

Relocation and Resilience: Exploring Co-Benefits in Aberdeen, WA

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Abstract

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The field of planning typically focuses on preparing for the expected, but does not pay enough attention to uncertain and extreme events that have the potential to reconfigure communities. I focus this thesis on Aberdeen, WA, where a tsunami triggered by a Cascadia Subduction Zone Earthquake could cause the permanent displacement of thousands of residents. I present a relocation concept as a resilience strategy. This concept includes short-term development opportunities on a site that can also adapt for temporary relief and permanent resettlement in the event of a tsunami. Although there are not many relocation precedents, I comparatively study Taholah, WA and La Push, WA; two indigenous communities on the Washington coast that have plans to relocate entirely. I argue that relocation is more than just a long-term disaster preparedness strategy, but rather should include near-term opportunities and reflect community values and needs.

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Chapter 1: Introduction

Planners tend to forecast for the expected, but uncertain events have the potential to reconfigure communities. This thesis focuses on Aberdeen, WA, a community planning for the unpredictable event of a tsunami triggered by a Cascadia Subduction Zone Earthquake. Scientific models show the possibility of subsidence and inundation extreme enough to cause the displacement of thousands of people from coastal areas of Northern California to British Columbia (Witter, et al., 2013). With the uncertain nature of planning for this extreme event, traditional hazard mitigation strategies may not be sufficient to prepare, or flexible enough to explore a full range of adaptive strategies. In this thesis, I propose a concept for relocation on higher ground as a resilient hazard mitigation solution. This includes near-term development prospects, the relocation of services, infrastructure and other assets, the use of the area as a refuge during a tsunami event, and long-term resettlement possibilities.

1.1 Problem Statement and Research Questions

A tsunami is a rare and unpredictable event, but still requires proactive planning. While my strategy is about planning under these uncertain conditions, the topic of relocation generally applies to the more predictable trend of permanent displacement due to climate change. Because of the increasing likelihood of rising sea levels, stronger storms, lower water supplies, and harsher droughts, planners now must think of how to plan for people displaced by climate related events. As many as 50 to 200 million people could be displaced in the 35 years, according to the United Nations University Institute for Environment and Human Security. Recently, the Department of Housing and Urban Development set a precedent by providing a \$48 million grant for Isle de Jean Charles, Louisiana, which is threatened by rising sea levels and consistent flooding (“Resettling the First ‘Climate Refugees’”, 2016). While the cost of relocating people before an event is very high, the cost of relief after an event is arguably much higher. Joyce Phillips, Senior Planner at the Washington State Department of Commerce stated that “proactive planning is often more effective and less costly than reactive planning, and it can also provide co-benefits, while we are preparing for the future” (Peacock, Planetizen Courses, 2013). In this thesis, I will explore the co-benefits of a proactive relocation plan in Aberdeen, WA.

In the past, resilience strategies have typically been focused on identifying hazards and taking steps to reduce them, often in the form of technological fixes. I approach relocation as an alternative resilience strategy, although in my research I found little precedent cases to draw from. This thesis

attempts to contribute to the planning field, by exploring how relocation might be a strategy for resilience, which will become increasingly relevant due to the predicted displacement of coastal communities in the coming decades. The more narrow focus of this thesis can be summarized in the following research questions:

- How can relocation planning reconcile long-term solutions (to uncertain future problems) with short-term needs and constraints?
- How can local, especially site-scale, context and community engagement inform a relocation design and strategy?

The first question involves a dilemma of relocation planning for most communities. That is, that often the cost of preemptively relocating people, services, or infrastructure far outweighs the perceived risk. I suggest that there are ways to coordinate long-term relocation possibilities with short-term opportunities. Short-term and long-term factors include not only reducing vulnerability to the tsunami hazard, but various economic, social and institutional factors as well (Ingram, Rio, & Khazai, 2006). The second question involves another unanswered question, of how relocation programs and designs can be appropriate and context sensitive. Relocation involves new development patterns, and new programming. I suggest that a well-crafted community-design process and context-driven design principles should inform a successful relocation strategy. I also suggest that relocation plans can be leveraged to uncover new economic opportunities and community functions. Answers to these questions will come from study of literature and precedent cases, as well as from the application of those lessons in the context of a relocation plan in Aberdeen.

1.2 Thesis Outline

This introductory chapter presents a problem which has not yet been solved, and will be explored through subsequent study of literature, cases, design precedents, and application in Aberdeen.

In Chapter 2 I establish a basis of intellectual thought about resilience as well as how it should be practiced. In this chapter, I present some defining characteristics of resilience, highlight different strategies, and discuss how the concept has developed over time. The chapter discusses urban design theory and ecological thinking, and how those fields are connected with resilience. Lastly, it discusses theory in community-design, and how it might enhance and legitimize resilience planning.

In Chapter 3 I introduce examples of relocation, beginning with the temporary relocation of people displaced by the 2011 tsunami in Japan. The crux of this chapter, however, is a discussion of a few examples of preemptive relocation plans. These examples come from indigenous coastal communities, such as Newtok, Alaska, Taholah, WA and La Push, WA. Taholah and La Push are especially relevant, as they are in the same geographical region as Aberdeen, and face the same existential threat of a tsunami. Beyond that, they are already experiencing more frequent storm surges, flooding, and coastal erosion. In these case studies, I describe the communities' plan to move, the process that went into designing the new settlement site, and the approaches that are transferable to Aberdeen.

In Chapter 4 I discuss relevant design concepts, such as Low Impact Development and other site planning principles that make sense for a resilient, sustainable development in the highlands of Aberdeen. I illustrate these principles in precedent examples, which includes site layout, building types, and site programming under similar conditions. They are also mostly within the same region, and suggest possibilities for a new market in Aberdeen, and the overall feasibility of the plan in the near-term.

In Chapter 5 I present one long-term adaptation strategy in Aberdeen, which I have called "resort-to-refuge." I discuss near-term development possibilities – specifically the development of a hilltop community of recreation resort facilities and housing - and the adaptability of that development to a disaster relief scenario, as well as the long-term relocation of permanently displaced residents. This work draws off an 11-week urban design and planning studio conducted by the University of Washington, which held a workshop with community members in Aberdeen to plan for a tsunami hazard, and creatively find solutions that reflect community values and needs. The purpose of this chapter is to combine the preceding theory, case studies and design precedents and apply that onto an untested site.

In Chapter 6 I discuss findings of the thesis. This includes a discussion of how all of the material relates, the transferability of the resort-to-refuge approach, and answers to research questions established in this chapter. It will also discuss the limitations of the project, and opportunities for additional research.

1.2.1 Methodology

The literature review section includes information found from relevant authors, as well as reports published by agencies such as NOAA and FEMA. Much of the information about case studies and design precedents had to be uncovered through popular articles. To get a more nuanced and relevant body of knowledge from case studies of Taholah and La Push, I conducted interviews with the planning directors for each of those projects, and made a site visit to Taholah. The interviews were conducted over the phone in the form of informal discussions as well as pre-determined questions. For additional inspiration for this thesis, interviews were held with members of the community in Aberdeen; Tillamook County, Oregon; Seabrook, WA, and other planning professionals involved with resilience planning.

In Aberdeen, some of the information used was collected through studio work done by the University of Washington. This includes a site inventory, review of planning documents, and a workshop held with community members on February 11, 2016. The workshop was conducted using a participatory mapping software called WeTable that allowed community members to identify assets and service providers. I conducted the initial design studies for this thesis as part of my contribution to the studio.

1.3 Limitations

This scope of this project was large and there was limited time to fully develop all of its facets. For my case studies, some data were unavailable. Much of the information for case studies had to come from newspaper articles, since it was not possible to conduct primary research for most of the information, or visit all of the case sites in person. Aberdeen itself is more than a two-hour drive from Seattle, and all the other reference sites considerably farther. These cases are also still in their conceptual phase, putting limits of how they can be evaluated. For work in Aberdeen, I carried out my research on relocation planning and design in the context of a broader studio on the multiple adaptive urban design strategies for earthquake and tsunami hazards, and to fulfill requirements of the Certificate in Urban Design as well as Master of Urban Planning degree. This thesis therefore focuses primarily on site development typology and design. With limited time and access to the site, I was unable to conduct a comprehensive site analysis, nor conduct a development feasibility study of the proposals. There was also a range of considerations for relocation that I did not consider in my conceptual work, such as issues with property rights, funding and implementation. The asset-based community design process that was undertaken in Aberdeen is important step toward a relocation

strategy, but is limited since it was not directly focused on relocation. However, the work in this thesis seeks to answer important questions regarding resilience and relocation, and is a starting point for more detailed subsequent research.

Chapter 2: Literature Review

The term resilience has only recently become a vogue word in planning dialogues. For coastal communities who are facing existential threats due to climate change or natural disasters, agencies are employing various approaches to resilience through hazard mitigation and disaster planning. There is no one model specific to resilience planning that can be universally applied. Still, the literature on the topic continues to grow and nuance the frameworks surrounding it. I review literature in this chapter intending to show the progression of hazard mitigation and resilience theory into an increasingly broader scope.

The topic of this thesis is relocation and resilience, yet I was unable to find theory that directly discussed the two together. However, I argue that a relocation strategy in Aberdeen should be informed by theory surrounding resilience to be most effective. Moreover, there is a strong urban design component of a relocation strategy, and in this section, I outline the connection between urban design and resilience. Lastly, I have included theory on community design, as any relocation strategy must include locally inspired design. In this section, I talk about how a community design process can encourage people to think optimistically and creatively when planning for a disaster.

2.1 Hazard Mitigation

Reported natural disasters have steadily increased in recent decades, with average annual losses in the U.S at around 30 billion (Peacock, Planetizen Courses, 2013). While the profession of planning continues to refer to disasters as acute, natural phenomena, it could be argued that they are instead a product of an interaction between biophysical systems, human systems, and the built environment. Climate change linked to greenhouse gas emissions, is evidence of human influence in damage caused by natural disasters. The counties in the U.S. with the highest population exist in coastal areas, and in many places, development continues to intensify in areas vulnerable to sea level rise and storm surges.

Hazard mitigation strategies frequently include goals of making communities safer and more fiscally responsible. Traditional ideas of hazard mitigation refer to vulnerability (usually in the form of physical infrastructure). It is a linear, logical process of identifying a hazard, determining what is vulnerable, and protecting it. A FEMA report defines hazard mitigation as “sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards” (FEMA, 2013, pg. 7).

The FEMA report also states that “effective integration of hazard mitigation occurs when your community’s planning framework leads to development patterns that do not increase risks from known hazards or leads to redevelopment that reduces risk from known hazards” (FEMA, 2013, pg. 8). That is a strong starting point for reducing vulnerability, but does not guarantee effective mitigation. An evaluation study of numerous hazard mitigation plans done by Texas A&M’s Hazard Reduction and Recovery Center shows that there is room for improvement (Texas A&M University, 2009). Plans were assessed based on their vision, process, fact basis, goals, coordination, policy, actions, and implementation. One finding was a large disconnect between hazard mitigation plans and other plans and stated goals, resulting in a loss of opportunity. One possible explanation for this is an over reliance on solutions that involve short-term technological fixes, such as a sea-wall. These fixes have the tendency to be done in isolation, potentially disrupt the environment, and have the unintended consequence of encouraging more development in sensitive areas. If these solutions do not adequately protect a community, the cost of recovery is typically very high, relies on external private and public sources, and may reproduce preexisting vulnerabilities (Peacock, Planetizen Courses, 2013).

Historically, hazard mitigation has been centered on the built environment, but it also has social dimensions, such as strengthening community institutions and networks that will help families and individuals to prepare and respond (Beatley, 2009). There are, in fact, many types of mitigation actions. These include, but are not limited to:

1. Hazard source control
2. Community protection works
3. Land-use practices
4. Building construction practices
5. Natural resource preservation and restoration
6. Risk communication, education, and outreach
7. Social infrastructure development

Finding the appropriate balance between these approaches for a given municipality, or enabling the right tools for their implementation, is challenging. How robust one strategy is, could be measured based on a variety of factors. One major influencing factor would be the degree to which institutional capacity is built through financial support, community support, and intra-agency support (Peacock, Planetizen Courses, 2013). Jurisdictional commitment to hazard mitigation goals are also vital, which could be reached by increased agency coordination, buy-in, and resource allocation.

However, whether or not hazard mitigation approaches are truly resilient is more subjective. Pursuing resilience through hazard mitigation can be done by effectively employing windows of opportunity, such as seeking programs that address multiple vulnerabilities (environmental, social, housing, physical, etc.). The next section will define and discuss resilience further, demonstrating the value-added possibilities of effectively integrating progressive resilience thinking with traditional hazard mitigation approaches.

2.2 Definitions of Resilience

The concept of resiliency has an evolving, dynamic meaning and its definition has been refined recently by many theorists and agencies. A basic, fundamental meaning of the term might be “the ability of a system to absorb disturbance and still retain its basic function and structure” (Walker & Salt, 2009, pg. 26). Others have defined it as “The measure of how quickly a system recovers from failures,” or “the capacity to draw upon personal and social resources to manage the consequences of disasters” (Beatley, 2009, pg. 111).

Many resilience strategies are focused only on vulnerabilities. An article in the American Planning Association Magazine framed it in this perspective by promoting the idea of safe growth audits (Godschalk, 2009). The safe growth principle could be implemented through comprehensive planning, zoning, development regulations, and capital improvement projects. Guidelines to achieve safe growth were listed as:

1. Create a safe growth vision
2. Guide growth away from high-risk locations
3. Locate critical facilities outside high-risk zones
4. Preserve protective ecosystems
5. Retrofit buildings and facilities at risk in redeveloping areas
6. Develop knowledgeable community leaders and networks

This process is indicative of much of the resilience planning that is happening today. However, theorists have broadened this idea with the notion that a truly resilient place can adapt to include a greater sense of place amount residents, a more diverse economy, and a more economically integrated population. Holling (1973) defines resilience as “the capacity of a system to absorb or utilize or even benefit from perturbations and changes that attain it” (Beatley, 2009, pg. 110). Another hopeful

definition would be “the ability of a community to not only deal with adversity but in doing so reach a higher level of functioning” (Beatley, 2009, pg. 111).

By these definitions, a truly resilient system may not only return to previous equilibrium, but might reorganize into a preferred state. This could be reached through design that stresses flexibility and adaptability. Rather than simply reducing vulnerability, this “non-equilibrium” model aims to promote flexibility through form, function and flow (Banerjee & Loukaitou-Sideris, 2011). A 2013 Urban Land Institute Report posited the optimistic idea that instead of “bouncing back” after a disaster, resilience thinking could allow places to “bounce forward through new frames, processes, and ways of working” (Brandes & LeBlanc, 2013, pg.3). They argue that planning for the future should not be limited to recovery planning because this creates an overreliance on one strategy. Instead of specializing on solving one problem, “what you really need is generalists solving six problems simultaneously” (Brandes & LeBlanc, 2013, 18).

A key term behind resilience planning is adaptive capacity. The adaptive capacity of a system would allow normal function to resume, and for communities to fluidly evolve, under a completely different set of circumstances. Walker and Salt (2009) emphasize that embracing change and adaptability is the key, and promoting a “complex adaptive system” that can have more than one stable state rather than being predictable. They define resiliency within a social-ecological systems framework by how it can absorb disturbance and has a “greater capacity to avoid unwelcome surprises in the face of external disturbances, and so has a greater capacity to continue to provide us with the goods and services that support our quality of life” (Walker & Salt, 2009, pg. 40). A resilient system would have the innate ability to bounce back, in the case of both known and unknown disturbances. This again supports the notion that an overreliance on one strategy to prepare for a disaster is not as strong as a flexible system that can recover and adapt from multiple types of disturbances. Such a system would stress the importance of more informal places and urban spontaneity, and downplay the role of specialized, static forms that only capture one use (Banerjee & Loukaitou-Sideris, 2011).

2.3 Urban Design Contributions to Resilience Thinking

It is only recently that urban design has been viewed as fundamental to resilience planning; recognized in a broadened approach that goes far beyond engineered solutions to identified vulnerabilities. Instead, good urban design should examine liabilities, and transform those liabilities to

assets. Built in adaptability should be present in urban design solutions, including flexible and dynamic forms, functions, and flows (Banerjee & Loukaitou-Sideris, 2011).

Present cities are typically comprised of highly specialized components and functions, but open-ended systems are more adaptable. This adaptability needs to be built-in so that change can happen organically, since forced change tends to cause stress and dysfunction among people. Randy Hester defines adaptability as “the capacity of an ecosystem to adjust to changing conditions with a minimum of unhealthy stress or expenditure of essential resources” (Hester, 2006, pg. 255). He is critical of contemporary urban form, saying that the trend toward ossified environments will have to be reversed to achieve resilience (Hester, 2006). Adaptable landscape is important, as was shown when open space and vacant land were quickly modified to meet people’s needs after the Christchurch, New Zealand Earthquake of 2011. However, resilient cities need adaptable forms and buildings as well. Adaptable buildings can be built in many ways, for example with a range of size in rooms with lighting, floors that can be added, and the possibility for partitions. Highly adaptable buildings and forms are built with good structure, and are filled with meaning over time, allowing people to reuse and reimagine space as it fits new and unexpected purposes.

