Mercer Island Public Safety and Maintenance Facility

Presentation Agenda

I. **PSM Facility Initial Planning Overview**

II. **Building Systems Resiliency Planning**

a. Potential for Solar Power Generation

b. Potential for Rainwater Harvesting and Re-Use

c. Potential for Emergency Potable Water Storage

II. **Facility Structural Systems**

a. Mass Timber, Steel, and Concrete Systems

AERIAL PHOTOGRAPH OF THE EXISTING SITE

This photograph illustrates the existing city-owned site, with the property line indicated in yellow. This slide is provided for orientation purposes.

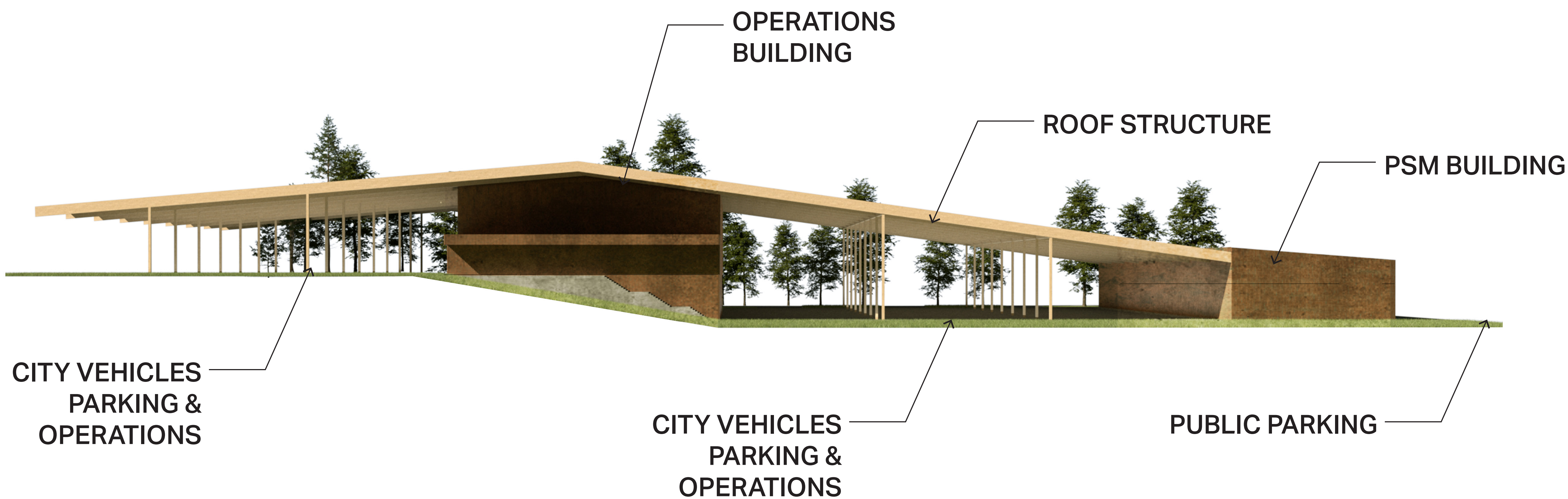
FACILITY SITE PLAN

This site plan illustrates the layout for facilities and operational areas. Buildings and covered operations areas are consolidated on the eastern portion of the site, opening the western portions (Lower and Upper Yards) of the site for Yard functions.

SITE PLAN
1" = 100'

OVERHEAD ILLUSTRATIVE VIEW

BUILDINGS AND COVERED AREAS ILLUSTRATIVE ELEVATION



EAST ELEVATION
NTS

Building Systems Resiliency Planning

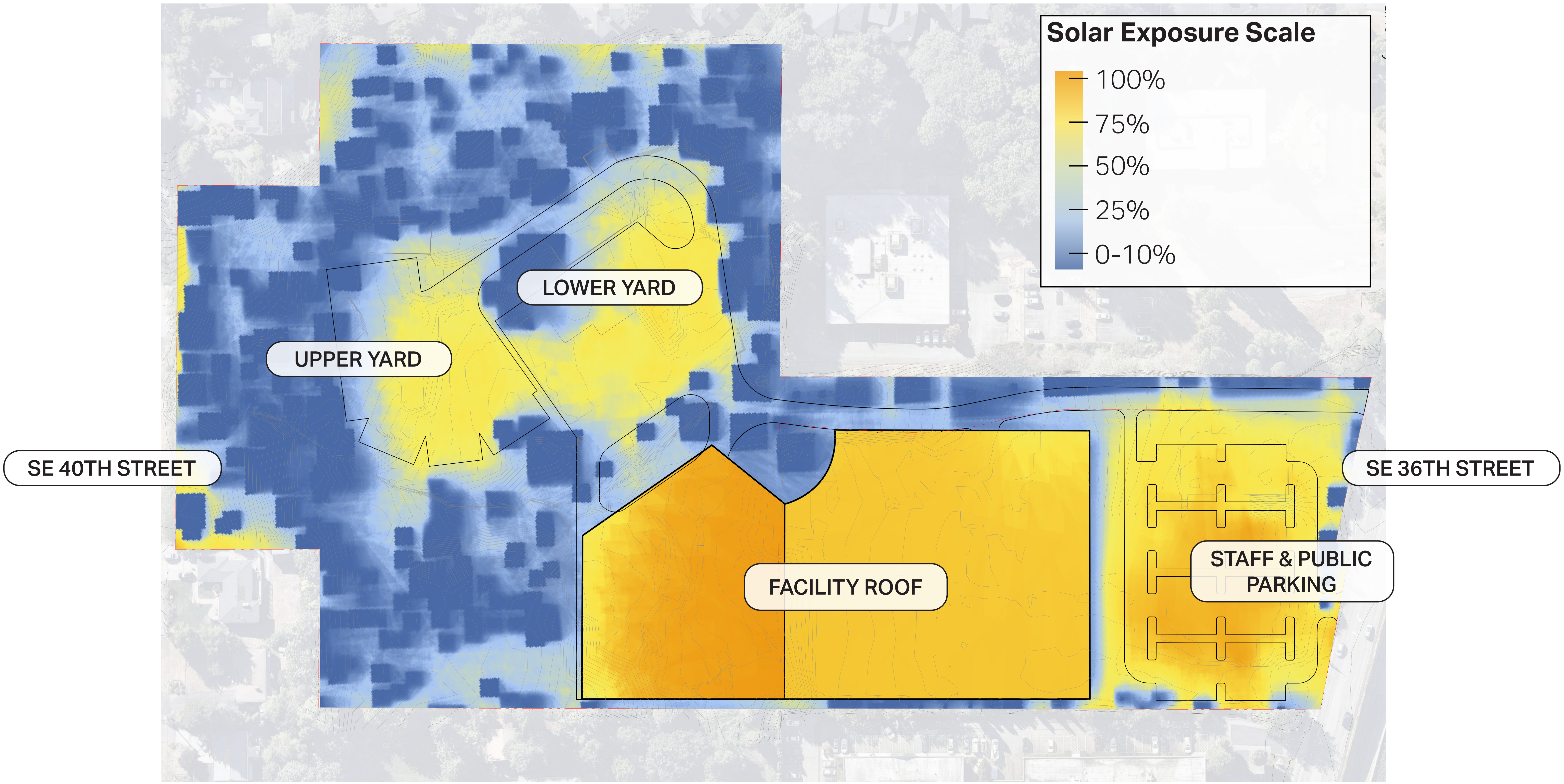
a. Potential for Solar Power Generation

b. Potential for Rainwater Harvesting and Re-Use

c. Potential for Emergency Potable Water Storage

SOLAR POWER GENERATION

The project is a good candidate for roof-mounted solar power generation to increase emergency resiliency and lower operational energy costs. This solar radiation analysis illustrates solar availability across the proposed PSM roof surfaces and adjacent site.

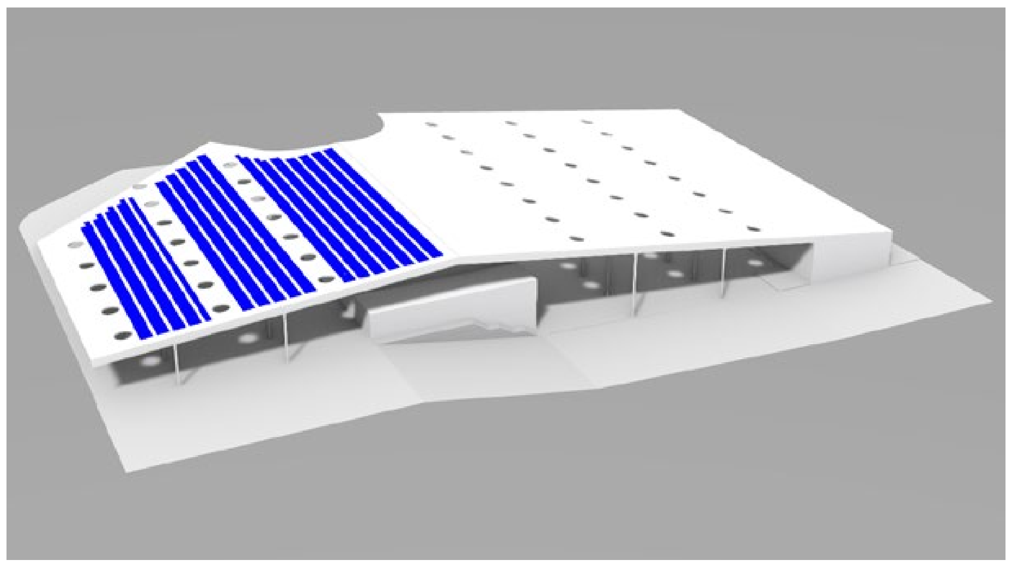


SYSTEM SIZES

Three design alternatives were studied:

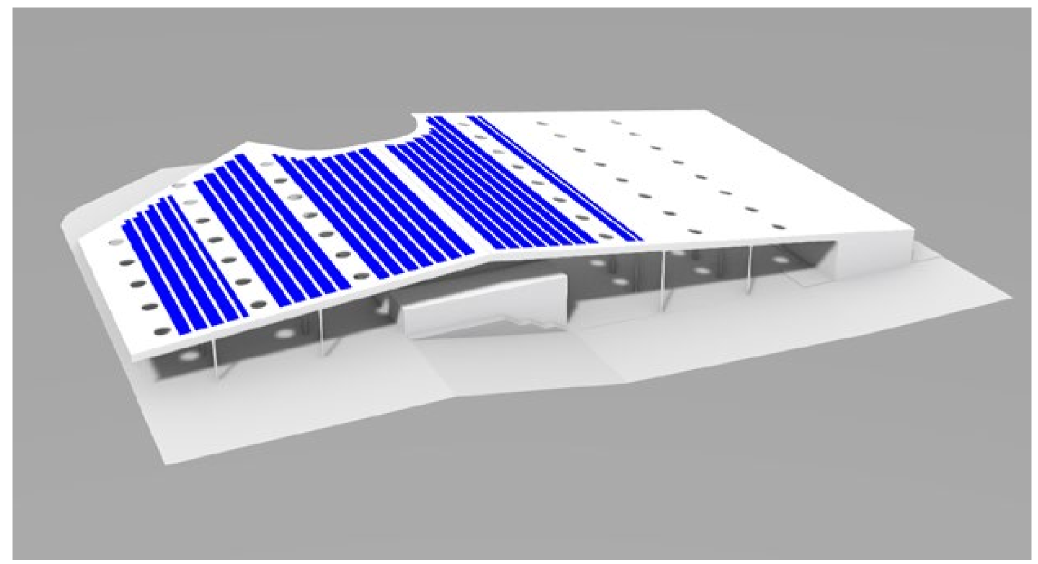
1. A Limited Solar System, located on the southern-sloping roof only;
2. An Expanded Solar System, located on portions of both the southern and northern roofs and sized to equal the total estimated annual energy need for the facility; and,
3. No Solar system.

LIMITED SOLAR SYSTEM



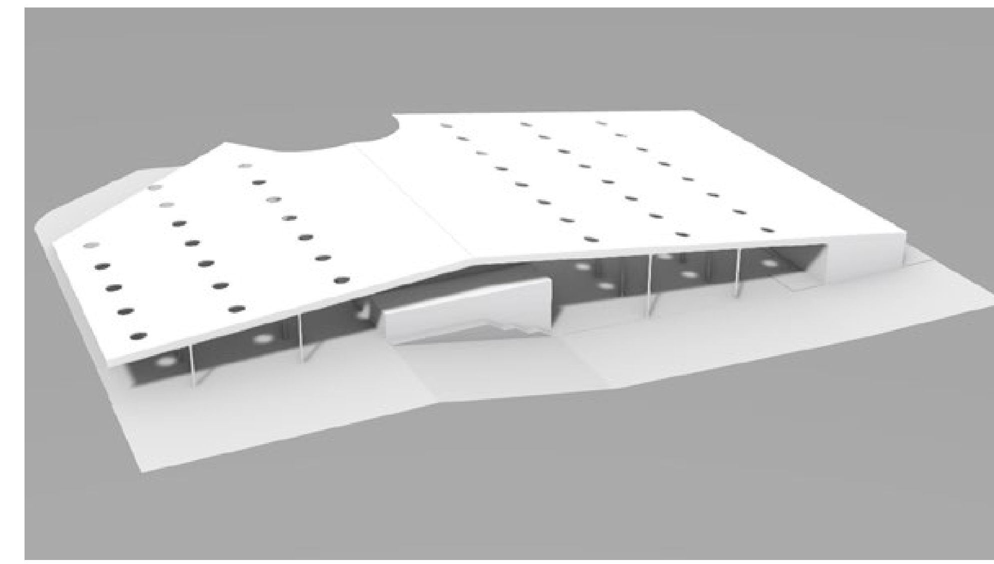
A Solar System is limited to the southern roof of the PSM Facility. This area could achieve approximately 63% of total estimated annual energy need of the facility at completion.

EXPANDED SOLAR SYSTEM



A Solar System is located on the south-facing roof with additional panels located on the northern roof, sized to provide up to 100% of the estimated annual energy need of the facility at completion.

NO SOLAR SYSTEM



No Solar System is incorporated into the PSM Facility design.

COST BENEFIT

"Cost benefit" considers potential cost savings over system cost, support for operations during power emergencies, and support for Mercer Island's adopted policies.

SYSTEM COSTS AND OPERATIONAL ENERGY SAVINGS

	LIMITED SOLAR SYSTEM	EXPANDED SOLAR SYSTEM*	NO SOLAR SYSTEM
ANNUAL ENERGY NEED	735,000 kWh	735,000 kWh	735,000 kWh
SOLAR SYSTEM ANNUAL POWER GENERATION	464,700 kWh	735,000 kWh	0 kWh
REMAINING ELECTRICITY NEED	267,800 kWh	0 kWh	735,000 kWh
ANNUAL ENERGY COST	$24,000	$4,200	$65,300
SOLAR ANNUAL ENERGY SAVINGS	$41,300	$61,100	$0
25-YEAR ENERGY COST	$655,755	$187,475	$1,632,500
SOLAR 25-YEAR COST SAVINGS	**$976,745**	**$1,445,015**	**$0**
SYSTEM CAPITAL COST (AVE)	$1,394,100	$2,197,500	$0
25-YEAR MAINTENANCE COST	$200,000	$200,000	$0
CAPITAL COST VS SAVINGS	($617,355)	($952,485)	N/A

NOTES ON CALCULATIONS

1. Energy costs are based on Puget Sound Energy (PSE) utility Schedule 25 and 667 rates.
2. Calculations are based on a 25-year performance period to align with industry-standard 25-year performance warranties
3. Calculations account for a 0.45% annual degradation in solar panel performance, based on example panels' performance and warranty metrics.
4. System capital cost is based on current system costs averaging $3.00/ watt.
5. *Potential to supply 100% of facility energy needs. Calculations include estimated performance degradation of solar panels per note #3 above.

COST BENEFIT

“Cost benefit” considers potential cost savings over system cost, support for operations during power emergencies, and support for Mercer Island’s adopted policies.

EMERGENCY POWER SUPPORT

On-site solar power generation would extend the operating duration of the facility during power outages. The project incorporates a diesel-powered generator sized to power the facility for up to seven days. On-site power generation could extend that duration by approximately 30%, from 7-days to approximately 10-days under normal power usage. Longer durations may be may be possible through reduced power usage, if possible, during emergencies.

POLICY SUPPORT

On-site solar power generation supports Mercer Island’s adopted Climate Action Plan goals in the Cross-Cutting and Municipal Focus area.

Action CC2.7 Municipal renewable energy storage:
“Expand solar installation and build renewable energy storage systems on City property.”

EV CHARGING FOR FUTURE FLEET VEHICLES

The following slides will indicate the summer-season capacity for EV charging, if utilized in-lieu of net-metering. Studied configurations are expandable to incorporate future EV charging.

Note:
EV charging canopies, for use in public parking lots, are evolving both in terms of efficiency and cost competitiveness. Potential systems should be reviewed closer to public parking construction to leverage advances in these products.

ENERGY AND SOLAR

NET ZERO POTENTIAL

- The energy use of the PSM (Public Maintenance and Safety) building is based on similar PAE projects of public works buildings in the Seattle area climate.
- The OPS building energy use is based on CBECS averages for warehouse building types.
- No energy model has been developed for this project and these estimates are likely conservative until further analysis is completed.

