Design for Relocation and Reassembly:
Self-Determined Adaptability for the Shoalwater Bay Indian Tribe's 'Upland Expansion'

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ABSTRACT

Design for Relocation and Reassembly:
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This thesis explores how buildings that are intended to be assembled, disassembled, and reassembled can address current and future needs of the Shoalwater Bay Indian Tribe (SBIT) while supporting cultural continuity for their community as they adapt to changing shorelines and coastal hazards through relocation and upland expansion. This continuity of "home" across multiple dwelling sites promotes self-determination of households, families, and the tribe as a whole by incorporating local materials and labor in adaptable, low-carbon design methods while connecting to historical practices. The methods used in this thesis are informed by traditional building methods and typologies of the region, and demonstrate how relevant technology and materials available today can be used to address the desire for culturally-relevant and deeply sustainable architecture that can meet the needs of the community, maintain their health and safety, address adaptation and mobility, consider attachment to place, and promote self-determination. Prefabricated panelized construction addresses the housing shortage and affordability problem in the tribe's current lowland location, supports the ability to move homes to safer upland sites, and addresses long-term, multigenerational housing needs. Access to housing and community services are inherent to the livelihood of the tribe during this transition. Architecture that responds to environmental risks in a culturally-affirming way can ease the transition to a new location while supporting current and future generations. The findings intend to benefit other tribal communities who are facing similar environmental threats to their lands.

Keywords: climate change; coastal hazards; resilience; housing; place attachment; Indigenous building practices

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náxʷɬqʷul’as / masi / thank you

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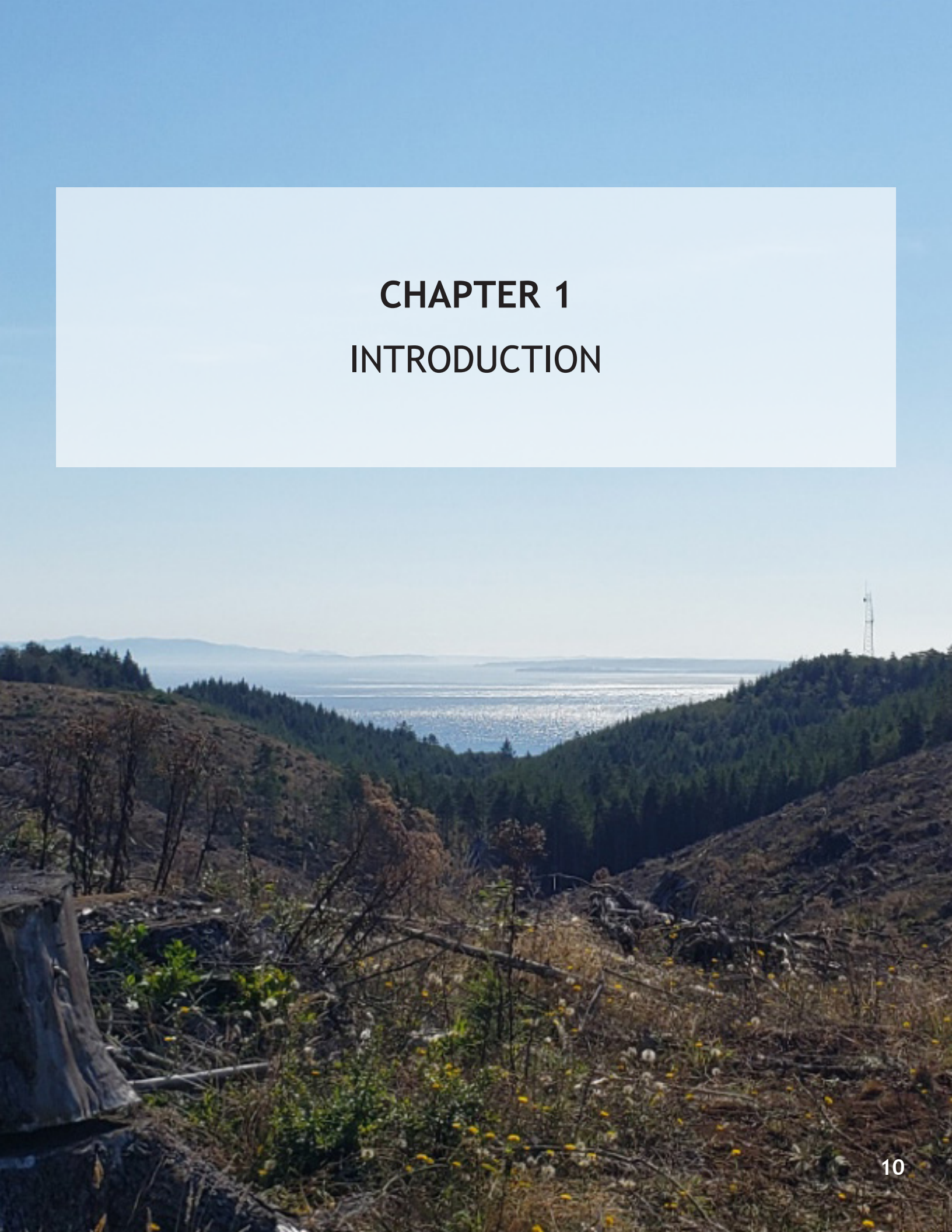
CHAPTER 1

INTRODUCTION



CHAPTER 1. INTRODUCTION

1.1 Problem Statement

The Shoalwater Bay Indian Tribe (SBIT) is a federally recognized Tribe in western Washington state whose people have traditionally stewarded the lands surrounding the Willapa Bay, from what is now Tokeland (north end) to Bay Center (south end), and as far east as Satsop (Figure 1). Their reservation[1] is located in Tokeland and the majority of their tribal members currently live along the Pacific Coast from Ilwaco to Aberdeen (Figure 2). This area has seen significant changes to its coastal landscape due to climate change, and the dynamic coastline is threatened by possibility of coastal erosion, sea level rise, tsunamis, flooding, storm surges, and landslides (History section of the Shoalwater Bay Indian Tribe website, n.d.; Hutchinson and Abramson, 2021).

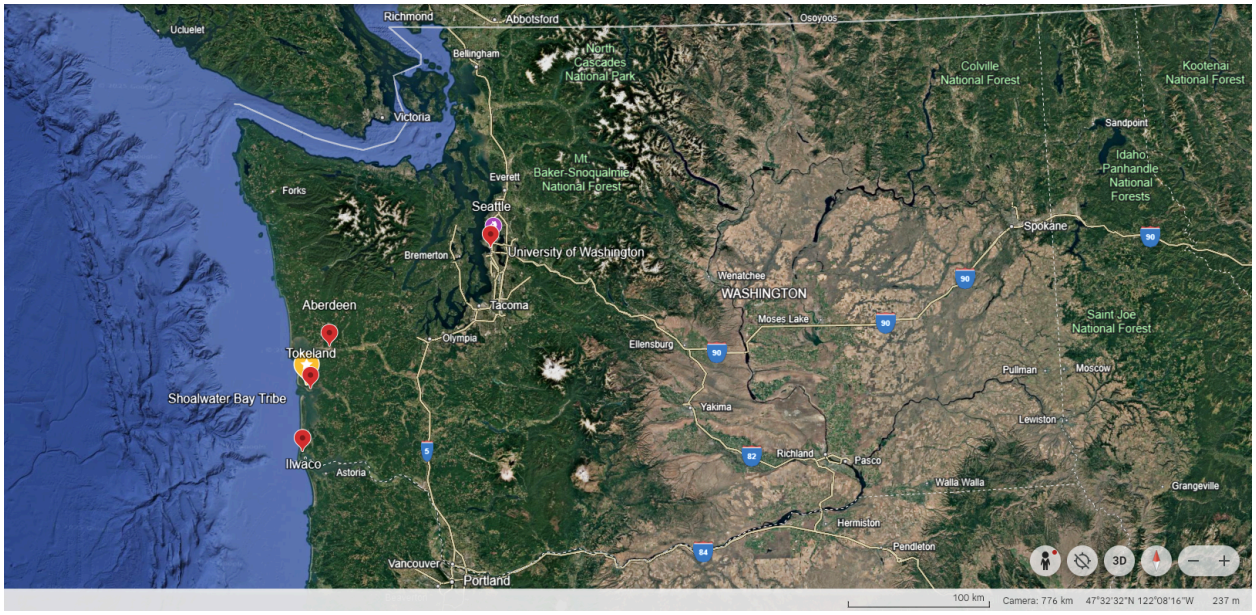


Figure 1. Map of Washington state with locations mentioned throughout this thesis. Created in Google Maps, 2025.

[1] A federal Indian "reservation" is an area of land reserved for a tribe or tribes under treaty or other agreement with the United States, executive order, or federal statute or administrative action as permanent tribal homelands, and where the federal government holds title to the land in trust on behalf of the tribe. Approximately 56.2 million acres are held in trust by the United States for various Indian tribes and individuals. There are approximately 326 Indian land areas in the U.S. administered as federal Indian reservations (i.e., reservations, pueblos, rancherias, missions, villages, communities, etc.) (US Department of the Interior Indian Affairs, 2017). The usage of the term "Indian" is used for legal purposes with the federal government and is a term to describe Native peoples for hundreds of years. However, based on personal interactions and observations, the shift to use the terms "Native" or "Indigenous" is popular among younger generations and is spreading to older generations as well.

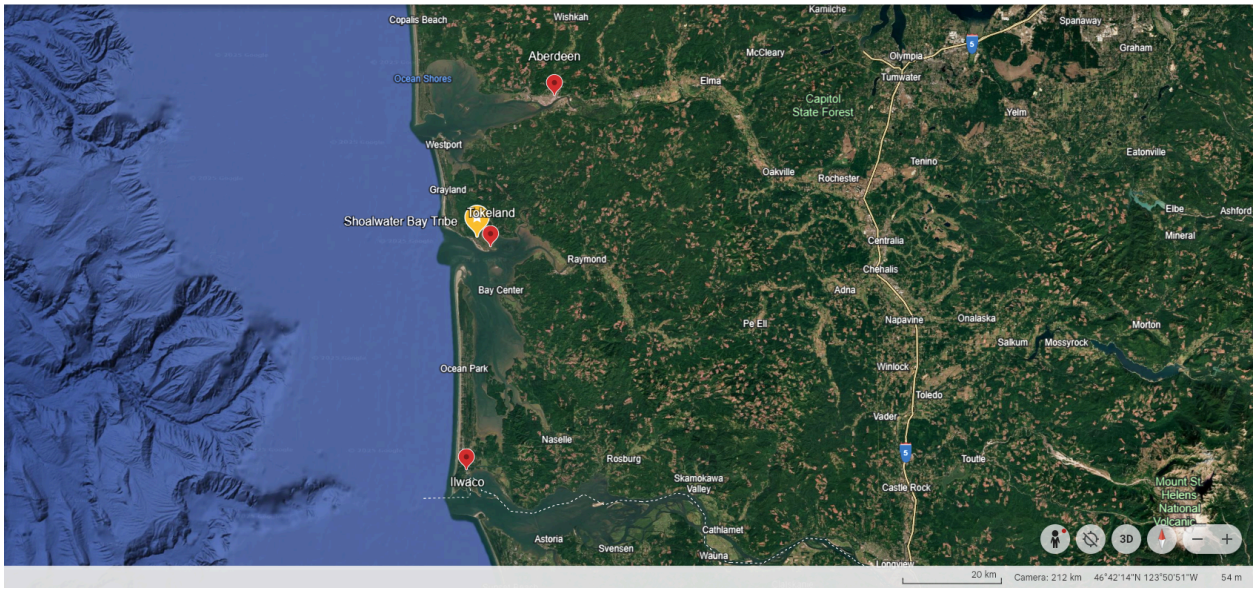


Figure 2. Map of regional area with locations mentioned throughout this thesis.
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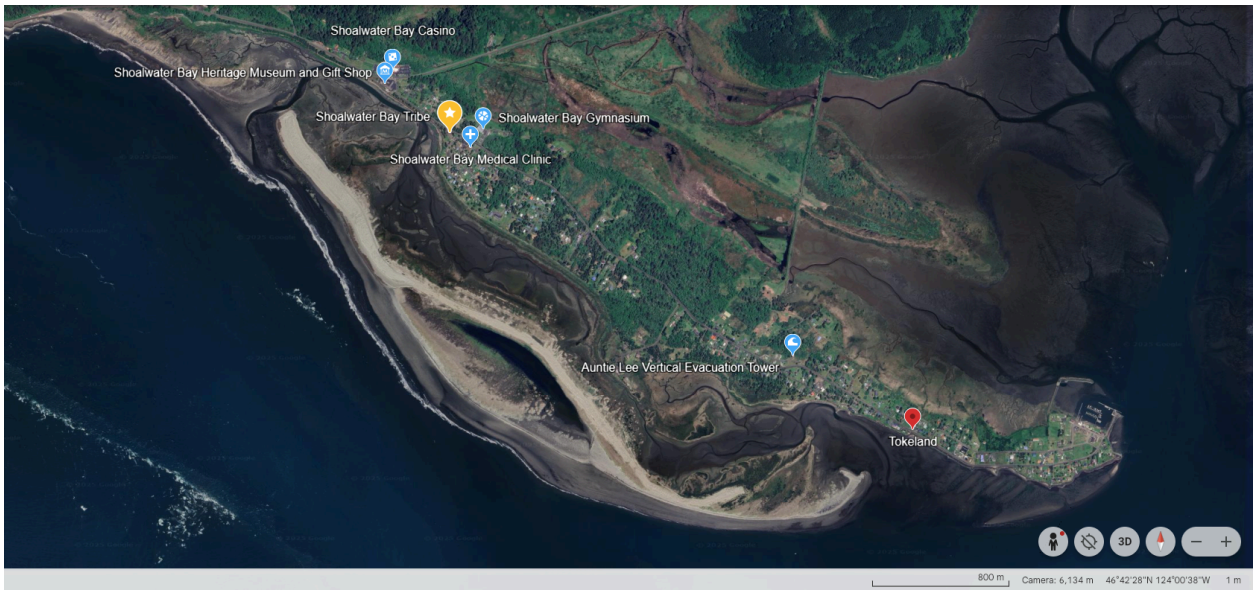

Figure 3. Map of local areas with locations mentioned throughout this thesis.
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In response to these environmental threats to their land and community, the Tribe is planning for an 'upland expansion' project to move their existing community from the lowland area (Figure 3) on the reservation into the upland area, which was reclaimed from timber companies and put into trust for the Tribe (Abramson and Judkins, 2022). The upland expansion is intended to ensure the safety and well-being of their community, considering currently living members and their future generations. They have received federal grant funding to begin the process, and have created a gravel road to get to the upland area which they intend to develop. The tribal government is successfully moving forward with the plan (Red Plains Professional Inc., 2024), and some members of the Tribe are looking forward to their new community infrastructure in the uplands, while others are mourning the loss of attachment to their coastal homelands as they have always known them and are reluctant to leave the lowlands (Abramson and Judkins, 2022). Displacement as a result of climate change is particularly painful for indigenous people who have such deep ancestral ties to their lands, and these kind of managed retreat projects involve communities relocating together, distinct from individual homeowners moving through property buyouts (Siders, 2019).

Coastal communities such as SBIT are facing drastic impacts to their natural and built environments, thus creating a need to adapt[2] and plan for the future (Hasert et al., 2024; Hicks, 2020; Hutchinson and Abramson, 2021). Architecture has a unique role to play in planning future communities that are safe physically safe from environmental threats while also making the new location feel like "home" to the people that make up the community. Cutting edge architectural methods informed by indigenous methods of building is a viable solution to these problems.

1.2 Research Question

What can architecture offer an indigenous community to help them respond to environmental risk in a culturally affirming way that supports self determination?

[2] According to the IPCC, the terms "adaptation" and "mitigation" are not interchangeable, as they are distinct responses to climate change. "Mitigation is an anthropogenic intervention to reduce the sources or enhance the sinks of greenhouse gases (IPCC, 2001a)" while "Adaptation is adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities (IPCC, 2001a)" (Klein et al., 2018). SBIT is doing both by adapting by preparing to move to the uplands and mitigating the risk of lowland climate hazards with vertical evacuation towers and sand berms.

1.3 Thesis Statement

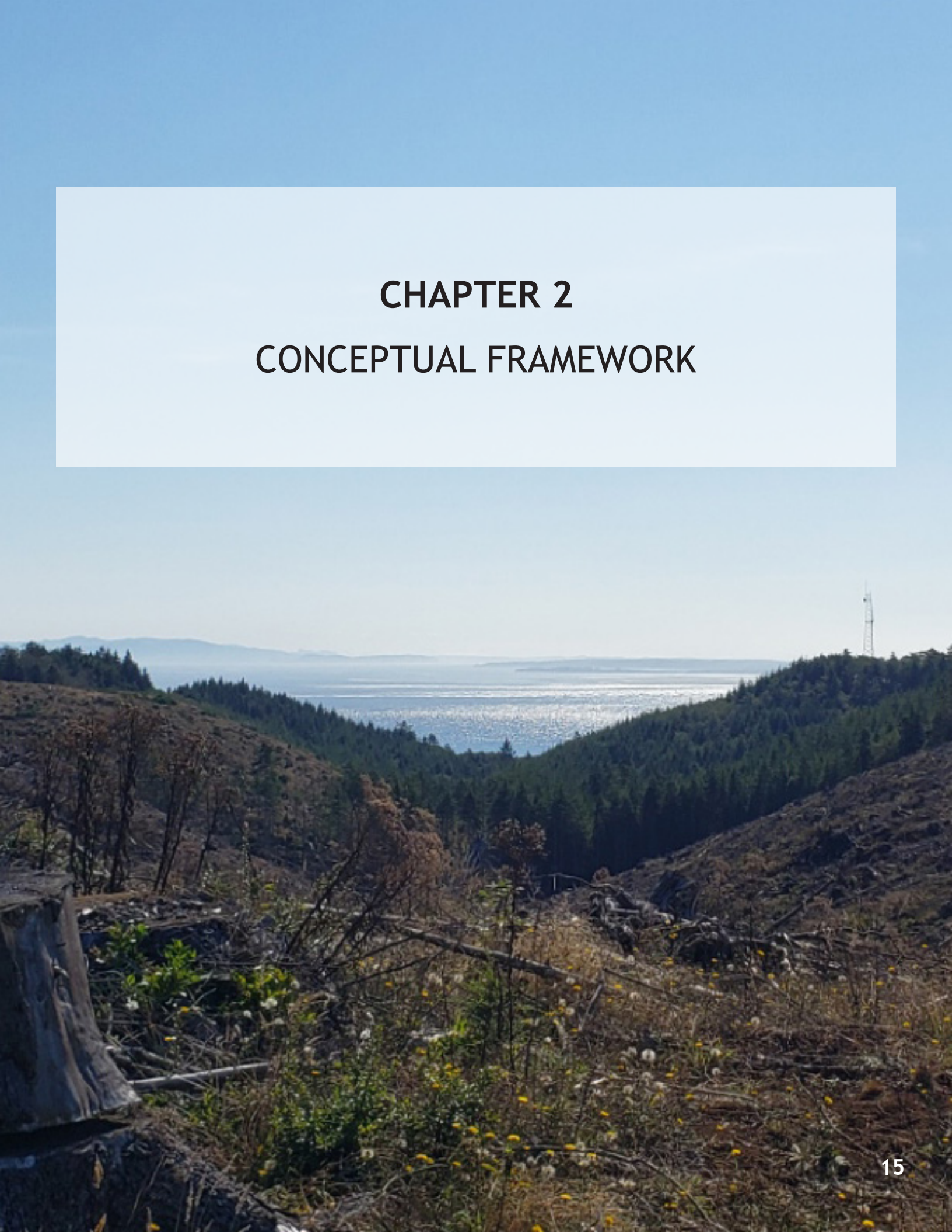
This thesis explores potential architectural design solutions, which I believe will meet the needs of the Shoalwater Bay Indian Tribe during their transition through relocation, and to the 'upland expansion.' Chapter 3 will delve into historical building precedents indigenous to the area and the modalities in which traditional structures were managed serve as a primary argument for potential building methods that follow such adaptations. This revitalization of traditional housing practices will simultaneously honor the Shoalwater Bay Indian Tribe's cultural heritage while also creating autonomy for each family over their new homes by providing opportunities to participate in the fabrication, assembly, disassembly, and reassembly as needed while monitoring climate change impacts to the area. Designing such adaptive structures that are also sustainable by employing low embodied carbon materials and construction methods as well as low operational carbon energy technologies for heating, cooling, and ventilation will enhance local self-resilience and self-determination and allow the community to not rely on outside resources and utilities as much. This thesis argues that community input, cultural continuity, adaptive low to zero carbon design, localized manufacturing, and maintaining deep connection to the land are imperative to ensuring a safe and sustainable transition for the community while meeting their safety needs now and in the future.

