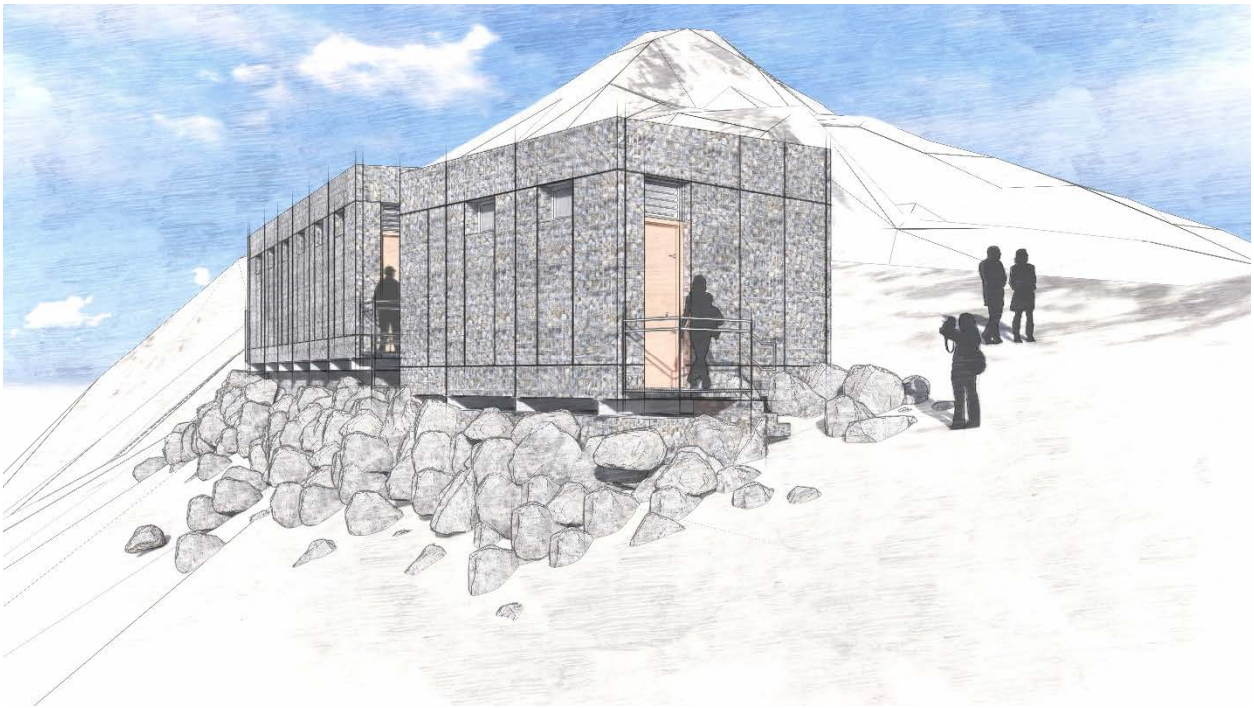
REHABILITATE CLIMBING FACILITIES AT CAMP MUIR

TITLE II DESIGN DEVELOPMENT AND CONSTRUCTION DOCUMENTS SERVICES
MOUNT RAINIER NATIONAL PARK, PIERCE COUNTY, WASHINGTON

100% CONSTRUCTION DOCUMENTS REPORT
PMIS # 307228

DECEMBER 03, 2025



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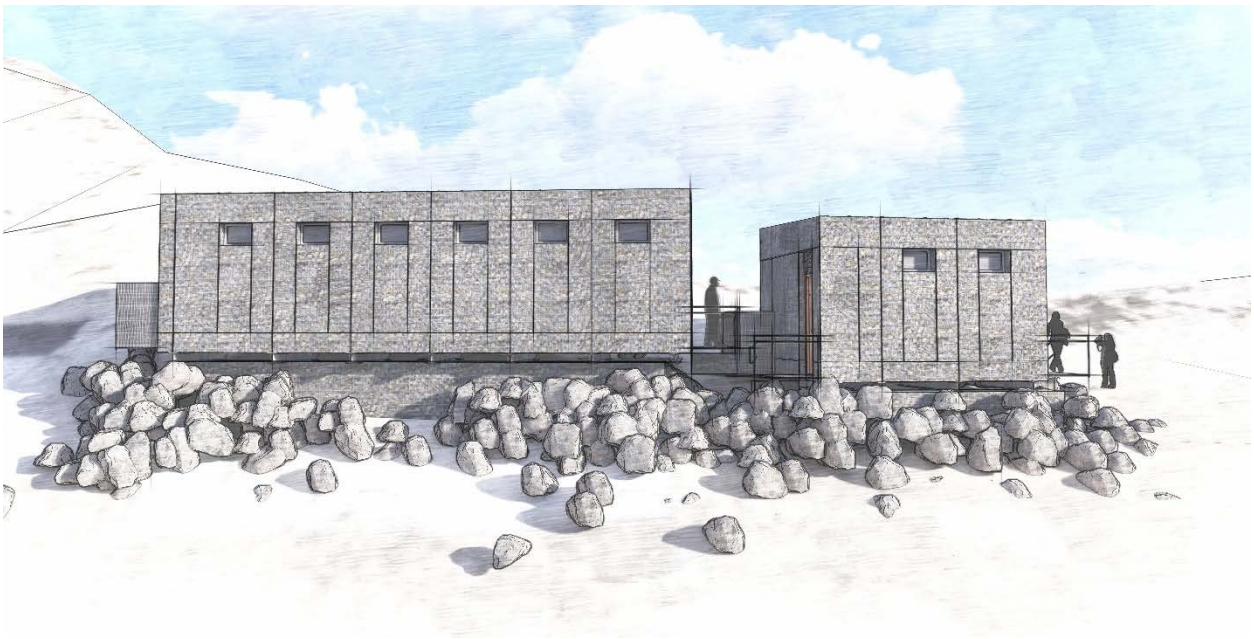
EXECUTIVE SUMMARY

