parkmerced

infrastructure report

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PARKMERCED

INFRASTRUCTURE REPORT

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ENGINEERS / SURVEYORS / PLANNERS

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1. INTRODUCTION

This report documents the proposed utility infrastructure for the Parkmerced development located in the southwest corner of San Francisco. The report details the general approach and strategy for the design and construction of the infrastructure necessary to support the proposed project.

The project consists of existing residential towers, new residential buildings, commercial buildings, public services and public open spaces.

The infrastructure report will address:

- Demolition and Deconstruction
- Site Grading
- Water System
- Wastewater System
- Recycled Water System
- Storm Drain System
- Dry Utilities (e.g., gas, electric, telecommunications)
- Central Plant

Other documents have been prepared to address transportation and sustainability goals for the project.

- “Parkmerced Standards and Guidelines” prepared by SOM
- “Parkmerced Vision Plan” prepared by SOM
- “Parkmerced Transportation Plan” prepared by AECOM
- “Parkmerced Sustainability Plan” prepared by SOM et al.

Project Description

Parkmerced is a 152 acre residential neighborhood located in the southwest corner of San Francisco. The neighborhood was built from 1941 to 1951 and has 3,221 residential units. The existing buildings consist of 170 two-story townhome buildings and 11 towers that are 13 stories tall.

Over 20-30 years the project will replace the 170 two-story buildings with new residential buildings, neighborhood serving retail and commercial spaces, fitness center, elementary school and maintenance facilities. The new residential buildings will be constructed in a diversity of housing types ranging from 35-foot tall low-rise townhomes to 145-foot tall towers. Some of the new buildings will be constructed on one to two-level below-grade parking garages. The 11 existing towers will be refurbished and retrofitted with energy-efficient appliances, building materials and plumbing fixtures. At project completion, there will be a total of 8,900 residential units, a net increase of 5,679 units.

Much of the existing street system will be maintained. However, the streets will be reconstructed to be consistent with the concepts of the city's Better Street Plan. Most street cross sections will be widened to improve pedestrian and bike travels and provide additional width to accommodate storm water control and treatment measures. The public space allotted to pedestrians has been increased and dedicated bike lanes have been provided on select streets. With all of these improvements the street alignments will generally be the same, which helps the future phased reconstruction. Intersections will be designed with bulbouts to create pedestrian friendly crossings. Main streets will have dedicated bike lanes that are adjacent to the sidewalks. Several new streets will be constructed to help reduce the apparent block size and improve pedestrian and traffic navigation through the site, while working to improve the general environment. East-West streets will be off-set to aid in the blocking of the westerly winds and North-South streets are kept continuous to allow better penetration of sunlight. North-South streets will also be planted with hedgerows of trees to further help reduce the westerly winds.

Phasing

The development for the project will be constructed in four major phases over a 20-30 year period. The four major phases will consist of several smaller phases that will be constructed over approximately 12 to 18 months. Each phase includes the construction of the associated utility and street infrastructure to serve the newly constructed buildings. The new infrastructure will be designed and constructed consistent with this report, the current SFPUC and the City of San Francisco Department of Public Works (SFDPW) requirements.

During the initial phases, the existing utility systems will be evaluated and upgraded as needed to serve the new and existing buildings and in an effort to minimize disruption of service while maximizing the construction efficiency. The existing buildings may continue to utilize the existing utility systems with temporary connections to the new utility systems until the existing buildings are removed or be connected to the new systems depending upon phasing of the new infrastructure. At the completion of the development program, the majority of the existing utility systems (with the exception of the sewer system) will be replaced and all users will be connected to the new systems. The existing sewer system will be inspected and repaired as necessary.

Project Variant

The infrastructure report describes a project variant at the intersection of Cambon Drive and 19th Avenue. With the base option, as shown on Figure 3.2, Cambon Drive does not connect to 19th Avenue. The variant option shows a new intersection at Cambon Drive and 19th Avenue. The intersection would be a right-turn only into the project from southbound 19th Avenue. Cardenas Avenue would be removed and Diaz Avenue would continue east to a new intersection with Cambon Drive. The report documents the changes to the major sewer and water utilities due to the variant.

2. DEMOLITION AND DECONSTRUCTION

The Infrastructure Report includes the deconstruction and removal of existing buildings and infrastructure including streets and pavements, retaining walls, utilities, trees and landscape elements.

The existing buildings slated for deconstruction and removal are primarily wood framed and stucco residential structures. To the extent practical, existing structures will be "deconstructed", allowing for maximum re-use or recycling of materials. The feasibility of materials reused or recycled may be limited by the requirements for abatement of hazardous materials and the potential value of the recycled material.

Building deconstruction and removal will start with the abatement of hazardous materials including lead paint, asbestos and other materials identified as part of a building survey. Hazardous materials will be removed pursuant to federal, state and local regulations. In addition to hazardous material removal, appropriate methods of vector control will be used to mitigate any possible vermin infestations from the existing buildings.

Existing pavements, underground utilities (except the combined sewer system), and overhead utilities in the demolition and deconstruction areas will be replaced or re-worked as appropriate with new infrastructure and phasing plan. All removal work and installation of new infrastructure will be phased to provide uninterrupted utility service to new and existing buildings, as best possible.

Where possible, concrete and asphalt pavements will be recycled and used on site or made available for use elsewhere. This could be accomplished by setting up a concrete/asphalt crushing plant operation during demolition. The location of the plant will consider the need for efficiency throughout the construction phases and the need to minimize the impact on existing residents and business. The recycled concrete/asphalt materials could be used for pavement and structural slab sub-base material, utility trench backfill, and where feasible, concrete and asphalt mixes.

Utility materials, primarily metals, will be recycled as feasible. Where transite pipe (asbestos-cement pipe) is encountered, appropriate abatement methods will be used to satisfy applicable regulatory agency requirements.

The majority of the existing trees will be removed or relocated during the course of demolition. The location of the existing trees and other plant material will be identified in an Arborist Report and necessary wildlife surveys will be completed prior to the start of removal. The Arborist Report will identify the trees and plants to be removed and those of significance to remain. The trees and plants not in conflict with the proposed plans will remain in place. All existing trees and plants to remain will be appropriately protected throughout the adjacent construction. All trees and plants to be removed could be recycled by composting for on-site uses associated with replanting and erosion control to the extent feasible.

Phases of Removal/Deconstruction

The proposed Removal/Deconstruction will occur in approximately 20 phases in conjunction with the construction phases. Each phase of removal will be further separated into smaller areas to better tailor the removal/deconstruction process within the area required for the individual building sites within each phase. The removal of smaller areas will allow the existing utility services, vehicular access areas, and vegetation to remain in place as long as possible in order to reduce disruption of existing uses around Parkmerced.

3. SITE GRADING AND DRAINAGE

Site Grading
The existing street slopes throughout the Parkmerced development are fairly flat and gentle. Along the westerly, southerly and easterly edges of the site, there are several retaining walls and relatively steep slopes from the site to the existing roadways. The ground elevations range from approximately 40' in the southwest corner of the site to approximately 200' near the southeast corner (all elevations in this plan are based on San Francisco datum). Figure 3.1 shows the existing elevations and approximate street slopes around the site.

With the proposed plan, several below grade parking garages will be constructed. Each parking garage excavation will generate large quantities of fill material. The main objective of the proposed grading plan is to reduce the amount of offhaul from the project and maximize the amount of fill on-site.

The proposed grading plan will raise site and street elevations in order to limit the amount of offhaul for the project. However, the new street elevations will be carefully designed and accounting the location and elevations of existing building entries, driveways, drainage patterns, traffic and pedestrian safety and constructability.

Several different grading scenarios have been studied throughout the extensive conceptual design process. The first and most straight-forward scenario would be to not raise street elevations and offhaul all excavated material from the site. While this solves many of the grading transition problems, it is not in line with the project's environmental and sustainability goals.

Another scenario would be to raise street elevations by approximately 8 feet. This scenario would almost create a balanced site in terms of earthwork. However, this creates many challenges with vehicular and pedestrian transitions. It would be almost impossible to maintain to existing driveways and buildings and transitions between reconstructed and existing areas would be impractical. Additionally, most of the existing utility lines in the streets cannot support an additional 8 feet of fill. It was determined this scenario is not technically feasible or practical.

The proposed grading scenario presented in this report will maximize the depth of fill over the existing streets, but also maintain safe and practical vehicular and pedestrian access through site during construction. This will be accomplished by:

- The proposed street elevations will be an average of 3' to 5' higher than existing elevations to provide locations to place material. The 3' to 5' change in street elevation provides the maximum depth to place fill and still allow temporary grading transitions at phase boundaries, existing building entrances and sidewalks.
- Proposed buildings that do not have below-grade parking garages will be constructed on 3' to 5' of fill material.

- The below-grade parking garages will be designed to minimize the floor-to-floor heights thus reducing the depth of excavation.
- Exterior courtyards will be constructed on top of the below grade parking garages. On-site fill material will be used in the courtyards for planters, under walks and stream water features.

Figure 3.2 shows the proposed elevations and street slopes. The proposed grading plan will generally follow the existing drainage pattern of the site. Street slopes will generally follow the existing direction to help maintain drainage areas and patterns.

Cut/Fill Quantities
The combination of below-grade parking garage excavations and the proposed site elevations will create approximately 687,000 cubic yards of offhaul.

Cut and fill quantities have been estimated for the entire project. Figure 3.3 shows a cut and fill map of the site that indicates the approximate depth of cut and fill across the site. The quantities have been further broken down by proposed block. These quantities are estimated based on the conceptual site grading plan and the conceptual architectural plan for the below-grade parking garages. Several assumptions have been made about the depth, floor-to-floor height and structural design of the parking garages. During the course of construction, a stockpile of fill will be created to stage material excavated during parking garage construction for future use as site fill.

The following table summarizes the total estimated cut and fill quantities.

Cut (cy)	Fill (cy)	Net (cy)
1,249,000	507,000	-687,000

Temporary Grading Transitions
This proposed grading approach does create challenges at the construction phase boundaries. The boundaries of the construction phases will typically follow an existing street alignment. Raising street elevations by 3' to 5' complicates access to existing buildings and parking areas, maintaining traffic lanes and maintaining pedestrian access through the site during construction. Careful consideration must be given to develop temporary grading transitions at the construction phase boundaries. With the current phasing plan, it is likely these transitions could be in place for several years.

Three concepts have been developed to illustrate how these grading transitions can be accomplished. As the detailed construction plans are developed, each transition must be reviewed to determine which option works for each condition. Figure 3.4 shows a schematic diagram to help illustrate these transitions.

- **Maintain the Existing Street** – This approach would generally maintain the existing street elevations after the new building is constructed. Since the new building entrances will generally be 5'-7' above the existing sidewalk elevations, temporary pedestrian and vehicle access improvements would be constructed to provide access to the new building. Vehicular and pedestrian access would be maintained to the existing buildings on the other side of the street. The existing utilities would remain operational in the street. New street utilities would be constructed concurrently with the new street during a later phase.

- **Construct Half the New Street** – With this concept, half of the new street and sidewalk will be constructed creating a split-level street. The other half of the street and sidewalk will remain at existing elevations, maintaining access to existing buildings. New utilities will be installed within the new street section, and possibly within the existing section depending on the location within the site. At street intersections, the new street elevations will conform to the existing street to create a smooth transition through the intersection.

- **Construct the Entire New Street** – This concept is similar to the one described above, however with this concept, the entire width of the new street will be constructed. The existing sidewalk on one side of the street will remain in order to maintain building access. Depending on the difference in elevations, there will either be a vertical or sloped transition at the edge of the new street and the existing sidewalk. This concept will allow all the new utilities to be installed in the street. Smooth transitions through street intersections will need to be provided.

For each temporary grading transition, a functional overland treatment system must be maintained within the right of way. In addition, the temporary grading transitions within the streets must also be able to convey the 100-year overland flow.

Along with the grading challenges, the phasing and installation of new utility systems must also be carefully analyzed. Since street grades will be generally raised 3’ to 5’, most utility systems will need to be installed concurrently or after the final road elevation is constructed. In the few areas where the proposed grade is lower than existing grade, some existing utilities lines may need to be relocated prior to establishing the final road elevations.

The design of the stormwater treatment measures must also be considered when phasing the construction of the streets. Since each section of newly constructed street must meet the city’s stormwater design guidelines, the required stormwater treatment infrastructure must also be constructed at the same time.

Retaining Walls

Existing retaining walls typically consist of cast-in-place concrete walls. Based on a visual inspection, most retaining walls appear to be in a serviceable condition, while some existing concrete walls show evidence of past water seepage at the face, indicating that they may be nearing the end of their design life.

It is anticipated that several of the existing retaining walls within the proposed project will be modified or rebuilt due to grade changes and road realignment. The condition of retaining walls proposed to remain in place will be evaluated on a case-by-case basis during final design. These walls may be seismically retrofitted or replaced to comply with City and County of San Francisco and CBC codes and the design-level geotechnical report.

There will be several new retaining walls constructed. The type of wall construction will be dependent on the location of the wall, height and whether the wall is in a cut or fill condition.

4. WATER SYSTEM

Existing Water System
The existing water system in Parkmerced is privately owned and maintained. The system was built in the 1940s with the original development. Existing pipes range in size from 6-inch to 16-inch in diameter. The pipe material is unknown, but likely a mix of cast iron, ductile iron and copper. There are no water storage facilities within the project. Figure 4.1 shows the existing water distribution system.

An existing San Francisco Water Department (SFPUC) distribution main runs through the site. It is 36-inch diameter line called San Andreas No. 3. Some sections of this line will need to be relocated around proposed buildings and into new street alignments.

The water system is fed from two connections to the SFPUC system. One connection is located at 1201 Junipero Serra Boulevard and the other off of Lake Merced Boulevard, 801 Font Boulevard. The 1201 Junipero Serra Blvd connection has four 8-inch turnouts. Each turnout has its own water meter that is connected in parallel that feed into a 16-inch water main. The 16-inch water main runs northwesterly in Font Boulevard. Smaller pipes branch off the 16-inch line to feed the outer perimeter of the project.

The 801 Font Boulevard connection has an 8-inch and a 10-inch turnout. Each turnout has its own water meter that is connected in parallel to feed a 12-inch water main that runs southeasterly in Font Boulevard and connects to the 16-inch water main described above. These two water mains provide the backbone of the existing water system.

The system provides domestic, irrigation and fire water. SFPUC reads the master meters at the points of connection on Junipero Serra Blvd and Font Blvd. Select blocks owned by San Francisco State University and irrigation services within the project also have their own deduct meters read by SFPUC. Since the master meters read both domestic and irrigation use, SFPUC subtracts the irrigation meter readings from the master meter readings to determine the domestic use for the project.

System static pressures within the project range from 76 psi to 99 psi, depending on the site elevation. Fire hydrant flow tests were performed by the San Francisco Fire Department in 2009 to estimate the available fire flow for the project.

- <u>Font Boulevard and Lake Merced Boulevard</u>
  Static Pressure = 99 psi
  Residual Pressure = 88 psi
  Observed Flow = 1,400 gpm
  Available Flow at 20 psi = 4,060 gpm

- Font Boulevard and Junipero Serra Boulevard
  Static Pressure = 76 psi
  Residual Pressure = 70 psi
  Observed Flow = 1,200 gpm
  Available Flow at 20 psi = 4,010 gpm

Proposed Domestic Water Demand
The Sustainability Report documents the proposed domestic water demand for the project for various scenarios. Different scenarios were analyzed for different types of water fixtures or varying efficiency. The “Existing” and “Full Buildout” scenarios assume standard water fixtures. The table below provides a summary.

Existing	Potable (mgd)	Non-Potable (mgd)	Total (mgd)
Residential	0.55	-	0.55
Non-residential	-	-	-
Irrigation	0.16	-	0.16
Total	**0.71**	**-**	**0.71**
Full Buildout			
Residential	0.74	0.14	0.88
Non-residential	0.03	-	0.03
Irrigation	-	0.09	0.09
Total	**0.78**	**0.22**	**1.00**
Full Buildout with efficient fixtures			
Residential	0.62	0.23	0.86
Non-residential	0.02	0.01	0.03
Irrigation	-	0.09	0.09
Total	**0.65**	**0.33**	**0.98**
Full Buildout with high-efficient fixtures			
Residential	0.51	0.18	0.69
Non-residential	0.02	0.01	0.03
Irrigation	-	0.09	0.09
Total	**0.54**	**0.27**	**0.81**

The Sustainability Plan provides the estimated domestic water demand for the project. Even with an increase of 5,679 units, the proposed use of high efficiency water fixtures; retrofitting existing units with high efficiency fixtures; and the use of recycled water for non-potable fixtures, the total domestic water demand use for the project will not significantly increase from existing uses. Therefore this report assumes the domestic water demand will not be a significant impact to the design of the new water system.

An Administrative Draft Water Supply Assessment, dated October 2009, has been prepared for the project. The WSA demonstrates the existing water system can provide an adequate and reliable supply of water for the project.

Proposed Domestic Water System
The proposed water system will be constructed in phases that coincide with the 20 construction phases. The existing buildings will continue to utilize the existing water distribution system with possible temporary connections to the new system and

temporary water infrastructure where required to maintain the existing uses until they are demolished or permanent connections can be made. At construction phase boundaries, the existing building water services will be connected to the newly installed water main in the street. All new buildings will be connected to a newly installed water main, unless phasing and constructability requires otherwise. At the completion of the project all buildings will be connected to the newly installed water mains throughout the project site.

During the construction of the new water system, Parkmerced will be responsible for maintenance of the intermingled water system, consisting of old and new pipes. When all of the new water system is installed, ownership and maintenance responsibility will be transferred to the SFPUC. The proposed water system is shown in Figure 4.2.

The system will consist of ductile iron pipes per SFPUC standards that will range in size from 6-inch to 16-inch in diameter. Domestic, fire and irrigation services will be fed by the new water system. New water meters will be provided for each building domestic service and each irrigation service. At the end of the project, the master meters will be abandoned and SFPUC will read each building and irrigation meter. Fire services will not be metered. New hydrants will be installed and spaced in accordance with current fire code and fire department requirements.

Another water service from the SFPUC transmission main in either Junipero Serra Blvd or Lake Merced Blvd may be required for the project. While the two existing services can provide an adequate water supply, another feed will provide an added level of redundancy and reduce the demand on the existing service at 1201 Junipero Serra Blvd.

During normal operations of the water system, the Junipero Serra Blvd transmission main provides the water for the site via the 16-inch main across Junipero Serra Blvd. The existing Lake Merced Blvd service only provides water to the site when the Junipero Serra Blvd service is closed for maintenance or testing. Since the Lake Merced Blvd main is at the low end of the site, the water system experiences lower pressures and reduced available flows when the Junipero Serra Blvd service is closed and water is provided via the Lake Merced Blvd service.

Conceptual Hydraulic Analysis of Water System

A conceptual hydraulic analysis has been performed of the proposed water distribution system using a computer modeling program. The preliminary analysis was performed to demonstrate the water system can provide a minimum fire flow and domestic flow simultaneously.

The California Code of Regulations, Title 22, requires that the water distribution system be capable of delivering the maximum daily demand coincident with the required fire flow. Based on the preliminary water demand calculations described above, the average day demand is approximately 0.78 mgd (542 gpm). The maximum day demand is equal to twice the average day demand, or 2 x 542 gpm = 1,084 gpm.

For this analysis, it was assumed the minimum design fire flow is 1,750 gpm with a minimum residual pressure of 20 pounds per square inch at the fire hydrants.

The analysis demonstrates that each node included in the model can provide a minimum fire flow of 1,750 gpm while simultaneously providing a maximum day demand of 1,084 gpm at a residual pressure of 20 psi. The results of the analysis are presented in Appendix A.

Recycled Water System

The project is planning for the installation of a recycled water system that will be used for irrigation and non-potable water uses in buildings. At this time, the source of the recycled water is not known. SFPUC staff has reviewed the project request for recycled water service in the context of other projects planned in the vicinity. As currently configured, there is not sufficient available capacity from the Harding Park Recycled Water Project to serve the non-potable needs at Parkmerced. The demand for the Harding Park Recycled Water Project is intended to fully utilize the residual capacity of the Daly City Wastewater Treatment Plant. The SFPUC is, however, working with the City of Daly City to assess the expansion of the recycled water production capacity at the Wastewater Treatment Plant. In the event that this expansion is developed, additional capacity may become available to meet some or all of the projected demands of the Parkmerced project.

The Project recycled water system will be supplied by the City's potable water distribution system until a recycled water supply is developed. The Developer will develop a functional recycled water distribution system for the Project site as described above, with an interim connection to the City's potable water distribution system. If and when an appropriate source of recycled water is available to serve the Project recycled water distribution system the Developer will cooperate with the City to follow the procedures required by the SFPUC in disconnecting the interim Project potable water system connections, and connecting the recycled water source to the Project recycled water distribution system.

Auxiliary Water Supply System (AWSS)

Parkmerced does not currently have an AWSS system for fire protection. An AWSS system provides an emergency supply of water for fire protection that is distributed via dedicated fire hydrants. The project is planning for a future installation of an AWSS as a backup fire protection system in the unlikely event of an extended total disruption of water supply. The exact nature of the AWSS will be discussed with the San Francisco Fire Department.

A dedicated underground piping system for the AWSS will be planned for throughout the project as shown on Figure 4.4. The AWSS is not planned to be installed on every street. The layout of the AWSS will be looped around two or three block areas. Separate AWSS fire hydrants will be located along the route of the piping at street corners.

5. SANITARY SEWER SYSTEM

Existing Sanitary Sewer System
The existing sanitary sewer system in Parkmerced is a combined system that conveys both sewage and storm drain flows. The system consists of 12-inch diameter pipes to 3'x5' horseshoe sewers. Pipe materials include vitrified clay pipe and concrete box culverts. Figure 5.1 shows the layout of the existing sewer system.

The sewer system is split into two systems with separate outfalls. Sewer flows from the majority of the project are conveyed to the southwest corner of the site where the system connects to a 60" pipe in Lake Merced Boulevard and then to the Lake Merced Tunnel sewer. The Tunnel Sewer is a deep tunnel under Parkmerced that conveys flows from a larger tributary drainage area north of the project. The Tunnel Sewer eventually conveys flows to the Oceanside Treatment Plant.

Sewer flows from a small portion of the southeast corner of the site drain to a 54-inch diameter sewer in Brotherhood Way. The 54-inch sewer flows westerly and connects to the Tunnel Sewer, connecting to the Oceanside Treatment Plant, as well.

At the start of the design phase, the existing sanitary sewer system will be evaluated for its physical condition and capacity. Reuse of any particular portion of the existing gravity combined sewer and support system in the manner described above shall be subject to further review by the SFPUC of the Developer's reuse proposal. Such review shall include an assessment of the condition of the existing pipe(s) performed by the Developer at its expense, using a technical assessment methodology approved by the SFPUC, prior to any construction or excavation work in the vicinity of the systems in question. To the extent that the project directly impacts the existing sewer system, the cost of any rehabilitation or upgrade to the sewer system required in connection with the Developer's reuse proposal shall be borne by the Developer.

Reuse, relocation or capacity upgrade of any particular portion of the existing combined sewer and support system in the manner described above shall be subject to further review by the SFPUC of the Developer's reuse, relocation or capacity upgrade proposal. For purposes of this paragraph a "relocation" shall include a relocation of an existing pipe in any direction (horizontal or vertical) for purposes of reconnection and reuse within the sewer collection system, and a "capacity upgrade" is defined as the replacement of an existing sewer line as required to increase capacity of such sewer line, if the proposed Project would exceed the capacity of such line, as set forth in the Stormwater Management Protocol of the Infrastructure Plan. The Developer shall bear the cost of any relocation or capacity upgrade work required in connection with the Developer's proposal; provided that the SFPUC shall bear the cost of any pipe rehabilitations or upgrades that are solely necessitated by existing structural conditions that the SFPUC would address under its typical practice with respect to maintaining and rehabilitating existing combined sewer pipes (i.e. those upgrades not directly attributable to the Developer's proposed relocation or increased capacity requirements). For those portions of the existing combined sewer and support system that are proposed to be reused in place or connected to as-is, the SFPUC shall retain the obligation of assessment and rehabilitation according to its own asset management practices. For those portions of the sewer system that are proposed for relocation based on the scope of the proposed Development Phase in question, the Developer shall be responsible for the assessment of the condition of such pipes at its expense using a technical assessment methodology approved by the SFPUC, which assessment shall be completed prior to any construction or excavation work in the vicinity of the systems in question. None of the work required by this Section for either the SFPUC or Developer (including Developer's reuse or relocation of existing SFPUC-owned pipes) shall affect the ownership of the combined sewer and support system within the Project Site.

Proposed Sanitary Sewer System

The existing combined sewer system will be used for the sanitary sewer system for the project. For most areas of the site, the new storm drainage system will convey the 5-year flows on the ground surface and will not require a below-grade system. Therefore only sanitary sewer flows from the project will be conveyed via the existing system to the treatment plant. Since the existing combined system was sized to convey both storm and sewer flows, there will be adequate capacity to convey only the sewer flows at the project completion even with the increase in total units.

The proposed sewer infrastructure is shown on Figure 5.2. Since most of the street alignments will be maintained, there will be only minor improvements to the existing sewer system. With the realignment of streets in some locations, new sewer infrastructure will need to be installed. A new sewer system will also be installed in all new streets. New sewer infrastructure will be installed per current SFDPW standards.

In areas where there is a proposed cut within a street, the existing sewer system must be reviewed to determine there will still be adequate cover. If there is not adequate cover per the current city design standards, the sewer system will need to be replaced to conform to current standards.

With each phase of construction, the existing sewer system should be inspected to determine if the pipes are in good condition. The system should be televised to determine if the pipes are cracked, joints are leaking or roots have clogged the pipes. Depending on their condition, some pipes may need in-situ repairs. These repairs could range from relining the pipes, slip-lining or pipe-bursting the smaller clay pipes.

Proposed Sanitary Sewer Generation

As discussed in Section 4, the increase in domestic water demand will be minimal from existing demands. Typically sanitary sewer demand is estimated to be approximately 90%-95% of the domestic water demand. Therefore, the increase in sanitary sewer demand will also be minimal.

	Indoor Water Demand			Sewer Generation (mgd)
Existing	**Potable**	**Non-Potable**	**Total (mgd)**	

	(mgd)	(mgd)		
Residential	0.55	-	0.55	
Non-residential	-	-	-	
Total	**0.55**	**-**	**0.55**	**0.52**
Full Buildout				
Residential	0.74	0.14	0.88	
Non-residential	0.03	-	0.03	
Total	**0.77**	**0.14**	**0.91**	**0.86**
Full Buildout with efficient fixtures				
Residential	0.62	0.23	0.86	
Non-residential	0.02	0.01	0.03	
Total	**0.64**	**0.24**	**0.89**	**0.84**
Full Buildout with high-efficient fixtures				
Residential	0.51	0.18	0.69	
Non-residential	0.02	0.01	0.03	
Total	**0.53**	**0.19**	**0.72**	**0.68**

Conceptual Hydraulic Analysis of Sewer System

A conceptual hydraulic analysis has been performed of the proposed sanitary sewer system. The analysis demonstrates the sewer system has capacity to convey the increased sewer flows from the project. The hydraulic performance of the system was also be analyzed to determine the pipe velocities within the system are at a minimum velocity of 2 feet/second. This minimal velocity provides a “cleaning” velocity to keep the pipes clear.

The results of the analysis are presented in Appendix B.

6. STORM DRAIN SYSTEM

Existing Storm Drain System
As discussed in Section 5, the existing combined system conveys both sewage and storm drain flows. The combined system is a gravity system. There are no pump stations within Parkmerced. Storm water is conveyed to the waste water treatment plant where it is treated and discharged to the ocean.

The existing system was likely designed to convey the 5-year storm event. As with most areas in San Francisco, larger storm events typically overwhelm the system. Flows from large storm events, such as up to the 100-year event, are conveyed in the streets. Most of the 100-year storm flows within Parkmerced are conveyed to the southwest corner and discharge down the slope to Lake Merced Boulevard.

Proposed Storm Drain System
The existing combined system will be converted to a sewer-only system in phases that correspond to the proposed development program. At full build-out only sewer laterals from the buildings will be connected to the existing combined system. However, several parcels north of the project (previously part of the original Parkmerced development) still drain both sewer and storm flows to the combined system that flows south through the project. These connections will be maintained after project completion.

The proposed storm drain system will be designed to convey the 5-year, 90 minute design storm event via bio-swales, streams, ponds, shallow pipes and trench drains. The storm drain system will also treat the 2-year, 24 hour design storm. At some locations, pipes will be required to convey flows through intersections and across streets. The bio-swales, streams and ponds will convey most of the runoff on the ground surface, eliminating the need for a piped storm drain system. The storm drain system will also have a series detention ponds located throughout the site to provide storage and reduce the peak rate of discharge from the site.

One of the design goals of the storm drain system is to infiltrate most runoff from small storm events into the groundwater aquifer. The Upper Westside groundwater basin is located under Parkmerced. Permeable surfaces will be installed where possible and applicable to help increase infiltration. Permeable surfaces are being considered for some pedestrian walkways, parking areas and other low-traffic areas.

At the southern end of the site, a stream system will be constructed that will carry flows from the majority of the site to a terminal pond at the southwest corner. Check dams along the stream will create ponds to help store runoff and slow down the discharge rate. At the lower end of the system, the stream will be lined to reduce erosion and protect the existing slope south of the stream.

The terminal pond will have a discharge pipe down the existing slope at the intersection of Lake Merced Boulevard and Brotherhood Way. Downstream of the terminal pond there are three different outfall options being studied.

- Option 1 – A new storm drain pipe will be installed under Brotherhood Way to carry flows from the discharge pipe to an existing storm drain system on the south side of Brotherhood Way. The existing storm drain system discharges to Lake Merced.
- Option 2 – Outfall directly to Lake Merced via an existing pipe under Lake Merced Boulevard; or install a new pipe that outfalls to Lake Merced.
- Option 3 – Maximize the on-site detention and infiltration of storm water on-site then connect directly the combined sewer system in Brotherhood Way that conveys flows to the treatment plant.

During the design phase, the project applicant will investigate the existing outfalls to assess their condition and make recommendations for repairs or replacement, if necessary. To the extent that the project directly impacts or modifies the existing sewer system, repairs or replacement of the existing system will be constructed by the project applicant. If other repairs or replacement to the sewer system are required in areas that have not been directly impacted by the project, they will be performed by the city.

Flows from a storm event larger than a 5-year storm will be convey by overland flow through the streets of the project towards the perimeter of the project. Most of the overland flow will flow to the west towards Lake Merced Boulevard, consistent with the existing drainage patterns of the site.

The removal of storm water from the existing combined system will be completed concurrent with the construction phasing and the other utility system replacement. Areas of the site that are not directly connected to a swale system will continue to drain storm water to the combined system. Temporary pipes and/or inlets (connected to the existing combined sewer system) in swales will be installed as necessary to provide an adequate storm drain system during construction or until the necessary downstream bioswales or streams are constructed. As the construction of the swale system expands, the temporary storm drain systems and inlets will be removed.

Since most bio-swales are located along streets that are adjacent to buildings, the design of the building foundations and below-grade parking garages must take into account the groundwater infiltration that will occur next to the buildings. Water proofing details, wall drainage and foundation systems will need to be carefully designed to protect the buildings from groundwater intrusion.

Overland Flows

The street cross sections will be designed to convey the 100-year flows and maintain the water level below the top of curb elevation. For streets that do not have curbs, the overland flow will be contained within the street right-of-way. Figure 6.2 shows the proposed overland flow path for each street. There will be several overland release points for the project. Most of the overland flow will release out to Lake Merced Boulevard, near the intersection with Brotherhood Way. A few small drainage areas on the east side of the site will release to Brotherhood Way or Holloway Avenue.

Proposed Storm Water Treatment System
The project will be required to complete a Stormwater Control Plan (SCP) to address storm water treatment prior to discharge to Lake Merced. The SCP will be developed in coordination with the SFPUC, and will comply with the requirements outlined in the San Francisco Stormwater Design Guidelines. The SCP will also meet water quality requirements in the SFPUC's NPDES permit and the goals of the San Francisco Bay Regional Water Quality Control Board's (RWQCB) San Francisco Bay Basin Plan.

Stormwater treatment will occur through bio-filtration and infiltration. A detailed water quality model will be prepared to demonstrate the effectiveness of the treatment system and show how the system meets the pollutant removal requirements of the SFPUC, Army Corps of Engineers and the Regional Water Quality Control Board.

Appendix C

Street Intersection Drainage
Street intersections create unique challenges to convey stormwater from one bio-swale to another bio-swale through the intersection. Since the bio-swales are fairly shallow (around 12" to 24" deep), the storm drainage infrastructure at intersections must also be shallow.

Figures 6.3 and 6.4 show different drainage concepts for a typical intersection. One concept is to install a trench drain across the intersection to connect one bio-swale to another. The trench drain will be shallow to match the depth of the bio-swales and sized to convey the 5-year flows. This concept will generally apply to the north-south streets.

The second concept would be to install a storm drain pipe with 30" minimum cover (as required by the city) to connect the bio-swales through the intersection. The invert of the storm drain pipe will be lower than the invert of the downstream bio-swale. This will create a "bubble-up" condition on the downstream end of the pipe. Runoff will bubble up out of an inlet and continue to flow down the bio-swale.

Each of these concepts requires routine maintenance to maintain their performance. Regular cleaning of the trench drains and "bubble-up" inlets would be necessary. The trench drain concept presents an added complication when the streets need to be overlaid with new asphalt.

7. DRY UTILITY SYSTEM

Existing Dry Utility System
Existing dry utilities in Parkmerced include electrical, natural gas and telecommunications. All dry utilities are below grade. There are no overhead lines in Parkmerced.

The electric and gas systems are owned and maintained by PG&E. The electrical system consists of a 4kV looped system throughout the project. Typically each building has its own subsurface transformer to step down the voltage.

The gas system in Parkmerced is fed from a 16" gas main in 19th Avenue. There is a 6" gas service from the 16" main near the intersection of Crespi Drive and 19th Avenue that serves the site. Smaller 4" and 2" gas pipes run throughout the site to serve each building. Each existing tower building has two gas meters and each block of garden apartments shares a common meter with individual meters for each garden apartment.

Existing telephone, cable television and street lighting services are below-grade. It is assumed this are located in a common joint trench throughout the site.

Proposed Dry Utility System
The proposed improvements include the construction of a new joint trench to replace all of the electrical, gas and telecommunication facilities. In addition, the joint trench will also include conduits and conductors for street lighting and fire/police communications.

The electrical and gas system will be designed by PG&E. The joint trench will be installed under the new sidewalks. Below-grade vaults and junction boxes will also be installed in the sidewalk area. New transformers, either above-grade or below-grade, and gas meters will be installed for each building.

The existing telecommunication and cable television facilities in Parkmerced will also be replaced. This report anticipates the telecommunication and cable TV distribution network for Parkmerced will be included in the joint trench facility. The final design of these facilities will be coordinated with the providers in this area.

8. OTHER SYSTEMS

Proposed Automated Waste Management System
Figure 8.1 shows a conceptual layout for an automated waste management system. The project is planning for this system that will collect waste and trash from locations around the site and convey it to a central collection plant via steel tubes located mainly in the streets. The collection plant acts like a large vacuum to collect waste and trash. The size of the steel pipes will likely range from 20 to 24 inches in diameter.

Co-Generation Piping
The project is also planning for a co-generation system to generate electricity and provide hot water for heating the buildings. The street cross sections are designed to allow room for the hydronic piping from the co-generation plant(s) to the buildings. Several different co-generation systems are being considered ranging from a central distribution plant to a block-based system. The hydronic piping system varies with type of system. Figure 8.2 shows a conceptual layout of the hydronic piping system based on the assumption that the system will be required in all streets.

9. STREET UTILITY CROSS SECTIONS

Typical street cross sections have been developed for the various street types. The dimensional layout and material design of the street types is described in the Design Guidelines and Standards and Vision documents. This report focuses on the utility layout within the street cross sections. Typical street utility cross sections are shown on Figures 8.3 and 8.4.

Street Utility Cross Sections

Conceptual street utility cross sections have been prepared to show the proposed utility layout for each typical street. The cross sections show the utility layout based on the minimum required spacing between each utility. Except for the alley ways, all utility systems have been planned for in each street. It should be noted that it is unlikely every utility system will be installed in every street.

Spacing Requirements

- Spacing between sanitary sewer and domestic water must be 10-feet clear per California Title 22 requirements.
- Spacing between domestic water and recycled water piping must be 4-feet clear per California Title 22 requirements.
- Spacing between PG&E facilities and other utilities must be 3-feet clear per PG&E requirements.
- Minimum spacing between hydronic piping, automated waste management piping and other utilities will be based on industry standards and constructability requirements.

FIGURES

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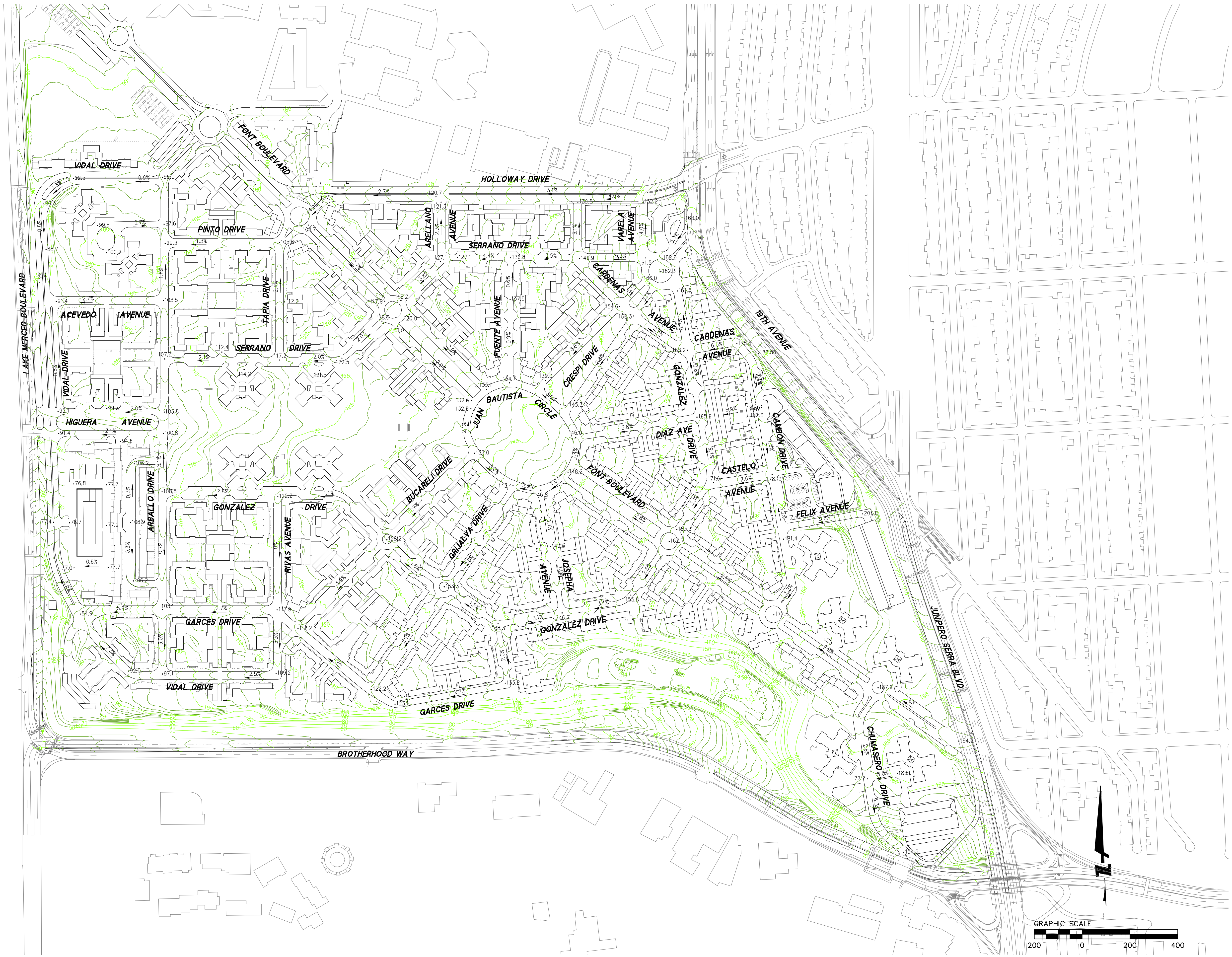

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FIG 3.1

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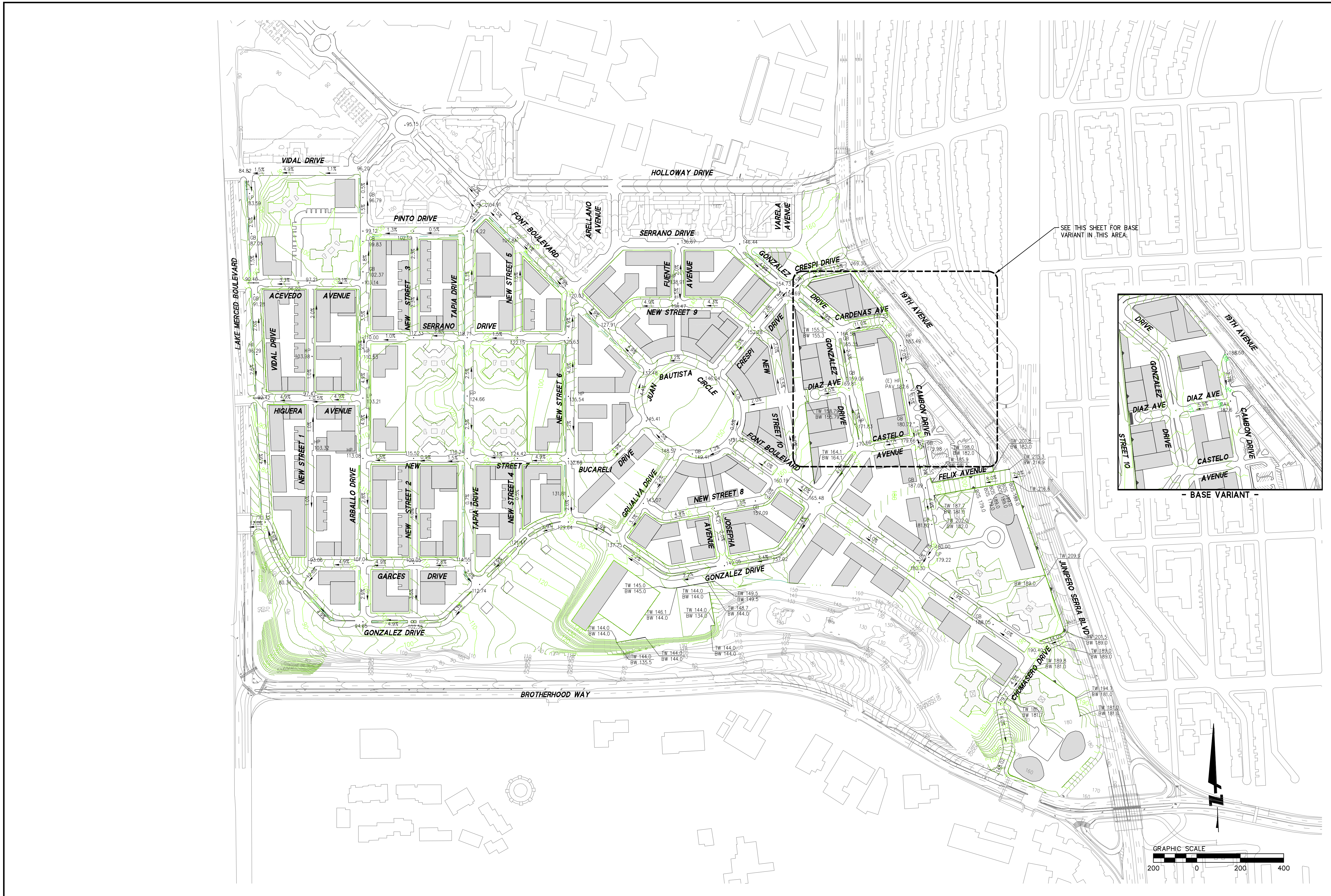

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FIG 3.2

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NOTE:

1. EARTHWORK QUANTITIES SHOWN ARE IN CUBIC YARDS.
2. NUMBERS INCLUDE AN ESTIMATED 3' AVERAGE FILL IN PLAZA AREAS (OPEN SPACE ABOVE GARAGES)

EARTHWORK SUMMARY

BLOCK	CUT	FILL	COURTYARD AREA FILL	NET
1	3,315	11,028	0	7,713 (F)
2	149,947	5,431	8,889	135,627 (C)
3A	48,700	15,966	6359	26,375 (C)
3B	4,588	33,302	0	28,714 (F)
4	17	6,927	0	6,910 (F)
5	153,170	854	6,778	145,538 (C)
6A	66,622	5,522	3,696	57,404 (C)
6B	755	15,715	0	14,960 (F)
7	160,572	1,449	7,052	152,071 (C)
8	23,081	1,639	1,444	19,998 (C)
9	132,884	790	7,481	124,613 (C)
10	59,252	21,287	2,867	35,098 (C)
11	132,994	1,257	6,000	125,137 (C)
12	1	38,091	0	38,090 (F)
13	453	17,195	0	16,742 (F)
14	87,700	29,191	1,863	56,646 (C)
15	54,890	32,555	381	21,954 (C)
16	65	52,077	0	52,012 (F)
17	734	98	0	636 (C)
18	22,761	1,833	726	20,202 (C)
19	50,836	25,054	400	25,382 (C)
20	23,456	20,871	667	1,918 (C)
21A	338	16,193	0	15,855 (F)
21B	20,472	3,876	0	16,596 (C)
21C	6,549	4,243	0	2,306 (C)
22	10,421	14,171	0	3,750 (F)
23 – FITNESS	13,203	72,307	0	59,104 (F)
24 – STREAM	19,720	1,314	0	18,406 (C)
25 – STREAM	1,836	21,228	0	19,392 (F)
26 – JUAN BAUTISTA	0	35,383	0	35,383 (F)
TOTAL	1,249,000	507,000	55,000	687,000 (C)