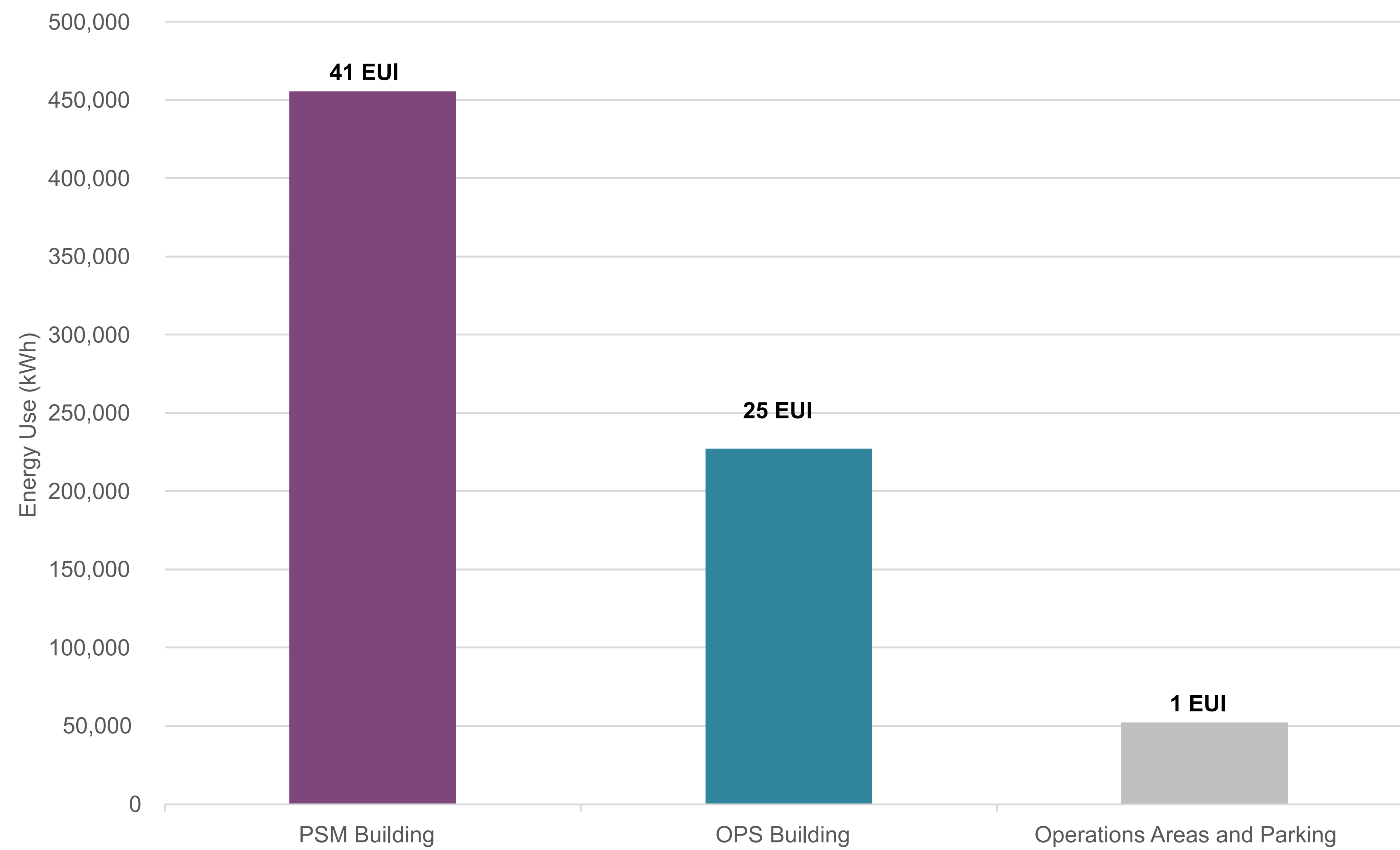
ENERGY COST

- Electricity costs are based on Puget Sound Energy (PSE) utility Schedule 25 rates for building energy use.
  - A flat rate of $0.0888/kWh is used which factors in the demand and use charges based on Schedule 25 for energy cost.
- Electricity payback from PSE is limited. PV arrays above 100 kW will not recieve net metering. This is schedule 667.
  - Schedule 667 pays back $0.06713 per kWh.
- Natural gas use is not included with this project.
- Energy Use Intensity (EUI) is a metric used in the building industry to compare energy use for buildings on a square foot basis in kBtu/sf/year units. The smaller the number, the less energy consumed. A Net Zero Energy (NZE) building will have an EUI of 0.

EUI is the metric that the City of Mercer Island would use for tracking WA Clean Buildings compliance.

PAE Engineers, Inc. (PAE) are the building systems engineers for the PSM Facility project.

ESTIMATED ENERGY USE OF SITE



BUILDING	GFA (FT2)	USE TYPE	ESTIMATED ANNUAL ENERGY (KWH)	EUI (KBTU/ SF/YR)	EST. ANNUAL ENERGY COST ($)
PSM Building	37,500	Office, Holding, Police/ Interview	455,500	41 EUI	$40,500
OPS Building	29,860	Maintenance, Storage, Shop	227,400	26 EUI	$20,200
Operations Areas and Parking	Police/PSM: 52,000 Boat/Trailer: 35,000 Storage Area: 68,000	Parking and open storage/ washbays (equipment, lighting only)	52,200	1 EUI	$4,600