1.4 How to Use This Thesis

This thesis is intended to present the Shoalwater Bay Indian Tribe, as well as other coastal Tribes and communities faced with managed retreat, with viable building design options for housing and community infrastructure that could meet current needs of housing affordability in the lowlands and future needs to move to higher ground while allowing some members of the Tribe that desire to remain in the lowlands to continue to reside there. When it becomes more urgent to move, these homes can be disassembled, transported, and reassembled amongst the growing community in the uplands.

CHAPTER 2

CONCEPTUAL FRAMEWORK



CHAPTER 2: CONCEPTUAL FRAMEWORK

2.1 Displacement as a Result of Climate Change

Displacement of communities due to climate change hazards is an increasingly urgent concern worldwide. According to the United Nations High Commissioner for Refugees (UNHCR), an average of 21.5 million people have been forced to relocate due to weather-related sudden onset hazards, such as floods, storms, wildfires, and extreme temperature. This does not include other hazards that take place over time, such as droughts or coastal erosion due to sea level rise (UNHCR, 2016). Additionally, the Climate Change 2014 Synthesis Report Summary for Policymakers published by the Intergovernmental Panel on Climate Change (IPCC) projects that environmental threats due to climate change will increase displacement of people in the future (IPCC, 2014). These crises require governments - federal, state, local, and tribal - to respond by developing plans for adaptive responses, such as managed retreat, in order to protect communities at risk.

"Managed retreat" is a proactive response to this environmental risk. It is defined as the "purposeful, coordinated movement of people and assets out of harm's way" (Siders, 2019, 216). It is an adaptation strategy that can potentially eliminate anticipated risk, as opposed to other strategies that resist. In the United States, flood management has typically approached the issue of people living within areas threatened by coastal hazards by keeping people and infrastructure in place in at-risk areas (Siders, 2019). These methods include resisting floods with seawalls and levees, adding sand to eroding beaches, or elevating homes to avoid rising tides. Managed retreat[3] is typically more difficult to organize and implement, but ultimately necessary for some communities (Siders, 2019). One region in the United States with particularly vulnerable coastlines is the Pacific Northwest. In Washington state and Oregon, Northwest coastal Tribes are participating in adaptation planning and implementation efforts to help guide funding, policy, technical services, and other activities to better support climate resilience (Hasert, 2024).

[3] It is important to note the difference between "managed retreat" vs "upland expansion," as the two terms are not interchangeable. Managed retreat is based in western quantitative reasoning, while upland expansion is more based on Indigenous qualitative reasoning. In managed retreat, there appears to be more intention to abandon a place that is faced with environmental threats, while upland expansion methods seek to maintain connection to the location - in SBIT's case, the lowlands - and does not focus on loss or retreat but on the wholeness. Managed retreat is subtractive, whereas upland expansion is additive and adaptive.

Northwest coastal Tribes are at risk of dislocation from sea level rise, ocean acidification, extreme heat events, increasing wildfire risk and declining snowpack. These climate change threats impact their communities' health, infrastructure, culture, and economics. As a result, many of these Tribes have taken action to prepare for impending environmental risks, such as by completing climate change vulnerability assessments and adaptation plans (Grossman et al., 2012), and by planning for community relocation (Lehman, 2017). Despite the leadership that tribes have taken in adopting these plans, tribal listening sessions with thirteen Northwest coastal Tribes in Washington and Oregon highlight the obstacles they continue to face in achieving their adaptation goals (Hasert, 2024). The main areas of concern among Tribes are adequate funding, Tribal staff and workforce capacity, maintaining collaborations and partnerships, sufficient technical assistance and climate services, and effective communication, education, and outreach (Hasert, 2024). Federal and state climate adaptation funding opportunities are vital to advancing adaptation planning for climate resilience, but these sources typically limit the autonomy of Tribal leaders. Tribes will typically be required to apply for multiple grants in order to bring in the large amounts of money needed to complete climate adaptation-related projects. Other issues that arise are general lack of funding or federal and state agencies not honoring Tribal autonomy over their funds (Hasert, 2024). Jamie Judkins, tribal member, former Tribal Planner of the Shoalwater Bay Indian Tribe, and current Account Executive with Resource Synergy, explains (Hasert, 2024, 10) how the Shoalwater Bay Indian Tribe's climate adaptation efforts, including moving their community to higher ground, have been met with challenges along the way:

> "I was thinking about the funding barriers that we have. We're trying to piecemeal all these different grants together. One [grant] is to build this house, but it's only for low-income people. Then you've got a different agency grant that can build the road but it can't take the infrastructure to that house."

Tribal governments often lack the staff and workforce capacity to carry out their climate adaptation planning and address obstacles such as personnel turnover. This lack of capacity then requires other tribal staff to take on even more work. Tribes are often located in rural areas and finding suitable housing for staff can be difficult (Hasert, 2024, 14). Additionally, tribal leadership may

change over the course of long-term climate adaptation projects. Despite these challenges, it is imperative that government agencies and technical service partners respect tribal sovereignty, as well as the Tribe's best interests and plans for their own communities. It's also vital to have effective communication amongst stakeholders, and outreach to the community to inform people about how their communities may change in the future. Many Tribes value the input of their tribal members, since future plans impact physical and mental health, livelihoods and economies, environmental quality, cultural continuity and other contributors of well-being for tribal communities (Hasert, 2024). In the case of the Shoalwater Bay Indian Tribe's 'upland expansion' project, the community will be moving from the coastal lowland area on and around their reservation to a safer area uphill thereby maintaining the continuity of their tribal community for future generations. They refer to their managed retreat efforts as 'upland expansion' because it evokes more hope and continuity, and it will impact tribal members individually, as well as the entire community as a whole.

Figure 4. Map of South Beach, Washington. Hutchison and Abramson, 2021.

The Shoalwater Bay Indian Tribe's reservation lands are located on the northern tip of the Willapa Bay (Figure 4) near Tokeland, Washington. Much of the reservation is coastal marsh subject to flooding and sand spits that have eroded or moved dramatically; the shoreline retreated inland an average of 100 feet per year in the century prior to 2017 (Talebi et al, 2017, 2). These threats to their land have prompted multiple large-scale coastal revetment and refuge projects to prevent their homelands from being significantly impacted by erosion. Although multiple construction projects to restore dunes on Graveyard Spit have slowed the erosion rate in recent years (Washington CHRN and WECAN, 2021), climate-driven sea level rise, changes in storm patterns, and other coastal dynamics threaten to further reduce the Tribe's habitable land (Wise Oak Consulting LLC, 2024). Another environmental threat to this area are rare megaquakes and tsunamis that transform great stretches of coast along the Cascadia Subduction Zone (CSZ) from Northern California to British Columbia (Hutchison and Abramson, 2024). With increasing amounts of water flowing into the land and increased rainfall due to climate change, the Shoalwater Bay Indian Tribe and other nearby coastal communities will experience flooding and coastal surges (Flavelle and Irvine, 2022). At this time, most of the Shoalwater Bay Indian Tribe's infrastructure is built on low-lying sand spits, putting their community's livelihood at risk of various environmental threats.

The Shoalwater Bay Indian Tribe's hazard mitigation efforts include a constructed dune (Figure 6) to prevent storm surges and erosion to the lowlands (Figure 5), and a vertical evacuation tower as a place to find refuge if a tsunami occurs. The Army Corps of Engineers worked with the Shoalwater Bay Indian Tribe to build a dune in 2013 for $8.4 million, but three storms breached the dune and damaged it. Another attempt was conducted in 2018, and this dune was also breached by storms. The Army Corps of Engineers are currently working on a larger stretch of dune which is anticipated to cost around $40 million dollars (Washington CHRN and WECAN, 2021; Flavelle and Irvine, 2022). As of July 21, 2025, "dynamic revetment construction and dune restoration began, and restoration work is expected to be completed in February 2026 (Washington CHRN and WECAN, 2021). In August 2022, the Shoalwater Bay Indian Tribe completed their tsunami vertical evacuation tower (Figure 7), intended to serve the tribe and surrounding Tokeland community, the second in Washington State and third in the nation - following the first tsunami vertical evacuation tower at the nearby Ocosta School District and a second

at the Hatfield Marine Science Center in Newport, Oregon. According to a Washington Military Administrator (2022), the tribe contributed about $1.2 million for the tower and a Federal Emergency Management Agency (FEMA) grant covered more than $3 million. Despite these impressive feats, these climate adaptation projects are not enough to fully protect the Shoalwater Bay Indian Tribe's community long-term. In 2023, the tribe received a Rebuilding American Infrastructure with Sustainability and Equity (RAISE) grant of $25 million to support the Upland Village Relocation Road Project, allowing them to begin construction on the road (Figure 8) that will take people into the uplands (Cantwell, 2024). The tribe has received additional funding, such as the 2024 EDA $1.25 Million Award "Upland Development Master Plan Update for both Short Term and Long Term Development Areas" and 2023 IHGBC $6.28 million Award for the first phase of construction uphill (Red Plains Professional Inc., 2024). The Tribe is successfully implementing the foundational work for their 'upland expansion' project (Figure 9).

Figure 5. Aerial view of the lowland sand dunes. Shoalwater Bay Indian Tribe, https://www.shoalwaterbay-nsn.gov/.

Figure 6. U.S. Army Corps of Engineers dune to protect the Shoalwater Bay Reservation. Flavelle and Irvine, 2022.

Figure 7. Shoalwater Bay Indian Tribe's Vertical Tsunami Evacuation Tower. WA Military Administrator, 2022.

Figure 8. Upland Road. Red Plains Professional Inc., 2024.

Figure 9. Eagle Hill Road Post-Construction, leading to the uplands. Red Plains Professional Inc., 2024.

Despite the fact that managed retreat or ‘upland expansion’ is a viable long-term option for the Shoalwater Bay Indian Tribe to move their community out of a hazardous zone, these choices do not suggest that there are no sacrifices to consider. Displacement due to climate change means people are involuntarily removed from their homes because of environmental threats for which they are not directly responsible. While managed retreat is a climate adaptation approach that physically moves a community and its infrastructure out of the environmentally hazardous zone, it involves social and psychological difficulties for the displaced people and is somewhat controversial (Dannenberg et al, 2019; Hino, Field & Mach, 2017). Both individual and group experiences of those being displaced can shape attachment to place, perceptions of the potential destination, and economic prospects, also shape attitudes toward retreat (Hino, Field & Mach, 2017).

Managed retreat significantly alters community dynamics, and aspects that hold that community together - such as physical proximity, culture, heritage, ecological knowledge, etc. - can be threatened or lost in the process. It is imperative that stakeholders in managed retreat projects focus on the ecological, technical, and economic areas of the project while not neglecting important psychological, symbolic, and particularly emotional aspects of a community’s attachment to place. This is particularly important for tribal communities, who have maintained a deep connection to their lands since time immemorial and envision passing down their cultural, ecological, and place-based knowledge to their future generations (Agyeman, Devine-Wright, and Prange; 2009, 509). According to Agyeman, Devine-Wright, and Prange, involving residents in relocation planning, and making an effort to understand how they relate to places can both enrich the value of managed retreat efforts and alleviate potential conflict throughout their implementation (2009).

The Shoalwater Bay Indian Tribe has addressed the need to include community input from tribal members, notably by hosting workshops with the University of Washington through an Earthlab grant so that researchers can understand the tribe’s understanding of and attachment to place. Findings from these workshops have informed prototypical housing and infrastructure designs for both the uplands and the lowlands. Through this feedback, it was evident that some people were excited about the move to the uplands, while others did not share the same sentiment.

2.2 Place Attachment

Place attachment describes the meaningful bonds that people have to particular places, and it is critical in understanding how displacement and relocation can threaten connections to important places and the individual and group levels (Manzo & Devine-Wright, 2020). Scannell and Gifford (2010, 5) define place attachment through their people, process, and place (PPP) framework as a bond between an individual or group and a place that can vary in terms of spatial level, degree of specificity, and social or physical features of the place, and is manifested through affective, cognitive, and behavioral processes (Figure 10). Some individuals experience place attachment through personal experiences that are meaningful - such as milestones and experiences of personal growth - while groups of people may experience place attachment through culture and community (Scannell and Gifford, 2010). Having a deep, emotional bond to a place fulfills fundamental human needs, and these strong connections have been found to make people resist relocation in the face of environmental risks (Scannell and Gifford, 2010). This is particularly relevant to the Shoalwater Bay Indian Tribe, since culture, community, and connection to ancestral lands are so prevalent among the Tribe.

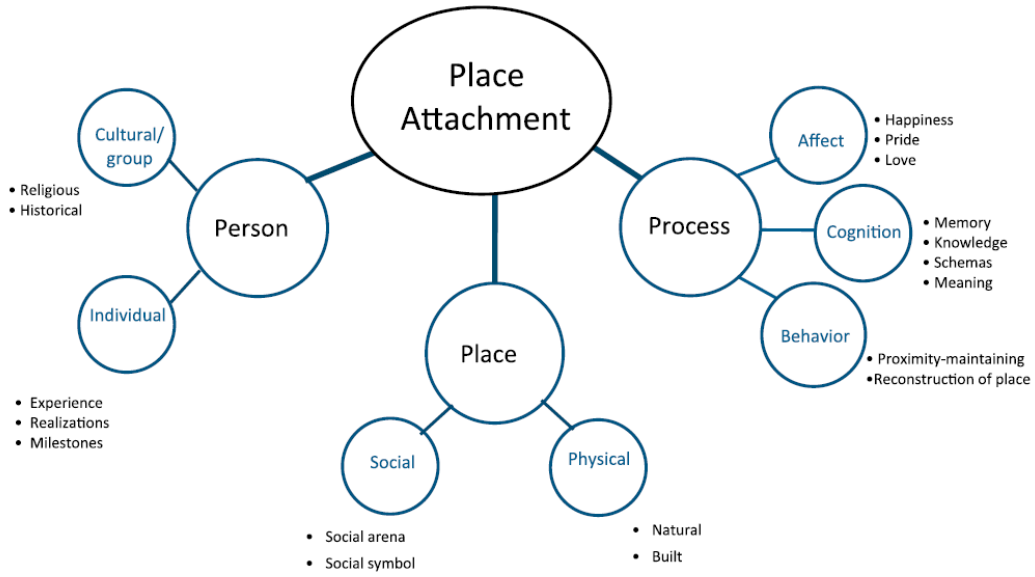


Fig. 1. The tripartite model of place attachment.

Figure 10. Tripartite organizing framework model of place attachment. Scannell and Gifford, 2010.

Manzo (2003) explains that people may be attached to a range of places at various scales, and that while place attachments typically involve positive affective bonds, attachments might include mixed emotions as well. The literature describes positive affective bonds to place as a 'mutual caretaking bond between a person and a beloved place' (Fullilove, 1996, as quoted in Manzo, 2003. Home as a place is not necessarily just the house, a physical dwelling unit, but embodies the sense of home, which includes the physical, social, and psychological relationships to space around the individual. This can also extend to outdoor natural environments in which attachment to that place can actualize in the forms of participation in how the land is managed, as well as ecological stewardship, emotional responses to nature, and a commitment to return to a setting (Manzo, 2003). The deep relationship that individuals and groups maintain to places that are important to them strengthens identity and well-being. Moving from places that have supported groups of people in their culture, lifeways, and knowledge can be disorienting, but communities moving together may be able to take action to ensure that these valued traditions and emotional connections are not lost (Manzo, 2003).

In the context of managed retreat, such disruption to places and place attachments can threaten the dynamic ways in which people connect to place and those around them as a community. When relocation becomes a necessary action, it is of utmost importance that decisions regarding relocation go beyond physical safety, but also consider emotional attachments that people have to the significant places they feel tied to. Though climate change poses significant risks on particular landscapes and the communities that live there, it may not be ultimately destructive. Clarke et al. (2018) analyze the ways in which climate adaptations and displacement can be disruptive, but also potentially transformative. Where disruptive change is viewed as positive and familiar, both support for change and place attachment can increase, enabling a pathway for transformation (Clarke et. al, 2018, 82). Disruptive change does not always produce negative attitudes, and considerate actions such as community engagement and inclusive planning for relocation can strengthen relationships and result in community resilience. Trying to maintain such stability and inclusion in solutions to respond to the potential significant changes is nonetheless difficult. Inclusive governance processes that engage communities in adaptation planning have been shown to reduce place disruption and increase support

for managed retreat by aligning interventions with affected peoples' values (Von Wirth et al. 2016, as cited in Clarke et al., 2018, 82).

