

Coastal Resiliency: How a CAH Can Provide Community Refuge

Erik Thorsen, MBA, Columbia Memorial Hospital
Michelle Checkis, MBA, ZGF Architects LLP

Coastal Resiliency: How a Critical Access Hospital can Provide Community Refuge

ASTORIA, OR



LEARNING OBJECTIVES:

1. Describe a Tsunami Vertical Evacuation Structure's role in a vulnerable community
2. Describe a strategy for designing a tsunami-resilient hospital.
3. Identify synergies between a vertical evacuation structure and a critical access hospital.
4. Learn how to navigate funding systems and leverage partnerships from local to federal levels to realize a complex project.

SPEAKERS:



Erik Thorsen
CEO, Columbia Memorial Hospital
Astoria, OR



Michelle Checkis, AIA
ZGF Architects
Portland, OR

Astoria, Oregon



Columbia Memorial Hospital

Independent
Critical Access
Hospital
Governed by
Community Board



Planetree Gold-Certified

The Patient Family Advisory Council (PFAC) shares perspectives and helps speak for patients in hospital decision-making.



Enjoying More
Than 13 Years
Collaboration
with OHSU



Comprehensive
Cancer Center
with OHSU





TWERS Tsunami Vertical Evacuation Refuge Structure

TOKELAND TSUNAMI VERTICAL EVACUATION TOWER

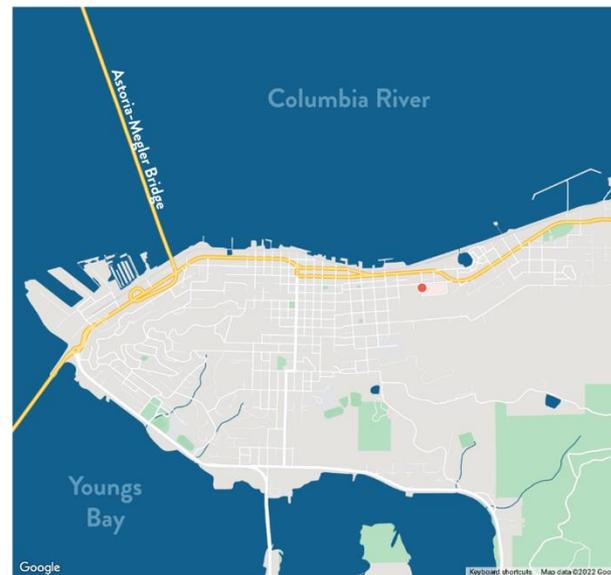
COMMUNITY BUILDINGS

Rognlin's constructed the first free-standing vertical tsunami evacuation tower in the United States. With capacity for more than 400 people, the tower is intended to provide refuge for Shoalwater Bay Indian Tribe members as well as residents in the neighboring community in the event of a Cascadia Subduction Zone earthquake that triggers a tsunami.

CLIENT
Shoalwater Bay Indian Tribe

PROJECT COMPLETION
2022

CONTRACT VALUE
\$2,670,000.00



Columbia Memorial Hospital

Post-Cascadia Earthquake Coastal Islands Map

- Coastal Hospital
- Island Boundary and Number
- Major Coastal Bridge
- Movable
- Historic Register
- Historic / Movable
- Major airport
- with no tsunami hazard and C130/C17 aircraft capability
- ODOT Maintenance Yard
- Mountains

This map shows potential geographically-isolated "islands" due to damaged transportation infrastructure:

North-south coastal Highway 101 will be impassable due to damage at major bridges, forming "island" boundaries.

East-west mountain highways will be impassable due to landslides.

Major bridges exceed 700 ft in length and were built before 1995.

Many smaller islands will occur at impacted locations (e.g., landslides, tsunamis, bridges).



0 12.5 25 50 Miles



Landslide Inventory



Great Coastal Gale of 2007

SITE HAZARDS

TSUNAMI	LANDSLIDE
FLOODING & DEBRIS	EARTHQUAKE
PANDEMIC	HIGH WINDS
LOSS OF POWER	



Due Diligence Timeline



- **1977 - CMH built on current site**
- **2008-2010** - Investigation 10+ years ago to alternate sites
- **2014** – Acquired John Warren Field, built CMH Field
- **2017 – 2019** - State of Oregon focuses on Coastal Hospitals Preparing for Cascadia Report
- **2018** – DOGAMI Site Visit
- **2018 – 2019**: CMH Board further studies alternate sites
 - Key Consideration – CAH Status and reinvestigate alternate sites
 - Should we relocate to Warrenton?
 - Do we remain a critical access hospital?
- **2021 to Present** - Engagement with ZGF Architects and Degenkolb Engineers
 - Additional Geotechnical and Resiliency Studies Including Utility Study, Site Survey and Landslide Risk Analysis
- **CMH can best serve its community in-place**

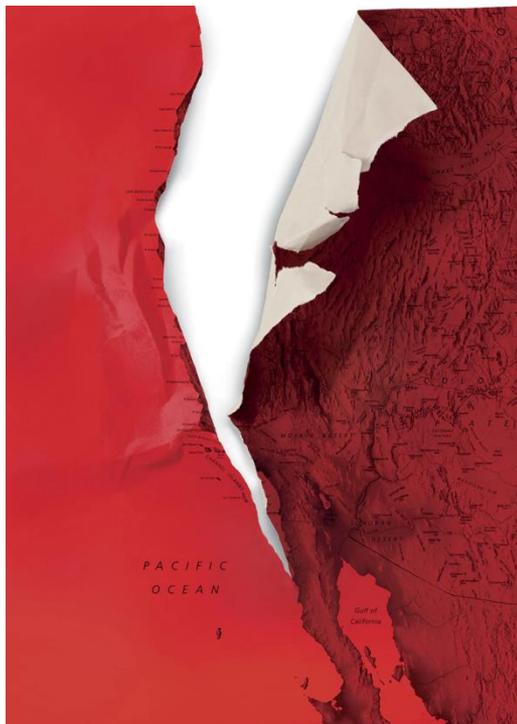
Assembling the Team



THE REALLY BIG ONE

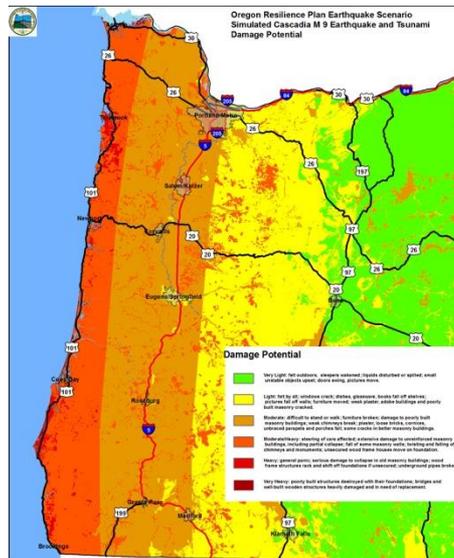
By Kathryn Schulz

July 13, 2015

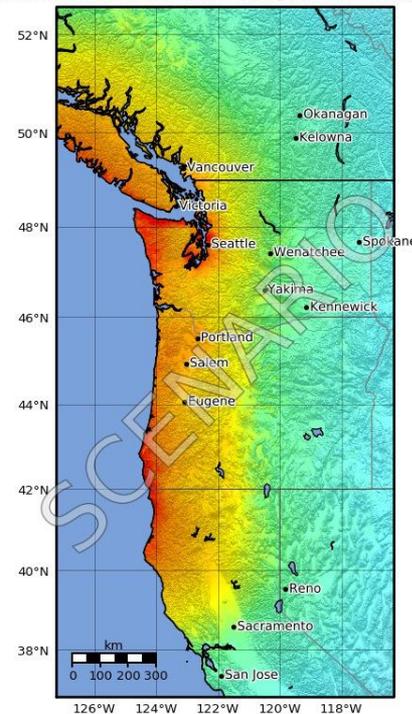


The next full-margin rupture of the Cascadia subduction zone will spell the worst natural disaster in the history of the continent, outside of the 2010 Haiti earthquake.