CUT / FILL DATA

Color	Range Beg.	Range End	Percent	Area (SF)
	−30.00	−25.00	6.9	441030.86
	−25.00	−20.00	5.4	341423.24
	−20.00	−15.00	5.2	328388.93
	−15.00	−10.00	5.9	377402.87
	−10.00	−5.00	4.4	280293.35
	−5.00	−1.00	9.5	605953.07
	−1.00	0.00	6.8	435332.18
	0.00	1.00	10.5	667391.47
	1.00	5.00	30.5	1944764.62
	5.00	10.00	12.6	800125.23
	10.00	15.00	1.6	100442.98
	15.00	20.00	0.5	34184.36
	20.00	25.00	0.2	15482.06

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FIG 3.3

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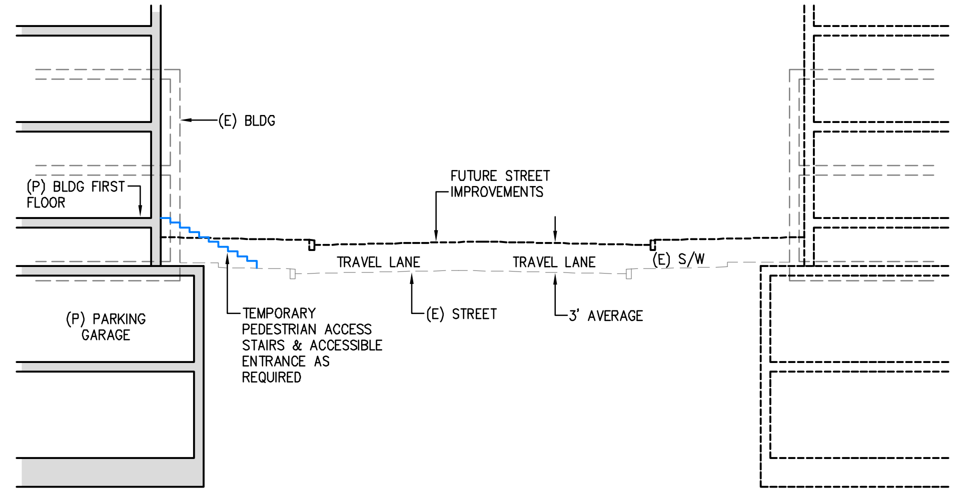
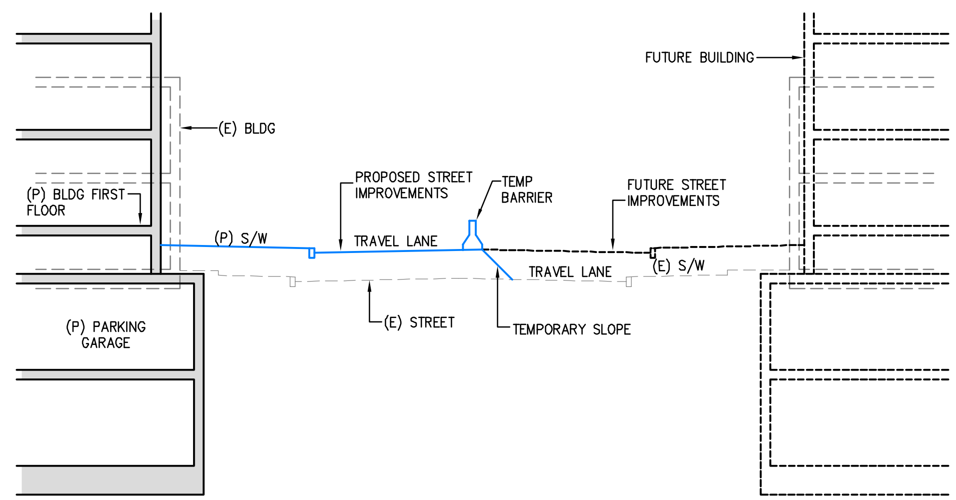
MAINTAIN THE EXISTING STREET
- MAINTAIN THE EXISTING STREET AFTER NEW BUILDING IS CONSTRUCTED
- POSSIBLY ELIMINATE PARKING ON ONE SIDE OF EXISTING STREET
- PROVIDE TEMPORARY PEDESTRIAN & VEHICLE ACCESS TO NEW BUILDINGS
- EXISTING UTILITIES TO REMAIN OPERATIONAL IN THE STREET
- INSTALL NEW UTILITIES WITH THE NEW STREET DURING A LATER PHASE



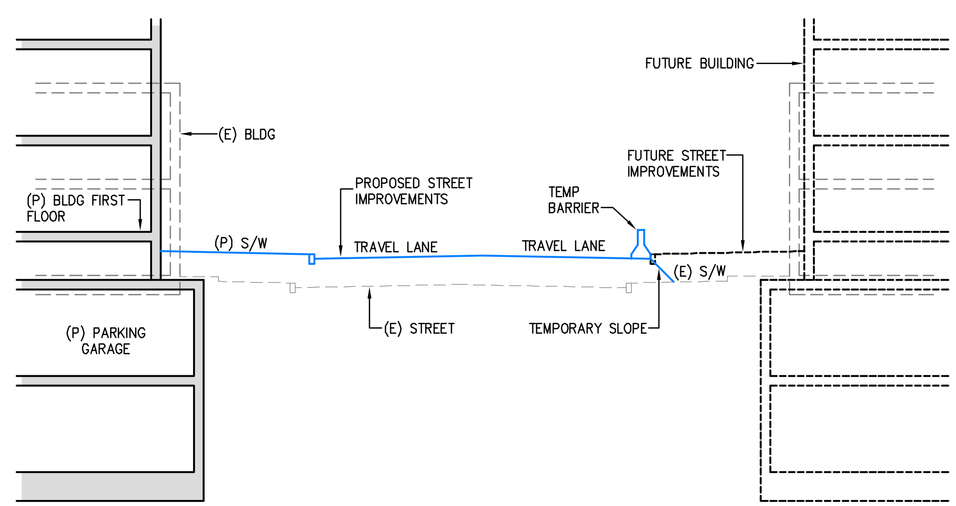
SECTION A–A
SCALE: 1" = 20'

CONSTRUCT HALF THE NEW STREET
- CONSTRUCT HALF THE NEW STREET & SIDEWALK AND MAINTAIN THE OTHER HALF OF THE EXISTING STREET & SIDEWALK TO PROVIDE ACCESS TO EXISTING BUILDINGS
- INSTALL NEW UTILITIES WITHIN NEW STREET SECTION
- AT STREET INTERSECTIONS, NEW STREET TO CONFORM TO EXISTING STREET THROUGH SMOOTH TRANSITION



SECTION B–B
SCALE: 1" = 20'

CONSTRUCT THE ENTIRE NEW STREET
- CONSTRUCT ENTIRE WIDTH OF THE NEW STREET & SIDEWALK WITH TRANSITION TO EXISTING SIDEWALK
- EXISTING SIDEWALK TO REMAIN ON ONE SIDE OF THE STREET TO PROVIDE ACCESS TO EXISTING BUILDINGS
- INSTALL NEW UTILITIES IN THE NEW STREET
- AT STREET INTERSECTIONS, NEW STREET TO CONFORM TO EXISTING STREET THROUGH SMOOTH TRANSITION



SECTION C–C
SCALE: 1" = 20'

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FIG 3.4

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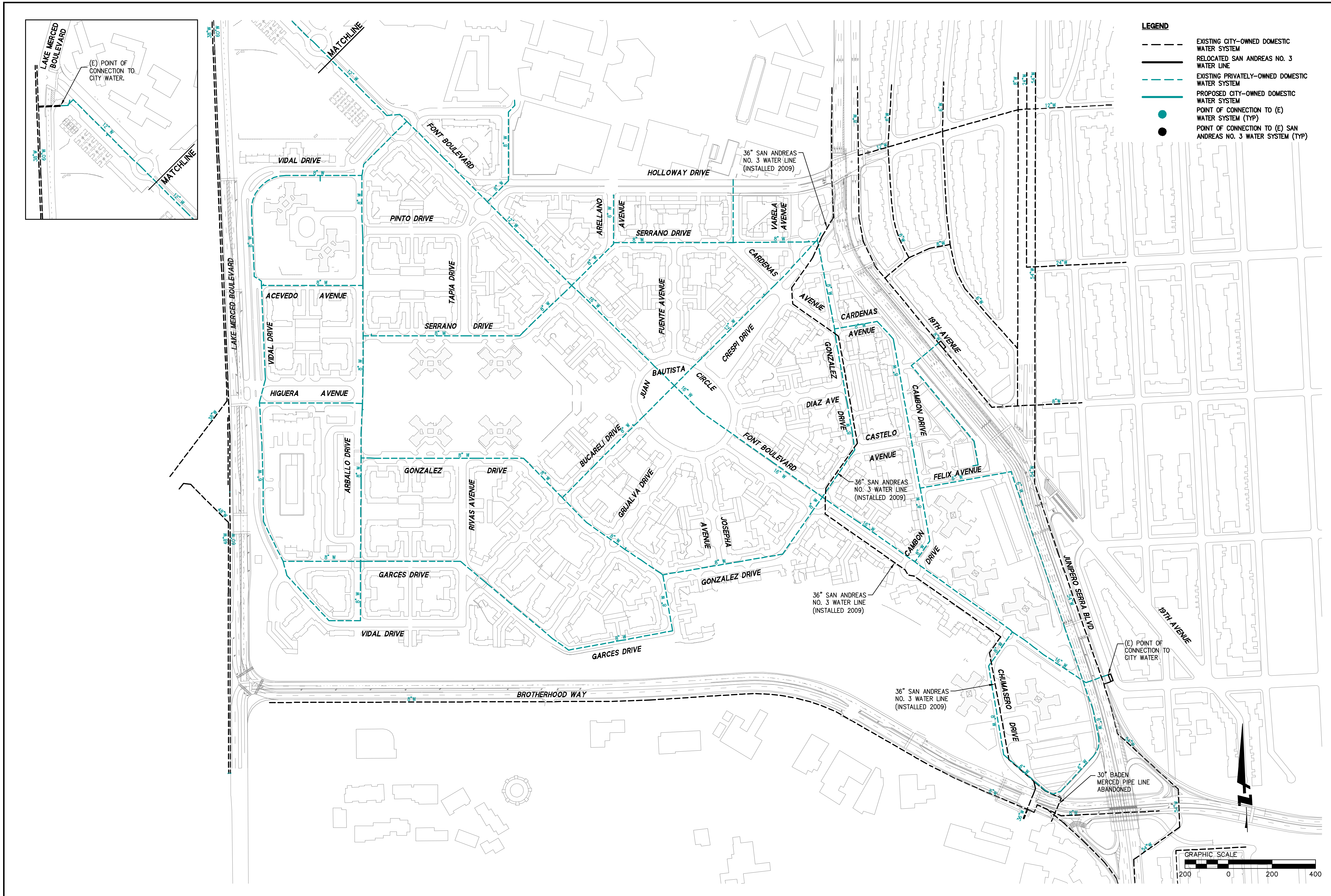

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FIG 4.1

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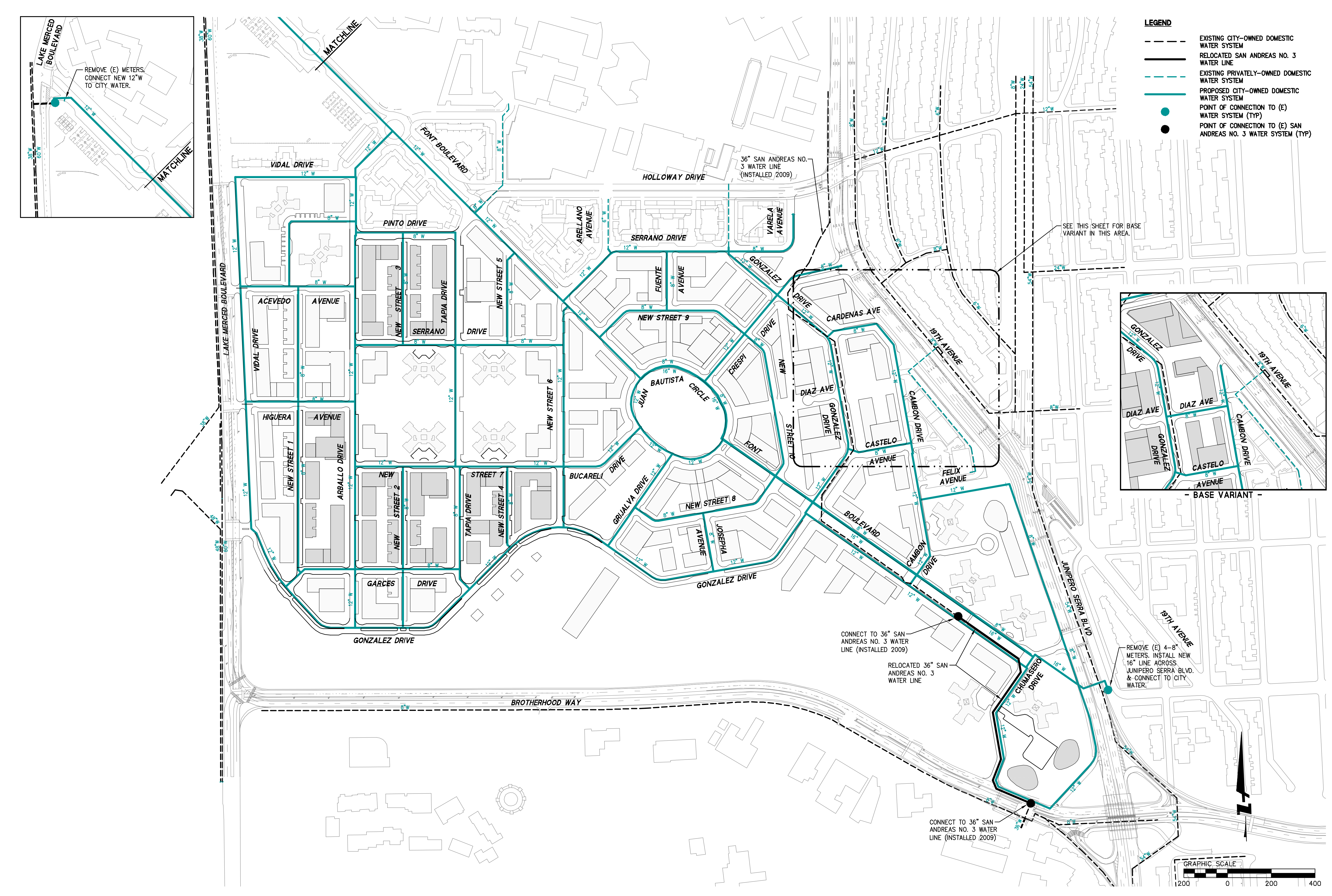

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FIG 4.2

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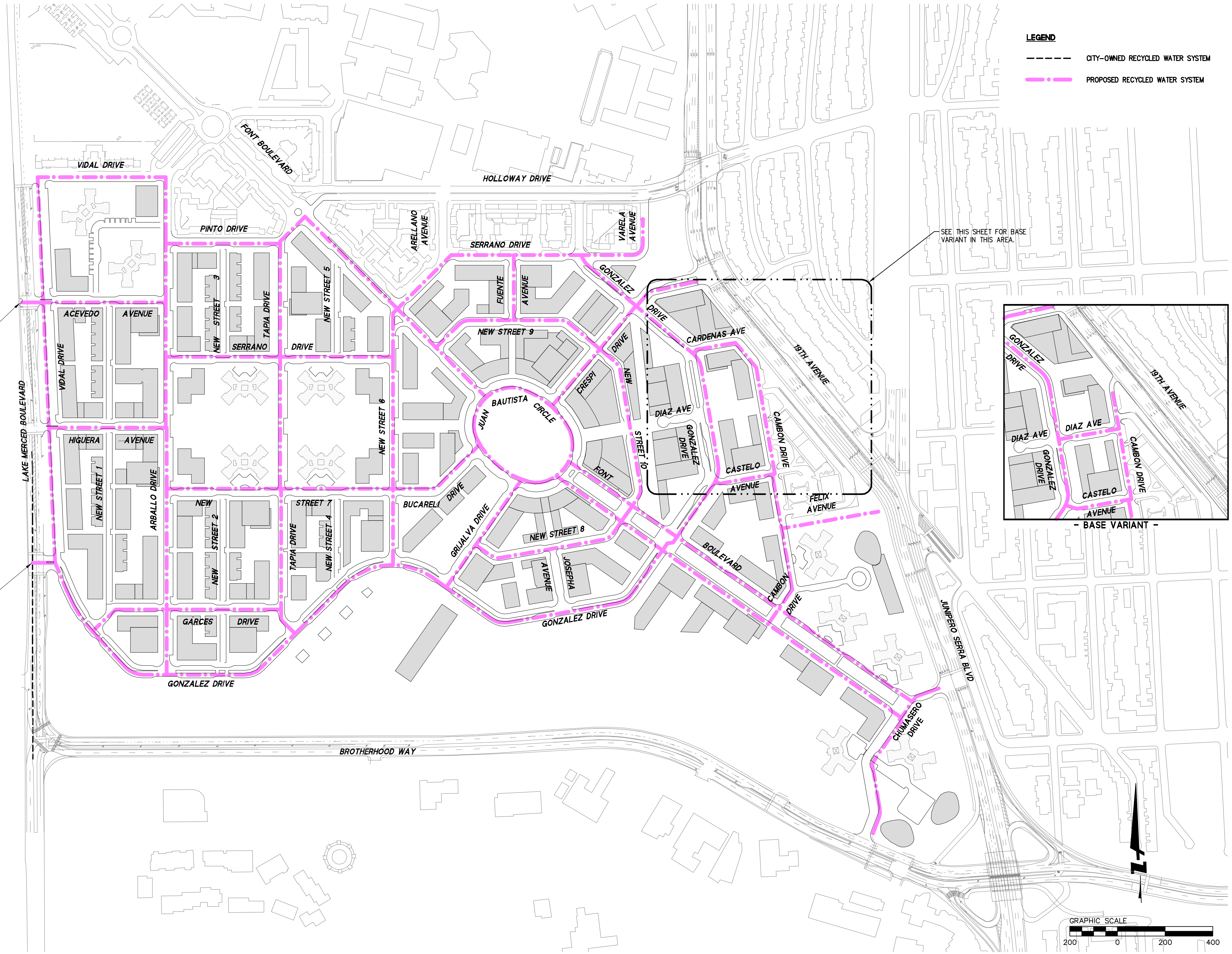

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FIG 4.3

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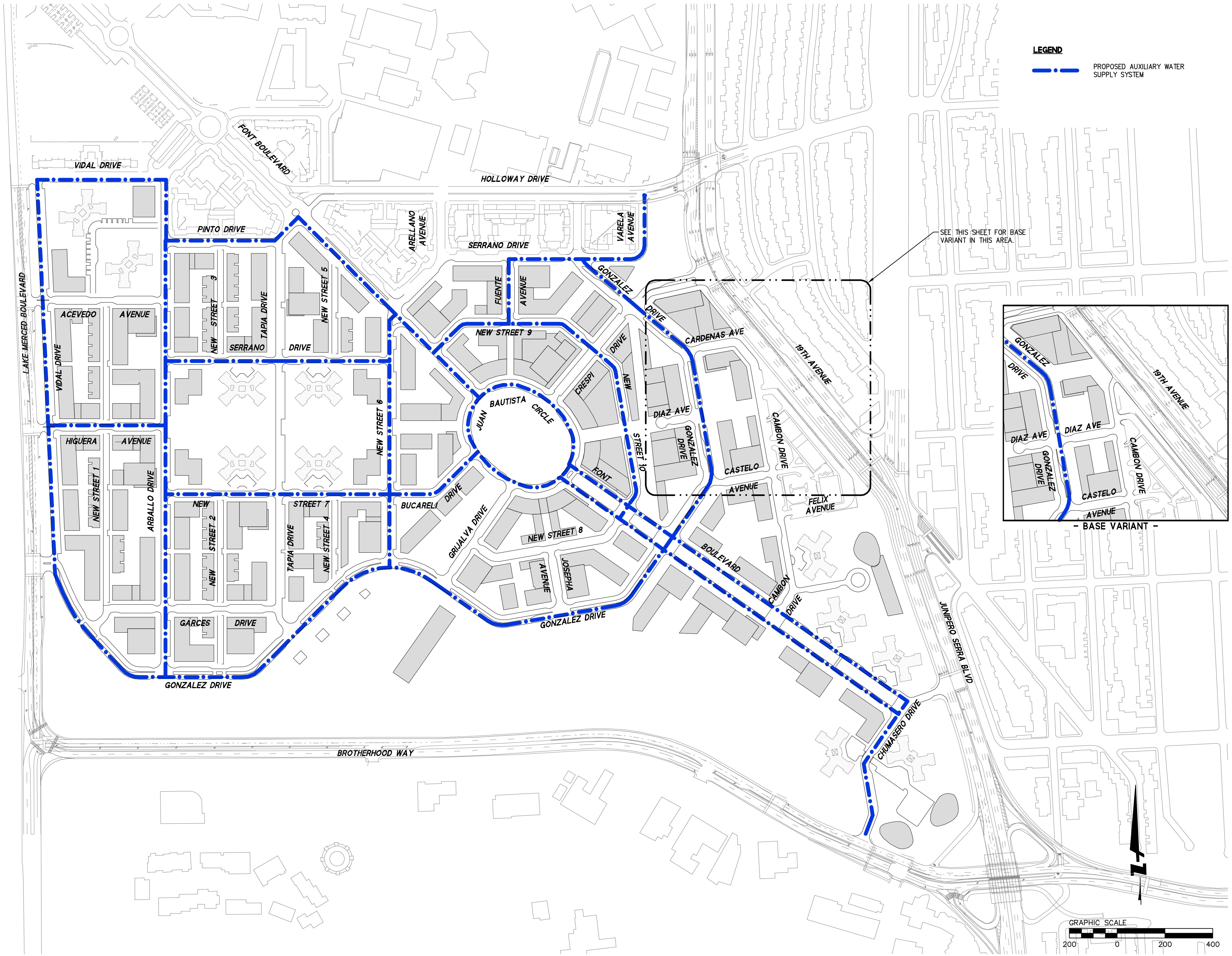

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FIG 4.4

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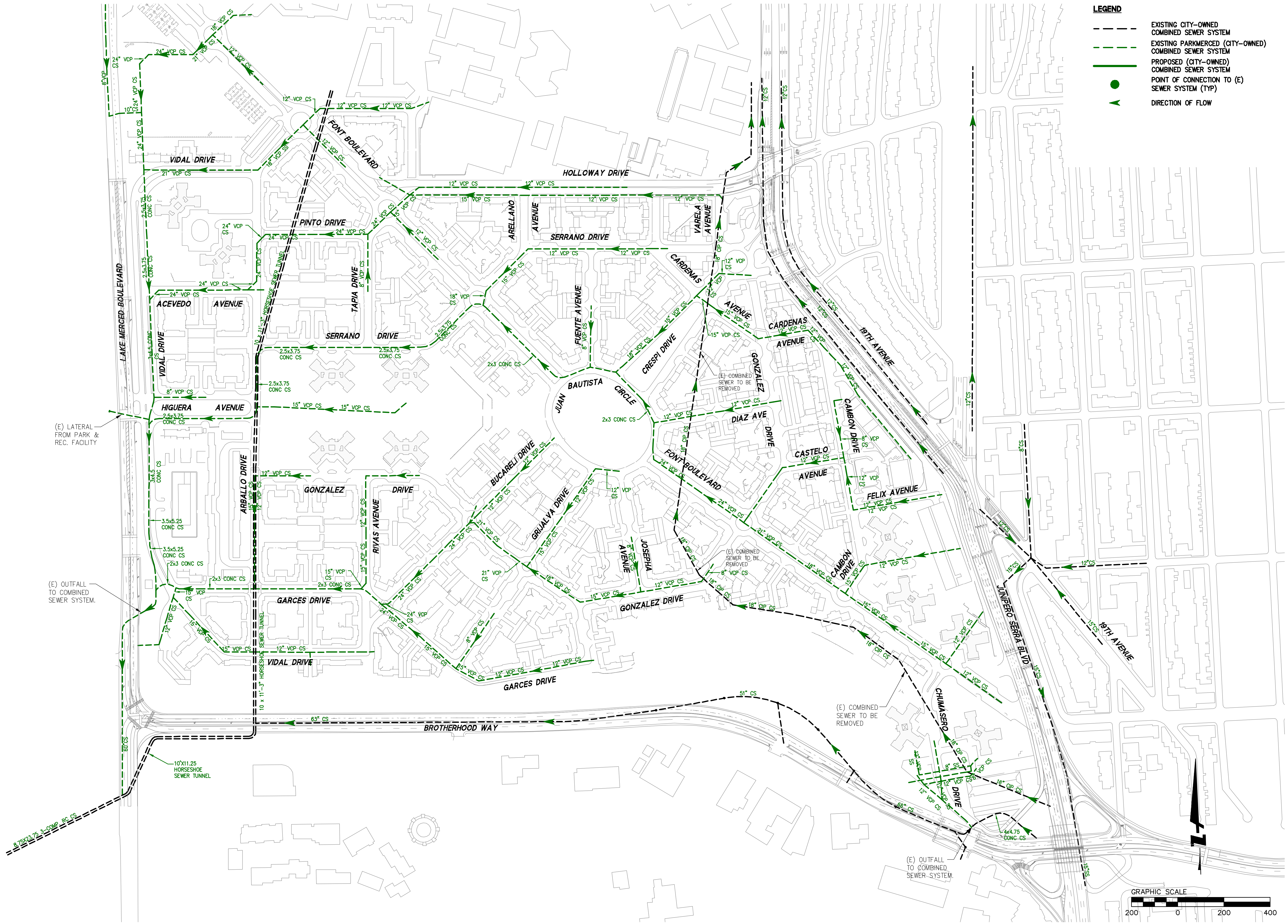

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FIG 5.1

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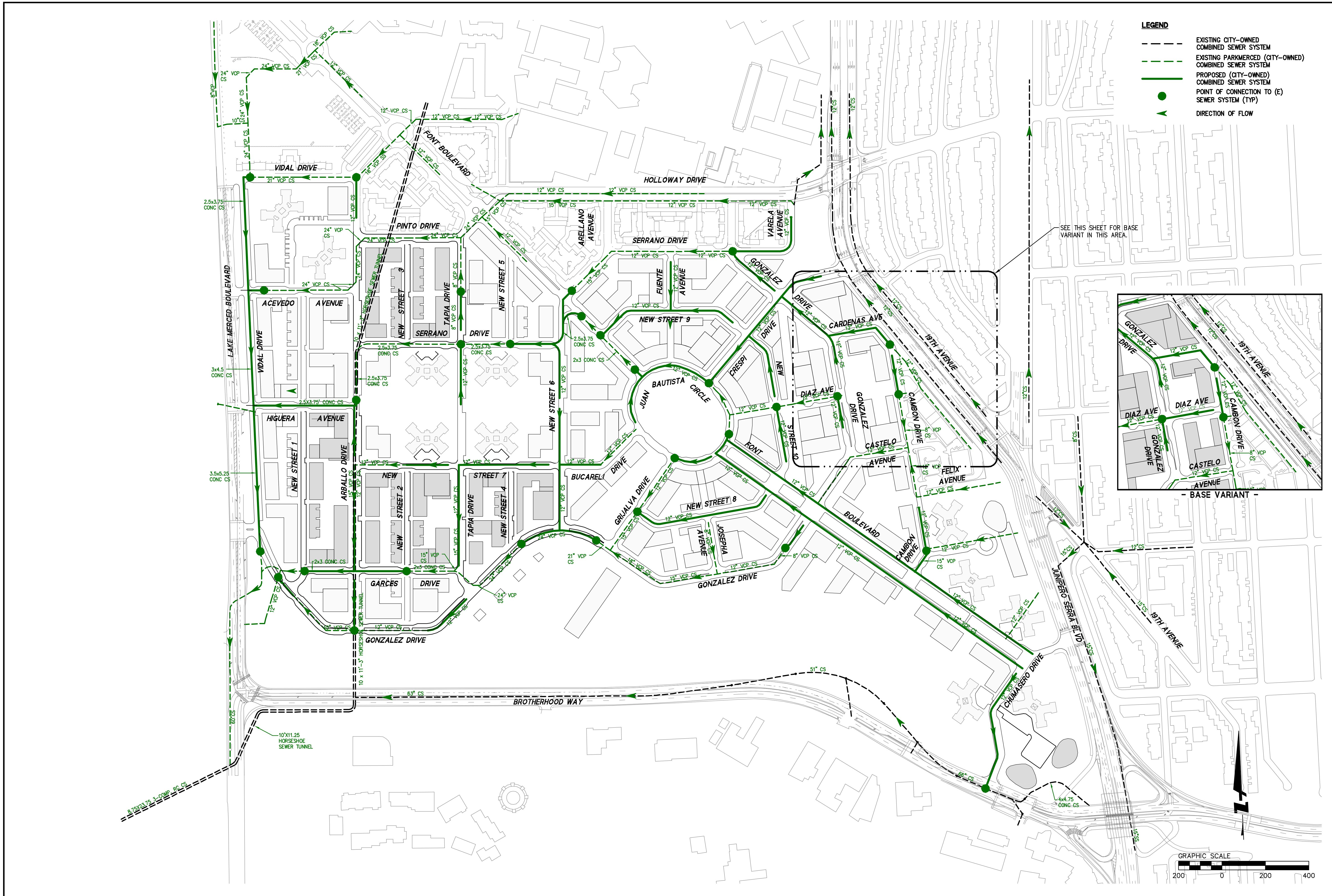

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FIG 5.2

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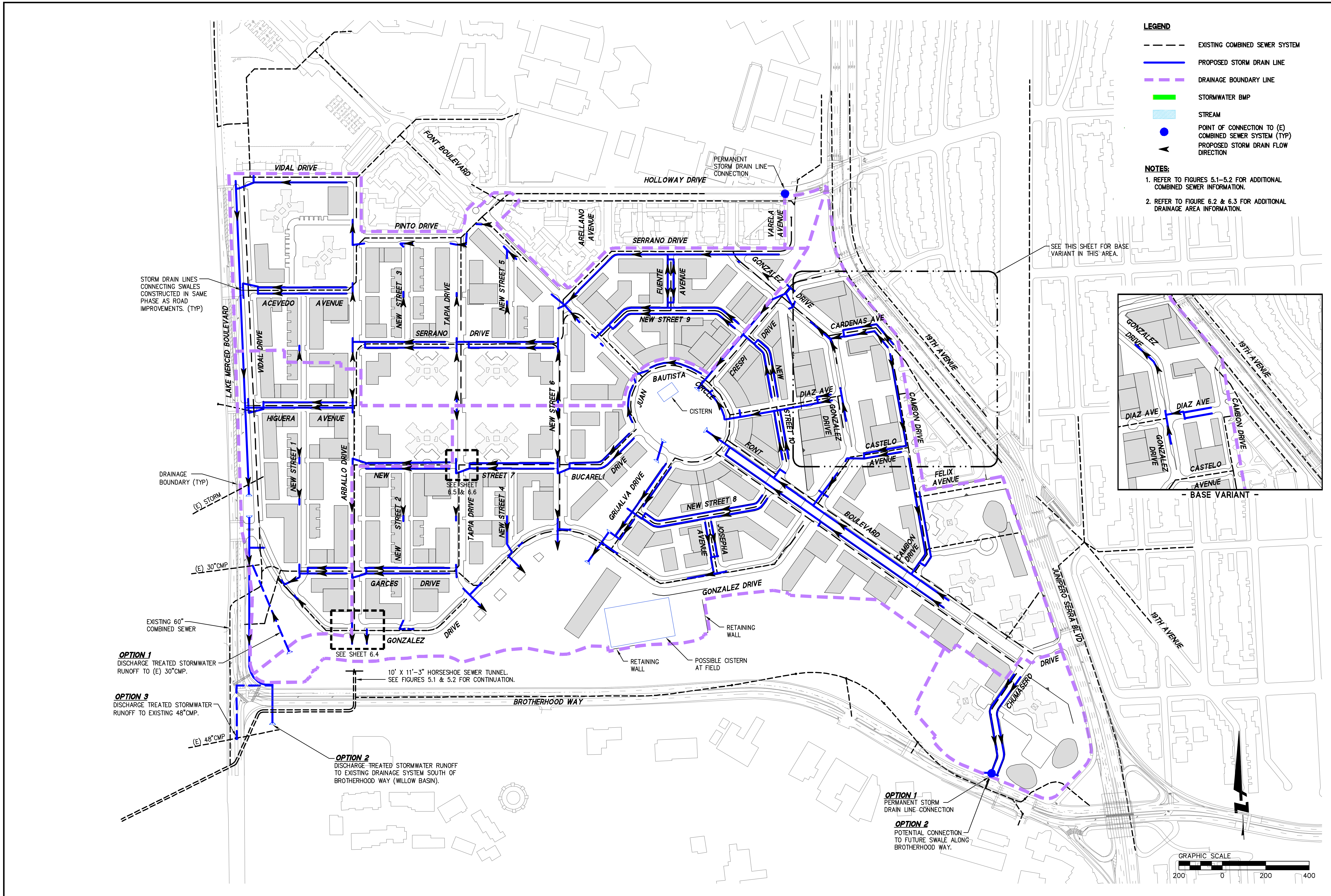

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FIG 6.1

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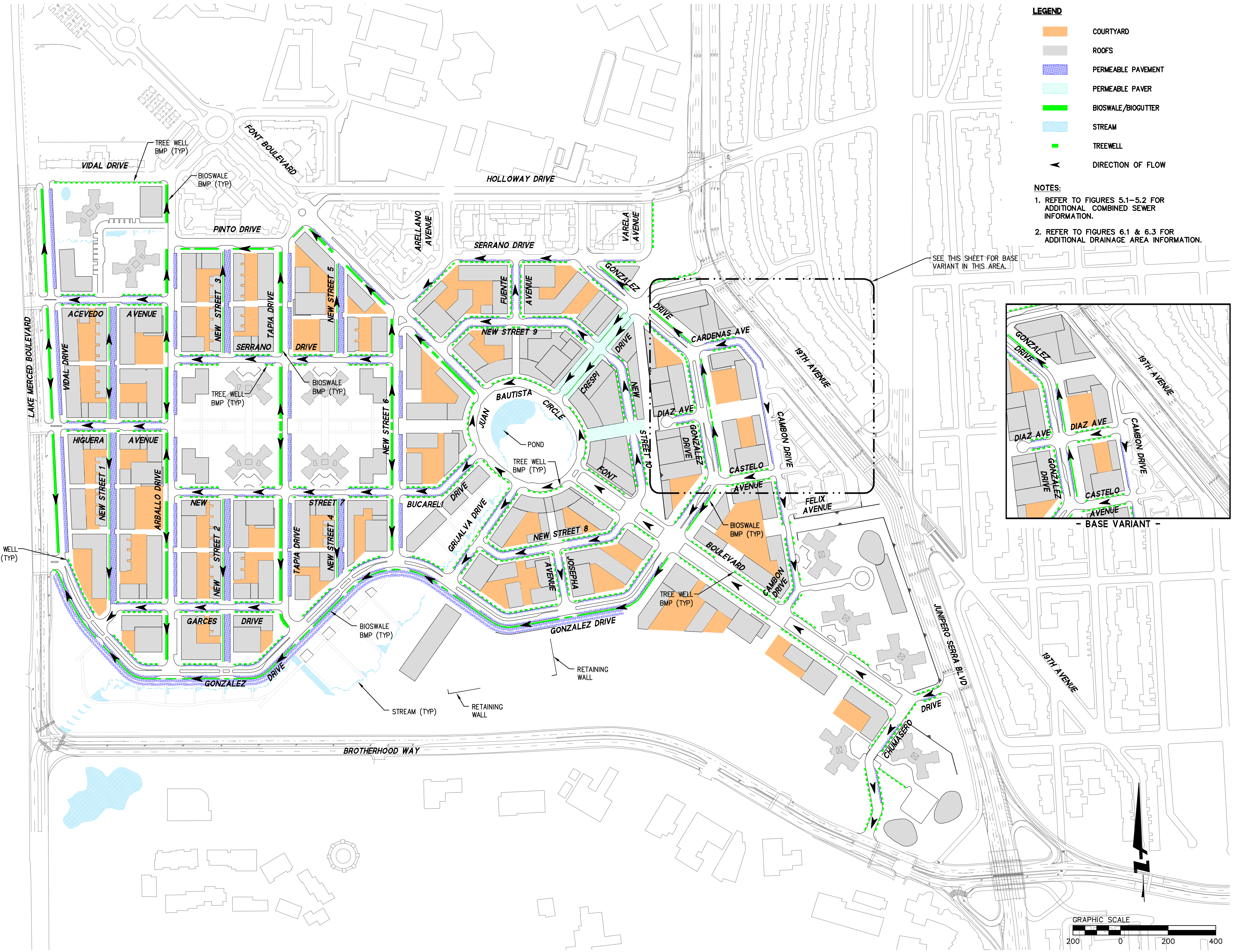

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REDWOOD CITY, CA 94065
650-482-6300
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PARKMERCED INFRASTRUCTURE REPORT
PROPOSED ABOVE-GRADE STORMWATER CONVEYANCE SYSTEM
SAN FRANCISCO COUNTY CALIFORNIA

Revisions

No.

Date: 6/23/11
Scale: 1" = 400'
Design: BS
Drawn: MS
Approved: JO
Job No: 20090086

Drawing Number:
FIG 6.2

DRAWING NAME: J:\Eng09\090086\DWG\Exhibits\Infrastructure Report\IR 6_01 SD.dwg (02)
PLOT TIME: 06-20-11 8:54am PLOTTED BY: heff

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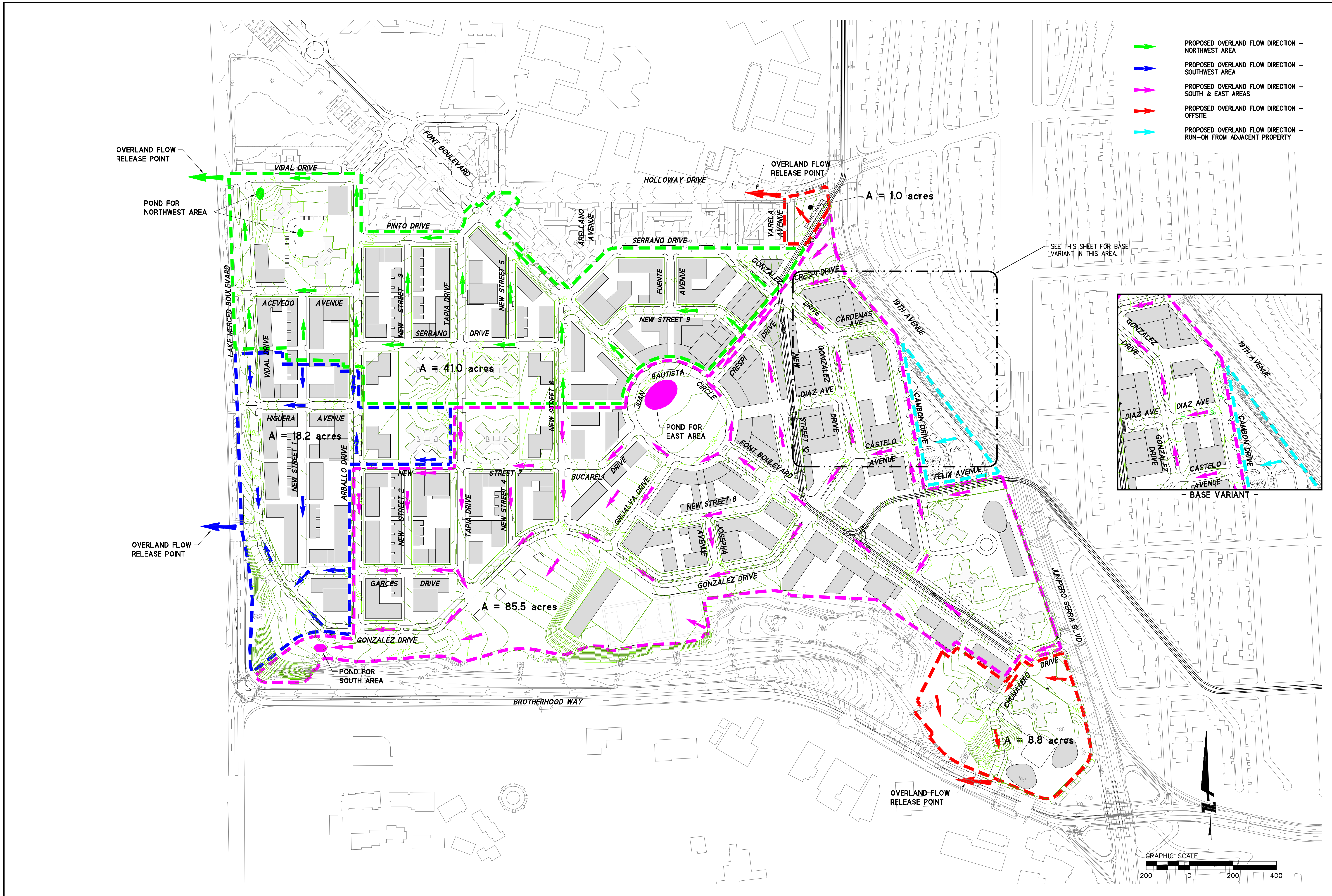

PARKMERCED INFRASTRUCTURE REPORT
PROPOSED OVERLAND FLOW

SAN FRANCISCO COUNTY
SAN FRANCISCO CALIFORNIA

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Date: 6/23/11
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Design: BS
Drawn: MS
Approved: JO
Job No: 20090086

Revisions

Drawing Number:
FIG 6.3

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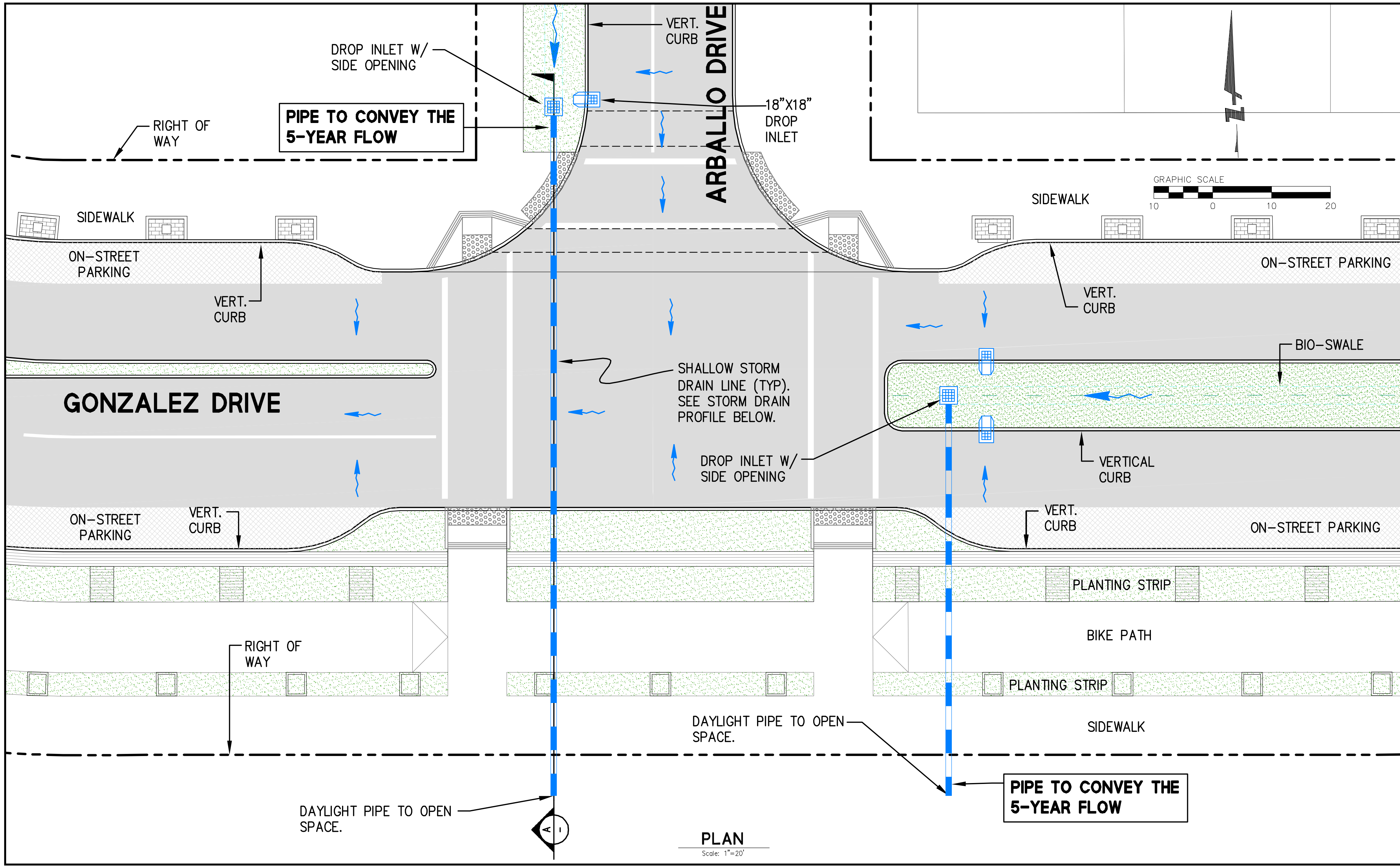
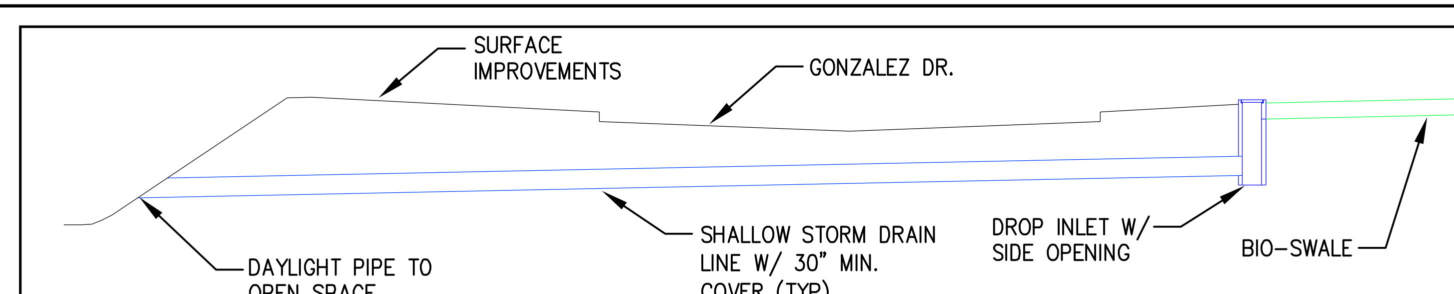
NOTES:

1. STORM DRAIN LINES CROSSING INTERSECTIONS HAVE A MINIMUM COVER OF 30".
2. BIO-SWALES, BIO-GUTTERS, SHALLOW STORMWATER INLETS AND BUBBLE-UP STRUCTURES CONVEY THE 5-YEAR STORM EVENT.
3. FOR STREETS WITH CURBS, 100-YEAR STORM EVENT IS CONTAINED WITHIN THE TOP OF CURBS. FOR STREETS WITHOUT CURBS, 100-YEAR STORM EVENT IS CONTAINED WITHIN AN SFPUC AND DWP APPROVED CONVEYANCE PATHWAY.