Title II Design Services for the Camp Muir Climbing Shelters is based on design criteria developed during Title I services. These included the Schematic Design Report (dated January 19, 2024, by DJ&A) and the Supplemental Design & Value Analysis Report (dated December 31, 2024, by ECI). The Value Analysis Workshop focused on evaluating construction methods for replacement shelters at Camp Muir in Mount Rainier National Park. The goal was to identify up to three viable construction or material systems, considering factors like logistics, visitor impact, and cost. The team then conducted life-cycle cost and qualitative analyses of the top options, leading to the creation of a Supplemental Design Report. As the study progressed, the team also examined foundation and siding alternatives. Using the Choosing by Advantages method to determine the optimal construction approach, the preferred option became the basis for the Title II design services.

DESIGN SUMMARY UPDATE IN TITLE II

The two climbing shelters will be constructed using Nail-Laminated Timber (NLT) as the primary structural system. The NLT panels will follow a 7-foot module and will be clad with a weather-resistant membrane on the roof and walls, overlaid with stone gabion basket cladding. The cladding will be installed using a cleat system, facilitating both initial construction and long-term maintenance.

The primary structural consideration is the International Building Code anticipated ground snow load of 800 lb/ft² is applied to the roof as agreed upon through discussions with NPS. This necessitates a wood “strongback” substructure to transfer loads to a gabion foundation system embedded into the existing grade. This wood framework also acts as a keying system to align and connect the 7-foot modules during on-site assembly. The modular approach allows the shelter units to be prefabricated off-site as four-sided tubes, which will be bolted together during installation. The foundation system will include adjustable elements to allow for annual shimming, accommodating regional ground movement over time.



CODE CONFIRMATIONS FOR NPS FROM TITLE II DESIGN UPDATE:

International Building Code (IBC):

- IBC requires a sprinkler system based on the R-1 occupancy type. A sprinkler system is not reasonably feasible at Camp Muir. A waiver will be required.

PROGRAM SUMMARY:

- Shelter A – 18 Clients / 6 Guides / 3 Storage Bunks / Cooking / General Storage
- Shelter B – 12 Bunks / Storage

STRUCTURAL SUMMARY: The Camp Muir shelter is designed to withstand extreme snow and seismic conditions. A ground snow load of 800 lb/ft² is applied to the roof as agreed upon through discussions with NPS. The structure uses modular Nail-Laminated Timber (NLT) for strength, sustainability, and ease of transport and assembly in a remote, high-altitude setting. The 7-foot-wide NLT modules are constructed from 2x6 Douglas Fir. The foundation anchors into permafrost using steel beams and gabion footings to ensure stability against seismic activity and frost movement. Structural tabs allow for seasonal jacking and shimming of foundation over time if ground conditions under the site shift.

CLADDING: Gabion siding and roof ballast will be dry stacked and held in place by wire baskets bound by steel angle to form panels of varying size and configuration. The baskets will be attached to the shelter structure/enclosure using a system of metal clips. Assembly does not require specialized labor and can be accomplished by carpenters and laborers. The resulting look will blend well with the historic district.

CONSTRUCTION LOGISTICS – GETTING MATERIALS TO THE SITE: Factors in the design include logistical staging areas for both manual ascents to Camp Muir and helicopter staging points. This consideration is a primary construction activity identified in the Environmental Assessment document.

SITE PHASING: The Site Phasing identifies both the opportunities and constraints of the Camp Muir site for construction staging. Construction activities are influenced by the Historic District Boundary, NPS operations, concessionaire guide services, and public use. All these activities will coincide with construction, requiring that current concessionaire operations be relocated and that NPS and public uses be safely and efficiently accommodated.

ELECTRICAL AND PHOTOVOLTAIC SYSTEMS: A concessionaire provided Photovoltaic (PV) System will be the sole power source for each shelter and may include roof-mounted solar panels, an inverter, and a Battery Energy Storage System (BESS).

Lighting: Natural light will meet code; no artificial lighting or emergency egress lighting required.

Special Systems: A smoke/CO detection and alarm system will be provided. Spare conduits will be installed during construction; systems added later by NPS/concessionaire.

Lightning Protection: Lightning protection will be provided due to remote location and NPS standards.

HAZMAT: The National Park Service conducted environmental testing at Camp Muir's existing climbing shelters on May 21, 2025 to determine the presence of hazardous materials like lead paint or asbestos. The lead assessment was negative and asbestos results are pending. Findings will inform updates to the project's design and guide any necessary safety and abatement measures, ensuring compliance with environmental regulations and protecting workers and visitors during construction.

