UW Tacoma
Milgard Hall

Project Definition Report
4 December 2020

ANDERSEN CONSTRUCTION
ARCHITECTURE RESEARCH OFFICE

5601 6th Ave S, Suite 550, Seattle, WA 98107 t 206.763.6712 f 206.763.6710 www.andersen-const.com
170 Varick Street 7th floor, New York, NY 10013 t 212.675.1870 f 212.675.1645 www.aro.net

Project Team

Owner:
University of Washington, Tacoma

Design-Builder:
Andersen Construction

Architect:
Architecture Research Office

Geotechnical/Environmental Engineer:
GeoEngineers

Civil Engineer:
AHBL

Structural Engineer:
KPFF

MEP Engineer:
PAE Engineers (Mechanical/Electrical)
Burman Design (Plumbing)
Auburn Mechanical (M/P Trade Partner)
McKinstry (Electrical Trade Partner)

Sustainability/LEED:
Lensa Consulting

Project Executive Committee (PEC):
Dr. Mark Pagano, UWT Chancellor
Dr. Altaf Merchant, Interim Gary E. & James A. Milgard Endowed Dean
Dr. Divya McMillin, Associate Vice Chancellor for Innovation & Global Engagement
Dr. Rajendra Katti, Dean School of Engineering & Technology (SET)
Stanley Joshua, UWT Director, Facilities Services
Michael McCormick, UW AVP Asset Management/University Architect
Steve Tatge, UW Executive Director, Project Delivery Group
Ben Mauk, UWT Associate Director of Capital Projects & Retail Operations
Joshua Knudson, UWT Vice Chancellor for Advancement
Cal Bamford, Advisory Member
Shannon Thompson, UWT Project Manager
Jennifer Myers, UWT Construction Manager

Project Management Team (PMT):
University of Washington
Andersen Construction
Architecture Research Office

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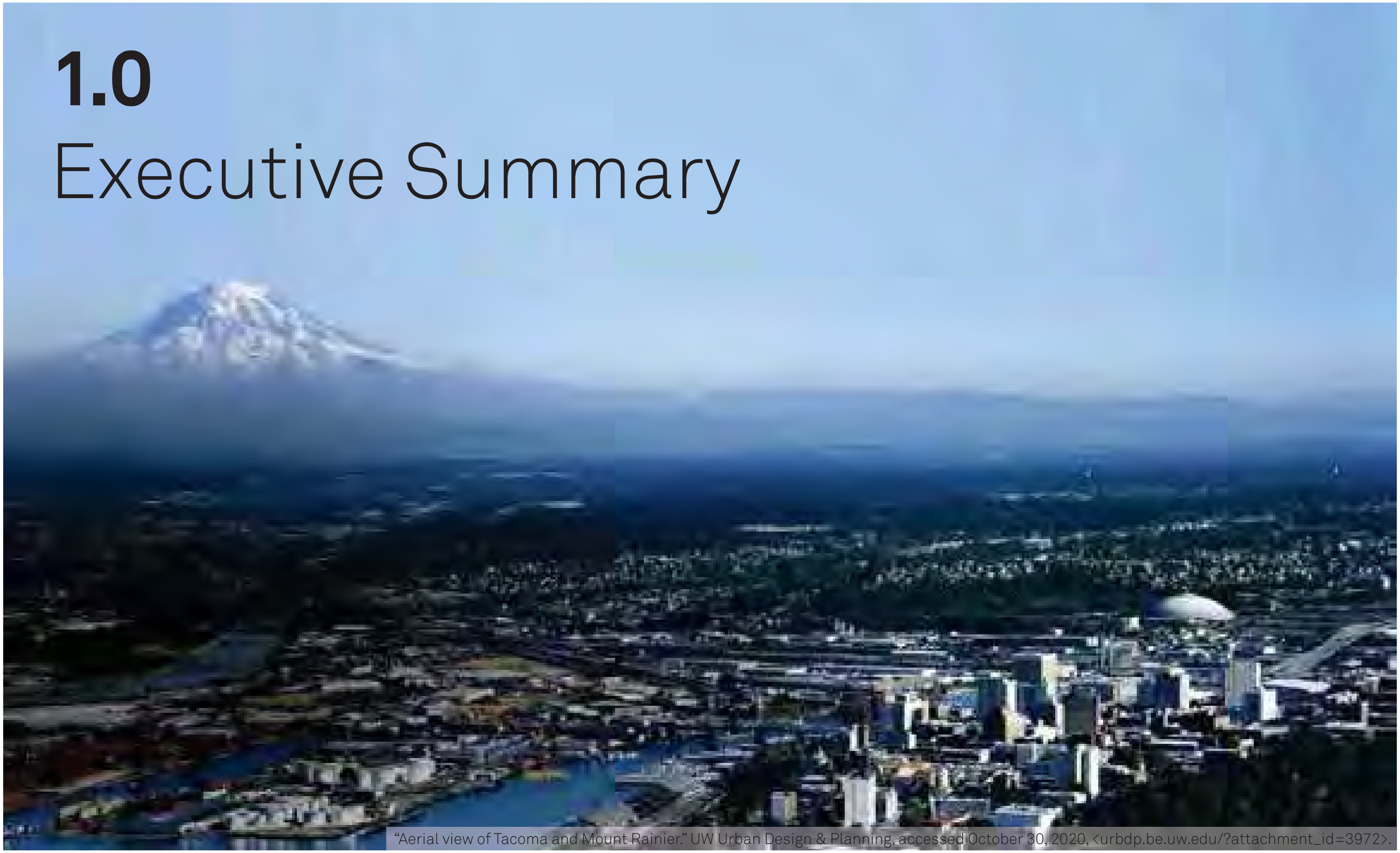


“Aerial view of Tacoma and Mount Rainier.” UW Urban Design & Planning, accessed October 30, 2020, <urbdp.be.uw.edu/?attachment_id=3972>.

1.0
Executive Summary

This document outlines the process and findings of a Project Definition phase conducted between April 2020 and October 2020 for the design of a new academic building, Milgard Hall, for the University of Washington Tacoma. Through site analysis, program studies, and benchmarks, it identifies standards and criteria for design, construction, and performance.

The 2018 Predesign Report prepared by the UW Office of Capital Planning and Development served as an initial reference for the beginning of the Project Definition phase. It identified a project site on campus and demonstrated the need for additional campus space and facilities, in particular additional labs and support spaces for new engineering programs and new classroom and collaboration spaces for the business school. The 2008 Campus Master Plan, 2015 Campus Implementation Plan, and the 2017 UWT Campus Mobility Master Plan also served as useful resources for developing background information as well as a project vision that aligned with wider University goals.

The updated program for Milgard Hall includes the Milgard School of Business (MSB), the Global Innovation and Design Lab (GID Lab), and the School of Engineering and Technology (SET). It also includes shared classrooms, a computer lab, and shared collaborative spaces. These spaces will enable interaction between the different academic programs, as well as the wider Tacoma community. The budget for this building is $35.5 million in design-build costs, $50.5 million total, which was used to inform the Target Value Design (TVD) exercise conducted during the Project Definition phase and which is detailed in this report. The TVD analysis shows that this budget will allow for a building of approximately 55,000 GSF, which exceeds the square footage projected in the Predesign Report by 5,000 SF.

This document also includes an analysis of the selected site for the new building. UWT requested that the team consider the Cragle Lot. The university and design-build team agreed that Cragle is the preferred site for a number of reasons, namely that it reinforces the academic block as shown in the 2020 Campus Development Plan. Through a process of Choosing by Advantages, the Cragle Lot site adjacent to the Snoqualmie Building and along South C Street was selected over the site originally presented in the Predesign Report. Its adjacency to the Prairie Line Trail, connectivity to campus, and site prominence were contributing factors. It was approved by the UWT Board of Regents in October 2020.

The following Project Goals section outlines the overall vision for the new building.

2.0
Project Goals

Aerial view of UW Tacoma campus. UW Tacoma Admissions, accessed October 30, 2020, <www.tacoma.uw.edu/admissions/visit>.

2.0
Project Goals

Innovate

- **Promote interdisciplinary innovation** through the creation of teaching and convening spaces that leverage existing industry and nonprofit partnerships and engage the Tacoma community.
- **Encourage Design Thinking** by promoting interactions between faculty, staff, students, and the community.
- Plan for expanding academic programs by incorporating design and building strategies that will **maximize value and enable efficient future growth**.

Educate

- **Provide a flexible environment** that will support evolving modes of teaching, learning, and collaboration throughout the building's lifetime.
- **Integrate ambitious sustainable strategies** through mass timber and energy efficient construction that demonstrate environmentally responsible design to students and faculty.

Engage

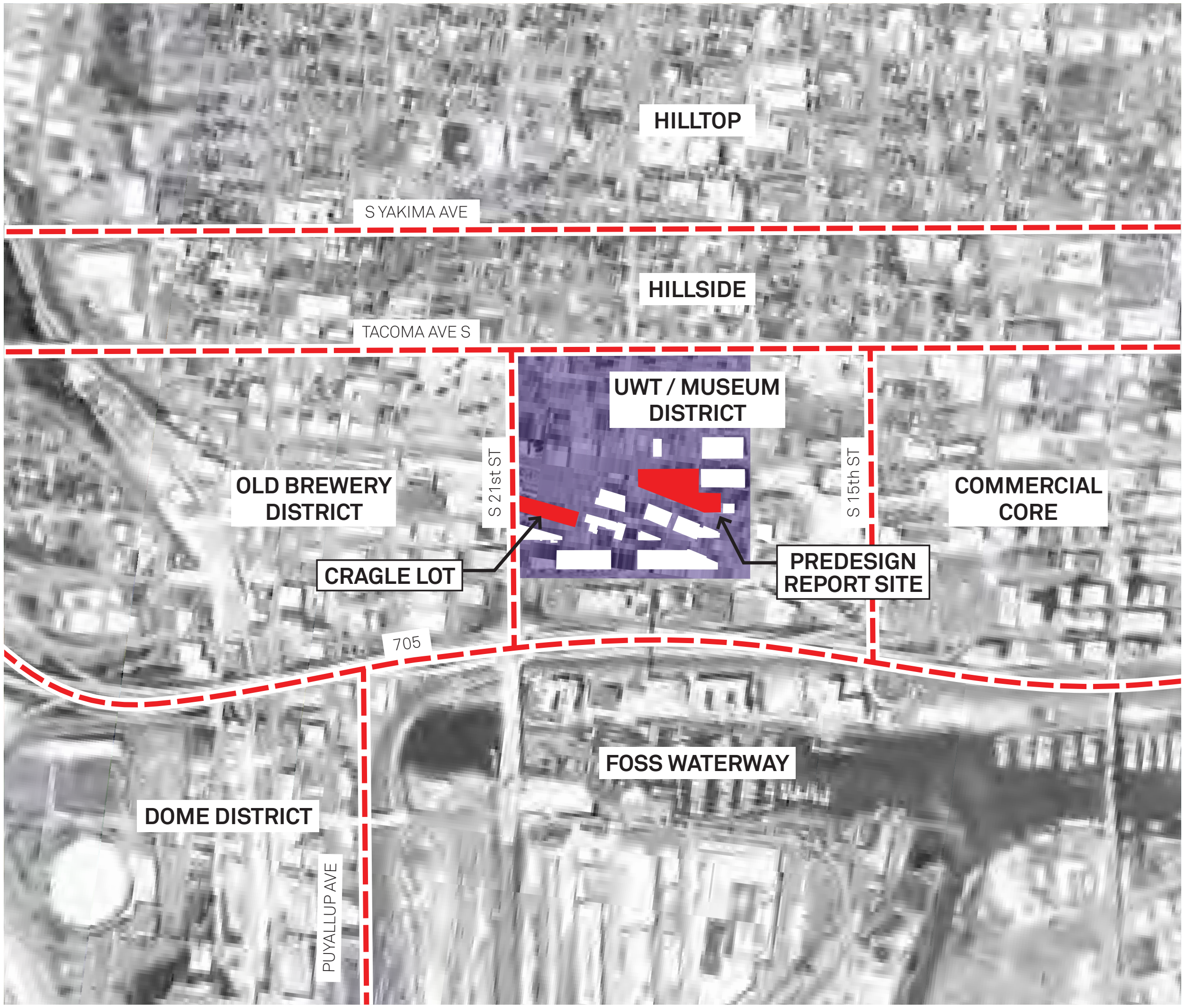
- **Establish a student-oriented hub** at the south end of campus that contributes to the academic core and reinforces the Prairie Line Trail.
- **Create a welcoming building** that engages the community, relates to Tacoma's rich history of timber and speaks to the future.

3.0
Site Analysis

3.0
Site Analysis

3.1 Campus Analysis
3.2 Site History
3.3 Soil and Groundwater Conditions
3.4 Site Improvements
3.5 Utilities
3.6 Constructability

3.1 Campus Analysis UW Tacoma Campus Context



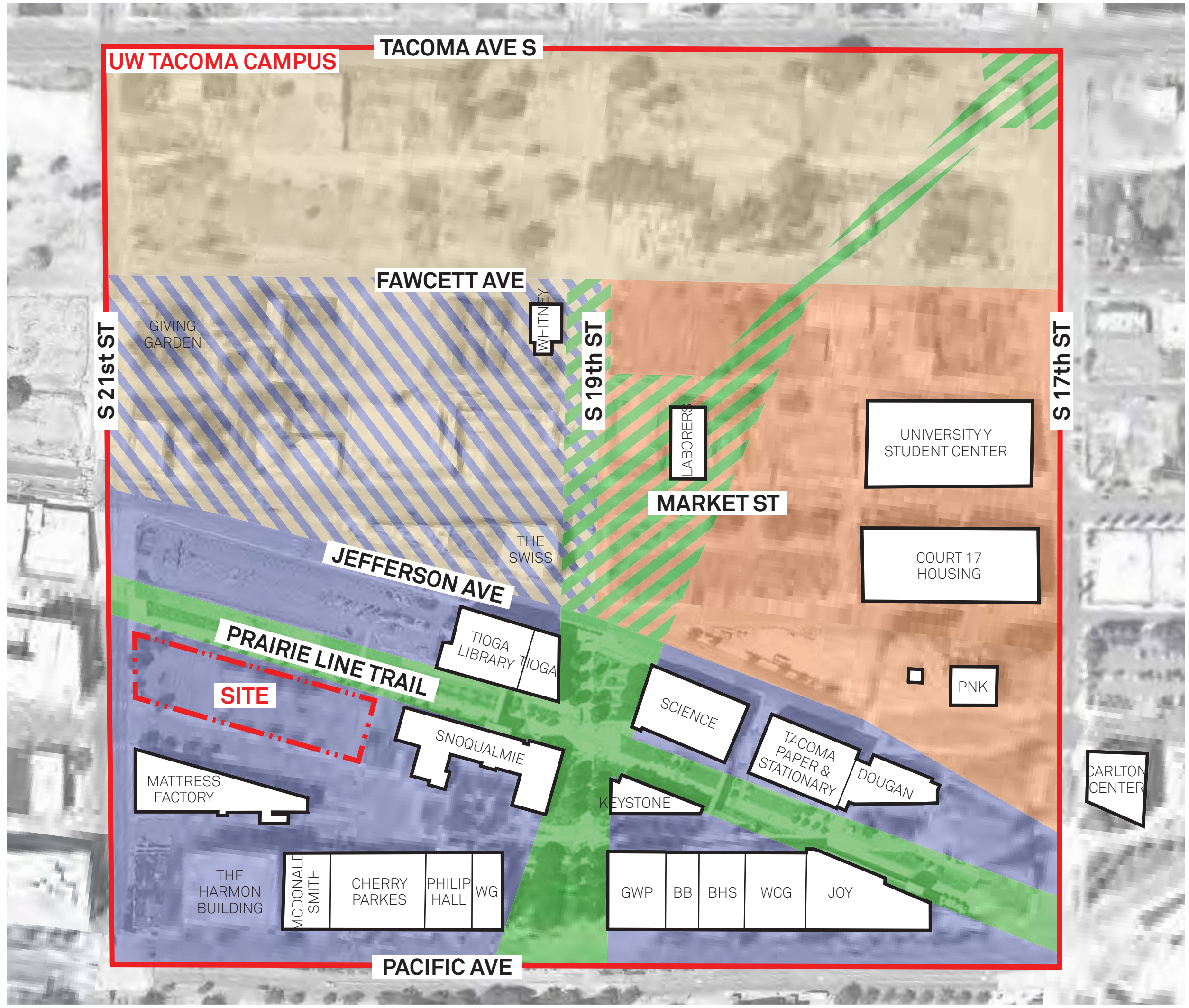
The UW Tacoma campus is located on a 46-acre site overlooking the Port of Tacoma with Mount Rainier beyond, adjacent to museums and Union Station. Its position on the southern edge of downtown Tacoma connects the University to the surrounding community, attractions, businesses, shops, parks, and historic architecture.

Campus Development Plan

- Academic expansion
- Focus areas for housing / student life
- Partnership exploration
- Academic or partnership exploration
- Current Green Spaces
- Campus Development Plan Green Space Expansion

The UW Tacoma campus extends from Pacific Avenue and covers the blocks between S 21st St and S 17th St up to Tacoma Ave S to the west.

The new building site is positioned within the academic expansion zone established by the 2020 Campus Development Plan. Milgard Hall will reinforce the southern edge of the academic core of the campus and connect to existing campus green spaces, including the Prairie Line Trail.

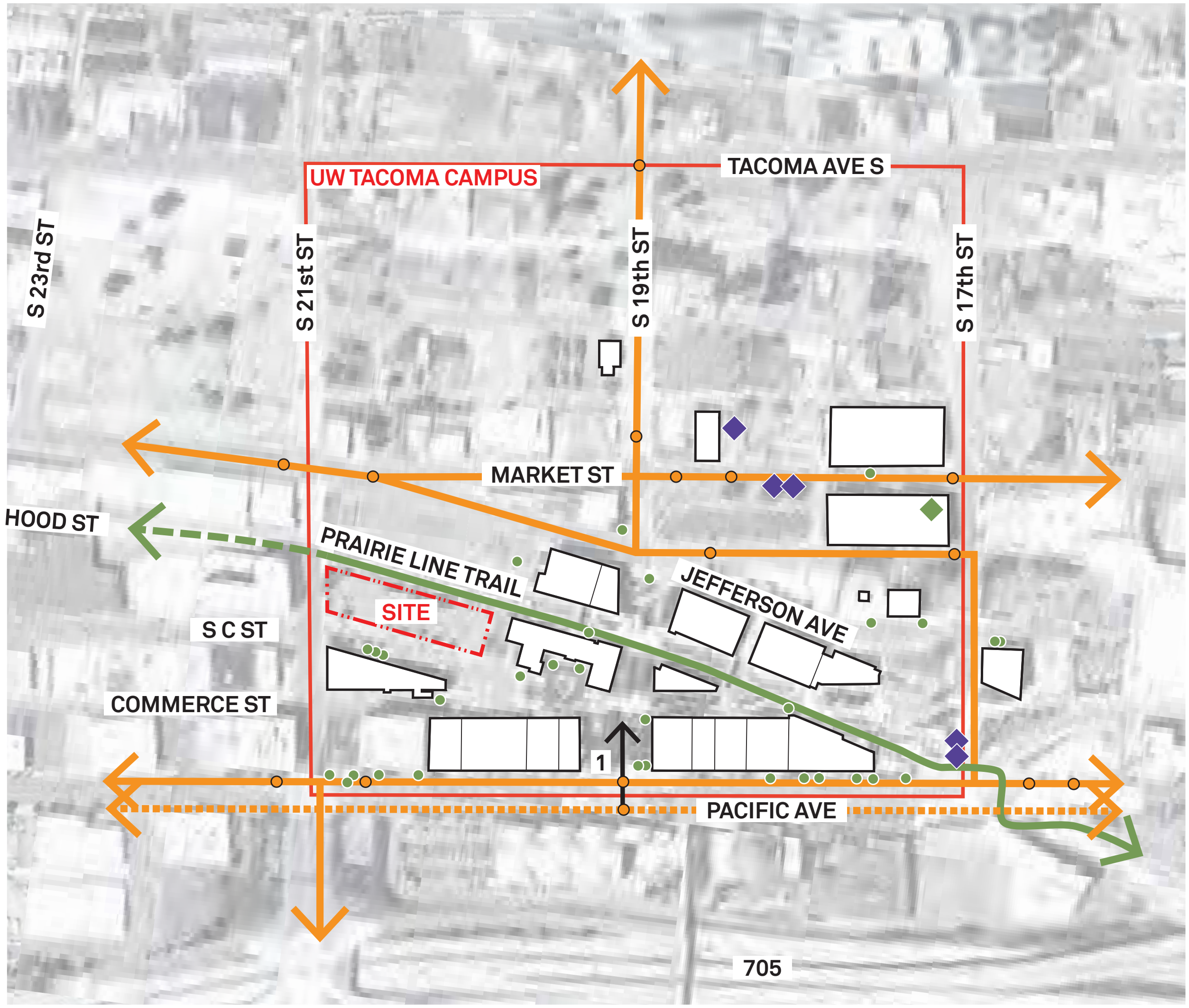


Source: UWT 2020 Campus Development Plan

Mobility - Public Transit and Bike Routes

1. Union Station

- Car Sharing
- Bus Route
- Light Rail
- Bus / Light Rail Stop
- Bike Routes
- Bike Rack
- Bike Storage



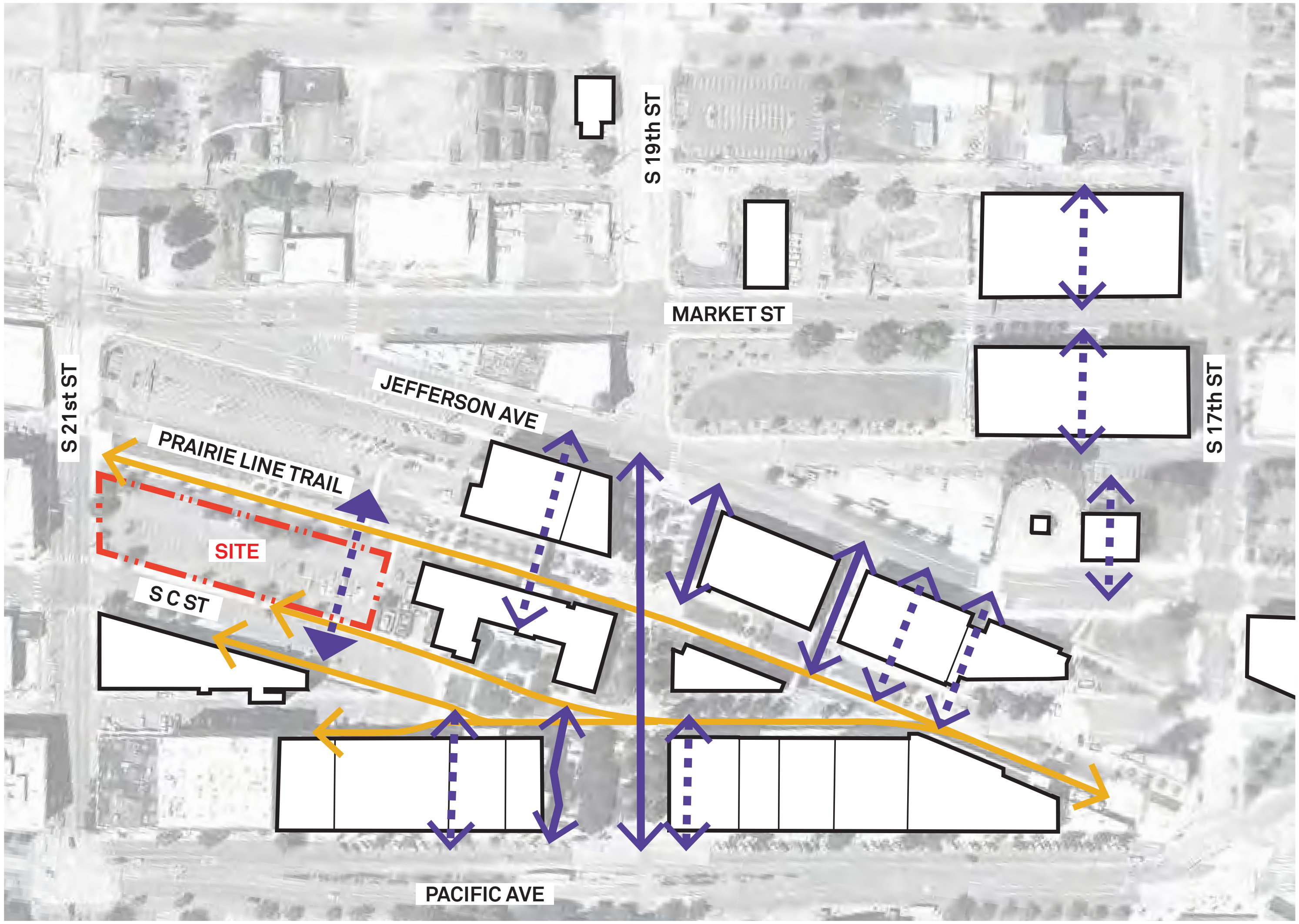
Mapping the campus access points via different methods of transportation shows that the site for the new Milgard Hall is adjacent to car and bike routes and a short walk from bus and light rail stops.

Proposed Campus Circulation

Vertical Campus Movement (Exterior)

Vertical Campus Movement (Interior)

Flat / Horizontal Campus Movement



The campus slopes dramatically upward from Pacific Avenue to Market Street, with a lesser slope in the north-south direction. Circulation through the new building will aim to maintain an east-west connection, as occurs in other buildings on campus promoting campus accessibility.

Site Constraints

Existing conditions on the new building site include an historic coal bunker on the west side, transformers in the southwest corner, and a trash compactor area, loading dock, and weather station to the north. The new building will eliminate some of the existing parking spaces in the Cragle Lot, though ADA spaces will be included in the redesigned parking lot to supplement the nearby stalls on S C Street.

1 Transformers

2 Coal Bunker

3 Snoqualmie Trash Compactor

4 Snoqualmie Loading Dock

Zoning Framework

DMU: Downtown Mixed-Use
Design Guidelines:

1. FAR - 2.00 as-of-right, **4.00 with design standards**, 6.00 with TDR

CONS: Conservation District
Union Depot / Warehouse District
Key Design Guidelines:

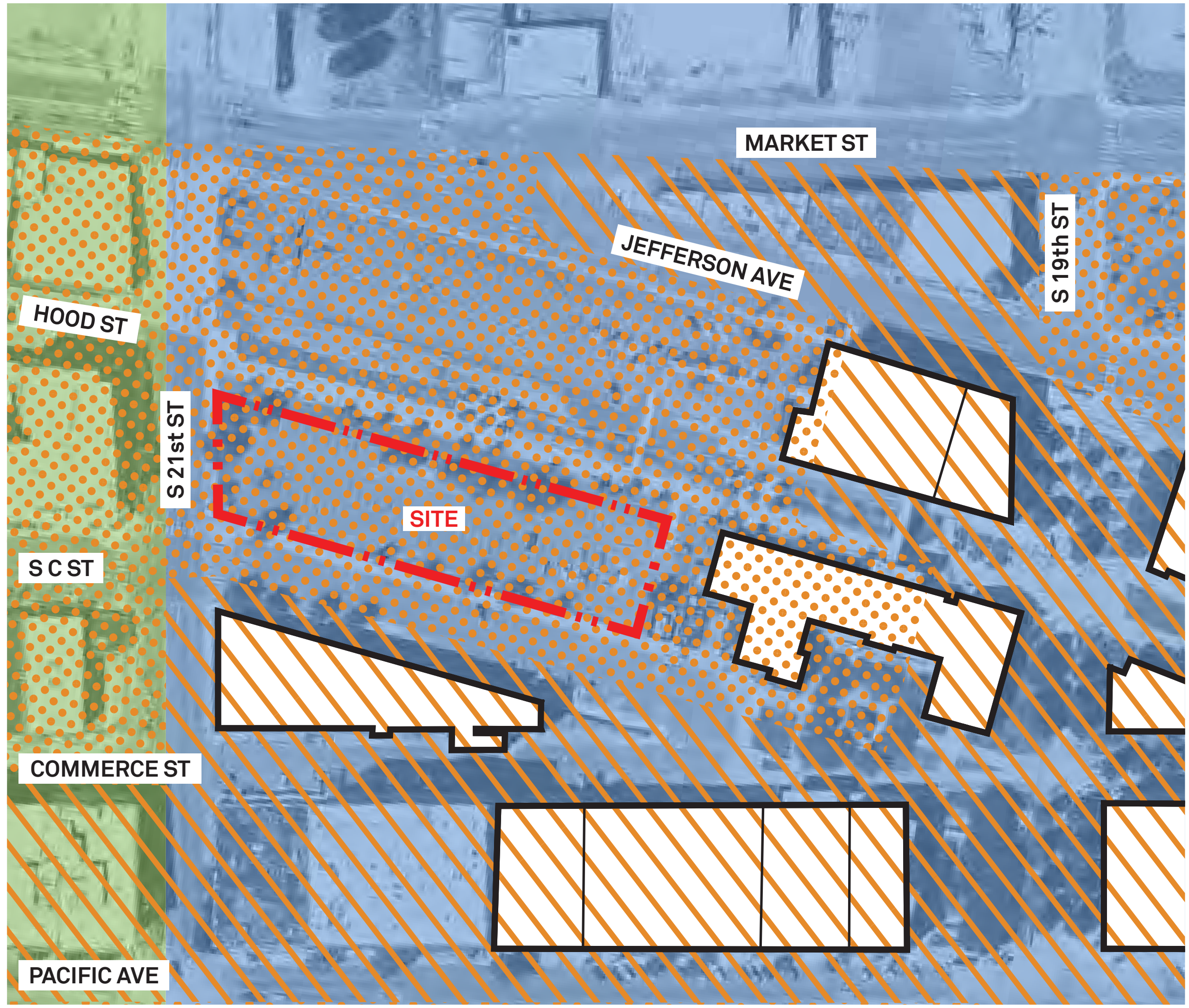
1. Height - **85 FT** maximum
2. Scale - Exterior building facades shall be of a **scale compatible** with surrounding buildings and no screening should be used for mechanical equipment
3. Materials - Predominantly **masonry** (brick, granite, terra cotta)
4. Color - Should contribute to **district character** and be **limited in palette**

DMU: Downtown Mixed-Use

WR: Warehouse/Residential

CONS: Conservation District Overlay

HIST: Historical Overlay



Source: Tacoma Landmarks Preservation Commission - Union Depot Guidelines-2018

3.2 Site History Tacoma - Historic Warehouse District - Along the Prairie Line

Present

1920s

Looking South down Commerce at the Prairie Line Crossing

Looking South across 19th Street crossing with Snoqualmie Falls Powerhouse on right

The new building site sits along the Prairie Line Trail, a linear green space that redeveloped a portion of the old decommissioned Prairie Rail Line railroad spur that ran through the City of Tacoma.

Historical photographs from “Prairie Line Terminal Section - Catalog of Character-Defining Features, Part 7.” <https://www.tacoma.uw.edu/finance-administration/history-prairie-line>.

UW Tacoma - Along the Prairie Line

Present

1920s

Looking North over the 21st Street crossing on the Prairie Line

Intersection of the Prairie Line and 19th Street looking North

Adjacency to the Prairie Line Trail presents a unique opportunity to connect the new building and the University with its surrounding context and history.

Historical photographs from “Prairie Line Terminal Section - Catalog of Character-Defining Features, Part 7.” <https://www.tacoma.uw.edu/finance-administration/history-prairie-line>.

Site - Existing Foundation

Legend

N.T.S.

- 1885 shows up on Sanborn Map
- 1888 shows up on Sanborn Map
- 1896 shows up on Sanborn Map
- 1912 shows up on Sanborn Map
- 1912-50 shows up on Sanborn Map
- Extant Railway
- 1885 shows up on Sanborn Map
- 1888 shows up on Sanborn Map
- 1896 shows up on Sanborn Map
- 1912 shows up on Sanborn Map
- 1912-50 shows up on Sanborn Map

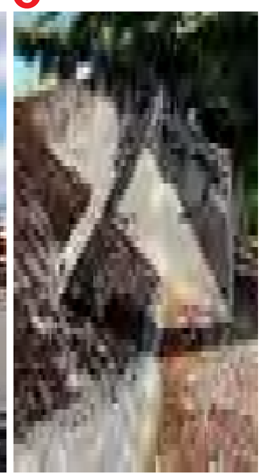
Historic photographs reveal that an existing foundation on the site is from the remnants of an old coal bunker that used to occupy the lot.

Present

1

2

3



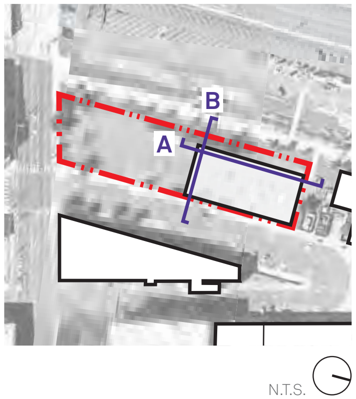
1920s

1

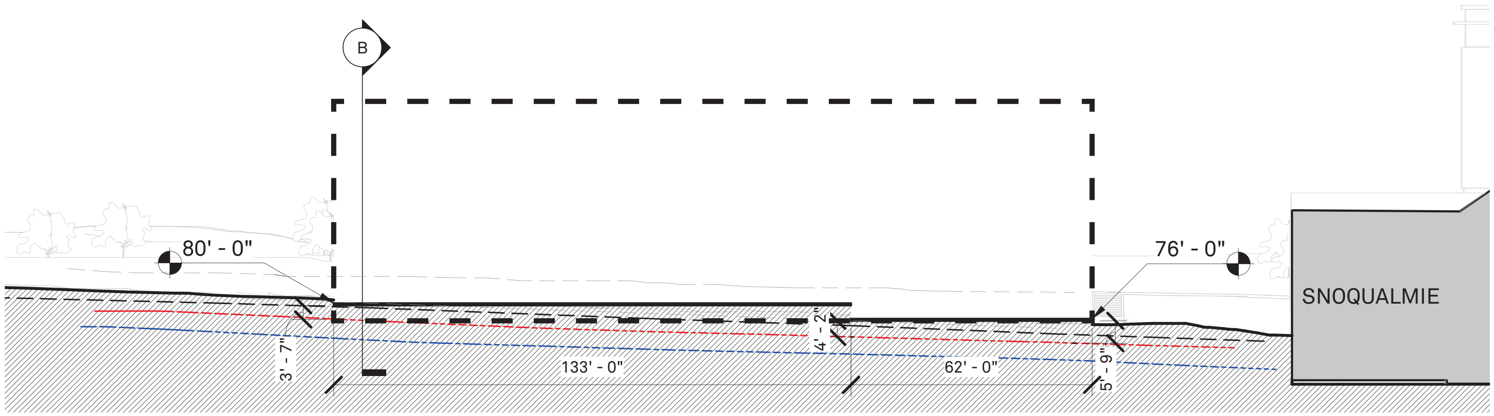
3

Historical photograph and map from "Prairie Line Terminal Section - Catalog of Character-Defining Features, Part 5." <https://www.tacoma.uw.edu/finance-administration/history-prairie-line>.