For Indigenous communities, the impacts of displacement are amplified by histories of colonization, forced relocation, and cultural erasure. Crawford O'Brien (2013) discusses the Shoalwater Bay Indian Tribe's experience with land dispossession and subsequent efforts to reclaim wellness through cultural continuity, environmental stewardship, and collective healing. The history of their reservation and relations with state and federal government illustrate well how deeply colonization has affected the community's attachment to this place, and in many ways made it dysfunctional. The people of the Shoalwater Bay Indian Tribe, descendants of the Lower Chehalis and Willapa Chinook tribes, have existed on the land along the northern shores of Willapa Bay - in what is now Tokeland, Washington - to the southern shores of the bay - in what is now Bay Center - since time immemorial. Prior to colonization, their ancestral homelands had many villages and abundant access to waterways, connecting them to the Pacific Coast and the Columbia River. The Shoalwater Bay chiefs in attendance at the Chehalis River Treaty Council of 1855 refused to sign the treaty offered by Governor Stevens. Eleven years later, President Andrew Johnson established the Shoalwater Bay Indian Tribe's 335-acre reservation by executive order, on lands that have since become largely submerged, as described above. In the 1960s, the federal government attempted to dismiss the tribe and take back the reservation lands and treaty rights, arguing that the reservation lands had been abandoned. However, the tribal members that lived on the reservation convinced the government of their continued existence on their lands. The Shoalwater Bay Indian Tribe became federally recognized in 1971, securing their rights and sovereignty of their lands and resources. Currently, the tribe owns 5,071 acres of off-reservation land, including the 2,512 acres upland area which is adjacent to the reservation. Their infrastructure includes residential housing (for 119 of the 478 tribal members), a Casino, Tribal Businesses, a Community Center, Tribal Police/Emergency Management, Education Center, and Wellness Center (Shoalwater Bay Indian Tribe, 2024, 4).

The people of the Shoalwater Bay Indian tribe have maintained their ancestral traditions, such as hunting (elk, deer, and other animals), fishing (mainly for salmon), shellfish harvesting (mainly oysters and crabs), and other ceremonial practices despite many attempts at cultural erasure by the

government and settlers landing in the area (Crawford O'Brien, 2013, 196). It is the deep continued connection to their coastal landscapes in particular that has sustained the community and maintained aspects of their cultural identity over time. Community efforts for healing from colonization, forced relocation, and cultural erasure have focused on reconnecting to tradition, to history, and to identity. The feedback given to Crawford O'Brien from the Shoalwater Bay Indian Tribe about how they understand wellness emphasized the importance of community, of creating spaces for spiritual and cultural practices, of intergenerational communication and involvement, of learning from and being involved with the natural landscape, and ultimately of creating a strong sense of personal identity and pride in one's culture (2013, 204-205). These important values that the tribe holds regarding the ways in which they take care of their people and consider the past, present and future should be included in the climate adaptation planning process.

Literature that explores how place attachment plays a role in managed retreat suggests that considering place-based identity, cultural values, community traditions, and affective bonds into climate adaptation planning processes are likely to be less jarring for the community at risk (Clarke et al., 2018, 82 citing Fresque-Baxter and Armitage, 2012). Creating opportunities for community-based participatory action throughout the climate adaptation planning process will likely result in more equitable outcomes and the community coming together to reach a consensus on how to move forward (Manzo and Perkins 2006; Scannell and Gifford 2010, 8). While there are technical aspects of climate adaptation planning that are needed to understand and manage the complex dynamics of the relocation process - such as hazard mitigation planning, land use planning, emergency evacuation planning, transportation planning, feasibility studies, master planning, cost estimating, and funding acquisition (Red Plains Professional, Inc., 2024), participation of the people facing displacement in the planning itself, e.g. through community-based participatory planning, can prevent distress and grief felt by those who are forced to relocate. Exploring the dynamics of displacement and focusing on adaptability to environmental change while maintaining a sense of continuity with significant place relationships is particularly important to tribal communities. While every community facing environmental threats and displacement should have autonomy in these scenarios, there are additional barriers that tribes are up against, such as sovereignty over the choices being made in the planning

process. Planning and design on tribal lands has historically been carried out by outside practitioners without much appreciation or consideration for traditional knowledge and cultural identity (Millette, 2011 citing Jojola, 2000). However, there is contemporary evidence of positive engagement with tribal communities that has resulted in a more successful and sustainable course of self-determination for indigenous communities.

2.3 Engagement with Indigenous Communities in Architecture and Planning

How is 'self-determination' defined in an indigenous context? Corntassel (2008) frames this idea of self-determination in contemporary indigenous-rights discourse, and defines it as a process that is "premised on the notion that evolving indigenous livelihoods, food security, community governance, relationships to homelands and the natural world, and ceremonial life can be practiced today locally and regionally, thus enabling the transmission of these traditions and practices to future generations" (Corntassel, 2008, 119). Sustainable self-determination seeks to expand the scope of indigenous self-determination and regenerate the implementation of indigenous natural laws on indigenous homelands. Indigenous self-determination principles apply to Indigenous planning - when Indigenous people are actively involved in the planning process, typically including traditional knowledge and cultural values - which differentiates it from Eurocentric planning practices. What distinguishes Indigenous planning from Eurocentric planning is that it acknowledges traditional Indigenous worldviews rooted in distinct community traditions that have evolved over a successive history of shared experiences (Jojola, 2008, 42). Traditional knowledge that comes from Indigenous communities can include knowledge of ancestral sites, resource areas, natural cycles, and community social and political aspects. With Indigenous planning, the management of lands and resources encompasses extensive planning with consideration of future generations and therefore can incorporate long standing traditional knowledge and long-term cultural, heritage and environmental strategies (Millette, 2011, 27). A concept that originates from the Haudenosaunee Confederacy and has spread across Indian

Country[4] is the Seven Generations Principle, which states the importance of making choices that will ensure a sustainable world seven generations into the future. This principle is reminiscent of Indigenous values of carrying ancestral teachings across generations, and reminds people that decisions being made should be mindful of the past, cognizant of the present, and suitable for the future (Jojola, 2008, 43). However, there are ranges of definitions for the Seven Generations Principle. Daniel J. Glenn, AIA, NCARB, Principal of 7 Directions Architects/Planners spoke to the Autumn 2022 interdisciplinary studio based on the Shoalwater Bay Indian Tribe's Upland Expansion planning. He shared that the Seven Generations Principle that he follows is making choices informed by the prior 3 generations, in consideration of the present generation and preparing for the next 3 generations (Glenn, 2022). He also acknowledged that other definitions may be different. Many of the definitions are similar in the sense that they focus on looking backwards to multiple generations of ancestors, and towards continuing and improving quality of life for the future generations - whether that is through culture, kinship, and resources. The following projects are examples and case studies of tribal communities engaging in Indigenous planning and architectural design, specifically focusing on methods of self-reliance: community involvement in participatory planning, creating opportunities to train and employ tribal members, and utilizing local resources available to the tribe.

Like the Shoalwater Bay Indian Tribe, the Quinault Indian Nation (located 80 miles north) is also facing environmental threats of sea level rise, storm surge, tsunamis, landslides, and river flooding in the Taholah Village in Washington State (Lehman, 2017). Their climate adaptation planning includes relocating 650 tribal members and community facilities a half-mile away from the existing village to a location that is above the tsunami and flood zones (Figure 11). Important steps in their process included identifying threats and determining vulnerabilities. After gaining more insight through assessments, they engaged their residents in selecting the method of adaptation, and relocation to higher ground was the plan the community chose to move forward with. Community meetings included community surveys and design charrettes to better identify the desired community layout, and the

[4] "Indian Country" and "Indian country" refer to different ideas and legal statuses. "Indian Country" is used by many Native people in the United States, and it typically refers to homelands of tribes and Native nations. The term reflects a relationship with the land that is deeply embedded in Native history and culture, land where Native people currently live or have lived. "Indian country" is a term used to define land statuses in legal and policy contexts. Indian country encompasses specific definitions of Native land areas including reservations, trust lands, restricted fee lands, and other land categories (US Department of Justice, 2015).

tribe emphasized the importance of centering facilities for elders and children (United States Environmental Protection Agency, 2016). As of December 2023, roads have been paved to the village (Figure 12), and a community building for daycare and elders programs is open (KUOW, 2023). The Quinault Indian Nation broke ground on their earthquake-safe K–12 School in November 2025 (The Daily World, 2025).

Figure 11. The Village of Taholah, on the Quinault River on Washington State's Pacific Coast. Department of Interior, 2024.

Figure 12. Progress of new village site, awaiting housing construction. Quinault Indian Nation Division of Natural Resources, 2023.

Self-determination and sustainability in Indigenous planning are, or should be, closely linked, and reflected in culturally appropriate and energy efficient housing design initiatives for tribal communities. Hildebrand (2020) addresses how the majority of housing and infrastructure on Indigenous lands in British Columbia (BC) and other parts of Canada does not meet the needs of the Indigenous communities they are supposed to serve. Historical acts of colonialism and assimilation within reserve[5] housing policies have resulted in substandard housing and infrastructure for First Nations people on their own nation's lands. This report references earlier guides such as the BC Housing's Guide (2018) and the Coastal First Nations Great Bear Initiative Guide (2018) and points to ways to incorporate tradition and culture in new construction, including the following methods: "designing for intergenerational connection and traditional practices; building for a diversity of demographics (singles, seniors, youth, small families, large families, etc); managing moisture (shelter from rain) for different numbers of people at different times of the year; building with resources that are readily available in the community to reflect culture and geography; creating outdoor gathering spaces; providing access to potable water for fish and traditional food processing; including space and storage for traditional practices and equipment; incorporating community kitchens; providing access to natural light and views; and including artwork or aesthetic design features local to the community" (Hildebrand, 2020, 24). While these guidelines are applicable across Indigenous communities, the report emphasizes the importance of avoiding one-size-fits-all approaches and to engage the community in design work so the members can see themselves in their housing and infrastructure.

Sustainable self-determination can be found in the Nuxalk Nation, located in Bella Coola, BC. This planning project goes beyond community participation and engagement in the design process to include the construction process itself. Building with local materials and engaging community members throughout the construction process may enhance economic self-sufficiency and foster local capacity. Indigenous communities can build capacity and generate employment through hiring local carpenters/laborers/contractors, partnering with local employment programs, providing access to training and apprenticeships, and working with contractors to encourage them to hire community

[5] A reserve is "a land set aside by the Canadian government for use by First Nations. Reserve lands represent a small fraction of the traditional territories First Nations had before European colonization" (Irwin, 2022). Also referred to as "Indian Reserve" or "First Nation Reserve." These are similar to "reservations" in the United States of America.

members. Communities who operate their own businesses to implement new construction (such as construction companies or sawmills) can provide employment opportunities, generate tribal member income, and help strengthen their local economies (Hildebrand 2020). The Nuxalk Nation Construction is an apprenticeship program for tribal members that matches apprentices with skilled construction workers and trains them to build homes with local resources. Training the Nation's own tribal members to construct buildings on their own land reduced construction costs, improved construction quality, and created a sense of pride and ownership over the new buildings in the community (Hildebrand 2020). Completed projects have included new homes (Figure 13-14), a fisheries office, education building, chief's building, and a new restaurant. This program was made possible by support from the Chief and Council, Camosun College in Victoria, and the Ministry of Advanced Education (Hildebrand 2020). Partnering with trade schools, colleges, and universities can lead to employment and training opportunities for community members and present career paths for youth, which ultimately provides opportunities to multiple generations of tribal members to expand their skill set and to support their communities in tangible ways (Hildebrand, 2020).

Figure 13. Nuxalk Tiny Homes, built by carpentry apprentices. Coast Funds Canada, 2018.

Figure 14. Nuxalk Tiny Homes, built by carpentry apprentices. Lindsay, 2018.

Finally, building with local materials and with local labor is an act of sustainable self-determination that can be found in other regions and climates as well. A prime example of this practice is the Nageezi House (Figure 15), a single family design-build prototype for the Nageezi community on the Navajo Reservation (7 Directions Architects, 2005). The home uses sustainable building methods that respond to the high-desert climate in northeast New Mexico (Figure 16), such as rainwater collection, passive solar design, Navajo FlexCrete (an aerated/fiber-reinforced fly ash-based concrete made in block form developed by the Navajo Housing Authority), structural insulated panels (SIPs) roofing, radiant floor heating, and natural cooling and ventilation. The Nageezi House has been celebrated for its variety of sustainable design approaches (both contemporary and traditional), locally sourced materials, and culturally informed design. The design of the home honors two traditional Navajo structures not typically found in modern housing on the reservation: a *hooghan*, the traditional form of Navajo housing typically used today for ceremonial purposes; and the *chahash'oh*, a traditional style of summer home for Navajo people that is reflected in the shade structure, which provides shading and passive cooling (7 Directions Architects, 2016). Additionally, the Nageezi House was built

with volunteer student labor and the Navajo Housing Authority construction crew, and completed with the Arizona State University Stardust Center.

Figure 15. Nageezi House exterior includes reclaimed and gathered materials, and Navajo Flexcrete made from fly ash, 2005.

Figure 16. Nageezi House was built by volunteer student labor and the Navajo Housing Authority construction crew, 2005.

2.3.1 Applications of Case Studies to the Shoalwater Bay Indian Tribe's 'Upland Expansion'

The case studies discussed in the previous section provide powerful examples of developing and managing construction projects with Indigenous communities. Key components include looking towards the future to understand how current climate conditions may alter tribal lands for future generations, acknowledging attachment to place, preserving and reimagining traditional building practices for contemporary applications, utilizing local and reclaimed materials, creating experience and employment-based opportunities for tribal members, and applying emerging sustainable building methods to construction projects. In order to understand which sustainable building methods are appropriate for each tribal community and their respective climate and community needs, it is imperative that there is an understanding of traditional lifeways and how those values shape the built environment for each community. Jamie Judkins, citizen and former Tribal Planner of the Shoalwater Bay Indian Tribe, provides insight into some of the primary concerns for the Shoalwater Bay Indian Tribe, specifically those who live on or near the reservation, as they move forward with their 'Upland Expansion' project in an interview regarding health and coastal adaptations (Hicks, 2020). The following quotes from Jamie Judkins reflect on the primary concerns for tribal members within the community and suggest how the project could benefit the community as a whole:

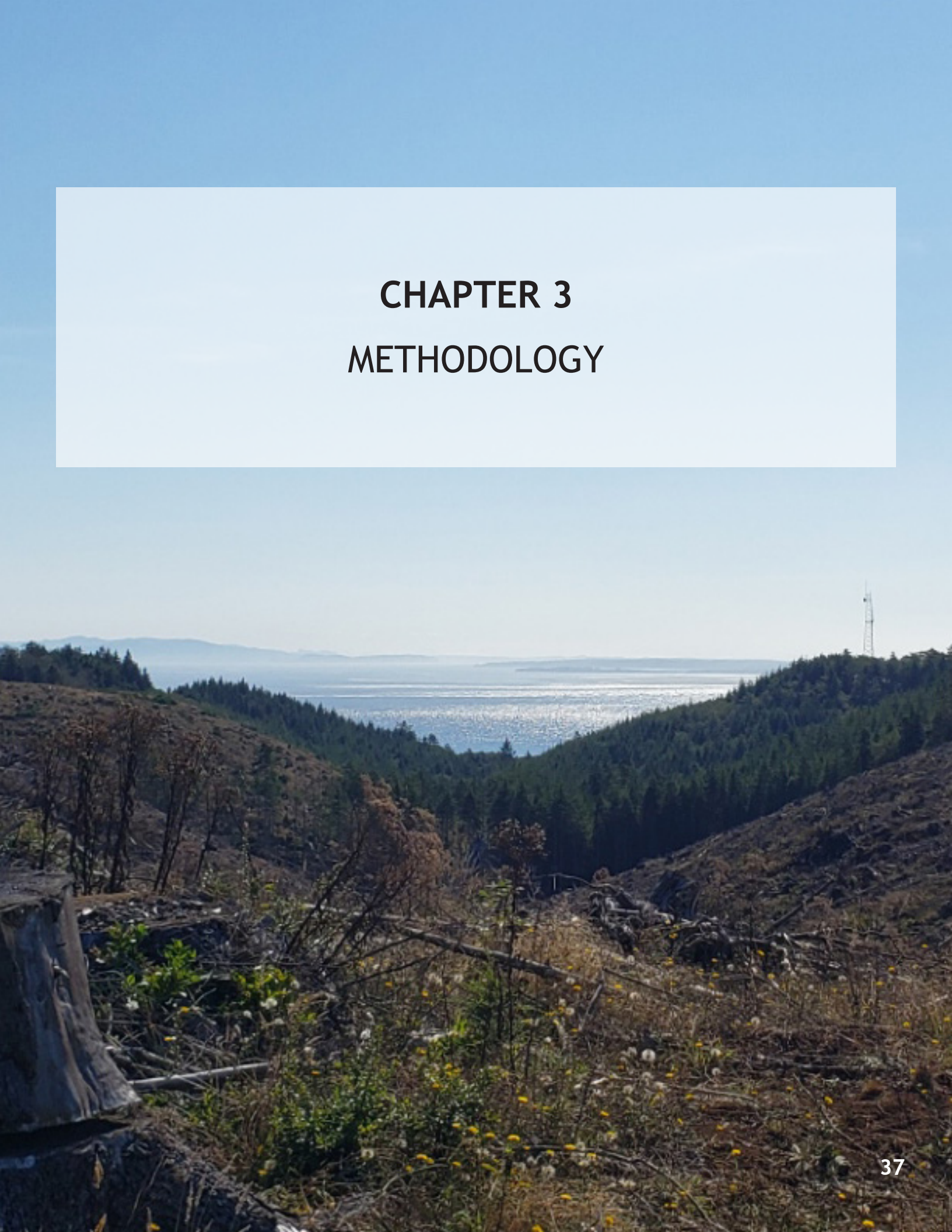
> "…We have some elders in the tsunami and flood zones who feel, 'This is where I've lived my entire life. I don't want to move even up the hill. This is where my family has always been. This is where they are buried.'"
>
> "Although they don't want to move, they still support others who would want to move uphill."
>
> "Learning and practicing our culture is really what is going to keep us alive."
>
> "Traditionally, our housing had to be easy to rebuild."