DESIGN & COST SUMMARY: Combining the above factors, the new climbing shelter design is based on a structure/enclosure constructed from mass timber panels with a steel subframe, set on a foundation of gabions and clad with gabion siding.

- *Estimated Construction Duration: 12 weeks*
- *Number of Helicopter Trip Days: 9.7 separate days with multiple lifts per day*
- *Note: all helicopter lifts are anticipated to be by a light lift helicopter, like a Bell 412, or a medium lift helicopter, like a Bell 205A-1 or 214-B-1*

DESIGN NARRATIVES: CODES

AUTHORITY HAVING JURISDICTION: NATIONAL PARK SERVICE (NPS)

OWNER: NATIONAL PARK SERVICE (NPS)

APPLICABLE CODES:

- 2024 INTERNATIONAL BUILDING CODE
- 2024 INTERNATIONAL FIRE CODE
- 2023 NATIONAL ELECTRICAL CODE NFPA 70

SECTION 302- OCCUPANCY CLASSIFICATION

- R-1 BOARDING HOUSE – SHELTER A
- BOARDING HOUSE DEF. A BUILDING ARRANGED OR USED FOR LODGING FOR COMPENSATION, WITH OR WITHOUT MEALS, AND NOT OCCUPIED AS A SINGLE-FAMILY UNIT.
- R-1 HOTELS – SHELTER B

TABLE 504.3 – ALLOWABLE BUILDING HEIGHT ABOVE GRADE PLANE

- FOR R-1, TYPE VB WITHOUT AN AUTOMATIC SPRINKER SYSTEM = 40 FEET ABOVE GRADE PLANE

TABLE 504.3 – ALLOWABLE NUMBER OF STORIES ABOVE GRADE PLANE

- FOR R-1, TYPE VB WITHOUT AN AUTOMATIC SPRINKER SYSTEM = 2 STORIES

SECTION 601 – TABLE 601- FIRE RESISTANCE RATING REQUIREMENTS FOR BUILDINGS ELEMENTS (HOURS)

- PRIMARY STRUCTURAL FRAME 0
- BEARING WALLS EXTERIOR 0
- BEARING WALLS – INTERIOR 0
- NONBEARING WALLS AND PARTITIONS -EXTERIOR 0
- NONBEARING WALLS AND PARITITIONS-INTERIOR 0
- FLOOR CONSTRUCTION AND ASSOCIATED SECONDARY STRUCTURAL MEMBERS 0
- ROOF CONSTRUCTION AND ASSOCIATED SECONDARY STRUCTURAL MEMBERS 0

SECTION 602 – CONSTRUCTION CLASSIFICATION

- TYPE VB

SECTION 704 TABLE 705.5 – FIRE RESISTANCE RATING REQUIREMENTS FOR EXTERIOR WALLS BASED ON FIRE SEPARATION DISTANCE

- $10 \leq X \leq 30 = 0$

SECTION 903.2.8 GROUP R AN AUTOMATIC SPRINKLER SYSTEM INSTALLED IN ACCORDANCE WITH SECTION 903.3 SHALL BE PROVIDED THROUHOUT ALL BUILDINGS WITH A GROUP R FIRE AREA.

- *POLICY MEMORANDUM 2301- POLICY E. Variances and Waivers Pursuant to the ICC family of codes, BCOs will issue variances and waivers for non-fire protection related issues. PPFL SMEs will advise regional BCOs as needed. FCOs will continue to issue variances and waivers for fire protection related issues.*

SECTION 1004 – OCCUPANT LOAD - MAXIMUM FLOOR AREA ALLOWANCES PER OCCUPANT

- SLEEPING AREAS 120 GROSS SF
- SHELTER A = 532 GSF/120 = 4.4 (Actual 27 Bunks (24 Bunks Sleeping & 3 Bunks Storage))
- SHELTER B = 271 GSF/120 = 1.7 (Actual 12 Bunks)

SECTION 1005.3 - MEANS OF EGRESS SIZING FOR ACTUAL

- SHELTER A = 24 X 0.2 = 4.8”
- SHELTER B = 12 X 0.2 = 2.4”

SECTION 1202.5 – NATURAL VENTILATION

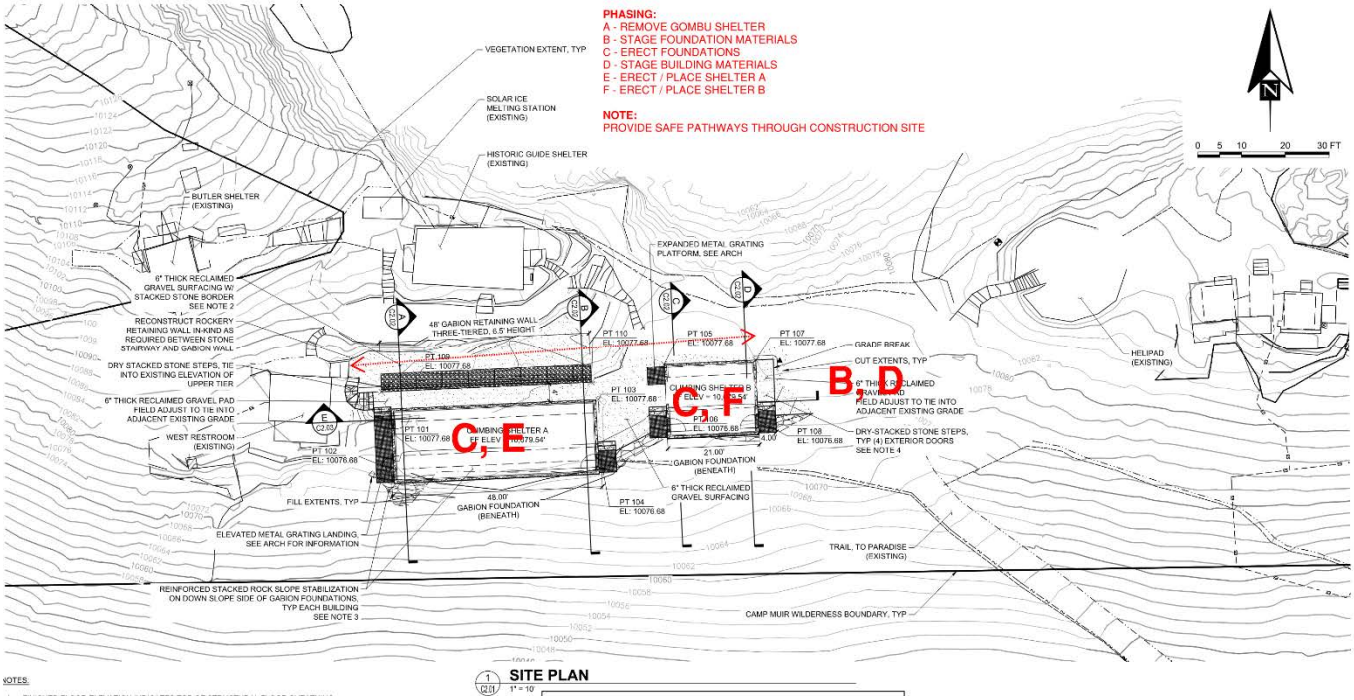
- THE OPENABLE AREA OF THE OPENINGS TO THE OUTDOORS SHALL NOT BE LESS THAN 4 PERCENT OF THE FLOOR AREA BEING VENTILATED.

CALCULATIONS:	ACTUAL		% OPEN
SHELTER A CLIENT BUNKS:	323 SF	36.48 SF / 323 SF	=11.2%
SHELTER A GUIDE BUNKS:	209 SF	8.8 SF / 209 SF	=4.2%
SHELTER A FOOD PREP:	133 SF	36.48 SF / 133 SF	= 27.4%
SHELTER B:	271 SF	70.3 SF / 271 SF	= 25.9%

DESIGN NARRATIVES: EXISTING CONDITIONS & SITE PHASING

There are multiple factors that need to be accommodated in the climbing shelter replacement project. Camp Muir will remain an active climbing camp during construction, with overlapping user groups. Some key factors to address in the final staging plan and construction procurement documents include:

- Material staging – both at helicopter lift point and at Camp Muir.
- Site access for construction activities – will need to be balanced with visitor, concessionaire and climbing activities that are occurring concurrently.
- Contractor use of site – define if self-support required or if access to existing building(s) is feasible. The Public Shelter may be a resource during construction.
- Public Shelter – Define use during construction. Visitor/Public vs Contractor.
- Demolition of Client Shelter will require concessionaire(s) to relocate operations to the glacier area. Target is maximum 1 climbing season impact.
- Sequencing of demolition.
- Contractor Work Schedule – Define allowances and approaches for extended workdays which could possibly include weekends and holidays.

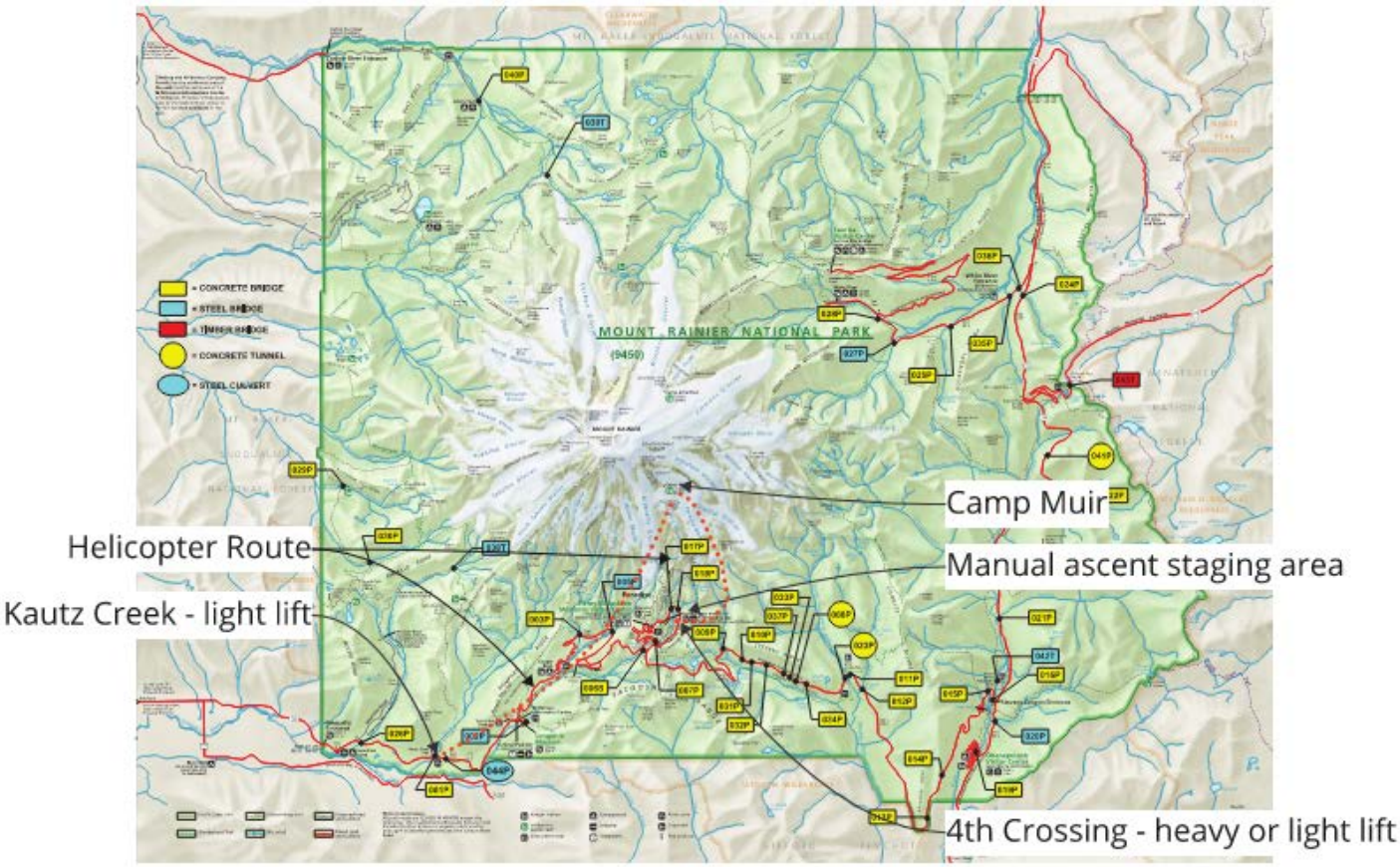


DESIGN NARRATIVES: CULTURAL RESOURCE COORDINATION

Alongside the Title II design services, NPS is developing a 2025 Minor Amendment to the Camp Muir Rehabilitation Plan to address proposed construction activities and facility design. The plan aims to: (1) preserve the historic character of the Camp Muir Historic District, (2) protect natural resources such as unstable soils, rare lichens, and downstream ecosystems, (3) enhance the visitor experience for both day and overnight users, and (4) improve safety through better waste management and reduced hazards in sleeping and cooking areas.

A major focus of the amendment is defining how materials and project support will be transported to the Camp Muir site. This includes detailed planning for the delivery of construction materials, equipment, and personnel to the remote alpine location. It is anticipated that the 4th Crossing area will serve as the primary staging site for helicopter operations, particularly for light- and medium-lift helicopters. This location has been identified based on its accessibility, minimal environmental impact, and logistical suitability for supporting aerial transport.

The graphic below illustrates the proposed flight route from the staging area to Camp Muir. These transport logistics are essential to ensuring safe, efficient, and environmentally responsible delivery of materials to support the shelter rehabilitation efforts.



General Staging Areas and Helicopter Lift Areas

DESIGN NARRATIVES: PROGRAM

SHELTER PROGRAM

- Sleeping tiers – 3 is ideal.
- Sleeping size – 3' wide / 7.5' deep / ability to sit up / store climbing gear at feet.
- Sleeping arrangement – Bunk style – head in. Avoid arrangements that could result in rolling off.
- Ventilation – accommodate cooking, humidity, smells, snow melting.
- Light – provide windows for general wayfinding / egress.
- Egress – provide multiple options and accommodate ability to egress in snow drifting or weather events.
- Storage – See Equipment Storage – Guide Operations / Client Support / Winter
- Education & Gathering – each sleeping unit requires the ability to gather for education events, rope training and group debrief by the climbing guide(s).

GENERAL PROGRAM ELEMENTS

- Aluminum ladder storage with ability to access at start of climbing season.
- Communication and electrical equipment attachment points on roof, exterior walls and interior walls. Provide sealable conduit pathways from interior to exterior to allow long-term wire management.
- Increased size of propane tanks for operations that occur on the glacier. Currently one of the concessionaire company's packs in fuel with each trip.
- Additional propane cooking fuel in an easy to manage and secure location.
- Transition areas at entries to manage tracked in snow.
- Ceiling tie off points for practicing rope work.
- Ability to address climbing group inside shelters for training and debrief.
- Kitchen operations:
    - Three primary water heating and cooking periods that align with climbing activities:
        - 7am / 5pm / 11pm – approximate 1 hour operation at each time.
- Building Code - fire life safety requirements:
    - CO & Smoke Detectors on batteries.
    - Ability to egress during heavy snow accumulation and weather events.
    - Ventilation and air quality management at cooking and sleeping areas.
    - Account for fire hazard and ability to egress and manage potential fire event.
- Solar power system:
    - Ability to accommodate solar panels and wire management with new structures. Assume systems will change and be upgraded over time.
- Water Production
    - Ability to harvest, melt and store water.