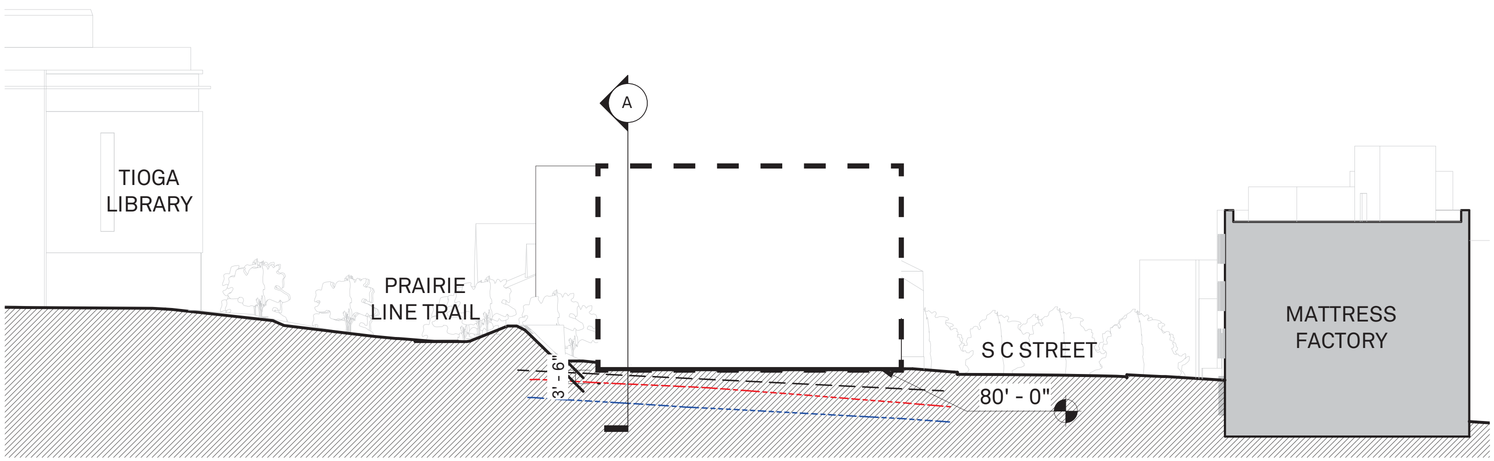
Groundwater Section



Site sections show the maximum and minimum groundwater levels in relation to the potential position of a 3-story building. The groundwater generally follows the slope of the land with the site's high point to the southwest. The building's ground floor will maintain a 3'-0" vertical offset between the slab and the maximum groundwater line. Maintaining this offset avoids groundwater infiltration and mitigates the need to add a vapor mitigation system or below slab drainage system. Refer to Appendix A.6 Geotechnical Supplement for groundwater intrusion mitigation alternatives.



A - North-South Section: Stepped Foundation

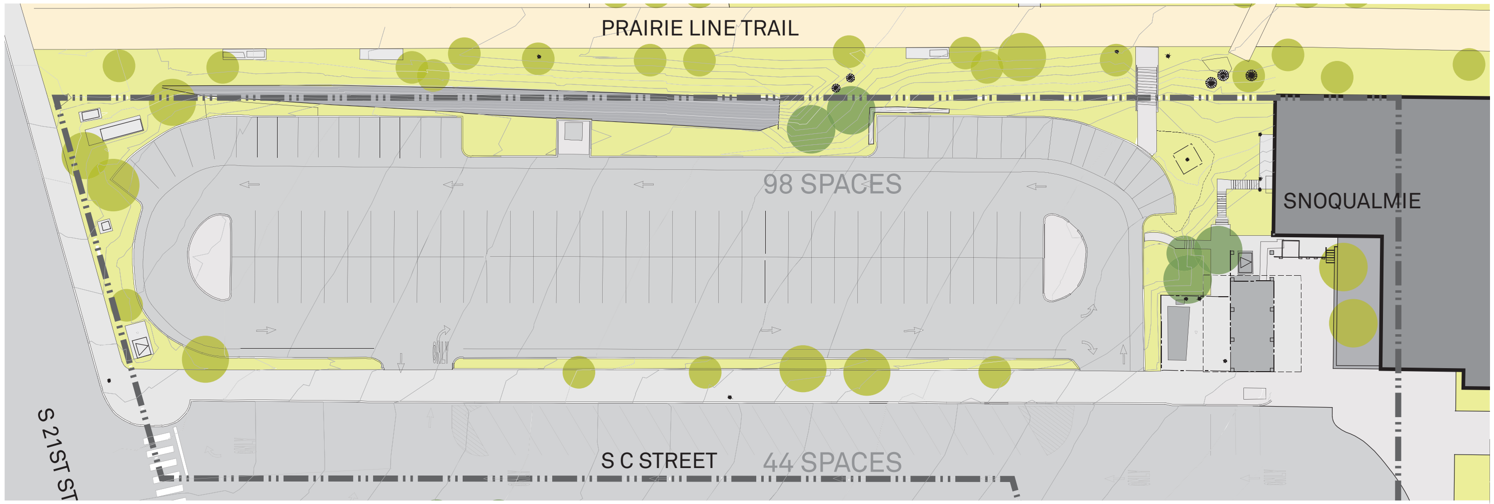


B - East-West Section: Stepped Foundation

– – – – 3'-0" Vertical Offset from High   – – – Groundwater Line (High)   – – – Groundwater Line (Low)

3.4 Site Improvements

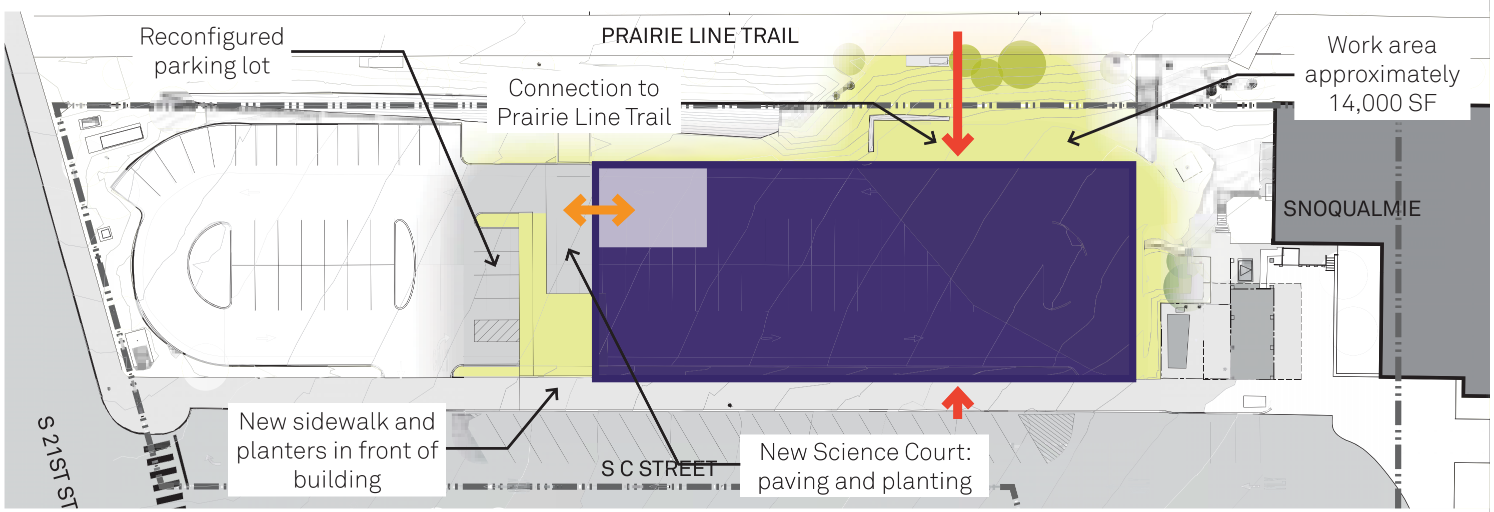
The existing conditions include parking on the site and adjacent parking along S C Street.



Primary Building Entrance

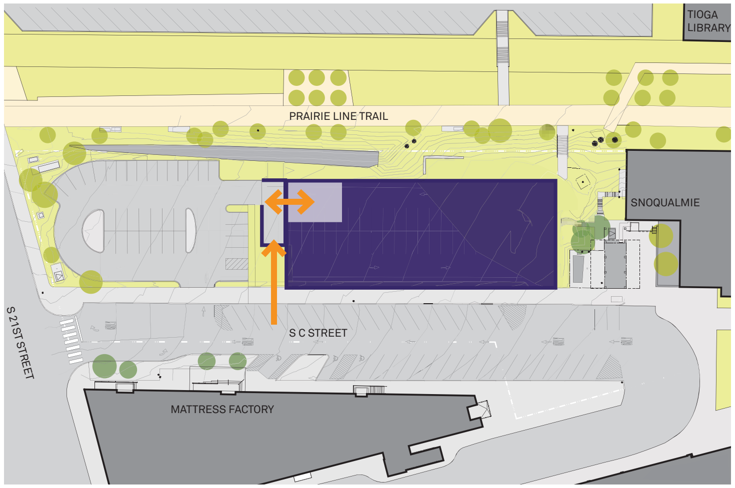
Science Court Connection

Several improvements to the site will enhance the approach and landscaping around the new Milgard Hall. A new science court and the connection between the Prairie Line Trail and South C Street will activate and extend the academic core of campus.

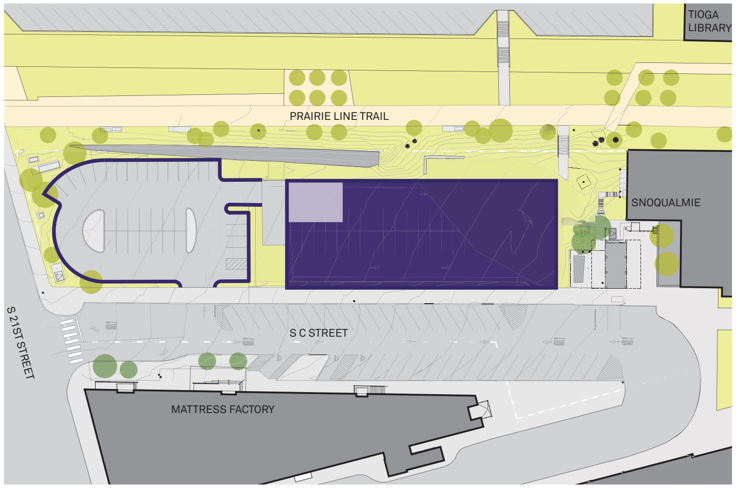


Site Strategies

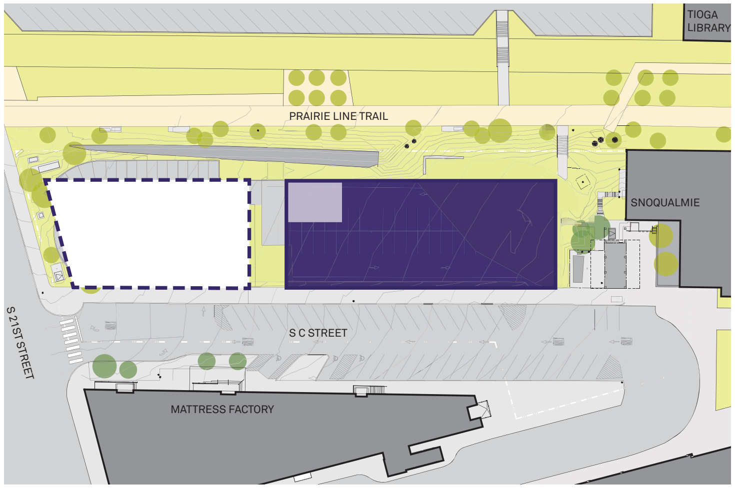
1. Create a Science Court



2. Maximize Parking



3. Allow for Future Development

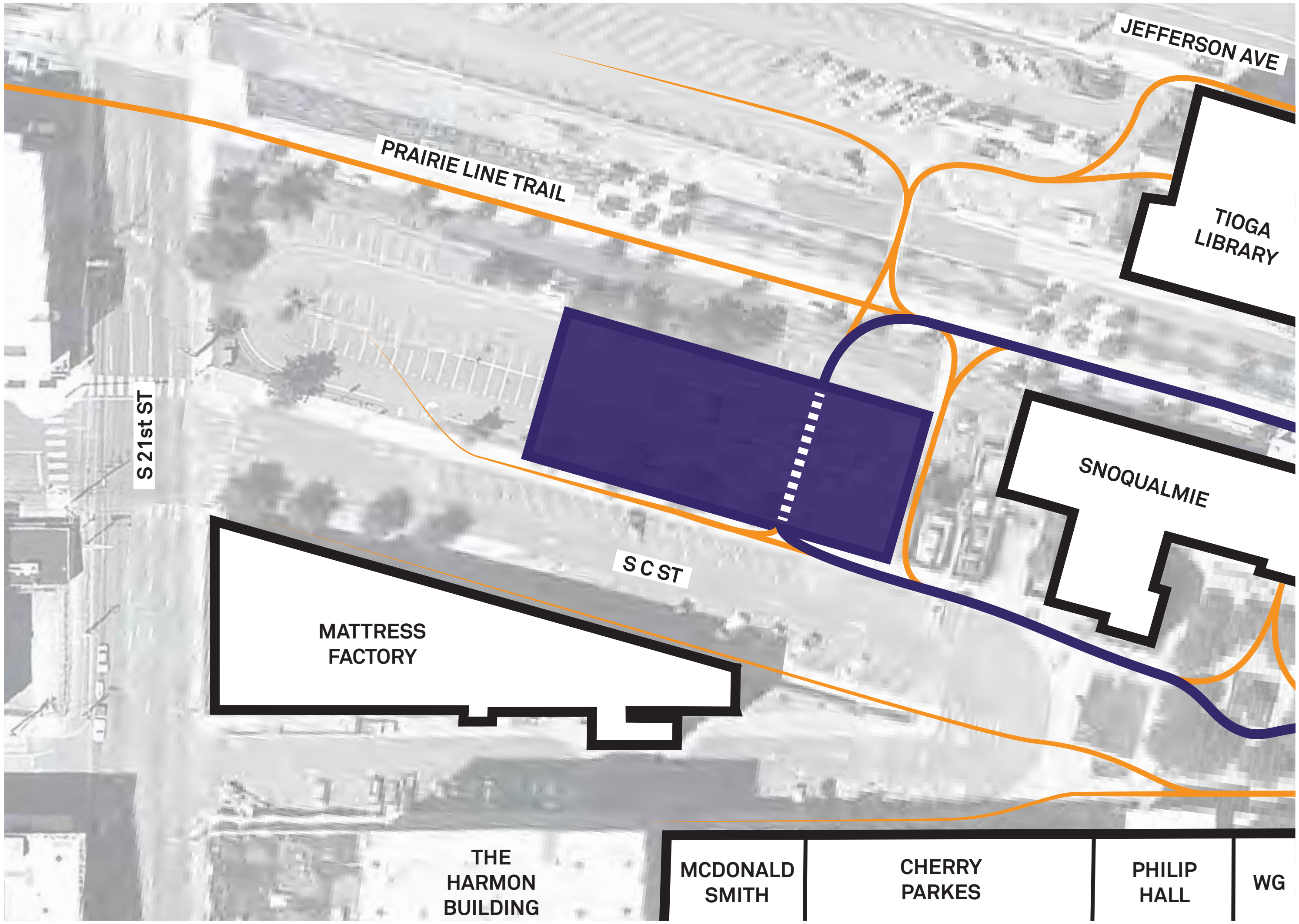


Potential approaches for situating the new Milgard Hall include planned outdoor spaces, maximizing parking, and allowing for adjacent future development.

Site Strategies - Circulation

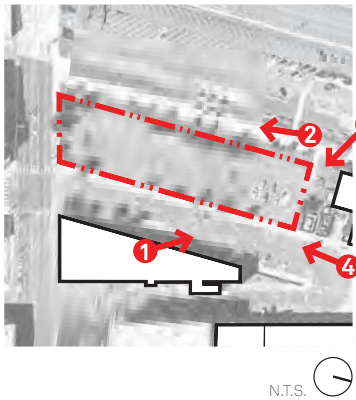
Campus Circulation

Site Approach



Keeping in mind the urban campus context, the new building will need to respond to the major thoroughfares to the east and west of the site.

Site Views



1


2


3


4


The new building will be visible from prominent campus locations including the Prairie Line Trail, Tioga Library, and Snoqualmie.

Site Views

N.T.S.

1

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3

4

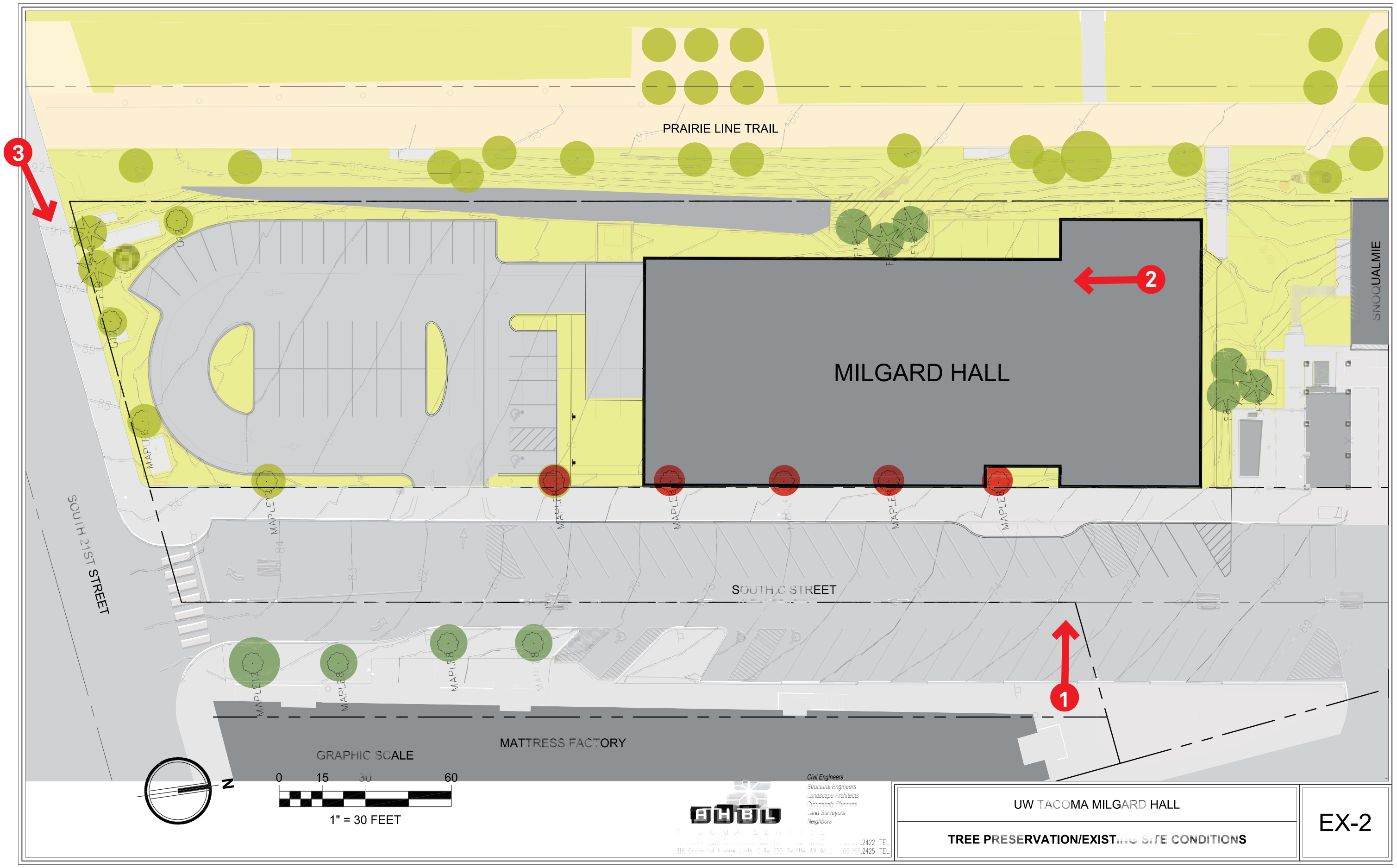
The building site is currently the Cragle Lot and contains the remnants of an old coal bunker foundation on the west edge.

Tree Preservation/Existing Site Conditions

1

2

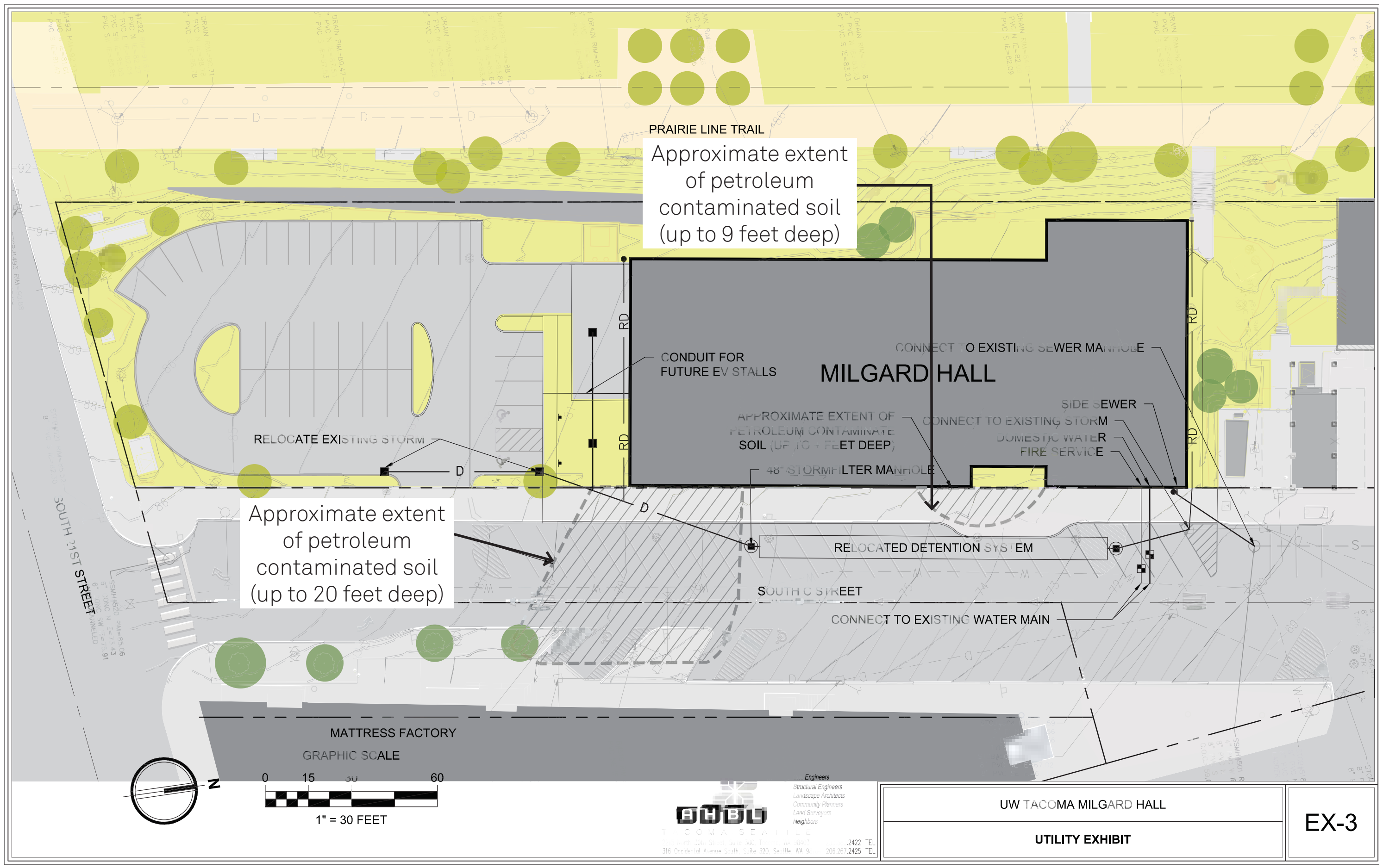
3



Trees to be removed

This plan shows the existing trees on the site. While protection of existing trees will be a priority, some tree removal is anticipated given the site constraints and proposed building footprint.

Utility Exhibit



This plan shows locations of the existing water lines, connections to sewers, and relocated storm drains and detention system.

3.6 **Constructability** Logistics Plan

- Pedestrian / Student Pathways
- Truck Route

- The construction field office will be located in the Tioga Building.
- Onboarding will be required for all trade partners and employees.
- Dust and water control measures will be in place prior to site activities.
- During mobile crane activities, no parking will be permitted on the west side of South C Street.
- A holding tank will be used for all water settlement prior to discharge; tank indicated in blue.

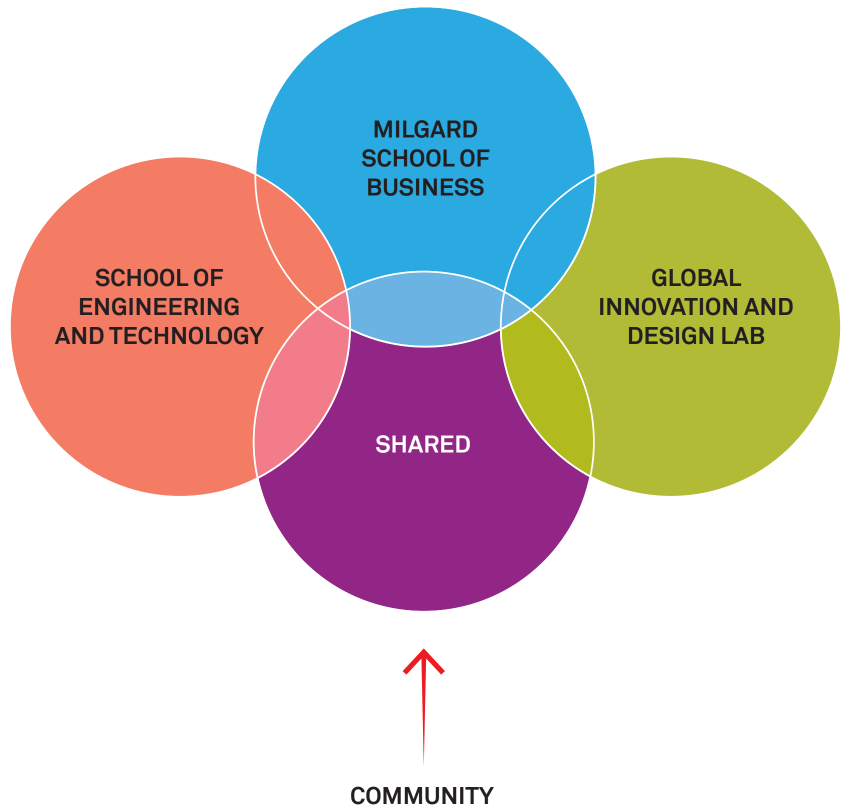
4.0 Program

4.0 Program

4.1 Space Requirements, Relationships, and Circulation
4.2 Project Standards: Area Allowances, Space Allocations, Travel Distances, FFE
4.3 Quantity Targets

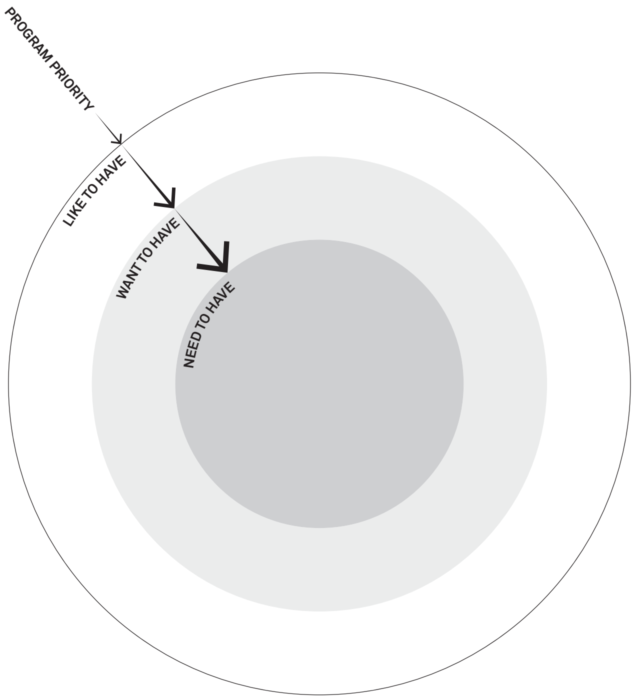
The Design Team held a series of meetings with the Project Working Team (PWT) for the academic programs to be housed in Milgard Hall: the Milgard School of Business (MSB), the Global Innovation and Design Lab (GID Lab), the School of Engineering and Technology (SET), and shared program areas. The Deans of these schools and Associate Vice Chancellor for Innovation & Global Engagement as well as other stakeholders provided invaluable input as the program was developed and refined. The Design Team referenced the targets presented in the Predesign Report and adjusted them throughout the Project Definition phase based on feedback from the working groups, test fits, and the target building size. Based on these meetings, the team established the following program targets, which will serve as a basis for the Design phase.

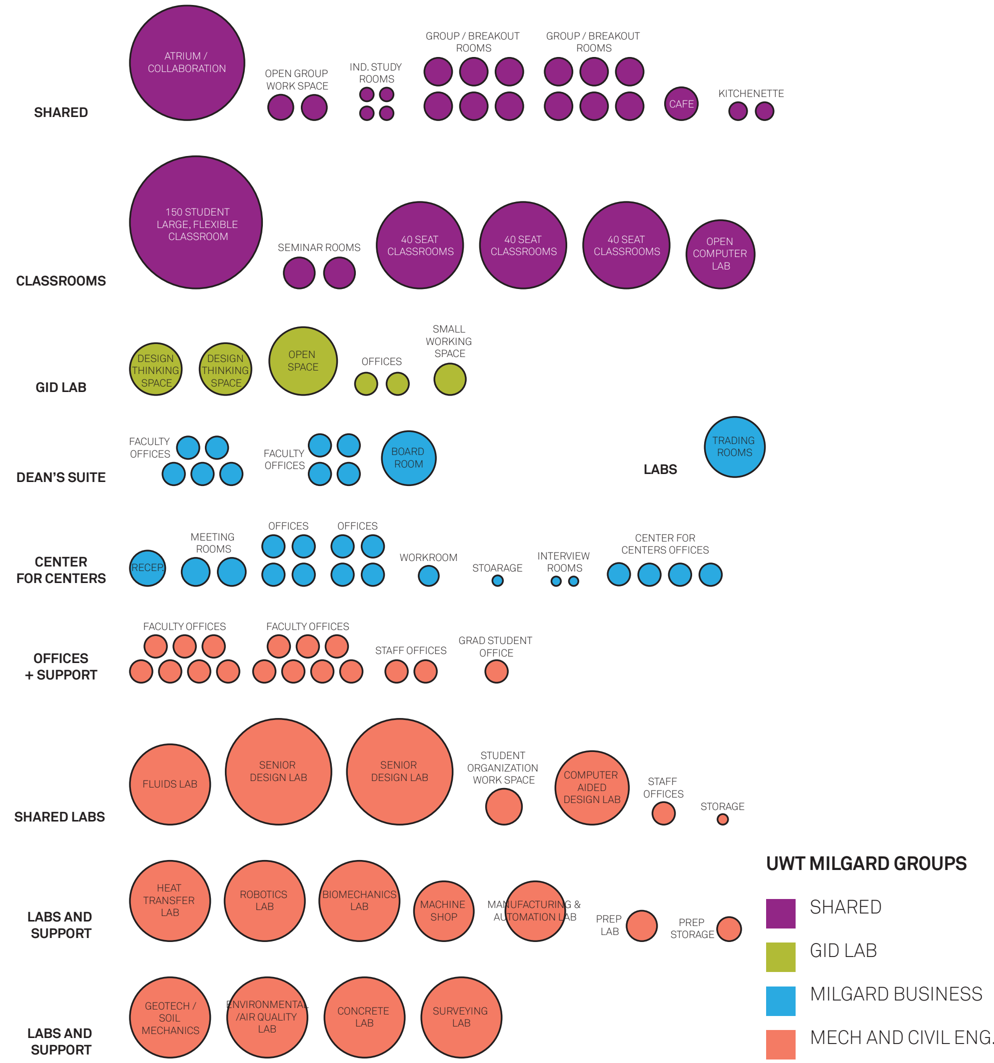
4.1 Space Requirements, Relationships, and Circulation Program Users



This diagram shows the program users that will be housed in Milgard Hall. In addition to fostering interdepartmental collaboration, one goal of Milgard Hall is to encourage community engagement with the University.

Program Priority - Working Group Meetings





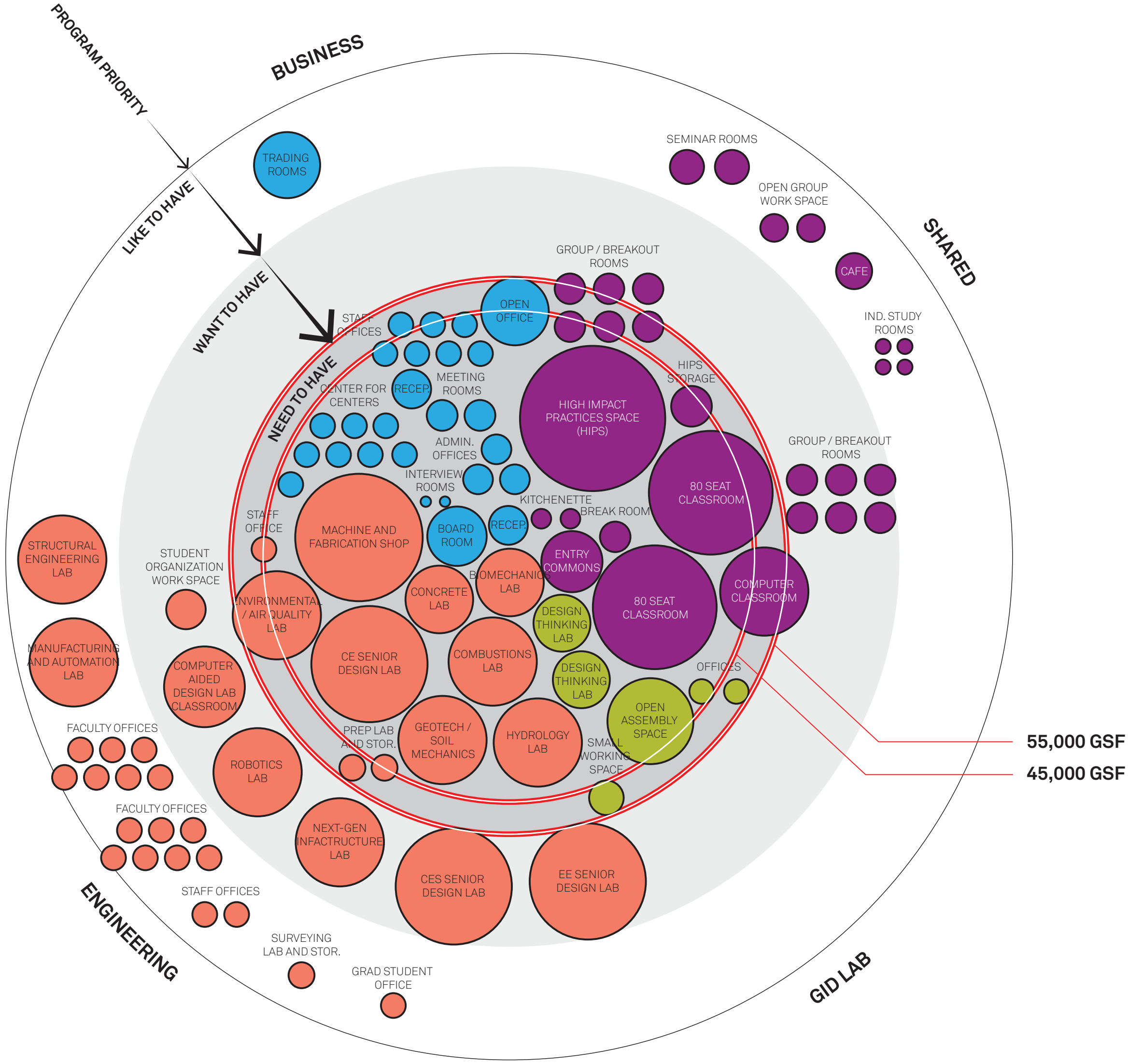
After tallying the square footage for initial program identified by the working groups, it became apparent that not everything could fit to meet budget targets and it would be necessary to prioritize program.

