Finance and Administration
Oregon State University
640 Kerr Administration, Corvallis, Oregon 97331-2156
T 541-737-2447 | **F** 541-737-3033

March 21, 2016

MEMORANDUM

TO: Oregon State University Board of Trustees

FROM: Ron Adams, Interim Vice President for Administration

SUBJECT: Site Selection for the Marine Studies Building in Newport

At the March 31, 2016 Board meeting, I will provide an overview of the process, timeline and criteria that will be used later this spring to recommend to President Ray a location for the construction of a Marine Studies Initiative building in Newport. I will also present a summary of findings from an evaluation of the Hatfield Marine Sciences Center (HMSC) as a potential site for the building. My presentation will be followed by a panel discussion regarding the many considerations in selecting a suitable location for this building. The panel discussion will be moderated by the College of Engineering Dean Scott Ashford and will include faculty members from the colleges of Earth, Ocean and Atmospheric Sciences (CEOAS) and Engineering, as well as a coastal community representative.

As background for this discussion, I am enclosing the HMSC site evaluation findings, letters to President Ray from faculty in the Geology and Geophysics Disciplinary Group of CEOAS, faculty in the School of Civil and Construction Engineering, and the State Geologist. President Ray’s responses to the letters are also included. A letter from the Seismic Safety Policy Advisory Commission to the Governor and Legislature is also included.

Enclosures

Marine Studies Initiative Building Complex

Earthquake & Tsunami Considerations

Oregon State University

Hatfield Marine Science Center

Newport, Oregon
March 18, 2016

Final Report

Chris D. Poland
CONSULTING ENGINEER

ESTIME´
Science & Technology
Facilities Planners

Table of Contents

1.0 Executive Summary

Oregon State University's Marine Studies Initiative (MSI) is a bold opportunity for the University to expand its teaching and research role in improving the health of the Pacific Ocean and increasing marine-related educational opportunities for OSU students. Because of the potential for earthquakes and tsunamis and the controversy about siting the project in a tsunami inundation zone, Oregon State University contracted with our firms to develop appropriate seismic and tsunami design criteria and assist with the site selection of the new MSI Complex.

It appears logical for the MSI to expand the existing HMSC campus and take advantage of the proximity to the sea, the existing facilities and research staff, and the area's research partners. Such a building location also means making a major capital investment and expanding the population at a location that will eventually be inundated by a major tsunami.

This report strives to clarify the issues related to earthquakes and tsunamis as they relate to the proposed MSI Complex and the HMSC to facilitate an informed and balanced decision about the short and long term status of the Center. It clearly states that major earthquakes and tsunamis will occur with a low probability and that the facilities and emergency response procedures can be designed to protect the lives of the students, faculty, staff and visitors.

Figure 1 Hatfield Marine Science Center, Newport Oregon

2.0 Introduction

Oregon State University (OSU) may expand the Hatfield Marine Science Center (HMSC) as part of their newly launched Marine Studies Initiative (MSI). As shown in Figure 2, the expansion is a complex reportedly planned to include new research facilities, teaching laboratories and classrooms for approximately 350 new students, faculty and staff. The facility is a key part of the University's commitment to pioneer a new research and teaching model that will help sustain healthy oceans and ensure wellness, environmental health and economic prosperity for future generations. It is a university-wide commitment that will have local and global impacts on the economy and environment. (www.marinestudies.oregonstate.edu)

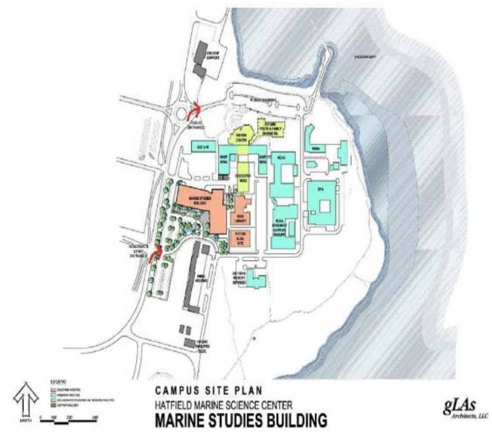

Figure 2 HMSC Site with conceptual location of new facilities (orange)

The HMSC is strategically located in the South Beach area of Newport Oregon to retain close connection to world class seawater facilities and proximity to a number of state and federal agency partners. As with all of the coast of Oregon, it is also located in an area subject to major earthquakes and within the resulting tsunami inundation zone. Figure 3 illustrates the area and the extent of the expected tsunami inundations. The yellow line shows the worst expected extent of inundation where only Safe Haven Hill and the Community College sites are on high ground.

Figure 3 South Beach Area showing the location of the community College, Safe Haven Hill, and HMSC.

Because of the potential for earthquakes and tsunamis and the controversy about siting the project in a tsunami inundation zone, OSU contracted with our firms to develop appropriate seismic and tsunami design criteria and assist with the site selection of the new MSI Complex. The focus of the work was on addressing the prevailing vulnerabilities and concerns related to expanding the existing HMSC campus.

OSU is committed to the safety of all students, faculty, staff and visitors. The HMSC facility currently has a robust emergency response program that includes tsunami evacuation plans and annual drills that are considered to be the best at OSU. The University understands and is addressing the seismic and tsunami hazards that include strong shaking, liquefaction and inundation.

The University has established the following "Building Principles" related to the planned expansion.

- All housing will be located on high ground, outside of the inundation zone.

- All new buildings will be seismically resilient structures that will survive and allow occupants to exit and follow the tsunami evacuation plan.
- Structural design criteria for the proposed building will exceed current seismic codes using state-of-the-art structural design criteria and options.
- The proposed expansion will improve current earthquake readiness and tsunami training.
- HMSC will continue to collaborate with the Tsunami Evacuation Plan Partners.

The 2011 Tohoku earthquake and tsunami brought the world instant images of the destructive power of a major tsunami not unlike the one that is expected along the coast of Oregon. Japan is rebuilding, but in a very cautious manner. Their new standards mandate that all 24/7 occupancies must be built on high ground and all other occupancies must be built with adequate plans for vertical and horizontal evacuation.

That event as well as the concerns expressed by many OSU professors lead to this study that is focused on what might happen and what can be done to mitigate the consequences. It began with meetings with a working group that was formed to manage the decision making process related to the siting and construction of the expansion. It involved a series of interviews with a wide variety of experts in the various disciplines related to earthquake and tsunami safety. It resulted in this statement of the issues, suggested design criteria, and opportunities for OSU to consider implementing.