Illustration by Christoph Niemann; Map by Ziggymaj / Getty



Macroseismic Intensity Map USGS
ShakeMap: M9.0 Cascadia, median ground motions
Jan 26, 1700 00:00:00 UTC M9.0 N36.00 W126.00 Depth: 0.0km ID:CSZM9_median_nohyp



SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
DAMAGE	None	None	None	Very light	Light	Moderate	Moderate/heavy	Heavy	Very heavy
PGA(%g)	<0.0066	0.0795	0.954	4.99	8.76	15.4	27	47.4	>83.2
PGV(cm/s)	<0.0028	0.0383	0.524	3.03	6.48	13.9	29.6	63.4	>136
INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

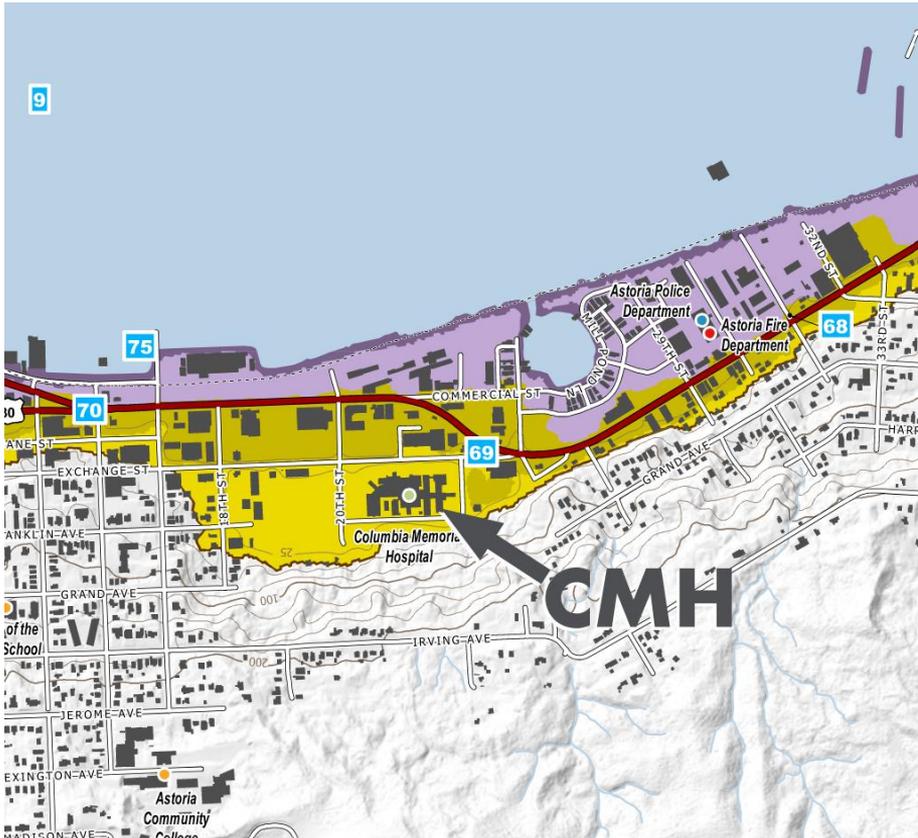
Scale based on Atkinson and Kaka (2007) Version 1: Processed 2020-11-15T02:19:47Z
 △ Seismic Instrument ○ Reported Intensity ★ Epicenter

