

TRIBAL HOUSING MARKET STUDY

CREATING HOUSING, JOBS, AND
RESILIENCE THROUGH MASS TIMBER
ON THE NORTH OLYMPIC PENINSULA



We acknowledge that the work informing this study takes place on the ancestral and contemporary homelands of the **Makah, Lower Elwha Klallam, Hoh, Quileute, Jamestown S’Klallam, and Port Gamble S’Klallam** peoples. We honor their enduring relationships with the mountains, forests, rivers, and coastal waters of the North Olympic Peninsula, and we recognize their inherent sovereignty, treaty rights, and ongoing stewardship of these lands and waters. We pay respect to Elders past and present, and to Indigenous youth as leaders of today and tomorrow.

With gratitude, we thank the Tribal nations of this region for their generosity in sharing knowledge, culture, and resources that shaped this market study. We understand that a land acknowledgement is a beginning, not an end. In that spirit, we commit to relationships grounded in consent, cultural respect, co-design, and shared benefit; to centering Tribal priorities in planning and delivery; and to accountability for how this work advances community well-being for the peoples of the North Olympic Peninsula.

EXECUTIVE SUMMARY

The 2025 Tribal Housing Market Study, prepared by 123 West Design Collective for the Clallam County Economic Development Council, evaluates the feasibility of producing and deploying cross-laminated timber (CLT) homes for six Tribes on Washington's North Olympic Peninsula - Makah, Lower Elwha Klallam, Hoh, Quileute, Jamestown S'Klallam, and Port Gamble S'Klallam. The study integrates demand assessment, cost modeling, design development, supply-chain planning, and a comparative analysis of building systems to deliver an actionable program tailored to remote, coastal, and culturally specific contexts. The central premise of the study is to localize value creation by pairing Makah-sourced western hemlock with regional manufacturing at the Composite Recycling Technology Center (CRTC), thereby shortening logistics, stabilizing costs, and retaining economic benefits within the Peninsula.

Findings indicate an aggregate near-term need on the order of roughly 200–250 homes across the participating Tribes over the next decade, excluding additional units that may be warranted for replacement of aging or substandard stock. Using current pricing estimates of these homes, this demand translates to \$60–80 million in Tribal housing investments needed for the Olympic Peninsula. The analysis compares CLT with stick-frame, structural insulated panels (SIPs), and other conventional building approaches. CLT from CRTC scores most favorably when evaluated across total cost of delivery in remote markets, construction duration amid persistent labor constraints, durability and moisture resilience in marine climates, and life-cycle performance.

The proposed solution advances a place-based CLT pipeline: sustainable timber inputs from Tribal lands and regional forests; fabrication and kitting at CRTC to enable rapid, repeatable assembly; and pre-approved plan sets that compress permitting and procurement timelines. The recommended product kit comprises a small family of adaptable models including a detached accessory dwelling unit (DADU), a single-story two-bedroom home, a three-bedroom A-frame, and a quadplex of two-bedroom flats. Each design is optimized for coastal exposure, seismic and wind loads, and household preferences such as generous kitchens, storage, single-level living, universal design features, and biophilic wood interiors. Target budgets are designed to meet or approach parity with traditional stick-frame homes while improving construction timelines. Preliminary timelines range from roughly six weeks for a DADU build to 12–16 weeks for larger models, inclusive of foundation work, CLT panelization, on-site assembly.

The study also identifies material constraints that must be proactively managed. Remote-market penalties, like freight costs, weather-related delays, and sparse contractor capacity, require disciplined packaging of projects and early pricing lock-ins. Capital flows remain complex, given reliance on Indian Housing Block Grants, Section 184 lending, state and federal grants, and philanthropic sources, all of which operate on different allocation and compliance cycles. Code acceptance and certification pathways for CLT (specifically PRG-320 compliance and Authority Having Jurisdiction familiarization) must be sequenced to prevent approval bottlenecks. Finally, governance and community trust are paramount: successful delivery will depend on visible Tribal

leadership, transparent resident engagement, and contracting that equitably shares risk and builds workforce capacity.

To operationalize the program over a 36-month timeline, the CLT housing program will need to advance through five tightly sequenced stages:

- 1) mobilize a coalition of partners (ex. CRTC, Clallam EDC, 123 West, and a lead Tribe), stand up a program management office, and lock-in a small pre-approved plan kit and specs);
- 2) deliver a single pilot home to validate costs, cycle time, and the authority-having-jurisdiction (AHJ) path while engaging residents and local builders;
- 3) formalize a joint-venture and procurement framework, complete certification/inspection protocols, and assemble a standardized funding stack for rental/ownership models;
- 4) ready the first community on Tribal land through pre-development, CRTC kitting with buffer inventory, and construction of 10–20 homes plus commissioning and occupant feedback;
- 5) scale county-wide through a launch of Peninsula College training pipelines, run 60–80 backlog-relief units in bundled waves, and create quarterly reviews and price locks.

If executed as designed, the program is expected to deliver homes faster and with greater cost stability than conventional approaches in similarly remote markets, while materially increasing local value capture across forestry, manufacturing, and construction. The proposed assemblies emphasize moisture control, energy efficiency, and low-toxicity finishes - reducing lifetime operating and maintenance costs and improving indoor environmental quality. Over time, a repeatable CLT pipeline is anticipated to strengthen Tribal housing authorities' delivery capacity, create skilled jobs, and enhance resilience to supply-chain shocks and severe weather events.

The study concludes that a locally rooted CLT housing initiative leveraging Makah timber resources, regional fabrication at CRTC, and culturally attuned, pre-approved designs offers a pragmatic and scalable path to closing critical housing gaps for the Peninsula's Tribes. By aligning production, financing, certification, and workforce development within a phased delivery plan, the program positions partner Tribes to meet near-term housing needs while laying the foundation for long-term economic and community benefits. Through this effort, we found that using locally sourced CLT panels can reduce housing barriers for Tribes on the Olympic Peninsula, provide longer-lasting and more sustainable housing, and create shared benefits for both Tribal communities and the County through participation in the full CLT supply chain—from production to installation.



Kyle Zimmerman, Founder/CEO, 123 West Design Collective
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LIST OF ABBREVIATIONS AND TERMS

AAR: After-Action Review

AHJ: Authority-Having-Jurisdiction

AMMR: Alternative Means and Methods Report

ANSI: American National Standards Institute

ANSI/APA PRG-320: The certification for engineered wood products

APA: The Engineered Wood Association (originally the American Plywood Association)

BIA: Bureau of Indian Affairs

BOLEH: Built-On-Lot-Engineered Home

CAD: Computer-Aided Design (or Drawing)

CAG: Community Advisory Group

CLT: Cross-Laminated Timber

CNC: Computer Numerical Control

CO₂e: Embodied Carbon

CPI: Consumer Pricing Index

CRTC: Composite Recycling Technology Center, located in Port Angeles, WA

CSZ: Cascadia Subduction Zone

DADU: Detached Accessory Dwelling Unit

DLT: Dowel-Laminated Timber

EBITDA: Earnings Before Interest and Taxes, Depreciation, and Amortization

EPD: Environmental Product Declaration

ERP: Enterprise Resource Planning

EV: Electric Vehicle

FRR: Fire Resistance Ratings

FSC: Forest Stewardship Council

GC: General Contractor

Glulam: Glue-Laminated Timber

HUD: U.S. Department of Housing and Urban Development

IBC: International Building Code

ICF: Insulated Concrete Forms

ICC-ES: International Code Council Evaluation Service
IEQ: Indoor Environmental Quality
IHBG: Indian Housing Block Grant
IP: Intellectual Property
KPI: Key Performance Indicator
LOI: Letter of Intent
MEP: Mechanical, Electrical, Plumbing
MOU: Memorandum of Understanding
NLT: Nail-Laminated Timber
PEFC: Program for the Endorsement of Forest Certification
PMO: Program Management Office
PRG: Power Rated Glulam (or Performance Rated Glulam)
RACI: Responsible, Accountable, Consulted, Informed
R-Value: Resistance to heat flow (e.g. insulation property)
QA/QC: Quality Assurance / Quality Control
USDA: U.S. Department of Agriculture
VOC: Volatile Organic Compound
WSU: Washington State University
WUI: Wildland Urban Interface

SCOPE OF THE TRIBAL HOUSING MARKET STUDY

The Tribal Housing Market Study, conducted by 123 West Design Collective for the Clallam County Economic Development Council (EDC), evaluated the feasibility of producing and deploying cross-laminated timber (CLT) homes using coastal western hemlock from the Makah Sawmill and processed through the Composite Recycling Technology Center (CRTC) to Tribal communities in the Olympic Peninsula. The 2025 study was structured into four interrelated phases, designed to produce a data-driven, culturally informed, and actionable framework for Tribal housing solutions.

“This study will explore the feasibility of offering a competitively priced home product built at the Composite Recycling Technology Center (CRTC) with Makah hemlock into the Pacific Northwest and US Tribal housing markets. The study will investigate housing demand, cost ranges and constraints, design parameters, and available housing options for Tribes across the Pacific Northwest and will be widely shared with parties interested in the data.”

- Clallam Economic Development Council

“The Tribal Housing Market Study represents an important opportunity to address critical housing needs while fostering job creation and innovation in the Tribal communities here on the Olympic Peninsula. The goal of getting to sustainable, affordable housing is achievable.”

- 123 West Design Collective

The Tribal communities explored as a part of this study were the 5 federally recognized Tribes of Clallam County, Washington (Makah, Lower Elwha Klallam, Jamestown S’Klallam, Quileute, and Port Gamble S’Klallam), and the Hoh Tribe of Jefferson County as it is similar in proximity, environmental factors, material and labor resources, and building conditions.

The four phases of the market study were as follows:

Phase 1: Defining Housing Demand. The first phase identified and quantified housing needs within the 6 Tribal communities in this study. Engagement included interviews and focus groups with Tribal leaders and housing authorities, analysis of census and enrollment data, and surveys targeting planners and knowledge experts.

Phase 2: Cost Ranges & Constraints. The second phase examined the financial feasibility of Tribal housing. Benchmarking compared Tribal funded, federally funded, state funded, and privately subsidized housing data to establish cost models. Key barriers such as land use, infrastructure, financing models, and labor availability were documented. Funding sources were assessed alongside production cost modeling with CRTC to estimate material, labor, and supply chain expenses.

Phase 3: Defining Design Parameters. The third phase focused on cultural and environmental priorities. Collaboration with Tribal elders, artists, and historians ensured that indigenous aesthetics and traditions were integrated into housing concepts. Climate adaptability, sustainability practices, and energy-efficient technologies—including passive heating/cooling,

water conservation, and renewable energy—were analyzed to align homes with both cultural values and environmental resilience.

Phase 4: Evaluating Available Housing Options. The final phase benchmarked existing housing stock and HUD-funded units against potential CRTC-produced homes. Comparative market analysis considered modular, subsidized, and conventional housing alternatives to identify the competitive advantages of CLT homes. Stakeholder surveys measured willingness to pay for high-quality, locally sourced housing products that reinforced Tribal economies.

The expected results of the study were:

- A housing demand analysis, cost models, and design recommendations for the 6 Tribal communities studied on the North Olympic Peninsula.
- A feasibility assessment for CRTC's housing product.
- Stakeholder insights from interviews, surveys, and workshops.
- A cost-benefit comparison to existing housing solutions.
- Implementation strategies for funding, production, and scaling deployment.

By combining rigorous data analysis with deep community collaboration, this study intends to provide a roadmap for innovative, locally rooted Tribal housing solutions with potential for replication across the Pacific Northwest and beyond.

BARRIERS TO TRIBAL HOUSING

The Tribes on the Olympic Peninsula face many similar challenges as other Tribal nations in Washington, but their geographic isolation and coastal environment make several barriers especially acute⁽¹⁾. Remote locations drive up the cost of building materials and utilities. Transportation of supplies is costly and time intensive. Infrastructure does not scale well for small, rural Tribal communities, making per-unit development costs significantly higher than in urban areas. A lack of local resources in architecture, planning, and engineering makes it difficult to align project teams with project funding and therefore many housing opportunities are often delayed or cancelled altogether. Peninsula Tribes struggle to attract or retain skilled construction labor. Contractors are often unwilling to take on small projects in hard-to-reach areas unless multiple projects can be packaged together to make the work worthwhile. Lack of workforce housing compounds labor shortages, since there are few places for workers to live near project sites. Below, the various barriers are discussed in great detail to understand the underlying issues preventing sustainable and affordable housing solutions for Tribal communities of the Olympic Peninsula.

LAND USE AND ENVIRONMENTAL CONDITIONS

Information was gathered on the environmental conditions for which Tribal communities on the Olympic Peninsula must bear in mind while constructing homes and public buildings. The Cascadia

Subduction Zone (CSZ) is a 600-mile fault running from northern California through Oregon and Washington into British Columbia, where the Juan de Fuca plate is being forced beneath the North American plate. This boundary has the potential to generate megathrust earthquakes in the magnitude 8–9 range and trigger large tsunamis, making it one of the most significant seismic hazards in North America. The last major event occurred in 1700, and scientists estimate these earthquakes occur every 300 to 600 years. For the Olympic Peninsula, this means homes and infrastructure are at risk from strong ground shaking, tsunami flooding in low-lying coastal areas, soil liquefaction in loose saturated ground, and landslides on steep slopes.

Because of these risks, building homes in the region requires a focus on resilience. Washington State building codes already mandate seismic design provisions, and engineers typically account for lateral loads, reinforced foundations, and flexible framing systems. Site selection is especially important - homes located inland or at higher elevations face lower tsunami risk, while geotechnical studies can help identify stable ground and reduce liquefaction concerns. Structural choices also play a role: lightweight wood framing and mass timber systems generally perform better in earthquakes than heavy masonry, and elevated designs or raised foundations can mitigate flood or tsunami impacts. Retrofitting older homes with seismic anchors and bracing is another way to reduce vulnerability. Many Tribes have begun implementing strategies to move their housing and main infrastructure to less risky areas on their reservation, including the Quileute's "Move to Higher Ground" initiative.

Even with good design, a major Cascadia event would disrupt infrastructure such as roads, bridges, and utilities. For this reason, many experts recommend that homes incorporate resilience features like backup power, water storage, and clear evacuation routes. Altogether, the CSZ is not a reason to avoid building on the Olympic Peninsula—it is a reason to build smarter. By combining careful site selection, adherence to seismic codes, and preparedness planning, homeowners can significantly reduce risks and improve safety in this hazard-prone but beautiful region.

Due to the history of seismic events in this area, the soil content along the Olympic Peninsula varies greatly. Soil quality, watershed, and bedrock location all play a pivotal role in the design of homes and their expected longevity.



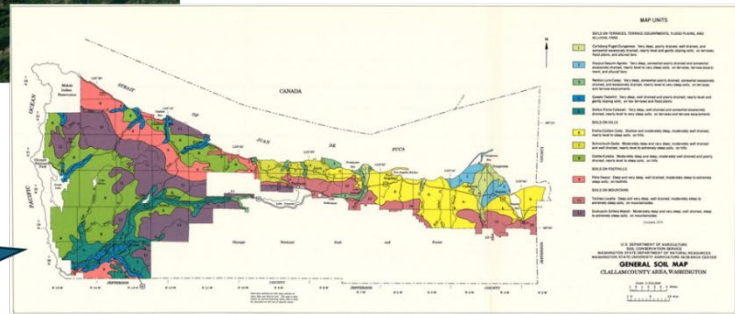
Image: Mustafa Lazkani/Federal Emergency Management Agency



Google Earth, 2025

This map shows the tribal reservations on the Olympic Peninsula that are included in the scope of this study. The environmental differences across the region are vast and therefore need to be understood before making housing design recommendations.

Department of Agriculture, Soil Map 1987, Confirmed 10/17/2024



This map shows the various soil types located throughout the Olympic Peninsula. At a high-level, the physical characteristics of the soil often help determine the best foundation types to use across the region.

Annual weather conditions, such as high rain load and wind load, bring additional challenges to this region, especially in Tribal communities that have smaller infrastructure systems (sewer, water, power). For the purposes of this study, the Tribes were split into two categories, Extreme Weather (Category A) and High Weather (Category B).

	Wind Load	Snow Load	Rainfall
Makah	140 mph	30 lbs./sf	120 in/yr
Lower Elwha Klallam	120 mph	35 lbs./sf	35 in/yr
Jamestown S'Klallam	120 mph	35 lbs./sf	35 in/yr
Quileute	140 mph	30 lbs./sf	120 in/yr
Port Gamble S'Klallam	120 mph	30 lbs./sf	50 in/yr
Hoh	140 mph	30 lbs./sf	140 in/yr

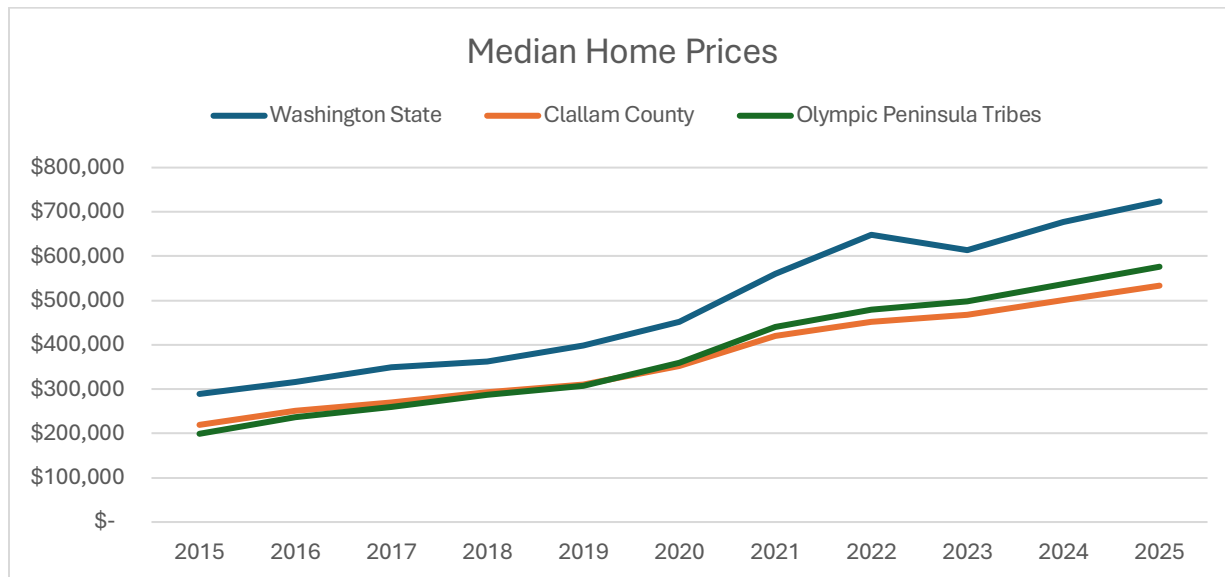
Table 1.1 – Brief Overview of Tribal Populations and Environmental Factors

Design Category A	Design Category B
Extreme wind, snow, and rainfall Loose soil is common Difficult access to build sites	Above average wind, snow, rain Ground is adequate Sites near populated areas
Deep pier systems, helical piles Steep pitched roofs Moisture-resistant insulation and constructed with a super tight envelope	Slab-on-grade or stem walls Many roof options, with solar Thermal efficiency and sunlight positioning are key to design

Further details of the Land Use Analysis are available in Appendix A.