3.0 Proposed Earthquake and Tsunami Design Criteria

Newport, Oregon, is located in a high seismic zone. As with the entire west coast of the United States, strong earthquakes have occurred over regular intervals and will continue to occur. In the Pacific Northwest, these earthquakes have three basic sources; shallow crustal events, deep Benioff zone events, and Cascadia subduction zone events. Over 1,000 earthquakes per year are recorded but only a few are large enough to be felt. Seismologists expect that a major earthquake ranging in magnitude 7.0 to 9.0 is possible but only expected every few hundreds of years.

Design for Earthquakes

Today, buildings and infrastructure systems at OSU, throughout the west coast and much of the United States are designed for the largest expected earthquakes as determined by the United States Geological Survey (USGS). USGS uses probabilistic theory to determine how strong the shaking will be throughout the region based on thousands of potential events. Estimates of the strong shaking with 2% probability of being exceeded in 50 years along with the levels of resulting damage that is considered acceptable are the basis of the building codes adopted and used today. The resulting designs take into account the expected strong shaking as well as the occurrence of landslides, liquefaction and lateral spreading where appropriate.

The minimum levels of acceptable damage incorporated in today's building code depend on the occupancy and function of the building or infrastructure system. At a minimum, all construction is designed to avoid damage that will cause serious injury or loss of life but without specific regard for re-use. In addition, buildings and infrastructure systems that are needed to support the immediate response and the early days of recovery are designed to remain usable. To accomplish these goals, the designs must provide appropriate foundations, robust structural systems as well as anchorage and protection of non-structural elements and contents. The new MSI complex is required by code to be designed only to the minimum code level, that is, as a Risk Category II building.

In the South Beach area of Newport, Oregon, the current building code requires design for a peak ground acceleration of .48g with consideration given to the maximum considered peak ground acceleration of .68g. At this intensity of ground shaking, liquefaction is expected to cause subsidence of up to 3 feet and lateral spreading of up to 30 feet at the HMSC sites. No liquefaction is expected in the vicinity around the Community College, though there may be some areas subject to landslides. Because of the proximity to the Cascadia subduction zone, the South Beach design values are about 50% higher than used for the design of buildings built in Corvallis at the main OSU campus.

Design for Tsunami Threats

The Cascadia subduction zone has the ability, and is expected at some time, to generate a major earthquake that will result in a significant tsunami that will inundate the Pacific Northwest Coast much like what happened in Japan in 2011. The arrival time and depth of the inundation at any particular site along the coast will depend on the size and location of the earthquake. An event of this magnitude has not occurred in over 300 years. Using turbidite paleoseismology, seismologists have been able to identify up to 41 Tsunami events of various sizes that have occurred over the past 10,000 years. They have subsequently determined that in the 100 year life of the MSI complex, there is a 39% to 58% probability that a tsunami of some size will occur at the site.

The characteristics of the expected tsunami inundation along the Oregon coast was the topic of a multi-year study by a group of experts convened by the Oregon Department of Geology and Mineral Industries (DOGAMI). The effort resulted in an Open File Report O-13-19 entitled Tsunami Inundation Scenarios for Oregon that included a digital data release of their modeling. They developed seven scenario events, five related to local Cascadia subduction zone events -- designated S, M, L, XL, and XXL and two related to events in Alaska.

In 2011, the Oregon State Legislature unanimously approved a resolution supporting the development of the Oregon Resilience Plan: Reducing Risk and Improving Recovery for the Next Cascadia Earthquake and Tsunami. The subsequent report was published in 2013 and included a series of recommendations related to actions that needed to be taken to make Oregon more resilient to a tsunami generating earthquake. A Governor's task force was convened after publication to develop specific recommendations for the plans implementation. This task force report was submitted to the legislature in 2015. Included in their recommendations is to designate the DOGAMI "L" Tsunami as the design and planning inundation zone for new construction as required by ORS 455.446 and 455.447. The following new facilities are therefore not permitted inside the "L" inundation zone.

- Hospitals and other medical facilities
- Police and Fire Stations
- Government communication centers and other facilities required for emergency response.
- K-12 schools and child care centers with a capacity greater than 250.
- Colleges or adult education schools with a capacity of greater than 500 persons
- Jails and detention facilities

All MSI buildings being considered to be located within the HMSC campus are permitted to be built in the tsunami inundation zone according to the recommendations of the Governor's Task Force. (http://www.oregon.gov/OMD/OEM/docs/resilience_tf/2014%2009%2029%20ORTF%20Report.pdf)

Regardless of the legal requirements, OSU has stated that consideration will be given to the feasibility of designing the MSI complex to be repairable given the occurrence of a DOGAMI "L" event. In addition, an evaluation of the risk to ongoing research projects and evacuation planning will be done based on the occurrence of a "XXL" event.

Figure 4 illustrates the estimated inundation depths at the HMSC site (DOGAMI Station 86) and arrival times for DOGAMI's five local events. Note that the depths at the site vary from less than 1 foot to 27 feet for the five local events and the arrival times are all about 30 minutes after the initial rupture.