EQUIPMENT STORAGE – GUIDE OPERATIONS

- Kitchen equipment.
- Kitchen supplies / pantry.
- Personal duffel for guides.
- Hard goods & equipment – climbing gear, items stored in (3) existing job boxes, etc.
- Soft goods – sleeping pads, sleeping bags, tents, etc.
- First aid supplies
- Building Maintenance & Equipment – tools, materials and supplies. Allow for ease of storage options on interior wall surfaces.
- Wet equipment storage & drying area – ropes & crampons.

EQUIPMENT STORAGE – CLIENT SUPPORT

- Large water cooler for each sleeping unit with a shelf for placement.
- Note – shelter should be empty and operationally cleaned out when clients arrive.
- Note – clients carry personal gear with each trip. No provisions for supplying clients with personal gear required.
- Note – trash is packed out with each trip.

EQUIPMENT STORAGE – WINTER

- Weather ports (shelters used with glacier operations) stored on pallets.
- Weather port kitchen equipment.
- Hard goods & equipment – climbing equipment & items stored metal job boxes.
- General Kitchen equipment and supplies.
- Note – winter equipment storage needs to be accommodated with the ability to retrieve equipment upon arrival at the commencing of climbing season. Drifted and packed in snow can result in limited access without significant excavation or waiting for increased temperatures for melting.

DESIGN NARRATIVES: ARCHITECTURAL

CIRCULATION AND FUNCTIONS: The general layout of Climbing Shelters A and B is based on three tiers of sleeping bunks, arranged on a 7-foot grid. This configuration provides six bunks per module, with an extended double module in Shelter A to accommodate the guide area and cooking space. A circulation spine runs along one side of the shelter, with a door at each end for access. Each module features an operable window to provide views, ventilation and emergency egress functions.

ROOF SYSTEM:

- Exterior Surface
- Unistrut Rails – Attached to gabion baskets to allow for solar panel installation
- Gabion Roof Gladding – Metal wire baskets with stone infill
- EPDM Maintenance Walk Protection Pad (entire roof)
- EPDM (ethylene propylene diene monomer) roof membrane – ½” per 1’-0” slope.
- Plywood – ½”
- Nail-Laminated Timber (NLT)
- Interior Surface

WALL SYSTEM:

- Exterior Surface
- Gabion Wall Gladding – Metal wire baskets with stone infill
- Metal Cleats
- Infiltration Barrier
- Plywood – ½”
- Nail-Laminated Timber (NLT)
- Interior Surface – note, items can be attached to interior wood as required

FLOOR SYSTEM

- Interior Surface
- Plywood Flooring – Replaceable
- Plywood Sheathing – ½”
- Nail-Laminated Timber (NLT)
- Exterior Surface

INTERIOR FINISHES: The walls and ceilings would be composed of exposed NLT wood with a clear non-odor sealer. The floor would utilize a plywood flooring and can be replaced as needed.

DOORS: The doors would be constructed as an exterior and interior layer of wood tongue and groove adhered to a plywood core with solid timber frames.

WINDOWS: The windows would be composed of extruded aluminum frames with laminated glass.

DAYLIGHT: The windows are arranged to provide a distributed level of lighting throughout the climbing shelters that comply with IBC requirements for occupied spaces.

NATURAL VENTILATION: Operable windows, floor vents, and the louvers above the exterior doors allow for natural ventilation in sleeping and cooking areas.

DESIGN NARRATIVES: GEOTECHNICAL & CIVIL

GEOTECHNICAL: The geotechnical report reveals that Camp Muir's ground is essentially a gravel glacier. This unstable site condition is subject to continuous change due to erosion, shifting snow patterns, glaciation, and permafrost. This is a primary factor in the selection of the foundation system and how the shelters are placed on the site. Foundation choice is based on a concept of changing conditions, a concept of evolving alongside the changing environment rather than trying to fight them.

GABION RETAINING WALLS: A Retaining wall constructed from galvanized wire gabion basket units will be constructed adjacent to proposed Climbing Shelter A to retain fill of the terrace above and maintain historical circulation and access on the north side of the shelter. The top basket unit of the gabion wall will also be infilled with reclaimed gravel from site excavations to provide a walkable surface on the terrace above the wall. The reclaimed gravel fill will be retained over the gabion rock with a combination of a layer of geotextile separation fabric and geogrid cellular paver matting. Cellular paver matting will be enclosed within the gabion to prevent tear out of the geotextile fabric underneath due to recurring wind events. The cellular paver units are rigid and of larger unit size than the gabion basket mesh opening size to "lock-in" the matting and geotextile within the gabion baskets. Both the geotextile fabric and cellular paver matting will be cutback short of the gabion basket exposed faces and will not be visible through the basket or rock. Shelter B does not require a retaining wall. The retaining wall will be keyed into the existing ground with a total exposed wall height of 6.5 feet. The proposed wall is a gravity wall system which does not require geotextile tie-back reinforcement and additional excavation.

EXCAVATION AND EARTHWORK: The proposed climbing shelter structures and gabion retaining wall will require a moderate amount of overburden excavation to get down to the more stable permafrost layer, likely beyond what is feasible by hand digging labor methods. It is anticipated that a mini-excavator that will be mobilized to the site with a medium-lift helicopter flight to perform necessary excavation for gabion foundation trenches and backwall cuts. Aggregate materials from excavation cuts will be repurposed as fill for to construct proposed gravel walkway tie-ins. Additionally, a mini-excavator unit will provide lifting capabilities for other structural and architectural materials.

Foundation and retaining wall subgrades, as well as fill materials for gravel walkways, can be conducted by small plate compactors or "jumping jack" compactors which can be mobilized with light or medium-lift helicopter flights.

MISCELLANEOUS SITEWORK: Stacked rocks reclaimed from the site work will be stacked, reinforced, and retained at the down-slope side of the southern gabion foundations at each shelter. The southern side slopes of the gabion foundations will be stabilized in order to limit the foundation reveal height above finished grade, as well as mitigate erosion of aggregates due to wind scour. Reinforcement of the stacked rocks will provide by a combination of a driven rebar grid to aid construction of the stacked rock slope, use of injection grout to bond stacked stone into a single mass, and steel rock mesh secured with rock bolts to retain the reinforced stone mass. All steel rebar, wire mesh, and rock bolts will be uncoated bare steel and left to rust for aesthetic purposes.

Dry-stacked stone stairs sourced from the site work will be provided at each of the four exterior doors and landings. Reconnection of the walkway on north side of Climbing Shelter A will be reestablished with dry-stacked stone stairway.

DESIGN NARRATIVES: STRUCTURAL

The Muir Climber's Shelter, located at 10,188 feet on Mount Rainier, is designed to provide a safe and resilient refuge for climbers in an extreme alpine environment. Situated on a semi-active volcano, the site presents unique challenges, including high seismic activity, unpredictable winds, and exceptionally heavy snow loads due to its proximity to glaciers. This structural narrative outlines the design approach to ensure the shelter's durability, safety, and compatibility with the harsh conditions of Mount Rainier, in alignment with the National Park Service's mission to preserve natural resources while supporting visitor safety.

DESIGN LOADS: The shelter's structural design is informed by the ASCE 7-22 Hazard Tool, tailored to the site's extreme conditions:

- Wind Speed: 105 mph (1,700-year MRI, 3% recurrence in 50 years). Note: Additional meteorological data is being sought to account for mountainous terrain effects.
- Seismic Parameters:
    - Ss: 1.15, S1: 0.33
    - Sms: 1.28, Sm1: 0.46
    - Sds: 0.85, Sd1: 0.31
- Seismic Design Category: D
- Snow Load: Ground snow load (pg) of 1,013 lb/ft² (2,500-year MRI, 2% recurrence in 50 years). Discussions with NPS have settled on an 800 psf snow load for roof snow load.

STRUCTURAL COMPOSITION: The shelter is constructed using modularized Nail-Laminated Timber (NLT) components, selected for their strength, sustainability, and adaptability to the site's logistical constraints. The design prioritizes modularity to facilitate construction in this remote, high-altitude environment while meeting the NPS's emphasis on environmentally sensitive materials.

GENERAL: The shelter comprises 7-foot-wide NLT modules made from 2x6 Douglas Fir (#1 or better), laminated flatwise. This modular system optimizes structural integrity and simplifies transportation and assembly at the site.

ROOF: The roof is designed to withstand extreme snow loads, utilizing continuous 2x6 NLT panels supported by a central wood ridge beam. The beam is by wood columns spaced at 7-foot intervals, aligning with the NLT module width. Roof panel seams are connected with a continuous 3/8"x6" steel flat bar, secured with ¼" self-drilling screws at 24" on center, ensuring robust load transfer.

FLOOR: The floor system consists of 2x6 NLT panels supported by steel floor beams that span the shelter's width, bearing on steel plates (shimmed as needed). Steel angles stabilize the beams and provide positive support for the walls and floor. Floor panel seams are joined with a 3/8"x6" steel flat bar, screwed at 24" intervals. Additionally, 3/4" diameter thru-bolts, will attach the structure to the foundation beams on one side of the beam at each end. The bolt will attach through the top flange of the beam, through the floor panel and through the steel edge angle attachment between the wall and floor panel system. This will reduce field effort while still provide a strong connection to the foundation.

STAIR LANDINGS: Metal grate stair landings are provided for safe access to the exterior doors and provide a secure landing for the dry stacked stone stairs. Grating is supported on all sides by edge angles that

attach to the cantilevered angles that frame into the edge beam at one end of the structure. A steel pipe railing provides fall protection at exposed edges. The cantilevered angles will also provide primary support for the propane tank storage bins.

WALLS: Walls are constructed from 2x6 NLT panels, maintaining the 7-foot modular width. Wall and roof seams are connected using the same steel plate and screw system as the roof, ensuring consistency and structural continuity. Walls, roof and floor are sheathed with ½" structural sheathing for lateral load resistance.

FOUNDATION: The foundation is designed to anchor the shelter securely to the permafrost layer, critical for stability in this seismically active region. Steel floor beams are bolted to embedment assemblies, each consisting of a steel pipe welded to top and bottom plates. These assemblies are anchored to a 3-foot-wide rock-filled gabion strip footing, embedded 42" +/- into the permafrost, providing robust resistance to seismic and frost-related forces.

EXTERIOR FINISHING: To enhance durability and blend with the natural environment, the walls and roof are clad with a 6" thick gabion fascia. The gabion facia is formed from wire mesh panels surrounded by steel angle. Mesh is welded to the angles to form semi-rigid components arranged to accommodate building module size, window and door locations and other openings as required. This fascia is supported vertically by the steel beams at the foundation and secured against seismic load via attachment of the angles to the NLT walls. offering protection against weathering and contributing to the shelter's aesthetic integration with Mount Rainier's landscape.

STRUCTURAL CONCLUSION: The Muir Climber's Shelter is engineered to withstand the extreme environmental conditions of Mount Rainier, including heavy snow, high winds, and seismic activity. The use of modular NLT construction, combined with robust steel components and a permafrost-anchored foundation, ensures long-term safety and reliability for climbers. The design reflects a commitment to environmental stewardship, aligning with the National Park Service's goals of preserving natural landscapes while providing critical infrastructure for visitor safety.

DESIGN NARRATIVES: ELECTRICAL

GENERAL: Electrical system equipment, devices, and installation methods will be designed and specified in accordance with applicable Codes and Standards including the latest edition of the National Park Service Design Standards.

PHOTOVOLTAIC SYSTEM: A concessionaire provided photovoltaic (PV) system will be the sole power source for the shelters. It may include roof-mounted solar panels, an inverter, and a battery energy storage system (BESS).

The BESS energy capacity of the concessionaire provided system is assumed to be less than the threshold capacity listed in IFC 1207. Note that systems with energy capacity over the threshold must meet the requirements of IFC 1207 which does not allow for installation of batteries in sleeping units. In addition, NFPA 855 does not allow for the installation of a BESS of any size in sleeping units. NFPA 855 is a reference standard and not a legally required code, however it is best practice to comply with applicable reference standards.

The anticipated conduit pathway for the PV system will include three 2-inch conduits between the inverter location and the roof. Conduits stubbed to the roof will have weather head fittings to prevent ingress of water from wind driven rain and snow. We anticipate that one conduit will serve the initial photovoltaic system and two conduits will be left spare for future expansion.

Unistrut mounting structures will be attached to the roof to provide attachment points for the PV panels. This standard attachment system will provide flexibility for future adjustments in panel quantity or layout.

CONDUIT SYSTEM FOR FUTURE INTERCONNECTION: An underground conduit between the two shelters will provide a pathway for future interconnection of the shelters. A short length of extreme temperature liquid tight flexible metallic conduit will be provided where the conduit enters each shelter to allow for differential ground movement. Additional conduits will be stubbed out below the shelters and capped for future interconnection of other campus shelters. Conduits will be galvanized steel rigid metal conduit (RMC) except where noted otherwise.

LIGHTING: Natural lighting complying with IBC 1204.2 will provide code required lighting within the shelters. Based on the size and occupancy of the shelters, emergency egress lighting is not required per IBC 1008. Artificial lighting may be provided by the concessionaire for occupant convenience and will be connected to the concessionaire provided photovoltaic system.

Low Voltage Systems and Instrumentation: Conduit pathway will be provided for future low voltage systems and instrumentation. NPS and/or the climbing concessionaire will install these systems after the construction is complete. Low voltage systems conduits in each shelter will include two 1-inch conduits stubbed to the roof and two 1-inch conduits stubbed to the underside of the shelter.

Conduits stubbed to the roof will have weather head fittings to prevent ingress of water from wind driven rain and snow. Conduits stubbed to the underside of the shelter will be capped.

A UL 217 listed, battery powered, wirelessly interconnected multi-station, smoke alarm system will be provided as required by IFC 907.2.11. The detectors will be dual sensing with both smoke and CO sensors.

LIGHTNING PROTECTION: A lightning risk assessment for the shelters performed in accordance with NFPA 780 Annex L indicates that lightning protection is recommended due to the remote location and difficulty of evacuating occupants. A lightning protection system will be performance specified for both shelters to meet the requirements of UL 96A and NFPA 780.

DESIGN NARRATIVES: HAZMAT

Given the age of the existing climbing shelters at Camp Muir, it is anticipated that hazardous materials, such as lead-based paint, asbestos-containing materials, or other environmental hazards, may be present. Based on current testing, no lead-based paint has been identified. Testing results for asbestos is still in process.

As results become available, the design narrative will be updated accordingly to reflect any necessary mitigation measures, abatement procedures, or changes in construction planning. This proactive approach ensures that all demolition rehabilitation activities are carried out in compliance with environmental and safety regulations, protecting both workers and visitors during the project.

APPENDIX A: PROJECT SCHEDULE

The overall project schedule is influenced by several critical factors, including the Environmental Assessment Review and the timely procurement of construction services to align with the 2026 construction season. Additional considerations include helicopter availability during fire season, pre-fabrication timelines that precede site mobilization, and contingency planning for early or late-season weather events that could potentially compress the overall site timeline.