Inundation Zone per Current Building Code



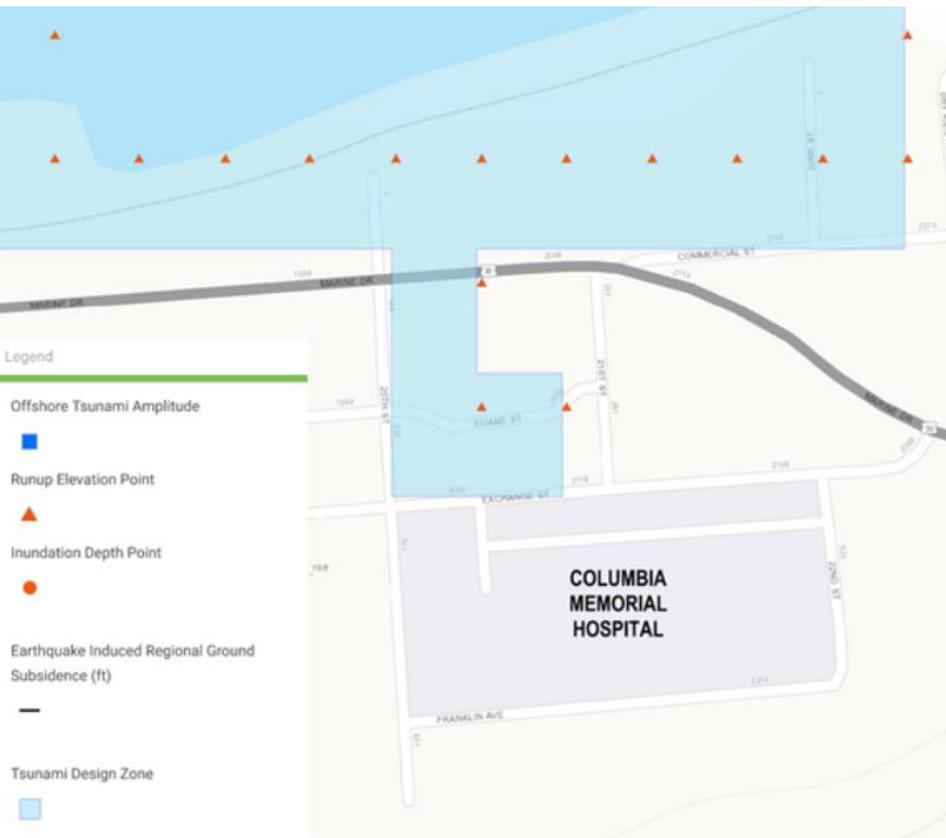
30' Inundation Elevation

DOGAMI XL Inundation Zone Design Model

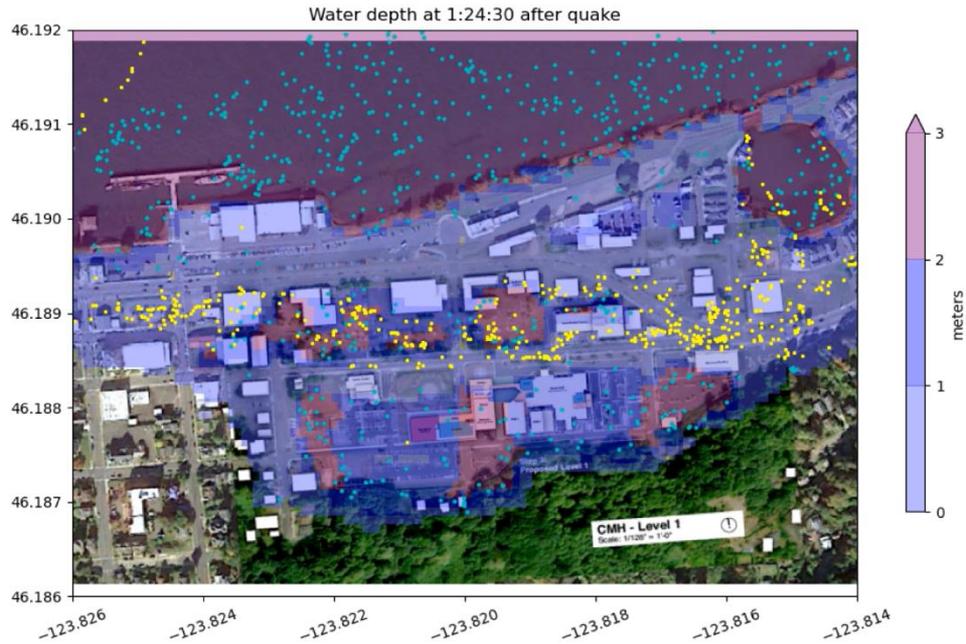


38' Inundation Elevation

Inundation Zone per Current Building Code



University of Washington Model



L1up_x1.290_CMH

ASCE_SIFT_Region3

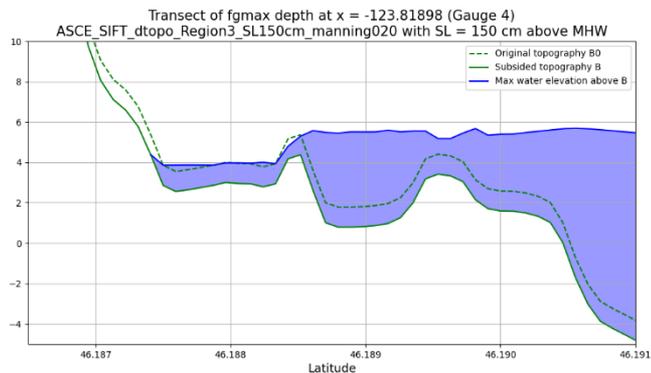
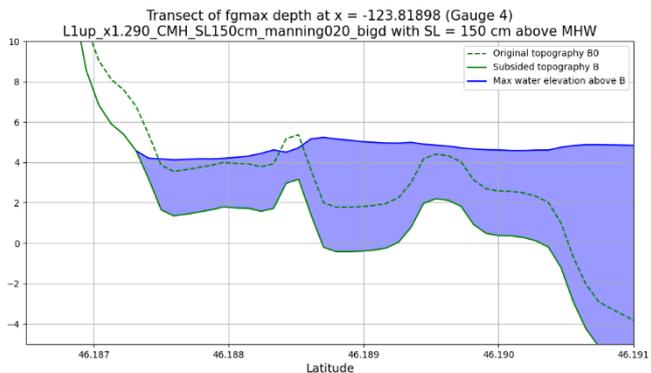
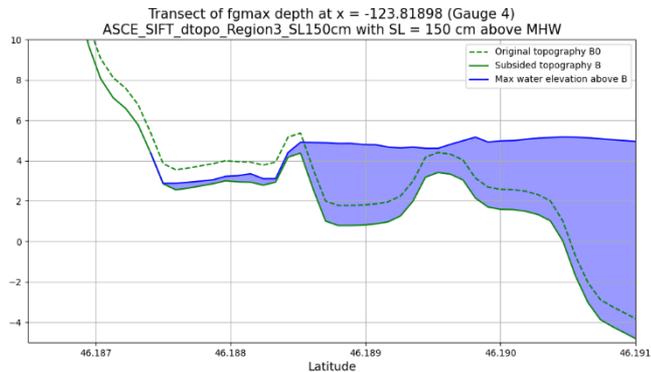
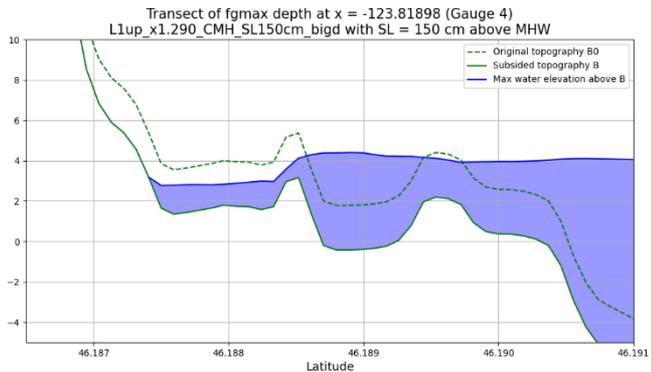
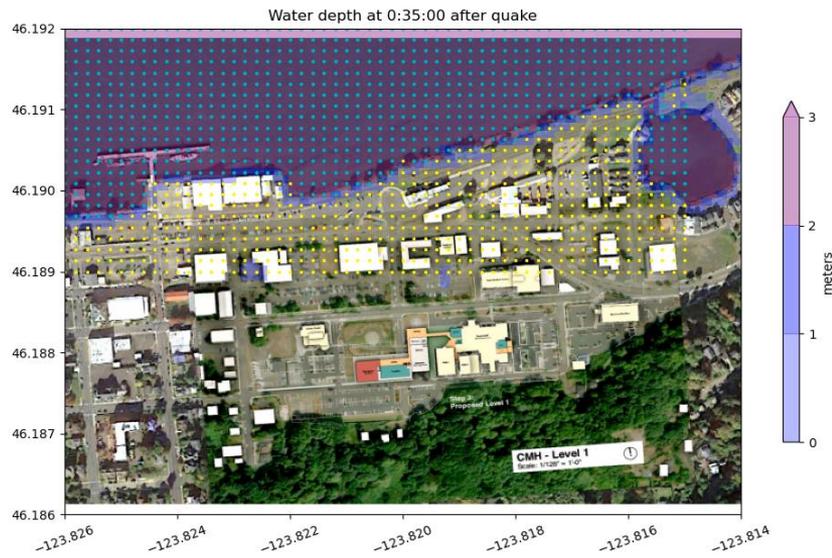
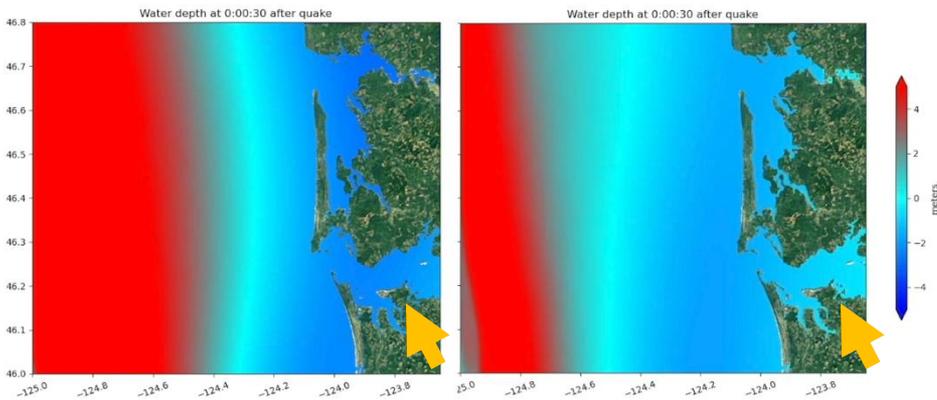
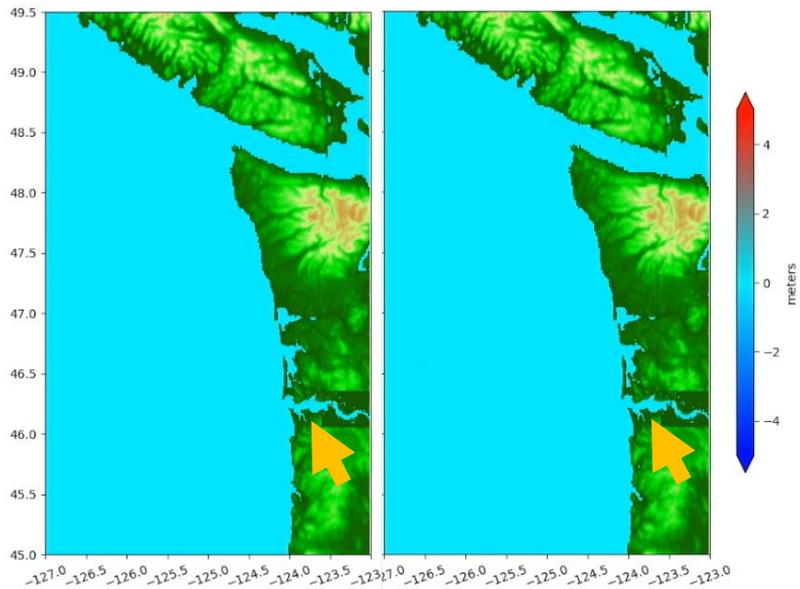