PLAN

Scale: 1"=20'



A STORM DRAIN PROFILE

Scale: 1"=20' Hor. 1"=10' Ver.

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PARKMERCED
INFRASTRUCTURE REPORT
INTERSECTION GRADING CONCEPT

SAN FRANCISCO SAN FRANCISCO COUNTY CALIFORNIA

Revisions

No.

Date: 6/23/11
Scale: AS SHOWN
Design: BS
Drawn: MS
Approved: JO
Job No: 20090086

Drawing Number:

FIG 6.4

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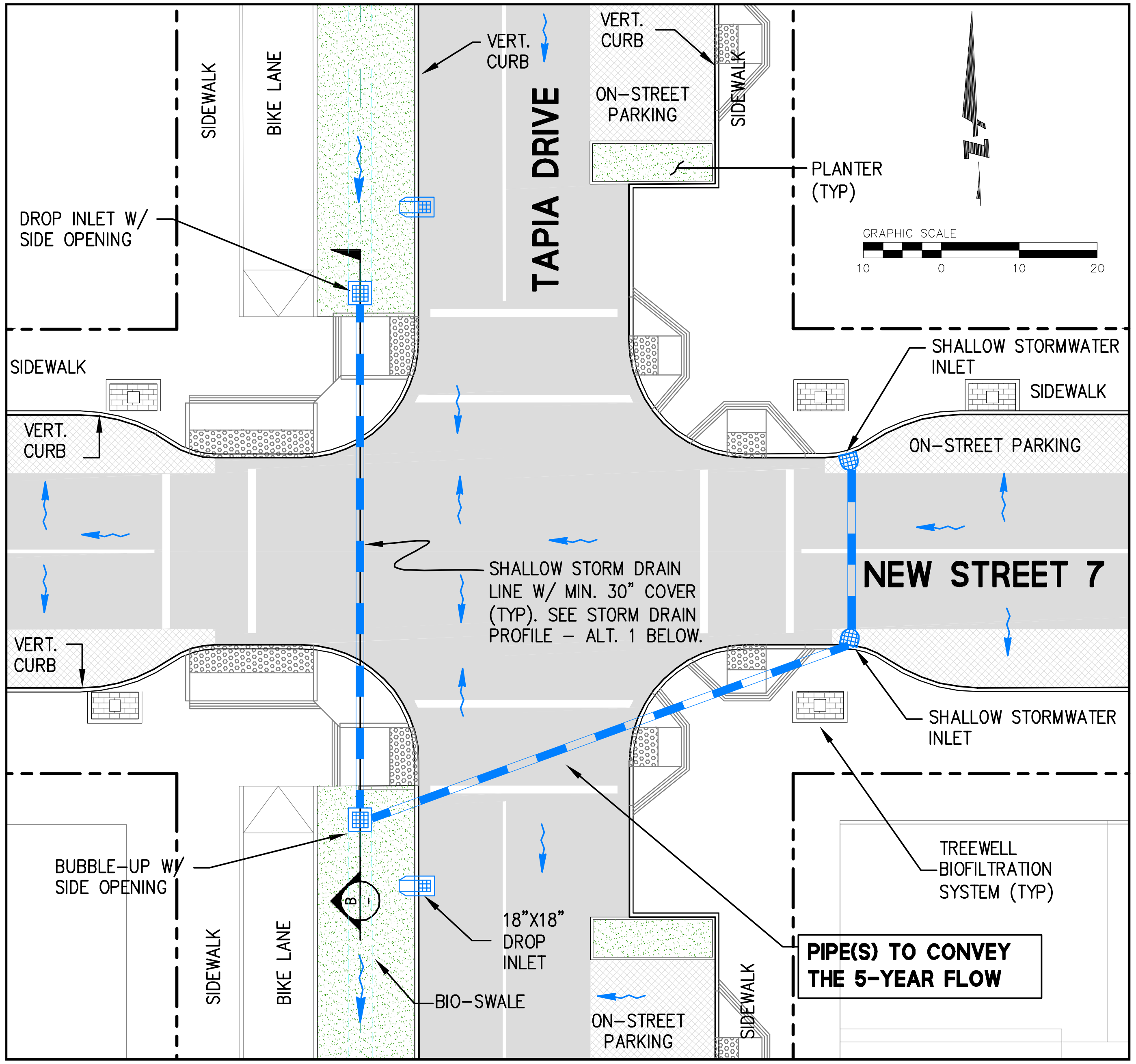
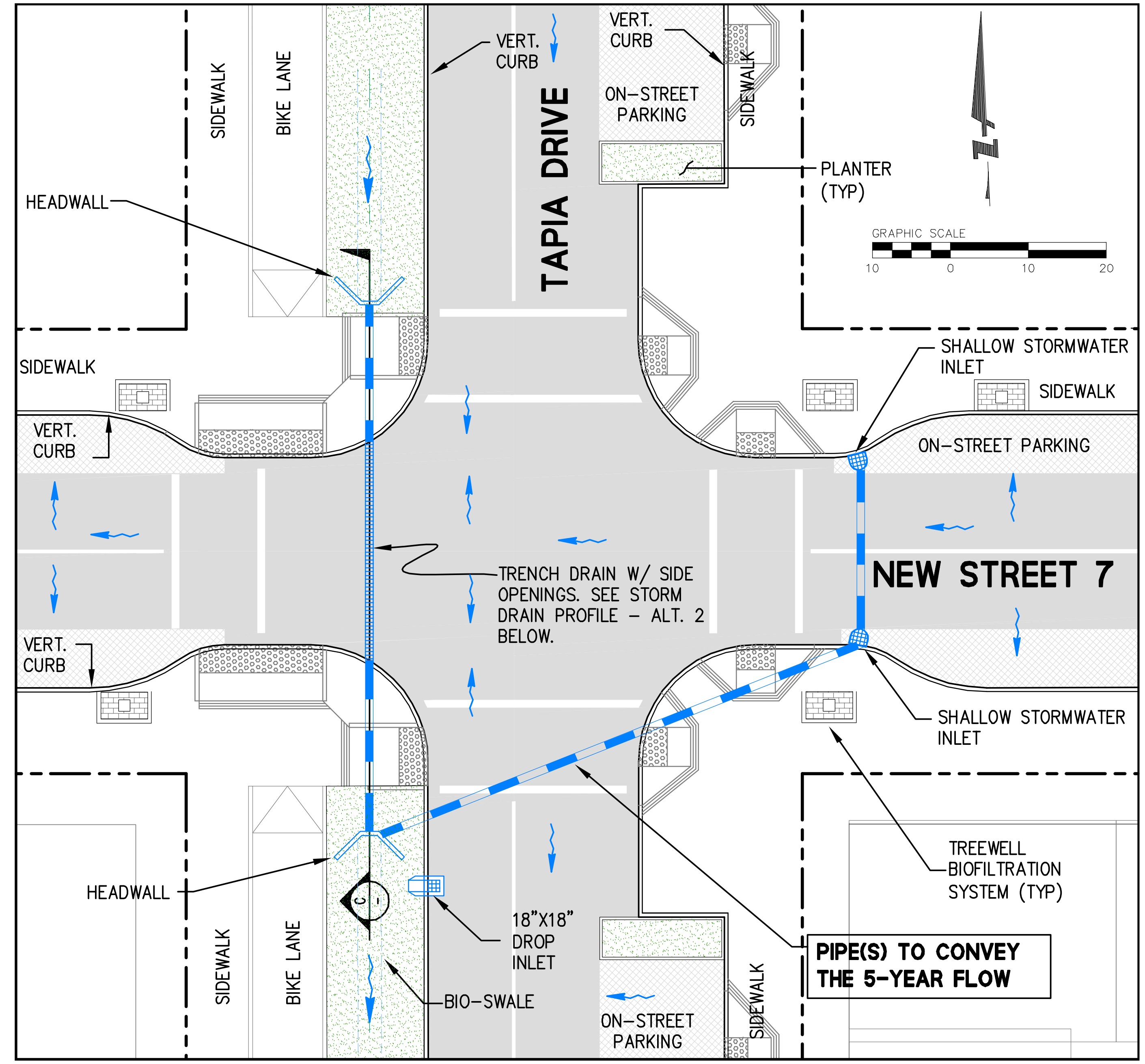
NOTES:

1. STORM DRAIN LINES CROSSING INTERSECTIONS HAVE A MINIMUM COVER OF 30".
2. BIO-SWALES, BIO-GUTTERS, SHALLOW STORMWATER INLETS AND BUBBLE-UP STRUCTURES CONVEY THE 5-YEAR STORM EVENT.
3. FOR STREETS WITH CURBS, 100-YEAR STORM EVENT IS CONTAINED WITHIN THE TOP OF CURBS. FOR STREETS WITHOUT CURBS, 100-YEAR STORM EVENT IS CONTAINED WITHIN AN SFPUC AND DWP APPROVED CONVEYANCE PATHWAY.



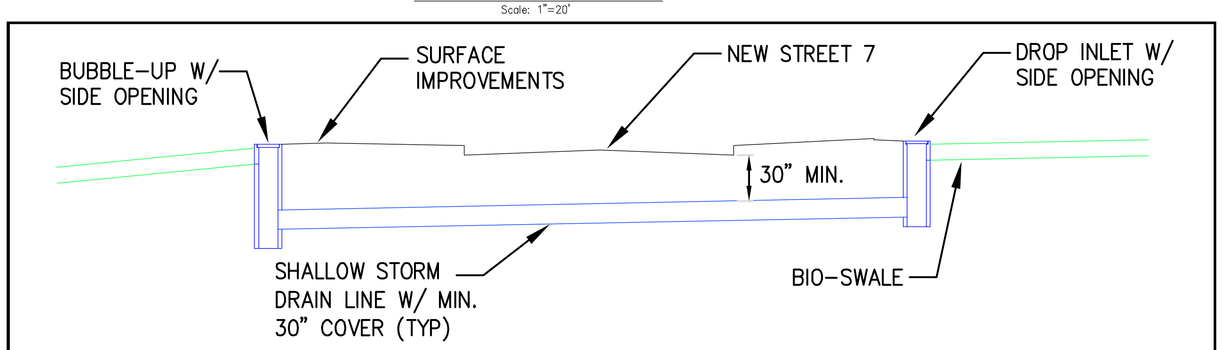
PLAN – ALT. 1

Scale: 1"=20'



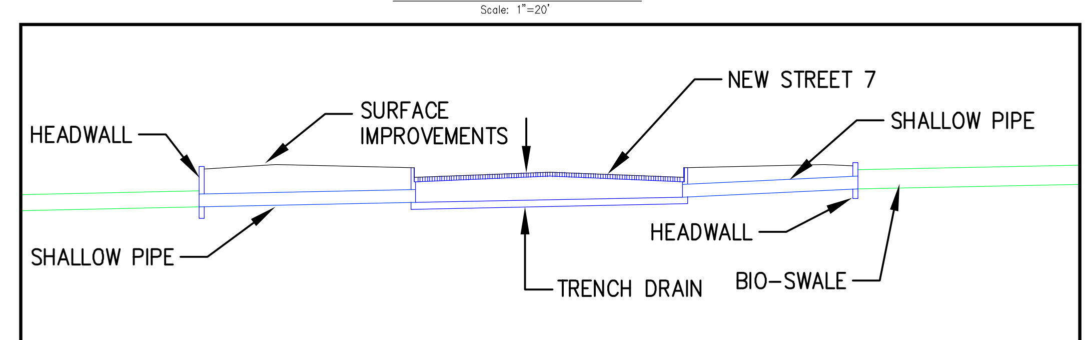
PLAN – ALT. 2

Scale: 1"=20'



STORM DRAIN PROFILE – ALT. 1

Scale: 1"=20' Hor. 1"=10' Ver.



STORM DRAIN PROFILE – ALT. 2

Scale: 1"=20' Hor. 1"=10' Ver.

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INFRASTRUCTURE REPORT
INTERSECTION GRADING CONCEPT

SAN FRANCISCO SAN FRANCISCO COUNTY CALIFORNIA

Revisions

No.

Date: 6/23/11
Scale: AS SHOWN
Design: BS
Drawn: MS
Approved: JO
Job No: 20090086

Drawing Number:

FIG 6.5

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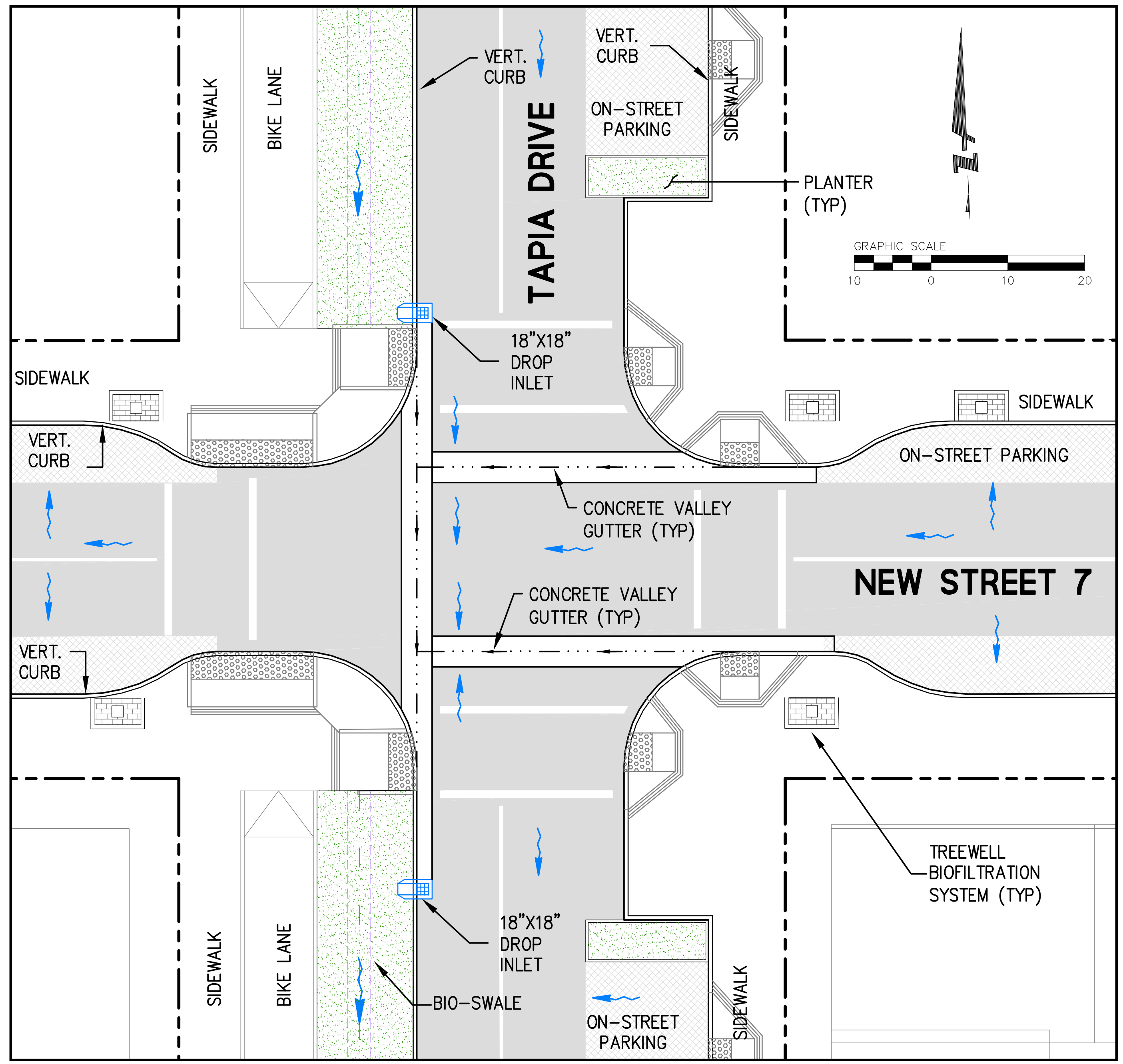
NOTES:

1. STORM DRAIN LINES CROSSING INTERSECTIONS HAVE A MINIMUM COVER OF 30".
2. BIO-SWALES, BIO-GUTTERS, SHALLOW STORMWATER INLETS AND BUBBLE-UP STRUCTURES CONVEY THE 5-YEAR STORM EVENT.
3. FOR STREETS WITH CURBS, 100-YEAR STORM EVENT IS CONTAINED WITHIN THE TOP OF CURBS. FOR STREETS WITHOUT CURBS, 100-YEAR STORM EVENT IS CONTAINED WITHIN AN SFPUC AND DWP APPROVED CONVEYANCE PATHWAY.



PLAN - ALT. 3

Scale: 1"=20'

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SUITE 200
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Revisions

No.

Date: 6/23/11
Scale: AS SHOWN
Design: BS
Drawn: MS
Approved: JO
Job No: 20090086

Drawing Number:

FIG 6.6

DRAWING NAME: J:\Eng09\090086\DWG\Exhibits\Infrastructure Report\IR 6_04 SD.dwg (03)
PLOT TIME: 06-20-11 9:00am PLOTTED BY: heff

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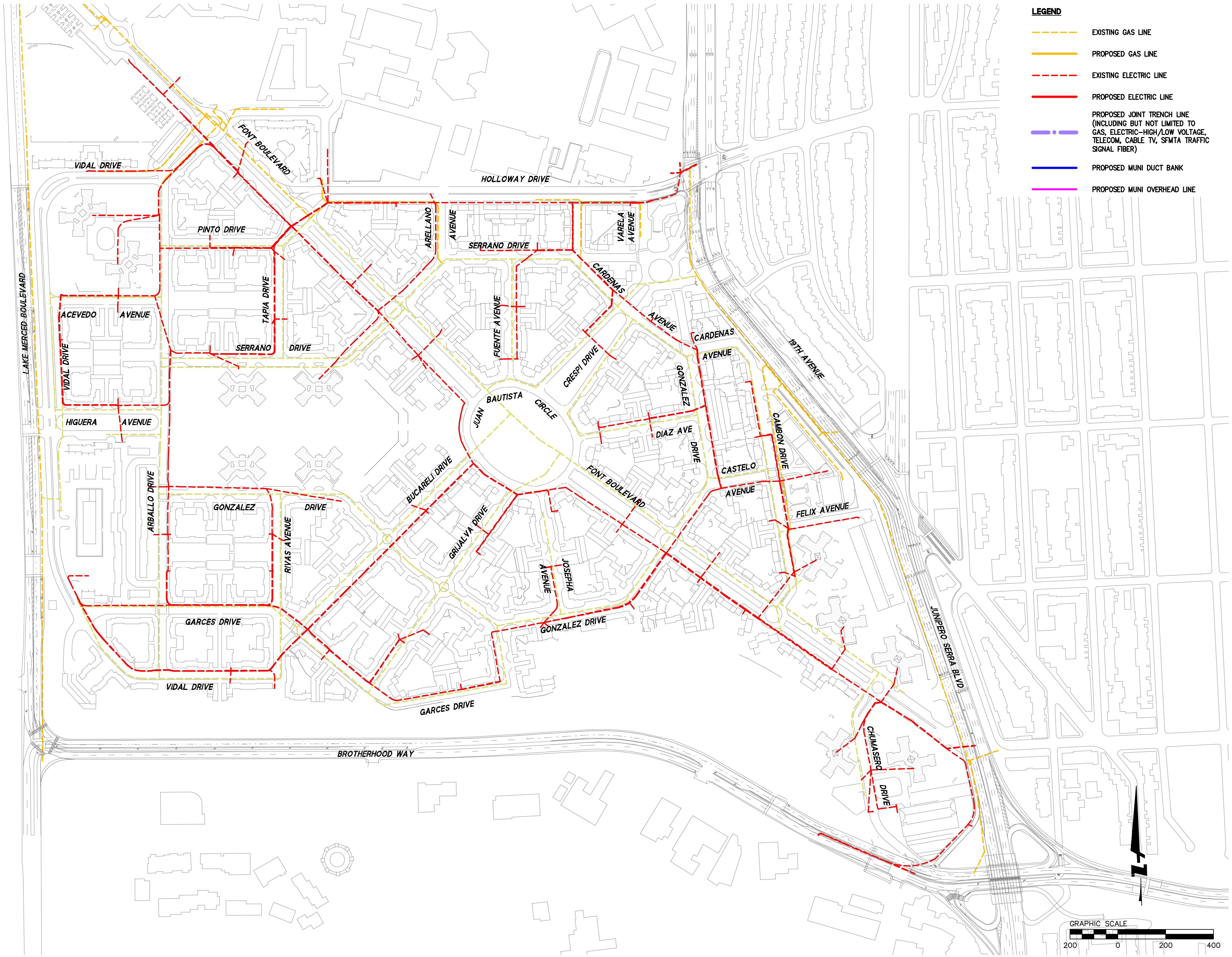

255 SHORELINE DR
SUITE 200
REDWOOD CITY, CA 94065
650-482-6300
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PARKMERCED INFRASTRUCTURE REPORT
EXISTING DRY UTILITY SYSTEM

SAN FRANCISCO COUNTY
SAN FRANCISCO CALIFORNIA

Revisions
No.

Date: 6/23/11
Scale: 1" = 400'
Design: BS
Drawn: MS
Approved: JO
Job No: 20090086

Drawing Number:
FIG 7.1

DRAWING NAME: J:\Eng09\090086\DWG\Exhibits\Infrastructure Report\IR 7_01 JT.dwg (01)
PLOT TIME: 06-20-11 9:02am PLOTTED BY: hleff

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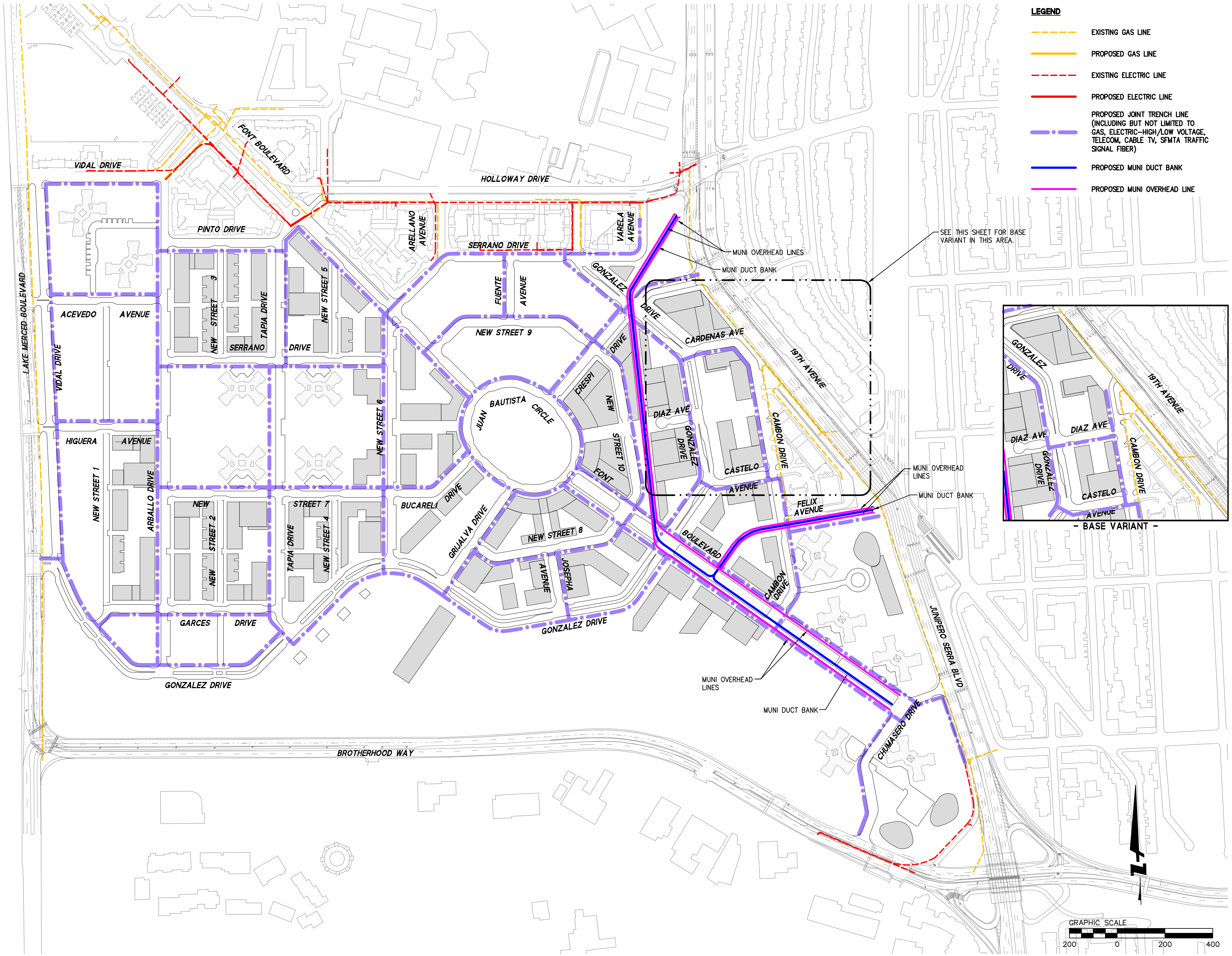

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SUITE 200
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INFRASTRUCTURE REPORT
PROPOSED DRY UTILITY SYSTEM

SAN FRANCISCO SAN FRANCISCO COUNTY CALIFORNIA

No.	Revisions

Date: 6/23/11
Scale: 1" = 400'
Design: BS
Drawn: MS
Approved: JO
Job No: 20090086

Drawing Number:

FIG 7.2

DRAWING NAME: J:\Eng09\090086\DWG\Exhibits\Infrastructure Report\IR 7_01 JT.dwg (02)
PLOT TIME: 06-20-11 9:01am PLOTTED BY: heff

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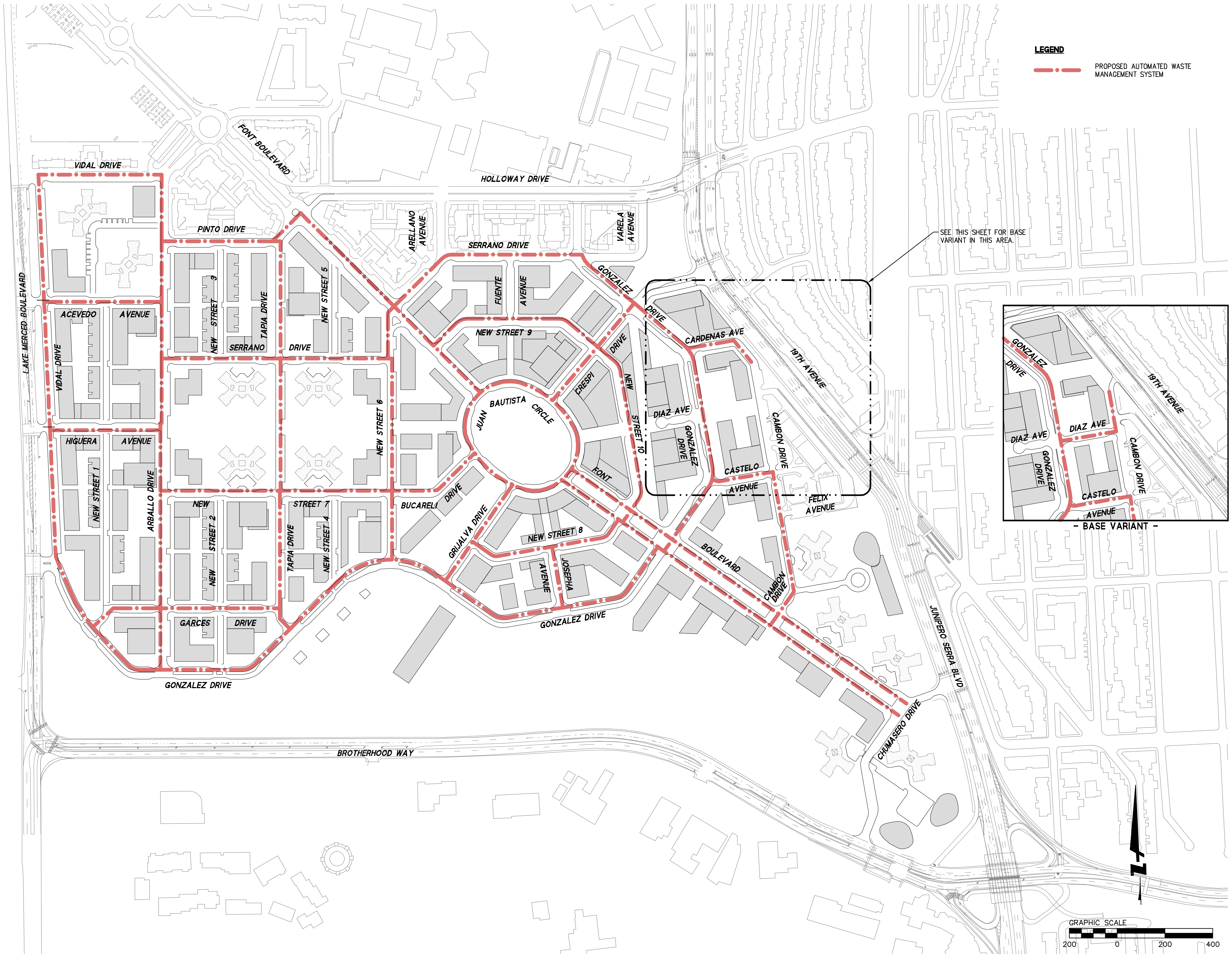

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PARKMERCED INFRASTRUCTURE REPORT
PROPOSED AUTOMATED WASTE MANAGEMENT SYSTEM

SAN FRANCISCO CALIFORNIA
SAN FRANCISCO COUNTY

No.	Revisions

Date: 6/23/11
Scale: 1" = 400'
Design: BS
Drawn: MS
Approved: JO
Job No: 20090086

Drawing Number:
FIG 8.1

DRAWING NAME: J:\Eng09\090086\DWG\Exhibits\Infrastructure Report\IR 8_01 AWMS.dwg (01)
PLOT TIME: 06-20-11 9:03am PLOTTED BY: heff

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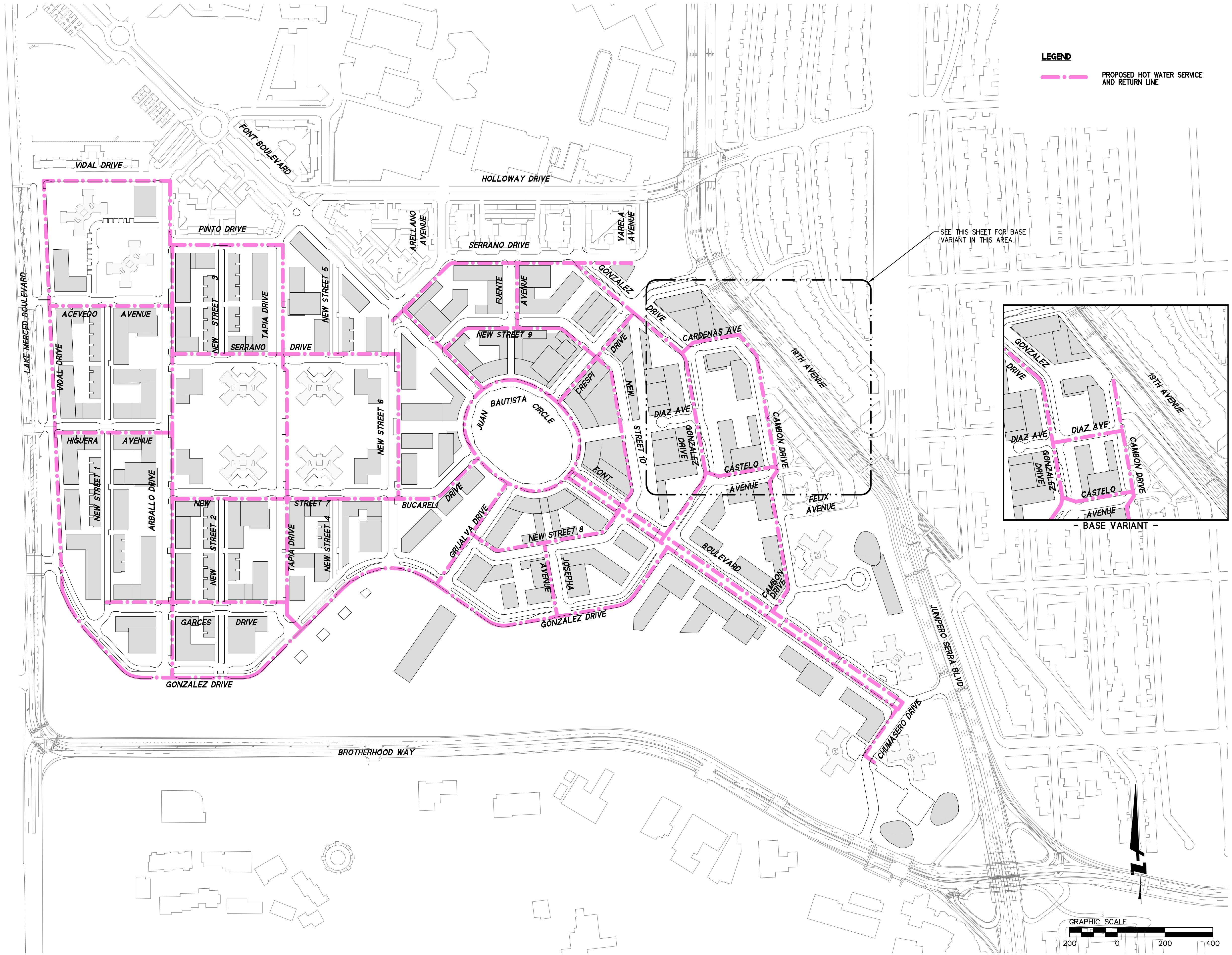

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PARKMERCED
INFRASTRUCTURE REPORT
PROPOSED CO-GEN SITE PIPING

SAN FRANCISCO — SAN FRANCISCO COUNTY — CALIFORNIA

No.	Revisions

Date: 6/23/11
Scale: 1" = 400'
Design: BS
Drawn: MS
Approved: JO
Job No: 20090086

Drawing Number:

FIG 8.2

DRAWING NAME: J:\Eng09\090086\DWG\Exhibits\Infrastructure Report\IR 8_02 COGN.dwg (D1)
PLOT TIME: 06-21-11 1:32pm PLOTTED BY: heff

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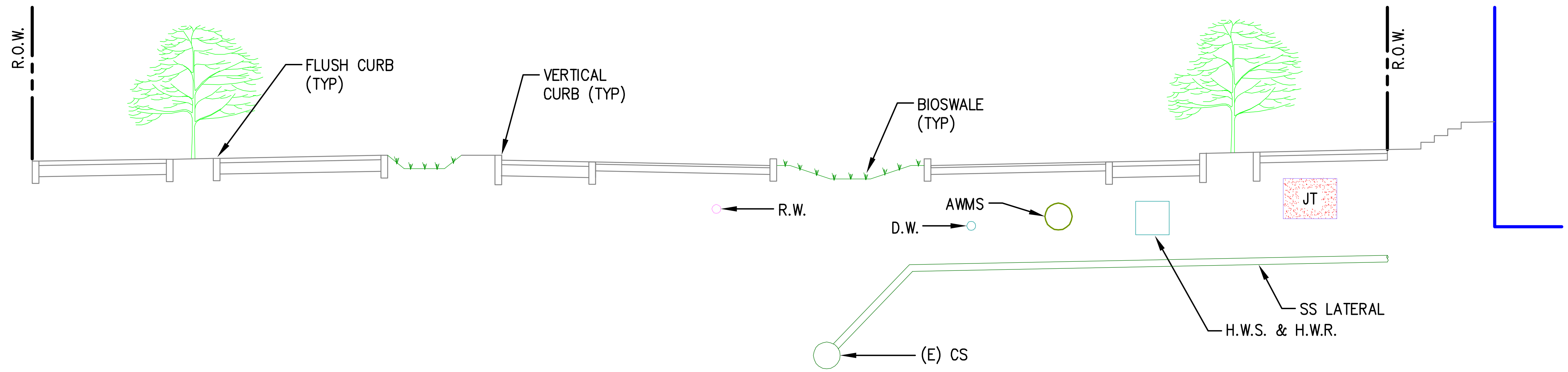
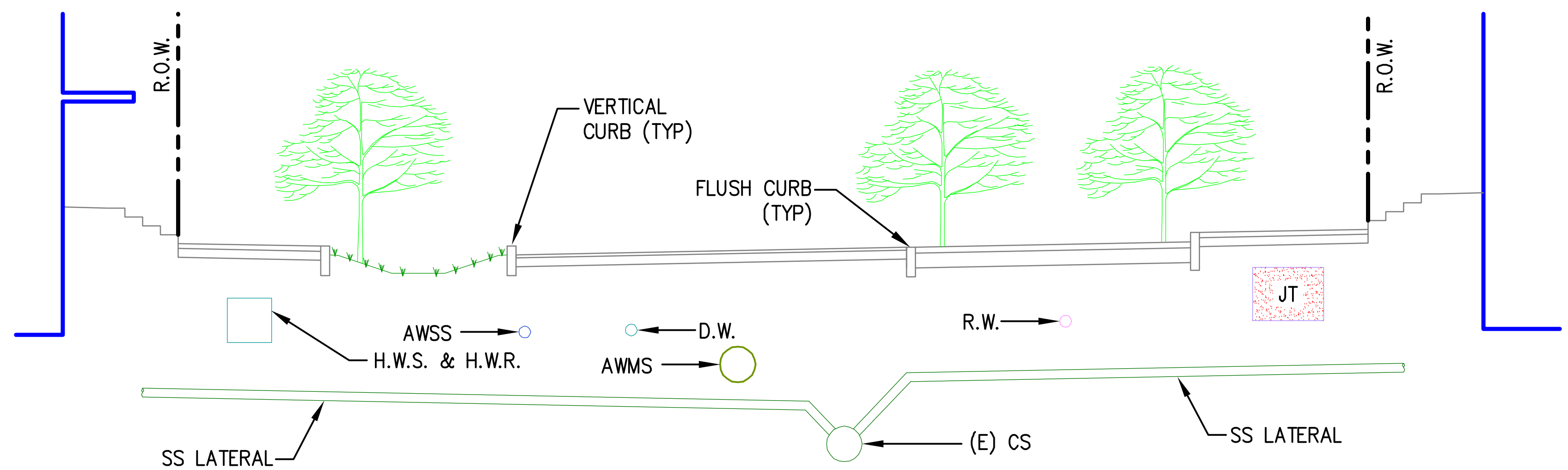
ABBREVIATIONS

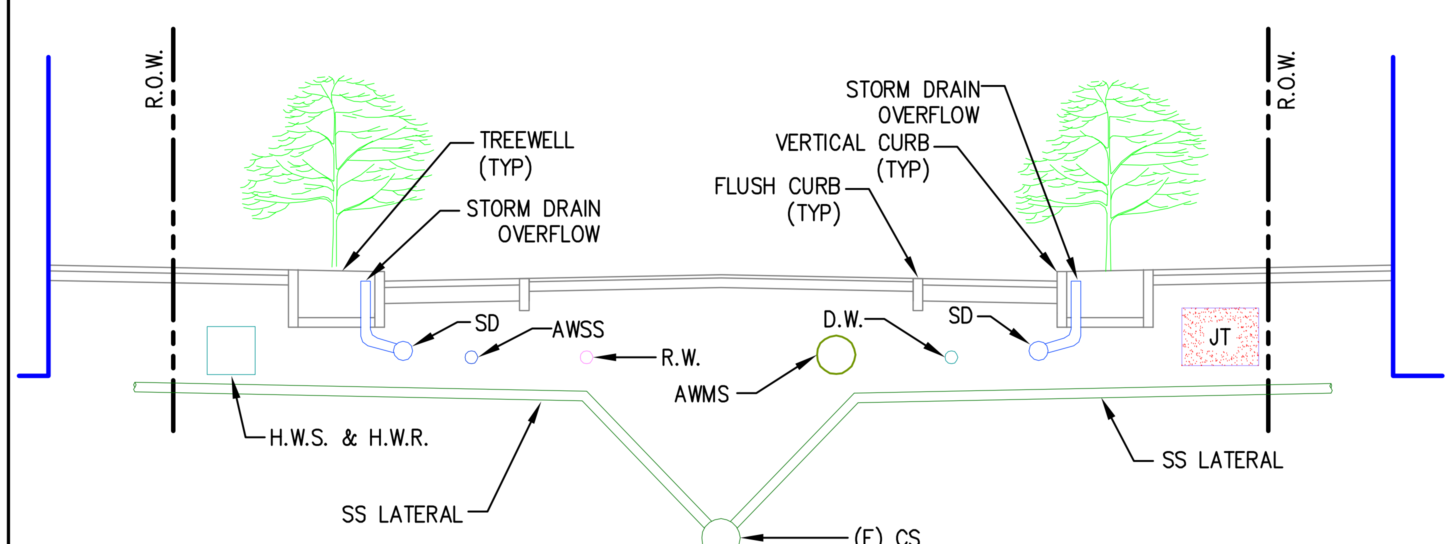
SYMBOL	DESCRIPTION
AWMS	AUTOMATED WASTE MANAGEMENT SYSTEM
AWSS	AUXILIARY WATER SUPPLY SYSTEM
CS	COMBINED SEWER
D.W.	DOMESTIC WATER
G	GAS
H.W.R.	HOT WATER RETURN
H.W.S.	HOT WATER SERVICE
JT	JOINT TRENCH
R.O.W.	RIGHT-OF-WAY
R.W.	RECYCLED WATER
SL	STREET LIGHTING
SS	SANITARY SEWER
SD	STORM DRAIN



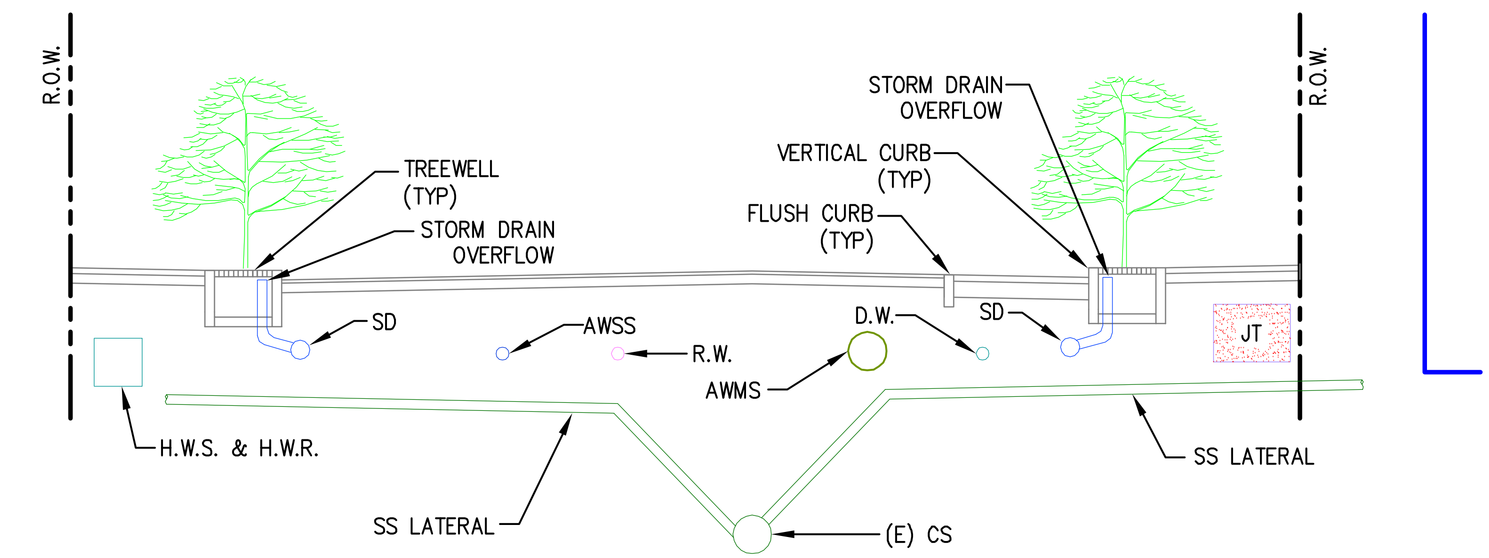
Street Type 1
- Gonzales Dr. -



Street Type 2
- Hedgerow St. -



Street Type 3
- East West St. -



Street Type 3 - Modified
- Chumasero Dr.-

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INFRASTRUCTURE REPORT
TYPICAL STREET UTILITY CROSS SECTIONS
SAN FRANCISCO SAN FRANCISCO COUNTY CALIFORNIA

Revisions
No.

