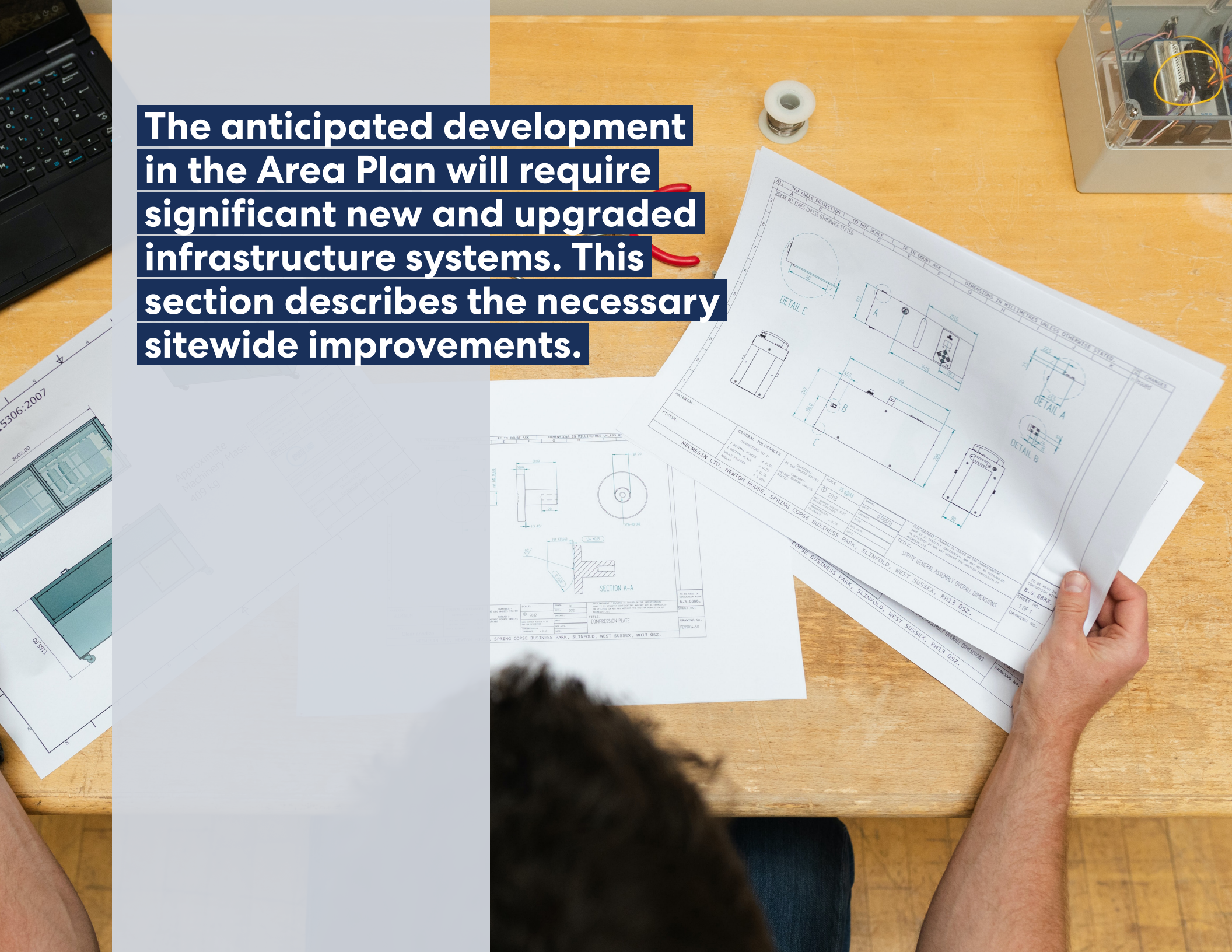
7 INFRASTRUCTURE

The anticipated development in the Area Plan will require significant new and upgraded infrastructure systems. This section describes the necessary sitewide improvements.



7.1 OVERVIEW

The proposed infrastructure within the SVS planning area aligns with the infrastructure plans in the Sacramento Draft Railyards Specific Plan (dated October 2016) and the Railyards Sewer, Water and Drainage Master Plan documents. The utility main trunk lines must be located and sized to accommodate new development within the site, including the transit station, private developments and the regenerative gardens west of the I-5 freeway. This will require construction of new mains and lateral connections to existing public utilities.

Three categories of utilities serve the SVS planning area, as follows:

- Existing public utilities, namely domestic water, sanitary sewer, storm drainage and electrical;
- Private telecommunication networks; and
- New on-site district energy and wastewater recycling systems.

To meet LCC requirements, the site is planned with no natural gas combustion in buildings or infrastructure, therefore gas infrastructure is not provided within the SVS planning area. The existing gas service to the historic building serves the building water boiler, and gas service is provided for tenant food service use. It is anticipated that the building water boiler would be replaced by connection to the site geothermal system, and the gas service for tenant food preparation would eventually transition to electric appliances.

7.2 EXISTING AND FUTURE UTILITIES

The Railyards Specific Plan provides the backbone infrastructure to serve new developments within its plan area. That portion relevant to the SVS planning area includes a new 42" water main and the separation of combined sewers with a 36" (Bercut) sanitary sewer and 48" storm drain. Sacramento Department of Utilities (DOU) requires a 30-ft easement from center of each of the three pipes passing through the SVS planning area, or 15-ft from the outer-most pipes where they are parallel.

Both the 42" water and 36" sanitary sewer mains are already constructed. The planned storm drain system includes several pipe sections passing through the SVS study area which will ultimately drain northward under the UPRR tracks and into a large pumping station near Railyards Boulevard, approximately 1200-ft to the north. According to DOU, planned storm drains passing through the SVS planning area should be constructed by the entity that needs them first. While the SVS project may not rely on all planned upgrades, the project may still replace some segments so as not to interrupt transit access in the future. Therefore this document refers to all planned pipes within the study area as proposed storm drains.

Refer to Figure 7.1 for proposed utilities easement zones.

