SSIP | SEWER SYSTEM IMPROVEMENT PROGRAM

Program Management Consultant TRANSMITTAL

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To:	Rosey Jencks SFPUC Project Manager	*From:* *Signature:*	for Martin Dorward PMC Program Management Advisor [signature]
Subject:	(FINAL DRAFT) SSIP Urban Watershed Assessment, Westside Drainage Basin Opportunities TM	*Preparer:*	David Wood Task Order Manager

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The following document has been prepared for your information:

- **(FINAL DRAFT) Westside Drainage Basin Opportunities Technical Memorandum**

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SEWER SYSTEM IMPROVEMENT PROGRAM

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San Francisco
Water Power Sewer
Services of the San Francisco Public Utilities Commission

WESTSIDE DRAINAGE BASIN URBAN WATERSHED OPPORTUNITIES

FINAL DRAFT
TECHNICAL MEMORANDUM

Prepared for:

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February 2015

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PROGRAM QUALITY ASSURANCE AND QUALITY CONTROL REVIEW:

Reviewers listed in the table below have completed an internal quality review check and approval process that is consistent with procedures and directives previously identified by the PMC. The table below outlines the corresponding reviewers for each deliverable document.

Table 1: Identification of Technical and Administrative Reviewers

Subtask	Westside Drainage Basin Urban Watershed Opportunities	Technical Reviewer	Complete	Administrative Reviewer	Complete	PCTA Reviewer	Complete
	WORKING DRAFT	David Wood	x	Scott Lowry		D. Donahue	
	DRAFT	David Wood	x	Scott Lowry	x	D. Donahue	x

Quality Assurance and Quality Control Review Complete:

David Wood – Task Order Manager

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ACRONYMS/ABBREVIATIONS

Acronym/ Abbreviation	Definition
CCSF	City and County of San Francisco
City	City of San Francisco
CSAMP	Collection System Asset Management Program
CSD	combined sewer discharge
CSR	Collection System Reliability Program
CSS	combined sewer system
DMA	drainage management area
EIP	Early Implementation Project
GIS	Geographic Information System
H&H	Hydrologic and Hydraulic (Model)
IPIC	Interagency Plan Implementation Committee
LMT	Lake Merced Transport/Storage Box
LOS	level(s) of service
MG	million gallons
MGD	million gallons per day
OSP	Oceanside Treatment Plant
PMC	Project Management Consultant
R&R	renewal and replacement
RWH	rainwater harvesting
SFDPW	San Francisco Department of Public Works
SFPUC	San Francisco Public Utilities Commission
SSIP	Sewer System Improvement Program
SWOO	Southwest Ocean Outfall
TM	Technical Memorandum
T/S	transport/storage
TBL	triple bottom line
UWA	urban watershed assessment
WWE	Wastewater Enterprise

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GLOSSARY

Term	Definition
Area of Influence	Area where there is the potential to address each LOS need.
Area of Suitability	Hierarchy within streets, parcels, and underground structures based on similar functional characteristics and suitability for potential projects.
Collection System Opportunities	All opportunities created through the Urban Watershed Assessment are Collection System Projects.
Combined Sewage Management Projects	Projects that manage combined sewage as opposed to only stormwater. This includes combined sewage detention tanks as well as conveyance projects and other types of projects.
Disadvantaged Communities	Communities that bear a disproportionate amount of socio-economic distress resulting from such cumulative impacts are often referred to as “disadvantaged communities”. In this case, disadvantaged communities are identified as census tracts with unemployment rates above 150 percent of the City unemployment rate or census tracts with incomes 80 percent below average median income for San Francisco.
Drainage Management Area (DMA)	The surface area that generates runoff. Used to quantify the area that flows to a runoff reduction technology or that is managed by a runoff reduction technology.
Excess Stormwater Challenges	Specific locations identified through characterization with concentrations of excess stormwater-related high risk to property or personal injury and where there is historical evidence of excess stormwater.
Function	General function of watershed infrastructure (i.e., retention [surface and subsurface], detention [surface and subsurface], conveyance [surface and subsurface]).
Grants	Non-repayable funding to private owners or agencies to implement projects that address sewer system needs. Intended to cover a portion of project cost implemented by others.
LOS Need	An existing deficiency in the combined sewer system relative to LOS goals.

Term	Definition
Operational Improvements	A strategy to improve system performance through changing operational procedures. Operational improvements may include minor or comprehensive collection system retrofits that facilitate operational improvements, such as flow modification appurtenances to optimally route flows and/or improve use of in-system storage.
Opportunity	Potential programs, policies, or locations paired with the application of technologies and methods that could contribute to meeting LOS needs and goals.
Opportunity Location	Potential highly suitable and moderately suitable streets, parcels, and underground locations within areas of influence to identified urban watershed challenges.
Physical Characteristics	Physical or spatial attributes of a location (streetscape, parcel, or underground structure).
Policy Recommendations	A recommendation to develop or revise policies or procedures that will clarify planning goals and objectives, physical parameters for project design and construction, and project implementation processes across the City family. Examples include the development of policies and standards for street improvement projects that have overlapping jurisdictions, modification of flood plain management policies, development of bond spending guidelines for SSIP, or formalization of project construction and asset acceptance processes.
Programs	Potential SFPUC or City incentives, SFPUC-administered grants, or existing stewardship programs that may be designed to address sewer system needs in addition to capital projects. An example is a downspout disconnection incentive program, which could be quantified for its ability to address LOS.

Term	Definition
Project Concepts	A project concept is an opportunity that has met the minimum criteria established through the Opportunities Feasibility Analysis. Project concepts will be evaluated with modeling analysis conducted for each watershed alternative. They will include general location, preferred technology, LOS performance, and planning-level estimated cost. This level of design will allow the UWA Team to develop cost and performance estimates while maintaining flexibility within the watershed alternative selection process. Some projects will include specific location information and may be recommended for near-term implementation within Phase II of the SSIP, whereas other projects may be sited more generally (within a neighborhood or minor watershed) and may be recommended for longer-term implementation. Locations for longer-term implementation projects will be further specified based on future SFPUC or interagency project synergy opportunities and other factors.
Runoff Reduction Opportunities	Stormwater management opportunities intended to reduce runoff into the combined sewer system. This includes green streets and permeable pavement, among other project types.
Stormwater Management Opportunities	Opportunities that manage stormwater as opposed to combined stormwater and wastewater. These projects include runoff reduction opportunities and stormwater conveyance or detention opportunities.
Strategy	Method of addressing collection system challenges, such as increasing conveyance, increasing storage, seismic upgrades, reducing runoff to the CSS, rerouting flows, or changing operational practices.
Suitability Matrix	Tool used to track and organize physical characteristics of locations (streets, parcel, underground) and criteria that influence the potential suitability of these characteristics for different collection system functions.
Technology	A specific tool or technique used to manage stormwater. These include rain gardens, pervious pavers, conveyance pipes, and other tools.

Term	Definition
Watershed Alternatives	A suite of candidate capital projects, programs, operational improvements, and policy recommendations that collectively meet the Commission-endorsed SSIP LOS in each watershed. Each watershed alternative will address local and system-wide combined sewer system needs, including areas of excess stormwater, regulatory compliance, reliability and redundancy, climate change adaptation, environmental sustainability, community benefits, and ratepayer affordability. Each watershed alternative will be evaluated using the triple bottom line model to quantify financial, social, and environmental benefits. The UWA Team will recommend the most favorable Watershed Alternative.

EXECUTIVE SUMMARY

A. Background and Purpose

This technical memorandum identifies collection system improvement opportunities within the Westside Drainage Basin in the City and County of San Francisco. The collection system includes all portions of the system that manage and convey wastewater and stormwater runoff from its sources to the City's wastewater treatment and discharge facilities. This effort is part of the Urban Watershed Assessment (UWA) being completed in support of the San Francisco Public Utilities Commission (SFPUC) Sewer System Improvement Program (SSIP). The UWA is a city-wide planning process that will assist the SFPUC by identifying specific projects, programs, and policies to reach Wastewater Enterprise (WWE) goals and Levels of Service (LOS).

The opportunities presented in this technical memorandum represent output from the Opportunities Phase of the UWA. The UWA team used the existing conditions, challenges, and LOS needs specified in the Characterization Phase to identify opportunity locations and specific strategies for collection system improvements. This document presents a comprehensive inventory of these opportunities organized within the UWA overarching framework of **Projects, Programs, and Policies**. This inventory serves as the foundation to develop watershed alternatives (suites of projects, programs, and policies) for the three urban watersheds within the Westside Drainage Basin. All opportunities on which the SFPUC could potentially spend ratepayer dollars must be spent on improvements to the services that the agency provides, as regulated by CA Propostion 218.

In addition to hydraulic, structural, and reliability needs, interagency project synergies and ongoing public outreach activities supported the identification and development of opportunities. Interagency coordination and public outreach are integral to the UWA process; therefore, those activities, the data collected, and how it is used are described in detail throughout the document.

B. Process of Developing Opportunities

To target location-specific opportunities that meet the WWE goals and LOS, a detailed inventory of combined sewer system (CSS) challenges, and watershed needs were developed during the Characterization Phase of the UWA and documented in the UWA *Westside Drainage Basin Urban Watershed Characterization Final Draft Technical Memorandum* (SSIP-Project Management Consultant [PMC], 2014a) (Westside Characterization Technical Memorandum). During the Opportunities Phase, the team modified and enhanced this inventory of wet weather, dry weather, and structural needs and spatially defined the areas contributing to each challenge. LOS-specific needs must be addressed not only through physical system improvements but also through procedural requirements as well as other considerations. These needs were grouped by similar characteristics into three types of LOS as an organizing principle for UWA planning purposes. The Opportunities Phase considers all of these LOS, but not in the same manner. These groupings and the LOS they relate to are described below:

Hydraulic and Hydrologic (H&H) LOS – These LOS include the wet-weather challenges of reducing combined sewer discharges (CSDs) and minimizing flooding, and they are the focus of UWA's analytical analyses. These LOS are quantitative in nature and can be addressed by a variety of strategies in spatially disparate locations. As such, an opportunity analyses was conducted to identify synergistic opportunities to meet these LOS while also addressing other system needs or sustainability goals.

- Combined Sewer Discharges (LOS 1 – Provide Compliant System)
- Flooding (LOS 2 – Manage Stormwater and Minimize Flooding)

Existing Structures LOS – Parallel SSIP efforts outside of UWA, such as the Collection System Reliability Program (CSR) and Climate Change Team, are principally responsible for prioritizing needs related to existing structures. However, UWA is coordinating closely with these efforts to document these needs and evaluate potential synergies with H&H LOS. Existing Structure LOS needs serve as synergy criteria within this memorandum and include the following:

- Structural, Reliability, and Redundancy Needs (LOS 1 – Provide a Compliant System)
- Collection System Odor (LOS 3 – Provide Benefits to Impacted Communities)
- Sea Level Rise Design Considerations (LOS 4 – Adapt to Climate Change)

Sustainability LOS – These include mitigating disproportionate impacts on affected communities, providing positive community benefits, and reusing nonpotable water. These LOS were utilized as synergy criteria to identify and prioritize opportunities to address H&H LOS needs.

- Environmental Justice and Community Benefits Policies (LOS 3 – Provide Benefits to Impacted Communities)
- Public Outreach and Interagency Coordination (LOS 3 – Provide Benefits to Impacted Communities)
- Nonpotable Water Reuse (LOS 5 – Achieve Environmental Sustainability)

In addition to the LOS categories noted, there are procedural components of meeting LOS, such as utilizing triple bottom line assessment to evaluate projects that will occur throughout the UWA process.

C. Summary of Results

As noted above, the Opportunities analyses focused on identifying CSD and flood reduction opportunities. As the system is currently in compliance, there are no defined CSD reduction targets on the Westside. However, UWA is assessing CSD reduction options as part of the SFPUC Commission's recommendation to evaluate the feasibility of reducing CSDs at public beaches. Westside public beaches (i.e., Ocean, Baker, and China beaches) are most directly impacted by CSD outfalls 001 to 003 and 005 to 007 (i.e., all Westside CSD locations but Mile Rock).

UWA's efforts are one piece of a broader SFPUC effort to assess the feasibility of Westside CSD reduction. The UWA team is contributing to the analysis by identifying opportunities and establishing the cost of using various technologies to reduce the volume and frequency of CSDs at Westside outfalls. However, UWA will not generate project recommendations because the assessment of CSD reduction "feasibility" must weigh project costs against water quality benefits. Water quality studies (conducted under a separate SSIP Task Order No. 28 by others outside of UWA) are still pending. Moreover, the cost-benefit analysis must also weigh the trade-offs of using the Southwest Ocean Outfall (SWOO) capacity for Westside CSD reduction rather than retaining the capacity to address unknown regulatory challenges that may arise in the future.[1] UWA will provide technical input as requested by SFPUC to inform this discussion but will not make project recommendations regarding CSD reduction until SFPUC has weighed all pertinent information and provided direction to UWA on the CSD LOS.

Per metrics defined as part of the Integrate Green and Grey Infrastructure to Manage Stormwater and Minimize Flooding LOS, the UWA team has also been tasked with identifying opportunities to reduce all instances of high and very high flooding risk during the 5-year, 3-hour LOS storm. As described in the Westside Characterization Technical Memorandum, the UWA team performed risk analyses to assess the potential for risk of both property damage and personal injury during the LOS storm based on factors such as land use, depth of flooding, and flow velocity on the surface.

Because the funding may not be available within this 20-year SSIP to address all parcels and street segments tagged with high flooding risk, the Characterization Phase defined and prioritized flood-prone areas based on the magnitude of risk and the likelihood of occurrence.[2] As a result of this process, three high-priority flood-prone areas were identified: Lake Street, Wawona Street/15th Avenue, and Ingleside/Ocean Avenue. The analysis presented herein focused on identifying opportunities to reduce risk at these high priority locations. However, opportunities were also identified to address all instances of high and very high flooding risk, regardless of location. The expectation is that addressing all instances of high and very high risk will play into a long-term scenario that will not be completed within this SSIP twenty year cycle.

The results of the analysis represent the opportunities having the highest potential to meet H&H LOS goals while minimizing costs or maximizing synergies with the Existing Structures and Sustainability LOS goals. Opportunity results are organized in the same overarching UWA framework of Projects, Programs, and Policies. Figure ES.1 shows the locations of all capital improvement opportunities (potential projects) identified within the Westside Drainage Basin. Table ES.1 summarizes the key attributes of these opportunities.