Figure 17: **Transect D.** Maximum flow depth along a north-south transect at longitude -123.81898 , passing through Gauge 4. See Section 7 for discription of the four simulations shown.





Resilience-Based Design Framework

Tsunami Hazard Levels

Expected Event

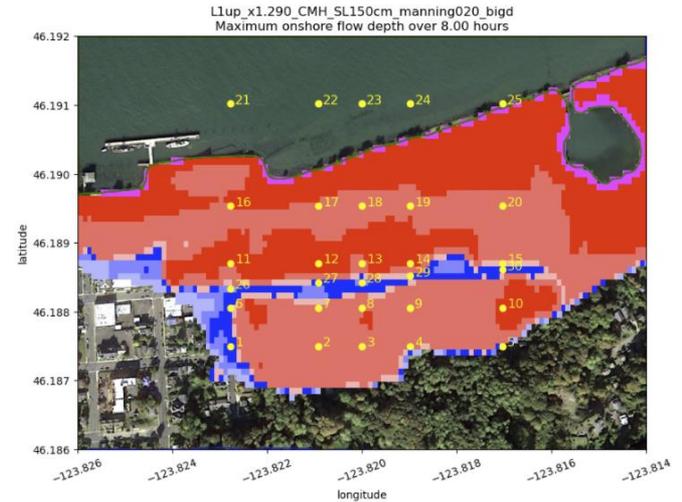
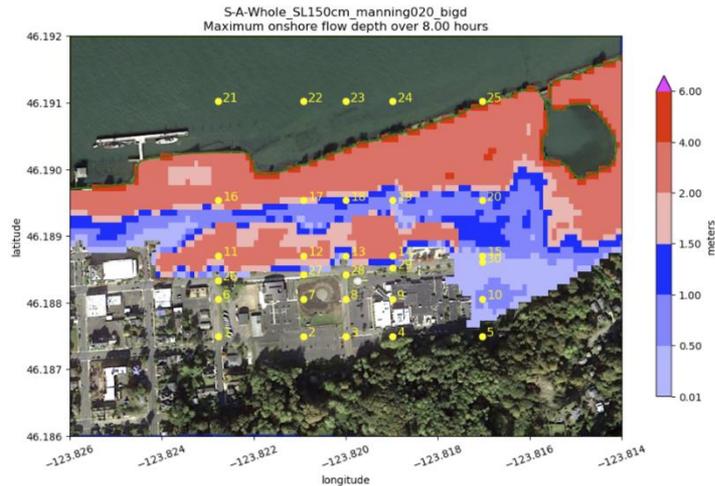
1/500-1/700 probability
(<10% chance over 50 years)

Immediate Occupancy Post-Event

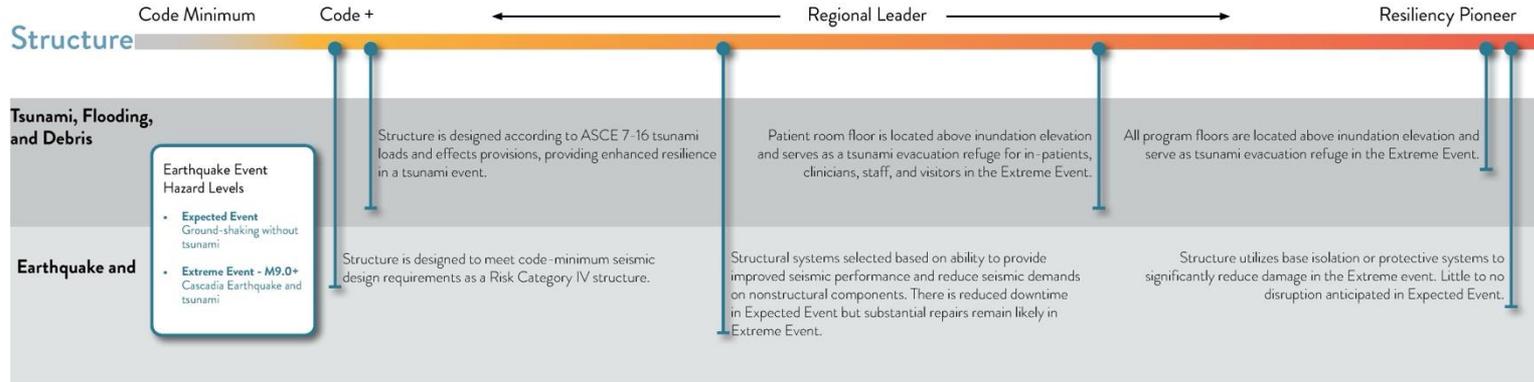
Extreme Event

1/2500 probability
(2% chance in 50 years)