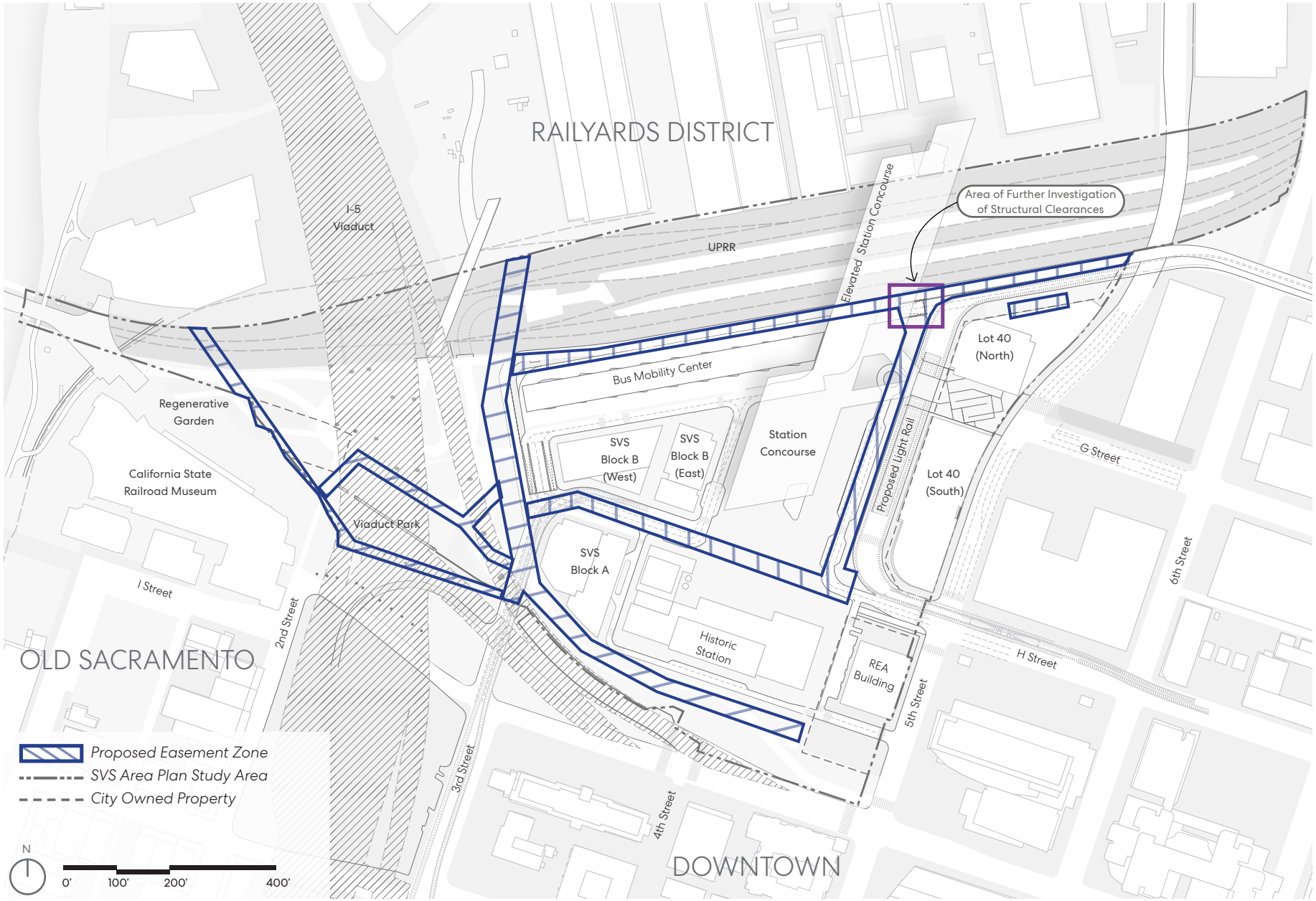


Figure 7.1 *Proposed Utility Easements*

7.3 PROPOSED UTILITIES

District Energy – Central Utility Plant

The SVS Area Plan includes a central utility plant (CUP) to supply heating and cooling to buildings. The CUP will be located in the development area northwest of the Historic Station in a new Regenerative Utility Center (RUC). It will be co-located with wastewater recycling plant where its processes can be showcased for educational purposes.

Compared to the conventional heating and cooling systems that would otherwise be installed in each building, the CUP will realize significant energy and carbon savings, likely leading to a more financially favorable solution for all connected buildings. Key drivers include the ability to recover heat efficiently between multiple building uses, and economies of scale for heating and cooling equipment. The CUP displaces most of the heating and cooling generation equipment needed at the buildings, resulting in more leasable area. Less equipment is required on rooftops, thus increasing the available area for roof gardens, solar panels and other uses.

The CUP should utilize highly efficient, all-electric technologies to meet thermal energy demands throughout the site. All-electric strategies are required to meet the LCC certification and provide higher efficiency operation than typical gas systems.

The CUP should serve all buildings on City-owned land, including the Historic Station (which was designed for a future connection of this type), the SVS Transit Center, consisting of the Bus Mobility Center, and the future new station concourse; and future private development blocks planned for residential and hotel uses.

Opportunities exist to partner with nearby developments to receive heating and chilled water service from the SVS Area Plan CUP. Additional connected developments to the CUP improve efficiency and opportunities for heat recovery at the CUP, thus benefitting all parties. Two primary opportunities based on proximity and expressed interest should be further evaluated at the next design stage for financial, phasing and ownership feasibility:

- Alternative 1 – include the historic railyard shops buildings north of the UP tracks which are planned for expansion of the California State Railroad Museum (CSRM). The City has received interest from the CSRM in connecting to the SVS Area Plan CUP due to the high cost of providing traditional heating and cooling; and
- Alternative 2 – include the planned development at Lot 40. This alternative will require further coordination with the Lot 40 developer and is suggested for consideration due to its proximity to the SVS Area Plan CUP.

Distribution of thermal services to buildings on-site or to the suggested alternative properties will be via heating hot water and chilled water supply and return pipes (four pipes in total). These can be direct-buried on-site or anchored within underground parking or vehicular tunnels. A conceptual arrangement of how these pipes can be anchored within an existing tunnel passing below UPRR is shown in Figure 7.2.