[1] A potential example would be increased stringency of Bayside discharge requirements.

[2] Where magnitude is based on model output of the total area of various risk rankings (high, medium, low) within a flood prone area. Likelihood considers not only model output during the LOS storm, but historical documentation of flooding events as well (e.g., claims, staff reports).

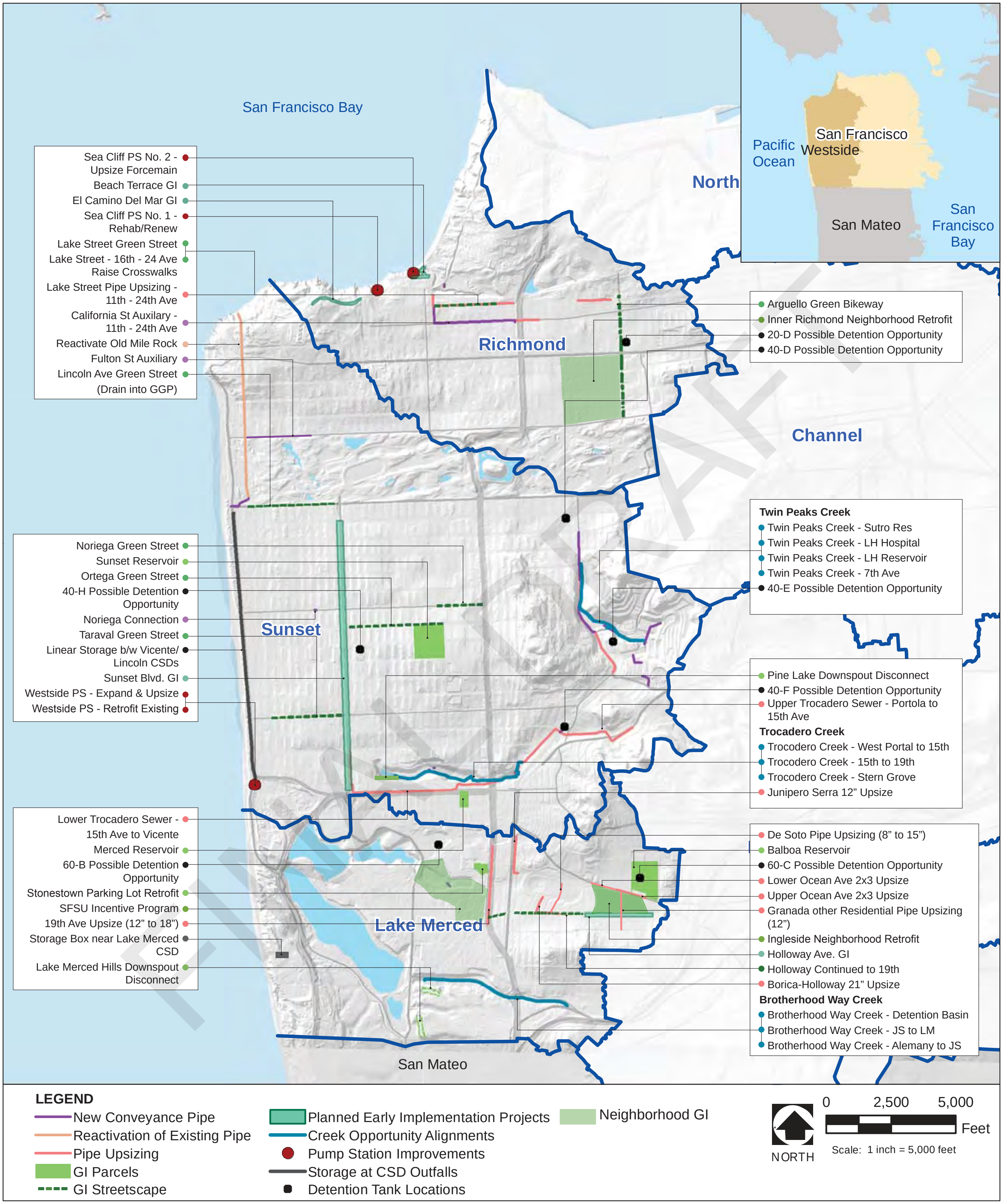

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Figure ES. 1 Westside Opportunities

Table ES.1: Westside Opportunities Summary

Project Name						Location		Technology Type		H+H Performance (Qualitative/Opps)				Cost Synergies			Multi-Benefit Synergies					Additional Information	
Principal LOS Driver	LOS Challenge Area	Strategy Identifier	Concept Identifier	ID	Project Name	Major Watershed	Minor Watershed	Technology Type	Infiltration Category	In Primary Contributing Area to Sensitive Area CSDs	Reduces Flows to Parcels Id'd as High Risk	Reduces Flows to Id'd Flood Prone Areas	Westside Aquifer Recharge or Reduced Potable Demand	Owner	Minimal Maintenance and Utility Conflicts	Interagency Synergies (Funded Planned Projects)	CSAMP (Synergy with R&R of High Risk Asset)	Reduce Odors/Improves O&M	Interagency Synergies (Non-Funded)	EJ/DC	Public Feedback	Site Visit Completed?	Project Description
F	HR	CD	1a	CD-1a	Twin Peaks Creek - Sutro Res	40	D	CD		x	x	x	x	PUC			VH MAJ				WG NC	x	Existing 42" concrete storm sewer, starting from above Sutro Reservoir and under the reservoir, to be connected to existing creek north of Laguna Honda Hospital
F	HR	CD	1b	CD-1b	Twin Peaks Creek - Laguna Honda Hospital	40	D	CD		x	x	x	x	Health	SD		-				WG NC	x	Existing creek north of Laguna Honda Hospital. To be connected with existing storm sewer to the north, and new project to the south
F	HR	CD	1c	CD-1c	Twin Peaks Creek - Laguna Honda Reservoir	40	D	CD		x	x	x	x	**PUC**	OS		VH MAJ				WG NC	x	Construction of diversion structure on an existing storm drain connecting existing LHH creek to Laguna Honda Reservoir to downstream end of reservoir
F	HR	CD	1d	CD-1d	Twin Peaks Creek - 7th Ave	40	D	CD		x	x	x	x	SFUSD/ PUC			VH MAJ		GC		WG NC	x	Downstream end of LH reservoir along 7th Ave (green connection street or through PUC property where there is an existing low marshy area), then through White Crane Springs Community Garden, city owned empty lot (Christmas tree lot) and Garden for the Environment.
R	OB	CD	2a	CD-2a	Brotherhood Way Creek - Lake Merced Detention Basin	60	D	DB		x		x	x	**PUC**	OS		-		GC		WG	x	Existing 30 ft deep area with ex 48" culvert to Lake Merced
R	OB	CD	2b	CD-2b	Brotherhood Way Creek - Junipero Serra to Lake Merced	60	D	CD		x		x	x	PUC DPW	BD	IPIC	-		GC		WG	x	Portion within PUC property along S side of street, captures Junipero Serra DMA
R	OB	CD	2c	CD-2c	Brotherhood Way Creek - Alemany to Junipero Serra	60	D	CD		x		x	x	DPW		IPIC	-		GC		WG	x	Portion within ROW on S side of street, could be extended to capture I 280 DMA
F	W	CD	3a	CD-3a	Trocadero Creek - West Portal to 15th	40	F	CD		x	x	x	x	DPW	-		VH MIN		SS		WG	x	Portion captures base flow from MUNI tunnel drain, could be a storm drain or open channel
F	W	CD	3b	CD-3b	Trocadero Creek - 15th to 19th	40	F	CD		x	x	x	x	Private /Ease	-						WG	x	Portion to link base flow from MUNI tunnel to Pine Lake, and also provide overland flow flood relief from 15th Ave. Route could be on South side of Condos instead, to minimize piped distance
F	W	CD	3d	CD-3d	Trocadero Creek - Stern Grove	40	F	CD		x	x	x	x	RPD	OS		VH MIN		GC		WG	x	Portion with existing grass open channel and dirt open channel, small culverts under footpaths may need to be replaced with larger size
F	IN	DT	1	DT-1	60- C Detention (Balboa Reservoir)	60	C	DT	N/A	x	x	x		**PUC**	PL				ROSE		WG	x	Combined sewage detention tank. Site likely to be sold by PUC for development, however potential to incorporate opportunity into any future project. Needs additional feasibility analysis in Alts phase
R	OB	DT	2	DT-2	60-B Detention (Lowell High School)	60	B	DT	N/A	x				SFUSD						DC			Suitable parcel in a good hydraulic location. However, CSS detention may be preferred as linear in the ROW. Parcel may be preferred for other GI technologies. To be analyzed further during alts development.
F	L	DT	3	DT-3	20-D Detention (Roosevelt Middle School)	20	D	DT	N/A		x	x		SFUSD			-	-	-	-	SU		Suitable parcel in a good hydraulic location. However, CSS detention may be preferred as linear in the ROW. Parcel may be preferred for other GI technologies. To be analyzed further during alts development.
F	HR	DT	4	DT-4	40-H Detention (Stevenson Elementary School)	40	H	DT	N/A	x	x	x		SFUSD							SU		Suitable parcel in a good hydraulic location. However, CSS detention may be preferred as linear in the ROW. Parcel may be preferred for other GI technologies. To be analyzed further during alts development.
F	W	DT	5	DT-5	40-F Detention (West Portal Playground)	40	F	DT	N/A	x	x	x		RPD									Suitable parcel in a good hydraulic location. However, CSS detention may be preferred as linear in the ROW. Parcel may be preferred for other GI technologies. To be analyzed further during alts development.
F	HR	DT	6	DT-6	40-E Detention (Laguna Honda Hospital Parking Lot)	40	E	DT	N/A	x	x	x		DPH									Suitable parcel in a good hydraulic location. However, CSS detention may be preferred as linear in the ROW. Parcel may be preferred for other GI technologies. To be analyzed further during alts development.
F	HR	DT	7	DT-7	40-D Detention (Irving/9th Off-Street Parking)	40	D	DT	N/A	x	x	x		City?					ROSE				Suitable parcel in a good hydraulic location. However, CSS detention may be preferred as linear in the ROW. Parcel may be preferred for other GI technologies. To be analyzed further during alts development.
R	OB	GI	1	GI-1	Sunset Reservoir GI	40	C	IT	A	x	x		x	**PUC**					ROSE			x	Mange stormwater from reservoirs that flows out at Pacheco and 28th. Steep slopes are adjacent to outlet, best opportunities are to connect to Ortega concept or a new concept on Pacheco. (See site visit write-up for more detail.)
R	OB	GI	2	GI-2	Merced Reservoir GI	40	N	IT/GS	A	x			x	**PUC**							SU	x	Manage runoff from reservoir on overly-wide, underused Ocean Ave on south edge of site. (See site visit write-up for more detail.)
F	IN	GI	3	GI-3	Balboa Reservoir GI	60	C	RWH/DT	A/B	x	x	x	x	**PUC**	PL	IPIC adjacent					WG	x	PUC planning to develop concept and sell land to developer. Consider Metered Detention RWH design (either save piece of land, easement, or public/private partnership). Potential to capture runoff from adjacent roof and parking lot. (Also see Balboa Rsvr Detention Tank.)