This commentary emphasizes the challenges and concerns of moving uphill away from today's infrastructure and services on the reservation in the lowland area. However, it also suggests that engaging in cultural practices is key to maintaining their community as their way of life changes with the move uphill. Looking to ancestral practice for building on their lands provides cultural connection

in daily life and creates opportunities to explore how contemporary technology can honor traditional building methods for the Shoalwater Bay Indian Tribe. Examining the functionality of the Shoalwater Bay Indian Tribe's traditional housing typology, the plankhouse, will help to understand methods of integrating traditional building methods into the housing that will be built in the near future for the tribe.

CHAPTER 3

METHODOLOGY



CHAPTER 3: METHODOLOGY

3.1 Traditional Building Methods of Indigenous Tribes in the Southwest Washington Region

The “plankhouse” building typology is a traditional structure for many tribes along the Northwest Coast, stretching from southeast Alaska to northern California, and also parts of British Columbia in Canada. Within this area, there are many variations in how plankhouses are built, maintained, inhabited, etc. For the purpose of this thesis, I will primarily focus on plankhouse practices in the Coast Salish and Chinookan region, as the people of the Shoalwater Bay Indian Tribe descend from both Willapa Chinook and Chehalis tribes (Shoalwater Bay Indian Tribe, 2024, 4).

3.1.1 Plankhouse Materials and Assemblies: Frames, Walls, and Roofs

Though a vast number of coastal tribes in the Pacific Northwestern region built and used plankhouses as their primary residence, the style of plankhouses among these tribes varied significantly based on geography, culture, and social structures. Despite these differences, one of the key similarities of most plankhouses is the use of Western Red Cedar, known as the “tree of life” to Northwest Coast Natives, as a primary building material due to its uniform, straight wood grain, ease of splitting into planks, rot resistance, minimal warpage, long life span, fire resistance, and beauty whether it be fresh or weathered (Stewart, 1984; Wallace, 2017). Construction details varied, but typically plankhouse construction began with arranging a frame of heavy post and beams to accommodate the multi-generational families who would live in these structures (Figure 17). The frame was considered the permanent element of the plankhouse structure while the planks were considered flexible or semi-permanent elements (Figure 18). Plankhouses varied in size and were anywhere from 30 to 400 feet long and 15 to 55 feet wide (Ames, 2022). The layout was typically rectangular with gabled roofs, and doors usually at the gable end with entrances typically facing an adjacent water source (Ames, 2022; Wallace, 2017). Next, the roof rafters we installed, followed by affixing the wall and roof planks - the order of installation of wall planks and roof planks did not matter since they were independent of each other. The wall planks were laid horizontally, while roof planks were laid vertically, and all planks had a slight overlap (Figures 19 and 20). They were fastened with a cedar withe, or cord, that tied to both the exterior poles and to the interior poles (Wallace, 2017).

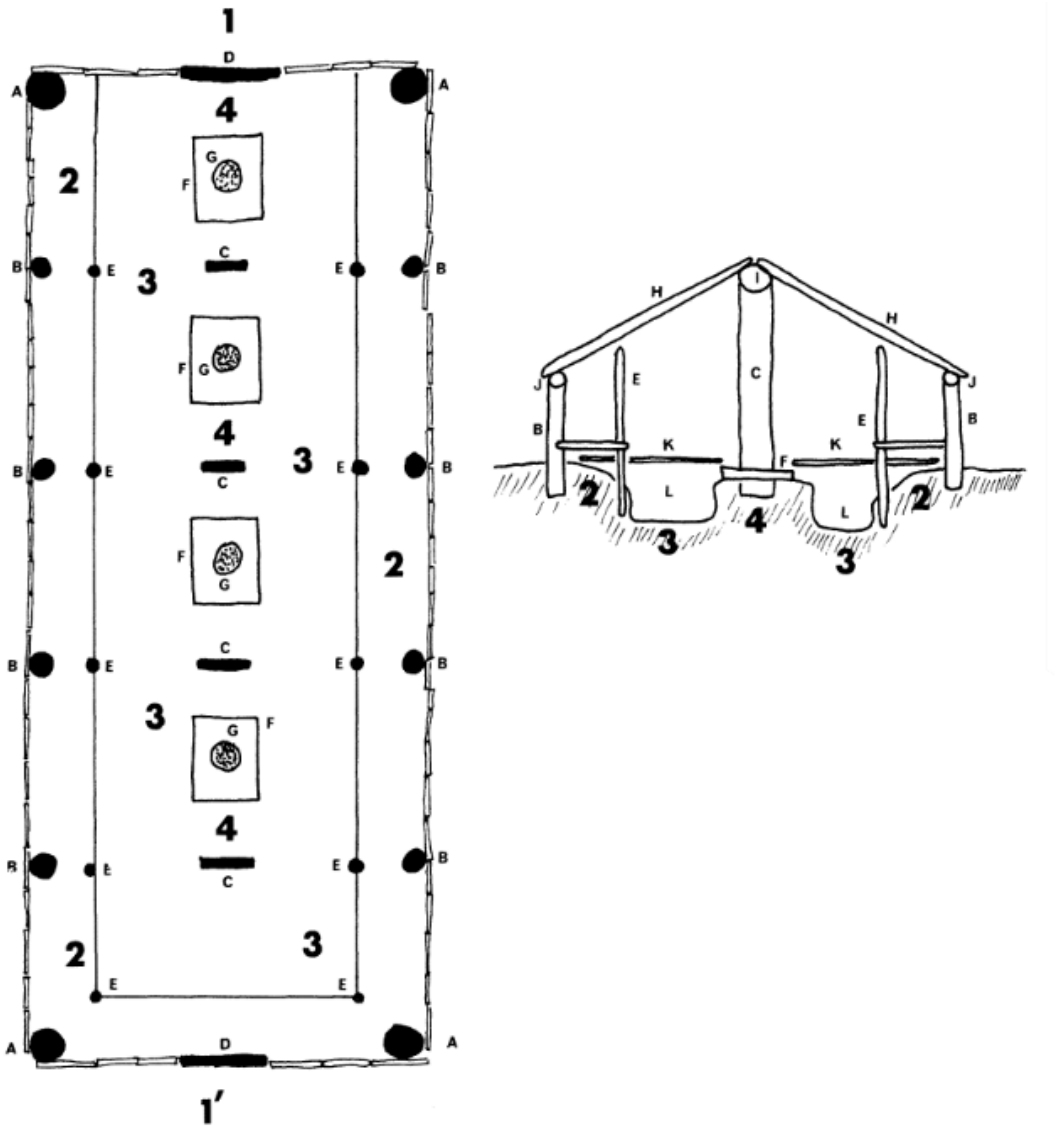


Figure 2. Plan view and cross section of our working model of a "typical" large Chinookan house. The structure in the drawing is 12 m × 30 m. Key: 1) the front end, with a door cut through the large end plank; 1′) the back end of the house; 2) platform area; 3) corridor; and 4) central area. A) corner posts; B) eave supports; C) ridge beam supports; D) end planks; E) platform support posts; F) hearth box; G) hearth bowl; H) rafter; I) ridge beam; J) eave pole; K) floor; and L) corridor pit trench. The height of the platform support posts is speculative. We have no information on how a plank floor would have been suspended.

Figure 17. Plan view and section of a typical large Chinookan Plankhouse. Key details in caption in photo from Ames, 1992.

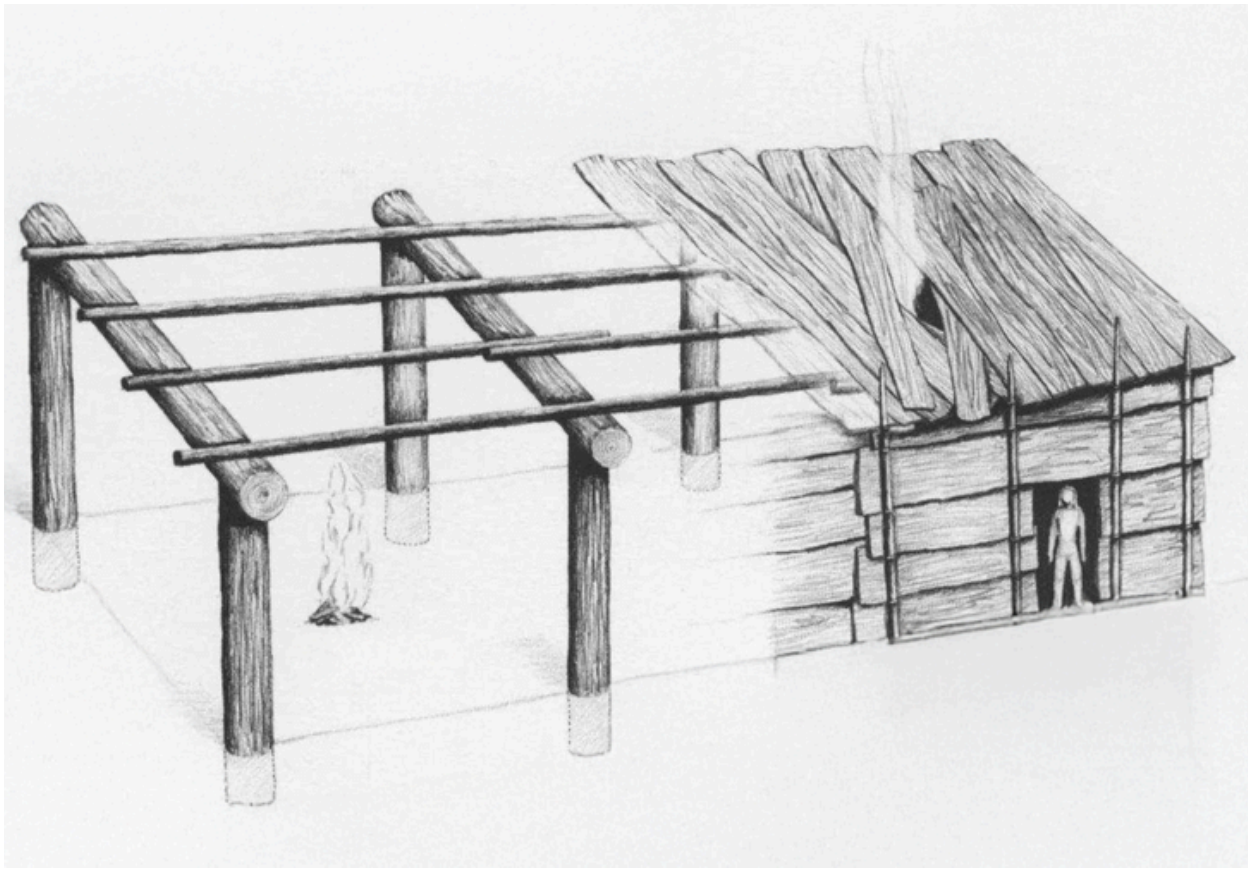


Figure 18. Plankhouse structure described in the ethnographic and historical record

(Graesch, Anthony, Dana Lepofsky, and David M. Schaepe, 2009)

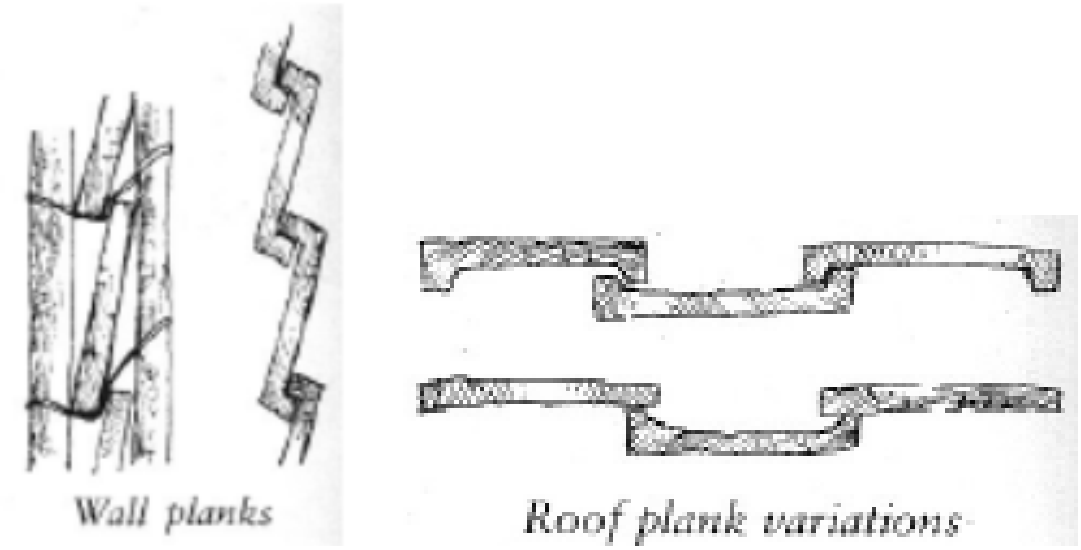


Figure 19. Diagrams of overlapping plank methods of wall and roof planks, from Nabokov and Easton, 1989.

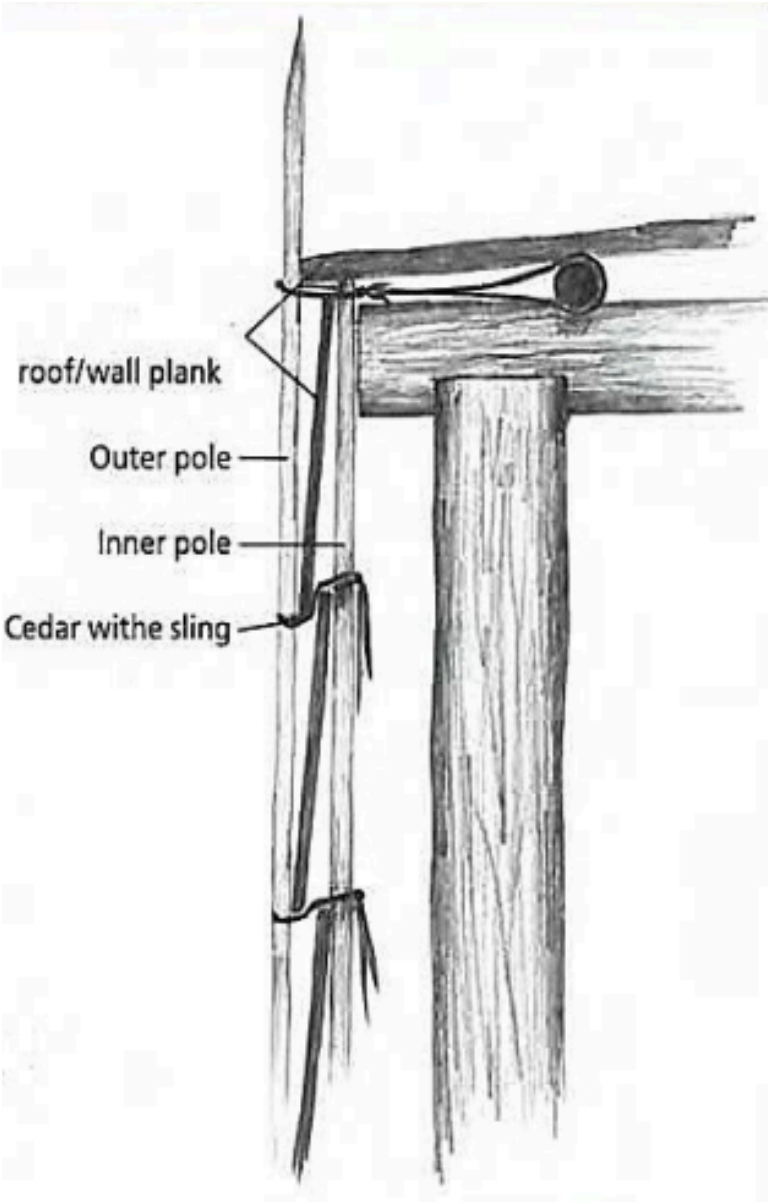


Figure 20. Detail of how wall and roof planks were fastened with a cedar withe, or cord, that tied to both the exterior poles and to the interior poles, from Christina Wallace, 2017.

3.1.2 Seasonal Movement and "Abandoned" Villages

Though the frames of posts and beams are described as permanent, plankhouses themselves are considered semi-permanent structures. They are often described as "winter settlements," as house forms and location of houses varied with the seasonal shifts (Wallace, 2017, 8). These plankhouses were typically occupied from November to early March. Oftentimes in the Lower Columbia and the

Northwest Coast, families within each tribe would maintain multiple house frames and transport their set of wall and roof planks from frame to frame during an annual cycle (Ames, 1992; Boyd, 2013; Gahr; 2006; Wallace, 2017). The transportation process would typically include dismantling the cedar wall and roof planks, tying them together with cedar withe, and then moving the bundles to the next location via canoes (Wallace, 2017). While some groups owned more than one house frame, allowing them to move residences seasonally by transporting planks between the frames, others used light weight, temporary mat lodges during warmer parts of the year when people were more mobile (Ames, 1992; Boyd, 2013; Gahr, 2006). Spring and summer houses were typically located near food gathering sites as people followed patterns of seasonal rounds. Materials used to build these spring and summer mat-lodge houses (Figures 24 and 25) were poles, mats, and the transported cedar planks. Although finding examples specific to the Shoalwater Bay Indian Tribe proved to be difficult, examples from Coast Salish tribes in Washington state (Skokomish Indian Tribe and Lummi Nation) and a replica of a traditional Chinook-style plankhouse called Cathlapotle Plankhouse (Figures 21-23) provide and example of the construction materials and methods This structure was built by the Chinook Indian Nation in March 2005 and it is located in Ridgefield, Washington.

Figure 21. Exterior view of Cathlapotle Plankhouse, a full-scale re-creation of a Chinook-style plankhouse; from Lewis and Clark Trail Experiences, n.d.

Figure 22. Installing vertical wall planks at the Cathlapotle Plankhouse in Ridgefield, Washington. Advisory Council on Historic Preservation, n.d.

Figure 23. Interior of Cathlapotle Plankhouse, Chinook style, Ridgefield National Wildlife Refuge, 2015.

Figure 24. A temporary summer shelter, Skokomish, Edward S. Curtis, 1912. Wallace, 2017.

Figure 25. A summer mat-lodge on the Columbia River on Umatilla lands in Oregon. Major Lee Moorhouse, 2018.

While winter and spring/summer plankhouses differed due to seasonal activities and needs during their respective times of year, the distinctions were not necessarily rigid. Adaptations to the plankhouse structure could be addressed in different ways to cater to those that may need additional assistance or accommodations. In addition to the winter and spring/summer houses, there was also a hybrid-state that the homes may exist in, where the wall planks and roof planks remained in place for a smaller portion of the house, while the larger percentage was dismantled. The people who lived in these conditions were primarily elderly, sick, or young children that were not able to travel to the summer locations. This house form directly responded to the specific needs of the residents, highlighting both the flexibility and adaptability of the plankhouse structure (Wallace, 2017).