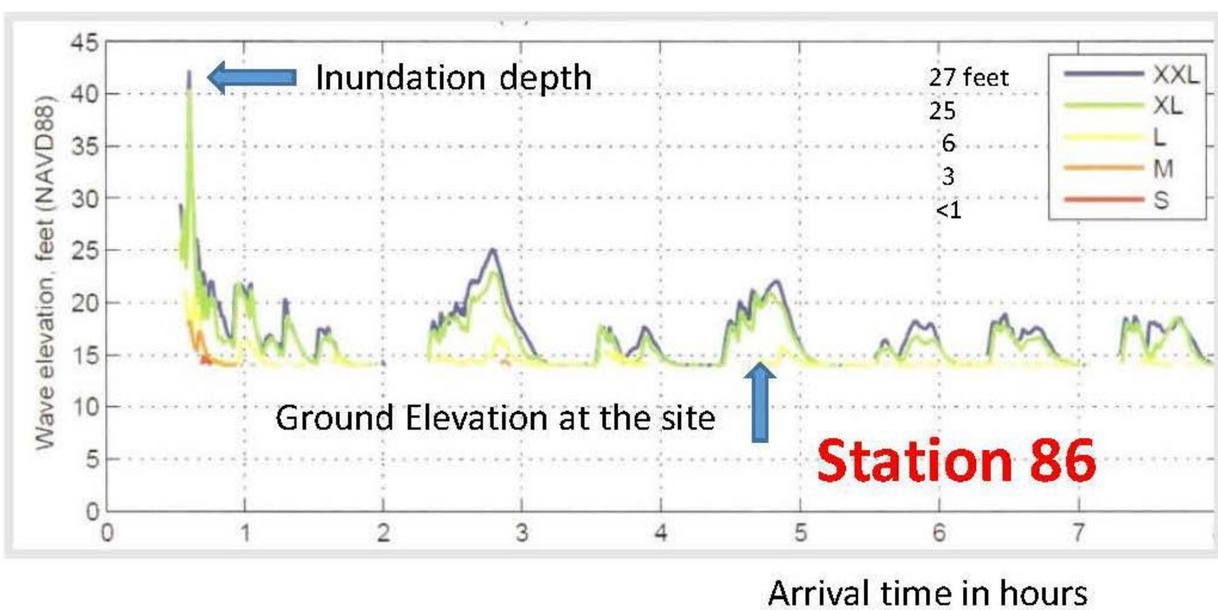

Figure 4 Tsunami Inundation Scenarios for HMSC Site (DOGAMI Station 86)

4.0 Considering the Effects of Earthquakes and Tsunamis

The consulting team worked with and interviewed OSU faculty and staff, DOGAMI staff, Newport City and Port Officials and members of Oregon Emergency Management to understand how to put these facts into perspective. The interview began with a brief written survey of issues to be considered followed by a series of questions related to the tsunami hazard, the associated risks, and the appropriate mitigation measures. The survey form and summary of results are included as Appendix A. The list of interview questions are attached as Appendix B.

The interview participants were selected by the working group and provided to the consultants. In person group interviews were conducted in 2015 on March 12-13 and November 16-17 and two additional interviews were conducted by phone later in November. As is apparent in the survey results, all participants were keenly interested in the MSI complex and committed to the program, as well as the health and safety of the University students, faculty and staff. The interviewers kept notes of the sessions and used them as the basis of the observations and considerations that follow.

The following people participated in the study as members of the working group, people interviewed, or both.

OSU College of Earth, Ocean, and Atmospheric Sciences

Jack Barth	Professor and Associate Dean for Research
Bob Cowen	Director, Hatfield Marine Science Center
Patrick Corcoran	Associate Professor, Geography, Environmental Sciences and Marine Resource Management
Bob Dziak	Affiliate Professor, Geology and Geophysics
Chris Goldfinger	Professor, Geology and Geophysics
John Nabelek	Professor, Geology and Geophysics
Anne Trehu	Professor, Geology and Geophysics
Bob Yeats	Professor Emeritus, Geology and Geophysics

OSU Administration

Mike Bamberger	Emergency Preparedness Manager
Glenn Ford	Vice President for Finance and Administration
Steve Clark	Vice President, University Relations and Marketing
Jock Mills	Government Relations
Kirk Pawlowski	University Architect, Capital Planning and Development

OSU College of Engineering

Scott Ashford	Kearney Professor of Engineering and Dean

OSU College of Engineering, Civil and Construction Engineering

Andre Barbosa	Assistant Professor, Structural
Dan Cox	Professor, Coastal and Ocean
Ben Mason	Assistant Professor, Geotechnical
Armin Stuedlein	Associate Professor, Geotechnical
Harry Yeh	Professor, Coastal and Ocean

DOGAMI

George Priest	Geologist
Ian Madin	Interim Director, State Geologist
Jonathan Allan	Coastal Geomorphologist

City of Newport and Port Officials

Spencer Nebel	City Manager
Kevin Greenwood	General Manager, Port of Newport
Derrick Tokos	Community Development Director

Oregon Office of Emergency Management

Dennis Sigrist	State Hazard Mitigation Officer
Althea Rizzo	Geologic Hazards Program Coordinator

There was considerable variation in the opinions expressed about the characteristics of the expected earthquakes and tsunamis and the opportunities for understanding and mitigating the consequence. Over 90 percent of those interviewed expressed support for locating the MSI complex as planned at HMSC. They collectively expressed the following major benefits and suggested mitigation measures to reduce the inherent life-safety risks. Some of the mitigation measures are already included in the building principals and design criteria established by the university. A number of other suggestions were made by those that did not support the current plans.

Major Benefits

1. Promotes increased collaboration among researchers at HMSC.
2. Enhances students' educational experience.
3. Strengthens the collaboration between the South Beach research partners.
4. Brings economic benefit to the community.
5. Provides access to the highest quality seawater for use in the labs.
6. Establishes new benchmarks for when and how to build in a tsunami inundation zone.
7. Creates an opportunity to improve the existing HMSC evacuation plans.
8. Provides an opportunity to enhance safety for all occupants in the South Beach area.

Additional Mitigation Measures

1. No 24/7 occupancies ever at HMSC (i.e. student housing). Relocate all that currently exist.
2. Evacuation measures should be based on worst-case inundation (XXL) -- regardless of probabilities.
3. Work closely with DOGAMI to define the “worst-case” scenario.
4. Consider relocating non-essential teaching and research activities to higher ground.
5. Design for sea level rise.
6. Design facility to be usable after repairs for the “L” tsunami with consideration given to the expected debris impacts.
7. Plan for total building loss and subsequent reconstruction of HMSC after a significant tsunami.

Other Suggestions

1. Relocate HMSC and the new MSI Complex to high ground. Maintain only the existing dock, tool shed, and warehouse facility at the current location.
2. Build the new MSI Complex on high ground with the intention of a complete relocation of HMSC in the long term.

5.0 Recommended Considerations

The Marine Studies Initiative is underway and well rooted in the future of Oregon State University. A decision to site the MSI complex within the Newport, Oregon community, has been made, with the needed student housing to be located at a new site on high ground near the Community College. Funding for the project is well developed and includes a monetary commitment from the State of Oregon Legislature. The process is obviously in motion, but there is time to make a balanced decision about how to proceed.