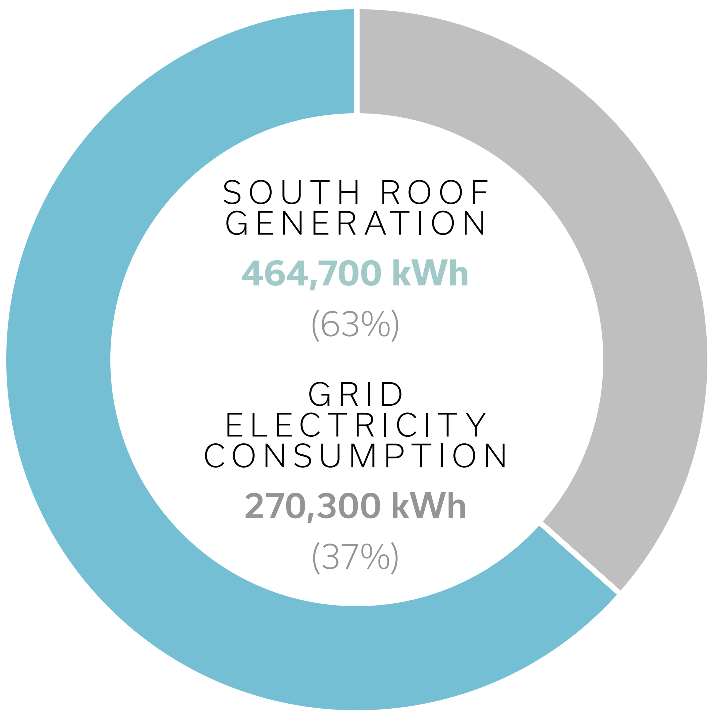
LIMITED SOLAR

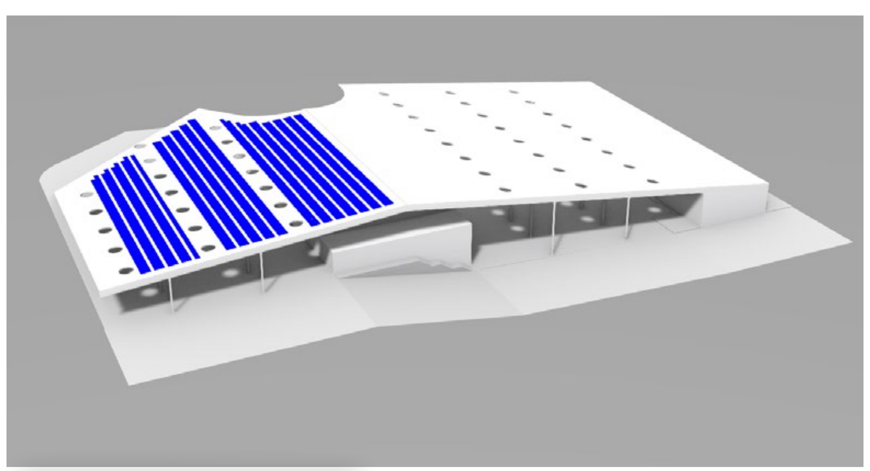
EUI

14

KBTU/SF/YR

454 KW ROOFTOP PV





927 PANELS

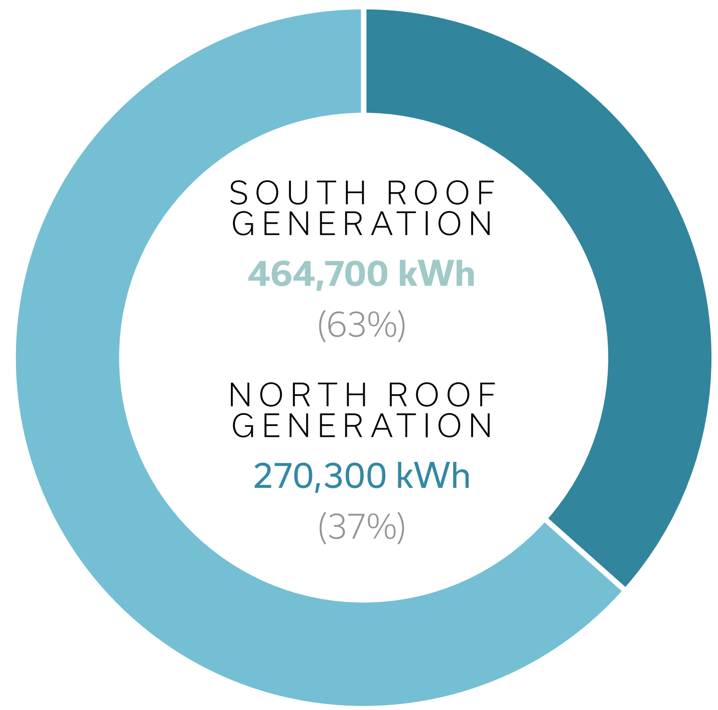
EXPANDED SOLAR

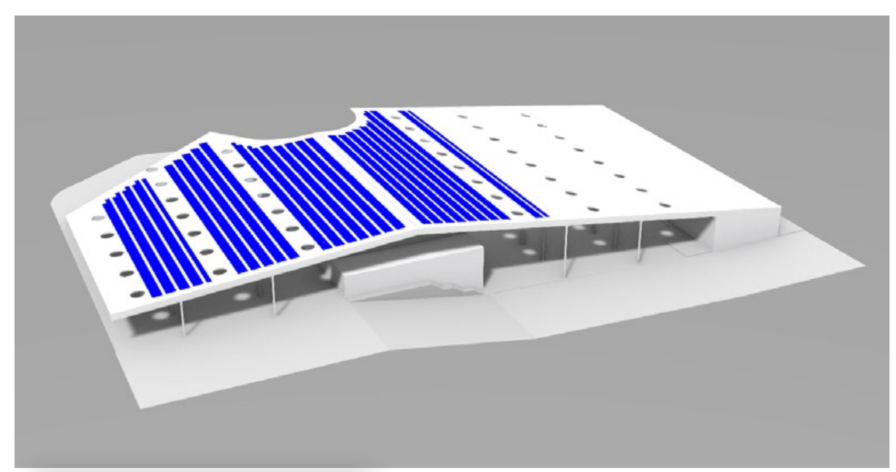
EUI

0

KBTU/SF/YR

744 KW ROOFTOP PV





1,519 PANELS

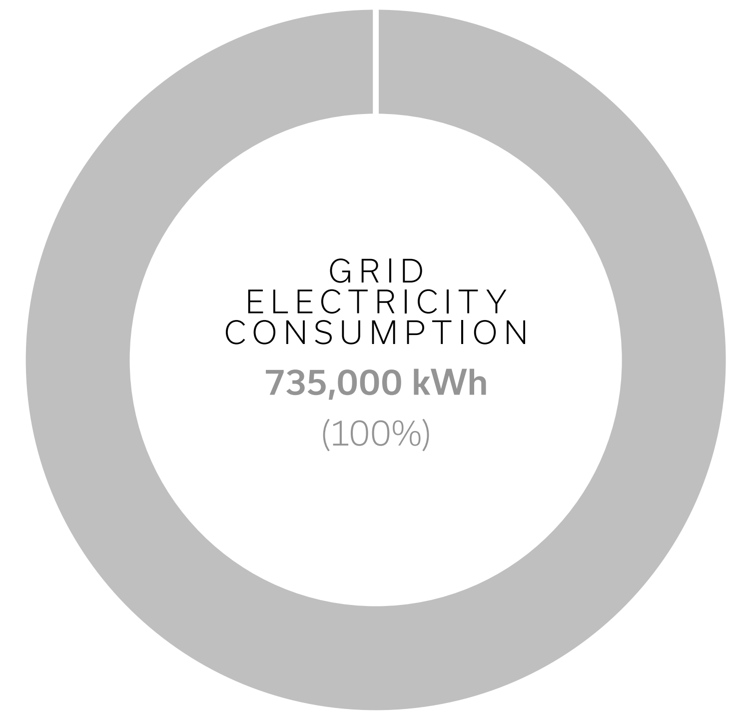
NO SOLAR

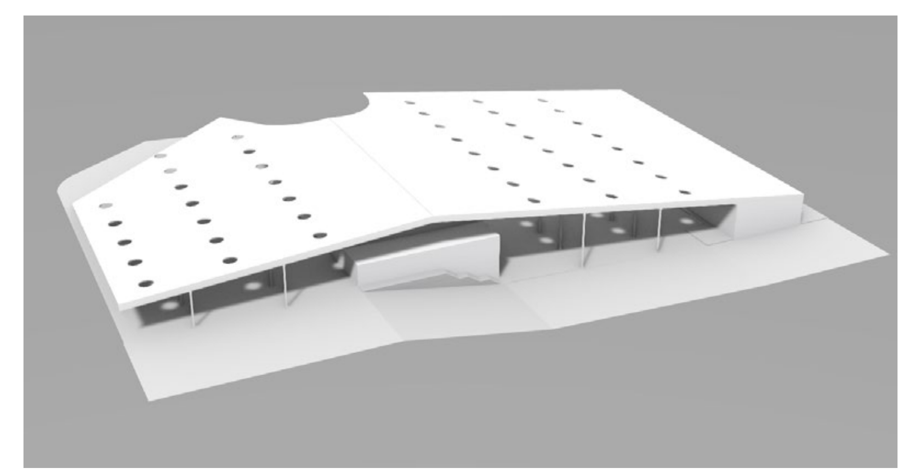
EUI

37

KBTU/SF/YR

NO PHOTOVOLTAIC (PV)





PAE Engineers, Inc. (PAE) are the building systems engineers for the PSM Facility project.

MONTHLY ENERGY USE AND SOLAR ENERGY GENERATION

ESTIMATED ENERGY COST

BUILDING	GRID ELECTRICITY CONSUMPTION (KWH)	EST. ANNUAL ENERGY COST ($)
Proposed Design	735,000	$65,300
South Roof PV	270,300	$24,000
North & South Roof PV for Net Zero	0	$4,200

Net metering limited by PSE to 100 kW PV array. PV systems larger are subject to a payback rate that is less than the electricity purchase rate.

Regardless of PV quantity, the electrical infrastructure will be set up so that the maximum PV array can be installed at any time in the future. This also includes space and infrastructure for a Battery Energy Storage System (BESS).

SUSTAINABILITY & RESILIENCE

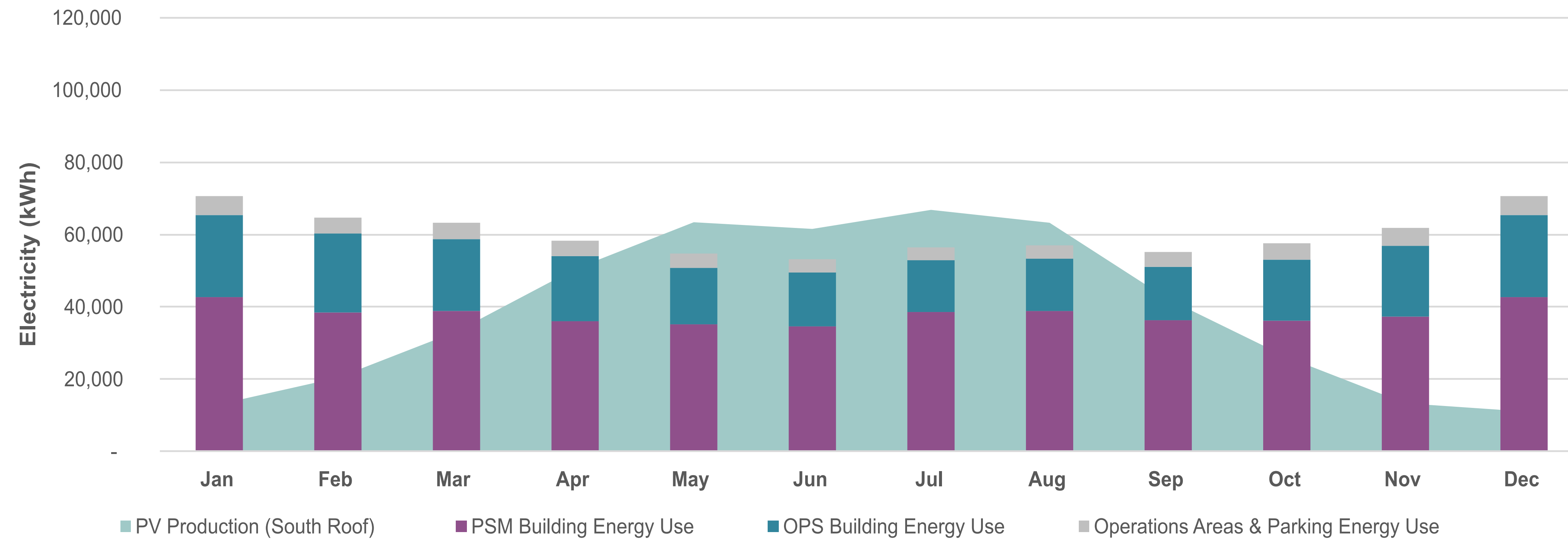
When we discuss sustainability, resilience is a natural and symbiotic additional benefit to the facility. Designing an on-site microgrid using a combination of PV's, BESS, traditional generator, and control system, this facility will be capable of continual operation in an emergency situation.

As part of the next steps of the design process, PAE can provide the City with potential resilience options and failure scenarios to help land on an agreed design path.

PAE Engineers, Inc. (PAE) are the building systems engineers for the PSM Facility project.