Date: 6/23/11
Scale: 1" = 10'
Design: BS
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Approved: JO
Job No: 20090086

Drawing Number:
FIG 8.3

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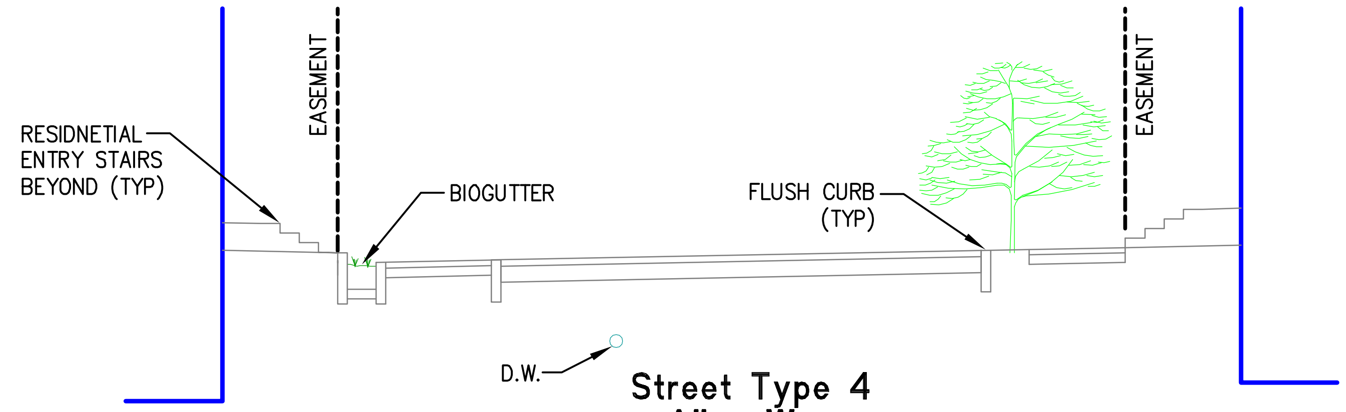
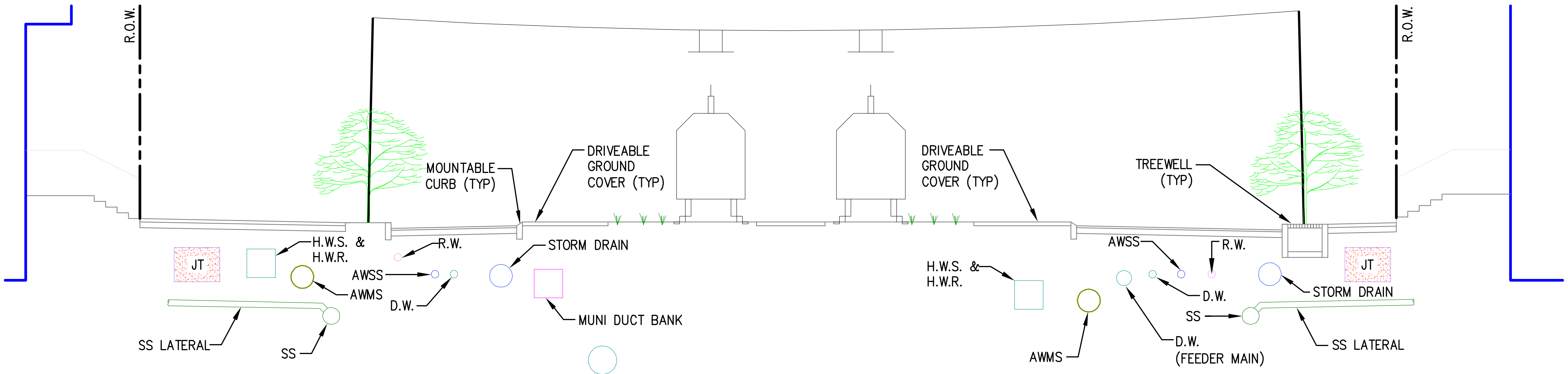
ABBREVIATIONS

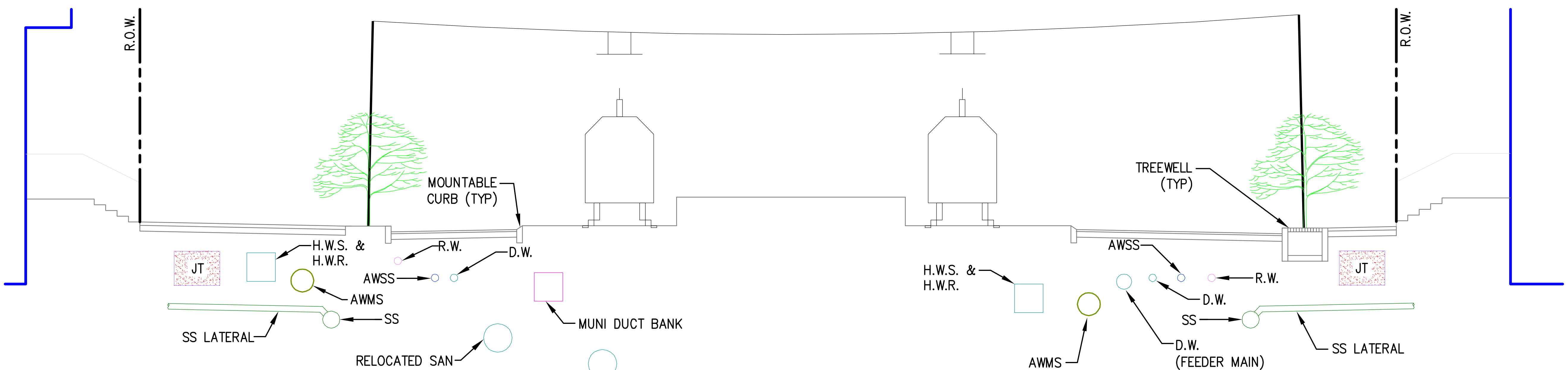
SYMBOL	DESCRIPTION
AWMS	AUTOMATED WASTE MANAGEMENT SYSTEM
AWSS	AUXILIARY WATER SUPPLY SYSTEM
CS	COMBINED SEWER
D.W.	DOMESTIC WATER
G	GAS
H.W.R.	HOT WATER RETURN
H.W.S.	HOT WATER SERVICE
JT	JOINT TRENCH
R.O.W.	RIGHT-OF-WAY
R.W.	RECYCLED WATER
SL	STREET LIGHTING
SS	SANITARY SEWER
SD	STORM DRAIN



Street Type 4
- Alley Way -



Street Type 5
- Font Blvd. South-



Street Type 5 W/ PLATFORM
- Font Blvd. South-

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INFRASTRUCTURE REPORT
TYPICAL STREET UTILITY CROSS SECTIONS
SAN FRANCISCO SAN FRANCISCO COUNTY CALIFORNIA

Revisions | No.

Date: 6/23/11
Scale: 1" = 10'
Design: BS
Drawn: MS
Approved: JO
Job No: 20090086

Drawing Number:
FIG 8.4

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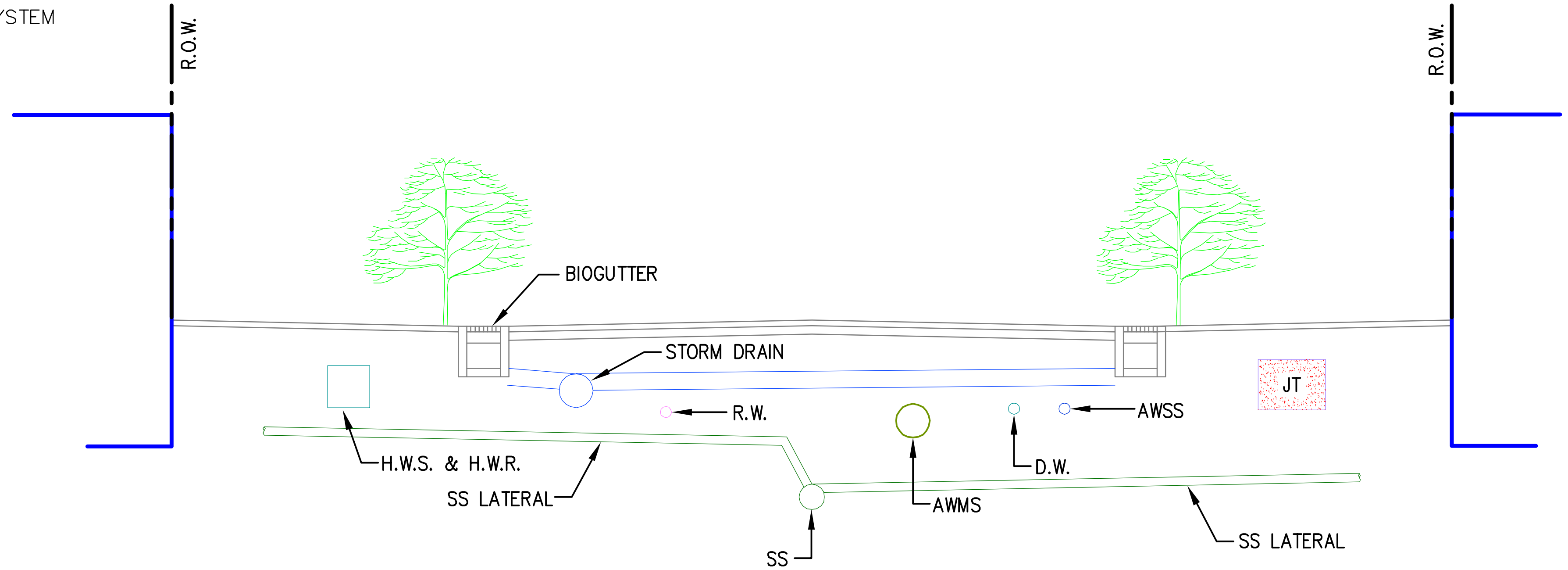
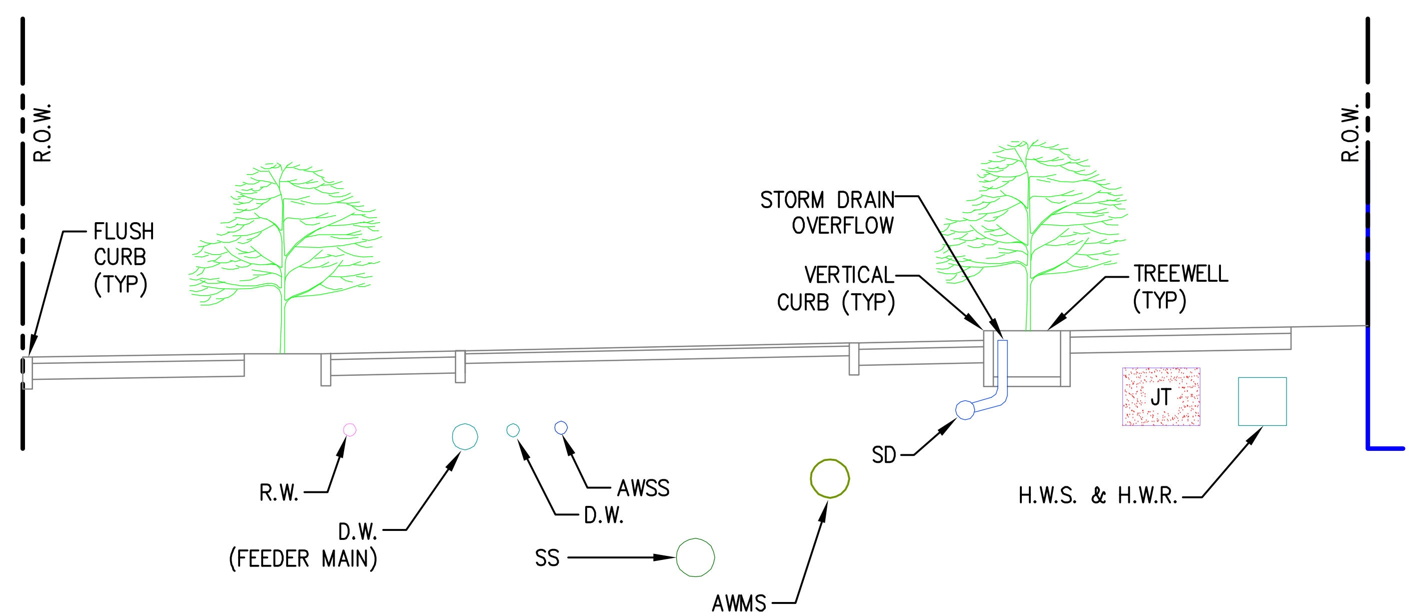
ABBREVIATIONS

SYMBOL	DESCRIPTION
AWMS	AUTOMATED WASTE MANAGEMENT SYSTEM
AWSS	AUXILIARY WATER SUPPLY SYSTEM
CS	COMBINED SEWER
D.W.	DOMESTIC WATER
G	GAS
H.W.R.	HOT WATER RETURN
H.W.S.	HOT WATER SERVICE
JT	JOINT TRENCH
R.O.W.	RIGHT-OF-WAY
R.W.	RECYCLED WATER
SL	STREET LIGHTING
SS	SANITARY SEWER
SD	STORM DRAIN



Street Type 6
– Crespi Dr. –



Street Type 7
– Juan Bautista Circle –

255 SHORELINE DR
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INFRASTRUCTURE REPORT
TYPICAL STREET UTILITY CROSS SECTIONS
SAN FRANCISCO SAN FRANCISCO COUNTY CALIFORNIA

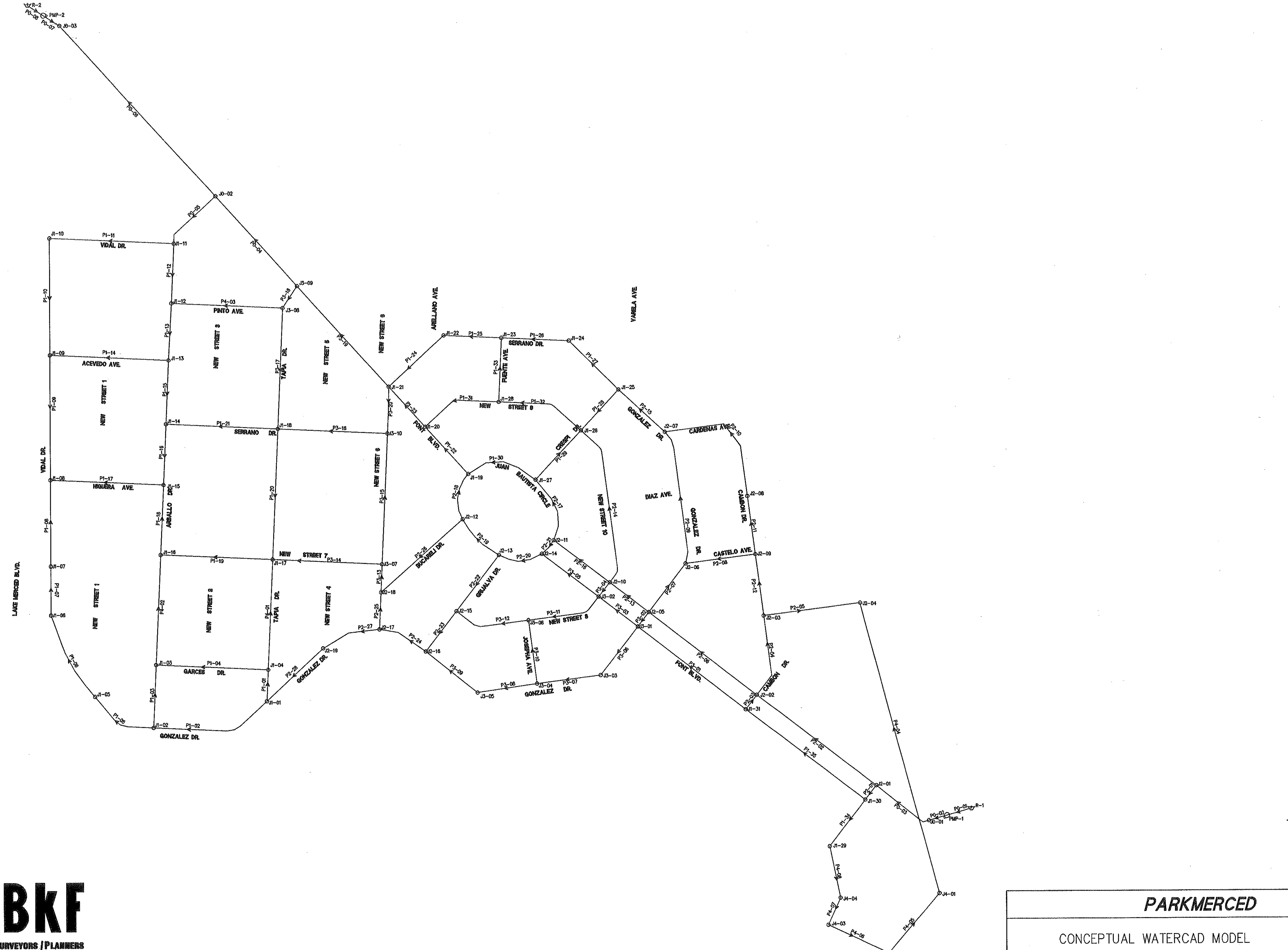
No.	Revisions

Date: 6/23/11
Scale: 1" = 10'
Design: BS
Drawn: MS
Approved: JO
Job No: 20090086

Drawing Number:
FIG 8.5

APPENDICES

APPENDIX A
CONCEPTUAL HYDRAULIC ANALYSIS OF WATER SYSTEM



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CONCEPTUAL WATERCAD MODEL

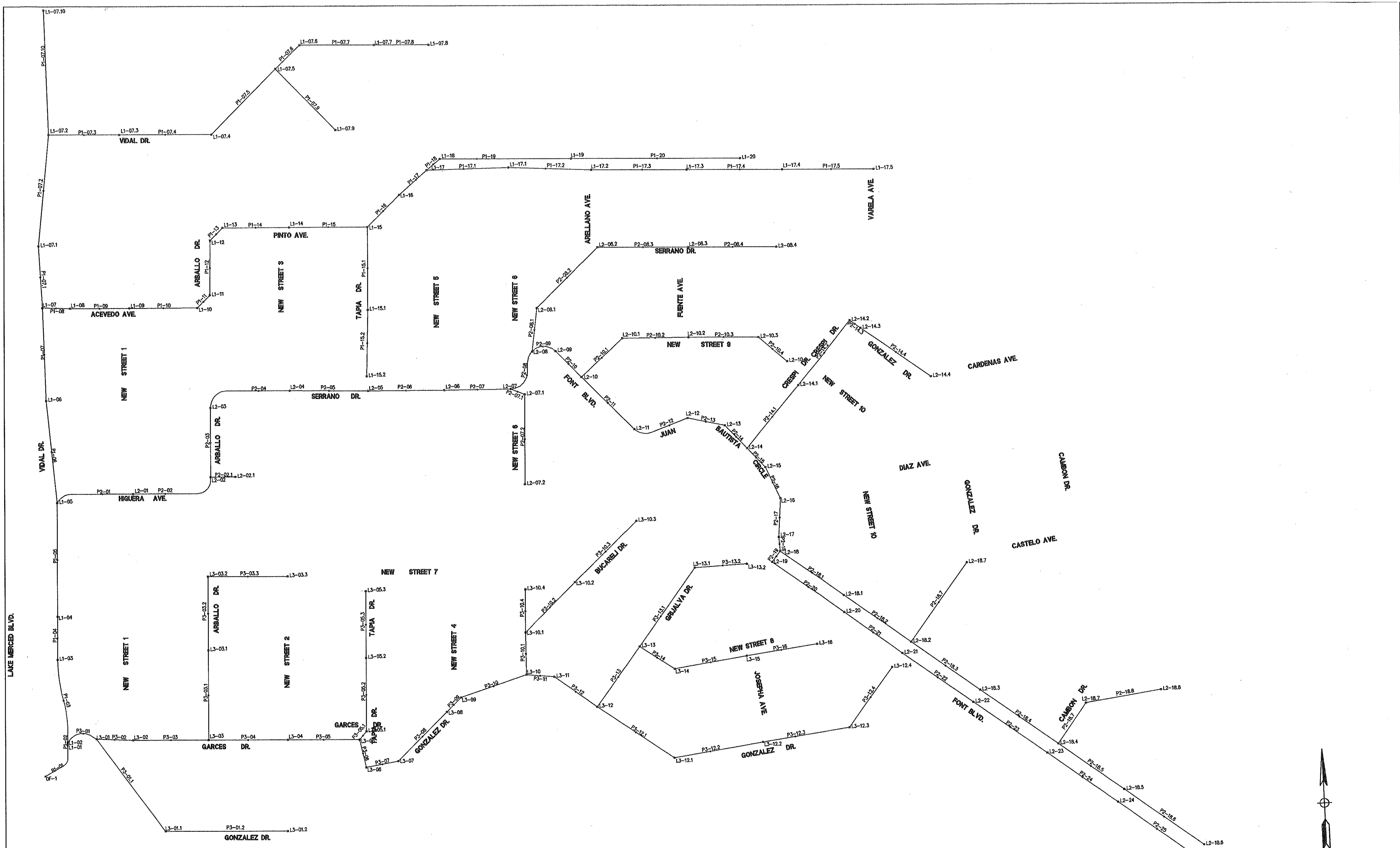
06-23-11

NO SCALE

DRAWING NAME: K:\Eng09\090086\DWG\WaterCAD\WaterCAD_Layout_Proposed.dwg
PLOT TIME: 06-20-11
PLOTTED BY: heff

Label	Satisfies Fire Flow Constraints ?	Fire Flow (Needed) (gpm)	Fire Flow (Available) (gpm)	Flow (Total Needed) (gpm)	Flow (Total Available) (gpm)	Pressure (Residual Lower Limit) (psi)	Pressure (Calculated Residual Lower Limit) (psi)	Junction w/Minimum Pressure (System)	Pipe w/Maximum Velocity	Velocity of Maximum Pipe (ft/s)
J0-01	TRUE	1750	4177	1750	4177	25	34.90	J2-04	P0-06	4.2
J0-02	TRUE	1750	4270	1753	4273	25	76.30	J2-04	P0-03	5.3
J0-03	TRUE	1750	4663	1750	4663	25	77.60	J2-04	P0-06	7.6
J1-01	TRUE	1750	4185	1755	4191	25	69.10	J2-04	P0-03	5.3
J1-02	TRUE	1750	4198	1755	4202	25	72.10	J2-04	P0-03	5.3
J1-03	TRUE	1750	4199	1762	4212	25	71.20	J2-04	P1-03	5.5
J1-04	TRUE	1750	4188	1761	4199	25	59.20	J2-04	P1-01	6.3
J1-05	TRUE	1750	4203	1755	4209	25	74.90	J2-04	P1-05	7.7
J1-06	TRUE	1750	4208	1755	4213	25	84.20	J2-04	P1-05	6.3
J1-07	TRUE	1750	4210	1754	4213	25	80.90	J2-04	P1-08	6.3
J1-08	TRUE	1750	4213	1761	4223	25	76.30	J2-04	P1-17	5.7
J1-09	TRUE	1750	4217	1759	4226	25	75.80	J2-04	P1-14	5.4
J1-10	TRUE	1750	4221	1760	4231	25	75.60	J2-04	P1-11	6.9
J1-11	TRUE	1750	4231	1758	4239	25	75.80	J2-04	P0-05	6.3
J1-12	TRUE	1750	4221	1758	4229	25	72.90	J2-04	P1-12	5.7
J1-13	TRUE	1750	4218	1768	4236	25	71.40	J2-04	P1-13	5.6
J1-14	TRUE	1750	4213	1761	4224	25	70.10	J2-04	P0-03	5.3
J1-15	TRUE	1750	4209	1773	4232	25	73.10	J2-04	P1-16	5.5
J1-16	TRUE	1750	4205	1757	4212	25	68.80	J2-04	P0-03	5.3
J1-17	TRUE	1750	4191	1782	4223	25	65.90	J2-04	P0-03	5.3
J1-18	TRUE	1750	4199	1777	4226	25	66.00	J2-04	P0-03	5.3
J1-19	TRUE	1750	4151	1778	4179	25	58.70	J2-04	P0-03	5.3
J1-20	TRUE	1750	4159	1760	4169	25	62.20	J2-04	P1-22	5.6
J1-21	TRUE	1750	4166	1756	4172	25	66.20	J2-04	P0-03	5.3
J1-22	TRUE	1750	4158	1752	4160	25	61.40	J2-04	P1-24	6.5
J1-23	TRUE	1750	4153	1772	4175	25	58.10	J2-04	P0-03	5.3
J1-24	TRUE	1750	4147	1755	4151	25	52.90	J2-04	P1-27	6.6
J1-25	TRUE	1750	4139	1763	4152	25	48.60	J2-04	P0-03	5.3
J1-26	TRUE	1750	4146	1752	4148	25	52.50	J2-04	P0-03	5.3
J1-27	TRUE	1750	4149	1778	4178	25	54.20	J2-04	P0-03	5.3
J1-28	TRUE	1750	4153	1761	4164	25	55.60	J2-04	P1-33	9.7
J1-29	TRUE	1750	4137	1760	4147	25	39.70	J2-04	P1-34	10.4
J1-30	TRUE	1750	4149	1766	4165	25	35.60	J2-04	P2-01	5.7
J1-31	TRUE	1750	4133	1775	4158	25	41.60	J2-04	P2-03	6.4
J2-01	TRUE	1750	4151	1760	4161	25	35.30	J2-04	P0-03	5.4
J2-02	TRUE	1750	4129	1770	4149	25	41.80	J2-04	P0-03	5.3
J2-03	TRUE	1750	4010	1760	4021	25	39.20	J2-04	P2-04	6.1
J2-04	TRUE	1750	3742	1762	3753	25	25.00	J2-01	P2-05	8.8
J2-05	TRUE	1750	4140	1756	4146	25	49.00	J2-04	P0-03	5.3
J2-06	TRUE	1750	4126	1759	4135	25	44.90	J2-04	P2-07	6.4
J2-07	TRUE	1750	4122	1765	4137	25	48.60	J2-04	P0-03	5.3
J2-08	TRUE	1750	4084	1750	4084	25	39.20	J2-04	P2-11	6.5
J2-09	TRUE	1750	4061	1767	4079	25	41.00	J2-04	P2-12	5.6
J2-10	TRUE	1750	4144	1750	4144	25	50.10	J2-04	P0-03	5.3
J2-11	TRUE	1750	4148	1757	4155	25	50.00	J2-04	P0-03	5.3
J2-12	TRUE	1750	4152	1756	4157	25	57.20	J2-04	P0-03	5.3
J2-13	TRUE	1750	4150	1766	4166	25	52.90	J2-04	P0-03	5.3
J2-14	TRUE	1750	4148	1750	4148	25	50.00	J2-04	P0-03	5.3
J2-15	TRUE	1750	4152	1760	4162	25	52.50	J2-04	P2-22	5.3
J2-16	TRUE	1750	4156	1750	4156	25	60.90	J2-04	P0-03	5.3
J2-17	TRUE	1750	4165	1750	4165	25	62.10	J2-04	P0-03	5.3
J2-18	TRUE	1750	4166	1760	4176	25	61.40	J2-04	P0-03	5.3
J2-19	TRUE	1750	4172	1751	4173	25	64.80	J2-04	P2-27	6.9
J3-01	TRUE	1750	4141	1763	4154	25	49.20	J2-04	P0-03	5.3
J3-02	TRUE	1750	4144	1753	4148	25	50.00	J2-04	P0-03	5.3
J3-03	TRUE	1750	4145	1759	4154	25	49.40	J2-04	P3-06	7.2
J3-04	TRUE	1750	4147	1754	4152	25	52.60	J2-04	P0-03	5.3
J3-05	TRUE	1750	4150	1762	4162	25	58.20	J2-04	P3-09	6.4
J3-06	TRUE	1750	4148	1762	4160	25	45.70	J2-04	P3-10	9.3
J3-07	TRUE	1750	4168	1772	4191	25	60.00	J2-04	P3-13	7.4
J3-08	TRUE	1750	4210	1762	4222	25	72.30	J2-04	P3-18	6.8
J3-09	TRUE	1750	4210	1759	4219	25	73.10	J2-04	P0-03	5.3
J3-10	TRUE	1750	4172	1765	4188	25	60.70	J2-04	P3-20	8.7
J4-01	TRUE	1750	4100	1757	4108	25	32.60	J2-04	P1-34	8.8
J4-02	TRUE	1750	4112	1750	4112	25	45.5	J2-04	P1-34	9.2
J4-03	TRUE	1750	4123	1750	4123	25	51.4	J2-04	P1-34	9.7
J4-04	TRUE	1750	4128	1757	4135	25	41.8	J2-04	P1-34	9.9

APPENDIX B
CONCEPTUAL HYDRAULIC ANALYSIS OF SEWER SYSTEM



BKF
ENGINEERS / SURVEYORS / PLANNERS

PARKMERCED

CONCEPTUAL SEWER MODEL

06-23-11

NO SCALE

DRAWING NAME: K:\Eng09\090086\DWG\Hydrology\SanitarySewer_StormCAD_Layout.dwg
PLOT TIME: 06-20-11
PLOTTED BY: heff

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(P) Sanitary Sewer System Study

Table A1 - Catch Basin

Label	Downstream Conduit	System Flow Time (min)	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Hydraulic Grade (Out) (ft)	Is Flooded	Velocity (Out) (ft/s)	Flow (Total Out) (gal/day)	Flow (Total Out) (ft^3/s)
L1-01	P1-01	26.48	65.00	55.9	56.51	FALSE	3.7	3042354	4.71
L1-02	P1-02	26.47	65.00	56.6	56.93	FALSE	3.5	3042354	4.71
L1-03	P1-03	25.45	69.00	59.0	59.32	FALSE	3.2	2342218	3.62
L1-04	P1-04	25.05	80.00	62.0	62.32	FALSE	3.2	2342218	3.62
L1-05	P1-05	23.94	90.10	67.7	68.04	FALSE	3.4	2308315	3.57
L1-06	P1-06	14.57	94.50	69.1	69.33	FALSE	2.6	1148649	1.78
L1-07	P1-07	12.81	92.00	70.4	70.64	FALSE	2.6	1132345	1.75
L1-07.1	P1-07.1	10.88	89.00	71.9	72.09	FALSE	2.3	574032	0.89
L1-07.10	P1-07.10	0.00	85.00	75.5	75.78	FALSE	2.3	343170	0.53
L1-07.2	P1-07.2	8.12	92.00	73.2	73.4	FALSE	2.0	560833	0.87
L1-07.3	P1-07.3	7.25	93.00	80.8	81.01	FALSE	2.1	217663	0.34
L1-07.4	P1-07.4	5.40	96.20	83.7	83.88	FALSE	2.0	176725	0.27
L1-07.5	P1-07.5	3.53	95.00	86.5	86.68	FALSE	2.0	156280	0.24
L1-07.6	P1-07.6	2.68	95.60	87.6	87.73	FALSE	1.7	62811	0.10
L1-07.7	P1-07.7	1.14	100.00	92.0	92.13	FALSE	1.7	62811	0.10
L1-07.8	P1-07.8	0.00	103.00	95.0	95.13	FALSE	1.7	62811	0.10
L1-07.9	P1-07.9	0.00	99.80	90.0	90.16	FALSE	1.9	93469	0.14
L1-08	P1-08	12.64	94.10	81.3	81.57	FALSE	2.7	558313	0.86
L1-09	P1-09	11.92	97.00	84.3	84.62	FALSE	2.7	544079	0.84
L1-10	P1-10	11.02	102.90	87.2	87.51	FALSE	2.6	536315	0.83
L1-11	P1-11	10.77	102.20	87.8	88.1	FALSE	2.6	509540	0.79
L1-12	P1-12	9.98	99.40	89.6	89.91	FALSE	2.6	509540	0.79
L1-13	P1-13	9.71	98.90	90.2	90.47	FALSE	2.5	434441	0.67
L1-14	P1-14	8.66	102.00	92.2	92.51	FALSE	2.5	434441	0.67
L1-15	P1-15	7.41	105.60	94.6	94.91	FALSE	2.5	434441	0.67
L1-15.1	P1-15.1	1.64	112.00	97.1	97.25	FALSE	1.8	64818	0.10
L1-15.2	P1-15.2	0.00	118.00	103.1	103.17	FALSE	1.3	16046	0.02
L1-16	P1-16	6.66	104.20	96.0	96.25	FALSE	2.4	352801	0.55
L1-17	P1-17	6.29	108.00	100.0	100.29	FALSE	2.6	352801	0.55
L1-17.1	P1-17.1	5.29	115.10	107.0	107.24	FALSE	2.3	214765	0.33
L1-17.2	P1-17.2	4.23	121.30	113.0	113.24	FALSE	2.3	214765	0.33
L1-17.3	P1-17.3	2.90	130.30	122.0	122.18	FALSE	2.0	120944	0.19
L1-17.4	P1-17.4	1.60	139.50	131.6	131.78	FALSE	2.0	120944	0.19
L1-17.5	P1-17.5	0.00	152.20	144.3	144.4	FALSE	1.5	36831	0.06
L1-18	P1-18	5.09	111.00	103.6	103.79	FALSE	2.1	138036	0.21
L1-19	P1-19	3.07	120.50	112.0	112.19	FALSE	2.1	138036	0.21
L1-20	P1-20	0.00	136.10	128.0	128.11	FALSE	1.6	49489	0.08
L2-01	P2-01	23.34	99.00	86.1	86.33	FALSE	2.8	1139480	1.76
L2-02	P2-02	22.39	108.00	92.9	93.12	FALSE	2.8	1102990	1.71
L2-03	P2-03	21.64	108.00	97.9	98.09	FALSE	2.8	1102990	1.71
L2-04	P2-04	20.39	113.60	101.1	101.32	FALSE	2.8	1049419	1.62
L2-05	P2-05	19.29	119.00	104.0	104.2	FALSE	2.7	1032080	1.60
L2-06	P2-06	18.19	124.30	106.7	106.91	FALSE	2.7	991142	1.53
L2-07	P2-07	17.36	123.00	110.6	110.78	FALSE	2.7	939593	1.45
L2-07.1	P2-07.1	2.09	129.90	111.0	111.15	FALSE	1.8	83591	0.13
L2-07.2	P2-07.2	0.00	138.00	113.7	113.84	FALSE	1.8	83591	0.13
L2-08	P2-08	16.61	126.00	112.0	112.19	FALSE	2.6	831675	1.29
L2-08.1	P2-08.1	4.38	122.00	112.4	112.55	FALSE	1.3	79062	0.12
L2-08.2	P2-08.2	2.95	128.00	120.0	120.13	FALSE	1.7	79062	0.12
L2-08.3	P2-08.3	1.53	138.70	129.0	129.14	FALSE	1.8	79062	0.12
L2-08.4	P2-08.4	0.00	149.00	138.0	138.12	FALSE	1.6	52924	0.08
L2-09	P2-09	16.32	124.00	114.9	115.07	FALSE	2.5	752613	1.16
L2-10	P2-10	15.86	128.80	117.0	117.22	FALSE	2.7	752613	1.16
L2-10.1	P2-10.1	4.45	133.50	123.0	123.11	FALSE	1.6	50810	0.08
L2-10.2	P2-10.2	2.36	135.70	127.0	127.06	FALSE	1.2	11732	0.02
L2-10.3	P2-10.3	0.75	147.00	137.0	137.06	FALSE	1.2	11732	0.02
L2-10.4	P2-10.4	0.00	155.00	145.0	145.06	FALSE	1.2	11732	0.02
L2-11	P2-11	15.03	132.30	123.5	123.71	FALSE	2.6	701803	1.09
L2-12	P2-12	14.23	135.10	126.0	126.21	FALSE	2.6	701803	1.09

Label	Downstream Conduit	System Flow Time (min)	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Hydraulic Grade (Out) (ft)	Is Flooded	Velocity (Out) (ft/s)	Flow (Total Out) (gal/day)	Flow (Total Out) (ft^3/s)
L2-13	P2-13	13.81	137.10	129.5	129.71	FALSE	2.6	701803	1.09
L2-14	P2-14	13.43	140.00	132.0	132.15	FALSE	2.5	624515	0.97
L2-14.1	P2-14.1	2.78	146.50	138.0	138.15	FALSE	1.8	106113	0.16
L2-14.2	P2-14.2	1.42	154.00	144.0	144.16	FALSE	1.9	106113	0.16
L2-14.3	P2-14.3	1.27	155.30	147.0	147.16	FALSE	1.9	106113	0.16
L2-14.4	P2-14.4	0.00	162.60	154.9	155.06	FALSE	1.9	106113	0.16
L2-15	P2-15	13.08	143.00	134.0	134.17	FALSE	2.3	518402	0.80
L2-16	P2-16	12.66	146.00	137.5	137.67	FALSE	2.3	518402	0.80
L2-17	P2-17	12.06	148.00	139.5	139.66	FALSE	2.3	459354	0.71
L2-18	P2-18	11.82	149.10	140.0	140.16	FALSE	2.3	459354	0.71
L2-18.1	P2-18.1	6.61	155.50	147.0	147.3	FALSE	2.6	338755	0.52
L2-18.2	P2-18.2	5.76	162.80	154.5	154.8	FALSE	2.6	338755	0.52
L2-18.3	P2-18.3	4.76	170.40	162.0	162.24	FALSE	2.3	212693	0.33
L2-18.4	P2-18.4	3.56	177.30	169.3	169.54	FALSE	2.3	212693	0.33
L2-18.5	P2-18.5	2.18	182.00	175.0	175.15	FALSE	1.8	81876	0.13
L2-18.6	P2-18.6	0.00	188.00	181.0	181.1	FALSE	1.5	40938	0.06
L2-18.7	P2-18.7	0.00	170.30	162.3	162.48	FALSE	2.0	126062	0.20
L2-18.7	P2-18.7	1.18	180.00	172.0	172.17	FALSE	1.9	122669	0.19
L2-18.8	P2-18.8	0.00	192.30	184.3	184.41	FALSE	1.5	45030	0.07
L2-19	P2-19	11.51	148.00	140.4	140.55	FALSE	1.8	120599	0.19
L2-20	P2-20	9.69	157.00	143.0	143.2	FALSE	2.0	120599	0.19
L2-21	P2-21	8.22	163.00	145.1	145.32	FALSE	2.0	120599	0.19
L2-22	P2-22	6.42	170.90	147.7	147.9	FALSE	2.0	120599	0.19
L2-23	P2-23	4.55	177.00	150.4	150.59	FALSE	2.0	120599	0.19
L2-24	P2-24	2.40	182.00	153.0	153.11	FALSE	1.7	65217	0.10
L2-25	P2-25	0.00	187.00	160.2	160.28	FALSE	1.3	23033	0.04
L3-01	P3-01	14.14	86.46	68.8	68.98	FALSE	2.6	700136	1.08
L3-01.1	P3-01.1	3.63	99.30	84.5	84.59	FALSE	1.4	36749	0.06
L3-01.2	P3-01.2	0.00	111.50	93.0	93.06	FALSE	1.2	15269	0.02
L3-02	P3-02	13.87	95.50	83.0	83.2	FALSE	2.6	663387	1.03
L3-03	P3-03	13.17	105.00	96.5	96.7	FALSE	2.6	663387	1.03
L3-03.1	P3-03.1	3.21	107.70	100.2	100.35	FALSE	1.8	103826	0.16
L3-03.2	P3-03.2	1.59	110.00	102.4	102.56	FALSE	1.9	98391	0.15
L3-03.3	P3-03.3	0.00	115.90	107.0	107.13	FALSE	1.7	69147	0.11
L3-04	P3-04	12.09	111.80	102.2	102.37	FALSE	2.3	516949	0.80
L3-05	P3-05	10.80	118.00	104.5	104.67	FALSE	2.3	498574	0.77
L3-05.1	P3-05.1	2.90	118.55	106.1	106.25	FALSE	1.9	118835	0.18
L3-05.2	P3-05.2	1.54	120.70	109.5	109.67	FALSE	1.9	118835	0.18
L3-05.3	P3-05.3	0.00	122.69	111.5	111.65	FALSE	1.8	85192	0.13
L3-06	P3-06	10.38	117.54	107.1	107.18	FALSE	2.1	344235	0.53
L3-07	P3-07	10.01	119.00	110.0	110.25	FALSE	2.4	344235	0.53
L3-08	P3-08	9.08	122.70	113.9	114.11	FALSE	2.4	344235	0.53
L3-09	P3-09	8.80	124.00	115.0	115.25	FALSE	2.4	344235	0.53
L3-10	P3-10	7.97	132.40	120.3	120.57	FALSE	2.4	344235	0.53
L3-10.1	P3-10.1	3.33	135.00	121.8	121.89	FALSE	1.8	113099	0.17
L3-10.2	P3-10.2	1.67	137.02	124.0	124.14	FALSE	1.7	72986	0.11
L3-10.3	P3-10.3	0.00	145.00	129.0	129.14	FALSE	1.7	72986	0.11
L3-10.4	P3-10.4	0.00	137.35	125.0	125.11	FALSE	1.6	40113	0.06
L3-11	P3-11	7.59	135.00	122.5	122.71	FALSE	2.2	231136	0.36
L3-12	P3-12	6.77	144.40	125.0	125.21	FALSE	2.2	231136	0.36
L3-12.1	P3-12.1	4.53	146.73	128.5	128.62	FALSE	1.6	67286	0.10
L3-12.2	P3-12.2	2.90	151.50	137.6	137.71	FALSE	1.5	49947	0.08
L3-12.3	P3-12.3	1.14	160.20	144.0	144.11	FALSE	1.6	49947	0.08
L3-12.4	P3-12.4	0.00	165.00	159.0	159.11	FALSE	1.6	49947	0.08
L3-13	P3-13	3.49	148.60	129.9	130.05	FALSE	2.1	163850	0.25
L3-13.1	P3-13.1	1.13	148.80	135.8	135.93	FALSE	1.7	64027	0.10
L3-13.2	P3-13.2	0.00	152.00	139.0	139.13	FALSE	1.7	64027	0.10
L3-14	P3-14	2.99	155.75	136.7	136.84	FALSE	1.9	99823	0.15
L3-15	P3-15	1.72	163.30	143.2	143.34	FALSE	1.7	60227	0.09
L3-16	P3-16	0.00	163.40	145.3	145.48	FALSE	1.8	60227	0.09

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(P) Sanitary Sewer System Study

Table A2 - Pipe

Label	Flow (ft^3/s)	Pipe Capacity (ft^3/s)	Diam. (in)	Length (ft)	Slope (ft/ft)	Upstream Invert (ft)	Downstream Invert (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Average Cover (ft)	Upstream HGL (ft)	Downstream HGL (ft)	Velocity (ft/s)	Freeboard (ft)
P1-01	4.71	638.80	54	130	0.106	55.90	42.18	65.0	53.8	5.9	56.51	42.46	11.8	8.5
P1-02	4.71	583.09	12	9	0.072	56.55	55.90	65.0	65.0	3.5	56.93	56.51	8.5	8.1
P1-03	3.62	214.36	12	251	0.010	59.00	56.55	69.0	65.0	4.0	59.32	56.94	4.1	9.7
P1-04	3.62	330.87	12	129	0.023	62.00	59.00	80.0	69.0	8.8	62.32	59.33	5.4	17.7
P1-05	3.57	186.08	12	340	0.017	67.69	62.00	90.1	80.0	15.7	68.04	62.23	5.1	22.1
P1-06	1.78	97.32	12	308	0.005	69.10	67.69	94.5	90.1	19.4	69.33	68.05	2.6	25.2
P1-07	1.75	99.11	12	278	0.005	70.42	69.10	92.0	94.5	19.0	70.64	69.33	2.6	21.4
P1-07.1	0.89	79.91	12	185	0.008	71.93	70.42	89.0	92.0	15.6	72.09	70.64	2.6	16.9
P1-07.10	0.53	16.00	24	460	0.005	75.53	73.23	85.0	92.0	12.1	75.78	73.48	2.3	9.2
P1-07.2	0.87	55.10	12	335	0.004	73.23	71.93	92.0	89.0	14.2	73.40	72.09	2.0	18.6
P1-07.3	0.34	29.80	21	214	0.035	80.80	73.23	93.0	92.0	13.7	81.01	73.36	4.1	12.0
P1-07.4	0.27	16.10	21	281	0.010	83.70	80.80	96.2	93.0	10.6	83.88	81.01	2.5	12.3
P1-07.5	0.24	10.58	18	276	0.010	86.50	83.70	95.0	96.2	9.0	86.68	83.89	2.5	8.3
P1-07.6	0.10	3.68	12	103	0.011	87.60	86.50	95.6	95.0	7.3	87.73	86.69	2.0	7.9
P1-07.7	0.10	4.94	12	229	0.019	92.00	87.60	100.0	95.6	7.0	92.13	87.74	2.5	7.9
P1-07.8	0.10	4.79	12	166	0.018	95.00	92.00	103.0	100.0	7.0	95.13	92.13	2.4	7.9
P1-07.9	0.14	4.14	12	259	0.014	90.00	86.50	99.8	95.0	8.2	90.16	86.69	2.5	9.6
P1-08	0.86	81.22	24	84	0.129	81.25	70.42	94.1	92.0	15.2	81.57	70.57	8.5	12.5
P1-09	0.84	29.45	24	180	0.017	84.30	81.25	97.0	94.1	10.8	84.62	81.57	4.1	12.4
P1-10	0.83	26.77	24	207	0.014	87.20	84.30	102.9	97.0	12.2	87.51	84.62	3.9	15.4
P1-11	0.79	23.87	24	53	0.011	87.79	87.20	102.2	102.9	13.1	88.10	87.53	3.5	14.1
P1-12	0.79	23.76	24	164	0.011	89.60	87.79	99.4	102.2	10.1	89.91	88.12	3.5	9.5
P1-13	0.67	23.64	24	54	0.011	90.19	89.60	98.9	99.4	7.3	90.47	89.92	3.3	8.4
P1-14	0.67	22.68	24	203	0.010	92.23	90.19	102.0	98.9	7.2	92.51	90.49	3.2	9.5
P1-15	0.67	22.62	24	240	0.010	94.63	92.23	105.6	102.0	8.4	94.91	92.51	3.2	10.7
P1-15.1	0.10	1.21	8	248	0.010	97.11	94.63	112.0	105.6	12.3	97.25	94.91	2.1	14.8
P1-15.2	0.02	2.10	8	199	0.030	103.10	97.11	118.0	112.0	14.2	103.17	97.26	2.0	14.8
P1-16	0.55	22.62	24	137	0.010	96.00	94.63	104.2	105.6	7.6	96.25	94.93	3.0	8.0
P1-17	0.55	12.26	15	111	0.036	100.00	96.00	108.0	104.2	6.9	100.29	96.18	5.0	7.7
P1-17.1	0.33	6.01	12	246	0.028	107.00	100.00	115.1	108.0	7.1	107.24	100.31	4.1	7.9
P1-17.2	0.33	5.54	12	248	0.024	113.00	107.00	121.3	115.1	7.2	113.24	107.25	3.9	8.1
P1-17.3	0.19	6.32	12	286	0.031	122.00	113.00	130.3	121.3	7.3	122.18	113.24	3.6	8.1
P1-17.4	0.19	6.53	12	286	0.034	131.60	122.00	139.5	130.3	7.1	131.78	122.18	3.7	7.7
P1-17.5	0.06	7.68	12	273	0.047	144.30	131.60	152.2	139.5	6.9	144.40	131.78	2.9	7.8
P1-18	0.21	9.37	12	52	0.069	103.60	100.00	111.0	108.0	6.7	103.79	100.30	4.9	7.2
P1-19	0.21	5.20	12	394	0.021	112.00	103.60	120.5	111.0	7.0	112.19	103.81	3.3	8.3
P1-20	0.08	6.34	12	505	0.032	128.00	112.00	136.1	120.5	7.3	128.11	112.19	2.7	8.0
P2-01	1.76	244.85	12	240	0.077	86.08	67.69	99.0	90.1	13.9	86.33	68.05	6.7	12.7