Owning multiple house frames and transporting sheathing materials was useful, and people who moved around throughout the year to follow the seasonal rounds maintained intentionally marked locations to set up semi-permanent and temporary villages. In historical accounts, as recent as 2005, non-native authors documented some examples of the house frames, and claimed that these standing house-frames marked the locations of long-abandoned villages, which was incorrect to assume from an outsider perspective (Ames, 1992; Ames, 2005). However, other authors correctly identified the purpose of leaving open house frames temporarily as the seasons shifted (Gahr, 2006). Though many of the images of plankhouses show the gable roof-style of plankhouse, there are also many tribes that constructed shed roof-style plankhouses (Figure 26 and 27). Christina Wallace, a member of the Coast Salish Snohomish Tribe, clarifies that the shed roof-style plankhouse structure were the most prevalent shelter constructed by tribes in the entire Salish Sea area, but many Coast Salish and Chinookan-style (not Coast Salish or Salish) plankhouse examples are often depicted as having the gable roof-style plankhouse, so variations amongst tribes due to geography and location differentiates styles of plankhouses (Wallace, 2017).

Figure 26. Frame of Salish shed-roofed house at Lummi Reservation in 1905. Wallace, 2017.

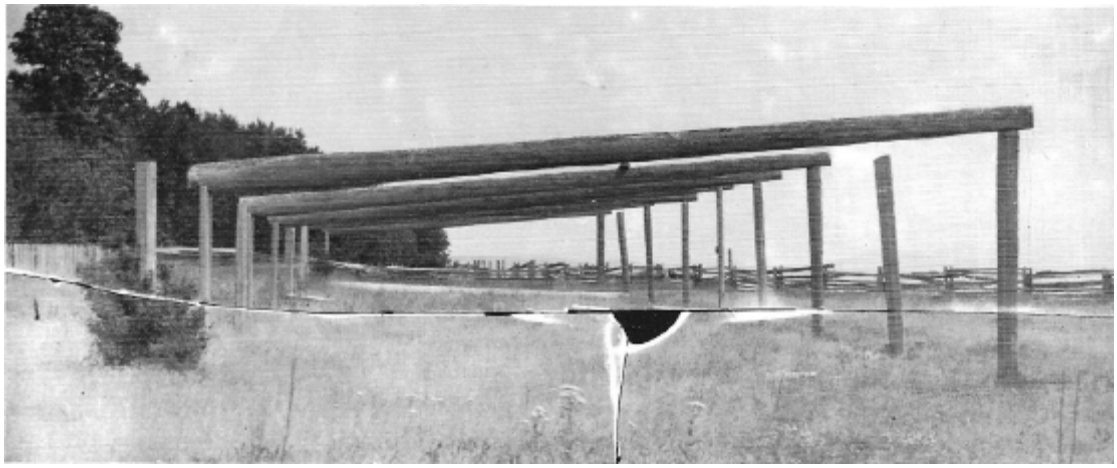


Figure 27. Frame of Salish shed-roofed house at Lummi, WA. Nabokov and Easton, 1989.

3.1.3 Social Relationships and Generational Homes

Plankhouses are a dynamic building typology that many coastal Northwestern tribes constructed and maintained for over 2,500 years. Not only were they shaped by the geography, they were also very much shaped by the culture of the people who lived in them. Families lived in different sections of the house that were determined by the structural layout of the posts, forming what were essentially interior apartments. Social hierarchy was evident based on a person's or family's placement in the home: the further towards the back of the house your area was, the more significant your role might be within the community. Additionally, house ownership was passed down generation to generation, and were often lived in by the same family's lineage for upwards of 400 hundred years (Wallace, 2017).

Plankhouses served a multitude of purposes for the families that lived in them besides housing (Figure 28). They were also the center for weaving and carving, preparation and storage of food, a workshop, a meeting place for multi-generational family affairs, sharing of rituals, education of the young, and the place where important winter ceremonies occurred each year (Dawson, 1973; Wallace, 2017). Regarding the ceremonial nature of a plankhouse, oftentimes one plankhouse within the village would have the honor of being modified for ceremonial purposes. For a plankhouse to be transformed into a space suitable for winter ceremonies to take place, the following changes were made to the structure: all interior partitions were removed, such as low walls, or mat partitions; all personal family

items were removed and stored elsewhere. It is assumed that occupants of the transformed house relocated temporarily to another house in the village; individual family fire areas were dismantled; the house was cleaned, including the platforms used for seating; two larger fire areas were constructed in the center aisle of the building, one on each end of the ceremony area; and a temporary area was set up for the preparation of foods for the ceremony, typically at one end of the plank house structure. (Wallace, 2017).

Once the ceremonies were over, the transformed house reverted back to secular use, with the standard interior configurations recreated. In general, winter was a time of economic inactivity, which afforded more leisure time. It was the season that stories and other cultural traditions were passed down, important decisions and planning took place, and repairs were made to canoes and other tools in preparation for the spring. Conversely, spring and summer were devoted to the collecting and processing of food (Wallace, 2017). Following the seasonal rounds and basing what types of activities needed to occur to sustain the tribe as a whole based on when was appropriate is an example of how time is perceived in a more cyclical manner versus the standard linear time manner many societies around the world know today.

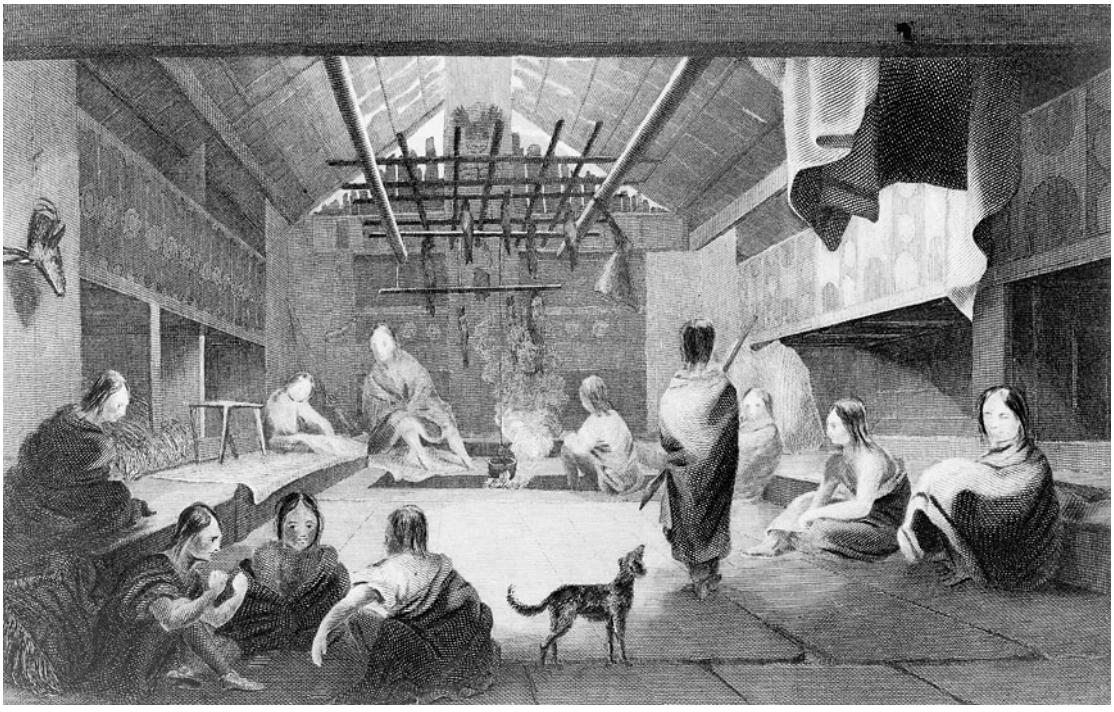


Figure 28. Interior of a Chinookan plankhouse. Wilkes, 1845.

3.1.4 Functionality and Adaptability

Plankhouses were incredibly dynamic and durable buildings, and the ways in which these structures were built, occupied, and maintained were incredibly sophisticated and intentional. The process of altering these homes - assembling, disassembling, or taking pieces to Spring and Summer settlements - with the variation of the seasons meant the entire semi-permanent structure or just parts of the structure would be used in some way all throughout the year. The durability of those households is indicated by the durability of the structures, which oftentimes stood for 400 years or more while in constant use (Ames, 2015). This constant use, change of use throughout the annual cycle, and the wet and rainy climate of the Northwest demanded changing the structure to meet needs and considerable maintenance (Dawson, 1973). Archaeologists have found evidence of routine types of maintenance that people would have done, such as mending planks by sewing splits with withes[6]. Broken planks and canoe fragments were recycled and used as wall planks. (Gahr, 2006). These salvaged materials, as well as planks in good condition, would have also been used for numerous purposes: at the base of the shelter to provide a stable surface off of the ground, storage shelves, seating areas, sleeping areas or as supports for drying foods. These examples of adaptability of materials are also evident in the plankhouse structure itself. Christina Wallace describes the variety of ways the structural system itself could be changed to accommodate changes based on changing conditions:

> "The quality inherent to the shed roof plank house was adaptability; the size could easily be changed with fluctuations of the household. The structural system allowed for additional bays to be added, tying into the existing structural system by removing the end wall plank walls, and adding more posts and beam structural elements. This is one of the reasons that the houses expanded to such great lengths, although all initially started out with significant dimensions. Houses were expanded to meet the needs of a growing family or kinship group. This was also true in the reverse - house sizes could be reduced if fewer families were in residence. The adaptability of size, the simple structural system and the easily removable walls to expand and contract are the significant, character-defining features of a Salish Sea shed roof plankhouse."
>
> "Most roof boards were not fastened in place so that they offered the flexibility of being moved easily. They could also be moved entirely to allow for sunlight into the interior" (Wallace, 2017, 12).

[6] A "withe" is a form of cordage used to tie elements together, made of cedar and pine, for planks in the plankhouse examples. "Cedar withes are the long, thin twigs that hang down from the branches of the western red cedar tree" (Wallace, 2017, 11).

By analyzing the construction methods found in traditional plankhouses built by the many tribes in the Pacific Northwest region, it is evident that these buildings were complex, adaptable, climate-responsive, and designed to accommodate generations of families over hundreds and thousands of years. There was clearly a deep understanding of materiality by those who built plankhouses. For example, the heavy, large diameter timber used for the primary structure - load-bearing components like posts and beams - was used because it is less vulnerable to ignition. Large diameter timber exposes less surface area to flame than small diameter wood and also allows increased spans between the structural elements, slowing the spread of fire by increasing the distance between combustible materials. These increased spans result in fewer structural elements providing fuel for fire (Gahr, 2006). Additionally, plankhouses used construction methods and systems that are used in many buildings being built today. For example, a timber frame building and a curtain wall system are examples where "an outer covering of a building in which the outer walls are nonstructural, but merely keep the weather out and the occupants in." The plankhouse wall assembly is an early example of this kind of system, as the planks affixed to the plankhouse frame are tied to interior and exterior poles independent of the primary structure. "This construction detail has been documented in plankhouse construction from the 16th century, two centuries earlier than architectural history textbooks indicate for the invention of curtain wall systems" (Wallace, 37).

3.1.5 Applications of Plankhouse Construction Methods to the Shoalwater Bay Indian Tribe

When researching ways to incorporate culture and community into future housing for the Shoalwater Bay Indian Tribe, the plankhouse served as inspiration for contemporary construction. The adaptability to add or subtract space based on changing family sizes, ability to transport materials into the uplands, using sustainable materials like salvaged or reusable materials, and supporting the tribe's goals of gaining as much community input as possible are important to address to ensure that the tribe's sovereignty is honored. A project such as this is an opportunity to explore design solutions that can address the needs of the Shoalwater Bay Indian Tribe today and for future generations. By laying a foundation of cultural understanding about traditional structures, such as the plankhouse, and the lifeways of the tribal community today, the people involved with the Upland Expansion project can best

accommodate tribal members' visions for the future of their tribe. This architectural exploration could potentially lead to more possibilities for the future plans of the tribe, including the possibility of building some immediate structures in the lowlands that could eventually be moved into the adjacent trust land as the housing is constructed in the uplands.

3.2 Applicable Contemporary Building Methods to Honor Indigenous Building Traditions

3.2.1 Defining "Sustainable" Architecture

Jamie Judkins, enrolled SBIT member, said she envisioned the upland expansion project to be the most sustainable and resilient village (Hicks, 2020). What are tangible design choices that can be made to create "sustainable architecture" for tribal communities? In conversations with members of the Shoalwater Bay Indian Tribe in Autumn 2022, a topic that was discussed was the desire to be able to generate their own power or have it localized, as power has been cut off for significant amounts of time during intense storms in their region. One quantitative way of understanding "sustainable architecture" is through looking at ways to measure energy efficiency of the buildings that will be built and make adjustments during the design phase of the project.

In contemporary architectural discourse, terms such as "green building" and "sustainable design" amongst other similar terms are commonly used to describe buildings that were designed with the intention of being less detrimental to our environment than standard buildings. There are various avenues to approach these goals, as well as different levels of building sustainably. Bruce King and Chris Magwood define these levels in "Build Beyond Zero" (2022) as green building and deep green building. Popular methods of green building may include limiting fossil fuels and harmful chemicals during the entire building process, considering the health of the environment and the occupants of the building. This approach in itself does not necessarily have a set list of items to achieve, but green building rating systems such as Leadership in Energy and Environmental Design (LEED), Building Research Establishment Environmental Assessment Method (BREEAM), Passive House Institute (PHI), Passive House Institute United States (PHIUS), Living Building Challenge (LBC), WELL, Fitwel, and others can measure sustainability of a building across multiple actions taken throughout the design process. Key areas of focus in green building rating systems can include site sustainability, water efficiency,

energy consumption, greenhouse gas (GHG) emissions, materials sourcing and transportation, natural resources, indoor environmental quality, community wellbeing, social equity, and overall carbon footprint, which is the total GHG released into the atmosphere (Anderson, 2024; LEED, BREEAM, PHI, PHIUS, LBC, WELL, and Fitwell websites). Each green building rating system varies in focus areas and rigor of the requirements for certification. Deep green building takes this even further, as designers may explore methods to foster, heal, or restore life both inside and outside (King and Magwood, 2022). While previous sections of this thesis discussed strategies and ideas related to culture, community wellbeing, and social equity, the following discussion will focus on energy, emissions, materials sourcing, and transportation. Each approach will have an example of projects built outside of Tribal reservations for the general population and those that are built on reservations and/or for Indigenous peoples. A comparative analysis of these rating systems was conducted in partnership with the SBIT taking into account culturally relevant values and priorities (Simonsen, 2023).

3.2.2 Net Zero Energy

Important factors to consider when designing green buildings is where the energy for the building is sourced and how efficient the building uses energy. While green buildings can be equipped with efficient products to conserve energy, it is possible to achieve “Net Zero Energy.” This design approach strategizes ways in which the intended building can generate at least as much energy as it uses. Some methods to achieve Net Zero Energy include high performance insulation, air sealing, windows, air ventilation and heating systems , renewable energy sources, and other components of an efficient building. Additional steps, like ensuring sustainable materials are used and how these materials are transported to the site are other components to consider.

Many tribes in the United States and Canada are adapting sustainable design and construction practices to meet the housing needs of contemporary tribal life - such as reliable basic utilities like heating and clean water, intergenerational living arrangements, space to progress foods from hunting and gathering, and areas for ceremony - despite barriers which slow the construction process, such as building permitting , funding, capacity building, and planning. In most cases, cultural and economic sustainability are as important as environmental sustainability (HUD, 2013). A publication from the HUD

Office of Policy Development and Research titled "Building Green and Respecting Native American Identity" highlights a project in which the Native American Sustainable Housing Initiative (NASHI) at the University of Colorado at Boulder (CU Boulder), Oglala Lakota College (OLC), and the South Dakota School of Mines and Technology (SDSMT) prototyped affordable, culturally relevant, and Net Zero Energy housing on the Pine Ridge Indian Reservation in South Dakota (Figure 29). As opposed to the conventional wood-frame houses that are typical on the Pine Ridge Indian Reservation, the use of solar panels and straw bale insulation in the walls of the housing prototypes resulted in net zero energy use. Straw bale also captures and stores carbon dioxide, which reduces its concentration in the atmosphere, also referred to as carbon sequestration. Straw bale, as well as plants, trees, and forests, absorb CO_2 through photosynthesis and store carbon in their biomass like trunks, roots, leaves and soils. A combination of renewable energy systems, including photovoltaic panels (PV), solar thermal hot water, and wind turbines were used in conjunction with cost-effective passive design strategies like natural ventilation and passive solar orientation. All four homes were designed using the Leadership in Energy and Environmental Design (LEED) for Homes rating system criteria, and each of the homes produce 20% more energy than they use (HUD, 2013).

Figure 29. Sustainable & Affordable Housing Prototypes for the Pine Ridge Indian Reservation. HUD, 2013.

3.2.3 Passive House

The Passive House Institute (Passivhaus Institut) is an independent research institute in Darmstadt, Germany that has developed the first internationally recognised, performance-based energy standard in construction. Passive House Institute US (PHIUS) is based in North America and is modeled on the same five key Passive House principles (among others) developed by PHI (Figure 30). Passive House is a building standard that emphasizes energy efficiency, comfort, and affordability. In order for a building to be Passive House Certified, there are rigorous requirements to meet a high standard of building performance. The metric requirements for Passive House Certification are as follows (Passive House Institute Requirements, 2024):

- **Thermal insulation:** All opaque building components of the exterior envelope of the house must be very well-insulated. For most cool-temperate climates, this means a heat transfer coefficient (U-value) of 0.15 W/(m²K) at the most, i.e. a maximum of 0.15 watts per degree of temperature difference and per square metre of exterior surface are lost.
- **Passive House windows:** The window frames must be well insulated and fitted with low-e glazings filled with argon or krypton to prevent heat transfer (typically triple pane glazing).
- For most cool-temperate climates, this means a U-value of 0.80 W/(m²K) or less, with g-values around 50% (g-value= total solar transmittance, proportion of the solar energy available for the room).**Ventilation heat recovery:** Efficient heat recovery ventilation is key, allowing for a filtered indoor air quality and saving energy. In Passive House, at least 75% of the heat from the exhaust air is transferred to the fresh air again by means of a heat exchanger.
- **Airtightness of the building:** Uncontrolled leakage through gaps must be smaller than 0.6 of the total house volume per hour during a pressure test at 50 Pascal (both pressurised and depressurised).
- **Absence of thermal bridges:** All edges, corners, connections and penetrations must be planned and executed with great care, so that thermal bridges can be avoided. Thermal bridges which cannot be avoided must be minimised as far as possible. Thermal comfort must be met for all living areas during winter as well as in summer, with not more than 10 % of the hours in a given year over 25 °C (77 °F).