We recommend that the University consider proceeding on two parallel tracks. The first is related to expanding the evacuation planning in a move to enhance its effectiveness and support for the surrounding community. Regardless of the final decision about the location(s) of the MSI Complex, there is ample opportunity to improve the excellent plans now in place based on the refined information and modeling techniques available. The second is related to commissioning the selected A/E design team to complete the conceptual studies needed to explore the suggestions offered during the interviews, develop cost models of the options explored, and complete the designs based on the selected solutions. Detail of each track follow.

Initiate Expanded Horizontal Evacuation Planning

1. Base evacuation planning going forward on the DOGAMI “XXL” event.
2. Expand the current planning committee to include representatives from the City of Newport and South Beach businesses and residents.
3. Build upon, augment and utilize available new technology to refine the evacuation process to improve efficiency and completeness. Seek counsel from ADA groups.
4. Determine optimized evacuation routes to Safe Haven Hill and the Community College area based on site specific, state-of-the-art agent based modeling now under development at OSU. Consider the opportunity to provide vertical evacuation structures, perhaps for use as a last resort. Strive to define a path to safety for every occupant of South Beach.
5. Seek state and local funding for evacuation route improvements including additional signage, automated alerts, evacuation route modifications, and temporary shelter support for evacuees.
6. Develop and implement a South Beach-wide evacuation plan that brings awareness and includes briefings, training and regular exercises.

Initiate the Design Process

1. Develop a cost and schedule model for relocating HSMC and the new MSI Complex on high ground.
2. Commission site specific studies related to strong shaking, liquefaction, subsidence and lateral spreading potential, tsunami inundation potential, identification of debris sources and the potential for large ship impacts at the HSMC site. Site specific design criteria is key to developing appropriate cost models.
3. Confirm the program and the adjacencies needed for the target research and teaching environment. Determine if any of the MSI Complex activities can be accomplished on high ground at the housing complex.
4. Develop alternate solutions for the design of the facilities that need to be at the HMSC. Determine cost models for code minimum construction and for construction that will be repairable after an “L” level inundation.
5. In collaboration with the evacuation planning efforts, determine the feasibility and a cost model for providing vertical evacuation at the site, perhaps as a last-resort option.
6. Using triple bottom line style of comparison (social, financial, environmental) , determine the best options for the short term and long term status of the HMSC and the new MSI Complex.
7. Design and construct the selected solution.

Appendix A

Survey Form and Summary of Results

Survey Form

OREGON STATE UNIVERSITY - HATFIELD MARINE SCIENCE CENTER
MARINE STUDIES INITIATIVE

Respondent Name: ____

How would you rate the following site selection factors?

Site Selection Factors	1 Not Important	2 Somewhat Important	3 Important	4 Very Important	5 Extremely Important
a. Site Accessibilty (Pedestrian, Vehicular, Marine)					
b. Access to critical research infrastructure such as sea water system					
c. Proximity to other scientists conducting related marine science research					
d. Proximity to research subject matter					
e. Additional costs and time associated with conducting research from a remote location					
f. Building construction project costs					
g. Economic impact on the local community					
h. Local politics and political influence					
i. Safety and security of students, faculty & staff					
j. Risks associated with potential natural disasters					
k. Shovel ready site (with utilities and other improvements)					
l. Other: (Please specify) ____________________					

The Estimé Group, Inc. and Chris D Poland Consulting Engineer **May 12, 2015**

Survey Results

Respondent No.:	Site Accessibility	Access to Research Infrastructure	Proximity to Other Scientists	Proximity to Subject Matter	Additional Costs for Remote Location	Building Construction Costs	Economic Impact on Community	Local Politics	Safety & Security of Occupants	Risks Assoc. Natural Disasters	Shovel Ready Site	Other:	*Description of Other*
01	3.0	3.0	3.0	3.0	3.0	2.0		4.0	5.0	5.0	2.0	3.0	*Public Education*
02	3.0	4.0	4.0	3.0	3.0	3.0	3.0	4.0	5.0	5.0	2.0		
03	4.0	5.0	4.0	4.0	4.0	3.0	3.0	2.0	4.0	3.0	3.0		
04	4.0	5.0	5.0	5.0	4.0	4.0	4.0	3.0	5.0	4.0	4.0		
05	4.0	4.0	4.0	4.0	5.0	3.0	2.0	3.0	5.0	4.0	3.0		
06	3.0	4.0	2.0	1.0	3.0	3.0	2.0	1.0	5.0	5.0	2.0	5.0	*Hazard Resilience*
07	5.0	5.0	2.0	2.0	3.0	3.0	5.0	3.0	5.0	5.0	3.0		
08	3.0	3.0	3.0	3.0	2.0	3.0	3.0	4.0	4.0	4.0	3.0		
09	3.0	4.0	4.0	3.0	3.0	2.0	2.0	2.0	5.0	5.0	2.0		
10	2.0	2.0	3.0	3.0	3.0	2.0	4.0	4.0	5.0	5.0	1.0		
11	1.0				4.0	5.0	4.0		5.0	5.0			
12	3.0	3.0	4.0	3.0	2.0	3.0	4.0	3.0	5.0	5.0	3.0	4.0	*Vertical Evacuation*
13	3.0	5.0	4.0	3.0	2.0	3.0	2.0	4.0	5.0	5.0	3.0	5.0	*Decrease risk for community*
14	3.0	4.0	4.0	3.0	2.0	3.0	5.0	4.0	5.0	5.0	3.0	4.0	*Improve safety for community*
15			3.0			3.0	4.0	3.0	5.0	5.0			
16			3.0			3.0	4.0	3.0	5.0	5.0			
17	4.0	3.0	3.0	3.0	5.0	4.0	4.0	3.0	5.0	5.0	4.0		
18	3.0	3.0	3.0	3.0	3.0	3.0	4.0	3.0	5.0	5.0	2.0		
19	2.0	5.0	5.0	5.0	5.0	4.0	4.0	3.0	5.0	4.0	4.0		
Averages	*3.1*	*3.9*	*3.5*	*3.2*	*3.3*	*3.1*	*3.5*	*3.1*	*4.9*	*4.7*	*2.8*	*4.2*	

Appendix B

Interview Questions

HMSC MRI Marine Sciences Building
10 Questions for the March 12-13 2015 interviews
Roz Estime, Chris Poland