Table ES.1: Westside Opportunities Summary

F	L	GI	4	GI-4	Arguello Green Bikeway	20	D	GS	A - D		x	x		DPW			H MAJ		GC SS PBS	DC	WG / SU		Green street project concept. Needs further analysis and coordination with analysis done for EIP NAR.
F	L	GI	5	GI-5	Inner Richmond Neighborhood Retrofit	20	C	PR	A		x	x		--			VH MAJ		ROSE		SU		Target streets for GI and pipe improvements where high risk CSAMP pipes exist in neighborhood area bounded by Geary to Fulton, Funston to Arguello.
F	IN	GI	6	GI-6	Ingleside Neighborhood Retrofit	60	C	PR		x	x	x	x	DPW			VH MIN		ROSE	DC	WG		Target suitable streets with majority of high risk CSAMP pipes in neighborhood area bounded by Ocean to Holloway, Ashton to Harold. (Note: N/S streets may also be opportunity to connect Holloway to CCSF or Balboa via GI).
F	IN	GI	7	GI-7	Holloway Green Street Extension - Continued to 19th	60	C	GS		x		x	x	DPW		IPIC	H MIN		GC SS PBS		SU/ WG		Create "College Bikeway" - SFSU/Parkmerced to City College. Constraints: narrow road, not identified as "most suitable" for GI.
R	OB	GI	8	GI-8	Pine Lake Downspout Disconnect	40	G	DD		x			x	Private			-						Downspout disconnection to known problem area.
R	OB	GI	9	GI-9	Stonestown Green Parking Lot Retrofit	60	B,C	PP		x			x	Private	PL		-			DC	WG		Target extremely large impervious area for runoff reduction.
F	HR	GI	10	GI-10	Noriega Green Street	40	C	GS	A	x	x	x	x	DPW			VH MIN		IN SB SS	-	SU		Matches SB stretch. One block from PUC reservoir. May help address flooding high risk parcel there. Noriega flood prone area is 22nd to 33rd, then again at 40th
R	OB	GI	10	GI-10	SFSU Incentive Program	60	B	PR		x		x	x	State			-			DC	WG		Target large impervious areas with single ownership.
R	OB	GI	11	GI-11	Ortega Green Street	40	H,C	GS	A	x	x		x	DPW			VH MIN		GC ROSE	DC	WG		Possible infiltration gallery site for Sunset Reservoir runoff. One block south of Noriega Invest in Neighborhoods/Sunset Blueprint stretch.
R	OB	GI	12	GI-12	Taraval Green Street	40	J	GS	A	x			x	DPW			H MIN		IN SB	-	SU		Commercial corridor, matches area identified in Sunset Blueprint.
R	OB	GI	13	GI-13	Lincoln Ave Green Street (drain into Golden Gate Park)	40	C, K	BR		x			x	DPW RPD			x	x	SB ROSE	-			SB advocated new entry ways into GGP. Concept would manage Lincoln runoff in GGP, create more of an entry into park in outer avenues.
F	L	GI	14	GI-14	Lake Street Green Street	20	B,C	GS	A		x	x		DPW			VH MAJ		GC PBS	DC	WG		Concept in combination with brick sewer replacement and elevated crosswalk project, reduce overflow potential to Lobos Creek
R	SC	GI	15	GI-15	Baker Beach EIP (El Camino Del Mar Green Street)	20	A	GS	A	x		x		DPW			H MIN		PBS		x		Baker Beach EIP
R	SC	GI	16	GI-16	Baker Beach EIP (Beach Terrace Green Street)	20	A	GS	A	x				DPW GGNRA							x		Baker Beach EIP
R	OB	GI	17	GI-17	Lake Merced Hills Downspout Disconnect	60	D	DD		x			x	Private	OS		-					x	Based on DPW EHY site visits, there may be opportunity to disconnect these areas to existing storm drain system on neighboring gold course.
R	OB	Op	1	Op-1	Reactivate Old Mile Rock	40	A, B, K	Tunnel	N/A	x	x	x		Multipl e									Past concept included overflow connections from Fulton and Lincoln Sewers for LOS Storm to Old Mile Rock
F	L	Op	2	Op-2	Lake Street Crosswalks - 16th - 24 Ave Raise Crosswalks	20	B	Grading	N/A		x	x		DPW			VH MAJ		GC PBS TC	DC	WG		Concept in combination with Lake Street Green Street and brick sewer replacement, reduce overflow potential to Lobos Creek
F	L	Pi	1	Pi-1	Lake Street Pipe Upsizing - 2nd to 6th	20	D	Pipe	N/A		x	x		DPW			-			DC			Upsize Lake Street to alleviate surcharging of high risk sewer. Post this recommendation, sewer collapsed in this location.
F	L	Pi	2	Pi-2	Lake Street Pipe Upsizing - 11th to 24th Ave	20	B, C	Pipe	N/A		x	x		DPW			VH MAJ			DC	WG		Upsize high risk brick sewer, coordinate with raised crosswalk project to prevent surface flows toward Lobos Creek
F	L	Pi	3	Pi-3	California St Auxiliary - 11th to 24th Ave	20	B, C	Pipe	N/A			x		DPW			-			DC	WG		Proposed auxiliary sewer to alleviate Lake Street flooding and potentially slow flows into head end of RTT (From SSIP 2010 LOS)
F	W	Pi	4	Pi-4	Upper Trocadero Sewer Upsizing - Portola to 15th Ave	40	F	Pipe	N/A		x	x		DPW			VH MIN						Reduce excess stormwater to 15th/Wawona, overlaps with green connections, synergy with CSAMP high risk minor sewer.
F	W	Pi	5	Pi-5	Lower Trocadero Sewer Upsizing -15th Ave to Vicente	40	G	Pipe	N/A		x	x		DPW			H MIN						Address flooding by provide add'l capacity from 15th/Wawona to downstream trunk sewer.
F	IN	Pi	6	Pi-6	19th Ave Pipe Upsizing (12" to 18")	60	B	Pipe	N/A			x		DPW									Address undersized sewers in flood prone area.
F	IN	Pi	7	Pi-7	Junipero Serra Pipe Upsizing (12")	60	C	Pipe	N/A			x		DPW									Upsize to alleviate surcharging of high risk sewer at Mercy High School.
F	IN	Pi	8	Pi-8	Upper Ocean Ave Pipe Upsizing (2x3)	60	C	Pipe	N/A		x	x		DPW						DC			Upsize Ocean Ave trunk sewer in flood prone area. Synergy with CSAMP high risk pipes and in disadvantaged community.
F	IN	Pi	9	Pi-9	Lower Ocean Ave Pipe Upsizing (2x3)	60	C	Pipe	N/A		x	x		DPW						DC			Extend Ocean Ave improvements to capture CSAMP major VH/H risk sewers
F	IN	Pi	10	Pi-10	Granada other Residential Pipe Upsizing (12")	60	C	Pipe	N/A		x	x		DPW						DC			Upsizing of smaller sewers to the south feeding Ocean Ave. Needs more evaluation of specific pipe segments in alts development.
F	IN	Pi	11	Pi-11	De Soto Pipe Upsizing (8" to 15")	60	C	Pipe	N/A			x		DPW									Upsize local sewers that are causing excess stormwater to collect in low point of Racetrack neighborhood.
F	IN	Pi	12	Pi-12	Borica-Holloway Pipe Upsizing (21")	60	C	Pipe	N/A			x		DPW									Upsize local sewers that are causing excess stormwater to collect in low point of Racetrack neighborhood. Potential synergy with green connections and opportunity to extend EIP along Holloway.

Table ES.1: Westside Opportunities Summary

F	HR	Pi	13	Pi-13	Fulton St Auxiliary	40	B	Pipe	N/A		**x**	**x**		DPW			**x**						Auxiliary sewer to address flooding near Fulton (Proposed in 2010 SSIP). Needs re-evaluation with respect to Old Richmond Tunnel and OMR recommendations and priority of reduction CSDs at Ocean Beach.
F	HR	Pi	14	Pi-14	Noriega Connection	40	J, H	Pipe	N/A		**x**	**x**		DPW									Finish crossover connection that was never completed
R	SC	PS	1	PS-1	Sea Cliff PS No. 1 - Rehab/Renew	20	A	PS	N/A	**x**				**PUC**	OS		**x**						Pump Station rehab/renewal
R	SC	PS	2	PS-2	Sea Cliff PS No. 2 - Upsize Forcemain	20	A	FM	N/A	**x**				**PUC**			**x**						Upsize forcemain for pump station
R	OB	PS	3	PS-3	Westside PS - Expand & Upsize	40	L	PS	N/A	**x**				**PUC**	OS								Expand or upsize pump station to move more flows
R	OB	PS	4	PS-4	Westside PS - Retrofit Existing	40	L	PS	N/A	**x**				**PUC**	OS		**x**	**x**					Retrofit existing pumpstation
R	OB	TS	1	TS-1	Storage Box near Lake Merced CSD	60	A	Tank	N/A	**x**				GGNRA	OS								Add new storage near CSD outfall to maximize effectiveness of using storage to reduce CSDs.
R	OB	TS	2	TS-2	Linear Storage b/w Vicente/Lincoln CSDs	40	K, L	Linear Storage	N/A	**x**				GGNRA DPW	OS								Add storage adjacent to Westside T/S in attempt to maximize efficiency of using storage to reduce CSDs.

__Legend:__

LOS Driver
R Regulatory
F Flooding

Challenge Area
OB Ocean Beach CSD:
SC Sea Cliff CSDs
L Lake Street
W Wawona and 15th
IN Ingleside and Ocean Ave
HR Other Areas w/ High Risk Flooding Parcels

Strategies
Pi Increased Conveyance/Pipe Upsizing
TS Large Scale CSS Storage
DT U/S Smaller-Scale CSS Storage
Op Reroute Flows/Operational changes
GI Runoff Reduction/Green Infrastructure
CD Creek Daylighting
PS Pump Station Upsizing (New or Retrofit)

GI Technology Type
BR Bioretention
PP Permeable Pavement
GS Green Street
RWH Rainwater Harvesting
IT Infiltration Trench or Gallery
DB Detention Basin
WT Wetland
CD Creek Daylighting
PR Programmatic GI
DD Downspout Disconnect

Owner
PUC SFPUC
RPD Rec and Park
DPH SF DPH
Ease SFPUC Easement

Interagency
GC Green Connections
IN Invest in Neighborhoods
SB Sunset Blueprint
MTA MTA bulbout
HIC High Injury Corridor
SS Streetscape Street
PBS Priority Bike Segment
TC Traffic Calming
IPIC Interagency Plan Implement:
IF Interagency Feedback

Public Feedback
SU SSIP Survey
WG SSIP Watershed Game
NC Nature in the City

CSAMP
H High Risk
VH Very High Risk
MAJ Major Pipe
MIN Minor Pipe

Minimal Conflicts
PL Parking Lot
SD Special District (Industrial, etc.)
BD Boulevard/Low Density Street
OS Open Space

In general, the Westside opportunities are characterized by green/grey hybrid solutions that manage flows cost effectively while maximizing synergies with SFPUC, interagency, and community-driven goals. Below is a brief summary of the types of opportunities presented in Table ES.1 and Figure ES.1. For a more comprehensive summary, refer to Section 3.5. Opportunities include:

- Pump station improvements to enhance system reliability and reduce CSDs.
- Pipe upsizing of high-risk, aging infrastructure in flood-prone areas (e.g., Lake Street brick sewers).
- Infiltration-based green infrastructure (GI) to assist in meeting H&H LOS while recharging the Westside Groundwater Basin, taking advantage of the abundance of wide, flat streetscapes and underlying sandy soils.
- Managing runoff from SFPUC-covered reservoirs (about 50 acres total of impervious area). These opportunities are also characterized by the potential for using larger-scale GI strategies such as infiltration galleries beneath the street or dual-stage rainwater harvesting cisterns with detention storage.
- Strategic green street retrofits along hydraulically preferred corridors with multiple interagency synergies (e.g., Green Connections, "Invest-in-Neighborhoods" streets, and Sunset Blueprint). The most opportune locations are those where SFPUC can be responsible for the cost of wastewater/stormwater improvements only rather than the entire cost of providing a complete street. These locations are likely to align with those where curb demolition and potential loss of parking are minimal or are the result of initiatives led by another agency.
- Creek daylighting along historical creek paths using SFPUC property and rights-of-way to connect green spaces. Proposed creek paths take advantage of existing creeks, detention features, and underused open space. Even where historical creek paths do not exist, there may be opportunities to develop overland flow paths that route stormwater to more desirable locations. Accordingly, the Alternatives Phase may identify relief pathways that route excess stormwater to a location that mitigates risk. However, evaluation of overland flow paths and flood mitigation during extreme events, such as the 100-year storm, is planned for task orders after UWA.
- Programs to take advantage of the widespread suitability of GI and the momentum garnered by efforts such as Front-Yard Ambassadors, Sunset Blueprint, Friends of the Urban Forest sidewalk landscaping, and others.
- Potential opportunities at schools and non-potable reuse opportunities are still under development pending continued coordination the San Francisco Unified School District and Water Enterprise, respectively. These opportunities will be further defined during alternatives development.

D. Next Steps

The next phase of SSIP-UWA, the Alternatives Phase, consists of alternatives development and alternatives analysis. The results of the Opportunities Phase will serve as the basis for developing alternatives; however, new opportunities may be identified during the alternatives development process. The goal of the Alternatives Phase is to present a variety of alternatives that facilitate Wastewater Enterprise decision-making and answer key collection system investment questions.

The UWA analysis conducted during Alternatives will focus on evaluating potential CSD and flood reduction improvements. CSD reduction goals, particularly at the Ocean Beach CSDs, are contingent upon the results of the ongoing cost-benefit analysis discussed earlier. Flooding analyses will evaluate ways to address flooding at the high priority flood prone areas but will also look at a long-term plan to address all areas with high risk. Using this approach, UWA will develop alternatives that demonstrate the effort needed, not constrained by cost, to meet all pertinent WWE Goals and LOS over the long term. The team will evaluate variations in alternatives' cost and performance with triple bottom line analysis and ultimately recommend a Westside SSIP alternative that adheres to the approved SSIP 20-year budget allocations.

1.0 INTRODUCTION WESTSIDE WATERSHED OPPORTUNITIES

1.1 Purpose and Background

This technical memorandum identifies collection system improvement opportunities within the Westside Drainage Basin in the City and County of San Francisco (CCSF). The collection system includes all portions of the system that manages and conveys both stormwater runoff and wastewater from its sources to the City of San Francisco's (City's) wastewater treatment and discharge facilities. This effort is part of the Urban Watershed Assessment (UWA) being completed in support of the San Francisco Public Utilities Commission (SFPUC) Sewer System Improvement Program (SSIP). The UWA is a city-wide planning process that will assist the SFPUC by identifying specific projects, programs, and policies to reach Wastewater Enterprise (WWE) goals and levels of service (LOS) for the collection system.

This technical memorandum builds upon the findings of the UWA Westside Drainage Basin Urban Watershed Characterization Final Draft Technical Memorandum (SSIP-Project Management Consultant [PMC], 2014a) (Westside Characterization Technical Memorandum). This memorandum describes the process used to develop opportunities and document the findings for each of the three Westside urban watersheds.

The Opportunities Analysis task builds upon the existing conditions, challenges, and needs identified in the Characterization Phase. The Opportunities Phase includes two tasks: Analysis and Feasibility. During this phase, the Opportunities Analysis further defines the spatial extent of each system need and its area of influence, and then focuses development of opportunities within that extent to resolve the need. After a potential opportunity location, technology, and scale are defined, that opportunity moves into the more detailed Opportunity Feasibility Analysis task. The final output is a catalog and preliminary analysis of the most promising opportunities to resolve known challenges in the Westside Drainage Basin collection system.

1.2 Sewer System Improvement Program and the Urban Watershed Assessment

Every day, San Francisco residents, businesses, workers, and visitors rely on the City's sewer system. San Francisco's sewer system is composed of two core elements, the wastewater collection system and the treatment system. These two systems include combined sewage management facilities, curbs, gutters, catch basins, collection sewers, pump stations, treatment plants, and outfalls that support both dry and wet weather needs. The SFPUC's combined system collects around 72 million gallons (MG) of wastewater on dry days and upwards of 500 MG of combined wastewater and stormwater flow on rainy days citywide. The system is aging – by 2035, approximately 40% of the sewers will be more than 100 years old (assuming current rates of rehabilitation and replacement) – and ensuring seismic reliability and functional redundancy requires ongoing efforts. Emerging issues such as climate change and associated sea level rise will require upgrades to protect both collection and treatment system infrastructure as well as plans for adaptive management to accommodate future uncertainties regarding rate of sea level rise. Additionally, capacity constraints and compliance with evolving regulatory requirements drive the need for substantial improvements to San Francisco's sewer system.

The SFPUC WWE is working proactively to identify the appropriate investments needed for the sewer system infrastructure. The SSIP is the SFPUC's 20-year capital improvement plan to address system-wide needs, update the aging sewer system, and protect public health and the environment. The SSIP is the result of an 8-year public planning process incorporating valuable feedback from the community. Improvements will upgrade the wastewater collection, treatment, and discharge facilities using innovative strategies to ensure compliance, reliability, and long-term sustainability.