Urban design is a process as much as a product. It considers short-term change (such as temporary urban spaces), and long-term change (such as public space and infrastructure), and the wide-range of benefits and constraints in both the short-term and long-term. While there is an abundance of literature on resilience and urban design theory, there is a paucity of theory that integrates the two. This section intends to introduce urban design and ecological syntax that complements the objective of holistic community resilience, as outlined in the previous section.

Resilience applies to preparation for any sort of disturbance. Increasing threat caused by climate change, environmental degradation, energy scarcity, and population growth, are just a few of the large challenges planners will need to face. Principles intended to help planners deal with these changes has been identified by a network of professionals at Resilient City¹ are listed in Table 1.

¹ Found at <http://www.resilientcity.org>

Table 1

Principle	Goal	Means
Density, Diversity and Mix	Reduce carbon footprint	Round-the-clock, mixed uses for diversity of users, allowing for low inputs of energy for transportation and logistics
Pedestrians First	Increase sustainability, quality of life, location desirability	Prioritize walking as preferred mode of travel
Transit Supportive	Reduce car dependency and oil dependency	Mobility hubs, intense corridors, transit-oriented development and design
Place-Making	Improve neighborhood identity and neighborhood structure	Pedestrian scale, local destinations, population density
Complete Communities	Reduce carbon footprint	Connectivity, everyday activities within 500m radius
Integrated Natural Systems	Enhance health of natural systems	Transform development patterns, preserve wetlands, endangered species and natural systems
Integrated Technical and Industrial Systems	Increase efficiency of city as a system and reduce carbon footprint.	Use waste products from one industry as an input to another
Local Sources	Become more self-sufficient, decrease costs, improve local economy	“100-mile diet:” sources within 100 miles should be prioritized
Redundant and Durable Life Safety and Critical Infrastructure Systems	Key infrastructural and safety systems to withstand event	Design in durability into whole system so one disruption does not result in disruption of another
Resilient Operations	Reduce servicing costs and environmental footprints	Compact development that relieves stress on municipal services and infrastructure
Engaged Communities	Sum total of individual choices and actions will be sustainable	Raising awareness through community design processes and educational programs

Some principles may seem more relevant than others to a specific hazard. However, when multiple design principles are employed at the same time, resiliency is improved, since the world is complex and interconnected. Trying to optimize one component of a system does not “deal with the dynamic complexity of the real world” (Walker & Salt, 2009, pg.7). In fact, a single, narrow focus, could end up making a larger system more vulnerable to shocks and disturbances. Efficiency can come at the cost of resiliency by eliminating redundancies. Similarly, optimization may be unsustainable, since

planning time horizons are often limited to a couple decades (Walker & Salt, 2009). Holistic approaches to urban design would strengthen systems, rather than individual components, to ensure enduring futures.

Just as natural processes work as ecosystems, cities are economic, natural and social systems. The systems approach aims to formalize a method of determining the role of components within the overall operation of a system. Cities are not isolated systems, but open systems “involving the transfer of both energy and matter with their surroundings” (Douglas, Goode, & Houck, 2011 pg. 240). Similar to this approach is the biosocial view of cities, which sees cities as integrated biosocial systems. This includes three critical resources: natural, socio-economic, and cultural. In a planning and political context, this approach is particularly helpful, because it emphasizes social interactions and sees individuals as crucial to leveraging changes within institutions.

Holling (1973) defines ecological resilience as “a measure of the amount of change or disruption that is required to change a system from being organized around one set of mutually reinforcing process and structures to operating around a different set” (Alberti, 2008, pg. 206). Land development can diminish ecological resilience by decreasing natural vegetation and affecting biodiversity. As a result, settlement patterns in some areas are evolving, albeit slowly, to relate urban form and density to the complex interaction of urban systems, humans, and ecological functions.

This type of ecological thinking is promoted in Randy Hester’s *Design for Ecological Democracy* (2006), as the essential connection between organisms, our environments, natural processes, and us. He argues that it is necessary for democracy and ecology to be combined and in doing so “can change the form that our cities take creating a new urban ecology” (pg. 4). However, in this work, Hester does not stress the participatory process itself, but rather focuses on city form. Form matters as much or more than government institutional capacity because form influences our daily behavior, reflects our values back to us, and can make us a more “resilient society and more fulfilled individuals” (pg. 7).

Hester outlines of how this resilient urban form might look in practice. It goes beyond technological fixes, and derives resilience from the surrounding ecology including climate, hydrology, vegetation, and building materials. Generally, resilient form enables the ability to endure, by providing “what the community needs, even in times of temporary crises” (pg. 138). It can retain the essence of its form even when disrupted. However, it is not static, it is dynamic, and while many American

communities could be characterized as resistant to change, resilience empowers us to change in ecologically healthy ways.

Resilient form comes at all scales. Individual elements such as buildings cannot find one established standard or prototype, but should reflect the particulars and the natural processes of a given site. At the site scale, form expresses natural processes, and aggregates rather than isolates parts of the systems. At the neighborhood scale, design should find connections between both social and natural ecosystems. Some ways of doing this would be through adding diversity to a neighborhood, creating identifiable architecture, and providing easy access to nature. At all scales, no one individual can claim a design solution, as it is a collective process and invention. The most resilient forms do not follow trends and gimmicks but are honestly inspired by “local natural processes and traditional culture... they are idiosyncratic: ecologically diverse, culturally expressive, integrated, contextually responsive” (pg. 10).

Hester believes that resilience planning and urban design are inseparable, led by design principles of *resilient form*, and democratic, context sensitive design. Another principle is *enabling form*, which allows people to become more connected through spontaneous interactions, orients us to our landscape, and makes it overall easier to live a more conscious and healthy life. Hester’s final principle is *impelling form*, which derives from recognizable everyday patterns, and “produces multiple avenues for stewardship” (pg. 9). Urban design that fosters resilience would include all of these principles in one single fabric. Resilient urban design is built, not prescribed, and is a process as much as a solution. Urban design is a catalyst toward promoting better understanding of local ecological processes, encouraging stewardship and fairness, and essentially providing the possibility for building enhanced, resilient futures.

Landscape Urbanism is an aesthetic movement in urban design that treats infrastructure as an expression of natural systems, and employs ecological thinking, as well as systems theory. No urbanism, whether it be Landscape Urbanism or New Urbanism, fully encompasses the complex and multi-faceted elements of urban life and relationships. The resilience of Landscape Urbanism comes through its involvement of “temporal changes, transformation, adaptation, and succession” (Waldheim, 2006, pg. 39). Rather than imposing design solutions, effective landscape urbanism pays close attention to the actual use of a place and urban life and reflects that in particular architectural forms and morphologies.

To some, landscape urbanism may be synonymous with green infrastructure, which does not guarantee resiliency or livability. James Kunstler, author of *The Geography of Nowhere*, points out that a

minimal attempt at designing with nature sometimes takes the form of a “nature Band-Aid.” Martha Schwarz criticizes what she calls a “thin veneer of naturalism” as “trying to mask our man-made environment” (Waldheim, 2006, pg. 173). Instead of this push towards naturalism, she espoused a highly aesthetic or visual approach that was “more human than disorientation caused by incessant lumps, bumps and squiggles of a stylized natural” (pg. 173). It could be argued that Kevin Lynch (1984) thought along those lines, since he promoted the imageability of the city as the crucial aspect. Imageability is a product of connections made between elements in a city, such as edges, paths, landmarks, nodes and districts; a language for mentally, or physically mapping a city. Lynch’s work was one of the first explorations of human values represented in city form. However, since then, urban theorists have come to add environmental functions as fundamental to urban patterns and human values. Some theorists think this is difficult, as the interaction between all of these elements is dynamic, complex and non-linear (Alberti, 2008).

What is needed is an effective integration of natural systems, aesthetics, forms, and functions; a challenging proposition of creating a hybrid between ecology and urban planning and its established intellectual heritage. Schwartz would argue we cannot advocate for just an ecological or natural approach to planning as this might compromise the visual and geometrical properties of a city that Lynch discusses, for example. Landscape urbanism is a theory that intends to fill the gap between the ideas of imageability and ecology, by seeing ecology as fundamentally a part of urban structures. Rather than having natural features as isolated elements in an urban design project, it should be integral and at the forefront of the image of the city.

Most importantly, urban structures and sites should be seen as dynamic, rather than static, and that a design process should focus on “cultivation, staging, and setting up certain conditions rather than obsession on fixity, finish and completeness” (Waldheim, 2006, pg. 33). A holistically resilient urbanism would combine legibility with ecological syntax, and would be a bottom-up support of conditions for human, natural and cultural systems, rather than top-down aesthetic design.

2.3.1 Urban Design into Resilience: “Rebuild by Design” Competition

One example of resilience practice that employs urban design thinking is “Rebuild by Design²,” a design competition for areas affected by hurricane Sandy that calls for creative, interdisciplinary

² Description of projects found at <http://www.rebuildbydesign.org/>

solutions to resilience. The competition yielded many progressive projects, and some of the finalists stood out as particularly comprehensive.

Finalist #1: “Resiliency and the Beach” – Jersey Shore

Jersey Shore is a place where tourism practices have impacted the ecology of the beach and shore communities. The project identified three different coastal typologies and resilient strategies for each. The first was Barrier Island, where the project sought to diversify the traditional beach economy and allow it to evolve as the shore shifts and changes. It provided new



Figure 1. “Resiliency and the Beach” concept.

tourist accommodations such as eco-lodges, cabins, and campsites, as well as a civic zone and a “resiliency center” that offered public education and entertainment programs. The second typology was the headlands, which focused on transforming infrastructure “hard edges” to mix better with adjacent ecology. For example, a boardwalk-dune hybrid honored the social function of the boardwalk, protected development behind it, formed dunes to protect beach wildlife, and created an intimate edge that promoted social interaction with the landscape with seating and steps.

Finalist #2: “Living with the bay” - Nassau County South Shore

This project sought to protect against extreme weather events and sea-level rise, while simultaneously strengthening what makes living near the bay great in the first place. By admitting that no one solution was the silver bullet, it focused on various interventions. Protective



Figure 2. Design for flood management that doubles as a public amenity.

infrastructure against storms doubled as a landscape amenity with access to the bay-shore. New marshlands were proposed to improve ecology as well as recreation, since development have negatively impacted those wetlands. Stream corridors were redesigned to deal with water flooding but also double as public space, with new development possibilities, and promotion of ecological recovery.

Finalist #3: “Resilient Bridgeport” - Bridgeport, Connecticut

This concept placed a premium on process. The project attempted to combine resilient design with ways to revitalize the neighborhood, and did so by having community-led workshops, design charrettes with key stakeholders, open houses, and educational activities with all ages. The community-driven programming included ways to strengthen Bridgeport’s identity, which was founded upon its relationship of people, industry, watercourses, estuaries, and beaches.



Figure 3. Community design process for “Resilient Bridgeport”

These three examples from the Rebuild by Design competition showcase urban design processes and concepts that combine economic needs such as tourism with local ecology restoration, community involvement, and protection against storms and flooding.

2.4 Community Design

As noted in section 2.3, resilient design is not a prototype but rather an idiosyncratic, democratic process to achieve enabling forms and structures. Community design can be defined as “the art of making sustainable living places that both thrive and adapt to people’s needs for shelter, livelihood, commerce, recreation, and social order” (Porterfield & Hall, 2001, pg. 1).

Beyond small-scale interventions, planning for disasters often involves large-scale, if gradual, community transformation such as significant or broadly applied retrofits, development or new building types and settlement patterns, or in some cases, relocation and resettlement. What is to inform this type of change? Agencies involved in this kind of planning can improve by providing thorough technical and non-technical analysis of existing character and conditions and a strong basis of data to support efforts. The design process itself is enriched through a community-design process such as charrettes. This process can improve coordination between experts, officials, and citizens, and encourage creative problem-solving and original design concepts.

Not all community processes work. Often, participation is low, and designers enter a process to build “winners” for preconceived plans (Francis, 1983). Over the last half-century it has been common to follow the path of least resistance, which has created places with a short shelf life (Porterfield & Hall, 2001). Traditional designs have tended to be product-oriented, while community design should be more concerned with meaning, context and appropriateness (Francis, 1983). Some ways of thinking about a community process may increase the chances of success. Mark Francis (1983) argued that community designers need special skills, including the ability to translate people’s everyday experiences into buildable plans, designs and policy. They anticipate the future and articulate impacts of design decisions. Finally, they understand that good environments are not design products, but evolutions. The end product of an effective community-design process is increased user-satisfaction, self-esteem, and stewardship.

Attention to the community-design process is essential to disaster planning. It builds awareness of vulnerabilities, but also fosters the development of acceptable short-term and long-term decisions. Hester argues that democratic involvement is increasing, but at the same time, ecological thinking infrequently informs local governance. He goes as far as to state that “free-enterprise democracy has made us irresponsible” (Hester, 2006, pg. 12). Ecological democracy, as Hester calls it, will create attractive choices that will make us more optimistic about change, rather than resistant. As stated before, resilience is not about merely technological solutions as it is about creative, forward-thinking plans. Along those lines, truly visionary ideas are stronger when rooted in everyday life and experience, and ones that “recognize, accommodate, and champion valued ways of living are more likely to be successfully implemented” (Hester, 2006, pg. 282).

In Hester’s documentation of his community design work, he searches for the social nuances that inspire form. This includes the identification of “sacred structures,” which can be defined as “places - buildings, outdoor spaces, and landscapes - that exemplify, typify, reinforce, and perhaps even extol the everyday life patterns and special rituals of community life, places that have become so essential to the lives of residents through the use of symbolism that community collectively identifies with the places” (Hester, 1985, pg. 7). He finds that even when places are in dire need of economic development, it is the affection for place and preservation that still takes precedence among community members. An involved community design process with close attention to this reality can change a vague discussion of values to a specific debate about what is valued. It could also mitigate impacts and increase the legitimacy and acceptability of the sweeping changes that may be needed to plan for disasters. A

process that encourages community members to identify values and assets would deemphasize the specifics of the risk scenario itself, and instead prompt community members to broaden their thinking about how to plan for disasters (Freitag, Abramson, Chalana, & Dixon, 2014). The process can be leveraged to seek ways that “both mitigation and recovery planning can benefit from incorporating general land use and community planning goals for everyday betterment” (Freitag, Abramson, Chalana, & Dixon, 2014, pg. 325).”It is a bottom-up approach, “nurturing and sustaining the capacity of people, communities, and societal institutions to adapt to and experience benefit from disaster” (Beatley, 2009, pg. 110). Finally, it reaches beyond expanding governmental institutional capacity and physical infrastructure to incorporate social capital; a factor that is vital to promoting trust, leadership and social networks that can strengthen a community’s capacity to respond together to disturbances.

2.5 Discussion of Literature

The literature reviewed above exemplifies the breadth of possibility in resiliency planning, starting from traditional hazard mitigation techniques and approaches, to the variety of resiliency definitions, to how community processes help to realize values and benefits beyond the hazard itself. The literature also shows an inextricable connection between urban design, resilience, and hazard mitigation. The connections outlined here are still developing, and must be better understood to prepare coastal communities in the most appropriate and opportunistic way, for the ever-increasing threat of natural disasters.

The US. Army Corps of Engineers recognize the importance of thinking beyond structural solutions to hazard mitigation by stating “Consideration of the full range of functions, services, and benefits produced by coastal projects is an important part of taking a systems approach to coastal risk reduction and resilience” (U.S. Army Corp. of Engineers, 2013, pg. 7). However, the creative solutions that effectively realize the windows of opportunity for disaster planning require creative, community-based design and decision-making rather than narrowly engineered solutions.

Chapter 3: Relocation Case Studies

The preceding literature review discussed definitions of hazard mitigation and resilience, the relation between urban design and resilience, and a number of approaches to resilience planning and design. This literature provides a basic conceptual foundation for an adaptive relocation strategy in Aberdeen, WA, as discussed in chapter 5.

The proposal for Aberdeen is a strategy for relocation of infrastructure, housing, and other programming on higher ground. This chapter looks at previous examples of relocation efforts for comparative study. Unfortunately, relocation efforts usually come after a disaster has struck, such as was the case in New Orleans after a hurricane, and Japan after a tsunami. These examples illustrate the difficulties associated with rebuilding communities in this way. Section 3.2 in this chapter discuss Taholah, WA and La Push, WA, which are two indigenous communities just a couple of hours away from Aberdeen which are relocating their villages entirely. I gathered information about their relocation plans primarily through interviews, and these examples provide a foundation of knowledge that can be applied to a relocation scheme in Aberdeen, WA. However, there are few examples of relocation efforts, and these case studies represent questions that have not yet been resolved, such as: what are the most effective and contextually appropriate resilience and hazard mitigation strategies? How can long-term relocation visions be reconciled with providing for current needs?