Label	Flow (ft^3/s)	Pipe Capacity (ft^3/s)	Diam. (in)	Length (ft)	Slope (ft/ft)	Upstream Invert (ft)	Downstream Invert (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Average Cover (ft)	Upstream HGL (ft)	Downstream HGL (ft)	Velocity (ft/s)	Freeboard (ft)
P2-02	1.71	140.90	12	268	0.025	92.88	86.08	108.0	99.0	10.3	93.12	86.33	4.7	14.9
P2-03	1.71	137.06	12	207	0.024	97.85	92.88	108.0	108.0	8.9	98.09	93.13	4.6	9.9
P2-04	1.62	96.57	12	271	0.012	101.08	97.85	113.6	108.0	7.6	101.32	98.11	3.6	12.3
P2-05	1.60	97.07	12	240	0.012	103.97	101.08	119.0	113.6	10.0	104.20	101.32	3.6	14.8
P2-06	1.53	95.60	12	232	0.012	106.68	103.97	124.3	119.0	12.6	106.91	104.20	3.5	17.4
P2-07	1.45	122.90	12	201	0.019	110.56	106.68	123.0	124.3	11.3	110.78	106.91	4.1	12.2
P2-07.1	0.13	3.56	12	44	0.010	111.00	110.56	129.9	123.0	14.7	111.15	110.79	2.2	18.8
P2-07.2	0.13	3.56	12	269	0.010	113.69	111.00	138.0	129.9	20.6	113.84	111.16	2.2	24.2
P2-08	1.29	88.46	12	143	0.010	111.99	110.56	126.0	123.0	9.5	112.19	110.79	3.2	13.8
P2-08.1	0.12	5.88	18	131	0.003	112.40	111.99	122.0	126.0	10.3	112.55	112.20	1.3	9.5
P2-08.2	0.12	11.11	15	257	0.030	120.00	112.40	128.0	122.0	7.6	120.13	112.55	3.0	7.9
P2-08.3	0.12	6.47	12	273	0.033	129.00	120.00	138.7	128.0	7.8	129.14	120.10	3.2	9.6
P2-08.4	0.08	6.59	12	263	0.034	138.00	129.00	149.0	138.7	9.3	138.12	129.15	2.9	10.9
P2-09	1.16	169.18	12	79	0.037	114.88	111.99	124.0	126.0	7.8	115.07	112.20	4.5	8.9
P2-10	1.16	67.73	12	110	0.019	117.00	114.88	128.8	124.0	7.5	117.22	115.03	4.0	11.6
P2-10.1	0.08	6.73	12	168	0.036	123.00	117.00	133.5	128.8	10.2	123.11	117.22	2.9	10.4
P2-10.2	0.02	1.71	8	199	0.020	127.00	123.00	135.7	133.5	8.9	127.06	123.12	1.6	8.6
P2-10.3	0.02	2.64	8	209	0.048	137.00	127.00	147.0	135.7	8.7	137.06	127.06	2.2	9.9
P2-10.4	0.02	3.23	8	112	0.071	145.00	137.00	155.0	147.0	9.3	145.06	137.06	2.5	9.9
P2-11	1.09	83.48	12	222	0.029	123.50	117.00	132.3	128.8	7.3	123.71	117.22	4.5	8.6
P2-12	1.09	58.82	12	172	0.015	126.00	123.50	135.1	132.3	6.0	126.21	123.72	3.6	8.9
P2-13	1.09	85.86	12	113	0.031	129.50	126.00	137.1	135.1	5.3	129.71	126.22	4.5	7.4
P2-14	0.97	78.51	12	95	0.026	131.96	129.50	140.0	137.1	4.8	132.15	129.72	4.1	7.8
P2-14.1	0.16	16.53	18	244	0.025	138.00	131.96	146.5	140.0	6.8	138.15	132.16	3.0	8.3
P2-14.2	0.16	10.05	15	248	0.024	144.00	138.00	154.0	146.5	8.0	144.16	138.11	3.1	9.8
P2-14.3	0.16	17.69	15	40	0.075	147.00	144.00	155.3	154.0	7.9	147.16	144.17	4.5	8.1
P2-14.4	0.16	11.37	15	255	0.031	154.90	147.00	162.6	155.3	6.8	155.06	147.16	3.3	7.5
P2-15	0.80	78.40	12	79	0.026	134.00	131.96	143.0	140.0	5.5	134.17	132.16	3.8	8.8
P2-16	0.80	89.50	12	104	0.034	137.50	134.00	146.0	143.0	5.8	137.67	134.18	4.1	8.3
P2-17	0.71	64.06	12	116	0.017	139.50	137.50	148.0	146.0	5.5	139.66	137.68	3.2	8.3
P2-18	0.71	53.23	12	42	0.012	140.00	139.50	149.1	148.0	5.8	140.16	139.66	2.9	8.9
P2-18.1	0.52	6.20	12	231	0.030	147.00	140.00	155.5	149.1	7.8	147.30	140.20	4.8	8.2
P2-18.2	0.52	6.23	12	245	0.031	154.50	147.00	162.8	155.5	7.4	154.80	147.31	4.8	8.0
P2-18.3	0.33	6.16	12	251	0.030	162.00	154.50	170.4	162.8	7.4	162.24	154.82	4.2	8.2
P2-18.4	0.33	5.71	12	284	0.026	169.30	162.00	177.3	170.4	7.2	169.54	162.24	4.0	7.8
P2-18.5	0.13	5.49	12	240	0.024	175.00	169.30	182.0	177.3	6.5	175.15	169.55	2.9	6.8
P2-18.6	0.06	5.12	12	291	0.021	181.00	175.00	188.0	182.0	6.0	181.10	175.08	2.2	6.9
P2-18.7	0.19	8.72	15	148	0.018	172.00	169.30	180.0	177.3	6.8	172.17	169.55	2.9	7.8
P2-18.7	0.20	5.84	12	290	0.027	162.30	154.50	170.3	162.8	7.2	162.48	154.81	3.4	7.8
P2-18.8	0.07	8.27	12	228	0.054	184.30	172.00	192.3	180.0	7.0	184.41	172.18	3.2	7.9
P2-19	0.19	22.62	24	40	0.010	140.40	140.00	148.0	149.1	6.3	140.55	140.16	2.2	7.4
P2-20	0.19	3.56	12	262	0.010	143.02	140.40	157.0	148.0	9.8	143.20	140.56	2.4	13.8
P2-21	0.19	3.56	12	212	0.010	145.14	143.02	163.0	157.0	14.9	145.32	143.20	2.4	17.7

Label	Flow (ft³/s)	Pipe Capacity (ft³/s)	Diam. (in)	Length (ft)	Slope (ft/ft)	Upstream Invert (ft)	Downstream Invert (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Average Cover (ft)	Upstream HGL (ft)	Downstream HGL (ft)	Velocity (ft/s)	Freeboard (ft)
P2-22	0.19	3.56	12	258	0.010	147.72	145.14	170.9	163.0	19.5	147.90	145.32	2.4	23.0
P2-23	0.19	3.56	12	269	0.010	150.41	147.72	177.0	170.9	23.9	150.59	147.88	2.4	26.4
P2-24	0.10	3.56	12	257	0.010	152.98	150.41	182.0	177.0	26.8	153.11	150.59	2.0	28.9
P2-25	0.04	5.64	12	288	0.025	160.20	152.98	187.0	182.0	26.9	160.28	153.04	2.0	26.7
P3-01	1.08	169.70	12	101	0.121	68.77	56.55	86.5	65.0	10.1	68.98	56.94	6.9	17.5
P3-01.1	0.06	13.75	15	347	0.045	84.50	68.77	99.3	86.5	15.0	84.59	68.99	2.7	14.7
P3-01.2	0.02	5.39	12	372	0.023	93.00	84.50	111.5	99.3	15.7	93.06	84.59	1.7	18.4
P3-02	1.03	174.68	12	111	0.128	83.00	68.77	95.5	86.5	12.1	83.20	68.99	6.9	12.3
P3-03	1.03	118.45	12	229	0.059	96.50	83.00	105.0	95.5	7.5	96.70	83.20	5.4	8.3
P3-03.1	0.16	7.58	15	269	0.014	100.20	96.50	107.7	105.0	6.8	100.35	96.70	2.5	7.4
P3-03.2	0.15	3.56	12	220	0.010	102.40	100.20	110.0	107.7	6.6	102.56	100.34	2.3	7.4
P3-03.3	0.11	4.91	12	242	0.019	107.00	102.40	115.9	110.0	7.3	107.13	102.58	2.5	8.8
P3-04	0.80	75.03	12	241	0.024	102.20	96.50	111.8	105.0	6.1	102.37	96.70	3.7	9.4
P3-05	0.77	50.00	12	219	0.011	104.50	102.20	118.0	111.8	8.6	104.67	102.37	2.8	13.3
P3-05.1	0.18	14.13	15	33	0.048	106.08	104.50	118.6	118.0	11.7	106.25	104.67	4.0	12.3
P3-05.2	0.18	8.05	15	220	0.016	109.50	106.08	120.7	118.6	10.6	109.67	106.26	2.7	11.0
P3-05.3	0.13	3.56	12	200	0.010	111.50	109.50	122.7	120.7	10.2	111.65	109.67	2.2	11.0
P3-06	0.53	84.01	12	86	0.030	107.05	104.50	117.5	118.0	9.0	107.18	104.67	3.4	10.4
P3-07	0.53	39.05	24	99	0.030	110.00	107.05	119.0	117.5	7.7	110.25	107.21	4.4	8.8
P3-08	0.53	30.82	24	208	0.019	113.86	110.00	122.7	119.0	6.9	114.11	110.26	3.7	8.6
P3-09	0.53	30.92	24	61	0.019	115.00	113.86	124.0	122.7	6.9	115.25	114.11	3.7	8.8
P3-10	0.53	36.18	24	208	0.026	120.32	115.00	132.4	124.0	8.5	120.57	115.26	4.2	11.8
P3-10.1	0.17	24.10	24	126	0.011	121.75	120.32	135.0	132.4	10.7	121.89	120.58	2.2	13.1
P3-10.2	0.11	3.68	12	211	0.011	124.00	121.75	137.0	135.0	12.1	124.14	121.90	2.1	12.9
P3-10.3	0.11	4.94	12	260	0.019	129.00	124.00	145.0	137.0	13.5	129.14	124.14	2.6	15.9
P3-10.4	0.06	1.92	8	129	0.025	125.00	121.75	137.4	135.0	12.1	125.11	121.89	2.5	12.2
P3-11	0.36	25.37	21	85	0.026	122.50	120.32	135.0	132.4	10.5	122.71	120.58	3.8	12.3
P3-12	0.36	19.99	21	157	0.016	125.00	122.50	144.4	135.0	14.2	125.21	122.72	3.2	19.2
P3-12.1	0.10	11.81	18	277	0.013	128.50	125.00	146.7	144.4	17.3	128.62	125.22	2.1	18.1
P3-12.2	0.08	11.92	15	267	0.034	137.60	128.50	151.5	146.7	14.8	137.71	128.62	2.7	13.8
P3-12.3	0.08	5.54	12	265	0.024	144.00	137.60	160.2	151.5	14.1	144.11	137.68	2.5	16.1
P3-12.4	0.08	8.91	12	240	0.063	159.00	144.00	165.0	160.2	10.1	159.11	144.12	3.5	5.9
P3-13	0.25	9.58	15	221	0.022	129.86	125.00	148.6	144.4	17.8	130.05	125.22	3.4	18.6
P3-13.1	0.10	5.01	12	300	0.020	135.80	129.86	148.8	148.6	14.9	135.93	130.06	2.5	12.9
P3-13.2	0.10	4.92	12	168	0.019	139.00	135.80	152.0	148.8	12.0	139.13	135.94	2.5	12.9
P3-14	0.15	8.35	12	124	0.055	136.68	129.86	155.8	148.6	17.9	136.84	130.06	4.1	18.9
P3-15	0.09	6.17	12	218	0.030	143.22	136.68	163.3	155.8	18.6	143.34	136.85	2.9	20.0
P3-16	0.09	1.21	8	212	0.010	145.34	143.22	163.4	163.3	18.4	145.48	143.35	2.1	17.9

APPENDIX C
DRAFT PRELIMINARY APPROACH TO STORMWATER MANAGEMENT
(HCE, DECEMBER 20, 2010)

Technical Memorandum

Parkmerced

Subject:	**Preliminary Approach to Stormwater Management**
Project:	Parkmerced
Prepared By:	Beth Goldstein, P.E., LEED AP
Reviewed By:	Chris Phanartzis, P.E.
Date:	December 20, 2010
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ATTACHMENT A Cistern Sizing Calculations

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Executive Summary

The preliminary plan for stormwater management at Parkmerced is to use Low Impact Design (LID) to manage runoff. The design rainfall event is a 5-year, 3-hour storm, as required by San Francisco City regulations. Examples of LID measures proposed for the site include bioswales, biogutters, permeable paving, wet ponds, wetlands, and a stream. The combined LID network will also achieve the requirements of the recently passed Stormwater Management Ordinance requiring compliance with the Stormwater Design Guidelines. Based on LEED NC credits SS c6.1 and c6.2, this ordinance requires a 25% reduction in both peak flow and volume during the 2-year, 24-hour storm and capture and treatment of 90% of the annual average rainfall.

Runoff in excess of the design storm, up to the 100 year storm, will flow off site above ground, as specified in the San Francisco Subdivision Regulations, to a combined sewer if capacity exists, or overland consistent with existing topography. Hardscape infrastructure such as pipes and drain inlets will only be needed to convey flow beneath street and intersections, as necessary.

The benefits of using LID to manage runoff rather than using the combined sewer include: recharge of Lake Merced aquifer, creation of green space amenities, potential reduction in potable water use, reduction in wastewater treatment fees and costs, replenishment of Lake Merced and potential reduction in combined sewer overflows.

Infiltration of stormwater runoff will be maximized—approximately **93**% of the annual runoff will be retained onsite of which **67%** will recharge the underlying aquifer and, indirectly, Lake Merced. Where rainfall exceeds the site infiltration rates, vegetated swales will collect the flow. The swales will provide additional infiltration, and convey runoff to the next LID measure in the treatment train.

One or more cisterns will detain sufficient runoff volume to provide makeup water for the pond through the summer months, to irrigate the farm and possibly the playing fields. The playing field turf will be planted in an engineered sand layer, enabling additional stormwater storage, as well as high efficiency sub-surface irrigation. Model results presented below and in Section 7 assume storage of stormwater for pond makeup water and irrigation of the farm.

Overflows from the LID measures and the central pond will be directed toward a stream. The stream will treat and reduce runoff while simultaneously conveying flow from about 2/3 of the site to a series of terminal ponds in the southwest corner. From there, runoff from the stream will be directed towards Lake Merced via one of five outfall options, described in Section 4. There will be a similar set of terminal ponds in the northwest corner of the site, which will treat runoff from the remaining 1/3 of the site.

In addition, permeable paving will be installed in pedestrian walkways, parking lanes, and other low-traffic areas to allow water to infiltrate at these hardscape areas. The courtyards, with underground parking below, will function similarly to ecoroofs—temporary storage will be provided in the soil, with pollutant removal provided as excess flows pass over the vegetated areas towards the bioswales and biogutters. Many courtyards will also be designed with a small stream/pond system to further increase detention times.

A detailed stormwater model was created using XP-SWMM to validate earlier conceptual planning efforts and confirm that the LID network is sized adequately to replace the combined sewer's drainage function as planned. The model was also used to calculate annual volumes of runoff that will infiltrate to the groundwater table, be treated by ponds and wetlands, or overflow to Lake

Merced to verify compliance with the Stormwater Management Ordinance, as shown in the two tables following. Finally, in future efforts detailed pollutant removal calculations will be made using the same model.

Model Results for Annual Average Runoff
(indicating exceedance of LEED SS c6.2)

	Average Annual Runoff (MG)	
Reused		
Farm Irrigation	2.74	4%
Pond Make-up	0.10	0%
Infiltrated		
Runoff Layer (pp, parks, treewells)	31.25	46%
Hydraulics Layer (swales)	14.46	21%
Evaporated		
from runoff surfaces (cisterns, swales)	6.00	9%
from network (ponds, cisterns, swales)	1.82	3%
Evapotranspired From Courtyards	7.20	11%
Discharged to Lake (volume through terminal pipe)	4.80	7%
Total	68.88	100%

Model Results for 2 Year 24 Hour Storm
(indicating exceedance of LEED SS c6.1)

	Peak Flow (cfs)	Total Volume (CF)
Pre-Development	115.7	2,168,000
Post-Development	66.97	1,042,750
% Decrease	42%	52%

Note: the pre-development model results were derived from the City-wide Infoworks model as provided by DPW/BOE/Hydraulics.

Model results for the 2 year/24 hour, 5 year/3 hour, and 100 year/3 hour storms are presented in Section 7.

1. Purpose

The purpose of this TM is to describe the proposed approach to stormwater management for Parkmerced. A hydrologic/hydraulic model of the site was created to validate preliminary sizing of conveyance and treatment elements. Each element in the stormwater network will be identified and described, with a discussion of how each element is modeled. Block by block routing, infiltration, and detention calculations have been performed using this model. The model will also be used in subsequent efforts to examine the proposed stormwater management strategy's effect on lake water quality.

2. Stormwater Model Development

2.1 Scope and Purpose of Model

A detailed stormwater model was created to validate earlier conceptual planning efforts, and provide additional detail as plans for Parkmerced progress. This section will describe the model, its development, assumptions, and sources of data. Actual model inputs and outputs are included in Attachment B.

XP-SWMM is a hydrologic and hydraulic modeling package which was used to build and run the model. It is based on the industry standard EPA-SWMM "Storm Water Management Model". Several additional features are provided by XP-SWMM, including database connections, GIS and CAD integration, and pollutant generation/transport modeling. The SWMM model is recommended by EPA for analyzing pre- vs. post-development hydrology and has dynamic hydraulic capabilities as well.

The model is used for several purposes. First, the initial sizing of the LID network was checked to ensure that it can replace the combined sewer's drainage function as planned. The model is also being used to calculate annual volumes of runoff that will infiltrate to the groundwater table, be treated by ponds and wetlands, or overflow to Lake Merced. It will be used to verify compliance with the Stormwater Management Ordinance, which requires peak and volume reduction of 25% during the 2-year, 24-hour storm (LEED NC credit SS c6.1) and capture and treatment of 90% of the annual average rainfall (LEED NC credit SS c6.2). Finally, in future efforts detailed pollutant removal calculations will be made using the same model.

All land within Parkmerced property was included in the model. Some of the supporting data extends beyond these boundaries, such as the proposed grading plan. There are also some areas within the property that will not contribute runoff to the proposed LID system—for example, the southeast corner of the site. These areas have all been accounted for, and their runoff excluded from the network.

CAD site plan drawings provided by the project architects SOM were used as a starting point in building the model. The network was laid out in project coordinates, so that background files can be easily overlaid for review or presentation. These drawings also were used to make detailed runoff area calculations at the building level. Updated files were checked against the existing model to review any conflicts.

Contributing areas and volumes within the right of way were calculated in a spreadsheet, based on street lengths derived from the CAD files. Detailed cross sections provided by the site civil engineer

BkF were used to model overland flow on the street surface and biofiltration treewells, and their connection to the network of biogutters and swales.

2.2 Model Inputs

The following basic inputs were used in the model:

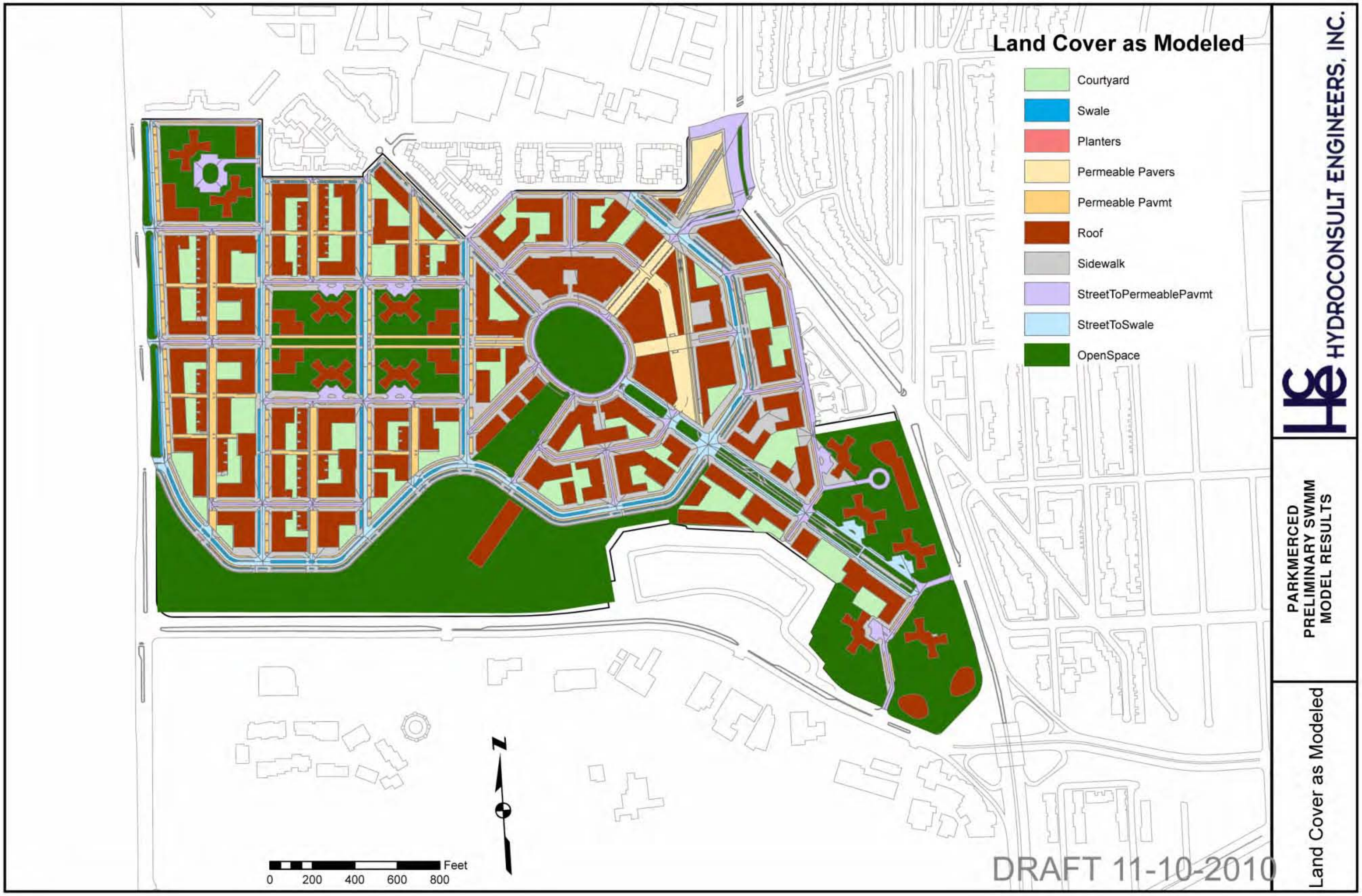
- 5-minute rainfall intensities for the 5-year 3-hour storm, the 100-year 3-hour storm, the 2-year 24-hour storm, and the typical year.
- Equilibrium infiltration rates provided by Treadwell & Rollo. Infiltration was assumed to occur only on permeable surfaces, and not in areas designated as fill. The Horton infiltration equation is used in the model to predict the time varying rate of infiltration due to soil saturation over time as follows:

$$f_t = f_c + (f_0 - f_c)e^{-kt}$$

where:
f_t is the infiltration rate at time t;
f_0 is the initial infiltration rate or maximum infiltration rate (assumed to be 2 times the equilibrium rate);
f_c is the constant or equilibrium infiltration rate after the soil has been saturated or minimum infiltration rate;
k is the decay constant specific to the soil.

- Evapotranspiration rates based on WUCOLSIII (ET_0 Zone 1)
- Evaporation rates based on previous studies by Gus Yates
- Street sections and slopes provided by SOM and BkF, as presented in the project Design Standards + Guidelines
- Land use and areas provided by SOM and Tom Leader Studios, as shown on the following page.

Please refer to Figures 6.1, 6.2, and 6.3 of the Infrastructure Report for detailed drawings of the proposed stormwater system as modeled.

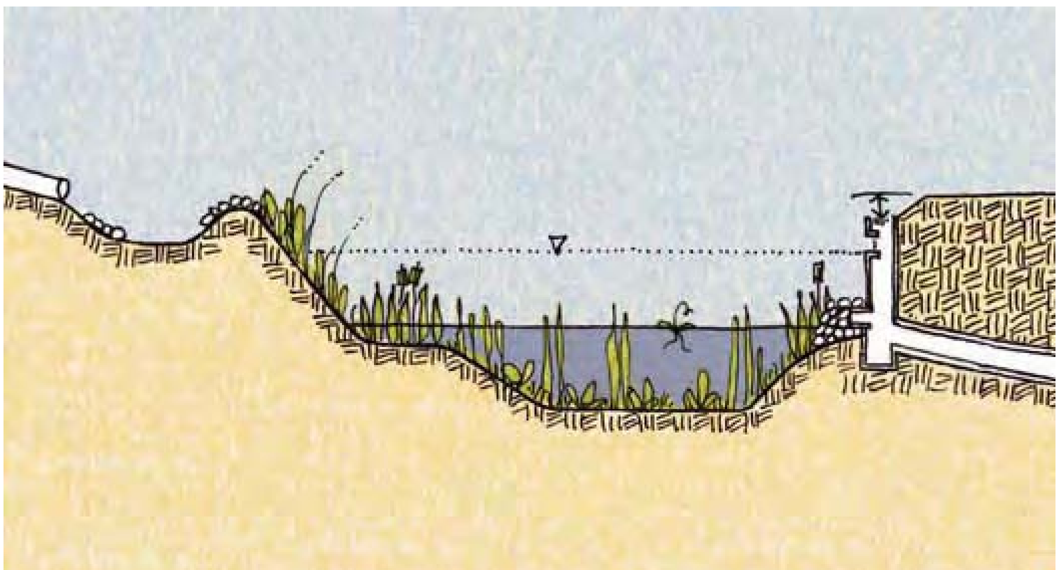

Land Cover as Modeled
Courtyard
Swale
Planters
Permeable Pavers
Permeable Pavmt
Roof
Sidewalk
StreetToPermeablePavmt
StreetToSwale
OpenSpace
N
Feet
0
200
400
600
800
DRAFT 11-10-2010
HYDROCONSULT ENGINEERS, INC.
PARKMERCED
PRELIMINARY SWMM
MODEL RESULTS
Land Cover as Modeled

3. Description of LID Network

The LID network conveys, treats, and discharges stormwater runoff that would typically drain to the City's combined sewer. The network consists of many different above and below ground elements, which together convey the design rainfall event, as well as provide pollutant removal so the water is of acceptable quality to be discharged to the adjacent Lake Merced. Each element is described in the sections following.

3.1 Ponds and Wetlands

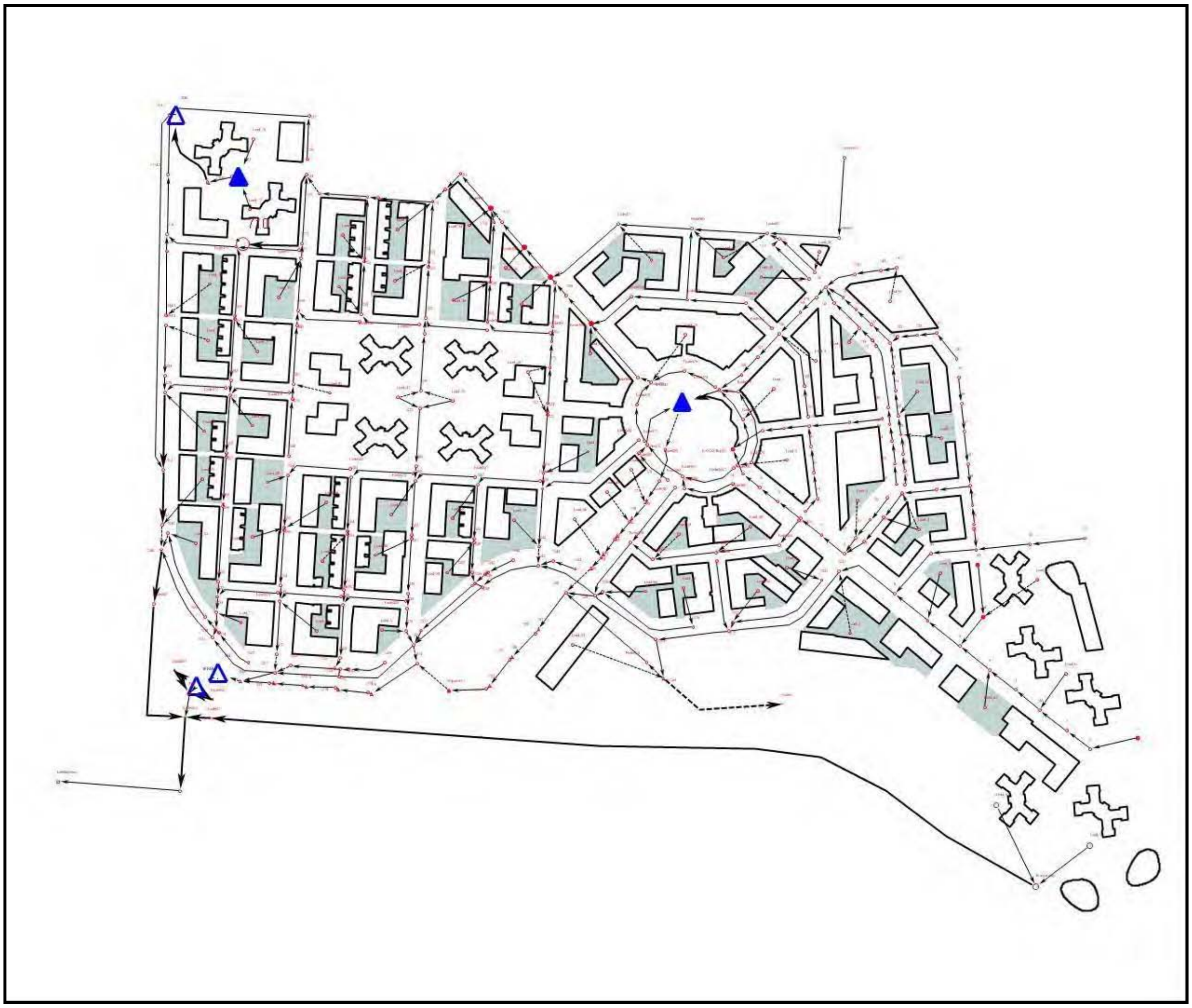
Ponds and wetlands will detain and treat stormwater at several locations. Wet detention ponds in Juan Bautista Circle and on Parcel P1 provide year-round water features. Terminal pools at the northwest and southwest corners of the site create treatment wetlands that provide final polishing before discharging to Lake Merced. All ponds and wetlands were modeled as lined, details of which will be provided during detailed design.



Typical Wetpond Section (source: SF Stormwater Design Guidelines)

Each pond was modeled using a storage node. The ponds are expected to become lined with silt removed by the treatment process, so infiltration was neglected. Each storage node has a stage-volume calculation, which is used to keep track of the detention volume. In future water quality studies, the ponds may be converted to BMP nodes, to simulate pollutant removal rates. Each pond has a weir and orifice. The weir is designed to safely pass the design storm flow, while the orifice is sized to drain the pond within the recommended draw down time.

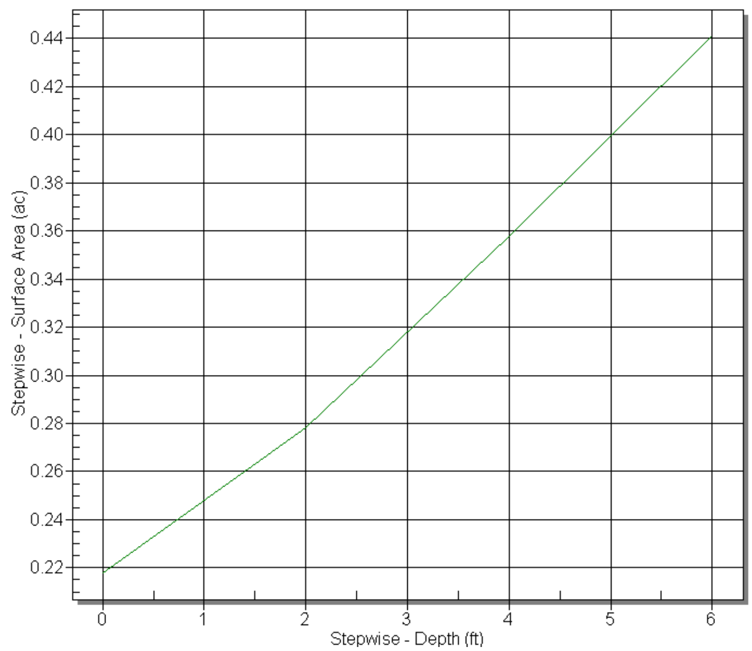
While the detailed configuration of each pond was not modeled, there should be a provision for sedimentation accumulation at points that can be easily accessed by maintenance equipment. For example, a forebay is often used at the head end of a constructed wetland as shown in the section above, so that most of the deposited sediment accumulates in one place and can be easily removed when it significantly reduces the volume of the pond.



Locations of Wetlands and Wet Ponds

3.1.1. *Juan Bautista Circle Wetpond/Wetland*

This pond may be coupled with a cistern to provide underground storage. Sized as a wet pond to detain runoff less than the 5-year storm, it would cover approximately 0.44 acres when full in the winter, with a permanent pool of approximately 0.36 acres through the summer. The average pond depth will be 4 feet and the maximum pond depth will be 6 feet. The pond is designed to draw down to the permanent pool in 48 hours and will overflow to the stream.



Assumed Stage-Area relationship in Juan Bautista Circle Wet Pond

3.1.2. *Parcel 1 Wetpond/Wetland*

This pond will be a permanent water feature and will collect runoff from the roofs of the two existing towers on Parcel 1. It will overflow to the terminal pond in the northwestern corner.

3.1.3. *Terminal Wetponds/Wetlands in the Southwestern corner*

These ponds will be sized to add additional nutrient removal, as necessary, as a final polishing to the runoff flowing to Lake Merced. A constructed wetland functions similarly to a wet pond, but is typically shallower and has more vegetation which increases the rate of nutrient removal.

3.1.4. *Terminal Wetponds/Wetlands in the Northwestern corner*

These ponds will function similarly to the southwestern terminal ponds. They will provide the final treatment to all runoff from the northern 1/3 of the site, before it reaches Lake Merced. These ponds will or share an outfall with the southwestern terminal ponds. The various outfall options are listed in section 4 of this TM.

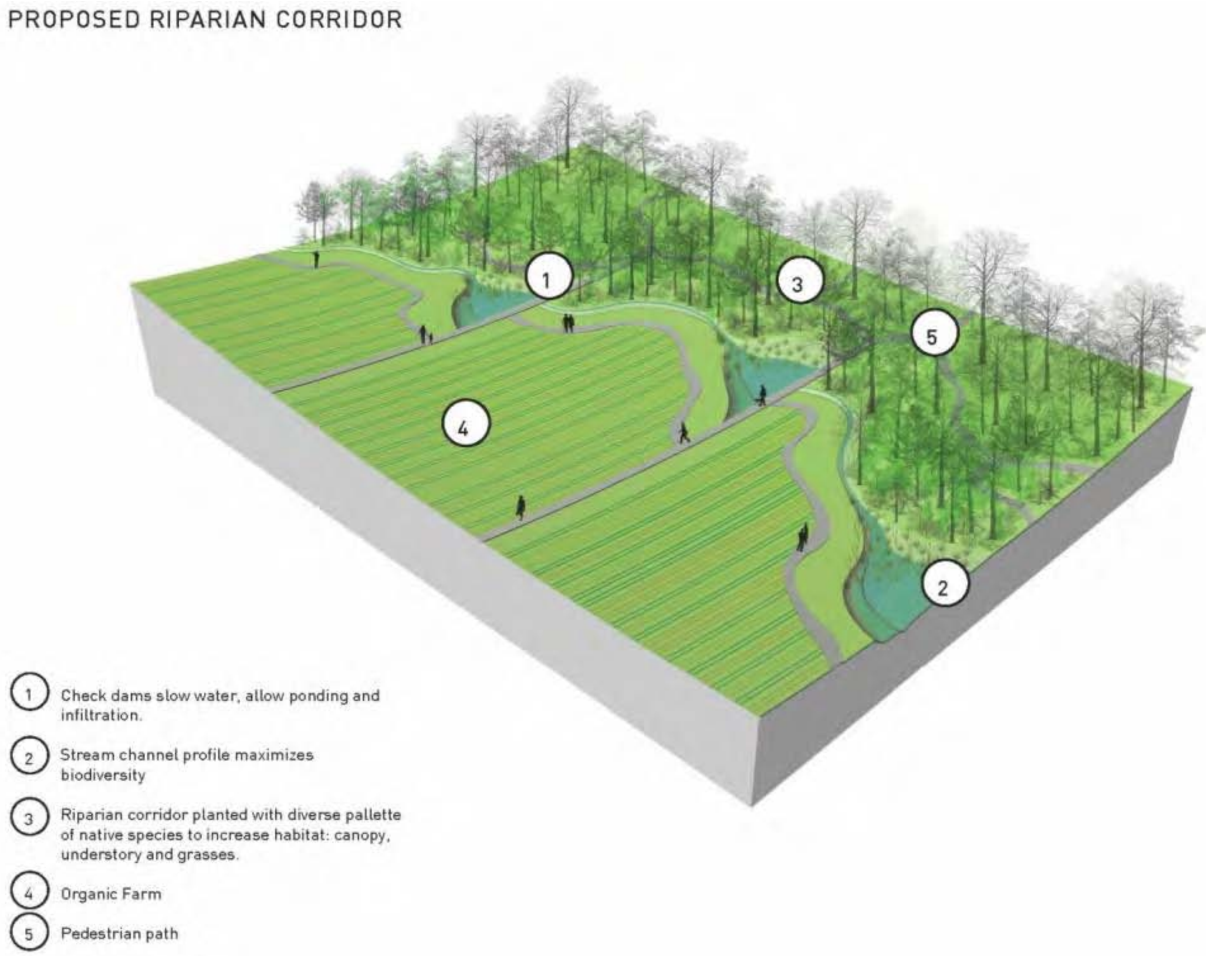
3.2 Stream/Riparian Corridor

A stream connects the central detention/treatment pond to the terminal ponds. It will have a series of cascading pools held back by low weirs, as it winds its way through a riparian corridor and organic farm. It was assumed in the model that the stream will be lined, details of which will be provided during detailed design.

A schematic of the riparian corridor is shown in the figure on the following page. The stream in the riparian corridor is approximately 2,000 feet long and will convey overflow from the Juan Bautista pond and from the swales and biogutters in the Hedgerow Streets, Alley Ways and Gonzalez Drive.

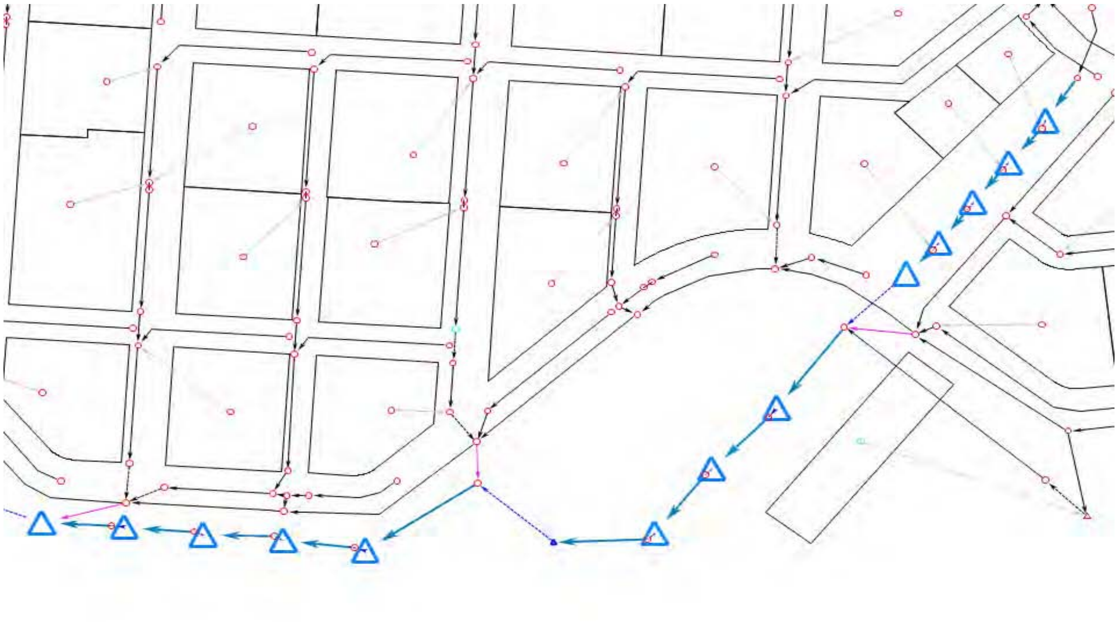
The pond, swales, and biogutters will serve as pre-treatment for the stream by removing sediment. The stream will include check dams to force ponding at approximately 12 locations which will provide storage for stormwater runoff. Each ponded area will cover approximately 300 square feet and pollutant removal will occur along the entire length of the stream. The riparian corridor will not be supplemented with additional fresh water during the summer months.

The stream was modeled as a shallow channel. At the end of each section, the triangular storage nodes represent the cascading pools. The storage nodes have stage-volume calculation, and are used to keep track of the detention volume. Each pool has an overflow weir connected to the downstream section of stream, and a small orifice that drains the pool to provide live storage volume for the next storm. Because of the proximity of the stream to the steep slope along the south of the property, infiltration is not proposed for the stream.

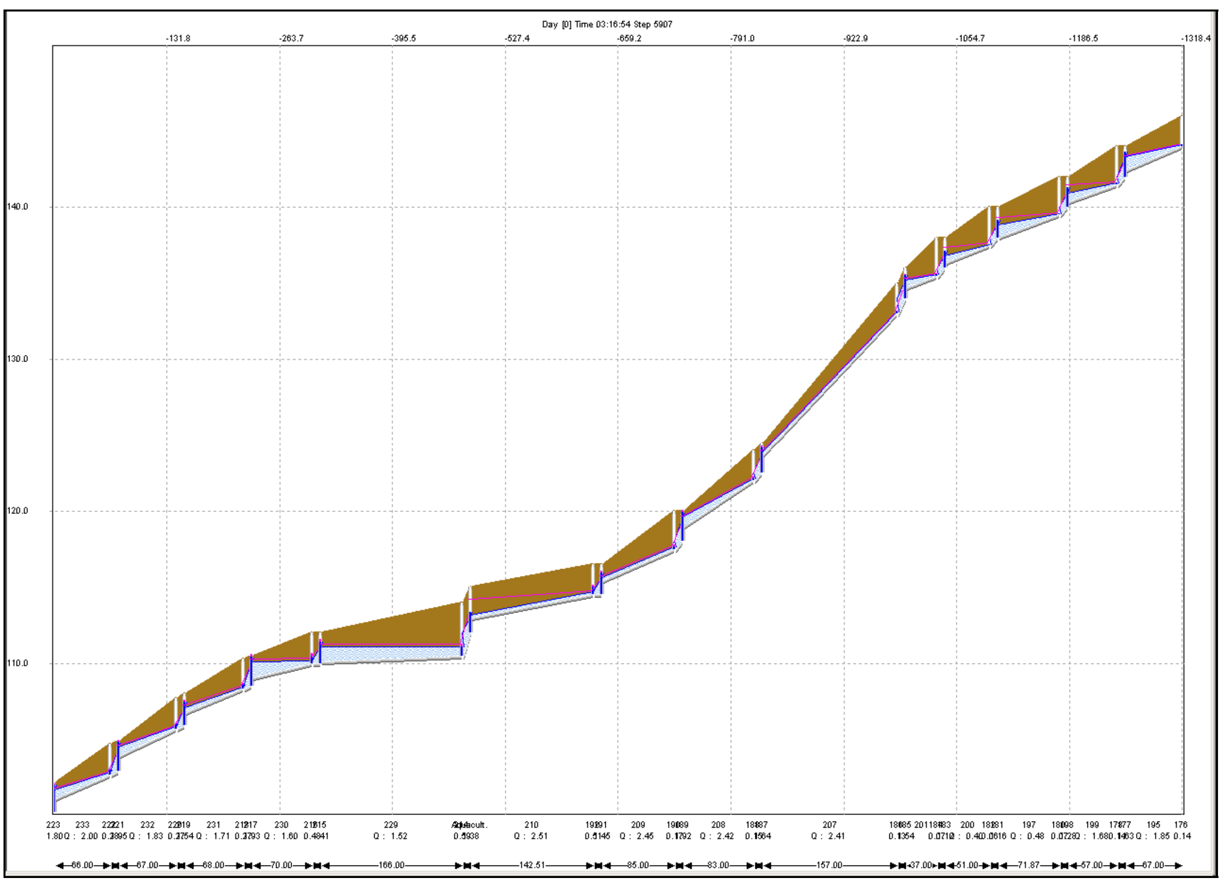


Source: Tom Leader Studios

<<note: per text on previous page, stream will be lined and will receive only seasonal flows>>



Locations of Stream and Cascading Ponds in Model



Elevation Profile along Stream section above (Juan Bautista Circle to Terminal Ponds)

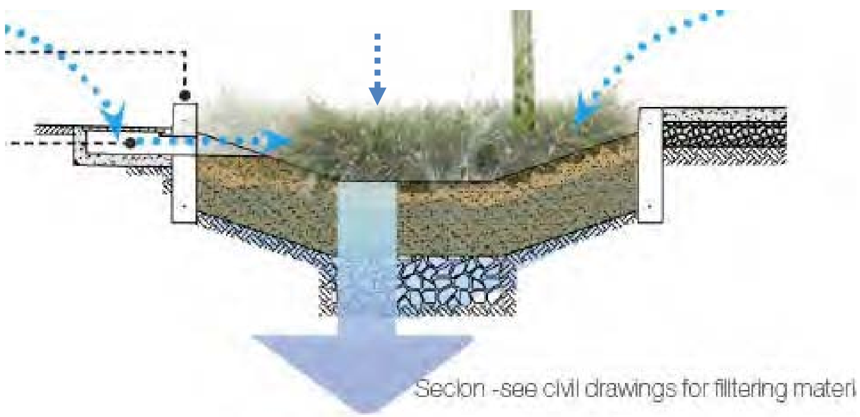
3.3 Bioswales

There will be bioswales in two general locations—the Hedgerow streets and Gonzalez Drive. There may also be a swale along Brotherhood Way from Chumasero Drive to Lake Merced Boulevard, although this is not on Parkmerced property.

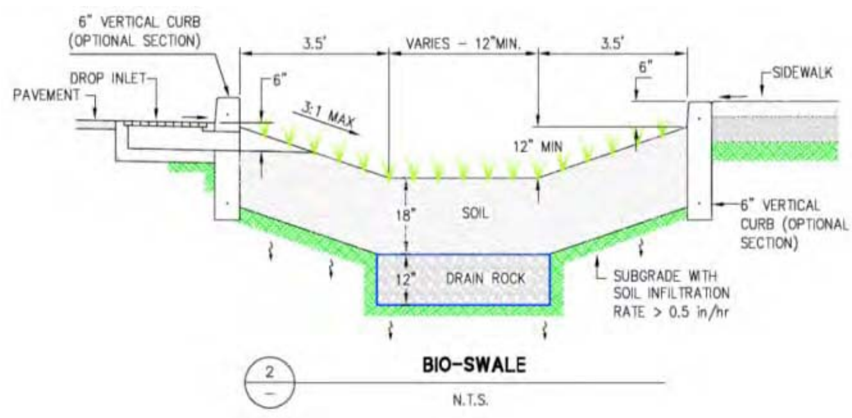
All of the bioswales will be unlined, encouraging infiltration. The bioswales are not designed to provide storage. Rather, they convey, treat, and infiltrate flows.

The swales on each block will be connected to the next block by underground culverts. The details of these culverts are yet to be determined, but the swale and culvert combination is sized to convey the 5-year design storm along the entire street. At the end of the street, the swales connect to the stream, which ultimately directs flows to the terminal ponds and Lake Merced.

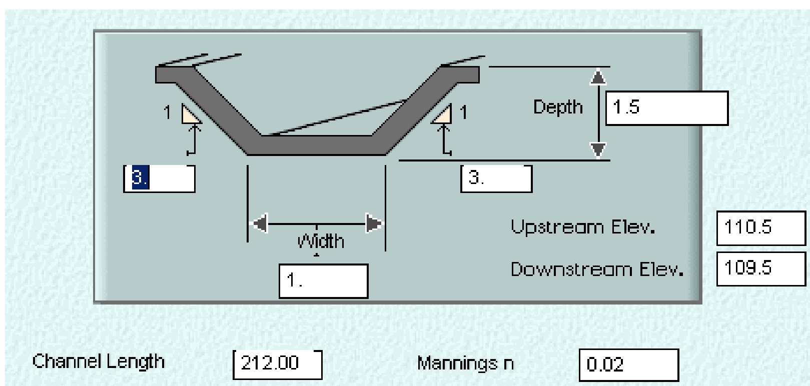
Bioswales are vegetated channels used for collection, infiltration and conveyance. Each proposed bioswale was modeled as a trapezoidal open channel, with exact dimensions provided by the site civil engineer. The swales take the place of storm sewers, and were sized to convey the standard municipal design storm (5-year, 3-hour). Infiltration rates were calculated based on the plan area of each swale.



Bioswale Schematic (source: SOM)

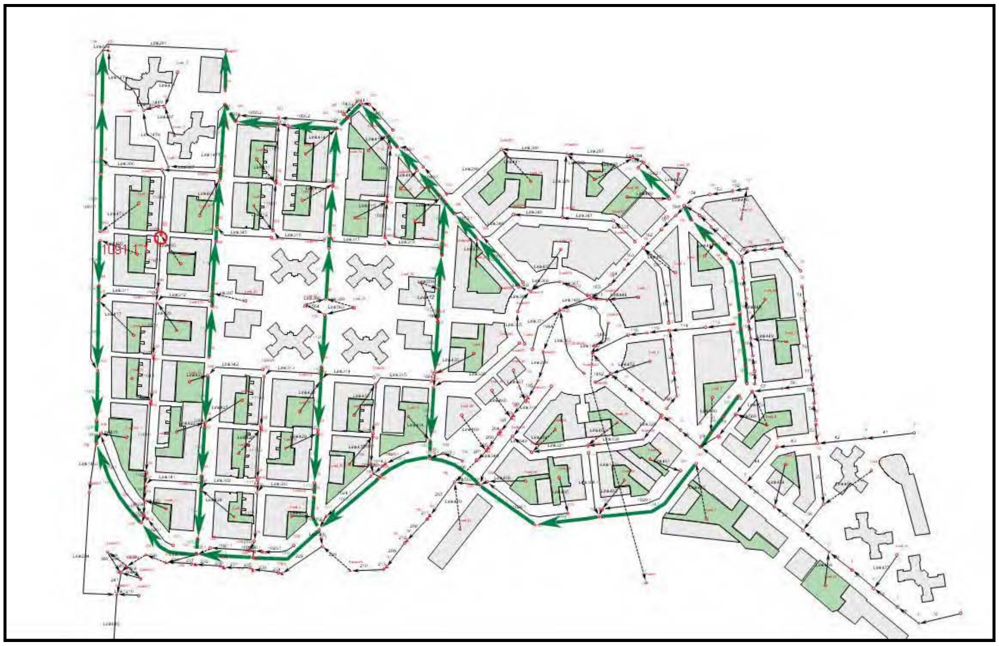


Bioswale Section (source: BkF, 2-1-2010)



Bioswale Section as Modeled (typ)

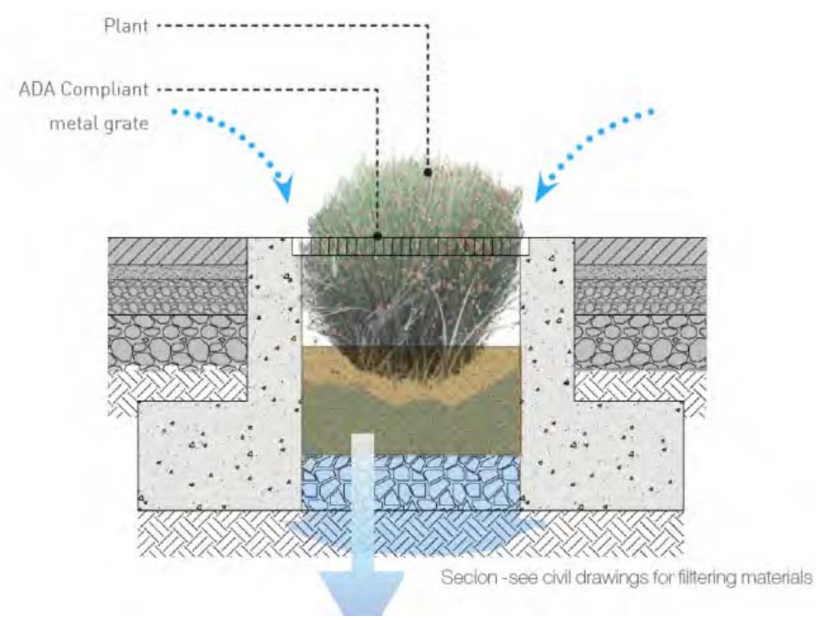
<<note 3:1 side slope>>



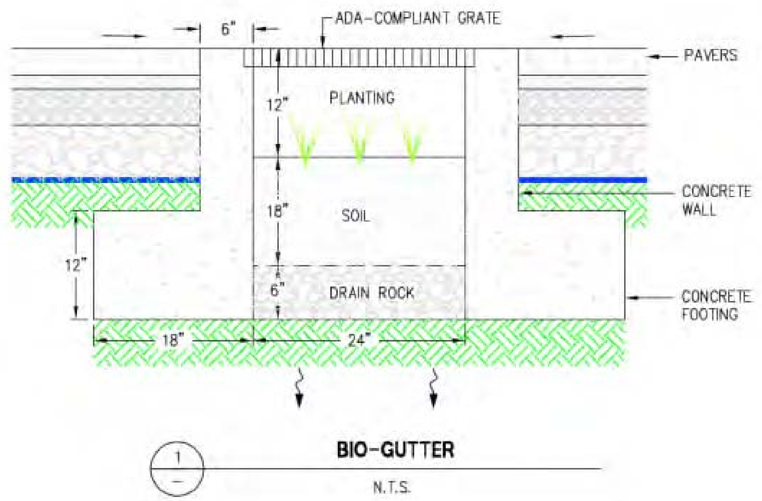
Locations of Bioswales in Model

3.4 Biogutters

Biogutters are small vegetated channels that collect and infiltrate runoff from smaller catchments and will be used on narrower streets, such as the Alley Ways, where space for a swale is not available. A thick layer of bioretention soil mix increases the infiltration rate, and provides some treatment. The biogutters are also sized to replace the typically required storm sewers.

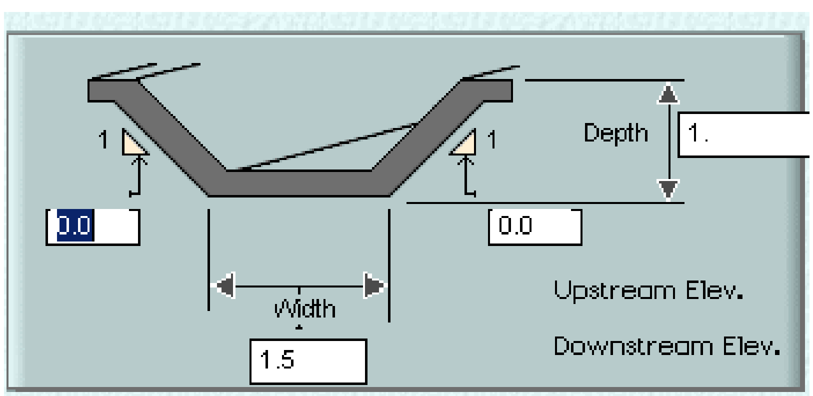


Biogutter Schematic (Source: SOM)



Biogutter Section (Source: BKF, 2-1-2010)

Each biogutter is modeled as a rectangular open channel link with a Mannings n factor of 0.016. Weighted infiltration rates were calculated and applied to the runoff node loading each biogutter.

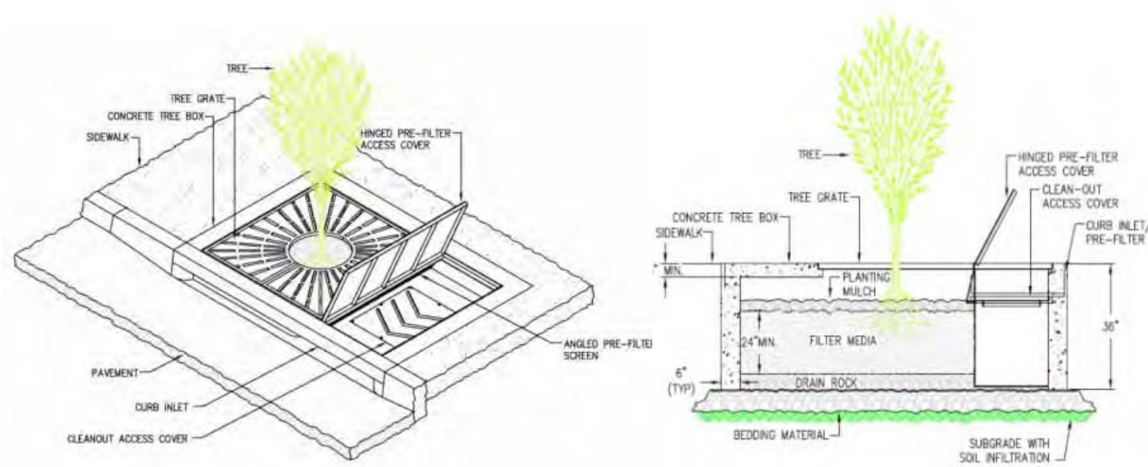


Biogutter Section as modeled (typ)
<<note vertical side slope>>

Locations of Biogutters in Model

3.5 Biofiltration Treewells

Treewells are provided to temporarily store and infiltrate runoff. A weighted infiltration rate was developed for a typical treewell. Then the number of treewells within the contributing area of each runoff node was counted using GIS software. This count was then used to develop a separate subcatchment in each runoff node, representing only the treewells.

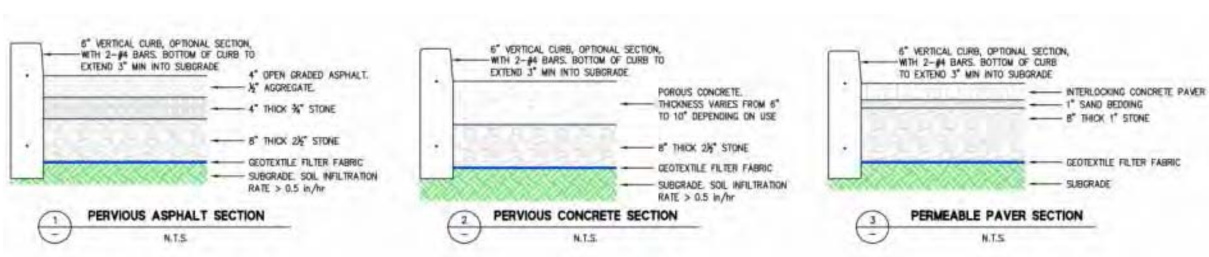


Biofiltration Treewell Schematic (Source: BKF, 11-25-09)

Location of Biofiltration Treewells (Source: SOM, 10/14/2010)

3.6 Permeable Pavements

Permeable paving will be installed in pedestrian walkways, alleyways, parking lanes, and other low-traffic areas to allow water to infiltrate at these hardscape areas. The permeable paving may take the form of permeable asphalt, permeable concrete, or permeable pavers. As modeled, the permeable surfaces were assigned the infiltration rate of the underlying soils.



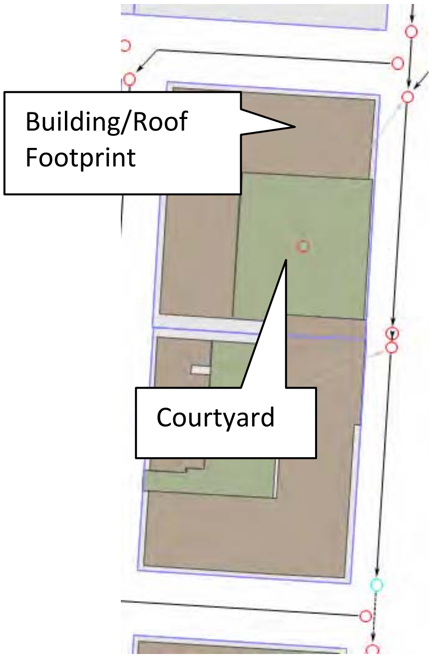
Permeable Pavement Options (Source: BKF, 11-25-09)

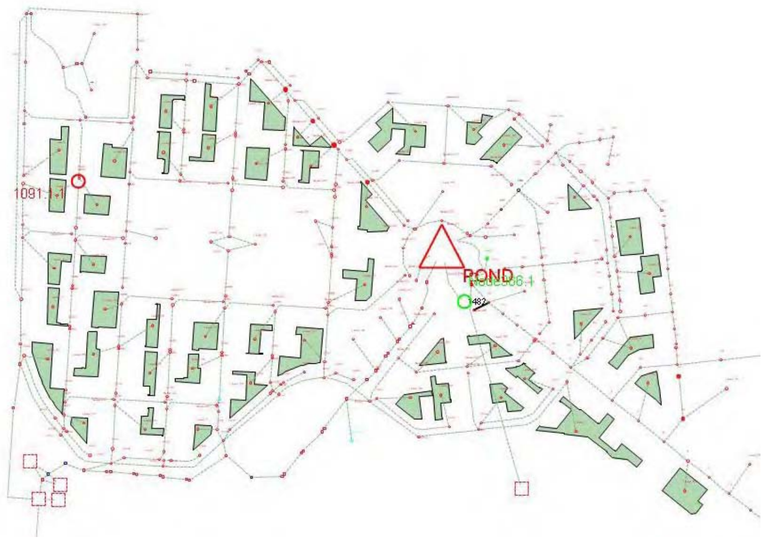
3.7 Eco-Roofs in Courtyards

Most blocks in Parkmerced will have a central courtyard, surrounded by buildings. The courtyards will be located on top of parking structures, and function as eco-roofs. They will collect runoff from adjacent roofs, providing temporary storage in the soil layer, and removing pollutants as excess flows pass over the vegetated areas towards the bioswales and biogutters. The Parkmerced Design Standards + Guidelines outline a typical courtyard layout, including a stream and pond, as shown in the figure below.

Typical Courtyard Layout (Source: SOM)

Across all of Parkmerced, a total of 25.7 acres of roof will drain to 13.3 acres of courtyards. 15.5 acres of roof will drain directly to the swale network, on blocks where there are no courtyards. Each courtyard eco-roof was modeled as a runoff node, with several separate subcatchments to represent the roof runoff, the pervious courtyard surfaces and the impervious courtyard surfaces. Runoff redirection was used to model the effect of roof runoff flowing onto the courtyard. Each courtyard could have a small pond or cistern, represented in the model with a storage node.

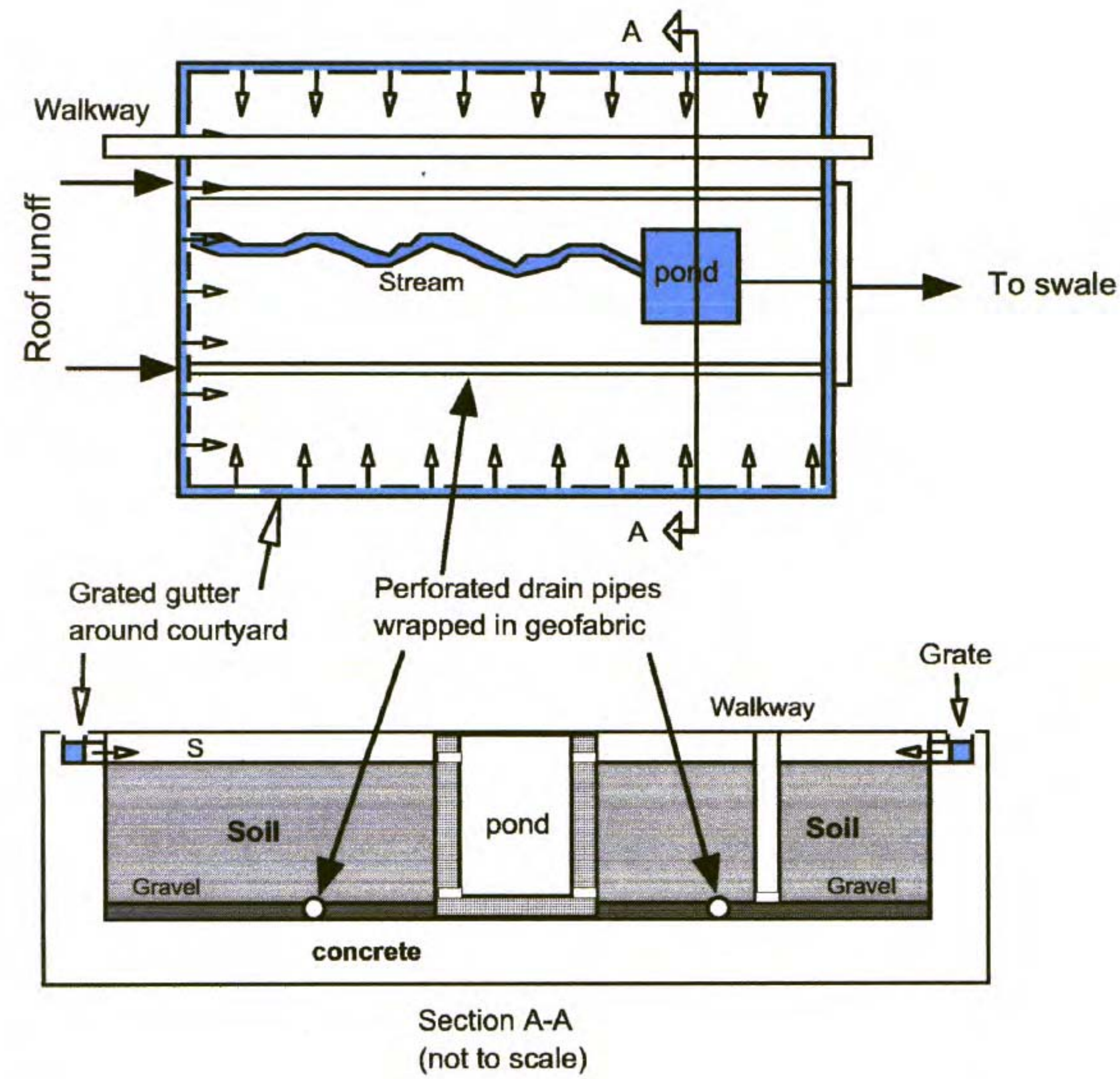




Typical Courtyard layout *Locations of Courtyards*

The courtyards will be built on a 3 foot thick layer of soil, and the average courtyard covers about 12,000 square feet. With a typical available pore space of 10%, the soil layer in an average courtyard will provide about 3,600 cubic feet of storage. A system of underdrains will be needed, as shown in the figure on the following page. The underdrains will prevent the soil from becoming waterlogged, as well as draw down the storage volume so it is available for subsequent storms.

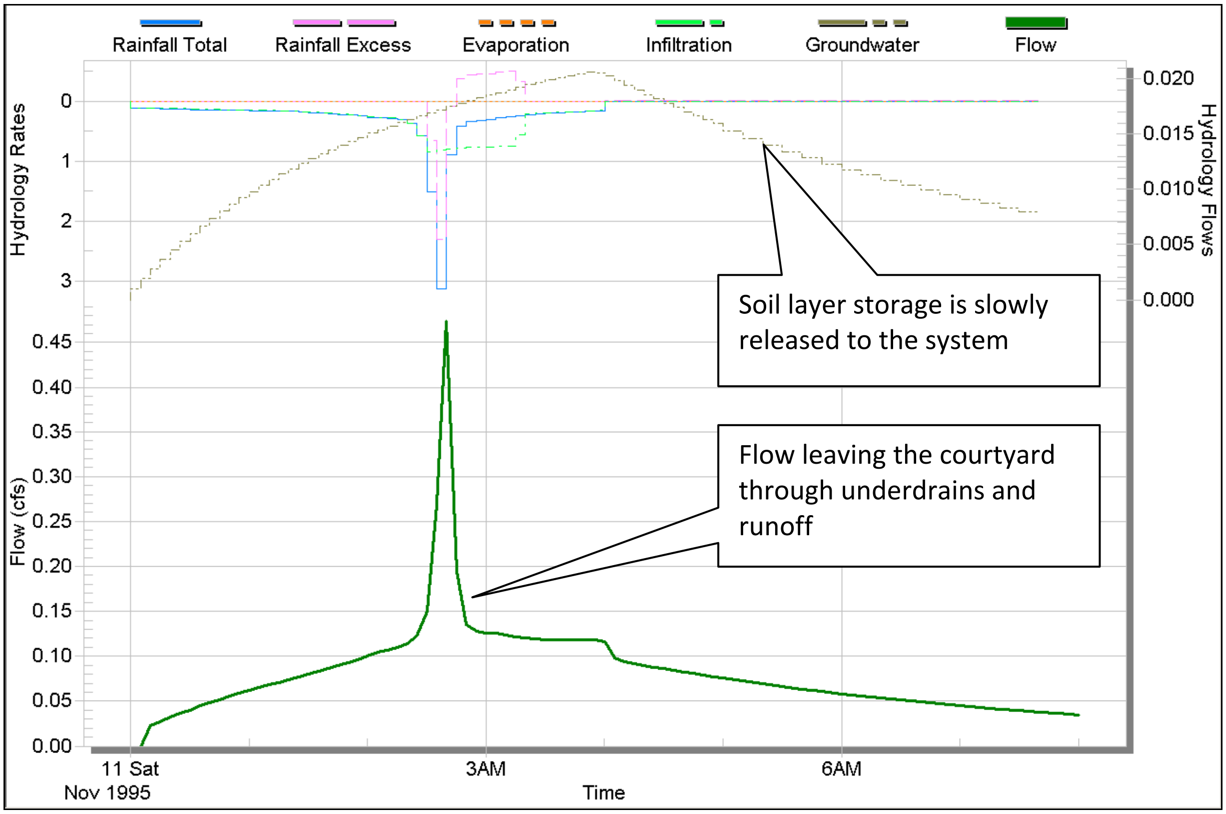
Additional temporary stormwater storage may be provided on the courtyard surface in the small ponds and streams. These features will provide additional storage on the order of 500 cubic feet for a typical courtyard. The ponds must be designed such that they drain in 48 hours to be ready for the next storm. Roof runoff must be added to the courtyards at distributed points for better distribution over the soil.



Conceptual Courtyard Schematic

The combined runoff from the roofs and courtyards will infiltrate into the soil layer, but since the courtyards are on top of parking garages the flow does not leave the system through deep percolation. The groundwater option in the runoff node was used to keep track of this flow.

Normally, in the groundwater data, runoff infiltrates to a user defined groundwater table, and then percolates elsewhere based on hydraulic conductivity settings. Groundwater can be "lost" from the system, or a specific node can be defined as the outlet. For the eco-roofs an outlet node was defined, so that the groundwater is slowly released back to the system as though through under-drains.



Courtyard model results, illustrating assumed soil-storage detention behavior

3.8 Cisterns

Stored stormwater will be used to provide make-up water to the pond, and possibly stream, during the summer months. Stormwater could also be used for irrigation of the farm and possibly playing fields if the use of recycled water is of concern.

The size, location, and design of the cisterns are not final, pending a value engineering study to determine the most cost effective approach for a stormwater storage solution. The two potential locations, underground next to the pond in Juan Bautista Circle or underneath part of the playing field, and their corresponding contributing areas are shown in the figure on the following page. The model currently assumes a single 1.05 MG cistern at Juan Bautista Circle, supplying the farm irrigation and pond make-up water demands.

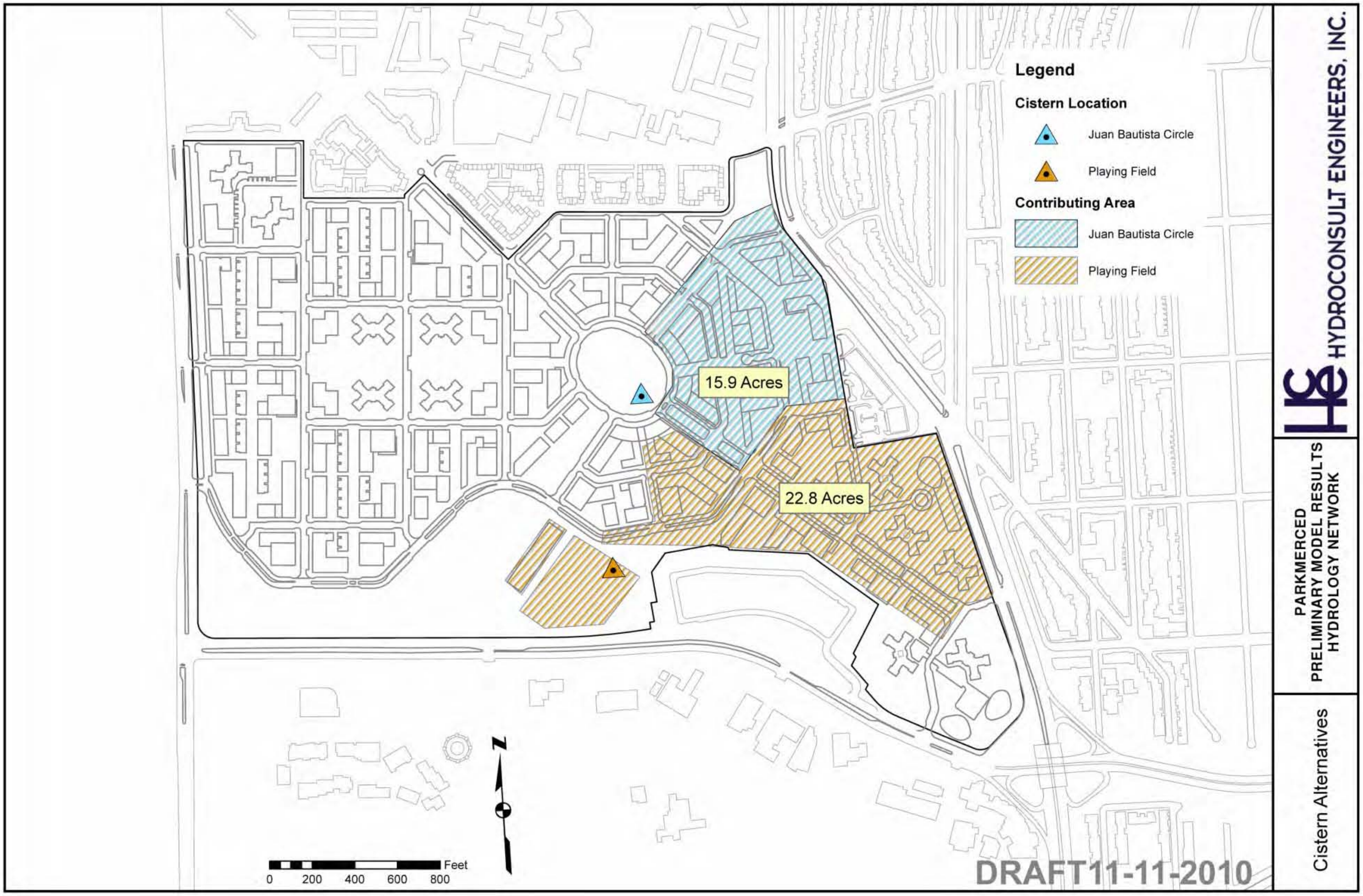
At either location, the stormwater would likely be stored a subsurface plastic chamber system, such as the StormTech detention/retention system. A concrete chamber could also be used.

StormTech Subsurface Chambers

On top of a cistern, the playing field turf could be planted in an engineered sand layer. This layer provides additional stormwater storage, as well as allowing high efficiency sub-surface irrigation. The unique drainage design eliminates surface runoff and the need for a crowned field.

The sand layer developed by Rehbein Environmental Solutions, or similar product, has been used in a number of playing field applications. The trays in the figure below are filled with a 2 inch layer of fine gravel which, along with the semicircular reservoir, stores and drains water. The gravel and reservoir are then covered with 11 inches of washed sand, in which the turf is planted. The sand layer allows the grass to self-water via capillary action. This general concept is often used in golf courses, and results in deep-rooted, uniform grass which should be well suited to the playing field. In large applications like this field, an EPDM liner may be used instead of the trays

Rehbein EPIC Tray System


Legend
Cistern Location
Juan Bautista Circle
Playing Field
Contributing Area
Juan Bautista Circle
Playing Field
15.9 Acres
22.8 Acres
Feet
0
200
400
600
800
N
DRAFT11-11-2010
HYDROCONSULT ENGINEERS, INC.
PARKMERCED
PRELIMINARY MODEL RESULTS
HYDROLOGY NETWORK
Cistern Alternatives

4. Outfall Options

The following five options are being considered for discharge of stormwater runoff from the site to Lake Merced. As described previously, approximately 93% of the annual average runoff will be infiltrated or re-used onsite with approximately 7%, or roughly 4.8 million gallons per year on average flowing directly to Lake Merced. Based on the model, this flow can be accommodated by a new 36" diameter concrete pipe (n=0.014) connecting to the existing 48" diameter CMP culvert (n=0.03, capacity approx. 95 cfs). Further studies will examine the potential impact of this inflow to lake water quality. Figures depicting each option are shown on the following pages.

Pending the results of future water quality modeling, it may be necessary to provide additional treatment under options 1-3. This treatment would likely be provided by a subsurface organic media filter at the upstream end of the culvert discharging to Lake Merced.

Media filters have adsorptive and ion-exchange capabilities and are effective at removing dissolved pollutants and organics. The media will be selected to target specific pollutant removal (e.g., nutrients of concern to Lake Merced). The media filters will be a below-ground unit set in a concrete vault at least 1.5 feet deep.

Option 1—In this option, stormwater would flow from Parkmerced to Lake Merced via an existing 30" diameter corrugated iron pipe culvert which originates around the location of the abandoned pump station at Vidal Drive and Garces Drive.

Option 2—In this option, stormwater would flow from Parkmerced in a new culvert underneath Brotherhood Way to a depression just south of Brotherhood Way, east of Lake Merced Boulevard. This depression has historically been a pond (see Appendix A, drawing #3), and appears to have been connected to Lake Merced before construction of Lake Merced Boulevard. The depression would be allowed to fill, with overflow to the Lake via the existing 48" corrugated metal pipe culvert.

Option 3—This option is similar to Option 2 but with flows bypassing the depression and flowing directly to the existing 48" corrugated metal pipe culvert. A new culvert would pass beneath Brotherhood Way to connect to the existing culvert.

Option 4—In this option, all stormwater runoff up to the 5-year storm would be detained on site. The surface storage would remain the same as the previous options with the addition of stormwater drainage wells, the locations of which have not yet been determined. Siting of the stormwater drainage wells would consider proximity to drinking water wells and provide adequate depth to the drinking water aquifer.

Option 5—In this option, excess runoff from Parkmerced from up to the 5year storm would be discharged directly to the existing combined sewer pipes that flow to the Oceanside Water Pollution Control Plant.

All five options were considered in the EIR. Options 2 and 3 were modeled as described in the following section. Option 1 was not modeled because it is unlikely the existing pipe will be located. Options 4 and 5 are considered project variants and were not modeled.

If option 1, 2, or 3 is selected, provisions will be made to divert or contain nuisance flows (e.g. runoff during dry weather from accidental spills or SSOs) at the end of the most downstream pipe leaving the project site to protect such nuisance flows from reaching Lake Merced.

4.1 Terminal Pipe as Modeled (Outfall Options 2 and 3)

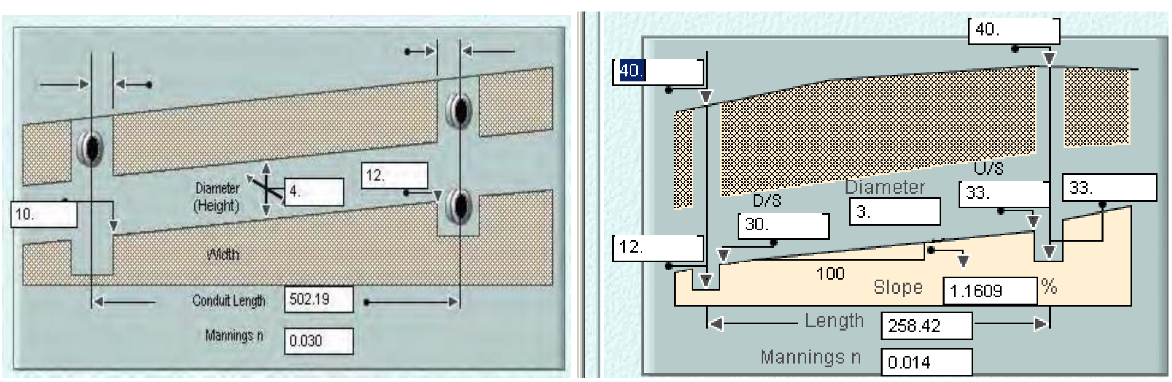
An existing 48” CMP (Corrugated Metal Pipe) culvert under Lake Merced Blvd was modeled as a starting point to size the required outlet pipe for Parkmerced. This culvert starts on the East side of the road in a deep overgrown depression South of Brotherhood way. It leads under the road to Lake Merced according to available documents below, although this should be field verified.

A fixed backwater outfall control was assumed at 14.9 feet, City Datum. This control elevation was selected after reviewing “Conceptualization of the Lake-Aquifer System – Westside Ground-Water Basin”, a hydro-geological report on the history of Lake Merced and the surrounding groundwater basin.

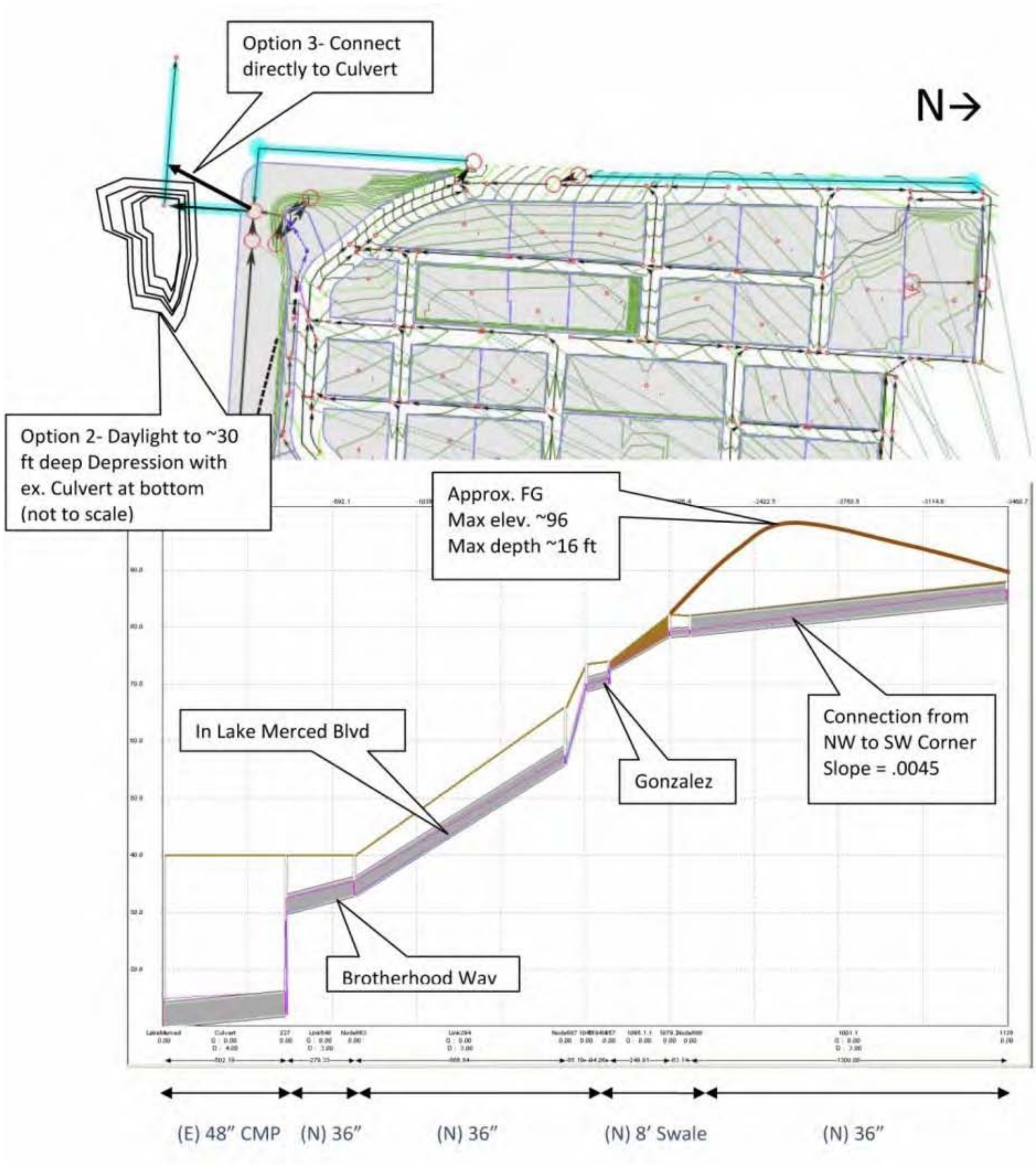
According to this report, the highest recorded elevation was 23.5 feet above mean sea level, when the lake last overflowed to the ocean. This level was converted to CCSF datum per BOE file LL-15330.2, to arrive at the control elevation of 14.9 feet. This elevation submerges the downstream end of the culvert completely.

The culvert was modified during construction of a sewer tunnel, introducing a sump where a section of the culvert was lowered to allow the tunnel to cross over it. This change was represented in the model with an entrance loss coefficient.

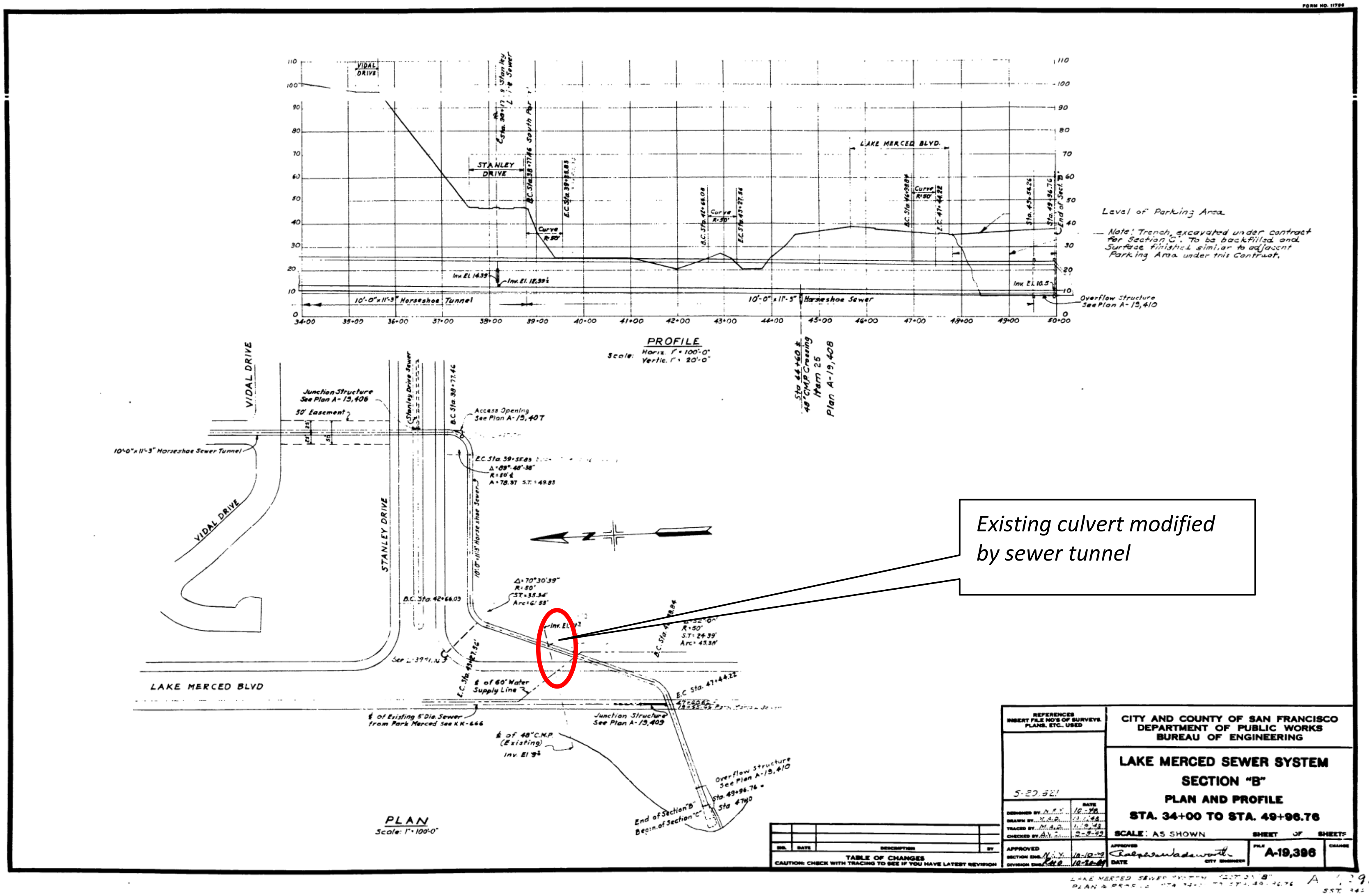
A proposed new 36” diameter pipe was modeled to cross Brotherhood Way and connect Parkmerced to the above mentioned 48” CMP culvert. Ground elevations were assumed to be 40 ft, which is the elevation at the intersection. There is a large elevation drop between Parkmerced and the 48” culvert. If there is a problem with the exact elevations assumed, the large elevation difference should allow a work-around to be easily found.



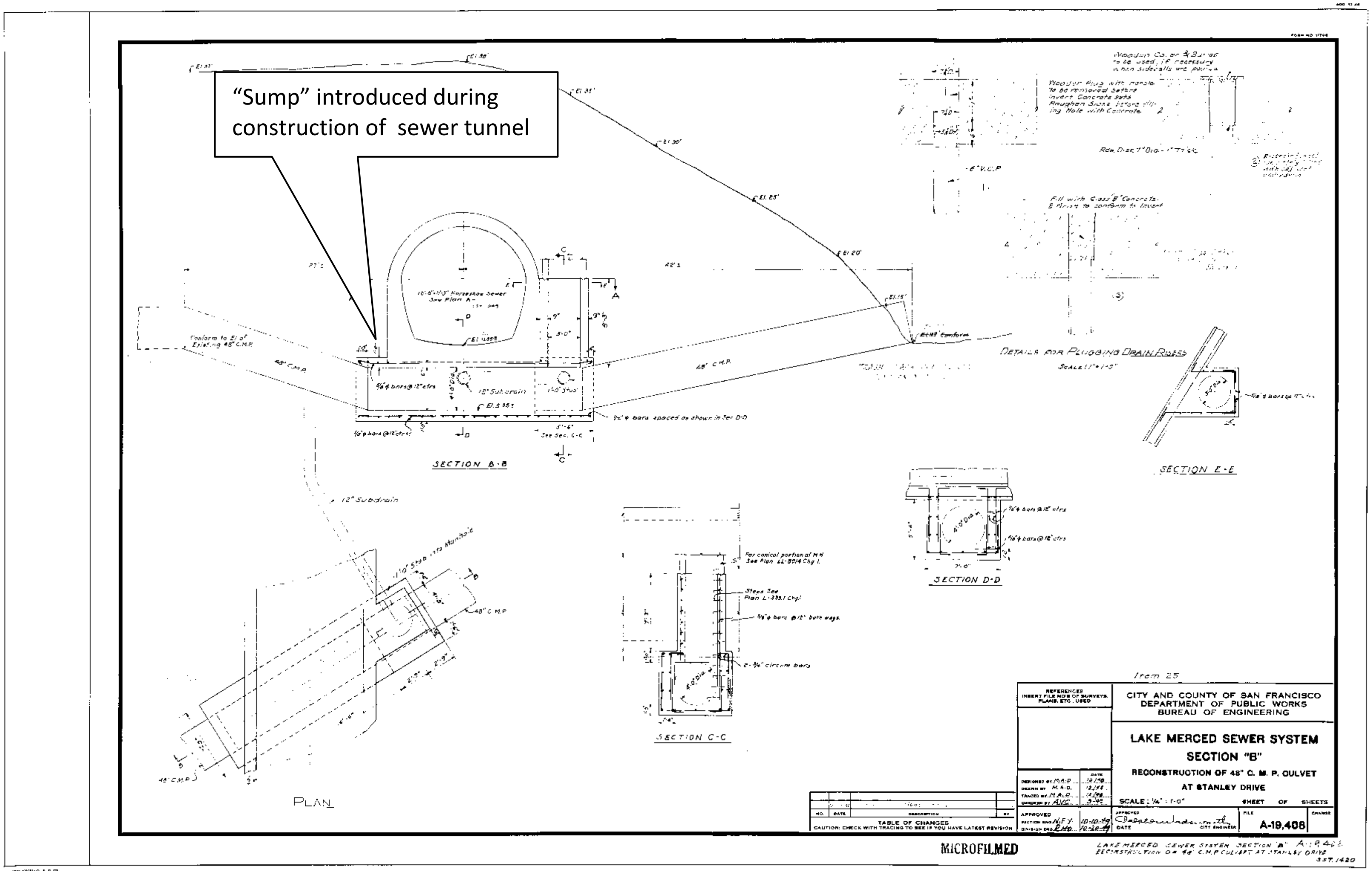
Pipe Details: Existing 48” CMP (left), Proposed 36” culvert (right)



Profiles: Outfall Options 2 and 3



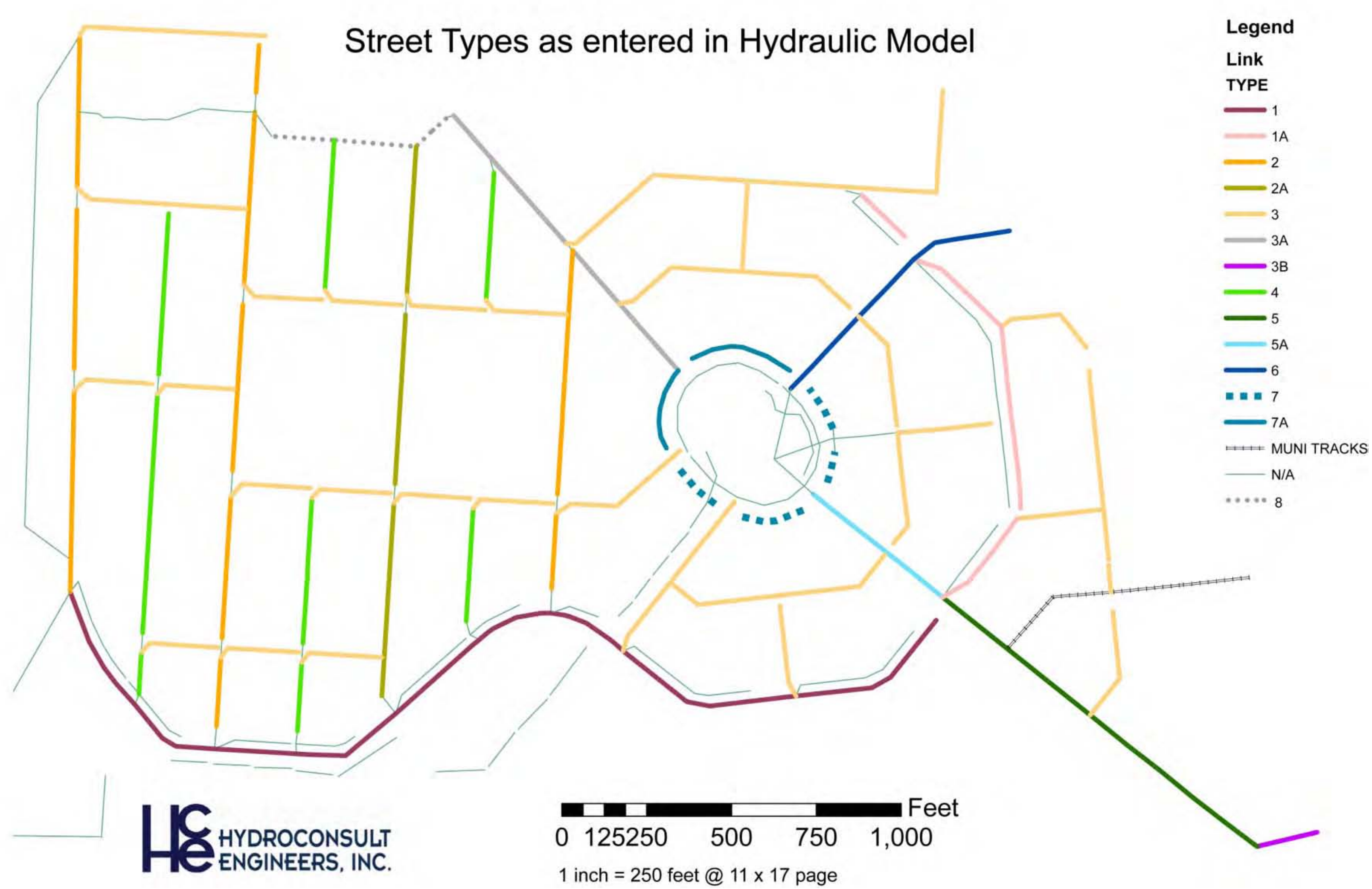
As-built Drawing of Terminal Pipe—PLAN (A-13,396)



As-built Drawing of Terminal Pipe—Profile (A-19,408)

5. Street Typologies

Cross-sections for each street type are provided below, with an explanation of how each street type was modeled. A map showing the location of each street type is shown below.



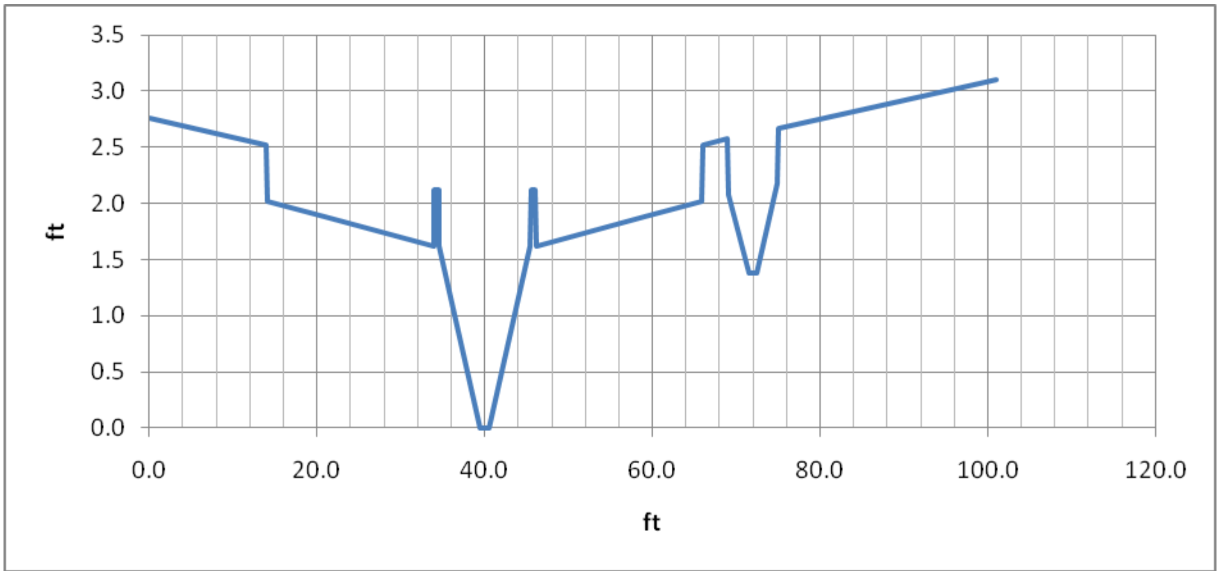
5.1 Gonzalez Drive (Type 1 and 1A)

The bioswale in the center of Gonzalez Drive will convey and treat runoff collected from the road surface as well as adjacent buildings. Sidewalk runoff will be captured and infiltrated by permeable pavement located in the parking lane, and will overflow to the bioswale. The bioswale will be 11 feet wide with sides sloped 3:1, a 6' curb on either side, and a 12" bottom width. The curbs will be designed to allow flow into the swale.

A second bioswale will be located on the South side of Gonzalez Drive, with dimensions as shown in the cross section below. This swale is located at the crown of the street, so it will not receive any runoff from the street directly. However, at various points along Gonzalez Drive, it will collect flows from other swales and pipes, including the swale in the center median of Gonzalez. It will have a net width of 6', 3:1 side slopes and will be 12" deep.

At several other points, the swale on the south side will overflow or discharge to other features. First, it will discharge to the cistern located under the playing field. At several points after that, it will connect to the stream.

In between the bike path and the sidewalk on the south side of the street will be a continuous planter with trees which will collect and infiltrate excess flow from the bike path. In some sections, Gonzalez was modeled as multiple conduits.



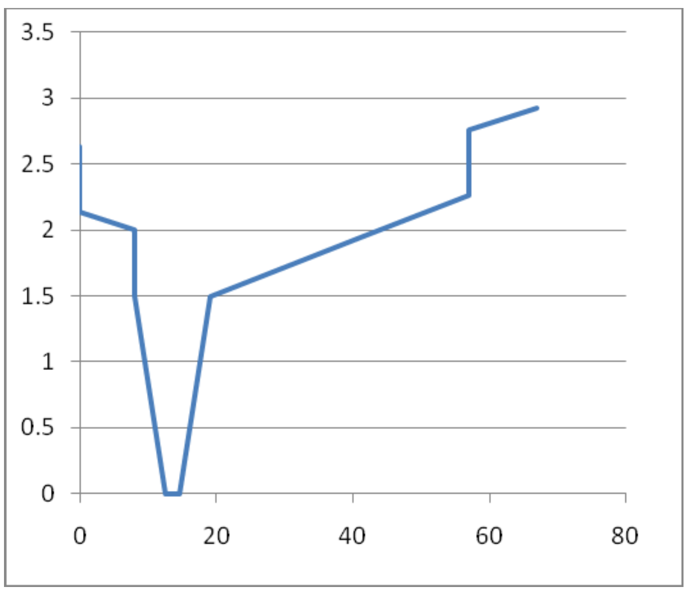
Modeled Street Cross Section Type 1

5.2 Bioswale Streets—Hedgerow and Pinto (Type 2, 2A, 8)

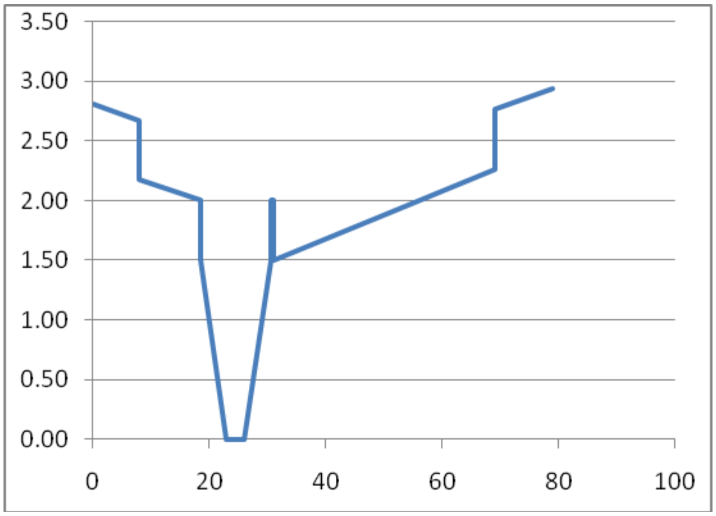
The Hedgerow streets run North-South and will include bioswales. The bioswale on the west side of the Hedgerow Streets will capture runoff from the street and the rooftops on the west side of the road. Runoff from the roofs on the east side of the road will be directed to the ecoroof above the central courtyard. Sidewalk runoff will be captured and infiltrated by permeable pavement located in the perpendicular parking spaces. Overflow from the permeable pavement and the courtyards will be directed to the swales.

The bioswales on the hedgerow streets will have a total width of 13 feet and a depth of about 1.5 feet. The minimum bottom width is 1 foot, with 3:1 grass side slope. There will be a 6 inch wide curb on either side, for a total width of 12 feet. The curbs will be design to allow flow into the swales.

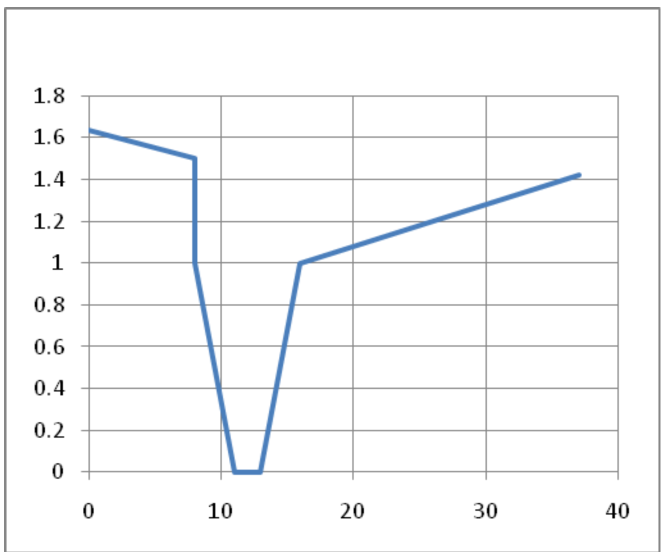
Pinto Avenue is not a Hedgerow Street, but will have a swale and so was modeled similarly. IN addition to the swale, Pinto will require an additional stormdrain or biogutter.



Modeled Street Cross Section Type 2



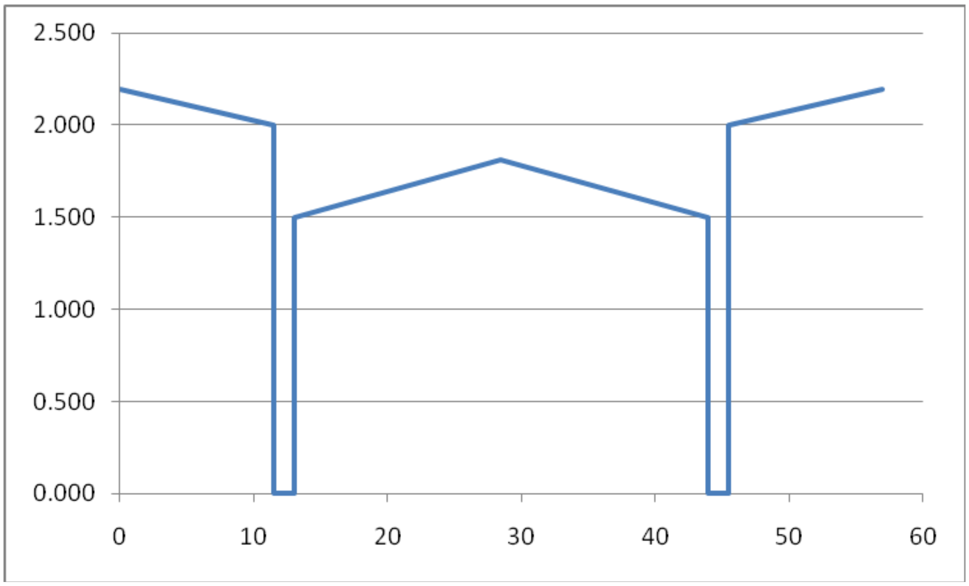
Modeled Street Cross Section Type 2A (Tapia)



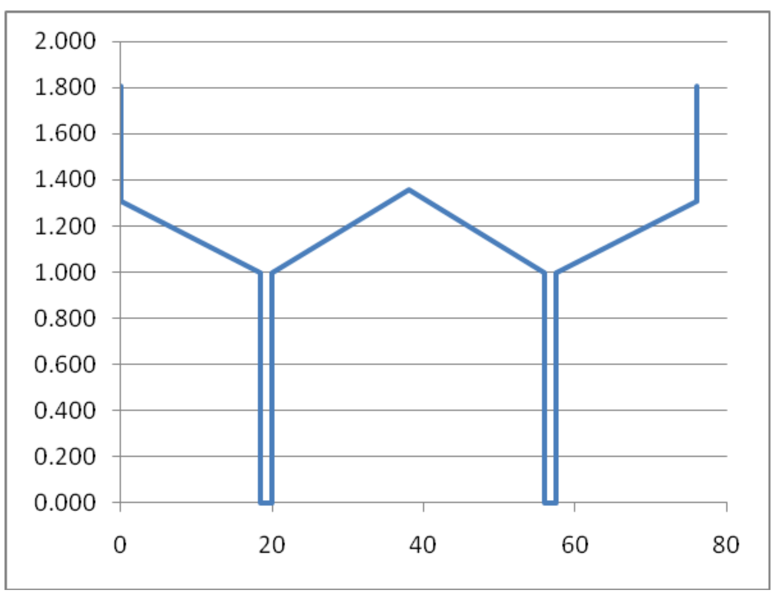
Modeled Street Cross Section Type 8 (Pinto)

5.3 Treewell Streets—East/West , Chumasero, Crespi (Type 3, 3B, 6)

These three street types have biofiltration treewells. Each biofiltration treewell is a precast concrete box with separate sections for stormwater pre-treatment and treewell planting medium. Located next to the curb approximately every 20 feet, the treewells provide temporary storage and infiltration. Street and sidewalk runoff is collected by permeable pavement in the parking lanes. The permeable pavement overflows to the treewells.

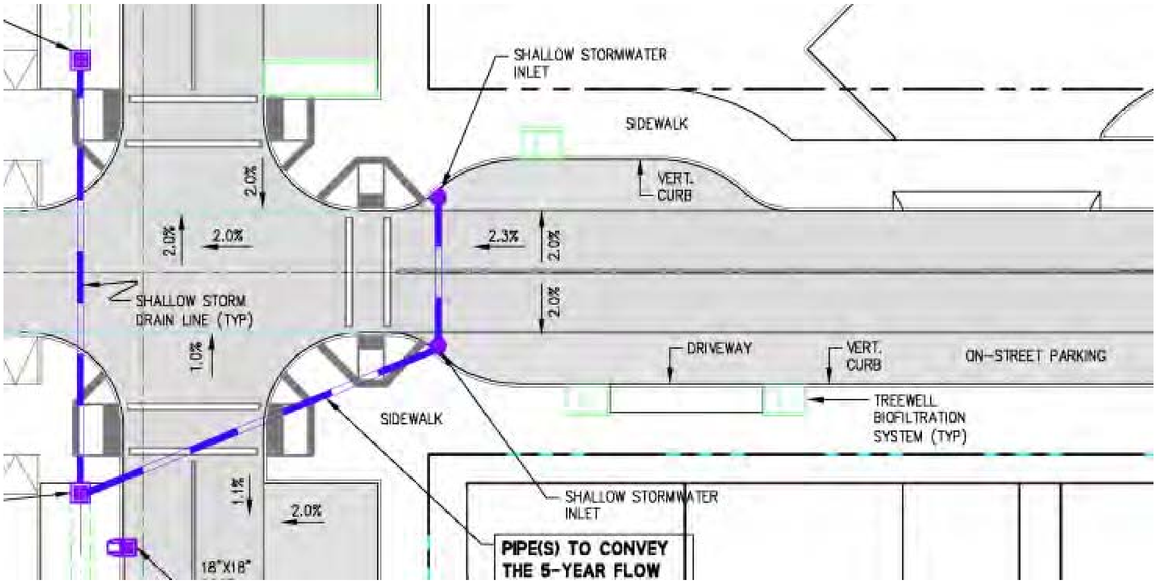


Modeled Street Cross Section Type 3/3B



Modeled Street Cross Section Type 6

Any flow in excess of the infiltration and storage capacity of the treewell will flow from treewell to treewell in either a below ground pipe, or above ground biogutter.. At the end of the block, storm drains and culverts will convey the flow to the nearest swale, as shown in this preliminary intersection layout.

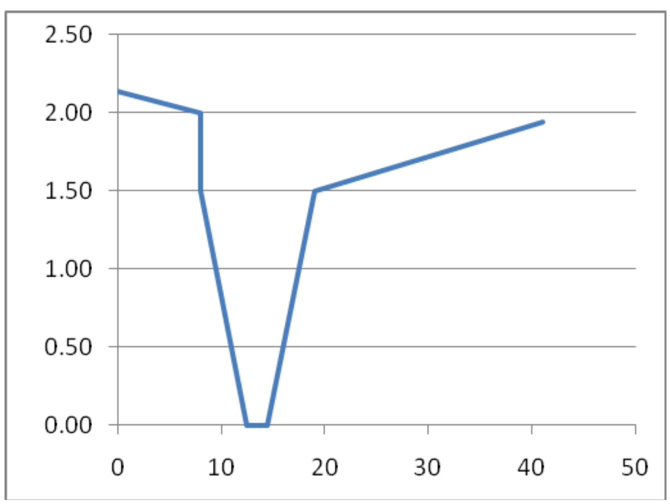


Source: BKF, 9-22-2009

5.4 Font Boulevard North (Type 3A)

Font Blvd extending from Juan Bautista Circle in a northwest direction to the northern project boundary. For the southern portion, the east side of the street from the crown to the Right of Way (R.O.W.) has biofiltration treewells and behaves similar to types 3 and 3B.

The west side of the street has an 8 foot wide swale which receives runoff directly from the sidewalk on the west. Street runoff flows to a permeable pavement (pp) and infiltrates, partly or totally, depending on pp infiltration. Excess flow, if any, discharges to the swale.

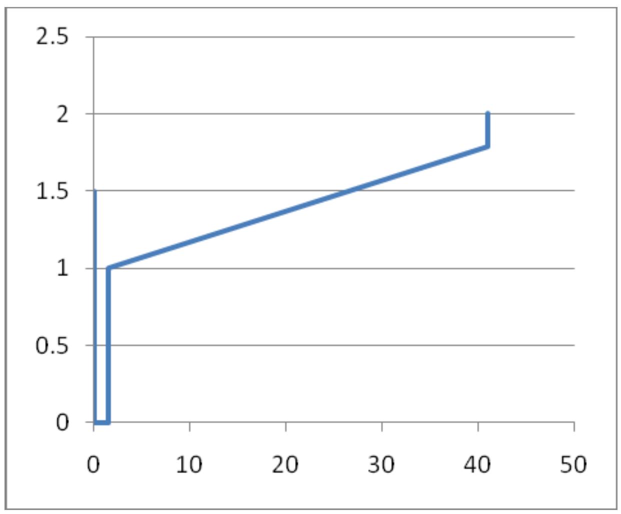


Modeled Street Cross Section Type 3A (north)

5.5 Alley Ways (Type 4)

The biogutters run north to south and function similarly to the bioswales but have vertical side walls thus providing less vegetation, and are narrower thus providing less infiltration. The biogutter on the west side of the Alley Ways will capture runoff from the roofs on the west side of the road. Sidewalk runoff will be captured and infiltrated by permeable pavement located in the street travel lane. Runoff from the rooftops on the east side of the road is directed to the ecoroof above the central courtyard. Overflow from the permeable pavement and the courtyards will be directed to the biogutters.

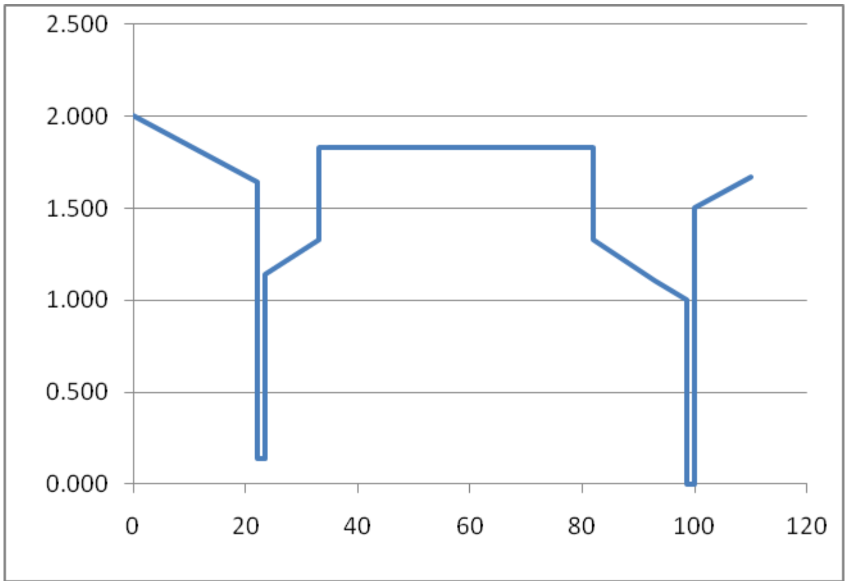
Biogutters in the Alley Ways are 2.5 feet wide with vertical sidewalls and a total depth of 1 foot, above a 2 foot deep layer of bioretention soil and drain rock.



Modeled Street Cross Section Type 4

5.6 Font Boulevard South (Type 5/5A)

Type 5 is along Font Blvd from Chumasero Drive to Gonzalez Drive is another street where there is no swale, and biofiltration treewells are used instead. Contrary to street types 3 and 3B discussed above, treewells in type 5B are only on one side of the street and receive flow from sidewalks and streets, both 100% impervious, plus overland flow, if any, from the 50 feet wide Muni strip, assumed to be 100% pervious. Type 5A is along Font Blvd and extends from Gonzalez Drive to Juan Bautista Circle. The street cross section is identical to that of Type 5 but the 50 feet wide strip in the middle of the street has no Muni tracks. Hydrologically and hydraulically the two types are essentially identical, except the lack of Muni tracks on this segment means less runoff. Similar to several of the East-West Streets, an additional storm drain or biogutter will be necessary to transport overflow from the treewells along both 5 and 5A.



Modeled Street Cross Section Type 5

5.7 Juan Buatista Circle (Type 7, 7A,)

Type 7A, the north side of Juan Bautista Circle, was assumed to drain away from the pond towards Font and ultimately towards the Northwest. Type 7, the south side of Juan Bautista Circle, was assumed to drain towards the pond.

5.8 Brotherhood Way

Runoff from the southeastern corner of the site and from the steep slope along the southern boundary of the site will flow off site towards Brotherhood Way. While not currently designed or included in this project, it is envisioned that Brotherhood Way could be redesigned to narrow the existing wide lanes of vehicular traffic enough to accommodate a bioswale. Details of this potential bioswale are under development and will be coordinate with the City, but it will likely resemble the bioswale on Gonzalez Drive, and connect at the downstream end to the outfall to Lake Merced. If this swale is not constructed, these flows will be directed to the combined sewer system, with associated measure incorporated so as to comply with the SMO for combined areas.

6. Maintenance of LID Network

The following typical maintenance activities were adapted from the San Francisco Stormwater Design Guidelines, Appendix A Fact Sheets. Final detailed operation and maintenance plans will be completed as described in the Development Agreement.

6.1 Wetponds/Wetlands

Seasonal or as needed:

- Clean and remove debris from inlet and outlet structures
- Mow or trim side slopes if vegetated
- Repair undercut or eroded areas
- Stock permanent pool area with mosquitofish (Gambusia spp.)

Every 5 to 7 years:

- Remove sediment from forebay area
- Replant vegetation in forebay or pond as necessary

Every 20 to 50 years:

- Remove sediment from permanent pool when volume has significantly decreased, or if the pond/wetland becomes eutrophic
- May need to re-grade or raise wetland berms over time as sediment and root mass accumulates

6.2 Stream/Riparian Corridor

Seasonal or as needed:

- Clean and remove debris from inlet and outlet structures
- Mow or trim side slopes if vegetated
- Repair undercut or eroded areas

Every 5 to 7 years:

- Remove sediment from pools behind check dams
- Replant vegetation as necessary
-

6.3 Bioswales/ Biogutters

As needed (frequent, seasonally):

- Mow grass to maintain a height of 3–5 inches. Remove litter prior to mowing. Compost clippings.
- Irrigate swale/biogutter during dry season (April through October) or when necessary to maintain the vegetation.

- Provide weed control, if necessary, to control invasive species

Semi-annual (beginning and end of wet season):

- Inspect for erosion, damage to vegetation, channelization of flow, debris and litter, and sediment accumulation.
- Additional inspections after periods of heavy runoff are desirable.
- Remove litter, branches, rocks, blockages, and other debris and dispose of properly.
- Repair any damaged areas within a channel identified during inspections. Correct erosion rills or gullies and re-plant bare areas as necessary.

Annual:

- Inspect check dams and overflow grates for clogging and correct as necessary.
- Based on inspection, plant alternative vegetation if original vegetation has not been successfully established. Reseed and apply mulch to damaged areas.

As needed (infrequent):

- Rototill or cultivate the surface of the soil bed if the swale does not draw down within 48 hours.
- Remove sediment build-up within the bottom of the swale once it has accumulated to 10% of the original design volume.

6.4 Cisterns

Annual (end of dry season, when cistern is empty):

Remove sediment build-up from inside the cistern by flushing or sweeping.

7. Conclusions

The results of the model can be used to draw several conclusions:

- The proposed LID stormwater management system will exceed the requirements of LEED Credits SS c6.1 and c6.2.
- The proposed LID stormwater management system is adequate as sized to convey the 5 year, 3 hour design storm.
- The proposed LID stormwater management system is able to convey the 100 year 3 hour storm curb to curb for all street types.
- The existing 48” diameter corrugated metal pipe crossing Lake Merced Boulevard (which is currently not in service) will be more than adequate to convey the 5 year peak flows from Parkmerced.
- As modeled (assuming total cistern volume of 1.1 MG), 93% annual average runoff is being retained on-site, as follows:

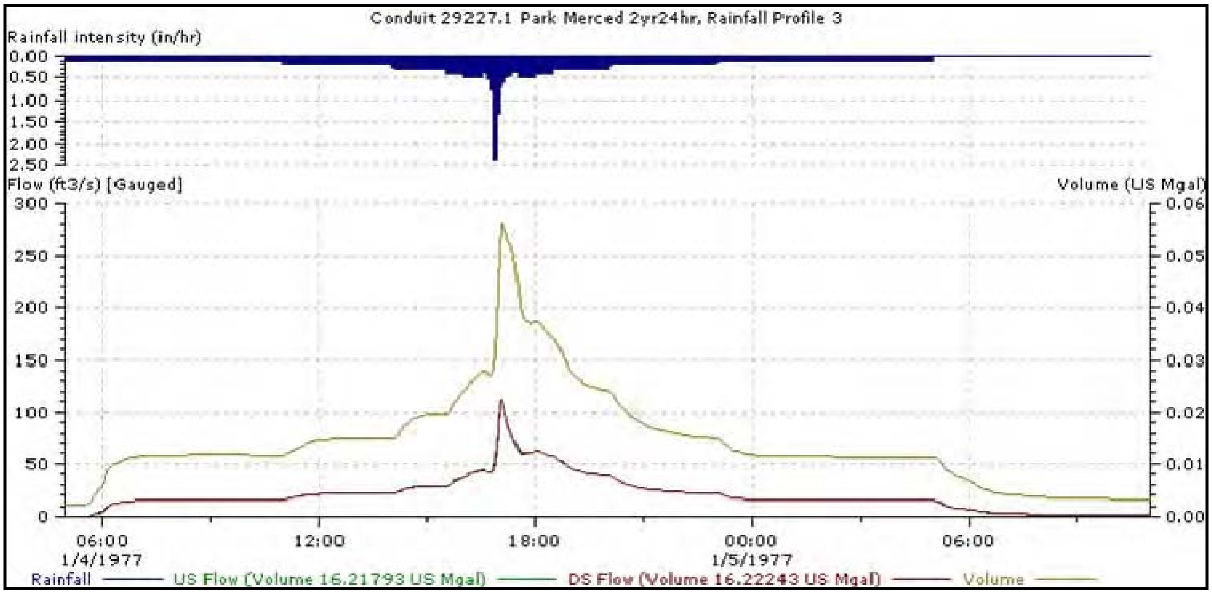
	Average Annual Runoff (MG)	
Reused		
Farm Irrigation	2.74	4%
Pond Make-up	0.10	0%
Infiltrated		
Runoff Layer (pp, parks, treewells)	31.25	46%
Hydraulics Layer (swales)	14.46	21%
Evaporated		
from runoff surfaces (cisterns, swales)	6.00	9%
from network (ponds, cisterns, swales)	1.82	3%
Evapotranspired From Courtyards	7.20	11%
Discharged to Lake (volume through terminal pipe)	4.80	7%
Total	68.88	100%

- Preliminary model results for the 2 year, 24 hour storm show a decrease in both volume and peak flow as follows:

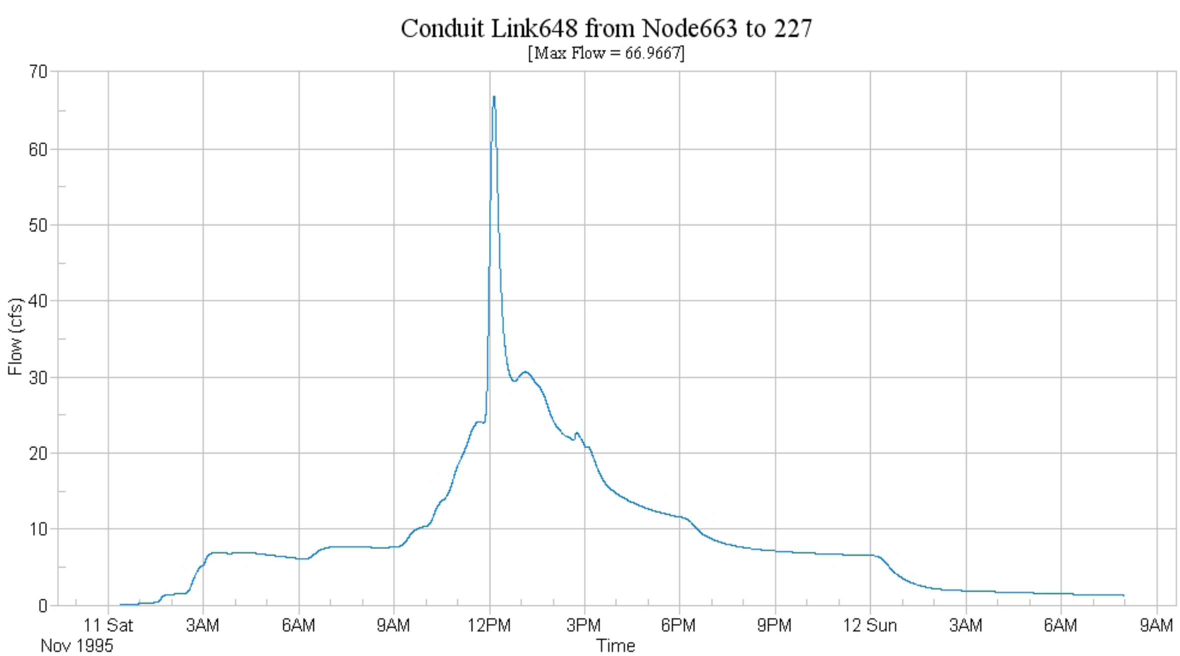
	Peak Flow (cfs)	Total Volume (CF)
Pre-Development	115.7	2,168,000
Post-Development	66.97	1,042,750
% Decrease	42%	52%

Note: the pre-development model results were derived from the City-wide Infoworks model as provided by DPW/BOE/Hydraulics.

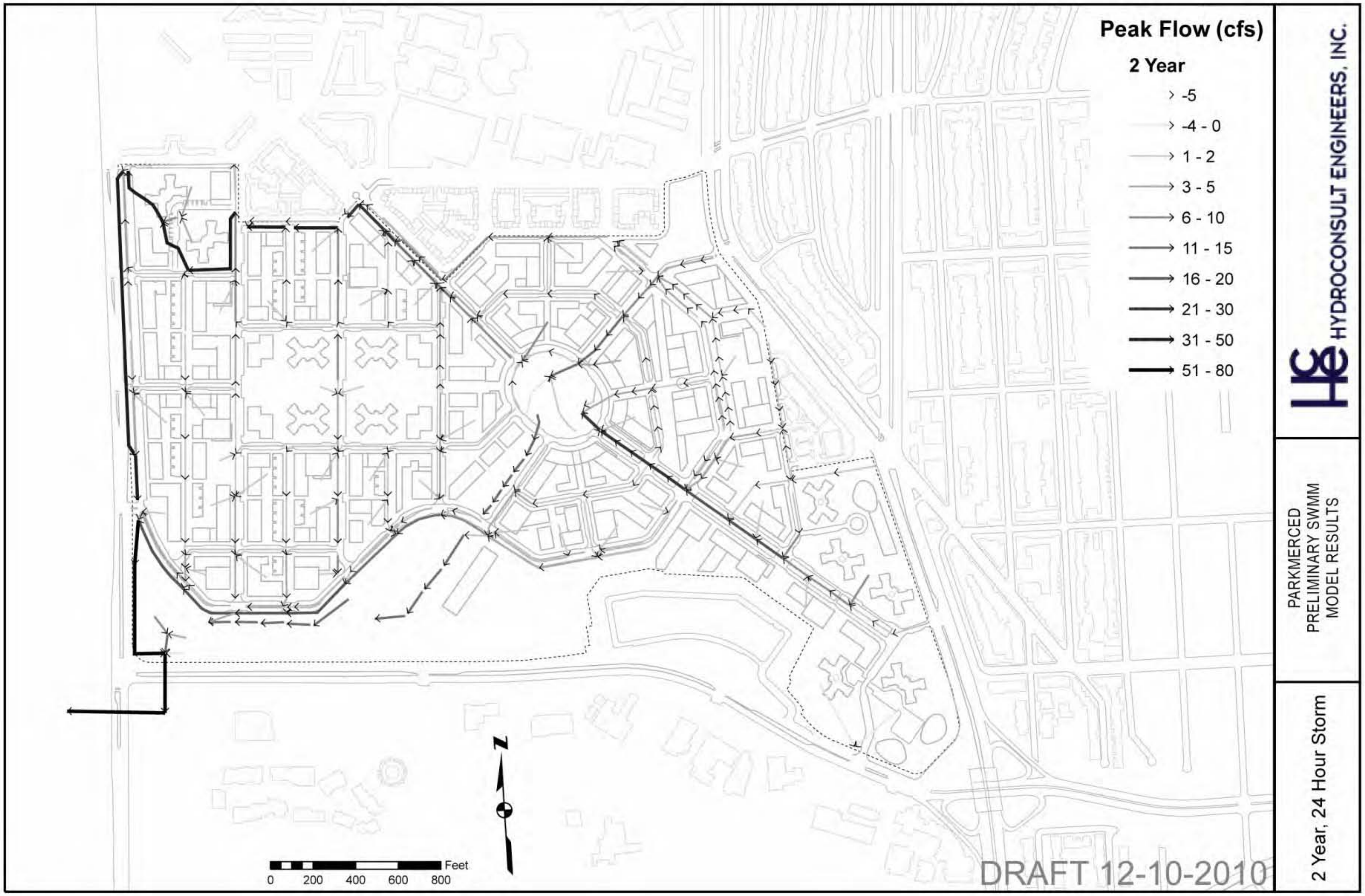
Model output for pre- and post-development and peak design flow rates through the LID stormwater network for the 2- and 5-year storms are presented in the figures below:

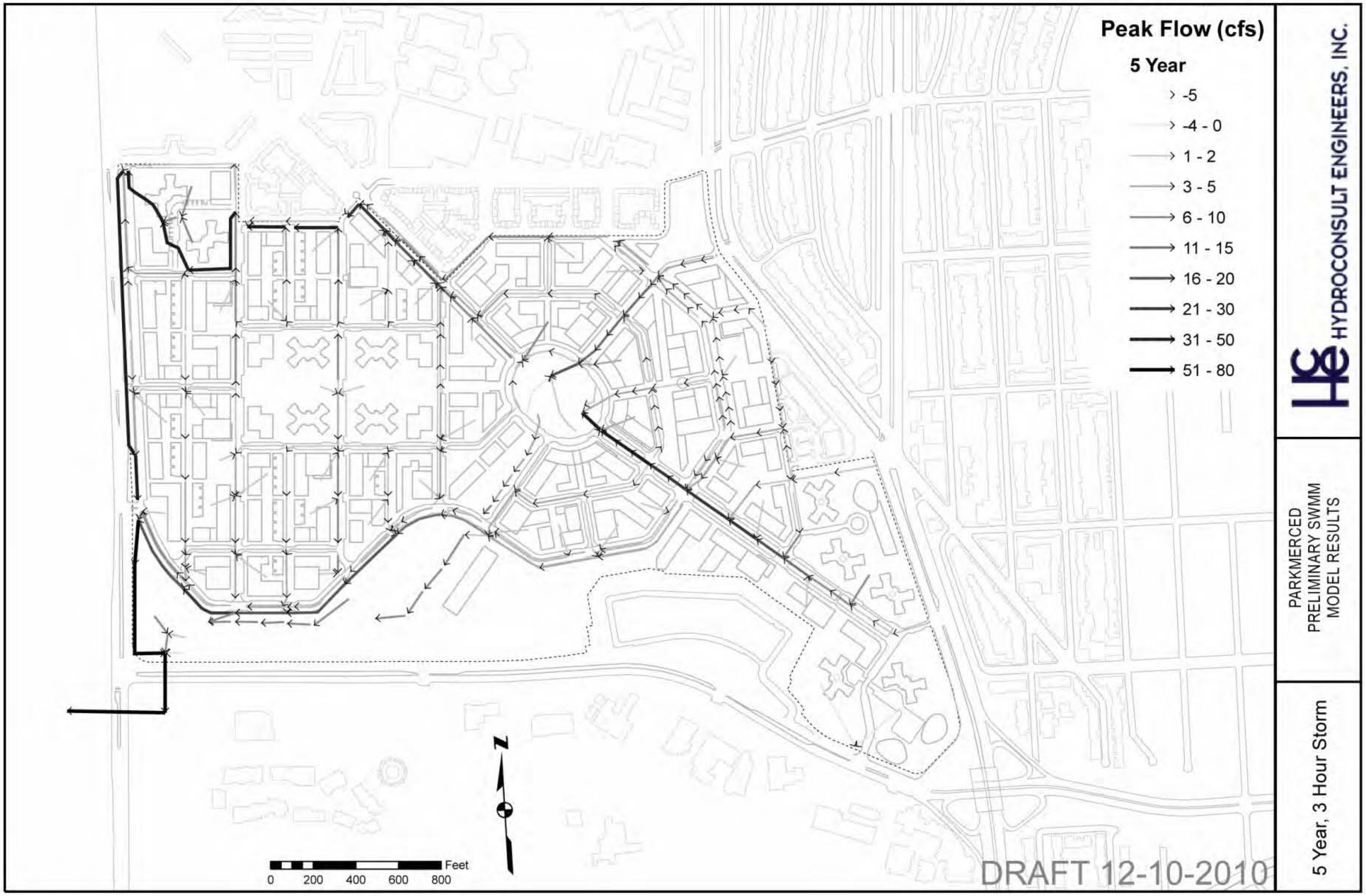


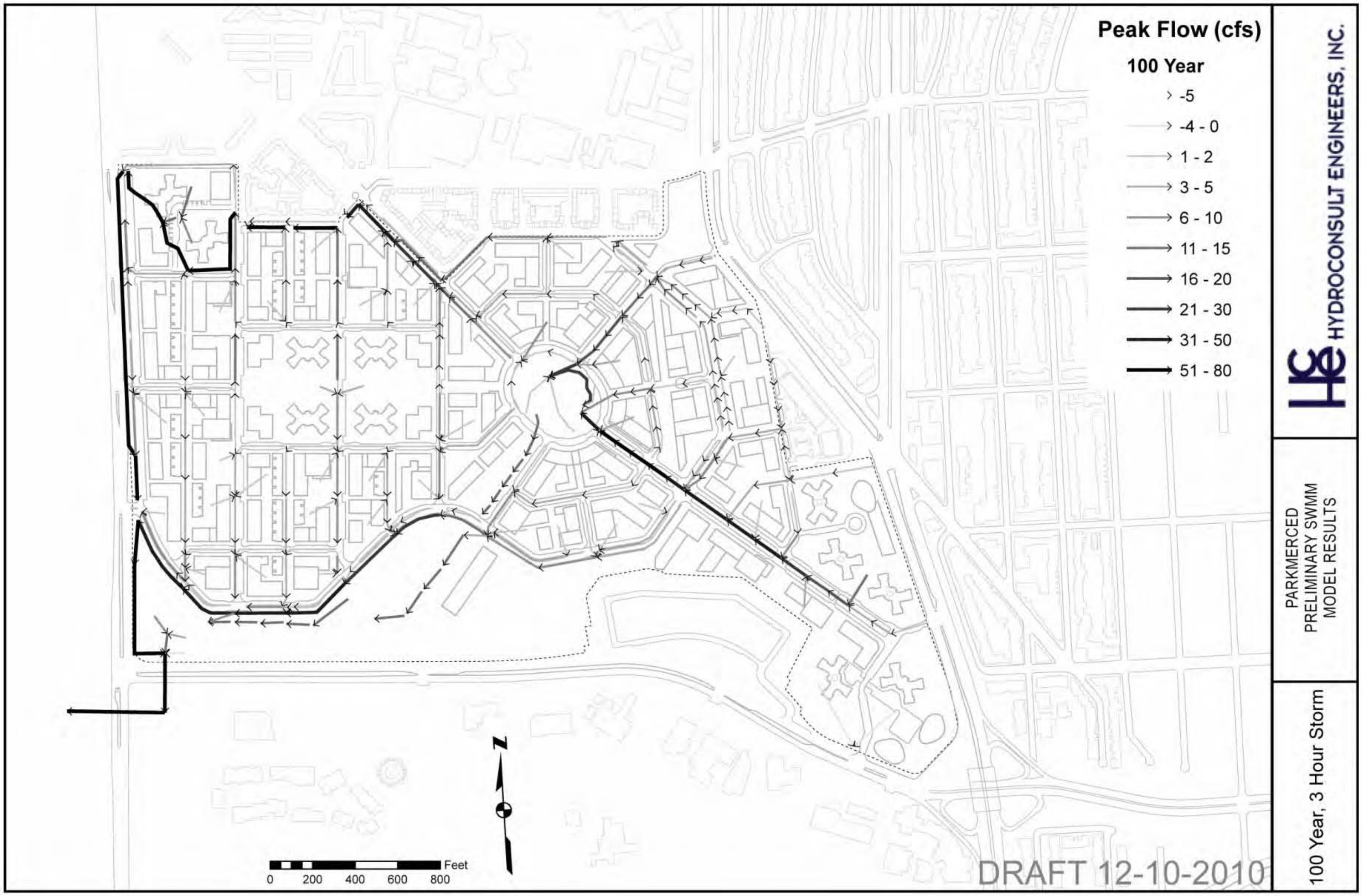
Pre-Development 2 year, 24 hour Peak Flowrates



Post-Development 2 year, 24 hour Peak Flowrates


Peak Flow (cfs)
2 Year
-5
-4 - 0
1 - 2
3 - 5
6 - 10
11 - 15
16 - 20
21 - 30
31 - 50
51 - 80
Feet
0 200 400 600 800
N
DRAFT 12-10-2010
HYDROCONSULT ENGINEERS, INC.
PARKMERCED
PRELIMINARY SWMM
MODEL RESULTS
2 Year, 24 Hour Storm


Peak Flow (cfs)
5 Year
-5
-4 - 0
1 - 2
3 - 5
6 - 10
11 - 15
16 - 20
21 - 30
31 - 50
51 - 80
HYDROCONSULT ENGINEERS, INC.
PARKMERCED
PRELIMINARY SWMM
MODEL RESULTS
5 Year, 3 Hour Storm
Feet
0 200 400 600 800
N
DRAFT 12-10-2010


Peak Flow (cfs)
100 Year
-5
-4 - 0
1 - 2
3 - 5
6 - 10
11 - 15
16 - 20
21 - 30
31 - 50
51 - 80
HCE HYDROCONSULT ENGINEERS, INC.
PARKMERCED
PRELIMINARY SWMM
MODEL RESULTS
100 Year, 3 Hour Storm
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0 200 400 600 800 Feet

8. Additional Design and Work - Post Entitlements

The dynamic hydraulic model used to verify and improve the stormwater network can be used to quickly and easily complete several additional tasks:

Water Quality Modeling—using the built-in capabilities of XP-SWMM, water quality influent concentrations and removal rates can be entered into the model, and water quality concentrations can be calculated for the excess runoff proposed for discharge to Lake Merced. This model will be used to adequately size the wetland system to ensure a proper wetland volume and flow though rate (hydraulic conductively) to achieve appropriate treatment. In addition to the end of pipe water quality modeling, the "water quality storm" (0.75 inch) will be modeled to to ensure that WQ treatment depths are adequate for treatment, and that the proposed BMPs are therefore wide enough to adequately treat the WQ storm.