1. Does the MSB need to be located at the HMSC?
2. Can the MSB be designed to protect the faculty, students and visitors during an earthquake and Tsunami?
    a. Are there any longer term experiments that need to be protected?
    b. Should the damage to the MSB be repairable so that it can be reopened afterwards?
    c. How soon?
3. In terms of the following characteristics, what size earthquake and Tsunami do you expect in the next 50 years? What is the largest that could occur?
    a. Magnitude
    b. Water height
    c. Velocity of the flow
    d. Subsidence
    e. Lateral spreading
    f. Debris sources
4. How detailed and accurate is the computer modeling of the South Beach area?
    a. Is there agreement among scientists about how to model these events?
    b. Have the estimates been peer reviewed?
    c. Factors of safety
5. Is it possible to control/redirect the expected debris flow?
    a. Levy at the Marina
    b. River as the least path of resistance
6. What are the early warning systems now in place and what is planned?
7. What are the current evacuation plans for South Beach?
    a. Partner Agency Plans.
    b. How many people will need to evacuate?
    c. Are there plans to use the multistory buildings in the area?
    d. What high ground is available?
    e. Will the bridge approach be usable?
    f. What are the existing barriers?
8. What can be done to improve the evacuation plans?
    a. Vertical evacuation
    b. Elevated Road way
    c. Debris mound near NOAA
9. What benefits will the MSB bring to the community?
10. Other comments and suggestions

OSU
Oregon State
UNIVERSITY

Geology and Geophysics Disciplinary Group
College of Earth, Ocean and Atmospheric Sciences
Oregon State University, 104 CEOAS Administration Building, Corvallis, Oregon 97331-5503
T 541-737-3504 | F 541-737-2064 | http://ceoas.oregonstate.edu/research/gg/

February 3, 2016

Dr. Ed Ray
President, Oregon State University

Dear President Ray;

The undersigned faculty of the Geology and Geophysics disciplinary group within CEOAS support the Marine Studies Initiative as part of the University's Strategic Plan 3.0 and recognize the economic importance of the MSI to the Oregon coastal community. Nevertheless, as Earth Science experts, we wish to express concern about plans to place the MSI building in the tsunami inundation zone. In the future, an offshore subduction earthquake of magnitude >8 is bound to occur, and would produce ground liquefaction, subsidence, and tsunami inundation at the planned MSI site at HMSC. This would threaten lives, damage buildings, and hobble the research capacity of this flagship Institute. In order to avoid putting students, staff, the public and the institution at risk, we urge you to request a full and independent technical analysis of alternative sites outside of known tsunami flooding zones.

As Oregon's leading science and technology research and educational institution, we have a special responsibility to address societal problems with state-of-the-art and forward-looking solutions based on the best research. New understanding of the science and attendant risks to infrastructure, human life and the economy from great megathrust earthquakes often leads seismic- and tsunami-specific building codes by many years. In light of our current knowledge of the expected inundation of HMSC during such an event, we are concerned that construction of the laboratory and classroom building in the current plan, as presented at a meeting on January 7, 2016 in Newport, includes unnecessary exposure to the hazard of a major tsunami. Consideration of an alternate site nearby outside of the tsunami inundation zone could enhance the connection between the MSI and the Oregon Coast Community College, and would fulfill the promise in the MSI Strategic Plan to consider such options and their potential for long-term safety and cost savings.

The current HMSC campus was established before the risk of a large earthquake and tsunami on the Cascadia subduction zone was widely recognized, and the existing structures are ageing and constructed to standards that do not meet current seismic codes. Given the inevitable need to eventually replace or move the existing facilities, consideration of an alternate site for the MSI facility can be viewed with this long-term need in mind. We believe that OSU, as a public institution with faculty expertise in community resilience and in earthquake/tsunami science and engineering, should hold itself to a high standard regarding public safety and accountability, even if this requires going beyond current building codes. Development of the MSI provides OSU with a unique opportunity to lead sustainable development by providing Oregonians with a safe and forward-looking model for coastal development.

Yours sincerely,

[signed on the following page]

Signed digitally, in alphabetical order:

Peter Clark	Professor
Jessica Craveling	Asst. Professor
John Dilles	Professor
Gary Egbert	Professor
Chris Goldfinger	Professor
David Graham	Professor
Anita Grunder	Professor, Assoc. Dean for Academic Programs
Rob Harris	Professor
Adam Kent	Professor
Eric Kirby	R.S. Yeats Assoc. Professor of Earthquake Geology and Active Tectonics
Anthony Koppers	Professor
Vern Kulm	Professor Emeritus — Kulmvs@cs.com
Mitch Lyle	Professor (Senior Research)
Jennifer McKay	Asst. Professor (Senior Research)
Andrew Meigs	Professor
Alan Mix	Professor
John Nabelek	Professor
Adam Schultz	Professor
Shanaka de Silva	Professor
Frank Tepley	Assoc. Professor
Anne Trehu	Professor
Kaplan Yalcin	Senior Instructor and Program Director
Bob Yeats	Professor Emeritus

cc/ Ron Adams, Jack Barth, Steven Clark, Bob Cowen, Michael Goodwin, Roy Haggerty, Patrick Hughes, Cindy Sagers

Sent by email

OSU
Oregon State
UNIVERSITY

Office of the President
Oregon State University, 600 Kerr Administration Building, Corvallis, Oregon 97331-2128
Phone 541-737-4133 | **Fax** 541-737-3033

March 2, 2016

Dear Colleagues:

Thank you for your letter of February 3, 2016, regarding Oregon State University's consideration of the Hatfield Marine Science Center campus as a location for a new marine studies building.

I welcome your offer to provide faculty expertise in this building's eventual siting, design, engineering and construction. Your world-class knowledge and capabilities are an asset that we will wisely engage.

I have requested a thorough and independent third-party evaluation of site alternatives for this building and have charged Ron Adams, interim vice president for administration, to coordinate this evaluation. As part of this effort, Dean Scott Ashford will serve as a liaison to expert Oregon State faculty and will work to engage you in this process.

Regardless of the eventual location for this building, I will require that the marine studies building meets the following principles:

- The building will be designed to ensure that structural integrity is maintained for the expected Cascadia Subduction Zone earthquake;
- The building's design and safety features will serve as a national and global showcase and demonstrate state-of-the-art structural options for future buildings in seismically active regions worldwide, as well as for earthquake and tsunami readiness;
- If located in a tsunami zone, the building will have a design occupancy of not more than 350 people; and
- The building's occupants – including those with disabilities – will be able to survive a future seismic event, exit the building in a timely manner and, if required, safely follow a tsunami evacuation plan to higher ground.

Again, my appreciation for your letter and offer of engagement.

Sincerely,

Ed

Edward J. Ray
President

cc: Ron Adams, Interim Vice President for Finance
Roy Haggerty, Interim Dean and Hollis M. Dole Professor of Environmental Geology, College of Earth, Ocean and Atmospheric Sciences
Scott Ashford, Dean, College of Engineering

OSU
Oregon State
UNIVERSITY

School of Civil and Construction Engineering
Oregon State University, 101 Kearney Hall, Corvallis, Oregon 97331
Phone 541-737-4934 | **Fax** 541-737-3052 | http://cce.oregonstate.edu

February 12, 2016

Dr. Edward J. Ray, President
Oregon State University

Dear President Ray:

The Cascadia Subduction Zone presents a major threat to life safety, especially along the Oregon Coast where the intense earthquake shaking will be followed quickly by tsunami inundation. It is only over the past decade or so that coastal communities have made a concerted effort to be more resilient to this hazard.

It is not the intent of our letter to endorse or to protest the expansion of the Hatfield Marine Science Center campus and the construction of a new Marine Studies building. Instead, we note that Oregon State University is in a unique position to provide evaluation in planning, design and construction, and education to reduce the coastal impact of the Cascadia Subduction Zone event. This is the first important building in Oregon to be designed within what is now recognized as a tsunami inundation zone. As a first of its kind, the design and construction of such a structure will set precedence for the standard of practice into the future. It must be recognized that being first demands special care and attention to achieve desired performance, resilience, and life-safety. The faculty of the School of Civil and Construction Engineering provide expertise in engineering for multi-hazards, and we encourage the OSU Administration to utilize these resources to build an exceptional educational facility that will serve as a state of the art model of resilient coastal construction in earthquake and tsunami hazard areas.

We encourage the university to consider:

- Characterization of the earthquake hazard, including ground motion, liquefaction, and the tsunami inundation hazard, including arrival time, flow depth and flow speed, debris, and scour potential, beyond that required by ASCE building codes. This includes performing site-specific probabilistic as well as deterministic development of seismic and tsunami hazard curves. It also entails detailed site topographic and bathymetric mapping.

- Use of innovative ground improvement methodologies to prevent liquefaction and tsunami-induced scour around building foundations.

- Design of the building for collapse prevention utilizing performance-based seismic and tsunami design methodology instead of conventional prescriptive methods, as allowed per ASCE 7, following alternate means and methods of design.

- Consideration that the new ASCE 7 design standards for tsunami resistance are as of yet untested. The expected performance of unique structures under tsunami conditions can be validated through physical model tests. OSU is uniquely qualified to conduct such physical model testing in the O.H. Hinsdale Wave Research Laboratory to assess hydraulic demands on the building and components. Experimental results combined with numerical modeling inform the design process to provide the most reliable and economical building.

- Instrument the structure and site to monitor strong shaking of the ground and the building to provide an early warning system and to analyze the performance of the structure immediately after an event as to assist in emergency response.

- Design of the building to include exposed interior structural elements to serve as a learning building for both students as well as the many visitors to the HMSC.

- Evaluation of the building design and orientation, including flow-through effects and flow diversion that may impact neighboring areas.

- Tsunami evacuation planning, utilizing dynamic simulations that include scenarios with unplanned transportation network disruption (i.e., bridge failures, or roadway blockage by building collapse) and realistic populations of the entire south Newport area and including vulnerable populations and people with disabilities. Consideration of vertical evacuation alternatives.

- Utilizing the collective faculty experience in earthquake and tsunami engineering through informal peer-review.

Kearney Hall, the home to Civil and Construction Engineering, was renovated with faculty input such that the building itself serves as a teaching tool for sustainable design and construction. Similarly, the Marine Studies building can be designed and constructed so that those building elements which make it more resilient to earthquakes and tsunamis can be highlighted to increase awareness and understanding of hazard-resilient coastal construction and further serves to reassure occupants that they are in a building designed to meet the challenge.

We, the undersigned members of the faculty in the School of Civil and Construction Engineering, encourage OSU to design and construct the new Marine Studies facility beyond the conventional code requirements to serve as a model for earthquake and tsunami resilience, and we stand ready to assist with the technical challenges if called upon.

W. Jason Weiss
Professor and Head, School of Civil & Construction Engineering
Edwards Distinguished Chair in Engineering
Director of the Kiewit Center for Infrastructure and Transportation Research

Dr. Daniel Borello
Assistant Professor

Dr. Christopher Higgins, P.E.
Drinkward Professor of Structural Engineering

Dr. David Hill
Associate Professor

Dr. Judy Liu
Professor

Dr. Pedro Lomonaco
Director, O.H. Hinsdale Wave Research Laboratory

Dr. Armin W. Stuedlein, P.E.
Associate Professor

Dr. Solomon C. Yim, P.E.
Glenn Willis Holcomb Professor of Structural Engineering

Dr. Andre Barbosa, P.E.
Assistant Professor

Dr. Daniel Cox
Professor

Dr. Merrick Haller
Associate Professor

Dr. K.M. Hunter-Zaworski, P.E.
Associate Professor

Dr. Michael Olsen
Associate Professor

Dr. Michael Scott
Associate Professor

Dr. Haizhong Wang
Assistant Professor

Dr. Harry Yeh, P.E.
Professor

sent by email

OSU
Oregon State
UNIVERSITY

Office of the President
Oregon State University, 600 Kerr Administration Building, Corvallis, Oregon 97331-2128
Phone 541-737-4133 | **Fax** 541-737-3033

March 2, 2016

Dear Colleagues:

Thank you for your letter of February 12, 2016, regarding Oregon State University's consideration of the Hatfield Marine Science Center campus as a location for a new marine studies building.

I welcome your offer to provide faculty expertise in this building's eventual design, engineering and construction. Your world-class knowledge and capabilities are an asset that we will wisely engage.

I have requested a thorough and independent third-party evaluation of site alternatives for this building and have charged Ron Adams, interim vice president for administration, to coordinate this evaluation. As part of this effort, Dean Scott Ashford will serve as a liaison to expert Oregon State faculty and will work to engage you in this process.

Regardless of the eventual location for this building, I will require that the marine studies building meets the following principles:

- The building will be designed to ensure that structural integrity is maintained for the expected Cascadia Subduction Zone earthquake;
- The building's design and safety features will serve as a national and global showcase and demonstrate state-of-the-art structural options for future buildings in seismically active regions worldwide, as well as for earthquake and tsunami readiness;
- If located in a tsunami zone, the building will have a design occupancy of not more than 350 people; and
- The building's occupants – including those with disabilities – will be able to survive a future seismic event, exit the building in a timely manner and, if required, safely follow a tsunami evacuation plan to higher ground.

Again, my appreciation for your letter and offer of engagement.

Sincerely,

Ed

Edward J. Ray
President

cc: Ron Adams, Interim Vice President for Administration
Scott Ashford, Dean, College of Engineering

Oregon
Kate Brown, Governor

Seismic Safety Policy Advisory Commission
Oregon Emergency Management
Mailing Address: PO Box 14370
Salem, OR 97309-5062
Phone: (503) 378-2911
Fax: (503) 373-7833

February 1, 2016

Governor Kate Brown and Oregon Legislature
State Capitol Building
900 Court Street NE, 160
Salem, OR 97301

Dear Governor Brown and Members of the Oregon Legislature,

As Chairman of the Oregon Seismic Safety Policy Advisory Commission, I am taking the opportunity of the new Legislative session to review both successes and concerns of the Commission on Seismic Policy and the implementation of the Oregon Resilience Plan (ORP). This last year saw a number of successes as the Legislature created the position of the State Resilience Officer (SRO), significantly increased the funding for the Seismic Rehabilitation Grant Program (SRGP), allowed communities to create loan/loan guarantee programs for seismic retrofits for commercial buildings, and addressed liability issues for the Critical Energy Infrastructure hub stakeholders, all of which were based the ORP. We look forward to working with Derek Smith, the new State Resilience Officer (SRO) after his approval by the Senate. We are pleased with the recent response to the SRGP program which received 117 applications for the current $50 million budget, many of which will need to be considered in the next round. This investment will significantly improve the seismic safety of our schools and essential facilities.

One of our major concerns continues to be the adoption of the revised DOGAMI Tsunami Inundation Maps (TIM) and the updating of the administrative rules for higher development standards in the tsunami inundation zone. The coastal communities need to be provided with the best science and clear directions on development and risk in their communities. The example of the new Marine Studies Buildings proposed by Oregon State University (OSU) at the Hatfield Marine Science Center (HMSC) inside of the tsunami hazard zone in Yaquina Bay is instructive since the current decisions are based on the SB 379 line and administrative rules that have not taken into account the lessons of the ORP or a review of the effectiveness of the existing administrative rules. We are cognizant of the economic benefit this project will have for Newport and appreciate the higher design standards OSU is employing to improve the safety of the users and visitors to the new facility. However, pending the adoption of the TIMs and new administrative rules we propose the following safety issues be addressed:

- That the standards for tsunami risk be based on the DOGAMI TIMs maps which are currently the best peer reviewed science for tsunami risk. Other scientific studies used to for an individual project should meet the same level of peer review as the DOGAMI TIMs study.
- That tsunami evacuation studies be done for the new OSU facility and Hatfield Marine Science Center and be conducted looking at the "safe haven hill" and their proposed vertical evacuation element to include staff, students and visitors.
- The tsunami evacuation study of these facilities need to include a thorough review to meet the Americans with Disabilities Act access requirements. This issue is being raised in other parts of country with respect to emergency evacuation and could present future liability issues.

There are also a number of resilience issues that are relevant not only for the OSU project but for other state funded projects on both the coast and the rest of the State:

- Consistency of funding standards: Given that K-12 schools applying for SRGP must pass a FEMA-based Benefit Cost Analysis (BCA) in order to qualify for the state grant funds, it is not unreasonable to request that a BCA be completed for OSU (or other such projects) to substantiate the best use of HB 5005 bond funds from 2015 Legislature.

- We are discovering that Oregon's Universities have some unique funding vulnerabilities to natural hazards since they rely heavily on student tuition, which may need to be refunded following a disaster. Research institutions such as OSU have an additional vulnerability in that they may need to return federal grant money for projects that cannot be completed if the research facility is destroyed or the ability to conduct the research is lost. We recommend that Oregon's public universities develop continuity of operations and resilience planning, since the loss of these institutions would be a significant blow to recovery efforts.

- Besides the HMSC, Oregon has a number of other institutions that study the coastal environment, which include the Oregon Institute of Marine Biology, along with the South Slough National Estuarine Research Reserve and the newly formed Oregon Marine reserves. The Cascadia earthquake and tsunami will have enormous impact on the coastal environment and ecology and we will need these institutions to help us understand the changes. While their mission involves them being located near the ocean, thought needs to be given on how their vital missions can continue after the next Cascadia event.

- Universities and the research institutions play a big role in the economies of their community and need to be resilient in order for the communities in which they are located to be economically resilient. We recommend considering that projects like the OSU project and similar projects receiving State or Federal money have an independent peer review process ensure the basic safety for people using these new facilities and to include alternatives, such as location and design, for the project with regards to improving the facility's resilience for both economic and continuity of program concerns.

The OSU project is an opportunity for us to demonstrate best practices for our universities and communities to become resilient from a Cascadia earthquake and tsunami. The process should help us determine the best balance between risk, safety, and the current and future economic viability. We recognize that not all the questions can be answered in one project, but the path towards resilience means that we must take positive steps with each opportunity.

Having traveled three times to the damaged areas in Tohoku, Japan after the 3/11 earthquake and tsunami, I observed how they are now applying hard-learned lessons to recover and relocate important community facilities to avoid unnecessary exposure to future tsunami risk. In learning from Japan, it is time Oregon updated ORS 455.446 and 455.447 to bring stronger state agency engagement from the Department of Geology and Mineral Industries, Department of Land Conservation and Development, Building Codes Division and Oregon Emergency Management to better coordinate and assist in these types of coastal development decisions.

We need to approach these development decisions with a post-3/11 perspective. The Oregon Legislature did just that when they directed OSSPAC to deliver the Oregon Resilience Plan. We are optimistic that with the leadership and coordination from the Governor's Resilience Policy Officer, we can better integrate the ORP recommendations into everyday decisions and make our State a safer, sustainable, and more resilient place for current and future generations.

On behalf of all the members of OSSPAC, we look forward to working with you during and after the 2016 Legislative Assembly.

Respectfully,

Jay Wilson, Chairman

Jay Raskin, Vice Chairman

Oregon
John A. Kitzhaber, MD, Governor

Department of Geology and Mineral Industries
Administrative Offices
800 NE Oregon St., Suite 965
Portland, OR 97232-2162
(971) 673-1555
Fax: (971) 673-1562
www.oregongeology.org

November 24, 2014

Dr. Edward J. Ray
President
Oregon State University
600 Kerr Administration Building
Corvallis, OR 97331-2128

Dear Dr. Ray:

It has been my pleasure to serve on the College of Earth, Ocean and Atmospheric Sciences (CEOAS) Board of Advisors for several years. I am writing to you today to express my confidence that Oregon State University, through your leadership, will do the right thing in regard to its recent Marine Studies Initiative.

OSU and the CEOAS have engaged in a new initiative, the Marine Studies Initiative, and are actively fundraising for new facilities to be constructed at or near the Hatfield Marine Center in Newport. The proposal is for a new 100,000-sq.-ft. building for teaching and research with a capacity of <u>500 occupants</u> built directly in the tsunami inundation zone at Newport. If designed for 501 or more occupants, this building would not be allowed under Oregon Revised Statutes (ORS) 455.446 and 455.447, which limit construction of certain critical and essential facilities in the tsunami inundation zone.

OSU researchers and engineers have been leaders in furthering the international understanding of the science and hazards associated with the Cascade Subduction Zone earthquakes and tsunamis. My agency has coordinated with said researchers to define the hazards, develop mitigation activities, and provide education and outreach to coastal communities to build resilience. An OSU professor co-chaired the Governor's taskforce to recommend implementation of the Oregon Resilience Plan, a plan specific to surviving and thriving after a Cascade Subduction Zone earthquake.

I urge you to show the same leadership now as the Marine Studies Initiative takes shape. If there is to be a new building funded and constructed through OSU in a recognized hazard area then I respectfully recommend you demand it be designed to be the most effective and safe tsunami vertical evacuation building possible. Better yet, locate the main occupancy building in the Newport area outside of the tsunami inundation zone and maintain a modest research facility at Hatfield Marine Center. I know you are not willing to put even one, much less 500, students and researchers in peril every day.

I am happy to meet with you to discuss your options and your ideas to develop a new facility in Newport that will stand the test of time and coastal challenges.

Many regards,

Vicki S McConnell

Vicki S. McConnell, Ph.D., R.G.
Oregon State Geologist

CC:

Mark Abbott, OSU Dean CEOAS
Anita Grunder, OSU CEOAS Chair
Ken Barrow, Chair CEOAS Board of Advisors
Larry Givens, Chair DOGAMI Governing Board
Jay Wilson & Jay Raskin, Oregon Seismic Safety Policy Council Co-Chairs

OSU
Oregon State
UNIVERSITY

Office of the President
Oregon State University, 600 Kerr Administration Building, Corvallis, Oregon 97331-2128
Phone 541-737-4133 | **Fax** 541-737-3033

December 12, 2014

Dr. Vicki S. McConnell
Department of Geology and Mineral Industries
Administrative Offices
800 NE Oregon St., Suite 965
Portland, OR 97232-2162

Dear Dr. McConnell,

Thank you for your letter dated Nov. 24, 2014 expressing your concerns with respect to OSU plans for expansion of the Hatfield Marine Science Center in anticipation of growing our teaching, research, outreach and engagement programs associated with the Marine Studies Initiative. We certainly share in your excitement of the Marine Studies Initiative as well as your realization of the challenges it creates. We are committed to meeting our institutional goals with the best possible solutions that ensure that we meet or exceed all safety standards for our students, staff and the community.

The points you raise are very much at the forefront of our planning process. Below, I provide a brief summary of our planning goals, as well as a few clarifications.

First, let me clarify our plans. We are planning for eventually supporting up to 500 students over the whole year. Since many students will also take advantage of the summer session, we anticipate no more than 300-400 students present at Hatfield during any given session. Moreover, our teaching facilities will ultimately include not only the new building, but at least two other OSU buildings already present on the HMSC campus – these latter buildings house a minimum of 8-10 classrooms/meeting rooms and laboratories. Consequently, we anticipate the students, staff and faculty 'occupants' of the new building to not exceed 250-300, which is well under the 501-occupant threshold you referenced. While this point clearly eliminates the Statute (ORS) 455.446 and 455.447 building issue, we stress that we remain extremely focused on what options we have to meet or exceed safety standards.

Second, while we are looking at building the new MSI facility on the HMSC campus, we are planning to site housing for the students off-campus, at a location 'up-the-hill' near the Oregon Coast Community College in or near the Wilder Development. This puts the students well out of the tsunami zone for the better part of their 24-hour day, and especially during the night when an event would be the most disorienting.

Third, our building plans will focus on maximizing the ability of the building, and its occupants, to survive the seismic event that may lead to the tsunami conditions so that people can follow our well-established evacuation procedures to higher ground. To this end, we are committed to working with experienced architectural and engineering firms to build a state-of-the-art seismically-resilient building as a demonstration project for other coastal residents/businesses to follow, as future building along such coastal environments as Oregon will continue out of necessity (e.g. Ports, communities). As leaders in research and innovation, there is considerable value in having a new OSU facility that is seismically strong as a demonstration of potential solutions where such building location is required, for whatever circumstance. We will also give a vertical evacuation design full consideration.

I reiterate our appreciation of your concerns and ensure you that we are very committed to the safety of our students and staff in our pursuit of meeting our academic mission. We will welcome your input throughout the entire process as we consider all of our options.

Sincerely,

Ed Ray

Edward J. Ray
President

cc: Mark Abbott, OSU Dean CEOAS
Anita Grunder, OSU CEOAS Chair
Ken Barrow, Chair CEOAS Board of Advisors
Larry Givens, Chair DOGAMI Governing Board
Jay Wilson & Jay Raskin, Oregon Seismic Safety Policy Council Co-Chairs