The WWE goals and LOS were developed and gained endorsement through a series of seven public workshops held before the Commission between October 2009 and July 2010 and were further refined and endorsed through Sewer System Improvement Program Validation workshops in August 2012. These goals correlate to qualitative and quantitative performance measures that must be met by proposed operational improvements, capital projects, programs, and policies. The SFPUC's endorsed WWE goals are:

- Provide a compliant, reliable, resilient, and flexible system that can respond to catastrophic events
- Integrate green and grey infrastructure to manage stormwater and minimize flooding
- Provide benefits to impacted communities
- Modify the system to adapt to climate change
- Achieve economic and environmental sustainability
- Maintain ratepayer affordability

The UWA is the process by which SSIP collection system improvement projects will be developed and evaluated to achieve the WWE goals. The UWA provides an integrated, urban watershed-wide approach to define the most effective operational improvements, capital projects, programs, and policy initiatives for each of the City's eight urban watersheds to address surface drainage and collection system challenges.

The SSIP includes other efforts related to the UWA. One closely related effort was the Collection System Validation. This year-long effort concluded in the summer of 2012 with a series of three presentations to the Commission. Through the validation process, the SSIP goals and levels of service were affirmed, and in some cases were modified to reflect a further understanding of sewer system issues and priorities. While some project concepts from validation were further evaluated in the UWA Opportunities Phase, the validation process was not intended to supplant the UWA process for defining potential projects to be carried forward into the UWA Alternatives Phase.

1.2.1 Urban Watershed-Based Planning

Based on the Commission's endorsement, the SFPUC made a commitment to urban watershed-based planning through the publication of the *Urban Watershed Framework* (SFPUC 2012). The goal of this framework is to define an objective, transparent process that will result in recommended collection system improvements across all urban watersheds to bring the entire combined sewer system (CSS) up to the adopted WWE LOS. These collection system improvements will be identified and implemented through a UWA process, whereby system benefits and impacts are assessed in terms of overall LOS performance and the project costs and benefits are assessed in terms of financial, environmental, and social factors (SSIP-PMC 2013b). The individual steps and how they are sequenced within the three larger phases of the UWA are described in the following subsection.

1.3 Role of the Opportunities Phase within the UWA

Each phase of the UWA – Characterization, Opportunities, and Alternatives – includes a set of analytical processes developed to implement the integrated, watershed-wide approach outlined in the *Urban Watershed Framework* (SFPUC 2012). These analyses will result in the development of a recommended suite of projects, policies, and programs in each of the eight major urban watersheds to meet all applicable WWE goals and LOS. Together, these three phases follow a sequence of tasks with individual steps:

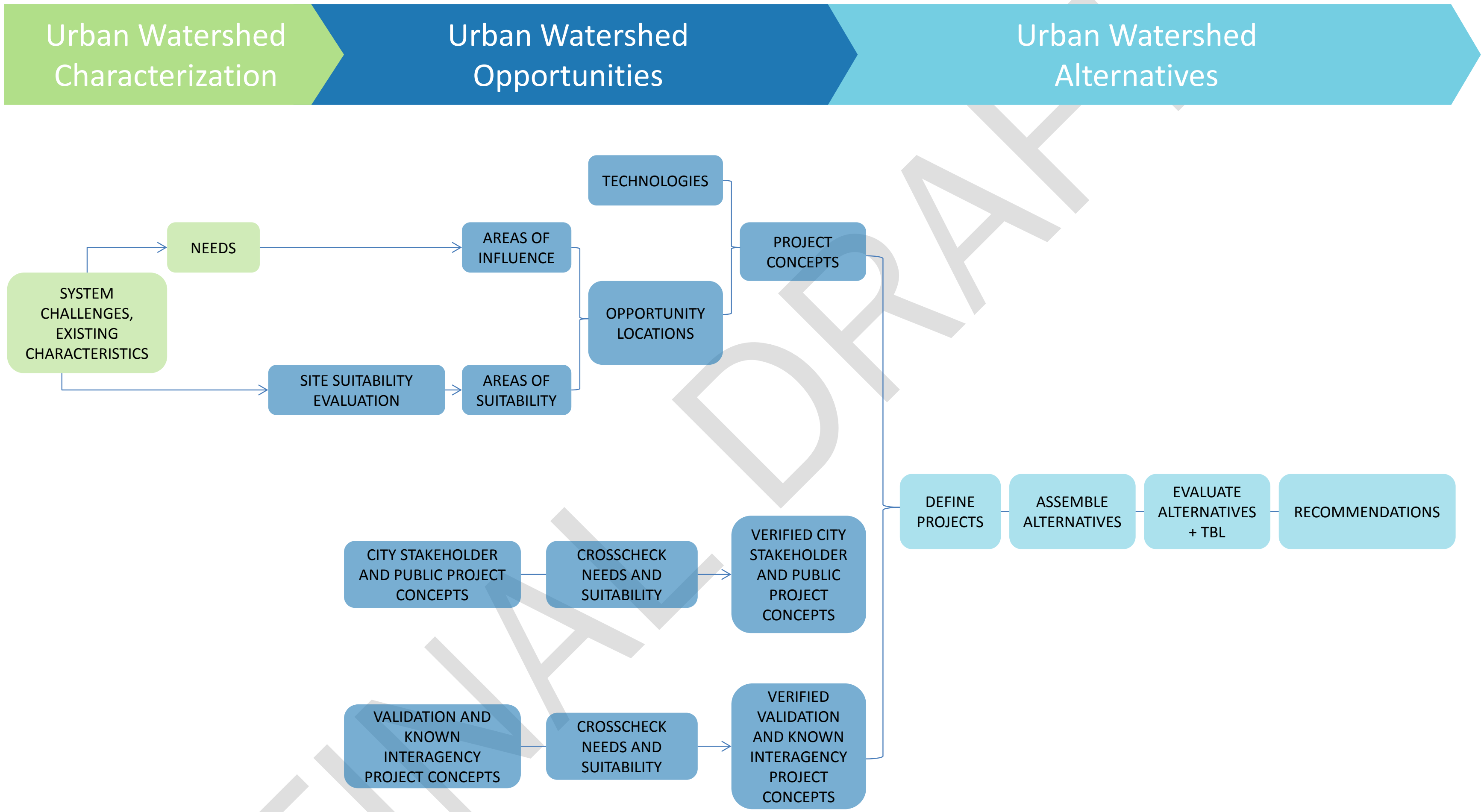
Phase	Task	Steps
Characterization	Needs Analysis	1. Identify collection system needs relative to the endorsed SSIP LOS goals.
Opportunities	Opportunities Analysis	2. Identify suitable locations and technologies for potential collection system improvements to address those needs.
		3. Identify potential project synergies to facilitate integrated projects and maximize cost effectiveness.
		4. Develop opportunities that maximize multiple benefits.
	Opportunities Feasibility Analysis	5. Assess the feasibility of opportunities and catalog by location and performance.

Phase	Task	Steps
Alternatives	Alternatives Development	6. Further develop feasible opportunities into project concepts. 7. Develop alternative suites of project concepts, called watershed alternatives, to meet WWE goals and LOS in each watershed.
	Alternative Evaluation and Recommendation	8. Evaluate watershed alternatives with the help of triple bottom line analysis and select a preferred alternative. 9. Develop a phasing and implementation plan for the preferred watershed alternative.

The opportunities presented in this technical memorandum represent output from the Opportunities Analysis and Opportunities Feasibility Analysis tasks. The UWA team used the existing conditions, challenges, and needs identified in the Characterization phase to identify broad opportunity locations for collection system improvements as well as suitable improvement strategies for those locations and needs. Potential interagency project synergies and ongoing public outreach activities guided the identification and development of opportunities throughout this analysis.

The results of the Opportunities Phase include a comprehensive inventory of locations for a range of potential collection system improvements. In the subsequent Alternatives Development task, the UWA team will build on these results with further project concept development and cost-benefit analysis. Alternatives Evaluation is the final task to identify a recommended watershed alternative and develop a phasing and implementation plan. The UWA process flow chart in Figure 1.1 shows the sequential order of these steps and how they are related.

Figure 1.1
UWA Process Summary Flow Chart



1.4 The Role of Interagency Coordination and Public Outreach

In addition to the technical and hydrologic/hydraulic work done by the UWA team, a watershed-based planning approach requires involvement by other City departments and agencies and by the public. This subsection describes the role of interagency and intra-agency coordination and public outreach for the UWA effort. The UWA has engaged with many groups within the SFPUC, including the Water and Power Enterprises

1.4.1 Interagency Coordination

Interagency coordination is an integral part of the UWA planning and project development process. The primary goals of the UWA interagency coordination efforts include 1) education on the SSIP and UWA planning processes and results; 2) identification of potential project synergies that could achieve multiple agency goals; 3) identification of potential project conflicts; and 4) solicitation of feedback on SFPUC projects, programs, and policies that involve other city agencies. To achieve these goals, the UWA team convened an interagency working group composed of members from the following agencies:

- San Francisco Municipal Transportation Agency
- San Francisco County Transportation Authority
- Water Emergency Transportation Authority
- Port of San Francisco
- San Francisco Department of Public Works/Capital Planning
- Neighborhood Empowerment Network
- Invest in Neighborhoods
- San Francisco Recreation and Parks Department
- San Francisco Department of the Environment
- San Francisco Planning Department
- San Francisco Fine Arts Commission
- San Francisco Unified School District

During the Opportunities Phase for the Westside Drainage Basin, the UWA team completed two large group meetings and a series of targeted individual meetings to address specific topics. Working group members reviewed key project information and technical analyses as they were developed, and they provided feedback to the UWA team in identifying and refining opportunities and assessing the feasibility of implementation. The topics of the large group meetings are as follows:

Meeting #1 (xxx): Westside Watersheds Opportunities *(to be updated)*

Meeting #2 (xxx): Westside Watersheds Opportunities *(to be updated)*

Through these meetings, and previous meetings held for the Bayside Drainage Basin, the UWA team obtained information on long-term city priorities such as the Pedestrian Strategy, Bicycle Strategy, Green Connections Network, Transit Effectiveness Program, various neighborhood plans, and other initiatives, as well as specific suggestions for potential coordination opportunities. Figure 1.2 illustrates how the UWA team incorporates interagency feedback throughout the UWA process. In future phases, the UWA team will continue to coordinate with other CCSF agencies to solicit feedback on project concepts included in watershed alternatives and to develop business practices and agreements for implementation.

Sections 2 through 4 describe how the UWA team incorporated interagency information to identify the opportunities outlined in this technical memorandum.

1.4.2 Public Outreach

In addition to interagency coordination, public outreach is also an integral component of the overall UWA process. The UWA team conducted an extensive public outreach program during the Opportunities Phase. The main objectives of the outreach were to 1) communicate with the public on the SSIP and UWA planning processes and the need for the SSIP; 2) hear stakeholder input on grey and green infrastructure technology preferences, potential project locations, and community values; and 3) engage a broad cross-section of San Francisco stakeholders representing geographic, demographic, and economic diversity from both the residential and business sectors. The process engages the public to help the SFPUC identify projects that align with community values.

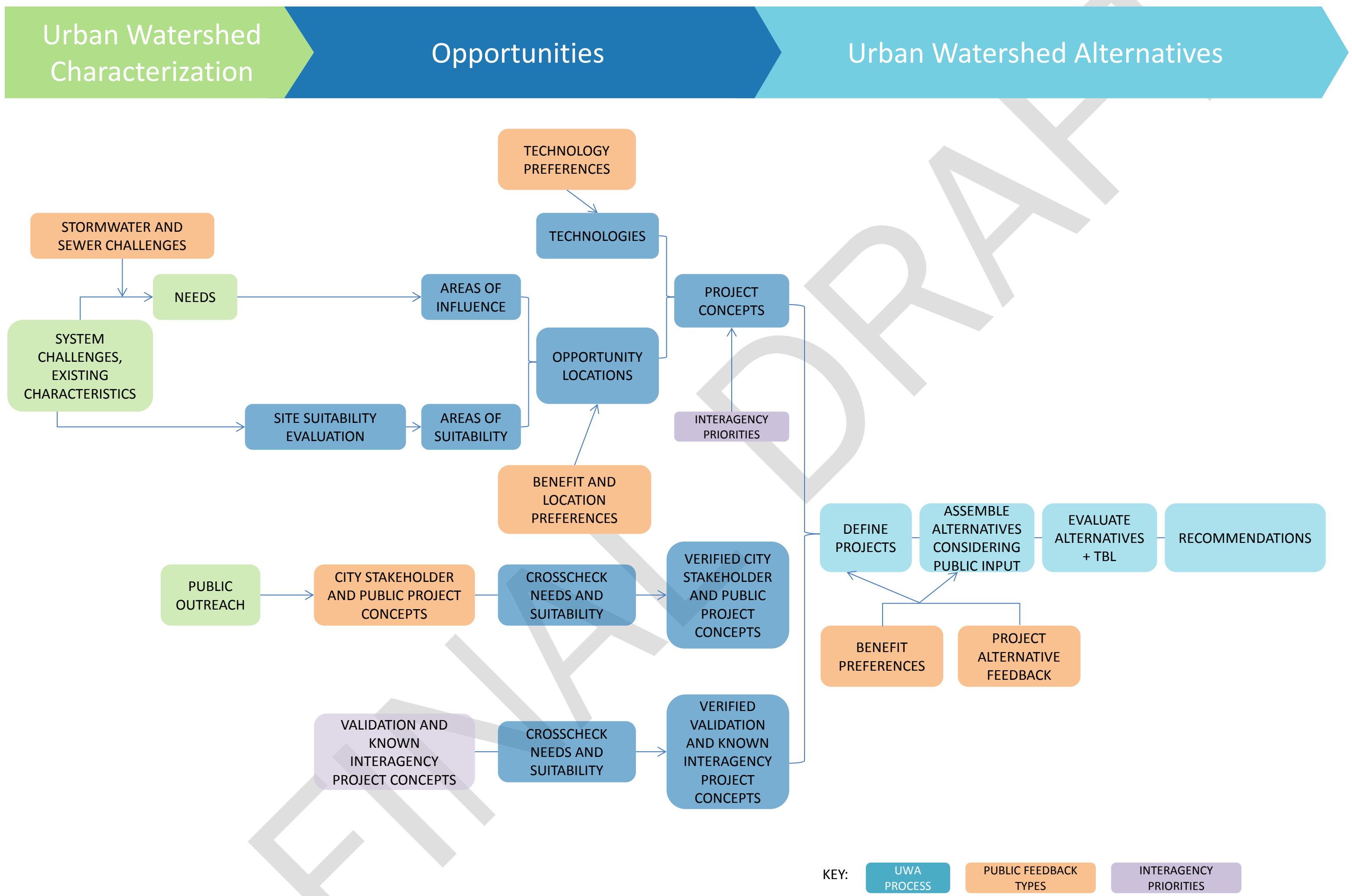
The UWA team used a range of methods while conducting outreach for the Westside Watersheds. These included:

- Meeting #1 (June 12): Westside Watersheds Characterization
- Webinar #1 (August 6): Westside Watersheds Characterization Webinar
- Meeting #2 (September 13): Urban Watershed Planning Game Workshop
- Surveys (May 20 – September 22): Intercept Survey and Online Survey

For each of these activities, the UWA team also defined and reported on public engagement outcome-based metrics in response to the *SFPUC Environmental Justice Policy 09-0170* (SFPUC 2009a), *Community Benefits Res. 11-0006 policy* (SFPUC 2011), and the 2012 Commission-endorsed policy to "inform, engage, and empower stakeholders and neighborhood partners during the whole life cycle (planning, design, and construction)." (See *Draft Memorandum: SSIP Level of Service "Provide Benefits to Impacted Communities" Recommendations for Implementation for UWA/SSIP, December 13, 2013*). These metrics can be found in Appendix B, which includes the public outreach summary reports. *(See Draft Westside Watersheds Outreach Metrics Report – UWA Characterization and Opportunities Phases, November 14, 2014).*

Section 2 presents outreach results and describes the process the UWA team used to incorporate public feedback in the evaluation of opportunities. *(See Draft Urban Watershed Workshop and Survey Community Input Summary September 13, 2014)*.