This graphic was used in an exercise that was conducted during one of several interactive sessions with the working groups. Each working group was asked to place each program element on the region corresponding to its priority in the building: Need to Have, Want to Have, Like to Have. The following pages show the outcome of these sessions.

Program Priority - Working Group Meetings

UWT MILGARD GROUPS

- SHARED
- GID LAB
- MILGARD BUSINESS
- MECH AND CIVIL ENG.



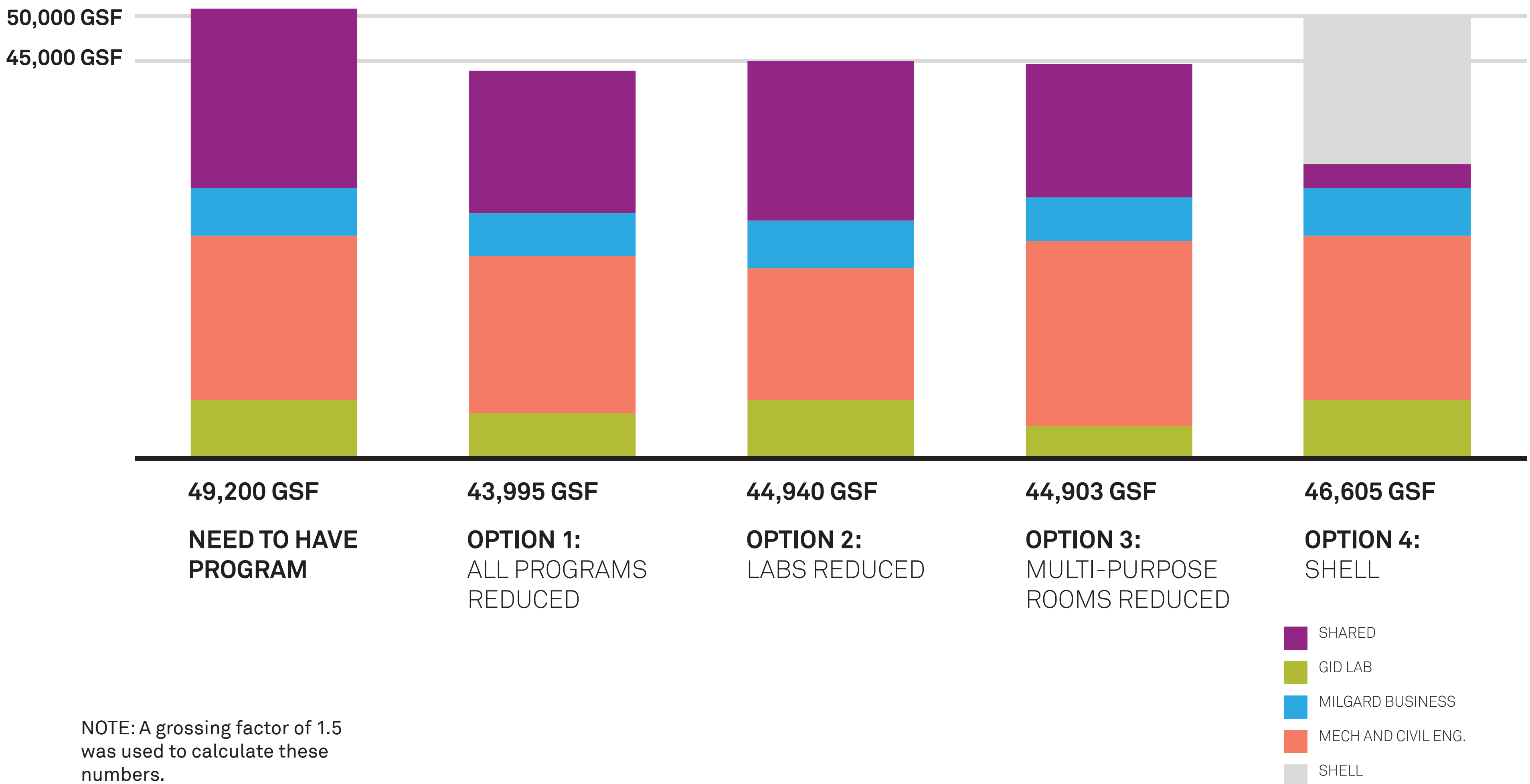
This diagram represents combined feedback from the working group sessions. By determining the "Need to Have" program at the center of the circle, the design team was able to determine an appropriate target GSF for the building. This tool was also useful for discovering possible overlaps and drawing out important program adjacencies.

Program Breakdown

Using the information from the Program Priority Exercise during the working group sessions, the design team developed four different program breakdown options for the PEC Meeting on August 18, 2020. These options were each evaluated using the Target Value Design (TVD) tool to estimate construction cost. Refer to Section 5.0 Benchmarks for the TVD and Appendix A.7 Program Supplement. Option 4 was the preferred direction of the options presented; however the PEC requested additional options that increased the square footage of the building.

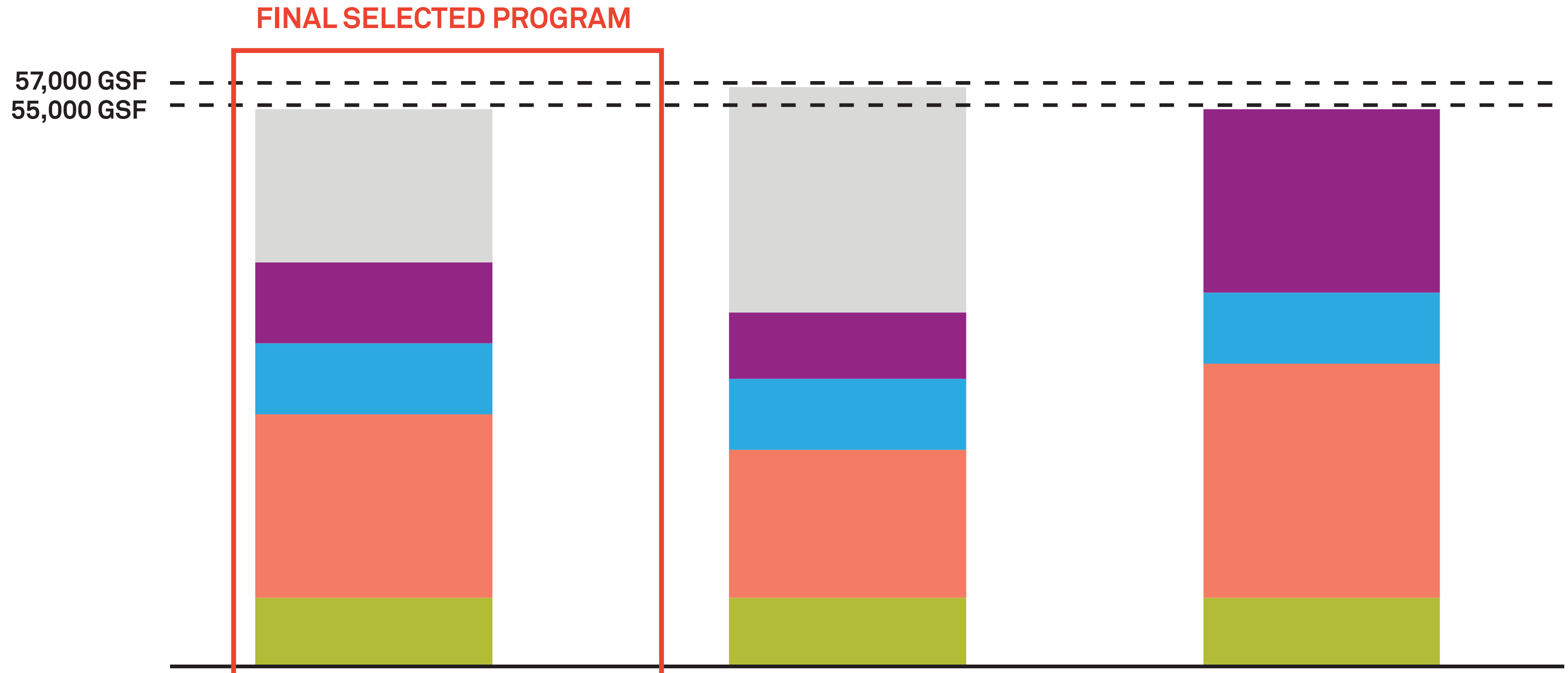
The Design Team presented additional program options to the PEC on October 23, 2020 that increased square footage to maximize value for the project. These three new options looked at increasing the program to 55,000-57,000 GSF. This was made possible by reducing target values and shelling space. In this case, the core and envelope of shelled spaces would be constructed, but the interior fit-out (finishes, casework, lighting, AV/IT) would be completed when funds became available. Upon review of these options, the PEC selected Option A for its ability to add necessary program without further compromising target values.

Program Options (18 August 2020 PEC Meeting)



NOTE: A grossing factor of 1.5 was used to calculate these numbers.

Revised Program Options (23 October 2020 PEC Meeting)



54,713 GSF

OPTION A: ~55,000 GSF
BASE TARGET VALUES*
WITH SHELLED SPACES

10% increase from PreDesign Target
12% increase from Option 4

56,843 GSF

OPTION B: ~57,000 GSF
BASE TARGET VALUES*
WITH MORE SHELLED SPACES

11% increase from PreDesign Target
22% increase from Option 4

54,713 GSF

OPTION C: ~55,000 GSF
REDUCED TARGET VALUES
WITH NO SHELLED SPACES

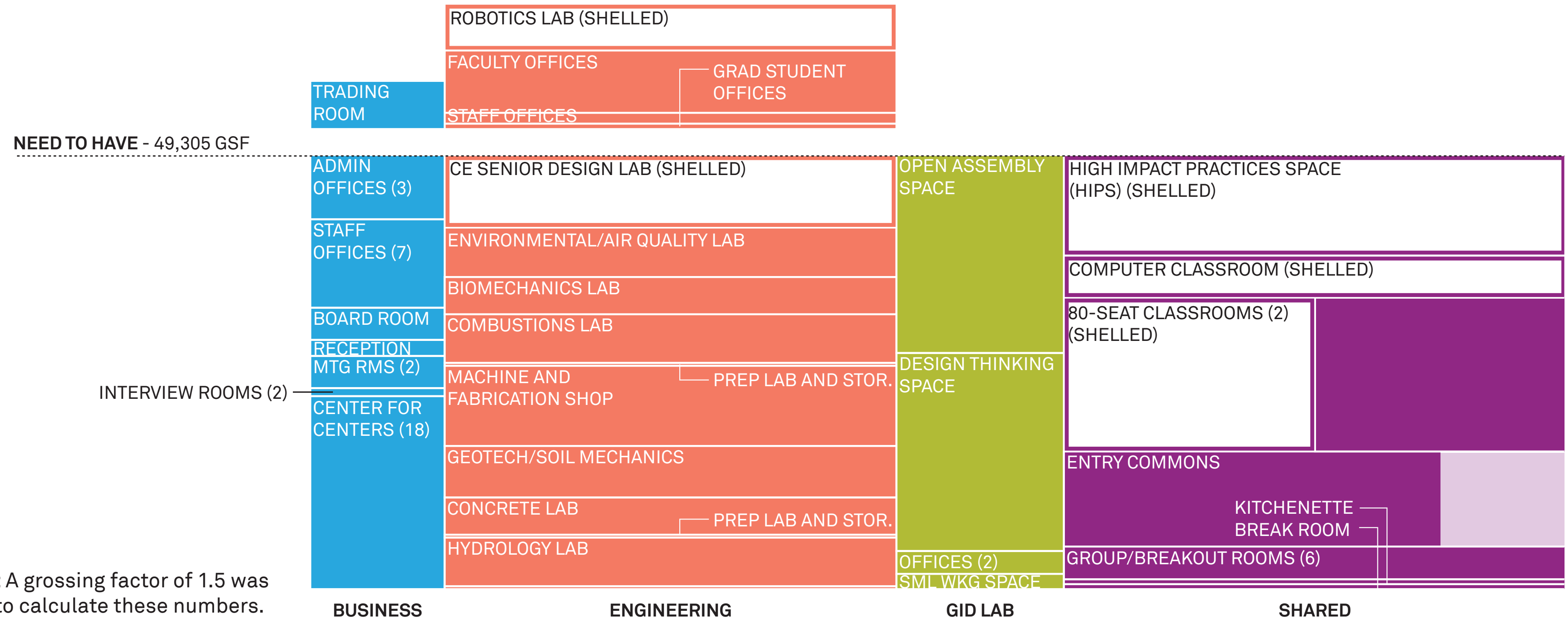
10% increase from PreDesign Target
12% increase from Option 4

UWT MILGARD GROUPS

- SHARED
- GID LAB
- MILGARD BUSINESS
- MECH AND CIVIL ENG.

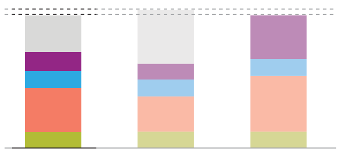
NOTE: A grossing factor of 1.5 was used to calculate these numbers.

Selected Approach: Option A, ~55,000 GSF Base Target Values With Shelled Spaces

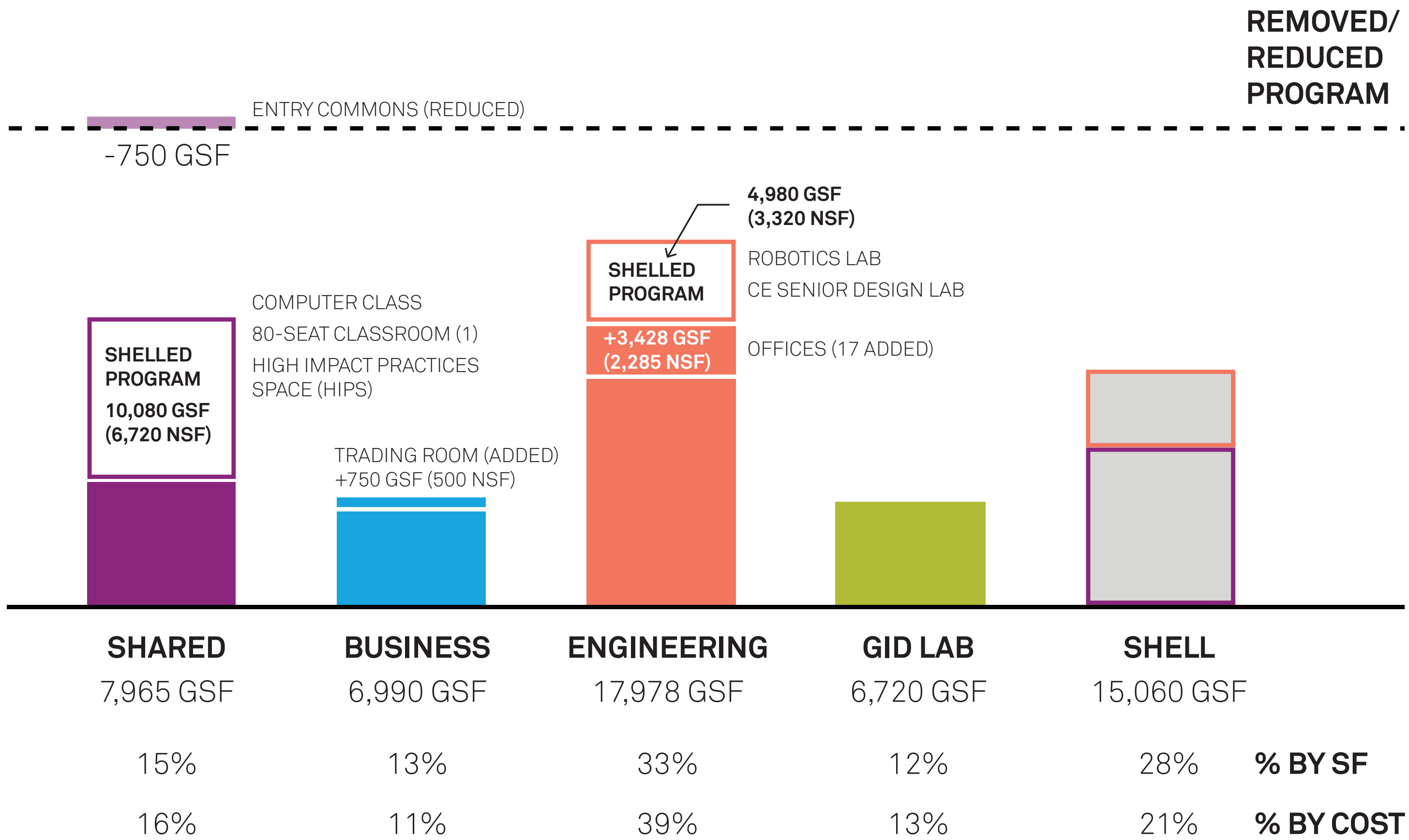


NOTE: A grossing factor of 1.5 was used to calculate these numbers.

Selected Approach: Option A, ~55,000 GSF Base Target Values With Shelled Spaces



Total: 54,713 GSF



This diagram shows the selected program option broken down by square footage and by percentage of the project's construction cost. It also shows how much of the building will be built out as unfinished shell space as well as program that was removed from the building. The shelled program will be finished if budget allows but has been identified as being at risk at this time. Finishing the shelled space will cost approximately $1.8M. Refer to the Target Value Design page in 5.0 Benchmarks for a cost breakdown.

NOTE: A grossing factor of 1.5 was used to calculate these numbers.

4.2 Project Standards: Area Allowances, Space Allocations, Travel Distances, FFE

Selected Approach: Option A, ~55,000 GSF Base Target Values With Shelled Spaces

NAME	ROOM TYPE	# OCC	NSF/ UNIT	QTY	TOTAL NSF
SHARED					
Entry Commons	Public / Informal	80	2,000 NSF	0.75	1,500 NSF
Group/Breakout Room	Meeting	10	180 NSF	6	1,080 NSF
Kitchenette	Public / Informal	0	75 NSF	2	150 NSF
Break Room	Informal	10	180 NSF	1	180 NSF
CLASSROOMS					
High Impact Practices Space	Classroom	120	3,000 NSF	0	0 NSF
80-Seat Classroom	Classroom	80	2,400 NSF	1	2,400 NSF
Computer Classroom	Classroom	45	1,320 NSF	0	0 NSF
MILGARD DEAN'S SUITE					
Admin Office	Office	1	200 NSF	3	600 NSF
Staff Office	Office	1	130 NSF	7	910 NSF
Board Room	Meeting	16	300 NSF	1	300 NSF
MILGARD CENTER FOR CENTERS					
Reception and Waiting	Office	1	150 NSF	1	150 NSF
Meeting Room	Meeting	8	150 NSF	2	300 NSF
Interview Room	Meeting	2	50 NSF	2	100 NSF
Ctr for Business Analytics	Office	1	130 NSF	1	130 NSF
Milgard CLSR	Office	1	130 NSF	1	130 NSF
Milgard Success Center	Office	1	130 NSF	1	130 NSF
Center for Sports Enterprise Management	Office	1	130 NSF	1	130 NSF
Executive Edu and Alumni	Office	1	130 NSF	1	130 NSF
New Center (TBD)	Office	1	130 NSF	1	130 NSF
Open Office (per seat)	Office	1	85 NSF	12	1,020 NSF
MILGARD LABS					
Trading Room	Classroom	16	500 NSF	1	500 NSF
SCHOOL OF ENGINEERING AND TECHNOLOGY OFFICES AND SUPPORT					
Faculty Office	Office	1	130 NSF	14	1,820 NSF
Staff Office	Office	3	155 NSF	2	310 NSF
Grad Student Office	Office	3	155 NSF	1	155 NSF

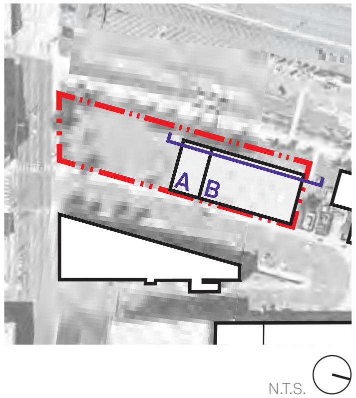
NAME	ROOM TYPE	# OCC	NSF/ UNIT	QTY	TOTAL NSF
MECHANICAL ENGINEERING LABS + SUPPORT					
Combustions Lab	Instructional Lab	24	1,320 NSF	1	1,320 NSF
Prep Lab and Storage	Prep Room	4	100 NSF	1	100 NSF
Robotics Lab	Instructional Lab	24	1,320 NSF	0	0 NSF
BioMechanics Lab	Instructional Lab	15	1,000 NSF	1	1,000 NSF
Machine and Fab Shop	Work Space	12	2,110 NSF	1	2,110 NSF
Manufacturing & Automation L	Instructional Lab	24	1,320 NSF	0	0 NSF
CIVIL ENGINEERING LABS + SUPPORT					
CE Senior Design Lab	Studio Space	45	2,000 NSF	0	0 NSF
Geotech/Soil Mechanics	Instructional Lab	24	1,320 NSF	1	1,320 NSF
Environmental/Air Quality Lab	Instructional Lab	24	1,320 NSF	1	1,320 NSF
Concrete Lab	Instructional Lab	18	1,000 NSF	1	1,000 NSF
Prep Lab and Storage	Prep Room	4	80 NSF	1	80 NSF
Hydrology Lab	Instructional Lab	24	1,320 NSF	1	1,320 NSF
SET SHARED LABS					
Staff Office	Office	2	130 NSF	1	130 NSF
GID LAB					
Open Assembly Space	Public / Informal	60	2,000 NSF	1	2,000 NSF
Design Thinking Space	Studio Space	20	1,000 NSF	2	2,000 NSF
Admin Office	Office	1	200 NSF	1	200 NSF
Staff Office	Office	2	130 NSF	1	130 NSF
Small Working Space	Meeting	8	150 NSF	1	150 NSF

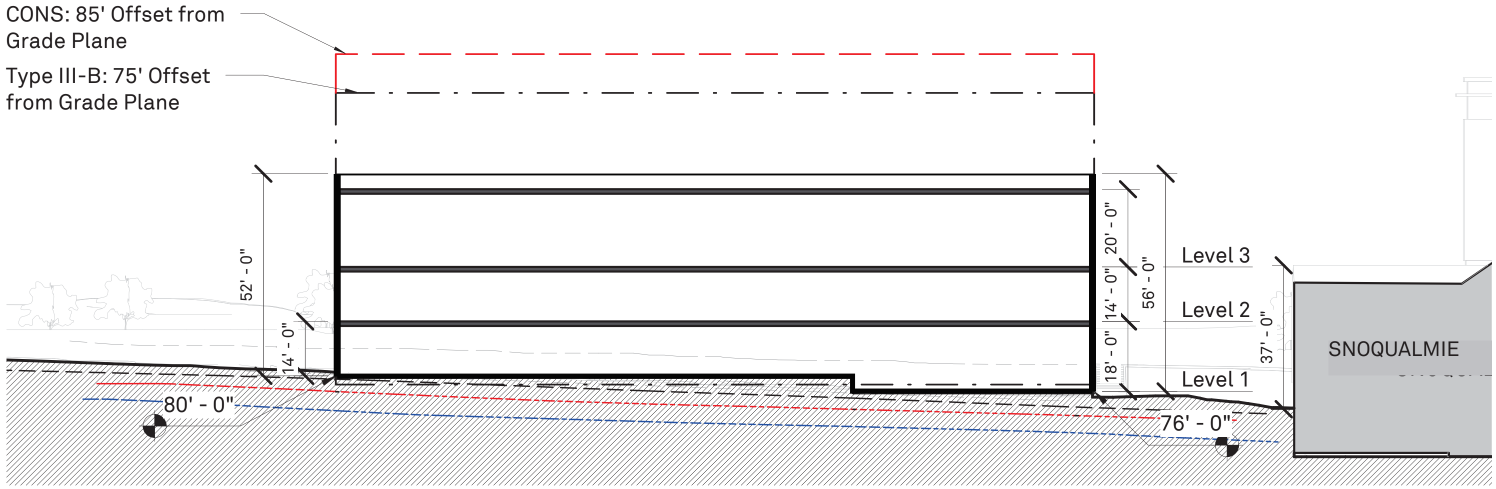
Total (NSF):	26,435 NSF
Total (GSF, 1.5 grossing factor):	**39,653 GSF**
Shelled Total:	15,060 GSF
Total:	**54,713 GSF**

NOTE: Gray text = Want / Like to Have program not included in this scheme.

The square footages shown are for planning purposes only and will adjust as the project develops.

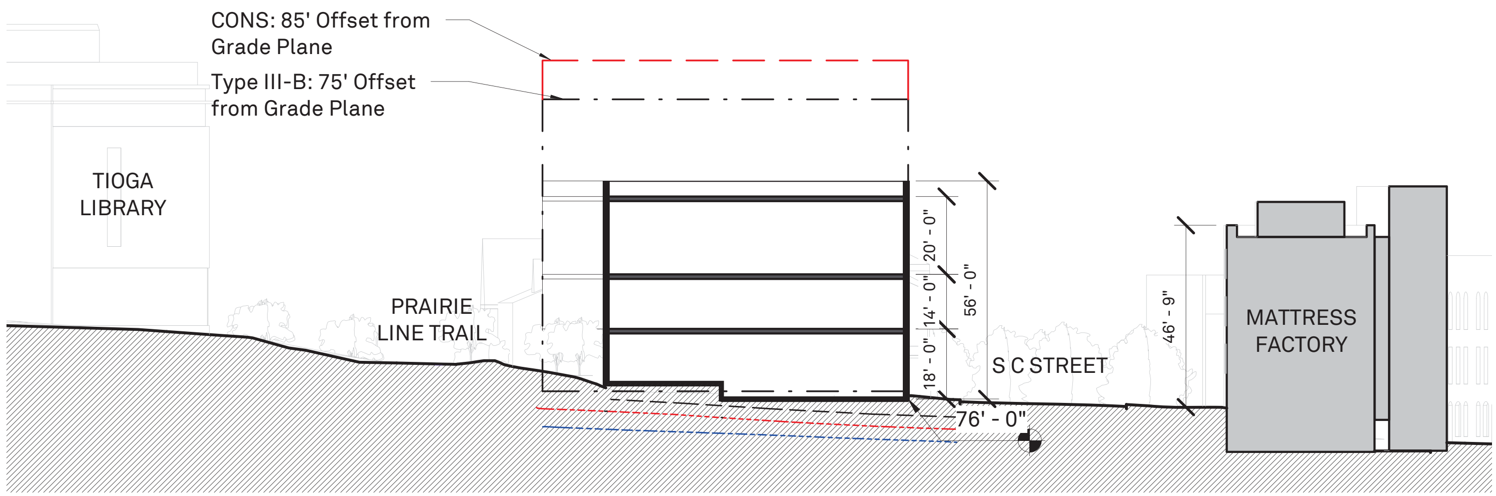
Building Height - 3 Stories (Selected Option)





A - North-South Section: 3 Stories

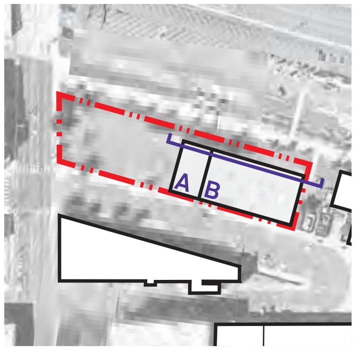
These 3 story building section diagrams show building height limitations according to the Conservation District guidelines and as allowed by the 2018 WA State Building Code for Type III-B construction. This option steps the ground floor slab to maintain a 3'-0" vertical offset between the slab and the maximum ground water line.



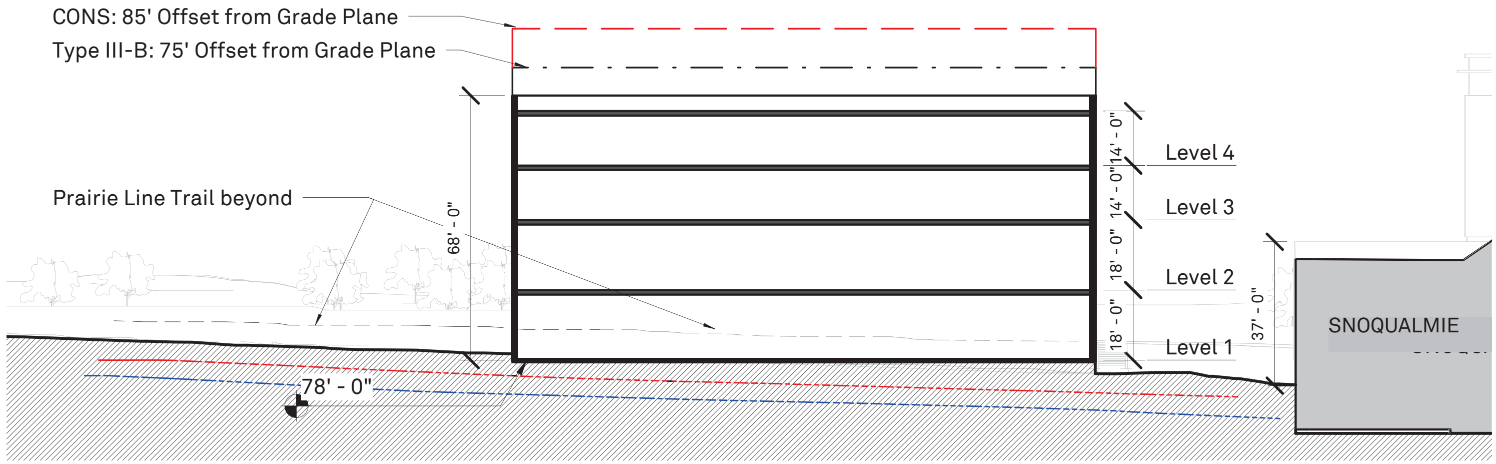
B - East-West Section: 3 Stories

3'-0" Vertical Offset from High — Groundwater Line (High) — Groundwater Line (Low)

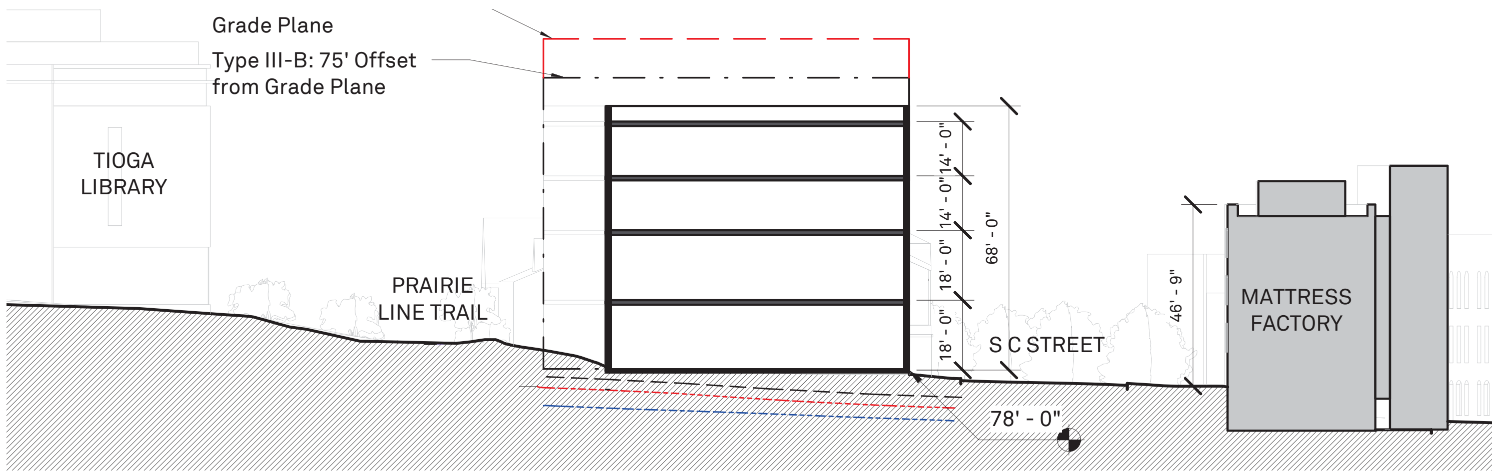
Building Height - 4 Stories



N.T.S.