LIMITED SOLAR ALTERNATIVE ENERGY USE AND GENERATION

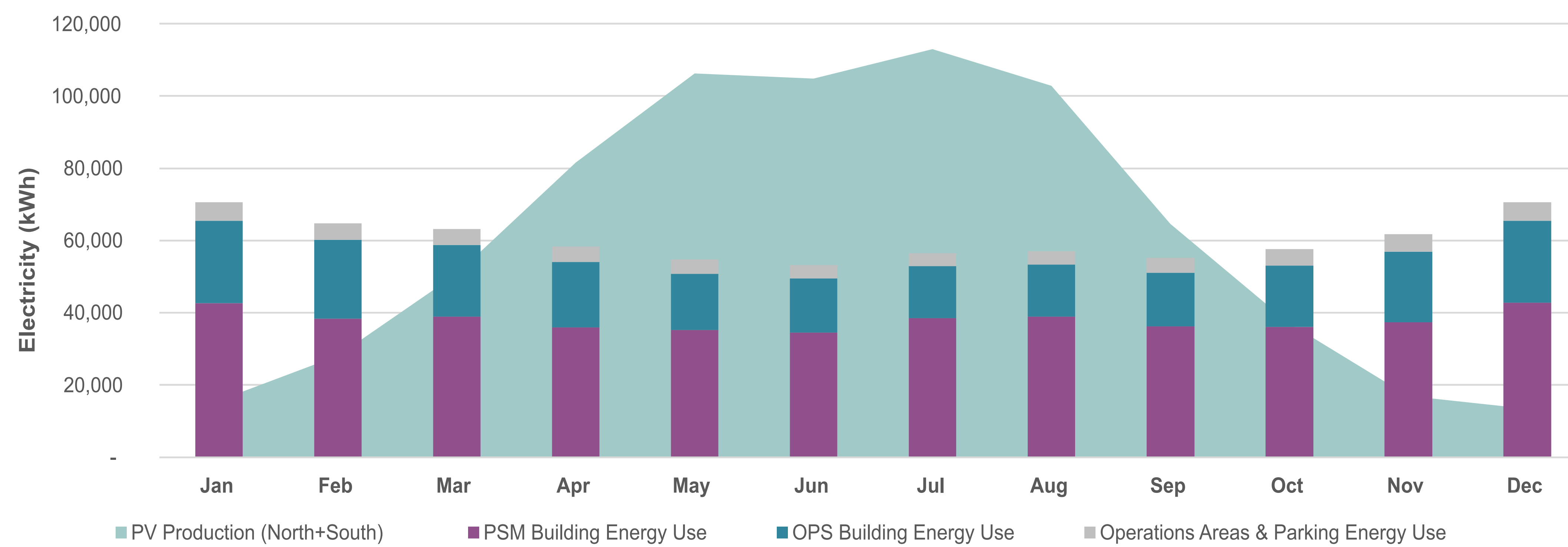
454 KW PV ARRAY



EXPANDED SOLAR ALTERNATIVE ENERGY USE AND GENERATION

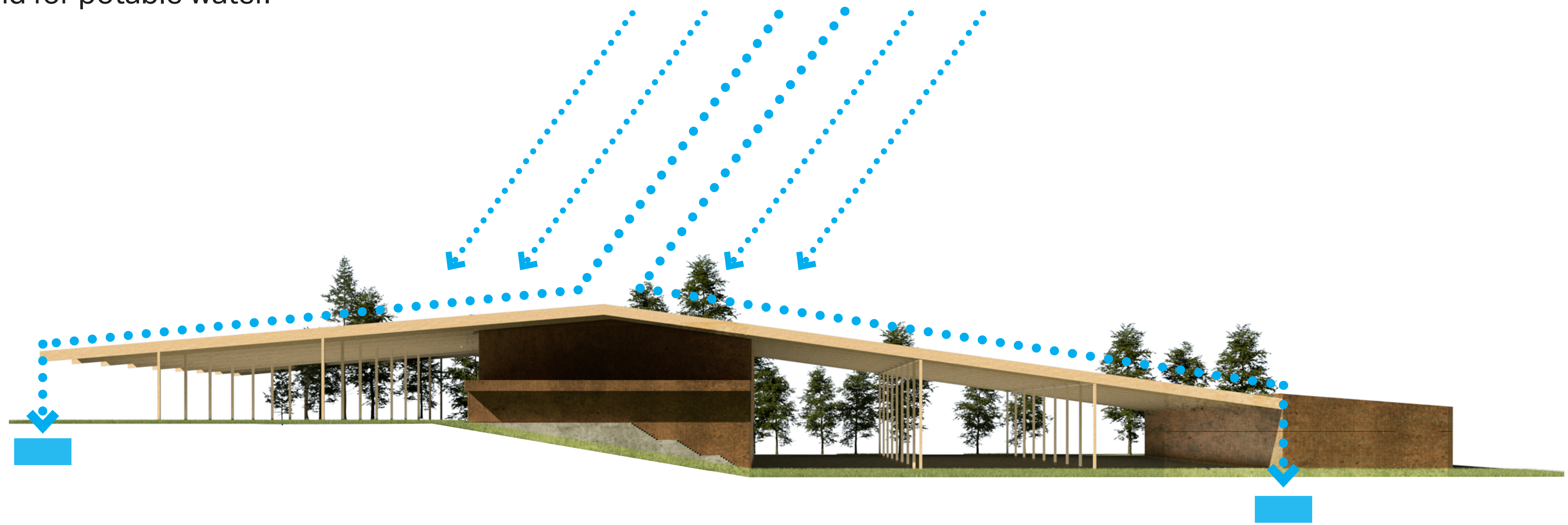
744 KW PV ARRAY

N



STORMWATER HARVESTING

Roof surfaces are capable of harvesting rainwater for on-site storage and reuse at vehicle and equipment wash stations, wheel wash areas, general site maintenance, and even plumbing fixture flush valves, lowering the city's operations cost by reducing the demand for potable water.



Stormwater storage cisterns may be located at either end of the roof, with piped connections to filtration systems at each facility, or cisterns may be co-located in a central mechanical area—adjacent the system filtration systems, with piped connections from catchment areas.

COST BENEFIT

“Cost benefit” considers potential cost savings over system cost, and support for operations during water emergencies.

SYSTEM COSTS AND OPERATIONAL SAVINGS

	NO STORMWATER SYSTEM	STORMWATER HARVESTING
NON-POTABLE WATER NEED	523,500 Gallons	523,500 Gallons
ANNUAL WATER HARVESTING	0 Gallons	388,200 Gallons
REMAINING WATER NEED	523,500 Gallons	135,300 Gallons
ANNUAL COST	$19,400	$5,000
ANNUAL SAVINGS	$0	$14,400
20-YEAR COST	$388,000	$0
20-YEAR SAVINGS	$0	$288,000
SYSTEM CAPITAL COST	$0	$250,000
20-YR SAVINGS OVER COST	$0	+ $38,000

Based on a 10,000 gallon cistern.

EMERGENCY WATER SUPPORT

Stormwater harvesting would provide support for building functions (toilets, flush valves, site water use) during water emergencies.

Rainwater Collection and Reuse

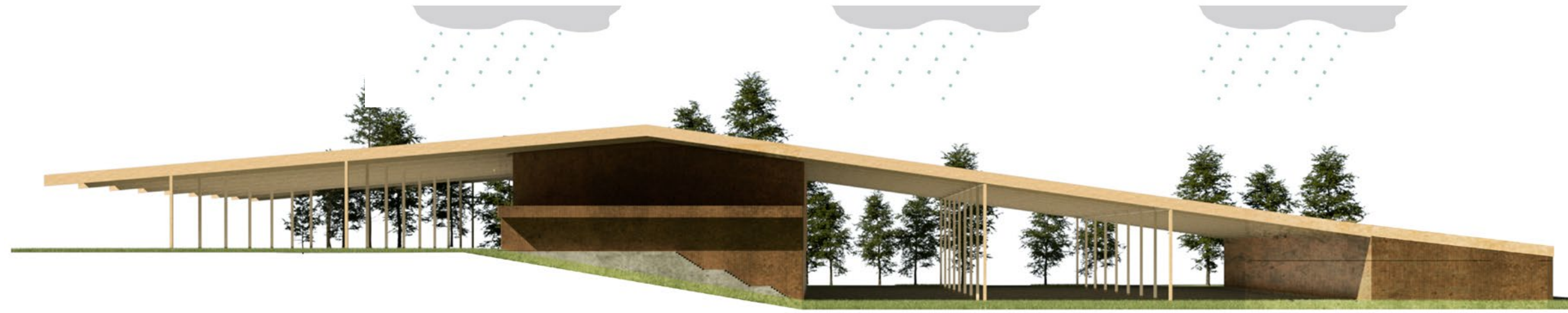
Rainwater can be collected from the rooftop and stored in a cistern (above or below ground).

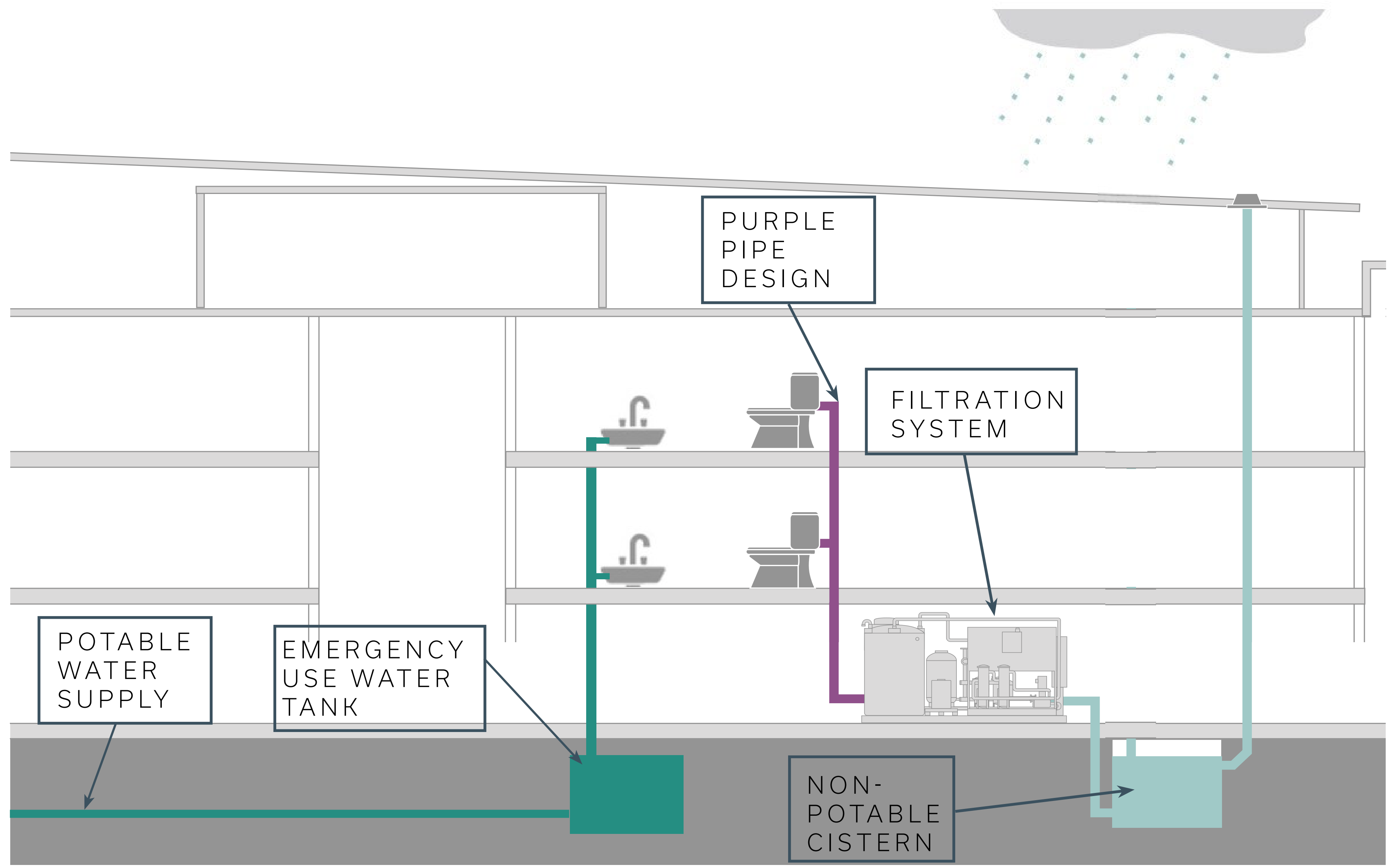
— A filtration system will be required for rainwater re-use to remove any debris collected from the rooftop.

RAINWATER STORAGE TANK

— Non-Potable Cistern: This tank can be used for collection of rainwater, filtered to non-potable standards, and distributed via purple pipe for flushing and vehicle washing.

— Emergency Use Water Tank: This tank would provide resilience for the facility by storing potable water from city sources. In an emergency, the potable water supply would be cut off and the tank could be used for the potable supply throughout the building or for select uses. The water would be able to cycle through the tank for normal day to day uses. A pump to deliver water where needed would be connected to backup power.





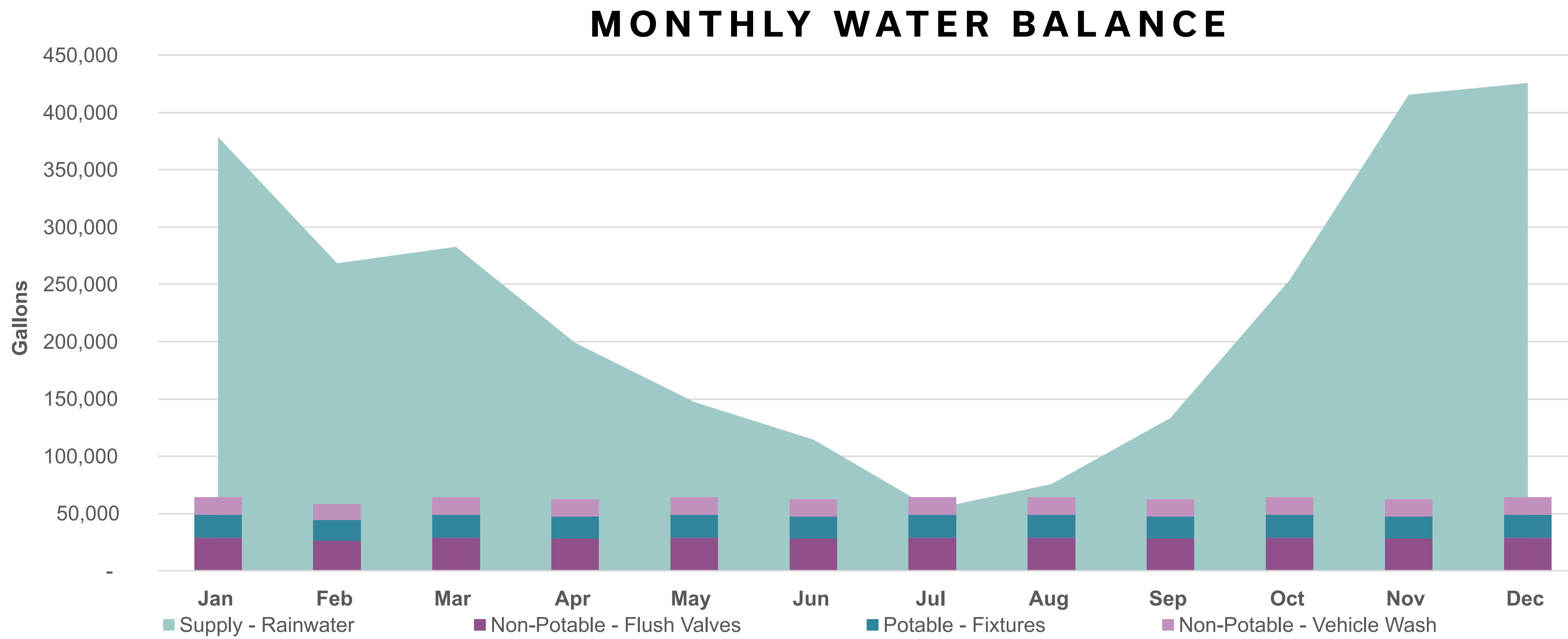
PAE Engineers, Inc. (PAE) are the building systems engineers for the PSM Facility project.

Rainwater Collection and Reuse

WATER USE ESTIMATE

The water use of the site is based on the following inputs:

- 200 Occupancy (Full Time Equivalent)
- Flow Fixtures:
  - Toilets: 1.28 gpf
  - Urinal: 0.5 gpf
  - Lavatory: 0.5 gpm
  - Kitchen Faucet: 1.5 gpm
  - Shower: 2 gpm
- Vehicle Wash with 10 washes per day at 50 gallons per wash



WATER COST

Water costs are based on rates published by Mercer Island and Seattle Public Utilities that provide water to the site. The following rates are used:

- Winter, Oct-May: $5.63/CCF
- Summer, June-Sept: $13.98/CCF
- King County Sewer: $7.77/CCF
- Sewer Line Maintenance: $9.97/CCF

	ANNUAL ESTIMATED WATER USE (GAL)	ANNUAL WATER COST ESTIMATE ($)	ANNUAL SEWER COST ESTIMATE ($)	WATER COLLECTION POTENTIAL (GAL)
Potable Water Use (Lavatories/Shower)	236,000 gal	$3,100	$5,600	2,750,000 gal
Non Potable (Toilets/flush fixtures)	341,000 gal	$4,500	$8,100	
Vehicle Wash Water Use	182,500 gal	$2,400	$4,400	
Total	759,500 gal	$10,000	$18,100	

PAE Engineers, Inc. (PAE) are the building systems engineers for the PSM Facility project.

Rainwater Collection and Reuse

CISTERN SIZING

— The chart here shows the percentage of non-potable water offset annually based on capacity of the cistern.

— After approximately a 10,000 gallon cistern, the water saving returns diminish significantly.

— A 60,000 gallon cistern could offset 100% of non-potable uses annually.

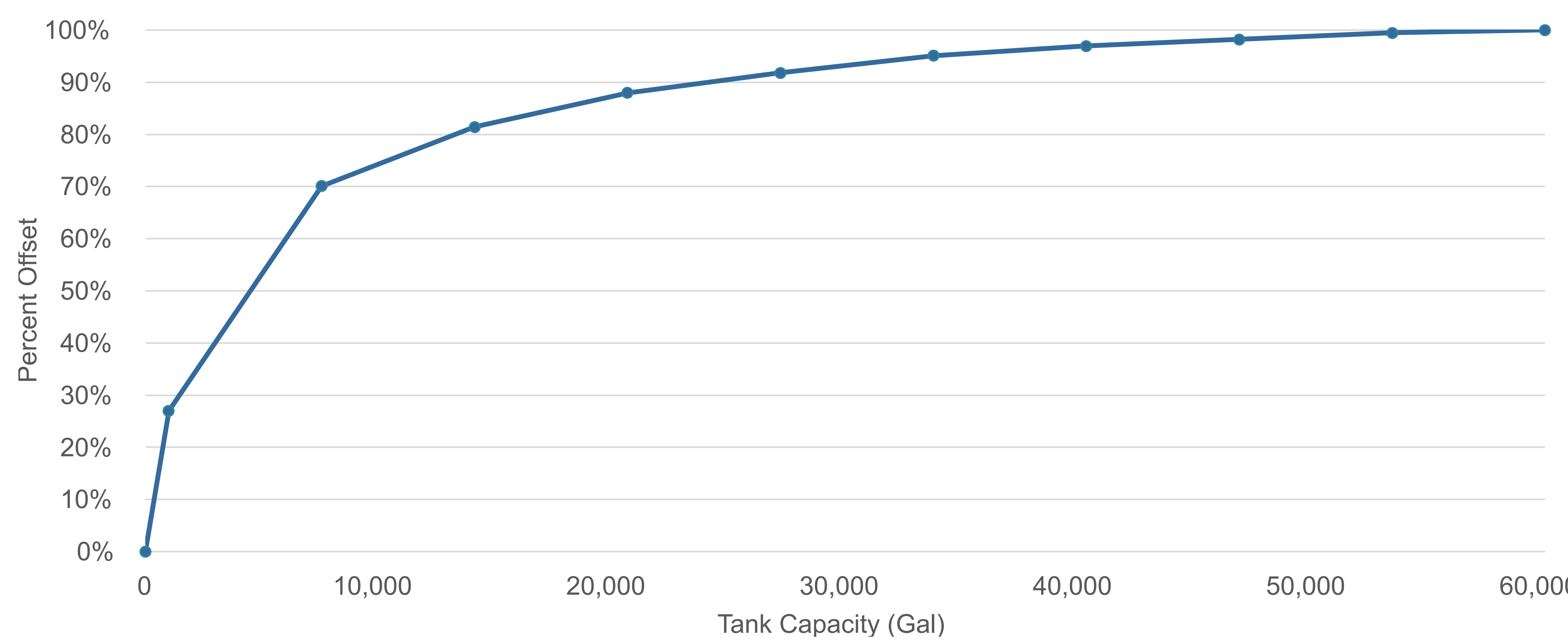
PAE Engineers, Inc. (PAE) are the building systems engineers for the PSM Facility project.

Non-Potable Rainwater Collection

1,000-60,000

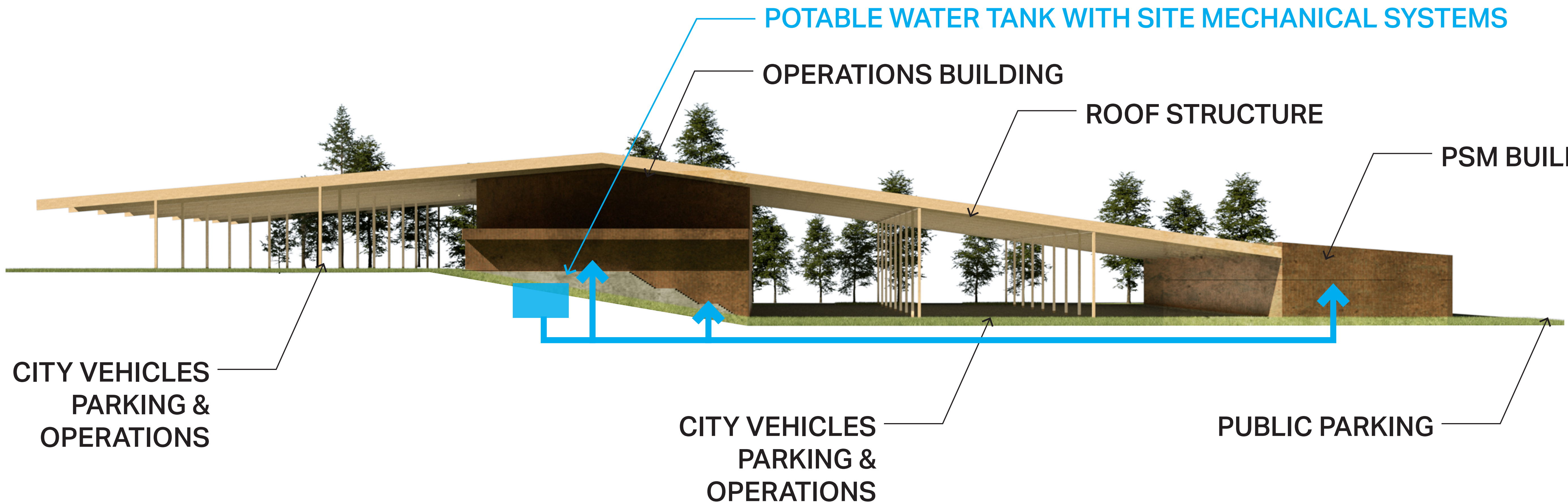
GALLON CISTERN FOR NON-POTABLE DAY TO DAY USE

CISTERN SIZE AND NON-POTABLE WATER OFFSET



EMERGENCY POTABLE WATER STORAGE

Storing potable water on-site would increase the PSM Building's emergency resiliency. A storage tank, located with other mechanical systems at the Operations Building, would enable water distribution for facility use during emergencies that affect the island's water supply.



EAST ELEVATION
NTS

Emergency Water Storage

WATER USE ESTIMATE FOR PSM

The water use of the PSM Building for emergency use is based on the following inputs:

- 180 Occupancy
- Flow Fixtures:
  - Toilets: 1.28 gpf
  - Urinal: 0.5 gpf
  - Lavatory: 0.5 gpm
  - Kitchen Faucet: 1.5 gpm
  - Shower: 2 gpm

EMERGENCY STORAGE TANK SIZING

- Emergency storage estimates based on 7 days of water use in the PSM building.
- If used as an area of refuge, an increase in number of people would increase the estimated water use.
- Use of potable city water can be used to fill emergency storage tank.

Emergency Storage - Potable Only

5,000

GALLON STORAGE FOR 7 DAYS

- Potable water includes potential drinking water, sink usage, showers.
- No toilet flushing water included.

Emergency Storage - Potable and Flush

10,000

GALLON STORAGE FOR 7 DAYS

- Includes potable water uses and non-potable water for flushing.

PAE Engineers, Inc. (PAE) are the building systems engineers for the PSM Facility project.

EMERGENCY POTABLE WATER STORAGE

Three system sizes were studied to outline planning for a potential 7-day water emergency utilizing typical potable water use estimates.

7-DAY STORAGE SYSTEM COMPARISON

	NO STORAGE	POTABLE & NON-POTABLE	POTABLE ONLY
NON-POTABLE WATER USE	6,000 Gallons	6,000 Gallons	
POTABLE WATER USE	4,200 Gallons	4,200 Gallons	4,200 Gallons
TOTAL WATER USE	10,200 Gallons	10,200 Gallons	4,200 Gallons
STORAGE CAPACITY	0 Gallons	+10,000 Gallons	+/- 5,000 gallons
SYSTEM CAPITAL COST	$0	$250,000	$170,000

Potable-only system sized to coordinate with rainwater harvesting system.

Support for durations longer than 7 days may be possible through reduced water usage during emergency operations.

Facility Structural Systems

Proposed structural systems utilize a hybrid approach that recognizes both the unique conditions present in each facility as well as the need to continue to control capital costs.

STRUCTURAL SYSTEMS FOR BUILDINGS AND WEATHERING COVERS

The selection of a structural system for any building is based on a wide range of factors including site conditions, functional requirements, facility type requirements, load and seismic analysis, material availability, environmental impact, building codes, and system cost.

For review, the factors listed above are consolidated into four overarching considerations :

- Applicability for a Risk Category IV structure.

- Achieving spans required for efficient layouts and use.

- The overall cost of the system.

- Alignment with Climate Action Plans adopted by the municipality.

STRUCTURAL SYSTEMS FOR BUILDINGS AND WEATHERING COVERS

Three structural systems are being utilized strategically across the project.

	MASS TIMBER	STEEL	CONCRETE
Risk Category IV Structures	✓	✓	✓
Achieve necessary spans	✓	✓	✓
System cost	$$	$$	$$$
Climate Action Plan Alignment	+	+/-	-

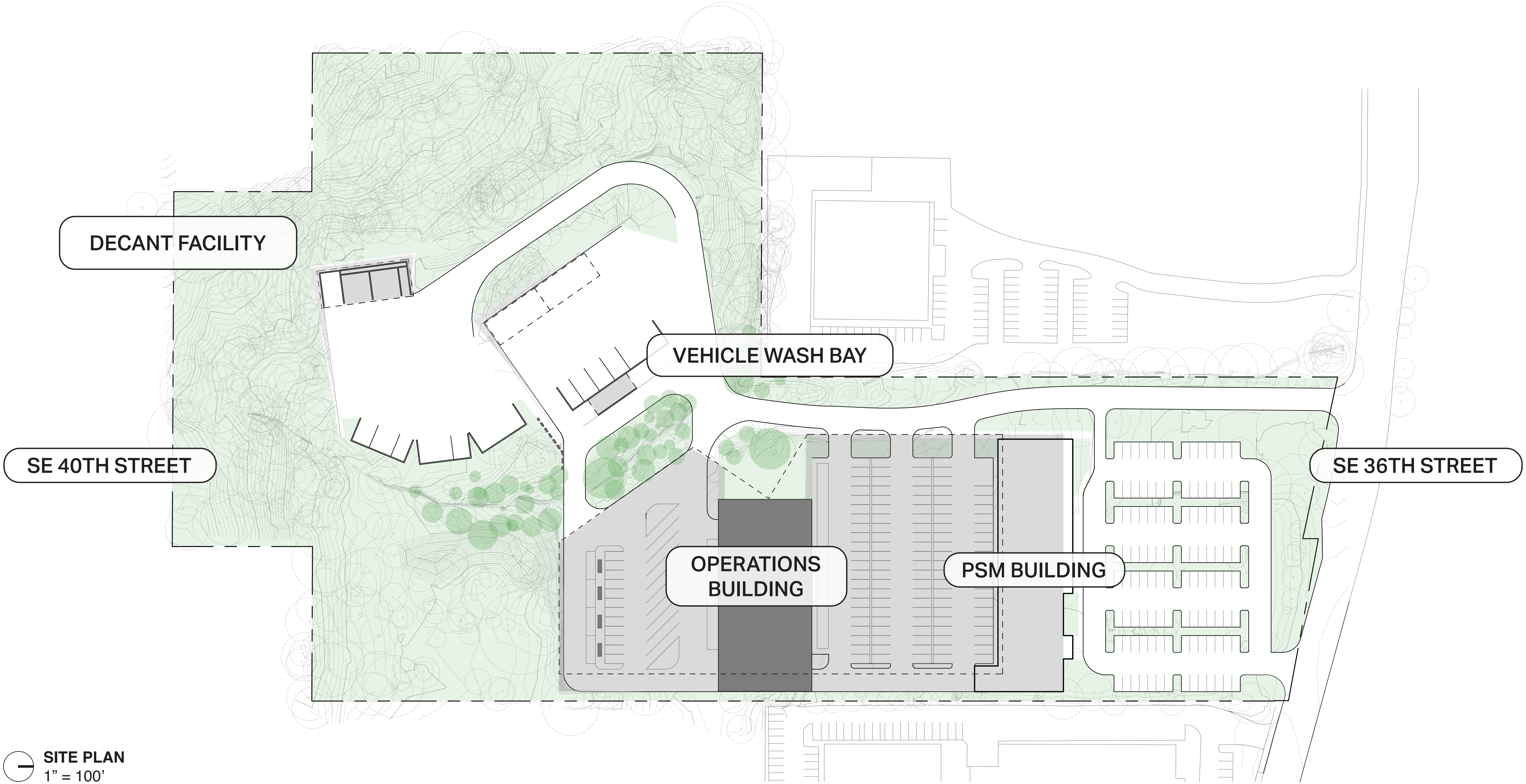
Risk Category IV structures and achieving necessary spans:
All systems meet requirements for use in Risk Category IV Structures and are capable of achieving necessary spans.