Figure 1.2
UWA Process and Consideration of Interagency and Public Feedback



2.0 LOS NEEDS AND STRATEGIES

This section describes the process and methods used to identify collection system improvement opportunities within each urban watershed. To locate specific opportunities, the UWA team assessed the suitability of different opportunity types and locations by superimposing the detailed inventory of watershed needs on top of existing conditions data layers. Data layers included those related to the collection system, surface and subsurface characteristics, hydrologic and hydraulic modeling, interviews and forums with operators of the collection system, interagency and public feedback, and the output from various analyses performed on these data. The following subsections document how these data were used to identify the most promising opportunity locations within each watershed.

2.1 Level of Service Needs

The Opportunities Phase considers all WWE goals and LOS, but not all in the same manner. The UWA team identified three types of LOS as an organizing principle for planning purposes. The presentation of methods and results herein reflect this organization.

- **Hydraulic and Hydrologic LOS:** These include the wet weather challenges of reducing combined sewer discharges (CSD) and minimizing flooding. These LOS are quantitative in nature and can be addressed by a variety of strategies in spatially disparate locations. Therefore, an opportunity analyses was conducted to identify synergistic opportunities to meet these LOS while also addressing other system needs or sustainability goals.
- **Existing Structures LOS**: These include challenges to existing WWE assets that require operational or physical improvements. Structural challenges include redundancy, seismic reliability, odor, and sea level rise at existing facilities. Whereas hydrologic and hydraulic (H&H) LOS can be addressed locally or upstream, solutions to existing structure needs are typically located at the structure itself. Within the UWA Opportunities Phase, strategies to address the Existing Structure LOS were identified and the LOS needs were used as synergy criteria within the CSD and flooding opportunity analyses.
- **Sustainability LOS:** These include mitigating disproportionate impacts on affected communities (i.e., addressing negative impacts), providing positive community benefits, and reusing nonpotable water. These LOS were used as synergy criteria to identify and prioritize opportunities to address H&H LOS needs. In addition, there are procedural components of meeting LOS, such as using triple bottom line assessment to evaluate projects that will occur throughout the UWA process.

Table 2.1 further clarifies this categorization of the LOS and explains the process undertaken by the UWA team in the Opportunities Phase to address each LOS. Terms such as opportunities, project concepts, and alternatives are defined within the glossary.

Table 2.1: WWE Goals and LOS

WWE Goals and LOS	Addressed in UWA	Category of Collection System Need	UWA Westside Opportunities Phase Tasks
Provide a Compliant, Reliable, Resilient, and Flexible System that Can Respond to Catastrophic Events			
Full compliance with state and federal regulatory requirements applicable to sewage and stormwater.	✓	**Hydrologic and Hydraulic (H&H)**	**Strategies:** Define applicable strategies to reduce CSDs to public beaches. **Opportunities:** Identify multi-beneficial opportunities to address needs using the strategies identified.
Critical functions are built with redundant infrastructure.	See note 1	**Existing Structures**	**Strategies:** Define applicable strategies to address relevant CSS needs. **TBL Criterion:** Use as synergy criteria within H&H opportunities analysis.
Primary treatment, with disinfection, must be on line within 72 hours of a major earthquake.	See note 1	**Existing Structures**	**Strategies:** Define applicable strategies to address relevant CSS needs. **TBL Criterion:** Use as synergy criteria within H&H opportunities analysis.
Integrate Green and Grey Infrastructure to Manage Stormwater and Minimize Flooding			
Control and manage flows from a storm of a three-hour duration that delivers 1.3 inches of rain.	✓	**H&H**	**Strategies:** Define applicable strategies to address high-priority flood challenge areas. **Opportunities:** Identify multi-beneficial opportunities to address needs using the strategies identified.
Provide Benefits to Impacted Communities			
Limit odors to within the treatment facility's fencelines.	✓	**Existing Structures**	**Strategies:** Define applicable strategies to address odor and other dry weather flow issues. **TBL Criterion:** Use as synergy criteria within H&H opportunities analysis.
Be a good neighbor. All projects will adhere to the Environmental Justice and Community Benefits policy.	✓	**Sustainability**	**TBL Criterion:** Use as synergy criteria within H&H opportunities analysis.
Modify the System to Adapt to Climate Change			
New infrastructure must accommodate expected sea level rise within the service life of the asset.	✓	**Existing Structures**	See Note 2
Existing infrastructure will be modified based on actual sea level rise.	✓	**Existing Structures**	See Note 2

WWE Goals and LOS	Addressed in UWA	Category of Collection System Need	UWA Westside Opportunities Phase Tasks
Achieve Economic and Environmental Sustainability			
Beneficial reuse of 100% biosolids.		--	--
Use nonpotable water sources to meet 100% of WWE facilities nonpotable water demands.	✓	**Sustainability**	**TBL Criterion:** Use as synergy criteria within H&H opportunities analysis.
Beneficially use 100% of biogas generated by WWE treatment facilities.		--	--
Stabilize life cycle costs to achieve future economic stability.	See note 3	--	--
Maintain Ratepayer Affordability			
Combined sewer and water bill will be less than 2.5% of average household income for a single family.	See note 3	--	--

Notes:
1 SSIP projects to address these needs are expected to primarily be facility projects (e.g., pump station or treatment plant improvements) rather than collection system projects. However, UWA Characterization also identified condition assessment, reliability, and redundancy needs related to the collection system.
2 Sea level rise is not expected to directly impact Westside assets. However, erosion of beaches may require increased protection-in-place for assets near the beach. In addition, assessment of impacts due to larger magnitude rainfall will be addressed in subsequent SSIP task orders to implement and prioritize UWA recommendations.
3 SSIP includes triple bottom line lifecycle cost analysis and project implementation scheduling to address these LOS.

2.1.1 Combined Sewer Discharges

Results of simulation modeling of long-term annual average using a typical rainfall year and historical reporting indicate that the Westside Drainage Basin experiences on average seven CSDs per year, less than the basin's long-term annual average design criteria of eight. The Westside Drainage Basin is currently meeting or exceeding its wet-weather regulatory requirements. However, per recommendations from the SFPUC Commission and as part of a broader feasibility analysis, UWA is evaluating opportunities to reduce CSDs to public beaches (i.e., China, Baker, and Ocean beaches). There is also a need to protect against overflows from Pine Lake Pump Station to Pine Lake, but an SFPUC project is underway to address that need.

The CSD needs are summarized in Table 2.2, which represents potential improvements to the SFPUC's already compliant system. Such improvements, if feasible, would be consistent with the approach of protecting beaches as sensitive uses under the National Combined Sewer Overflow Policy. These issues are also shown in Figure 2.1.

Table 2.2: Westside Drainage Basin – CSD Needs

Urban Watershed	Wastewater Collection System Needs: CSD LOS Group
Richmond	Evaluate the feasibility of reducing CSDs that discharge to China and Baker Beaches (i.e., CSD-005, 006, and 007). Investigate enhanced floatable control at Sea Cliff Pump Station 1.
Sunset	Evaluate the feasibility of reducing CSDs that discharge to Ocean Beach (i.e., Vicente CSD-002 and Lincoln CSD-003) Prevent overflows from Pine Lake Pump Station to Pine Lake (*Note: an SFPUC project is currently in the Design Phase that will address this need*).
Lake Merced	Evaluate the feasibility of reducing CSDs that discharge to Ocean Beach (Lake Merced CSD-001).

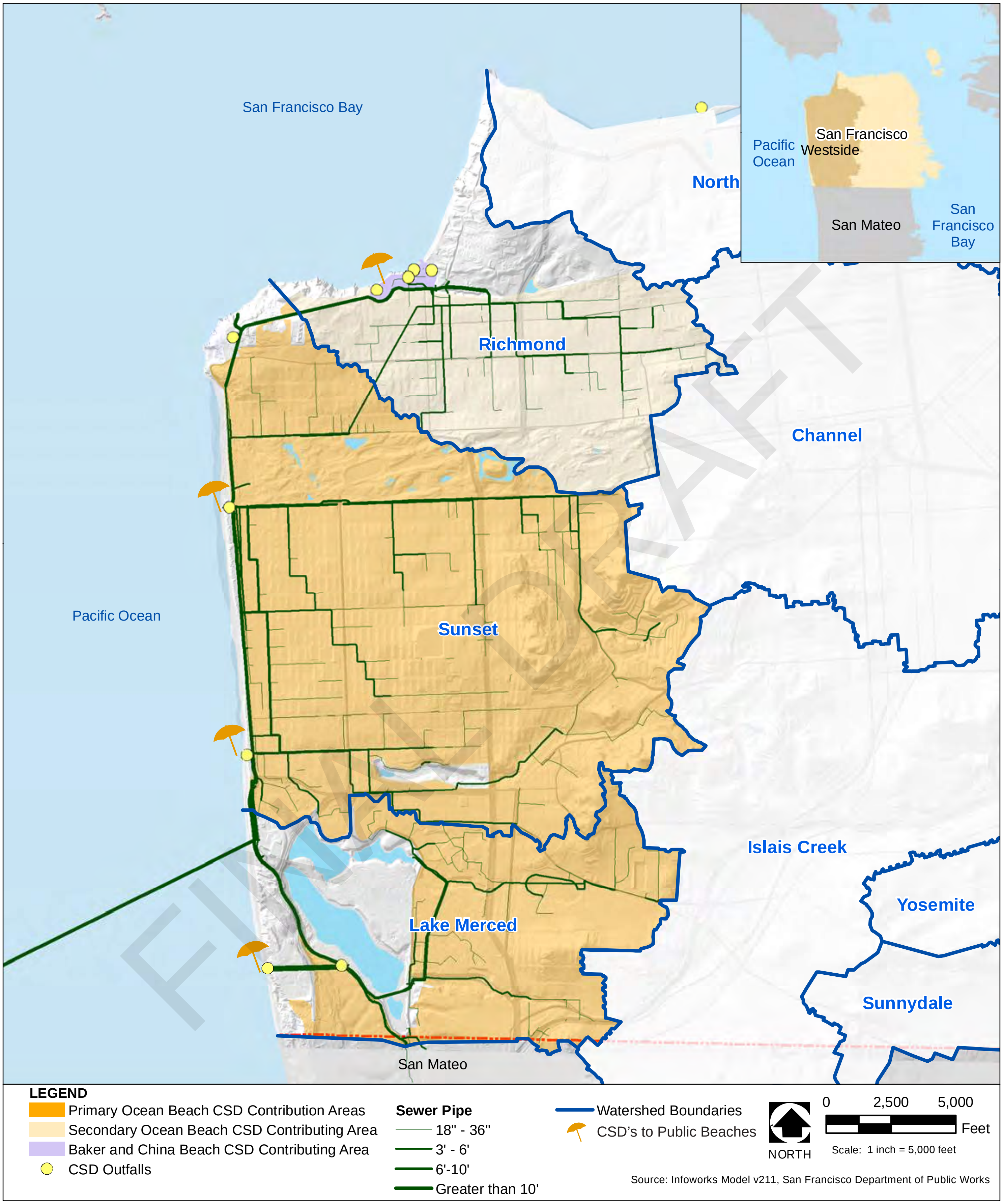


Figure 2.1 Combined Sewer Discharge Needs and Areas of Influence

San Francisco Water Power Sewer
Services of the San Francisco Public Utilities Commission

San Francisco Public Utilities Commission Sewer System Improvement Program
Westside Drainage Basin Urban Watershed Opportunities
FINAL DRAFT Technical Memorandum (February 2015)

SSIP PMC
SEWER SYSTEM IMPROVEMENT PROGRAM

2.1.2 Minimize Flooding

The risk classifications throughout the Westside Drainage Basin ranged from negligible during the LOS storm, where no significant impacts are expected, to very high, where the likelihood and consequence of flooding is predicted to be significant. The risk classifications for each street segment and parcel, the spatial extent of clustered risk areas, and historical flooding information (i.e., field observations, interviews with San Francisco Department of Public Works (SFDPW) and SFPUC staff, public feedback, and claim data) were combined to arrive at a ranking of excess flow challenge areas within the Westside. Solving these challenges will require the removal of sufficient excess stormwater to mitigate high-risk locations for property and personal injury. More information about the risk assessment process used to identify these areas of risk can be found in the Westside Characterization Technical Memorandum*.* Table 2.3 notes the specific locations of excess stormwater challenges within each urban watershed. Figure 2.2 displays the location of the challenges areas and identifies the areas of influence that contribute to the highest priority challenge areas.

As shown in Table 2.3, three areas were identified as the highest priority Westside flood prone areas to be addressed by SSIP. These three areas are the focus of the flood reduction opportunities analysis conducted within this memorandum. However, through the UWA Opportunity and Alternatives Phases, projects will be identified to address all parcels with model-predicted high or very high risk of flooding during the LOS storm.