➔ **Renewable Primary Energy Demand:** the total energy to be used for all domestic applications (heating, hot water and domestic electricity) must not exceed 60 kWh per square meter of treated floor area per year.

In addition to energy efficiency, comfort, and affordability achieving these metrics often result in lower maintenance and long term durability for buildings in various different climate zones around the world is achievable through following Passive House requirements. Cold climate conditions require focus on minimising heat losses and optimising solar gains, while mild climates require moderate insulation and improved window qualities, and hotter climates require more insulation with reduced or minimal humidity and solar loads through windows, walls and roofs. Studies concerned with implementing Passive House design principles around the world have highlighted examples shown to be successful in Canada, the USA, Germany, China, Greece, Spain, Taiwan, Mexico and the United Arab Emirates (Schnieders et al., 2019).

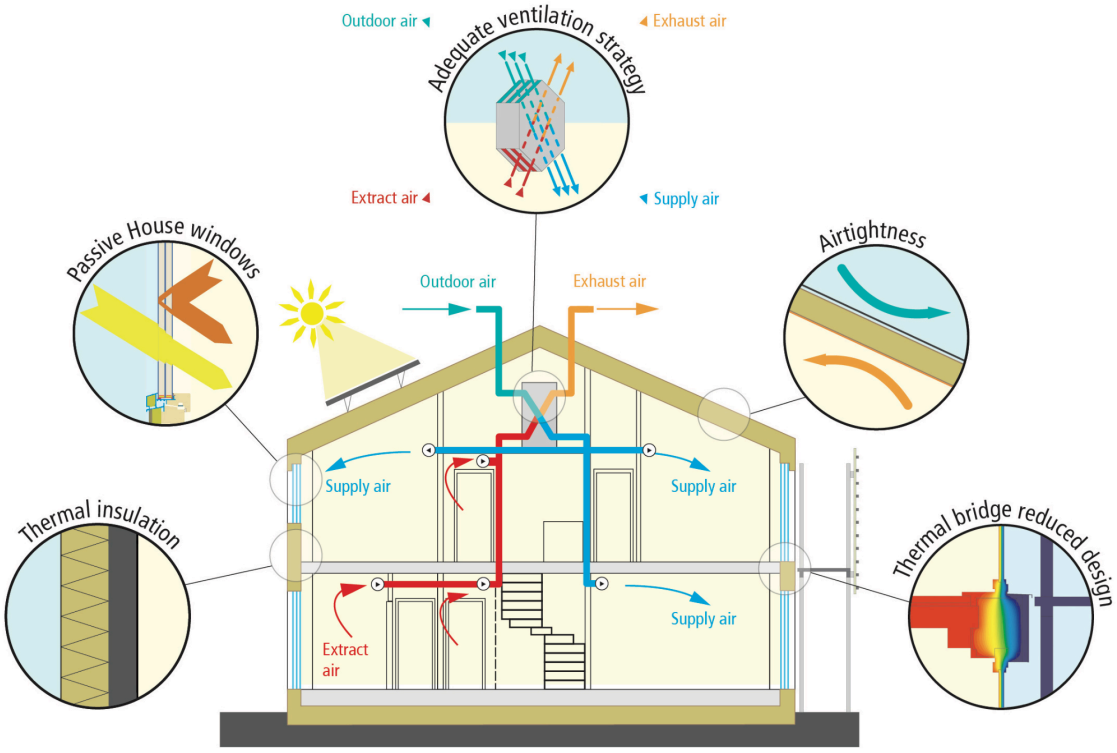


Figure 30. Diagram of Basic Principles to meet Passive House Requirements. Passive House Institute, n.d. https://passivehouse.com/02_informations/02_passive-house-requirements/02_passive-house-requirements.htm

The first Passive House Certified health center in North America was commissioned by a First Nations community of the Dunne-za and Cree people located near Moberly Lake in northern British Columbia, Canada. A University of British Columbia Sustainability Scholars Report from 2020 by UBC Sustainability Scholar, Jenna Hildebrand, explains how First Nations in British Columbia envision culturally-appropriate and energy-efficient homes and buildings, building standards in the development of new construction, as well as barriers and successes First Nations are experiencing implementing new construction projects (Hildebrand, 2020). In the report, Hildebrand cites the West Moberly First Nations Health Clinic (Figure 31) as a successful implementation of Passive House certification for cold climates. The architecture firm for the project, Iredale Architecture, affirms that by utilizing Passive House design strategies there would be a 90% reduction in the building's annual heating and cooling costs. They also ensured that the building would be highly durable with the detailing of the envelope design and would require minimal maintenance due to the specified cladding materials (Iredale Architecture, 2018).

Figure 31. West Moberly First Nation Passive House Certified Health Centre by Iredale Architecture. Hildebrand, 2013.

3.2.4 Prefabricated Structures

Both the roof and wall assemblies for the West Moberly First Nation Health Centre were made of pre-fabricated panels. Pre-fabricated components are typically made offsite and then brought to the site for installation. Collective Carpentry is an example of a construction company based in Invermere, B.C., Canada that specializes in panelized fabrication of wall and roof building elements. Other North American prefab companies include: BC Passive House, BPublic, and Phoenix Haus. Their roof and wall assembly panels are assembled in an indoor facility where 90% of framing, insulation, and air and moisture control layers are installed, while also achieving a greater level of control over quality, design, waste management, material selection, and worker health and safety as opposed to standard construction operations. Prefabricated panel companies provide the structural, insulated, airtight, weathertight building envelope (Figures 33 and 34). A local architect is responsible for permitting and a local general contractor is responsible for preparing the site, building a foundation, and backfilling prior to panel install. After panel install, the general contractor is responsible for completing the build (Figure 32). As these companies have grown, they have partnered with architects and developers to provide a building system that meets Passive House or Net Zero standards of energy efficiency and comfort while optimizing factory output and minimizing material waste, making off-site construction more affordable.

Figure 32. “Calina” model of Collective Homes, a line of affordable prefab-optimized home designs.

Bozeman, MT. Collective Carpentry, 2022.

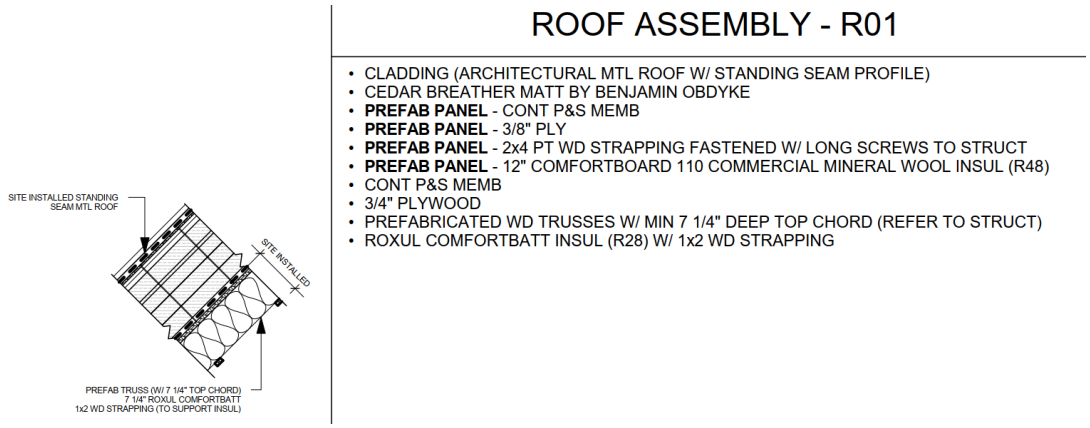


Figure 33. Roof Assembly Detail for the West Moberly First Nation Health Centre. Collective Carpentry, 2018.

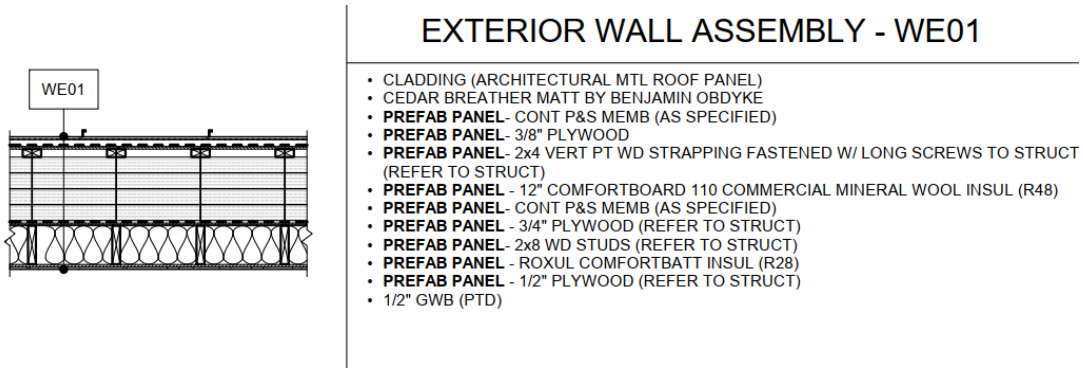


Figure 34. Exterior Wall Assembly Detail for the West Moberly First Nation Health Centre. Collective Carpentry, 2018.

Another notable pre-fab building company in Mount Currie, British Columbia, Canada working with First Nations is BC Passive House. In 2018, BC Passive House completed two projects with First Nations communities: Ts'Kw'aylaxw Centre multi-purpose facility in Lillooet, B.C for the Ts'Kw'aylaxw First Nation community (Figure 36), and Tsleil-Waututh Nation Building (Figure 35), an administration and health centre in North Vancouver, B.C. for the Tsleil-Waututh First Nation community. Their fabrication process starts by taking the construction drawings and programming the CNC machine to cut and label each panel piece with high precision per the design specifications. Then the framing line equipment is used to manufacture the building components, and this system ensures modules are built within very tight tolerances. As the panels go through the assembly line, the panels are fully insulated

and enclosed. The final part of the fabrication process is to install protective barriers, such as thermal and moisture barriers. From there, the panels are loaded and wrapped inside the facility to ensure protection from the elements during transport. Finally, the building components are unloaded and assembled on site.

Figure 35. “Tsleil-Waututh Nation Building.” Panelization assemblies by BC Passive House, 2018.

Figure 36. “Ts’Kw’aylaxw Centre.” Panelization assemblies by BC Passive House, 2018.

While the relevant case studies I found that were Indigenous-led, Passive House Certified, and prefabricated are located in British Columbia, Canada, the climate in Washington state is similar to or milder than conditions further north, so similar strategies can likely be used. However, with rising costs of prices of building materials due to supply chain challenges, rising inflation, and tariffs, working with companies that are located within the United States might be a more cost-effective option. Phoenix Haus is a Passive House prefab construction company located in Colorado - which also partners with architects and general contractors in Washington state - that encourages sustainable living by creating open-sourced, carbon-free homes assembled by local builders. Their optimized design approach, the Alpha System, was designed to be manufactured using dimensional, domestic, builder-friendly materials. They provide thermal bridge detailing, researching and verifying healthy materials, and sourcing windows fabricate panels to build a Passive House-certifiable structure. Phoenix Haus' panelization process (Figure 37) includes cutting with a computer numerical control (CNC) machine, framing, insulating and enclosing panels, installing thermal and moisture barriers, transportation, and installation. (Phoenix Haus, n.d.). The ability to pack the building components onto a 18-wheel flatbed trailer (Figure 38) is appealing when considering traversing the steep, gravel roads into the uplands near the Shoalwater Bay Indian Tribe's reservation.

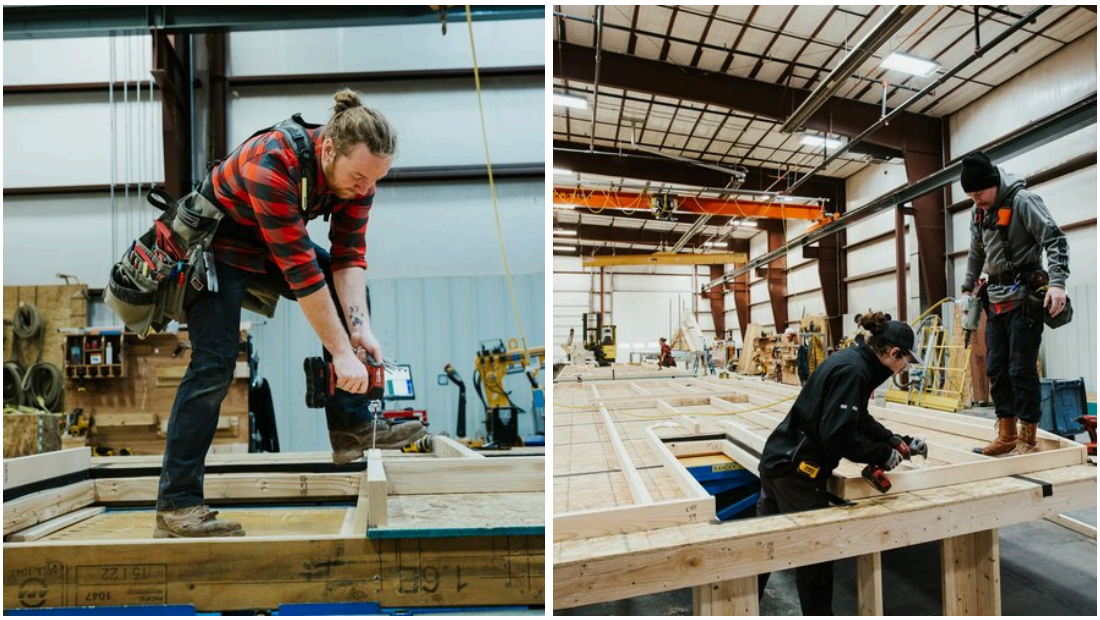


Figure 37. Prefab Design Panelization Process. Phoenix Haus, https://phoenixhaus.com.

Figure 38. H6 | 23 Housing Design and Installation. Phoenix Haus, https://phoenixhaus.com.

3.2.5 Design for Disassembly

The idea of pre-fabricated panels as a method of building assemblies can be translated to other construction approaches as well. In fact, using prefabricated subassemblies is one of many approaches to achieve disassemblable built structures. Design for Disassembly is a relatively new design philosophy that focuses on creating structures that can be easily taken apart for purposes such as repair, reuse, or recycling (Crowther, 2005). Crowther states that current construction practices tend to be linear - extract natural resources, process resources into materials, manufacture materials into building components, assemble components into buildings, and then the building is ready for use. When the building has run its course, it may be demolished and the building materials and components will be turned into waste. This linear view of the built environment (Figure 39) limits the end-of-life options when a building has reached the end of its service life. Crowther argues that “a cyclic view of the built environment, and the materials within it, recognises the need to consider, at the design stage of a project, the disassembly process as well as the construction process” (Crowther, 2005, 1). The primary reason that a building may become obsolete is if it no longer functions appropriately for its occupants - whether that be via technology, functionality, deterioration, or it is no longer needed in that particular location. The ability to retrofit or disassemble and replace parts of buildings can extend the

functionality of a building and lead to longer term usage (Figure 39), and allow for easy repair and refurbishment after fire damages, for example. However, disassembling existing buildings comes with significant barriers to successfully retrieving and reusing building components and materials. While that in itself is a difficult feat, knowing that a cyclical process of buildings at the material and component level is possible, it is arguably beneficial to envision the disassembly and reuse of parts of buildings from early stages of the design process.

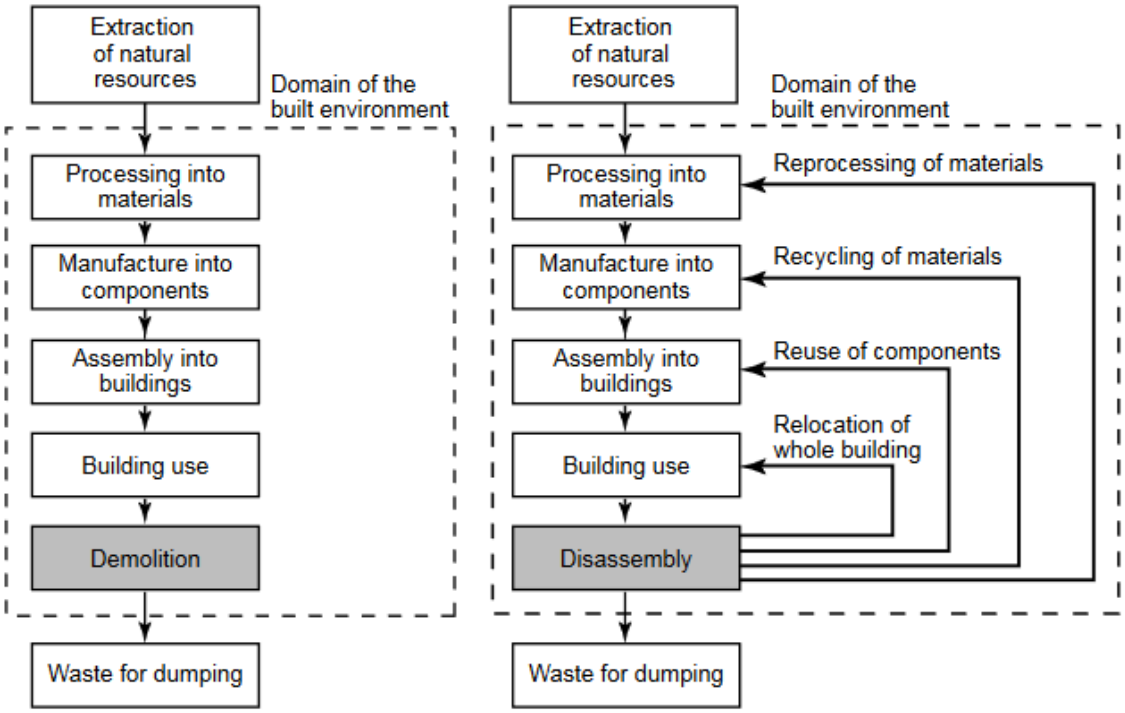


Figure 39. Typical and Alternative end-of-life scenarios for the built environment. Crowther, 2005.