A - North-South Section: 4 Stories

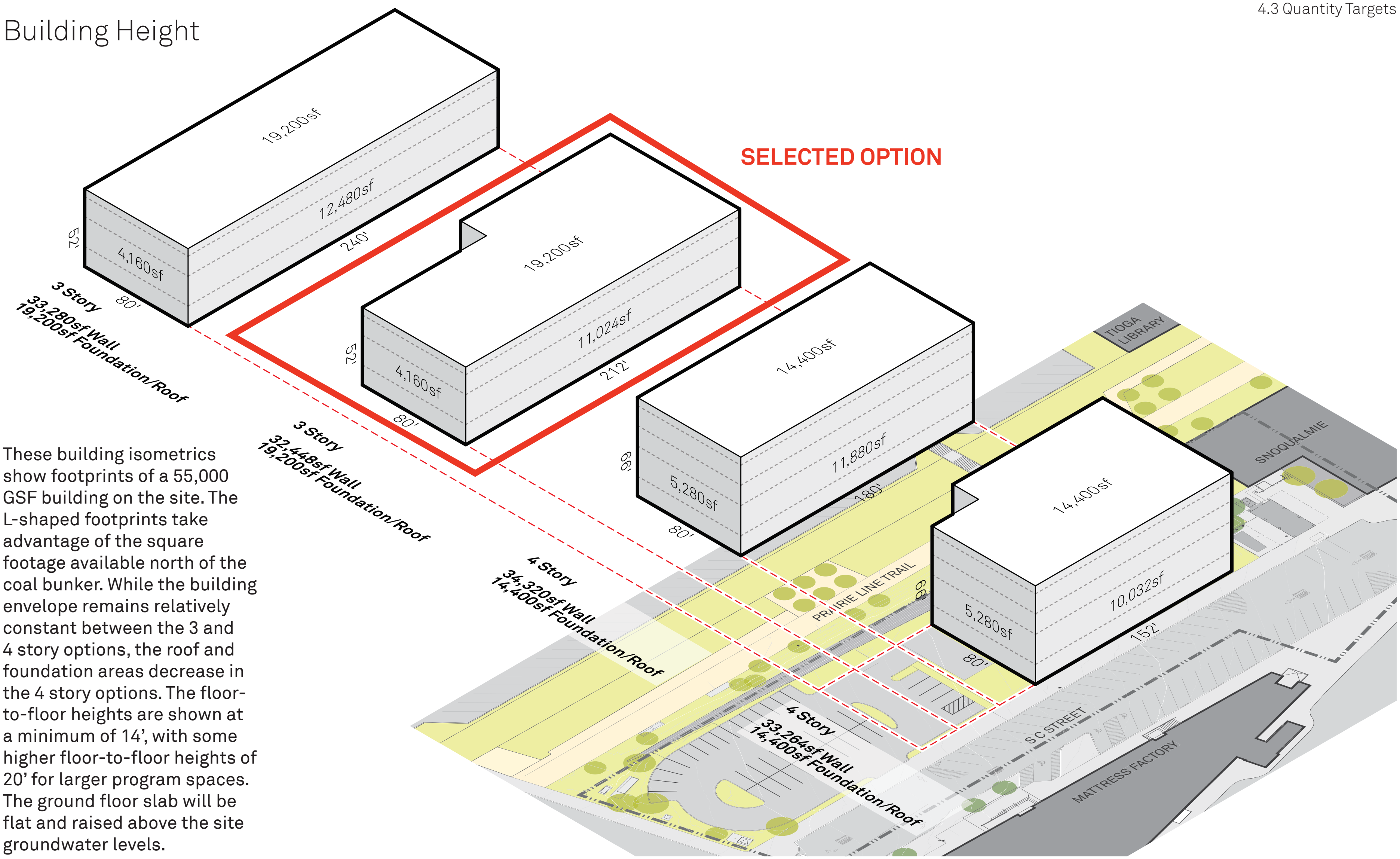


B - East-West Section: 4 Stories

3'-0" Vertical Offset from High — Groundwater Line (High) — Groundwater Line (Low)

These 4 story building section diagrams show building height limitations according to the Conservation District guidelines and as allowed by the 2018 WA State Building Code for Type III-B construction. This option explores a flat ground floor slab that sits above the minimum 3'-0" vertical offset above the maximum groundwater line.

Building Height



These building isometrics show footprints of a 55,000 GSF building on the site. The L-shaped footprints take advantage of the square footage available north of the coal bunker. While the building envelope remains relatively constant between the 3 and 4 story options, the roof and foundation areas decrease in the 4 story options. The floor-to-floor heights are shown at a minimum of 14', with some higher floor-to-floor heights of 20' for larger program spaces. The ground floor slab will be flat and raised above the site groundwater levels.

5.0
Benchmarks

5.0 Benchmarks

Target values have been established for Milgard Hall based on historical data from similar projects as well as other anticipated project factors. The Target Value Design (TVD) will serve as a framework for the iterative design process that will begin after the Project Definition phase.

The images included in this section represent projects with known benchmark costs. They are intended to illustrate quality and aesthetic goals only, not literal material choices for the project. The Design Team will use these benchmarks as a reference to ensure the project aligns with the target vision, program, and budget.

The team identified several benchmark projects to provide a cost foundation for Milgard Hall. These were chosen based on similarity in various factors including: higher education buildings, laboratory program, mass timber structure, and located in the Pacific Northwest region. Of these benchmarks, projects of particular relevance are:

- **UW Bothell STEM 4** (currently in design): STEM 4 is targeting UW Green Building Standards and 2018 Building and Energy Code Requirements. The delivery method and contract structure are similar to Milgard. The program includes labs and teaching spaces. The cost data for STEM 4 is less firm because the project has not been built.
- **UW Bothell Discovery Hall**: Discovery Hall has a similar program to Milgard Hall with labs and teaching spaces. Construction began in 2012, and UW Standards were less stringent at that time.
- **OSU Peavy Hall**: Peavy Hall is a higher education building, primarily teaching spaces and offices. It has a mass timber structure. The project included high-end interior and exterior finishes that are not comparable for Milgard.
- **District Office**: District Office is a mass timber structure with a highly simplified parti. This project is not fully fit out

with the cost shown, and the program type is office, so systems are less intensive.

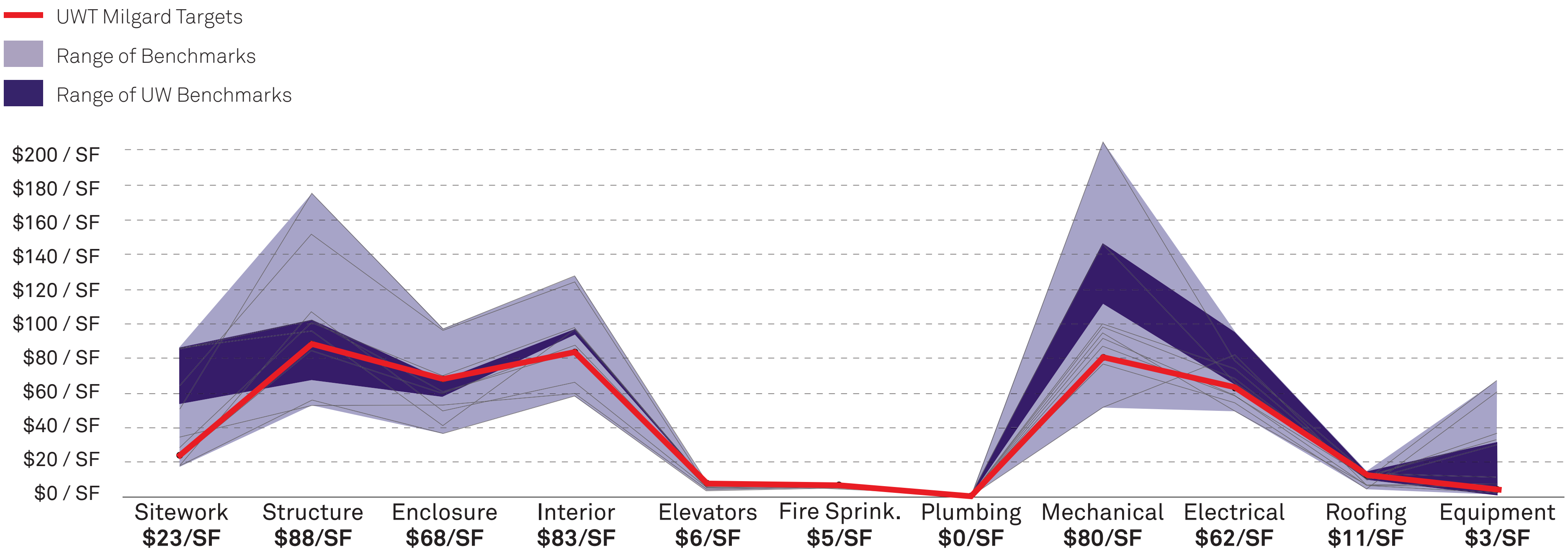
- **Sideyard**: Sideyard is a mass timber structure. Like District Office, the project is not fully fit out with the cost shown, and the program type is office so systems are less intensive.
- **Fourth & Montgomery Building**: The FMB program is primarily office and classroom space, similar to Milgard but with slightly less intensive interiors and systems. The exterior consisted of fiberglass windows and a simple, repetitive metal panel exterior, with storefront at the ground floor.
- **Knight Cancer Research Building**: KCRB includes research labs. Much of the interior is an open floor plan with exposed ceilings and concrete floors. At 320,000 sf, the building was able to achieve an economy of scale that will not be realized at Milgard. Further, the building has an adjacent project planned so the façade on that side is minimal enclosure, and lab casework and equipment is carried in the equipment category rather than interiors.

During the Project Definition phase, the design-build team worked with the client group to understand requirements and goals for the project, and then made a recommendation for the building based on the information collected and the benchmark cost data. The PEC requested that the design-build team provide more program and acknowledged an inherent shift in expectations for other components of the building such as MEP systems and interior finishes. Refer to the architectural narrative for the approved program including shell space, and a list of potential compromises.

All projects have been escalated to April 2021.

Other considerations that impact the cost foundation for Milgard Hall include durability, 2018 code requirements and UW Green Building Standards, and Milgard's location in a historic district.

Target Value Design (TVD)



Project Area:	**55,000 GSF**
Project Budget:	**$50,500,000**
Design-Build Cost:	**$35,500,000**
Comparison Inputs:	**Higher Education, Lab, Mass Timber**

- Plumbing and Building Controls are included in the Mechanical target.
- Lab casework is included in the Interiors target.
- Lab equipment will be primarily owner provided. Minimal equipment is included in the target values.
- Furniture is not included in the target values.
- The Interiors value reflects the shell space as indicated in the program.
- The fit out Interior target value is $115/SF.
- The shelled space has code minimum lighting, fire protection, and heating to prevent pipes from freezing. Fitting out these spaces is a high priority and will be tracked on the Last Responsible Moment log. Project savings or additional funds may be used to fit out these spaces, or to fully condition the shelled space if fit out is not attainable.

TVD Benchmark: Site Improvements

UWT Milgard Hall Site Improvements Target:

$23/SF

Sideyard
$21/SF

OSU Austin Hall
$25/SF

OSU Linus Pauling Science Center
$28/SF

Knight Cancer Research Building
$32/SF

UWT Milgard Hall
$23/SF

Target value for site includes all sitework: excavation, dewatering, utilities, paving, site concrete, landscaping, miscellaneous site improvements, etc

TVD Benchmark: Structure

UWT Milgard Hall Structure Target:

$88/SF

District Office
$76/SF

Portland Community College
$84/SF*

Sideyard
$90/SF

FSC Peavy Hall
$152/SF

UWT Milgard Hall
$88/SF

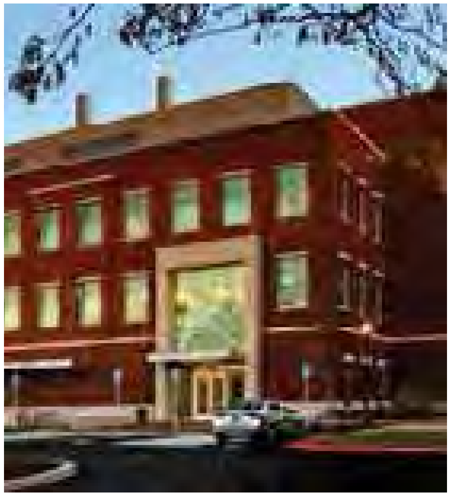
*Target value for structure; project has not started construction.

TVD Benchmark: Enclosure

UWT Milgard Hall Enclosure Target:

$68/SF

Knight Cancer Research Building
$60.39/SF



OSU Linus Pauling Science Center
$68/SF

OSU Austin Hall
$69/SF

Legacy Emanuel West Expansion
$95/SF*

UWT Milgard Hall
$68/SF

*Project is under construction.

TVD Benchmark: Interior Fitout

UWT Milgard Hall Interior Fitout Target:

$83/SF

OSU Linus Pauling Science Center
$87/SF

OSU Austin Hall
$98/SF

FSC Peavy Hall
$127/SF

UWT Milgard Hall
$83/SF

Target Value Summary: Option A, ~55,000 GSF Base Target Values with Shelled Spaces

The selected approach, Option A, is a 55,000 GSF building with 15,000 GSF of shelled space, to provide Need to Have and some additional program. The cost to complete the interior fit-out of the shelled space is approximately $1.8M; savings and additional funds raised in the next 12 to 18 months could be used to achieve this.

This option adjusts the previous base target values (Option 4 Shell) in order to increase program area. These adjustments include:

- **Structure:** no changes from mass timber structure
- **MEP systems:** consideration of some systems changes, such as fewer spaces provided with cooling, single piping for plumbing with localized water heaters, utilizing MC cable throughout, and aluminum wiring
- **Sustainability goals:** meets LEED Silver target, but does not meet UW Green Building Standards targets
- **UWT Design Standards:** some UW Facilities Design Standards are not met
- **Exterior skin:** includes economical/uninsulated metal panel, brick with punched windows, and limited storefront glazing
- **Interior finishes:** limited interior glazing and casework
- **Classroom acoustics and casework/storage:** no reductions
- **Lighting and AV:** no reductions
- **Landscape:** no reductions

Target Value Summary

Structure
Mass timber structural frame and floor decking

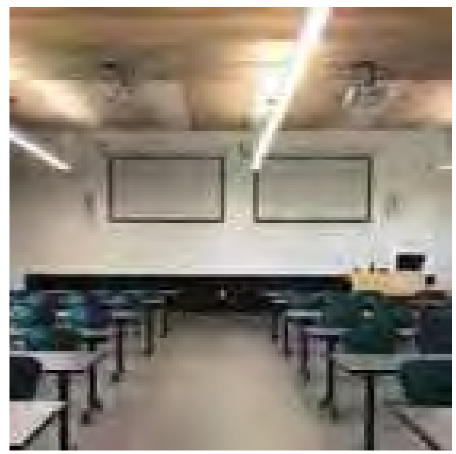
Mechanical Systems
Centralized mechanical system

Enclosure
Brick with punched windows, storefront glazing at entry

Offices
Primarily closed private offices

Interior Glazing
Selective interior glazing

Interior Glazing
Selective interior glazing



Classrooms
Lighting, AV, and open structure for flexible teaching environments

Instructional Labs
Robust worktables, selective casework

Cost Assumption: Mass Timber

Mass Timber

$82/SF

- CLT and glulam framing
- 3" concrete topping slab on CLT
- Foundation/slab on grade: concrete
- Elevator shear wall: concrete
- Approximately $4.1 million cost for 50,000 SF building

Steel

$72/SF

- Structural steel framing and metal deck
- 3" concrete topping slab on metal deck
- Foundation/slab on grade: concrete
- Elevator shear wall: concrete
- Approximately $3.6 million cost for 50,000 SF building

Concrete (Post-Tensioned)

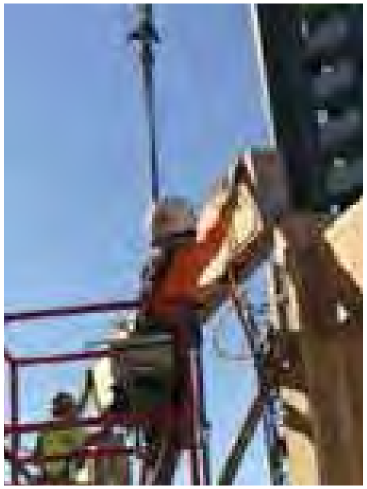
$75/SF

- Post-tensioned deck, columns, beams
- Foundation/slab on grade: concrete
- Elevator shear wall: concrete
- Extended construction schedule (2 mos.)
- Approximately $3.8 million cost for 50,000 SF building

Cost Assumption: Mass Timber


1. Regional Material


2. Beautiful



3. Economical


4. Sustainable

1. Regional material: New innovations in timber construction can contribute to an iconic building on UW Tacoma's campus.

2. Beautiful: Unfinished mass timber is a cost-effective level of finish that has a warm aesthetic.

3. Economical: Precut mass timber can expedite construction sequence.

4. Sustainable: Mass timber has a lighter carbon footprint and less embodied energy than other commonly used building materials.

6.0
Performance

6.0 Performance

The Design Team worked with the University to identify performance goals and standards based on current building codes, campus standards, maintenance concerns, and sustainability goals. Throughout Project Definition, the Design Team met in weekly Big Room meetings over Zoom and used virtual collaboration tools such as Zoom breakout rooms, virtual pull planning, and cloud software. The TVD helped confirm feasibility of scope in regards to cost to develop bases of design.

The project will adhere to the 2018 Washington State Codes using Type III-B Construction with sprinklers. The following page outlines the code requirements based on our target construction type and occupancy classifications.

6.1 Building Code Summary

APPLICABLE CODES

BUILDING CODE	2018 WA State Building Code Chapter 50-51 WAC (IBC 2015 with amendments)
MECHANICAL CODE	2018 WA State Mechanical Code (IMC 2015 with amendments)
FIRE CODE	2018 WA State Fire Code (IFC 2015 with amendments)
PLUMBING CODE	2018 WA State Plumbing Code (IPC 2015 with amendments)
ENERGY CODE	2018 WA State Energy Code, Commercial (IECC 2015 with amendments)
ACCESSIBILITY	ICC/ANSI A117.1-2009 and amendments

BUILDING CODE SUMMARY

OCCUPANCY CLASSIFICATION	Group B, Business (post-secondary education, labs: testing and research) Group A-3, Assembly (lecture halls) Group S-1, Moderate-hazard Storage
OCCUPANCY SEPARATION	In order for the building to have non-separated occupancy, the building must be limited to 3 stories as limited by A-3 occupancy. A-3 will require a 1 hr separation from B occupancy spaces in a 4 story building. If A-3 is less than 10% of the floor area, A-3 can be considered an Accessory Occupancy function and no separation will be required.
CONSTRUCTION TYPE	Type III-B, sprinklered (non-combustible exterior, unprotected)
ALLOWABLE BUILDING HEIGHT *Table 504.3*	75 feet above grade plane

BUILDING CODE SUMMARY (CONTINUED)

ALLOWABLE NUMBER OF STORIES *Table 504.4*	4 stories above grade plane
ALLOWABLE AREA FACTOR *Table 506.2*	57,000 square feet for B occupancy with accessory uses
FIRE RATINGS FOR BUILDING ELEMENTS *Table 601* *Table 602*	Primary Structural Frame: 0 hr Bearing walls: Exterior: 2 hrs Interior: 0 hr Non-Bearing Walls: Exterior: 1 hr within 30 ft from other structures Interior: 0 hr Floors: 0 hr Roof: 0 hr
FIRE RATINGS OTHER *Section 1023.2* *Section 712* *Table 707.3.10* *Section 3006.2* *Section 713* *Section 1024.3*	Stairway Enclosures: 2 hrs when connecting 4 stories or more 1 hr when connecting less than 4 stories Hoistway Enclosures: 2 hrs when connecting more than 3 stories or more than 75 ft in height Shafts: 2 hrs when connecting 4 stories or more 1 hr when connecting less than 4 stories Horizontal Exits: 1 hr minimum, but not less than that required for any connecting interior exit stairway or ramp

EGRESS

EXIT ACCESS TRAVEL DISTANCE *Table 1017.2*	B	300 feet (sprinklered)
	A-3	250 feet (sprinklered)
	S-1	250 feet (sprinklered)
COMMON PATH OF EGRESS TRAVEL DISTANCE	B	100 feet (sprinklered)
	A-3	75 feet (sprinklered)
	S-1	100 feet (sprinklered)
EGRESS CAPACITY	Stairs: 0.3 inches per occupant Other: 0.2 inches per occupant	
OCCUPANT LOAD	Refer to Occupant Load Factor chart	
NUMBER OF EXITS *Table 1006.3.2*	Based on Occupant Load	
	< 50	1 means of egress
	50-500	2 means of egress
	> 500	3 means of egress
	> 1,000	4 means of egress

OCCUPANT LOAD AND EGRESS

FUNCTION OF SPACE	OCCUPANT LOAD FACTOR
Accessory storage areas, mechanical equipment room	300 gross square feet
Assembly without fixed seats (concentrated, chairs only, not fixed)	7 net square feet
Assembly without fixed seats (unconcentrated, tables and chairs)	15 net square feet
Business	150 gross square feet
Educational (Classroom area)	20 net square feet
Educational (Shops and other vocational room areas)	50 net square feet
Locker rooms	50 gross square feet
Storage	300 gross square feet

Occupancy Separation

3-story building

1. Group A and B can be located up to the third floor. The building can therefore be classified as a non-separated occupancy following the provisions of Section 508.3. This option allows non-rated structure, floor, and interior wall assemblies.

4-story building

Group A can be located up to the third floor, Group B up to the fourth floor.

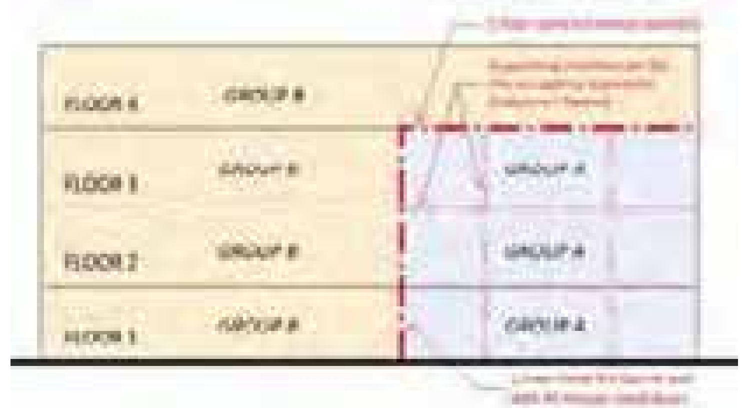
2. *Completely separated Group A Occupancy:* Group A is stacked and separated from Group B at all floors by a 1-hour rated construction.

3. *Combination of separate and non-separated occupancies:* The Group A is separated from Group B at Floor 4 and can be non-separated at Floor 1, 2 and 3.

4. *Non-separated with accessory Group A occupancy:* Group A can be located on any floor, including Floor 4, as long as it is limited to 10% of the floor area.

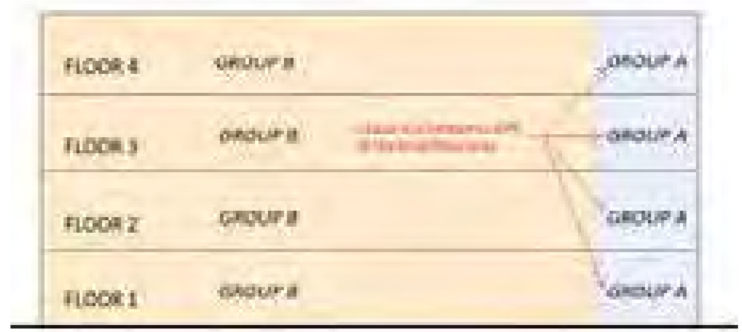
1. 3-story building:
   Non-separated occupancy

2. 4-story building:
   Completely separated Group A occupancy



3. 4-story building:
   Combination of separate and non-separated occupancies

4. 4-story building:
   Non-separated with accessory Group A occupancy



Reference: 2018 WSBC Table 504.4, Sections 506.2.4, 508.2, 508.3. Options shown for a Type III-B sprinklered building for occupancies A-3 and B.

6.2 Basis of Design

6.2.1 Civil

Temporary Erosion and Sediment Control:

- Provide temporary erosion control during construction to meet City of Tacoma and Washington Department of Ecology Standards.

Site and Utility Demolition

- Demolish the existing site improvements within the limits of work. Demolish utilities that are in conflict with the proposed building location.

Storm Drainage

- Provide catch basins and areas drains to collect stormwater from site areas and route it to the downstream storm drain system.
- Connect the new building roof downspouts to the existing storm drainage in South C Street.
- Reinstall the Cragle Lot's detention tank and water quality treatment vault within C Street.

Site Utilities

- Provide a new sanitary side sewer connection to the sewer main in South C Street.
- Provide a new domestic water and fire service connection from the water main in South C Street.

Roadway Improvements

- Provide new concrete sidewalk in front of the proposed building.
- Reconfigure a portion of the existing parking lot to provide ADA accessible parking stalls and a science court adjacent to the proposed building.

6.2.2 Landscape

C Street Corridor

- Streetscape improvements on South C Street are to include new concrete sidewalk along the face of the new building. The portion of C Street along the building is vacated right of way and belongs to the University of Washington Tacoma.

Transit Facilities:

- There are existing transit facilities on Pacific Avenue, to the east of the site, and on Jefferson Avenue, to the west of the site. There is a Link Light rail station stop at Pacific Avenue to the east.

Bicycle Facilities & Circulation

- Short and Long-Term bicycle parking is required by the City of Tacoma.
- The Prairie Line Trail, a multi use trail, borders the west face of the building.

ADA Accessible Pedestrian Circulation

- ADA accessibility will be provided from all pedestrian access points to the site. ADA parking stalls will be created on the south end of the building on the north portion of the remaining Cragle Lot. Accessible entries to Milgard Hall will be provided on the east and west faces of the building.
- Pathways, courts, terraces and furnishings to be designed to meet ADA requirements. Surfacing materials, products, railings and furnishings to meet accessibility criteria.

On-Site Stormwater Management

- On-site stormwater management facilities per the 2016 City of Tacoma's Stormwater Management Manual will be provided.

Site Lighting & Power

- Pedestrian scale lighting per UW Campus Standards will be located along all pathways and within courtyard spaces for safe nighttime circulation. Outlets for events and maintenance are anticipated to be required at courts and roof terraces.

Tree Preservation & Replacement

- The proposed improvements will impact several existing trees with the project area. The impacted trees will be removed.
- Existing trees at the south end of the Cragle Lot, and along the Prairie Line Trail, will be protected to remain.

Planting

- Planting will be designed to meet UW Campus Standards, Best Management Practices and per LEED Water-Efficiency requirements. All trees are expected to be specimen quality and all shrubs and groundcovers to be Grade A nursery stock.

Soils

- Soil depths throughout to be specified per UW Campus Standards, Best Management Practices and per LEED Protect or Restore Habitat requirements.

Irrigation

- Irrigation systems will be designed to meet UW Tacoma Campus Standards, Best Management Practices and per LEED Water-Efficiency requirements. It is expected that the irrigation system will employ current water saving technologies including Evapotranspiration monitoring and rain sensor overrides.

6.2.3 Architecture

UW Tacoma Milgard Hall

1950 S C St, Tacoma, WA

Project Definition Architectural Narrative

November 16, 2020

Architectural Narrative

The following scope is organized by general project areas, with descriptions of architectural work. Materials and finishes specified in this report do not reflect final design decisions; selections must be reviewed and approved by the Owner.

General

- Construction of a new 3 to 4 story building.
- Goal is to achieve LEED Silver v4 building certification. LEED Gold v4 will be targeted, but might not be achievable.
- UW Facilities Design Standards (UWFDS) Updated July 2020
- 2018 WA State Building Code
- 2018 WA State Energy Code
- Tacoma Municipal Code

Substructure and Superstructure

- Refer to structural narrative by KPFF.
- Concrete footings and concrete slab on grade with under-slab rigid insulation and waterproof barrier.
- Refer to geotechnical report by GeoEngineers for vapor control system assembly.
- Structural framing shall be mass timber utilizing CLT (cross-laminated timber) and glulam beams.
- Steel beams and columns will be used as required for longer spans at the High Impact Practices Space (HIPS) and 80 seat classrooms.
- Concrete core or steel braced frames will be used for lateral resistance.

Envelope

- Exterior wall shall be primarily brick masonry cavity wall and metal panel rainscreen system. Cladding support systems shall be thermally broken.
- Backup wall shall consist of sheathing on metal stud or wood framing with a fluid applied weather barrier membrane and appropriate flashings per manufacturer standard details at penetrations.
- The building envelope will incorporate a continuous insulation layer and an airtight envelope to efficiently maintain comfortable interior conditions.
- Parapet or guardrails will be provided at roof levels per UWFDS.
- Primary entry and entry doors will be a thermally broken storefront system.
- Windows will be thermally-broken, with insulated, low-E glazing. Windows will be primarily punched and fixed; operable windows shall be motorized and coordinated with HVAC zone controls for energy efficiency.
- Glazing target of 40% window-wall-ratio to achieve envelope performance targets.
- Roof to be low-slope roofing SBS modified bituminous membrane on R40-R50 rigid insulation to meet envelope performance targets.
- Roof will be solar ready.
- The University of Washington shall engage an enclosure commissioning agent (BECx) to ensure the envelope meets performance requirements of the University.

Interior Construction and Finishes

FLOORS

- Sealed concrete throughout with polished concrete flooring at select public areas unless otherwise noted (UON).
- Walkoff mats shall be provided at entry vestibules to meet LEED requirements and UWFDS.
- Carpet at 80 seat classrooms, High Impact Practices Space (HIPS), and in private offices.

WALLS

- Interior partitions shall primarily be metal stud framing with painted gypsum wall board and rubber base; Level 5 finish.
- Gypsum wall board assemblies will be detailed to meet fire-rating and acoustic requirements.
- Intersections between interior partitions and mass timber structure will be acoustically sealed to maintain STC performance of partitions.
- Restrooms shall have ceramic wall tile on wet walls.
- Interior glazing shall be provided at select areas.

CEILINGS

- Ceilings will be a combination of exposed CLT structural floor slab and suspended acoustical ceilings.
- Ceilings will be coordinated to provide access to MEP equipment per UWFDS.
- MEP systems will be primarily exposed and coordinated with the structure in order to maximize ceiling height and clearances within spaces.

DOORS AND OPENINGS

- Hollow metal or solid-core wood doors with hollow metal frames. Glass vison panels and side lites shall be provided at select locations. Aluminum storefront systems shall be provided at select locations.

CASEWORK

- Casework shall be provided to support program requirements. It shall be wood veneer or plastic laminate and meet AWI standards.
- Countertops shall be structurally supported per UWFDS.

STAIRS

- Stair finishes will be durable and easily maintainable.

VERTICAL CONVEYANCE

- (1) gearless traction elevator, machine-room-less (MRL)
- Capacity: (1) 4,500 lbs. for passengers and service loads
- Cab size to accommodate stretcher
- Stainless steel doors
- Durable and low maintenance elevator cab floor, walls, and ceilings

OTHER

- Building signage and wayfinding shall be provided throughout the building to efficiently guide occupants and visitors to program spaces.
- Writable surfaces shall be provided at classrooms, labs, conference rooms, breakout rooms, and offices.
- Manual window shades shall be provided in classrooms, labs, conference rooms, breakout rooms, and offices per UWFDS.
- Audio-Visual systems will be provided at the following spaces: 80-seat classrooms, HIPS, the GID Lab Design Thinking and Open Assembly spaces, and conference rooms.
- Access control shall be coordinated with UW Tacoma Facilities.

6.2.4 Structure

A. Structural Overview

1. Introduction

This narrative summarizes the design criteria and structural systems for the Project Definition Phase for Milgard Hall at the UW Tacoma campus.

2. Reference Documents

The following reference documents were used:

- Preliminary Geotechnical Engineering Report, GeoEngineers, October 1, 2020
- University of Washington Facilities Design Standard (FDS), July 2020
- UW Tacoma Facility Services Supplemental to FDS, February 22, 2018

B. Design Criteria and Loads

1. Building Code and Design Guides

The structural system will be designed in accordance with the 2018 International Building Code as amended by the City of Tacoma and will reference the University of Washington Facilities Design Standard (FDS).

2. Dead Loads

The structure will be designed for the self-weight of the framing plus the following superimposed dead loads:

Solar Ready Roof	5 psf +175 psf	typical over a 2-foot by 2-foot area every 1,000 square feet for inverters
MEP & Fire Sprinklers	5 psf	-
Ceiling, Flooring, Misc.	10 psf	(minimal finishes)

The exterior cladding will consist of several materials:

- About 20% of the building cladding is assumed to be glazing combined with a lightweight panel. We have provided an allowance of 15 psf (on the projected face) for this cladding.
- About 80% of the building cladding is assumed to be a heavier material such as terra cotta rain screen, precast concrete, or brick. We have provided an allowance of 75 psf (on the projected face) for this cladding.

3. Live Loads

The structure will be designed for the following live loads:

Roof	25 psf	reducible
Classrooms, Typical	100 psf	non-reducible
Labs	100 psf	non-reducible
Office	100 psf	non-reducible (includes 15 psf for partitions)
Assembly Areas, Lobby	100 psf	non-reducible
Corridors, Stairs	100 psf	non-reducible
Mechanical Areas	150 psf 75 psf	non-reducible -OR- at open areas around mechanical equipment

There will be a Civil Engineering Lab located within the building on a slab-on-grade. This area will be designed for equipment weighing up to 20,000 lb.

4. Snow and Rain Loads

Snow and rain loads are based on the provisions of ASCE 7-16 and will include the recommendations of the snow load white paper prepared by the Structural Engineers Association of Washington for the low-lying areas of Puget Sound.

Minimum Snow Load 25 psf

5. Wind Design Criteria

The following criteria for wind are based on the IBC 2018 wind design criteria.

- ***V = 105 mph***
- ***Exposure C***
- ***Kzt = 1.00***
- ***Risk Category III***

6. Seismic Design Criteria

The following criteria for seismic are based on the IBC 2018 seismic design criteria.

- ***Site Class C***

  Ss = 1.35 ***Fa = 1.2*** ***SDS = 1.08***

  S1 = 0.47 ***Fv = 1.5*** ***SD1 = 0.47***
- ***Seismic Design Category D***
- ***Risk Category III***
- ***Seismic Importance Factor = 1.25***

C. Gravity Framing System

1. Typical Floor Framing

Typical floor framing will consist of cross-laminated timber (CLT) with a concrete topping slab. The CLT will be non-composite and will span between steel beams and glulam beams. The topping slab will act as a structural floor diaphragm and may be connected to the steel beams for composite action.

Metal deck may be used in lieu of CLT at some areas.

2. Columns

Glulam columns will bear directly on the foundations with raised steel connections. The typical column spacing will be 10 feet in one direction (without beams) and longer in the other direction (with beams). This will allow most of the building systems to be routed around the beams.

Steel columns may be used in some locations.

3. Basement Floors

A 5-inch-thick slab-on-grade (SOG) will be used at the ground level except at the Civil Engineering Lab, where an 8-inch thick SOG will be used. The SOG will be reinforced and will have control joints spaced at a maximum of 20 feet. There will be a vapor barrier, capillary break, filter fabric, and a drainage system below the slab. The Preliminary Geotechnical Report also suggests adding waterproofing below the slab.

4. Roof Penthouse

Steel or timber framing will be used for the rooftop stair overruns and elevator bulkhead.

5. Floor Flatness

The FDS requires the following slab flatness and levelness unless the finishes have more stringent requirements:

- *FF = 35 overall and 25 localized*
- *FL = 25 overall and 17 localized*

6. Slab over Electrical Rooms

The FDS requires slabs over primary electrical rooms to have a micro silica concrete mix, or a shrinkage limit of 0.00030 inches per inch. Add polypropylene fibers and treat all cracks with Methylmethacrylate.

7. Floor Vibration

There is no specific design criteria for floor vibration. Vibration sensitive equipment to be located near columns or on the SOG. Equipment that causes vibration will be fitted with isolators.

8. Secondary Structural Systems

- The canopies will use steel or timber framing.
- Elevator guide rails will be braced by steel or timber posts.
- Support steel or Unistrut will be used where heavy systems are mounted to the ceilings.
- Tall glazing panels will be braced by steel beams or posts.
- Exterior cladding will be supported by metal stud backup walls. Wood studs might be used, if allowed by the building code.

D. Lateral Force Resisting System

1. Vertical Lateral System

The vertical lateral system will consist of concrete shear walls or steel braced frames.

2. Diaphragms

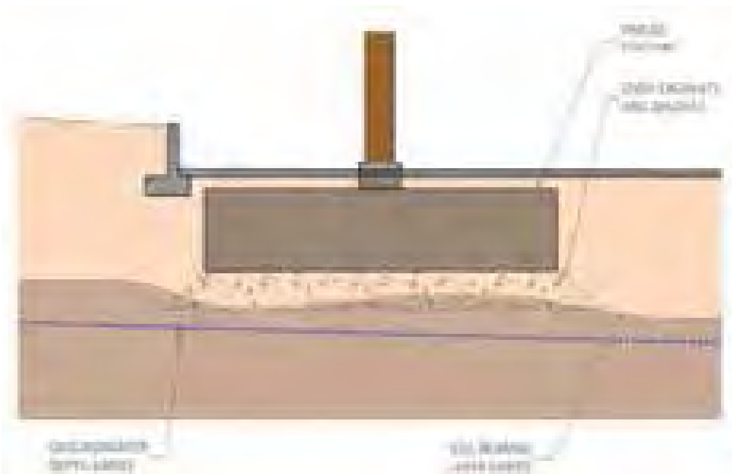
Diaphragm loads will be resisted by the concrete floor slabs. Mild reinforcement will be added as necessary to strengthen the slab due to diaphragm action.