Table 2.3: Westside Drainage Basin – Excess Stormwater Needs

Area Name	Location Description	Extent of Challenge Area[1]	Model-Predicted Risk Level During the LOS Storm	Observed Basis[2]	Priority
WWE LOS: Control and manage flows from a storm of a three-hour duration that delivers 1.3 inches of rain					
Richmond					
Lake Street / California Street Corridor	Along both Lake and California Streets from Arguello Street down to 19th Avenue	Large	Property damage: High Physical injury: Low	High	**High**
Inner Richmond	Along Geary and Balboa between 4th Avenue and 7th Avenue	Small	Property damage: Med Physical injury: Low	Low	**Low**
Sunset					
West Portal	Along Ulloa Street starting around Kensington Way, then turning south down Wawona Street and West Portal Avenue extending down to 15th Avenue	Medium	Property damage: High Physical injury: High	High	**High**
Outer Richmond	Between Balboa Street and Fulton Street west of 42nd Avenue running down to the Great Highway	Medium	Property damage: High Physical injury: Low	Medium	**Medium**
Noriega Street	Running west from 22nd Avenue down to 33rd Avenue, then starting again at 40th Avenue and continuing down to the Great Highway	Large	Property damage: High Physical injury: Low	Low	**Medium**
Laguna Honda	Laguna Honda Boulevard at Clarendon Road next to the Laguna Honda Reservoir	Small	Property damage: High Physical injury: Low	Low	**Low**
Judah at 12th Avenue	Potential property and injury risks at this intersection and extending south one block on 12th Avenue	Small	Property damage: High Physical injury: High	Low	**Low**

Area Name	Location Description	Extent of Challenge Area[1]	Model-Predicted Risk Level During the LOS Storm	Observed Basis[2]	Priority
7th Avenue / Locksley Avenue	On 7th Avenue starting at Kirkham Street and running south to Moraga Street; also one spot on Locksley Avenue at Lawton Street	Small	Property damage: High Physical injury: Low	Low	**Low**
Lake Merced					
Vista Grande Canal[3]	The point of entry for the Vista Grande stormwater canal from Daly City near the southern tip of Lake Merced	Medium	Property damage: High Physical injury: Low	Medium	**Medium**
Junipero Serra/ 19th Avenue/ San Francisco State University	Transient pressure challenges where steeper upstream system transitions to relatively flat Parkmerced Tunnel; corresponding excess flow challenges immediately upstream of transition near Junipero Serra and 19th Avenue. Transient pressure challenges also exhibited at downstream end of Tunnel into three compartment sewer.	Medium	Property damage: Low Physical injury: Med	High	**Medium**
Ingleside	Running down Ocean Avenue starting near the top of the watershed, then turning with the large sewer main onto Ashton Avenue and into the Ingleside Terrace neighborhood	Large	Property damage: High Physical injury: High	High	**High**

Source: CCSF H&H Model –EHY13v211 March 2014

Notes:

[1] The measured area ranges associated with each extent grouping are Small < 20 acres, Medium = 20–50 acres, Large = 50–100 acres.

[2] Qualitative measure of observed/historical documentation of flooding at each need area based on claim data and SFPUC/SFDPW staff observations.

[3] Daly City is in the process of upsizing a section of the Vista Grande Canal that should address this challenge.

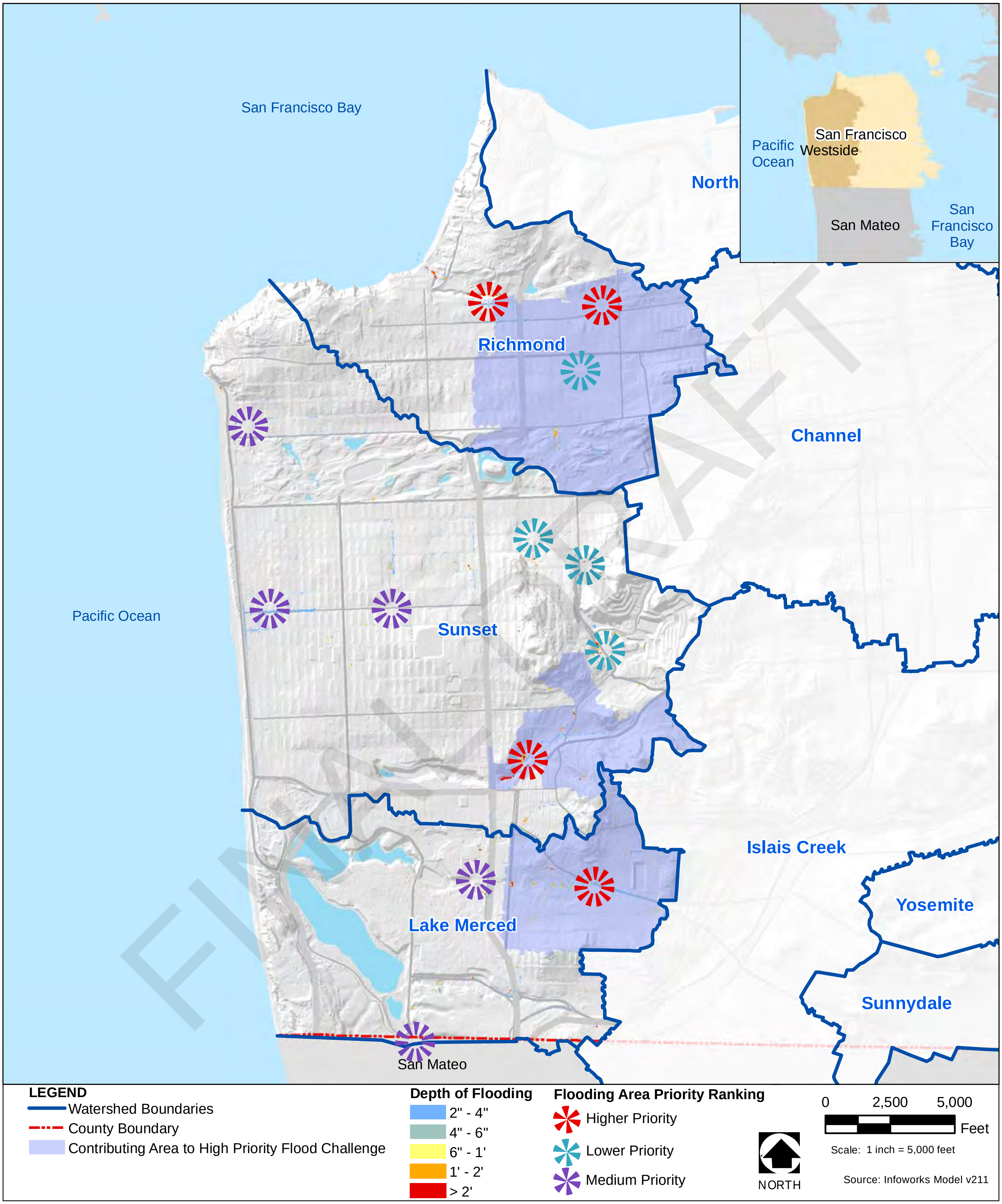


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Figure 2.2 Flood Reduction Needs and Areas of Influence

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2.1.3 Existing Structures

The Existing Structures LOS group includes all needs of the collection system and the transport/storage (T/S) network not related to wet weather performance. This includes needs related to redundancy, seismic reliability, dry-weather performance including odors, and sea level rise adaptation. In general, the SSIP Collection System Reliability Program (CSR) will lead the recommendation and prioritization of projects to address SSIP Existing Structure Needs. The SFPUC's Renewal and Replacement (R&R) program, which maintains the Collection System Asset Management Program (CSAMP) asset management database, will continue to lead the prioritization of projects to address structural and reliability issues of pipes ≤ 36-inches in diameter.

UWA will coordinate with CSR and R&R to identify synergies with H&H LOS needs and ensure that project recommendations are in sync. The CSR consists of several parallel ongoing efforts, including those described below.

The Condition Assessment Task Order of the SSIP is evaluating major structures for needs related to structural and seismic reliability. This task order will ultimately develop a detailed list of prioritized improvement recommendations. The UWA team has been actively coordinating with the condition assessment team, and any recommendations for rehabilitation or repair that are ready for the Alternatives Phase will be included in UWA watershed alternatives. Similarly, the UWA team has provided to the condition assessment team information on priorities for improvements based on wet weather and other known challenges in order to prioritize analysis for structural evaluation.

Similarly, the Odor Task Order of the SSIP is also currently ongoing. This task has created a model to predict locations of odor emanation from the system under existing conditions that will be used to corroborate known odor issues in various locations conducive to odor creation and emanation (e.g., drop manholes or other inducers of turbulence, flatter pipes with low velocities or stagnant water, and locations prone to backwater conditions). This task order will also create recommendations for odor management strategies, including capital projects and operational and maintenance strategies. These recommendations will be included in UWA watershed alternatives.

The evaluation of impacts on existing structures from projected sea level rise falls not within CSR, but rather is part of the SSIP Climate Change Task Order. This task order will evaluate the criticality and vulnerability of major structure of the CSS to climate change to develop project recommendations for system resiliency with respect to climate change. These recommendations will be incorporated into UWA watershed alternatives as available. At this time, there is no expected impact of sea level rise on Westside assets. With current projections of sea level rise and a 2-year storm surge, weir crest elevations of the Westside CSDs are predicted to be at least 8 feet above the tidal elevation in Year 2050. Refer to the Westside Characterization Technical Memorandum for more information.

Although sea level rise is unlikely to impact the Westside collection system during the service life of the assets in question, the increased rate of coastal erosion caused by climate change may speed up the deterioration of Westside CSD outfalls and other assets near the coast. In particular, the Lake Merced Transport Tunnel is at risk of losing its groundcover over the next couple decades due to erosion and will need a plan to protect the asset.

Existing structure issues are distributed throughout the watersheds, as shown in Figure 2.3 and described in Table 2.4.

Table 2.4: Westside Drainage Basin – Existing Structures Needs

Urban Watershed	Wastewater Collection System Needs: Existing Structures LOS Group
Richmond	Condition assessment of force mains and CSD structures.[1] Continued inspection and updated risk-based prioritization of renewal and replacement needs for brick sewers, sewers >36-inch diameter, and tunnels.[1] Assets identified as needing more immediate investigation improvements include 2.8 miles of brick high-risk major sewers (70 risk score) and 1.8 miles of very high-risk major sewers (100 risk score) and 2.7 miles of high-risk major sewers.[1]
Sunset	Westside Pump Station force main redundancy.[2] Condition assessment of force mains and CSD structures. Continued inspection and updated risk-based prioritization of renewal and replacement needs for brick sewers, sewers >36-inch diameter, and tunnels. Assets identified as needing more immediate improvements include 9.1 miles of high-risk major sewers (70 risk score) and 1.6 miles of very high-risk major sewers (100 risk score). Assets identified as needing more immediate investigation included 0.8 miles of brick sewers (including the 36-inch brick sewer adjacent to Laguna Honda) and 1.9 miles of high risk major sewers.
Lake Merced	Condition assessment of force mains and CSD structures. Continued inspection and updated risk-based prioritization of renewal and replacement needs for sewers >36-inch diameter and tunnels. Assets identified as needing more immediate improvements include 0.5 miles of high-risk major sewers (70 risk score) and 0.1 miles of very high-risk major sewers (100 risk score). Assets identified as needing more immediate investigation included the trestle sewer near Rolph Nicol Playground and 0.4 miles of high-risk sewer. Continued coordination with SPUR and development of a plan to protect SFPUC assets impacted by coastal erosion on Ocean Beach, particularly the Lake Merced Transport Tunnel.

Notes:
(1) The Collection System Reliability Program within SSIP will lead the recommendation and prioritization of structural and reliability improvements within the collection system. The needs presented in the table represent UWA's findings during the Characterization Phase based on coordination with the ongoing SSIP reliability and condition assessment efforts.
(2) The pump stations on the Westside will also undergo reliability improvements. Pump station and treatment plants improvements are not within the purview addressed by UWA unless capacity expansions are proposed that have the potential to impact collection system performance.
Sources: CSAMP Database, March 2014; Interviews with SSIP-PMC Condition Assessment, SFDPW, and SFPUC staff.