COST OF HOME BUILDING

Across the region, home building prices have skyrocketed in the last 5 years. Tribal communities have experienced even higher costs than many other locations in Washington due to rising costs for materials and labor in rural areas.



Graph 1.1 - Median Home Prices of Washington State, Clallam County, and Olympic Peninsula Tribes ⁽²⁾⁽³⁾

Even though Tribes have sovereignty, their economics are greatly dependent on regional, non-Tribal economics. In the above graph, Tribal housing has now surpassed the cost of building homes in Clallam County, and that is even after removing the costs for land, permitting fees, design fees, and inspections that are typical of non-Tribal home costs. Tribes on the Olympic Peninsula do not have all the material and labor resources on the reservations to build their own homes and therefore are reactive to regional pricing. Often, material shipment costs and the cost of travel for laborers increase for work on Tribal land due to the remote nature of the projects.

CPI Increase (2020-2025) ⁽⁴⁾	+22%
Construction Labor Increase (2020-2025) ⁽⁵⁾	+21.80%
Construction Material Increase (2020-2025) ⁽⁶⁾	+40.50%

Table 1.2 - Comparison of CPI Increase vs. the Labor and Materials Cost Increase from 2020 - 2025

The cost of construction labor has held steady to CPI increases, however, in Clallam County, the number of professionals in the construction industry has continuously decreased per capita causing large fluctuations in the cost of labor per job. The discrepancy in wages between government-funded jobs using prevailing wage and private jobs creates a labor pool that is less motivated to work on Tribal housing projects ⁽⁷⁾.

The costs for construction-related materials have doubled over CPI in the past 5 years. This increase has directly contributed to increased home prices and forced a reduction in material selection as certain products become less available. The supply chain for housing products on the Olympic Peninsula has shrunk since 2020 and driven up prices on standard products like drywall, 2x4 lumber, and general hardware.

To avoid these increased housing costs, Tribes often rely on federal, state, or county grants to reduce the cost burden and establish meaningful partnerships with local suppliers.

COMPLEX FUNDING PROGRAMS

As Tribal communities are typically built on sovereign Tribe land on the Olympic Peninsula, typical funding mechanisms through banks and mortgage lenders do not work. Lenders are often reluctant to issue mortgages on trust land due to foreclosure restrictions, complex title and lease arrangements, and a perceived higher risk due to ever-changing legislation. To alleviate these issues, the federal government started the Indian Housing Block Grant (IHBG) program in 1996 for home lending through the HUD Section 184 guidelines. Unfortunately, as this is a federal program, the funding requirements can often be too generic and do not fit the needs of the individual reservations, especially here on the Olympic Peninsula. Additionally, local Tribes are held to the whims of federal policy, which impacts the availability of funding as well.

As an example, the Indian Housing Block Grant (IHBG) — the main source of Tribal housing funding — did not increase from 1996 to 2021⁽⁸⁾, while material and labor costs had risen significantly. As home prices boomed in 2021, IHBG funding finally increased, but at a rate much lower than that of the US housing market. As a result, Olympic Peninsula Tribes find it especially difficult to both maintain aging housing stock and develop new units to meet demand when the price to do either is much higher on Tribal land than nearby private land.

Any project that uses HUD 184 standards requires a Builder's Certification (HUD 92541) which the builder needs to sign up for including a 10-year warranty. This requirement often adversely affects innovative building ideas, like CLT or SIPs, because local contractors may not be willing to sign up for such a long warranty. USDA, in contrast, only requires that the Authority Having Jurisdiction (AHJ), aka the local building code officials, to approve the design. However, if the local jurisdiction does not have the resources to approve alternate building innovations, either through an AMMR process or a new construction type, the Tribe does not benefit from new innovations in housing.

“Trust land partnership” programs continue to be investigated as a potential solution, however, the land ownership status on Tribal land creates bureaucratic hurdles for homeownership and development. Traditional lenders often refuse to work within Tribal land frameworks, making mortgages difficult to secure and slowing Tribal housing projects.

Private investment rarely makes financial sense on Tribal land due to lower household incomes and very low rental fees by housing authorities below market value. These revenues are insufficient to cover operations, let alone fund new construction.

The Washington State Covenant Homeownership program was created in 2024 to provide downpayment assistance for historically discriminated communities, including Tribes. This program has not yet been adopted by the lenders for Tribes due to many factors, both politically and from a process perspective. Namely, the program does not apply to homes on tribal reservation as of the date of this release.

Currently, 1st Tribal Lending, a national mortgage lender for Tribal communities, is the only lender for the Tribes on the Olympic Peninsula. They specialize in HUD 184 financing with Tribal members but are not yet approved to process Washington Covenant Homeownership downpayment assistance.

Lastly, if a Tribal member opts for a manufactured home, they are not necessarily exempt from sales tax on the home. A few key rules must be followed. First, homes must be delivered within the boundaries of the Reservation to qualify for sales tax exemption and only Tribal members may receive the sales tax exemption. For Real Estate tax exemption, only homes built on trust land are eligible to be tax exempt and Tribe or Tribal members must own/lease the trust land. Some Tribes will sometimes own the land and lease to Tribal and non-Tribal members to ensure the land maintains tax exempt status.

For additional information on Tribal lending options, see Appendix B.

INFRASTRUCTURE, REGULATIONS, AND HOUSING AUTHORITIES

Many Tribal areas in Clallam County lack basic infrastructure, including well-maintained roads, water/sewer lines, power, and broadband internet, making the cost to develop a homesite potentially balloon into a large capital campaign worth millions to create or repair the infrastructure. These systems are costly to develop and must often be funded or coordinated by multiple agencies, making project startup slow and expensive. To support the infrastructure projects that lead to more housing, Tribes will look to use USDA Rural Development grants, Washington state grants or special HUD programs to fund a large development project. These funds are limited and highly competitive, with long application cycles and stringent compliance requirements. Often, even if money is available for Tribal housing development, it may not align with the Tribe's personal development timeline which can force Tribes into building quickly and cheaply, or not at all.

To manage the complexities of these large projects, Tribal housing authorities act as the leaders of these programs and will hire outside consultants and designers on an as-needed basis. On the Olympic Peninsula, small Tribal housing departments face staff turnover that erodes institutional knowledge and slows projects. Limited administrative capacity makes it harder to compete for federal or state grants that require intensive reporting and compliance efforts. Hiring local, non-Tribal experts is often impossible due to competing wages (e.g. government construction jobs pay better than Tribal construction jobs).

SUPPLY CHAIN BARRIERS

The U.S. housing supply chain is a complex network of land acquisition, financing, design, permitting, materials manufacturing, labor, and logistics that collectively determine the speed, cost, and availability of new home construction. All these components are even more complex when it comes to Tribal land, especially Tribal land in the very remote, northwest corner of the country. In this analysis, we will look at the current challenges related to design, material manufacturing, labor, and logistics on the Tribal land in Clallam County.

DESIGN AND PROJECT MANAGEMENT BARRIERS

Clallam County is greatly lacking experts in home design and construction management. Clallam County has 1/6 the number of architects per capita compared to the national average, 1/3 the number of professional engineers, and 1/3 the number of professionals involved in the construction trade. Simply put, this region does not have enough people to meet the housing demands needed. To make matters worse, most of these professionals will refuse to work on projects on Tribal land due to the increased bureaucracy in the cases of government funded projects and the increased risk due to project unknowns. As design is the first, and often most important step in the housing process, many programs can't even get off the ground due to lack of professional resources. This unfortunately results in home designs on Tribal land being over simplistic in nature or modular, like trailers, mobile, or manufactured homes, to avoid needing professional architects and engineers.

Equally, when the projects start, there are very few construction crews that are willing to work on Tribal housing projects and have the project management support available to be located on site. As some of the reservations are far away from city centers, housing projects on Tribal lands often get less on-site project management support which can lead to less quality workmanship or schedule delays. Without high quality project support, many projects will stall out or end up as losses for the contractors. For housing programs to be successful, the design process needs to consider the site teams and contractors that will be running the construction effort.

PERMITTING AND BUILDING CODE BARRIERS

While there are typically no traditional permit processes for housing on Tribal land, buildings obviously need to be built with safety in mind. While not having a permitting process helps accelerate the schedule, it puts the responsibility of building a reliable housing product solely on the design team. Because of this, many Tribes require contracts with builders to ensure a quality housing product that large builders are not willing to sign if it contains legal language not supported by their organization. Often, this results in the buildings being built by small contractors, varying in skill and experience. Some Tribes will attempt to avoid this by maintaining a continuous supply of qualified builders within the Tribal membership, but this simply isn't a sustainable model. To ensure safety and affordability in the housing construction process, Tribes need to develop a deep level of trust with building teams before engaging in large projects.

MATERIAL SUPPLY BARRIERS

The national average of dimensional lumber is \$454 per 1000 feet across various hardwoods. This price is reduced because of the high number of Eastern Pine and Yellow Pine in the mainstream big-box stores. Pacific Northwest timber like Douglas Fir and Cedar are higher in price resulting in all lumber in Clallam County being roughly 25% higher in price than the national average. This pricing contributes directly to higher home prices in Clallam County.

In the last decade, many new mass timber manufacturers have started in Washington, Oregon, and Montana to help create a competitor to traditional dimensional lumber, especially in large projects like multi-story apartments and commercial high-rises. These companies all have a specific focus – CLT, glulam, laminated veneer, or prefabricated homes. However, these products are typically not available for individual resale that is required for residential homes or small community projects. In speaking with distributors for this region, Clallam County is currently undesirable as a region to serve mass timber or engineered wood products because of its lack of large projects and small profit margins that come from the jobs that do exist. Residential projects are not desired because they require a lot of coordination with very little payback for large distributors. Additionally, due to the higher margins and higher volume of work in the Seattle-Tacoma region, many manufacturers of wood products in Washington are already booked up for a year or more with production capacity.

LOGISTICAL BARRIERS

Shipping and distribution are constant challenges in the Pacific Northwest, and more so to Tribal land. Aside from many distributors not even wanting to get involved in projects on the Olympic Peninsula, the ones that do often experience difficult shipping conditions that either result in risk to the supplier or costs to the Tribes. Mudslides, rockslides, and heavy rain often can wash out major roads leading to Tribal land delaying projects by limiting material supply and labor access. Products that do make the trek also need to be secured using higher-end transport to avoid breaking apart on the rough county roads and rocky, unpaved developments they are often going to. Again, this creates an advantage for local manufacturers for Tribal homes simply because of the shortened distances to Tribal communities and the ability to batch warehouse material in the event of logistic delays or road closures.

For Olympic Peninsula Tribes, geographic remoteness intensifies systemic barriers such as underfunded federal programs, limited contractor availability, and planning exclusion. These challenges leave many Tribal households overcrowded, in substandard housing, or priced out of the limited housing stock available. Overcoming these barriers will require region-specific strategies, such as pooled contracting, workforce housing, and stronger government-to-government coordination with surrounding counties and cities. Amidst all these challenges, the largest one, social trust, is probably the biggest barrier to overcome. From a long history of broken treaties and exploitation, mistrust is common when it comes to housing innovation or assistance from outside resources. This means meaningful community engagement and trust-building are essential, but time-consuming.

TRIBAL HOUSING OPTIONS

Based on the Land Use Analysis, the importance of structural integrity, ability to avoid moisture problems, and cost performance are critical to achieving a robust design on Tribal land on the Olympic Peninsula. Below is a table assessing the various home construction methodologies with each type weighted based on Tribal performance priorities. The weighting and scoring strategy are documented in Appendix C.

	Cost	Practicality	Build Time	Sustainability	Total
Cross-Laminated Timber (CLT)	4	5	4	5	59
Stick-Framed (Light Wood Frame)	4	5	4	3	55
Structural Insulated Panels (SIPs)	3	5	5	4	53
Insulated Concrete Forms (ICFs)	3	4	3	5	47
Dowel/Nail-Laminated Timber (DNT/DLT)	3	4	3	5	47
Glue-Laminated Timber (Glulam)	3	4	3	4	45
Heavy Timber / Post-and-Beam	2	4	3	3	38
3D-Printed Homes	2	3	4	4	38
Steel Frame Construction	2	3	4	3	36
Concrete Construction	2	3	2	3	32
Straw Bale	2	2	2	5	32
Masonry Construction	3	2	2	2	31
Rammed Earth / Adobe	2	1	1	5	26
Cob	1	1	1	5	21

Table 1.3 – Criteria Matrix for Construction Methods on Clallam County Tribal Land

When designing residential homes, traditional stick frame construction - typically using dimensional lumber like 2x4s or 2x6s - emphasizes flexibility, availability of materials, and cost-effectiveness. This method is deeply embedded in U.S. building culture, with an extensive labor force familiar with its techniques and codes. Stick framing allows for relatively easy modifications on-site and supports a wide variety of architectural styles. However, it can be vulnerable to issues like warping, mold, and less airtight construction unless carefully managed. Insulation is usually added between studs, which can create thermal bridging unless advanced framing techniques or continuous insulation are used.

Structurally Insulated Panels (SIPs) offer several advantages for building on Tribal land in Clallam County, particularly given the region's cool, damp climate and the need for energy-efficient, durable housing. SIPs provide excellent thermal performance, reducing heating costs and supporting energy sovereignty. Their prefabricated design also speeds up construction, which can be beneficial in remote areas with limited skilled labor. However, SIPs can present challenges, including higher upfront material costs and transportation expenses due to their size and the need for specialized handling. Additionally, proper detailing and ventilation are critical in Clallam County's moist environment to prevent trapped moisture and mold. Finally, SIP systems can limit flexibility for future modifications or expansions unless carefully planned, which may not always align with evolving community or cultural needs.

In contrast, cross-laminated timber (CLT) construction offers a prefabricated, solid-wood panel system that provides superior structural strength, seismic resilience, and airtightness. CLT panels act as both structural and finish components, reducing the need for interior framing and potentially speeding up construction time. The design process is highly detailed upfront since panels are precision-cut off-site, which means design changes during construction are harder to accommodate. CLT homes often excel in sustainability metrics, including lower embodied carbon and better thermal performance when paired with the right insulation strategy. However, access to qualified contractors and code approval can be more challenging in some regions, and CLT is generally more expensive on a per-square-foot basis due to material and fabrication costs.

Typically, stick framing is more adaptable and cost-effective for conventional builds. SIPs are used when construction time and energy efficiency are paramount and cost is not a large issue. CLT offers a hybrid between these two methods: high-performance, sustainable alternative better suited for homes prioritizing durability, energy efficiency, and modern aesthetics. While CLT is typically at a high price point – similar to SIPs - CRTC (Composite Recycling Technology Center) in partnership with the Makah Tribe have developed a process to use local Western Hemlock to create structural CLT panels at a cost point close to stick frame homes. Additionally, as the cost of labor continues to increase, especially for homes built on Tribe land, CLT begins to be more cost-effective than stick framing due to its reduced construction time and more efficient production.

PRICING ESTIMATES

Home pricing is highly variable across construction type, region, site location, materials, and final kit out. For the purposes of this study, a single-family home design was compared using Traditional Stick Frame, CLT, and SIPs construction methods. The site location was kept consistent across all three, a flat rural lot in Clallam County. Where appropriate, materials were held consistent so that only the labor and materials of the overall construction methodology were examined. Using this process, the following are rough price points per square footage of the three construction types.

Construction Type	Price Per Square Foot (Range)
Traditional Stick Frame using 2x6 Walls	\$285-\$305 per square foot
Cross-Laminated Timber from CRTC	\$270-\$290 per square foot
Structurally Insulated Panels (SIPs)	\$305-\$325 per square foot

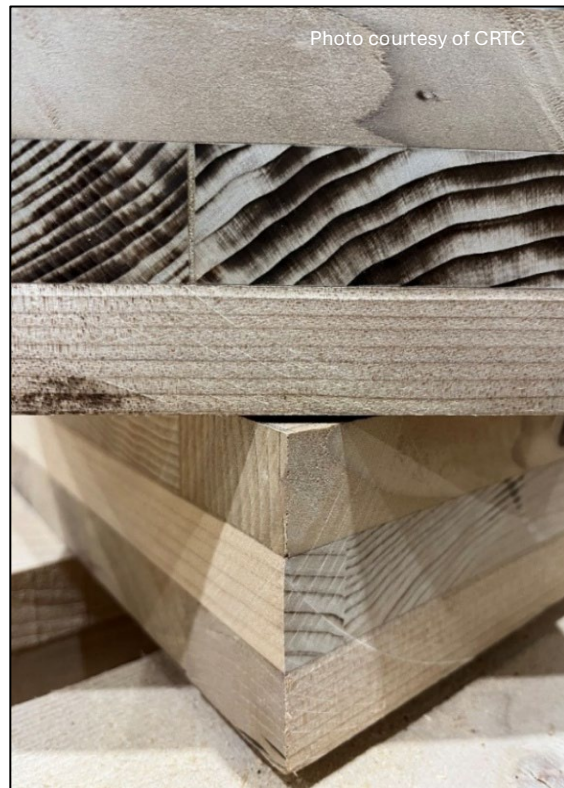
Table 1.4: Pricing ranges per square foot (not including land costs, permitting, and fees)

The pricing shown here reflects localized CLT. If the CLT panels were to be manufactured and shipped from another producer and region, the cost effects would not be as significant and CLT would likely be higher in price than both Traditional and SIPs methods. This shows how important the commercial ecosystem of the CLT product is and how the Tribes can greatly benefit from using wood products created from Tribal land with local manufacturing. Over time, the likelihood of local CLT prices staying more stable is greater than that of Traditional and SIPs pricing since they are more susceptible to global demand.

HOME DESIGN OPTIONS USING CROSS-LAMINATED TIMBER

Tribal communities on the Olympic Peninsula face persistent housing challenges: high construction costs, limited workforce, funding gaps, cultural design needs, and vulnerability to climate impacts. Prefabricated CLT panels from CRTC, as shown to the right, and modular wet cores (containing plumbing, mechanical, and electrical systems) allow homes to be built in days or weeks, not months⁽⁸⁾. This rapid construction directly addresses labor shortages in rural Tribal areas, where attracting contractors is difficult.