E. Foundation Systems

1. Footings

The building columns will be founded on shallow spread footings. Continuous footings will be used to support the exterior walls. The preliminary geotechnical report estimates an allowable bearing pressure of 5,000 psf. The anticipated groundwater elevation ranges from 65 feet to 75 feet across the site.

Waterstop will be placed at all construction joints below grade.



F. Excavation Shoring and Earthwork

There appears to be adequate space for “open cut” grading, so excavation shoring is not anticipated.

Over-excavation will be required to reach suitable bearing soil. The preliminary geotechnical report estimates that 2 feet of over-excavation will be required over 25% of the foundation footprint.

6.2.5 Mechanical, Plumbing, Fire Protection, Electrical, Technology Systems

Project Description Revision – November 16,2020

Following the submission of Projection Definition in October 2020, several changes to the project have been made. These include:

- Increase square footage to 55,000 SF
- No overall budget change, requiring a smaller $/SF for each system.

As this change has been made, there has been acknowledgement from UW Tacoma that several project goals may be sacrificed. These include:

- UW Sustainability Goals, UW Green Building Standards
- LEED Silver as minimum (not LEED Gold)
- Reduction from UW FSDG requirements, most cost-effective MEP materials and methods

Mechanical Revision – November 16,2020

In order to meet the new budget and the reduction in goals the following items are being considered (and deviate from the rest of this report).

- Full mechanical cooling for all spaces is under review due to costs. Spaces that are not required to be mechanically cooled per the UWFSDG are under review and options to provide passive cooling or no cooling in those spaces will be explored in design.
- While a VRF system is likely the most cost-effective system for full heating and cooling compared to a 4-pipe ASHP option, a full VRF system may still not be within the project budget. More passive cooling approaches such as a high-performance envelope, operable windows, ceiling fans, etc. coupled with heating only (possibly electric heat) will be explored in design. Thermal comfort will likely be a sacrifice to stay within the project budget.
- Th extent of the measurement and verification system will be explored in design. At a minimum, code required metering and verification will be required but additional measures for LEED/UW Standards may not be affordable.
- The anticipated total tonnage of the mechanical system with full cooling is anticipated to be reduced to 175 tons.

Plumbing Revision – November 16,2020

In order to meet the new budget and the reduction in goals the following items are being considered (and deviate from the rest of this report).

- Consider using more point of use hot water heaters instead of central system with recirculating loops.
- Any type of water reclaim will likely not fit within this budget and will not be considered further.
- Use of unisex restrooms may offer some savings if it combines/consolidates the overall fixture count.
- Configuring restrooms or other plumbing items on a common wall chase or in the vertical position will help reduce piping main distribution costs.

Electrical Revision – November 16,2020

In order to meet the new budget and the reduction in goals the following items are being considered (and deviate from the rest of this report).

- The original assumption was that a 150kW generator would be required for this project. The need for a generator to support emergency power loads will be deferred to Design Documents drawing stage.
- The main electrical room will be sized at 35'x35'. As the design progresses, the size will be refined.
- The original assumption was that the majority of mechanical and lighting on upper floors would be fed from 480/277V. This was updated so that mechanical and lighting can be specified for any voltage, and therefore determine the distribution.
- The use of aluminum conductors for feeders may be utilized if approved by UWT.
- Separate isolated ground conductors will not be provided for branch circuits with sensitive loads.
- Electric Vehicle Charging Section will change to read "Infrastructure requirements will align with WAC 427" in lieu of the specific description of current WAC requirements.
- Interior lighting design will be completed by design-build contractor in lieu of a lighting consultant. All fixtures will be LED and may use 277V, 120V or low voltage.
- Wattstopper was the original basis of design manufacturer for lighting controls. Lighting control systems by other vendors may be used if approved by UWT.
- Control of classrooms and event spaces will be via the lighting control system or A/V control system. Final method of control will be determined in the design process.
- PV is only being considered if it's necessary for a LEED point.

Technology Systems Revision – November 16,2020

In order to meet the new budget and the reduction in goals the following items are being considered (and deviate from the rest of this report).

- Cabling: Network cabling requirements and updates to Division 27 of the UW IT Design Guide will be reviewed with UWT IT team. Final workstation port requirements to be coordinated with UWT IT team during design phase.
- Rack Bonding Bars (RBB) bonded to the PBB/SBB will be provided in each communication cabinet and IT rack in the MDF/IDF Rooms in lieu of every telecom enclosure.
- "Communication cable tray, conduit, and sleeves" will be bonded to the PBB/SBB in lieu of "racks, cable trays, conduits, and other telecom system equipment."

1.0 Project Description

1.1 Building Description

The project is in Tacoma, WA and includes a new 47,500 GSF business and engineering building on the University of Washington Tacoma campus. The building will be three to four stories.

The building program elements include:

- Open and Closed Offices
- Classrooms/Flexible Learning Spaces
- Administration Area
- Computer Lab
- Maker Space and Fabrication Shop
- Specialty Labs

1.2 Codes and Standards

The following is a list of codes, guidelines, regulations and other references that will be put into practice in the design of the building. Many of these codes references are based on a Building Permit submission after Feb 1, 2021, which is when WA state adopts to the new Building Codes, it is anticipated that the City of Tacoma will adopt the same day.

- 2018 International Building Code with Washington Amendments
- 2018 International Fire Code with Washington Amendments
- 2018 International Mechanical Code with Washington Amendments
- 2018 Washington State Energy Code
- 2018 Uniform Plumbing Code with Washington Amendments
- 2020 National Electrical Code with Washington Amendments
- ASHRAE Standard 62.1-2010 – Ventilation for Acceptable Indoor Air Quality
- ASHRAE Standard 55-2010 – Thermal Environmental Conditions for Human Occupancy
- ASHRAE Standard 90.1-2010 – Energy Standard for Buildings Except Low-Rise Residential Buildings
- ADA or Uniform Federal Accessibility Standards
- National Fire Protection Association (NFPA) Standards
- USGBC LEED Green Building Rating System for New Construction (LEED-NC)
- American National Standards Institute (ANSI)
- Institute of Electrical and Electronics Engineers (IEEE)
- National Electrical Manufactures Association (NEMA)
- Underwriters Laboratories (UL)
- American's with Disabilities Act (ADA)
- Telecommunications Industry Association (TIA)
- Building Industry Consulting Service International (BICSI)
- 2020 UW Facilities Services Design Guide (FSDG)
  - Including the UW Lab Safety Design Guide dated 2014
  - Including the UWT Supplemental requirements
- UW IT Design Guide

2.0 Mechanical

2.1 Design Criteria

The following tables illustrate the design criteria that will be utilized to design the facility systems.

Table 1: Outdoor Conditions

Operation	Reference	Temperature
Cooling	ASHRAE 0.4% (Dry Bulb/Mean Coincident Wet Bulb)	84°F/64°F
Evaporation	ASHRAE 0.4% (Wet Bulb/Mean Coincident Dry Bulb)	66°F/81°F
Dehumidification	ASHRAE 0.4% (Dew Point/Mean Coincident Dry Bulb)	61°F/69°F
Humidification	ASHRAE 99.6% (Dew Point/Mean Coincident Dry Bulb)	15°F/36°F
Heating	ASHRAE 99.6% (Dry Bulb)	29°F

Note: Numbers are based on the 2009 ASHRAE Handbook, for the location "Tacoma Narrows".

Final equipment Selection to be based on Heating and cooling setpoints from 2018 Washington State Energy Code if different from above

Table 2: Indoor Climate Conditions

Occupancy	Relative Humidity	Cooling	Heating
Offices	0% – 65%	78°F ±2°F	68°F ±2°F
Conference Rooms	0% – 65%	78°F ±2°F	68°F ±2°F
Corridors	n/a	78°F ±2°F	68°F ±2°F
Restrooms	n/a	78°F ±2°F	68°F ±2°F
Vestibules	n/a	n/a	50°F ±2°F
Storage	n/a	80°F ±2°F	60°F ±2°F
Mechanical Spaces	n/a	80°F ±2°F	60°F ±2°F
Electrical Spaces	n/a	80°F ±2°F	60°F ±2°F
MDF Spaces	0% – 65%	80°F ±2°F	60°F ±2°F
IDF Spaces	0% – 65%	80°F ±2°F	60°F ±2°F
Classrooms	0% – 65%	78°F ±2°F	68°F ±2°F
Lecture Classrooms	0% – 65%	78°F ±2°F	68°F ±2°F
Specialty Labs	0% – 65%	78°F ±2°F	68°F ±2°F
Maker Spaces and Fabrication Shop	0% – 65%	78°F ±2°F	68°F ±2°F
Passive Conditioned Spaces	n/a	80°F ±2°F	70°F ±2°F

Notes:

1. All space design condition setpoints are based on the UW FSDG when applicable.
2. **UW FSDG states that in general, mechanical cooling is not to be provided in general use buildings except for libraries and large auditoria. The design team is currently planning to provide mechanical cooling for all spaces listed above in addition to the UW FSDG minimum requirements.**
3. Relative humidity shown for reference only based on expected values. No active humidity control will be provided.

Table 3: Minimum Airflow Rates

Occupancy	Outdoor Air	Supply Air	Exhaust Air
Offices	17 CFM/person	varies	n/a
Conference Rooms	7 CFM/person	varies	n/a
Corridors	0.06 CFM/SF	varies	n/a
Restrooms	n/a	n/a	12 ACH
Vestibules	n/a	n/a	n/a
Storage	0.06 CFM/SF	varies	n/a
Mechanical Spaces	0.06 CFM/SF	varies	n/a
Electrical Spaces	0.06 CFM/SF	varies	n/a
MDF Spaces	0.06 CFM/SF	varies	n/a
IDF Spaces	0.06 CFM/SF	varies	n/a
Classrooms	15 CFM/person	varies	n/a
Lecture Classrooms	11 CFM/person	varies	n/a
Specialty Lab	varies	varies	varies
Maker Space and Fabrication Shop	varies	varies	varies
Passive Conditioned Spaces	varies	varies	n/a

Notes: Outdoor air and exhaust air for Specialty Lab spaces and Maker Spaces to be determined in design phase based on space programming and UW Lab Design Criteria.

Table 4: Acoustical Design Guidelines

Occupancy	Room Criterion
Open Offices	40
Private Offices	30
Conference Rooms	30
Corridors	40
Restrooms	40
Vestibules	n/a
Storage	50
Mechanical Spaces	50
Electrical Spaces	50
MDF Spaces	50
IDF Spaces	50
Classrooms	25
Lecture Classrooms	25
Specialty Labs	35
Maker Spaces	30

Note: NC Values shown above are taken from the UW FSDG.

Table 5: Internal Load Assumptions

Occupancy	Occupant Density	Plug Load	Lighting Load
Offices	200 SF/person	1.0 W/SF	0.7 W/SF
Conference Rooms	20 SF/person	1.5 W/SF	0.7 W/SF
Corridors	n/a	0.25 W/SF	0.5 W/SF
Restrooms	n/a	0 W/SF	0.5 W/SF
Vestibules	n/a	0 W/SF	0.5 W/SF
Storage	n/a	0 W/SF	0.43 W/SF
Mechanical Spaces	n/a	0 W/SF	0.43 W/SF
Electrical Spaces	n/a	10 W/SF	0.43 W/SF
MDF Spaces	n/a	10 W/SF	1.0 W/SF
IDF Spaces	n/a	10 W/SF	1.0 W/SF
Classrooms	20 SF/person	0.5 W/SF	0.74 W/SF
Lecture Classrooms	15 SF/person	0.25 W/SF	0.71 W/SF
Specialty Labs	60 SF/person	1.5 W/SF	1.1 W/SF
Maker Spaces	40 SF/person	1.5 W/SF	1.0 W/SF

Table 6: Duct and Pipe Sizing Criteria

Low-Pressure Ductwork	
Static Pressure Loss	Maximum 0.10 inches water column per 100 feet
Main Velocity	Maximum 1,500 feet per minute
Branch Velocity	Maximum 1,200 feet per minute
Flexible Ducts	Maximum length 8 feet, minimize total 90 degree bends
Medium-Pressure Ductwork	
Static Pressure Loss	Maximum 0.28 inches water column per 100 feet
Main Velocity	Maximum 2,400 feet per minute
Branch Velocity	Maximum 2,000 feet per minute
Hydronic Piping	
Static Pressure Loss	Maximum 4 feet water column per 100 feet
Velocity	Maximum 7 feet per second

2.1 Mechanical System Overall Description

The air systems for mechanical do not need system exploration as they are set by the specialty lab requirements and the energy code. Two air systems will be provided. For the specialty lab spaces, a VAV unit, 100% OSA with terminal unit re-heat, and specialty/hazardous separate exhaust will be provided. For all other spaces, a DOAS, 100% OSA unit with supply and exhaust and a heat recovery device will be provided. This is described further in this narrative.

The way to provide local heating and cooling is still being explored. The two recommended strategies to be carried forward on this project are, Variable Refrigerant Flow (VRF) and Air to Water Heat Pumps (AWHP).

A VRF system is a mechanical HVAC system that provides heating and cooling through outdoor air sourced heat pumps with compressorized refrigerants routed from the outdoor heat pumps to multiple energy sharing indoor units throughout the building. An AWHP system is a mechanical HVAC system that provides heating and cooling through outdoor air sourced heat pumps, with the refrigerant being contained to the outdoor unit. The AWHP generates heating and chilled water which is then distributed to indoor units for heating and cooling.

During project definition, the VRF system was discussed to be the baseline option while the AWHP is considered a better option from a sustainability and longevity perspective. Further evaluation of the merits and advantages of AWHP over VRF will be done in design. A description of each system and the proposed betterments is described below.

Sketches are included in this narrative that help to describe the air systems and the heating and cooling options.

2.2 Heating and Cooling – VRF Option

In this option, the building will be heated and cooled by air source variable refrigerant flow (VRF) heat recovery heat pumps. There will be outdoor condensing units with refrigerant piping routing from the heat pumps, through the building to branch controllers/heat recovery boxes/coil kits, then routed to terminal equipment. The outdoor condensing units can be located on either the roof or a ground level equipment yard.

Since the lab VAV system requires re-heat, part of the VRF system option will require a small separate heating hydronic system, this is shown as a small AWHP (10 Ton) in the sketches.

The VRF system would provide heating and cooling to the general use spaces in the building and to the AHUs that serve both the labs and the general use areas.

Table 7: VRF Equipment

VRF Equipment					
Equipment	Quantity	Unit Capacity	Total Capacity	Electrical	Manufacturer
Outdoor Condensing Unit	5	40 tons	200 tons	460V/3 PH (x5) FLA: 50 A	LG, Daikin, Mitsubishi, Samsung

2.3 Heating and Cooling – AWHP Option

In this option, the building will be heated and cooled by four pipe air source heat pumps (AWHP). The AWHP's will either be located on the roof or on a ground level equipment yard. Buffer tanks will be provided on chilled and heating water loops to prevent short cycling of heat pump compressors. Electric resistance boilers would be provided to provide back-up heating for extreme winter conditions that do not allow for air source heat pump heating. The electric boiler will be sized for 20% total capacity. Variable speed pumps sized for N+1 redundancy will distribute the heating and chilled water to terminal equipment within the building.

The AWHP hydronic system would serve the specialty lab spaces (re-heat) and general use spaces in the building, as well as the AHUs that serve the building.

Building wide use of this AWHP option is unlikely due to the budget constraints. However, more analysis is needed to determine where AWHP technology and/or passive cooling strategies may be used.

Table 8: AWHP Equipment

AWHP Equipment				
Equipment	Quantity	Total Capacity	Electrical	Manufacturer
AWHP 1	1	145 tons	460V/3PH FLA: 400 A	Aermec, Multistack, Climacool
AWHP 2	1	50 tons	460V/3PH FLA: 200 A	Aermec, Multistack, Climacool
CHW Pumps	3	60 ft/[illegible] gpm	(x3) 5 HP	B&G, Taco, Armstrong
HW Pumps	3	60 ft/[illegible] gpm	(x3) 3 HP	B&G, Taco, Armstrong
Buffer Tanks	2	800 gal	-	B&G, Taco, Armstrong
Air Separators	2	6" Inlet/Outlet	-	B&G, Taco, Armstrong
Electric Boiler	1	240 MBH	75 kW	[illegible], Cleaver Brooks

2.4 Air Handling Systems

The air handling systems recommended are broken out into two separate systems. One system serves the specialty lab spaces, maker spaces, etc. while the second system serves the general use spaces such as offices and classrooms. The air systems described below apply to both heating/cooling options (the VRF system or the AWHP system) with slight differences noted below.

VARIABLE AIR VOLUME ("VAV") – SPECIALTY LAB SPACES

Air for ventilation and air change per Hour (ACH) requirements will be distributed to all specialty lab spaces by a central, custom, factory fabricated, variable air volume 100% outside air, air handling unit. This unit will provide supply air only.

Unit will be equipped with the following components:

— Outside air damper
— Pre-filters (MERV 8) – supply air
— Final filters (MERV 13) – supply air
— Coils to provide heating and coiling
  - VRF Option: VRF coil kit and VRF Coil
  - AWHP Option: hydronic coils with circulation pumps.
— Variable speed supply fans with N+1 redundancy
— Supply air acoustic silencers (if required)

If multiple units are required, zoning of air handling units will be based on environmental requirements, operating schedules, and specialty lab requirements.

The supply fan section will include 4 fans to allow for partial redundancy. In the event 1 fan fails the remaining fans will be designed to achieve 100 percent of full design airflow.

Supply fan speeds will vary speed to maintain the minimum airflow required to maintain ventilation and air change rate requirements as well as meet cooling demands.

Heating and cooling coils valves will modulate to maintain supply air temperature between 55- and 70-degrees F.

A proposed betterment option is providing a heat recovery run around loop between the Supply AHU and Exhaust AHU – this may be required by code, pending exhaust requirements.

Table 9: Specialty Lab Supply AHU

Specialty Lab Supply AHU					
Equipment	Quantity	Fan Capacity	AHU Capacity	Electrical	Manufacturer
Supply Air Fans	4	[illegible]	[illegible]	[illegible]	[illegible]

DEDICATED OUTDOOR AIR SYSTEM (DOAS) – GENERAL USE SPACES

Air for ventilation and dehumidification will be distributed to all occupied spaces (other than specialty labs) by a central, custom, factory fabricated, variable air volume dedicated outdoor air handling unit.

Units will be equipped with the following components:

— Outside air damper
— Relief air damper
— Pre-filters (MERV 8) – supply air
— Final filters (MERV 13) – supply air
— Pre-filters (MERV 8) – return air
— Heat recovery wheel with face/bypass dampers
— Coils to provide heating and coiling
  - VRF Option: VRF coil kit and VRF Coil
  - AWHP Option: hydronic coils with circulation pumps.
— Variable speed supply fans, N+1 redundancy
— Variable speed return fans, N+1 redundancy
— Supply air acoustic silencers (if required)
— Return air acoustic silencers (if required)

If multiple units are required, zoning of air handling units will be based on environmental requirements and operating schedules.

The heat recovery wheel sized for full airflow rate will transfer energy from the return airstream to the supply air stream, bypass dampers will be provided and modulated as needed to maximize economizer hours, and minimizes pressure drop.

The supply and return fan sections will include 4 fans to allow for partial redundancy. In the event 1 fan fails the remaining fans will be designed to achieve 100 percent of full design airflow.

Supply and Return fan speeds will vary speed to maintain the minimum airflow required to maintain ventilation and dehumidification requirements.

Heating and cooling coils valves will modulate to maintain supply air temperature between 55- and 70-degrees F.

The baseline AHU utilizes a wheel heat recovery system which has an efficiency of ~60%. A proposed betterment option is to increase the heat recovery effectiveness of the AHU to 90% plus.

Table 10: General Use AHU

General Use AHU					
Equipment	Quantity	Fan Capacity	AHU Capacity	Electrical	Manufacturer
Supply Fans	4	[illegible]	[illegible]	[illegible]	[illegible]
Return Fans	4	[illegible]	[illegible]	[illegible]	[illegible]

2.5 Terminal Heating and Cooling Equipment

The terminal heating/cooling equipment is broken out into two categories, terminal equipment serving the specialty lab spaces and terminal equipment serving the general use spaces. Terminal equipment are similar between the VRF option and AWHP option with differences noted below.

SPECIALTY LAB TERMINAL EQUIPMENT

Variable volume terminal units with reheat will be provided for specialty lab spaces delivering conditioned outside air directly to the space to maintain space temperature, space pressurization, and the required ACH.

For the VRF option, there are a few options for reheat. Either a VRF duct coil will be added downstream of each terminal unit or a central VRF hydronic kit will be provided. The VRF hydronic kit would create a dedicated heating water loop that will provide hydronic reheat for each terminal unit. Another option (and the one shown in the sketches) is to provide a small and separate AWHP to create a hydronic loop.

For the AWHP option, the terminal unit reheat will be through the heating hot water system generated by the AWHPs.

As the program layout has not been determined, a quantity of terminal devices is unknown at this time.

GENERAL USE TERMINAL EQUIPMENT

Variable volume DOAS terminal units will be provided for occupied portions of the building delivering outside air directly to the space providing the minimum ventilation rates and ramping up as needed for spaces with demand control ventilation. Heating and cooling for each space will be provided by some type of fan coil unit. The terminal units and the fan coil units will be separate such that the fan coil units can shut off while the terminal units still provide ventilation air to the occupied spaces.

For the VRF system option, VRF fan coil units will be provided. For the AWHP system option, four pipe fan coil units will be provided.

Unit heaters will be provided for unoccupied portions of the building. Cabinet unit heaters will be provided for vestibules and stairwells for freeze protection.

As the program layout has not been determined, a quantity of terminal devices is unknown at this time.

2.6 Exhaust Systems

The exhaust systems are broken out into two categories, exhaust systems serving the specialty lab spaces and exhaust systems serving the general use spaces. Exhaust systems are identical between the VRF option and AWHP option.

SPECIALTY LAB EXHAUST SYSTEMS

Exhaust air for specialty labs, canopy hoods, and local lab exhaust systems will be exhausted by a central, custom, factory fabricated, variable air volume dedicated exhaust air handling unit. The exhaust AHU will be provided with high plume, dilution fans for suitable discharge to avoid re-entrainment of exhaust air by building outside air intakes.

Units will be equipped with the following components:

— Relief air damper
— Pre-filters (MERV 8) (if heat recovery run around coil is provided)
— Variable speed exhaust fans, N+1 redundancy
— Exhaust air acoustic silencers (if required and appropriate)

The exhaust fan section will include 4 fans to allow for partial redundancy. In the event 1 fans fail the remaining fans will be designed to achieve 100 percent of full design airflow.

Exhaust fan speeds will vary speed to maintain pressure, ACH, and general exhaust airflow requirements.

The baseline Exhaust AHU is not provided with a heat recovery coil. A proposed betterment is to utilize a heat recovery run around loop between the Exhaust AHU and the Specialty Lab AHU. Estimated heat recovery efficiency is around 50%.

Table 11: Specialty Lab Exhaust AHU

Specialty Lab Exhaust AHU					
Equipment	Quantity	Fan Capacity	AHU Capacity	Electrical	Manufacturer
Return Air Fans	4	[illegible] cfm	[illegible] cfm	[illegible]	[illegible]

GENERAL EXHAUST SYSTEMS

Exhaust for all other non-specialty lab spaces will be routed through the DOAS system serving those spaces so that heat recovery can be achieved.

2.7 Natural Ventilation & Passive Cooling

As part of design, the team will continue to explore if there are general use spaces where natural ventilation and passive cooing strategies can be used. The following design considerations will be part of this exploration (see the Sustainability report for more information):

— Expanded thermal comfort ranges, on the cooling side
— High Performance Envelope
— Other passive strategies such as operable windows and ceiling fans
  - Operable windows would be automated (ie: not manual). Switches would be used to open and close the windows by both the users and have control at the BMS for night shut down as well as shut off any heating/cooling elements when the windows are open.

There is a tipping point of these strategies where we can eliminate "terminal heating and cooling" equipment all together – and simply provide a small electric heating element in each space. Ahead of that tipping point there is an opportunity for mechanical savings for both upfront cost (by reduction of size and piping) and operational savings as well.

One result of these strategies may be having spaces that operate in "mixed mode" meaning taking advantage of the outside air when temperatures permit, but still having a full mechanical system available when the outside air conditions require any operable windows to be closed.

Note that natural ventilation or passive cooling is not being explored for the specialty lab spaces – as they have exhaust and pressurization requirements. However, a high-performance envelope in those spaces will result in lower operating heating and cooling costs.

2.8 Stairwell Pressurization

Exit stairwells exceeding 75 feet in height will be provided with pressurization systems to maintain pressure within the stairwell above adjacent spaces with the intent of preventing smoke from entering the stairwell during a fire event. Based on expected building footprint and elevations, no stairwell pressurization fans are expected to be required. This is an unlikely condition for this project.

2.9 Controls

A direct digital control (DDC) system will be provided to control and monitor all HVAC equipment and systems regardless of selected system. Valve and damper actuation will be electric type. The control system will be integrated into the existing campus system to allow full control and monitoring from the existing operator's terminal. The control system will perform all required control functions, including optimization of equipment and system performance, reliability, equipment life and energy consumption.

A proposed betterment option is to provide additional smart controls for the lab exhaust systems. Depending on what is being done in labs, fast-acting valves may be required.

Controls system will be Siemens, ATS or Delta Controls.

2.10 Measurement and Verification

A widespread measurement and verification system is anticipated to carefully monitor the building's energy use. The building's energy and water use will be tracked by the building BMS system. The sharing and analysis of that data is to be determined.

PRELIMINARY RECOMMENDATION

Our recommendation is to proceed with the non-utility metering strategy in accordance with LEED M&V, described below.

Monitoring building energy use at this level provides the following benefits:

— Continuous optimization of building performance.
— Education of building occupants.
— Serves as a case study for other building designs, helping the greater community of the built environment.

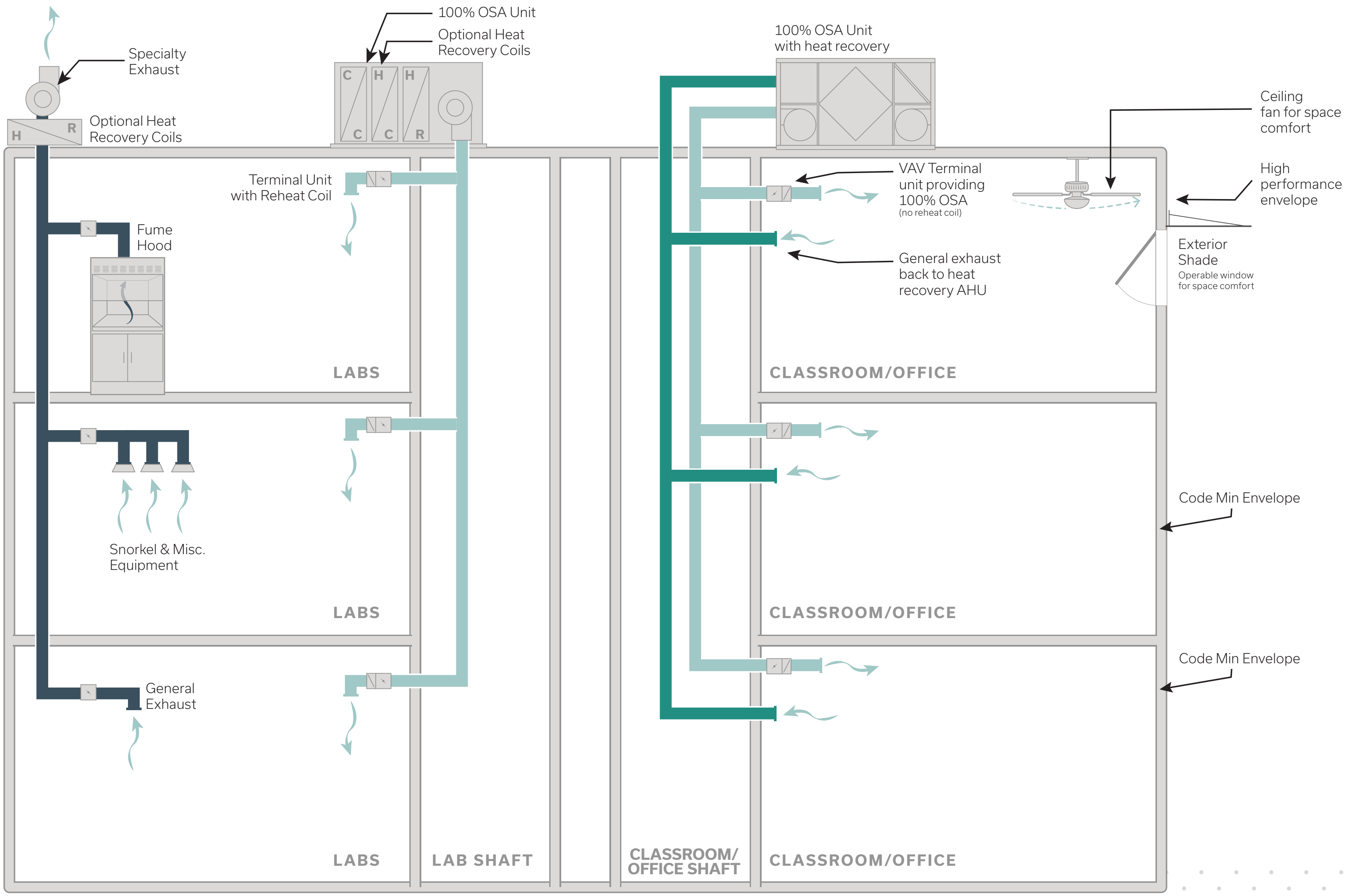
LEED V4 MEASUREMENT AND VERIFICATION REQUIREMENTS

Separate monitoring of the following end use loads:

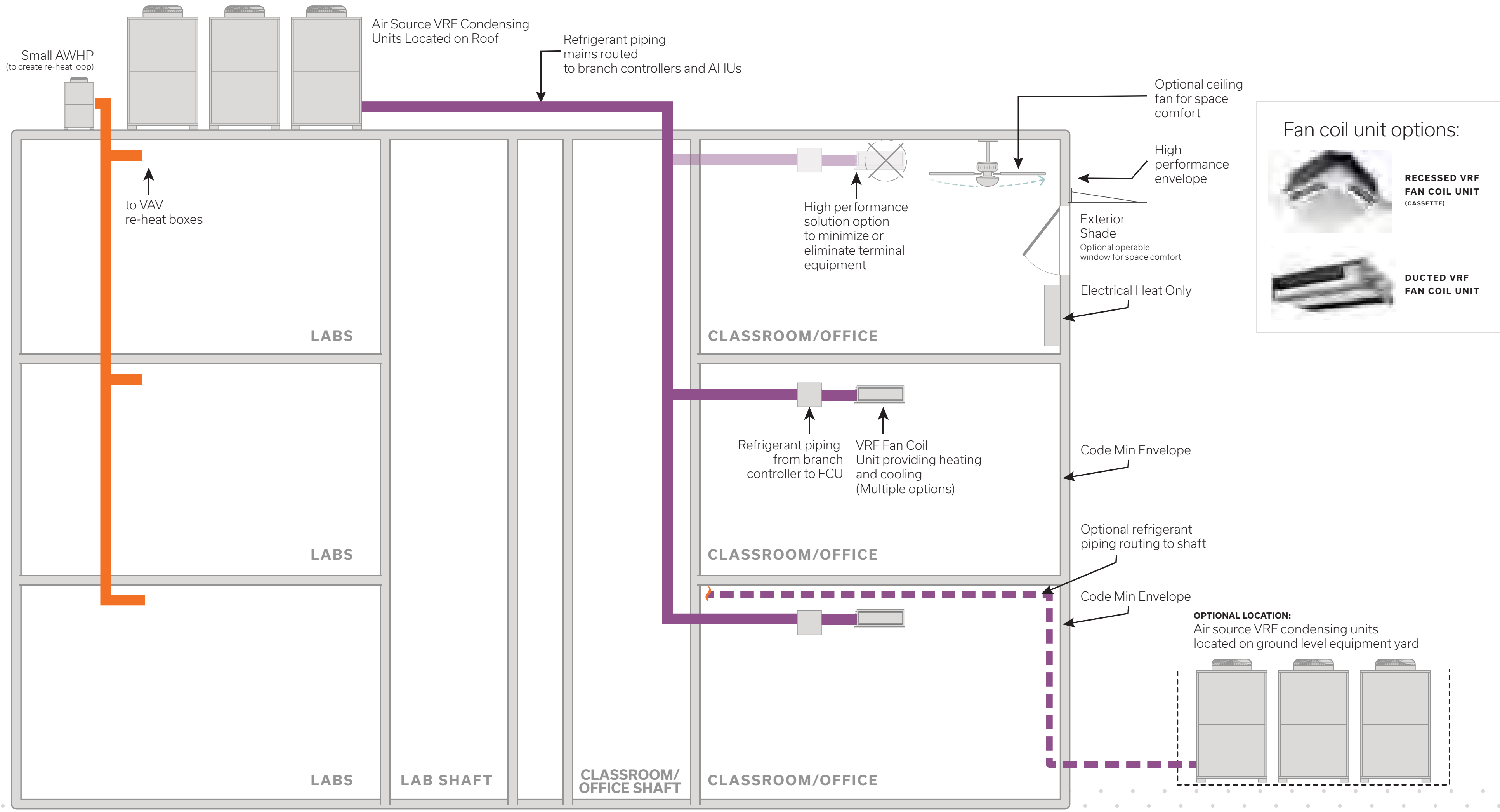
— Lighting
— Receptacles
— Heating
— Fans
— Cooling
— Pumps
— Elevator
— Water – total building use
— Domestic hot water

In addition, a measurement and verification plan will be developed to analyze the building energy and water use after occupancy to optimize the building performance.

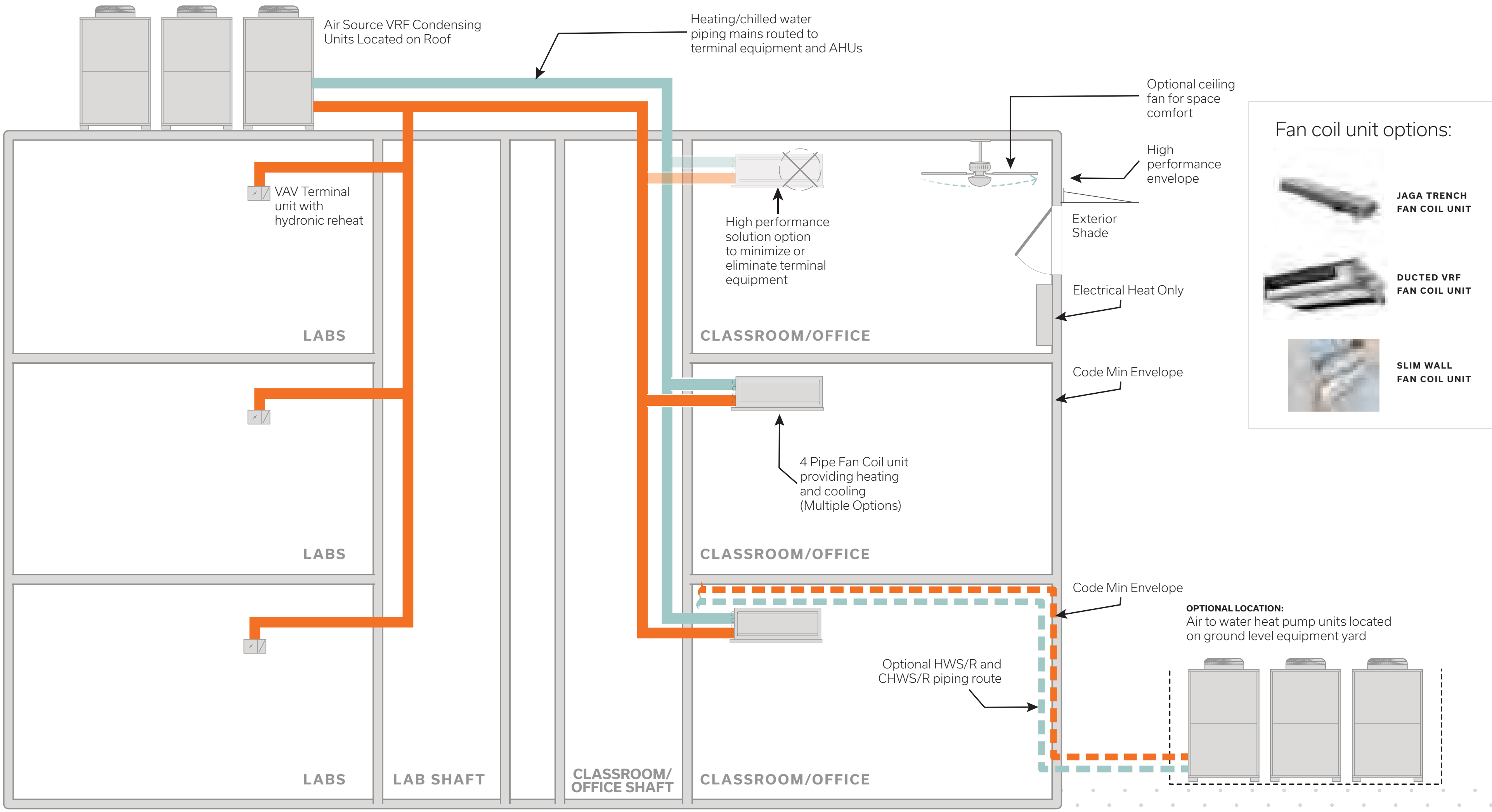
Air Side Riser Diagram



VRF System Riser Diagram



AWHP System Riser Diagram



3.0 Plumbing

3.1 Design Criteria

Table 12: Plumbing Piping Sizing Criteria

Domestic and Non-Potable Water Piping	
Minimum Pressure	30 PSI at most remote outlet
Maximum Pressure	70 PSI
Friction Loss	Maximum 3 feet per 100 feet
Velocity	Maximum 8 feet per second (Cold & Non-potable Water) Maximum 5 feet per second (Hot Water) Maximum 3 feet per second (Hot Water Return)
Sizing	Per Code (UPC 2018 – Appendix A)
Below Grade Material	3 inch and smaller, Type K, Hard drawn copper tubing, Soldered\brazed fittings 4 inch and larger, Ductile iron, Incoming main, Class 150 Boltite mechanical joint 4 inch and smaller, Type L, Hard drawn copper tubing, Soldered\brazed fittings 6 inch and larger, Type L or Schedule 10 Stainless Steel, Brazed fittings
Domestic Hot Water Supply/Return, Above Grade Insulation	3/4 inch and smaller, 1-inch thick fiberglass, all-purpose jacket or elastomeric 1 inch and larger, 1-1/2-inch-thick fiberglass or all-purpose jacket
Storm Drainage Piping	
Rainfall Rate (extract local rainfall for project location)	1.0 inches per hour 2.0 inches per hour (combined main drain and overflow)
Piping Slope	Minimum 1/4 inch per foot
Sizing	Per Code (UPC 2016)
Material	Service weight cast iron with no-hub couplings
Insulation	Drain bodies and first 10 feet of pipe connected to the drain body 1/2-inch, Fiberglass, All-purpose jacket
Waste and Vent Piping	
Piping Slope	Minimum 1/4 inch per foot for piping less than 4 inches, 1/8 inch per foot for 4 inches and larger
Sizing	Per Code (UPC 2016)
Material	Service weight cast iron with no-hub couplings
Material	Above Grade, Interior 2 inch and smaller, Black steel, Schedule 40, Screwed fittings
	2-1/2 inch and larger, Black steel, Schedule 40, Welded fittings
	Above Grade, Exterior (or exposed to corrosive environment) 2 inch and smaller, Hot-dipped zinc galvanized steel, Schedule 40, Screwed fittings 2-1/2 inch and larger, Hot-dipped zinc galvanized steel, Schedule 40, Welded fittings Acid resistant piping shall be provided in lab areas where required
	Below Grade Polyethylene pipe conforming to ASTM D2513-80a, Mechanical fittings

3.2 Plumbing Fixtures

Commercial grade low flow fixtures will be provided where indicated on the architectural drawings. Refer to table below for representative flow rates for each type of fixture.

Table 13: Plumbing Fixture Types and Locations

Fixture	Location	Type	Control	Flow*	Basis of Design	Notes
WC-1 Water Closet	Restrooms	Wall hung, vitreous china	Sensor Operated flush valve	1.28 GPF	Kohler water closets with Sloan flush valve	
WC-2 Water Closet	Restrooms (ADA wheelchair and ambulatory stalls)	Wall hung, vitreous china	Sensor Operated flush valve	1.28 GPF	Kohler water closets with Sloan flush valve	Seat at 18 inches above floor, centerline at 17 inches from wall
L-1 Lavatory	Restrooms	Counter mounted, vitreous china	Sensor Operated	0.5 GPM	Kohler sink basin with Delta faucet	All locations are ADA accessible
U-1 Urinal	Restrooms	Wall Hung, vitreous china	Sensor Operated flush valve	0.5 GPF	Kohler Urinal with Sloan flush valve	
U-2 Urinal	Restrooms (ADA)	Wall Hung, vitreous china	Sensor Operated flush valve	0.5 GPF	Kohler Urinal with Sloan flush valve	Rim mounted at 17inches above floor
SH-1	Shower	Single Shower Head	Thermostatic mixing valve	1.25 gpm	Powers	
S-1 Sink	Kitchenettes	Self rimming, counter mounted, Stainless steel	Single lever faucet, swing spout	1.5 GPM	Elkay sink basin with Delta faucet	ADA faucet

Fixture	Location	Type	Control	Flow*	Basis of Design	Notes
S-2 Sink	Labs	Self rimming, counter mounted, Stainless steel	Single lever faucet, gooseneck spout	1.5 GPM	Elkay sink basin with Delta faucet	ADA faucet
S-3 Sink	Lab sink	Self rimming, counter mounted, Stainless steel	TBD	TBD	TDB	ADA faucet
S-4 Sink	Custodial sink	Floor mounted mop basin	Dual handle faucet, wall spout	3.0GPM	Zurn sink basin with Delta faucet	
DF-1 Drinking fountain with bottle filler	Varies	Dual height with bottle filling station, stainless steel	Front push pad operation for drinking fountains and sensor operation at bottle filler	1.5 GPM at bottle filler	Elkay	Non-refrigerated
*Code minimum flush/flow rates.						

Table 14: Fixture Options and Alternates

Fixture Type	Code Flow (Cal Green)	*0/2817 Low Flow	Ultra-Low Flow	No Flow	ASHRAE 189	Proposed
Water Closet	1.28 GPF	1.6/1.1 GPF Dual Flush	1.28 GPF	Composting	1.28 GPF	
Urinal	0.125 GPF	0.5 GPF	0.125 GPF	Waterless	0.5 GPF	
Lavatory–Commercial	0.5 GPM	1.0 GPM	0.5 GPM	--	0.5 GPM	
Shower	2.0 GPM	2.0 GPM	1.25 GPM	--	2.0 GPM	
Kitchen Faucet	1.8 GPM	2.2 GPM	2.0 GPM	--	2.2 GPM	
GPF = Gallons per Flush GPM = Gallons per Minute						

3.3 Domestic Cold-Water System

A water main entering through the main water room will serve the domestic water system. The domestic water system will be provided with positive means to control backflow, with appropriate backflow preventers at sources of possible contamination within the building, such as mechanical equipment or industrial cold/hot water systems. The water room should be located on an exterior wall to avoid running water lines below the building foundation.

Cold water will be distributed to the plumbing fixtures, laboratories, exterior hose bibbs and other areas requiring water. Freeze-proof hose bibs to be distributed around perimeter of building at every 100 feet and be provided for other areas needing washdown.

A water pressure test has not been completed, but at this time (based on other buildings nearby) it is assumed that street water pressure will be adequate for a 3 or 4 story building.

Vertical domestic water risers will be provided which will serve horizontal distribution piping at each floor. A copper manifold with shutoff valves will be provided at each major plumbing group.

IRRIGATION

A backflow device will be provided for the irrigation system within the water service room. Irrigation piping will be stubbed out of the building for the landscape use.

3.4 Domestic Hot Water System

The baseline assumption is that high efficiency electric water heaters will provide domestic hot water to the building. As a betterment, heat pump water heaters will be considered in design.

The domestic hot water system components will be controlled by the building management system.

Two water heaters located in the main level water room will serve the entire building. Point of use electric water heaters may be considered for remote fixture locations.

A recirculating hot water loop and hot water circulation pump will be provided.

The water heaters will produce 140 degrees F for health and equipment efficiency purposes.

A master thermostatic mixing valve will temper the hot water to 120 degrees F for general use.

Thermostatic mixing valves will provide tepid water to emergency fixtures per ANSI/ISEA Z358.1. Tepid water will be supplied no less than 60 degrees F and no greater than 100 degrees F.

Expansion tanks will be provided on hot water systems at water heaters to eliminate pressure buildup when the system is not being used.

3.5 Storm Drain System

A roof and overflow drain system will be provided as required by code. Overflow storm drain system will daylight utilizing downspout nozzles at the ground level above grade.

Water Reclaim Option: The storm water piping will be routed to a storm water reclamation system. Overflow from the below grade storm water reclamation storage tank will be piped to the storm system at the street.

Storm water will pipe separately to points along the east side as needed to accommodate roof drains.

A running trap will be provided on the storm water piping leaving the building to prevent sewer gases from entering the building storm water piping systems.

3.6 Sanitary Sewer System

Sanitary waste and vent piping will be provided in toilet rooms and other spaces as required.

Separate acid resisting waste and vent piping systems will be provided for labs and classrooms, as required. The acid resisting waste piping system will be piped to a sampling manhole located outside the building where it will connect to the sanitary sewer system.

Sanitary waste piping leaving the site will connect to site sanitary line via a side sewer at the NE corner.

Sump pumps will be provided for elevator shafts and connected to the gravity sanitary system within the building.

3.7 Rainwater Reclamation System – (Budget Permitting)

A rainwater reclamation system will be explored to reduce the storm water impact on this combined system and may provide opportunities to reduce the storm and or sewer SDC charges. The system will collect the rain that falls on the roof and pipe it to a below grade storage tank. The water will then be utilized to flush toilets, urinals, mechanical or lab make-up, and for irrigation needs. The plumbing code requires fixtures served from the rainwater system to be on opposite walls from those served with potable water (lavatories and drinking fountains).

3.8 Other Lab Plumbing Systems

COMPRESSED AIR

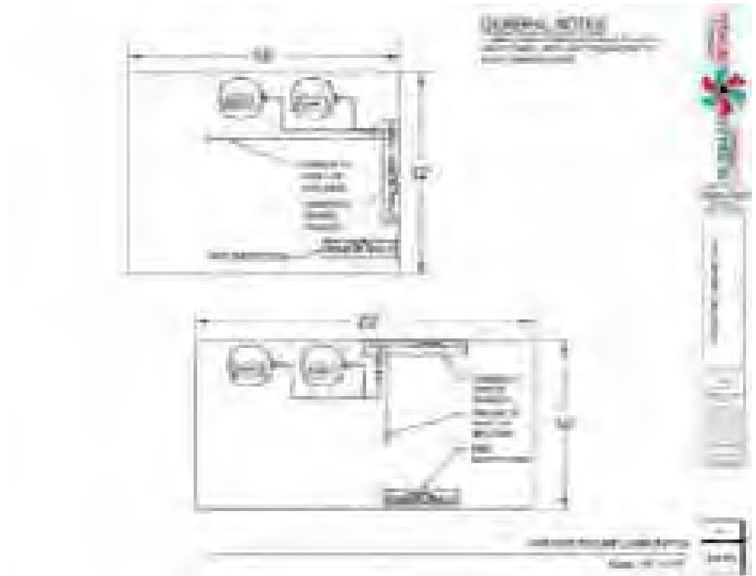
Compressed air will be produced by a packaged system, which includes duplex air compressors, receiver tank, and air dryer. Compressed air will be delivered at 100 PSI to all required labs or classrooms. Pressure will be reduced by means of a pressure regulator for those spaces requiring 15 PSI compressed air.

NATURAL GAS, OTHER GASES

At this time, it is understood that all gases will be provided by local tanks, and no building wide piped distribution system will be required. Piped systems will be limited to individual lab spaces.

EMERGENCY FIXTURES

Emergency eyewashes and showers will be provided complete with tempered water source and drainage as required to suit the lab use and location.



4.0 Fire Protection

4.1 Design Criteria

The project fire protection system will be designed in accordance with the following standards, State Fire Code, and local Fire Marshall requirements.

- NFPA 13: Standard for the Installation of Sprinkler Systems
- NFPA 14: Standard for the Installation of Standpipe and Hose Systems

4.2 General

FIRE WATER SERVICE

A 6-inch fire service will be provided and enter the building at the Riser Room.

A detector double check assembly will be provided for the fire service by Civil in an exterior buried vault/where the fire service enters the building/at the Riser Room located on the main level at an exterior room.

A reduced pressure backflow assembly will be provided for the fire service by Civil on site/by Civil in a heated enclosure on site.

FIRE DEPARTMENT CONNECTION (FDC)

The Fire Department Connection (FDC) will be located adjacent to the backflow device vault.

DOMESTIC MANUFACTURER REQUIREMENTS

Fire protection system materials to be of a domestic manufacturer.

SPRINKLER HEADS

Finished areas will be provided with chrome plated semi-recessed pendant type with polished chrome escutcheons for spaces with ceilings. For areas without ceilings (majority of project) upright will be used.

Unfinished areas will be provided with upright rough brass finish type heads.

Overhangs less than 4 feet in depth, loading docks, and other perimeter areas subject to freezing will be provided with horizontal dry sidewall sprinkler heads.

Light hazard occupancies will be provided with Quick-Response heads.

4.3 Wet Pipe Sprinkler System

The fire sprinkler system will consist of main flow alarm station, zone control valves and flow indicators, alarm bell, fire sprinkler piping and heads.

Accessories related to the system will be provided. Tamper, flow, and pressure switches will be coordinated with the fire alarm system.

Piping will be black steel, routed concealed.

Required system isolation valves will be provided with tamper switches.

Each floor will be provided with a zone isolation valve with tamper switches, flow switches, and fire department test stations.

The fire department test drains will terminate outside of the building.

4.4 Dry Pipe Sprinkler System

FREEZE PROTECTION

A dry pipe sprinkler system will be used where sprinklers are subject to freezing (exterior overhangs exceeding 4 feet in depth, parking areas, etc.).

Piping will be galvanized inside and out, threaded or with cut grooves.

Air compressors will provide system air pressure.

4.5 Standpipe System

WET SYSTEM

A manual wet standpipe system will be provided in interior stairwells.

The standpipe will be combined with the sprinkler system.

Each floor will be provided with hose valves.

FIRE DEPARTMENT CONNECTION (FDC)

A dedicated fire department connection (FDC) will be provided for the standpipe system.

5.0 Electrical

5.1 Design Criteria

The following load allowances will be provided for the project:

Table 15: Lighting and Power Load Densities

Area	Lighting Systems (VA/SF)	Power Systems* (VA/SF)
Office/Support	0.9	13
Lab	2	38
Cafe	1.1	27
Classrooms	1.5	12
Telecom Space	0.7	1.5
Mechanical/Electrical Space	0.9	15
Common Areas	0.6	5
Stairs	0.5 – 0.6	0.5
Restrooms	0.9	1.0
Storage	0.9	0.5

*Power VA/SF includes receptacles, equipment, and HVAC

5.2 Service and Distribution

UTILITY SERVICE

The building will be served from the campus medium voltage (MV) service from Tacoma Power. The main campus MV loop originates at the south end of the existing Cragle parking lot at a 4-way MV switch. The circuit extends from this switch in cabling in ductbank(s) in S C Street. See the diagrams below showing general locations of the equipment on site and a partial single line diagram.

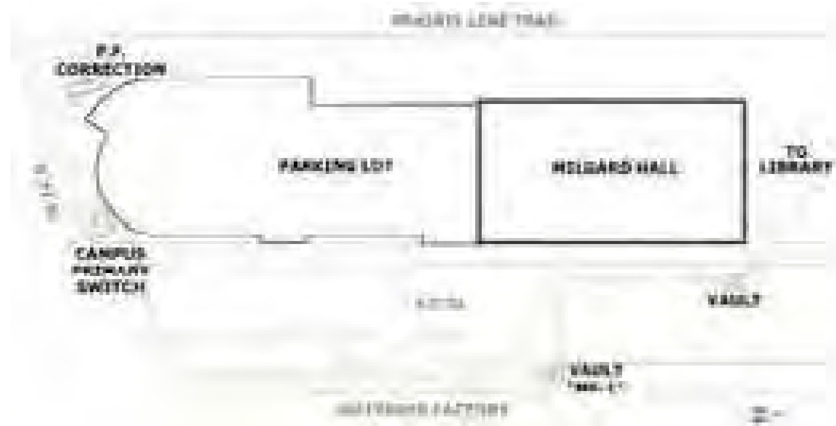


Figure 1 Diagrammatic Site Power Plan

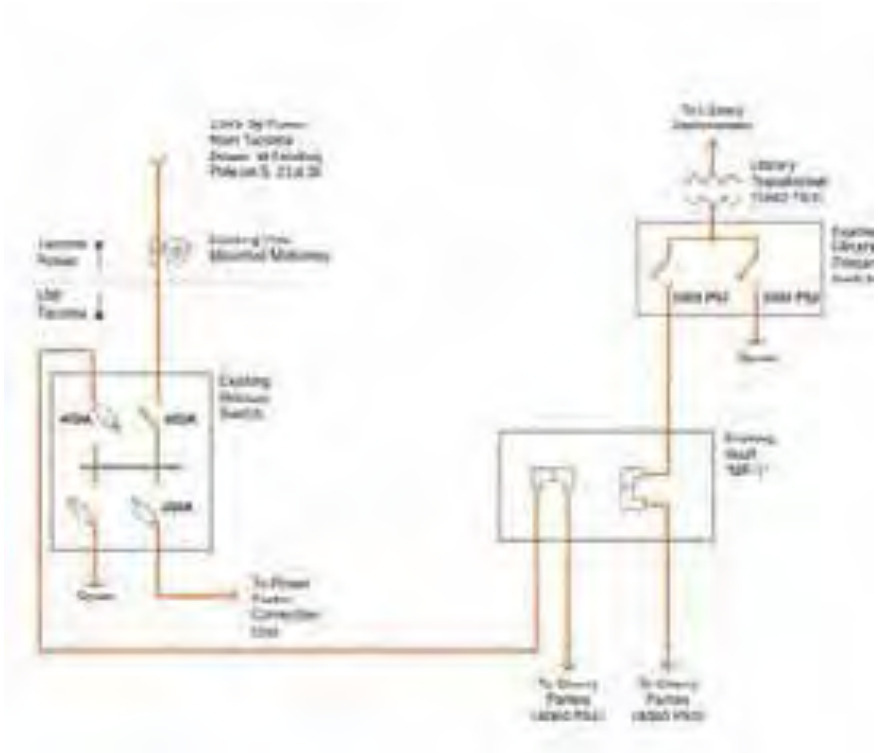


Figure 2 Existing Partial Campus Single Line

There are two options shown of how feed the primary switches within the building. The first option is to intercept the campus circuit to feed the new Milgard Hall at a vault within C Street; vault "MF-1" shown on the site plan diagram. A schematic single line diagram of Option 1 is below.

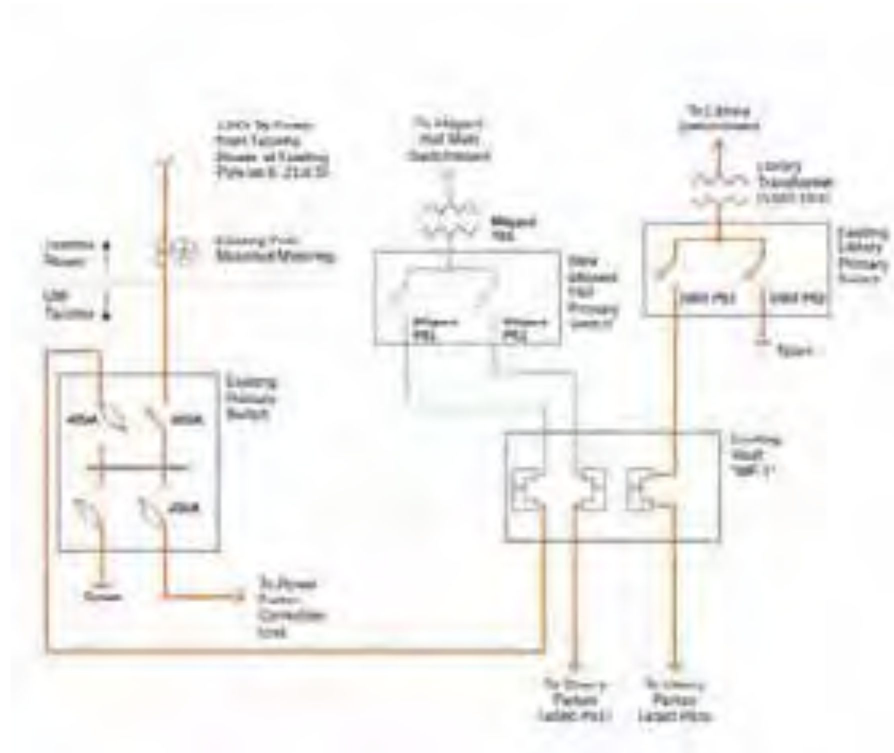


Figure 3 Option 1: Intercept at Vault MF-1

The second option is to feed Milgard hall from the spare Primary Switch at the Library. A schematic single line diagram of Option 2 is below.

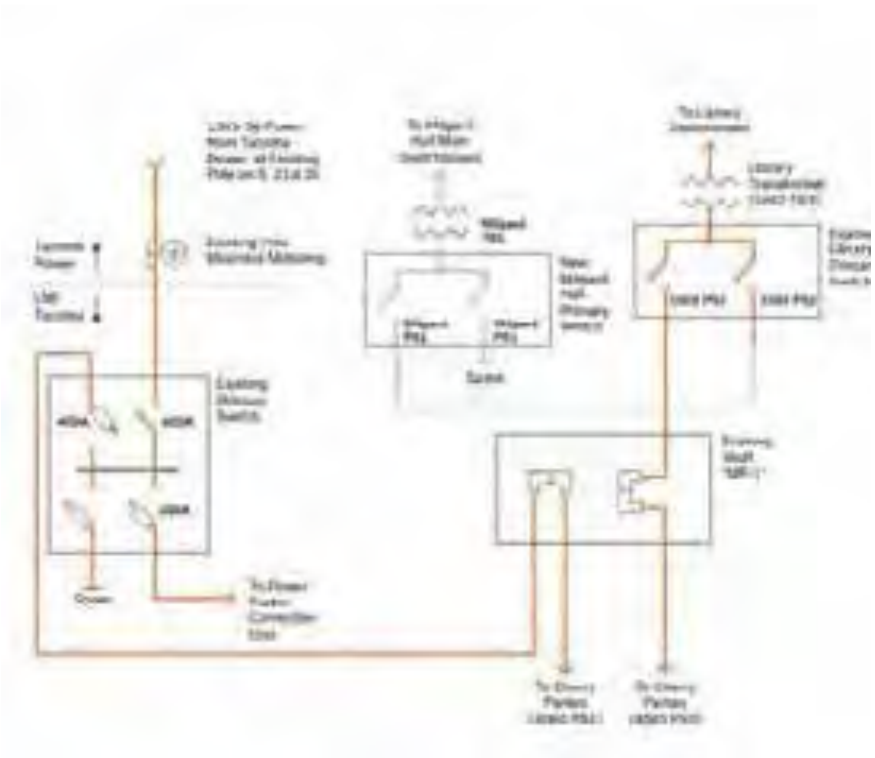


Figure 4 Option 2: Feed from Library Primary Switch

In either option from above, two 15kV feeders will be extended from the campus distribution into the main electrical room. They will terminate at manually operated primary switches within an in-building medium voltage (MV) unit substation.

Based on an overall gross area of 40,000 ft² to 50,000 ft² and an average of 26 VA/ft², a preliminary service size estimate is 1,040 to 1,300 kVA. This would be a 1,250 kVA transformer and 1,600A switchboard lineup in the MV unit substation. This will be revisited throughout the Design phase and adjusted as needed to serve the building loads.

EMERGENCY POWER

For a project baseline, Emergency (NEC 700) and Standby (NEC 701 and 702) loads will be fed from a new diesel generator. The estimated size is 150kW. It will be an outdoor unit with weatherproof enclosure and a sub-base ("belly") fuel tank sized to supply fuel for a minimum of 2 hours of run time. Circuits from the generator will be extended to the building below grade and up into the building, landing at automatic transfer switches (ATSs) within the emergency electrical room. NEC 700 power is required for egress lighting and the fire alarm system, at a minimum. It is unclear what the Legally Required Standby (NEC 701) power requirements will be for the project, at this time.

There is approximately 100 kVA of Optional Standby (NEC 702) load estimated, primarily for lab use. Should this be significantly reduced, an alternate is to feed the Emergency power for Milgard hall from the generator at the Academic building. This will need to be refined in the Design Phase.

For either option, the emergency power is distributed at 480/277V, 3-phase, 4-wire.

DISTRIBUTION

A main electrical room will house the service entrance equipment for the normal power service. An emergency power electrical room housing the emergency power entrance equipment will be located adjacent to the main electrical room. Each floor should have branch electrical rooms, and they should stack. The rooms should be a minimum of 8'-0" x 10'-0" (inside clear dimensions). Multiple rooms per floor may be required to ensure branch circuits will be no more than 150' in length to minimize voltage drop.

It is anticipated that mechanical equipment and lighting will be fed from 480/277V branch panels. The plug loads will be fed from 208/120V branch panels. The transformers may be in each branch room, or there could be larger capacity transformers at a lower level that use a distribution board to feed the branch rooms at upper levels.

Flexibility

The power distribution system will be developed to provide flexibility for reconfiguring office, lab, and classroom spaces. Lab spaces will be provided with individual branch circuit panels as required to minimize impact to adjacent spaces. Separate panels will permit a shut down on the panel for safe work on the panel when a modification is being performed in/on an adjacent space. Spare raceways and or chases will be provided for future distribution and to accommodate flexibility. Each plug load panel will have 25% spare pole spaces. Spare raceways and/or chases will be provided for future distribution and to accommodate flexibility. Refer to SD one-line diagram in the appendix.

Power Quality

Quality of power supply is affected by noise sources within a facility as well as outside (utility transferred). The power distribution system will include measures to help safeguard equipment from utility surges and transient conditions. Surge Protective Devices (SPD) will be provided at the service entrance electrical equipment for a first level of protection and at the branch panelboards for a second level of protection. A third level of SPD's could be utilized by the owner using portable plug strips with surge protection at equipment. Load types will be separated on panels to prevent large mechanical loads from affecting general-purpose branch circuitry.

Branch Circuit Wiring

Copper conductors routed in EMT raceway will be used throughout the building for branch distribution. Flexible metal clad (MC) cabling will be used only as approved by UWT and Facilities. The homeruns back to the panel will be EMT/copper conductors. Lab spaces will use surface metal raceway (SMR, Wiremold) to route power and data cables adjacent to the tasks in the lab. The SMR permits ease of reconfiguration of power and data cabling within a space without disturbing building walls and finishes. Ground fault circuit interrupter receptacles will be provided in toilet rooms at sinks, roof, outdoor and wet areas.

Equipment Connections

Electrical power connections will be made to all mechanical equipment, to include providing all electrically associated devices such as disconnect switches, contactors, magnetic or manual starters, lock-out switches, etc., not furnished under Division 23. VFDs furnished under Division 23 and installed under Division 26.

Electrical power connections will be made to support miscellaneous equipment. Connections include disconnect safety switches and wiring to support interlocks to remote devices.

Grounding System

A grounded power system will be provided in compliance with the NEC. This ground system consists of the building service ground consisting of multiple ground rods, UFER ground, ground ring around the building perimeter and bonding to the water service and structure steel. The grounding system will be extended thru out all electrical systems in facility. Grounding busses will be provided in the electrical and telecom network rooms. All metallic systems will be grounded to the building grid. An equipment grounding conductor will be provided in all feeder and branch wiring runs. Separate isolated ground conductors will be provided for branch circuits with sensitive loads.

5.3 Renewable Power System (PV)

An allowance for a renewable power source using PV (Photovoltaic) should be made for this building. The photovoltaic array will be located on the roof. The baseline option is to install a PV ready system. The better/best option for PV is to provide enough PV on the roof to account for 10% of the building's energy use. The exact amount of kW of PV will be revisited throughout the design phase and adjusted as needed. Power inverters will be located within the building a tied into the building normal power source.

5.4 Electric Vehicle Charging

Electric vehicle (EV) charging infrastructure will be provided within the parking area to accommodate a prescribed quantity of electric vehicles.

The Washington Administrative Code requirements for the electric vehicle changing stations are:

- 5% of parking spaces for newly constructed buildings,
- Electrical capacity designed for 20% of parking spaces with EV charging stations
- Infrastructure to be based level 2 style, 208V, 40A charging stations.
- At least one accessible parking stall shall have an EV charging station.

During the design phase, the final parking lot layout and parking count will establish the minimum EV charging station requirements.

5.5 Signal Systems

Power connections for devices and head-end system controls will be provided for Fire Alarm, IT, Security, and A/V, as required. Power for the MDF and IDF rooms is anticipated to be fed from plug load branch circuits. Dedicated panels in each room are not anticipated at this time. Refer to UW IT Design Guide, UW Facilities Design Standard, and other sub-consultant system descriptions for this scope of work.

FIRE ALARM

The Fire Alarm system will consist of a fully addressable, networkable, intelligent voice fire alarm system in accordance with all applicable codes and standards. The fire alarm system consists of fire alarm control panel, remote annunciator at Fire Department point of entrance, power supplies, initiating devices, notification appliances, and control and monitoring relays. The system for the building will be networked into the overall campus and will be manufactured by JCI/Simplex. Fire alarm riser cabling will be in conduit, and device circuits at each floor will be open cabling.

SYSTEM EQUIPMENT

Fire alarm equipment will be housed within electrical rooms or as required by the AHJ. Device coverage is anticipated as indicated in the table below.

Table 16: Fire Alarm Device Coverage

Device	Coverage
Manual pull stations	Located at each exit and each exit leaving an elevated floor.
Smoke Detectors	Corridors, Air handlers (>2,000CFM), Elevators lobbies, Elevator machine rooms, Elevator hoistways.
Fire Sprinkler	Tamper and Flow
Annunciation	Remote Annunciation at entry, with voice communication capability
Building Annunciation	Speaker and Strobe annunciation thru out the facility.
System output	Relay interface for mechanical system shut down and elevator recall.
Monitoring	Central Station Monitoring

CLOCK SYSTEM

A hard-wired clock system is not anticipated at this time. If this system is desired at a later stage, it would be a hard-wired system. The basis of design system is the Campus standard Simplex. A circuit for the clock system will need be connected to the building system via the utility tunnel stub under C Street.

OTHER SYSTEMS

Power connections for devices and head-end system controls will be provided for IT, Security, and A/V, as required. Power for MPOE, MDF, and IDF rooms is anticipated to be fed from plug load branch circuits.

Dedicated panels in each room are not anticipated at this time. Refer to UW IT Design Guide, UW Facilities Design Standard, and other sub-consultant system descriptions for this scope of work.

5.6 Lighting

INTERIOR LIGHTING

The electrical engineer and/or a lighting consultant will help further define this system during the Design/Preconstruction Phase. It is anticipated that all fixtures will be LED and circuited at 277V or explore the use of a POE lighting system.

SITE LIGHTING

Campus site lighting within the vicinity of Milgard Hall that is either impacted or upgraded due to this project is anticipated to be powered and controlled by the new systems at the building. Any building mounted exterior lighting will also be powered and controlled by the building systems.

LIGHTING CONTROLS

Lighting controls for areas requiring timeclock or scene control will be via a networked lighting control system. Other individual spaces may be connected to the network lighting control or they may be stand-alone control within each room. Basis of design manufacturer is Wattstopper.

Classrooms and event spaces will have systems capable of controlling projectors, AV sources, lighting, and shades as established during design.

Control of lighting will be provided by the following methods for the respective tasks/areas, in accordance with the 2018 Washington State Energy Code:

Table 17: Lighting Control Methods

Task/Area	Control Method
Offices – Enclosed	Occupancy sensor with manual on, daylight dimming, manual dimming
Offices – Open	Occupancy sensor with manual on, daylight dimming, scene control and/or manual dimming
Classrooms	Occupancy sensor with manual on, daylight dimming, scene control, integration with A/V systems for screen and shade control
Conference/Meeting/Study	Occupancy sensor with manual on, daylight dimming, manual dimming
Circulation	Corridor occupancy sensor, daylight dimming, and manual override
Stairwells	Dual level fixtures with integral occupancy sensor, no switch
Café	Daylight Dimming, scene control and/or manual dimming
Restrooms	Occupancy sensor with full automatic on, manual override
Storage	Occupancy sensor with manual on
Mechanical/Electrical	Toggle switch only

6.0 Technology Systems

6.1 Design Criteria

The IT systems will closely follow the latest requirements from the UW IT Design guide.

6.2 Structured Cabling

TELECOMMUNICATIONS SPACES

Spaces will be established in the following locations:

— One Main Telecom Room (MDF) on Level 1, which will also act as the building's Telecommunications Entrance Facility (MPOE) for Service Providers. The MDF size allowance should be 12' x 16' (inside clear dimensions).

— Additional Telecom Rooms (IDFs):
  - At least one IDF on every other floor. The minimum IDF room size is 10' x 12' (inside clear dimensions).
  - Total quantity of IDFs will be provided to ensure all areas of the building are within 295 cabling feet or less from an IDF due to distance limitations of Category cabling.

— Wherever practical, Telecom Rooms on different levels will stack/align vertically.

Exact size and location of Telecom Rooms will be coordinate with the Architect, meeting industry and/or owner standards.

Figure 5: Example IDF Room

OUTSIDE PLANT

Service to the building will be provided via new underground pathways from existing campus infrastructure located at the utilidor that is below grade on the south side of C Street. The pathways will be conduits extended from the end wall of the utilidor, routed below C Street, and will enter the new building at the Level 1 main telecom room. Owner provided systems will be brought to the building using these underground pathways.

PATHWAYS AND CABLING

Backbone and horizontal cabling will be in conduit for vertical portions and in cable tray and/or conduit for horizontal portions. Connections to activation points/devices on the walls will be installed using the "ring and string" method (i.e. a mud ring and device cover plate a the wall with cable run open air through the wall down from the ceiling cable tray down to the device cover plate).

A general assumption for connectivity throughout is 1.5 active stations/ports per workstation in the offices.

GROUNDING AND BONDING

A telecom grounding and bonding system will be provided for all telecom rooms and spaces throughout the building.

Dedicated Telecom Bonding Backbone

This system is separate from the electrical grounding system in that an electrical grounding system is required for safety, but telecom grounding and bonding systems are required to protect active equipment in the system from disruptions due to either outside interference or unbalanced voltage potentials to ground. They are integral in that telecom system must be bonded to the electrical system so that they may function as a single cabling system.

A Primary Bonding Busbar (PBB, formerly TMGB) will be provided in the Main Telecom Room. The PBB will be connected (bonded) to the electrical system's main panel board's (sometimes referred to as the main switch board, or main distribution board) ground via the Telecommunications Bonding Conductor (TBC).

Secondary Bonding Busbars (SBB) will be provided in every Telecom Room to provide a bonding point for all equipment in that room.

Rack Bonding Busbars (RBB) will be provided in every telecom enclosure.

Racks, cable trays, conduits, and other telecom system equipment will be bonded to the PBB/SBB.

6.3 A/V Systems

The classrooms and conference rooms will have A/V systems. The A/V equipment will follow the current UW standards.

Each of the classrooms is large enough that the standard package for podium style classes is assumed.

At a minimum, each of the conference rooms will be equipped for web conferencing and video capture.

6.4 Campus Automated Access Management System - CAAMS

Access control is the main security system anticipated for the building. Each of the main entry points into the building will have controlled access via card reader.

It is also anticipated that each main program area or suite will also have secured access.

The final program layout will dictate the quantity and location of card access secured areas within the building.

The CAAMS equipment is typically located in a dedicated closet on the main level with a backboard of minimum available wall space of 6' wide by 8' tall, 3' of clearance away from any panel installed on the backboard. Additional closets may be required on upper levels, depending on final design.

6.5 Code Required Two-Way Communications Systems

EMERGENCY RESPONDER RADIO COVERAGE (ERRC) DISTRIBUTED ANTENNA SYSTEM (DAS)

A code-compliant Emergency Responder Radio Coverage Distributed Antenna System is anticipated.

The system will include a donor antenna mounted on the roof to receive/transmit these signals to a Master Control Unit (MCS) in the MDF. Verify with UWIT that the MCS is allowed within the MDF. The MCS will then provide fiber-optic cabling to remote units in each IDF. Remote units are transceivers that convert the signal to coaxial cabling. The coaxial cabling is attached to amplifiers to extend signal out to small passive antennas distributed throughout the building.

The system will support the current radio frequencies of all Emergency Responder entities that may respond to the building.

Predictive modeling of RF propagation will be provided by the system installer (contractor).

After installation the system installer (contractor) will be responsible to test the building per NFPA 72 to ensure the above coverage requirements have been met.

At the conclusion of the project, software will be provided to the owner for managing the ERRC DAS.

The system will meet the following code requirements, as coordinated with the AHJ:

- Pathway Survivability for DAS cabling and power circuits supporting DAS equipment.
- Integral battery-backup power.
- Integration and monitoring of the system through the Fire Alarm Control Panel.

AREA OF REFUGE/ELEVATOR LOBBY TWO-WAY COMMUNICATIONS SYSTEMS

For code-required Areas of Refuge, a Two-Way Communication System will be provided as a means of communicating with emergency responders in the event of an alarm condition and/or fire. The system will consist of a call station in each Area of Refuge (and associated signage) and a Control Station near the main entry/vestibule. This system will be equipped with an analog phone line that will call to the agreed upon contact/agency for emergency services.

Where the architect has indicated dedicated area of refuge locations in the building, these devices will be provided in each elevator lobby above or below the level of discharge/egress.

The system will meet the following code requirements, as coordinated with the AHJ:

- Pathway Survivability for cabling and power circuits supporting the equipment.
- Integral battery-backup power.
- Location of the Control Station coordinated with responding Fire Department, or as directed by the AHJ. It is typically located in the main entry vestibule adjacent to the fire alarm remote annunciator.

6.2.6 Sustainability

BAM Revision – November 16,2020

Following the submission of Projection Definition in October 2020, several changes to the project have been made. These include:

— Increase square footage to 55,000 SF
— No overall budget change, requiring a smaller $/SF for each system.

As this change has been made, UW Tacoma has acknowledged that several project goals may be sacrificed. These may include:

— UW Green Building Standards, UW Climate Action Plan
— LEED Silver as minimum (not LEED Gold)
— Reduction from UW FSDG requirements, most cost-effective MEP materials and methods

In order to meet the new budget and the reduction in goals the following items are being considered (and deviate from the rest of this report):

— All sustainability goals (i.e. LEEDv4 Gold, 15% Better than Code EUI, Net Zero Carbon) are being reconsidered as alternates and stretch goals for the project.
— If proven the most cost effective solution, high volume refrigerant systems, like VRF, as described on page 122 may be part of the mechanical system solution.
— Select envelope upgrades described in the table on page 177 will be considered individually as alternatives and may or may not be implemented to specific spaces, not all spaces, based on cost and building performance metrics.

Overview

The new UW Tacoma Milgard has a number of high performance goals that have the potential to make it one of the best performing buildings for the University of Washington Tacoma. The project team has been working closely with the UW of Tacoma to design a building that can meet all of the projects goals including sustainability goals.

THE SUSTAINABILITY GOALS INCLUDE:

- All Electric
- Architecture 2030 Challenge Target
- 15% More Efficient than 2018 WSEC
- 50% Total Water Use Reduction
- LEED v4 Gold
- ILFI Net Zero Carbon (Stretch)

The UW Sustainability Action Plan action plan has a goal to reduce the greenhouse gas emissions for the campus by 45% below 2005 levels by 2030. This means all new buildings need to explore the potential for net zero carbon (NZC) performance to avoid adding additional emissions to the campus. Ideally, new buildings would not only operate as net zero carbon but they would also act as carbon sinks and energy producers for the campus. UW Tacoma Milgard has taken a big step to reduce emissions by planning on avoiding burning fossil fuels on-site and going all-electric.

Student Engagement: Building as a Teaching Tool

An important part of the UW Sustainability Action Plan is increasing student engagement with sustainability coursework through innovative content and incorporating sustainability into their curriculum, to name a few. The new Milgard building could stand out as a building that far achieves this goal by acting as a teaching tool, in itself, through it's design. Examples of this include, but are not limited to:

- Living Laboratory
- Ongoing Building Performance Monitoring and Reporting
- UW Sustainability Plan Interaction

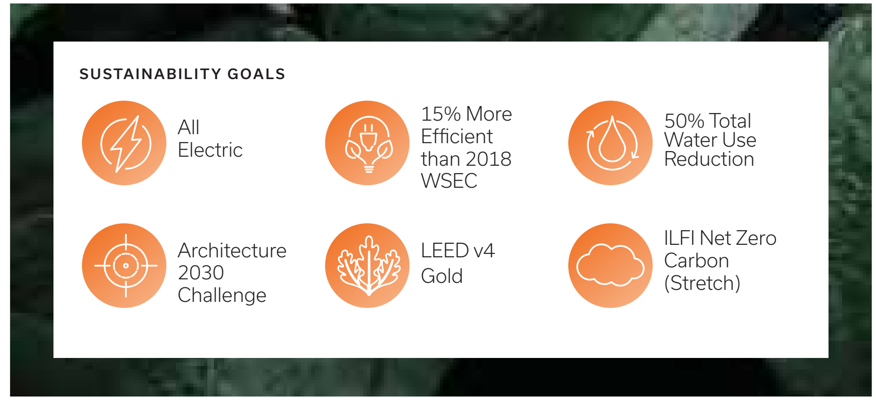
Why All Electric?

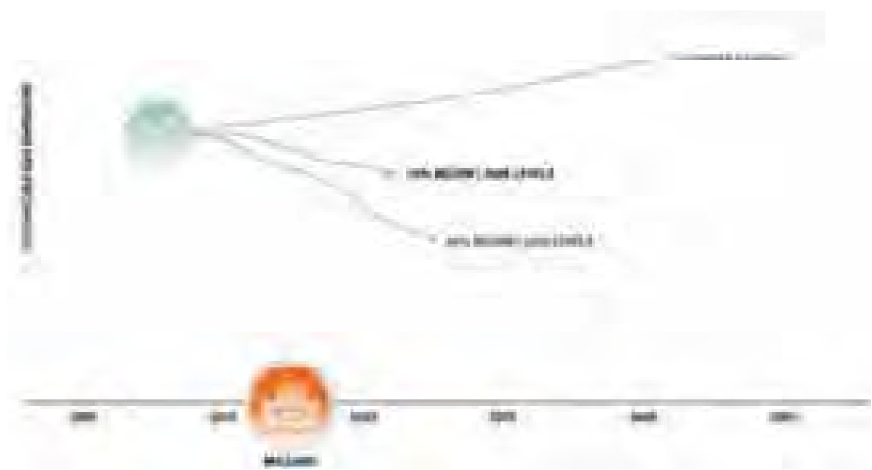
A single, Net Zero Energy building is a hallmark achievement, but it is often surrounded by buildings that remain fossil-fueled. This dichotomy highlights and opportunity to think bigger. While a single building - like an educational facility - might not be able to achieve Net Zero Energy through on-site renewables alone, if the building is all-electric, the same carbon savings can be realized by a renewable powered-grid. With a fully electrified building, carbon impacts are dictated by the utility grid they operate on. **By going all-electric with well-designed, efficient systems, the design team is ensuring that UW Tacoma Milgard will operate cleaner as the grid gets greener.**

Eco-Charette

PAE and Lensa held an Eco-charette with UW Tacoma Milgard project team members and stakeholders on September 8th,2020 to determine any and all project goals surrounding sustainable design. These goals were anywhere from standard energy saving measures to audacious, but achievable, Carbon Neutral target setting. The team in attendance included UW Sustainability, UW Tacoma Facilities, and the design team. The charette was successful in determining an array of goals that would meet the project vision. Highlights of the most notable targets are listed below. Although no one goal or set of goals has been officially chosen by the team to pursue, the outcomes of the charette are emblematic of the team's desire and dedication to think bigger than the once-average lab building.

- Achieve at least 35% energy savings and strive for Carbon Neutral through ILFI Certification.
- Include better than baseline energy and water meeting with teaching elements for students and faculty throughout the building.
- Design an all-electric building.
- Design a high performance façade that significantly reduces mechanical loads
- Strive to achieve the LEED Advanced Refrigerant Management credit which would disqualify large volumes of HFCs on the project and most likely disqualify VRF as a potential mechanical system
- Achieve the LEEDv4 Daylighting Credit which means at least 55% of building has sufficient daylight
- Include automated operable windows with an expanded thermal comfort range to reduce system cooling loads and save energy.
- MERV 14 filters.
- Target at least 45% reduction in indoor water use which may require a rainwater catchment system for flush fixtures.





CLIMATE RESPONSIVE DESIGN

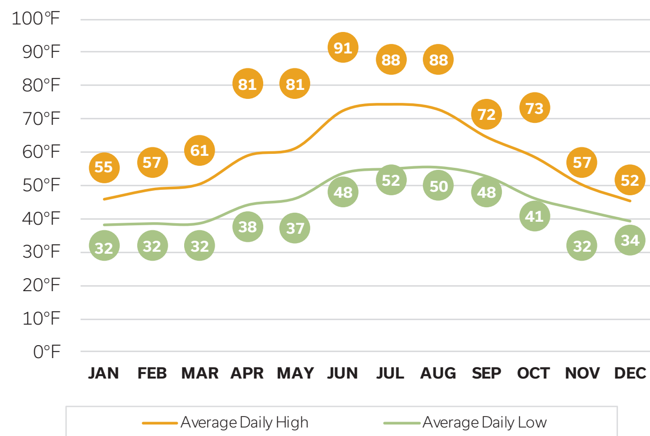
Tacoma, Washington

When considering the location and climate surrounding UW Tacoma Milgard it's important to analyze historical and future weather trends, known as typical meteorological years (TMY) which represent the statistical average year. Though historical trends are good for predicting annual energy usage care must be taken when using them for occupant comfort in buildings. Future weather is estimated to be significantly warmer than the current TMY3 weather files which will result in higher percentages of the year where occupants are thermally uncomfortable. In order to show the potential impacts of global warming on this building, future weather files have been used to analyze the building performance.

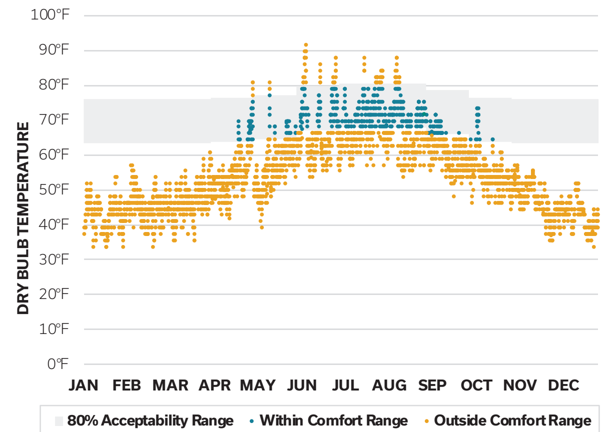
The future weather files use data from the Intergovernmental Panel on Climate Change (IPCC) to inform the impacts on the Tacoma weather file. The future weather included in the analysis includes the years 2020 and 2050. Results from this weather should better resemble performance for the building after occupancy.

The impacts of global warming can be seen in the 2020 weather files for Tacoma. The top two charts to the right show the average monthly temperatures and the amount of hours within an acceptable thermal comfort range. Note, the current summer design day for Tacoma is 84°F while these future weather files are showing a peak day of 91°F, thus showing how global warming is predicted to have an impact in the next few years. The bottom charts show the percent of hours where natural ventilation is most effective and the average daily solar radiation. Just in the next few years there is predicted to be 6% of hours outside of the thermal comfort range for natural ventilation. Meaning, the rooms will be perceived as too warm with the windows open.

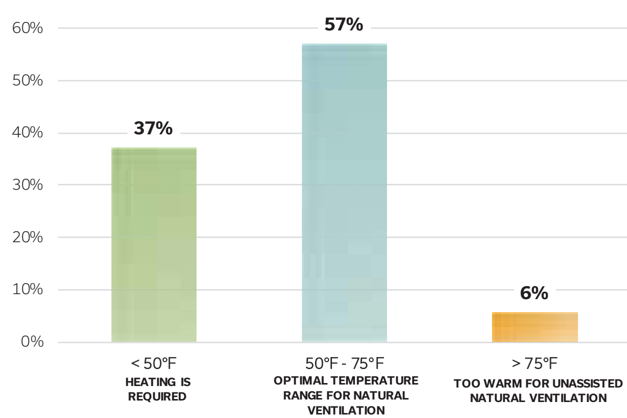
AVERAGE MONTHLY TEMPERATURES WITH MAX + MIN (°F)



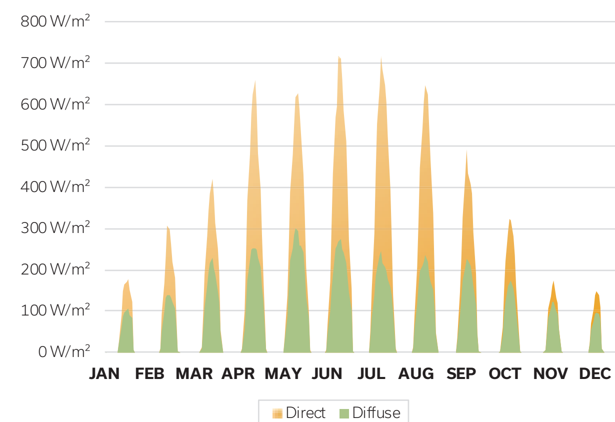
THERMAL COMFORT | DAYTIME HOURS WITHIN 80% ACCEPTABILITY



NATURAL VENTILATION EFFECTIVENESS, PERCENT OF DAYTIME HOURS



AVERAGE DAILY SOLAR RADIATION



CLIMATE RESPONSIVE DESIGN

Facade Optimization + Thermal Comfort

When considering building performance, it is equally important to consider the thermal comfort of the occupants of the building. Building performance and thermal comfort are typically co-dependent. Thermal comfort is an individual perception which expresses satisfaction with the thermal environment. There are large variations, both physiologically and psychologically, from person to person which makes it challenging to satisfy everyone in a space. When a building is designed for high-performance, specifically around improving envelope performance, thermal comfort performance typically follows. Sustainable design considering thermal comfort requires careful analysis of the building's systems and energy use. An educational facility presents a unique opportunity to both reduce energy consumption and maintain thermal comfort if the right systems are implemented. Designing an engineering lab building that uses less energy while maintaining thermal comfort requires refocusing on many elements; envelope orientation, massing, shape and size, program, schedule, and usage.

Simple rules of thumb around envelope design can be taken into account to greatly improve the performance and thermal comfort of the building. These rules are shown in the diagram to the right. One key design strategy is to place the largest amount of glazing on the North facade and the least amount of glazing on the South facade, to optimize the sun's natural position and thermal energy. Other strategies include utilizing the North side of the building for premium daylighting, the West side of the building for transient spaces such as labs, and the South side for occupant dense spaces, such as offices or classrooms.

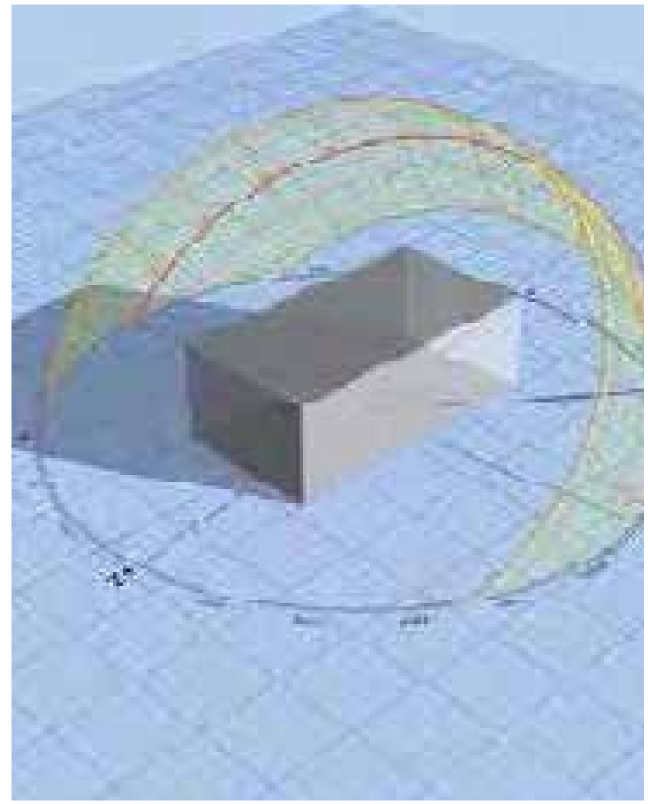
The table to the right indicates envelope construction values that could be used to aid in both building performance and thermal comfort performance. Investing in improving the envelope of the building means improving building performance, occupant thermal comfort, and potential cost-savings around energy and operational usage.

The proposed high performance envelope is an initial estimate for an ideal envelope to reduce mechanical loads and save energy. The proposed envelope for the building will be determined in the next design phases through performance and cost optimization exercises.

BUILDING ENVELOPE

CONSTRUCTION	PERFORMANCE COEFFICIENT	TYPE	WSEC 2018	HIGH PERFORMANCE ENVELOPE (PRELIMINARY RECOMMENDATION)
ROOF	R-Value	IEAD	38 ci	58
ABOVE GRADE WALL	R-Value	Wood Mass	21 9.5 ci	35 16
BELOW GRADE WALL	R-Value		Same as above Grade Walls	Same as above Grade Walls
SLAB ON GRADE	R-Factor	Unheated Heated	10 or 24″ below 10	10 or 24″ below 10
EXTERIOR DOOR	R-Value	Swinging Door	4.75	4.75
FENESTRATION VERTICAL	U-Value	Fixed	0.34	0.28 (Fiberglass, Triple Pane)
		Operable	0.36	0.28 (Fiberglass, Triple Pane)
		SHGC	0.40	0.27
		% Glazing	40%	40%
FENESTRATION SKYLIGHTS	U-Value SHGC	Aluminum with Thermal Break	1.51 0.40	0.70 (Triple Pane) 0.27
INFILTRATION	CFM/sf Facade		0.40	0.15 (Passive House)

3D SITE SUNPATH

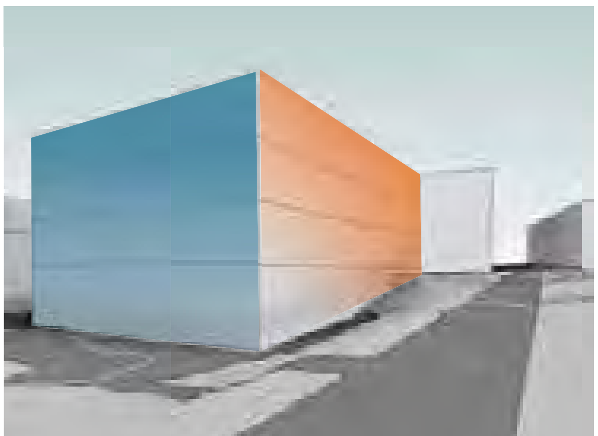


CLIMATE RESPONSIVE DESIGN

Facade Optimization

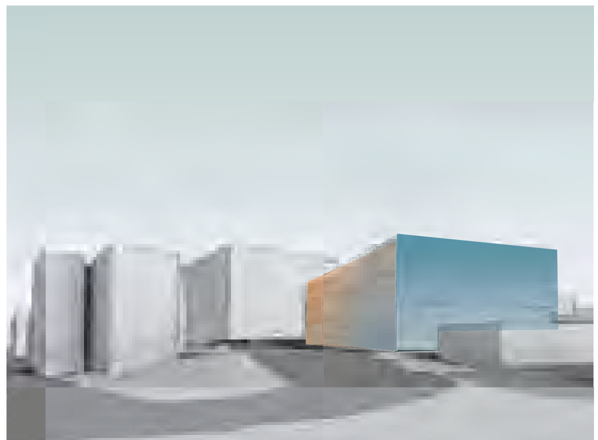
SOLAR HEAT GAIN

LOW — **HIGH**



NORTH

- Premium Daylighting
- Highest Glazing Percentage



WEST

- High, late afternoon Solar Gains
- Optimal for Transient Spaces and Low Occupant Dense Spaces
- Low glazing percentages
- High Performance Glazing with low SHGC

SOUTH

- High Solar Gains
- Low glazing percentages
- High Performance Glazing with low SHGC
- High potential for visual discomfort
- Optimal for less occupant dense spaces

CLIMATE RESPONSIVE DESIGN

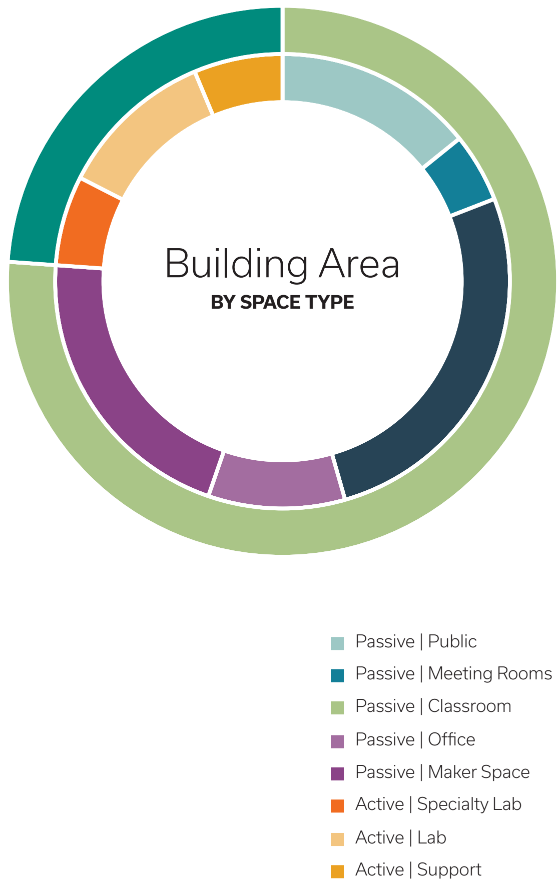
Program Optimization

Climate responsive design is a synergistic approach to design that considers the built environment and the natural world. The built environment provides setting and comfort for human activity, while the natural world, or natural environment, provide natural resources that affect human survival such as air, water, climate, and radiation. Optimizing program design by considering the natural environment and utilizing it's natural resources, such as sun position, can in turn optimize building performance and reduce building footprint. That is to say, the program of the building has the capability to reduce the mechanical equipment sizing, saving on annual energy use and emissions.

The diagram to the right is an example of strategic program layout, optimizing the program based on space type. As an engineering lab building, there will be specialty and non-specialty spaces that have different factors driving the mechanical heating and cooling requirements. Specialty labs and maker spaces, for example, have a high volume of air changes required, thus driving the heating and cooling loads in the space, which are typically higher than the solar heat gain. Offices, meeting rooms, or common areas, however, have a heating or cooling load that is driven predominantly by the envelope load. Climate responsive design would place the spaces requiring predominantly active building systems (ie: labs, maker spaces, and classrooms) on the South and West sides of the building, where solar loads are high, but do not drive the equipment loads. Premium spaces (ie: offices, meeting rooms, common areas) would be placed on the North and East sides where expanded thermal comfort ranges are acceptable, sun direction can be harnessed for daylighting, and the solar heat gain is not as high, thus driving down the equipment load and opening up valuable ceiling space.

From a performance perspective, it is advantageous for the project to group space types with like space types vertically. Stacking the labs vertically has economic and performance advantages. For example, stacking the labs vertically will save on mechanical system costs by conserving duct sizing and save on energy use by maximizing heat recovery.

The pie chart indicates the ratio of "active" spaces requiring active building systems to "passive" spaces that can be optimized for passive building systems, decreasing mechanical equipment and distribution layout. This ratio also represents the savings potential of the building.



PROGRAM PLACEMENT TO OPTIMIZE SOLAR HEAT GAINS

UNIVERSITY OF WASHINGTON TACOMA MILGARD

Energy & Operating Emissions

Energy Performance Baselines

When discussing building performance and energy and operating emissions, it is important to first establish a performance baseline to improve upon. The University of Washington's Green Building Standard (UW GBS) lays out design standards necessary to achieve the UW Climate Action Plan goals, thus it seems appropriate to use these standards as the baselines as they are the minimum performance metrics to be met.

To meet the UW GBS targets, two baseline's are prescribed: 15% better than 2018 Washington State Energy Code (WSEC) and LEEDv4 Gold. It is important to note that these two baselines are based upon two different standards. 2018 WSEC Performance Compliance Path uses ASHRAE 90.1 2016 as the baseline, whereas LEEDv4 looks to ASHRAE 90.1 2010 as the baseline.

Why Emissions?

Holistic building design takes into account more than just a building's energy usage. Optimizing a building's annual energy use through efficient mechanical and electrical systems is critical, but it does not make up the whole picture when discussing a building's impact on the environment. Often, the energy discussion focuses on site EUI; the amount of annual energy your building is using. What is often missed, or left out of the conversation, is source EUI; where your building is getting it's electricity, and more importantly, how that utility is producing electricity (ie: burning coal or natural gas). You can have a building that has a low EUI, but has high operating CO2e emissions due to the grid that it is connected to or the systems used to heat and cool the building.

Said differently, UW Tacoma Milgard could have an operating EUI of 55 and be considered "Net Zero Energy" with onsite PV, but could have a high environmental impact from operating emissions due to the use of natural gas boilers or VRF systems (refer to Embodied Emissions | Refrigerants section for more detail on environmental impact of refrigerants). However, by going all-electric with well-designed, efficient systems, the design team is ensuring that UW Tacoma Milgard will operate cleaner as the grid gets greener.

On Site Renewable Energy

The Eco-Charette proved interest in renewable energy technologies for the project, and more specifically, most attendees showed interest in some PV on the roof of the building. There is a range of PV options that would earn the project credit toward LEEDv4 Gold. The project may also target Net Zero Energy with almost 100% of the roof covered with PV by achieving an EUI 55. The feasibility of PV on the project may be explored in the next design phase.

Preliminary (Shoebox) Energy Model

The energy and operating emissions results are based on early shoebox modeling. These results are preliminary and destined to change as the building program, facade, and systems design progresses. The model assumes one typical floor based on the four story footprint (approx. 158 ft x 84 ft). The model assumes 14 ft building height. The typical floor model includes office area, classrooms, support space, meeting rooms, workshops, transition/public space, labs and specialty labs. Program areas are distributed based on the August program document from ARO. The labs are cooled to 72°F and heated to 68°F with 5°F setbacks. All other spaces are heated to 70°F with a 10°F setback and cooled to 78°F.

The UW comfort standard is to cool to 78°F and heat to 68°F. Strategies like ceiling fans and a high performance envelope may help to achieve these comfort standards with less energy than code minimum heating and cooling systems.

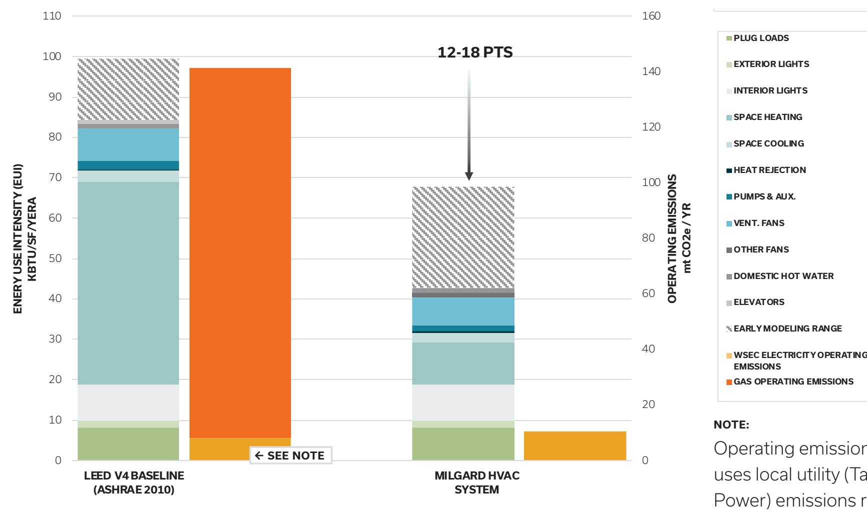
Percent of hours outside comfort zone should be considered in conjunction with occupancy of certain spaces. Space with relativly low occupancy during the summer, like offices, should consider wider thermal comfort ranges. Cooling should be focused in lab spaces and can also consider higher comfort zone and mitigation measures.

The ASHRAE 90.1 baselines follow the requirements of Appendix G. The models include 40% glazing. The HVAC systems are modeled with fossil fuel boilers, direct exchange cooling and VAV with reheat air distribution. The specialty lab assumes 6 air changes per hour with 50% heat recovery and 50% air volume turn down during unoccupied hours.

The proposed model assumes a 2018 WSEC code minimum envelope with 40% glazing. The HVAC system models heat pump technology with COP 3, VAV with reheat air distribution for the labs and DOAS air distribution for all other space types. 50% heat recovery is included for all spaces. The specialty labs are also provided with 6 air changes per hour with 50% volume turn down during unoccupied hours same as the baseline.

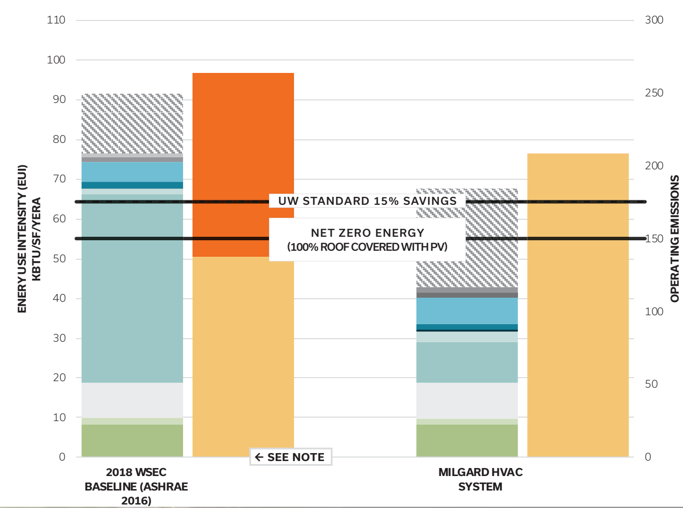
The energy results are intended to aid discussion in the coming design phase. The assumptions noted above for the proposed model are likely to change dramatically as the design develops.

LEED V4 OPTIMIZING ENERGY PERFORMANCE



NOTE:
Operating emissions calculation uses local utility (Tacoma Power) emissions rate

UW 15% BETTER THAN 2018 WSEC



NOTE:
Electricity emissions calculation uses emissions rate determined in 2018 WSEC which represents a regional emissions rate. Further investigation can be made to explore alternatives and use the local utility emissions rate.