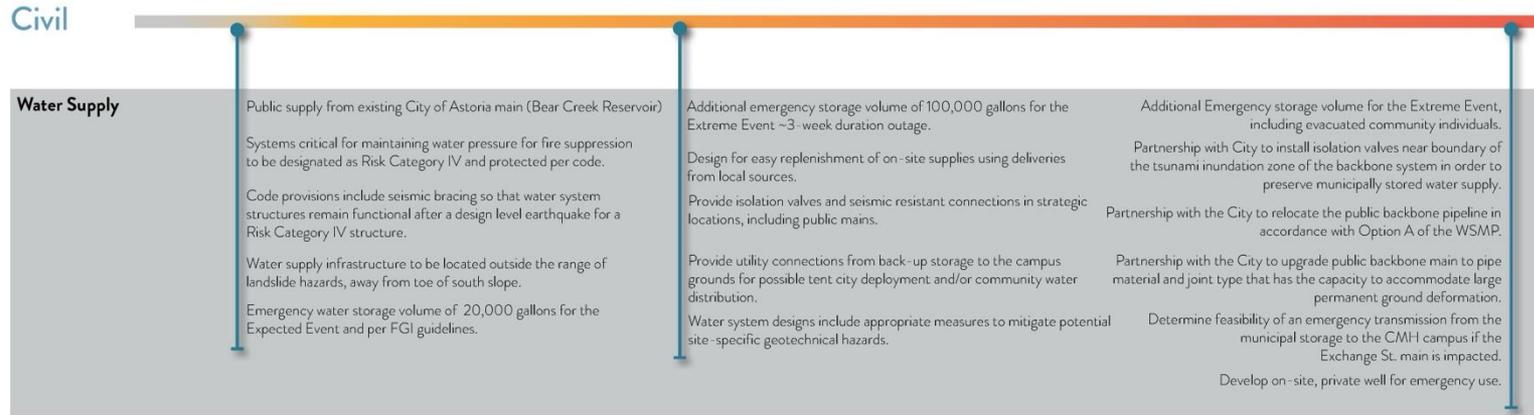
Life Safety Performance



1 Resiliency Opportunity Spectrum

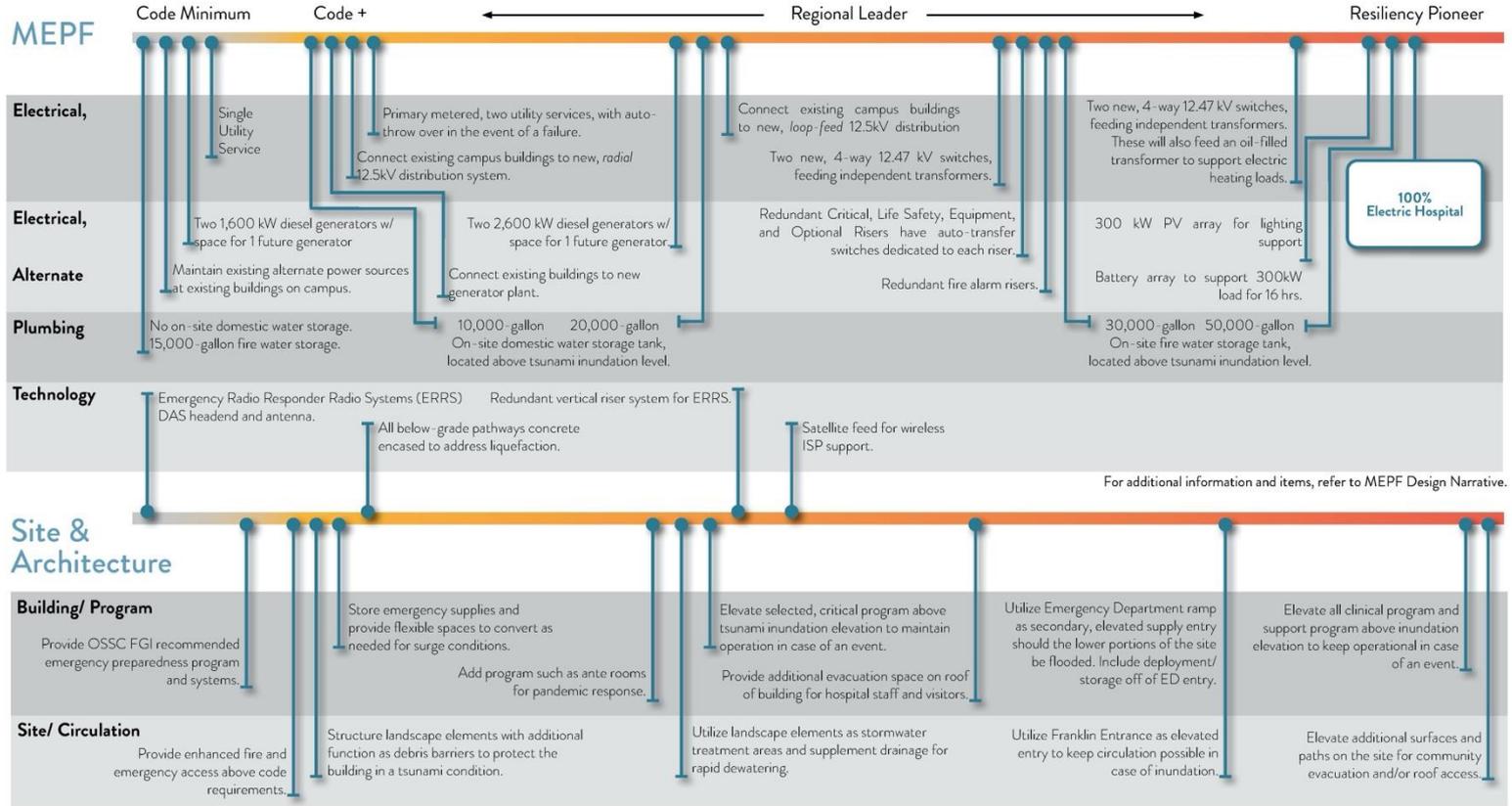


For additional items and information, refer to Structural Design Narrative.

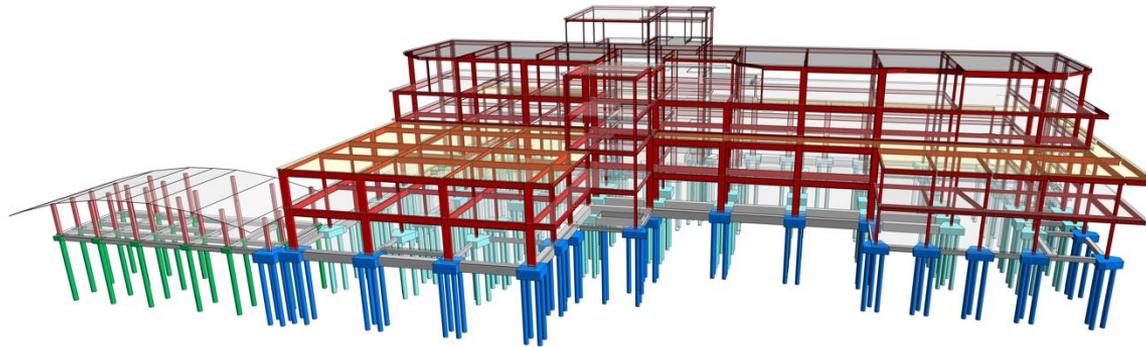


For additional information and items, refer to Civil Design Narrative.

1 Resiliency Opportunity Spectrum



Healthcare Resiliency Synergies



Resiliency-Based Performance Objectives

Timeline	Expected Event	Extreme Event
At time of alarm	Evacuation from vulnerable structures	Evacuation from vulnerable structures
Wave arrives	Minimal water inundation on CMH Expansion site	Site is inundated
"All Clear" End of Event	L1, including ED, can be occupied after event	L1 remains inundated
Site Evacuation	Route to Franklin less affected, some debris clearing may be needed to connect to 18 th	Debris clearing will be required for evacuation
Event Effect		
Community	Astoria Community and surrounding area heavily impacted Loss of utilities	
Project Performance	Life Safety + Occupiable Spaces after event	Life Safety, Patient Stabilization, and Evacuation

Resiliency-Based Performance Objectives

Utility / System	Expected Event	Extreme Event
Project Performance	Life Safety + Occupiable Spaces after event	Life Safety and Evacuation
	Code-level earthquake event without tsunami inundation, liquefaction occurs	Code-level earthquake event with tsunami inundation, liquefaction and scouring occurs
Structural System	Structure is expected to sustain little damage and inspections may be completed while the building remains occupied. Operations are minimally impacted due to the structural inspection process.	Structure is expected to maintain ability to function as a tsunami safe refuge . In the event of tsunami inundation, building inspections will be required and repairs to foundations, floor slabs, finishes, and other Level 1 components can be expected .
Normal Power	Utility will be impacted, generators will be required to maintain a reduced level of systems operation.	Utility will be impacted, generators will be required to support refugees and evacuation
Generators	Generators and below-grade storage tank are expected to remain operational and support emergency power needs for the hospital.	Generators are expected to remain operational and below-grade storage tank is likely to remain intact.
Water/Wastewater	Utility will be impacted, water access reduced to what is stored on site. "Code Dry"	Utility will be impacted, water access reduced to what is stored on site. "Code Dry"
Telecommunications	Utility will be impacted, communications maintained via Emergency Radio Communications Center	Utility will be impacted, communications maintained via Emergency Radio Communications Center
Medical Gases	Tank Farm connection may be impacted Reduced to enlarged gas storage upstairs in building.	O2 Tank Farm connection anticipated to be impacted Supply reduced to enlarged gas storage upstairs in building.



Guidance for
Designing Health and
Residential Care Facilities
that Respond and Adapt to
Emergency Conditions

FGI EMERGENCY CONDITIONS COMMITTEE

**Guidelines for Design
of Structures for Vertical
Evacuation from Tsunamis**

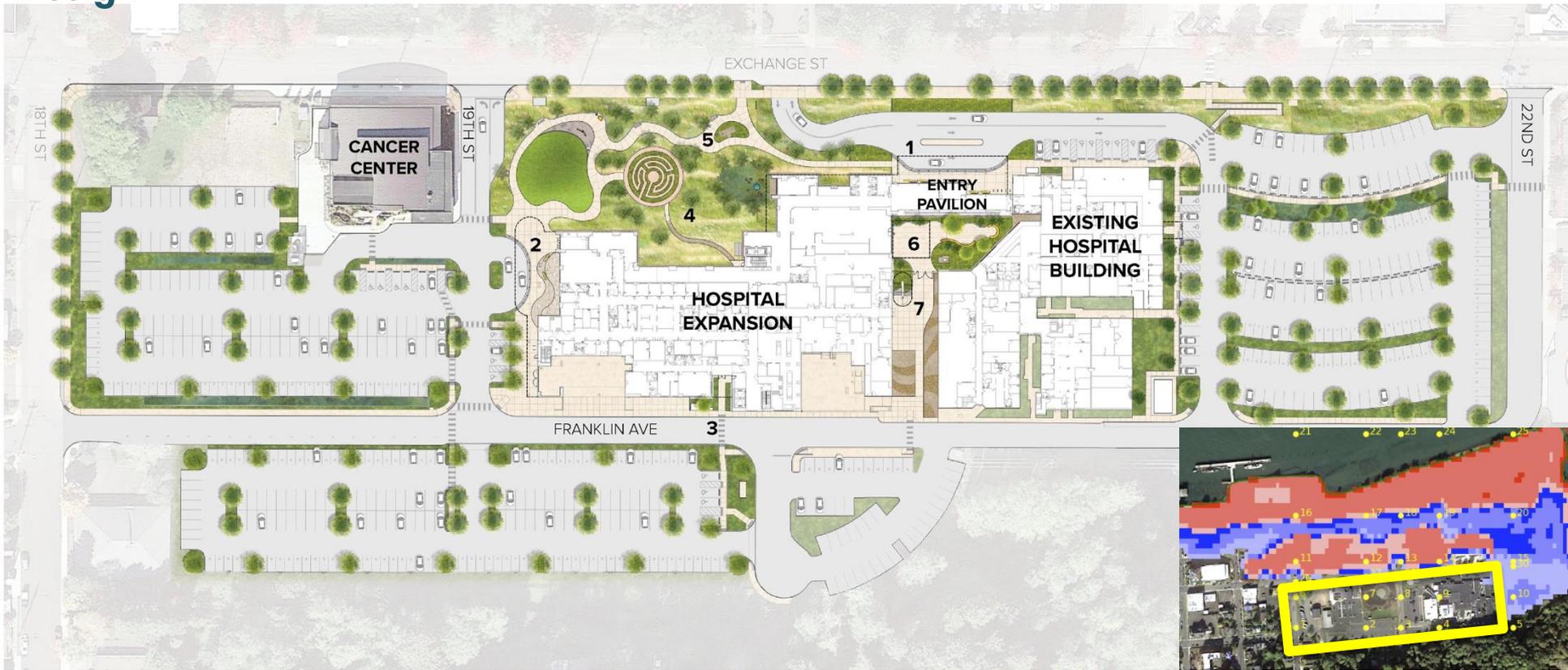
Third Edition

FEMA P-646 / August 2019



March 2021

Design



1 MAIN ENTRY

3 CAREGIVER ENTRY

5 WELLNESS TRAIL

7 TSUNAMI EVACUATION STAIR

2 EMERGENCY ENTRY

4 HEALING GARDEN

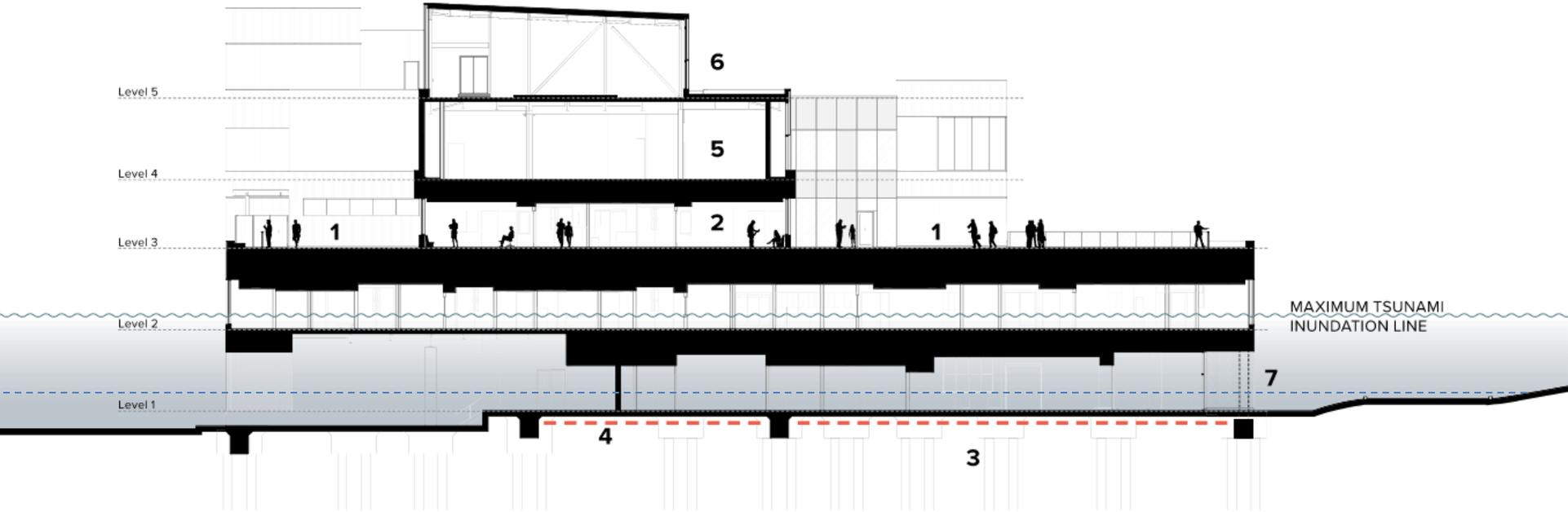
6 COURTYARD GARDEN

CAMPUS SITE PLAN



Design

Section North-South



1 Safe Refuge Areas can protect up to 1,900 people

2 Acute Care Patient Rooms are located above the tsunami inundation line

3 Deep pile foundations and grade beams support the building from liquefaction and scouring on unstable fill soils

4 Subgrade utilities supported from bottom of structural slab on grade to allow facility to come back online more quickly post-event

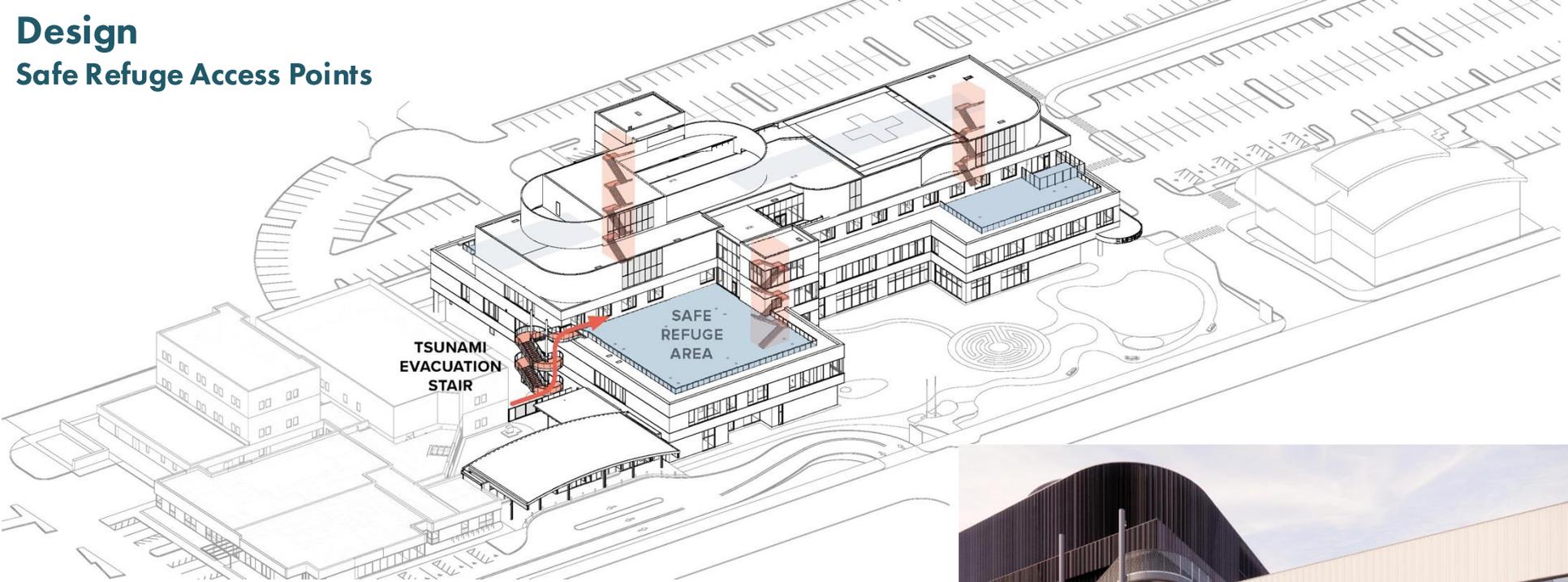
5 Mechanical and electrical systems located on upper floors keep critical systems operational during a natural disaster

6 Helipad located on the roof for emergency access in any scenario

7 Stronger L1 Columns for debris impact and hydrodynamic loads

Design

Safe Refuge Access Points



“...a place the community can evacuate to.”
Erik Thorsen, CMH CEO







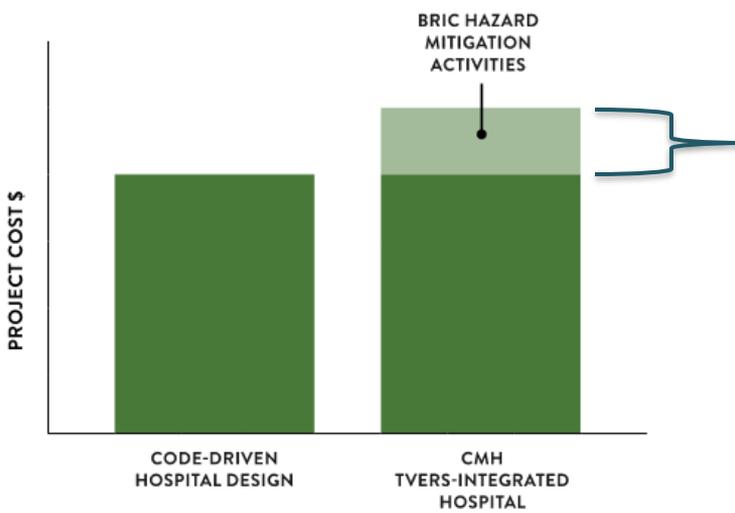
COLUMBIA
MEMORIAL
HOSPITAL

COLUMBIA
MEMORIAL
HOSPITAL

BRIC Funding



FEMA



BRIC Premium:

7% of total CMH Expansion project

BRIC Grant: \$21 Million - Awarded 2022
Cancelled April 2025

\$15M – Federal share 70%

\$6M – Non-federal share, 30% local match
(2% of project budget)



Project Budget & Funding

Project Budget*	
Architect/Engineer	\$ 19,000,000
Professional Services & Other	5,500,000
Building Construction	242,000,000
Furniture/Fixtures/Equipment	26,000,000
Owner Contingency	7,500,000
Total	\$300,000,000

Secured Funding*		Currently 95.6% Funded
New CMH Debt	67%	\$ 200,000,000
CMH Cash Reserves	24%	72,000,000
State of Oregon	2%	6,000,000
Capital Campaign & Grants	2.6%	8,000,000
Potential Funding Sources*		
Restoration of FEMA BRIC Grant		\$15,000,000
Additional Grants & Philanthropy		2,000,000
Additional CMH Cash Reserves		\$13,000,000 - \$15,000,000



*Amounts are rounded for illustration purposes

Funding Process/BRIC Restoration

Letters of Support



FEMA

US Senator Jeff Merkley
US Senator Ron Wyden
US House Representative Suzanne Bonamici
Representative Suzanne Weber of Oregon
Representative Cyrus Javadi of Oregon
Regional Solutions Team (Oregon), including:

- Department of Land Conservation and Development
- Oregon Department of Environmental Quality
- Oregon Health Authority
- Business Oregon
- The Columbia-Pacific Economic Development District (Col-Pac)

Clatsop County
Clatsop County Sheriff
City of Astoria
City of Warrenton
Astoria-Warrenton Area Chamber of Commerce (AWACC)
Seaside City Council Member Tita Montero
Astoria School District
Clatsop Community College
Lifeflight
Oregon Health and Science University (OHSU)
Patrick Corcoran, previous Oregon State University and
Oregon Sea Grant agent, with a focus on Coastal Natural Hazards
Professional Staff at Columbia Memorial Hospital
Medix
Pacific Power

Congress of the United States
Washington, DC 20510

December 8, 2022

Administrator Deanne Criswell
Federal Emergency Management Agency
500 C Street, SW
Washington, DC 20472

RE: Request for Building Resilient Infrastructure in Communities (BRIC) funding for Columbia Memorial Hospital Resiliency Project

Dear Administrator Criswell:

Columbia Memorial Hospital (CMH) is a full-service, 25-bed, critical access, not-for-profit, Level IV trauma center located in the small, rural, coastal town of Astoria, Oregon. CMH serves a substantial portion of Oregon's North Coast, and the CMH campus is designated as critical infrastructure in Clatsop County's FEMA-approved Hazard Mitigation Plan.

However, the current single-story CMH campus is well within the tsunami inundation zone, on liquefiable soils, and is not seismically safe. Accordingly, the hospital is at significant risk of earthquake and tsunami impacts from a Cascadia Subduction Zone earthquake. There is a critical need to invest in resilient infrastructure so that CMH can continue to provide services for patients, staff, and any on-site visitors in the

CMH is requesting funding through the BRIC to construct an expansion that integrates climate design. In addition to securing continued core funding will allow CMH to meet new healthcare demand for healthcare services in a medically

Thank you for your full and fair consideration. We have any questions regarding this project, please contact me at 503-318-4509, Fritz Girdham at 503-318-4509, or Espen Swanson in Congresswoman

8553.

S


Jeff A. Merkley
United States Senator


Suzanne Bonamici
Member of Congress



Clatsop County
Board of Commissioners

800 Exchange St., Suite 410
Astoria, OR 97103
(503) 325-1000 phone / (503) 325-8325 fax
www.co.clatsop.or.us

December 29, 2022

Administrator Deanne Criswell
Federal Emergency Management Agency
500 C Street, SW
Washington, DC 20472

RE: Request for Building Resilient Infrastructure in Communities (BRIC) funding for Columbia Memorial Hospital Resiliency Project

Dear Administrator Criswell:

Columbia Memorial Hospital (CMH) is a full-service, 25-bed, critical access, not-for-profit, Level IV trauma center located in Astoria, Oregon at the estuary where the Columbia River and the Pacific Ocean meet along the North Coast of Oregon. The Pacific Northwest coastline is at significant risk of earthquake and tsunami impacts from the Cascadia Subduction Zone and the CMH campus is identified as within the tsunami inundation zone by the State of Oregon.

CMH is proposing to expand the current hospital facility to support the growing need for services in the community and plans to integrate a Tsunami Vertical Evacuation Refuge Structure (TVERS) into the construction of the hospital expansion. This will allow for hospital patients, caretakers, staff, visitors, and the public to evacuate vertically from a Cascadia-generated tsunami.

I fully support this FEMA BRIC funding request for the resiliency cost premiums necessary to integrate the Tsunami Vertical Evacuation Refuge Structure (TVERS) in the new hospital expansion.

Sincerely,



Lianne Thompson
Vice-Chair, Clatsop County Commissioner

Commitment to Project

- **CMH remains 100% committed to resiliency goals**
- **No changes in design – too late in the process**
- **Will find the \$ from other sources or will self fund**
- **Foundation construction underway**



BuildCMH Team and Project Benefits



CMH Board's vision and commitment to community

Key Stakeholders/Support

City Astoria
Clatsop County
State and Federal Elected Officials

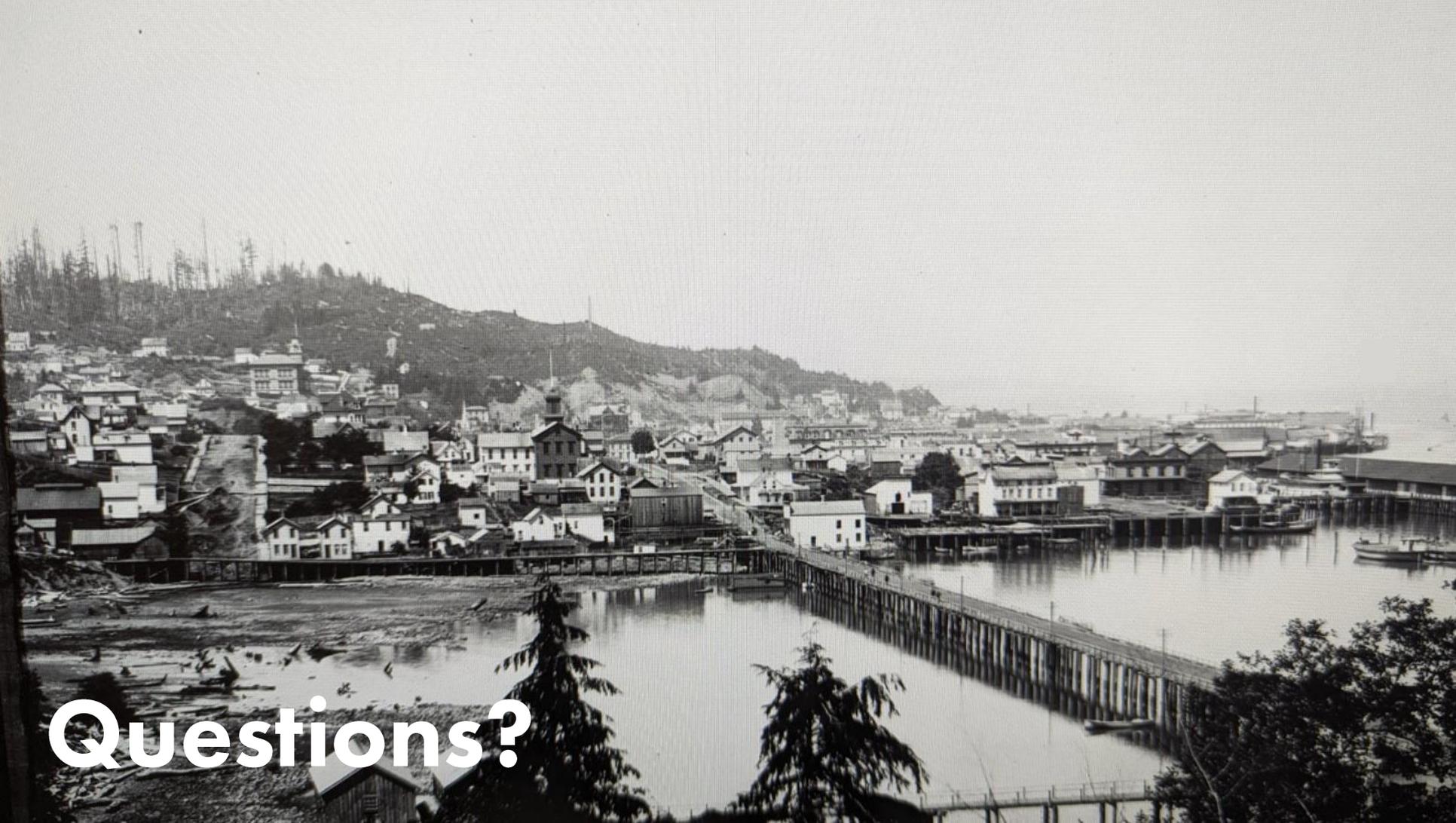
Key Consultants

ZGF Architects
Degenkolb Engineers
SEFT Consulting
University of Washington

Will be region's first Tsunami Vertical Evacuation Structure
Can provide safe refuge for up to 1,900 patients/residents

Will be the most resilient hospital located on the Oregon Coast.
A model for other coastal communities

Allows CMH to meet its Mission of service to the community during a natural disaster, winter storm, or power outage.



Questions?