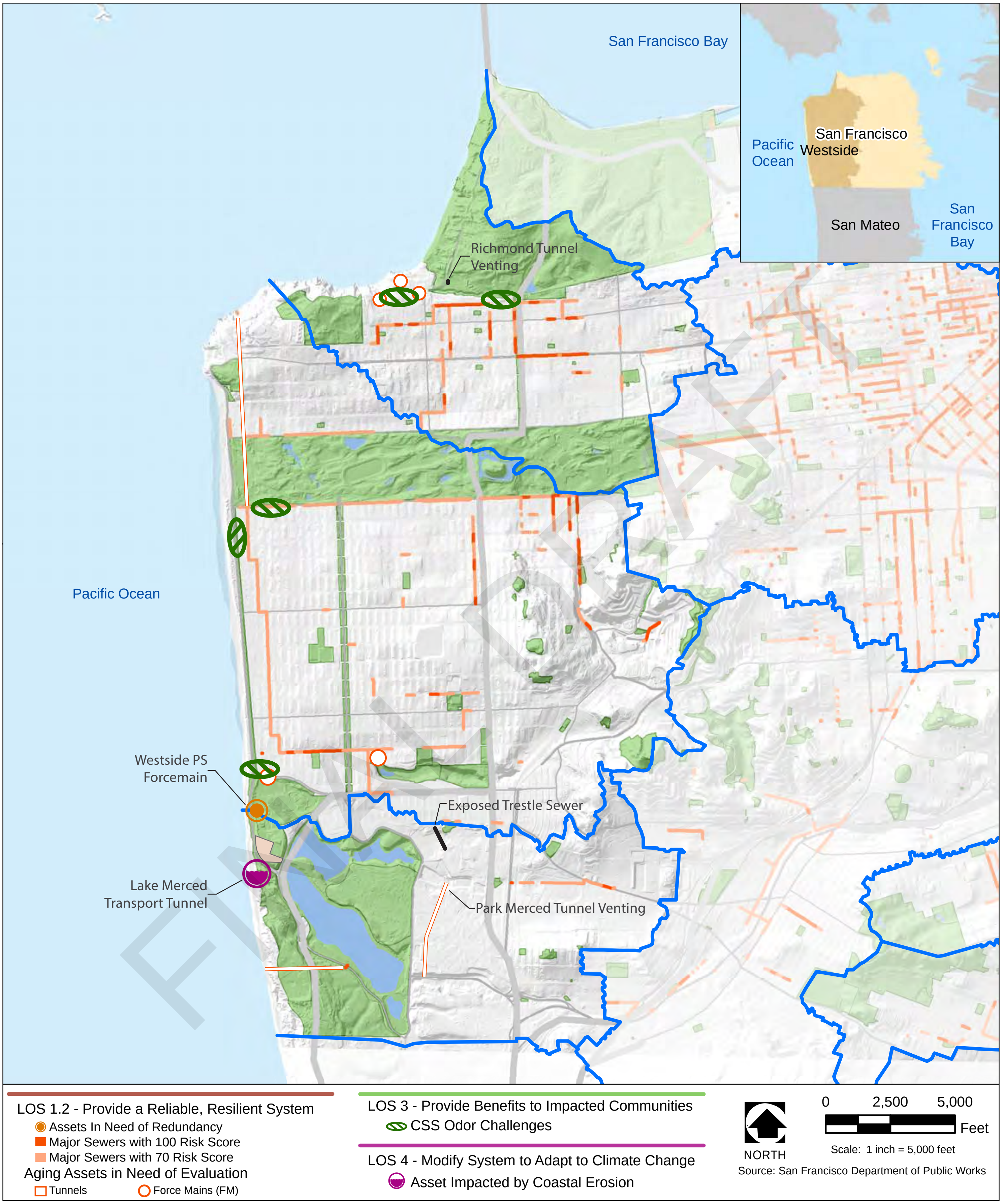

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Figure 2.3 Existing Structure Needs

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2.1.4 Environmental and Social Sustainability LOS

Nonpotable Water Reuse

The major sources of nonpotable demand on the Westside are process and washdown activities at Oceanside Treatment Plant (OSP) and flushing of the Westside T/S Box and Lake Merced T/S Box (LMT). Flushing and the majority of washdown activities at OSP use secondary effluent that has undergone additional screening. A few process activities at OSP that require more finely screened wastewater effluent are currently utilizing potable water. However, at the time of this writing, a project is in the design phase to provide filtered secondary effluent for these activities. Upon completion of this project, the remaining nonpotable demands being met with potable water will include toilet flushing and irrigation at OSP as well as washdown and process activities at the pump stations on the Westside. Green infrastructure projects that use rainwater harvesting (RWH) technologies could also offset these uses of potable water. The total amount of RWH will be evaluated in the Alternatives Phase of UWA analysis. In addition, additional analysis for non-potable water use will follow in subsequent task orders for SSIP. All of these will require coordination with the Water Enterprise.

Community Benefits

The LOS to "be a good neighbor" includes strategies to provide community benefits, work with CCSF agencies to coordinate projects, and engage residents in locating projects. In contrast to solving specific system challenges and needs with improvement projects, meeting LOS relating to community benefits and environmental justice involves the consideration of socio-economic data, opportunities to coordinate with other CCSF agencies, and public feedback through a process-based approach throughout the planning, design, and implementation of all infrastructure investments. Community benefits are achieved by good public process, prioritizing where projects are sited, mitigating negative impacts of system operations, and realizing benefits in areas of need. (See *Draft Memorandum: SSIP Level of Service "Provide Benefits to Impacted Communities" Recommendations for Implementation for UWA/SSIP, December 13, 2013*.)

Community benefits have been classified into three tiers based on the type of benefit and how it is incorporated into the Opportunities Analysis.

Tier 1: The first group of considerations includes the spatial extent of environmental justice areas of concern and disadvantaged communities. In these areas, potential impacts from additional infrastructure projects require specific evaluation. On the Westside, this only includes disadvantaged communities.

Tier 2: The second group of considerations includes opportunities to coordinate with interagency and citywide goals. Specifically, these include streetscape projects for pedestrian safety and walkability, priority segments of the bicycle network, proposed green connections network, open space priority areas, Interagency Plan Implementation Committee (IPIC) priorities from neighborhood area plans, and other interagency feedback. Since these have been considered at a planning level, a subsequent task order will refine the characteristics and thresholds for synergy opportunities.

Tier 3: The third group of considerations includes feedback from the public regarding preferred infrastructure technologies, project locations, community values, location preferences, and specific proposed project concepts. These data come from the surveys and public workshops described in the public outreach summary memos included in Appendix B.

Location-specific community benefit issues occur throughout the watersheds, as shown in Figure 2.4, Figure 2.5, and Figure 2.6 and described in Table 2.5. Figure 2.4 illustrates Environmental Justice Areas of Concern and Disadvantaged Communities[3], Figure 2.5 illustrates other long-term city priorities, and Figure 2.6 illustrates public feedback. In addition, Appendix B contains public outreach summary memoranda. Interagency priorities include citywide goals to improve pedestrian safety and calm traffic, improve the bicycle network, implement projects from neighborhood area plans, implement the Better Streets Plan, improve public transportation, or improve open space and access to it, among others. These priorities are reflected in the following:

- Environmental justice areas of concern
- Disadvantaged communities
- Pedestrian high-injury corridors – safety streets
- Streets identified for streetscape redesign – streetscape streets
- Portions of the bicycle network with low comfort levels
- Portions of the bike network on flat, low-traffic streets
- Proposed Green Connections (and alternative routes)
- Open space priority areas
- Projects identified in Area Plans and implemented by the Interagency Plan Implementation Committee (IPIC)
- Additional interagency priorities from coordination meetings

[3] Defined in coordination with the SFPUC Community Benefits team. Environmental Justice areas of concern are those zip codes with high cumulative environmental impacts. They are defined by zip code and supported by the 2010 US federal census data, the federal Environmental Protection Agency and the Bay Area Air Quality Management District and related Bay Area governmental agencies. Disadvantaged communities are those census tracts with high unemployment and low income.

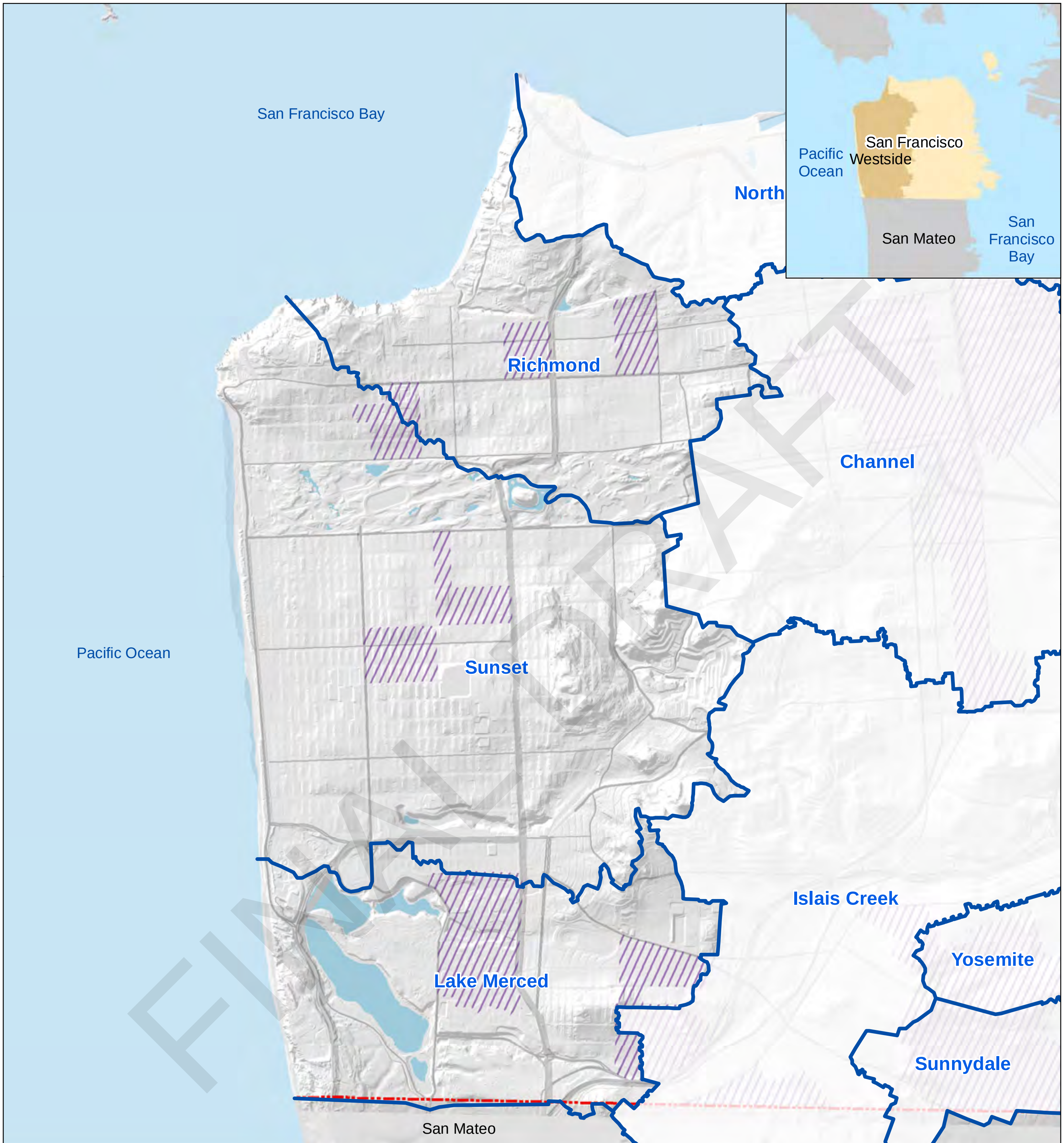
Table 2.5: Community Benefits Considerations

Urban Watershed	Wastewater Collection System Considerations: Community Benefits LOS Group
Richmond	**Tier 1 Consideration – Environmental Justice Areas of Concern and Disadvantaged Communities** Disadvantaged communities in the Inner Richmond and Outer Richmond neighborhoods.
	Tier 2 Consideration – Interagency Coordination Priority segments of the bicycle network, high-injury corridors, and streetscape streets along Lake St, California Street, Clement Street, Geary Boulevard, Cabrillo Street, Fulton Street, Arguello Boulevard, 8th Avenue, Park Presidio Boulevard, 15th Avenue, and 23rd Avenue, among other shorter street segments. Green connections concentrated along Lincoln Boulevard, Lake Street, Anza Street, Cabrillo Street, Arguello Boulevard, 8th Avenue, Park Presidio Boulevard, and 23rd Avenue. Open space needs in the Outer Richmond, Inner Richmond, and Presidio Heights neighborhoods.
	Tier 3 Consideration – Public outreach feedback <u>Technology preference</u>: Rainwater harvesting, pavement to plants incentive program, and rain gardens (survey). Rain gardens, creek daylighting, and permeable pavement (from Westside Planning Game Workshop). <u>Location Preference</u>: Very high densities[1] of green street proposals in portions of the Inner Richmond (survey). Project ideas preferred on streets, schools, and parks (Westside Planning Game Workshop). <u>Benefit Preference</u>: Pedestrian improvements, improve open space, and educational opportunities (survey). Neighborhood beautification, educational opportunities, habitat connectivity, Westside Planning Game Workshop). <u>Public Project Concepts</u>: Conveyance pipes along Lake Street, California Street, Anza Street Rain Gardens; repair, replace, and retrofit Arguello Boulevard Green Corridor (from Westside Planning Game Workshop).
Sunset	**Tier 1 Consideration – Environmental Justice Areas of Concern and Disadvantaged Communities** Disadvantaged communities in the Outer Sunset neighborhood.
	Tier 2 Consideration – Interagency Coordination Priority segments of the bicycle network, high-injury corridors, and streetscape streets along Geary Boulevard, Cabrillo Street, Fulton Street, throughout Golden Gate Park, Judah Street, Kirkham Street, Noriega Street, Taraval Street, Vicente Street, 19th Avenue, 20th Avenue, 34th Avenue, Sunset Boulevard, and the Great Highway, as well as other shorter street segments. Green connections concentrated along Cabrillo Street, Kirkham Street, Ortega Street, Vicente Street, 14th Avenue, 41st Avenue, and the Great Highway. Open space needs in the Outer Sunset, Inner Sunset, and Parkside neighborhoods.

Table 2.5: Community Benefits Considerations (continued)

Urban Watershed	Wastewater Collection System Considerations: Community Benefits LOS Group
Sunset (continued)	**Tier 3 Consideration – Public outreach feedback** Technology Preference: Rainwater harvesting, rain gardens, and pavement to plants incentive programs as identified as top three technologies (survey). Rain gardens, creek daylighting, and permeable pavement (Westside Planning Game Workshop). Location Preference: Very high densities of green street suggestions in portions of Central and Inner Sunset (survey). Project ideas preferred on streets, schools, and parks (Westside Planning Game Workshop). Benefit Preference: Neighborhood beautification, improved open space, and educational opportunities identified as the top three green infrastructure ancillary benefits (survey). Neighborhood beautification, educational opportunities, and habitat connectivity (Westside Planning Game Workshop). Public Project Concepts: Moraga Street Permeable Pavement, Ortega Street Greet Street, Sunset Boulevard Green Street, 14th Avenue Green Corridor, Creek Daylighting at Laguna Honda, Creek Daylighting and Conveyance to Pine Lake, Portola Drive Green Street (Westside Planning Game Workshop).
Lake Merced	**Tier 1 Consideration – Environmental Justice Areas of Concern and Disadvantaged Communities** Disadvantaged communities in the Lakeshore and Ocean View neighborhoods.
	Tier 2 Consideration – Interagency Coordination Priority segments of the bicycle network, high-injury corridors and streetscape streets along Holloway Avenue, Randolph Street, Beverly Street, 19th Avenue, and Skyline Boulevard, as well as other shorter street segments. Green connections along Holloway Avenue, Brotherhood Way, and Skyline Boulevard. Open space needs in the Lakeshore and Ocean View neighborhoods
	Tier 3 Consideration – Public outreach feedback Technology Preference: Rainwater harvesting, rain gardens, and pavement-to-plants incentive programs as identified as top three technologies (survey). Rain gardens, creek daylighting, and permeable pavement (Westside Planning Game Workshop). Location Preference: Very high densities of green street suggestions in portions of Balboa Terrace, Ingleside, and Lake Shore (survey). Project ideas preferred on streets, schools, and parks (Westside Planning Game Workshop). Benefit Preference: Neighborhood beautification, educational opportunities and improve open space as the top three green infrastructure ancillary benefits (from survey). Neighborhood beautification, educational opportunities, and habitat connectivity (Westside Planning Game Workshop). Public Project Concepts: Creek Daylighting through San Francisco State University, Stonestown Mall Zero Runoff Demonstration Project, Lake Merced Neighborhoods Downspout Disconnect Program, Balboa Park/City College Retrofit, San Francisco State University Demonstration Vegetated Roof, Holloway Avenue Green Corridor, Holloway Avenue Storage and Park Merced Creek Daylighting, and Creek Daylighting along Brotherhood Way (Westside Planning Game Workshop).

(1) See Figure 2.6



LEGEND

- Watershed Boundaries
- County Boundary
- Disadvantaged Communities

NORTH

0 2,500 5,000 Feet

Scale: 1 inch = 5,000 feet

Source: San Francisco Public Utilities Commission, 2010 Census, and 2011 ACS

Figure 2.4 Potential Locations to Provide Community Benefits: Tier 1

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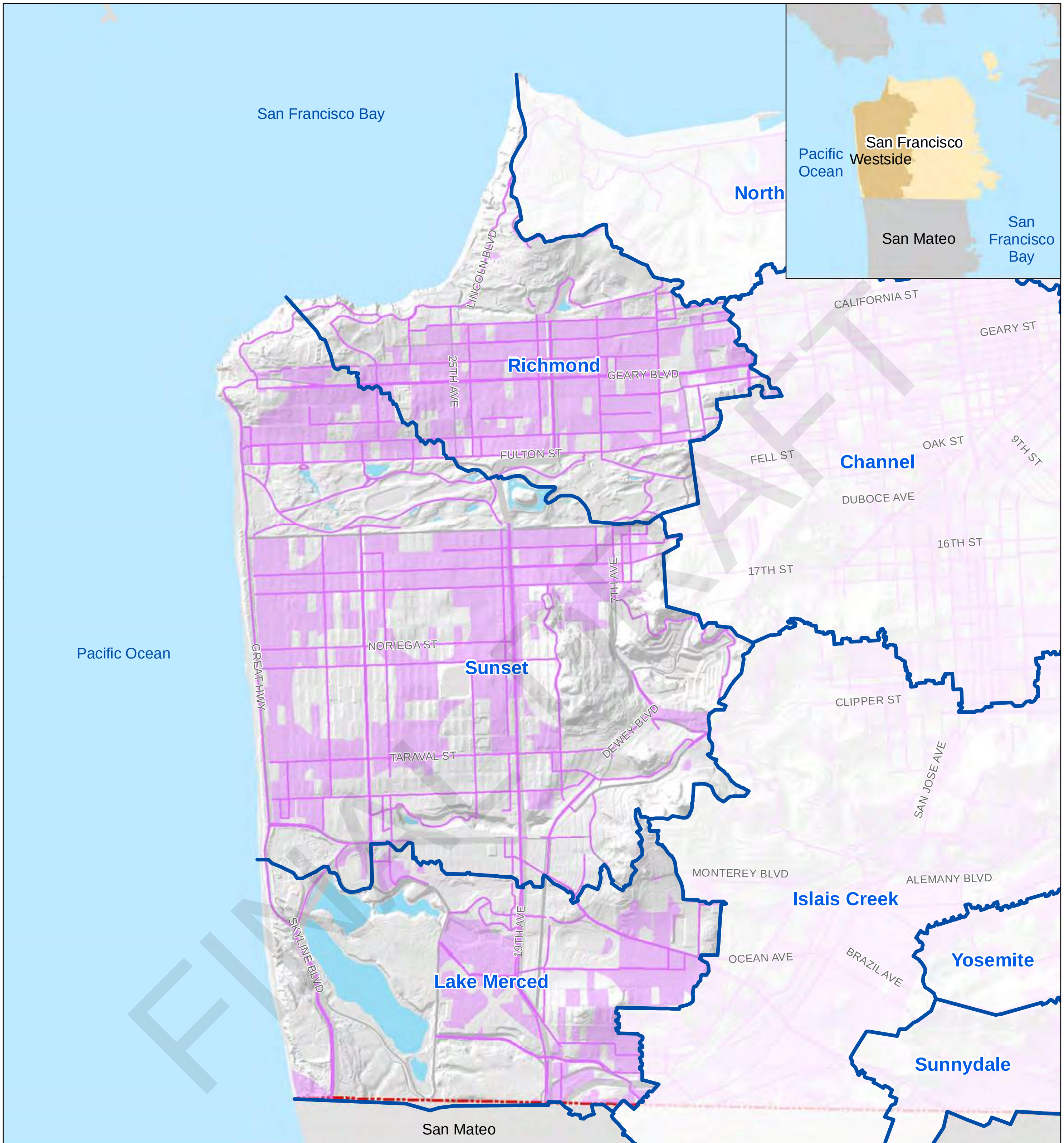

Legend

- Watershed Boundaries
- County Boundary
- Interagency Long-Term Priorities
- Priority Open Space Areas

CRITERIA CONSIDERED:

Pedestrian Improvement Pariorities
Interagency Plan Implementation Committee Priorities
Green Connections Network
Bicycle Improvement Priorities
Priority Open Space Needs

NORTH

0 2,500 5,000 Feet

Scale: 1 inch = 5,000 feet

Source: San Francisco Planning Department, Recreation and Open Space Element of the San Francisco General Plan, SFMTA, and SFDPH

Figure 2.5 Potential Locations to Provide Community Benefits: Tier 2

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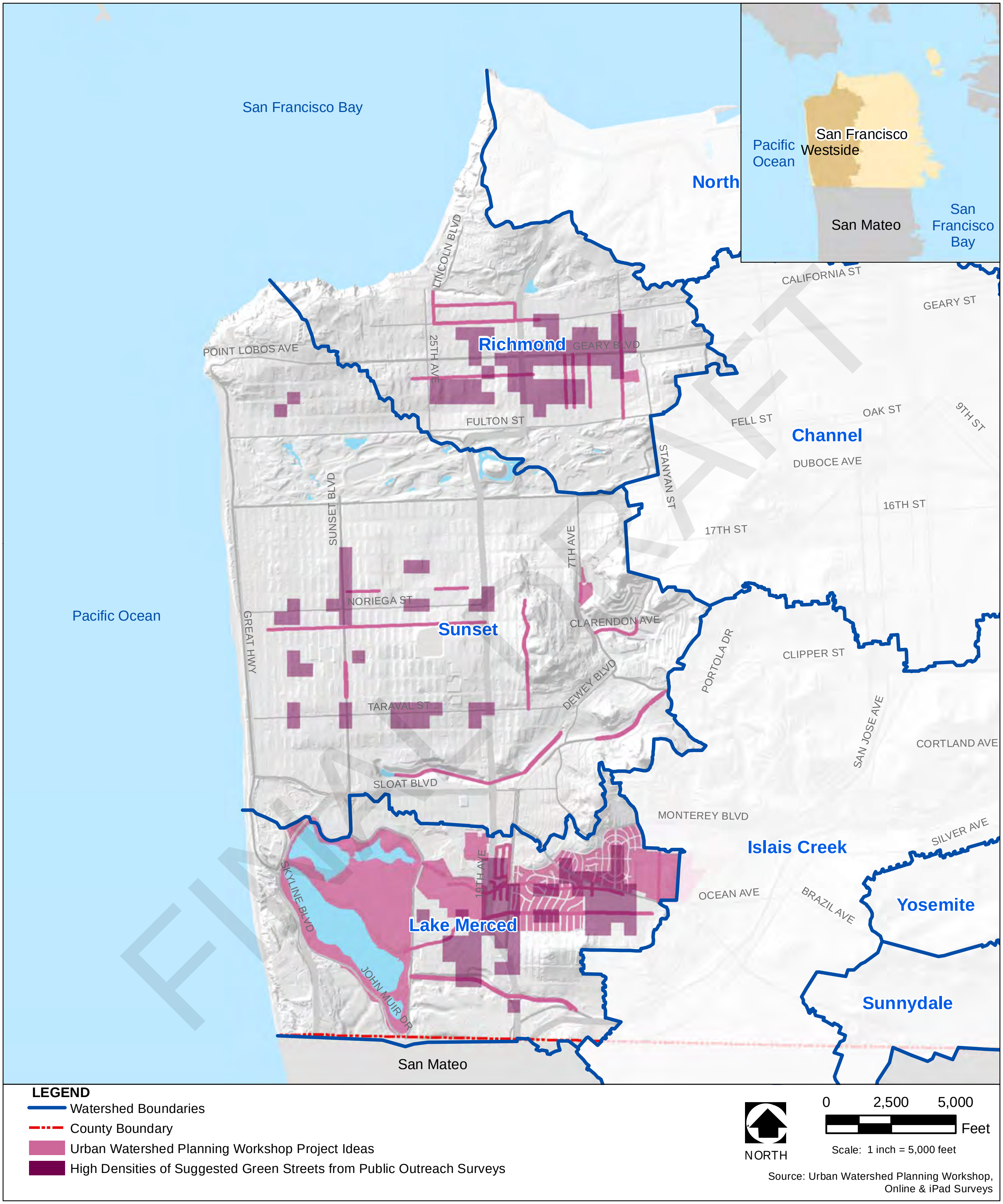


Figure 2.6 Potential Locations to Provide Community Benefits: Tier 3

2.2 Strategies to Address System LOS Needs

This section summarizes the strategies that are applicable to addressing the CSD, flooding and existing structure LOS needs on the Westside. After defining the appropriate strategies and generalized areas of applicability, Section 3 will then build upon this information to develop a list of opportunities to meet the needs. “Opportunities” are unrefined project concepts that have the potential to address an LOS need at a lower cost or increased benefit due to site characteristics or synergies with other planned projects, SFPUC goals, and interagency/community goals.

The strategies applicable for addressing the H&H needs are listed below. More description of the H&H strategies as well as the applicable existing structure strategies is included in Appendix A.

- New or Retrofit Pump Station (Pu)
- Reroute Flows/Operational Changes (Op)
- Increased Conveyance/Pipe Upsizing (Pi)
- Large-scale Downstream Detention (T/S)
- Upstream Distributed Detention (DT)
- Runoff Reduction/Green Infrastructure (GI)
- Creek Daylighting (CD)

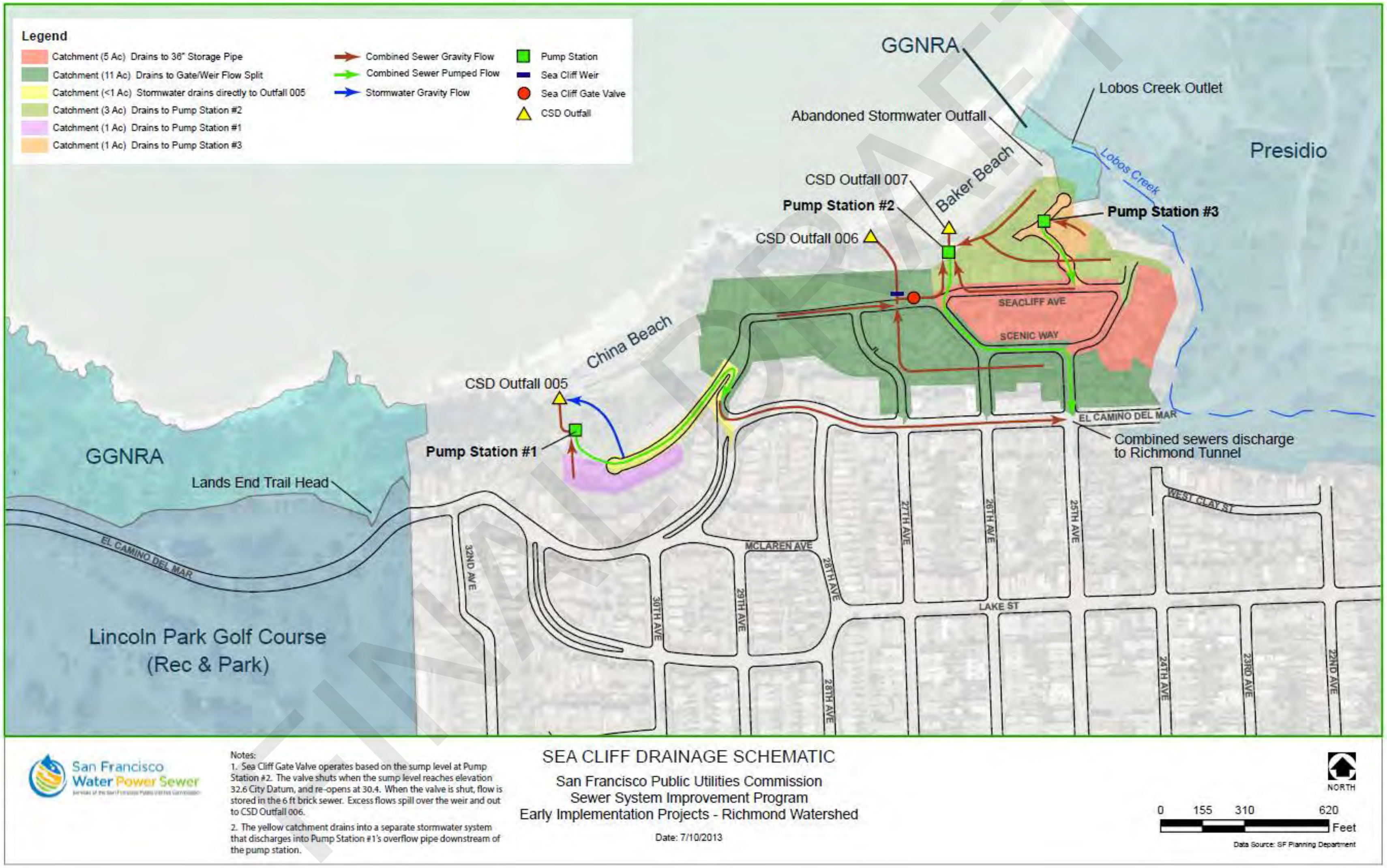
2.2.1 Combined Sewer Discharges

The principal H&H need related to combined sewer discharges is to evaluate the feasibility of reducing CSDs to public beaches. