Appendices

Appendix A- Studio Materials

Urban Design Studio Syllabus

URBAN DESIGN STUDIO: URBAN DESIGN FOR COMMUNITY RESILIENCE
Urban Design and Planning 508B (5.0) SLN 21149 • Winter 2016 • MTh 1:30-5:20 • Gould 416

Instructor: Dan Abramson (PhD, Associate Professor)
Office Gould 448J • office phone 543-2089 • e-mail abramson@uw.edu
Doctoral TAs: Peter Dunn ptdunn@uw.edu, and Adnya Sarasmita adnyaps@uw.edu
Course discussion board: https://catalyst.uw.edu/gopost/board/abramson/41716/

STUDIO TOPIC – URBAN DESIGN FOR COMMUNITY RESILIENCE

URBDP 508 satisfies the Studio requirement for the Master of Urban Planning, and especially the advanced 2nd studio for MUP students specializing in Urban Design, as well as the 2nd or 3rd studio for all students in the Certificate of Urban Design program (MUP, Master of Architecture, and Bachelor/Master of Landscape Architecture students). The 2016 Advanced Urban Design Studio is offered in conjunction with the National Science Foundation (NSF)-funded "M9" project to study how communities planning for resilience might make use of new probabilistic information about tsunami hazards associated with a Magnitude 9 (M9) Cascadia Subduction Zone (CSZ) earthquake.

- Learn how tribal communities on the Olympic Peninsula are leading the nation in adaptive community planning for coastal environmental change
- Work with UW M9 team, state and local agencies and community members to "plan with uncertainty"
- Organize and run a workshop with local staff and residents that combines asset-based community mapping techniques with hazard mapping using the latest scientific tsunami models and *weTable* interactive participatory GIS
- Develop a multi-phased adaptive urban design strategy for new settlement siting and forms based on local values and assets
- Explore how planning for long-term adaptation in the face of an infrequent, unpredictable but consequential change can help a community realize its short- and medium-term developmental and environmental goals

The studio centers on a workshop with local staff and residents that combines asset-based community mapping techniques with hazard mapping using the latest scientific models and interactive participatory GIS technology. The workshop includes a research component to compare how some participants use deterministic representations of the hazard with how other participants use representations that make uncertainty about the hazard more explicit. The studio will then use the workshop as part of a larger visioning exercise for new settlement siting and forms based on local values and assets, to explore how planning for long-term adaptation in the face of an infrequent, unpredictable but consequential change can help a community realize its short- and medium-term developmental and environmental goals.

COMMUNITY SITE AND PARTNERS

The site and community "client" is Aberdeen, WA. Quinault Tribe is also offering an introduction to their tsunami- and climate-change-adaptive planning process, and an option to assist with relocation planning for the tribal community of Queets.

SCHEDULE

Weeks 1-3. Phase I – Initial Community Engagement, Asset Mapping, and Hazard Analysis (20%)

In this phase, students develop background understanding of the project's goals, gather basic site and community information, participate in community engagement, research relevant design principles and precedents, and undertake site analysis for design.

Monday 1/4

First meeting:
- Studio topic, sequence, class objectives, evaluation, format (overlap with Bob Freitag's class, 4:30-6:30)
- Students self-introduce, share backgrounds, goals for studio learning
- Studio culture, media, environment and classroom logistics: keys, space, desks, etc.
  - Discussion, esp. re media
- Community and site engagement logistics: client (Aberdeen vs. Quinault?), dates, travel, accommodation, and communications
- Overview of concept of resilience and relation to urban design

First assignment: Home Community Asset Map

Thursday 1/6

1st Assignment due: Students present Home Community Asset Maps; brainstorm and assign themes for first (remote) pass at second assignment.

Second assignment: Aberdeen Community Asset Maps - Remote

Friday 1/8 2:15-3:30 Gould 208J	**Quinault Tsunami Resilience Presentation** Charles Warsinske, Quinault Community Development and Planning Director

Monday 1/11

2nd Assignment due: present remote efforts to map Aberdeen Community Assets

Organize trip to Aberdeen and tasks for ground-truthing community assets and key site conditions.

Thursday 1/14
All Day

Site Visit to Aberdeen
11:00am – 1:30pm: Lunch Meeting with Aberdeen key stakeholders in downtown Aberdeen, D & R Event Center, 111 South "I" Street.
1:30pm – dark: windshield survey by van of key sites

Friday 1/15	**Optional Visit to Quinault Communities of Taholah and Queets** Overnight stay in Aberdeen Thursday, 1/14; return to Seattle late Friday night.

Monday 1/18	NO CLASS – MARTIN LUTHER KING JR. DAY
Thursday 1/21	***3rd Assignment due***: Present individual site visit impressions and overview of data gathered, using PowerPoint pechakucha format (20 slides in 20 seconds; see http://www.pechakucha.org/) Group brainstorm: Aberdeen SWOT analysis; what design precedents/ reference prototypes would address the Strengths, Weaknesses, Opportunities and Threats we observed in Aberdeen? - what further information-gathering from Aberdeen do we need to do? Work session: - adopt workshop roles (community stakeholder; UW facilitator; UW note-taker; etc.?) for role-playing with weTable - revise and digitize asset map layers with ground-truthed data for use in ArcGIS and weTable

Weeks 4-6. Phase II – Prototype Design Ideas; Community Resilience Workshop (30%)

Monday 1/25	***4th Assignment due***: Present digitized asset map layers. Mini-Lectures: - Methods of participant observation and note-taking for small group meetings - introduce the hazards; deterministic vs. probabilistic scenarios; visualizing uncertainty Work session: begin practicing map layer use in weTable?
*input from modelers	
Thursday 1/28	Possible guest lecture topics: - Cascadia Subduction Zone earthquake and earthquake-related hazards - Tsunami vertical evacuation design Work session and desk crits with TAs: develop prototype studies
Abramson away at conference	
Monday 2/1	In-class charrette: use weTable and role-playing to brainstorm possible locations of prototype design solutions Work session and desk crits with TAs: - develop prototype studies - prep workshop

Thursday 2/4	***5th Assignment due***: Present precedent/reference prototype case PPTs; argue for their applicability based on Aberdeen site and community asset analysis Work session: begin work on design precedent/reference prototype posters
Monday 2/8	**6th Assignment due**: Bring design precedent/reference prototype posters to class
Gould 007f Digital Commons	FEMA HAZUS training session ***Watch in advance***: one of the ARF or MP4 files for the 40-minute presentation on "HAZUS-20141127 0039-1" in the "FEMA" folder in "Resources" on the studio Google Drive. Prep workshop

Wednesday - Thursday 2/10-11	**Community Resilience Workshop in Aberdeen**
Friday 2/12	**Optional Second Ground-truthing Survey in Aberdeen**

Weeks 7-11 Phase III – Envisioning a New Post-Earthquake Normal: Adaptive Urban Design Strategy (50%)

Monday 2/15	NO CLASS – PRESIDENTS' DAY
Thursday 2/18	**7th Assignment due**: Present analysis of workshop proceedings In-class charrette: use weTable and workshop participant input to begin work on "new normal" design schemes
Monday 2/22	Work session; individual desk crits
Thursday 2/25	Work session; individual desk crits
Monday 2/29	Work session; individual desk crits
Thursday 3/3	Work session; individual desk crits
Monday 3/7	Work session; individual desk crits
Thursday 3/10	Work session; individual desk crits
Monday 3/14	Dry Run

Thursday 3/17 **Final Review**

Tsunami hazard mapping – R&D to improve hazard communication and resilience decision-making

Background. Deterministic Tsunami Hazard Maps are an important element of community emergency preparedness and response planning. Typically, most such maps present inundation zones delineated by a single, crisp line (Figure 1). Such maps lack any representation of the uncertainty in the science that underlies these maps – complex modeling of multiple factors, including spatial and temporal details of the tsunami source, tidal stage, variable bathymetry and topography, seismic uplift or subsidence of coastal land, etc. Also, the conventional use of such maps in planning is as follows: first, the hazard map scenario and associated community vulnerabilities are presented; second, possible responses to the hazard are developed and discussed. In contrast, an "Asset-based" approach first has stakeholders create an inventory of built, natural, and social community assets, then examine the hazard scenarios and associated vulnerabilities and, finally, identify those assets that could facilitate planning that is adaptive – i.e., assets that could help achieve comprehensive community planning goals, enhance mitigation of the hazard, and recover from the disaster (Freitag, et al., 2015).

Figure 1. *From Walsh, et al (2003), showing tsunami inundation limits on Neah Bay, Waatch River valley and northern section of Makah Bay*

Several important questions thus arise, regarding hazard uncertainty and community resilience planning. (1) Can adding uncertainty information to hazard maps improve their usefulness? (2) Will probabilistic or uncertainty information about a hazard influence community members to make more risk-taking or risk-averse (precautionary) decisions? Here usefulness is defined in the context of whole community resilience – i.e., as collective decisions that consider and address a wider range of community values, capital or social, natural and built assets (Freitag, et al., 2015). (3) Does starting discussions with a focus on community values and assets, as opposed to hazard scenarios and community vulnerabilities, make a difference in community planning?

Goals. To address questions (1) and (2), we will

• Develop tsunami hazard maps with and without representing uncertainties in the hazard assessment, and assess the influence of these maps in an asset-based approach to decision-making. If time and resources permit addressing question (3), we will also

• Test both versions of the tsunami hazard maps using a conventional hazard scenario approach to planning. This would be worthwhile because we are not aware of any previous research on whether including probabilistic or uncertainty information will *itself* prompt a more values-based discussion of the hazard and related adaptive strategies.

Behavioral science background. There has been little empirical study of how emergency managers, planners, the public at large, or even scientists from different disciplines, might understand and use representations of probabilities and/or uncertainty in various kinds of hazard maps, especially for rare events such as tsunamis. For frequent events such as icing, some research suggests that visual uncertainty information can reduce the quality of decisions, while also demonstrating that uncertainty information presented in other formats can improve decision-making (Savelli and Joslyn, 2013). Based on the literature and previous research by our team, we expect that:

Figure 2. *Fuzziness as applied to points (left) and lines (right), from MacEachren et al 2012)*

1) Discussions of hazard response that invoke a greater diversity and number of different community assets and values as sources of resilience are likely to favor more precautionary courses of action, but also more creative strategies in contrast to conventional mitigation. Such strategies would include policies, investments and initiatives that meet a wide range of community developmental goals beyond the avoidance of damage to existing assets (Freitag et al 2015).

2) A focus on a catastrophic, high-consequence, low-probability hazard (e.g. rare, extremely large tsunamis) will prompt discussion of more precautionary courses of action than a representation that includes higher probability less extreme outcomes, according to Prospect Theory (Kahneman & Tversky 2001; Sunstein 2015; Tversky & Kahneman 2001).

3) Fuzzier information (representations of uncertainty or probabilistic values) will also prompt discussion of more precautionary courses of action. In other words, representations of uncertainty associated with probabilistic hazard assessments (e.g. with fuzzy lines or areas representing probabilistic assessment of inundation – see Figure 2 and Thompson et al 2015) may evoke different risk attitudes than do deterministic representations of expected inundation (ie., sharp lines). In past studies showing confidence bounds on point estimates, some portion of message recipients focus on the riskiest estimates rather than the expected values (see discussion in Bostrom, et al., 2015). In

contrast, Savelli and Joslyn (2013) test a gradient representation of a predictive interval temperature forecast (i.e., an interval based on the probabilistic distribution of forecast temperatures); this gradient representation bears some visual resemblance to the type of fuzzy line that are also proposed in their study. They compare it experimentally to a deterministic temperature forecast – i.e., a single estimated temperature, and find that the gradient predictive interval improves risk decision-making over the deterministic forecast, although the gradient does not alleviate some known interpretation errors (e.g., the deterministic construal error).

Recent research on probabilistic volcanic hazard maps finds that data classification, color scheme, content, and how the map key is expressed all influence how users engage with and interpret probabilistic volcanic hazard maps (Thompson et al 2015), for which reason these elements would likely be kept as similar as possible across maps to be assessed.

Map Assessment Strategy – Community Workshops. The mechanism to achieve our goals will be community workshops with small-group interactions that are designed to inform on-going planning efforts in partner communities, as well as to address broader questions of collective human response to different types of hazard information. For example, if conducted in Neah Bay, the workshop would follow up previous vertical evacuation planning efforts and on-going new housing development and facilities relocation siting plans, with the coordination of Makah Tribe General Manager, Meredith Parker, and the Makah Emergency Management Program coordinator, Andrew Winck.

Each community workshop will be similar to those that were held for the FEMA-funded project described in Freitag et al (2015). Participants will characterize their community in terms of the goods and services that constitute its quality of life (values), and the sources and providers of those goods and services. Goods and services included material things and activities such as "water," "exercise," and "medicine"; non-material things like "information" and "cultural expression"; and combinations of material and non-material things such as "refugee services" and "social gathering over food." Sources and providers will be specific to the community and could be located on a map, though they could also include spatially dispersed or mobile organizations or networks. In order to have a broad values-based discussion – i.e. identify all the assets that might help a community get through a disruptive event – it is important to hear from as diverse a representation of the community as possible. It is also important to bring an adequate number of participants (minimally 12; ideally 24) into the discussion to compare how people work with the two types of hazard information: deterministic and probabilistic/uncertain. Ideally, therefore, participants would include different ages of community members, residents of different locations within the community, owners and employees of different businesses, as well as emergency managers and other public officials .

Unlike the FEMA-funded workshop, however, the current proposed activity would take place in the context of a planning studio course at the UW, similar to those that took place for Project Safe Haven with coastal communities for tsunami vertical evacuation in 2010-2011. In other words, the workshops would be part of a student-community engagement over the course of one academic quarter (3 months) that would include a community asset- and values-mapping exercise, new hazard maps, and conclude with a more detailed, phased plan for new or relocated housing and facilities, vertical and horizontal evacuation structures, routes and trail systems, and/or other programs that might not involve land-use decisions.

To help stakeholder groups discuss data produced by the project and analyze opportunities to adapt settlement forms spatially, the workshop would (if possible) employ interactive touchable tables or wall surfaces, i.e., participatory GIS (Tanaka, et al., 2007; Tanaka, et al., 2009; PlaceMatters, 2010). The research team will train students and work with community members to document these activities by photography, and interview a sample of participants before and after the activities to elicit what lessons they feel are worth sharing from the experience, including what changes have taken place, if any, in their view of risk, change and planning, and the value of their community's place on the coast. Once the community members have completed an inventory and map of values, assets and sources of resilience, they would divide into two groups to consider the hazard/change agent: one to work with a map representing a single, sharply defined deterministic scenario, the other to work with a map representing uncertainties in hazard assessments.

For both groups, the maps will be supplemented by (the same) qualitative descriptions of the experiences and damage forecast for these types of events, as well as likely long-term changes. Each group will be tasked to discuss which of the values and assets identified in the first phase of the exercise will be able or unable to withstand changes inflicted by the hazard, and which of those values and assets will enable the community to maintain its viability and identity through the changes. Finally, each group will be tasked to envision long-term strategies that, if adopted now or sometime before the change, would better enable the community to maintain its viability and identity through the changes.

Trained student observers, working under the supervision of M9 team members and UW doctoral students, will take note of the number and diversity of values and assets that workshop participants considered useful for long term adaptation in the face of the two different kinds of hazards in the two different communities. Other trained students will be

tasked with observing and recording indicators from the discussion that participants were either more or less precautionary or creative in their formulation of adaptive strategies. To what extent do participants tend to deny, ignore or de-emphasize risks posed by environmental change, or, alternatively, the risks posed by their own strategies? To what extent do they embrace or resist the notion of environmental change itself? To what extent do they envision strategies that accomplish multiple goals, that have lower external costs, or that can be reversed if necessary or involve multiple back-up systems in case of failure? Observations would be supplemented by short surveys at the end of the workshop(s), assessing participants' understanding and the ease-of-use of maps (e.g., uncertainties and inundation areas), their subjective risk assessments, and their preferences.

If the number and mix of local participants are adequate, we may also divide each of these two groups into two groups again, in order to test the difference that the asset- and values-based approach makes. One of each of the two "deterministic" groups and the two "uncertainty" groups would begin their discussion with the listing and mapping of assets and values (as described in Freitag et al, 2015), while the other group in each pair would begin discussion in the more conventional way, by describing the hazard and identifying vulnerability and risk.

Development of tsunami hazard maps that represent uncertainties. Uncertainties associated with Tsunami Hazard modeling can be categorized as: Source Specification, Model Physics, and Digital Elevation Model (DEM) quality issues. The relative importance of each category may be highly community- and source-specific; however, Source Specification is believed to be responsible for most of the uncertainty in near-field Tsunami Hazard Assessment (THA) studies – for example, studies conducted to assess Cascadia Subduction Zone (CSZ) tsunami hazards that threaten U.S. West Coast communities. In particular, results of such studies are highly sensitive to the detailed spatial distribution, on characteristic length scales of 10s of kilometers, of the near-field crustal deformation. Source Specification efforts must therefore address the very difficult (and frequently controversial) task of providing credible and scientifically defensible predictions of these detailed spatial distributions for future CSZ seismic events.

This important issue of THA Uncertainty is closely related to a goal of the Tsunami R&D component of the UW M9 Project (https://hazards.uw.edu/geology/m9/), namely

- Provide WA EMD/DNR with site-specific inundation studies, including supplementary probabilistic information to usefully inform decision-making.

Uncertainty and Probability are closely related concepts but, in the specific context of near-field THA, we make the following distinction. Given a credible and scientifically defensible suite of CSZ source models, a formal Probabilistic Tsunami Hazard Assessment (PTHA) modeling study requires that each of the multiple sources be assigned a numeric probability; this additional step can be significantly challenging. Thus the distinction that, if numeric probabilities are not utilized in a study, we may still have reasonable confidence that the occurrence of any of the scenarios is scientifically credible and possible. Even where there is scientific consensus on past and probable future events, there will always be some level of *uncertainty* regarding the *probability* of any given scenario.

We note that decisions to include or exclude numeric probabilities and/or to conduct formal Probabilistic Tsunami Hazard Assessment (PTHA) studies and/or to utilize PTHA products may be based on either scientific grounds (e.g., the numeric probabilities are not adequately defensible), or programmatic, policy, operational or other practical concerns. R&D will, of course, continue on PTHA that is aimed at producing "best available science" products and testing their impact on decision-making; whether or not these products are adopted for operational use, they may nonetheless prove valuable as additional guidance for decision-makers.

Given the scientific challenges, are there criteria that might provide guidance regarding the Source Specification issue ? As a practical matter, the following factors might be considered.

1. Has the Source Specification work been vetted in the peer-reviewed scientific literature, and is there an adequate degree of scientific acceptance of the proposed sources ?
2. Can the sources be considered conservative in some sense, i.e., do they likely err on the side of greater, rather than less, potential hazard ?
3. Are the sources consistent with US National Seismic Hazard Mapping Program (NSHMP) recommendations ?
4. Are the sources consistent with relevant programmatic policies and legislation (e.g., "best available science", worst considered case, building codes, etc.)

Thus, Washington State has adopted the L1 earthquake scenario for most THA studies. It is one of 15 sources developed by Witter, et al. (2013), and was chosen as a "worst case considered" scenario believed to be both conservative and have an estimated Average Recurrence Interval period acceptably close to a 2500-year building code horizon; in addition, portions of this work were adopted in the most recent US NSHMP recommendations. (Note that there are continuing efforts to improve CSZ source specification, most notably: the M9 Project R&D by Art Frankel; the

refinement and extension of the Witter, et al. (2013 *Geosphere*) work by several of the authors and M9 Tsunami team members; more general stochastic realization methodologies by LeVeque and other M9 tsunami team members.)

As a step toward the above M9 goal, we will present some ideas, for general discussion and feedback, on Hazard Map products that represent scientific uncertainties, as candidates for assessment at the community workshop. Such products will also serve as a natural intermediate step in the R&D to develop formal PTHA products that may be useful to WA State decision-makers.

At this point, in particular, a simple, two-map set is under consideration. The first map – a deterministic "Single Source Hazard Map" – would display the maximum inundation line associated with the scenario adopted by WA State, i.e., the Witter, et al. (2013) L1 source; the second map – a "Multiple Source Hazard Map" with additional scientific information – would display the L1 source plus additional selected sources from the remaining 14 sources developed by Witter, et al. (2013). For example, the five sources SM1, M1, L1, XL1 and XXL1 are each identified as the "most likely" in each of the 5 size categories (SMall, Medium, Large, eXtra Large and eXtra eXtra Large), with M1 being the most likely of all 15 sources; each is also the most conservative in its size category, because it is associated with maximum values of parameters that are indicative of potential hazard – i.e., peak slip, offshore uplift, offshore subsidence, shoreline wave height and inundation distance. The selection of sources, different possible representations of the inundation lines and the possible addition of information such as estimated average recurrence intervals will be topics for general discussion.

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Final Review for Studio

University of Washington URBDP 508B - Advanced Urban Design Studio
Final Review - Gould Hall Room 100 - 17 March 2016

Urban Design for Community Resilience: Using Cascadia Earthquake and Tsunami Scenarios to Envision a Sustainable Aberdeen, WA

Dan Abramson, Instructor, abramson@uw.edu
Peter Dunn and Adnya Sarasmita, Doctoral Teaching Assistants

Schedule

2:00 - 2:10 *Welcome & Introductions* by Dan Abramson

2:10 - 2:30 *Studio Process Overview and Master Plan* by Ashley Bennis

2:30 - 2:40 *Gallery Walk of Posters*

2:40 – 4:20 Break out into Parallel Presentation and Discussion Sessions

Session I – Reviewers: Bob Freitag, Director, UW Institute of Hazards Mitigation;
Cynthia McCoy, FEMA Region X Risk Analyst GIS/Hazus;
Susmita Rishi, UW Urban Design & Planning PhD candidate.

Students and topics:
Ashley Bennis – *Overview of the Studio Approach*
Max Baker – *Bike Plan Aberdeen: Enhance, Evolve, Evacuate*
Lizzie Moll – *Division Street Berm: Protect, Preserve, and Play*
Jingchen Liu – *Collage City: Intensifying and Revitalizing Downtown*
Ru'a Al-Abweh – *Resilience in the Public Realm: Recreation & Refuge*
Ziqin Pu – *Moving Up To Safety*

Session II – Reviewers: Manish Chalana, Associate Prof., UW Urban Design & Planning;
Himanshu Grover, Assistant Prof., UW Urban Design & Planning;
Sara Jacobs, UW Built Environments PhD candidate;
Leann Andrews, UW Built Environments PhD candidate.

Students and topics:
Michelle Caponigro – *Looking to Nature: Shoreline Design for Flood and Tsunami Mitigation*
Ze Wang – *Downtown Waterfront Levee as Public Amenity*
Stevie Koepp - *Imagine Fry Creek: Building the Confluence of Forest, City and Estuary*
Jialing Liu - *Living with Water: Flood-Accommodating Neighborhood Design for West Aberdeen*
Colin Poff – *Resort to Refuge: Uphill Relocation Possibilities*

4:20 – 4:30 Coffee break and 2nd gallery walk

4:30 – 5:00 *Wrap-up Roundtable Discussion*
Some questions for consideration:

- Did the studio succeed in showing how thinking about a disaster can help with long-range planning for the community generally?
- Did the studio succeed in showing how thinking about community developmental goals can help with disaster preparedness?

- How can this approach better demonstrate the value of "resilience thinking" to long-term planning and hazards mitigation?

Final Report Urban Planning Studio

ABERDEEN STORY
FINAL REPORT

Alfred Thompkins Ltd.

CONTENTS

01 ABERDEEN COMMUNITY PROFILE AND STUDIO INTRODUCTION

Historic Postcards. Source: Library of University of Washington Special Collection

1964 Aerial Photo of Aberdeen. Source: Library of University of Washington Special Collection

Aberdeen: Overview | Ashley Bennis |

The 2016 Advanced Urban Design Studio in Aberdeen actualized the research phase in a National Science Foundation (NSF)-funded project to study how communities might make use of new probabilistic information about tsunami hazards associated with a Magnitude 9 (M9) Cascadia Subduction Zone (CSZ) earthquake. The university team, known as M9, that carried out the research is a multidisciplinary group of specialist seeking to address scientific and engineering challenges that come with reducing risk while also learning how to convey complex information to communities involved in resilience planning. The first step in the process involved brainstorming which community along the Washington coast would be ideal for implementing the pilot project as the eruption of the CSZ fault would be felt all along the western coast from Cape Mendocino California, through Oregon and Washington up to Vancouver Island in Canada. The Washington State Emergency Management Division (EMD) works closely with local emergency managers who drive the outreach and projects within their communities and through this the state EMD connected with the Director of Emergency Management in Grays Harbor. The cities within Grays Harbor have a long history of community outreach efforts steeped in their struggles with natural hazards. The city of Aberdeen has the largest coastal population, is the economic and commercial hub of the county and, is very conscious of the threat of an earthquake tsunami event. The students explored how planning for long-term adaptation in the face of an event of high consequence and low probability can help Aberdeen realize its developmental and environmental goals. The following report is a culmination of a larger visioning exercise for new settlement siting and forms inspired by the local values and assets of the community.

Context maps. Left: Location of Grays Harbor County in WA. Middle: Location of City of Aberdeen in Grays Harbor County. Right: City of Aberdeen Jurisdiction.

BACKGROUND

The city of Aberdeen is situated 35 miles past the capital city of Olympia, along I-5 as it branches to the west and becomes Highway 101, nestled between the Pacific Ocean to the west and lush forest to the north east. The Wishkah and the Chehalis rivers converge at this point contributing to the topography characteristics of the land, a result from centuries of sediment deposits. Incorporated in 1888, Aberdeen fulfills the role of the residential and commercial core in Grays Harbor. Consequently the city maintains the only deep water port on the west coast of Washington with the port of Grays Harbor being the largest coastal shipping port north of California. Settlement in the region grew out of successful ventures in timber and fishing due to the burgeoning natural resources and proximity to the ocean and rivers as avenues for transporting goods. The success soon furnished businesses such as mills, canneries, and shipbuilding that continued to contribute prosperity to the region well into the twentieth century. By 1970 the timber industry began to slow due to over logging and by the 1990s most of the mills closed down culminating in an economic downturn for the region and a general shift away from natural resource industries to be replaced by education, health care services and retail industries. It has maintained a modest increase in population since the 1990's but has yet to recoup the 15.1 percent loss of population from 1950 to 1990[1].

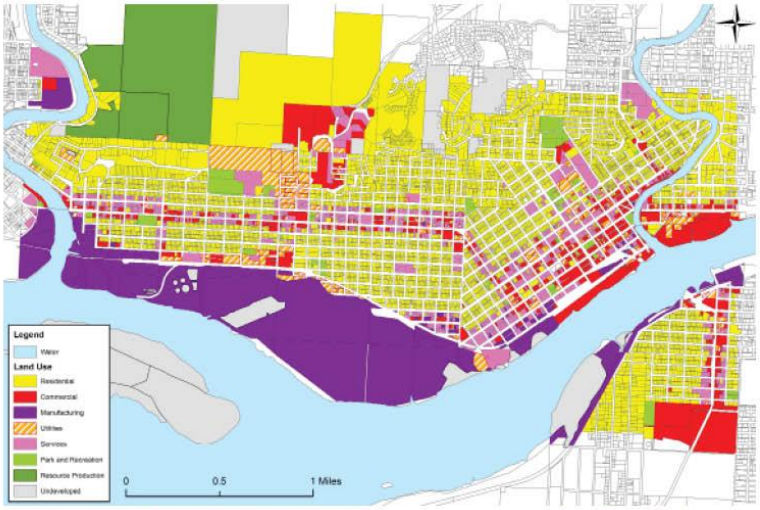
Tourist from all over Washington are drawn to the region for the opportunity to pass through the gateway to the pacific coast, the Olympic National Park and the gorgeous beaches along the coast. Calling South Aberdeen home, the Grays Harbor Historical Seaport provides many opportunities for tourist attraction through their procurement of the vessels the Lady Washington and Hawaiian Chieftain. This nonprofit organization engages tourist with educational programs, public sailing excursions, public walk-on tours as well as battle sails that provide a taste of 18th century maritime life. The national popularity of the band Nirvana also continues to contribute to the tourist traffic through the region with the Kurt Cobain Memorial Park and welcome sign emblazoned with their most infamous lyrics as well as a multitude of recreational options that allows individuals to be immersed in nature.

DEMOGRAPHICS

The city harbors a population of over 16,000 at a density of 1,586 per square mile, making it the biggest city on the west coast. When combined with Hoquiam and Cosmopolis, the three cities are the basis of the economic hub and location of half the population for the county of Grays Harbor.

The population alters throughout the day as only 3,185 or 55% of citizens who work in Aberdeen live with in the city limits. The other 2,499 or 45% of workers commute from

1. "Comprehensive Plan - City of Aberdeen." 2013. 23 Apr. 2016 <http://aberdeenwa.gov/pdf/2001_comp_plan.pdf>



Study Area Land Use Map. Source: Post Earthquake Aberdeen: Community Impacts of subsidence and tsunami inundation after a Cascadia Subduction Zone earthquake. 2016. Ashley Bennis, Peter Dunn, Jingchen Liu, Ziqin Pu.

all over the region. An important aspect to consider when it comes to having the knowledge during times of crisis. In particular, many of the representatives from emergency management, safety and security, do not live with in the city.

The City of Aberdeen has a slightly higher percentage of single family residences and a significantly smaller percentage of mobile homes than the statewide averages. Aberdeen has the lowest percentage of family households, at 60.7 percent,and persons per household, at 2.34 percent, of the Harbor cities. Approximately one-quarter of the housing stock in Aberdeen is multi-family housing. Between 1990 and 1997, the number of multi and single family housing units declined in Aberdeen. Of the 6,074 residential units in Aberdeen 3,281 are owner occupied and 2,793 are renter-occupied. According to the American census data over 1,000 residence are vacant with an estimated 133 of these designated as homeowner vacant, most likely second homes.

Around 50% of the 16,371 population is female and at a median age of 35 years. The 2011 comprehensive plan notes that in age groups six through 64 Aberdeen experiences a drop in population of about three to five percent that is contributed to the large migration of younger city residents during the economic downturn of the 1980's. About 18 percent of Aberdeen's population are located below the poverty level with is much greater than the state's average of 10.9%.

LAND USE

Much of the industrial uses in Aberdeen are located on the waterfront that is shared by larger commercial uses located near the Wishkah river. The historic downtown core is located at the southeast region of city along Highway 101. Around 80% of the land is zoned as some level of residential and covers a wide range of economic roles.

ASSETS

Aside from natural amenities Aberdeen boasts a wide range of built and social capital providing a quality of life for all stages of life. A robust education system complete with four elementary schools, two high schools, two colleges and a much anticipated STEM school provide opportunities to the younger residents of the town. Aberdeen is the medical hub for the coastal region with the newly built Grays Harbor Community College and wide array of specialized clinics that can address most medical ailments. A strong Public Utilities network has provided unobstructed power to the residents and businesses of Aberdeen throughout countless natural disruptions. Not to mention a thriving international port, home to a wide variety of businesses that provide jobs and economic opportunities to both Aberdeen and Hoquiam. Though a small town by Seattle standards, Aberdeen provides an exorbitant amount of amenities for its citizens to grow up, learn, recreate, work and retire while still maintaining a small town feel that contributes to the strong social ties that characterize the town.

HAZARDS

FLOODING

According to a Sea Level Rise in the Coastal Waters of Washington State report by the University of Washington Climates Impact Group and the Washington Department of Ecology the sea level rise on the west coast of Washington is less than the global average due to the amount of tectonic uplift. The International Panel on Climate Change estimates that the Olympic Peninsula can stand to see 35 cm of sea level rise by 2050 and 88 cm by 2100. Aberdeen's strategic location at the convergence of the Wishkah and Chehalis River also create substantial flooding issues, especially in the historic downtown core. During the winter and spring time, when snowpack melt is high, the city can experience devastating floods. It is estimated that Aberdeen residents pay some of the highest premiums for flood insurance in the state.

LANDSLIDES

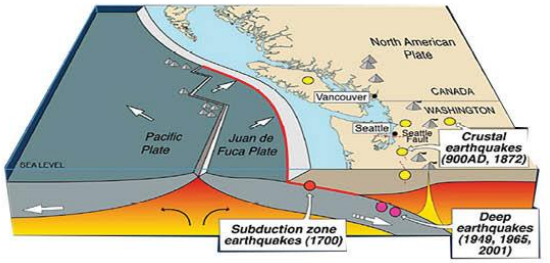
Aberdeen has always enjoyed a more mild climate with a high prevalence of rain which can cause the soil to liquefy and flow. As a result Aberdeen has a high prevalence of landslides along the bluffs that designate upper and lower aberdeen.

STORMS AND STRONG WINDS

The coast of the Pacific Northwest experiences several low pressure systems which can produce winds as strong as 60 mph from the months of October to March. Winds have been known to cause downed power lines, tree branches, and external damage to houses.

FIRES

The Olympic National Park is one of the wettest places on earth but an unusually dry winter prevented the formation of snowpack in 2015 causing a devastating fire to overtake the forest. The fire lasted for more than 3 months and burned through over 1,600 acres of forest before it was distinguished. Changing climate conditions will continue to bred unusual events that are not often seen such as the Paradise Fire in Washington. Along with that the older median house age in Aberdeen means that homes are constructed from wood and possess older electrical systems that have caused many fires for a city of it's size in the past.



Cascadia earthquake sources. Source: http://www.huffingtonpost.com/2012/12/17/cascadia-subduction-zone_n_2316700.html

Tsunami evacuation map for Aberdeen and Hoquiam. Source: http://file.dnr.wa.gov/publications/ger_tsunami_evac_aberdeen_hoquiam.pdf

CASCADIA SUBDUCTION ZONE

Not only is Aberdeen located in geological hot spot known as the Ring of Fire, a region where earthquakes and volcanoes caused by tectonic activity are frequent, the sediment contribution of the Wishkah and Chehalis does not provide a stable foundation on which to build. The county of Grays Harbor is located at the convergence of the Pacific plate, the Juan de Fuca Plate and the North American Plate. The fault line created from these plates is known as the Cascadia Subduction Zone named for the volcanic mountain range that runs parallel 100 miles inland, and can potentially cause a substantial amount of damage to the built, social and natural environment. Any amount of ground shaking endangers the entire region to liquefaction of the soil; a phenomenon in which water saturated layers of soil take on properties of a liquid due to the pressure created by the earthquake. The Juan de Fuca Plate is currently sliding underneath the North American Plate causing the land plate to bulge upwards at a rate of about 3 to 4 millimeters a year and compress eastward at a rate of 30 to 40 millimeters.

If the tension, that has been building up for the past 300 years, is released, an earthquake at a magnitude of 8.7 to 9.2 could be felt all along the western coast from Cape Mendocino California, through Oregon and Washington up to Vancouver Island in Canada. An event of this magnitude would create enough damage alone but as the fault is located on the ocean floor offshore, the implications for subsequent, damaging tsunami waves are high. Various models implicate that millions of citizens will be affected by such an event with exact numbers impossible to predict.

HAZARD MITIGATION

Flooding is an expensive issue that affects many communities all over the United states. As a way to keep damage associated costs at a reasonable level the United States Congress implemented the National Flood Insurance Program in 1968. The basic role of the NFIP is to help FEMA to identify flood hazards, assesses flood risks and partner with states and communities to provide accurate flood hazard and risk data to guide them to mitigation actions. The Floodplain maps are the basis for the NFIP regulations and flood insurance requirements displayed in the Flood Insurance Rate Maps (FIRMs). FIRMs include statistical information about data such as river flow, storm tides, hydrologic/hydraulic analyses and rainfall and topographic surveys using best available technical data.

NORTH SHORE LEVEE PROJECT

The susceptibility of the Hoquiam and Wishkah River to flooding has created extensive issues for the citizens of Aberdeen that are both disruptive and costly. Currently flood insurance rates in Aberdeen are egregiously expensive due to a lack of flood protection measures in the city. In an effort to protect the cities of Aberdeen and Hoquiam the North Shore Levee project has been proposed to decrease the risk of annual flooding and insurance rates for citizens and business owners. Generating business growth has proven to be difficult not only because of the high insurance rates but both cities downtown cores are located in the worst flooded regions of the city.

The Levee project is the combination of many previous proj

Flood-prone areas within the scope of the new North Shore Levee. Source: http://kbkw.com/flood-authority-approves-funding-for-design-of-new-north-shore-levee-project/

ects aimed at flood mitigation and has been narrowed down to two major implementations; a dike along market street and a South Side Dike/Levee Certification. Acquiring a Conditional Letter of Map Revision--First step towards a letter of map revision which"is a legally-binding document guaranteeing that if a levee system is built as submitted to FEMA, and is in agreement with effective FEMA models and maps at the time of construction."[2] The next step in the process will be completion of a Letter of Map Revision (LOMR) which can lead to "eliminating mandatory flood insurance through the National Flood Insurance Program for mortgages while also providing comprehensive protection to frequently flooded areas." (Aberdeen-North Shore Levee Project). The project is scheduled, funded by the Chehalis River Basin Authority and underway. The following projects are proposed and funded through the North Shore Levee Project:

MARKET STREET DIKE

Status: Project is getting prepped to hire design/engineering consultant

Purpose: This project will protect Aberdeen and Hoquiam from coastal flooding. It is aimed at removing Aberdeen and Hoquiam from the floodplain and placing them in a mapped zone x, eliminating mandatory flood insurance through the NFIP for mortgages while also providing comprehensive protection to frequently flooded areas. Projected to protect 2,700+ homes/properties and provides projected annual flood insurance savings ($1M-$1.5M).

SOUTHSIDE DIKE / LEVEE CERTIFICATION

Status: Certification is about 60% complete

Purpose: This levee was designed by the Army Corps of Engineers and built to protect south Aberdeen. This project currently needs a complete certification process. Certifying the South side Dike will ensure the compliance with USACE standards and the effectiveness of the Dike to protect South Aberdeen. It will protect a residential population (approx. 4000 people) an elementary school, junior high school, major shopping centers and various commercial businesses.

PROJECT SCHEDULE

July 2016 -- Alignment Analysis & Concept Design

October 2016 -- 60% of plans complete.

February 2017 -- CLOMR Submittal & FEMA Review

2. "Aberdeen - North Shore Levee Project." 2013. 23 Apr. 2016 <https://www.ezview.wa.gov/?alias=1775&pageid=34768>

North Shore Levee Project

ORGANIZATIONS ACTIVELY ENGAGING

M9 PROJECT AND UNIVERSITY OF WASHINGTON

Analysis conducted on the Cascadia Subduction Zone by researchers in the UW geology and forestry department inspired an interdisciplinary project, funded by a grant from the National Science Foundation. This UW led effort, known as the M9 Project, is working to address the scientific and engineering challenges that come with reducing risk by employing a suite of 3D state-of-the-art simulations of fault rupture and ground motions of Cascadia megathrust earthquakes. The goal, along with reducing risk to citizens, is to acquire deeper insight into the phenomena of earthquakes and tsunami and improve estimation of their effects by considering factors that have previously not been addressed such as:

- Distribution and timing of energy release on the fault
- The coherent variation of frequency content of fault motion and depth
- The 3D effects of the deep basins along Puget Sound
- More realistic scenarios of seafloor deformation
- Estimating battering power of entrained debris

The researchers have been confronted with a wide range of challenges including understanding the ways current science can be conveyed in a public forum to a degree that generates creative, resilient planning solutions. The interdisciplinary project is pulling expertise from a variety of specializations including geology, engineering, urban design and planning, earth and space sciences, statistics and applied mathematics making the project. The involvement of so many specializations creates a holistic analysis that looks at the phenomena of earthquake tsunamis from as many angles as possible to find varied solutions.

The passion of the citizens of Grays Harbor and proximity to such a variety of natural resources has also inspired a number of collaborative efforts in the region, including:

FORTERRA

Citizens in the city of Aberdeen are passionate about their seafaring past and have been collaborating on their Coastal Resilience and Shoreline Master Plan to reconnect the city with the waterfront. Forterra, one of the largest conservation and community building groups in the Northwest, was hired by the Grays Harbor Historical Seaport Authority to assist with grant writing and fundraising from public and private corporations, and government.[3] This work is a part of Forterra's Olympic Agenda, an organization that focuses on developing economies in rural communities in ways that are sensitive to the environment. Forterra has also helped facilitate community listening sessions to engage residents in planning efforts to redevelop the historic downtown area.[4]

WASHINGTON SEA GRANT

The Washington Sea Grant is part of a national network of 33 Sea Grant Programs, administered by the National oceanic and Atmospheric Administration. Building off of the University of Washington's academic strengths in marine science, engineering and policy the WSG supports marine research, education and works with communities to strengthen understanding and sustainable use of ocean and coastal resources.[5] WSG is currently a part of the state team commissioned by the Washington Legislature to develop a Marine Spatial Plan for Washington's Pacific Coast. The WSG is trying to find a balance between the variety of uses (shipping, recreational, fishing, habitat conservation) by creating a spatial plan grounded in public participation and science-based decision making. WSG is working with Aberdeen and other coastal communities to help them understand these implications and facilitate information sharing between state planners, federal partners, tribes and other stakeholders (WSG). As Aberdeen is located within the Marine Spatial Planning study area boundary WSG is looking at a variety of factors from energy suitability, possibility for recreational activities, habitat conservation, water quality, infrastructure and human uses.

D&R building. Photo by Michelle Caponigro

3. "Sailing the Harbor aboard the tall ships | The Daily World." 2014. 23 Apr. 2016 <http://thedailyworld.com/news/local/sailing-harbor-aboard-tall-ships>
4. "Forterra | For the people. For the land. Forever." 2007. 23 Apr. 2016 <http://forterra.org/>
5. "Washington Sea Grant." 2014. 23 Apr. 2016 <https://wsg.washington.edu/>

THE STUDIO

The 2016 Master of Urban Planning class is an Urban Design focused studio project working in conjunction with the "M9" project to study how communities planning for resilience might make use of new probabilistic information about tsunami hazards associated with a Magnitude 9 (M9) Cascadia Subduction Zone (CSZ) earthquake. Though the focus of the studio are solutions centered around design the three month class was so much more than that.

GOAL

Through comprehensive community collaboration the students of the studio tried understanding how framing an issue can contribute to planning in a creative and resilient way. Students created 9 design-based planning solutions and though there are varying levels of feasibility, the students recognized the importance of trying out a variety of approaches to find a solution that fits.

PROCESS

The 11-week studio centers on a workshop with local staff and residents that combines asset-based community mapping techniques with hazard mapping using the latest scientific models and interactive participatory GIS technology. The workshop as part of a larger visioning exercise for new settlement siting and forms based on local values and assets, to explore how planning for long-term adaptation in the face of an infrequent, unpredictable but consequential change can help a community realize its short- and medium-term developmental and environmental goals.

ASSET V. HAZARDS

How does a convo beginning asset v. vulnerability help us understand what actions a community might take to enhance its resilience?

The workshop organized participants into small-group discussions not only comparing how stakeholders approach hazard mitigation and resilience in community planning but exploring if introducing communities to an asset focus or hazard focus will lead to more creative planning solutions and resiliency. The asset approach asked participants to describe the city of aberdeenV in terms of what makes it a good city to live in and to what extent do certain goods and services contribute to that. Groups that began with a hazard were asked to assess the extent that a hazard could negatively affect their city before contemplating the providers of goods and services.

The "Asset-based" approach aims to coax the stakeholders into creating an inventory of built, natural, and social community assets, then examine the hazard scenarios and associated vulnerabilities and, finally, identify those assets that could facilitate planning that is adaptive i.e., assets

Timeline of the studio fom January 4 to March 10.

that could help achieve comprehensive community planning goals, enhance mitigation of the hazard, and recover from the disaster (Freitag, et al., 2015). The "Hazard-based" approach emphasizes vulnerabilities of the city and is the most common approach taken in hazard mitigation and community collaboration efforts.

PROBABILISTIC V. DETERMINISTIC

The studio also explored how different visual representations of hazard information can inspire different understanding and solutions in resiliency community planning.

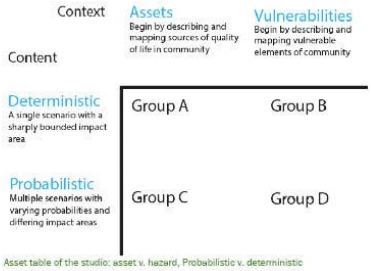
Maps that represent a earthquake tsunami hazard are commonly displayed with the inundation area encompassed by a single crisp line. Such maps lack any representation of the uncertainty in the science that underlies these maps – "complex modeling of multiple factors, including spatial and temporal details of the tsunami source, tidal stage, variable bathymetry and topography, seismic uplift or subsidence of coastal land, etc" (Freitag, et al.).

The studio hoped to discern if breaking away from the conventional procedure of presenting hazard maps to a community (first using the hazard map scenario, presenting associated community vulnerabilities then developing and discussing possible responses to the hazard) could spur more resilient solutions.

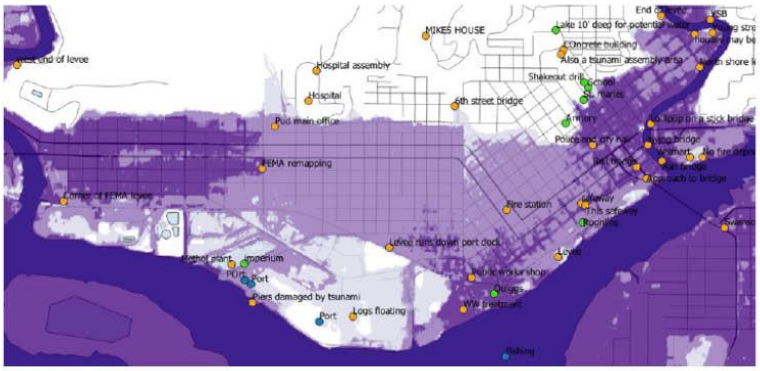
WE TABLE

Employing modeling provided to us by researchers from the M9 Team the studio employed new technology never before used in Washington to incorporate community participation with GIS technology to create an interactive interface on any tabletop. Participants were able to interact with the technology with very little instruction.

Through the studio process of collecting background information on Aberdeen, conducting the workshop, speaking directly with citizens about their city and learning about the



Asset table of the studio: asset v. hazard, Probabilistic v. deterministic

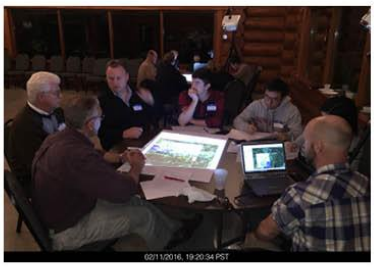


Workshop results from group A

proposed levee project, the students, were influenced and went to work coming up with creative urban design solutions that complimented what was already there. The levee project represents an interesting challenge for good urban design and ecologically sensitive hazard mitigation in the cities of Hoquiam and Aberdeen. The students, playing off of this, felt that there could be another layer added on to the levee project that incorporated the long range vision for aberdeen and also protect areas of the city not only from frequent storm flooding, but also from the rarer but highly consequential Cascadia earthquake subsidence and tsunami hazards that threaten it.

RETREAT, ACCOMMODATE, PROTECT

One general concept of the studio is to illustrate how three different responses to both frequent flooding from storms, as well as rarer more severe flooding from earthquake-related subsidence and tsunamis, could either work together or separately. The students employed a variety of design solutions; in some cases designing for robust protection of important assets like the historic downtown from all these hazards. In other cases, the students designed for the surrendering



WeTable discussion in the workshop. Photo by Adnya Saraswita.

of developed land to more biologically functioning streams, wetlands and shorelines but they also considered designs for the coexistence of development and wetland. The variety of students work illustrates how resilience can be achieved through designs and programs that meet short-term developmental goals while providing for a more secure future in the face of long-term threats. Complicated issues require complex solutions, for example, Aberdeen has shrunk economically and demographically in recent decades; perhaps some of it could be given back to nature, while some of it becomes denser and more intensely protected, more lively but with a smaller footprint.

WORKSHOP CONTRIBUTION

The students of the University of Washington Studio visited the city of Aberdeen on two separate occasions. The first was a part of a ground truthing exercise or a form of fact checking the background research students conducted earlier in the process. On both occasions the students were able to meet with citizens of Aberdeen, ask them questions and hear them speak passionately about their city. Apart from the opportunity to give the studio a third, cultural dimension, students were also able to combine their knowledge of design solutions with the desire of the citizens to produce thoughtful solutions.

Many things were abundantly clear to the students; for one those employed by the City of Aberdeen and Grays Harbor are fiercely passionate about the fate of their community and the citizens they serve, and the residents value the wellbeing of their neighbors as high as they value their own. The city experienced a devastating flood event in 2015 but the community spirit could not be deterred as the citizens of Aberdeen felt a commitment to their neighbors which will be, above all, the most important asset in the event of a CSZ earthquake-tsunami event. By visiting the city and sitting down with the community at the workshop the students were able to gauge what was truly important to them rather than what the students felt were important from their experience conducting background research and studying maps.

The thirteen individuals that participated in the community workshop at the Log Pavilion in Aberdeen on February 11th 2016 provided a wide variety of information to the students including assets, vulnerabilities, goods, services and the providers of goods and services. The goods, services and providers were mapped using the WeTable technology as shown in (example map). There were notable differences between the four groups but there were also universal similarities that the students took note of. The value with which the natural resources and recreational amenities offered was indispensable to the residents. The city grew because of the natural prosperity of the region and, even though the city no longer relies on these resources for economic purposes as much, it still continues to define the character. The proposed bike plan by student Max Baker endeavors to bring the residents and tourist closer to nature by utilizing a network of roads and trails that existed from the height of the logging industry but have since been underutilized. The Olympic Peninsula already possesses a vast bike network and the bike plan would not only add to this but also provide citizens with alternative escape routes to the upper regions of the city if disaster struck. The network would include a lit portion along division street in Aberdeen which would provide a beacon to residence in the lower region in the case of a total blackout.

Participants also expressed pride in their thriving port and extensive waterfront. A waterfront park and bike path run along the northern banks for the Chehalis River but for the most part the waterfront has been largely utilized for commercial and industrial purposes. The first visit as well as the workshop gave the students the impression of a strong desire for the city to be reconnected with the waterfront, a feat that could be met with Michelle's natural berm design and Zoe's robust levee and floodwall system. Flooding creates issues from both directions of the Aberdeen and Hoquiam. Michelle's natural berm would provide protection for the residents and commercial core of Hoquiam, activate underutilized land and provide an opportunity for tourist and residents to reconnect with the water while enjoying a forested, natural environment. Zoe's levee and seawall would protect the commercial core of Aberdeen from flooding caused by

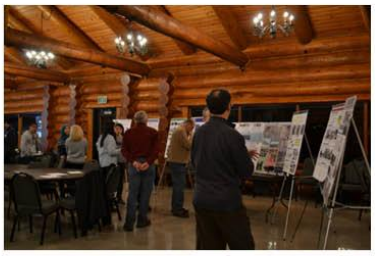
the Wishkah and Chehalis but also be constructed in a way that would reconnect the downtown with the rivers. Both are an extension of the already existing plans for the North Shore Levee but would provide another social, communal and recreational layer.

The North Shore Levee project and the Aberdeen Revitalization Movement are both consistent in their desire to protect and enhance a historic gem of the city; downtown Aberdeen. Zoe's levee and seawall as well as Lizzie's Division street berm would secure this area from future flooding and inundation caused by a tsunami. With this extra protection insurance rates would potentially lower and developers could invest more into development in the downtown. Jingchen's design project looks at the feasibility of increasing density and the urbanity of the downtown region. An aspect of this will show how a transfer of development rights program could assist property owners and residents in areas being "surrendered" to wetland as proposed in Stevie's Fry Creek design, to redevelop and re-inhabit the historic center. The construction of the North Shore Levee, implementation of Lizzie's division street berm and erection of Zoe's sea wall would ensure that the downtown is the best protected region in Aberdeen. Visiting Aberdeen, Stevie could not help but notice the amount of standing water still lingering on the streets near and around Fry Creek. Relinquishing this region back to the wetlands they once were would add extra storage for flood waters as well as lessen the impact of tsunamis waves. If such a project was implemented many residents would find themselves displaced; not an ideal prospect for anyone. Jingchen's project provides an alternative, better protected location for those residents to go. Colin's resort and refuge design also provides options for these residents. The students had the opportunity to learn about relocation efforts in Queets from the planning director Charles Warsinke. The region above the bluffs in Aberdeen already inhabits residents and the hospital, Colin's design postulates the possibility of creating a low-impact neighborhood that creates new opportunities for homebuyers, those displaced by the wetland design and vacationers. Colin has also designed for basic amenities that could provide much needed refuge in the event of an earthquake that can be easily accessed using Max's bike network. If subsidence renders a portion of Aberdeen uninhabitable, Colin's refuge could provide people with temporary and long term residence options.

Jialing's flood-accommodating neighborhood design can be an alternative for citizens not wanting to relocate from the wetland proposed region or be an addition to the housing opportunities created by Jingchen's and Colin's projects. Water is a major part of the identity of Aberdeen and Hoquiam and along with accommodating it through natural solutions the city could consider the options for creating flood tolerant buildings as is being proposed in The Netherlands, a country with 24% of land below sea level.

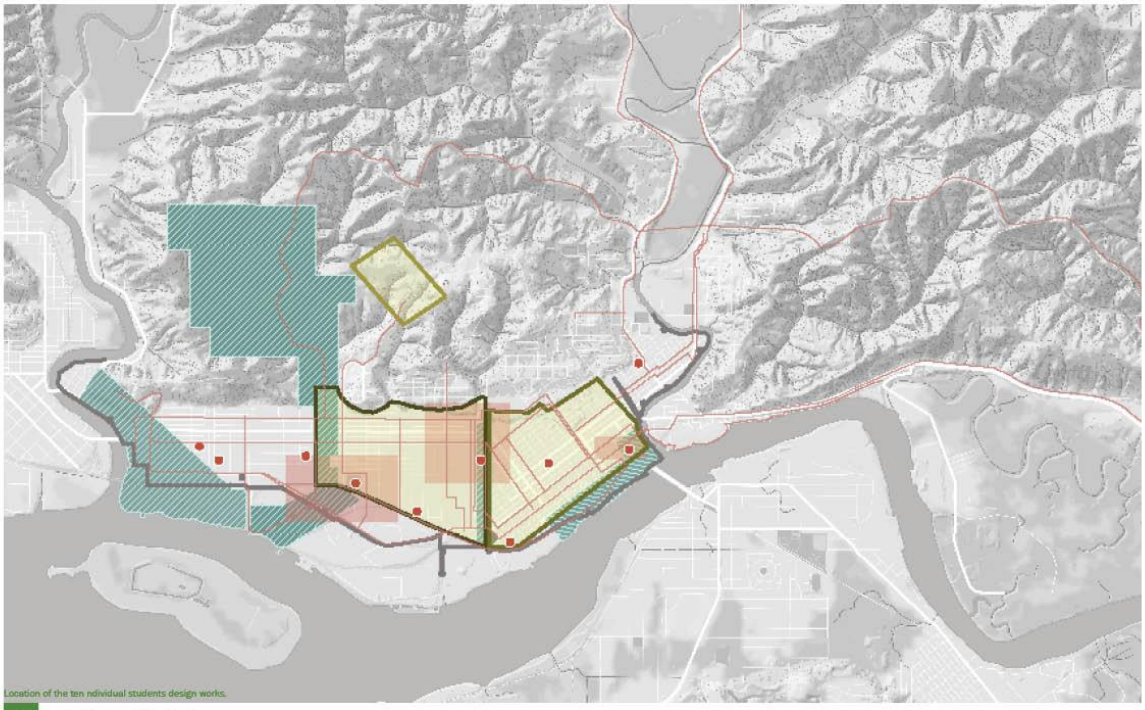
The residents will need many options to help protect them in the event of a CSZ, Ziqin contended with how to create vertical evacuation structures that also serve vital community functions when they are not being used for protection. The residents and city employees expressed aspirations for more community gathering spaces which could be met with the design work Ru'a has proposed while also creating a network of refuge from natural disasters that connect with Max's bike routes and Ziqin's vertical evacuation structures.

The goal of the studio was to demonstrate a variety of design solutions to help Aberdeen mitigate the risk of an earthquake and tsunami caused by a Cascadia Subduction Zone. Not all of the design projects reinforce each other and not all of them are economically feasible. If Michelle's and Lizzie's natural berm systems that are largely constructed from soft material could be implemented in congruence with the North Shore Levee project the downtown region would be protected and Zoe's design would be less feasible to implement. Each of the three residence relocation designs offer a different approach to address, essentially, the same need. Jingchen's offers the lowest development cost and highest density and could be the most feasible for the city to implement first.



Workshop participants reviewing students' design prototype posters. Photo by Adnya Saraswita.

Big group discussion in the workshop. Photo by Adnya Saraswita.



Location of the ten ndividual students design works.

PROJECTS ON MAP

North Shore Levee Project – The combination of many previous projects aimed at flood mitigation and has been narrowed down to two major implementations; a dike along market street and a South Side Dike/Levee Certification.

Max–Master Bike plan for Aberdeen that would increase recreational biking options in Grays Harbor and provide an evacuation route during a Cascadia event.

Ziqin–Vertical Evacuations and that also function as community sites outside of natural hazards.

Ru'a–Shows how sites in Aberdeen can function as new public amenities and refuge sites as a part of Ziqin's vertical evacuation and Max's bike plan to create Community Networks.

Michelle– A forested, bermed barrier would be an extension of the levee plan for West Aberdeen and East Hoquiam. This project would provide a more biologically and recreationally functioning waterfront than a conventional levee, and would also absorb energy from an incoming tsunami.

Stevie–Proposes widening Fry Creek and restoration of estuarine wetlands in West Aberdeen, making it more resilient both to storm flooding as well as change in the coastline.

Lizzie– A bermed levee along Division Street, separating West Aberdeen from Downtown, would tie the waterfront levee back to higher ground, and complete the protection of the historic center. It would be sized to withstand inundation from both subsidence and tsunamis following a Cascadia event, as well as serve as a back-up protection of Downtown Aberdeen in the event that storm flooding continues to affect West Aberdeen.

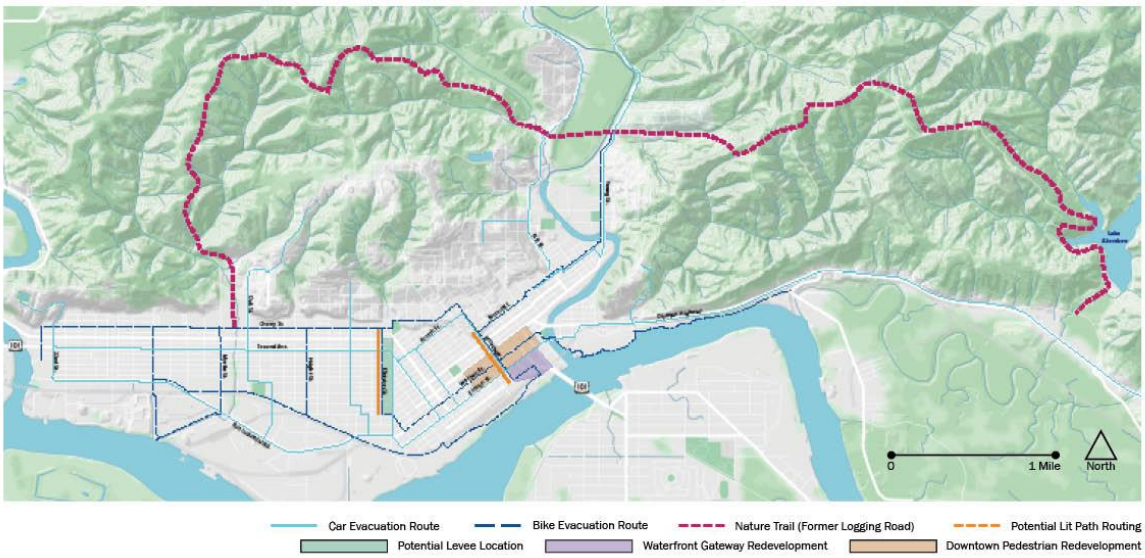
Zoe–This robust levee and floodwall system along the Chehalis and Wishkah riverfronts of Downtown Aberdeen would protect the historic center of Aberdeen from both frequent storm flooding as well as subsidence and tsunamis following a Cascadia earthquake.

Colin–Uphill Resort/Refuge illustrates how sites at higher elevations could develop low impact infrastructure for new markets of homebuyers and/or vacationers, as well as serve as a long-term viability relocation site for people displaced by changes in the coastal flatlands.

Jingchen–Shows how a transfer of development rights program could assist property owners and residents to transition from areas being "surrendered" to wetland to redevelop and re-inhabit the historic center, enhancing the urbanity of downtown.

Jialing–Flood-accommodating neighborhood design shows how West Aberdeen might evolve into a smaller neighborhood of new infrastructure and building types that live with a wetter environment.

02 INDIVIDUAL DESIGN WORKS



Bike Plan Aberdeen: Enhance, Evolve, Evacuate | Max Baker |

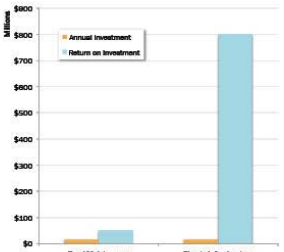
Creating a resilient transportation network for all situations.

BIKES AS A GOOD RETURE ON INVESTMENT

Bicycle ridership has been steadily increasing across the United States, with the Pacific Northwest being perhaps one of the most significant outliers. Not only is bike commuting in cities becoming more popular, but recreational riding in the less congested areas outside of major metropolitan areas is as well. The Olympic Peninsula is one of those areas, with many new cycling infrastructure projects being pushed forward in areas such as Port Angeles, Sequim and Olympic National Park.

The Banks-Vernonia trail in northern Oregon is an example of a extremely successful rails to trail project completed in the past few years. Constructed for a cost of $1.4 million, this trail runs for 21 miles between the towns of Banks and Vernonia through a section of L.L. Stub Stewart State Park. It now attracts nearly 20,000 visitors each year to this remote section of the state.

Bicycle infrastructure is also an incredibly sound investment for cities to make. According to one research study completed in 2010, the city of Portland experiences a 53x total return on every dollar invested in bike infrastructure, compared to just 3.3x for every dollar spent on road paving and maintenance. This takes into account every net positive benefit, be it from reduced infrastructure needs, residents' improved health, fewer vehicle accidents, less dependency on automobiles, etc. By taking these small steps, great returns can be experienced by all.

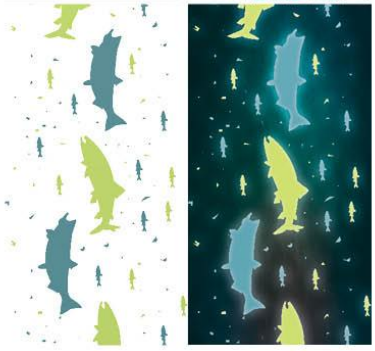


Data: Portland Bureau of Transportation and Journal of Physical Activity and Health

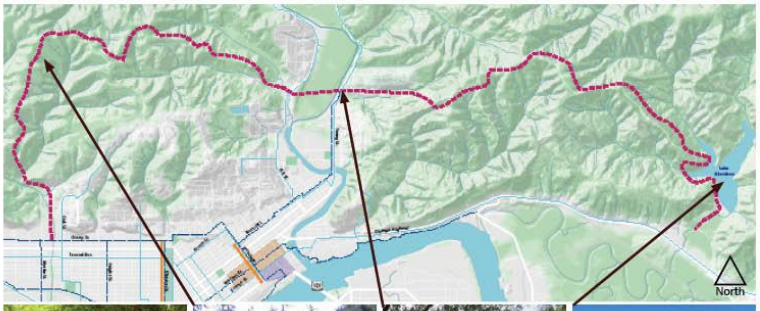
BIEK PATH AS ATTRACTION/EVACUATION ROUTES

In the city of Eindhoven, Netherlands there exists a path that doubles as a work of art, an ode to the hometown of Van Gogh. What makes this pathway unique is the fact that it is able to emulate the painting that inspired it in a way that no other path could. Using a combination of solar-powered LEDs and glow-in-the-dark materials, the path depicts Van Gogh's famous Starry Night, a work that is best viewed in low light. After the pathway was completed in 2014, visitors have flocked to the attraction by the thousands. It is one section of a larger regional network that is meant to bring visitors to the less-visited areas of northern Holland.

Such a pathway could act as both a tourist attraction as well as a safety route for evacuees when the lights go out. Considering that the Pacific Northwest coast can be shrouded in darkness for nearly 16 hours a day during the winter months, such a feature would be well-suited for Aberdeen. Artwork could be integrated in the system to celebrate the city's storied history, with the depicted Salmon run to the right being one such example. If the power were to go out during an earthquake, the lit path court provide an evacuation route north to higher ground. This pathway could



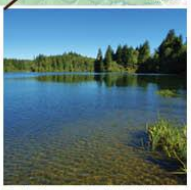
be located in either the downtown core along Broadway, or along the top of the proposed Division Street Levee. It should also be located in an area that is easy for pedestrians to navigate to during moments of chaos, providing a safe gateway to the rest of the pedestrian evacuation network. Such a path would only need to run between 1/4 to 1/3 of a mile from end to end, minimizing costs and reducing maintenance needs.



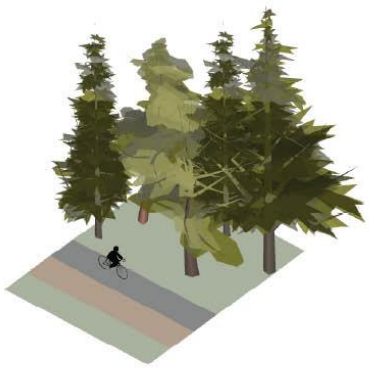
An improved bike path allows all skill-levels safe access through the forest. (Photo: Cycling Sojourner)

Water tanks scattered through forest are made accessible for emergency use. (Photo: celebratebig.com)

A pedestrian bridge over the Wishkah river saves money and attracts tourists. (Photo: Dezeen Magazine)



The city is connected with Lake Aberdeen, a stunning local point of interest. (Photo: Bropke Rejcich)



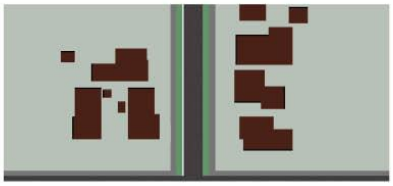
The creation of a two-way bike lane with minimal space on either side creates a wide enough corridor for first responder vehicles in an emergency.

A NATURE TRAIL THAT DOUBLES AS AN ALTERNATIVE EMERGENCY ACCESS ROUTE

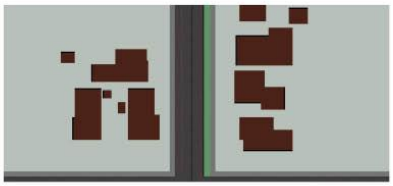
During the open house with Aberdeen residents and decision makers, it became clear that major access points to the city would likely be compromised in the event of a major earthquake. Be it due to landslides along the Olympic Highway or the collapse of any one of the century old car bridgCes, Aberdeen would be effectively severed from outside resources. Logging roads were identified as a potentia l asset that could be utilized in an emergency, many of which terminate just outside the northern edge of the city.

By enhancing and connecting a series of existing logging roads and transforming them into a five mile nature pathway, the city could simultaneously ensure connections with neighboring cities while providing residents with a valuable recreational attraction. A pedestrian bridge over the Wishkah could be constructed connecting the northern sections of the city for a fraction of the cost of a similar vehicular structure. This nature trail would travel to a number of points of interests, including Lake Aberdeen, the Wishkah river, city water tanks (which could potentially be used in an emergency), new hilltop housing developments and Frye Creek.

Existing Cherry Street layout.



Cherry Street improvements with a bike lane on either side. This layout allows for easier transitions between Cherry Street and perpendicular routes.



Cherry Street improvements with a two-way bike lane on the northern edge. The southern edge preserves parking, allowing homeowners greater flexibility.

A NETWORK TO CONNECT

While Aberdeen has a robust car evacuation network, it is lacking streets that are designated and designed to facilitate evacuation on foot. This is incredibly important when one considers that most emergency agencies suggest leaving vehicles when attempting to make way to higher ground during a tsunami.

By developing a network that works to route foot and bike traffic away from busy car corridors like Sumner and Simpson Ave, the city could ensure more corridors will remain safe and accessible during an emergency. Design improvements would help to make bike travel safe at any time and will have minimal impact on adjacent properties. Alternative connections would be made between neighborhoods and city points of interest such as downtown, Kurt Cobain Memorial Park, the proposed Aberdeen nature trail and the waterfront. It would also provide students with safe travel routes to and from school on streets that have been reoriented to favor alternative modes of transportation.

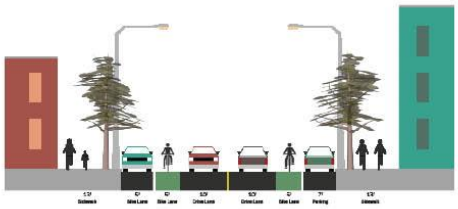
An example of highly-visible bike lane treatments. Accidents along this section were greatly decreased following implementation. Photo: City of Alexandria, VA

Cherry Street's role in the Aberdeen bike network is vital, connecting downtown, the Division St. Levee and western neighborhoods to the nature trail evacuation route.

DOWNTOWN PEDESTRIAN REDEVELOPMENT PLAN

The Aberdeen Conceptual Master Plan that was developed in May of 2014 provides a solid foundation for the creation of a new pedestrian-oriented realm in the downtown core. By moving westbound Highway 101 traffic from to Market Street, Wishkah Street is given the opportunity to act as main street for Aberdeen. This allows for a new, more functional Wishkah to be developed, with bike lanes and slower two-way traffic allowing for the creation of a quieter and more enjoyable pedestrian realm.

Vehicular traffic to and from 101 would be rerouted to provide better pedestrian and bicycle access to the proposed waterfront and Gateway Center Project from downtown, limiting unnecessary maintenance on lesser traveled streets in the process. The bicycle network would be integrated into this new realm in a way that would encourage residents from throughout the city to enter the downtown core without their car.

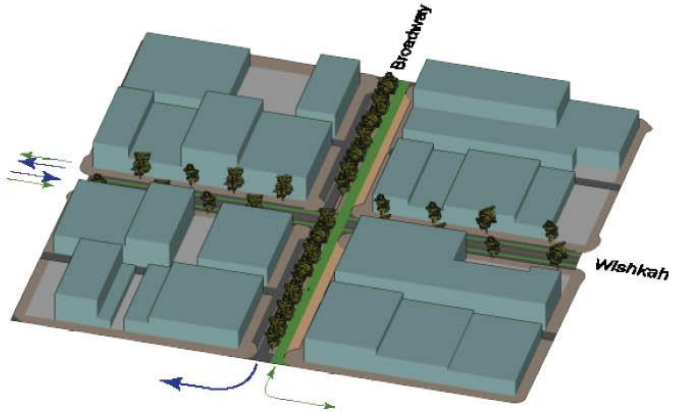


WISHKAH STREET PLAN

Wishkah Street would be converted from a three lane one-way road into a narrow, two-lane road with bike lanes and parallel parking on either side. Locating the parked cars between the sidewalk and travel lanes will help to keep any fallen debris out of the roadway during an earthquake.

ENHANCED CONNECTIONS TO WATERFRONT

With the discontinuation of vehicular traffic along the northbound lane of Broadway, E State Street's need in the network is reduced significantly. This allows for the creation of a pedestrian/bike trail that could travel from the downtown core to the redeveloped waterfront.



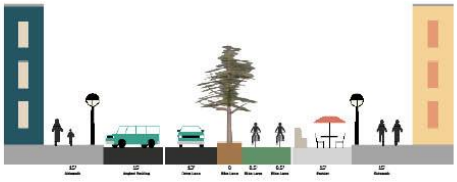
BROADWAY PEDESTRIAN PLAZA

Broadway Street's boulevard design lends itself nicely to the creation of a two to three block pedestrian plaza along the northeastern half of the street. By removing vehicles on the one side of the street, a two-way bike lane can be introduced that would run the entire length of Broadway. The southbound traffic lane of Broadway could remain intact to allow families and senior citizens convenient access to the pedestrian core. Traffic from Wishkah would also be allowed to exit using this street, reducing the number of cars within the downtown realm.

In the downtown core the former angled parking spaces could be converted into a sizable pedestrian plaza, with businesses able to set up dining and seating areas. This section of Broadway is also attractive in the downtown core due to the fact that many of the historic buildings are still standing and in good condition. This area is also located close to the proposed Gateway Center Project and Waterfront Park, a mere two block walk away. By reorganizing and connecting the downtown core of Aberdeen, the city will create a safe and enjoyable atmosphere for residents and tourists alike.

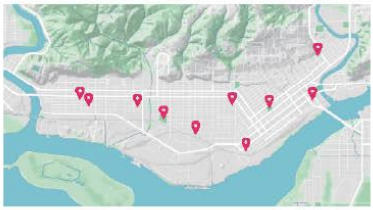
BROADWAY AND WISHKAH PEDESTRIAN CENTER

The intersection of Broadway and Wishkah is an obvious center point for the city of Aberdeen. The new Wishkah pedestrian plan would connect conveniently to the greater bike network, while Broadway itself demarcates where many streets transition from an east to west naming convention.

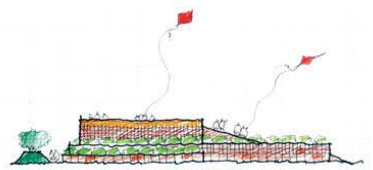


BROADWAY STREET PLAN

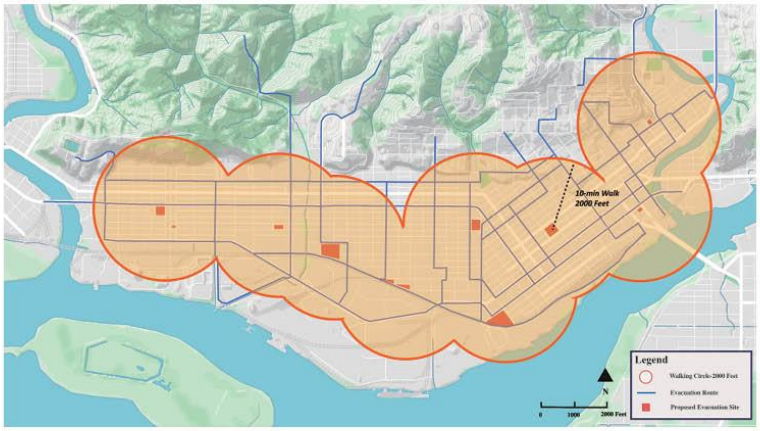
Broadway traffic would be reduced down to one lane southbound, with angled parking to help keep speeds to a manageable level. The northbound lane would be turned into an entirely pedestrian oriented realm, with the traffic lane turned into a two-way bike path. The median acts as an existing protective barrier between the two environments, with the remaining northbound parking transformed into a pedestrian plaza.



Project Location



Project Safe Haven. Source: Tsunami Vertical Evacuation On The Washington Coast, Grays Harbor County



Vertical Evacuation Strategy Map for the Study Area

Moving Up To Safety: A Vertical Evacuation Strategy | Ziqin Pu |

According to some previous studies, the first tsunami wave is predicted to arrive at our study area approximately 25 min after a Cascadia Subduction Zone earthquake, and most of the low-lying areas in Aberdeen requires fewer than 25 min of pedestrian travel time to the near natural high ground, with travel time up to 49 min in waterfront areas. This means the majority of the city's population has enough evacuation time before the arrival of tsunami. However, Aberdeen has the highest number of population exposure to the tsunami hazard in Grays Harbor County, when considering the slow travel speed of children, elder residents, and people with disabilities, travel time needed to get up to the high ground would increase. Also, the changed post-earthquake landscape, such as the debris and broken roads, could block people's evacuation. Psychological and sociological factors could also lengthen people's evacuation time.

Considering those factors that might lengthen people's evacuation time, we propose to build some artificial vertical evacuation structures in the city as backup for the natural high ground. These structures would provide safe places for refugees who could not get up to the hills when tsunami waves come. And they are designed to combine with communities' daily activities to increase their functionality, but not only the structures for evacuation.

WHAT IS TSUNAMI VERTICAL EVACUATION?

Typically, when tsunami waves attacking coastal communities, people evacuate to high ground outside of the inundation zone. However, in areas that lack natural high ground, or the time is not enough to allow people to evacuate, the horizontal evacuation may not be a appropriate strategy. Then, a vertical evacuation strategy is necessary.

Vertical evacuation structures (VES) are refuges that lead people to safety by moving them above the hazard during a tsunami. Typically, a tsunami vertical evacuation structure could be a tower, building, or earthen mound that has sufficient elevation above the maximum level of tsunami inundation. It cold also be an evacuation trail that allows people move up to the natural high ground. A tsunami vertical evacuation structure should be designed and constructed with the strength to withstand ground shaking and water flow.

A berm constructed in Okushiri-Island, Japan. Source: Tsunami Vertical Evacuation On The Washington Coast, Grays Harbor County

Berms are artificial high ground created from soil. A soil berm is constructed to raise the ground level above the inundation height and providing access to the elevated surface. Berm slope sides should be designed and constructed to against scour and ramping of the waves, while providing efficient ingress.

A reinforced concrete parking garage in Biloxi, Mississippi after Hurricane Ktrina. Source: Guidelines For Design Of Structures For Vertical Evacuation From Tsunamis.

A building used as a tsunami evacuation structure should have ground floors to allow the tsunami waves to flow through it, or it has the structural integrity to against the force of the waves. The upper floors of the building are the refuge providing safety for people.

A tsunami refuge tower used in Yaizu, Japan. Photo source: https://upload.wikimedia.org/wikipedia/commons/thumb/7/77/Jrb_20061121_Tsunami_Evacuation_Platform_001.JPG/1280px-Jrb_20061121_Tsunami_Evacuation_Platform_001.JPG?1464900721289

A tsunami evacuation tower is an elevated platform above the height of tsunami inundation that has a ramp or stairs leading to the platform. The tower should be designed with a stable foundation to ensure the safety of the structure in use and be able to withstand the forces of the tsunami.

An evacuation trail leads to high ground in Aberdeen.

The evacuation trail is not a typical vertical evacuation type. It is not an actual structure that provides safe haven, but the route that provides the direct access to the natural high ground. The trail should have the strength to avoid breaking during the hazard and keep safe for passing through.

Vertical Evacuation Location Map for Downtown Aberdeen and East Aberdeen Neighborhoods

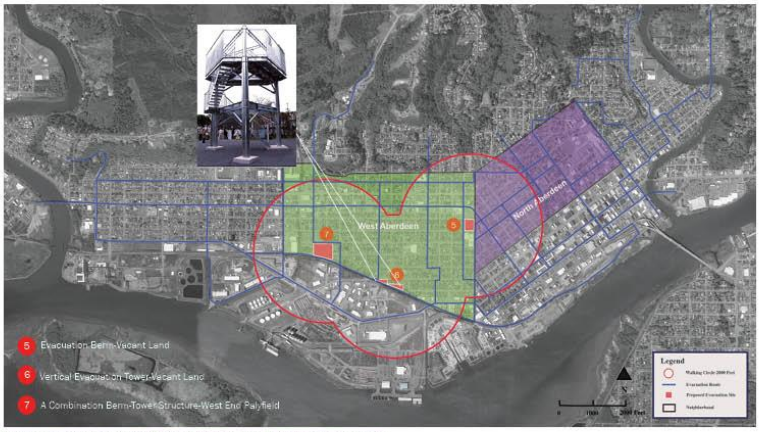
An evacuation trail leads to high ground.

A soil berm combined with a community open space. Source: Source: Tsunami Vertical Evacuation On The Washington Coast, Grays Harbor County

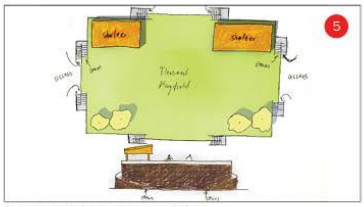
DOWNTOWN ABERDEEN AND EAST ABERDEEN

These two neighborhoods are both close to the waterfront and thus are most easily flooded when tsunami waves come. Downtown Aberdeen is a commercial zone that clustered with hotels, banks, grocery stores and other commercial uses. It is almost a daytime activity center. Visitors, employees, government staff and other workers are the major groups in this area. Except some new concrete buildings like the City Council and Bank of America that may could be used as VES, most other buildings in this area are historic or low rised that are highly vulnerable during the earthquake and tsunami hazards. A reliable and high capacity vertical evacuation structure is needed to serve this region. The selected Franklin Field can be used to develop a soil berm. A berm that raises the ground level above the inundation height and provides open space on the top. It provides space for daily recreational activities and then it can also be used as a VES during the hazard. The sites 2 and 4 have available vacant space and an evacuation tower can be built in each of the place to serve the neighborhoods at risk.

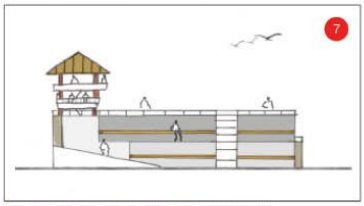
The East Aberdeen neighborhood is a residential predominant area and with high risk to be flooded if a tsunami event happen. But fortunately, this area is very close to the natural high ground, and several evacuation routes also go through this neighborhood. Instead of building a structure to save lives, we could just provide a convenient and efficient evacuation trail to help people up to the high ground after a Cascadia Subduction Zone earthquake. This trail is located at the back of the New Beginnings Community Church, and has a direct passage to the high ground as shown in the picture above.



Vertical Evacuation Location Map for West Aberdeen and North Aberdeen neighborhoods



An elevated playfield next to the school district.



A combination berm-tower structure with playfield on the ground.

WEST ABERDEEN AND NORTH ABERDEEN

These two neighborhoods are located at the hinterland of the City of Aberdeen and they have relatively long distance to the waterfront. But when medium to large tsunamis attack the study area, these two nighborhoods are still at high risk and will be inundated. Site 5 is now a vacant land and next to a school district. The school complex includes preschools and high schools, and many children are at risk if a tsunami come. The design idea is to develop this vacant land and elevate the ground to be a playfield above the inundation height. This elevated playfield could both serve for the kids at schools and evacuees from the neighboring areas. And it will be used as a normal open space when there is no hazard event. Site 7 is designed as a combination berm-tower structure with a playfield on the ground. This retains the function of the original West End Playfield and then provides safe haven for evacuation. The design also considers that if the Fry Creek near the site developed to be a wetland, then the tower and bem could become a obervation place for sightseeing. Site 6 is two small pieces of unused land, and two vertical evacuation towers are proposed to build there.

The North Aberdeen neighborhood is not planned to build any new VES. Because this area is close to the natural high ground and most of the area is out of the inundaVtion zone when the level of tsunami is small to medium. Many evacuation routes are also available in this neighborhood, and people live here can walk up to high ground when hazard happen. Besides, the vertical evacuation sites 3 and 5 are located at the border of the neighborhood and they can both serve for this neighborhood.

Vertical Evacuation Location Map for East Hoquiam and the Port

Reinforced Washington School can be used as vertical evacuation structure.
Source: Google Streetview

Vertical evacuation towers can be placed in the port area.

EAST HOQUIAM AND THE PORT

East Hoquiam is an area that has high level of exposure. Any level of tsunami attacks this area will all heavily affect this neighborhood for its low elevation and close location to the waterfront. East Hoquiam is a major residential area and over 2000 residents live there. When a tsunami coming, people in this area can choose to evacuate to the hill or move into the inland of the City of Aberdeen, but considering the large number of residents at risk, the vertical evacuation structures are still required in this area. One of the VES is the Washington School. The roof of the two-story concrete building can be used as a evacuation place. The school facility can both satisfy the evacuation need of students and other escapees from the neighborhood. The other two vertical evacuation locations are the Hoquiam Fire Department and the Washington State Patrol, Hoquiam Detachment. Both of the two places have patch of land that can be used to build VES, and vertical evacuation towers could be the choice. On the other hand, the departments can maintain the structures when they are not in use and the staff can provide help for evacuees when there is a tsunami event.

The port is an industrial area, and most people here are factory workers.This area has relatively higher elevation than other neighborhoods on the low-lying ground, and some of the area in the port could even out of inundation under all the levels of tsunami hazard. Since there is no possibility to use the land in the port to build a berm under the current land use, and exisitng buildings in this area are not reliable for evacuation, towers could be built to serve this region. Several towers could be placed in the port, and close to daily gathering places. They can also be used for observation when the tsunami waves coming.

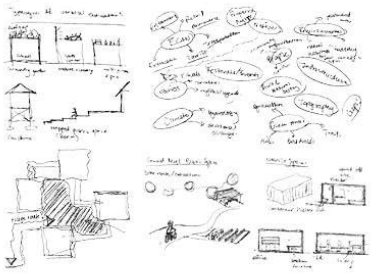
Proposed Vertical Evacuation Sites Overlap With Other Projects

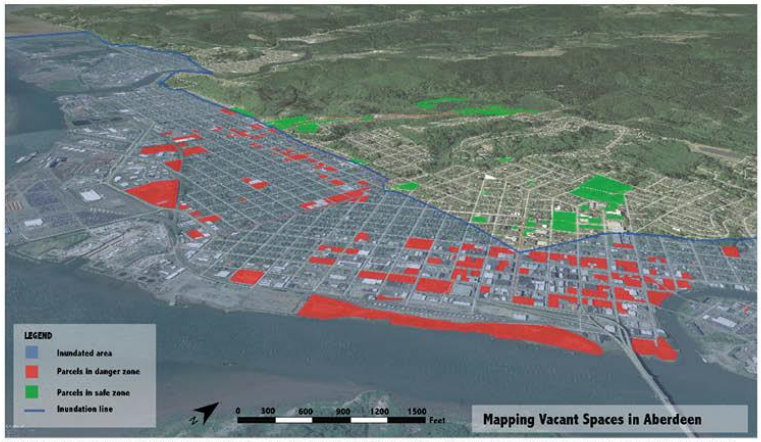
OVERLAPPING WITH OTHER PROPOSED PROJECT

The previous analysis is based on the status quo of our study area, and all the sites are chosen to locate on the available land. Except the vertical evacuation strategy, members in our team also develop other planning strategies to improve the resilience of this area, and their plans may affect the location and necessity of the VES. The map above shows some of the plans that may overlap with the verical evacuation strategy. As you can see, if levees are proposed to develop on the Division Street and along the waterfront, then sites 2 and 4 near the levee at the waterfront, and site 5 next to the Division Street will all be affected. Because a levee can serve as a vertical evacuation structure and it has a large capacity to provide safety for people. The sites 2 and 4 are not necessary and site 5 will be replaced. The levee along the waterfront would be a VES serving the communities close to it. The levee along the Division Street will be used as a recreation place in daily life, and served as a safe haven when a tsunami coming.

The proposed wetland along Fry Creek will not affect the use of the two (Sites 7 and 8) VES close to it. Since site 7 is dsigned as a combination berm-tower structure, the berm and tower can be used as observation platform for visitors, and when tsunamis coming, it can be used for evacuation. Site 8 is out of the inundation area of the wetland and it can still serve as a VES. The structures in the East Hoquiam (sites 9 and 10) could still be useful, because the berm along the waterfront can not totally neutralize the force of a tsunamis, and people in the neighborhood still need vertical evacuation structures as backup for evacuation.

Project Location



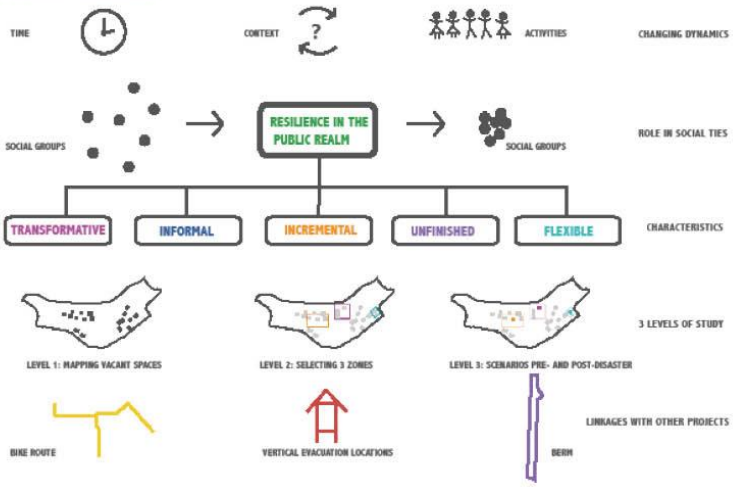


Above: Map of Vacant Plots of Land. This map shows existing vacant plots of land in Aberdeen that could be utilized as public spaces. Some are in the inundation zone and others are not.
Left down: Concept Sketches. Sketches that helped develop the project concept, from brainstorming the assets in Aberdeen, to conceptualizing networks and linkages, to thinking about typologies of public spaces, to considering concepts of modularity, flexibility, and transformation.

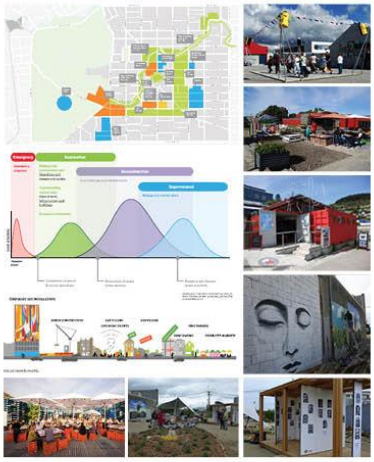
Resilience in the Public Realm: Recreation & Refuge | Ru'a Al-Abweh |

Resilience in the Public Realm explores public space as a tool for community resilience. This idea developed after conversations with the community in Aberdeen about people's natural tendency to come together in difficult situations, such as the flood in 2015. While the community bond is generally strong, Aberdeen seems to have a few different social groups that remain relatively disconnected on a daily basis. It also lacks public spaces for events, activities, and gatherings where these different groups could interact. Resilience in the Public Realm attempts to enhance and improve these existing social ties by imagining the activities that could happen in public space, both on a regular day ("Recreation") and in the event of an earthquake and tsunami ("Refuge").
Overall, this design concept was inspired by the city of Christchurch, New Zealand and their use of informal public spaces, activities, and events as a main pillar of community resilience and a tool for recovery after the 2010 and 2011 earthquakes. A core element of their approach is incrementality, which involves making the best use of existing infrastructure, assets, and spaces to build back the city over time (both figuratively and literally). They have also concentrated many of their developments around an important axis, the Avon River, enhancing its importance.

CONCEPT DIAGRAM



CASE STUDY: CHRISTCHURCH



Plans and diagrams are part of the Christchurch Central Recovery Plan; the photos show different placemaking and tactical urbanism projects that popped up around the city after the earthquakes in 2010 and 2011.

Through then lens of informality, transformation, and existing assets (whether physical structures or intangible characteristics of Aberdeen), *Resilience in the Public Realm* proposes uses of different public spaces and attempts to visualize the situations pre- and post-disaster. It also links with three other projects developed in this studio – *Division Street Berm*, *Bike Plan Aberdeen*, and *Moving Up to Safety*. This design concept assumes that the berm and bike path/evacuation route are in place; furthermore, the outcome of the analysis carried out in *Moving Up to Safety* helped determine one of the zones examined more closely in this project.

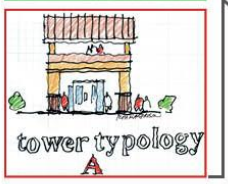
Resilience in the Public Realm examines public space on three different levels. Firstly, vacant public plots of land (including parking lots) were mapped, focusing on areas around two main axes – the proposed bike/evacuation route and the berm. This included assessing which spaces would be in "danger" (i.e. in the inundation zone) and which would be "safe" (i.e. outside the inundation zone). Furthermore, it was important to analyze how an open space network could serve as a "wayfinding" tool and strengthen people's familiarity with the berm and bike path/ evacuation route, which would be critical destinations during an earthquake and tsunami.

CASE STUDIES ON...

Recreation & Refuge

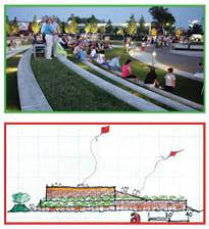
UP

Since West Aberdeen is at a risk of flooding, even with the addition of Division Street Berm, people need to immediately go "UP" in the event of an earthquake and tsunami. Thus, a raised structure is needed that could act as a viewing platform on a daily basis and a vertical evacuation structure for a disaster situation.



Above: viewing platform on the waterfront in Aberdeen that could serve as an inspiration for the design.
Below: the tower typology for a vertical evacuation structure from *Project Safe Haven: Tsunami Vertical Evacuation on the Washington Coast*

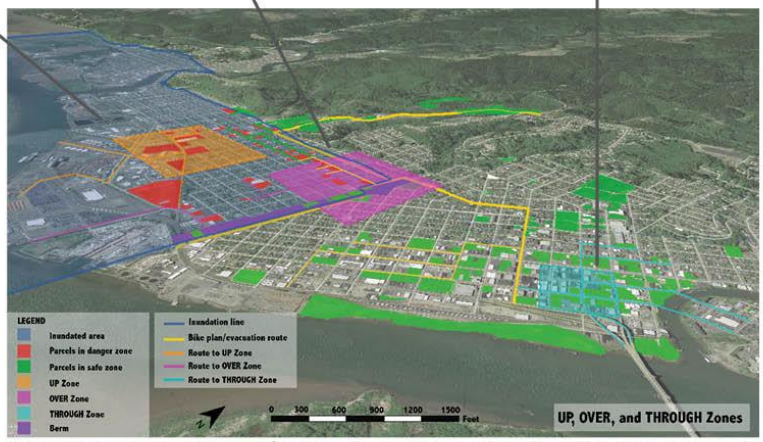
OVER



The proposed Division Street Berm has potential to be both a raised public space and a protective berm that gets people "OVER" to the safe side of town.. Above: Mitch McConnell Riverpark Center -EDSA -a multi-use plaza and venue. Below: the berm typology from *Project Safe Haven*.

THROUGH

With a berm, east Aberdeen would be safe from flooding but face damages from the earthquake. Therefore, it is a suitable place for people to pass "THROUGH" for assistance. Above: City Collaborative Initiative temporarily transformed a vacant downtown lot into a lively space. Below people assemble in a square in Kathmandu, Nepal after the 2015 earthquake (AP Photo/ Bernat Armangue.)

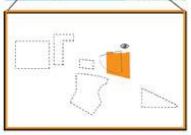


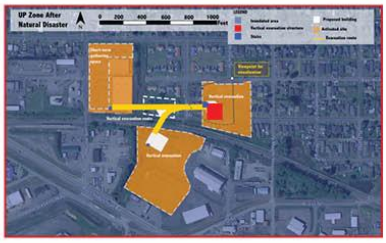
The map above shows the three zones -UP, OVER, and THROUGH- selected as locations of study for Resilience in the Public Realm, along with the proposed Bike Plan Aberdeen and Division Street Berm. It also shows how the street grid would link to the three zones, indicating where people would likely head first in the event of a disaster.

Secondly, three "zones" -UP, OVER, and THROUGH - were selected to take a closer look at different micro-systems of public space, focusing on how the spaces within these systems would function together and which plots of land would be activated pre- and post-disaster. Thirdly, a section of each of the three zones was examined even more closely, showing a more human-scale visualization of three different scenarios in a state of "recreation" (before a natural disaster) and "refuge" (after a natural disaster). While the scenarios for this design concept are sited and contextual, similar concepts could be applied to other spaces around Aberdeen or even other cities.

UP

Viewing Platform & Vertical Evacuation Structure

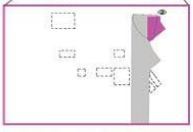


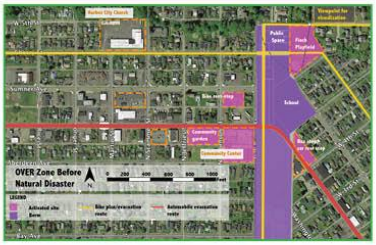


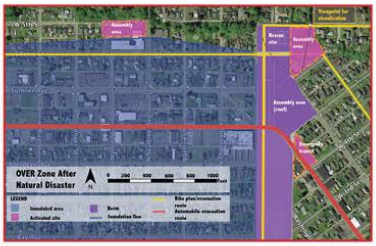
Located in southwest Aberdeen, this area is mostly industrial with few recreational amenities and is relatively far way from the evacuation route, higher ground, and the berm. Therefore,this scenario proposes a viewing platform to enhance West End Playfield and a cafeteria for the port employees. It also serves as a vertical evacuation structure connected to Grocery Outlet to the west and the cafeteria building to the south through a pedestrian bridge raised above the railway. Both buildings would have stairs or ramps that lead to the roofs, so that people can quickly get to higher ground. Then they would cross over to the main vertical evacuation structure through the raised pedestrian bridge.

OVER

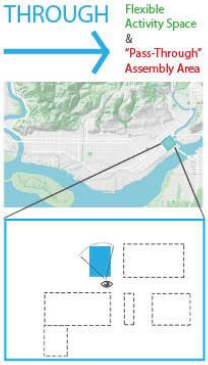
Urban Terracing & Cross-Over Rescue Berm







This zone contains the proposed Division Street Berm, which acts as a spine down the middle of Aberdeen and integrates with the proposed Bike Plan Aberdeen. Raised to a safe height above the inundation level, the berm would salvage the eastern part of the city from flooding while also getting people to higher ground and over to the eastern side. This scenario would require a redesign of a large part of this area, including proposing a school building, terraced urban gardening, and a sports area. Looking more closely at Finch Playfield, the visualizations show its use as a lively public space on a regular day and as an assembly area in the aftermath of a disaster, including using the urban gardens as a source of food and the berm as a rescue area and shelter space.



This zone in downtown Aberdeen is near the D&R theatre, a vegetable market, and other commercial amenities. Using "tactical urbanism", this site would be utilized for events and activities with movable elements. It is adjacent to spaces that could be utilized as a pop-up café and farmer's market. Assuming Division Street Berm is in place, this side of Aberdeen would be outside the inundation zone. However, it would still be affected by the earthquake. Therefore, this zone could be an important space to assemble in temporarily and pass through for urgent medical care, shelter, water, food, and electricity.

Project Location and Site Context: Aberdeen and East Hoquiam, Washington

Aerial: Aberdeen and East Hoquiam, Washington
The site is primarily located on a abandoned pulp plant

Relative Probability of Tsunami Inundation: for Cascadia Subduction Zone- M9.0 Earthquake

Looking to Nature: Shoreline Design for Flood and Tsunami Mitigation | Michelle Caponigro |

RESPECTING NATURE:

With intensified media coverage on tsunamis and natural disasters, increased awareness has caused coastal cities to choose to armor their shorelines with seawalls or hardened structures. As demonstrated in the 2011 Japan tsunami, seawalls are overcome by natural forces time after time. Not only do seawalls cause damage to the natural ecosystems native to the shoreline, but they also serve as a physical barrier for community members to connect to the waterfront. Instead of fighting nature, we should look to work in harmony with biological forms to counter tsunamis and flooding. Natural berms constructed of varying topography will serve as a natural barrier, trees along the berm serve to dissipate wave energy, and the berms will be enjoyed in non-emergency situations as a public greenbelt. The greenbelt will connect two existing highpoints, the port of Aberdeen and East Hoquiam, and in return, the most vulnerable areas of West Aberdeen and East Hoquiam will be protected.

SITE PLAN: GREENBELT PARK

VISION

Create a greenbelt that works with nature to mitigate flooding and tsunami threats. The greenbelt park serves not only to protect the community, but also creates a place for people of all ages to gather and enjoy nature. The park will honor the rich logging history of Aberdeen through the planting of new trees, and by reutilizing an abandoned pulp plant.

CONNECTION TO THE HARBOR

Forests and native plants thrive along the shoreline, while walking trails allow the community to enjoy the waterfront from the berms and along the shore.

Reconnect the citizens to their beautiful waterfront; create a series of outdoor places for social gathering and recreation.

Reutilize abandoned pulp plant for outdoor event center and community viewpoint.

RESILIENCY AND FLOOD REDUCTION

Natural berms constructed with varying topography, serve as a natural barrier for flooding. The design works with natural elements and ties into existing highpoints.

Land currently is vacant and not being used to its full potential. Remediate shoreline, and properly demolish existing abandoned pulp plant.

Natural shoreline and trees dissipate wave energy versus causing large wave reverberations from seawalls.

PROGRESSION FROM STRUCTURED

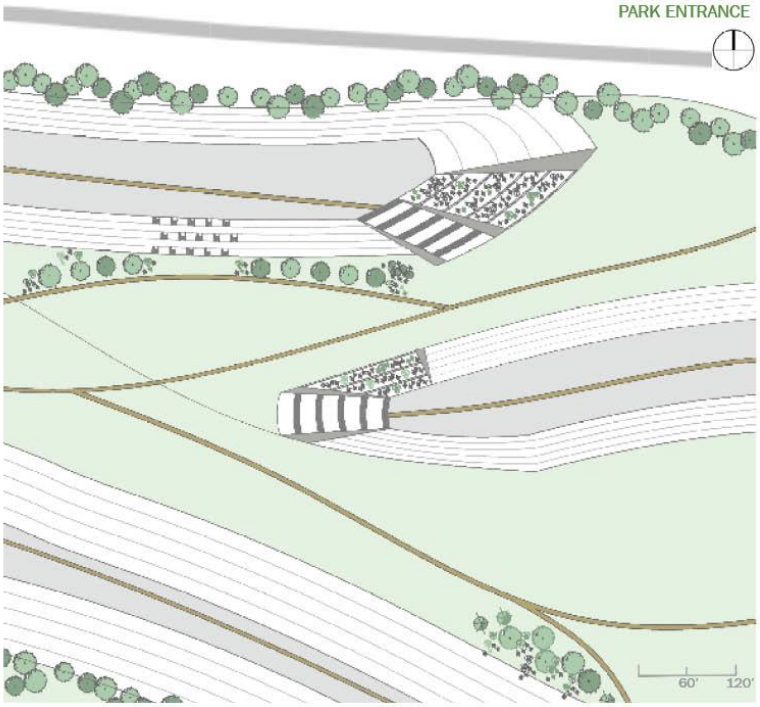
TO BIOLOGICAL SPACES

A defined entry welcomes the community to the park, while enticing visitors to come in and discover what is within.

A community event center reclaims existing pulp plant structures, while demonstrating the transition from a structured environment to natural formed berms.

A biological shoreline is restored. Piles, bulkheads, and the dock will be removed. Native plants and soil replaced.

PARK ENTRANCE



Sculptural Berms Concept:
EnaPeyza Design

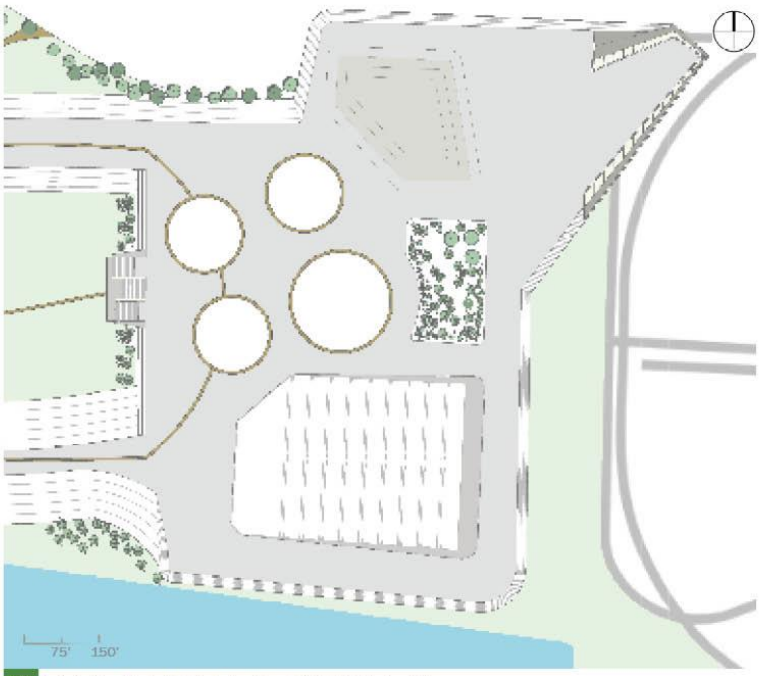
The Hundred Step Garden:
Tadao Ando

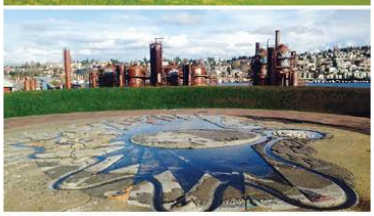
Olympic Sculpture Park: Landezine © Andrew Buchanan

DEFINED ENTRY

The entry is created by combining the organic form of the berm with the rigid form of structural concrete. A series of tiered planters with native plants creates contrasting textures and colors against the concrete forms. The entry is flanked with two sets of stairs, which welcomes visitors to explore on the berms. Beyond the entry, a series of trails meanders through a valley of trees, gardens, and play areas for children.

REVITALIZED COMMUNITY EVENT CENTER



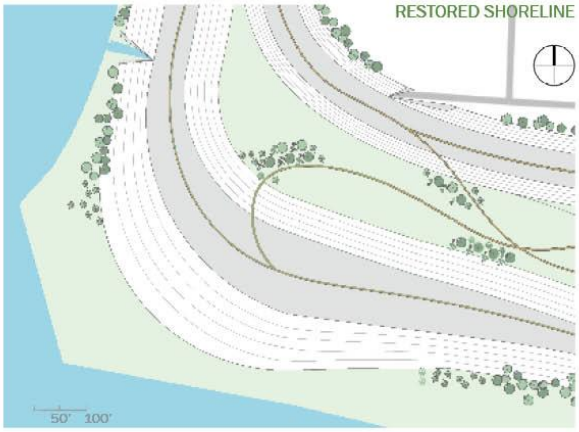


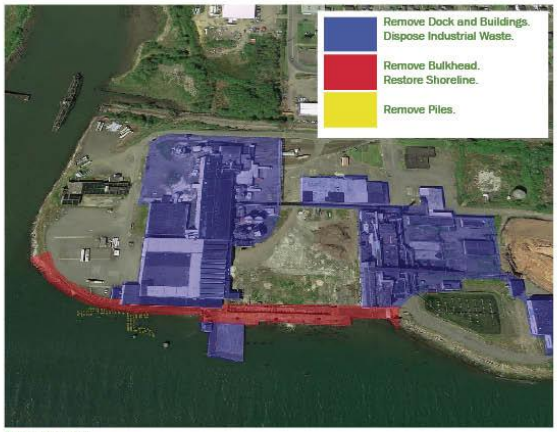
Gas Works Park: Richard Haag

COMMUNITY EVENT CENTER

The existing Harbor Paper pulp plant is on high ground, and creates a strong anchor point within the greenbelt park. The site is currently owned by private investors, and has ongoing clean up requirments. Existing retention ponds will be properly remediated and cleaned. The four circular ponds will be reutilized as a series of fountains. The largest pond will be excavated and an outdoor amphitheater will support community concerts and gatherings. A viewpoint will be constructed with an additional berm, which will overlook the city of Aberdeen, Hoquiam, and Grays Harbor. Throughout the space, there will be relics demonstrating the rich logging history that was so important in creating the pride and social fabric of the community.

RESTORED SHORELINE





Remediation Actions

Restoration of Shoreline Habitat:
Images from Grays Harbor National Wildlife Refuge

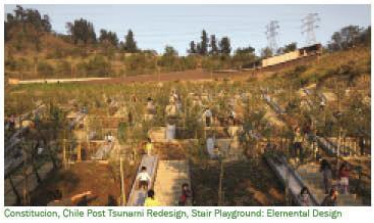
Native Salt Grass: Lyngbys Sedge
Upland Native Bush: Red Elderberry

Migratory Bird: Western Sandpiper

BIOLOGICAL SHORELINE

Grays Harbor is one of the largest concentration points for shorebirds along the west coast. The shoreline along the greenbelt park will return to its biological state. All piles, bulkheads, and docks will be demolished. Native plants, stones, and sand fill will be used to naturally harden the shoreline, without fixed manmade structures that sever adjacencies of upland and aquatic areas. Native shrubs and trees will be planted upland to encourage native birds to return to the site. The benefits include a more natural appearance along the shore, increased habitat for birds and fish, water filtration, and recreation.

Frederik Meijer Gardens & Sculpture Park: Image West Michigan Horticultural Society



Constitucion, Chile Post Tsunami Redesign, Stair Playground: Elemental Design

A COMMUNITY PARK FOR ALL

The greenbelt park will provide playful opportunities for people of all ages. The primary gathering space of the park will be an open-air amphitheater constructed of a series of concrete steps and grass planes within the revitalized pulp plant's retention pond. A series of steps and slides will be cut into the entry berm, providing a playful area for children to experience the changing topography of the berm. Native plants, shrubs, and trees will be planted adjacent to play areas, along with informational displays to demonstrate the biological diversity of the greenbelt park.

Constitucion, Chile Post Tsunami Redesign, Waterfront Park: Elemental Design

Constitucion, Chile Post Tsunami Redesign, Trail System: Elemental Design

RESILIENCY THROUGH NATURE

Meandering trails along the berms, on top of the berms, and along the shoreline allow visitors to experience multiple biological zones, and provide dramatic views of the surrounding city and harbor. The greenbelt park becomes a refuge within the city, and creates a destination place for community members and tourists. The park demonstrates the revitalization of the environment and the community, all while making the city of Aberdeen and Hoquiam resilient against flooding and tsunami inundation.

"Free public access to the waterfront existed in the past and the coastal, natural environment was important to local life."

Imagine Fry Creek: Building the Confluence of Forest, City and Estuary | Stevie Koepp |

This project intends to spur discussion negotiating short term needs of Aberdeen with long term goals of hazard mitigation. The ecology, history, and social context of Fry Creek sets the stage for a creative approach to redefining the city by improving access to its unique natural resources and hydrology.

FOREST: Fry Creek begins in the forest where a mixed hardwood trees stabilize steep slopes and increase the evapotranspiration of frequent rains. As the stream collects, palustrine and estuarine wetlands provide valuable ecosystem services. Phase one of planning aims to incorporate the highlands with the lowlands and realize the impact of upstream development.

CITY: West Aberdeen and East Hoquiam must reestablish their relationship to each respective urban center. First and foremost, flooding of what is primarily residences must be mitigated. Second, incentives and planing initiatives should plan to rebuild aging and deteriorating housing stock more densely, out of the way of less frequent but dangerous hazards (tsunami, earthquake, and landslides). Phase 2 finds potential in the transition and relocation of homes in the way of hazard.

ESTUARY: As an envisioning exercise, this project turns towards the Chehalis estuary as a major opportunity for development in all phases of design. Plans to better incorporate the waterfront into the city of Aberdeen have thus far focused on shopping and retail potential. Starting with Fry Creek and re-imagining new waterlines post disaster and subsidence, the economic, social, and environmental amenities offered by the waterfront are stressed.

*For **thousands of years** the Lower Chehalis have lived around Grays Harbor and in the river valleys that feed into the bay. Bands of the Salish-speaking communities moved between a number of village sites near the saltwater where they gathered shellfish, fished for salmon and sturgeon, and hunted otter and other sea mammals. In the warmer months, they traveled to village and camping sites in the mountains for gathering plants and berries, harvesting trees for canoes and other items, and hunting."

*In June **1870**, John Fry settled at Sylvia Creek, at what would become Oocsta, just around the south side of the bay from the mouth of the Chehalis. He built a sawmill there with M. F. Luarck. At first they cut 6,000 to 10,000 board feet per day. By 1888 they had increased production to 15,000 board feet per day, which is the equivalent of nearly 3,000 of today's 2 x 4 inch studs."

*In a Coast article from **1907**, Jean Stewart, an early settler, tells her version of the town's naming: "I wrote a letter to one of the papers suggesting that the new settlement be called Aberdeen, since it was at the mouth of the Rivers Wishkah and Chehalis, just as Aberdeen in Scotland is at the mouth of the Don and the Dee, and also since Aberdeen means 'at the mouth of the river.'

*Completed in **1895**, the railroad provided an overland connection to cities on Puget Sound and to Portland, offering access to those markets for the region's lumber and agricultural produce."

*Considering its small size, with just under 4,000 people, Aberdeen had a diverse population. Many of the sailors, loggers, millworkers, and farmers who lived in Aberdeen hailed from foreign countries in Europe and Asia."

*A serious downtown fire in **1902** was followed the following year, on October 16, 1903, with a conflagration that destroyed some 200 acres of Aberdeen's downtown. Three people died and 140 structures burned to the ground. But the city council wasted no time in addressing the future. While the ruins smoldered, meetings were held and codes enacted to ensure the safety of the Aberdeen that arose from the ashes."

In **1908** the city began filling the low areas. Much of the fill came from a now-leveled hill in town, where Aberdeen High School stands.

*In **1924** a new milestone for annual lumber production was reached when the one billionth foot of timber was shipped from Aberdeen, earning the town the title of "Lumber Capital of the World.""

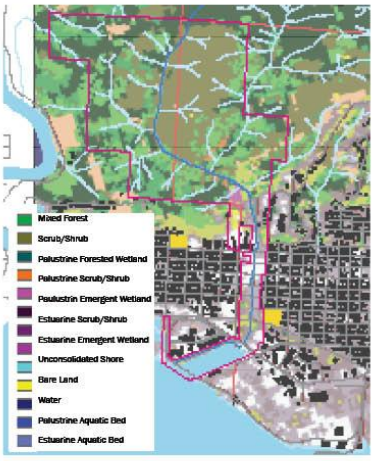
*Another change in the logging industry involved the trees being cut. Beginning in the **1930s**, local leaders began to question to clearcutting ethos that brought so many logs into Aberdeen to be cut."

*On October 5, **1918**, workers at the Grays Harbor Motorship yard set a record for fastest ship construction. In just 23 and one-half days they built the Aberdeen, a 4,000-ton wooden ship with two propellers."