3.1 Post-Disaster Temporary Housing

A report by the Urban Land Institute was critical of narrow hazard mitigation strategies, stating that “overreliance on any one strategy - whether it be levees and pumping systems or revetments on ocean fronts - is a recipe for disaster. Overreliance on any one strategy also gives people a false sense of security” (Brandes & LeBlanc, 2013, pg. 19). When the levies broke during hurricane Katrina, 80 percent of the city was inundated, resulting in over 1,000 deaths and causing total property damage over \$108 billion (Knabb, Rhome, & Brown, 2005). The levies that were built in New Orleans might have been a measure for disaster preparedness, but do not constitute overall resilience. The failure of one highly specialized system left the city more vulnerable than if a resilient, diverse, and interconnect system had been established.

Thousands of displaced people were then temporarily housed in the Superdome, without many basic services and provisions needed. The superdome itself is located in a floodplain, and was never

intended to provide sufficient disaster relief. In the following days, FEMA purchased 145,000 trailers to house displaced victims. Despite this effort, many of these trailers are not livable. Even if they were, there is more that goes into rebuilding a community than temporary shelter.

My proposed relocation strategy in Aberdeen addresses this point. Planners must proactively plan for disasters with adaptability in built form so that when a disaster does strike, a community has means to rebuild itself.

3.1.1 Japan

Another example of post-disaster temporary housing is in Japan, which was built in response to the 2011 earthquake that caused a powerful tsunami. Like trailers in New Orleans, Japan's temporary projects provide shelter, but do not provide the variety of other services that communities need to rebuild.

In the wake of the devastation, thousands of households that survived the disaster were left without a place to live. Over 100,000 fled to evacuation shelters and many still remain there (Hu, 2016). Five years later, temporary housing has been built for nearly 60,000, such as the example shown in figure 4. The government has set up a program to provide housing for those who are displaced, but there is a significant shortage of money, workers, and materials. Permanent relocation plans in many of these areas have been significantly delayed, causing many to 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



Figure 4. Temporary Housing Outside of Disaster Zone in Minamisanriku, Japan. Source: The Atlantic.

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. Even with the provision of housing, communities, schools, businesses, and civic uses do not exist. It is not certain that evacuees will return, even if large

sums of money to rebuild infrastructure are spent. As a result of this ongoing struggle, a central aspect of Japan's future disaster management will be operational continuity, which aims to prepare all sectors of society to continue activities under conditions of hardship (Siembieda & Hayashi, 2015). In regards to the recent tsunami, Japan will need to continue to address the social disruption caused by the event, as much as the physical damage.

Tsunamis hit Japan in 1896, 1933 and 1960, and many cities have since developed thorough disaster plans (Washington Military Department, n.d.). Toro, Japan built sea walls, created evacuation maps, placed evacuation signage, and conducted exercises. However, the town was devastated by waves when the 2011 tsunami flowed over the sea walls. While some tall buildings had been reinforced to withstand flooding, the hazard mitigation solutions were not enough when faced with the size of the disaster. In Rikuzentakata, a 5.5-meter-tall embankment, with agriculture fields and dense pine trees as buffers, protected the city. Still, the tsunami overtook these barriers.

Today, there are still unanswered questions as to how to prepare and rebuild in Japan. A massive seawall is one solution, but not the most pragmatic for a tsunami event that is so rare (Normile, 2012). Seawalls adjacent to a waterline also tend to divide the shore ecosystem. Planners in Rikuzentakata initially considered a 12-meter-tall embankment to replace the old one, but have since pursued broader solutions, such as a memorial park along the shore and a museum that doubles as a tsunami refuge, as well as raising the business district 15 feet and relocating some housing to higher ground. However, land shortages and difficult topography make relocation difficult. While moving to higher ground would make the city safer, it comes with a host of logistical and political problems.

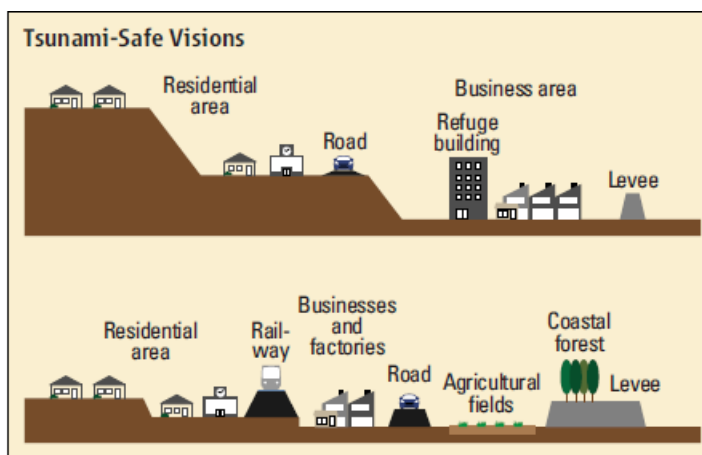


Figure 5. Two visions for Rikuzentakata. The top includes relocated infrastructure and housing on higher ground, with a protected business area and refuge building near the waterfront. Source: Science Magazine.

Separating people from the water would also be at odds with strong traditions such as fishing and seaweed cultivation. The vision in figure 5 shows that one solution is to keep a fortified business district and other uses in lower ground, while critical infrastructure and housing can be moved to higher ground.

While Japan was better prepared than New Orleans, the hazard mitigation strategies did not go far enough, and as a

result recovery efforts are expensive and many problems remain unsolved. For decades, the Japanese government has supported hazard awareness and disaster preparedness (Siembieda & Hayashi, 2015), but the tsunami was much larger than expected, and cities do not have the adaptive capacity to rebuild from its damage. In the future, Japan will need a holistic focus and a flexible approach that allows society to resume its function after a disaster, without heavily relying on external resources for recovery.

The case of Japan illustrates many of the issues of resilience and hazard mitigation that I describe in chapter 2, and elucidates many difficulties involved with post-disaster recovery. For example, the case of temporary housing in Japan shows that housing for displaced people in Aberdeen will not be sufficient unless complemented with other elements that make a complete community. On the other hand, the case of Rikuzentakata shows that community values need to be woven into a relocation plan. I argue that relocation in Aberdeen should include a development with streets and buildings that can naturally adapt from temporary crises relief to a permanent and complete community.

3.2 Preemptive Relocation Efforts

Context-sensitive design includes three main considerations: nature, culture and people (LaGro, 2013). Therefore, successful design should accrue social, economic as well as environmental benefits. The challenge of approaching a context sensitive, ecologically resilient design is even greater when a community is relocating entirely. Events such as those in New Orleans and Japan, as well as the reality of climate change, are making permanent displacement and relocation an increasingly unavoidable prospect for coastal areas around the globe. Recently, Isle de Jean Charles in Louisiana was allocated a \$48 million grant by the Department of Housing and Urban Development to relocate. However, a site for relocation has not been determined, and officials are worried that moving people can be very disrupting to families and communities (“Resettling the First 'Climate Refugees'”, 2016)

The implications for relocation are more than just the logistics around moving, but large social and cultural transformations. Beyond safety, relocation efforts have the opportunity to build-in resilience and to strengthen their new communities. An organization called Re-Locate partnered with a Seattle based firm called Civilization to cover issues surrounding worldwide relocation efforts, and had this to say about the issue:

“From our point of view, relocation is not just about moving buildings and infrastructure away from climate dangers. Global relocation planning efforts are opportunities to build worlds where the particular subjectivities, material cultures, cultural practices, and politics of displaced communities can endure and flourish. In order for these particularities to be recognized and supported, the governmental, cultural, environmental, and economic situations within which displaced communities negotiate ways of living also need to be understood, visualized, and interrogated.”³

A few small indigenous coastal communities are already developing relocation plans as a response to climate change. A place getting the most attention is Newtok, a village 500 miles west of Anchorage. It is one of the most eroded Native Alaskan villages on the state’s coast, and now the isolated village could be considered a national model for relocation, as it is anticipated that there will be many more to follow. The relocation plan was created mainly in response to a \$2 billion coastal climate resilience program proposed by the U.S. Department of Interior, with \$400 million set aside to aid with the unique circumstance of vulnerable native villages in Alaska (“Alaska Seeks Federal Money”, 2015). Newtok is also competing to receive grant money from the department of Housing and Urban Development’s (HUD) Disaster Resiliency Competition.

Newtok is only one of Alaska’s several threatened communities that has begun a physical move. It is a tempting solution for numerous places threatened by coastal storms and climate change. However, relocation efforts are difficult to initiate because the costs of a move often outweigh expected benefits. The Army Corp. of Engineers expect that relocation of Newtok will cost \$130 million, with 35% of the cost expected to be covered by the village. An additional challenge is timing the move. For example, a school cannot be built until a population lives there to support it, and people cannot move until all necessary infrastructure is in place to support living there. Finally, Newtok is an isolated community, only accessible by plane, and is accustomed to a self-sufficient lifestyle supported by moose, seals, fish, berries, and other local plants. A move would require a shift in how the community operates, but with the population’s nomadic history, prospects are good.

3.2.1 Taholah, WA

A relocation project has become a real possibility for an indigenous community in Taholah, WA, located only 56 miles to the northwest of Aberdeen. Due to the threat of a tsunami, the population of

³ Retrieved from <http://www.relocate-ak.org/>

600 engaged in a community design process for new settlement in an uphill location. Taholah is the most populous village of the Quinault Indian Nation, and is already experiencing frequent storm surges and coastal erosion. The issue is complicated, however, as the relocation design includes new development patterns, separated from the waterfront on which they are culturally and economically dependent. This is a case that requires exceptional urban design thinking, beyond merely safety from a hazard. The community has already been involved in a design workshop, and that process adds legitimacy to a resilient solution. The new design also includes stormwater management techniques, self-sufficient infrastructure such as backup power, a multi-functional community center, and other resilient programming. However, the final result will need to include ways for the design to be appropriate for the traditions of the community that have lived through thousands of years. It will also need to be dynamic enough to provide the possibility of an improved economic, social, and ecological state, in order to be truly resilient.



Figure 6. Depiction of lower village in inundation zone, with planned relocation area above.

Relocation has been topical in Taholah since the 1930's, due to issues of repetitive flooding (NOAA, 2016). More serious discussions began in 2005 for moving childcare programs and senior living, and in 2012 Taholah received a grant to pursue a master plan of an entire relocation. A community-design process was initiated which involved the designated master planning team getting to know the community, and empowering people to be involved. A complexity of issues became apparent, ranging from questions such as land ownership and status, access to critical programs, housing needs, and the

viability of commercial and retail space. The community design process began with building up knowledge among community leaders, communicating the hazard, and enabling residents to talk freely about it. Planners found that in this community, it was best to start by creating a basis of knowledge, done by utilizing inundation maps, and then to broaden scope. The discussion began with immediate goals, such as stockpiling emergency foods, to long-term visions, which prioritized elders and children. The relocation discussion also adopted a more opportunistic tone, including how the community can introduce new industries such as cross-laminated timber. When interviewed, Charles Warsinske, the Manager of Community Development and Planning for the Quinault Indian Nation, stated that the village relocation and redevelopment is an “economic catalyst of the whole Nation” (Warsinske, 2016). The community design process in Taholah exemplifies how discussion of a hazard can evolve into a discussion of long-term economic strategies as a means to a more resilient future.

While the vision for relocation is in development, the community is still planning for immediate needs. Each new constructed building now meets new design and construction standards, and is adaptable for refuge. Review of plans for a large community building are underway, which is designed to serve multiple purposes such as a use by the elders program, head start programs and food storage. It is also intended to become a new communication and evacuation center, with capacity to sleep up to 400 people.

The master plan design process began by profiling existing village conditions, including how the lower village relates to surrounding water, retail areas, and public buildings. The community consensus was to pursue a 5-minute walk concept, which requires denser, mixed land uses, and grading to reduce slope to below 5%. While paying close attention to the existing village conditions, the redevelopment is

pursuing new development patterns, inspired by examples from other areas. The design includes typical Low Impact Development (LID) stormwater practices, and buildings with new ventilation systems and triple pane windows.

While looking for guidance from design best practices, the intention is to mix that knowledge with freedom and creativity to build with local context and values. The



Figure 7. The existing Seawall in Taholah. Storm surges have recently surpassed this barrier.

design aims to reflect the essence of the place, for example, in the importance that the community places on family identity. Warsinske stated that “the design is to accommodate families, not families that accommodate design.” He believes that this can be done through a focus on livability and self-expression that people already enjoy in their homes and in their larger community. Solutions in Taholah will need to be unique for two reasons: because there are few precedents for relocation to follow, and because there are challenges, values, and opportunities particular to their community. For example, the nation has very loose zoning rules. Private property is not a main consideration as the nation owns and leases most of the land. The community is more socialistic than many, and the building of consensus is different in a tribal community, than it would be elsewhere.

If a tsunami happened today in Taholah, people would only have the administration building and health clinic to rely on. People would be left outside, without many resources for safety and well-being, let alone resources for rebuilding their community and their economy. None-the-less, Warsinske believes the tribe may have better prospects for recovery than Aberdeen, due to factors beyond just readiness of the built environment. The Quinault nation has been adapting and evolving on their land for centuries, and often faced natural and human disruptions. They have developed skills, resources and a resilient ethic overall. They know how to harvest food from the local environment, shelter themselves with local materials, and live in a self-sufficient manner, which would be crucial, as a tsunami could isolate the community for months.

There is much that Aberdeen can learn from Taholah, both in terms of adaptive urban design solutions, as well as creating the conditions for resilience. Instead of thinking that technological fixes in Aberdeen will ensure long-term success, hazard mitigation money would go further with investment in the people, to build an ethic and awareness that can support a long-term recovery. While the people of Taholah have a long cultural tradition, Aberdeen’s history only extends back to 1884. During that time, however, there is a rich history to build on. Unfortunately, from a planning perspective, the genesis of Aberdeen did little to set the city up for a resilient future. Growth was based on natural resource extraction, evident by a shoreline made up of mainly underutilized industrial uses, and now the economy struggles along with the timber industry. In the 1970’s, big box stores were built, and today the mall is mostly vacant and the historic core is in need of revitalization. Much of the city is built on estuarial flatlands that have been filled or paved over, leading to regular flooding and putting structures at risk from liquefaction following an earthquake. Other areas of the city are built on bluffs prone to landslides. During disaster planning, the question that both Aberdeen and Taholah need to answer is not

necessarily how to get to higher ground, but what happens after. The answer will require a social and physical approach to resilience.

3.2.2 La Push, WA

Similar to the case of Taholah, but with some notable differences, is the “Move to Higher Ground” project in La Push, WA. La Push is a small coastal community to the north of Taholah that is home to the Quileute tribe. The project began in 2012 when legislation transferred 285 acres of land to the tribe (“First to Move Out”, 2014).



Figure 8. La Push's existing village.

Since the transfer, the Army Corp. of Engineers has conducted an environmental and cultural assessment of the site. Since it is a heavily wooded area, the forest management plan and timber harvest plans have been updated.

The driving piece of the project was to relocate La Push’s school, which is scheduled to break ground within the year. The movement of the school is important as it is a catalyst for subsequent projects. The new school is built on the far end of the relocation site, but has received extra funding for the extension of utilities and infrastructure, which will provide the services for future development that normally would not receive enough funds. After construction of the school, main arterials will be built, followed by housing, administration and cultural facilities. While the full build out of the site could house the entire community, priority is given to the 45 households that are currently in the inundation area, as well as the many families that are on the housing queue.

The housing that will be built to meet more urgent housing needs will be in the northwest corner of the site, closest to existing residential. The site overall is separated into four districts, divided by natural features. Suitability and layout of the site was determined by the existing wetlands and topography. The master plan establishes residential districts, as well as a cluster of cultural facilities, and a school and higher education area. Unlike Taholah, lot size and density will not change much from what is existing in La Push, at 3-4 units per acre.