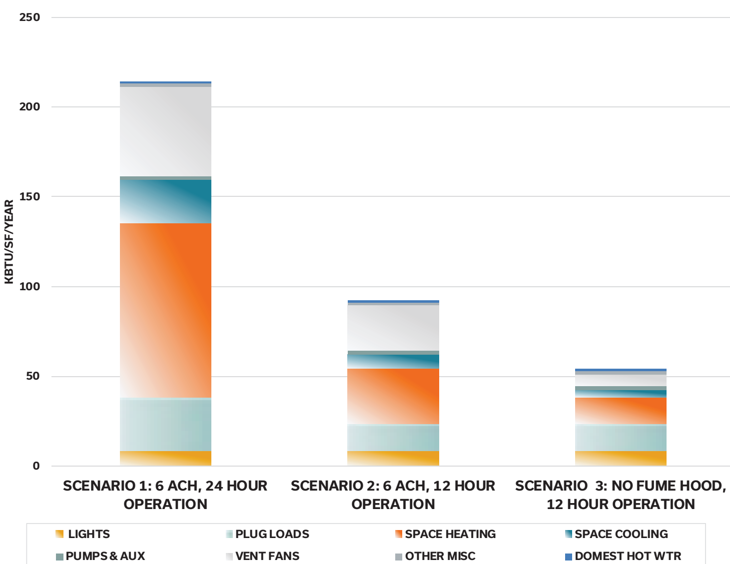
UNIVERSITY OF WASHINGTON TACOMA MILGARD

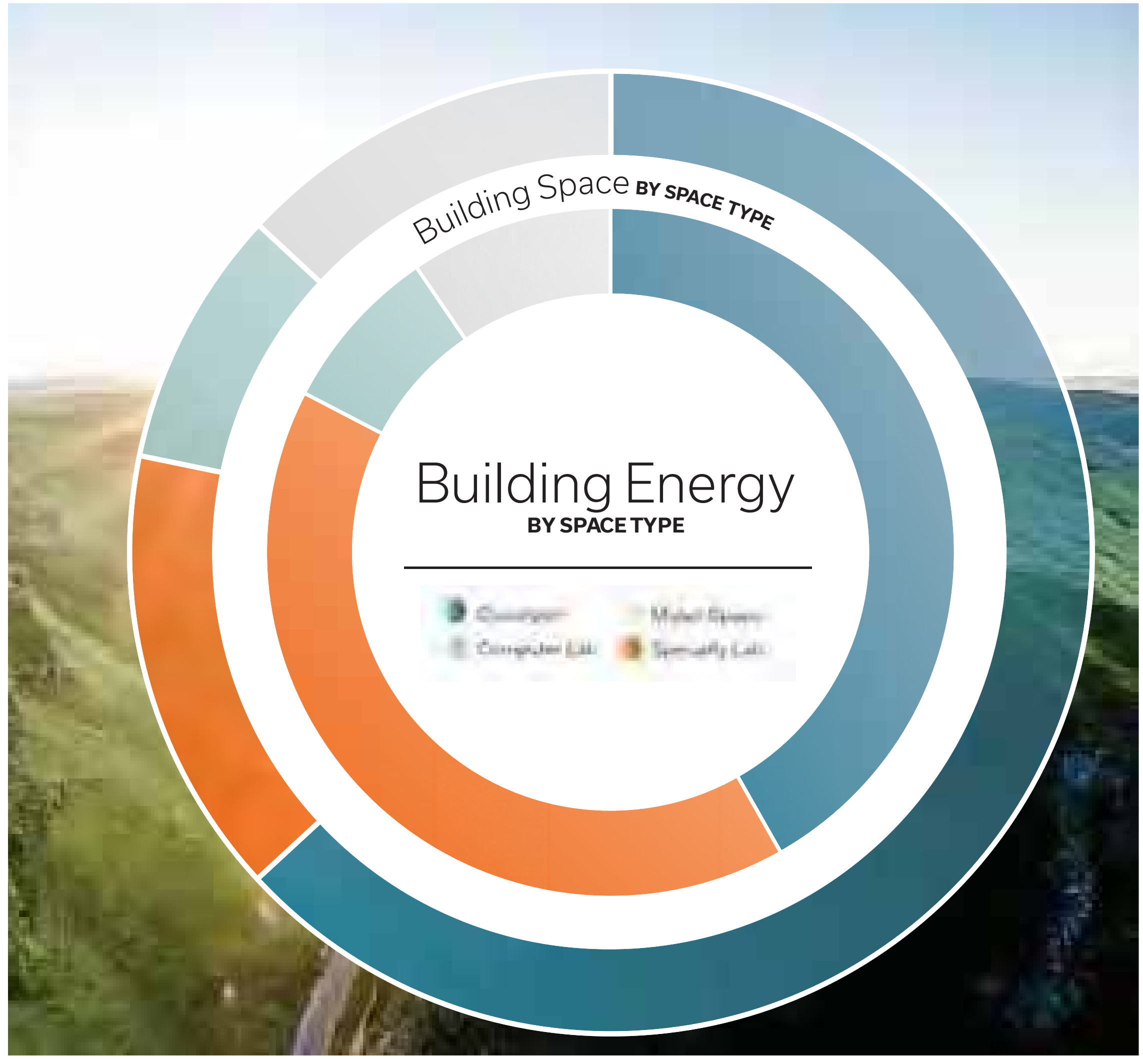
Energy & Operating Emissions

Strategies to Reduce Energy Consumption in Labs

Labs make up a small portion of the program but will likely be responsible for a majority of the building energy.

Specialty lab air change requirements drive the energy use of the space and the building. Local exhaust strategies and smart operating controls help to reduce fan, heating and cooling energy.





EMBODIED EMISSIONS | REFRIGERANTS

VRF AND HEAT PUMPS SYSTEMS USE R-410A REFRIGERANT TO GENERATE HEATING AND COOLING FOR THE BUILDING.

R-410a is a hydrochlorofluorocarbons (HFCs) which have been identified by the Intergovernmental Panel for Climate Change (IPCC) as one of the most harmful and potent greenhouse gases. Gram for gram, HFCs are up to 12,000 times more harmful to the atmosphere than carbon dioxide (CO_2).

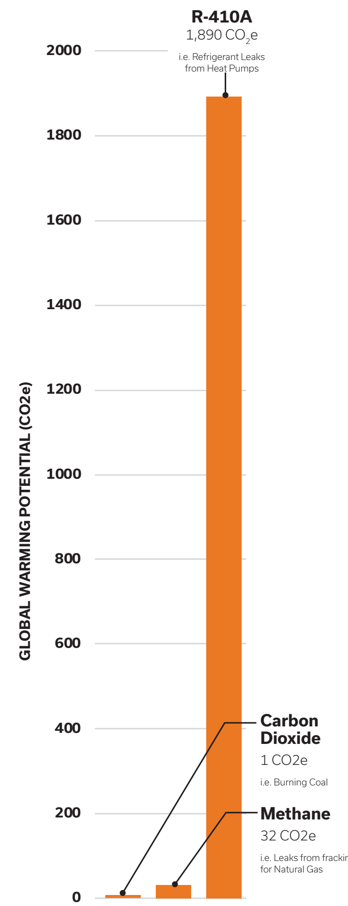
The Global Warming Potential chart compares the global warming potential (GWP) over 100 years of the refrigerant used in heat pumps (R-410A) to other common gases released by different energy sources. GWPs represent the normalized value of greenhouse gases as compared to CO_2, this is referred to as CO_2e. For example, you can see in the chart that **THE GLOBAL WARMING POTENTIAL OF R-410A IS 1,890 TIMES HIGHER THAN THE SAME AMOUNT OF CO_2 RELEASED INTO THE ATMOSPHERE.**

Heat pumps provide a highly energy efficient solution for mechanical systems, but if the refrigerant inside the equipment leaks it can cause damaging effects on the environment.

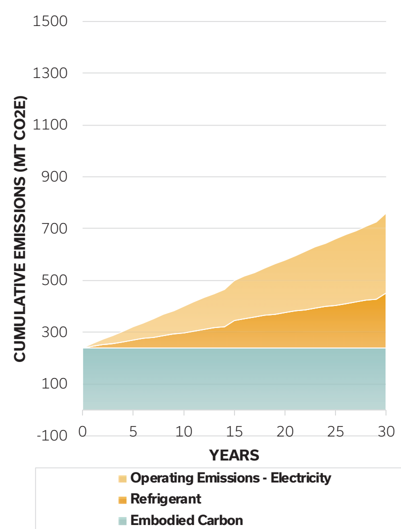
In addition to an energy efficient solution, the goal is to use the lowest volume of refrigerants as possible. The VRF mechanical system options poses a threat to containing as little refrigerants as possible on the project. The Air Source Heat Pump (ASHP) option contains refrigerants in a central location in the building with a smaller charge of refrigerants than a VRF system. A Variable Refrigerant Flow (VRF) system routes R-410a throughout the building in pipes. VRF not only has a higher volume of R-410a than the heat pump options, but the system has more piping connections and it must be installed on site, and not at a controlled manufacturing plant, so there is more risk of leaks and a higher potential for emissions.

Through PAE's research with the City of Seattle, VRF systems may leak up to 7% per year compared to centralized heat pumps that may only leak up to 3% each year. The data on leakage rates is sparse and seldom collected. Some equipment can lose its charge (total volume of refrigerants) in the first year after installation. Others may seldom leak. PAE reccomends investing in refrigerant systems that have centralized and contained refrigerants. Site built refrigerant systems like VRF have a higher record of leaks and are difficult to repair. The emissions chart shows the total GHG emissions in metric tons CO2e over 30 years assuming that the equipment is replaced every 10 years. Embodied emissions from construction is based on typical construction included in the chart for reference. It does not reflect the embodied emissions of the building yet.

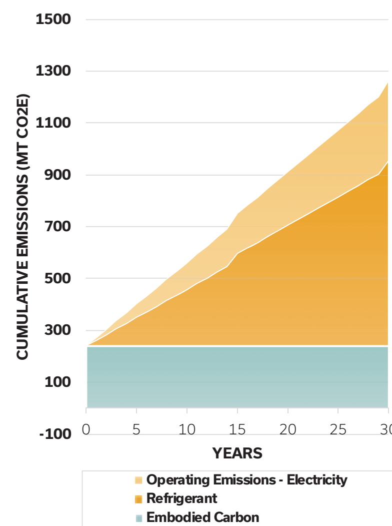
GLOBAL WARMING POTENTIAL OF ENERGY RELATED GREENHOUSE GASES



AIR SOURCE HEAT PUMP



VRF



PATH TO

Net Zero Carbon

Greenhouse gas emissions (often referred to as carbon emissions) takes a much broader looks at our impact on the environment than energy. Emissions analysis looks to the energy source and its implications on natural resources and their contribution to global warming.

For example, a building may use energy efficient systems to reduce its energy consumption with heat pump technology - which uses refrigerants. However, the refrigerants in the mechanical equipment, if released into the atmosphere, have a global warming potential 1800X higher than CO2.

Carbon Neutral takes a holistic view of a building's impact on the natural environment. Taking into consideration the natural resources that are extracted and transported for construction materials and the exploitation of natural resources for energy generation.

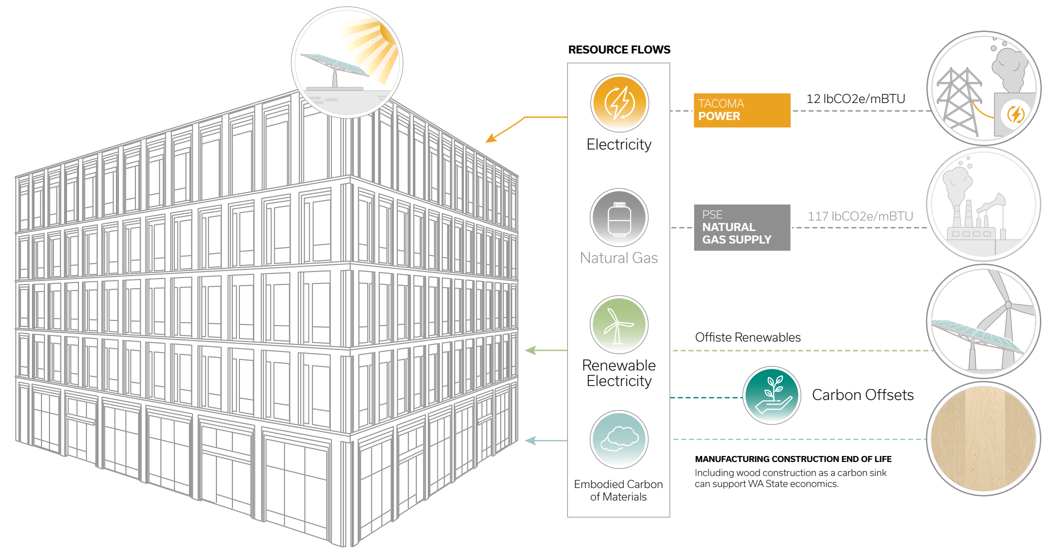
The Net Zero Carbon certification by ILFI provides a framework for meeting this goal and verifies the design after occupancy. The standard requires that one hundred percent of the operational energy use associated with the project must be offset by new on- or off-site renewable energy. One hundred percent of the carbon emissions impacts associated with the construction and materials of the project must be disclosed and offset.

During a one-year performance period, buildings must achieve a targeted energy efficiency level. New projects may not utilize on-site combustion. One hundred percent of the project's energy use must be offset by on- or off-site renewable energy on a net annual basis. The project must provide offsetting renewables which have the equivalent of 15 years of project power, provide directionality, and have durable ownership integrity associated with the project.

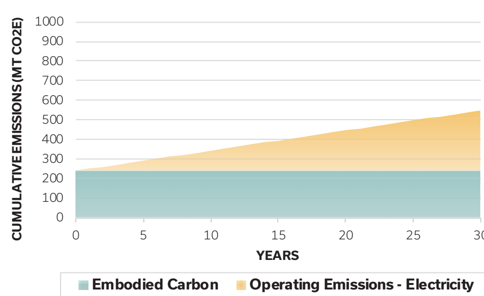
Setting a goal for **NET ZERO CARBON GOES ABOVE AND BEYOND MOST SUSTAINABILITY GOALS** to consider both direct and indirect impacts energy use and materials for the built environment have on the natural environment.

The construction materials will need to be sourced from low impact, local resources. All remaining emissions, embodied and operating, associated with the building must be offset by purchasing carbon offsets. Designing an energy efficient and locally sourced building may significantly reduce the number of carbon offsets needed to achieve Net Zero Carbon certification through IFLI. Carbon Neutral takes a holistic view of a building's impact on the natural environment. Taking into consideration the natural resources that are extracted and transported for construction materials and the exploitation of natural resources for energy generation.

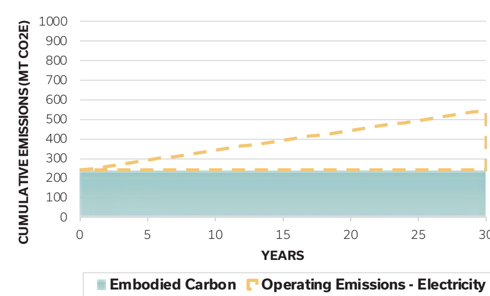
ZERO CARBON CERTIFICATION



PROJECT GHG EMISSIONS TO OFFSET (OPERATING + EMBODIED)



PROJECT POWERED BY ON SITE RENEWABLES



POST OCCUPANCY TRACKING

Operations + Maintenance Strategies

Post occupancy strategies are critical to ensuring the building operates as designed. Attendees of the Eco Charette expressed interested in pursuing above average M&V strategies.

Post occupancy monitoring of the building's energy and water consumption are an opportunity to engage students in campus sustainability. Displaying meters, iterative installations or sustainability integrated curriculum are opportunities for students to engage in real world applications the natural world's resources integrating with the built environment.

Further exploration of ways that students can engage with the building and energy and water can be measured and verified should be considered and studied in the following design phases.

Base | Better | Best in Class

POST OCCUPANCY TRACKING

	Base	Better	Best in Class
	36%	50%	14%
OCCUPANT ENGAGEMENT/ CARBON (ENERGY) (BUILDING LEVEL ENERGY METERING)	Panels separated by use Permanent submeters on major energy sources Meets LEED requirements for advanced metering.	Permanent meters on major energy sources Fault detection software in place (SkySpark) 1 year M&V setup after occupancy & Building Dashboard Integration	Permanent meters on major energy sources Fault detection software in place (SkySpark) >1 year M&V setup after occupancy & Building Dashboard Integration
	13%	67%	20%
OCCUPANT & STUDENT ENGAGEMENT/ WATER (WATER METERING)	DHW Meter Flush & Flow Metering, Irrigation Meter	DHW Meter Flush & Flow Metering, Irrigation Meter Building Dashboard Integration and Student Engagement	DHW Meter Flush & Flow Metering, Reclaimed Water Meter, Process Water Meter, Irrigation Meter Building Dashboard Integration and Student Engagement
	13%	44%	44%
REFRIGERANT MANAGEMENT	Annual leak inspections. No flare fittings.	Quarterly leak inspections. No flare fittings.	Quarterly leak inspections. Only brazed connections.

Water Conservation

There are a number of methods to achieve excellent water performance for the project. The new UW Tacoma Milgard project is aiming to meet:

- **50% Water Savings beyond Code (Indoor + Outdoor)**
  UW GREEN BUILDINGS STANDARD
- **LEEDv4 Gold | Indoor Water**
  (OUTDOOR WATER SAVINGS CALCULATED SEPARATELY)

Currently, Seattle Code does not have a requirement or guidelines for indoor water usage. Therefore, PAE recommends using LEED's metric tool (EPA WaterSense water budget tool) to establish a baseline, and target achieving 50% reduction over this baseline.

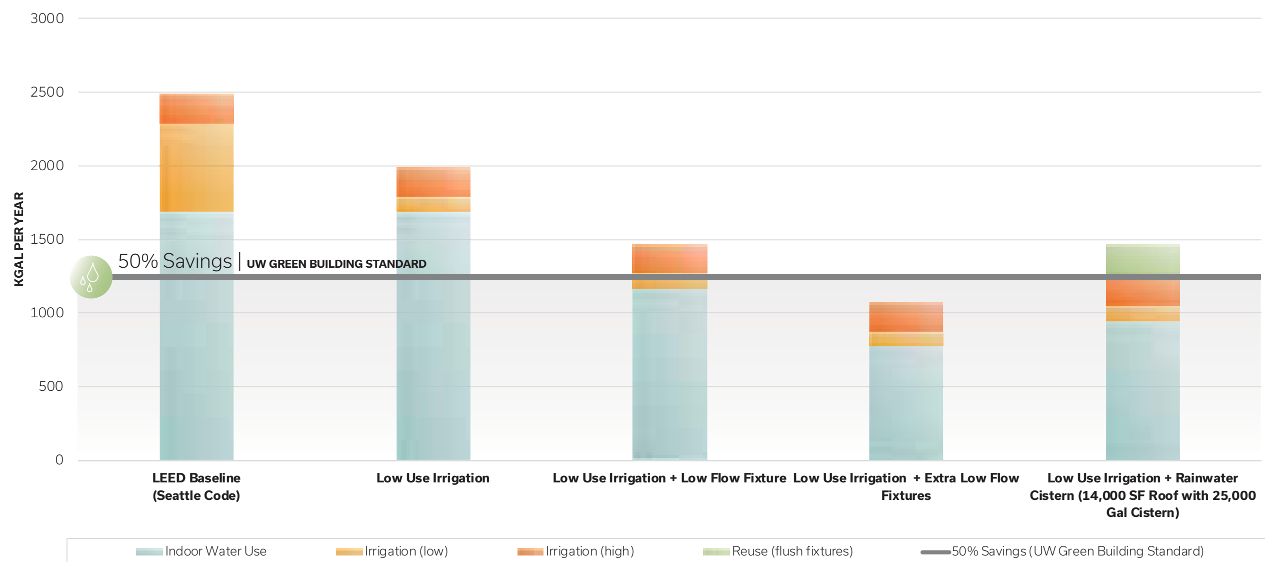
Strategies to meet these goals include low flow toilets, pint flush urinals and low flow fixtures for lavatory faucets. Rainwater reuse for flush fixtures can help further increase water savings to meet the project goals.

The table below details the assumptions used for this analysis. These details are based on early design assumptions and are likely to change as the design progresses.

Analysis Assumptions

INDOOR WATER USE	FUNCTION	**Higher Education**
INDOOR WATER USE	NUMBER OF PEOPLE	**54 FTE occupants** **862 average visitors/day**
INDOOR WATER USE	RAINWATER CATCHMENT TANK	**25,000 gallons**
INDOOR WATER USE	CATCHMENT AREA	**14,000 sf**
OUTDOOR WATER USE	IRRIGATION AREA	**4,400 sf**
OUTDOOR WATER USE	BASELINE PLANT FACTOR	**0.5**
OUTDOOR WATER USE	LOW USE PLANT FACTOR	**0.2**

WATER STRATEGIES | ANNUAL BUILDING WATER USE (KGAL)



	LEED BASELINE (SEATTLE CODE)	LOW USE IRRIGATION	LOW USE IRRIGATION + LOW FLOW FIXTURE	LOW USE IRRIGATION + EXTRA LOW FLOR FIXTURES	LOW USE IRRIGATION + RAINWATER CISTERN (14,000 SF ROOF WITH 25,000 GAL CISTERN
TOILET	1.6 gpf	1.6	1.28	0.8	1.28
URINALS	1.0 gpf	1	0.125	0.125	0.125
LAVATORY	0.5 gpf	0.5	0.5	0.35	.05
SHOWER	2.2 gpf	2.2	1.25	1.25	1.25
KITCHEN SINK	2.2 gpf	2.2	1.75	1.75	1.75
IRRIGATION	Average	Low Water	Low Water		Low Water
RAINWATER COLLECTION	No	No	No		Yes
INDOOR WATER SAVINGS		0%	31%	54%	44%
TOTAL WATER SAVINGS		20%	41%	57%	50%

Appendix

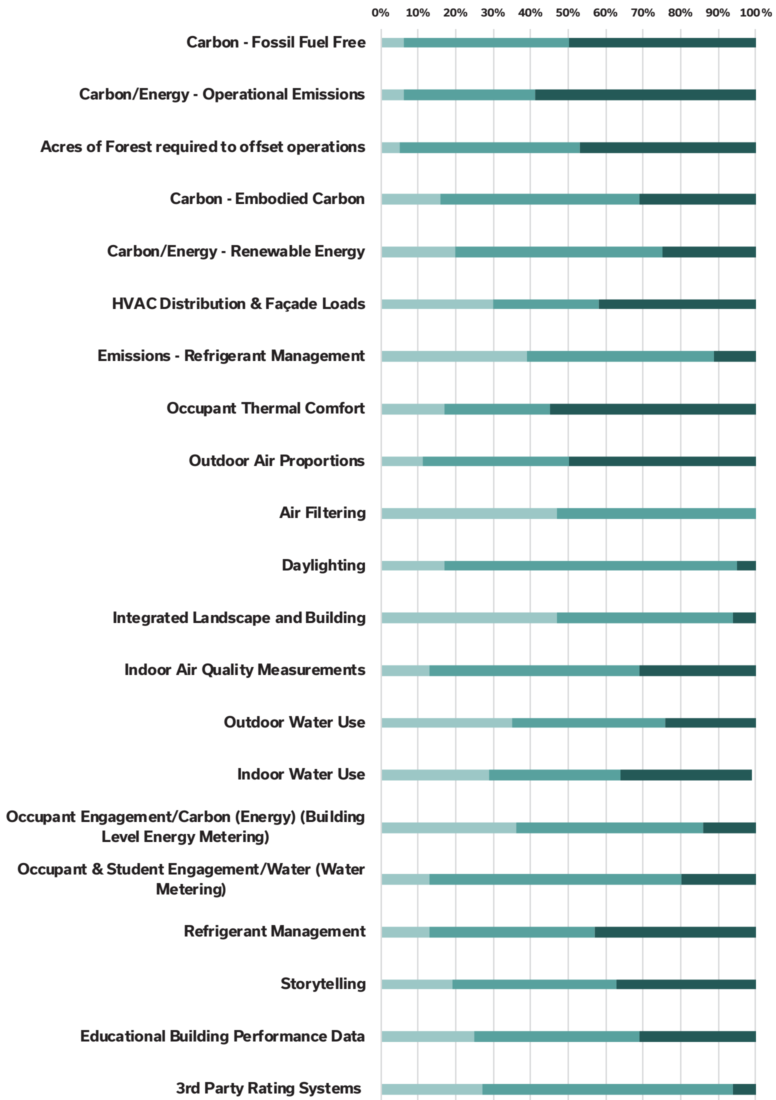
Eco Charette Meeting Notes and Poll Results

PAE and Lensa held an Eco-charette with UW Tacoma Milgard project team members and stakeholders on September 8th,2020 to determine any and all project goals surrounding sustainable design. These goals were anywhere from standard energy saving measures to audacious, but achievable, Carbon Neutral target setting. The team in attendance included UW Sustainability, UW Tacoma Facilities, and the design team. The charette was successful in determining an array of goals that would meet the project vision. Highlights of the most notable targets are listed below. Although no one goal or set of goals has been officially chosen by the team to pursue, the outcomes of the charette are emblematic of the team's desire and dedication to think bigger than the once-average lab building.

- Achieve at least 35% energy savings and strive for Carbon Neutral through ILFI Certification.
- Include better than baseline energy and water meeting with teaching elements for students and faculty throughout the building.
- Design an all-electric building.
- Design a high performance façade that significantly reduces mechanical loads
- Strive to achieve the LEED Advanced Refrigerant Management credit which would disqualify large volumes of HFCs on the project and most likely disqualify VRF as a potential mechanical system
- Achieve the LEEDv4 Daylighting Credit which means at least 55% of building has sufficient daylight
- Include automated operable windows with an expanded thermal comfort range to reduce system cooling loads and save energy.
- MERV 14 filters.
- Target at least 45% reduction in indoor water use which may require a rainwater catchment system for flush fixtures.

PAE would recommend holding a second charette to address sustainability goals for materials.

		Base	Better	Best in Class
CLIMATE RESPONSIVE DESIGN	CARBON - FOSSIL FUEL FREE	All electric building heating systems.	All electric building heating and DHW systems.	All electric building heating, DHW and backup power systems.
	CARBON/ENERGY - OPERATIONAL EMISSIONS	15% Better than WA Energy Code 2018 Meets UW Climate Action Plan	35% Better than LEED Energy & Carbon Meets UW Climate Action Plan	Net Positive Carbon & Achieve AIA 2030 Meets UW Climate Action Plan
	ACRES OF FOREST REQUIRED TO OFFSET OPERATIONS	40 acres	20 acres	0 acres
	CARBON - EMBODIED CARBON	Achieve 10% Reduction for LEED v4 Building Life-Cycle Impact Reduction (LEED credit minimum)	Achieve 20% Reduction for LEED v4 Building Life-Cycle Impact Reduction	Achieve 40% Reduction for LEED v4 Building Life-Cycle Impact Reduction
	CARBON/ENERGY - RENEWABLE ENERGY	PV Ready Roof and Roof Slope Optimized for Solar	100 kW PV arrays on roof	200 kW PV array on roof
	HVAC DISTRIBUTION & FAÇADE LOADS	All labs have local exhaust only as needed (advanced controls and reduced air flows).	Peak loads allow for a two pipe change over system in all zones. All labs have local exhaust only as needed (advanced controls and reduced air flows)	Peak loads allow for radiant panels and/or floors in all zones. All labs have local exhaust only as needed (advanced controls and reduced air flows)
	EMISSIONS - REFRIGERANT MANAGEMENT	Meet LEED v4 minimum refrigerant management	Meet LEED v4 enhanced refrigerant management	Only low-Impact Refrigerants
INDOOR ENVIRONMENTAL QUALITY	OUTDOOR AIR PROPORTIONS	Satisfy ASHRAE 62.1 Critical Zone	Satisfy ASHRAE 62.1 Critical Zone plus 30%	Provide 100% Outside Air at all times
	OCCUPANT THERMAL COMFORT	All spaces never drift over 78° F	All spaces never drift over 82° F for more than 0.5% hours and automated operable windows	All spaces never drift over 82.4° F for more than 1% hours and automated operable windows
	AIR FILTERING	Merv 13 filter	Merv 14 filter	HEPA filter
	DAYLIGHTING	Daylighting as "design feature"	Achieve LEED v4 Daylighting credit	Achieve LEEDv4 Daylighting credit, Option 1 (sDA plus ASE, 3 points)
	INTEGRATED LANDSCAPE AND BUILDING	50% of building area has view to outside vegetation	75% of building area has view to outside vegetation	Daylight inputs 90% of building area has view to vegetation
	INDOOR AIR QUALITY MEASUREMENTS	Implement thermal comfort survey (per LEED v4).	Meet LEED v4 requirements for survey.	Implement IAQ monitoring devices for ongoing IAQ performance tracking.
WATER STRATEGIES	OUTDOOR WATER USE	50% Reduction over LEED Baseline (50% reduction in overall water use)	75% Reduction over LEED Baseline	No Permanent Irrigation
	INDOOR WATER USE	35% Reduction over LEED Baseline (50% reduction in overall water use)	45% Reduction over LEED Baseline	> 50% Reduction over LEED Baseline
POST OCCUPANCY TRACKING	OCCUPANT ENGAGEMENT/CARBON (ENERGY) (BUILDING LEVEL ENERGY METERING)	Panels separated by use Permanent submeters on major energy sources Meets LEED requirements for advanced metering.	Permanent meters on major energy sources Fault detection software in place (SkySpark) 1 year M&V setup after occupancy & Building Dashboard Integration	Permanent meters on major energy sources Fault detection software in place (SkySpark) >1 year M&V setup after occupancy & Building Dashboard Integration
	OCCUPANT & STUDENT ENGAGEMENT/ WATER (WATER METERING)	DHW Meter Flush & Flow Metering, Irrigation Meter	DHW Meter Flush & Flow Metering, Irrigation Meter Building Dashboard Integration and Student Engagement	DHW Meter Flush & Flow Metering, Reclaimed Water Meter, Process Water Meter, Irrigation Meter Building Dashboard Integration and Student Engagement
	REFRIGERANT MANAGEMENT	Annual leak inspections. No flare fittings.	Quarterly leak inspections. No flare fittings.	Quarterly leak inspections. Only brazed connections.



		Base	Better	Best in Class
BUILDING AS TEACHER	STORYTELLING	20% of faculty member research represented in building design or interpretive materials.	40% of faculty member research represented in building design or interpretive materials. Green building audio website. Engineering students use building performance data in curriculum.	60% of faculty member research represented in building design or interpretive materials. Engineering students use building performance data in curriculum. Green building audio tours and website.
	EDUCATIONAL BUILDING PERFORMANCE DATA	Educational materials in lobby showing carbon, water and material stories	Educational materials on website, lobby & site showing carbon, water and material stories Environmental Building Declaration (EBD) published	Environmental Building Declaration (EBD) published Interactive educational materials on website, lobby & site showing carbon, water and material stories. Floor by floor energy competitions possible.
PERFORMANCE METRICS	3RD PARTY RATING SYSTEMS	LEED v4 Gold	LEED v4 Gold + _____	LEED v4 Gold + _____ + _____

6.2.7 LEED

UNIVERSITY OF WASHINGTON TACOMA MILGARD HALL

BASIS OF DESIGN - LEED CERTIFICATION

The project is required to obtain at minimum LEED Silver certification and will use the LEED v4 for Building Design + Construction: New Construction (LEED BD+C:NC) rating system. The project's design and construction measures will comply with all LEED prerequisites in addition to obtaining at least 50 points for LEED Silver. While the project will use the LEED v4 version as the primary certification rating system, it is anticipated that the project will also utilize the LEED v4.1 rating system on a credit by credit basis.

The project will also leverage concepts and measures from other certification programs (e.g. WELL, Fitwel, Living Building Challenge) and aspirational program metrics (i.e. Architecture 2030, Net Zero Carbon) to further meet the sustainability and LEED goals. Various strategies will be explored and evaluated at the commencement of the Design Phase of the project, with a focus on the early goals identified at the Eco-Charrette. The summary below identifies some initial considerations for the LEED categories and related prerequisites and credits that will be assessed and further developed as the design process progresses.

INTEGRATIVE PROCESS

The project is implementing an integrative design process using early design analysis for energy and water to inform design strategies, systems selection and performance targets.

LOCATION AND TRANSPORTATION

The project is located on a previously developed site within existing urban fabric, with access to diverse services and public transit. Additional transportation management measures to be explored for the project include infrastructure for cyclists (bicycle storage and showers), provision for electric vehicles, and campus parking strategies. The project site itself is an existing parking lot, with known groundwater contamination that will be appropriately remediated.

SUSTAINABLE SITE

In line with the LEED requirements, erosion and sedimentation controls will be implemented during the Construction Phase. Stormwater management measures will be implemented in accordance to the city's requirements, but due to the impervious nature of the site and limitations on infiltration, the project is not anticipated to meet the LEED requirements for the SS Credit Rainwater Management. An outdoor science court proposed will provide accessible outdoor learning spaces. Site and roof material selection will take account of heat island impacts, while exterior lighting strategies will limit light pollution.

WATER EFFICIENCY

Landscape design strategies will take account of the campus and LEED water efficiency requirements, with native and/or drought tolerant plant species where possible, and water efficient irrigation system and controls provided as needed. All new plumbing fixtures will be ultra-low flush or low-flow, and water usage will be metered. The project will aspire to meet the UW Green Building Standard requirements to use 50% less water than code, and strategies to meet this and the LEED requirements will be explored in depth during the design phase.

ENERGY AND ATMOSPHERE

The project has identified preliminary energy performance goals based on the Eco-Charrette and will aspire to comply with the UW Green Building Standard requirements to be at least 15% more efficient than the 2018 WSEC.

During the design phase, the project will evaluate high performance building measures to align with UW's green building and sustainability goals, including carbon emissions. Building massing and envelope design will be analyzed as well as mechanical and lighting systems. Energy reduction strategies for the labs will be a priority given the high energy usage of these spaces.

Passive design strategies such as daylight and shading will be explored where applicable. Natural ventilation opportunities will also be explored but given the site's location, the outdoor air quality may limit such opportunities.

While energy efficiency will be a major consideration for systems selection, the impact of refrigerants will also be factored into the design decisions.

All energy systems will be commissioned in accordance with the LEED requirements, and building envelope commissioning will also be implemented.

For ongoing performance monitoring, it is anticipated that all major energy uses of the building will be metered and the data monitoring and tracking could be integrated into curriculum opportunities for students. The project could also have wall cut-outs to allow students views to the building systems.

MATERIALS AND RESOURCES

The project will include storage and collection areas for recyclables at strategic locations in the building. The project will institute a comprehensive Construction Waste Management Plan during the Construction Phase.

Material selection will factor environmental impacts due to material sourcing, manufacturing, shipping, and installation. Preference will be given to locally sourced materials, FSC certified wood, products with high recycled content, bio-based content, or products that have completed life-cycle assessments or health product declarations.

INDOOR ENVIRONMENTAL QUALITY

The project will seek to incorporate various measures to optimize the indoor air quality of the interior occupied spaces. During the design phase, the project will determine feasibility of measures such as enhanced filtration and ventilation and controlling potential pollutant sources. Interior building products, including finishes, will be specified as low-emitting or non-toxic products based on the LEED requirements for VOC content and emissions testing, to the extent possible. Construction indoor air quality management practices will be adopted for the project, with a building flush-out or IAQ testing conducted following construction completion. During the design phase, thermal, visual, and acoustical comfort design measures will be explored and incorporated into the project as appropriate to create productive learning and working spaces. Lighting and thermal comfort systems will offer appropriate levels of control based on the space or users' needs. Daylight strategies, augmented by quality lighting, will be considered for all academic and office spaces, and access to views to the outdoors will be prioritized for these spaces.

INNOVATION

Various innovation credit ideas will be explored and may include the following: A green educational outreach program for the project that includes a case study and tour outline; operations and maintenance related policies (e.g. green cleaning, Integrated Pest Management); occupant surveys; reduction of chemicals in materials; or other applicable innovations. At least one pilot credit will be pursued, and potential options include those centered on social equity, resilience, and health.

REGIONAL PRIORITY

The following are the Regional Priority credits for Tacoma, WA, and are automatically awarded if the required thresholds are met for the corresponding credit:
EA Credit Demand Response (achieve 1 point)
EA Credit Renewable Energy Production (achieve 2 points)
MR Credit Building Product Disclosure and Optimization – Environmental Product Declarations (achieve 1 point)
MR Credit Building Product Disclosure and Optimization – Sourcing of Raw Materials (achieve 1 point)
SS Credit Rainwater Management (achieve 3 points)
WE Credit Indoor Water Use Reduction (achieve 4 points)

Thank you.