System Cost:
Mass Timber and Steel are relatively cost comparable, and currently vary within +/4% depending on factors such as procurement timing, project location, and scope of work, while Concrete systems are generally more expensive.

Climate Action Plan Alignment:
Mass Timber aligns with Mercer Island's Climate Action Plan GHG targets. Steel systems may align depending on the forging methods and emissions controls used during production. Concrete structures may utilize various manufacturing strategies to reduce GHG impacts but may not fully align with policy targets.

CAST-IN-PLACE CONCRETE

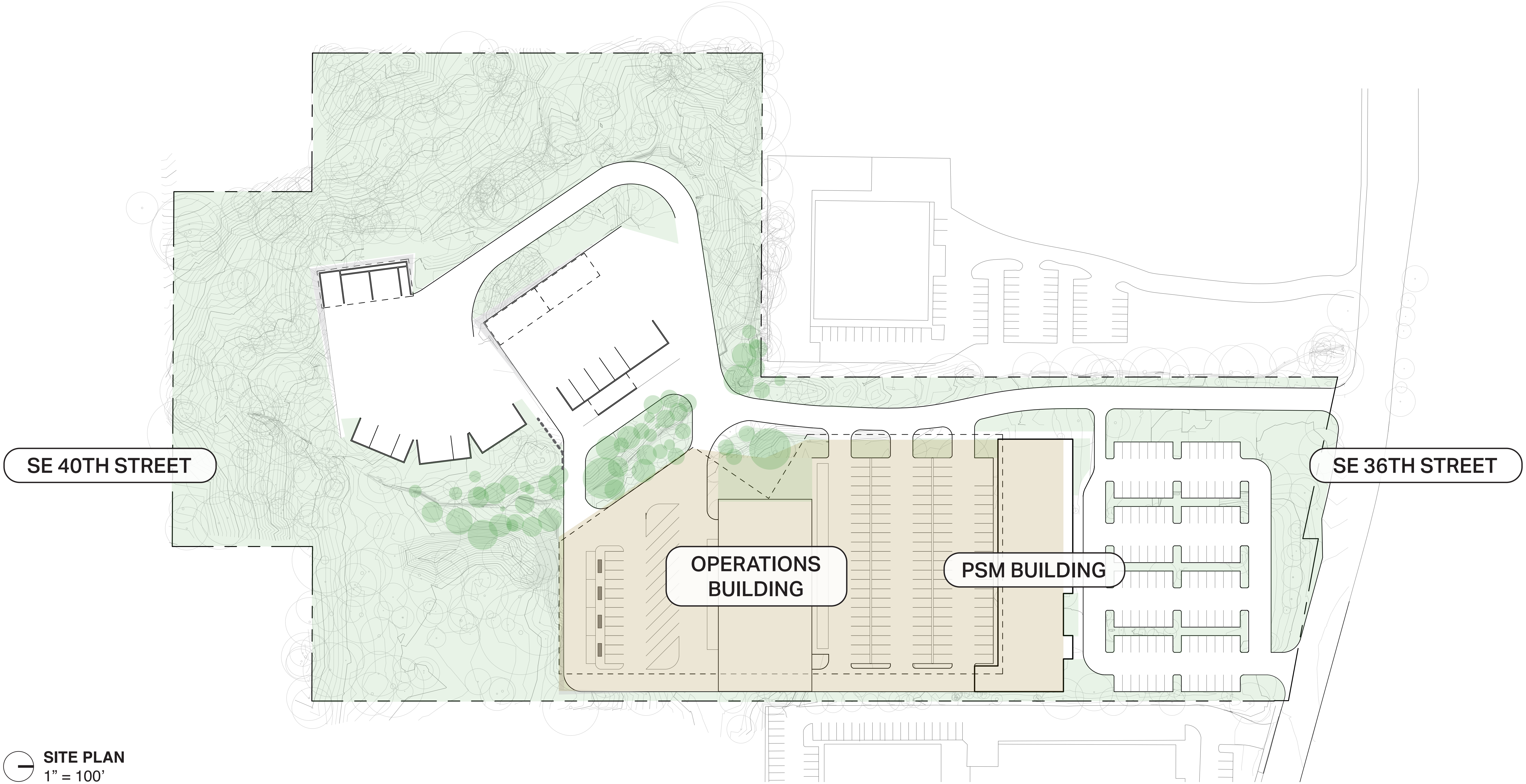
Cast-in-Place Concrete construction, illustrated within the gray shaded areas in this diagram, would be utilized for select project retaining structures, facility foundations, and the ground floor of the Operations Building.



SITE PLAN
1" = 100'

MASS TIMBER

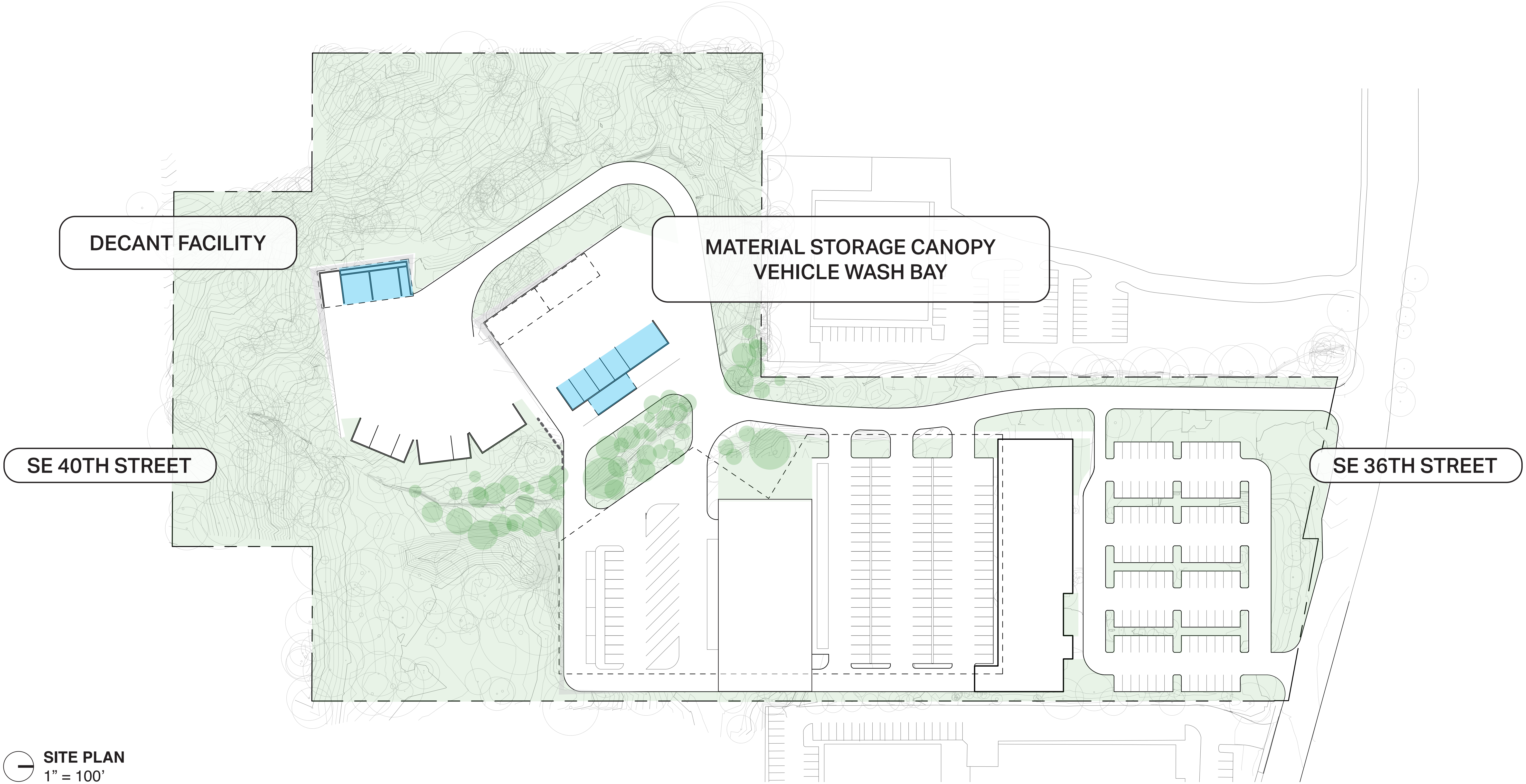
Mass Timber construction, illustrated within the tan shaded areas in this diagram, would be utilized as the primary structural system for the PSM Building, weathering covers at operational areas, and the second floor and roof of the Operations Building.



SITE PLAN
1" = 100'

PROPOSED LOCATIONS FOR STEEL OR HYBRID STRUCTURES

Steel construction, illustrated within the blue shaded areas in this diagram, would be utilized as the primary structural system for the Lower and Upper Yard facilities including the Vehicle Wash Bay, weathering covers, and the Decant Facility canopy.



Mercer Island Public Safety and Maintenance Facility