Stormwater Control Plan (compliance with SF Stormwater Ordinance and Stormwater Design Guidelines)— As required and in compliance with the SF stormwater Management Ordinance and the Stormwater Design Guidelines, the information presented in this TM and in the infrastructure plan will provide input to the required submittals under the San Francisco Stormwater Ordinance.

100 Year Overland Flow Study—the preliminary results from the existing model will be used to develop a more detailed design report indicating block by block routing of overland flow for the 100 year/3 hour design storm as required by the San Francisco Subdivision Regulations. This study will offsite infrastructure as necessary (e.g., the existing 48" diameter CMP culvert)

Phasing Study—The model can be used to analyze how each phase, sub-phase, or site could individually comply with the requirements of the Stormwater Design Guidelines.

9. References

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ATTACHMENTS

ATTACHMENT A Cistern Sizing Calculations

ATTACHMENT B Model Input/Output

Cistern Sizing Calculations-(cistern serving ponds, stream and farm area only)

1. Calculate Farm Irrigation Demand

Irrigated Area	2	acres
	87,120	square feet

Parkmerced Farm

Crop Coefficient	0.8
Irrigation Efficiency	85%
Leaching Rate Factor	1

Month	Reference ET Et0	Actual ET ETL	Average Monthly Rainfall inches/month	Irrigation Demand (in/unit area)	ft^3/month	Gallons per month	% of annual	gpd
January	0.93	0.744	4.21	0.0000	0	0.0		
February	1.4	1.12	3.55	0.0000	0	0.0		
March	2.48	1.984	2.85	0.0000	0	0.0		
April	3.3	2.64	1.31	1.5647	11,360	84,971.0	7%	2,832
May	4.03	3.224	0.45	3.2635	23,693	177,225.3	16%	5,717
June	4.5	3.6	0.13	4.0824	29,638	221,691.4	19%	7,390
July	4.65	3.72	0.02	4.3529	31,602	236,385.6	21%	7,625
August	4.03	3.224	0.07	3.7106	26,939	201,502.8	18%	6,500
September	3.3	2.64	0.18	2.8941	21,011	157,164.5	14%	5,239
October	2.48	1.984	0.99	1.1694	8,490	63,504.7	6%	2,049
November	1.2	0.96	2.56	0.0000	0	0.0		
December	0.62	0.496	3.77	0.0000	0	0.0		
Totals	32.92	26.34	20.09	21.0	152,733	1,142,445.22		37,352

1.A Pond Evaporation Data from: P:\070010_SOM_Parkmerced\Demand Projections\consolidated_demand_calcs_4EIRTM.xlsx

Month	Reference ET Et0	Pond ET Et0*Ce	Ave. Rainfall inches/month	Water loss (in/unit area)	ft3/month	gal/month
January	0.93	1.1625	4.5	0.0000	0	0
February	1.4	1.75	3.8	0.0000	0	0.0
March	2.48	3.1	2.8	0.3000	449	3,361.9
April	3.3	4.125	1.4	2.7250	4,083	30,537.1
May	4.03	5.0375	0.6	4.4375	6,648	49,727.9
June	4.5	5.625	0.2	5.4250	8,128	60,794.1
July	4.65	5.8125	0	5.8125	8,708	65,136.5
August	4.03	5.0375	0.1	4.9375	7,397	55,331.0
September	3.3	4.125	0.2	3.9250	5,880	43,984.7
October	2.48	3.1	1.1	2.0000	2,996	22,412.6
November	1.2	1.5	2.6	0.0000	0	0.0
December	0.62	0.775	3.8	0.0000	0	0.0
Totals	32.92	41.15	21.1	29.5625	44,290	331,285.8

1.B Add 20% of pond evaporation for stream

2. Calculate Drainage Area to Cistern

Runoff Coefficient 0.75

Drainage Area	Acres	Square Feet	Description
B1b	16	692,604	Crespi Drainage Area
Totals	16	692,604	

3. Calculate Cistern Size

Assume starting cistern size, adjust until demand met.

Cistern Size (gal)	Depth (ft)	Area sf	Area acres
1,050,000	**2**	**70,187**	**1.61**

Note: total area of circle is about 2.5 acres

Assumes cistern is full at the beginning of January

Month	Runoff to Cistern ft^3/month	Runoff to Cistern gal/month	Cistern Demand (gal/mo)	Net Volume (gal/mo)	Ending Pond Volume (gal)	Overflow (gal/month)
January	182,241	1,363,166	0	1,363,166	1,050,000	1,363,166
February	153,672	1,149,463	0	1,149,463	1,050,000	1,149,463
March	123,370	922,808	4,034	918,774	1,050,000	918,774
April	56,707	424,168	121,616	302,552	1,050,000	302,552
May	19,479	145,707	236,899	-91,192	958,808	0
June	5,627	42,093	294,644	-252,551	706,256	0
July	866	6,476	314,549	-308,074	398,183	0
August	3,030	22,665	267,900	-245,235	152,948	0
September	7,792	58,283	209,946	-151,663	1,285	0
October	42,855	320,554	90,400	230,155	231,440	0
November	110,817	828,908	0	828,908	1,050,000	10,348
December	163,195	1,220,697	0	1,220,697	1,050,000	1,220,697
Totals	869,651	6,504,989	1,539,988			4,965,000
			0.0065	cfs, annual		

APPENDIX D

PRELIMINARY GEOTECHNICAL EVALUATION (TREADWELL & ROLLO, MARCH 27, 2008)
PERCOLATION TESTS MEMO (TREADWELL & ROLLO, MARCH 25, 2010)
PERCOLATION TESTS MEMO (TREADWELL & ROLLO, DECEMBER 16, 2009)

Treadwell&Rollo

MEMORANDUM

TO: Mr. Seth Mallen – Stellar Management

FROM: Maria G. Flessas / Frank L. Rollo

DATE: 27 March 2008

PROJECT: Parkmerced
San Francisco, California

PROJECT NO. 4596.02

SUBJECT: Preliminary Geotechnical Evaluation
Subsurface Conditions and Foundation Types

Number of Pages: 3

Per your request, this memorandum presents our preliminary geotechnical evaluation regarding subsurface conditions at the Parkmerced site and presents probable foundation types for the planned development.

PROJECT DESCRIPTION

Parkmerced is an approximately 116-acre site in the southwestern portion of San Francisco, adjacent to Lake Merced. It is bound by Font Boulevard, Pinto Avenue and Serrano Drive to the north; 19th Avenue and Junipero Serra Boulevard to the east, Brotherhood Way to the south, and Lake Merced Boulevard to the west.

Parkmerced is a residential community with 170 two-story buildings, and 10 thirteen-story towers. It includes associated parking, building services, and a private day care facility.

The planned development includes demolishing and removing the two-story residential buildings, and replacing them with 1- to 14-story structures (mix of rental and sale units) over a period of 15 to 30 years. The new structures may include one- to two-levels of below grade parking. The existing thirteen-story towers will remain on the site. The project also includes the construction of a new neighborhood core with retail and office space and new open space uses, including athletic fields, walking and biking paths; and community gardens and associated traffic and infrastructure improvements.

SUBSURFACE CONDITIONS

Our understanding of the subsurface conditions at Parkmerced is based on our review of the available subsurface information at the site and its vicinity.

Geology and Subsurface Conditions – The Parkmerced site is generally underlain by Colma Formation. The Colma Formation consists of medium dense to very dense sand with minor silt and clay that was deposited in an estuarine and coastal environment. The Colma Formation overlies marine sediments of the Merced Formation, which consist of sand, silt, and clay deposited in a shallow marine environment.

The available subsurface information indicates the site is underlain primarily by medium dense to dense sand, except in three areas where deep fill is anticipated. The deep fill areas are discussed below:

- Lobes off Lake Merced – Available geology maps indicate two lobes off Lake Merced extended into the westernmost section of the site. The old channels have been filled with mostly fine- to medium-grained sand. Logs of borings drilled in 1948 for the thirteen-story buildings indicate the channel fill is up to 50 feet deep.

- Sewer Tunnel – Available drawings from 1949 for the Lake Merced Sewer System indicate the presence of a horseshoe sewer tunnel (10 feet by 11 feet) mostly along Arballo Drive, and partially beneath existing structures, in the western portion of the site. The tunnel is about sixty feet below the existing ground surface. The tunnel was likely installed using an open cut excavation. Therefore, the material placed above the top of the tunnel is fill. Historically, the fill was placed without any compaction effort.

- Existing and New Waterline – The new, 4.4-mile-long, San Andreas Pipeline No. 3 will cross the easternmost section of Parkmerced. This pipeline will replace the Baden-Merced pipeline, which is out of service. The depth of fill placed over the existing pipeline and the pipe alignment within the site are not known at this time.

Groundwater – The groundwater beneath the site is from the Westside Basin Aquifer, the major groundwater basin that stretches from Golden Gate Park to the City of South San Francisco. Available subsurface information indicates the groundwater is approximately 20 to 30 feet below ground surface (bgs) on the northeast portion of the site and as deep as 80 feet bgs towards Lake Merced. The groundwater level has been affected by ongoing pumping of the Westside Basin Aquifer.

FEASIBLE FOUNDATION TYPES

Three of the ten existing thirteen-story towers that will remain on the site are supported on pile foundations. The pile-supported structures are in the cluster of the four, 13-story towers, near Lake Merced. Foundation types for the support of the new buildings should be evaluated based on the results of site specific subsurface exploration. In general, we anticipate new tall buildings over areas of deep fill will likely require deep foundations. Outside the deep fill areas, shallow foundations can likely be used for building support. We do not anticipate groundwater will be encountered during excavation for the below grade parking levels. However, perched groundwater, where present will require dewatering.

Foundation Types for Planned Structures

On the basis of the available subsurface information we conclude, in areas outside the deep fill, spread footings can be used for the 1- to 5-story wood-frame construction with two below-grade levels. For wood-frame, 1- to 5-story buildings in deep fill areas, with one level of basement, mat foundations supported on several feet of compacted fill may be feasible provided the buildings have short footprints, and they can accommodate some differential settlement.

Outside deep fill areas, it is likely that mat foundations can be used for the support of the 6- to 14-story towers with two below-grade levels. Where only one below-grade level is planned, the taller buildings may require ground improvement and a mat foundation. Alternatively, shallow end-bearing piles may be more economical. Appropriate foundation types should be confirmed with site specific exploration for each building.

Proposed tall buildings in deep fill areas will require special consideration. Excavation for the basement level(s) will remove some of the fill. The remaining fill will not be satisfactory for foundation support and should be improved or ignored. If ignored, drilled, jet-grouted or driven piles may be appropriate.

Buildings over Old/New Utility Lines

The depth and location of the existing Baden-Merced pipeline has not been evaluated; however, the pipeline will be removed where it occurs beneath the proposed buildings. The new water line will be installed near the eastern edge of the site. The planned location of the pipeline should be coordinated with the planned Parkmerced development to avoid its installation beneath new building sites.

If you have any questions, please call.

45960201.MGF

25 March 2010
Project No. 4596.02

Mr. Seth Mallen
Director of Construction
Stellar Management
West Coast Operations
3711 Nineteenth Avenue
San Francisco, California 94132

Subject: Percolation Tests
Parkmerced Development
San Francisco, California

Dear Mr. Mallen:

This letter presents the results of the percolation tests we performed at the Parkmerced project in San Francisco, California. We performed percolation tests in December 2009, and February 2010, as discussed in the following sections. Previously, we presented our findings and conclusions related to the geologic, geotechnical and seismic conditions at the Parkmerced site in a report dated 8 May 2008.

December 2009 Percolation Tests

In December 2009, we performed two percolation tests (PT-1 and PT-2) at the Parkmerced site and presented the results in a letter dated 16 December 2009 (test locations included on Figure 1). PT-1 was performed in an area where native soil is likely present at shallow depths below the existing ground surface (bgs). Test TP-2 was performed in a deep fill area, within one of the historic channels off Lake Merced. The results of the December 2009 percolation tests are presented in Table 1. Pre-soaking consisted of filling the test holes with water and allowing it to dissipate prior to performing the tests.

TABLE 1
December 2009 Percolation Test Results

Test No.	Test Area	Rate (inches/hour)	Fines Content (%)
PT-1	Historic channel	4.00	6
PT-2	Outside historic channels	0.75	7

The soil excavated from the test locations consisted of sand with clay; fines content (percent passing the No. 200 sieve) for the soil excavated from each test location is included in Table 1.

February 2010 Percolation Tests

On 25, 26 and 27 February 2010, we performed three percolation tests (PT-3, PT-4 and PT-5) at the locations shown on Figure 1. Test locations were selected by Hydroconsultant Engineers, Inc., the project hydrologists. Two of the tests, PT-3 and PT-5 were performed in areas where native soil is likely present at shallow depths below the existing ground surface. Test TP-4 was performed in an area of deep fill, within the historic channels off Lake Merced.

The tests were performed in six-inch-diameter holes, excavated with a post-hole digger to a depth of approximately 30 inches below the existing ground surface. To perform the tests we used a survey lath with one inch measurement increments marked along its face, and a watch. The tests were performed in grass areas; the grass section at each test location was carefully removed before the tests, and placed back upon completion of the tests.

We performed the tests by filling the excavations with water and timing the water level dissipation. Each location was pre-soaked for at least 12 hours prior to monitoring the water dissipation rate. During the pre-soak period we maintained the water level at the top of each excavation. After the 12-hour pre-soak period, the measuring lath was firmly placed in each excavation. Subsequently, the water level was topped off in the excavations until it was at least 12 inches deep, and it reached a measurement mark on the lath. In each test location, we recorded the time for the water level to drop one inch, over a six-inch depth. The percolation test was performed twice in each hole. We used the second set of water dissipation measurements to calculate the percolation rate (inches per hour) at each test location. The percolation test results are presented in Table 2.

TABLE 2
February 2010 Percolation Test Results

Test No.	Test Area	Rate (inches/hour)	Fines Content (%)
PT-3	Outside historic channels	0.75	9
PT-4	Historic channel	9.12	10
PT-5	Outside historic channels	0.43	10

The soil excavated from the test locations consisted of orange brown and dark brown sand with silt. We submitted representative soil samples from each test location to a laboratory to determine the sand gradation and fines content (percent passing the No. 200 sieve). The gradation test results are presented on Figure 2; the amount of fines at each location is included in Table 1.

CONCLUSIONS

The test results indicate the percolation rate for the tests performed within the historic channel areas (PT-1 and PT-4) varies from 4.0 to 9.1 inches per minute. The percolation rate for the tests performed outside the historic channel areas (PT-2, PT-3 and PT-5) varies from 0.43 to 0.75 inch per minute. The duration of the pre-soaking period does not appear to affect the percolation rates.

Please call if you have any questions regarding the percolation tests.

Sincerely yours,
TREADWELL & ROLLO, INC.

Garrett Harris

Garrett Harris, PE
Project Engineer MJ

Maria G. Flessas

Maria G. Flessas, GE
Principal

REGISTERED PROFESSIONAL ENGINEER
MARIA G. FLESSAS
No. 2502
Exp. 9-30-10
GEOTECHNICAL
STATE OF CALIFORNIA

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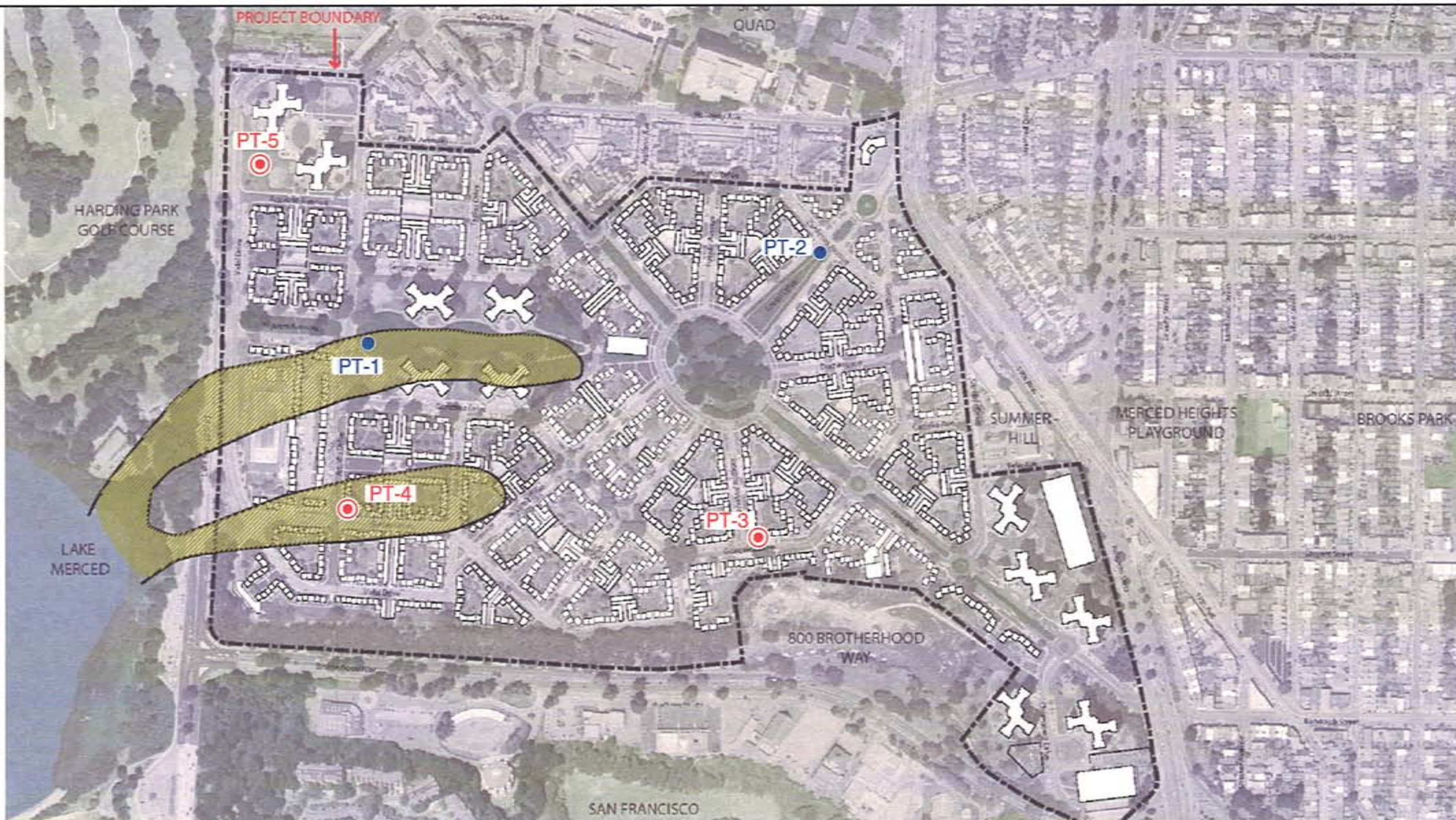
Attachments: Figure 1 – Percolation Test Locations
Figure 2 – Particle Size Analyses



EXPLANATION

PT-3 ◉ Approximate Percolation Test Location, February 2010

PT-1 ● Approximate Percolation Test Location, December 2009

—·—·—·— Project Boundary

Historic Channel off Lake Merced

Reference: Base map from a drawing titled "Existing Site Plan, Sheet ASK-156", by Parkmerced Investors LLC, dated 13 June 2008.

0 600 Feet

Approximate Scale

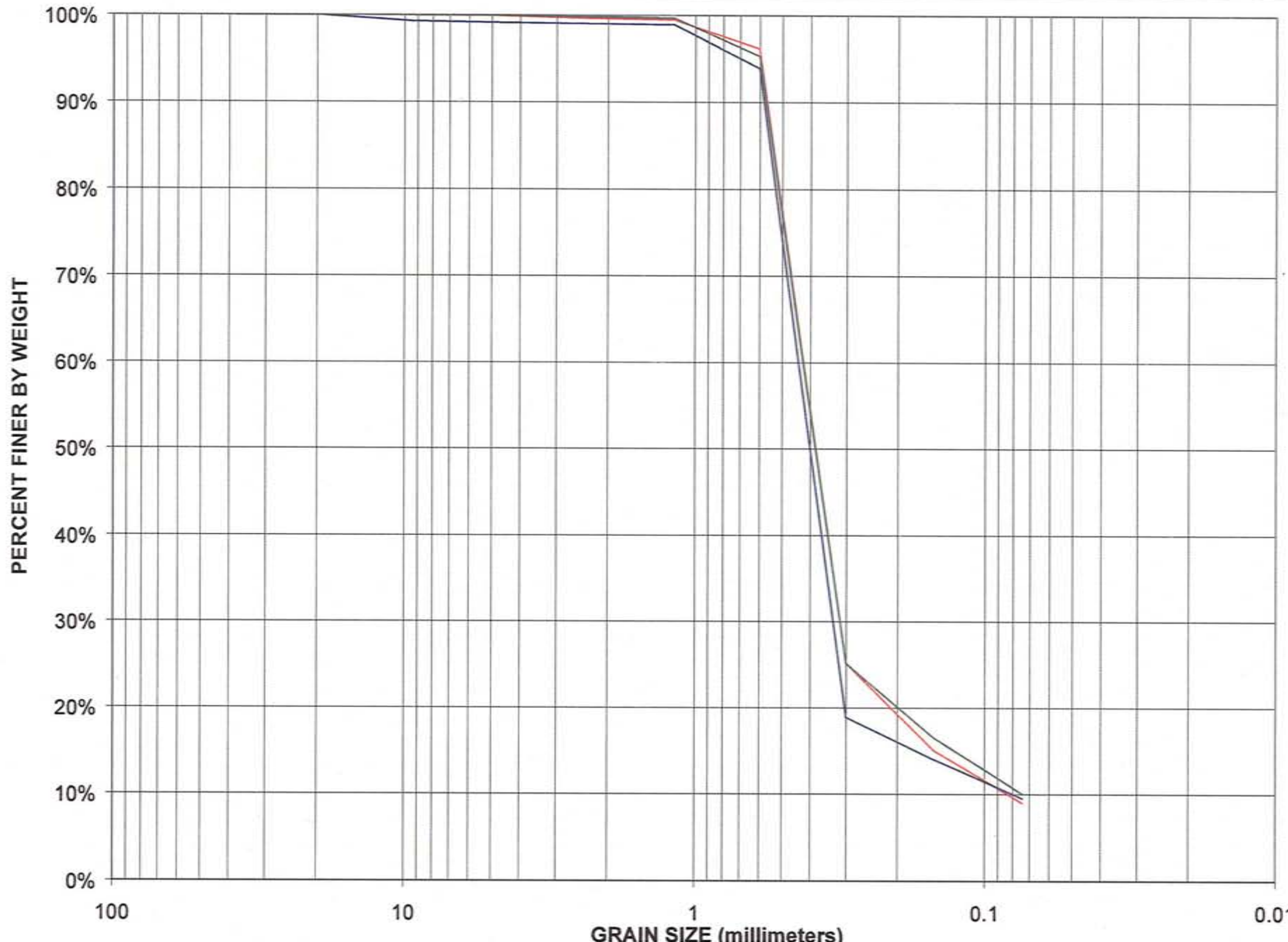
PARKMERCED DEVELOPMENT
San Francisco, California

PERCOLATION TEST LOCATIONS

Date 03/25/10	Project No. 4596.02	Figure 1

Treadwell&Rollo

R: | Trgraphics | 4500's | 4596.02 | Percolation Test | 4596.02 Percolation Test Location_R.dwg 3/25/10



PT #3 SAND with SILT (SP-SM) orange brown, with some clay

PT #4 SAND with SILT (SP-SM) dark brown

PT #5 SAND with SILT (SP-SM) dark brown

PARKMERCED San Francisco, California	**PARTICLE SIZE ANALYSES**
Treadwell&Rollo	Date 03/25/10 | Project No. 4596.02 | Figure 2

Treadwell&Rollo

16 December 2009
Project No. 4596.02

Seth Mallen
Director of Construction
Stellar Management
West Coast Operations
3711 Nineteenth Avenue
San Francisco, California 94132

Subject: Percolation Tests
Parkmerced Development
San Francisco, California

Dear Mr. Mallen:

This letter presents the results of the percolation tests we performed at the Park Merced project in San Francisco, California. On 2 December 2009, our field engineer performed two percolation tests (PT-1 and PT-2) at the locations shown on the attached Figure 1. The test locations were selected by Hydroconsultant Engineers, Inc., the project hydrologists; and Treadwell & Rollo. Inc. The tests were performed in holes excavated with a post-hole digger to a depth of approximately 30 inches below the existing ground surface. Each hole was approximately six inches in diameter. The tests included the use of a survey lathe with one inch measurement increments marked along its face and a watch.

We performed the tests by filling the excavations with water and timing the water level dissipation. After the water initially placed in the hole dissipated, the measuring lath was firmly placed in the excavation, to reduce potential lath movement during the test. Subsequently, water was placed in the excavations until it was about 12 inches deep, and it reached a measurement mark on the lathe. The time was recorded for the water level to drop per inch over a 12 inch depth. The test with lath measurements was performed twice in each hole. The results were recorded and the percolation rate (in inches per hour) was calculated using the second set of measurements of water dissipation with time. The calculated percolation rates are listed in Table 1.

TABLE 1
Percolation Test Results

Test No.	Rate (inches/hour)	Fines Content (%)
PT-1	4.00	6.1
PT-2	0.75	7.3

The soil from Percolation Test Excavation PT-1 consisted of orange brown, dense, moist, clayey sand. The soil from Percolation Test Excavation PT-2 consisted of dark brown, dense, moist, clayey sand. Representative soil samples from each location were submitted to a laboratory to measure the amount of fines (percent passing the No. 200 sieve); the amount of fines measured at each location is included in Table 1. The tests were performed in grass areas; the grass section at each test location was carefully removed before the tests, and placed back upon completion of the tests.

Please call if you have any questions regarding the percolation tests.

Sincerely yours,
TREADWELL & ROLLO, INC.

Garrett Harris, PE
Project Engineer

Maria G. Flessas, GE
Principal

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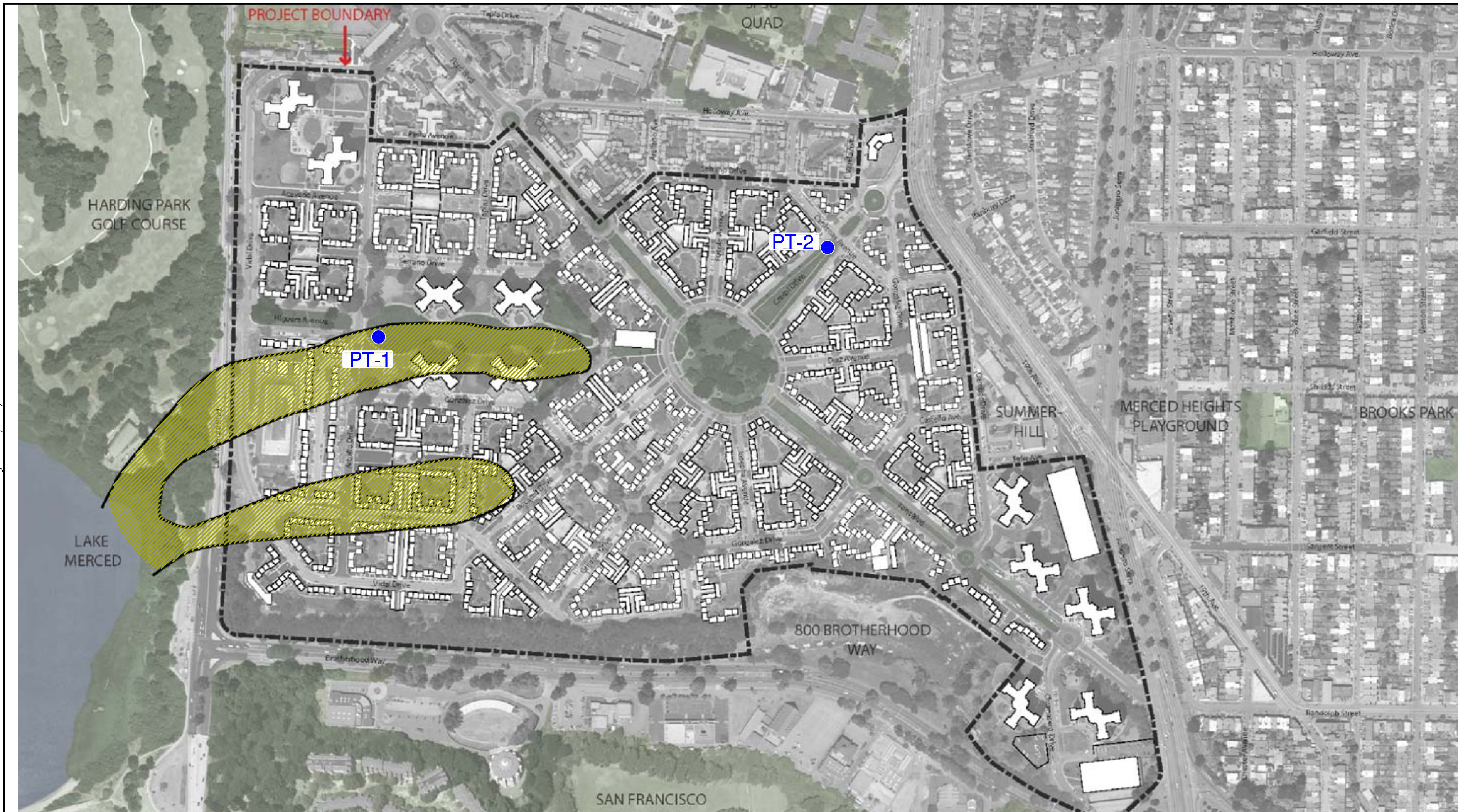

EXPLANATION

PT-1 ● Approximate Percolation Test Location

-·-·-·- Project Boundary

Approximate Alluvium Channel

Reference: Base map from a drawing titled "Existing Site Plan, Sheet ASK-156", by Parkmerced Investors LLC, dated 13 June 2008.

N

0 600 Feet

Approximate Scale

PARKMERCED DEVELOPMENT
San Francisco, California

PERCOLATION TEST LOCATIONS

Date 12/10/09	Project No. 4596.02	Figure 1

Treadwell&Rollo

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APPENDIX E
STORMWATER SYSTEM REVIEW PROTOCOL FOR PARKMERCED DEVELOPMENT AGREEMENT

Stormwater System Review Protocol for Parkmerced Development Agreement
FINAL 1/24/11

Infrastructure Plan Appendix I: Review and Approval of Stormwater System

a. Intent. The Project's proposed stormwater system (the "Stormwater System") represents an innovative approach incorporating an interrelated and integrated set of improvements. The Developer has provided the SFPUC with data and analysis illustrating how the overall system should operate at full build-out. In preparing the Development Agreement, the parties have reviewed the Infrastructure Plan and other information regarding the schematic design of the proposed Stormwater System. The parties agree that the schematic design of the Stormwater System conforms with existing applicable codes and regulations, including the Stormwater Management Ordinance. However, as noted in Section 3.4 of the Development Agreement, the Project will be constructed in a series of Development Phases. The Development Agreement does not require that the Development Phases occur in a particular order nor does the Development Agreement identify specific locations for each Development Phase. As such, portions of the overall Stormwater System will be constructed with each Development Phase and the overall Stormwater System will not be complete until full build-out of the Project. In light of this uncertainty regarding the character of each Development Phase, this Stormwater System Review Protocol is intended to assist Developer and SFPUC staff with the submission, review and approval of applications associated with the portions of the Stormwater System proposed in each Development Phase, by clarifying the laws and regulations applicable to such review and approval.

b. Objectives. To guide the interpretation of the intent of these review protocols, the parties agree on the following principles with respect to the SFPUC's review of Development Phase Applications, Design Review Applications and applications for Implementing Approvals that implicate aspects of the Stormwater System:

1. Such review process shall ensure that a functioning Stormwater System which complies with City stormwater management laws, codes and regulations in effect as of the date any application is submitted is in place at all times.

2. The Development Phase Application shall demonstrate that the Developer or its successor(s) will be able to appropriately satisfy its maintenance obligations with respect to such Stormwater System as described under the Development Agreement.

3. Such review process shall ensure that the Project shall not discharge stormwater flows from the Stormwater System directly to Lake Merced via an outfall

constructed for such purpose at any time unless minimum water quality requirements are met, in compliance with all regulatory permits and requirements.

4. Such review process shall ensure that, consistent with the review criteria set forth below, the Project shall not increase the risk of: (A) localized wet weather flooding; (B) combined sewer system (CSS) and/or separate sanitary sewer system surcharges into streets; or (C) cross connection between sewage surcharges and surface Stormwater System runoff.

5. Such review process shall ensure that, consistent with the review criteria set forth below, the Project include a valve or similar improvement that would allow the Developer and/or SFPUC to shut off flows from the Project Site to Lake Merced and divert such flows to the CSS in order to prevent potential accidental spills and CSS and separate sanitary sewer system surcharges from reaching downstream water bodies such as Lake Merced.

c. Reviewof Project Applications. As required by the Development Agreement, each Phase Application (and sub phase application, if applicable) and Design Review Application shall be reviewed for consistency with the following requirements.

1. Applicable Law. The Project shall comply with federal, state and City laws, codes and regulations in effect as of the date any such application is submitted, including but not limited to the Stormwater Management Ordinance, to the extent permitted by Section 2 of the Development Agreement.
    a. Because the regulations treat areas served by a CSS differently than areas served by a separate stormwater system, and because the Project proposes a phased transition from a CSS to a separate stormwater system over a period of 20-30 years, the Developer agrees that any portion of the Project that is temporarily or permanently connected to the CSS shall meet all applicable combined sewer regulations and any portion of the Project that is temporarily or permanently connected to aseparatestormwater system shall meet all applicable separate stormwater system regulations. Therefore, portions of the Project that are temporarily connected to the CSS but are planned to transition to a separate stormwater system in future phases must meet the requirements for areas served by both types of systems.
    b. Similarly, vegetated separate stormwater systems like the system proposed for Parkmerced by the Developer may need a period for plant establishment before such system is relied upon to treat and convey storm flows. The Stormwater Control Plan shall detail the period of time required for plant establishment, and the satisfaction of treatment requirements during this establishment period.

2. Water Quality. This area of review focuses on the Project's compliance with the City's NPDES Phase II Stormwater General Permit, or any successor to such permit, including end of pipe requirements (if any) for discharge to Lake Merced, and SFPUC policies for protection of groundwater quality in the North Westside Groundwater Basin. Each Development Phase shall meet the following benchmarks:

   a. The Developer shall meet all legal requirements of the City's NPDES Phase II Stormwater General Permit or other permits applicable to construction and/or use of any outfall pipe to Lake Merced.

   b. The Project shall include a valve that can shut off flows from the Project Site to Lake Merced and divert such flows to the CSS in order to prevent potential accidental spills and CSS and separate sanitary sewer surcharges from reaching downstream water bodies such as Lake Merced. The features and design of such valve shall be subject to the reasonable review and approval of SFPUC and Developer, and shall include remote actuation capability to the extent reasonably practicable.
   c. The Developer shall comply with -applicable SFPUC policies governing discharges to Lake Merced and allowable activities and land uses above drinking water aquifers.

3. System Capacities. This area of review focuses on the Project's dry weather and wet weather inputs to the destination collection system(s), and is intended to ensure that system capacities are not exceeded.
   a. Pipe Capacity Benchmark:
      i. Combined sewer system: The peak hourly dry and wet weather flow proposed by each Development Phase shall not exceed the capacity of the combined sewer system as required by the applicable codes and regulations.

      ii. Proposed separated collection systems:
         1. The peak flows to pipes proposed for use in the separate sanitary sewer system or separate stormwater system must be shown to not exceed the capacity of such pipes as required by applicable codes and regulations.
         2. The conveyance Stormwater System sizing shall be designed with freeboard per City regulations. At no point along the conveyance pathway shall the hydraulic grade line overtop the top edge of the Stormwater System for the 5-year design storm.

b. Volumetric limit benchmark:

    i. Prior to full build out of the Project and completion of the Stormwater System, combined sanitary and storm flows will not exceed the capacity of the City's combined sewer system during the 5-year 3-hour storm.

    ii. Upon completion of the Stormwater System, total flows to the City's combined sewer system during the 5-year 3-hour storm will decrease compared to existing flows.

4. Overland Flow. This area of review focuses on the Project's ability to safely convey and discharge the 100-year design storm overflow. The Developer shall meet the following benchmarks:

    a. Within any area of the Project Site that is redeveloped pursuant to the Development Agreement, overland flow must be contained at any and all points in time as required in applicable codes and regulations, or as approved by SFPUC for temporary or curbless street designs.

    b. The flow path for the overland flow of the 100-year design storm for each approved Development Phase must be functional at the earliest practicable date, but no later than the completion of such Development Phase, including but not limited to the construction by the Developer of any off-site improvements reasonably necessary to protect publicly- and privately-owned property downstream (including the waters of Lake Merced). The need, or absence of need, for any such off-site improvements shall be demonstrated by the Developer through modeling the 100 year overland flows at the Project Site for both existing conditions and for the proposed Development Phase in question. SFPUC and DPW will provide the City's hydraulic model for the Developer to use to prepare the comparative overland flow demonstration described above. Developer will add surface flow analysis to determine current conditions as well as proposed changes. Such City agencies shall provide oversight to the Developer in determining appropriate assumptions for such analysis, and any additional analysis, data products or modeling outputs created by the Developer for such effort shall be shared with the City agencies for purposes of incorporation into and improving the model(s) and data utilized by the City to analyze such overland flow issues.If the comparison of the “existing” and “proposed” models referenced above demonstrates that the 100 year overland flows leaving the Project Site will not increase in volume, rate or velocity after implementation of the Development Phase in question, such proposal shall be deemed to not exacerbate any existing conditions and thus would not require additional offsite improvements to protect downstream property. However, if the comparative analysis indicates that the volume, rate or velocity of the 100 year overland flows leaving the project site is increased relative to existing conditions, and such flows are anticipated to create or exacerbate any flooding or related problems downstream, the City may require the Developer to implement additional off-site improvements depending on the conditions in the vicinity of the project at the time of such application. Such Developer responsibility shall be proportional to the Project’s relative contribution to the problem being addressed.

c. Offsite Discharge: If the overland flow of the 100 year storm is determined to exacerbate existing conditions under the framework described above, on-site overland flows shall be safely discharged from project site in a manner approved by SFPUC and DPW based on an assessment of conditions in the vicinity of the Project at the time of such review.

5. Function and Connectivity: This area of review focuses on the Project’s ability to phase the implementation and maintenance of the Stormwater System in a manner that will successfully meet the proposed level of performance and overall intent of the interrelated and integrated Stormwater Management System, in acknowledgement of the fact that each Development Phase may be required to stand on its own for some period of time after its completion due to the factors outlined in Section 3.4.1. The Developer shall meet the following benchmarks:
    a. Each Development Phase must include an assessment of the activities required to appropriately maintain the proposed Stormwater System, along with an analysis of whether the funding mechanisms established as required by the Development Agreement will be sufficient to defray the Developer’s maintenance obligations.

        i. Such assessment and analysis shall be based on achieving appropriate levels of ongoing functionality, based on both the experience of operating and maintaining previously-implemented elements of the Stormwater System as well as the generally accepted practices for operating and maintaining the system in a good and workmanlike condition.

ii. If the SFPUC in its reasonable discretion determines that the maintenance funding source is not sufficient for the appropriate maintenance activities required under clause 1 above the parties shall meet and confer on how best to address such shortfall. These measures could include reconfiguring the system to reduce the anticipated maintenance costs or identifying additional funding sources that will defray the anticipated expenses in excess of the existing funding mechanism. The SFPUC shall not be required to approve the relevant application until such measures are agreed upon.

6. Development Phase Hydraulics and Hydrology Plan. In addition to explaining how the Stormwater System proposed by each Development Phase meets the requirements of this section, each Development Phase Application shall include a hydraulics and hydrology plan (each, a "Development Phase Hydraulics and Hydrology Plan") that includes:

a. A detailed description of how each sub-phase within suchDevelopment Phase, at the start and finish of each sub-phase, will be pursued in such a way as to provide the effective development of the Development Phase from commencement of construction to the completion of the full Development Phase.

1. Such description shall include a proposed timing for implementation of the Stormwater System relative to the occupancy of buildings and other milestones within each sub-phase.

2. Such description shall be based on the requirement that the Stormwater System in operation at the completion of any portion of the Development Phase would provide an appropriate level of stormwater treatment performance even if no further construction is completed. For avoidance of doubt, the parties acknowledge that the Project will meet the required stormwater treatment performance measures for the entire Parkmerced project area, including the rights-of-way and other property that may be dedicated to the City, notwithstanding the potential that each development site may seek to satisfy its stormwater obligations in a building-specific manner rather than relying on the anticipated common improvements to do so.

3. For contextual information purposes only, such description shall also include a schematic plan of how future potential Development Phases will function

and connect to the currently proposed Development Phase and all previous Development Phases to satisfy the criteria listed above.

i. Note: such future potential phasing is simply for illustrative purposes and shall not in any manner bind either party to any particular phasing approach. Rather, the intent is to generate a shared understanding of the future activities that will be necessary to implement the full integrated Stormwater System as described under clause (a) above.