The Composite Recycling Technology Center (CRTC) in Port Angeles is already producing Advanced CLT (ACLT) panels using Makah-sourced western hemlock. By thermally modifying undervalued species, ACLT creates durable, mold-resistant housing panels at a lesser cost than traditional CLT panels, making Tribal housing more affordable and scalable⁽⁹⁾. Their BOLEH (Built-On-Lot-Engineered-Home) prototype (965 SF, 2BR/1BA) demonstrates how CLT housing can be designed with local input, balancing livability in remote coastal conditions with affordability and elegance. CLT's durability in wet climates, elimination of drywall (a weak point in damp conditions), and resilience in Wildland Urban Interface (WUI) fire zones make it particularly suited for Tribal lands.



Solid mass timber construction produces airtight, energy-efficient envelopes that lower utility costs, a major burden for low-income households. Exposed wood interiors reduce reliance on synthetic finishes, improving indoor air quality and creating biophilic environments linked to lower stress and better well-being. Reputable studies and case work show 15–25% faster construction than concrete/steel due to factory prefabrication, with measured schedule gains⁽¹⁰⁾.

Repeatable, pre-approved housing designs (like Sierra Houses and CLT House 1.0) that can be quickly adapted for Tribal communities are great examples of how to streamline housing for specific communities. This approach reduces design costs and allows Tribes to scale housing production without starting from scratch on each project.

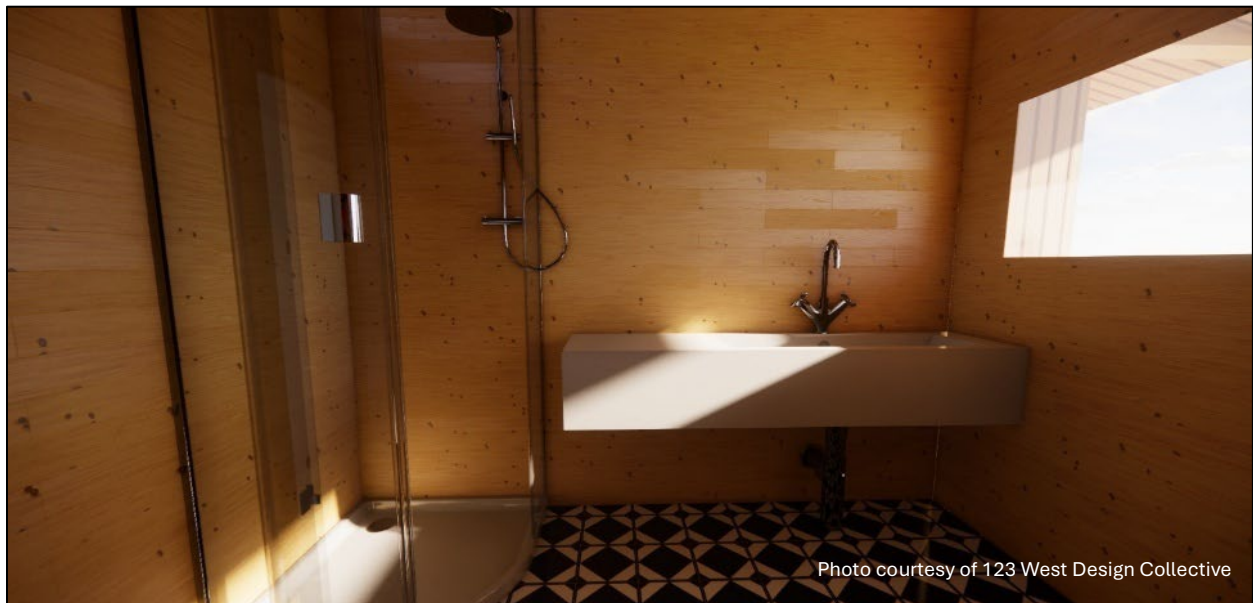
By creating a localized supply chain (Makah forestry → CRTC production → Tribal housing), Tribes can generate jobs in forestry, milling, prefabrication, and construction. This reinforces Tribal sovereignty and economic independence while addressing housing needs.

A local, Tribal mass timber product offers a holistic solution for Tribal housing:

- Cost-effective (prefabrication + modular assembly).
- Locally rooted (Makah hemlock + regional supply chains).
- Culturally adaptable (designs reflecting Tribal lifeways).
- Climate resilient (fire-resistant, mold-resistant, energy efficient).
- Scalable and replicable (pre-approved designs + standardized kits).

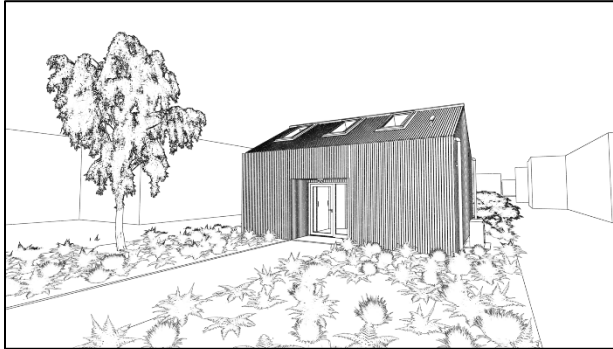
For the Olympic Peninsula, investing in mass timber housing, using locally sourced CLT, is not only a way to close the housing gap but also a strategy to build Tribal economic strength while honoring cultural and environmental values.

Side note: the wood being sawn, dried, thermally-modified and produced through this process is locally known as “coastal western hemlock”. In practice, there is no real difference between this and “western hemlock”. They are indeed the exact same tree, and the “coastal” name simply refers to the same tree growing closer to the coast. The trees near the coast do grow faster and therefore have wider rings, but as far as all regulating bodies are concerned (NDS, NLGA, WWSA, etc.) they are the exact same. Other CLT manufacturers have found some minor differences in how the trees properties behave do their growth origin, but nothing significant.

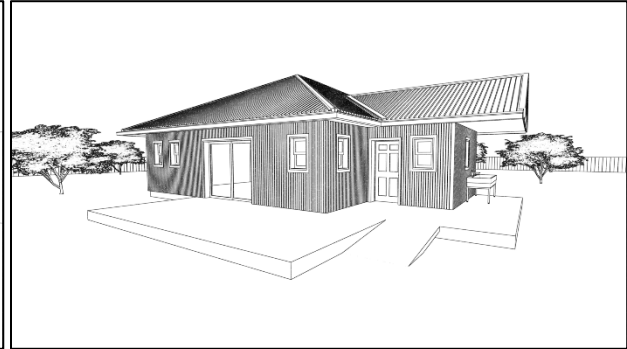


HOUSING SOLUTIONS AND COMPARISONS

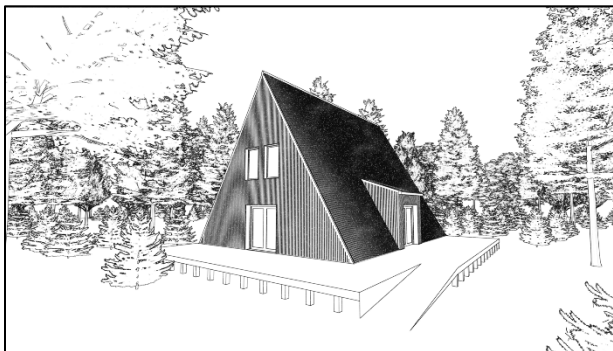
A collection of 4 home types engineered by 123 West Design Collective was assessed as part of this study using CLT as the structure. The homes were designed in connection with Tribal members to inform the layout and configuration of the units.



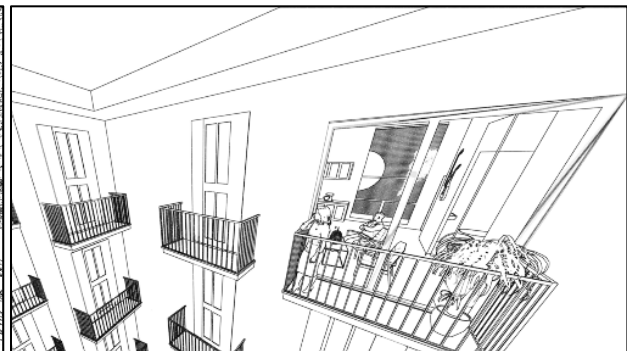
550 sf DADU



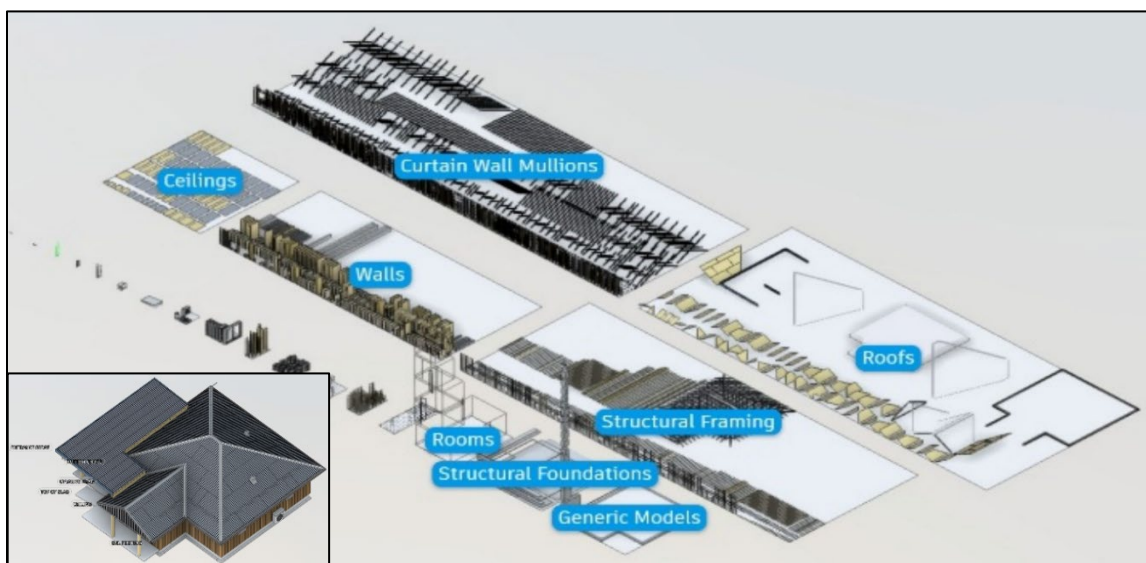
965 sf BOLEH



1350 sf A-Frame



1175 + 400 sf Quadplex



BIM Model of the BOLEH Home to Assess Cost and Construction Laydown (courtesy of Autodesk Tandem)

DADU HOME DESIGN

1 Bed / 1 Bath | Single Family | One Level | 550 sf

The featured DADU is a one-bedroom, one-bathroom unit designed for affordability, sustainability, and rapid deployment. Typically, DADUs will share a lot with a pre-existing home so that they can piggyback off their utility connections to save cost. Their small footprint makes them ideal for infill housing density within existing lots.

Key Specifications:

- Size: 550 sq. ft. total (415 sq. ft. standing floor area).
- Construction Timeline: ~6 weeks (30 workdays).
- Cost: ~\$160,000 turnkey.
- Construction Method: Prefabricated cross-laminated timber (CLT) walls and roof from locally sourced timber (Makah/CRTC).

Exterior Features

- Solid CLT panels with fire resistance and durability.
- Thermally modified wood siding or optional aluminum roofing.
- Premium windows, skylights, seamless gutters, and low-maintenance landscaping.

Interior Features

- Natural wood interiors with no drywall or VOCs, optional lime plaster finishes.
- Energy Star appliances (fridge, induction cooktop, convection oven, dishwasher, washer/dryer).
- 50-gallon high-efficiency water heater and ductless mini-split system.
- Smart-home ready wiring and modular electronics.
- Large walk-in shower and accessible storage.

Sustainability & Options

- Carbon-neutral construction.
- Options for green roofs, solar panels, EV-charging, decks, or rainwater capture systems.
- Energy Code compliant with high insulation (R-38 roof, R-20+5 walls).

Design schematics for the DADU model are available in Appendix D.

BOLEH HOME DESIGN

2 Bed / 1 Bath | Single Family | One Level | 965 sf

The BOLEH is a two-bedroom, one-bathroom home designed for couples or small families. The design was a joint effort between CRTC and Makah Tribal members. The home meets a demand for affordable, sustainable, single-level living - suitable for rural lots or infill sites. The traditional hip roof gives it a classic design aesthetic while also showcasing useful overhang roofing and an outdoor sink for fishing, hunting, and general outdoor adventure. The home can be easily expanded to meet larger family needs.

Key Specifications:

- Size: 965 sq. ft.
- Layout: 2 bedrooms, 1 bath, open kitchen-living space.
- Target Cost: ~\$260,000 turnkey.
- Construction Timeline: 8–10 weeks.
- Method: Prefabricated CLT wall and roof panels for quick assembly.

Exterior Features

- CLT structure with thermally modified wood siding and optional aluminum roofing.
- Large-format windows for natural light, skylight optional.
- Covered front porch and optional back patio.
- Designed for accessibility and aging in place.

Interior Features

- Durable all-wood interior finishes—no drywall or VOCs.
- Full kitchen with Energy Star appliances and built-in cabinetry.
- Spacious bath with walk-in shower; optional accessible upgrades.
- Open-plan living for flexibility and natural airflow.

Sustainability

- Energy Code compliant: R-38 roof, R-20+ walls.
- Options: solar-ready, green roof, EV charger, rainwater harvesting.
- Efficient ductless heating/cooling and Tier 3 heat pump water heater.

Design schematics for the BOLEH model are available in Appendix D.

A-FRAME HOME DESIGN

3 Bed / 2 Bath | Multi-Level A-Frame | 1350 sf

The A-Frame is designed for rugged areas that have high wind, snow, and rain through the winter months. The design is best for family living or seasonal homes. The iconic design appeals for rural, mountain, or waterfront sites and therefore is attractive to both full-time residents and families that grow and shrink with seasonal work.

Key Specifications:

- Size: 1,350 sq. ft.
- Layout: 3 bedrooms, 2 baths, vaulted great room with loft.
- Target Cost: ~\$325,000 turnkey.
- Construction Timeline: 12 weeks.
- Method: CLT panelized A-frame system with precision prefabrication.

Exterior Features

- Distinctive A-frame roofline engineered in CLT for strength and snow load.
- Expansive glazing at the front façade for natural light and views.
- Durable standing seam metal roof, optional skylights.
- Optional decks and outdoor living spaces.

Interior Features

- Double-height living space with exposed wood beams.
- Lofted third bedroom or office overlooking main living area.
- Two full bathrooms; option for soaking tub or tiled shower upgrades.
- Open kitchen/dining/living plan emphasizing flexibility.

Sustainability

- Naturally efficient roof form sheds snow/rain reduces maintenance.
- CLT walls and roof provide airtight envelope, high R-values.
- Solar-ready roof orientation, wood stove option for off-grid living.

QUADPLEX HOME DESIGN

2 Bed / 2 Bath | Four-Unit Cluster | 1175 + 400 sf

The Quadplex is a small, multi-family building that can appeal to efficient-living residents, but without the headache of large apartment campuses. The units provide community-scaled affordability, with four families housed per site. The building can serve as elder housing, workforce housing, rental stock, or a complete mix.

Key Specifications:

- Size: 1,175 sq. ft. per unit + 400 sq. ft. shared area for residents.
- Layout: Each unit: 2 bedrooms, 2 baths, open kitchen-living.
- Target Cost: ~\$1,500,000 for full quadplex.
- Construction Timeline: 14–16 weeks.
- Method: CLT modular walls/floors for stacked or side-by-side units.

Exterior Features

- Shared quadplex footprint designed for small urban or Tribal community lots.
- CLT structure with durable siding and shared courtyard entry.
- Optional balconies or porches for each unit.

Interior Features

- Efficient 2BR/2BA layout—ideal for workforce or elder housing.
- Exposed wood walls for warmth and durability.
- Full kitchens, Energy Star appliances, stackable laundry.
- Shared utility systems reduce cost per unit.

Sustainability

- Dense, land-efficient housing form reduces per-unit cost.
- CLT fire resistance and durability well-suited for Tribal village centers.
- Solar-ready, heat pump HVAC, and water heating.

ALTERNATIVE HOME DESIGN COMPARISONS IN CLALLAM COUNTY

- **Traditional Stick-Built Homes:** In Clallam County, the median price per square foot is roughly \$300/sf not including land costs, permitting, and fees. This is higher in price than the CLT homes listed in this study, however, prices will vary based more on the homebuilder and their labor efficiency in relation to the drawing plan.



Typical 1,500 sf Stick Frame Home Design, Estimated Sales Price: \$550,000. Courtesy of 123 West Design Collective

- **Modular or Prefab Homes:** Sticker ranges vary widely; some sources cite \$60–\$90/sf (typically *excluding* site, foundation, transport, hookups) which amounts to the final costs being anywhere from ~\$200–\$500/sf. These homes are found a lot around the Olympic Peninsula in Park Model applications, RV parks, and senior facilities. Manufactured homes do not last nearly as long as built-on-site homes, greatly reducing their resale value and total cost of ownership. While cost-effective in the short-term, they are not in the long-term.



Typical 1,300 sf Manufactured Home Design, Estimated Sales Price: \$150,000 (home only). Courtesy of Wilder Homes.

- **Townhomes and Small Multi-family Apartments:** Reported around \$400/sf for typical WA townhomes. From an investor perspective, or if trying to maximize lot area, apartments become a good long-term solution. However, from a livability standpoint, apartments ranked the lowest preference among Tribal members due to their tight living spaces and ability to become closed off from community. CLT could be used to make the apartments more connected to the earth through biophilic practices and potentially save costs, but the biggest hurdle will be the social one – creating a culture of apartment living in a Tribe.



Typical Multi-Unit Apartment Design. Courtesy of Peninsula Housing Authority

The maintenance and operating costs of each of these home types also varies. The manufactured home models do not last as long as “long-term” housing models like stick frame or CLT. Manufactured homes are structurally connected and insulated with a lot of resin-based components that deteriorate faster than metal and wood products resulting in walls and roofs that become saturated with rain in harsh winter conditions. Townhomes and apartment buildings utilize highly connected systems that require an on-site maintenance person 24/7 resulting in higher operating costs to the renters or rental agency. The burden of continuous maintenance is not desirable on Tribe land because those maintenance costs directly impact the financial sustainability of Tribal housing. Low maintenance costs are important to maintain housing sovereignty.

Against current Washington benchmarks, the CLT home collection studied here is price-competitive, faster to build, and compelling on long-term quality and carbon efficiency. The DADU and Quadplex stand out based on their efficient use of space, and the BOLEH and A-Frame create family homes that are well-built and long-lasting. But building these homes as one-off products do not fully implement their benefits. To see the highest financial returns and community benefits, these homes should be implemented within various neighborhood models that deploy them on a larger scale. Below are a few of these models that have worked well in other Tribal communities.