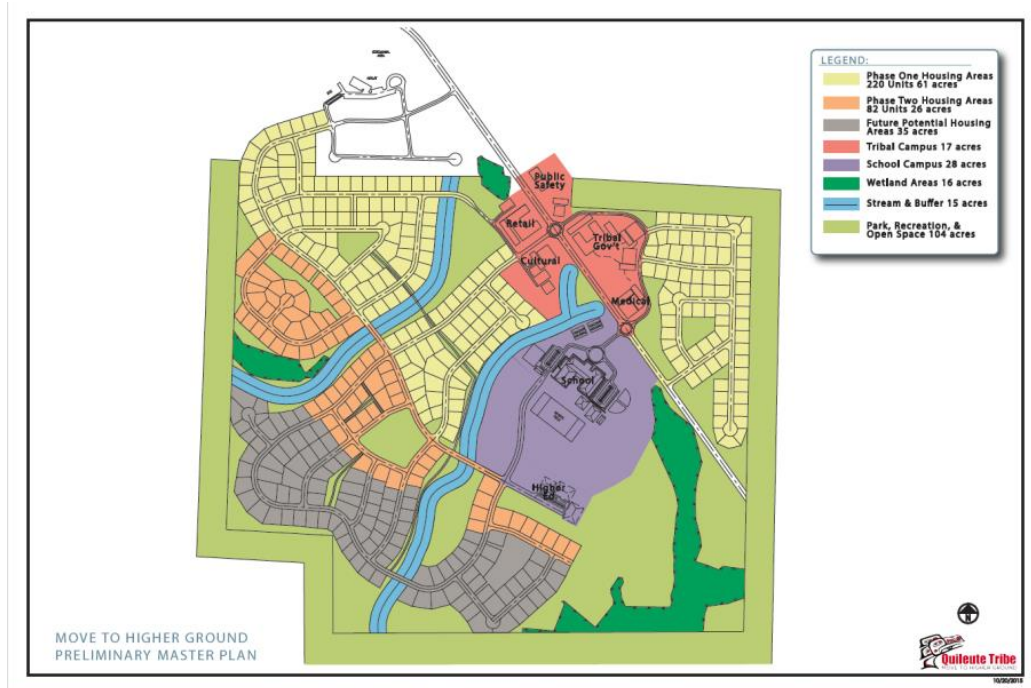


Figure 9. Relocation master plan. Existing village to the north.

Prior to any community design process, raising awareness and disseminating information about the tsunami hazard was important. Community members created videos to depict a tsunami scenario and the existential danger it posed, and due to the success of that campaign, a company has been hired to produce another video to illustrate and communicate risk. While most people are now aware of the

risk, some are reluctant to accept the need to move. The community sits at the mouth of the Quileute River and the Pacific Ocean, and the long historical ties and dependency on the water as a cultural and economic necessity have made relocation planning difficult. Of the 130 homes that exist, at least someone in each household is involved with

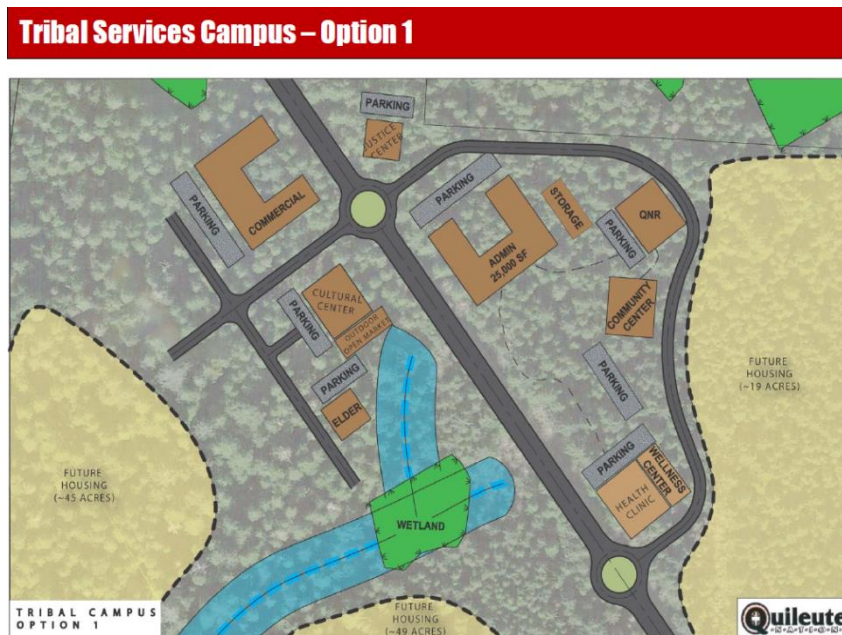


Figure 10. A conceptual plan of a cluster of community and administrative uses.

industry in the inundation area, such as in commercial fishing or tourism.

For these reasons, it was important to engage in a community dialogue about relocation that included more than just safety concerns. A design charrette was held so that values, concerns and visions of the community would be evident in the new master plan, covering issues such as housing, administration, cultural needs, cultural expectations, and education. The new plan includes a cluster of cultural facilities that are requisite to the resilience of the community, adjacent to the tribal government and commercial uses. Among these cultural facilities is a museum and cultural center, which had always been desired by the community but never funded. The \$50 million Move to Higher Ground Project was leveraged to include important elements such as this, since the cost was justifiable compared to the overall scale of effort. The relocation project has opened up many possibilities such as this for a strong neighborhood center.

The relocation plans must also take advantage of economic opportunities. Larry Burtness, Planner and Grant Writer for the Quileute Tribe, stated in an interview that “getting the economic base reorganized and operating again is very important” (Burtness, 2016). A tsunami would likely destroy the commercial fishing industry, along with the livelihoods associated with it, as well as other important sources of revenue such as the resort and general store. During the design process, Burtness said that they “continue to explore ways to make sure that tribal government and business operations can be done safely and have continuity during a disaster, and acquisition of new property opens opportunities for new enterprises, new opportunities, and new jobs.” This includes the creation of space for smaller scale retail opportunities, and a seafood processing facility for canning and smoking of fish. A business park was also acquired near the relocation area.

La Push is in some ways already well prepared for a disaster, with a gymnasium as an evacuation center, regular emergency drills, tsunami sirens, and NOAA radios. Those will continue to be enhanced in the short-term, but the Move to Higher Ground Project is a more robust way to make the community resilient in the long run. La Push is an isolated community, and design that can foster self-sufficiency for months to a year is crucial. This includes emergency storage of food and water, fuel storage, alternative power sources such as solar panels, shelter facilities, and health services. Thinking even further ahead, the relocation area is fit for rebuilding community after a disaster. Burtness stated that “resilience is a difficult thing to predict.” However, a design with space and form that is adaptable to new economic opportunities, cultural uses, and overall community development, will allow La Push to exist and thrive in a new set of unpredictable circumstances.

Chapter 4: Design and Site Planning Precedents

Beyond the importance of creating a locally inspired design scheme, relocation design in Aberdeen should be inspired by guidelines and maxims that promote sustainability. While goals and values can be stated by the community, the possibilities on the site, as well as the requirements of a specific site, can be informed externally by various design prototypes, urbanisms, and precedent examples.

To this point, a potential hillside development in Aberdeen has been underpinned by theory in resilience and community design (chapter 2), and case studies from the region (chapter3). This chapter aims to complement those factors with precedent examples from the state of Washington that illustrate possibilities in Aberdeen. These examples all show how Low Impact Development (LID) techniques can be used to mitigate storm water. Beyond natural infrastructure, low impact development also includes various site planning and layout techniques that can make a site more sustainable. Many of the case studies also showcase innovative architectural features, layout, or onsite programming that could revitalize Aberdeen and improve quality of life.

4. 1 Site Planning Principles

Natural systems and local ecology have not always been considered as main drivers of urban design best practices. However, much of the literature discussed in chapter 2 shows that it is crucial to resilient form and design. Low impact and sustainable designs have co-benefits for resilience, environmental conservation, quality of life, and real estate values. Areas with high vegetation and open space often have higher housing prices (Urban Green-Blue Grids, 2016).. They are also positively correlated with good health since green areas provide recreation for all ages, and encourage people to use active transportation.

4.1.1 Low Impact Development

For these reasons and others, Low Impact Development techniques make sense for uphill development in the City of Aberdeen; both for long-term and near-term development goals. Historically, development in the City has not been low impact evident by the amount of development in sensitive areas prone to floods, landslides, and liquefaction from earthquakes. One of the most important

considerations of future development in Aberdeen will be hydrology. It is located in one of the wettest regions in the country with an average 83.6 inches of rain per year, well above the national average of 36.5 inches. The flooding has severely hurt the already struggling housing market in the low-lying west-end of the city. Hydrologic considerations will be highly relevant in any uphill development, since the proposed relocation area is surrounded by streams that collect storm water runoff and steep slopes that are particularly vulnerable to sliding during extreme weather events.

The transformation from a forested site in Aberdeen to a developed area requires substantial mitigation. Urban areas increase peak water discharge and store and absorb significantly less water in the soil than forested or rural areas do. A reduction in groundwater infiltration caused by excessive paving can significantly affect surrounding vegetation. While conventional drainage techniques remove water from a site, then can cause significant downhill flooding, which would amplify an already chronic problem in Aberdeen. Uphill development should include permanent and temporary detention areas and pervious surfaces to avoid this potential problem.

Conventional suburban developments in the United States can most aptly be characterized by large building footprints, vast amounts of impervious surfaces, soil disturbance, waste, small isolated open spaces and generally unsustainable construction and design practice. Aberdeen has developed with a predominance of low-density single-mainly housing, and a street grid lay out oriented for automobile access and property transactions. Low Impact Development (LID) principles address all of these shortcomings. Perhaps, the starkest difference between conventional suburban design and LID is in approach to hydrology. While stormwater could be seen as a liability, LID fully incorporates a site's hydrology, makes it visible, and turns it into an asset. The main goals are to reduce surface run-off and increase pervious surfaces that will allow water to percolate and purify in the soil before reaching the water table (LID Techniques, 2016). A designer would begin by identifying on-site hydrological patterns and physical features, such as streets native soils, wetlands, and vegetation. Below are some examples of low impact techniques to achieve these goals. By maintaining these features, storm water runoff can be reduced, fine sediment deposition decreased, native forests and vegetation conserved, and pollutants decreased (Puget Sound Partnership, 2012). Other important features of low impact development are listed below, along with their potential benefits:

- Bio retention: Green infrastructure such as swales, cells and planters, protect water quality by mitigating storm water input.

- **Permeable Pavement:** Impervious surfaces increase storm water runoff and the amount of pollutants that reach the watershed, while permeable pavement allows water to percolate into the ground.
- **Rainwater Harvesting:** A technique to store rainwater, such as run-off from roofs, is an effective way to reuse water.
- **Community gardens:** Gardens can be a community amenity that also absorb stormwater, and provide locally sourced food.
- **Site Layout:** Many LID developments in the suburban context use a hybrid curvilinear/grid design. Curvilinear designs often reduce the amount of pavement but grids provide better connectivity and promote walking, biking and efficient emergency vehicle use.
- **Building Footprint:** Housing types used in LID have small footprints by using narrow lot frontages and reducing setbacks. The cottage housing typology, for example, is a growing housing market that has a small building footprint.
- **Housing Clustering:** When a cul-de-sac or loop is designed, housing clustering techniques should be used to increase density and reduce overall footprint. A bio retention area within a cul-de-sac can reduce the radius of the pavement in half while improving storm water runoff and aesthetics.
- **Parking:** As much as 20% of suburban roads are driveways. Instead of a large driveway, alleyways can provide backside garage access (attached or detached) and vehicular/pedestrian circulation without adding to the overall street network. Developments can also orient buildings to use shared driveways, further reducing the amount of pavement needed. Parking garages that are placed in the back with alley access increase on-street curb space for parking and allow homes to be placed at the front of lots, connected to the street.
- **Open Space:** Open Space can be used as a public amenity as well to store and slow storm-water. Site layout with a variety of open space typologies and shared public space can reduce pervious surface and conserve open space networks.

For resilient and attractive development, LID principles could be incorporated as amenities. LID principles are resilient because they have the ability to manage storm water, support flexibility in design, and add economic and community vitality to new developments (LID Techniques, 2016). Many LID elements are evident in the uphill relocation conceptual design discussed in chapter 5. I also discuss

these elements in the following design precedents section in this chapter, to illustrate how they look in practice, and how they can have a potential range of environmental, social, and economic benefits.

4.1.2 Other Guiding Site Planning Principles

Incorporating sustainability into site planning has no one prescribed solution. There is a low percentage of truly sustainable site development practices, although there are many design principles that could inform such a design, when applied correctly. Generally, sustainable site planning includes considerations of the impact of the site development on the local ecosystem, and should apply principles such as: utilizing renewable energy resources, contributing to a sense of community, reducing automobile dependence, reducing and reusing materials, minimizing use and runoff of water, maintaining original ecological function of the site, and more (Jarvis, 1993).

Site Selection is a crucial aspect, and arguably the most important step in the site design process. For uphill development Aberdeen, this would include considerations such as location, environmental conditions such as soils and vegetation, topography, and hydrology, pedestrian and automobile access, land development regulations and zoning, surrounding context, and other attributes such as cultural features and community interests. To reduce externalities as well as internal difficulties, identifying site constraints is just as important as opportunities. Siting must meet a determined selection criteria, which is created through clarified project objectives and requirements. An effective three step site selection process includes a site inventory (Physical, Biological and Culture), followed by a site analysis, and grounded through conceptual designs (LaGro, 2013). A site analysis should summarize a site's suitability for the programmed use, and can be determined by looking at three primary factors:

1. Physical Attributes (Soils, topography, hydrology, geology, and climate)
2. Biological Attributes (Vegetation and wildlife)
3. Cultural Attributes (Land use, legal, utilities, circulation, historic, sensory)

Site Layout should be done in such a way as to express a designer's analysis and sensitivity to site conditions. Site layout should show a designer's values, goals of the project, community standards, and local ordinances (Jarvis, 1993). From a sustainability aspect, lot layout alternatives have emerged as a response to rapid post World War II suburbanization and the resulting sprawl and environmental

degradation. Smaller housing types, housing clusters, narrow lots, and traditional neighborhood design are common practices to reduce the footprint of new suburban developments.

Placemaking is another crucial aspect of successful site design. Placemaking can include schemes such as creating a theme, carefully locating amenities, designing a unique landscape, using dominant architecture style, and making site graphics (Jarvis, 1993). This will vary greatly on the intended use of a place, for example, upscale markets will require different amenities than more affordable markets. Amenities can be categorized in two ways: natural amenities (views, vegetation, slopes) and planning amenities (open space, recreation, image and identity). This is critical in a struggling Aberdeen housing market, since well-designed real estate products may in fact succeed in tight markets where poorly designed products will not (LaGro, 2013). Placemaking is largely a product of context-sensitive design. LaGro (2013) defines context-sensitive design in three ways: design with nature, design with culture, and design for people. This means that it should accrue social, economic, as well as environmental benefits. Context-sensitive solutions are creative and community inspired, and they are acceptable to community and client goals.

4.2 Design and Programming Precedents

Precedent examples have been vital to advancing the field of planning. The New Urbanism movement relied on earlier forms of development (LaGro, 2008). Precedent examples can yield information about best practice such as spatial organization, environmental protection, site programming, contextually sensitive planning and more. Development in Aberdeen will need to be evaluated on its own merits, not on its adherence to previous examples, but should still be informed by outside influences. This section includes precedents that illustrate local Washington State examples of sites that have incorporated the design principles outlined in the previous section, and also exemplify successful site programming that meet objectives and requirements for conditions similar in one respect or another to those in Aberdeen. They show possibilities of what development in Aberdeen could achieve and inform many of the design strategies discussed in Chapter 5.

4.2.1 Danielson Grove: Kirkland, WA

Danielson Grove is a residential suburban infill project in Kirkland, WA. It includes 16 homes arranged in lots sizing between 2,400 and 3,000 square feet (The Cottage Company, 2015)⁴. The project added density to the affluent area while preserving native soils, vegetation and open space. It incorporates cottage housing units, made possible by Kirkland’s innovative Housing Demonstration Project Ordinance. The ordinance was a pilot project in order to garner community support for future public approval of similar developments. By making the interim ordinance permanent, housing supply and choice of housing styles could be greatly increased, and LID Practices like those in Danielson Grove could be replicated. The homes are built with cedar-shake roofing, steep-pitched gable roofs, and other architectural features that improve as well as blend with the community’s existing feel. In the City of Aberdeen, where single-family detached housing is probably the most familiar typology, and where affordability is an issue, the cottage housing model could be applied appropriately, especially on sites where space is constrained by steep slopes and sensitive hydrology.

The housing units are clustered in order to preserve existing old growth trees and vegetation. Ten percent of soils were left undisturbed, and native vegetation exists throughout the site. Front porches are oriented toward a shared common open space. Other features of the site include amended top soil, bio retention areas, permeable pavement, clustered parking, and shared infrastructure.



Figure 11. Danielson Grove shared courtyard. Source: Triad Associates.



Figure 12. Native vegetation at Danielson Grove. Source: Triad Associates.

⁴ Site Plan shown in appendix 7

4.2.2 High Point: Seattle, WA

The High Point development in southwest Seattle is an award-winning mixed-income community built in 2004 under the Hope VI program. The project replaced 716 subsidized housing units with condominiums, townhomes, apartments and many parks. Not only does the site include suitable housing for families of different socio-economic backgrounds, but it also includes innovative low impact and New Urbanist design techniques that set a strong precedent for Aberdeen; due to how stormwater infrastructure and open space are incorporated into its design.



Figure 13. Bioswale at High Point. Source: SvR Design.

The structure of High Point is a hybrid curvilinear grid but with high connectivity to the surrounding West Seattle neighborhood. Through narrow streets, wide green buffers, short-blocks, and attractive design, it is pedestrian friendly. Many of these green buffers are vegetated swales that collect storm water. There are more than four miles of such swales on the site, which includes a variety of attractive native plantings. The swales clean storm water before it is discharged to Longfellow creek.⁵ On site is also a large retention pond that also doubles as a community space and neighborhood amenity with a surrounding quarter-mile long walking trail.

One of its main achievements is that it is the first development of its size to feature low impact sustainable design practices in a dense urban setting (Seattle Housing Authority, 2016). It includes a variety of low-footprint building types that are available for owning and for renting at all income levels. The homes have front porches that face small common areas to promote social interaction between residents. Construction included minimum grading on site, and reuse of displaced soil. Perhaps the most impressive part of High Point is not in its buildings but in its open space. The development includes multiple park types, including semi-private spaces, community gardens pocket parks, and large community parks which add up to more than 20 acres. Over 100 mature trees were retained and about 2,600 were added during redevelopment.



Figure 14. High Point. Source: SvR Design,

⁵ See appendix 8 for High Point stormwater diagram.

A key feature of many sustainable developments such as High Point is the inclusion of some sustainable homes or a sustainable central building that are a model for what is possible. High Point includes 60 breathe easy homes which attracted \$1.8 million in grants to be built. These homes have features such as filtered air, airtight drywall to reduce moisture and mold growth, filter vacuums to remove allergens, and more. The high point neighborhood also includes a central community center built with sustainable features such as solar panels, ground source heat pumps, porous concrete, drought-resistant plants (to reduce water use), triple pane windows, and water efficient toilets. Not only does the community center act as a placemaking feature and help build social capital, but it also emphasizes the sustainable practices inherent in High Point’s design. The inclusion of sustainable design in Aberdeen could serve the community while also attracting attention and funding necessary to make an innovative project possible in a constrained market. High point shows that sustainability can be added with low-cost interventions, and high-cost interventions can attract investment and revitalize the community. Furthermore, it shows that sustainable design is not exclusively for wealthy neighborhoods. By incorporating natural infrastructure, public health, social relationships, and economic viability, High Point is holistically resilient.

4.2.3 Sycamour Park: Redmond, WA

Located in the affluent suburbs of Redmond, WA, Sycamour Park was a small but innovative project. Twelve units were included in a 1.5 acre site, which is a political accomplishment considering it is double the allowed zoning on the site (Poff, 2014). The site includes six detached units and six attached units as well as four accessory dwelling units. Units include shared driveways to limit paved surfaces and keep the driveway from becoming the dominant architectural feature. While initially meeting some discontent from neighbors, the development has become more accepted and could be a model for future suburban developments.



*Figure 15. Shared Driveway at Sycamour Park.
Photograph taken by the author.*

The driving concept in the development is the “living street” which is designed to support various activities as equally or more important than vehicular circulation. This street includes raised and decorated paved areas, an absence of curbs, and traffic calming features that encourage residents to

use the streets safely among cars. The streets themselves act as a public amenity, while additional public spaces between homes encourage interaction between residents. The Sycamore Park development may only be 1.5 acres, but is an example of how density and vitality can be incorporated into a small suburban setting, which is translatable to what would be needed in a hillside development in Aberdeen.

4.2.4 Seabrook, WA

The 11-year-old small town of Seabrook, WA sits along the Washington coast, just northwest of Aberdeen. It is mostly an up-market summer resort community, serving many temporary residents and siting many vacation

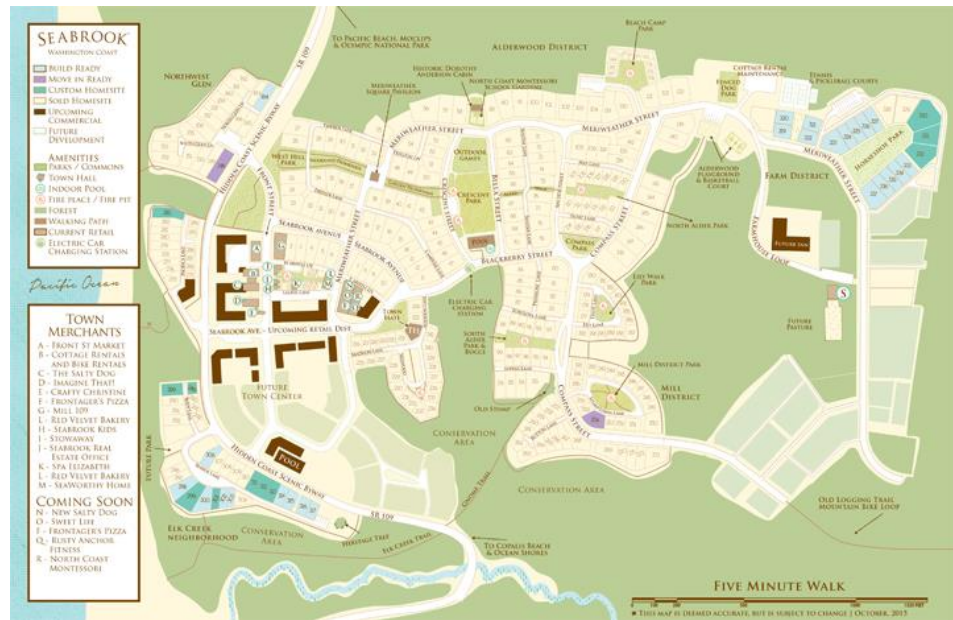


Figure 16. Seabrook Site Plan

homes. Much of its popularity is due to its New Urbanist style design. It is still increasing in size and demand for homes is high. As of June, 2015 there were 280 privately owned homes in Seabrook, and more than half of them are designated as cottage rentals. These rentals are available by the nightly or weekly basis. Cottages for purchase currently on the market range from \$299,000 to \$2,000,000 (Seabrook Land Company, 2016). The area is dense; planned for a total of over 450 residential units in a variety of styles such as cottage housing and townhomes. It is built with craftsmen architecture with New England details. The site uses many natural features to give the area a unique Washington coast feeling, but also has designed in informality to some retail areas and a “main street” look to engineer a small-town community feeling.

It may be too idealistic to think that a retrofit of existing housing in Aberdeen is possible, especially given the poor housing market in flood prone areas. New Urbanist style design is most commonly used in greenfield development (which would be the case for Aberdeen relocation), and it

could be argued that developers are attracted to greenfield development. Seabrook suggests that there may be a market for that type of housing in Aberdeen. While increasing density and improving Aberdeen’s historic core, the city can also be revitalized through the availability of new housing options on the hilltop.

From an environmental point of view, the Seabrook development is perhaps the only example in the Washington region of dense, sustainable design in a wooded, hillside environment that receives large amounts of rainfall. Permeable surface along streets is created through the use of Seashells, which doubles as a placemaking amenity. There are no curbs along streets and storm water is directed to raingardens. The backside of houses often face ravines where water from roofs is discharged. There is not as much shared community space as High Point in Seattle in terms of overall square footage. However, on-site programming does include a gazebo, playground and basketball court and community garden. Other community spaces include a bike shop/repair area, town hall, and indoor swimming pool. The small community also provides amenities such as boat/bike rentals, running paths, and a retail core. There are plans to bring more amenities to the neighborhood to further improve Seabrook’s walkability. While most of Washington’s seafront communities are less than 20 feet above sea level, Seabrook was built at 70 feet, well above run-up of a tsunami.

Casey Roloff, developer of Seabrook, stated in an interview that one reason for the development’s success has been a shortage of other places that use traditional design principles, even though they are in demand (Roloff, 2016). He believes that the design of the Seabrook resort can inspire people to see development in another way and expects development trends may follow. While some new developments include some aspects of its design (such as small lots) it is rare to see a place that comprehensively includes the architecture and community aspects that give the place its appeal. Overall, the strength of its Roloff’s brand is sense of community, and connections to friends and family. It is currently home to 70 permanent residents and 50 percent rental homes, but Roloff expects that the



Figure 17. New England inspired architecture in Seabrook. Photographs by Dan Abramson.



Figure 18. Permeable sidewalk fronting seasonal retail area



Figure 19. Alleyway access to townhomes and cottages.

area will grow over time and become a more permanent community with an increase in full-time residents, services, retail, and employment opportunities. The branding of Seabrook as a place with strong community connections, as well as its evolving function as a resort to a more permanent community, are examples of how near-term development driven by a specialized demand can grow into something more complete, adaptable and thus resilient.

4.2.5 Ecotourism and Programming

Programming and use of a site are as important as design to the resilience of a development. For some places, ecotourism is a means for promoting resilience because it provides new economic opportunities, and leverages those opportunities to raise awareness about sustainable practices and actively promotes the preservation of the natural environment, wildlife and local culture. Other goals of ecotourism include providing local and organic food, place-based community minded businesses, and supporting the local economy through locally sourced supplies of building materials, food, and other products.

For Aberdeen, a strategy that includes these goals are important to resilience. New ways to grow economically and encourage community development in the near-term are paramount to the future of Aberdeen. For this reason, the development concept shown in chapter 5 includes programming meant to foster economic and community development, as much its physical layout and design.

An example of ecotourism in a place with a similar climate to Aberdeen is “IslandWood” on Bainbridge Island. It is a 255-acre outdoor learning center to foster stewardship of natural environment

(Islandwood, 2016). Educational opportunities include school programs and an urban environmental education graduate program that stresses social-ecological resilience, sustainability, equity and justice. It also features a multi-purpose event center used for weddings, dining, retreats, adult education, and lodging.



Figure 20. IslandWood development connects users with nature. Source: IslandWood.

Sustainable design features at IslandWood are central to their marketing scheme. The campus is integrated with nature with minimal carbon footprint, but has capacity for many different functions.⁶ It uses roof rainwater used for irrigation, sustainable forestry and locally sourced materials, recycled uses such as carpeting, solar power, and natural ventilation.

Many developments in this region attract a resort community through their sustainable practices, natural surroundings, and the recreation it offers. Sleeping Lady Mountain Resort in Leavenworth, WA is one such place which offers amenities such as a fitness center, game room, library, sauna, organic garden, volleyball, horseshoes and badminton and bike rental.⁷ The housing types are clustered cabins, with a small footprint and reclaimed wood construction. The development also features an organic garden for food used in the kitchen and for composting.

Treehouse Point in Issaquah, WA transformed a wooded area into an up-scale “private event center and overnight retreat” (Treehouse Point, 2016). It consists of a main lodge with a library, dining, and lodging, as well as five tree houses that can be rented. It is a destination that frequently holds tours, events and weddings. The resort has a three-fold mission: nature conservancy centered on treehouses, a cultural events center that inspires and educates community, and an environmental learning center that facilitates stewardship of natural resources. While operating as a resort, Treehouse Point also seeks a wider range of sustainable benefits.

Like Seabrook, WA, discussed earlier, Oyhut Bay in Ocean Shores, WA is another example of a resort along the Washington Coast offering short-term cottage rentals. Rather than offering new amenities, the development markets itself through the existing recreation that make Ocean Shores attractive. It advertises possibilities of flying kites, making beach fires, clamming, bird watching, and biking. Construction is underway of a dense, walkable community with cottage homes. Multiple cottage types are offered and prices range from \$269,000 to \$439,000. The village uses Traditional Neighborhood Design concepts.⁸ Many amenities are clustered such as the village square, bike rental office, teen center, beach club, and bocce ball. Other amenities include nearby trails, community fire pits, and direct beach access. A caveat to Oyhut Bay being an appropriate model is that it sits in a highly vulnerable area in the event of a tsunami, and is threatened by erosion, storms, and sea level rise. In fact,

⁶ Site plan for Islandwood is shown in appendix 4. Floor plan of multifunctional building in IslandWood is shown in appendix 3.

⁷ Site plan for Sleeping Lady is shown in appendix 6.

⁸ Site plan for Oyhut Bay is shown in appendix 5.

there are many resort developments that sit in similar precarious positions along the west coast, further indicating the feasibility of a resort development in Aberdeen's higher ground in the long-term.

All of these ecotourism examples relate to resilience as they augment near-term development with environmental stewardship, educational opportunities, and place-based awareness. In Aberdeen, hazard mitigation and resilience planning should be concurrent with economic development, natural preservation, and social benefits. The examples here are important precedents as Aberdeen seeks to reinvent its struggling economy and revitalize its community.

Chapter 5: “From Resort-to-Refuge”

All of the preceding work to this point – literature, case studies, and design guidelines – is to inform one long-term adaption strategy in Aberdeen, WA. I present other contextual information about Aberdeen in this chapter, which was largely collected during an 11-week studio of University of Washington students (further discussed in section 5.2). I propose an adaption strategy in this section named “resort-to-refuge,” which is a relocation scheme that discusses near-term development opportunities, as well as its ability to provide relief as an evacuation center, and to adapt to a more permanent resettlement option.

5.1 Background Information

With 16,544 inhabitants, Aberdeen is the most populated City in Grays Harbor County. The tri-city area of Aberdeen, Hoquiam and Cosmopolis adds another 14,000 people. The City is situated 35 miles from the state capitol of Olympia, and 95 miles from Seattle. It is the self-declared “gateway to the Olympics,” due to its location on historic highway 101, just before the road heads north to the more remote areas of the Olympic Peninsula and Olympic National Park. Millions pass through Aberdeen’s downtown each year. However, even with this traffic, Aberdeen captures little in the way of tourism, and Aberdeen’s economy is struggling due to declining industry. The median household income has increased some in recent years to \$39,745, but 23.67% of the population lives below the poverty line, compared to the Washington State average of 13.55% (City Data, 2016). Although timber and fishing are not nearly as prominent as they once were, Aberdeen still relies heavily on these industries. Today, educational and health care services, agriculture, accommodation, and food services make up a large portion of the City’s economic base.

The impetus for this thesis is the threat of a tsunami caused by a Cascadia Subduction Zone earthquake. Scientific models show a magnitude 9 earthquake with the potential to cause liquefaction,



Figure 21. Aberdeen sits at the meeting point of Grays Harbor, Chehalis River, and the Wishkah River on the west coast of Washington State. Not far to the north are Taholah and La Push.

permanent subsidence of Aberdeen's most populated areas, as well as high levels of inundation.⁹ Beyond the threat of a tsunami, Aberdeen frequently floods, and many homes are currently ineligible for subsidized FEMA flood insurance. The region in general is very wet, averaging 83 inches of rainfall each year. Many homes in northern Aberdeen sit on steep slopes or bluffs that are prone to landslides. Much of the city is paved over estuarial flatlands. Due to this, Aberdeen floods regularly, and buildings are vulnerable to liquefaction following an earthquake. The climate and geography of Aberdeen are challenges, and in this chapter, I attempt to design a hilltop development that promotes growth in a way that is safe from hazards.

5.1.1 History

One of Aberdeen's strengths is its rich history, beginning with its original settlement by the Chehalis native people. The area's dense forest, fish, and abundant natural resources provided thousands of years of sustenance. The City was founded in 1884 and quickly populated due to its economic position as a provider of timber, fish and shipping (Brum and Associates; Thomason and Associates, 2014). As the demand for timber grew worldwide, and the City's shipbuilding industry became renowned, the population jumped from 1,638 in 1890 to 13,660 in 1910. It reached its peak of 21,723 people in 1930 and has since been slowly decreasing. Once considered the lumber capital of the world, the city was producing 450,000 board feet of lumber per day in the early 1990's out of only six sawmills. The rapid growth also made Aberdeen a place notorious for drinking, gambling, and prostitution.

At one time, Aberdeen was home to the most millionaires per capita in the country. This was brought to an end by 1930 due to clear cutting and the stock market crash. However, the industry bounced back due to post-WWII home building increasing the demand for timber products, and the introduction of more sustainable forestry practices. By the 1980's environmental restrictions and decreasing demand cause many mills to close. In 2005 the large lumber employer of Weyerhaeuser began to leave town, displacing hundreds of decent-paying jobs. The late 20th and early 21st century have been times of struggle for the Aberdeen economy and historic downtown. However, Aberdeen's waterfront is still largely occupied by mills that remain in order, and the shipping and shipbuilding industries continue to be a large part of the City's identity. None-the-less, structural economic changes

⁹ Appendix 2 shows inundation line used in deterministic model.

present a challenge, as well as opportunity, for Aberdeen to reinvent its economic base while maintaining its rich identity that is rooted in its tumultuous history.

5.2 University of Washington Studio Work

Most information and analysis about the City of Aberdeen for this thesis was gathered during an 11-week studio. The main objective of the studio was to engage the community regarding a potential tsunami, and in doing so find holistically resilient adaptive urban design solutions that address a variety of community needs. The studio was done in conjunction with the “M9” project, funded through a National Science Foundation grant, which aimed to study how communities planning for hazards might make use of probabilistic information of a tsunami hazard.¹⁰

Through site visits and remote research, students took an inventory of relevant information for the City. Students also each created their own individual “asset map,” to inventory business, land use, habitats, institutions, historic buildings, agriculture, tourism, events, shoreline use, industry and more.

Many of the identified assets were physical, and some non-physical. An example of physical tourism assets were Aberdeen’s 11 lodging options, 13 properties on the historic registry, and common attractions such as the Aberdeen Museum of History, Grays Harbor Historical Seaport Authority and the Kurt Cobain landing. Non-physical assets for tourism would include regional events, such as the Razor Clam Dig and Aberdeen Oktoberfest. Overall, a full inventory of assets is necessary before creating urban design solutions. However, it was necessary to match this information with a community workshop to learn more about which assets were most significance, and how they related to an adaptive resilience strategy.

¹⁰ The UW studio used both probabilistic and deterministic models in mapping and communicating the extent of tsunami hazard. Major sources for this information include (Witter, et al., 2013) and (Gonzalez, LeVeque, & Adams, 2014).

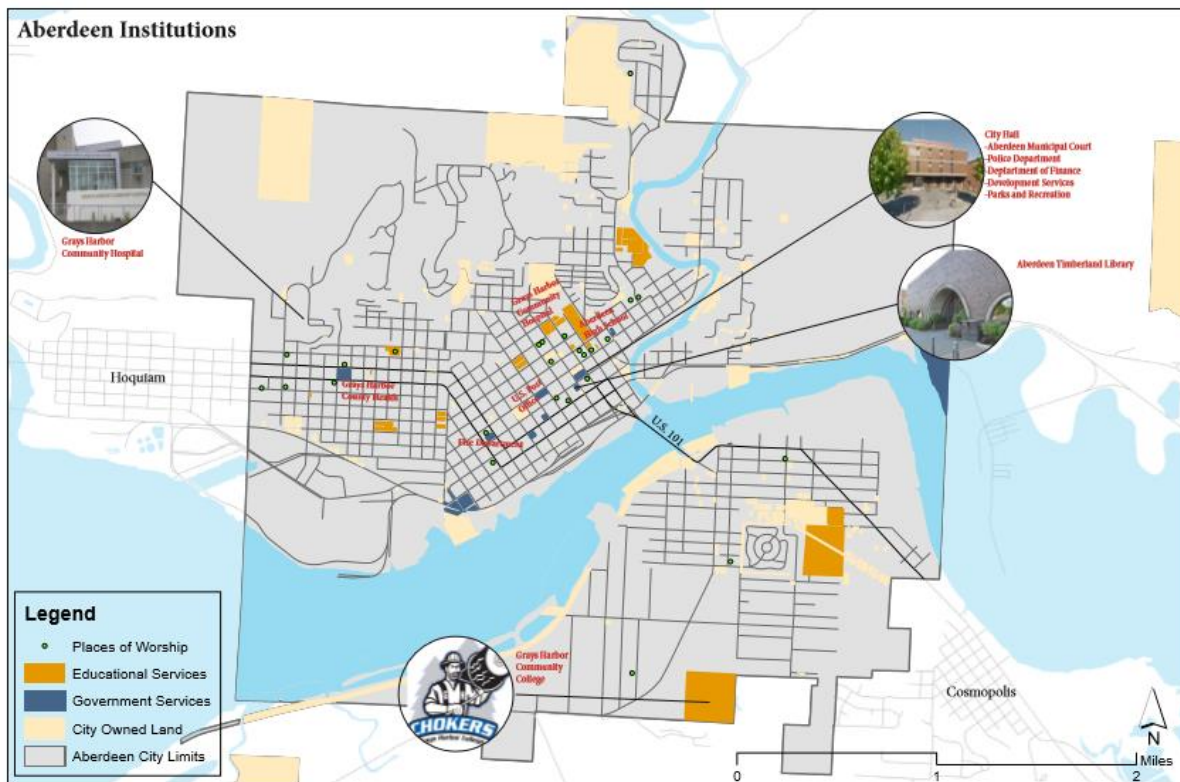


Figure 22. "Asset mapping" from UW studio. Map made by author.

5.2.1 Community Engagement¹¹

On February 11, 2016, the UW studio held a workshop in Aberdeen. The three main goals of this community process were to:

- 1.) Help state and county emergency managers to use new scientific info about a Cascadia Subduction Zone Earthquake
- 2.) Apply knowledge of community engagement methods, hazard mitigation planning and urban design
- 3.) Empower community become more resilient to all changes and plan for the future

¹¹Detailed information about community engagement process and results, including use of deterministic and probabilistic tsunami models, is covered in Ashley Bennis' 2016 University of Washington Thesis, titled "Public Risk Interpretation in Community Resilience Planning: A Case Study in Aberdeen, WA".

For any adaptive urban design strategy, community input is important. Even more beneficial would be an engaged participatory design process, as described in some of the literature and cases in chapters 2 and 3. In Aberdeen, the UW studio held a workshop with Aberdeen community members, using an interactive participatory GIS technology called WeTable. The community members, many of them professionals working for the City, split into groups where discussions included narratives, story telling, and the use of interactive maps to spatially identify assets, risks, and solutions. Facilitation questions were given in three rounds, as follows:

- 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?

The workshop invoked both an asset-based and vulnerability-based approach. While most hazard mitigation approaches start with vulnerabilities, the asset-based approach allowed stakeholders to freely discuss what was important in the community. This process encouraged participants to think more creatively about solutions, and identify a wider range of comprehensive planning goals, while a vulnerability approach typically causes a more narrow-minded focus on the hazard itself. Through this workshop, UW students collected valuable information about community assets, values, providers, and short-term and long-term goals, which in turn inform urban design solutions that are multi-faceted and grounded. The abbreviated responses from the workshop are summarized in the Table 2.

Beyond identifying all of this, the workshop revealed a willingness by participating stakeholders to explore creative solutions. Participants took advantage of the discussion about the hazard to discuss as well the possibility for various revitalization strategies. Beyond identifying only vulnerabilities, they uncovered many opportunities, for example the untapped potential of tourism. However, stakeholders also understood the existential threat of a tsunami. Relocation of infrastructure and residents was discussed as both a pre-disaster and post-disaster solution. With this, residents expressed concern that a relocation area would need to be completely self-sufficient for at least 30 days. Opportunities were scattered amongst concerns for a relocation scenario, such as small businesses becoming the catalyst for recovery, and a “new Aberdeen” allowing for possibilities of new industries, such as cross-laminated timber production and tourism.

Table 2

<p>Assets: Quiet Good place to retire Outdoors and natural resources Urban life but with fishing and water Access to water and sloughs/ catching crab History Rainforests Largest city in region Known for education/school system People know people. People help people</p>	<p>Vulnerabilities: Elementary school City hall Police station Fire station Port facilities Grocery stores and all food sources Sewer treatment facility Rail infrastructure Bridges Hospital Water and power sources Ambulances</p>
<p>Providers Post-Disaster: Main hospital East Campus of hospital Life Straws (temporary solution for water) Fire (temporary alternative for power) Logging roads Uphill water tanks Greater Grays Harbor Community Areas on higher ground Home owners outside of inundation area Kits of food (good for at least 7-14 days) Neighbors Helping Neighbors</p>	<p>“New Normal” Providers: National Guard US Army Corps Red Cross State (roads/ highway) FEMA Utilities Air traffic Dam outside of town Logging industries up the Wishkah river Grayland Airfield Small businesses (first to revitalize) Port of Aberdeen (first to “bounce back”) Undeveloped northern area Rebuilding homes and relocating Train lines</p>

The challenge following the workshop is to synthesize input and realize it in design. Students came up with a variety of solutions, from doubling evacuation routes as regional bike paths, fortifying the historic downtown, and reusing the shoreline in a way that is resilient as well as a public amenity. In the case of relocation, where I have focused my efforts, much was discussed about the idea in general terms. For example, residents expressed worry that higher ground would become the new normal after an event, homeowners outside the inundation area would be relied upon, infrastructure needed to be moved preemptively, and people would need to be self-reliant for at least 30 days after evacuation.

However, there were little specifics of how this would look in a design. One of the limitations of this thesis, as noted in section 1.3, is that an effective community design process that informs a relocation strategy, would need to focus more directly on the issue of relocation, as was seen in the engagement process undertaken in Taholah and La Push. However, the information uncovered discusses needs that are illustrated in my resort-to-refuge concept. I combine this information from the workshop with theory, site analysis, and urban design principles in the following section.

5.3 From Resort-to-Refuge

The culminating product of this thesis is a relocation scheme for Aberdeen. Chapter 2 established a foundation of theory around resilience and how it can be achieved. Chapter 3 showed examples of different resilient approaches in practice, including first-of-its-kind village relocation master planning for indigenous villages along the Washington coast. Chapter 4 established precedent theory and examples of sustainable and resilient site design and programming. To this point, chapter 5 specifically discussed the context of Aberdeen, including the threats of a tsunami and frequent flooding, and the need for community designed, holistically resilient, adaptive urban design solutions. In this section, I apply many of the concepts uncovered in this work on one untried site.

This chapter applies preceding research and analysis to answer central research questions that remained unsolved: How can relocation planning reconcile long-term solutions (to uncertain future problems) with short-term needs? How can local context and community engagement inform a relocation design and strategy? In order to address these questions, my relocation scheme in Aberdeen applies theory, precedents, and local context on one untried site. Resilience in the relocation plans can be measured not only by how it can provide relief, but also by how it can uncover co-benefits in the short and long-term, whether it be economic, social, or environmental. A few of the main goals of this project are listed below:

- 1.) Area should be designed with 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 through its high level of sustainability and livability.
- 3.) Duplication or relocation of city infrastructure and assets would increase resiliency.
- 4.) Careful site planning and programming could accommodate a resort community in near-term development, as well as be adaptable enough to be a long-term resettlement option.

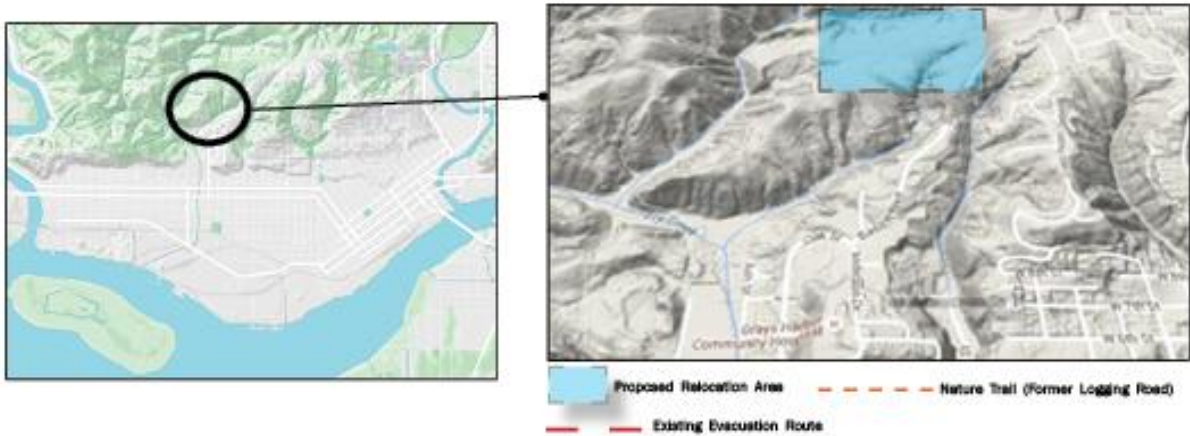


Figure 23. Location of proposed relocation area.

5.4 Site Conditions and Schematic Design Concepts

The proposed relocation area spans over four large parcels, with a total area of 43.3 acres. However, the buildable area is severely constrained by streams, surrounded by steep slopes. Low density residential skirts the site to the east of Basich Boulevard, while Grays Harbor Community Hospital is adjacent to the south. The parcel farthest to the left is city owned, the northern parcel is owned by Wayerhauser lumber company, and the other two by a private owner. The site is along a major evacuation route.

While site development potential is high due to it consisting of large, undeveloped parcels with few owners, it poses many challenges due to its topography. Still, much of the area is flat and has high capacity if housing is clustered, lots are small, and other low impact techniques are used (as outlined in Chapter 4). Many of the site's characteristics are opportunities through the integration of natural infrastructure in the overall layout. The diagrams in figure 28 illustrate concepts of the site's arrangement and use.



Figure 24. GIS map showing relocation parcels and surroundings.



Figure 25. Current Seabrook development superimposed on Aberdeen site for scale. Seabrook is an example of Low Impact and New Urbanist design and has similar topography and geography as the relocation site. See section 4.2.4 for more about Seabrook.



Figure 26. Logging roads go through the relocation site. Photograph taken by author.



Figure 27. During heavy rains, swampy areas such as this can be rain gardens that mitigate storm water and offer aesthetic benefit. Photograph taken by the author.

5.4.1 Site Ecology

The natural conditions on the site pose some challenges, as well as opportunities. Aberdeen receives 84 inches of rainfall every year, creating the need for stormwater management strategies. The wet conditions have caused landslides in the area adjacent to the site. The site ecology diagram in figure 28 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. I show green space corridors in the site ecology diagram, which connect the steep ravines and streams with trails, and orients the development toward its great natural surroundings.

5.4.2 Districts

The second diagram in figure 28 shows a concept for districts on the site. The darkest area is a central area near Basich Boulevard, and is a gateway to the site with commercial and retail uses. The next darkest color is an open-space corridor that 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 surroundings - where different housing types can be located.

5.4.3 Circulation, Nodes and Landmarks

The final diagram in figure 28 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 comprised 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.

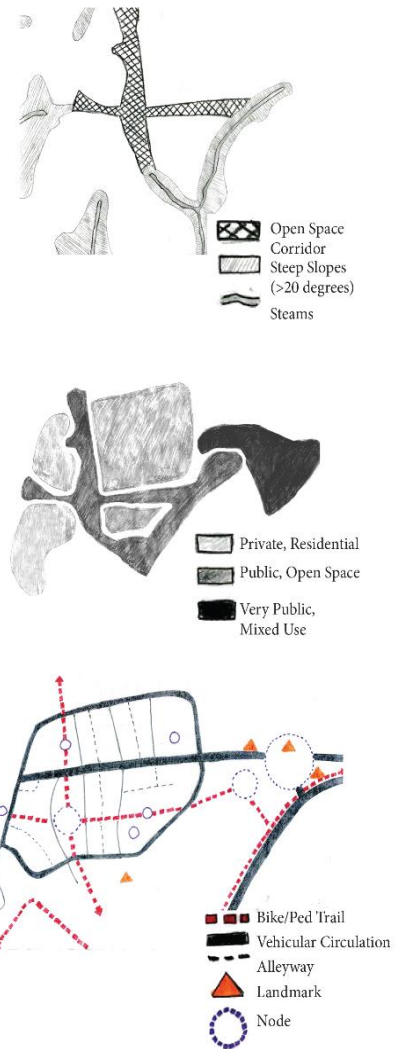


Figure 28. Conceptual diagrams of site.

5.5 Near-Term Development

North of Aberdeen’s historic downtown is where wealthy mill owners historically built their homes on hillsides and slopes, such as on Broadway Hill. Many middle class residents built on Scammell Hill and Arnold Hill. Many of these dwellings reflected wealth of mill owners through finely crafted wood construction popular styles of the early 20th century. The prospect of uphill development in Aberdeen

today is to introduce an entirely new product that can help recreate Aberdeen’s identity, in a way that is consistent with the community’s values and needs.

The City has an old housing stock, with a high percentage built before 1959. The median home list price is \$104,000, although that is an improvement from only \$80,300 in 2009, but is

very low compared to the Washington State average of \$250,800 (City-Data, 2016). Aberdeen has many long-term residents, with 45.8% of housing stock is owner occupied. Of the remaining, 39% is renter occupied, and 15.17% is vacant. Most dwellings are single-family detached, and approximately one-quarter of the housing stock in Aberdeen is multi-family housing.



Figure 29 Example of historic neo-Georgian style home in Aberdeen. Photograph taken by author.

Despite the housing statistics, a near-term development in the uphill area of Aberdeen can provide a new product that attracts current residents, as well as new residents. On site, programming and site marketing can attract vacation rentals, delving in to a growing ecotourism market on the Washington coast that Aberdeen has been unable to capture. The target market in the near-term is largely in this demographic, as means for revitalization in the short-term, which in turn provides resources to prepare for long-term resilience.

Figure 30 shows Aberdeen’s low home list prices compared to the state average. Pacific Beach,

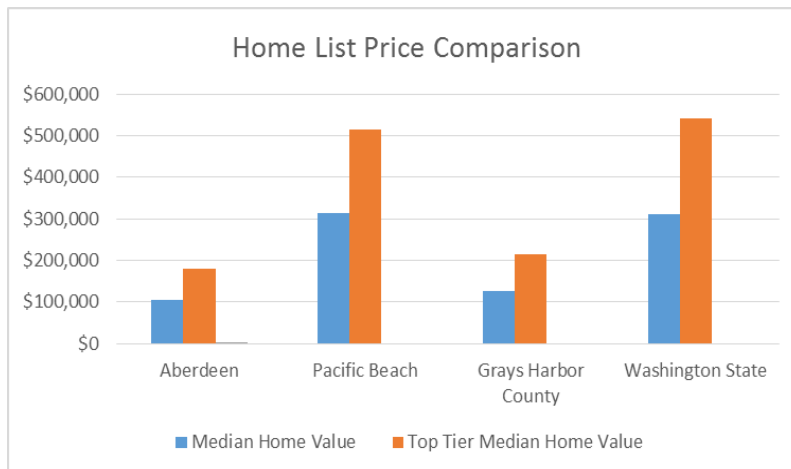


Figure 30. Home List Price Comparison. Source: Zillow

only 30 miles from Aberdeen and more remote but directly on the coast, has much higher home values, especially in the top tier category, at nearly three times that of the top tier in Aberdeen. This is due to Seabrook, a resort community discussed in section 4.3.5. The success of Seabrook indicates a latent demand for this brand of housing. With continued growth in

demand for second homes and vacation rentals, a new uphill development in Aberdeen could capture some of that market due to its favorable location. While most resort communities in Washington and

Oregon are built on sand spits on the coast, Aberdeen offers a heavily wooded location close to urban amenities. The motivations of second-home buyers can be summarized as “push” factors (a desire to escape something that was undesirable) and “pull” factors, meaning the amenities offered at a new location (Meyer, 2006). Pull factors in Aberdeen could be connection to nature, recreation, and on site activities, and proximity to the restaurants, theatres, health services and other amenities of Aberdeen.

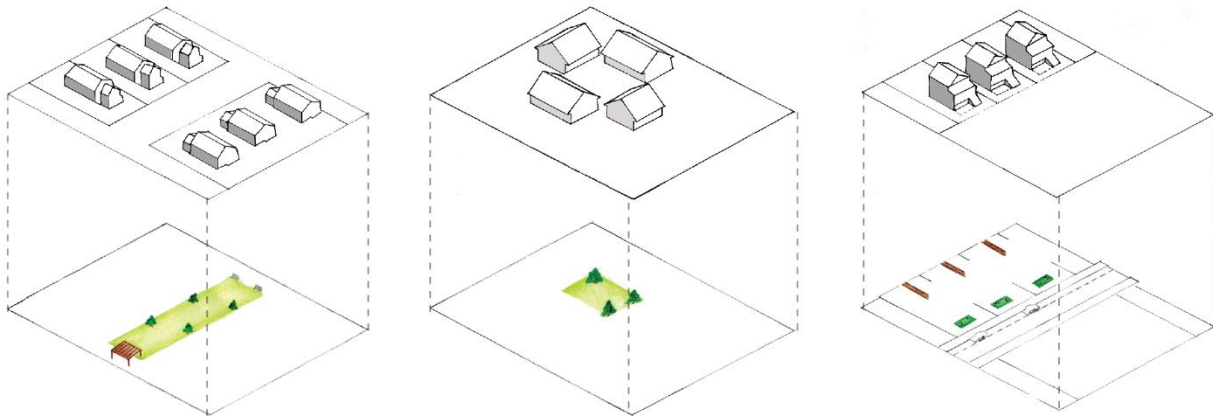


Figure 31. Diagram of potential building typologies such as a cottage community with common open space (left), a lodge cluster (center), and townhomes with alleyway access (right).

New housing products that could be introduced in Aberdeen are shown in figure 31. These typologies are available in other successful markets and support different needs. For example, cottage housing is often less than 1200 square feet, small enough for a second home of a retired couple and affordable enough for first time owners. The lodge clusters offer a small intimate community and have worked well as vacation rentals in the resort community of Sleeping Lady in Leavenworth, WA, as discussed in section 4.2.5. Shared open spaces are an amenity for homeowners and also reduce the amount of square footage needed for individual lots and increase the amount of pervious surface.

The site plan above shows one potential build out of the site, illustrating its capacity. The concept avoids sensitive areas and incorporates natural systems as circulation corridors for bicycles and pedestrians. The design uses many of the low impact development principles discussed in chapter 4. Features of this site layout are as follows:

- Narrow lots (40’* 100’) that support diverse housing types, detached garages, and ADUs
- Alleyway access for parking
- Hybrid Curvilinear/grid street network for reduced paving and increased walkability

- Hierarchy of large open spaces to semi-private communal spaces
- Clustered Housing

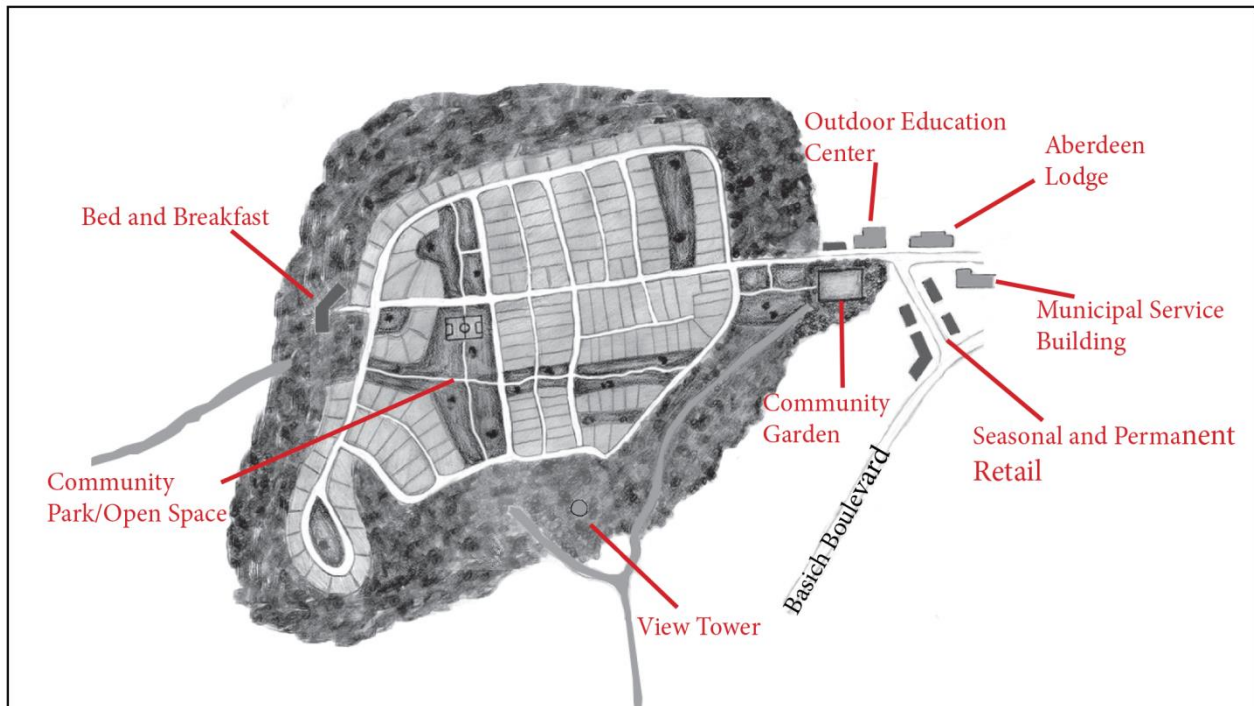


Figure 32. Conceptual site plan showing full build out of site using design principles discussed in chapter 4. Site plan illustrates potential uses on the site, with most community and commercial facilities located near Basich Boulevard.

The site also supports amenities for a resort community and permanent residents, such as:

- Outdoor Education Center used for school trips to promote hands on learning about Aberdeen’s ecology, lumber industry history, recreation, and more
- Aberdeen Lodge with multi-functional space
- Regional and local biking/pedestrian paths through open space corridors
- Bed and Breakfast
- Community Garden
- Seasonal Retail

I have two motives for programming the site in this way. The first is amenities to attract new markets into Aberdeen and to make the project stand apart from other developments in the area. For example, the outdoor education center, community garden, seasonal retail, and many recreational

opportunities are part of an ecotourism package: designed to provide entertainment and leisure while also keeping Aberdeen’s history and environment at its core.

The second motive is the adaptability of the site as a strategy for resilience. The site is already adjacent to reserve water towers, as well as Grays Harbor Community Hospital, and is a premier location for additional relocation or redundancy of municipal services and infrastructure. This includes a municipal service building for relocation of the fire department, which is currently vulnerable. Beyond that, much of the buildings and programming on this site support refuge and permanent resettlement, as is discussed in section 5.6.

5.6 Refuge and Resettlement

As noted before, the site plan in the previous section is one concept of a build-out of this site, but it is likely to happen in phases as it evolves to meet new needs. I chose literature in chapter 2 that stresses the importance of adaptability in form and function, and put it into practice in this design concept. There are many layers to the issue of resilience in Aberdeen, with different scopes and different timings. As much of the literature argues, a resilient place is not from a top-down design but rather one that can adapt to a changing set of circumstances. Much of the adaptability of this site is in its built form, while some takes more imagination. Overall, a development will need to provide in three different phases. First is the near-term development. Second is the use of the area as immediate relief in the event of a tsunami. Third, is the evolution of the area to a more permanent community, as it becomes an option for relocation of displaced households, due to inundation and permanent subsidence.



Figure 33. Concept of a three-bedroom vacation-rental townhome converted into housing for two families as temporary shelter after a disaster.

Phase 1: Near Term Development

- Low density
- Vacation rentals and private homes
- Seasonal retail and resort amenities

Phase 2: Refuge

- Very dense
- Reuse of facilities for relief
- Vacation rentals occupied as temporary housing

Phase 3: Resettlement

- Medium density
- Increase in civic space
- Commercial activity

5.6.1 Immediate Relief

Uphill development is a place to duplicate city infrastructure and services. 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 likely during and after 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.¹² Important city services that are currently in the inundation area should be reproduced on this site, such as fire, police services and emergency vehicles.¹³ 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.

5.6.2 Refuge

As is often the case after a crisis, temporary housing becomes the only option for many people. After Hurricane Katrina, thousands were kept in the Super Dome where conditions were poor.

¹² Figure 24 shows location of some existing infrastructure adjacent to relocation site.

¹³ See table two for identified vulnerabilities and figure 22 for their mapped location.

Sometimes people have the option of moving in with friends or family, sometimes they do not. As was mentioned in section 3, the 2004 tsunami in Japan, many are still living in temporary housing, hoping for their community to be rebuilt, but are lacking necessary services, jobs, and community facilities.

Uphill development in Aberdeen offers the possibility of temporary housing that would be appropriate for families, elderly, and other groups. The resort site plan shown earlier features an inn that could house many people for a short period. Civic buildings such as the Aberdeen lodge could also be converted into shelter, and cluster housing, such as the typology shown in the last chapter, may be appropriate as a temporary senior center. Temporary rental units would likely be vacant and available for use. Bedrooms that have their own bathroom may need to be occupied by individuals or families, while kitchen and common area facilities can be shared, as illustrated in figure 33. The Aberdeen lodge can also house hundreds temporarily, until better options are uncovered.



Figure 34. Concept of Aberdeen lodge with resort programming on the left, and reuse as evacuation center and temporary shelter on the right

Figure 34 shows one example of a building accommodating second use to assist during a crisis. Instead of simply housing people, a reused community center can support refugees in a variety of ways.

While large conference and lobby spaces, as well as a covered outdoor area, can house hundreds temporarily, other rooms can be reprogrammed to meet various needs. For example, a bistro can become a community kitchen, with food coming from the storage area as well as the community garden. The bike shop can be converted to a community bike sharing operation. The building should have large areas set aside for storage of emergency supplies, backup power, and a communications facility.

5.6.3 Resettlement

In the February 11 workshop, some officials agreed that small businesses would lead Aberdeen's recovery. The infrastructure set in place along Basich Boulevard would allow for a transition to a more permanent commercial center. What were once boutique retailers and seasonal food vendors would become service providers and a center for a resettled population. Larger spaces would need to be used for light manufacturing uses.

The uphill development design concept has good bones, meaning it is not intended for one specific use, such as a resort community or subdivision, but can expand into a community. The diverse housing types support ownership and rental opportunities for many of the relocating Aberdeen residents.

The vision for resettlement is for a complete community, meaning the inclusion of civic uses. Aberdeen lodge's third life would be a community-focused space, housing youth programs, a library, a museum and a computer lab. The outdoor education center could become a fully functioning K-12 school. Bike and pedestrian connections to Aberdeen's historic core could be strengthened. As the site grows to meet every day needs of the population, it will start to naturally evolve from a temporary function to a more permanent one.

5.7 Summary

The plan above describes and illustrates a vision for a long-term adaption strategy, and its conceptual spatial representation. It does not describe specifics for implementation, which could be pursued in subsequent research. Design standards could be conceivably implemented through a planned unit development in order to allow greater flexibility in configuration of buildings and uses on the site. Low Impact Development techniques can be implemented through enhancement of development regulations and incentives (lower minimum lot sizes, limited impervious surface

allowance, open space requirements, density incentives for retention of native vegetation, etc.) The resort-to-refuge scheme, however, does conceptually illustrate the elements that should be included in a resilient relocation plan. Generally, these elements include the infrastructure, services, community facilities, economic opportunity, and a community-inspired design. Table 3 shows comparisons of these aspects to the Taholah and La Push case studies.

Table 3

	Taholah	La Push	Aberdeen
Relocation of services/infrastructure	Communication facility and evacuation center	Emergency storage of food, water and fuel, alternative power sources such as solar panels, shelter facilities, and health services	Fire department, Emergency vehicles, storage of water, food, fuel, and supplies, reuse of Aberdeen lodge as shelter, community garden, bicycles
Community facilities	Multi-purpose community center	Tribal government building, museum/community center, school	Aberdeen lodge, outdoor education center, community garden, retail area, view tower, parks and trail system
Design principles	Low impact development, 5-minute walk concept, energy efficient homes	Divided into districts based on existing site conditions	Low impact development, housing diversity
Economic opportunity	Cross-laminated timber manufacturing	Small-scale retail space, acquisition of business park, seafood processing facility	Ecotourism, up-market housing, small-scale retail space
Community engagement	Series of workshops	Educational videos, Design charrette	University-led participatory mapping workshop

It is unlikely that Aberdeen could attempt any relocation master plan such as the ones in Taholah and La Push, due to differences with private property rights, social organization, and funding. However, the phased approach allows different projects to be leveraged at different times. Growth can be focused and incentivized in the uphill areas of Aberdeen through re-zoning, flexible development standards, density incentives, and capital improvement projects. Development in the near-term opens

up funding for new infrastructure and utilities that can support the relocation of other city-owned buildings, and the locating of new industries. Aberdeen should explore opportunities to leverage projects, whether initiated by the City or by private market, to realize both short-term opportunities as well as long-term adaption possibilities.

Chapter 6: Conclusion

As noted in the introduction, the relocation of coastal communities is going to become an increasingly relevant field of study in the planning profession. Increasing coastal storms and climate change could cause the displacement of millions. This thesis discussed a much more uncertain event of a tsunami, but my argument applies to any hazard or threat that faces a community. Proactive planning for even the most uncertain scenarios is necessary, and is arguably less costly than the potential cost of relief, but only if it also serves more immediate and certain needs.

There are not many precedent examples in the United States to study for relocation planning. A major challenge in this thesis was to take an undeveloped body of knowledge and apply it to an untried site in Aberdeen. Instead, this thesis pulls from a range of literature about resilience, design precedents, and local conditions, in order to develop a contextually sensitive site-planning concept that meets, or at least addresses, a variety of issues. Further, the resort-to-refuge scheme attempts to leverage opportunities in near-term development, as means for the long-term needs for disaster relief and resettlement in the event of a tsunami. Exploring the co-benefits of resilience planning suggests that Aberdeen can prepare not only to survive the immediate effects of a disaster, but also to recover, rebuild, and reorganize into a preferred state.

Aberdeen's resilience is not a quantifiable metric but rather a qualitative outlook as to how well it can thrive through adaptation and evolution. The purpose of the conceptual site plan in figure 32 is not to illustrate exactly how Aberdeen could look post-disaster, but to suggest how uphill development could create conditions that foster recovery. This vision also requires funding physical improvements on the site, which is done through short-term development opportunities. The University of Washington studio strove to demonstrate how a community asset-based disaster planning could help communities prepare for uncertain futures, even as they address current needs. The resort-to-refuge plan applies resilience thinking by considering Aberdeen's short-term needs and long-term recovery in one site. The case of Japan in 3.1.1 highlights the importance of a disaster plan that reduces vulnerability, but also ensures continuity of all elements of society without much reliance on external providers. I conceptualize this continuity in my resort-to-refuge scheme.

Aberdeen's example draws parallels to relocation case studies discussed in chapter 3. Despite obvious differences, such as land-ownership issues (leasing of tribally owned land) and social organization (role of elders), both Taholah and La Push have relocation plans that are directly relatable,

as shown in Table 3. Overall, this is through incorporation of cultural and economic opportunities into their uphill plans, so that people do not need to rely on external providers, but instead have means to help each other and to rebuild.

My first research question was: How can relocation planning reconcile long-term solutions (to uncertain future problems) with short-term needs and constraints? While the motive for relocating in Taholah and La Push was to ensure the long-term safety of the community, the planning process also explored new economic and community development opportunities. In Aberdeen, long-term recovery plans are enhanced by exploring short-term development possibilities on the site. The site is also an excellent location for redundancy of infrastructure and emergency supplies in the short-term, to better prepare for a disaster.

My second research question was: How can local, especially site-scale, context and community engagement inform a relocation design and strategy? This question requires context-specific analysis and design. Taholah and La Push developed design principles both from outside examples, as well as information gathered through community engagement. On-site programming reflected cultural values through the community facilities and housing types. In Aberdeen, on site programming was inspired by a community workshop. Because the workshop did not directly address a relocation design, I developed concepts based on a set of precedent examples from developments in similar conditions. These precedent examples included developments in the region that illustrated possibilities in Aberdeen at the site scale, such as low impact development principles, as well as housing typologies and on site programming possibilities. In chapters 4 and 5, I make the argument that these site scale possibilities have a relationship to short-term needs and opportunities in Aberdeen.

6.1 Future Research Opportunities

The resort-to-refuge project combines many elements into one vision, but subsequent work should focus in greater depth in one area or another. As noted in the limitations in section 1.3, I did not include a study of feasibility of near-term development, or suggest a marketing strategy. The adaptation of the site to a refuge situation would include property rights issues, land scarcity, political obstacles, and funding. It is important for future research to look at the public sector as an agent for this kind of change. How might a city initiate voluntary buy-outs of vulnerable homes? How can municipal codes, public incentives, and public expenditures lead to the adaptable built form that I advocate? Another opportunity for research is in the connection between urban design and resilience. My design concepts

are inspired by an Aberdeen workshop and by urban design theory, such as the importance of flexible and adaptable forms and functions. Future research should focus on how relocation design can be truly context sensitive, for example, through a critical study of New Urbanism and its ability to meet the needs of all demographics in Aberdeen; rather just the sub-market of vacation home owners and renters. This could also be done by designing a community engagement process that can further identify community values and needs in an uphill relocation, such as housing preferences, civic space, economic opportunities, and design concepts.

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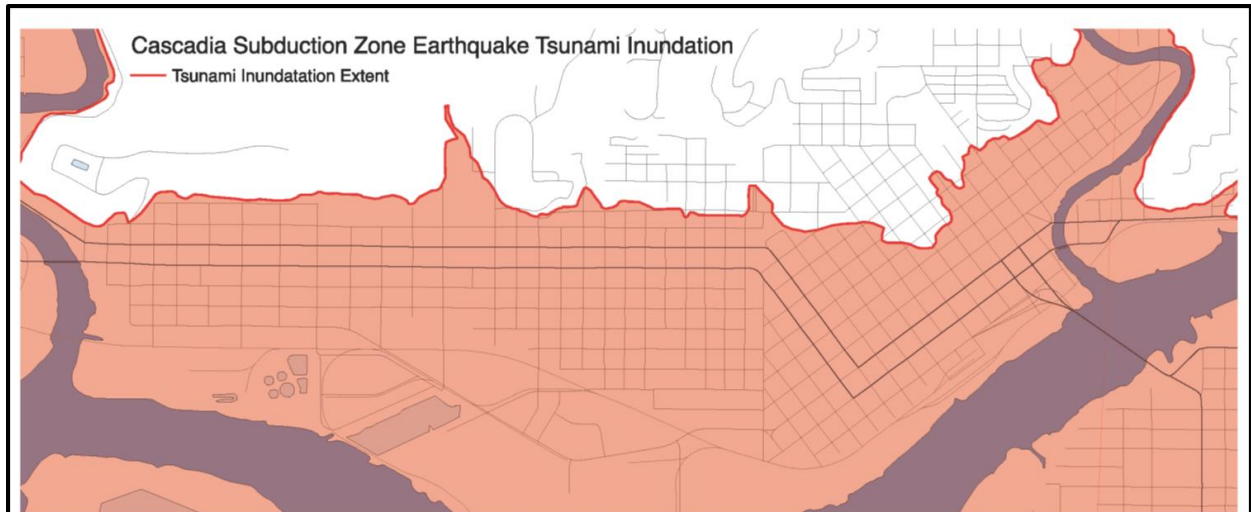
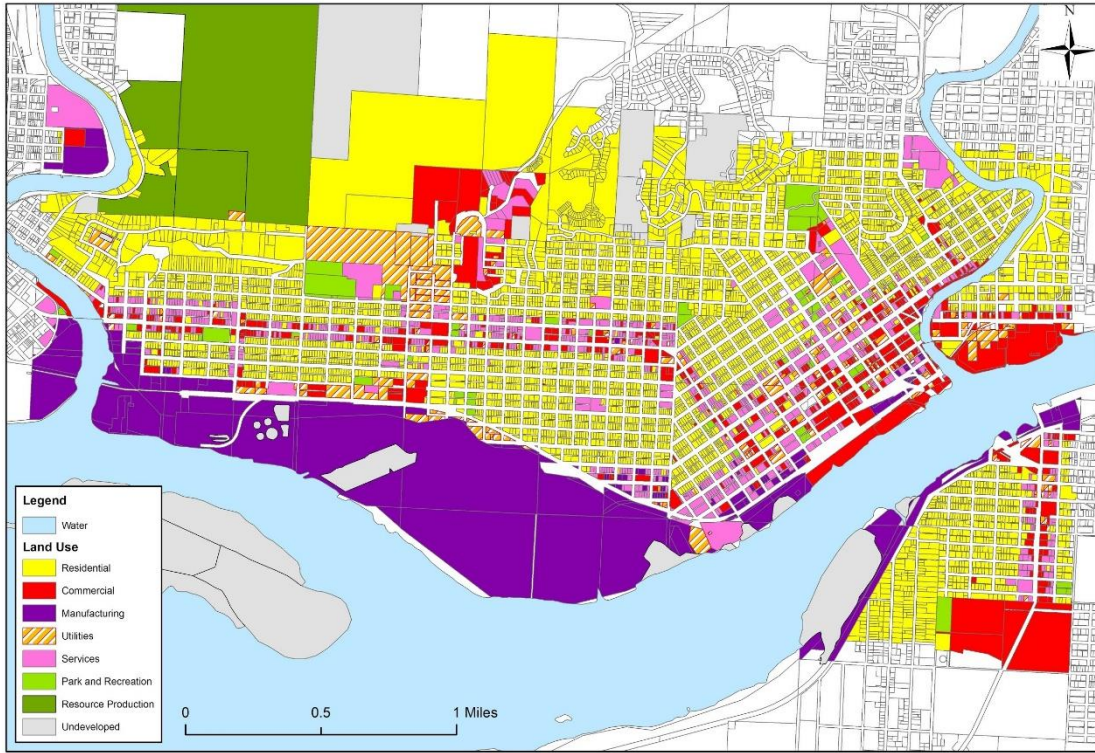
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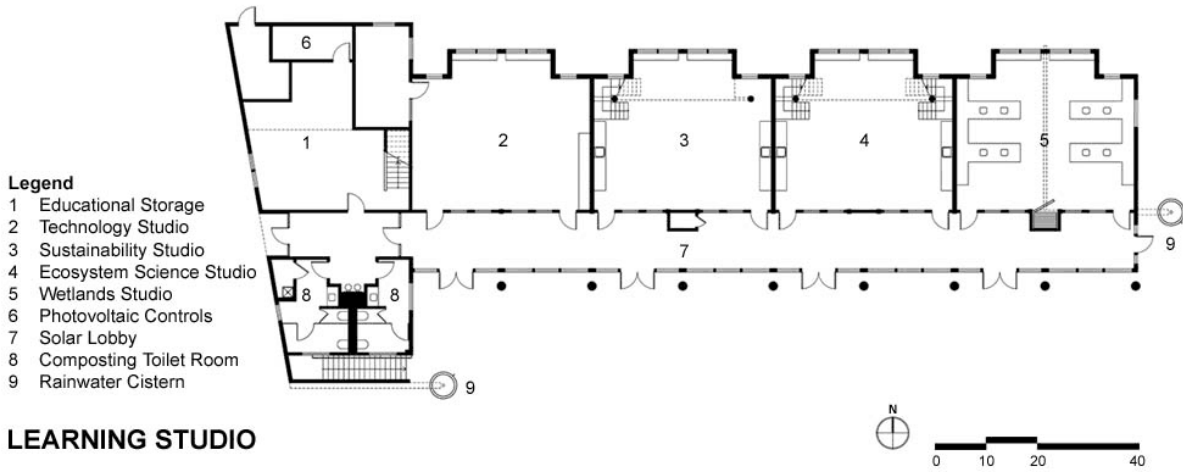
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Study Area Land Use Map



Appendix 3: Learning Studio Floor Plan at IslandWood.



Appendix 4: Islandwood Site Plan.



Appendix 5: Oyhut Bay Site Plan.



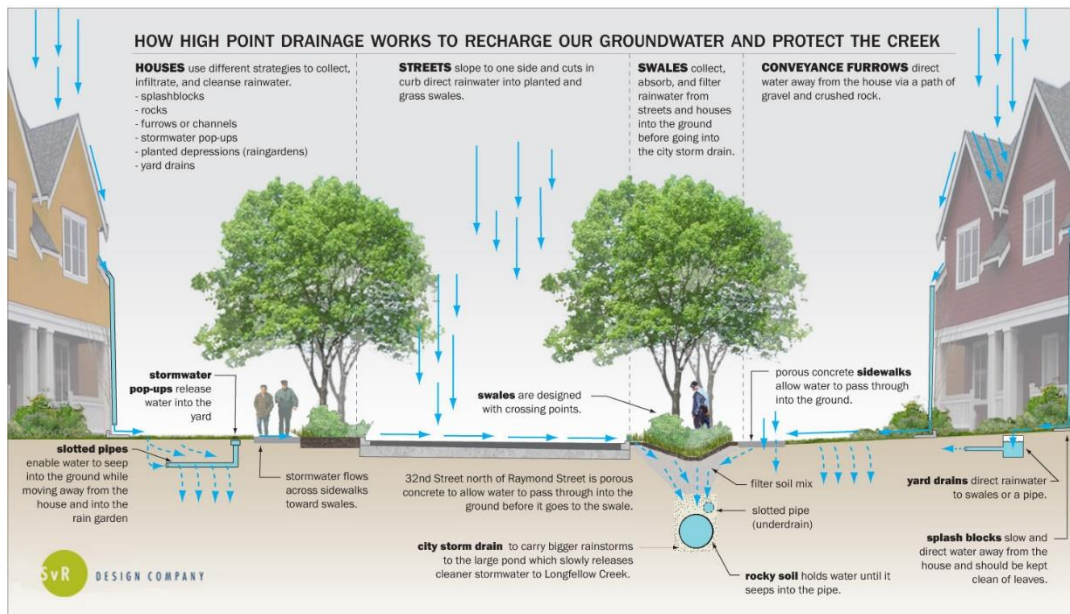
Appendix 6: Sleeping Lady Site Plan.



Appendix 7: Danielson Grove Site Plan



Appendix 8: High Point, WA Illustration of LID Stormwater Principles.



Uphill Development For a Revitalized Aberdeen

Colin Poff

Why Relocate on Higher Ground?

- 1.) Area could have capacity to assist temporarily displaced in 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

Where on higher ground could a relocation area be sited?



Low Impact Design

Low Impact Design includes techniques for stormwater management, natural infrastructure, and minimizing paved surfaces to minimize flood risk while promoting sustainability.



A standard cul-de-sac in Taholah, WA is designed with a Bioretention area to reduce the amount of paved surface and enhance aesthetics.



The High Point mixed-income community in Seattle, WA is made up of 40% open space by including semi-private space, pocket parks, and community parks.



Simple features like this one in Portland, Oregon are a cost-effective and attractive way of collecting stormwater runoff using native plantings.

Innovative New Development

Diverse housing types, connection to nature, and onsite programming are a few of many ways to make an attractive community in northern Aberdeen.



The Innovatively designed community of Seabrook along the Washington coast is an example of a housing market that could potentially work in Aberdeen.



The Islandwood campus on Bainbridge Island connects people to nature through sustainable practices and outdoor education programs.



Danielson Grove in Kirkland, WA is a walkable suburban community with low-impact cottage housing and well-placed community amenities.

Leave Suggestions Below!

What Needs to be Relocated to Higher Ground? (Ex: Infrastructure/Housing)



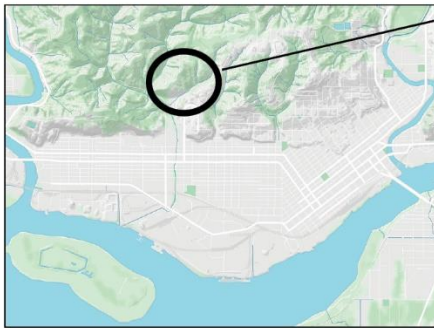
What Else Could Go in a New Hillside Development? (Ex: Comm. Center/Trails)



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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 reliability 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.



Proposed Relocation Area Existing Evacuation Route Nature Trail (Former Logging Road)

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.

Schematic Design

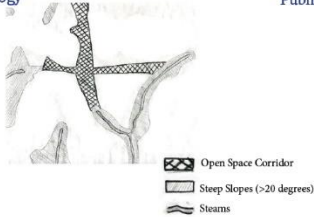
Site Ecology: The natural conditions on the site pose some challenges, as well as opportunities. Aberdeen receives 84 inches of rainfall every year, creating the need for storm water management strategies. The wet conditions have caused landslides in the area adjacent to the site. The site ecology diagram 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 orient 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

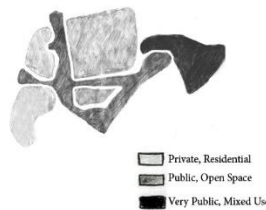
and civic uses can be clustered here to serve the site as well as the surrounding area, and would be a highly public area. The medium shaded area mimics the green space corridor shown in the site ecology diagram. The corridor connects regional trails, public parks, and wooded areas, and acts as a public 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.

Site Ecology



Public and Private



Site Photos



The Experience



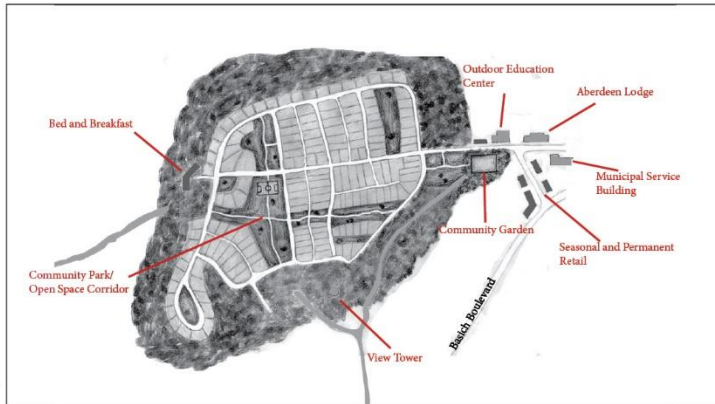
Near-Term Development

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' x 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.

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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 multifunctional 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.

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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 meant 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.

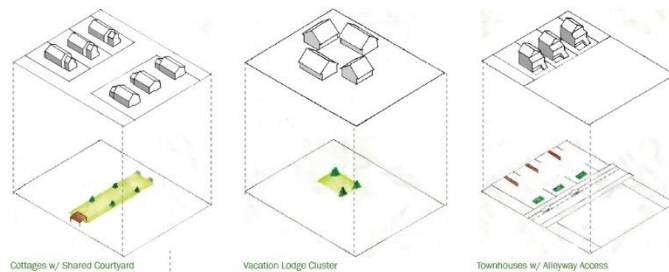
Seabrook, WA

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



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Residential Typologies



Cottages w/ Shared Courtyard

Vacation Lodge Cluster

Townhouses w/ Alleyway Access

"Islandwood," Bainbridge Island, WA

- 255 acre outdoor learning center to foster stewardship of natural environment
- Multipurpose event center houses weddings, 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.)



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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

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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 like-

ly 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.



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.

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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 of 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.

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Temporary housing for thousands of families in Minamisanriku, Japan.



Temporary housing for evacuees of the Utsata Village, Japan.



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.

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