Strategies for Design for Disassembly include using materials and components that can be reused or recycled while particularly avoiding toxic and hazardous materials, considering how those who are disassembling the building in the future will approach the process. For this reason, it is more desirable to use mechanical connections rather than chemical ones. Streamlining the number of different types of fasteners or connectors can make disassembly simpler, as it will not require disassemblers to use multiple types of tools or methods to take apart the building. Designing and using building parts that are interchangeable or have multiple uses is helpful, as it minimizes the number of

different types of materials and components. It is imperative to provide access to all parts of the building and to all components, and helpful to label which parts connect makes assembly and disassembly more efficient. At the building scale, being able to read the building and understand how it is assembled and disassembled can be simplified by using structural grids and modular design.

Since Design for Disassembly is a relatively new approach to design and construction of buildings, successful examples are few and far between. Relevant case studies were primarily experimental, prototypical, or based in extensive research and development. A particularly compelling case study is the Zero House (Figure 40), designed by the Endeavour Center and Ryerson University for their 2017 Sustainable Building & Design project. The Zero House is net zero energy, net zero carbon footprint, zero toxins or chemicals, zero construction waste, stackable (Figure 46), architecturally appealing, and affordable home designed as a single family dwelling (Endeavour Center and Ryerson University, 2017). This building was intended to be assembled, disassembled, and reassembled to showcase its adaptability. The team used a temporary “flying factory” set up in a large tent to assemble the floor, wall and roof panels for the building, while also providing a dry place to store all the panel sections (Figure 41 and 42). The precision achieved during the fabrication process of the panels made the assembly relatively easy and fast, as construction of the Zero House was completed within 3 months. After installing the panels (Figures 43-45), the building was then wrapped in an air control layer and interior vapor control layer, then sealed with non-toxic caulking. The service cavities for electrical systems were kept inside the barriers to minimize leaks in the wall assembly. The Endeavour Center and Ryerson University were able to keep their project relatively affordable while using high quality windows, doors, and non-toxic finishes. In particular, the prefab panelization method allowed the team to use affordable structural materials and reduce labour costs, enabling them to use some more costly nontoxic finishes. Energy to sustain occupants in the home was generated by photovoltaic (PV) panels. It was transported to the EDIT Expo at Unilever Factory in downtown Toronto, then the building’s panels were disassembled and arranged onto two flatbed trucks to its final destination. Specific information about the Zero House can be found in the presentation by the (Endeavour Center and Ryerson University, 2017; Feigin, 2019).

Figure 40. Exterior and interior photos of the Zero House completely assembled. Endeavour Center and Ryerson University, 2017.

Figure 41. Assembly of angled roof panels inside the “Flying Factory” workspace. Endeavour Center and Ryerson University, 2017.

Figure 42. Storage of wall and roof panels, labeled and organized, inside the “Flying Factory” workspace. Endeavour Center and Ryerson University, 2017.

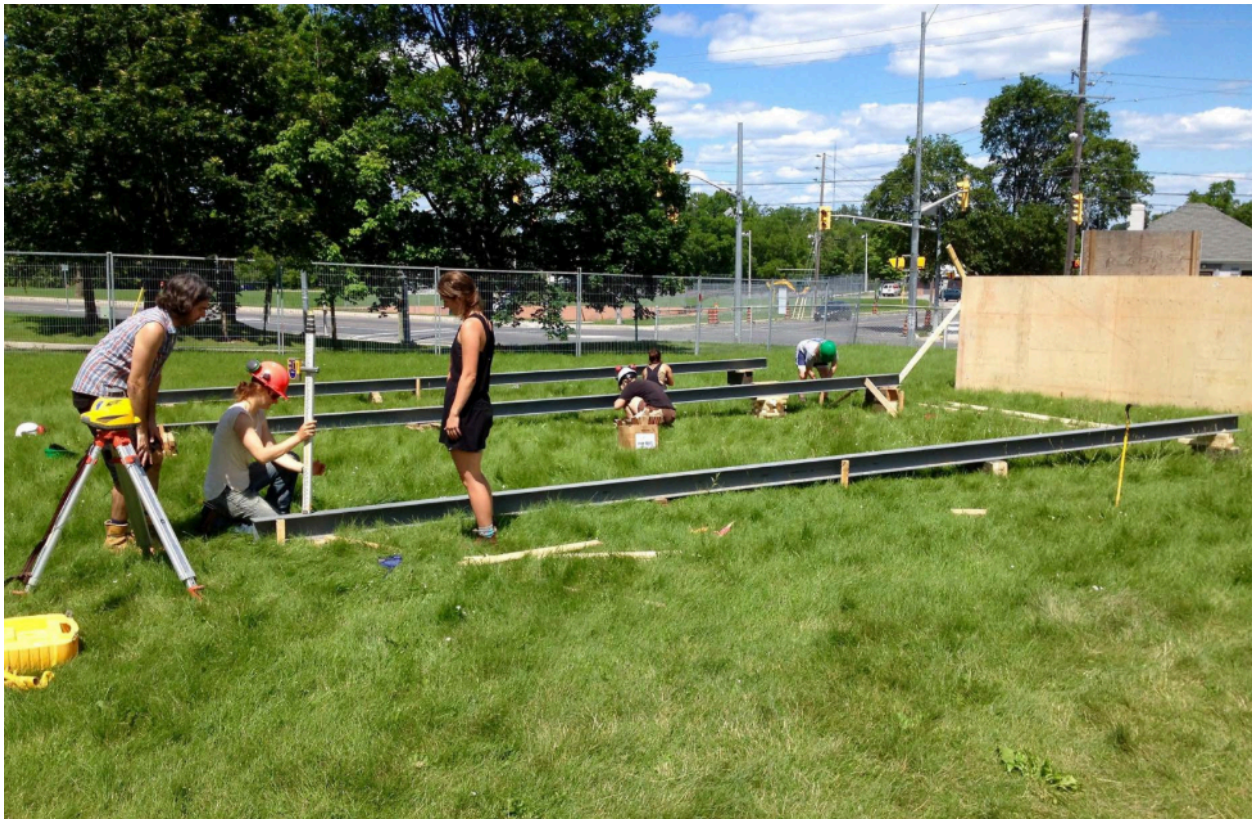


Figure 43. A temporary platform foundation for the building using steel beams. Endeavour Center and Ryerson University, 2017.

Figure 44. Moving the floor panels from the tent to the foundation by manually using rollers and the power of the whole team. Endeavour Center and Ryerson University, 2017.

Figure 45. Assembling the floor panels: Sliding the floor panels onto the foundation beams. Endeavour Center and Ryerson University, 2017.

While these single-family homes are an incredible feat on their own, this single house design can be one unit in a much larger multi-family housing facility. The Zero House was built as a small, single-family dwelling at 1,100 square feet. However, Zero House can also serve as one unit in a stackable row house design intended to address rebuilding at a reasonable density (Endeavour Center and Ryerson University, 2017). This design approach in particular would be applicable to potentially build homes in the lowlands which can then be disassembled and reassembled in the uplands. Since one unit could be connected to multiple units, it would be beneficial for tribal members and their families to add on and remove as relatives are born, in need of a place to live, or when elders may need additional support from family. Though SBIT likely would not need row housing at this density in the lowlands or the uplands, envisioning a few homes connected together is a potential solution to keeping families together whether they decide to remain in the lowlands or move to the uplands.

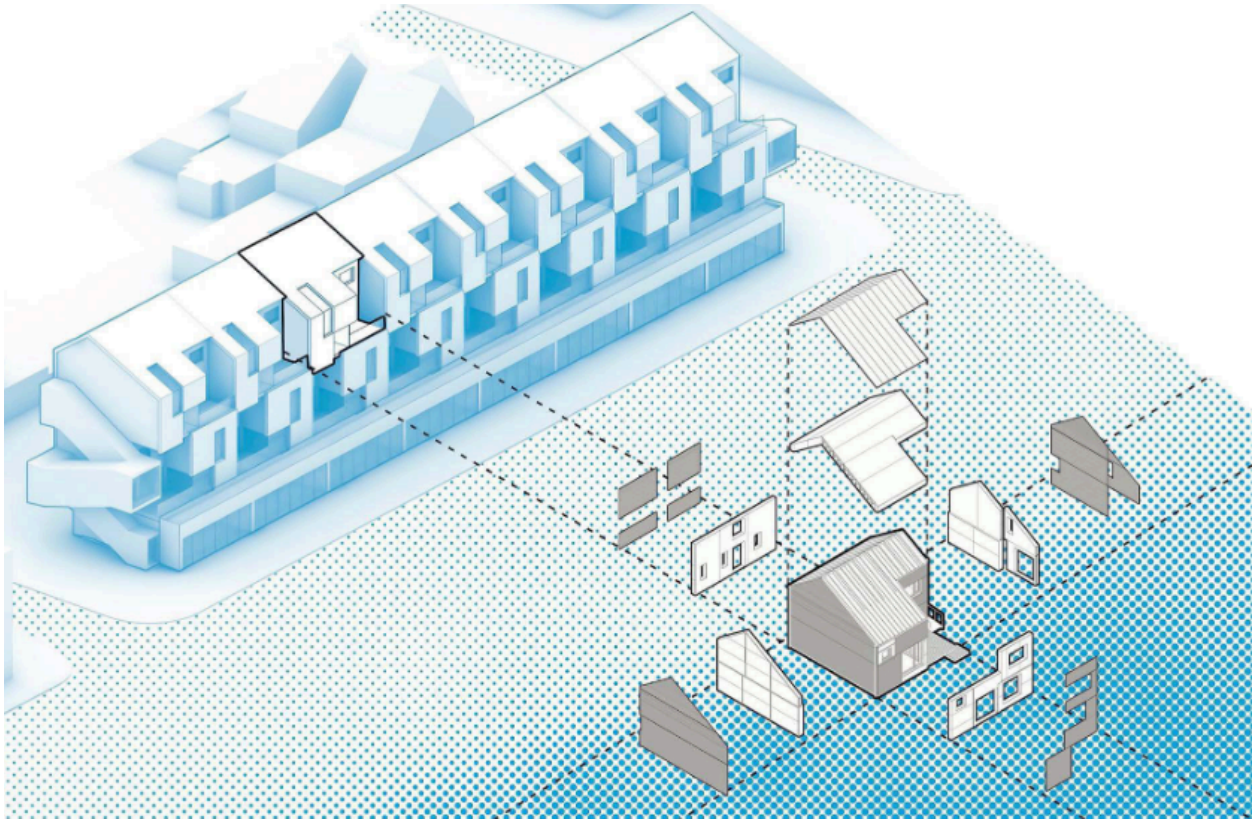
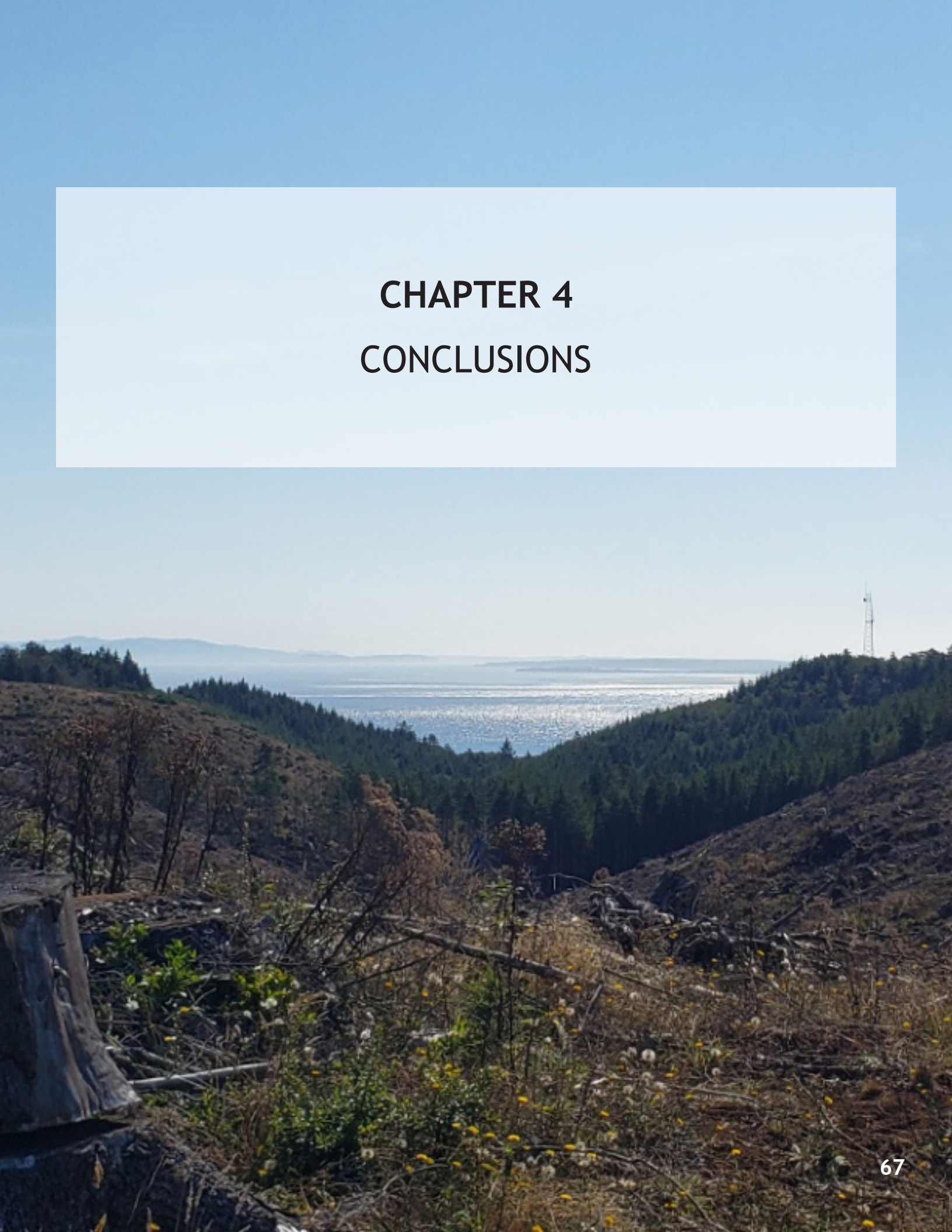


Figure 46. “One Piece of a Larger Design” Diagram. 2017 Zero House Presentation, Endeavour Center and Ryerson University.

CHAPTER 4

CONCLUSIONS



CHAPTER 4: CONCLUSIONS

4.1 Summary and Future Research

The Shoalwater Bay Indian Tribe's 'Upland Expansion' plan is a complex project involving relocation of a tribal community from their lowland reservation lands where their housing, businesses, and services have served generations of families and relatives. The future outlook of environmental threats to these lands make tribal members living within the reservation and outlying communities concerned for the safety and security of their livelihoods in the face of adverse climate impacts. Deep ancestral ties to their lands makes thoughts of relocating difficult, as finding solutions to meet the needs of the entire community while maintaining cultural continuity and access to significant relations and resources are so tied to their relationship to place. Though the intention is to meet the needs of all tribal members, realistically, it is unreasonable to assume that all tribal members want the same outcomes. They all likely have different ideas of whether, when and how to move. Relocation may potentially provide opportunities to return to ancestral cycles that involve moving around throughout seasons for food, medicine, etc. and more sustainable ways of living on the land that are commensurate with the teachings and values of previous generations. Exploring unconventional methods of building today, such as designing for assembly, disassembly, and reassembly in a new location may address the multitude of variable desires of SBIT tribal members. Through opportunities for community engagement and collaboration, SBIT activates their sovereignty over their lands and the well-being of future generations. Adapting to changes in landscapes by envisioning how a community can grow and expand in safer territory requires collaboration across specialties and knowledge systems. A particularly important piece of this puzzle is envisioning ways in which a community can maintain and expand access to housing and services in the upland area to which they plan to relocate to. Exploring prototypical design approaches and forward-thinking construction methods can create expansive ideas as to how to build a resilient, sustainable community that benefits current and future generations.

The methods of building explored in this thesis address building methods that are based in the traditions and practices of Indigenous peoples in the Pacific Northwest region of what is now the United States of America. Utilization of traditional materials and climate-responsive design strategies from

cultures native to this region can inform ways of adapting to the future with respect to climate change. Of the strategies explored, Design for Disassembly (AIA, 2023) with the intent to move to and reassemble on higher ground aligns with the construction and assembly practices of the plankhouse typology. This approach addresses the housing shortage and affordability of quality homes in the lowland areas of the Shoalwater Bay Indian Tribe's reservation lands. The ability to design sustainable homes that can be built within the near future on the lowlands, and progressively moved to the uplands as time and resources permit, addresses long-term needs of the tribe while promoting self-determined adaptability. Access to housing and community services are inherent to the livelihood of the Tribe during this transition from the lowlands to the uplands, and there is a need to meet current deficiencies in the lowlands while considering long-term settlement in the uplands. Architecture that responds to environmental risks in a culturally-affirming way can ease transition to a new location while supporting current and future generations. Community engagement and collaboration have created ample opportunities for dialogue between tribal planners, tribal employees, university faculty and students, architects, planners, landscape architects, designers, and consultants. These conversations about approaching the feat of Upland Expansion with the Shoalwater Bay Indian Tribe have led to collaborative projects in various seminars and studio courses at the University of Washington College of the Built Environments (CBE).

4.2 Personal Statement on Research Projects and Course Work with the SBIT and UW CBE

As part of my relationship with this overarching research project, I myself was part of a graduate architectural studio course titled "Collab/Fab with the Shoalwater Bay Indian Tribe" during the spring quarter of 2023 at the University of Washington. Informed by previous research from other courses, this studio focused on research and development of prototypes for sustainable housing that could adapt advanced digital manufacturing and high-performance building systems to traditional Coast-Salish and Chinookan building traditions and hyper-local material resources. The pedagogical model for the Collab/Fab studio was "Action Research." This approach is characterized by seeking transformative change through the simultaneous process of taking action and doing research, which are linked together by critical reflection.

The team that I was a part of delved deeply into WikiHouse, a modular system for creating high-performance, zero-carbon buildings. WikiHouse uses digital fabrication via CNC machines to create building components that can be assembled quickly and efficiently. Embracing the Shoalwater Bay Indian Tribe's philosophy of working with the land and doing no harm to nature, the design of the "CNC Plankhouse" (Figures 47-48) relied on designing around site conditions, traditional spatial relationships, off-grid living, passive houses, and Wiki boxes. The upland expansion provides different sloped conditions (Figures 51-52) that trigger variations of locations where outdoor spaces can be placed along the home. Using the building as wind protection, our group generated floor plans (Figures 49-50) that were designed for the three different conditions that can be adaptable for depending on the site chosen. The Wiki box structure is both structural and thermal, providing an all-in-one building material that can be made complete with a CNC machine and installed with a small team of people. This light touch extended the use of the resources from the land and allowed the house to be off-grid. The great wind from the west could be used to create energy to power the house; enough rainwater can be collected by the roof to provide for the needs of the household and would be cleaned before going back to the land. Vermicomposting is suggested as a way of using the natural process of the land to provide fertilizer for other crops or gardens from waste (Becker, Crane, Randall, and Obi, 2023). The lessons learned from this design project in particular laid the foundation to explore further research topics in this thesis.

The group design project for the ARCH 505 Collab/Fab studio course with Rob Corser, AIA and Julia Ann Kriegh, Ph.D, AIA involved a multitude of avenues to deep dive into. Starting with environmental factors - like wind, sun, and orientation to the water - to suggest a variety of potential arrangements, and then programming each house variety informed by programmatic elements of a traditional plankhouse and feedback from tribal members about some of their desires in their homes, resulting in floor plans that are responsive to their environment and orientation while also challenging how standardized homes are typically laid out. Once we modeled the homes into the 3D model of the uplands, we considered environmental systems that would be relevant to the region, such as wind power, water drainage down the hills, and waste management options like vermicomposting. Given that this studio was focused on architecture specifically, as opposed to previous interdisciplinary studios, we

also chose from a variety of structural systems and considered using culturally significant materials, transportation of materials, and sustainable alternatives such as hemp wool and straw bale for their insulating properties. In our group, we focused on a modular Wiki House approach to the structure in which fabricators could use CNC machines to create the pieces that fit together with joinery. Benefits of this building system were suitable for many of the tribe's concerns, such as affordability, quick but efficient fabrication, and a modular system that can be customized or adjusted. Through some examples of buildings that were designed to be disassembled and reassembled, the idea of basing a process that would meet current needs in the lowlands while also contributing to preparing a village in the uplands on design for disassembly principles arose. A further realization that the idea of having homes in different locations with the potential to move or alter the home as family and community needs change, suggesting that design for disassembly is a potential way to physically strengthen connection to ancestral ways of living and a process that would serve the needs of many.

4.3 Future Research and Limitations

Future research for this area of study could explore several topics. Though this study focuses on the Shoalwater Bay Indian Tribe, various tribes and even non-tribal coastal communities will likely face similar challenges with displacement as a result of climate change. Risk of damage to land and infrastructure related to sea level rise, ocean acidification, extreme heat events, increasing wildfire risk and declining snowpack are issues that communities in Washington state are currently facing, and these concerns extend to the greater United States and internationally. Place-based cultures exist around the world, and their connections to land and environment make studies in place attachment theory viable avenues of study as well. Contributing knowledge to this field could prompt innovative solutions across various regions and climates. Collaborative approaches such as community-led design and planning are applicable in both tribal and non-tribal communities, but there are additional factors to consider when working with Indigenous peoples in the contexts of their worldviews and the ways in which they intend to provide for and protect their people for future generations. The findings of this thesis are intended to bridge Indigenous ways of building - which are inherently sustainable, climate responsive, and adaptive to environment - to innovative, high-performance approaches - which are

popular in today's architectural research and practices - to architecture and construction of current and future projects in the built environment. Exploring opportunities for more quantitative details regarding affordability of housing or infrastructure, particularly with temporary vs. immovable foundations, as well as with utilities, waste systems, and water systems could result in finding that could be very beneficial to SBIT's Upland Expansion project goals. Achieving secure foundations with light, moveable building footprints that would accommodate well with the lowlands and the relatively loose soil in the uplands would be quite the endeavour on its own. However, the separate issue of ecological benefits of low-impact, light footprint construction for moving homes can allow for ecosystems to recover. An important component of potential research could also emphasize construction cost estimating and analysis for comparative construction methods and materials. Next steps could also include more specificity on materials and technology that is specific to SBIT and the surrounding region in general would reach a considerable population of communities facing potential relocation due to climate change.

4.4 Limitations in Application to Other Tribes and Places

Additional research in material studies between materials used by Indigenous peoples and low-embodied carbon materials would be helpful, especially as it pertains to local access and availability of materials on lands that are in the hands of tribes. Tribes could also have agency in the design and construction process by developing programs to educate tribal members on how to sustainably harvest natural resources for material purposes and specialized training in construction of their buildings to contribute to the local economy. Further research in these areas may be used in future managed retreat project implementation, and the findings from qualitative and quantitative research will support other Native nations facing similar circumstances. Knowledge sharing and decision-making that contributes to maintaining cultural continuity while sustaining the current and future generations of Indigenous peoples are of utmost importance for successfully achieving self-determined adaptability in response to climate change.

Figure 47. Rendering of “CNC Plankhouse” design project from UW CBE Spring 2023 Collab/Fab Architecture studio. Design and representation is credited to Cecelia Becker, Jackie Crane, Frank Obi, and Audrey Randall.

Figure 48. “CNC Plankhouse” design for UW CBE Spring 2023 Collab/Fab Architecture studio, responding to the ridge of the uplands with a view of the ocean in the distance.

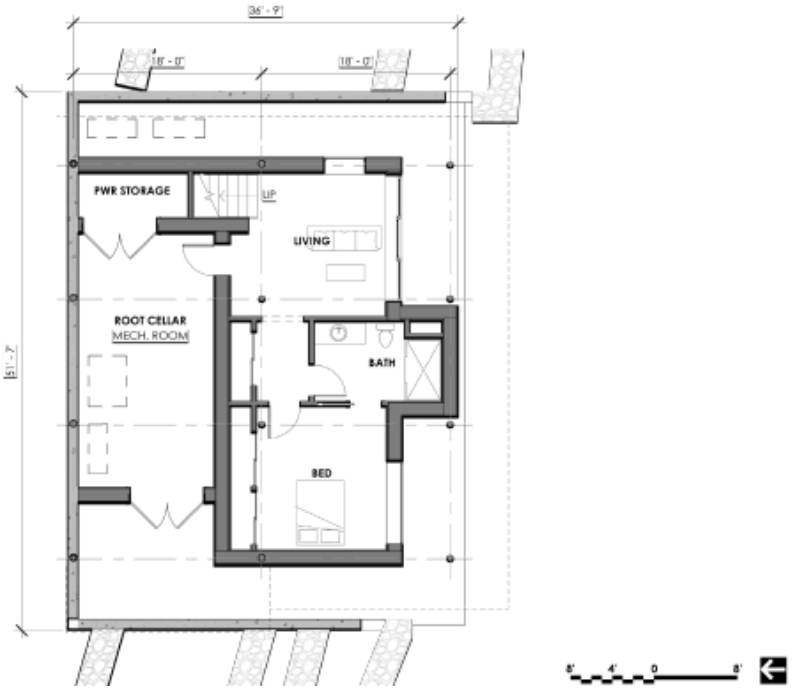


Figure 49. Bottom Floor Plan for “CNC Plankhouse” design project from UW CBE Spring 2023 Collab/Fab Architecture studio.

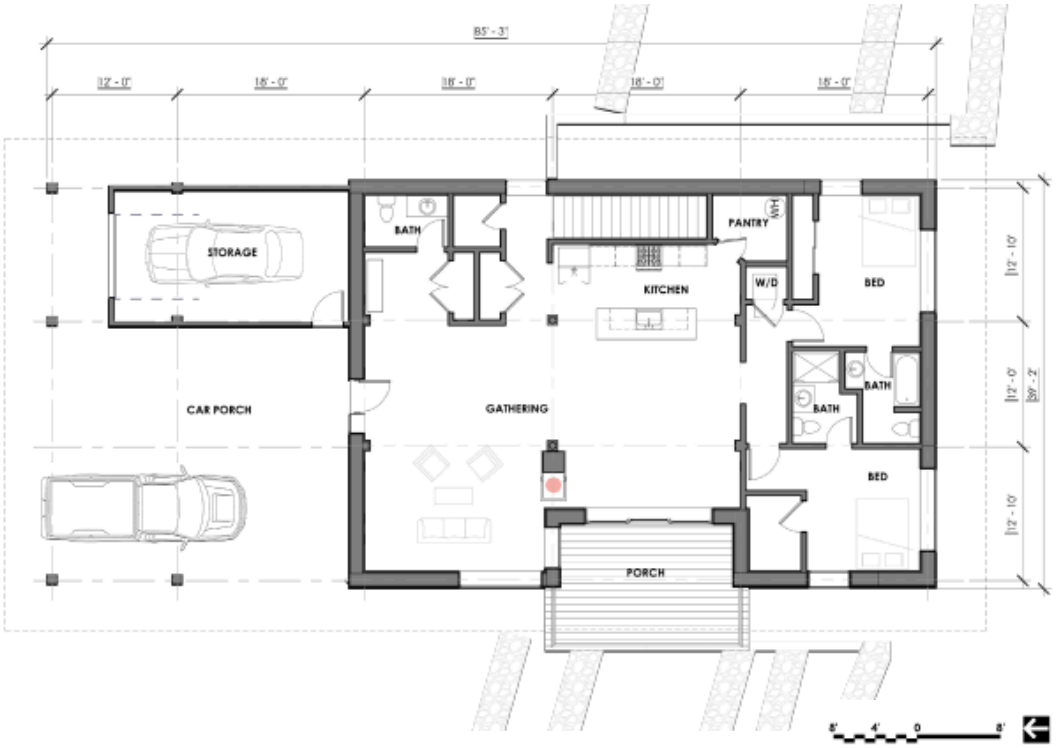


Figure 50. Main Floor Plan for “CNC Plankhouse” design project from UW CBE Spring 2023 Collab/Fab Architecture studio.

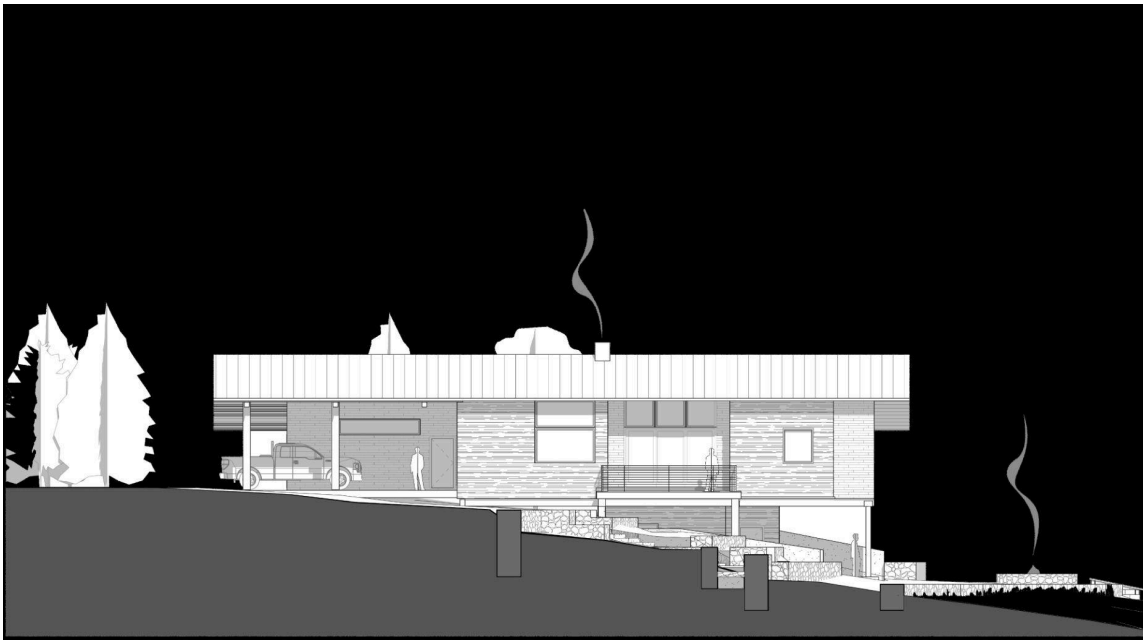
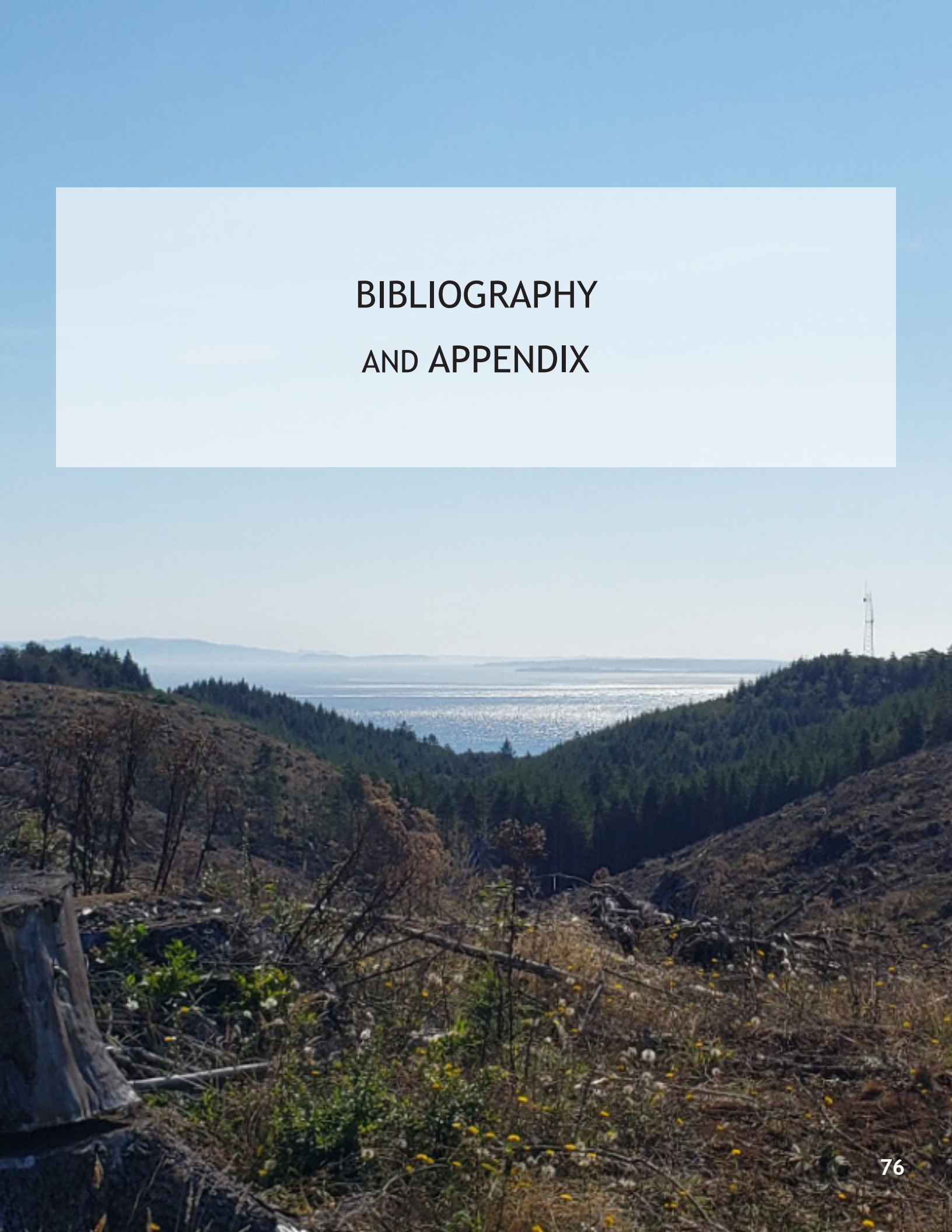


Figure 51. Section for “CNC Plankhouse” design project from UW CBE Spring 2023 Collab/Fab Architecture studio.

Figure 52. Section with an addition for “CNC Plankhouse” design project from UW CBE Spring 2023 Collab/Fab Architecture studio.

BIBLIOGRAPHY AND APPENDIX



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APPENDIX

The items listed listed below include my own personal work, including my Masters Thesis poster (submitted May 1st, 2025), Masters Thesis Presentation for "Design for Relocation and Reassembly: Self-Determined Adaptability for the Shoalwater Bay Indian Tribe's 'Upland Expansion,'" which I presented in on May 27th, 2025 in partial fulfillment of the requirements for the degree of Master of Architecture from UW in Seattle, WA. I also presented a variation of this powerpoint alongside Daniel B. Abramson, Ph.D (Chair) and Julia Ann Kriegh, Ph.D (Committee Member) at the Indigenous Housing Summit at Western Washington University in Bellingham, WA on May 30th, 2025. I included the ArcGIS Story Map for the Shoalwater Bay Indian Tribe's Development for the Future, created by Red Plains Professional, Inc., since it is a useful interactive tool to understand the progression of project phases for SBIT's development. The maps within this ArcGIS Story Map are particularly helpful, and the 3D Rendering of Uphill Roads video is a great complement to it. I included the SBIT Master Plan, SBIT Request for Proposal, and the SBIT Community Development and Planning page on their website for reference and further linked information to explore.

Documents and Online Resources

"Design for Relocation and Reassembly: Self-Determined Adaptability for the Shoalwater Bay Indian Tribe's 'Upland Expansion'" Masters Thesis Poster on May 1st, 2025:
https://drive.google.com/file/d/1watn_dvcA0GNEg3aiggcmZfqEMYxSSWC/view?usp=sharing

"Design for Relocation and Reassembly: Self-Determined Adaptability for the Shoalwater Bay Indian Tribe's 'Upland Expansion'" Masters Thesis Presentation on May 27th, 2025:
https://docs.google.com/presentation/d/19MLLCkP_-YjA4osNaLyYnpyV3C7yxM4xAMqtQY_Vt9w/edit?usp=sharing

"Design for Relocation and Reassembly: Self-Determined Adaptability for PNW Coastal Tribes' 'Upland Expansion'" Modified version of Masters Thesis Presentation for the Western Washington (WWU) Indigenous Housing Summit on May 27th, 2025:
https://docs.google.com/presentation/d/19btnP-BazR97RwEusGs2bqAnvkckI5YwU25dje4oOdY/edit?usp=sharing

Phased-Planning Approach to the Upland Development: Interactive Story Map

Request for Proposal: Development of Master Community Relocation Plan for the Shoalwater Bay Indian Tribe

Shoalwater Bay Indian Tribe Community Development and Planning: Projects, Partnerships, Mission, Services, and Contacts

Shoalwater Bay Indian Tribe Master Plan: *munk-saxali nám̓sčać* Shoalwater Bay Indian Tribe Rising May 2025

3D Rendering of Uphill Roads: SBIT Raise Loop and IHGBC Projects 1 2025