NEIGHBORHOOD DEVELOPMENT MODELS

Tribal communities in the Olympic Peninsula are relatively small in population and therefore, have very integrated neighborhoods. There are three neighborhood models that can be applied to new developments that can be easily added to tight-knit communities and work to enhance the entire population: Cul-de-sac, Infill, and Multifamily models.

Park-area Cul-de-sac Model



Courtesy of Stillaguamish Tribe in Arlington, WA

The goal of a park-area cul-de-sac model is to create a compact cluster around a shared green that prioritizes play, gatherings, and stormwater capture. The site is typically a looped cul-de-sac with a central park (play lawn, picnic shelter, community garden) and a secondary “green finger” for stormwater.

Using the CLT homes listed above, the larger BOLEH or A-Frame homes can be placed on the outer ring (larger lots, family proximity to play) and the inner ring can be lined with smaller BOLEH homes and ADUs for gentle density and great park frontage. If demand warrants, 1–2 Quadplexes can be added at the cul-de-sac entry as a “gateway” mass, with porches facing the park path.

For efficient mobility & parking, keep the cul-de-sac low-speed (chicanes/neck-downs at entries) and use edge or alley parking only; reserve the park edge for people, not cars. Provide guest spaces near the entry, not at the park.

The central green doubles as a stormwater sponge: shallow swales, amended soils, native canopy trees for shade. Use boardwalks or crushed rock paths to keep runoff permeable.

A small mass-timber pavilion (covered tables, power for events), mailbox kiosk, or tool library shed can be added for additional community hubs. Play elements embedded in grade (logs, boulders) rather than plastic structures will help to keep the natural elements.

Infill Housing Model



Courtesy of Lummi Nation in Bellingham, WA

The goal of the Infill Housing model is to add units sensitively within existing blocks - protecting trees, privacy, and neighborhood character. Use DADUs behind existing or new primary homes; prioritize alley-loaded sites to avoid new curb cuts. Deploy the BOLEH home on narrow lots and corner lots as it bridges scale between cottages and larger neighbors. On double lots or near transit, insert a Quadplex with a courtyard entry; break massing with bays/porches.

Place window groupings high on side yards; use fins, screens, or green trellises facing neighbors. Keep service yards (trash/HVAC) internal to the site or along alleys, limit equipment along shared fences. Retain or plant street trees; maintain porches at 12–18 ft setbacks where typical; avoid garage-dominant frontages. Provide secure bike storage for DADUs/Quadplexes to reduce parking pressure.

Infill Housing models are well-liked because of their ability to add density to an area without the need to develop land or increase utility infrastructure. From a new development standpoint, phasing becomes very easy. First, create a sewer, water, electric, and telecom planned network that is already scaled up for the number of people you wish to live in the neighborhood. Then, allow the builders to develop the properties in a way that best makes sense for community accessibility, density, and architectural style. Each new dwelling can connect to the existing systems as to reduce the project cost for each individual building.

Multi-family Housing Model



Courtesy of Little Earth in Minneapolis, MN

The goal of Multi-family Housing is to build attainably priced, community-scaled density with shared courtyards and efficient services. Quadplex clusters (2–4 buildings) should be organized around a central common with BOLEH cottages along edges as scale buffers to adjacent single-family. Reserve corners or key frontages for A-Frame or larger BOLEH models to diversify unit sizes (multigenerational options).

Use perimeter or podium-adjacent parking courts, maintain a car-light interior (deliveries at edges), and target shared parking ratios and unbundle where allowed; integrate EV-ready conduits in edge lots.

Make the central commons car-free, with a soft surface loop, seating nooks, and a play-to-park gradient (tot lot to quiet lawn). Add edible landscaping islands (blueberries, herbs) and rain gardens between buildings. Group trash/recycling and package lockers at entries; design for straight, short maintenance routes. Centralize heat-pump water heaters and ERVs in service rooms shared by a pair of buildings where code permits.

EXAMPLES OF TRIBAL DEVELOPMENT SUCCESS STORIES

There have been many examples of successful Tribal housing projects in the past that have similar barriers to Tribes on the Olympic Peninsula. The Ohkay Owingeh Pueblo rehabilitation and Puyallup Tribe's Place of Hidden Waters are examples of designing housing that reflects cultural heritage while meeting modern needs. Community engagement during the design process ensured housing fits social and cultural lifeways. Tribes that have embraced new technology have also experienced greater success than other Tribes when it comes to housing. Multiple projects have emphasized green construction: straw bale insulation (Coeur d'Alene), solar hot water and photovoltaics (Kumuhau, Hawaii), and passive solar orientation (Navajo Nageezi House). On the Peninsula, where

energy costs and damp climates pose challenges, super-insulated homes, rain gardens, solar water heating, and passive design could improve affordability and resilience, while maintaining the cultural heritage of the Tribe.

The Port Gamble S’Klallam Tribe’s Teekalet Village balanced increased density with protection of a salmon creek and hatchery through rain gardens, permeable paving, and native landscaping. This model shows that housing on the Olympic Peninsula can be co-located with natural resources while protecting vital ecosystems — highly relevant for coastal Tribes whose culture and economies are tied to salmon and water.

The Kumuhau Subdivision (Hawaii) used expandable home designs (stub-outs for extra bathrooms/rooms, outdoor “lanai” living, carports as shaded social spaces). Olympic Peninsula Tribes could benefit from expandable units that adapt to large, multigenerational households, while keeping upfront construction costs lower.

Success stories often rely on partnerships with universities, nonprofits, and design-build teams. For example, the Pinoleville Pomo Nation partnered with UC Berkeley to create culturally inspired green homes and develop their own Tribal green building codes. Peninsula Tribes could pursue partnerships with institutions like Peninsula College or WSU to co-develop housing prototypes, transfer technical knowledge, and strengthen local workforce training.

Devine Legacy in Phoenix demonstrated how mixed-income, transit-oriented housing linked residents with health and social services. For remote Peninsula Tribes, housing integrated with community centers, clinics, or cultural facilities could reduce costs and improve resident wellbeing.

Design for culture and climate: Coastal Tribes can draw on traditional designs while integrating modern green buildings. Cluster and densify smartly: Higher density housing near community hubs lowers infrastructure costs. Invest in partnerships: Outside expertise + Tribal knowledge creates stronger, replicable housing models. Build adaptable homes: Expandable layouts support multigenerational households without driving up initial costs. Protect natural resources: Housing can and should coexist with salmon streams, forests, and coastal ecosystems. These solutions, grounded in best practices from across Indian Country, provide a roadmap for Olympic Peninsula Tribes to pursue affordable, culturally relevant, and sustainable housing.

EXAMPLES FROM TRIBAL COMMUNITIES OF THE SALISH SEA

Across the Juan de Fuca Strait, Vancouver Island is undergoing a mass timber renaissance, much of it rooted in innovations led on tribal lands. In nearby cities like Seattle and Vancouver, these breakthroughs are being scaled into major development projects that strengthen Indigenous communities both culturally and economically. Facing many of the same challenges, the Olympic Peninsula can look to these efforts as powerful examples of what a sustainable and culturally grounded future might hold.

Several recent Indigenous and mass timber projects offer strong parallels to the work being planned with the Makah and CRTC in Port Angeles. The Malahat SkyWalk Visitor Centre on Vancouver Island is a tourism and cultural landmark co-developed with the Malahat Nation that combines a CLT-clad glulam tower with prefabricated components to minimize forest impact while inviting visitors into the cultural landscape. Similarly, the Nanaimo Cruise Ship Terminal integrates large glulam forms with Coast Salish artwork, making it a gateway project that mirrors Port Angeles' own waterfront placemaking goals. For community and health spaces, the Tseshah Tribal Multiplex in Port Alberni and the First Nations Health Authority Headquarters in North Vancouver showcase how CLT and glulam structures can reinterpret Indigenous longhouse and plank-house traditions while delivering warm, daylight-filled spaces for health and governance - clear inspiration for Tribal community facilities on the Olympic Peninsula.

On the housing side, the Cowichan Tribes Rapid Housing Project demonstrates how modular mass timber can be used to quickly deliver affordable housing on Nation lands, directly aligning with Makah and CRTC's goal of pairing local fabrication with workforce training. The most advanced Indigenous housing precedents are the Khupkhaipay'ay/Chief Leonard George Building and the Frances Street Passive House, both developed by Indigenous housing societies in Vancouver. These projects use CLT panels and hybrid timber systems to create resilient, culturally grounded multi-family housing with community spaces, sweat lodges, and gardens, a model that resonates strongly with the Olympic Peninsula's coastal and cultural context. Similarly, the 327 Main Street Transformation Lodge, an urban Indigenous supportive housing project, integrates CLT with ceremonial and healing spaces, offering a precedent for culturally specific social housing prototypes.

While not explicitly Indigenous, projects like the Langford CLT Warehouse and Cordova Bay Elementary School provide useful lessons in industrial and educational typologies, hybrid timber systems, and rapid permitting, practical knowledge that can be applied to CRTC's fabrication facilities. Taken together, these precedents highlight how Indigenous culture and mass timber technology can intersect across tourism, housing, health, and community infrastructure. They offer clear pathways for the Makah and CRTC to create housing and cultural facilities that are fast, resilient, and deeply reflective of place.

IMPORTANCE OF SUSTAINABILITY IN HOME DESIGN

Sustainability and health are increasingly central to home design, as homeowners and communities recognize the connection between building practices, environmental impact, and overall well-being. A sustainable home not only reduces energy use and carbon emissions but also creates healthier indoor environments by minimizing toxins, improving air quality, and using materials that support long-term durability. Cross-laminated timber (CLT) plays a vital role in advancing these goals ⁽¹⁰⁾. Made from layers of sustainably harvested wood bonded in a way that creates strength and stability comparable to steel or concrete, CLT dramatically lowers the carbon footprint of construction by storing carbon rather than emitting it. At the same time, wood's natural warmth and biophilic qualities have been shown to reduce stress and improve comfort for

occupants, supporting both mental and physical health. By combining structural performance, low embodied carbon, and positive human health impacts, CLT offers a pathway to homes that are not only more sustainable but also more livable and resilient.

In comparing home types, a traditional stick-frame and drywall home produced 18,000 kg CO₂e (embodied Carbon) compared to only 7,000 kg CO₂e in a CLT home. At scale, this creates an opportunity to reduce carbon emissions globally from the home construction industry or even eliminate it altogether when combined with regenerative power systems like hydro and solar.

Homes built with cross-laminated timber (CLT) and designed without paint, drywall, or fiberglass insulation can be significantly healthier than traditional construction. By leaving CLT panels exposed or finishing them with natural oils instead of paint or sealants, homeowners avoid volatile organic compounds (VOCs) that often off-gas for years and degrade indoor air quality. Unlike drywall, which creates fine dust during installation and renovation, CLT requires no such surface layers, reducing particulate exposure. Similarly, fiberglass insulation - a common source of lung and skin irritation - can be eliminated in favor of exterior wood fiber or mineral wool insulation, which is safer and less prone to trapping moisture. Because CLT naturally absorbs and releases humidity, it helps stabilize indoor air and reduce conditions that promote mold or dust mites. Beyond these measurable health benefits, exposed wood surfaces contribute to psychological and physiological advantages as well: studies show that natural wood interiors lower stress hormones, reduce blood pressure, and create a sense of comfort and well-being. Together, these qualities make CLT homes healthier environments, offering clean air, reduced toxins, and natural resilience that traditional materials cannot match.

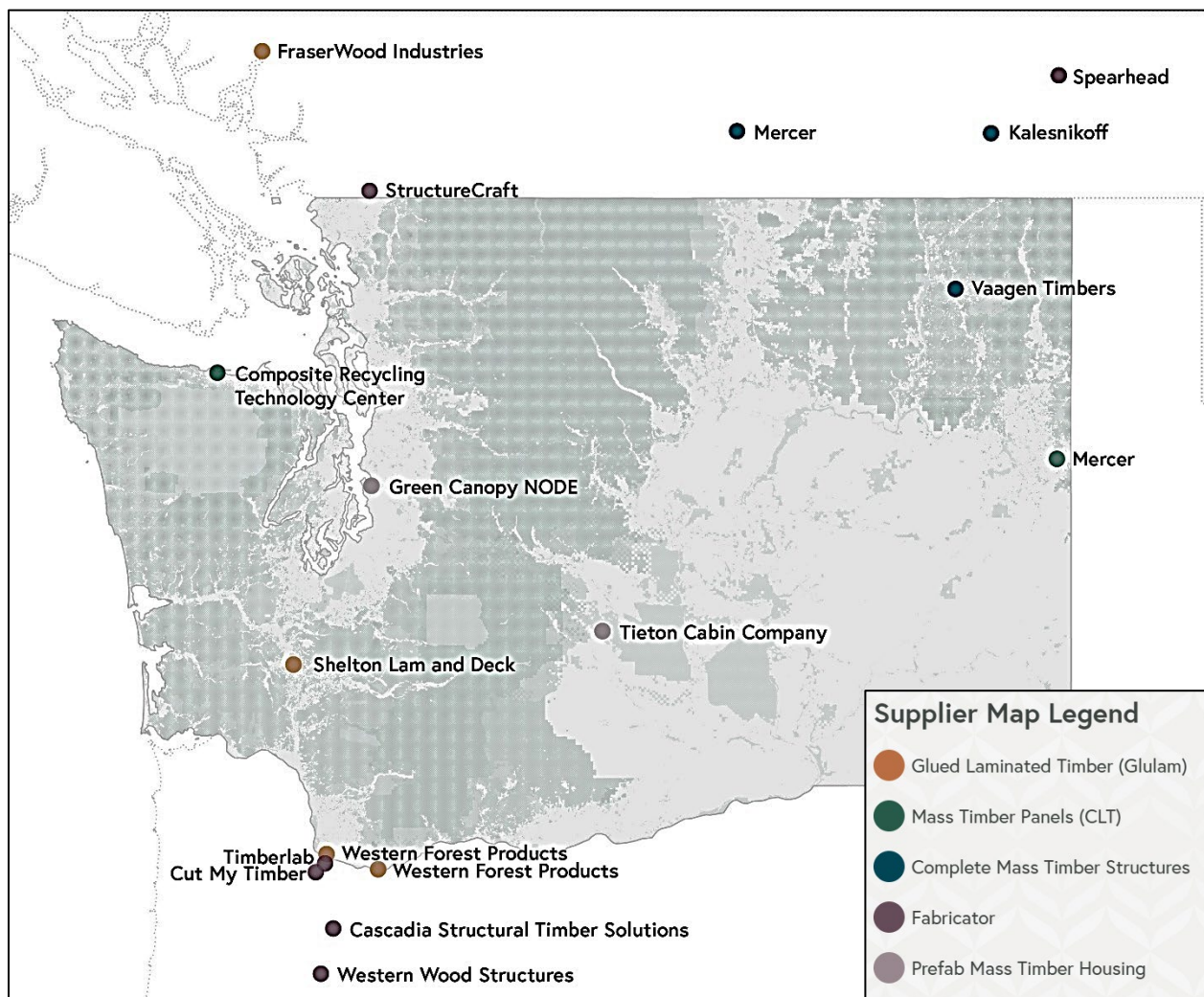
IMPORTANCE OF CROSS-LAMINATED TIMBER FROM CRTC

The Composite Recycling Technology Center (CRTC) in Port Angeles is a mission-driven manufacturer that turns underused resources into useful, low-impact products while advancing the “Three E’s” - economy, environment, and education - through job creation, carbon-waste reduction, and workforce training for high-value composites work. In addition to product development, CRTC operates a thermal modification service for wood that uses a heat-and-vacuum process (via a Maspell kiln) to drive off moisture and caramelize sugars, improving dimensional stability, decay resistance, and expected service life - without chemicals - and offering a sustainable alternative to tropical hardwoods or chemically treated lumber. The service is suited to exterior and interior applications (e.g., siding, decking, cladding, doors, paneling), sources lumber ethically including from the Makah sawmill, and can be used for non-structural applications as-is, or structural applications when value-added into the CLT process.

CRTC is in unique position for Tribal housing to use CLT at a cost level that is on point with traditional stick framing and to maintain the supply needed to meet the demand. To avoid the same traps as other wood manufacturers in Washington, here are some simple actions that they can take:

- Develop relationships with multiple local timber sources - including Tribal, public, and private forest landowners to avoid massive gaps in product supply.
- Maintain buffer inventory of critical inputs like adhesives and fasteners (often imported and more prone to delays).
- Use digital tools (ERP or supply chain software) to track orders, lead times, and stock levels in real time and include a feedback loop to continuously improve their KPIs.
- Plan for volatility and risk in the early phases to manage growth properly.
- Proactively involve local code officials in product demonstrations and testing processes to build familiarity and trust.

Below is a map of the mass timber manufacturers of Washington and British Columbia. Canadian supply is currently far too expensive due to tariffs between the US and Canada.



Courtesy of www.wamasstimber.org

CROSS-LAMINATED TIMBER REGULATIONS

Product Certification for Structural Use. To be used legally in construction on non-Tribal land, CLT panels must be certified by an accredited agency as meeting recognized standards: ANSI/APA PRG 320 – Standard for Performance-Rated Cross-Laminated Timber. This is the primary standard in the U.S. for CLT products which sets the requirements for materials, layup, bonding, strength, and stiffness. Certification is conducted by approved third-party agencies like APA – The Engineered Wood Association, headquartered in nearby Tacoma, WA.

Building Code Recognition. CLT is recognized in the 2015 IBC (limited use) and more fully in 2018 IBC and 2021 IBC, which include expanded provisions for mass timber construction. These codes provide prescriptive and performance-based pathways for: Structural design, Fire resistance, and Seismic performance. The International Residential Code (IRC), for detached one- and two-family dwellings, permits CLT when designed in accordance with ANSI/APA PRG 320 and approved by the local authority having jurisdiction (AHJ). THE AHJ on Tribal land is typically the Tribal Council or a local official that is delegated to the Tribal Housing Authority.

Fire Resistance and Safety Testing. CLT products must also pass fire testing for: charring rate, fire resistance ratings (FRRs) under ASTM E119, and surface burning characteristics (ASTM E84).

Environmental and Sustainability Certifications. While not required for structural approval, these are common in sustainable buildings for compliance. FSC (Forest Stewardship Council) or PEFC (Program for the Endorsement of Forest Certification) for sustainably harvested wood and the Environmental Product Declarations (EPDs) for transparency about environmental impacts. There are several FSC or PEFC certification authorities on the Olympic Peninsula.

Tribal Approval Process – Canadian Precedent

Several First Nations in Canada have used their own jurisdiction to pilot prefabricated CLT home designs more quickly than typical off-reservation projects. On many reservations, building-code enforcement is inconsistent unless a Nation adopts its own bylaws or the project is tied to government funding—so approvals are often community-led, which can shorten permitting steps and enable rapid prototyping.

Notable pilots include Douglas Cardinal’s “Cardinal House” at Elsipogtog First Nation (NB), a prefabricated CLT prototype assembled rapidly on site, and early CLT housing initiatives in Little Grand Rapids First Nation (MB).

That said, “no enforcement” isn’t universal: many First Nations act as the authority having jurisdiction and can run their own permitting processes; federally funded projects typically require documented National Building Code compliance.

Alternative Means and Methods

In the US, CLT can occasionally be approved through an Alternative Means and Methods Report (AMMR) if it is used for a specific purpose, and only for that purpose, on a project. A local AHJ will

need to act as the approver of the AMMR, which means they will need to have staff on-hand to correctly test and certify the product. This is rare for structural applications or for new products in the marketplace.

In cases where local code officials don't have the resources to approve an AMMR, the AHJ will typically allow for an ICC-ES report in conjunction with a Structural Engineering stamp to be supplied on the project, if the product is structural in nature.

An ICC-ES report is third-party verification that a product (like CLT panels) complies with the International Building Code (IBC) or International Residential Code (IRC). It gives building officials confidence that the material meets performance standards (fire, structural, durability, etc.). CLT products in the U.S. typically carry an ICC-ES ESR based on PRG-320 (the North American product standard for CLT).

A licensed professional engineer can design the building using CLT and provide stamped drawings showing code compliance. The stamp means the engineer takes responsibility for the structural adequacy of the design under local conditions (seismic, snow, wind loads, etc.).

Even with an ICC-ES report and an engineer's stamp, the project still requires permit approval by the AHJ (city, county, or Tribal building department). Building officials rely heavily on those two documents in making their decision, but the final "approval" comes from the permit authority.

JOB CREATION

A successfully implemented cross-laminated timber (CLT) housing program in Clallam County would create two complementary streams of employment: a stable core of year-round positions anchored in local fabrication and program operations, and a larger, project-driven wave of construction and ripple (indirect and induced) jobs that ebb and flow with annual build volume. Assuming a program on the order of 200-250 homes over ten years, roughly \$60-\$80 million in total construction value, the initiative becomes a meaningful economic engine rather than a one-off project.

On the steady side, Clallam County would gain a durable manufacturing and logistics base centered on machining and kitting CLT components for rapid assembly in the field. A light-manufacturing model that receives CLT panels and converts them into house-ready kits would typically have staff on the order of 6-8 employees across CNC operators, press/layup technicians, finishers, shipping/receiving, quality assurance, maintenance, environmental health and safety, and schedulers. If the operation expands from kitting toward a fuller CLT production line, that headcount can scale toward 15-20 or more, reflecting benchmarks from comparable small U.S. facilities. Around this core, the city would see additional steady roles in logistics and warehousing (approximately 4-6 positions for yard management, drivers/dispatch, and inventory control), program and project delivery (10-12 positions in program management, project controls, procurement, grants/finance, and community engagement), and a modest local hub for design and engineering (8-10 architectural and structural/CAD roles supporting shop drawings and

coordination). A training pipeline, likely through Peninsula College and industry partners like 123 West Design Collective, would add 2-3 instructional and lab positions, while business-service firms (tool rental, safety supplies, equipment service, and IT) would account for another 8-10 ongoing jobs as the ecosystem matures.

The second stream of employment is tied to the construction expenditure itself. On the ground, those jobs translate into crews of mass-timber installers and carpenters, crane operators and riggers, site supervisors and schedulers, and the full complement of MEP trades (electrical, plumbing, and HVAC), as well as short-cycle professional and administrative roles in estimating, permitting, procurement, and grant reporting.

These employment impacts are responsive to a few clear levers. Every additional \$10 million of residential construction typically yields another ~40 jobs at the regional scale, and the Clallam County share rises as more fabrication, staging, and contracting are sourced locally. Likewise, moving from a kitting model to fuller CLT manufacturing increases the permanent headcount on the factory floor and strengthens the city's position in the regional mass-timber supply chain. Beyond direct employment, the program also induces steady demand for local services-tool and equipment rental, safety gear, fuel and maintenance, short-term lodging and food for visiting crews, and even childcare-further stabilizing the local economy.

In sum, the CLT program offers Clallam County a balanced jobs portfolio: a reliable, skills-based manufacturing nucleus paired with cyclical but substantial construction employment and service-sector growth. By centering fabrication at CRTC, cultivating a local contractor bench emphasizing Tribal participation, and formalizing workforce pathways through Peninsula College, the city can maximize local capture of both the steady positions and the job-years, translating a decade of homebuilding into durable industrial capacity and broad-based household income.

FEEDBACK FROM TRIBAL MEMBERS

Getting direct feedback from Tribal members who are currently living on these reservations and who wish to live on them in the future is critical to understanding the design elements required to be successful. Below are the key findings from surveying Tribal members during summer 2025:

- There is too much paperwork in the housing process for Tribal members making the process not just challenging, but sometimes a deterrent to housing at all. Many Tribal members get denied in the approval process because of timing or paperwork challenges, not due to lack of funds or negligent applications.
- Making the housing affordable to maintain is difficult due to poor upfront designs and sub-standard products being installed due to cost constraints.
- Getting full project funding approved is almost impossible due to the time it takes to gather funding vs. the time to implement the project. The gap in time allows costs to rise and exceed the original project budget.

- A preferred housing community example by many Tribe members is the Stillaguamish Tribe in Arlington, WA. The reason this was so well liked was because the homes were single-story, had dedicated outdoor storage containers (mini-garages), and were centered around a large, neighborhood play space with playground equipment, outdoor grills, and open yard space...perfect for community building.
- Inside Tribal homes, more closet space is often a high priority. The examples shown with ample storage space inside and out were more desirable.
- Larger kitchens are needed in family homes due to the large volume of food cooked daily. Galley kitchens are not desirable because they are ultimately far too small to work in, not suitable for multiple people efficiently cooking, and they do not flow into the living space very well. Larger kitchens with islands are a must for larger families or Tribal elders that cook for their families.
- Age-appropriate homes were a typical feedback point for all families, not just seniors. Many family homes often have elderly members stay with them for long periods of time and therefore, all houses should be ADA accessible throughout to make sure it is usable for various housing situations. Specifically, walk-in showers, single story bedrooms, and well-insulated walls were discussed as options that Tribal elders would want to see as requirements.
- Customization of homes is also a common need. Currently, most of the Tribal homes have strict rules against painting or customizing the design in any way. Options for residents to easily update colors, siding, and other architectural features would go a long way to making each home feel unique. Homes that have a better perceived appearance for a homeowner are statistically more likely to be well-cared for⁽¹¹⁾.

A collection of meetings and interviews with Tribal members are documented in Appendix F. Additional feedback from Tribal members will continue to be gathered from this report and will be released as an addendum at the conclusion of this program.

FORECASTING TRIBAL HOUSING PROJECTS

The number of Tribal housing projects on the Olympic Peninsula will vary greatly based on economic and societal factors. Based on current census data, household size, and number of available units (both on Tribal land and off Tribal land), below is a projection of new homes that will be built over the next 10 years. This projection aims to estimate the demand for Tribal housing on or near the reservations by assessing the total Tribal population and the available housing units for those Tribal members, regardless of fee-simple or Tribal trust land.

Tribe	Baseline Households	Backlog Today	Low Growth 2%/yr	High Growth 5.0%/yr
Makah	415	40	49	65
Lower Elwha Klallam	173	32	39	52
Hoh	25	15	18	24
Quileute	92	19	23	31
Jamestown S’Klallam	241	25	30	41
Port Gamble S’Klallam	350	30	37	49
TOTAL	1176	161	196	262

Table 1.5 – Tribal Housing Forecast for the Tribes of the North Olympic Peninsula

Housing projections are difficult in Tribal communities because of a variety of factors:

- **Double Counting.** Occasionally, Tribal members or their families are on housing lists at multiple Tribes.
- **Uncounted.** Many Tribal members do not actively keep their name on housing demand lists if they are able to secure other forms of housing.
- **Unknown demand growth.** If Tribes on the Olympic Peninsula build new, affordable housing, there may be an uptick in Tribal members coming back to the reservation to live that originally did not intend to because of lack of housing.
- **Land ownership.** The mix of Tribal members on fee simple land and on trust land varies and makes it difficult to connect the number of tribal members to the number of Tribal homes.

Roughly speaking, there is an immediate demand for an additional 200-250 homes among the 6 Tribes studied over the next 10 years. This volume roughly equates to \$60-80M in capital budget that will be spent on housing by the Tribes – a major investment in the Olympic Peninsula. This volume would also equate to a half million dollars in EBITDA for the Makah Sawmill. The largest financial impact would occur if Tribal communities could also build homes with their own labor. As of now, most of the home costs would leave the Tribal communities and go towards non-Tribal trade labor. If Tribal trade labor is available, or Tribal owned businesses can be used, then many of the home costs (55% or higher) will go back into Tribal communities. If Tribes choose to partner with local manufacturers in Clallam County, an additional 25% of the total costs of the homes will go back into the region, helping to boost the economy and create good paying jobs.

Alternatively, non-tribal sales pipelines exist in Clallam County for CLT but were not the major focus of this study. However, they still represent a small portion of profit returning to the Tribes from the timber harvesting and sawing processes as well as the contractor labor that will hopefully flourish because of the uptick in tribal housing projects and training.

RECOMMENDED STRATEGIES

The most successful housing strategy for Tribes in Clallam County will blend innovative construction (like CLT), local workforce development, strategic funding alignment, and culturally grounded governance. With proactive planning and community engagement, Tribal communities can build durable, affordable, and self-determined housing that meets both immediate and future

needs. These projects can help support job creation in Clallam County economy for both Tribal members and non-Tribal members. If done right, these Tribal housing programs can be used to support an entirely new economy of mass timber product manufacturing in Clallam County. With labor training and efficiencies growing at scale, CLT produced by CRTC could introduce an entirely new housing supply in this region and in turn, reduce home costs for the foreseeable future. Below are tips on how to navigate through the multi-faceted approach to solving Tribal housing barriers:

Leverage CLT via CRTC:

- Support CRTC in scaling CLT manufacturing through grants and investments using local timber with the emphasis on Western Hemlock from Makah Tribal land.
- Ensure product certification (ANSI/APA PRG 320) and involve local code officials early to streamline approvals.
- Develop storage facilities and buffer inventory for adhesives, fasteners, and other materials to counter supply disruptions.

Build Local Capacity:

- Invest in training programs for Tribal members in architecture, construction, and project management with a specific focus on Tribal housing products.
- Establish internal permitting and inspection standards to ensure consistent build quality and contractor accountability.

Diversify and Layer Funding:

- Stack funding from multiple sources (IHBG, USDA, state, and Tribal funds) for infrastructure and housing development.
- Use Tribal sovereignty to build creative financing models, e.g., Tribal-owned housing entities that blend rental and ownership opportunities.
- Target down payment assistance programs to Tribal members who qualify for Covenant Homeownership or Section 184 loans.

Foster Long-Term Relationships with Builders:

- Prioritize contractors willing to work on Tribal land and include them in early design discussions.
- Focus on large developments that utilize integrated neighborhood concepts to save costs with efficient labor and layout.
- Create pre-negotiated contracts with legal language acceptable to both Tribal governments and contractors.

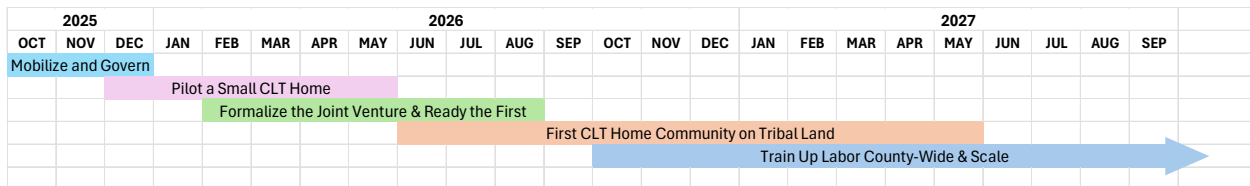
Engage the Community:

- Strategic partnerships like Habitat for Humanity, United Way, Clallam EDC, etc. will create new granting and funding opportunities to house Tribal and non-Tribal members simultaneously.

- Center housing efforts in culturally resonant design and ensure Tribal voices are integral to all planning stages.
- Build social trust through transparency and sustained engagement, particularly when introducing outside capital or new construction methods.

RECOMMENDED IMPLEMENTATION TIMELINE

Below is a general implementation timeline to achieve a robust CLT program that focuses on Tribal housing execution and long-term economic improvement for Clallam County.



Phase 0 (Month 0–2): Mobilize & Govern

1. Form the coalition and PMO.
 - Sign a Letter of Intent among CRTC, Clallam EDC, 123 West, Clallam County, and a lead Tribe; appoint a Program Management Office (PMO) with a single point of accountability.
 - Stand up a Tribal Community Advisory Group for co-design and transparency.
 - Deliverables: LOI/MOU, RACI chart, shared schedule, risk register, comms plan.
2. Lock standards & target kit.
 - Confirm the pre-approved plan kit (DADU, 2BR single-story, A-Frame 3BR, Quadplex), moisture-resilient assemblies, ADA/universal features, and “no drywall/fiberglass” spec.
 - Deliverables: Basis of Design, draft spec book, sample details.

Phase 1 (Month 2–6): Pilot a Small CLT Home

3. Pilot site + approvals.
 - Select a high-visibility site (Tribal, partner parcel, or inside at CRTC), complete cultural/environmental review, utility checks, and early AHJ briefings (special inspections, PRG-320 pathway, shop-drawing protocol). Use ICC-ES if needed.
 - Funding: bundle IHBG + county funds + philanthropy for a fast, single-unit package.
4. Fabricate, install, and open house.
 - Run a DADU or BOLEH through machining/kitting at CRTC; time each step; capture QA/QC data; install with a mixed crew (Tribal members + local contractor).
 - Host a community open house + builder demo to build trust and recruit labor.
 - Deliverables: as-built set, punch-list log, safety record, cost & schedule actuals, “what we’d change” memo.

Phase 2 (Month 4–10): Formalize the Joint Venture & Ready the First Community

5. Execute the JV and procurement framework.

- Convert the LOI into an operating agreement (governance, IP, pricing, QA, data).
 - Bid and award Design-Build master agreements for: site/civil, vertical GC, MEP trades, and transportation—allowing task orders per cluster.
6. Certification & AHJ acceptance at scale.
 - Complete any remaining PRG-320 compliance steps, special-inspection protocols, and AHJ pre-approvals; run a mock inspection at CRTC.
 - Deliverables: approved inspection/test plan, inspector sign-off letter, QC handbook.
 7. Funding stack and pro formas.
 - Standardize rental vs. ownership pro formas (Section 184 compatibility), line up IHBG, USDA, state grants, and bridge capital; pre-clear environmental & title items to avoid draw delays.
 - Deliverables: financing plan, draw schedule, lender term sheets.

Phase 3 (Month 8–20): First CLT Home Community on Tribal Land

8. Pre-development & sitework.
 - Choose the lead Tribe's site; finalize clustering (park-court, gentle density), infrastructure phasing, and cultural design elements (porches, big kitchens, storage).
 - Begin utilities/roads with a task-order to the site/civil contractor.
9. Fabrication readiness at CRTC.
 - Install/verify tooling, ERP inventory tracking, and a buffer stock of panels, connectors, membranes, and windows to blunt supply shocks.
 - Deliverables: production schedule, material min/max levels, safety & maintenance plans.
10. Vertical build – Phase 1 (10–20 homes).
 - Release shop drawings; sequence kitted deliveries; track cycle time, rework, and cost per unit.
 - Hold two AHJ touchpoints (mid-phase & pre-occupancy) to lock repeatable inspections.
11. Community handover & feedback loop.
 - Commissioning, warranty orientation, homeowner/renter training; conduct a post-occupancy evaluation (moisture/IEQ check, satisfaction survey).
 - Deliverables: After-Action Review (AAR), versioned details/specs.

Phase 4 (Month 12–36): Train Up Labor County-Wide & Scale

12. Workforce pipeline (powered by lessons learned).
 - Launch Peninsula College micro-credentials for CNC techs, installers, rigging, and QA; embed jobsite rotations on active builds; place graduates with Tribal housing and local GCs.
 - Target: 30–60 completers per year, with ≥60% placed locally within 90 days.
13. Backlog-relief sprint (multi-Tribe).
 - Using the refined kit, program 60–80 units across Tribes in 2–3 waves; bundle sites to get volume pricing; run a rolling 8–12 week kitting → install program.

- Add a planned replacement rate (e.g., 8–12% of aging stock over 10 years).
14. Continuous improvement & cost discipline.
- Quarterly cost/schedule reviews; update standard details; negotiate annual price locks on big-ticket items; maintain a living risk register (weather, freight, labor).
 - Publish a Playbook v1, v2... so every partner stays aligned and produces transparent results as part of this program. Broadcast this to the general public.

FINAL NOTES

Tribal communities on the North Olympic Peninsula face a pressing housing crisis. Families are burdened by high costs, limited availability, and homes that too often fail to meet cultural and environmental needs. This is a call-to-arms for leaders, partners, and neighbors to come together and build a future rooted in sovereignty, resilience, and innovation. By harnessing the Composite Recycling Technology Center's cross-laminated timber (CLT) product in conjunction with the Makah Sawmill in Neah Bay, WA, we have the opportunity to create affordable, sustainable housing that honors tribal traditions while showcasing local ingenuity. The moment to act is now: together, we can transform today's challenges into a model of equity and sustainability for generations to come.

For questions or concerns regarding the information in this report, or to learn more about the next steps in implementing CLT homes for Tribal communities in the North Olympic Peninsula, please contact Kyle Zimmerman, kyle@123westdesigncollective.com.

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APPENDIX

A – Land Use Analysis

B – Tribal Lending Options

C – Weighting and Scoring Criteria

D – DADU Drawing Package

E – BOLEH Drawing Package

F – Interviews and Tours

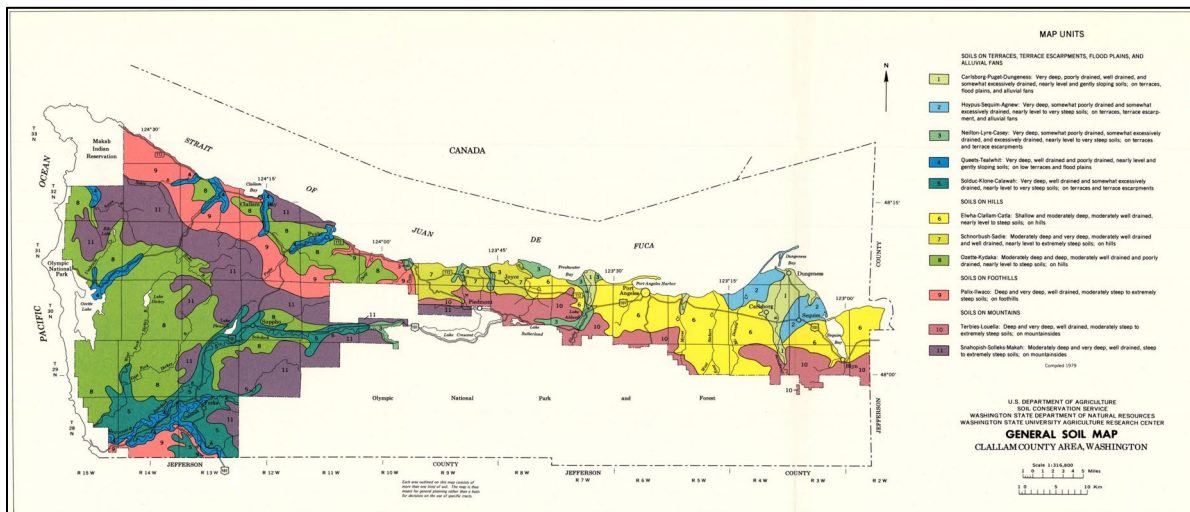
Appendix A – Land Use Analysis

This document summarizes the locations, populations density, environmental conditions, buildability and soil information for the four tribal communities located in Clallam County (Makah, Lower Elwha Klallam, Jamestown S'Klallam, Quileute) and two tribal communities in nearby Kitsap County (Port Gamble S'Klallam) and Jefferson County (Hoh).

This land use analysis is solely based on available, credible data sources. No direct land surveying or geotechnical work was done as a part of this analysis. Data sources have been cited per each tribal community for further reference.



Google Earth, 2025



Department of Agriculture, Soil Map 1987, Confirmed 10/17/2024

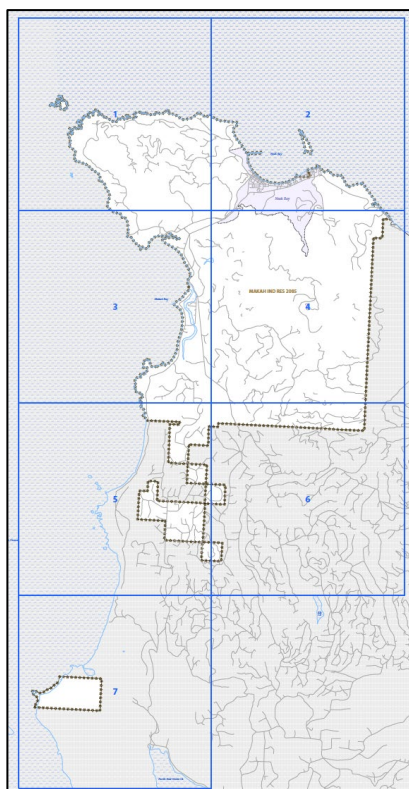
Makah

Reservation Location: Situated at the northwestern tip of the Olympic Peninsula in Washington State, the Makah Indian Reservation encompasses approximately 47 square miles, including Tatoosh and Wa'adah Islands.

Population: The reservation includes the village of Neah Bay, which serves as the primary population center. There are over 1,500 tribal members living on the reservation with the average age of residents around 34 years old. Population density: 1 resident per 87,000 sqft.

Environmental Considerations: The area is exposed to environmental risks such as high seismic activity, tsunami threats, high wind speeds, intense precipitation, small landslides, and coastal storms. Wind Load: 130–140 mph, Snow Load: 20-30 pounds per square foot, Annual Precipitation: 100–120 inches.

Buildability and Soil: The terrain includes high, heavily forested ground and low-lying coastal areas. The coastal zones, particularly Neah Bay, are vulnerable to environmental hazards, which can impact construction and land use planning. Timber production and wildlife are the principal uses. Small areas are used for cropland and permanent pasture. Native vegetation is western hemlock, Sitka spruce, and red alder. Well drained; slow runoff; moderate permeability. These soils are subject to none or rare flooding. Queets soils are on river terraces at elevations of 0 to 600 feet. They formed in silty alluvium. Tealwhit soils are on bottomlands and low terraces at elevations of 20 to 1,200 feet. Slopes are 0 to 8 percent. They formed in alluvium. Ozette soils are on hills at elevations from sea level to 1,800 feet. They formed in loess and ablation till derived mainly from sandstone and siltstone over dense, very compact glacial till. Kydaka soils are on glacial outwash terraces at elevations of 10 to 660 feet. They formed in silty glacial lacustrine sediments over glacial outwash or till.



Construction Notes: Stout structural design is important for wind and snow loads. Place homes on raised platforms or use pier/piling foundations for flood-prone/coastal sites. Install advanced site grading and stormwater systems for adequate drainage. Use corrosion-resistant fasteners, fiber-cement siding, marine-grade finishes.

Sources

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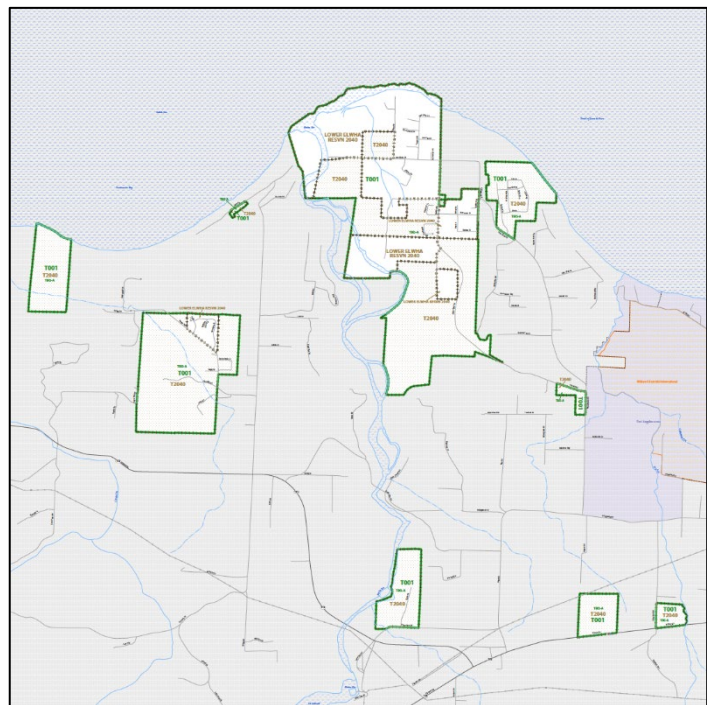
Lower Elwha Klallam

Reservation Location: Located west of Port Angeles on the north coast of the Olympic Peninsula, the Lower Elwha Klallam Reservation encompasses approximately 1,000 acres in the lower Elwha River valley.

Population: The tribe has 985 enrolled members, with 395 residing on the reservation. Population density: 1 resident per 111,822 sqft.

Environmental Considerations: The tribe has developed a Vulnerability Assessment to explore expected impacts from climate change to key tribal resources. Wind Load: 110–120 mph, Snow Load: 25–35 pounds per square foot, Annual Precipitation: 25–35 inches.

Buildability and Soil: The area includes river valleys and coastal zones, which may present challenges for construction due to soil stability and flood risks. Lydon and Ovall soils are moderately deep to bedrock. Schneider and Siouyon soils have an umbric epipedon. McElroy soils have 5 to 30 percent glass in the upper 7 to 14 inches of the solum. Lyre soils are on terraces at elevations of 50 to 800 feet. They formed in glacial outwash. Slopes are 0 to 30 percent. The soils are in a mild marine climate and have cool, dry summers and cool, moist winters. Somewhat excessively drained; medium runoff; permeability of the solum is moderately rapid and permeability of the substratum is rapid.



Timber production and cropland are the principal uses. Casey soils are on terraces at elevations of near sea level to 600 feet. Slopes are 0 to 10 percent. The soils formed in stratified glacio-lacustrine or marine sediments. Poorly drained; slow runoff; very slow permeability.

Construction Notes: Stout structural design is important for wind and snow loads. Focus on thermal efficiency for comfort due to cooler winters. Use slab-on-grade or stem wall on stable soil; raise floors in Elwha River floodplain zones. Solar-ready rooftops are viable due to moderate rain shadow exposure.

Sources:

Encyclopedia of Puget Sound. Lower Elwha Klallam Tribe Profile. eopugetsound.org
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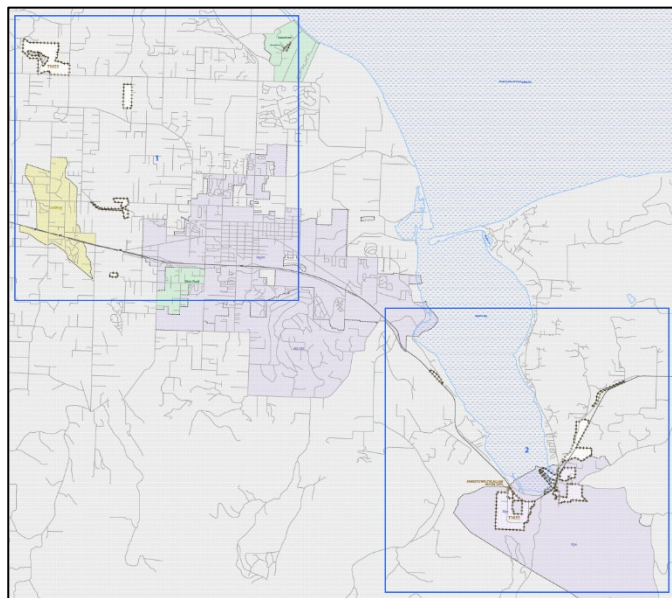
Jamestown S'Klallam

Reservation Location: The Jamestown S'Klallam Tribal headquarters is located along the Olympic Peninsula in Blyn, Washington, encompassing about 14 acres.

Population: The tribe has over 600 enrolled members with the average age of reservation residents around 47 years old. Population density: 1 resident per 1,000 sqft.

Environmental Considerations: The tribe's Environmental Planning Program addresses environmental problems by coordinating with habitat programs and community partners on watershed issues. The reservation experiences mostly mild weather conditions occasionally escalating into high wind speeds, intense precipitation, small landslides, and coastal storms. Wind Load: 110–120 mph, Snow Load: 25–35 pounds per square foot, Annual Precipitation: 25–35 inches.

Buildability and Soil: The area includes prairies, wetlands, shoreline, and rivers, which require careful planning to protect sensitive habitats during development. Elwha soils are on hillslopes of glacial drift plains at elevations of 0 to 610 meters. They formed in glacial drift over dense glacial drift. These soils are in a mild marine climate with cool, dry summers and mild, wet winters. Clallam soils occur on hillslopes and have greater than 35 percent coarse fragments in the control section. Elwha soils have a perched water table as high as 40 centimeters from November to March. These soils are used for livestock grazing, forage crop production, timber production, and homesites. Catla soils are on hills and till plains at elevations of 50 to 500 feet. Slopes are 0 to 15 percent. They formed in dense, very compact glacial till or a mantle of ablation till over very compact lodgment till.



Construction Notes: Stout structural design is important for wind and snow loads. Require delineation studies to avoid wetland disturbance. Optimize orientation for heating and daylighting due to clearer skies. Consider ember-resistant vents and defensible space due to dry summer conditions.

Sources:

Tribal Climate Adaptation Guidebook. Jamestown S'Klallam Tribe Case Study.
tribalclimateadaptationguidebook.org

Jamestown S'Klallam Tribe. Environmental Planning Department. jamestowntribe.org

Jamestown S'Klallam Tribe. 2022 Report to Tribal Citizens (PDF). jamestowntribe.org

Quileute

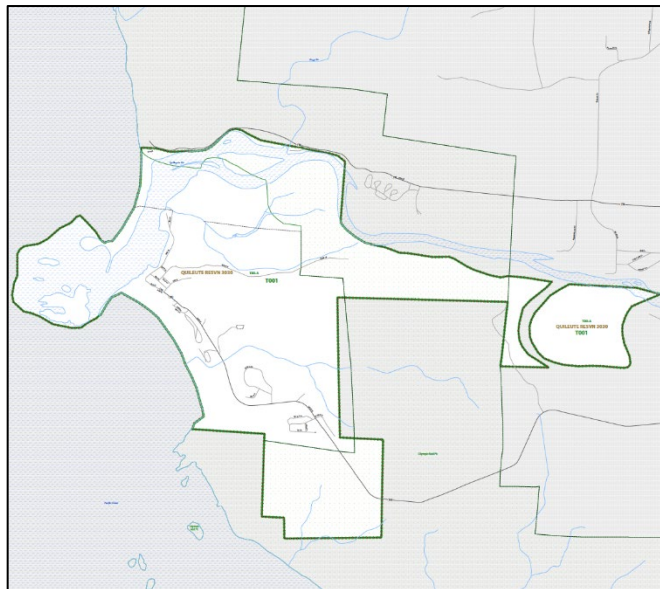
Reservation Location: Located near the mouth of the Quillayute River on the Pacific coast of the Olympic Peninsula, the Quileute Indian Reservation encompasses approximately 1.5678 square miles.

Population: As of the 2000 census, the reservation had an official resident population of 371 people with the average age of 31 years old. Population density: 1 resident per 117,700 sqft.

Environmental Considerations: The reservation is within a tsunami zone and faces threats from coastal flooding and marine storms. The tribe is engaged in a long-term "Move to Higher Ground" program to relocate critical infrastructure to safer elevations. Wind Load: 130–140 mph, Snow Load: 20–30 pounds per square foot, Annual Precipitation: 100–120 inches.

Buildability and Soil: The coastal location presents challenges due to erosion and flood risks. Relocation efforts aim to move facilities to areas with more stable and secure land conditions. Queets soils are on river terraces at elevations of 0 to 600 feet. They formed in silty alluvium. Tealwhit soils are on bottomlands and low terraces at elevations of 20 to 1,200 feet. Slopes are 0 to 8 percent. They formed in alluvium.

Construction Notes: Stout structural design is important for wind and snow loads. Follow "Move to Higher Ground" planning by building above tsunami zones. Use elevated and seismic-resilient designs (pier foundations with shear bracing). Emphasize water shedding exterior materials; incorporate rain screens and capillary breaks.



Sources:

Wikipedia. Quileute Indian Reservation. en.wikipedia.org

Northern Arizona University. Quileute Tribe – Tribal Climate Change Profile. www7.nau.edu

YES! Magazine. Climate Change and Indigenous Communities. yesmagazine.org

Port Gamble S’Klallam

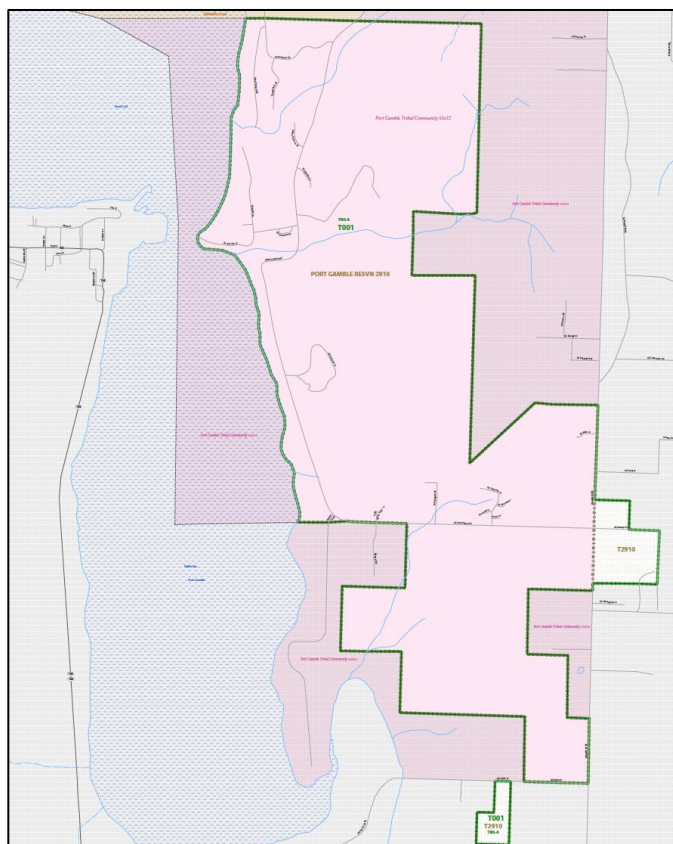
Reservation Location: The Port Gamble S’Klallam Reservation is located on the northern tip of the Kitsap Peninsula in Washington State, covering approximately 1,340 acres. This area falls in the Kitsap County region.

Population: Over half of the nearly 2,000 enrolled tribal members live on the reservation and the median age is 38 years old.

Environmental Considerations: The tribe is addressing environmental concerns, including contamination from historical industrial activities in Port Gamble Bay. Wind Load: 110–120 mph, Snow Load: 20-30 pounds per square foot, Annual Precipitation: 40–50 inches.

Buildability and Soil: The reservation includes areas affected by past industrial use, necessitating environmental assessments and remediation efforts to ensure safe development.

Construction Notes: Stout structural design is important for wind and snow loads. Require soil testing on all sites for contamination due to historical industrial use. Implement infiltration systems with bio-retention (rain gardens, bioswales). Use durable, mold-resistant materials with attention to crawlspace ventilation.



Sources:

Encyclopedia of Puget Sound. Port Gamble S’Klallam Tribe Profile. eopugetsound.org
Northwest Treaty Tribes. Port Gamble Indian Reservation’s Brownfields. nwtreatytribes.org

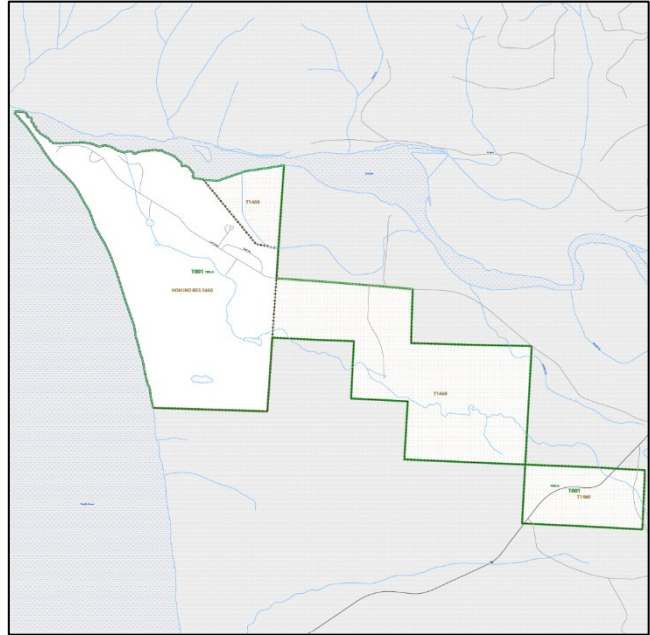
Hoh

Reservation Location: The Hoh Indian Reservation is situated along the Pacific coast of the Olympic Peninsula, encompassing areas along the lower Hoh River. This area falls in the Jefferson County region.

Population: The reservation is home to members of the Hoh Tribe, approximately 50 members, who have traditional ties to the Hoh watershed.

Environmental Considerations: The reservation faces disproportionate impacts from flooding and tsunami hazards. Relocation development plans aim to move housing and services outside of high-risk zones. Wind Load: 130–140 mph, Snow Load: 20–30 pounds per square foot, Annual Precipitation: 120–140 inches.

Buildability and Soil: The Hoh series soils are very deep, moderately well to well-drained, formed in mixed alluvium, and are located on low terraces and flood plains with slopes of 0 to 10 percent.



Construction Notes: Stout structural design is important for wind and snow loads. Avoid low terraces or floodplain areas; seek higher elevation lots. Deep pier systems or helical piles are recommended in soft alluvial soils. Use closed-cell spray foam or moisture-resistant insulation to protect against persistent dampness.

Sources:

Hoh Tribe Official Website. Cultural Resources. hohtribe-nsn.org

FEMA. Draft Programmatic Environmental Assessment for the Hoh Tribe Relocation Project. fema.gov

USDA NRCS. Official Soil Series Description – Hoh. soilseries.sc.egov.usda.gov

Appendix B – Tribal Lending Notes

- Funding is constantly a barrier for most Tribal communities, especially in remote areas, because there are typically only one or two lending companies that can manage it. Larger banks often say they can, but don't have staff to process HUD Section 184 paperwork for loans. 1st Tribal Lending is really the only good option right now for homebuyers on Tribal land on the Olympic Peninsula.
- The main reasons that Tribal members struggle to secure a loan are:
 - Poor credit history or (sometimes) no credit history
 - Lack of downpayment funds available
 - Lack of closing cost funds or extra funds in case of issues during closing
- Pre-qualification is easy, usually pre-approval happens quickly. The struggle comes when HUD 184 underwriters start looking into the details of the plan.
 - Fee simple land is easy and takes 45 days to process.
 - Tribal trust land needs permission from the tribal government to qualify and that process can take time. Currently, there aren't many "fast track" processes in tribes to make that faster. The back and forth between tribal governments, Bureau of Indian Affairs (BIA), and the underwriters can sometimes take 6 months or more.
 - In some cases, the BIA plays a larger role because the land might be fractionated (e.g. owned by multiple living or deceased family members) and they need to vet and confirm ownership before starting the process.
- Because of these long-term paperwork battles, the cost of home building goes up and interest rates shift so that by the time the loan is approved, it might be different terms or total loan values. This makes it very difficult for new homebuyers who don't have much float in their budget.
- Another major issue in the underwriting process is to prove that there are qualified, experienced contractors doing the work. A stamped and approved design with an experienced building team behind it makes the process go smoother. Without that, the homeowner is often at the mercy of the underwriter to make a call.
- So far, the Washington Covenant Loan Program has not been used with Tribes on the Olympic Peninsula, but 1st Tribal Lending is currently working through the paperwork to become an approved lender under it. There are some challenges with the terms, but in general, this program could help tribal members with downpayment assistance.

Appendix C – Weighting and Scoring Strategy

Cost is categorized by the total cost to build including foundation work and finishes. A 5 is given to homes that are incredibly cost-effective. In this case, the CLT is assumed to be produced from CRTC in Port Angeles. If this is not the case, the cost assignment should be reduced to 3.

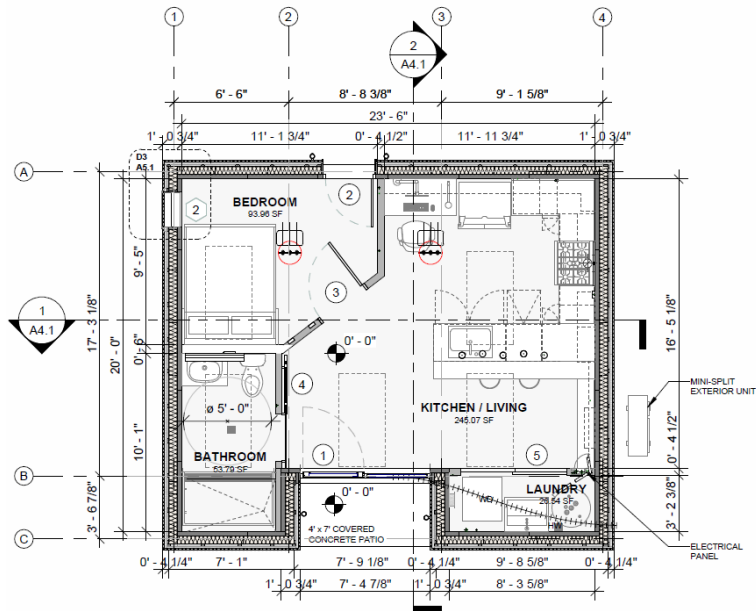
Practicality is categorized by homes that are positioned best for the environmental and social conditions of the Pacific Northwest. From the Land Use analysis, it's clear that the homes on Tribal land, especially along the western coast (Makah, Quileute, Hoh) require homes that can withstand intense wind load, snow load, and annual precipitation.

Build Time is categorized by which homes are the fastest to build/assemble on site. Quality contractor labor is expensive across the entire Olympic Peninsula and the Tribal reservation land often experiences even higher costs due to difficult building conditions, distance from construction resources, and contract terms that are passed down from programmatic grants and federal funding sources. Higher marks are for construction methods that save time and energy on site.

Sustainability is categorized by which construction methods are the least carbon intensive during the build phase of the project and the least energy intensive in the operation of the home.

Total. Each category is weighed against the construction method on a scale of 5 (best) to 1 (worst) and tallied to result in a total score. The top three construction methods for Tribal land in Clallam County are Cross-Laminated Timber (CLT) from CRTC, Stick-Framed construction using light wood framing, and Structural Insulated Panels (SIPs). As this analysis is primarily focused on wood products in Clallam County, only CLT and Stick-Framed home designs will continue to be analyzed.

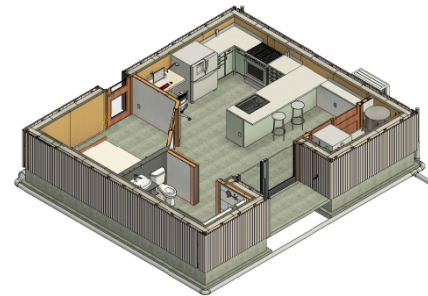
Appendix D – DADU Drawing Package



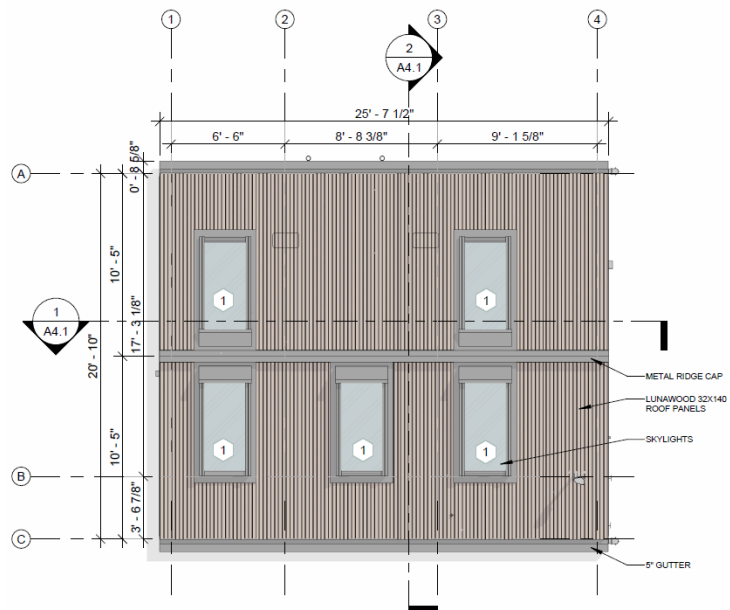
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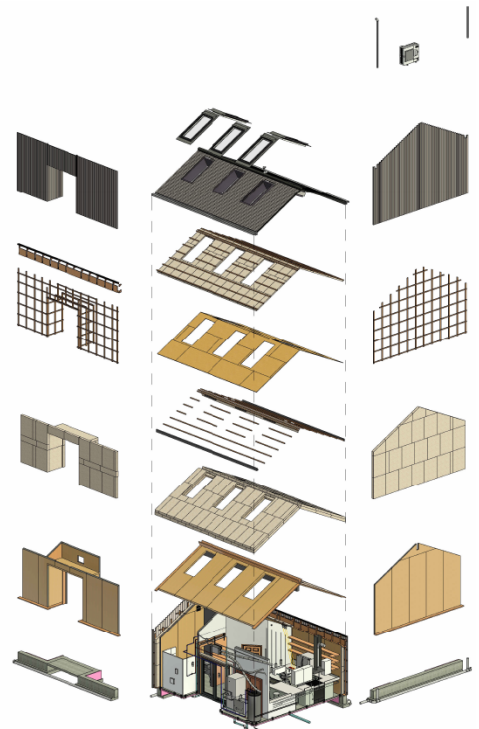
2 3D MODEL
Scale



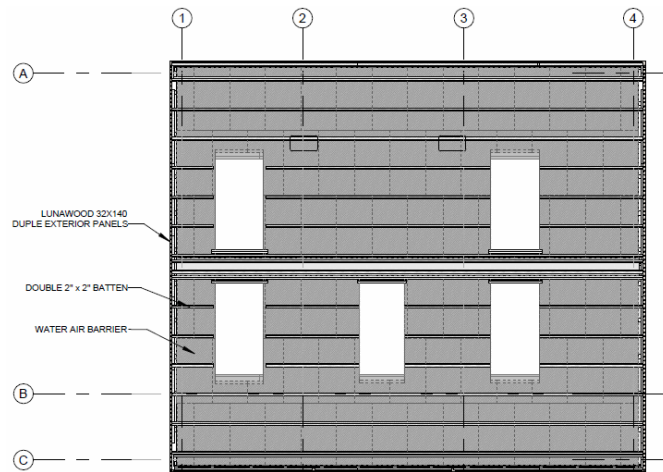
3 3D FLOOR PLAN
Scale



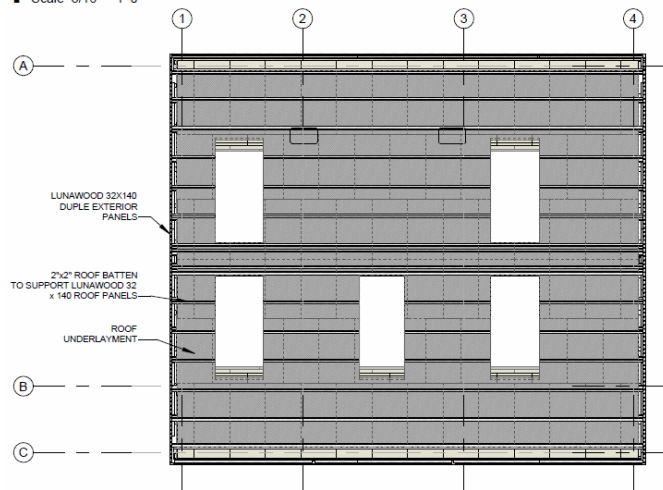
1 ROOF PLAN
Scale 3/16" = 1'-0"



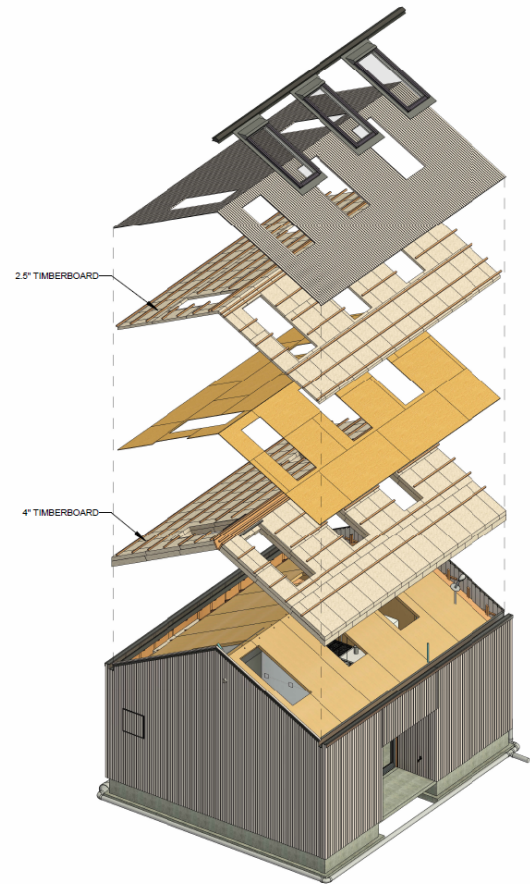
2 AXO - MODEL DISPLACE
Scale



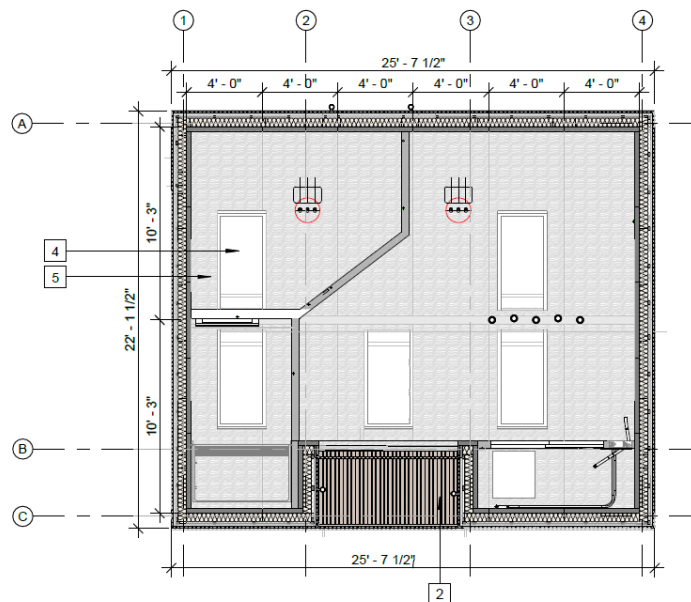
1 ROOF DOUBLE BATTEN OVER 4" TIMBERBOARD
Scale 3/16" = 1'-0"



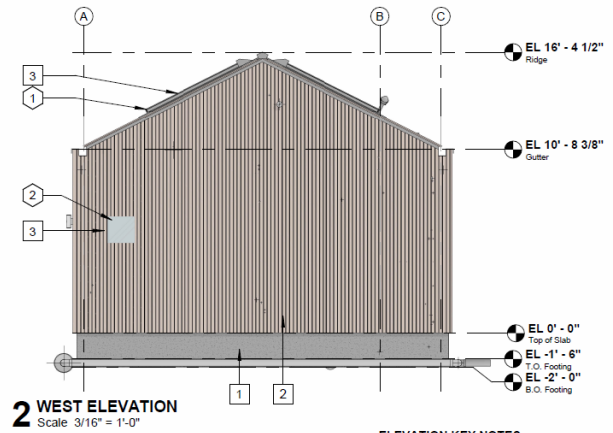
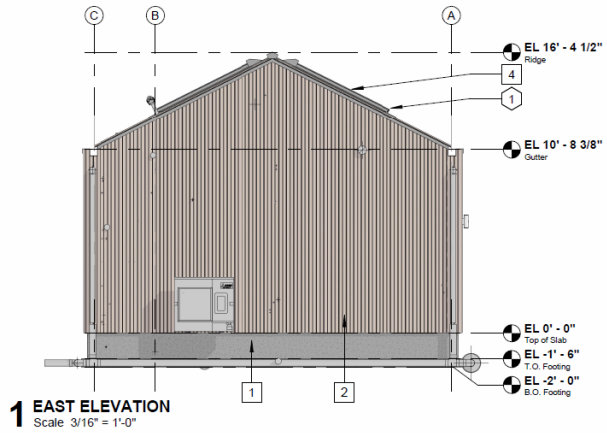
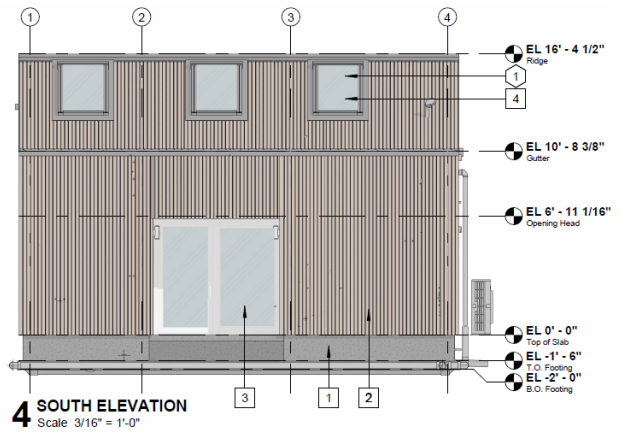
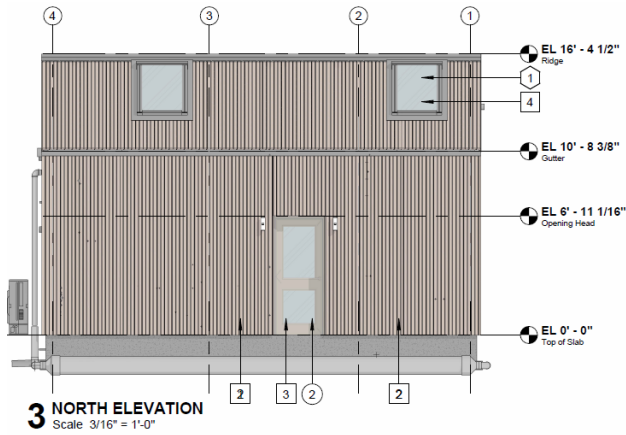
2 ROOF BATTEN OVER 2.5" TIMBERBOARD
Scale 3/16" = 1'-0"



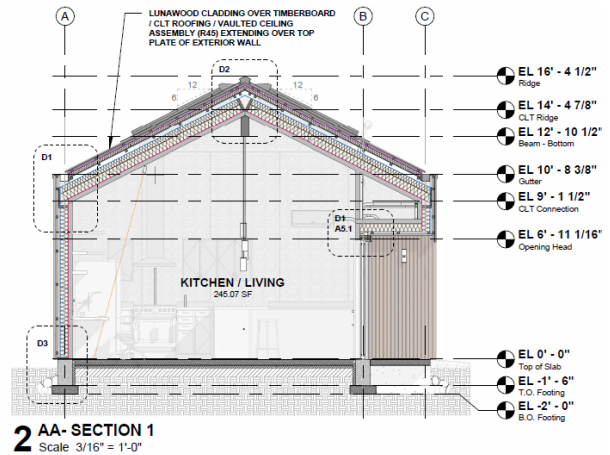
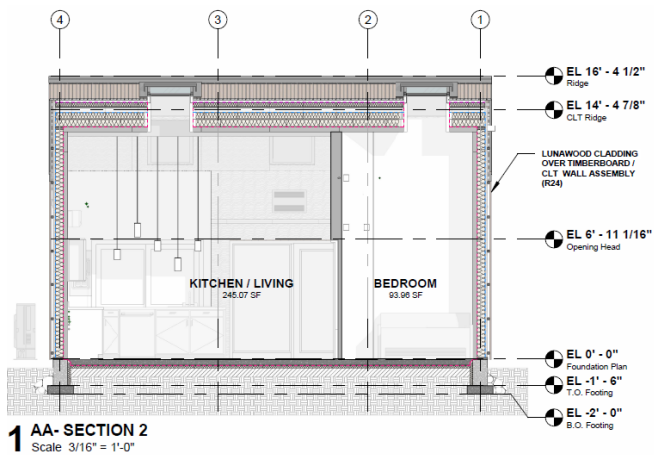
3 AXO- ROOF DISPLACE
Scale



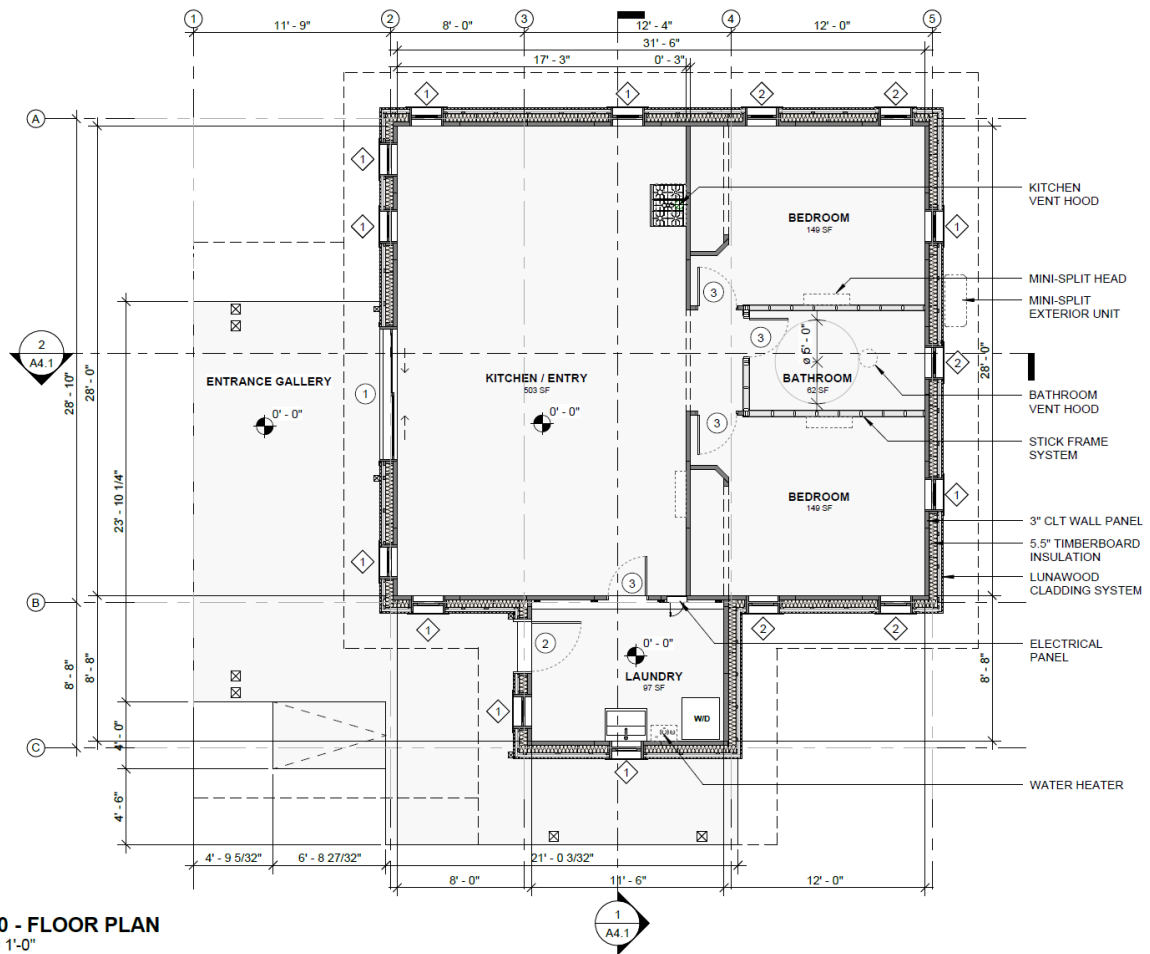
1 AA - CEILING PLAN
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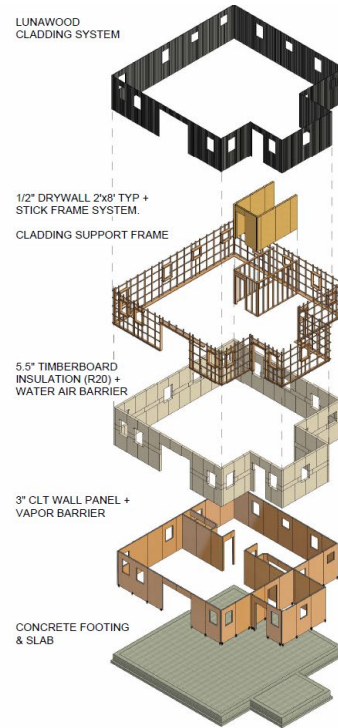
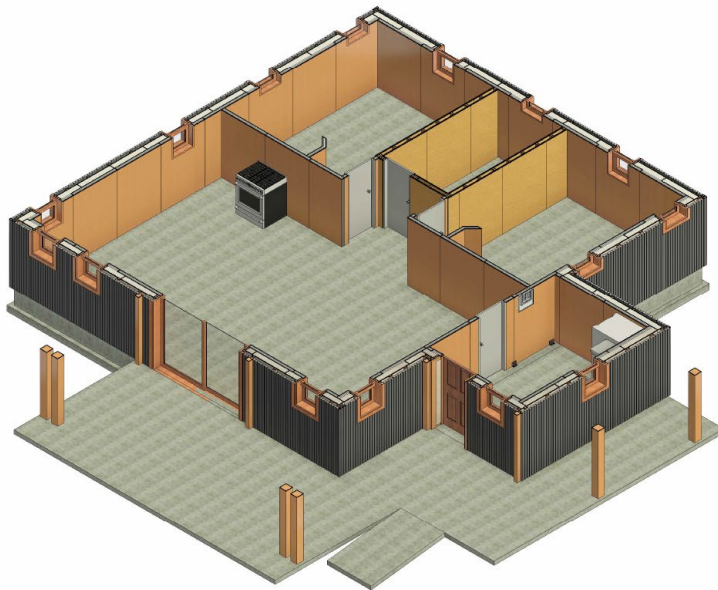


- ELEVATION KEY NOTES**
- 1 CONCRETE
 - 2 LUNAWOOD CLADDING SYSTEM
 - 3 OPENING
 - 4 METAL & GLASS SKYLIGHTS



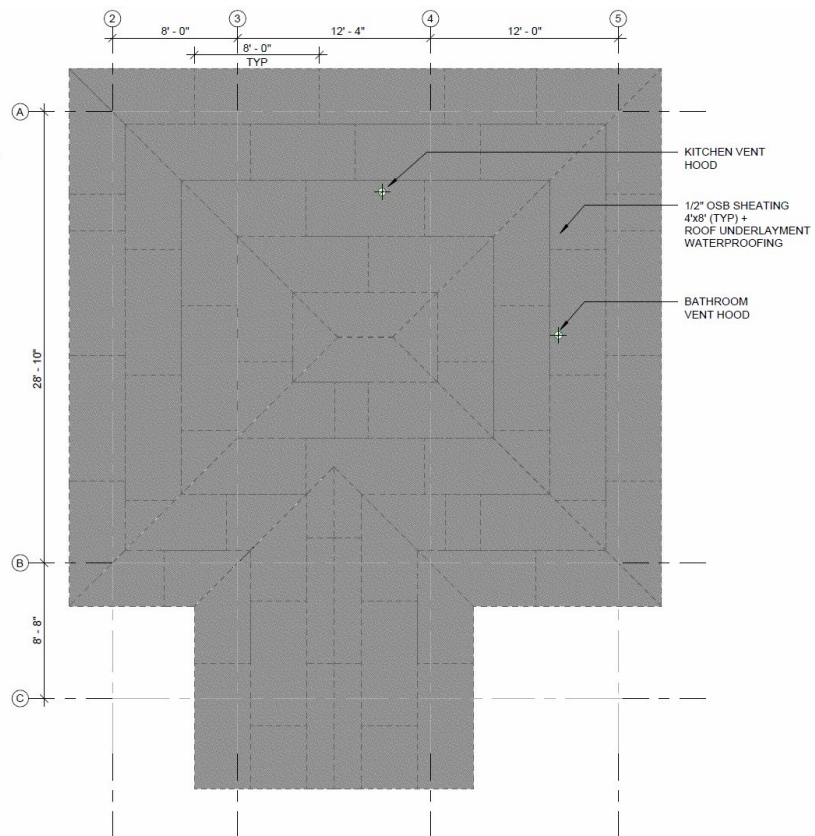
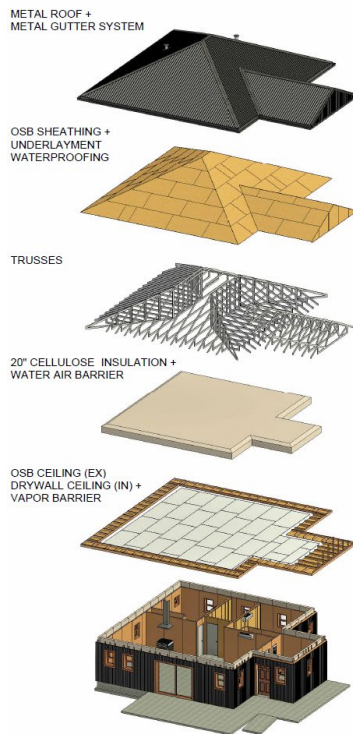
Appendix E – BOLEH Drawing Package





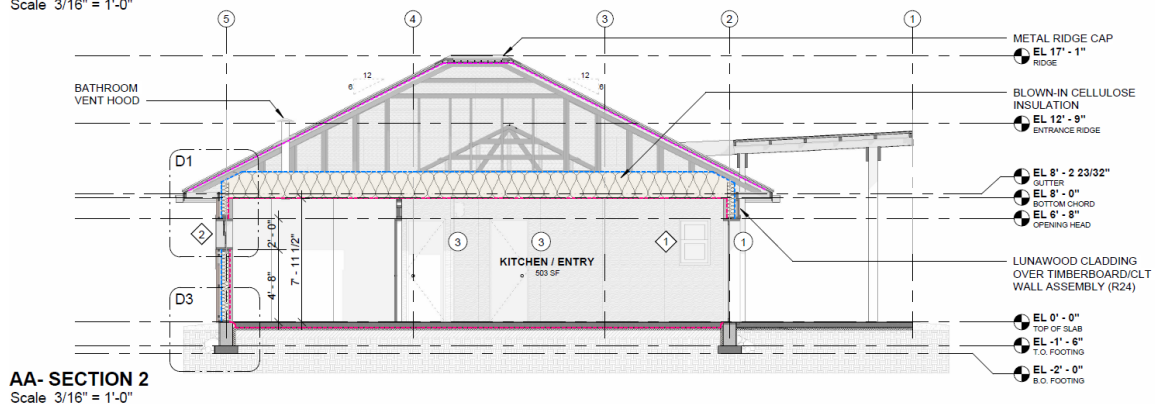
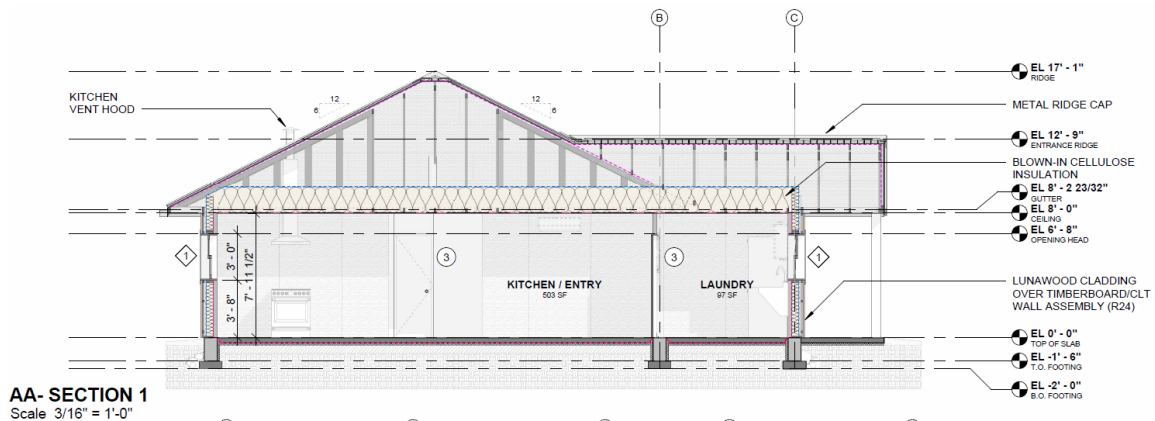
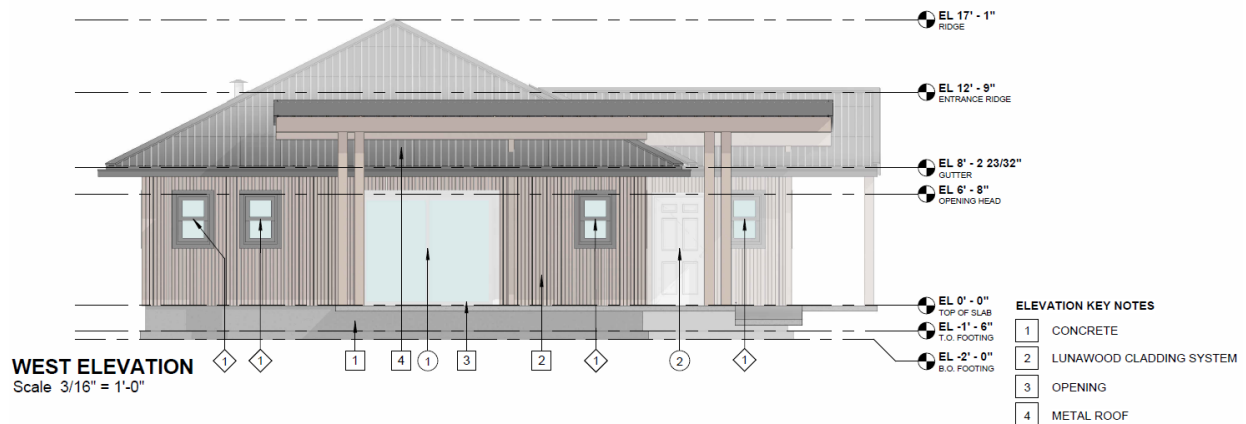
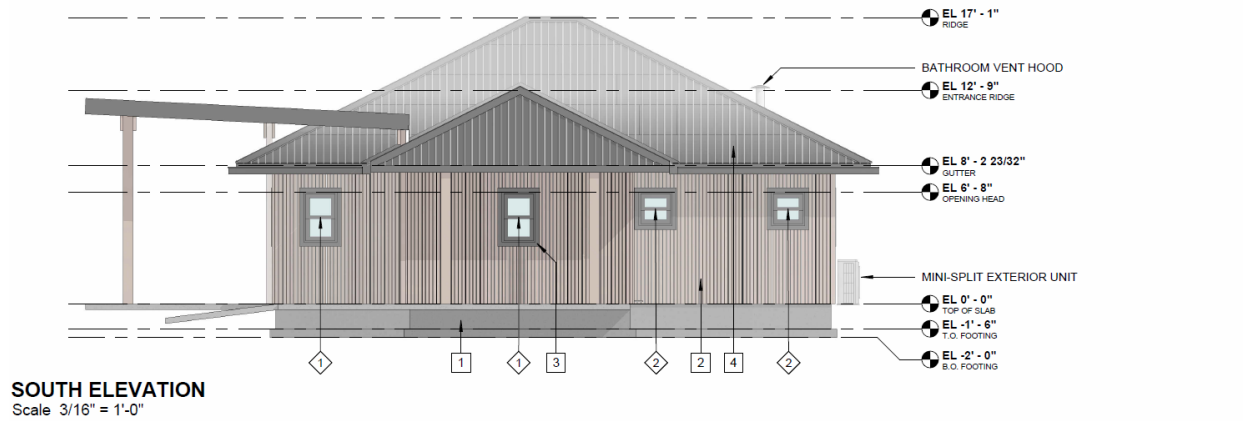
3D - FLOOR PLAN
Scale

3D - FLOOR PLAN DISPLACE
Scale



AXO - ROOF DISPLACE
Scale

ROOF PLAN - OSB
Scale 3/16" = 1'-0"



Appendix F – Interviews and Tours

Thank you to the following participants for their time in consulting with us:

- Roger Bain, Marla Tolliver, and Christopher Martinez of the Makah Tribal Council
- Wendy Lawrence, Executive Director of the Makah Housing Authority
- Jennifer Hutto, Executive Director of the Lower Elwha Housing Authority
- Ann Jagger, Executive Director of the Quileute Housing Authority
- Cynthia Toop, Project Manager of the Hoh Tribe
- Luke Strong-Cvetich, Tribal Planning Director of the Jamestown S’Klallam Tribe
- LaTrisha Suggs, Port Angeles Councilwoman and Jamestown S’Klallam Tribal Member
- Glenn Ellis Jr., Housing Business Manager for CRTC and Makah Tribal Member
- Darkfeather Ancheta, 1st Tribal Lending
- Rick Dickerson, Native American Housing Liaison, Habitat for Humanity
- Mallore Weinheimer, Chickadee Forestry
- John Niedzwiecki and Brent Lawrence, RedBuilt
- Zack Middleton, Middleton Engineering and Design
- CRTC Leadership and Staff
- Sustainable Northwest Woods volunteers and participants
- Lower Elwha Housing Fair volunteers and participants