

18.0 MAINTENANCE FACILITY & SUBSTATION LOCATIONS

18.1 Maintenance and Operations Facility

Potential locations for a maintenance and operations facility (MOF) were analyzed to determine the viability of each location. Any selected site must be large enough to accommodate a vehicle maintenance building, storage and maintenance tracks for the streetcar vehicles, and employee parking. The maintenance building should be approximately 10,000 sq ft, with the first level consisting of maintenance bays for up to two streetcar vehicles, wheel truing equipment, truck replacement capability, as well as vehicle cleaning and fare collection facilities. The facility should also include a paint spray booth, maintenance pits, and mezzanine maintenance structures for rooftop equipment maintenance. The upper level could house administrative and support functions including a streetcar control center. The external yard would have a storage capacity for approximately 20 streetcar vehicles.

Potential MOF sites were evaluated using a set of criteria including site configuration, land use, location/distance from the streetcar alignment, environmental impacts, existing and future land use, and site access.



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Site configuration criteria for the MOF site include:

- Minimum practical size of 2.5 to 3 acres for 20 vehicles (7 to 10 acres if the MOF is to be shared with Bay Link)
- Minimum site dimension of 250 feet (350 feet preferable)
- Minimum track curvature radius of 80 feet
- Relatively level across long dimension

Operational considerations for the MOF site include:

- The site size should accommodate the vehicle maintenance building, vehicle storage tracks, a car washing facility, a substation for traction power, stormwater retention, and parking for employees and visitors.
- Storage capacity should be large enough for an initial fleet size of eight vehicles; space to accommodate up to 20 vehicles would be desirable.
- The site should be in an industrial-type land use with compatible surrounding land uses; site characteristics include 24-hour operation, three shift changes, some noise, bright lights, a storage yard, and primarily nighttime vehicle



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maintenance (1:00 a.m. to 5:00 a.m.) while the fleet is out of service.

- The site should be either adjacent to the streetcar line or close enough to the main line to reduce non-revenue service to the extent possible; it should preferably be located on a section of the track where no passengers are carried and which is used only for connecting the MOF to the operating line. If future phases or extensions of the initial line are anticipated, the MOF site location can be assessed to include these considerations.
- The site should have good access from major surface streets for employees and delivery trucks. Access should not require employees and delivery trucks to traverse a residential area.
- Typically, the site should be oblong or rectangular in shape. A general layout of the site should be developed early in the evaluation process to confirm functionality.
- The MOF requires all major utilities: water, sewer, electric, and communications.

Considerations regarding acquisition of the MOF site include:

- Reasonable cost.
- The potential for shared use with Bay Link and additional size requirements.
- Minimal business and residential displacements, to the extent possible—If there are perceived impacts on any adjacent properties, the possibility for mitigation should be addressed, and some assessment of the cost of mitigation should be included in the acquisition cost assessment.
- Potential for joint use of the MOF—For example, the maintenance bays and parking could be located on the lower floor(s), and commercial or industrial office space on the upper floors.
- Potential site contamination—A survey should be conducted upon approval from the property owner.

A number of potential MOF sites were identified and evaluated based on these considerations. Data was collected from aerial photographs, property ownership records, and visual observation. At this time, there are several locations that may satisfy the criteria for an MOF site. The selection of a final MOF site should be part of the design of the project so that timely acquisition of the site can be completed.

18.2 Traction Electrification System

For this project, a traction electrification system (TES) would provide power to the streetcars at 750 volts DC. The TES would consist of three major elements:

- Substations, converting commercial AC power to 750 volts DC

- Overhead contact system carrying 750 volts DC from the substations to the streetcars
- Running rails, welded and electrically bonded to ensure the integrity of the return circuit

Traction power substations would feed power to the OCS. The OCS design should minimize visual impacts while controlling costs. The substation size should be coordinated with the OCS. For larger substations (1 MW), either a full catenary system consisting of both a messenger and a contact wire or a single contact wire OCS with parallel feeders in an underground conduit must be used. For smaller, more closely spaced substations, a single contact wire without feeders may be used. The reason for this is voltage drop, which becomes a concern with the higher current levels in acceleration. The longer the distance and the less copper in the air, the larger the voltage drop.

Within this context, the location and size of substations is variable and interdependent. For instance, 350 kW substations would need to be located approximately every 0.5 mile along the streetcar alignment, whereas 1 MW substations would be located approximately every mile. However, a 1 MW substation would require a larger site than a 350 kW substation. Given their smaller size, 350 kW substations offer the most flexibility for placement along the streetcar alignment, with minimal property acquisition requirements.

The general equipment size of a 350 kW substation is approximately 4 feet by 10 feet. The space required by a 350 kW substation depends on where the substation is placed. At a location where it is exposed to weather, the substation is placed in an enclosure for protection. For a 350 kW substation, the enclosure would be approximately 12 feet by 20 feet, allowing sufficient room for access to the electrical equipment within the

enclosure. In open locations, a plot of about 18 feet by 26 feet is needed to provide 3 feet around each side of the substation for a perimeter ground. When placed in a protected location (such as a parking garage), a substation can be protected using a cement block firewall with doors that provide sufficient clearance for access to the electrical equipment. Such an enclosure requires the equivalent of about two parking spaces. A 1 MW substation of 20 feet by 40 feet, together with its ground mat, requires a plot of about 30 feet by 60 feet.

General criteria for the substation sites include:

- Substations must be sized and spaced to provide adequate power to streetcars at all points along the line, and to provide sufficient capacity such that operations can continue with one substation off-line.
- Substations should be located either adjacent to the streetcar line or close enough to the line to require as short a power feed line as possible.
- Substations should be located on public property to the greatest extent possible to minimize the potential for property acquisition.
- Substation locations should have good access from roads for maintenance.

Urban design aesthetics play an important role in decisions regarding the TES. For this project, these goals can be best achieved using a feederless single contact wire OCS and a larger number of smaller substations. OCS support and streetlights or traffic lights should use the same poles. Wherever possible, OCS span wires should be attached directly to buildings to reduce the number of poles needed.

To the extent possible, uniformity in system equipment is a desirable characteristic. Generally, the number of substations is not large but the cost of spare parts is significant. With more than one type of substation and/

or OCS design, it would be necessary to stock at least small quantities of a larger variety of expensive parts.

Locations for substations have not been selected at this point in time. The siting of substations should be part of the design phase. During design, the location and sizing of the substations and OCS will be modeled and optimized. For this work, the guiding principle is “whatever is best for the project.”



Portland, Oregon—Maintenance and Operations Facility



Portland, Oregon—Traction Power Substation