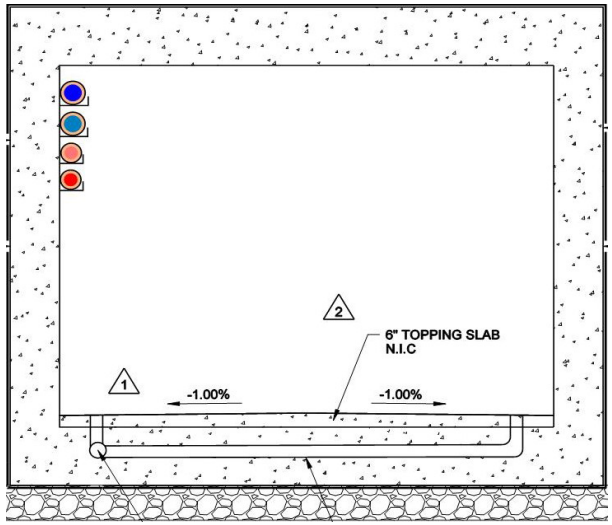


Figure 7.2 *Conceptual Arrangement of District Thermal Pipes*

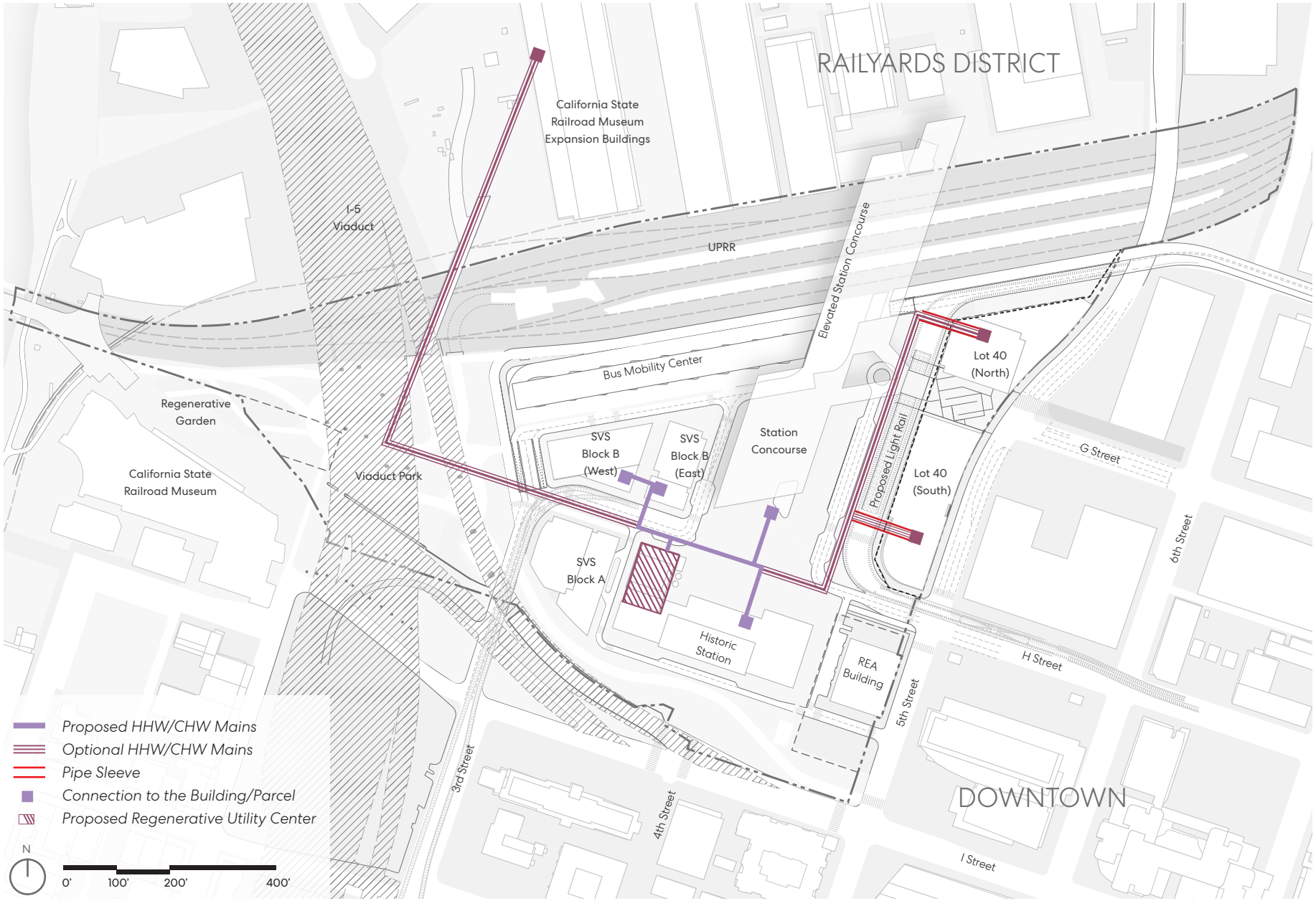


Figure 7.3 *Utilities - District Energy*

The Baseline CUP concept provides an efficient, all-electric heating and cooling solution, consistent with the goals of the Living Community Challenge. Baseload heating and cooling is provided through heat recovery chillers, with peak cooling provided via efficient centrifugal chillers connected to evaporative cooling towers for heat rejection. Peak heating is provided through air source heat pumps. Heat recovery chillers allow for a higher condenser water temperature to match the heating hot water distribution temperature for the building, enabling a higher efficiency thermal production. For planning purposes, the following table provides an estimate of spatial requirements within the RUC to accommodate the CUP equipment:

The following innovative technologies are being considered as supplemental CUP alternatives:

- Centralized ground source heat pumps: would provide heating and cooling for the district and improve energy efficiency. Ground loops would be installed into piled foundations and below the concrete slab in the bus mobility center or other buildings that require piles, see Figure 7.4, Figure 7.5 and Figure 7.6. In the central courtyard, additional ground loop bores could be added to the maximum depth achievable while remaining above the cobble layer. The ground loops would be tied to a condenser loop running back to the RUC, for either heat rejection (cooling) or heat extraction (heating) via the central heat recovery chillers or water source heat pumps. Distribution to the buildings would be accomplished by the same heating hot water and chilled water supply. Centralized ground source heat pumps would reduce water consumption by offsetting cooling tower use.
- Wastewater heat recovery: effluent from the on-site water treatment train can provide a source of additional heating. The effluent serves as a source of heating for a water source heat pump, which generates additional district heating. Both technologies generate heating more efficiently than air source heat pumps and improve the overall efficiency of the CUP by approximately 10%.

The alternates would increase the total space requirement within the RUC to 10,500 sq. ft. but reduce the open-air space to approximately 4,000 sq.ft. The regulatory risks and geotechnical considerations for the CUP alternatives were assessed by the City during the Phase 2 rehabilitation of the station with favorable explorations on the northwest side of the station. Deep bores were found to be favorable, except for the drilling cost premium through the cobble layer, which limited the scope to energy piles within this project. However, these risks should be assessed during the next design phase to verify their feasibility. For further information regarding the sanitary sewer system, refer to Figure 7.7.

Table 7.1 *Spatial Requirements for CUP Equipment*

District Energy Components at the RUC	Baseline	Baseline + Lot 40	Baseline + Railway Museum	Baseline + Lot 40 + Railway Museum
Heating Equipment Inside the Building	3000 ft²	4100 ft²	2900 ft²	4100 ft²
Cooling Equipment Inside the Building	4500 ft²	7500 ft²	4900 ft²	7800 ft²
Electrical Equipment Inside the Building	3000 ft²	3000 ft²	3000 ft²	3000 ft²
Heating Equipment on the Roof	1200 ft²	3700 ft²	1200 ft²	3700 ft²
Cooling Equipment on the Roof	2800 ft³	3700 ft³	2800 ft³	4000 ft³

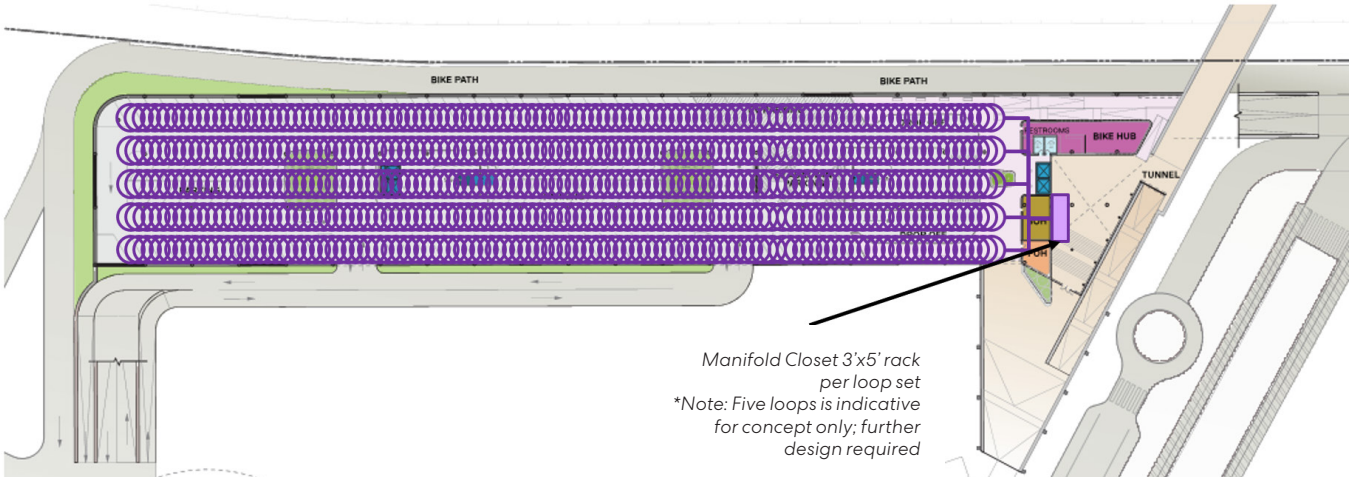


Figure 7.4 *Conceptual Diagram of Horizontal Ground Loops Beneath the Bus Station*

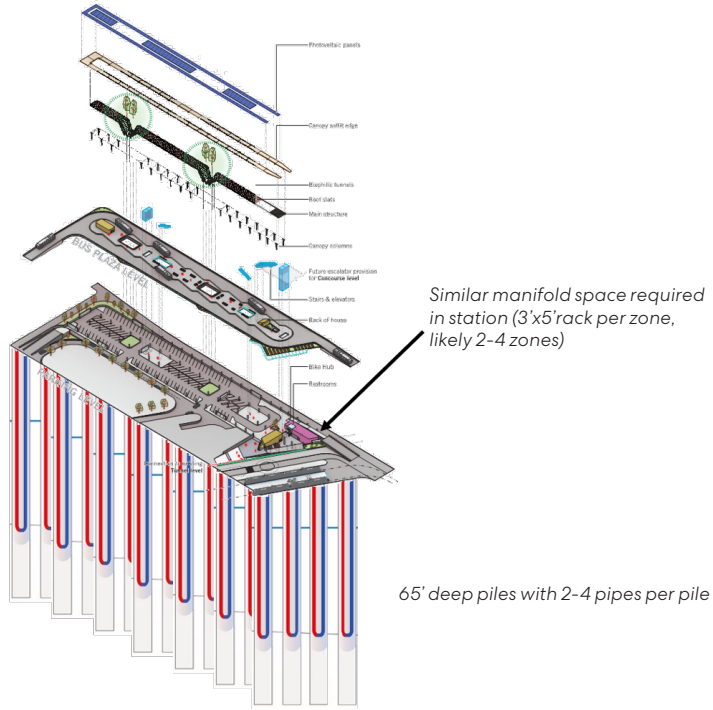


Figure 7.5 *Ground Loops Embedded in Structural Piles*

Figure 7.6 *Ground Loop Tubing within Rebar Cages of Structural Piles*

District Water – Wastewater Recycling Plant

The SVS Area Plan includes a wastewater recycling plant (WRP) that will turn all wastewater generated within the SVS planning area into recycled water. Recycled water will be fed back to the buildings to serve all non-potable demands. The plant will be located in the development area northwest of the Historic Station in a new Regenerative Utility Center (RUC). It will be co-located with central utility plant (CUP) where its processes can be showcased for educational purposes.

The WRP satisfies the Water Petal imperative under Living Community Challenge (LCC) which requires that all wastewater be treated onsite and all non-potable demands be met with recycled water. The WRP will reduce potable water demand to the SVS planning area by approximately 50% and, pending DOU modeling, has the potential to free up capacity in the City's 3rd Street sewer and the County's Regional Wastewater Treatment Plant for other development.

For planning purposes, the following table 7.2 provides an estimate of spatial requirements within the RUC to accommodate the WRP equipment:

Sewer

Sewer improvements align with the Railyards Sewer Master Plan (dated May 2016). Sewage currently generated from the Railyard north of the UPRR tracks is conveyed through the SVS plan area in a combined storm sewer system (CSS) at 5th and H Street. As the Railyards and SVS plan area develop, new, separate storm and sewer facilities will be built. New sewer mains will be owned and maintained by Sacramento Department of Utilities (DOU), designed in accordance with the City of Sacramento Design and Procedures Manual Section 9 (Sewer) and located within public roadways or utility easements to comply with DOU standards.

Sewage generated by the Bus Mobility Center, the transit station and private development blocks will be collected by a new gravity sewer system that drains toward a new district wastewater recycling plant, co-located with the district energy systems in the RUC. An additional 7,000 gross sq. ft. is required within the RUC for wastewater recycling, where the regenerative processes can be showcased for educational purposes. Preliminary cost/benefit studies were made for the evaluation of this system, however, the procurement strategy for implementing the wastewater recycling plant should be further evaluated at the next design stage based on financial, phasing, and ownership feasibility. Until the recycling plant is implemented, new buildings may temporarily connect to the city's 3rd Street sewer.

An emergency overflow connection to the city's 3rd Street sewer should be provided at the RUC, allowing the WRP to be temporarily shut down for maintenance during non-peak hours, or for any critical situation. Sewage generated by the Lot 40 development is expected to drain to the existing 5th Street sewer main, however, consideration should be given to a future connection to the SVS district wastewater recycling system. To accommodate future connection to Lot 40, pipe sleeves should be installed below the new light rail tracks and platforms.

To make gravity connections to the bus mobility center basement, the sewer mains are anticipated to be approximately 15 feet deep. The future detail designs should consider utilizing ejector pumps in the basement that may allow the sewer to be raised.

Installing deep utilities can be a complex and expensive undertaking, especially with high on-site groundwater and adjacent contaminated plume. An alternative approach should be further considered during detailed design, which would be to install a vacuum sewer system in lieu of the traditional gravity system. The vacuum system would comprise a vacuum lift station, a network of collector pipes, and receiving pits at each service connection. As the entire system would be pressurized, the pipe network would be shallower (approximately 4 to 6 feet deep) and offer similar routing flexibility to a force main. This would be a new technology for the City; therefore, DOU would need to adopt the concept before detailed design could commence.

Refer to Figure 7.7.

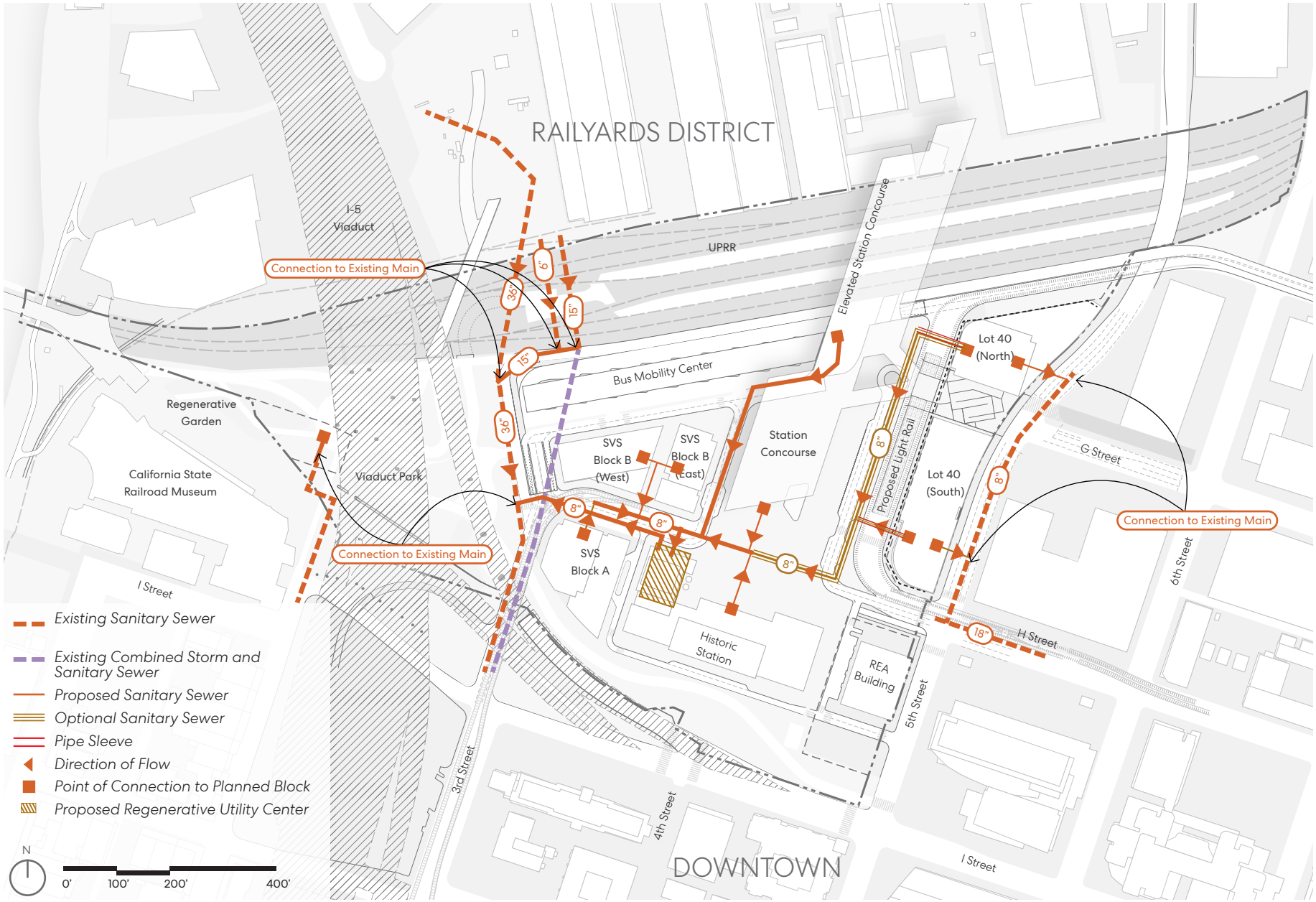


Figure 7.7 *Utilities - Sanitary Sewer*

Recycled Water

The RUC will produce recycled water that meets disinfected tertiary standard for distribution within the SVS planning area. According to California Title 22, recycled water meeting disinfected tertiary standard is allowed for use in residential landscaping and to flush toilets and urinals. There are several treatment technologies on the market that can produce this water quality standard. The space allocation within the RUC assumes compact membrane technologies are used. To further showcase wastewater treatment at SVS, additional polishing of the treated effluent could occur in the wetland zone of the Regenerative Gardens.

To meet LCC requirements, a new 8-inch recycled water main (purple pipe) will deliver recycled water to development blocks within the SVS planning area to meet non-potable water demands. The Lot 40 development is not included in the LCC area; however, a recycled water connection could benefit the Lot 40 developer by reducing its potable water footprint by 50% or more, and allowing tenants to realize long-term cost savings on their water bill. To accommodate future connection to Lot 40, pipe sleeves should be installed below the new light rail tracks and platforms.

Should excess recycled water be generated, the excess water could either be:

- Distributed to other adjacent users if available;
- Infiltrated onsite to the extent feasible, following the required level of treatment and upon obtaining the relevant permitting by the Regional Water Quality Control Board; or
- Discharged to the city's sewer network.

Table 7.2

District Water Components at the RUC	Baseline	Baseline + Lot 40
Compact Wastewater Treatment Equipment	5000 ft²	8000 ft²
Sludge Treatment Equipment	500 ft²	850 ft²
Temporary Biomass Storage (up to 7 days)	3 yd³	5 yd³
Recycled Water Controller Equipment	100 ft²	150 ft²
Recycled Water Storage Tanks (Exterior)	4000 ft³	6000 ft³

Potable Water

Water system improvements align with the Railyards Water Master Plan (dated May 2016). Potable water mains will serve the SVS planning area with a new 8-inch looped network. Connections to the City's existing system are anticipated at the existing 12-inch and 42-inch mains just east of the I-5 freeway, and the existing 12-inch main in 5th Street. The Lot 40 development should connect directly to the existing water main in 5th Street.

New potable water mains will be owned and maintained by Sacramento Department of Utilities (DOU), designed in accordance with the City of Sacramento Design and Procedures Manual Section 13 (Water). They must be located within public roadways or utility easements in accordance with DOU standards.

Refer to Figure 7.8.

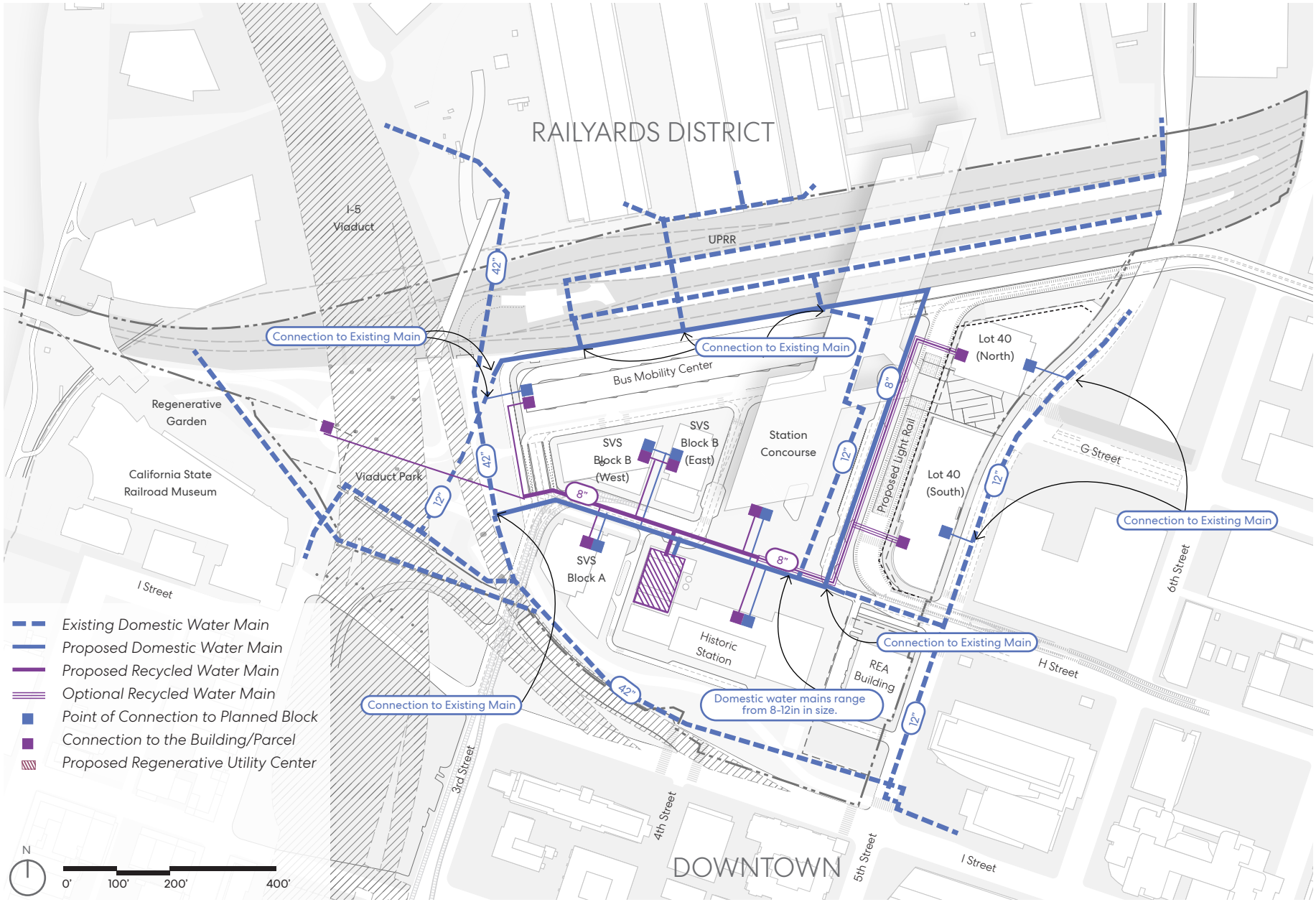


Figure 7.8 *Utilities - Water*

Stormwater

Stormwater improvements align with the Railyards Drainage Master Plan (dated October 2016). Stormwater runoff generated by the SVS planning area is currently conveyed in a combined storm and sewer system (CSS) that drains by gravity toward 3rd Street. As the Railyards and SVS planning area develop, new, separate storm and sewer systems will be built.

New stormwater mains will be owned and maintained by Sacramento Department of Utilities (DOU), in accordance with the City of Sacramento Design and Procedures Manual Section 11 (Stormwater) and located within public roadways or utility easements to comply with DOU standards.

Stormwater runoff from the majority of the SVS planning area must discharge north toward the Railyards Drainage Master Plan area. Runoff from these areas will ultimately flow to a stormwater pump station located within the Railyards development area that discharges to the Sacramento River. Stormwater generated by the SVS planning areas south of the Historic Station, I-5 and west of I-5 must continue to discharge toward the south into the city's existing CSS system.

Runoff from the Union Pacific (UP) railway tracks and platforms currently drains into the City's CSS system. This area is owned by the City and Union Pacific holds an exclusive easement. The Railyards Specific Plan proposes to divert runoff from the UP area into the new Railyards storm system, making the runoff subject to regional NPDES permit requirements. To avoid constructing new pipes within the UP area, existing CSS pipes collecting only stormwater runoff should connect to new stormwater mains within the SVS planning area along the southern UP boundary line. Runoff generated by the UP area must then be treated by stormwater best management practices (BMPs) within the SVS planning area.

There is a community stewardship opportunity to divert runoff from Caltrans roadways during smaller rain events into new at-grade stormwater treatment BMPs located within the city's Viaduct Park below the freeway. Runoff from the I-5 viaduct and on-ramp is currently collected by drain inlets and diverted into open channel gutters mounted to the underside of the elevated structure. These gutters drain by gravity into leaders that discharge to the city's CSS system near 2nd Street. Diverting some freeway runoff into new BMPs will help to improve stormwater quality and reduce flow to the CSS system.

Stormwater runoff generated by the SVS planning area that discharges into the Railyards separate stormwater system must be treated in accordance with the Sacramento Region Stormwater Quality Design Manual. The goal of the stormwater quality management plan is to maintain the existing overall permeability of the site and treat runoff from impermeable surfaces using a decentralized set of treatment Best Management Practices (BPMs) throughout the SVS planning area. Since much of the existing site is permeable, porous pavements and soft landscaping within open spaces should be prioritized to maintain the existing permeability. Such surfaces are considered "self-treating", promote groundwater recharge, and help to minimize the size and number of downstream BMPs.

Several opportunity sites are envisaged within the SVS planning area to accommodate porous pavements as well as a variety of treatment BMP measures. Porous pavements should be installed at all public plazas and pedestrian walkways. Bioretention basins should be installed within large open space areas like Viaduct Park and Civic Plaza.

Bioretention planters, which have a similar function to basins, are best suited for constrained areas such as along public streets and within private development blocks. They are envisaged to be integrated within the Bus Mobility Center and Station Concourse as architectural elements. Green roofs, which are also considered "self-treating", should be considered for the private development blocks as they reduce runoff and help to reduce the heat-island effect. The Regenerative Garden in Viaduct Park is envisaged as having two engineered wetland zones, one serving to treat stormwater runoff, and the other to showcase and educate visitors on the merits of onsite wastewater treatment.

Refer to Figure 7.9 and Figure 7.10.

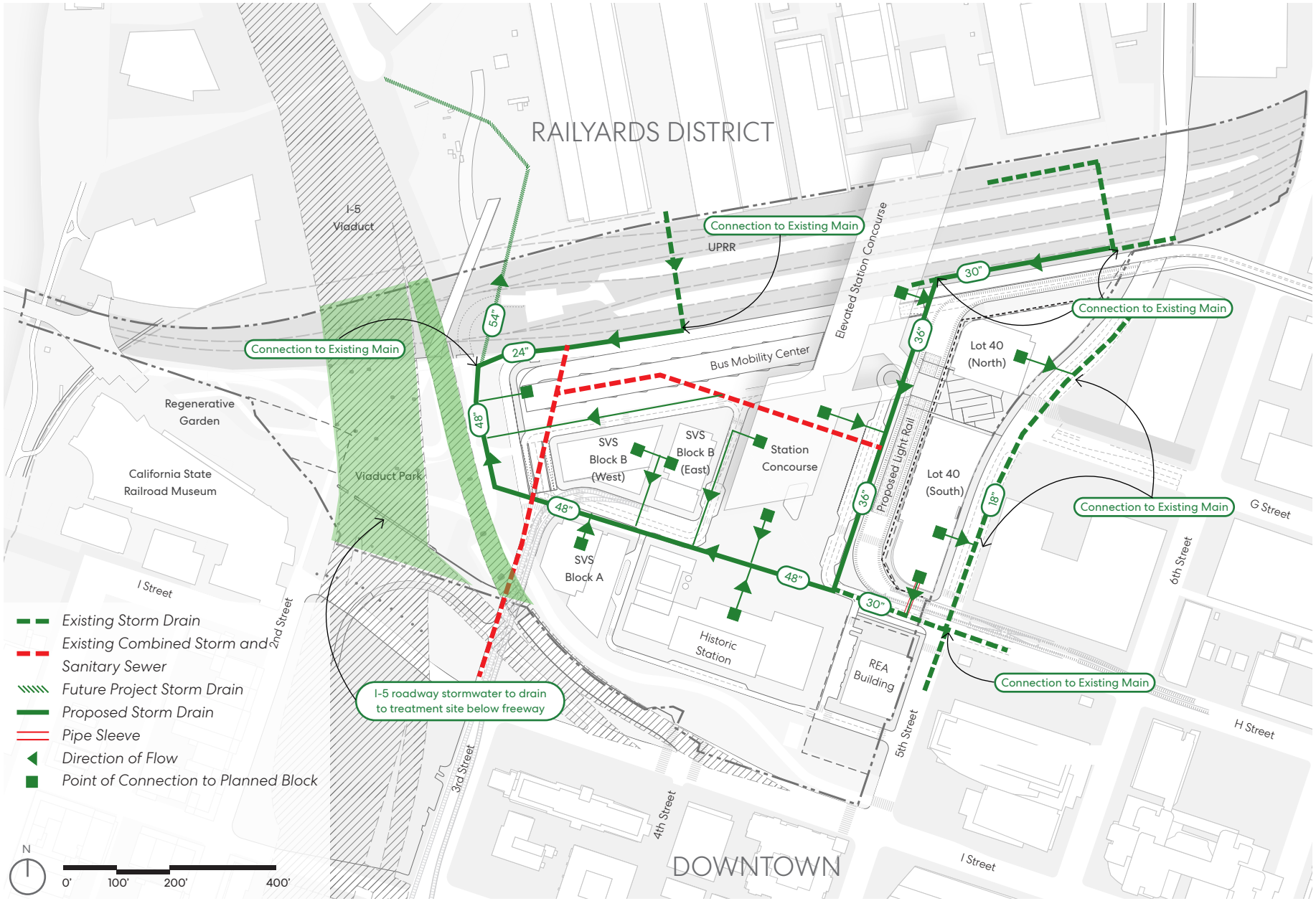


Figure 7.9 *Utilities - Storm Drainage*

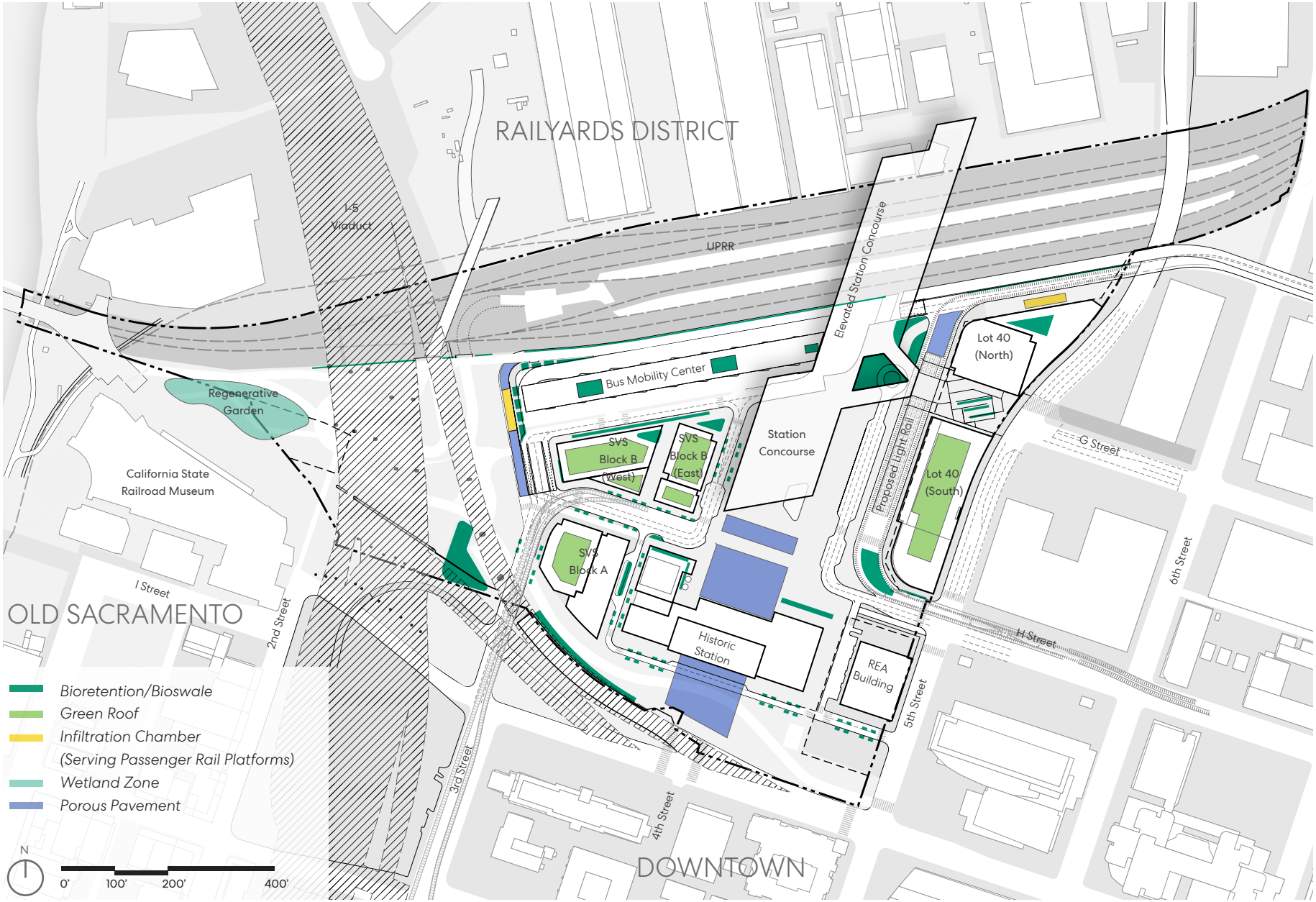


Figure 7.10 *Utilities - Stormwater BMP Opportunity Areas*

Future Climate

Infrastructure and buildings constructed today will experience significantly different weather patterns over the course of their lifetime due to the impacts of climate change. Many climate models are on the market to help with forecasting. Future climate scenarios have been studied preliminarily using the WeatherShift™ design tool, developed by Arup and Argos Analytics, to evaluate the change in future rainfall intensity for several design storm frequencies in the Sacramento area. The tool uses data from 21 global climate models (GCMs) under the Coupled Model Intercomparison Project 5 (CMIP5) ensemble published in the Fifth Assessment Report (AR5) by the Intergovernmental Panel on Climate Change (IPCC) to generate projected rainfall statistics for a range of emission scenarios and future time frames.1 Emission scenarios under CMIP5 are called Representative Concentration Pathways (RPCs) which describe alternative trajectories of greenhouse gas concentrations in the atmosphere. For reference, CMIP5 data is similarly utilized by the United States Environmental Protection Agency (USEPA) under its Storm Water Management Model Climate Adjustment Tool (SWMM-CAT) tool but with less granularity.

The study performed for the Area Plan assesses two time and emission scenario combinations: RCP4.5 in Year 2035, which reflects a modest reduction in GHG emissions over time, in a year corresponding to the approximate completion of the SVS planning area construction; and RCP8.5 in Year 2090 that reflects almost no reduction

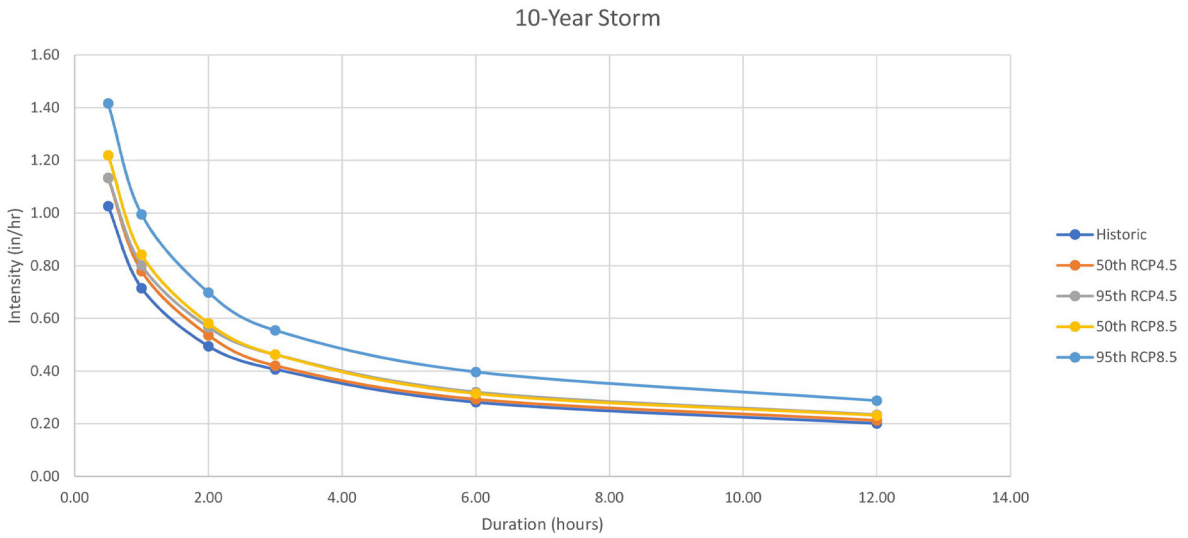


Figure 7.11 *Utilities - Future Storm Study - WeatherShift Offsets 10-year*

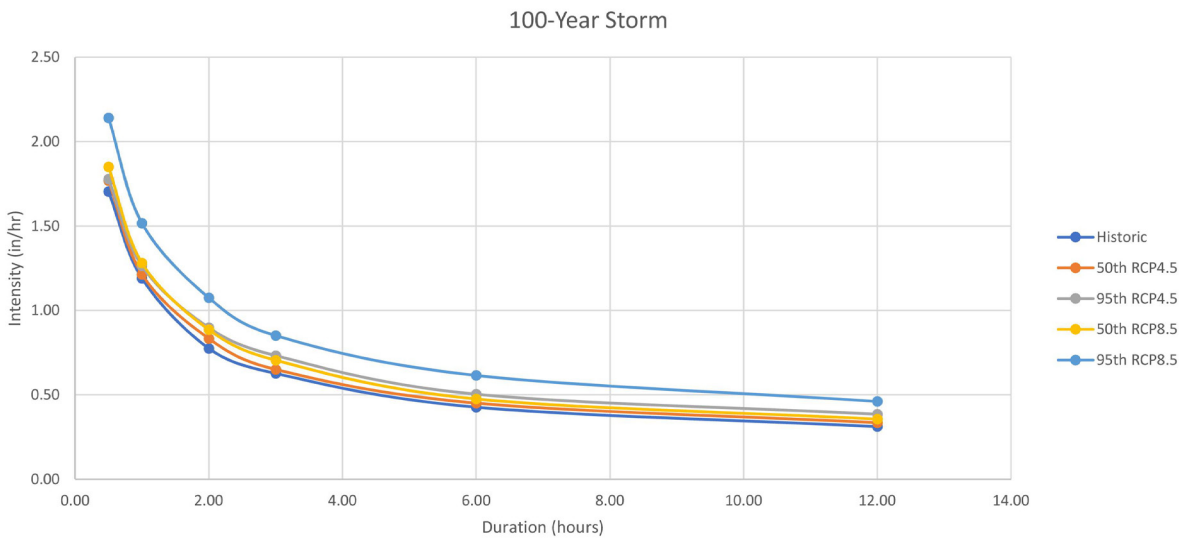


Figure 7.12 *Utilities - Future Storm Study - WeatherShift Offsets 100-year*

1 For more information on The Intergovernmental Panel on Climate Change and its Fifth Assessment Report, see https://www.ipcc.ch/.

in GHG emissions over time (business-as-usual) toward the end of the century. The WeatherShift™ data yields the following future intensity-duration-frequency (IDF) curves.

The 10-year storm has a 3-14% increase in rainfall intensity by Year 2035 under RCP4.5, and a 14-36% increase under RCP8.5 by Year 2090. The 100-year storm has a 4-17% increase in intensity by Year 2035 under RCP4.5, and a 13-36% increase under RCP8.5 by Year 2090. Refer to Figure 7.11 and Figure 7.12.

The design of storm drains and stormwater quality BMPs at the SVS planning area should consider future rainfall data when developing its sitewide drainage strategy. Preliminary design has shown that the SVS planning area has spatial capacity to accommodate larger stormwater pipes and BMP areas to accommodate future rainfall. Further study on the impacts of future climate on planned drainage infrastructure within the Railyards specific plan area should be considered such that they can either be mitigated or adapted over time.

For mechanical and energy systems, future climate scenarios have been studied preliminarily using the WeatherShift™ design tool, to evaluate the change in future average, maximum, and minimum temperatures for the California Climate Zone 12 weather file, which represents Sacramento. The tool uses data from 21 global climate models (GCMs) under the CMIP5 ensemble published by IPCC to generate projected increases in temperature for a range of emission scenarios and future time frames.

A study of the change in temperature performed for the Area Plan assesses temperature in Year 2050, the approximate end of life of the initial mechanical equipment under the RCP8.5 (high warming) scenario. The WeatherShift™ data yields future outdoor minimum, maximum, and average temperature ranges.

The data indicate that there is an approximately 7 degree Fahrenheit average increase in temperature by 2050. There is a consistent increase for the monthly minimum and maximum termperatures experienced as well. This change is lowest in spring, with an average increase of 5 degrees, and a maximum in summer of 8 degrees.

These will likely drive an increase in cooling capacity by 2050, which may require larger cooling equipment to serve increased loads. Chilled water pipes within the buildings or connecting buildings to the Regenerative Utility Center may need to be upsized in design to allow for the future increase in cooling. As heating demand is likely to decrease in the future in response to elevated temperatures, heating design should be based on current climate.

Refer to Figure 7.13.

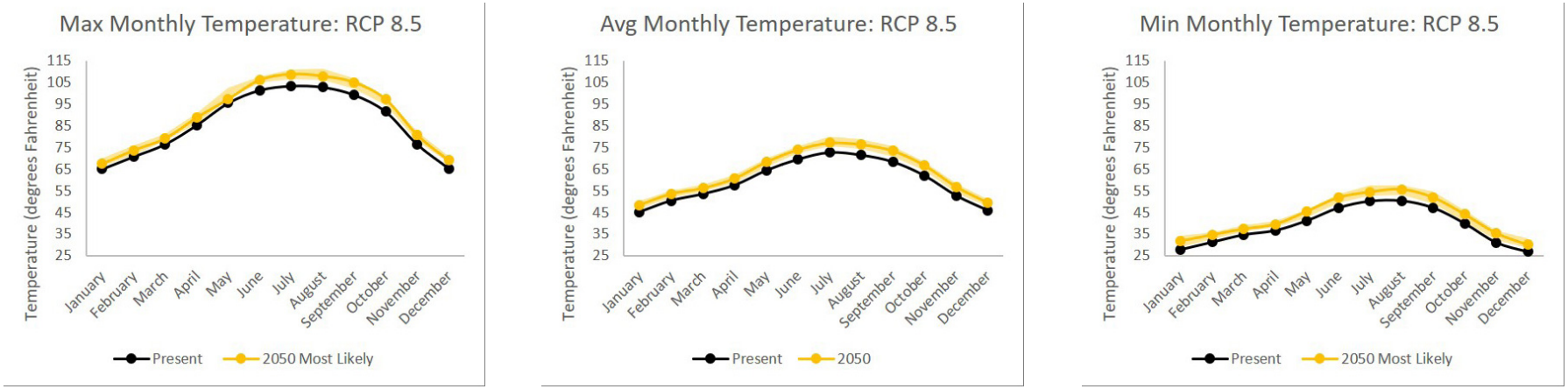


Figure 7.13 *Utilities - Future Climate Study - WeatherShift Temperature Offsets*

Electrical

Electrical service is provided by the Sacramento Municipal Utility District (SMUD). SMUD currently has both 12kV and 21kV networks serving downtown Sacramento. An existing substation (Station H, located at 6th Street & H Street) will be replaced by a new adjacent substation that will add 80MW of capacity in 2024. SMUD has confirmed that there will be enough capacity to serve the entire SVS planning area once the substation is complete, as well as enough capacity to serve the site's construction power needs until that time.

Each development block should connect to SMUD's 21kV network with at least one service connection. Each service connection must be metered. Electrical vaults and conduits, switchgears, transformers and metering equipment should be located within public rights-of-way or dedicated easements. The electrical equipment 'before the meter' will be owned and maintained by SMUD and must be designed in accordance with SMUD standards. Other energy equipment such as the photovoltaic panels and geothermal systems, as part of a district energy network, may be owned and operated by others. The ownership structure of these systems will be determined during feasibility engineering stage.

Telecommunications

A variety of telecommunication service providers have service equipment located within and adjacent to the SVS planning area, including telephone, cable television, and fiber optic lines. The precise location of existing services, and service connection points into the SVS planning area, should be further examined during engineering feasibility stage.

Refer to Figure 7.14.

Natural Gas

To meet LCC requirements, the site is planned with no natural gas combustion in buildings or infrastructure, therefore gas infrastructure is not provided within the SVS planning area.

Biogas systems, non-combustion technologies like fuel cells or future technologies of this type may meet the LCC intent. Should these systems be approved in the future, a connection to adjacent existing gas infrastructure could be made at that time.

The historic station uses a natural gas boiler which will be disabled once the building is connected to the district energy system. Existing natural gas service to restaurant tenents will need to be phased out or switched to a biogas source or all electric appliances.

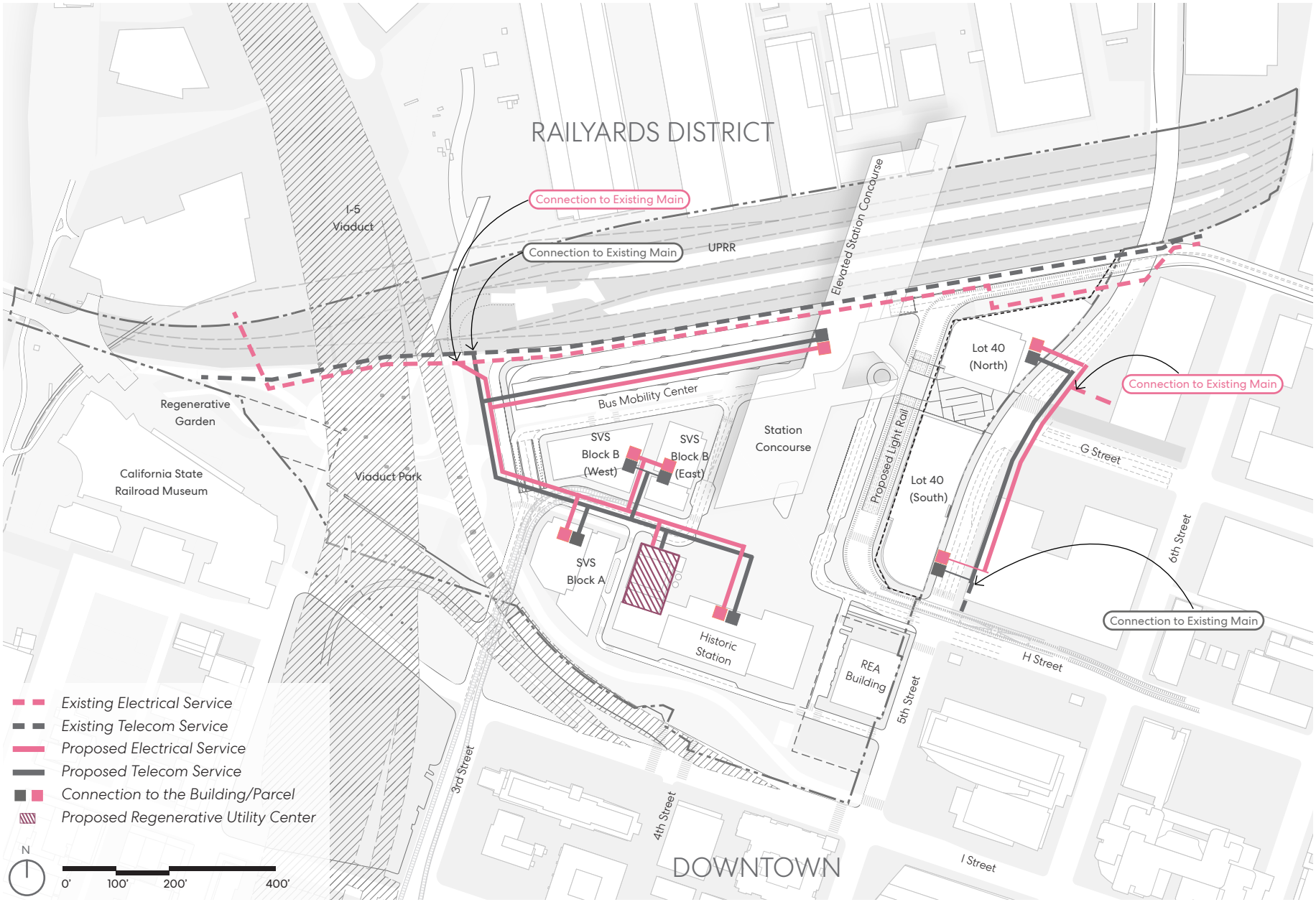


Figure 7.14 *Utilities - Electrical and Telecoms*