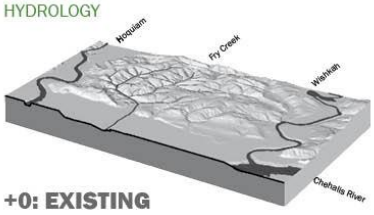
(From Washington History link.org)

HISTORICAL

STUDY AREA & LANDCOVER

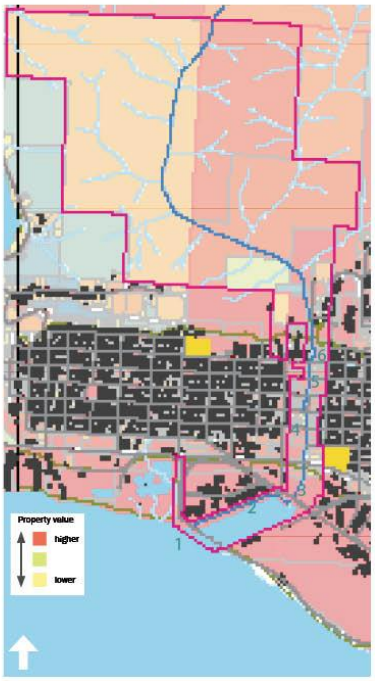


HYDROLOGY



+0: EXISTING

PARCELS, OPEN SPACE, LINKAGES



THE PEDESTRIAN EXPERIENCE

1 Mouth of the Creek, existing waterfront

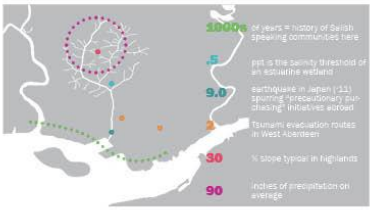
2 Industrial channel

3 Lock/stream control structure

4 Westend park/ housing

5 Hwy 101 development, subsurface piping

6 PUD, hosipital view

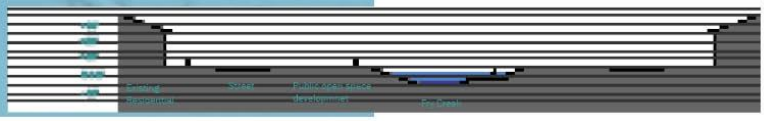


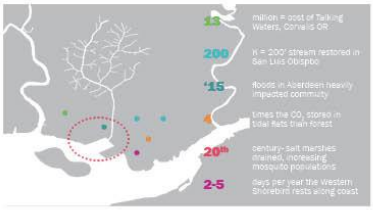
FIRST PHASE

The restoration and daylighting (at Hwy 101) of Fry Creek will provide vital community and natural resources, along with flood mitigation, to the cities of Aberdeen and Hoquiam in the immediate future. North to South continuity between forest and waterfront is stressed to promote envrionmental literacy and connect residents and buisinesses to water resources.

Primary objectives:

- Flexible, connected open space development (urban agricuture, park amenities, community engagement)
- Clear Pedestrian evacuation Route
- Stream restoration and increased wildlife habitat
- Space for community and tourist development
- Natural play and educational opportunities
- Community health and well-being



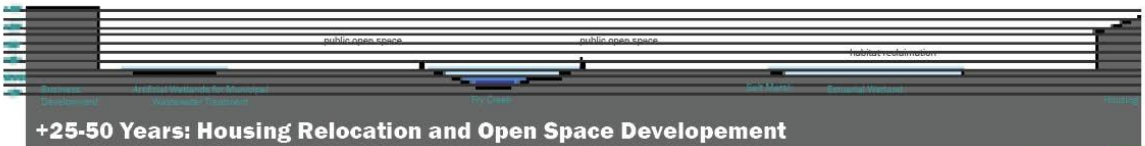


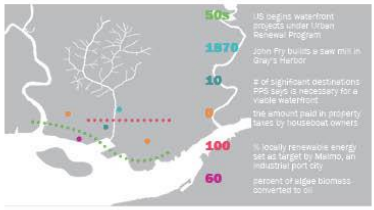
SECOND PHASE

This is an intermediary step towards hazerd mitigation in the case of an major earthquake event. Flooding has been reduced in Phase 1, but housing is relocated to higher ground in this long term planning initiative. The city's relationship to the waterfront is developed.

Primary objectives:

- Relocate water treatment facility, build municipal artificial wetlands and connected green way (case study: Talking Waters- Corvallis, OR)
- Relocate households to higher ground, utilize FEMA funding in both cities
- Salt marsh wetland development for natural amenity and wildlife function
- Urban aquaculture - algae (biomass) and estuarine plant species



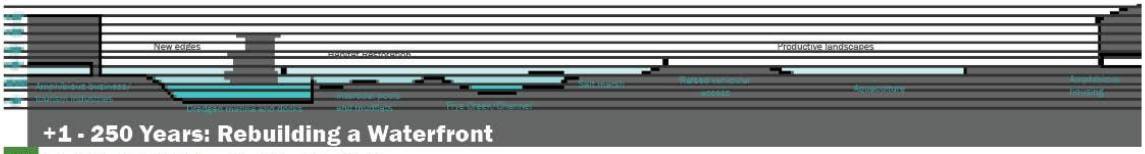


PHASE 1, 2 OR 3

This plan projects a future post earthquake event or alternatively, in favor of major waterfront improvements following housing relocation. Fry Creek persists as a physical and symbolic connection to the past despite major shifts in mean high water level and changes to its hydrology.

Primary objectives:

- Establish waterfront destination accessible by highway 101 (Project for Public Spaces "Powers of Ten"
- Houseboat communities, amphibious housing development
- Biomass (algae) farming
- Carbon offetting through mitigation projects
- Critical wildlife reclaimation projects



Location of Division Street berm shown in green in Aberdeen, Washington

Division Street Berm: Protect, Preserve, and Play | Lizzie Moll |

Division Street in Aberdeen is an important street for many reasons. It runs north-south and the street where the street grid changes. It is in the middle of town and divides the west end of Aberdeen from the downtown core. There is also an east-west change in elevation by four feet from Williams Street to Division Street. Creating a berm on one block between Williams Street and Division Street would help to protect the downtown core of Aberdeen during a tsunami. The blocks from east to west are 300 feet wide. Accounting for the ground subsiding with a major earthquake, the berm would have to be ten feet tall in order to protect the downtown from the waves that would arrive with the tsunami. The slope would not need to be very dramatic in order to be effective. In the short term the berm would provide opportunities for community green space and for adjacent buildings and housing to be built on the inside of the berm. It would also include a passive recreation trail along the top of the berm. In the event of a tsunami, the trail could then be used as an evacuation path and as a vertical evacuation option. Other neighboring structures can also be used for vertical evacuation. The mass and height of the berm would keep the water from reaching downtown Aberdeen.

CASE STUDIES

Lucca, Italy is a medieval city that has incorporated their Renaissance-era walls into their urban fabric. These walls are now a pedestrian promenade called the Passeggiata delle Mura Urbane. These tree lined walkways and bicycle pathways encircle the ancient city center and serve both as a tourist destination and a giant park for passive recreation by residents of the city.

Suwon, Korea is a walled city in the Gyeonggi Province. The city has grown outside of the walls built in 1796 and are now a designated UNESCO World Heritage site. There is a path around the walls that tourists and locals alike walk along. There are different structures, observation towers, and pavilions along the wall that are points of interest with panoramic views of the city.

The South Park Blocks in Portland, Oregon is a linear twelve block park in downtown Portland that is 100 feet wide. It is touted as the heart of the city's cultural life with public art and flexible spaces for festivals. The park has walkways down the center with automobile streets around the periphery. This is an important case study because it does not divide the city - it unifies it.

Pedestrian and bicycle trails along the top of the Renaissance-era walls. Image from bicyclespokesman.com

A section of the wall that runs through Suwon Korea. There is a pedestrian pathway on top of the wall surrounded by open space. Image from: Wikipedia.org

The South Park Blocks are basically at grade and were built as a linear park. They have a pedestrian corridor that cuts down the center of the park. Image from: Wikipedia.org

The medieval city of Lucca, Italy with the surrounding Passeggiata delle Mura Urbane. Image from: www.realestate-lucca.com

The wall in Suwon acts as a green belt way through the city. Image from: Wikipedia.org

This plan from Portland State University shows how the blocks fit within the context of the campus. Image from: Yost Grube Hall Architecture

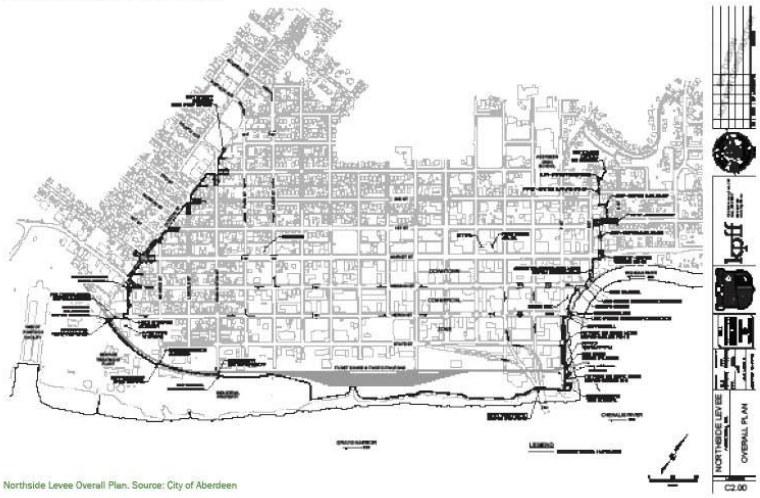
BEHIND THE BERM

Tsunami's are a result of water rushing in to replace subsided land after an earthquake happens and tectonic plates shift. Often the tsunami will continue over multiple high tide and low tide cycles. This means that it is not safe to immediately return home after an earthquake. Although the water rushes in - it does not suddenly appear like a massive wall of water. Instead it will often look like a rapidly rising high tide.

A berm will provide extra elevation in the land in order to protect structures and stop the flow from entering Aberdeen's downtown core at the time of the event.

Climate change has also meant an increase in sea level rise and changes in precipitation which could lead to a need for extra fortifications from seasonal flooding.

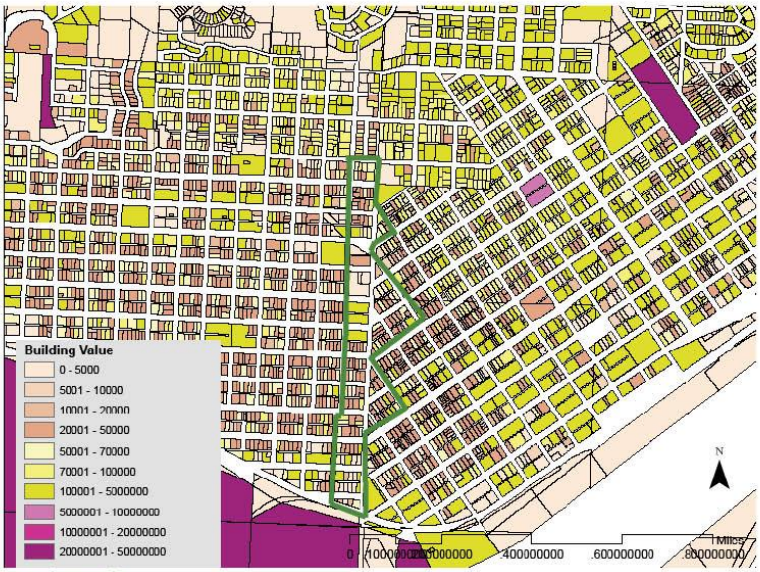
The engineering firm kpff is in the process of creating a system of levees and sea walls in order to protect Aberdeen and neighboring Hoquiam from tsunamis and flooding. They had initially proposed a wall at Division Street when their client was the City of Aberdeen. Since their first plan, the city of Aberdeen and the city of Hoquiam have joined together to create one large master plan for protecting their cities from tsunamis and flooding. This means that the Division Street wall was abandoned in their plans. We are still proposing a berm at Division Street. In resiliency redundancy is important because sometimes the first option fails and this berm could be pivotal in protecting downtown historic Aberdeen. By creating a green belt through the city instead of a wall, Aberdeen will have a unifying park instead of a divisive structure.



Northside Levee Overall Plan. Source: City of Aberdeen

Tsunami flow will be higher than mean high water (MHW). A berm stops the water.

BEHIND THE BERM



Data from Gray's Harbor GIS

This proposal impacts 171 parcels of land. Based on 2015 Tax Assessor Data, the average building value is $50,570.38 and the average land value is $23,284.29 within the area with the green border representing the berm. The map to the left shows building values by parcel in the area of Aberdeen around Division Street. The blocks between Williams Street and Division Street have comparatively less value than the buildings in the downtown core to the east of Division Street.

View of Division Street looking south. Image by Dan Abramson

View of Pacific Ave from intersection with Division Street looking west
Image by Dan Abramson

MULTI-USE SPACE

Circulation and Uses of Berm

The berm along Division Street serves multiple purposes. It serves the community as a linear park with multiple points of interest. Designing the park blocks with community gardens, providing new housing options that are protected by the berm, and a new school will give the berm some programmed, active spaces.

This is a huge opportunity to invest in the community with educational facilities and gathering spaces for the residents and a point of interest and novelty for tourists.

Roads

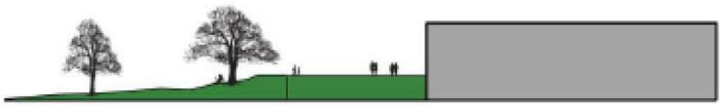
U.S. Route 101 goes through Aberdeen and will go directly over the berm. Route 101 is used by many tourists who are on their way to Olympic National Park and Aberdeen could have more opportunities to take advantage of the tourism money that drives through the city. By creating an interesting linear park, it might encourage drivers to stop, get out of their car, go for a walk, and maybe spend some money. All of the connecting roads will go over the berm in order to preserve the structural integrity and emergency purpose of the berm. This plan keeps most of the major street connects but integrates the odd shaped blocks into the berm.

Blocks

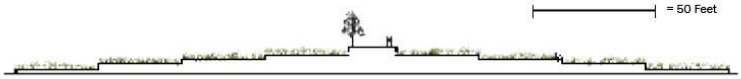
This plan creates larger blocks. This provides some opportunities to create community spaces larger than the current 300 foot blocks. It also helps to incorporate the switch in grid and leaves room for complementary uses. For example, across from the community garden is space for new housing units at different scales that can use the garden space. They are also inside the berm making them better investments.

A trail on top of the berm can be used for evacuation as well as recreation and can be used as part of our proposed bicycle plan. It changes in width as the adjacent use changes.

The berm along Division Street is ten feet above the current street level at its peak.



The berm would include a new three story school built to replace one story Harbor High School, an alternative high school in the Aberdeen school district whose building is over 60 years old. During a tsunami the school could be used for vertical evacuation using a similar model to Project Safe Haven in the Ocosta School District. The slopes are all above 5%, but lower than 8% slope to fit with accessibility standards. The highest point (the trail) on the berm is ten feet.



With a new regrade of the block between Division and Williams streets, there are options for new community uses of the space. A terraced community garden with the pathway connector would provide locally grown food options. Since new top soil will be brought in to create the berm, community members will have less of a worry about soil contamination with their food.

The berm south of Market Street but north of the port is currently more industrial. This area is also currently a few feet lower in elevation than at 5th Ave at the north side of Division Street. This area can become more of a park in order to connect with the proposed waterfront levy and park and take advantage of the views of the water.

BERM BENEFITS DAY-TO-DAY

In the short term, the berm can be a vehicle for a network of community gathering spaces. It is at the geographic center of Aberdeen, but it also has the opportunity to be a cultural center as well.

A new high school and community garden will invigorate the area and keep the park space active. It will encourage use of the green belt berm by multiple generations. It will also provide new infrastructure in the form of a new school and more local food options.

People want to live near parks, so by creating this linear park that is potentially part of a larger trail and park system we are creating a desire and also an option to live downtown. Residents can be near community members and open space, but also be protected from a tsunami. This will lead to increased land values and reinvestment in the downtown core. There is a potential for more economic investment in the town with the reduced flood insurance cost and more security from disasters.

With the berm there are opportunities for new housing options at different scales. Cottage housing or town houses could be alternative options to single family houses if more people would like to live nearer to the berm or on the east side of the berm in case of inundation from a tsunami.

This berm is part of a park and trail green belt system that can be used by residents and tourists alike for active and passive recreation.

Harbor High School from Division Street. Image by: Dan Abramson

Ocosta elementary school built to also serve as a community vertical evacuation structure. Image from: www.ocosta.k12.wa.us

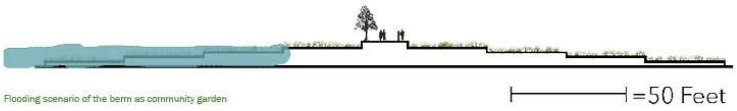
BERM BENEFITS DURING THE DISASTER

In the long term, the berm will be the most useful for easing the impact of the tsunami. Even if the berm is only useful for one catastrophic event, it will have protected downtown Aberdeen. By creating a ten foot tall berm, the water will not be able to penetrate the downtown core of Aberdeen.

The trail at the top of the berm can be used as a trail towards higher ground at the time of the event. The sides of the berm will not be too steep in order for people to climb the berm. Every side will be a slope angle that is ADA compliant.

The pathway itself is high enough that - if need be - it can be used as a vertical evacuation structure at the time of the event. It will be a form that people can recognize because of its park-like distinctive appearance day or night.

The berm also provides options for other vertical evacuation structures to be built along side the berm. These structures could serve dual purposes. For example, the new school could also be built to be a safe building to be on top of during an earthquake and tsunami.



Flooding scenario of the berm as community garden

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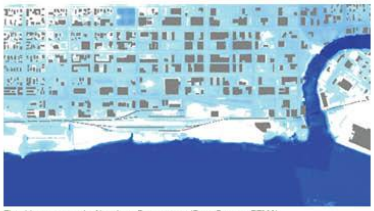
Staircase uphill at the north end of Division Street. Image by: Dan Abramson

Vision for Downtown Waterfront Levee

Downtown Waterfront Levee as Public Amenity | Zoe Wang |

Aberdeen is located at the eastern end of Grays Harbor, near the mouth of the Chehalis River and southwest of the Olympic Mountains. Grays Harbor is notable as the northernmost ria on the Pacific Coast of North America because it has remained free of glaciers throughout the Quaternary due to unfavorable topography and warm temperatures. Waterfront here is mostly owned by the Port of Grays Harbor, a leading export port and the No.1 seafood landding point for Washington State. The city was once prosperous with its great natural resources and stable economic development. However, it expericences economic decline and faces with the threats from tsunami and flood these days. Solutions are called for to revitalize the city.
One way to deal with the issue is by establishing a park and levee system, along the Levee serves as a barrier, preventing water from pouring into downtown and residential areas; park aims to offer more opportunites for recreational and commercial uses, activting downtown development. With careful design and planning, the park and levee system could make Aberdeen a more resilient and vibrant city.

Tsunami Impact Area in Aberdeen Downtown (Data Source: Fema)



Flood impact area in Aberdeen Dowantown (Data Source: FEMA)

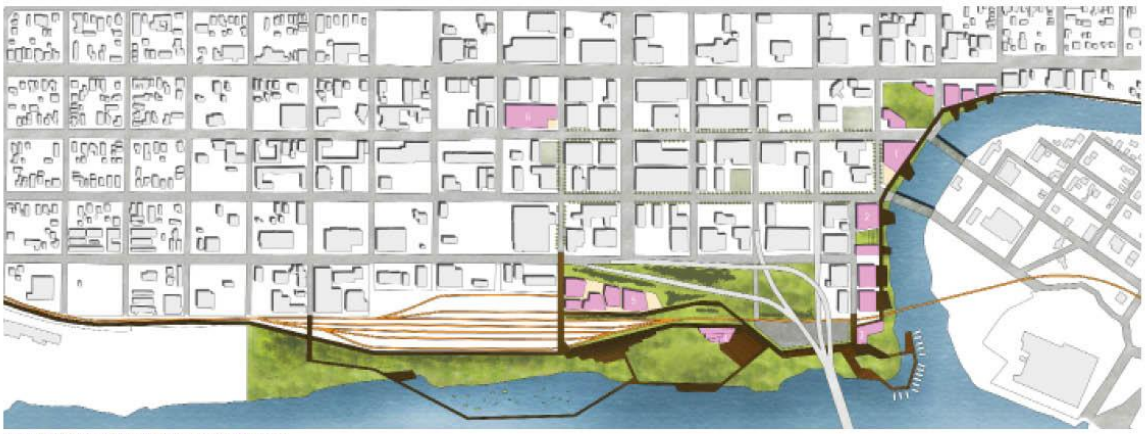
Aberdeen Dowantown landuse map

Aberdeen Dowantowan transportation map

ASSETS AND ISSUES

Urban structures and nature resources are both assets and obstacles to the development of the city. Waterfront along Whiszkah and Chehalis river is left natrually developed, could be better utilized. Land adjacent to the waterfront is mainly for commercial and institutional uses, with some abondoned buidlings at some pieces. There are some commercial development already exist along Whishka river. Railway is a big issue for the area. It cuts the connections between downtown and waterfront, leaving only two entrances, one of which goes under the flyover while the other one goes under the elevated rail lines.

The entrance and export way of the flyover impede local traffic circulation. However, the heavy traffic brought by both flyover and bridges make the waterfront a gateway of the city. According to Fema Data Report, all of the area is under the threat of tsunami. In terms of flood, all downtown area and some land on the waterfront are below the water surface. The average flooding depth is less than 10 feet.



Master Plan of Aberdeen Downtown Waterfront and Levee System

VISION

- Promote a resilient and vibrant Aberdeen

GOALS

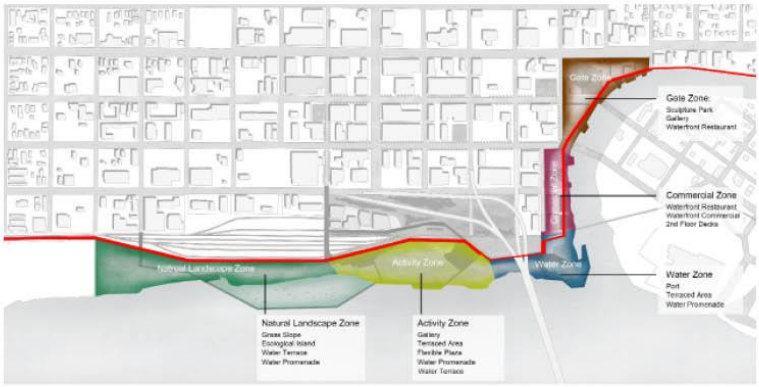
- Prevent hazards from tsunami and floods
- Provide diverse waterfront activities
- Promote downtown development

STRATEGIES

A hybrid levee along the waterfront, preventing water from pouring in as well as serving as connections between downtown and waterfront, increasing the accessibility of the waterfront.

A multi-functional waterfront, divided into Gate Zone, Commercial Zone, Water Zone, Activity Zone, and Natrual Landscape Zone, facilitaing diverse activites involving fishing, boating, and waterfront catering.

A pedestrial-friendly street system, both inside and outside the waterfront area, promoting bicycling and walking, connecting with evacuation routes, and activting the downtown development.



Waterfront and Levee System Different Functional Zone

Above: Boating in the waterfront park. Source: http://www.townofmanteo.com/index.asp?SEC=B061EAAE-6B8F-46DF-BB2A-08760CA17C94&Type=B_BASIC
Below: Fishing in the waterfront park. Source: http://www.zeffemel.nl/?m=201007

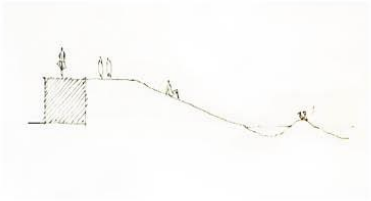
MULTIPLE ZONES

A multi-functional waterfront, divided into Gate Zone, Commercial Zone, Water Zone, Activity Zone, and Natrual Landscape Zone, facilitaing diverse activites involving fishing, boating, and waterfront catering.

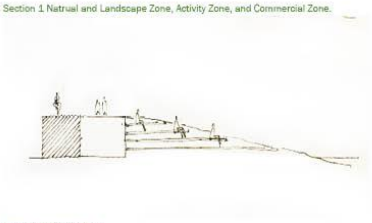
The different functional of the five zones are determined by the water conditions and its relationship with surrouding areas. Each of them matched with different infrastruatures.

Gate Zone consists of sculpture park, gallery, and waterfront restaurants; Commercial Zone is facilitated with waterfront restaurant, waterfront commercial, and 2nd floor decks; Water Zone has port, terreced area, and water promenade; Activity Zone includes gallery, terraced area, flexible plaze, water promenade and terrace; Natural Landscape Zone is characterized by grass slope, ecolofical island, water terrace and promenade.

What Waterfront Area would be like when flood came.



Section 1 Natrual and Landscape Zone, Activity Zone, and Commercial Zone.



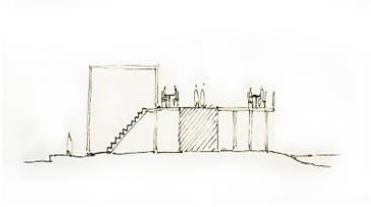
Section 2 Activity Zone

MULTIPLE FUNCTIONS

A hybrid levee along the waterfront, preventing water from pouring in as well as serving as connections between downtown and waterfront, increasing the accessibility of the waterfront.

To protect the inside areas, levee should be around 10 feet in height at least. Stoplogs are involved at the entrances of the two bridges. Railway should be elevated a little bit more at the crossing to the levee.

The structure of the levee could be adjusted to offer adaptivity to the functional use of waterfront. For Gate zone, the levee is merged into grass slope; for Commercial Zone, the levee is connected with two-story buildings and their decks; for Water Zone and Activity Zone, terraces are added to offer activity platform; for Natural Landscape Zone, levee is more naturally looked as grass slope.



Section3 Commercial Zone.

The upper one shows the transportation system both inside and outside the waterfront; the lower one shows the impact of waterfront to downtown area.

PEDESTRIAN-ORIENTED NETWORK

A pedestrial-friendly street system, both inside and outside the waterfront area, promoting bicycling and walking, connecting with evacuation routes, and activting the downtown development.

Two lanes for pedestrial walking and bicycling are provided on the levee.

Water terrace and promenade are made for facilitating waterfront activities.

The access points of the levee is connected with evacuation routs, as well as bicycle trails that already exist.

Green belt is built along the railway, as well as selected downtown streets, facilitating shopping.

Important nodes are proposed to future development.

Figure 1-1 Project Location

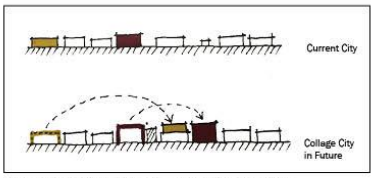


Figure 1-2 Design Concept: from current city to collage city in future

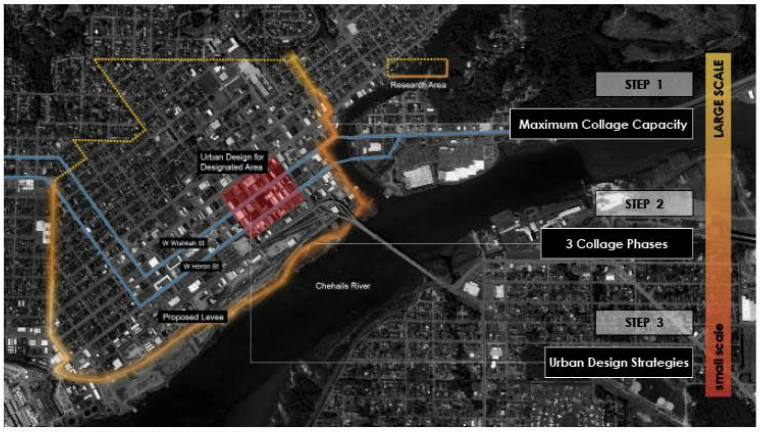


Figure 1-3 Design Strategies: from large scale to small scale

Collage City: Intensifying and Revitalizing Downtown Aberdeen | Jingchen Liu |

This project focuses on the area that will be protected by proposed levee (see Figure 1-2 and Figure 1-3), which is mainly downtown Aberdeen. My vision of this project is to intensify and revitalize downtown Aberdeen by usning "collage city" as an approach.

According to our large group's vision and arrangement, in future, my research area will be be responsible for accormodating relocated residents from west Aberdeen. It makes my project different from general urban infill or revitalization proposals, because I need to consider both where new residents come from and where they could be relocated. Therefore, I try to use "collage" as the core concept in this design, which means pick up elements in west Aberdeen and collage them into my research area (it can be better demonstrated by Figure 1-2). For downtown Aberdeen, it can also be intensified and revitalized through this "collage".
To realize this concept, I am going to work on three steps, from large scale to small scale: 1) calculate maximum collage capacity in my research area; 2) arrange 3 redevelopment phases in future; 3) propose detailed urban design strategies.

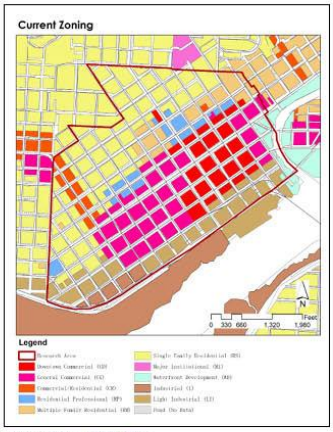


Figure 2-1 Map of Current Zoning

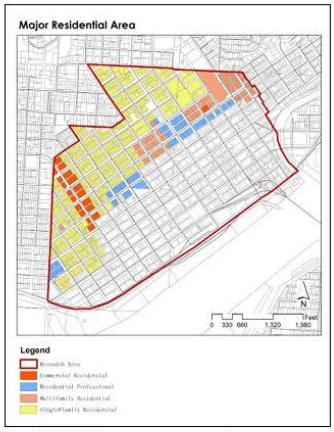


Figure 2-2 Map of Major Residential Area: parcels zoned primarily for residential use

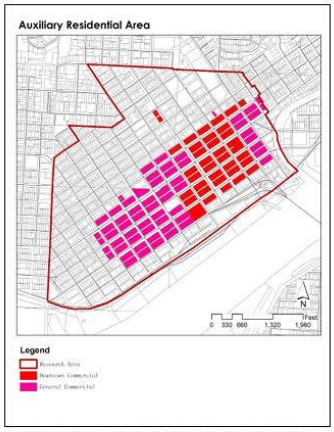


Figure 2-3 Map of Auxiliary Residential Area: parcels zoned primarily for commercial use with residential as auxiliary use

	TOTAL	Major Residential Area				Auxiliary Residential Area	
	Maximum Infill Capacity	Single Family Residential (R-S)	Multiple Family Residential (R-M)	Residential Professional District (R-P)	Commercial Residential (C-R)	Downtown Commercial District (C-D)	General Commercial District (C-G)
Total Area (sqft)		3426800	836971	563601	362844	1429951	2163360
Density Limit (sqft/unit)		6223	1500	1500	1500	*1500*	*1500*
Maximum Units	4122	551	558	376	242	953	1442
Maximum Population	8202	1608	1629	1097	706	2784	4211

1. Research Area: Current Units: 1477; Current Population: 2940
2. There is no accurate "Density Limit" on auxiliary residential area, and *1500* is based on rough assumptions.

MAXIMUM COLLAGE CAPACITY

Maximum collage capacity in my research area is calculated first based on current zoning's regulation. All parcels with potential residential use are divided into two parts: major residential area and auxiliary residential area (See Figure 2-2 and Figure 2-3). These two area's residential capacity are calculated separately.

According to calculation, research area's maximum units capacity is 4122 units, and its maximum population capacity is 8202 people.

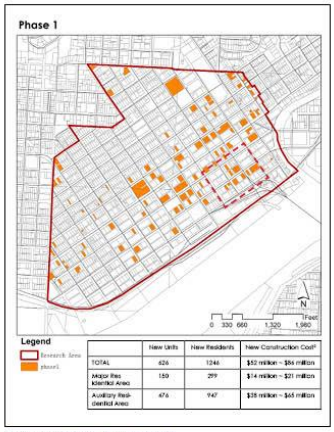


Figure 3-1 Phase 1: infill vacant parcels

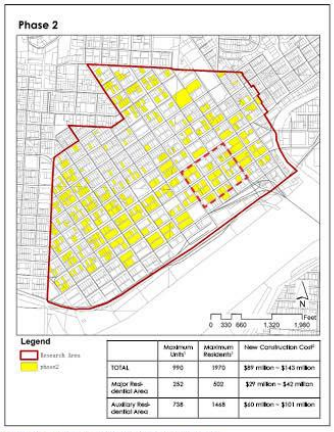


Figure 3-2 Phase 2: redevelop low-value properties

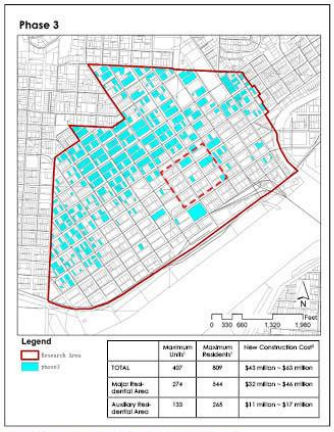


Figure 3-3Phase 3: redevelop medium-value properties

1. "Maximum Units" and "Maximum Residents" are based on maximum capacity estimation according to current zoning. But in realistic, not all these units and people will be accomodated.
2. New Construction Cost is estimated based on "National Building Cost Manual 2014", and use the medium standard in this book for calculation

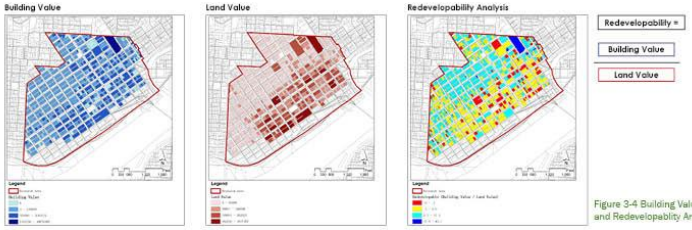


Figure 3-4 Building Value, Land Value and Redevelopability Analysis

3 COLLAGE PHASES

Research area can be redeveloped in three phases, but these phases may overlap with each other (see Figure 3-1, 3-2, 3-3). Each phases' related units, residents and new construction cost are also calculated, and they could be used for future's financial considerations.

The primary logic behind these three phases is our redevelopable analysis, which represents the ratio of building value and land value. Among all parcels, smaller ratio value means higher economically reasonable for redevelopment. (See Figure 3-4)

Figure 4-1 Current Situation

Figure 4-3 Historical Buildings
Building 1: Grand Heron
Building 2: Pearson's
Building 3: D & R Theater
Building 4: Electric Building

URBAN DESIGN STRATEGIES(1)

CURRENT SITUATION (Figure 4-1)

Nine blocks in downtown Aberdeen are designated for proposaling detailed urban design strategies. These blocks are chosen based on two reasons:

1. There are four historical buildings in this area, which can be sacred places for future's community resilience.(See Figure 4-3)

2. At the center of downtown, this area has potential to be redeveloped as a gathering place for both residents in Aberdeen and visitors from outside in the future.

By using "collage" as an urban design approach, I am going to demonstrate how redevelopment could happen in general and also how specific properties can be redeveloped or adaptively reused.

Figure 4-2 Phase 1

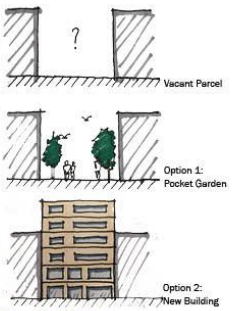


Figure 4-4 Infill Options

PHASE 1 (Figure 4-2)

This phase will primarily focus on infilling current vacant land, and there are two options for developing these land:

Option 1: Redevelop current vacant land into community's pocket garden or gathering space.

When choosing parcels for this development, we should try to make them evenly distributed in different blocks.

Option 2: Redevelop current vacant land for new mixed-use buildings, with retail, restaurant, apartment, small office and other uses.

When conducting this option, we should give higher priorities and intensity to parcels at four corners of each block. Because these parcels have higher accessibility to people on streets, and they are more important to this area's vitality in the future.

Figure 5-1 Phase 2&3

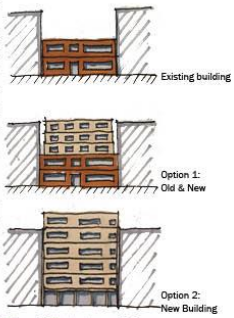


Figure 5-2 Redevelopment Options

PHASE 2 & 3 (Figure 5-1)

After vacant land being infilled, parcels with lower and medium property value will be redeveloped. There are also two options for these parcels redevelopment.

Option 1: Conserve existing buildings and intensify their structure systems, and then build new buildings with separate structures above existing buildings.

Properties with historical value or considered as sacred places to community may use this option.

Option 2: Remove existing constructions and build new mixed-use buildings.

Properties with no specific value to community may use this option for redevelopment.

Adaptive use of parking lots: Figure 5-2 and 5-3

Figure 5-2 Adaptive Use of Parking Lots: Aberdeen D&R Beer Garden

Figure 5-3 Adaprive Use of Parking Lots: Aberdeen D&R Outdoor Theater

URBAN DESIGN STRATEGIES (2)

PROPOSED ARCHITECTURE: COLLAGE BUILDING

In consistent with large and medium scale urban design, this proposed architecture design tries to collage several existing housings' characters into one integrated project.

Four housing in west aberdeen are chosen first, and we assume that these housings' owners will be relocated to a same mixed-use building in downtown. Characters of these four housings (material, stytle, windows, etc.) are picked up, and then translated into new architecture language. Finally, this new mixed-use building is designed with architecture language of those four existing housings in west Aberdeen.

This design approach could be memory or celebration of this large scale urban relocation event, and it will also help relocated residents to find their identity again.

PRECEDENTS

Silodam was designed to fulfil and reflect different users requirement in that building, which made it become such a "collage building". Medical Faculty Housing was largely a custom-made project, because users were involved into design process to form their unique housings.

Figure 6-3 Silodam, Amsterdam, by MVRDV (http://www.galinsky.com/buildings/silodam/)

Figure 6-4 Medical Faculty Housing, Belgium, by Lucien Kroll (https://www.pinterest.com/pin/290271138458984054/)

Figure 6-5 Rendering of Proposed Architecture: Collage Building

From Resort to Refuge: Uphill Relocation Possibilities | Colin Poff |

A tsunami caused by a cascadia subduction zone earthquake could potentially lead to the temporary or permanent displacement of Aberdeen residents. In such an event, the need for relocation is a given. However, thinking about relocation now can be a resilient strategy for the City of Aberdeen by meeting current needs and simultaneously preparing for relief in the immediate aftermath of a disaster, and permanent residence in the years after.

A current evacuation and gathering area north of Grays Harbor Community Hospital is one potential site that is suitable for uphill development. This section of the report illustrates the sites capacity, design concepts, and relatability to other proposed projects (such as Fry Creek daylighting and a regional nature trail network). It also discusses how the site can adapt to accommodate people in time of crisis.

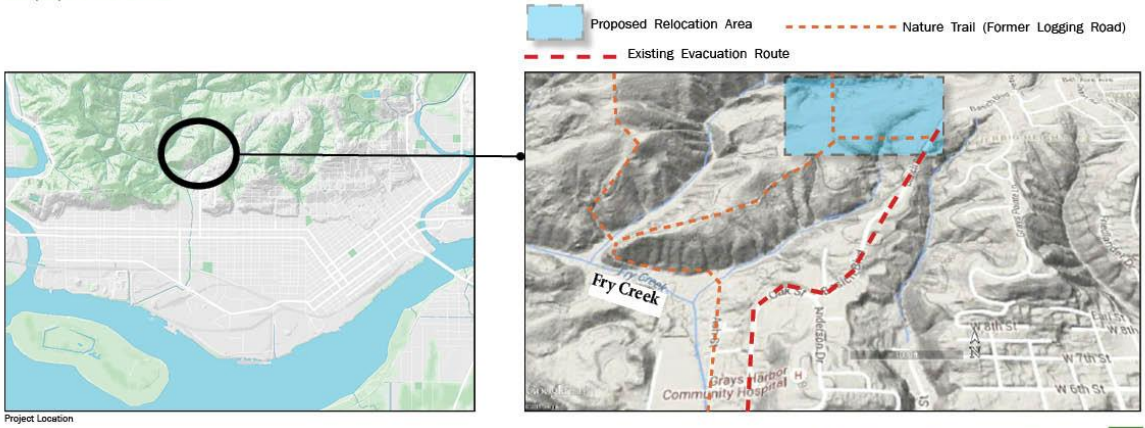
POSSIBILITIES FOR RELOCATION:

1.) Area could have capacity to assist temporarily displaced in the event of tsunami or flooding

2.) Innovative design outside of flood and tsunami prone areas could attract new investment

3.) Duplication or relocation of city infrastructure and assets would increase resiliency

4.) Careful site planning could accommodate a variety of models of near-term development, as well as adaptable enough to be a long-term resettlement option.



Project Location

SCHEMATIC DESIGN

SITE ECOLOGY: The natural conditions on the site pose some challenges, as well as opportunities. Aberdeen recieves 84 inches of rainfall every year, creating the need for storm water management strategies. The wet conditions have caused landslides in the area adjacent to the site. The site ecology diagram below shows steep slopes, which development will need to avoid. However, there is a large flat area suitable for dense building. The steep slopes are also a benefit, as they provide views of the city below, and the streams that they surround can be a public amenity, as they are secluded trails that lead to Fry Creek and the waterfront. The surrounding area is heavily wooded in parts with western hemlocks, douglas-firs and sitka spruces. Green space corridors are shown in the site ecology diagram which connect the steep ravines and streams with trails, and orients the development toward it's great natural surroundings.

PUBLIC AND PRIVATE: This diagram shows "districts" on the site. The darkest area is a central area near Basich Boulevard, and is a gateway to the site. Retail, commercial and civic uses can be clustered here to serve the site as well as the surrounding area, and would be a highly public area.

The medium shaded area mimics the green space corridor shown in the site ecology diagram. The corridor connects regional trails, public parks, and wooded areas, and acts as a public amenity and connection with some more exclusive use for residents. The lightest shade shows more private areas, but still well connected with the surrounding context, where different housing types can be located.

THE EXPERIENCE: The final diagram shows the overall experience of the site with connections, nodes, and landmarks. Vehicular circulation hierarchy is shown in black. The local and regional paths shown in red are for biking and walking and interact with open space on the site. The major node of the site would be along Basich Boulevard, where mixed use activity is the most intense, and other nodes are made up of public, and semi-public parks. Landmarks include a multi-functional building near the entrance, a municipal service building, an outdoor education center, and a view tower. Surrounding logging roads converted to bike paths, other regional interurban mountain bike trails, open space corridors, walk/biking paths mixed with public space.

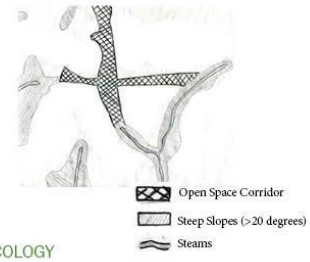
SITE PHOTOS

An old logging road cuts through the site and can be converted to a main road from Basich Boulevard

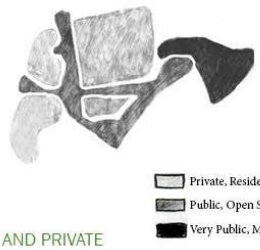
During heavy rains, swampy areas such as this can be rain gardens that utilize native vegetation and offer aesthetic benefit

This is the current state of one of Aberdeen's evacuation area, which offers very little relief and comfort in a time of crisis.

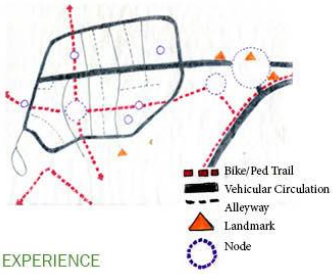
Near Basich Boulevard land is appropriate for commercial and civic uses, while the wooded areas to the west are better for residential



SITE ECOLOGY



PUBLIC AND PRIVATE



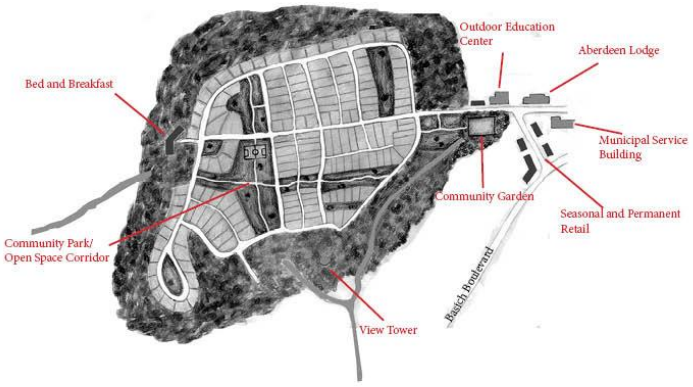
THE EXPERIENCE

NEAR-TERM DEVELOPMENT

The relocation site lends itself to many possibilities beyond just refuge. The area is a spacious, wooded location with access to recreation, close proximity to Grays Harbor Hospital, and a short trip to Aberdeen's historic downtown. In the near-term, the site could feasibly be used to attract new markets, as well as existing residents to this part of Aberdeen. There is also a strong case to be made for connecting this development with recreation, open space corridors, new commercial uses, educational services, civic buildings, and relocation of municipal services. The site plan on the right shows one conceptual build out of the relocation site. It has two main purposes: to show the full capacity of the site, and to show potential programming and amenities.

A GROWING MARKET: Most resorts in the western coast of Washington and Oregon are built on sand spits and don't experience forested landscapes and full variety of recreational opportunities that the region has to offer. The compact, new urbanist development pattern is in demand, but in short supply. An innovative design such as this can attract a new housing market in Aberdeen, that offers affordable permanent dwellings, as well as multiple options for daily and weekly rentals. The success of nearby resort communities on the coast signify a possible latent demand for innovative and coherent neighborhood development in Aberdeen. This site could be the location for new and existing residents, ecotourism, outdoor education, and more.

SITE LAYOUT: The design of this site is largely based on design precedents shown on the next page, as well as local context. It includes a variety of open space typologies, such as large community parks, semi-private shared courtyards, and an integrated open space/trail system. Long, narrow lot sizes (around 100'*40') and a grid/curvilinear hybrid street network support a walkable community with homes built to lot lines and alleyway access to parking. Design is sensitive to steep slopes, and private lots maximize views at high elevations, while a public and visible mixed use area is concentrated near Basich Boulevard.



AMENITIES FOR RESORT

- Integrated local and regional bike/walking paths as well as mountain biking trail system and bike shop.
- Community Garden
- Seasonal retail
- Views
- Public Parks with sport courts and Semi-private parks
- Bed and Breakfast
- View Tower Structure
- Aberdeen lodge w/ private event space, bistro, and rental office

PUBLIC USE OF ON-SITE AMENITIES

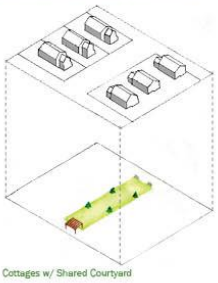
- Commercial uses near main arterial, such as community bike rental/repair shop.
- Aberdeen Lodge with multifuctional space
- Regional and local biking/pedestrian paths through open space corridors
- Outdoor education center used for school trips to promote hands on learning about Aberdeen's ecology, lumber industry history, recreation, and more
- Municipal Service Building: Fire and Police service duplicated uphill outside of inundation area. Also serves as additional storage place for emergency supplies.

DESIGN PRECEDENTS

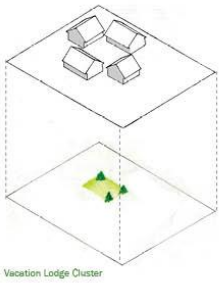
The conceptual site plan could include many possibilities. The developments described below exemplify innovative and sustainable elements that would be appropriate in an uphill relocation area in Aberdeen. These elements include their site layout, housing types, sustainable design features, open space, and overall programming. The three examples are built in a similar wet and hilly western Washington landscape. The building typologies to the right are mean to show how an area can be dense and walkable, but diverse enough to support many different preferences.

All of these examples illustrate low impact design principles. Low impact design includes techniques for storm water management, natural infrastructure, and minimizing paved surfaces to minimize flood risk while promoting sustainability. Along with that, these design features double as amenities.

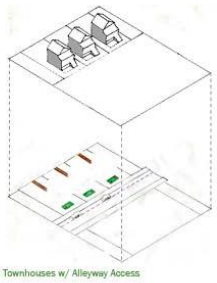
RESIDENTIAL TYPOLOGIES



Cottages w/ Shared Courtyard



Vacation Lodge Cluster



Townhouses w/ Alleyway Access

SEABROOK, WA

- A growing development only 30 miles from Aberdeen built in the new urbanist style.
- 280 privately owned homes, with half des ignated as cottage rentals.
- Resort amenities allow attract temporary and seasonal residents, but the percent age of permanent residents is expected to grow as it becomes more self sufficient.
- Dense, walkable design in a heavily wood ed, hillside environment (similar to site in Aberdeen).
- Permeable surface along streets consist ing of sea shells absorbs storm water and is a unique, attractive feature.
- Storm water is discharged into rain gar dens, or ravine behind houses.

"ISLANDWOOD," BAINBRIDGE ISLAND, WA

- 255 acre outdoor learning center to fos ter stewardship of natural environment
- Multipurpose event center houses wed dings, dining, retreats, adult education and lodging.
- Numerous sustainable features such as roof rainwater reuse, locally sourced building materials, natural ventilation, and solar power.

"DANIELSON GROVE," KIRKLAND, WA

- Lot sizes between 2,400 and 3,000 square feet.
- Clustered housing to preserve existing old growth trees and native vegetation.
- Cottage housing types surrounding shared semi-private courtyard (shown in building typology above.)

THE REFUGE

Because of previous experiences with flooding in Aberdeen, it is not difficult to imagine a scenario where the low-lying west end is covered in water. In the event of a cascadia subduction earthquake, subsidence of the land and water rushing in from a tsunami would cause long-term inundation and cause residents to be temporarily, or even permanently displaced. Because of this, a resilient strategy would include imagining the possibility for reuse of uphill development in a time of crisis. The site plan described in the previous pages does not only provide amenity, but also supports adaptive reuse. The important aspects of adaptability are in the overall *form* of the neighborhood, as well as the changing *function* of land uses and buildings. This section describes how the amenities listed on page 3 can be imagined as something different both as providing relief during a disaster, but also evolving into a stable, permanent residence in the following years.

PREPAREDNESS AND IMMEDIATE RELIEF

Uphill development can be a place for city infrastructure and services to be duplicated. This will create a better preparedness for the city as a whole to assist during a crisis, and to resume normal functions afterwards. Because this area is already on major evacuation routes, it serves as a good option for a gathering area that provides comfort and relief for evacuees. The area is flat compared to its surroundings, keeping it safe from the landslides that commonly happen in Aberdeen and would be possible during shaking. Currently existing on the site are uses that could serve during a major evacuation, such as a large cleared field exists along the Basich Boulevard, which could act as a gathering space. Nearby is Grays Harbor Community Hospital in the south that can readily provide medical assistance. To the north are water storage tanks. Important city services that are currently in inundation area could be reproduced on this site, such as fire and police services. These buildings could also provide storage of emergency supplies and food, as well as backup power sources. New uses in the development, such as a community garden, could provide a source for fresh food.

A variety of temporary housing would be needed to house displaced people, appropriate for families, the elderly, and other groups. The resort site plan shown earlier features an inn that could house many people for a short period of time. Civic buildings such as the Aberdeen lodge could also be converted into shelter, and temporary rental units would likely be vacant and available for use. Cluster housing, such as the typology shown in the last page, may be appropriate as a temporary senior center. A community workshop on February 11, 2016 elucidated the fact that a disaster could create the need for Aberdeen residents to be self-sufficient for weeks or months, so a relocation site will need to have infrastructure to support that reality. In addition to emergency supplies and services, adaptable housing creates needed safe and sanitary housing that has not been present in many post-disaster scenarios. Thoughtful site planning can encourage social interaction and perpetuate the ethic of helping neighbors that has long existed in Aberdeen.

RESETTLEMENT

The reality is that a tsunami could cause long-term displacement for many residents. The challenge would then be for facilities, services and amenities to reach a level that meets residents needs. To create a community that incorporates these needs, Aberdeen's assets and values, as well as local culture, it would take a community-driven vision. The site plan above is just one of many possible layouts, but some long term adaption strategies for this site could be translatable to a similar site. For example, what is a small commercial area in the plan, consisting of boutique, seasonal shops, could intensify into a mixed used center. In this center, local business could find support and help build the economic base needed for long term recovery. As local retailing begins to increase, and other everyday need providers are established, the percentage of permanent residents would be likely to increase. The Aberdeen lodge, which is a proposed multi-functional public building in the site plan housing private events, a bistro, and a rental office, could evolve into a fundamental civic center. Next door, the outdoor education center could incorporate its former purpose with a new use as a fully-functional school. While the site is currently programmed for a more temporary, resort community, it is well connected to the existing Aberdeen community. A series of converted logging roads provide mountain biking recreation or bike/pedestrian access to the downtown area. Open space which is primarily used by resort goers could become more public, and their immediate connection to the surrounding wooded landscape could create a strong connection to Aberdeen's existing identity.

Businessmen standing downtown during the 1933 flood. The city has a history of neighbors helping each other during times like this, and uphill development should be designed in a way to encourage and perpetuate this kind of community-based resilience. Source: Jones Photo Historical Collection

PRECEDENTS

TEMPORARY HOUSING IN JAPAN

In the wake of the 2011 earthquake and tsunami in Japan, thousands of households were left without a place to live. In some cases, temporary housing has been provided, such as the examples to the right. Unfortunately, permanent relocation plans in many of these areas have been significantly delayed, causing many to seek move away and seek new life elsewhere.

For the residents that have stayed, the new living situation has been in place for five years now. Houses are built with poor materials, and residents express that they feel little sense on independence. With little progress on relocation planning, residents are left with few housing options and few opportunities to rebuild their community.

TAHOLAH, WA RELOCATION PROJECT

Some small villages along the Washington Coast are preemptively thinking about relocation. Taholah, a village in the Quinault Reservation northwest of Aberdeen is planning a total resettlement of its 600 residents on higher ground. Breaches in the seawall (shown right) have already happened, and tribe leaders say that problems have gotten worse due to climate change.

The planning that is going into the relocation project involves much more than just safety. The people are culturally and economical dependent on the water, so the use of the uphill site, as well as the new use of the shoreline must incorporate needs of the residents. The new settlement pattern will also need to reflect Taholah's values and the ways in which people want to live and organize their society. A community-led design process has been undertaken in order to plan the uphill site in a way that keeps Taholah livable as well as resilient.

Temporary housing for Thousands of Families in Minamisanriku, Japan

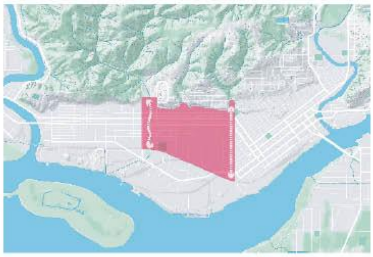
Temporary housing for evacuees of the Litate Village, Japan. Source: NPR

Seawall to protect the village of Taholah, WA from storm surges.

CONCLUSION

The National Oceanic and Atmospheric Administration (NOAA) describes the resilience process in 5 steps: Identify the problem, determine liabilities, investigate options, evaluate risks and costs, and take action. However, resiliency planning in Aberdeen offers an opportunity think more creatively and holistically than what is offered in that process, and this is exemplified throughout the proposals in this report. The relocation possibilities identified in this section present not just the potential to make Aberdeen safer, but to add vitality as well. The conceptual site plan illustrates new development patterns that can attract existing residents, as well as new markets. The site can programming benefits the public as a whole, and can make Aberdeen more resilient by offering outdoor education programs, and relocation of municipal services. Finally, the site is adaptable to fit the needs of immediately displaced residents in the immediate aftermath of a crisis, and to evolve into a permanent, resilient and sustainable development in the long term.

A community-driven vision for the future should include consideration of uphill development. Out of the inundation area, it offers potential for redundancy of infrastructure and services, new uses that connect people with Aberdeen's wooded landscape, innovative new development patterns, and self-sufficiency in the event of a disaster.



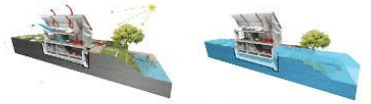
Area of focus and related projects. The focused area is West Aberdeen, where residents suffer from innudation casued by regualar flooding and possible subsidence. The related projects are Fry Creek wetland restoration on the west, and Division Street levee.

Looking south from Willow St. Rethinking a neighborhood that lives with water. The view of floating houses, jetties, 101 bridge.

Living with Water:
Flood-Accommodating Neighborhood Design for West Aberdeen | Jialing Liu |

"Living with water" tells the story of the relationship between human and water in West Aberdeen. It represents the history of economic boom related to activities on water. It represents the attitude toward disasters related to weather, water, and geological movements. It represents the actions taken to deal with the impact and losses. It also represents innovations of the neighborhood form and the way of life. This project is focused on flood-accommodating neighborhood design for West Aberdeen. It is a strategy providing multiple built environment solutions to better deal with everyday emergency of flooding, the risk of major CSZ earthquake and tsunami, and the new normal that would change the landscape and lifestyle of West Aberdeen. Based on research, analysis, and case studies, a series of interventions are selected that are adaptive to West Aberdeen in different phases. By taking smaller-scale and incremental actions that are individually related in the near future, West Aberdeen are able to be better equipped for everyday emergency and get positive feedback from the improvement of the neighborhood. As a result, there will be more investments on larger-scale and radical changes. Residents will be more confident to prepare for earthquake and tsunami event, rethink the neighborhood form and lifestyle, or even rebuild the neighborhood where it has always been for economic opportunity.

Assets and threats of West Aberdeen



Rethinking building technology: UK's first amphibious home on banks of the Thames
http://www.wired.co.uk/news/archive/2012-02/15/the-uks-first-amphibious-house

Rethinking public space design: floodabal park in Copenhagen
http://tredjenatur.dk/portfolio/enghaveparken-her-og-nu/

Rethinking form of neighborhood and lifestyle: floating neighborhood in Amsterdam
http://www.rohmer.nl/en/project/waterwoningen-ijburg/

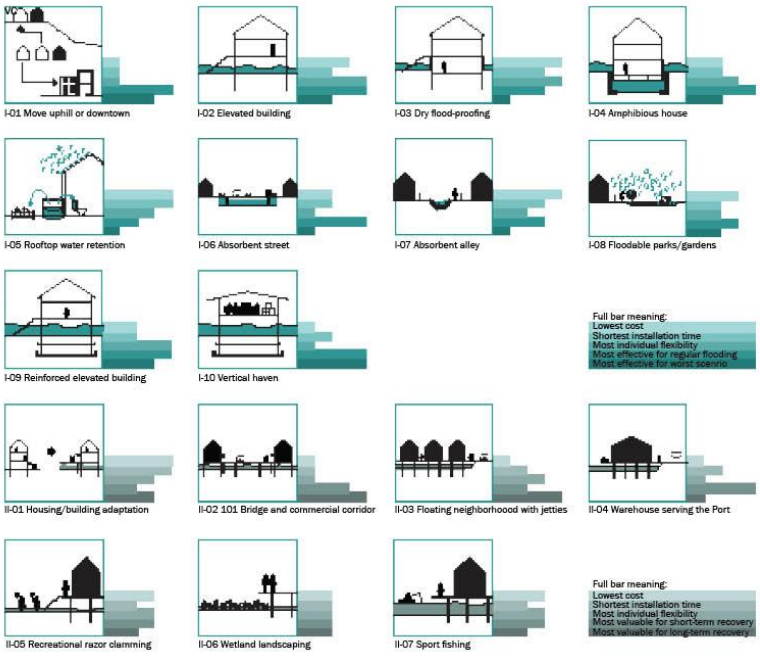
VULNERABILITY AND THREATS

West Aberdeen sits on the low and plain lands and suffer from flooding annually caused by heavy storm in the rain season. The inundated area can be up to 5-6 feet under water, leading to great private and public property losses. Moreover, because of subsidence after a CSA earthquake, it is 80% possible that the area will be inundated during high tide. The depth of water ranges from 3-10 feet depending on the magnitude of the earthquake. However, houses, streets, and public spaces in West Aberdeen are not fully designed to face all these everyday and future risks: regular flooding, earthquake, tsunami, and subsidence.

ASSETS AND OPPORTUNITIES

West Aberdeen is home to over 1200 households and many hearted places, such as local businesses, parks, schools, and churches. These places are mostly clustered along 101, while single-family homes spread south to the Port. The residents are no strangers to flooding. They have helped each other out and cleaned up after yet another storm. There is great opportunity for West Aberdeen to recall their optimistic spirit and rethink how their neighborhood can adapt to future changes through self-generated actions. Moreover, some flood-proofing projects will alleviate flood insurance burden, leading to opportunity to reinvest the neighborhood.

Self-generated neighborhood flood-accommodating actions in the 1933 flood in Aberdeen, showing the genetic and shared optimism toward "living with water". Resiliency is part of Aberdeen resident's nature. Photo courtesy: Polson Museum
http://www.graysharbortalk.com/2015/01/22/flood-history-grays-harbor/



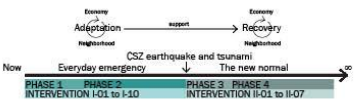
I-01 to I-10: Illustration and evaluation of interventions for everyday resistance to regular flooding
II-01 TO II-07:Illustration and evaluation of iInterventions for recovery to new normal after worstcase scenario

INTERVENTIONS AND PHASES

Flood-accommodating neighborhood design is a strategy to better prepare for the everyday emergency of flooding, the risk of major earthquake and tsunami, and the new normal that would change the landscape and lifestyle of West Aberdeen. The general concept is that by adapting to more regular and familiar disaster scenario, residents may start to provide support and redesign their neighborhood, so that there is opportunity to recover from disasters in the future. For now and the future, the actions taken should benefit the built environment improvement and social relationships enhancement of the neighborhood, and be feasible and promising economic-wise.

Based on research and case studies, a series of interventions are selected. These interventions are adaptable to West Aberdeen either in a short term or long term. The main focus is on the built environment improvement, but with evaluations on the $cost, time spent, flexibility, and effectiveness. The 17 interventions are grouped into two, serving respectively the adaptation to everyday emergency and the recovery to the new normal.

The timeline of flood-accommodating neighborhood design is divided in to four phases. Phase 1 & 2 show how West Aberdeen can gradually adapt to a neighborhood better prepared for regular flooding, what might the neighborhood be like if certain interventions are applied where suitable. Phase 3 & 4 show how the landscape of West Aberdeen will change, and how it may recover from disaster based on the assets from previous phases.



Conceptual model and timeline for adaptation and recovery phases and interventions

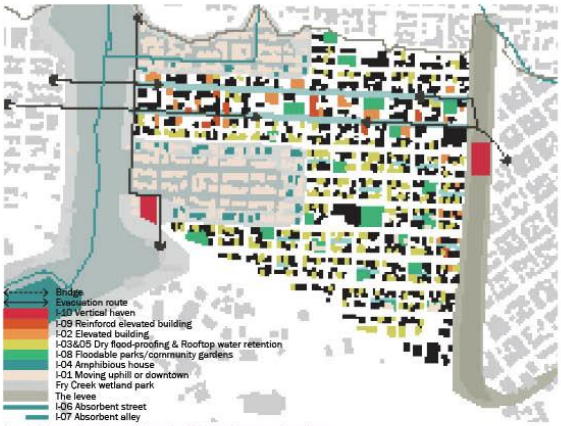
PHASE 1: Short-term adaptation to regular flooding adn future risks

In this phase, the Fry Creek wetland restoration project and the Division Street levee project have started. There are bridges connecting east-west traffic. Vertical evacuation facilities (I-10) will be built adjacent to the projects. Investments to elevate buildings (I-02) or build new elevated buildings are encouraged along the 101 commercial corridor and the levee. The buildings can have mixed uses (retail, office, or parking on the first floor, with living spaces above) and use waterproof materials and furniture on the first floor. For other part of West Aberdeen, residents may choose to abandon their properties with compensation and move to uphill and downtown area (I-01). The vacant lands can be acquired by public sectors to build floodable parks or gardens for local agriculture (I-08). For residents who decide to stay, small-scale and incremental interventions can be adopted to their property to adapt to regular floods, such as rooftop water retention (I-05) and dry flood-proofing (I-03).

Phase 1 Map: major projects and housing & built environment adaptations

PHASE 2: Long-term adaptation to regular flooding and future risks

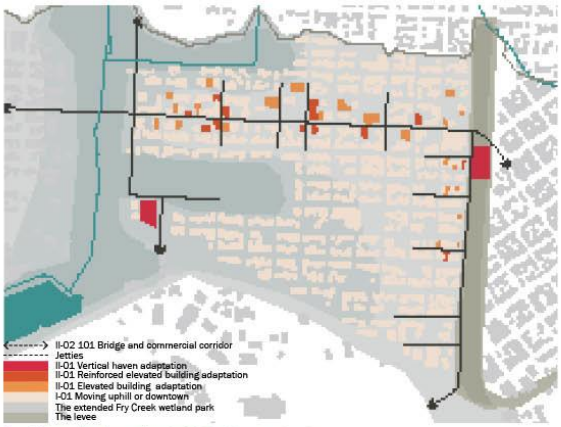
Interventions adopted in Phase 1 are still applicable in Phase 2. The bridge connecting east-west traffic on 101 will be extended to better prepare for regular floods. More houses will be adapted into elevated houses (I-02), or even reinforced ones (I-09) that can survive earthquake shaking and tsunami waves when people have enough money and confident to invest. Meanwhile, more houses will adopt the incremental changes to their properties (I-03 and I-05). In addition, emphasis can be placed on redesigning streets into stormwater retention infrastructures (I-06). The alley system in West Aberdeen can be turned into green infrastructures as well (I-07). Compared to phase 1, the Fry Creek estuarial wetland will expand to achieve better performance in stormwater management. As a result, more residents will be moving out of West Aberdeen. If residents living within the wetland area do not want to move, they can rebuild their houses into amphibious ones (I-04).



Phase 2 Map: major projects and housing & built environment adaptations

PHASE 3: Short-term recovery responding to major CSZ earthquake

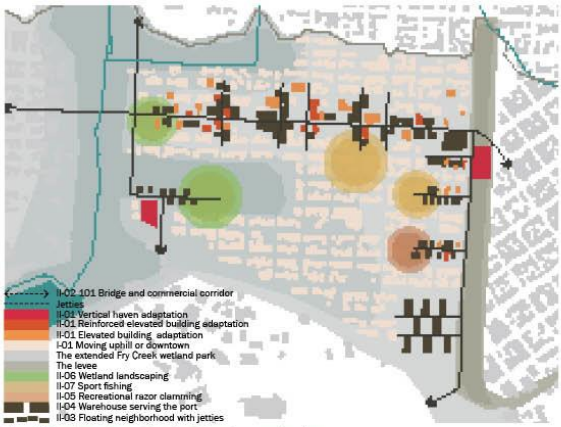
After a major CSZ earthquake and tsunami have stricken West Aberdeen, the most possible scenario is that most buildings are destroyed and will be in water for most time of the day because of subsidence. Residents may choose to move to uphill and downtown areas (I-01). However, the vertical evacuation facilities and buildings that are elevated or reinforced will survive. The survived buildings can be adapted to new uses (II-01), leaving first floor vacant because there be water most of the time. In Phase 3, the bridge on 101 can be extended to connect downtown and Hoquiam (II-02). Based on this bridge, by moving first floor businesses to the bridge level (II-01), the 101 commercial corridor can be brought to life in the long run. New bridge can also be built based on the evacuation route. Jetties can be built as well to connect survived buildings to bridges and the levee, or in places that are identified as potential area for economic recovery.



Phase 3 Map: major projects and housing & built environment adaptations

Phase 4: Long-term recovery to new normal

This a long-term recovery process that will not only involve rebuilding of the physical environment, but also that of social networks and economic vitality. The survived and adapted buildings (II-01), and the bridges and jetties (II-02) provide opportunities to rebuild neighborhood and social relationship with a different form. The new water-based developments can incorporate several forms of living with the water, such as floating houses, amphibious houses, and houses that stand free of the water on mounds, levee or other waterside situations (II-03). Based on the floating neighborhood, there can be opportunities of economic recovery utilizing the new geography and landscape for tourism. The new neighborhood can provide accommodation for tourists coming for leisure, sport fishing and recreational razor clamming (II-06, II-07, II-08). Besides tourism, there can be water-based light industry development adjacent to the Port (II-04).



Phase 4 Map: major projects and housing & built environment adaptations

Vision of Phase 2 and Phase 4: How different interventions can be applied and how the urban landscape may change.

FEASIBILITY

The images to the left show the evolvement of urban landscaping and how different interventions can be applied to site. However, they are not deterministic images of future West Aberdeen, but one alternative as a result of certain choices made by individuals and the community. There are more questions to ask before taking actions. The interventions should be further evaluated by cost-benefit analysis, availability of technology, and community discussion. There also should be analysis on how these implementations would need adjustment of code and plan. It should also be taken into consideration what policies would encourage such self-generated improvement by the residents, and if there is funding resourcesV available. The purpose of these analysis and consideration is to find out the low hanging fruits that are more acceptable and cost less to implement. Moreover, for the other interventions, under what circumstances will they be feasible to implement.

The scenario of regular flooding is more familiar to West Aberdeen residents, while how a CSZ earthquake and tsunami would change the neighborhood is unknown. By dealing with the worst case scenario, residents can start to imaging what if it is possible to rebuild West Aberdeen on the water. "Living with water" provides one possible vision where the relationship between water and the neighborhood is reconciled, and where there is opportunity of economic recovery. However, this is not the only vision that is possible. By asking more questions about the future, there will be more thinking about what are the existing assets and how to create more assets to support the future.

Appendix B- Workshop Materials

Coastal Resilience Workshop Flyer

COASTAL RESILIENCE WORKSHOP

CITY OF ABERDEEN
COMMUNITY DEVELOPMENT
AND
THE UNIVERSITY OF WASHINGTON

FEB 11, 2016
6 PM TO 9 PM
ROTTERY LOG PAVILION

COMMUNITY OUT REACH MEETING WITH ABERDEEN STAKEHOLDERS, LOCAL OFFICIALS, BUSINESS OWNERS AND RESIDENTS

MAKE A DIFFERENCE

JOIN US FOR A WORKSHOP CREATING A PLAN.....

RSVP : RENEE REYNOLDS - rreynolds@aberdeenwa.gov

The staff and students of URBDP 508 B (Advanced Planning Studio) taught by Associate Professor Daniel Abramson at the University of Washington will facilitate a 3-hour ommunityoutreach meeting with stakeholders, local officials and residents of Aberdeen Washington, to discuss and map community assets and values, and scenarios of Cascadia Subduction Zone (CSZ) earthquake and tsunami hazards, to inform Aberdeen's planning for resilience and conducting research on new methods of conducting such planning. Community resilience is the capacity of the community to maintain function after a shock or disturbance. State and county emergency managers are interested to know how local communities can use new models of earthquake and tsunami hazards for immediate life safety as well as long-term land use planning. Students will use the information generated in the meeting to inform their own attempts at design and policy strategy which they will present to community leaders at the end of the quarter.

The point of contact between the students and staff of the UW studio is the City of Aberdeen's Director of Community Development, Lisa Scott. In consultation with UW faculty, Lisa reached out to stakeholders, city council and community members to invite them to participate.

The community meeting will be organized into small-group discussions, allowing comparison of how stakeholders approach hazard mitigation and resilience in community

WORKSHOP SCHEDULE

• • •

6:30 TO 7:00

ROUND TABLE DISCUSSION

PIZZA PROVIDED DURING SMALL GROUP DISCUSSIONS

• • •

7:OO TO 7:30

ROUND 2 DISCUSSION

• • •

7:30 TO 8:00

ROUND 3 DISCUSSION

• • •

8:00 TO 8:05

BREAK

• • •

8:05 TO 8:40

REPORT BACK AND FULL GROUP DISCUSSION

• • •

8:40 TO 8:50

PARTICIPANT QUESTIONNAIRE

• • •

8:50 TO 9:00

PARTICIPANT FEEDBACK

M9 Mapping Workshop Syllabus

UW M9 Project Student Workshop: Mapping Hazard Information with uncertainties
September 1-September 4, 2015

Data Science Studio, Physics Astronomy Tower, 6th Floor, University of Washington Seattle

UW M9 Project (NSF Grant 1331412)

Lead instructors: D. Abramson, A. Bostrom, F. González , R. LeVeque

Background: This workshop for M9 graduate students is part of an NSF-funded research project (M9) on Cascadia subduction zone (CSZ) events and related hazards. The vision of the M9 project is to reduce the catastrophic potential of a CSZ Magnitude 9 (M9) event through integrated research advances in prediction, warning and adaptive planning across the social, built and natural environments. Specifically, M9 research aims to advance hazard sciences by moving away from generalized scenarios toward probabilistic predictions of M9 seismic events and the subsequent hazards, with the objective of integrating these into community resilience planning and advancing the state of earthquake early warning systems. M9 Cascadia earthquakes provide an integrative focus for interdisciplinary hazards and risk research that is relevant to a broad range of hazards and extreme events. This interdisciplinary endeavor also informs the structure of the workshop, which builds on the disciplinary expertise of the students to support team problem solving.

The workshop aims to begin to engage M9 graduate students in interdisciplinary research relevant for the development of maps for community planning that convey probabilistic hazard information. The workshop will include an introduction to the development of probabilistic models of tsunami and other earthquake-related hazards, and to scientific methods of testing the applicability of those models and their products to the development of maps for planning for community resilience. Maps of tsunami inundation zones are already an important element of community emergency preparedness and response planning. However, these maps are simplified, deterministic representations of hazards that are best understood scientifically as non-linear, probabilistic phenomena that are inherently uncertain in their outcomes. Risk analysts and scientists have begun developing Probabilistic Tsunami Hazard Assessment (PTHA), which from a geoscience perspective will support the production of more complete, transparent, and thus honest and useful maps and other hazard representations, but there is little to no evidence regarding whether PTHA products—i.e. probabilistic representations—are ready for operational applications. To date there has been little empirical study of how different stakeholders—e.g. emergency managers, planners, the public at large, or even scientists from different disciplines—might understand and use representations of probabilities and uncertainties in various kinds of hazard maps, especially for rare events such as tsunamis. For more frequent events (e.g., storms or icing) some research shows that communicating uncertainty information visually can reduce the quality of decisions, while other research suggests that conveying uncertainty information can be helpful for decision-making. This workshop will contribute to the small body of research on the effects of representing probability and uncertainty information in maps, especially for tsunami hazards.

Goals: The immediate goals of the workshop are to:

a. Introduce students to research on the representation and interpretation of probability and uncertainty information on maps
b. Teach the students basic PTHA concepts that are needed to develop candidate hazard maps that represent uncertainty,
c. Explore different ways of representing probability and uncertainty information about tsunami hazards on maps,
d. Develop and pilot test a format for testing these candidate maps in other situations, for example in community planning meetings.

Ultimately, the goal is to derive deeper insight on how to communicate the best scientific knowledge (including probability and uncertainty information) so that communities can better plan for hazardous events. While "best" and "better" are moving targets, we will proceed on the assumption that individuals and groups need to be able to make decisions and act on information they have now, even as they know that the best information will change, and that the specifics of some phenomena are inherently unpredictable. Part of our goal, therefore, is to enhance public understanding of the evolutionary nature of hazards science,

and to foster a higher level of trust in scientific knowledge and comfort with probabilities and uncertainty that can improve decision-making.

Activities: M9 faculty and M9 stakeholders (including state officials John Schelling and Tim Walsh) will contribute short lectures and be available for Q&A. The purpose of this workshop will be to provide a transdisciplinary educational and research experience for the M9 students, in which they will, as a team:

- Develop candidate probabilistic tsunami hazard maps
- Design experiments to assess the utility of the candidate maps
- Conduct an initial evaluation of the candidate hazard maps.

Workshop Agenda

***Prior to workshop**: Please familiarize yourselves with the Gonzalez et al. Crescent City report sections, and the National Tsunami Hazard Mitigation Program guidance document on evacuation mapping before the workshop.*

Day 1, September 1st (4 hours) 10am to 2pm, including lunch and teamwork

- 10am to 10:30am: Introductions, workshop overview, purpose and goals. (John Vidale, all)
- 10:30am to 11:15am: Existing tsunami hazard maps, how maps are produced and used. What would you like to see in the next generation of hazard maps? (Tim Walsh, John Schelling)
- 11:15am to 12pm: Overview and summary of PTHA: Crescent City results and different kinds of maps (Randy, Loyce, Frank)
- 12pm to 12:10pm: Break
- 12:10pm to 12:45pm: Discussion over lunch (lunch will be brought in) of current and future maps of tsunami hazard risk
- 12:45pm-2pm: Hands-on notebook work (Randy), Tsunami modeling issues; map construction (Randy, Frank)

Teamwork: Read *MacEachren et al. 2012, Joslyn and LeClerc 2013, Bostrom et al. 2008 and Tanaka et al. 2009* for the September 2nd session. If you have time, the additional papers will be helpful as well. For each paper, please identify a couple of you to take the lead on preparing questions and discussion points.

Day 2, September 2nd (2.5 hours) 10am to 12:30pm, followed by lunch (brought in) and teamwork

- 10am to 10:30am: Map design, designing evaluations of risk communications – criteria, candidate experimental and survey designs (Ann)
- 10:30am to 11am: Community context, effects of de-emphasizing boundaries (Dan)
- 11am to 11:30am: Representation of uncertainty in decision making under uncertainty (Susan Joslyn)
- 11:30am to 12pm: Visualizing risk and uncertainty (Jessica Hullman)
- 12pm to 12:15pm: Break
- 12:15pm to 1pm: Lunch discussion of ideas for map representations of risk and uncertainty, including MacEachren's paper, different approaches and possible future products: Vulnerability maps, diverse types of risk maps.

1pm to 2pm Teamwork: Discuss additional readings, design three candidate maps and propose a map evaluation scheme (Gould Hall or Data Science Studio) [Faculty will prepare this session by discussing some map production approaches and providing materials]

Day 3 September 3rd (including lunch, which will be brought in)

- Teamwork to develop maps

Teamwork: develop and refine candidate maps, conduct and analyze preliminary evaluation (possibly as an online voluntary exercise for M9 project members and others at UW)

Day 4 September 4th (2 hours*) Note earlier start and finish: 9am to 11am closing session*

- Team presentation of proposed mapping approaches, proposed evaluation scheme and results of any preliminary evaluation
- Discussants: Michael Lindell and Ian Miller
- Discussion of follow-up (all) and adjourn

Readings

To access the readings, go to https://catalyst.uw.edu/gopost/conversation/abramson/891681/post/3163485#3163485

*(*recommended optional reading)* Abramson, D., L. Manzo and J. Hou. "From Ethnic Enclave to Multi-ethnic Translocal Community: Constructed Identities and Urban Design in Seattle's Chinatown-International District," *Journal of Architectural and Planning Research*, Vol. 23, No. 4 (Winter 2006): 341-360. (*Read this article specifically to understand some implications of mapped boundaries for community planning; key point is in the 4th full paragraph on p.354; just skim the rest of the article.)*

Bostrom, A., L. Anselin, and J. Farris. "Visualizing Seismic Risk and Uncertainty." *Annals of the New York Academy of Sciences* 1128, no. 1 (2008): 29-40.

Freitag, R. C., D. B. Abramson, M. Chalana, and M. Dixon. "Whole Community Resilience: An Asset-Based Approach to Enhancing Adaptive Capacity before a Disruption." *Journal of the American Planning Association* 80, no. 4 (2014/10/02 2014): 324-35.

Gonzalez, Frank I. , Randall J. LeVeque, Loyce M. Adams, Chris Goldfinger, George R. Priest, and Kelin Wang. **Probabilistic Tsunami Hazard Assessment (PTHA) for Crescent City, CA.** Final Report (2014-09), available at https://digital.lib.washington.edu/researchworks/handle/1773/25916 Sections 2, 3.3, 4, 7.6.0-7.6.3, 8.0, 9.0, 10.0, Appendices A and E.

Joslyn, Susan, and Jared LeClerc. "Decisions with uncertainty: the glass half full." *Current Directions in Psychological Science* 22, no. 4 (2013): 308-315.

Leveque, Randall, Jupyter notebooks. **PLEASE NOTE**: We plan to use SageMathCloud (SMC) to simplify doing some computing and plotting during the workshop, and to make it easy to distribute some files to everyone. You can create a free account on this cloud computing platform at: https://cloud.sagemath.com It only takes a minute to create an account. If you do this and want to be added to the group who will receive materials, please email this info to Professor Leveque (rjl@uw.edu) before the workshop. He can then add you as a "student". This means a new "project" will appear on your SMC account with the relevant files. Projects are simply virtual machines running linux that you can log into and do anything you'd do on other linux machines, but more easily and through any web browser. For more info, see https://cloud.sagemath.com/help.

MacEachren, A. M., R. E. Roth, J. O'Brien, B. Li, D. Swingley, and M. Gahegan. "Visual Semiotics & Uncertainty Visualization: An Empirical Study." *Visualization and Computer Graphics, IEEE Transactions on* 18, no. 12 (2012): 2496-505.

National Tsunami Hazard Mitigation Program guidance document on evacuation brochures. **Please familiarize yourselves with this material before the workshop:** http://nws.weather.gov/nthmp/documents/NTHMPTsunamiEvacuationMappingGuidelines.pdf

*(*recommended optional reading)* Pang, Alex. "Visualizing uncertainty in natural hazards." In Bostrom A., French S. and Gottlieb S. (eds), *Risk Assessment, Modeling and Decision Support*, pp. 261-294. Springer Berlin Heidelberg, 2008.

*(*recommended optional reading)* Severtson, D. J. and Myers, J. D. (2013), The Influence of Uncertain Map Features on Risk Beliefs and Perceived Ambiguity for Maps of Modeled Cancer Risk from Air Pollution. Risk Analysis, 33: 818–837. doi: 10.1111/j.1539-6924.2012.01893.x

*(*recommended optional reading)* Steinitz, Carl. *A framework for geodesign: Changing geography by design*. esri, 2012. For the May 2015 GeoDesign workshop with Carl Steinitz and Tim Nyerges, with some video from the workshop, see: http://depts.washington.edu/pgist/node/32

Tanaka, T, D. B. Abramson, and Y. Yamazaki. "Using GIS in Community Design Charrettes: Lessons from a Japan-U.S. Collaboration in Earthquake Recovery and Mitigation Planning for Kobe." *Habitat International* 33, no. 4 (October 2009): 310-18

*(*recommended optional reading)* Thompson, Mary Anne, Jan M. Lindsay, and J. C. Gaillard. "The influence of probabilistic volcanic hazard map properties on hazard communication." *Journal of Applied Volcanology* 4, no. 1 (2015): 1-24.

Participants, including guest speakers:

UW graduate students working with M9 faculty
Alicia Ahn
Peter Dunn
Michael Greenfield
Alex Grant
Nasser Marafi
Jacob Ortega-Gingrich
Johnny Paige
Donsub Rim
Ian Stone
Mika Thompson
Andrew Winter

UW Postdoctoral researchers
Brittany Fiore-Gartland
Erin Wirth Moriarty

UW Faculty and Researchers
Dan Abramson
Loyce Adams
Cecilia Aragon
Ann Bostrom
Frank Gonzalez
Jessica Hullman
Susan Joslyn
Randall Leveque
Michael Lindell
John Vidale

Washington State Department of Natural Resources
Recep (Ray) Cakir
Tim Walsh

Washington Emergency Management Division
John Schelling

Washington Sea Grant
Ian Miller

Protocol for Aberdeen Community Meeting

Draft Protocol for Aberdeen Community Meeting: February 11th 2016

On Thursday February 11th 2016 the staff and students of URBDP 508 B (Advanced Planning Studio) taught by Associate Professor Daniel Abramson at the University of Washington will facilitate a 3-hour community outreach meeting with stakeholders, local officials and residents of Aberdeen Washington, to discuss and map community assets and values, and scenarios of Cascadia Subduction Zone (CSZ) earthquake and tsunami hazards, to inform Aberdeen's planning for resilience and conducting research on new methods of conducting such planning. Community resilience is the capacity of the community to maintain function after a shock or disturbance. State and county emergency managers are interested to know how local communities can use new models of earthquake and tsunami hazards for immediate life safety as well as long-term land use planning. Students will use the information generated in the meeting to inform their own attempts at design and policy strategy which they will present to community leaders at the end of the quarter.

The point of contact between the students and staff of the UW studio is the City of Aberdeen's Director of Community Development, Lisa Scott. In consultation with UW faculty, Lisa reached out to stakeholders, city council and community members through mailings and face-to-face interactions to invite them to participate. The 24-32 participants are attending of their own accord and have expressed interest to be a part of these planning efforts, and comprise a diverse group of stakeholders representing different perspectives on the community. Some of the participants will hold elected positions, including the mayor and up to 12 members of the city council; local government staff from the school district, hospital, police and fire departments, and municipal water and sewage; business and community leaders including representatives of the Aberdeen Revitalization Movement, the Port of Grays Harbor, and the Aberdeen Historical Seaport Society; and independent residents and business owners.

The community meeting will be organized into small-group discussions, allowing comparison of how stakeholders approach hazard mitigation and resilience in community planning, depending on whether they are working with a single, deterministically represented scenario of tsunami hazard as opposed to a set of probabilistic scenarios, and also whether they are beginning their conversation with a consideration of community assets and values (sources of quality of life), or with a consideration of vulnerability and risk. Dependent variables of particular interest are the extent to which these different combinations of discussion conditions prompt participants to: (1) list more or fewer types of assets and values as important to community resilience; (2) imagine strategies that are either more risk-taking or more precautionary (i.e. involving multiple back-up plans, redundancy in the systems they would put in place, etc.); and (3) take positions that either reflect particular individual

interests with respect to the hazard, or reflect a desire for consensus among all community members.

Participating stakeholders will join one of four small groups, A, B, C and D, each to work with a different combination of these types of information and discussion sequences, as shown in the diagram below.

SEQUENCE: HAZARD MAP REPRESENTATION TYPE:	**Begin conversation by describing, mapping and listing sources of quality of life, before discussing hazard and vulnerability**	**Begin conversation by describing, mapping and listing hazard and vulnerability before discussing quality of life**
Deterministic (e.g. single scenario with a sharply bounded hazard area)	Group A - list more/fewer	Group C
Probabilistic (e.g. multiple scenarios associated with different probabilities, represented by variously shaded areas)	Group B	Group D

Each group will sit at its own table and be assisted by four UW students: 1 group dynamics facilitator; 1 mapping facilitator; and 2 observer note-takers. Group dynamics facilitators will be responsible primarily for keeping conversation flowing, within time, and on topic, and all participants in each group have opportunities to speak. Mapping facilitators will ensure that as many items mentioned by participants that have spatial/locational properties are mapped. Student observers will take notes with quotes from participants and observations regarding how and how often they talk about assets and values, risk, precaution and hazard, consensus or agreement versus their own differing or independent position, and expressions of uncertainty (with reference to coding scheme). Student observers will also note participants' facial expressions, focus, and affect/emotion.

The meeting will consist of two or three rounds of discussion, depending on the different sequences outlined above, according to the draft agenda below:

6:00-6:30	**Introduction** by Lisa Scott and UW lead faculty Dan Abramson, outlining the background and objectives of the meeting as described in the first paragraph above. The introduction will be neutral with respect to the different kinds and

<table>
<tr><td></td><td colspan="2">sequence of information being used by the different groups. Participants grab pizza, and form into the four groups. (They will be pre-assigned, so that each group has a balanced number of elected officials, municipal staff with some expertise in emergency management, and other community stakeholders.)</td></tr>
<tr><td>6:30-7:00</td><td colspan="2">Round 1 Discussion</td></tr>
<tr><td></td><td>In the first 5 minutes, student facilitators present to Groups A and B a brief definition of “quality of life" based on the Millennium Ecosystem Assessment, and explain the distinction between the goods and services necessary for quality of life (basic material, health, security, and good social relations), and the local providers of those goods and services.

Groups A and B discuss three questions:

(1) What generally makes Aberdeen a good place to live?

(2) “What specific goods and services contribute to quality of life in general?”

(3) “What/who specifically in Aberdeen provides those goods and services?”

To the extent these providers can be mapped, participants or student note-takers will mark them on maps. Non-mappable providers will just be listed on a chart. Facilitators encourage participants to be broad and inclusive in listing these providers, considering built, natural and socio-economic, but avoid</td><td>In the first 5 minutes, student facilitators present to Groups C and D a definition of “hazard”, “vulnerability” and “risk”, and a summary explanation of CSZ hazards facing the community, shown on maps (deterministic for Group C and probabilistic for Group D), and supplemented by analysis using FEMA’s HAZUS software and local data from the existing hazard mitigation plan.

Groups C and D discuss three questions:

(1) “What would happen in Aberdeen during and after a CSZ earthquake and tsunami?”

(2) “What/who in Aberdeen would be at risk during a CSZ earthquake and tsunami?”

(3) “How would a CSZ earthquake and tsunami affect quality of life (as defined by basic material, health, security and good social relations) in Aberdeen?

To the extent that at-risk items (people and things) in Aberdeen can be mapped, participants or student note-takers will mark them on maps. Non-mappable risks will just be listed on a chart. For the last five minutes of the round, stakeholders select the 3-5 most important at-risk items.</td></tr>
</table>

	suggesting specific possible answers. For the last five minutes, stakeholders select the 3-5 most important providers.	
7:00-7:30	**Round 2 Discussion**	
	In the first 5 minutes, student facilitators present to Groups A and B a definition of "hazard", "vulnerability" and "risk", and a summary explanation of CSZ hazards facing the community, shown on maps (deterministic for Group C and probabilistic for Group D), and supplemented by analysis using FEMA's HAZUS software and local data from the existing hazard mitigation plan.	In the first 5 minutes, student facilitators present to Groups C and D a brief definition of "quality of life" based on the Millennium Ecosystem Assessment, and explain the distinction between the goods and services necessary for quality of life (basic material, health, security, and good social relations), and the local providers of those goods and services.
	Groups A and B discuss "Immediately after a CSZ event, what/who would provide the goods and services you identified in the first round as contributing to quality of life? Which of the providers identified in Round 1 will be able or unable to withstand changes inflicted by the hazard, and which will enable the community to maintain its viability and identity through the changes?"	Groups C and D discuss "Immediately after a CSZ event, what/who would provide the goods and services you need for quality of life? In addition to the providers identified in Round 1, what other providers will be able to withstand changes inflicted by the hazard, and which will enable the community to maintain its viability and identity through the changes?"
	As above, student facilitators list participants' answers to this question on a chart, and map as many items as can be mapped. Participants are free to add any new goods and services to the initial list.	As above, student facilitators list participants' answers to this question on a chart, and map as many items as can be mapped. Participants are free to add any new goods and services to the initial list.

7:30-8:00	**Round 3 Discussion** All groups (separately) discuss "In the months and years following a CSZ event, what/who from round 1 (column 2) and round 2 (column 3) provides the goods and services that would do ALL of the following: (1) best help the community adapt to the "new normal" and recover over the long term; (2) put the community in better position should another disruption occur; and (3) provide a better quality of life."
8:00-8:05	**Break**
8:05-8:40	**Report Back and Full Group Discussion** Each group then elects a spokesperson to summarize for the whole gathering the results his/her group's discussions in each round. The UW faculty explains to the whole gathering the different types of information and sequences of discussion each group worked with, and the rationale for dividing the activities in that way. The whole gathering then reflects on what was learned.
8:40-8:50	Students set up easels with posters of preliminarily researched potential design and policy strategies, while community participants fill out a questionnaire with questions as listed below.
8:50-9:00	Community participants' give feedback on posters by writing on post-it notes.
9:00-10:00	Community participants adjourn. Students stay to write up field notes on their group discussions, and go through their notes to clarify them.

Please answer the Questions below using a 1 to 7 scale (1= not at all to 7= extremely). Provide further explanation where necessary.

1) How concerned are you about a Cascadia Subduction Zone earthquake and tsunami risk?

2) Did your concern about the CSZ and tsunami risk change after viewing the map[s]? In what way?

3) How much do you trust the information on the map[s] provided? Please explain.

4) What is your level of confidence in the accuracy of the map[s]?

Please select which of the two maps below you prefer and briefly explain your choice.

Community Exercise Sheet:

Asset-based

<table>
<tr><th colspan="2">Round 1</th><th>Round 2</th><th colspan="2">Round 3</th></tr>
<tr><td colspan="2">Warm-up question: What generally makes Aberdeen a good place to live?
List below: What specific goods and services contribute to your quality of life? What/who provides these goods and services in Aberdeen?
Prompt: Think about all the goods and services necessary for quality of life: include various types of basic materials (food, etc.), health, security, and social relations -- whatever is important to the community and its members.
(a) List goods and services in column 1.
(b) List providers in column 2. (Feel free to draw lines connecting goods and services to providers.) Save five minutes at the end to circle the 3-5 most important providers.</td><td>In the hours and days after a Cascadia Subduction Zone (CSZ) event -- What / Who provides the goods and services you listed in Round 1, Column 1?
Prompt: Which of the providers identified in Round 1 will withstand the changes inflicted by the hazard and continue to function? If any of those providers cannot withstand the hazard, what other things/people/places might take their place and provide the goods and services needed for community members to survive?
List providers in column 3.</td><td colspan="2">In the months and years following a CSZ event, what/who (from columns 2 and 3, as well as any new strategies you can envision) provides the goods and services that would do ALL of the following:
• best help the community adapt to the "new normal" and recover over the long term,
• put the community in a better position should another disruption occur, and
• provide a better quality of life.
(a) List providers in column 4.
(b) Include any other ideas about possible actions to take in column 5.</td></tr>
<tr><td>Column 1</td><td>Column 2</td><td>Column 3</td><td>Column 4</td><td>Column 5</td></tr>
<tr><td>Goods and Services</td><td>Providers</td><td>Post-Event Providers</td><td>"New Normal" Providers</td><td>"Parking Lot"</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Vulnerability-Based

<table>
<tr><th colspan="2">Round 1</th><th>Round 2</th><th colspan="2">Round 3</th></tr>
<tr><td colspan="2">Warm-up question: What would happen in Aberdeen during a Cascadia Subduction Zone (CSZ) event? List below: What/who in Aberdeen would be vulnerable to impacts of a CSZ event? What/who would not be vulnerable?
Prompt. Think about all the sources or providers of goods and services necessary for quality of life in Aberdeen; include various types of basic materials (food, etc.), health, security, and social relations -- whatever is important to the community and its members.
(a) List the providers that would likely not withstand the changes inflicted by the hazard in column 1.
(b) List the providers that would likely withstand the changes inflicted by the hazard in column 2.
Save five minutes at the end to circle the 3-5 most important providers in each column.</td><td><u>In the hours and days after</u> a Cascadia Subduction Zone (CSZ) event -- What / Who provides the goods and services that are at risk?
Prompt: How would the community replace the goods and services whose sources are vulnerable (identified in Round 1, Column 1)? What new or alternative providers of basic material, health, security and good social relations would be available? (These could be items from Column 2, or entirely new items.)
List providers in column 3.</td><td colspan="2">In the months and years following a CSZ event, what/who (from columns 2 and 3, as well as any new strategies you can envision) provides the goods and services that would do ALL of the following:
• best help the community adapt to the "new normal" and recover over the long term,
• put the community in a better position should another disruption occur, and
• provide a better quality of life.
(a) List providers in column 4.
(b) Include any other ideas about possible actions to take in column 5.</td></tr>
<tr><td>Column 1
Vulnerable</td><td>Column 2
Providers</td><td>Column 3
Post-Event Providers</td><td>Column 4
New Normal Providers</td><td>Column 5
"Parking Lot"</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Note Taker Theme & Guide for Feb 11th Workshop

Notetaker Guide for Aberdeen Meeting
February 11th 2016

As the note takers you are tasked with the job of capturing meaningful dialogue to obtain insight into how the community of Aberdeen uses earthquake and tsunami models for safety and long-term land use planning. You're focus throughout the meeting will be the participants' responses to the questions, body language and facial inflections indicating personal feelings (disagreement, discomfort, animated) and whether or not the participants converse with one another.

One of the first things you will note is which of the groups you are assigned during the meeting (A, B, C or D). In the table below I have identified the themes that you will be listening for throughout the discussion in the far left column. Examples of the keywords and phrases that you might hear are listed in the far right column as taken from our first visit to Aberdeen.

Theme	What You're looking for	Phrase/keyword
Risk/Disaster/ Hazard	Reference to Flooding/Earthquake/Damage	"If it happens..." "The Wishkah always floods."
Uncertainty	Aspects of event that are unknown	"They don't even know what will happen" "It's impossible to know what will happen"
Probability	The chance or likelihood that something will happen	"Likely", "unlikely",
Recovery/ Resilience	Positive references to actions or state of community after the storm	"After an earthquake.." "strong social networks" "we wouldn't make it without…"
Loss	Destruction of social/built/natural capital	"destroyed" "damaged" "lose" "finished" "loss"
Assets	The providers/sources of goods/services that contribute to Quality of Life	"The port provides us with.." "Aberdeen Revitalization Movement is a great organization"
Values	What people consider important; what they consider to be a good life	"Strong community" "Family/neighborly ties" "wildlife…"
Preparation	reference to plans in the case of an event/disaster	"If it happens I will.." "evacuation route"

Precaution	Measures that take risk into account and avoid it	“I wouldn’t live there…” “This would be good in case of…”
Trust	belief or disbelief in the contents of the maps or questioning of source credibility	“How do they know this will happen?” “Where did they get this information?”
Truth		
Vulnerable	Reference to helplessness or vulnerable aspects of the community in the instance of an event	“if the bridge goes out we will be on our own” “we are an island”

It will be helpful to organize your notes into separate columns (seen below) as well as also having a blank sheet handy for scratch notes that do not fit within the columns. Your notes should be broken up by rounds so that you will be able to tell the context the phrases were mentioned within without having to take the time to write it out. I want you to use a format that it most comfortable for you as the pace will be very fast. I have provided different ways that you can organize your notes but using some kind of table format will be the easiest. Notice how I try to keep rows separated by who said what and how they said it making sure not to line up phrases with someone else’s body language or vice versa. Doing this will make typing up your notes later much easier as you will better recall how the conversation flowed. The participants will be given codes to protect their identity but it would be helpful if you are able to note who is saying what and how they are saying it (are they talking about the bridges in a negative way? Do they mention the waterfront as a positive asset?). Using a simple (+) or (-) symbol is an easy way to record this. The numbers in parenthesis in the second table below are examples of how you might link responses with a stakeholder without the use of names.

What was said?	How? (body language)	Did they talk with each other?
we are not a producing area, we are a consuming area (=) "Everyone gathers at the community center every week to check in" (+) A lot of people cannot access the upper region (-) "Don't you think that would be the best route to take?" (+) "We have the highest fundraising pop/capita" (+)	Crossed Arms Shaking Head (-) → Nodding in Agreement →	Side talk with neighbor Another person agrees Looking to neighbor Looking around table for consensus

You could also forgo the columns and use free style on blank paper to record using a system such as:

What was said? Who said it? (Participants coded by group and number, e.g. A3)	**Did they talk to someone else at the table?**
A1 → "The hospital is protected on the hill" (+) D3 → "we would be an island" (-) All -->silence B2/C4 → "bridges" (-)	A1/C6 private convo / crossed arms, everyone responds with a nod in agreement frowning/shaking head

Appendix C- Survey Materials

Aberdeen Community Meeting: February 11th 2016
Post Meeting Questionnaire

Please circle which discussion group you belonged to: A B C D

Please answer the Questions below using a 1 to 7 scale (1= not at all to 7= extremely) and providing further explanation where necessary.

1. How concerned were you before this workshop about the Cascadia Subduction Zone earthquake and tsunami risk? (please circle one)

   1 2 3 4 5 6 7

2. How concerned about the Cascadia Subduction Zone earthquake and tsunami risk are you now? (please circle one)

   1 2 3 4 5 6 7

Do you have any comments about how your concern about the CSZ and tsunami risk changed after viewing the hazard maps?

3. Please consider the main tsunami hazard map your group used in the workshop discussion; what is your level of confidence in the accuracy of the hazard maps (please circle one, where 1 is least confident and 7 is most confident)?

   1 2 3 4 5 6 7

Appendix D- Result Tables

Each of the Participants responses was separated according to a pre-determined set of themes to determine if different topics were discussed in the Asset-based groups versus the Hazard-based Groups. A snap shot of a larger table is separated along the theme and groups. Each page will display the Asset-based responses compared to the hazard-based responses.

A-B- Risk/Disaster

		Group A	Group B
Risk/Disaster/Hazard	Round 1		
	Round 2		
	Round 3		

H-B-Risk/Disaster

		Group C	Group D
Risk/Disaster/Hazard	Round 1	"I've heard the low area would be flooded--my house is right about there 30 ft above--so i think im safe." "If the ground shifts and we have the liquefaction--there are no services."	
	Round 2		"I think we've all seen models that are worst than what you're showing us. When i talk to the public I try to stay away from the tsunami and talk more about the earthquake dangers." "Right after the eq everyone will be going to high ground--regroup--then determine what you're going to shut down--close valves and save water has to be manually done at the tank. I dont believe this will be done the first day--aftershocks will be a problem so they will hold people back until they are sure."
	Round 3		

A-B-Uncertainty

Uncertainty	Round 1		"But there are questions about the landslides and whether the hospital will survive."
	Round 2	"What if the town is built on fill--the entire area-- a lot of woodside fill and then timber fill. [showing the shaking map] how do they know that one dot is different from another?" "I dont know that [about electricity]--the BPA lines come from north- nut sure about the redundancy."	"We don't have anything on the hill. Refers to Japan and relocation of villages on hills. " Idk if we have that ability but it should be looked at and considered" "I need a reference point to envision where the water will be after an earthquake" "Idk how you plan for it. Doing the best we can until state and federal assets come in. All of our main utilities is in the inundation area." "what happens when they get up? There is nothing up there. It will have to rely on neighbors helping neighbors"
	Round 3		"So the new normal is that underwater at high tide? If I were going to say "I'm going to rebuild, is that possible?" "Access is going to be a huge issue for us. Are they going to take precedence on I-5? Where do we fall in? Would FEMA say we are not going to help you rebuild?" "Looking at Japan--large concrete sea walls- maybe that's a solution for us but if the ground is going to drop is that a feasible solution? That's a question to all of you."

H-B-Uncertainty

Uncertainty	Round 1		
	Round 2	"How big of an event?" "Like a 9.0?" "It's interesting because you can go to a half a dozen different agencies and get a half a dozen different answers"	"The port is one of the main economic drivers for the county--if we lose that "do they turn the lights back on?" "why would they?"
	Round 3	"Whoever the president is would have to declare a national emergency right?" "I want to know the statistics of people who live and/or work in Aberdeen because a lot of people who work here do not live here. How do we deal with those non-residents?" "An event will affect everything from here to Olympia so when you talk about what to do afterwards, that's pretty hard to figure out because it is a regional issue."	

A-B- Probability

Probability	Round 1		
	Round 2	"All of our services in the inundation zone. Water treatment is north, it may stay intact but I do not know that."	"So if it's dark purple it is over your head? (yeah) huh.. I'm glad I live up here [points to map]" "The fire station will probably not exist." "The main [electrical] line comes in from Central park and Cosmopolis. We might have some electrical options."
	Round 3		"Let's say some of this remains, people might try to remain because there is dwelling there so we will have to think of how to service these people." "If the medical survives it would be the key to repopulating. If we lose it that would be the final blow."

H-B-Probability

Probability	Round 1		"The PUD main office, their gear may be in the higher ground [according to this map]." "Chances are [hospital] it could come down in an event or extreme raining." "The logging roads may be a way out once the bridges are gones which would lead up north. Some of them will not be accessible." "Water storage tanks--newer steel tanks--could possibly be a source of water after."
	Round 2		"[shown shaking map HAZUS] all this data is +/- 30% could be more could be less." "The weather will play a role (winter)" "Churchers possibly [for refuge], but they are all old brick buildings (according to the shaking map it will probably be heavily damaged)." "The railroad will be damaged--there is a lot of debate about the Port and how much of it will survive."
	Round 3		

A-B- Recovery

Recovery	Round 1		
	Round 2	We can restart, build a town square.	
	Round 3	"New infrastructure at the port is new and should be seismically sound. Businesses and amenities will be what brings back the citizens." "All existing infrastructure will not cease to exists. We are a deep water shipping port closest to the pacific rim, it will come back for that."	"Is it an opportunity to start over [for us]? Build earthquake resistant structures, vertical evacuation center, make everything shiny and new." "You could say it's a rebirth. We have significant fire issues in older houses with shotty electrical work." "Central PArk might become the new center in GH. It has room for growth. It is actually one of the sites that we are looking at for the new transfer station…that may be the new Aberdeen."

H-B-Recovery

Recovery	Round 1		"The public works area--that will be important in recovery."
	Round 2		"Area north of town is undeveloped. Housing development has lots set aside but none of it has been developed yet bc the economy is horrible here. It is all really nice, really usable property." "But it there is nothing left it falls back on industry and maybe there will be residential for the workers." "They do not have the continuity to rebuild. If we lose part of it, just like in NOLA, and they did not have a plan the government can just come and take it. If Aberdeen has a plan than maybe it will come back." "Dam 20 miles out of town--if you cant restore water--wont have a community.
	Round 3	"These are state highways so the state would have to be involved in rebuilding some of the infrastructure." "I could see the port rebuilding" "[the question is] "would you rebuild in the same location? If I lost my buildings in and earthquake Im not sure I'd rebuild them."	"I think they need better codes for where and what to build. Buildings should be more structurally sound."

A-B- Resilience

Resilience	Round 1		
	Round 2		
	Round 3		"There is a sense of resiliency. People step forward--volunteers with ARM--The city of
			Aberdeen is bare bones, down to essential services. Volunteers make a difference in the
			Town."
			"[After the floods in 2016] we don't have vacant homes because we act at a local level

H-B- Resilience & Loss

Resilience	Round 1		
	Round 2		"Economic resilience because of the port and industries"
	Round 3		
Loss	Round 1		
	Round 2		
	Round 3	"These are state highways so the state would have to be involved in rebuilding some of the infrastructure."	

A-B- Loss & Asset/Values

Loss	Round 1		
	Round 2		
	Round 3		
Assets/Values	Round 1	"[what makes aberdeen a good place to live] Cheap (inexpensive), Flat, lot's of water access to the coast. Small town feel but it's the biggest in the country, could own a bigger house for cheaper, good quality amenities (food, water, activities). Trails, kayaking, canoeing, healthcare hub, city own safety and security	"Economic driver--got the city life but also the recreational life" "Quiet, Smaller city--less traffic--great place to retire The outdoors--great resources" "Medical Hub for the area" "Great Port--Infrastructure"
	Round 2		
	Round 3		"There is a sense of resiliency--there is a lot of pride in the town. Volunteers make a difference in the town and people notice it." "There is a sense of resiliency--there is a lot of pride in the town. Volunteers make a difference in the town and people notice it."

H-B- Asset/Value

Assets/Values	Round 1		
	Round 2		
	Round 3		

A-B- Preparation

Preparation	Round 1		
	Round 2	"Chances are we will be on our own for a bit of time. Need to take time to educate people to get to higher ground." "Survival kits for employees so that they can take care of themselves to help other people." "St. Joesph may serve as an alternative hospital. Sam Benn park is an evacuation zone.	"We have learned from the experts--Aberdeen is not going to exist We will be trapped--End of day's events can really turn people off How can you plan when the outlook is very bleak? West port and Ocean Shores will be Gone." "We are a tsunami and stormready prepared city." "Im curious to know if we did a random poll if the citizens would be aware--how do you
		College may serve as a triage center."	get the word out?"
	Round 3		

H-B- Preparation

Preparation	Round 1	"I think The high school is elevated 20-30 feet and could provide an evacuation location The hospital is in a safe area--that would be an okay spot there." "If you showed them this map everyone would agree that the hospital would be the gathering place for any kind of service." "East campus--and Sam Benn park--that is an evacuation route so that could be an option."	"Around the tsunami assembly area. Looking at buying a filter plant, there is a lake and creek that runs through that could serve as drinking water." "Assembly area next to the hospital might not be the best place to go--trying to get people to think of going higher."
	Round 2		"Talked about utilizing Sam Benn park with canvas tents and food storage but if that is not in metal containers then animals will get to it."
	Round 3	"Satsop park--The army has a plan for a big event and Satsop would be where the base is located."	"Supplies are coming from other states. The military have plans to drop resources to certain areas but it will not be enough. People need to prepare for 7-10 days of Self-sufficiency." "The residents might have an issue with believing that they could survive whatever happens because of how they have survived in the past through flooding and storms."

A-B- Precaution & Trust

Precaution	Round 1		
	Round 2		"We are moving our operations out, replacement transformers, trying to consider where to put things that make the most sense. Once they're gone we wont have anything left." "Everyone needs to have a 3-day kit, or more like 7-14 day kit, because much of it will be a matter of self-reliance. Because there is no way that city services can support 16,000 people."
	Round 3		"We do have a plan for moving infrastructure. Long term plan is to move the main operation service center out of Aberdeen."
Trust	Round 1		
	Round 2		"We were told you will not be able to move over the bridges or get to I-5.You have to assume all the relief efforts will go to population centers first and then us, maybe a month or so later."
	Round 3		

H-B- Precaution & Loss

Precaution	Round 1	"If we have some sort of catastrophic event the only way we can get to the hospital is over the hill."	"GH is looking at staging equipment out of inundation zone on high ground. Public works has a concrete building for generators, vehicles and any kind of rescue equipment we dont use everyday. They will hopefully be available during/after a disaster."
	Round 2		"The departments have been trying to consider how to get equipment to a location it will actually be usable but for now almost all of it is in the low lying areas."
	Round 3		
Trust	Round 1		
	Round 2		
	Round 3		

A-B- Vulnerability

Vulnerability	Round 1		
	Round 2	"Vehicles (ambulances) are in the inundation zone." "We'd cease to exist." We would lose everything, there are a few places that do not show up on our critical areas map."	"If ships are tied up at the terminal those could all be sitting in downtown Aberdeen."
	Round 3		

H-B- Vulnerability

Vulnerability	Round 1	"Pretty much everything would be vulnerable . All of our businesses and services are within this red area, the port is within this red area Every food source, every grocery store, is within this red area." "Bridges are key to getting out, otherwise isolated" "There is no alternative that don't exist within that red" "[The city is] Unique--aren't many ways in and out" "Unless the hospital starts stockpiling food and water we don't have options"	"Treatment plant is definitely in the inundation zone." "[there is some likelihood it will not, does that give you confidence?] This whole area is low elevation--this whole are use to be tidelands--sawdust and fill. We've got the worst soil in the state." "The three grocery stores are all in the inundation zone." "The bridges are vulnerable to collapse, the one that spins on it centers is no longer usable." "There will be a lot of isolated regions that will not be able to have access to emergency rescue. There will be no electricity or refrigeration." "Hospital on top of hill--chances are it could come down in an event or extreme rain." "There is no evacuation route if they do not have a bridge. The bluffs always come down and will most likely during an event." "Concrete covered reservoir--with shaking they would be gone."
	Round 2		"there is a fair amount of the town that will have mild damage due to shaking." "Each subsequent wave will be worst for the infrastructure." "[what are some options for providing things after?] Nothing outside the inundation zone--everything is in the same core area." "Most likely if the event happens outside of work hours many workers won't be there--won't be able to access the town." "There is a lot of methanol in the port area and if it spills you are looking at a toxic disaster and potential for fires."
	Round 3		"The rail line is really old--we've had some derailments and the bridge will be gone. It currently is not as stable as it could be." "No cops, no fire, no city hall, no roads, no gas, no bridges--you're stuck." "Less than 10% of than work force lives in Aberdeen." "At night time it will be black-- if you can see where to go uphill that will be an issue for survival."

MacEachren Typologies (2005)

The following table outlines the nine typologies adapted from MacEachren (2005) which are discussed in the methodology section. Any response during the workshop that pertained specifically to the information of this map was organized into this table. The colors designate different groups: red, asset-based, deterministic information, green designates asset-based, probabilistic information, gold is Hazard-based Deterministic and purple is hazard-based, probabilistic. An extra row was added at the bottom to include a response mentioning the WeTable technology specifically.

Accuracy/Error	Survey Response- Group D	"I think it will be much worse that your map predicted many areas your map shows as minimally impacted are areas of poor soils and low elevations"
	Asset-Based, Deterministic	"What of the town is built on fill--the entire area--a lot of woodside fill--and then timber fill Showing the shaking map--questions "how do they know that one dot is different from another?"
	Hazard-Based, Deterministic	"Is this liquidation or liquefaction" --> no, no, just the inundation zone --> "Oh, inundation, okay"
	Hazard-Based, Deterministic	"This must be an old map because it does not show any of the port infrastructure in here."
Precision	Asset-Based, Probabilistic	"if we put in a dike...maybe thats a solution for us but if the ground is going to drop is that a feasible solution? Thats a question to all of you"
	Asset-Based, Probabilistic	"Higher ground--dont know what kind of earthquake damage they might have" "So the new normal map--does that mean that that's underwater at high tide?"
	Hazard-Based, Probabilistic	"There is a fair amount of the town that will have mild damage due to shaking All this data is +/- 30%--could be more could be less"
	Hazard-Based, Probabilistic	"So these areas are 100% inundation zones and these areas are not?" "Is that based on elevations or how the wave moves up the channel?"
	Hazard-Based, Deterministic	"What's the elevation at this point? Above sea level?" [shows the DEM layer] "So this is 11-9, is that what is represents"
	Hazard-Based, Deterministic	"I dont think it would affect the high school' → do you think it would withstand a tsunami Wave?" "I think The high school is elevated 20-30 feet and could provide an evacuation location"
Completeness	Survey Responses- Group B	impact a CSZ would/could have on Aberdeen. The exercise was very beneficial due to the probabilistic mapping showing the scientific modeling for subsidence and inundation.
	Asset-Based, Probabilistic	"So if it's dark purple it is over your head→ huh…(some laughter)"
	Hazard-Based, Deterministic	"How big of an event?" "Like a 9.0?"
	Hazard-Based, Deterministic	"I want to know the statistics of people who live and/or work in Aberdeen because a lot of

		people who work here do not live here. How do we deal with those non-residents?”
	Hazard-Based, Deterministic	“Would this area be affected or are you not considering that?” --we didnt consider that
	Hazard-Based, Deterministic	“How big of an event is this predicated on? Like a 9.0? Thats the figures Ive heard”
	Hazard-Based, Deterministic	“So if this does happen we’re talking a, what, 1 in 300 year event?” “So like, what’s the risk?” "so that would get into a whole planning thing. Develop plans that you can create areas where basic necessities could be distributed”
Consistency		
	Asset-Based, Probabilistic	“We’ve done a lot of outreach--we are a tsunami and stormready prepared city, we bring it up.Im curious to know if we did a random poll if the citizens would be aware--”how do you get the word out?”
	Hazard-Based, Deterministic	“An event will affect everything from here to Olympia so when you talk about what to do afterwards, that's pretty hard to figure out because it is a regional issue.”
Lineage	Hazard-Based, Deterministic	“Centered on this landscape here, in the event of an earthquake this size, will affect everything here to Olympia. It’s a regional issue and will be hard to figure out what to happen next.”
Currency	Hazard-Based, Deterministic	“The weather will play a role (winter time)” “Most likely if the event happens outside of work hours many workers won't be there--won’t be able to access the town.”
Crediability	Survey Response-Group A	“I believe the maps are accurate based on the BAS and from what we have learned from world disasters Subjectivity Interrelatedness”
	Asset-Based, Probabilistic	“So if i were going to say “im going to fill and rebuild, is that possible?” I would say most of town is 1 ft underwater.”
	Hazard_Based, Probabilistic	“there is a lot of debate about the Port and how much of it will survive”
Subjectivity	Hazard-Based, Deterministic	“It’s interesting because you can go to a half a dozen different agencies and get a half a dozen different answers”
Interrelatedness		
Use of WeTable	Asset-Based, Probabilistic	“Were we supposed to stay inside one area or if it’s on the map it’s fair game? --”it’s fair game” ”this map isn’t static, if you want to talk about the Wishkah we can go there. This is just the general framework but we want to talk about your community (whatever that entails)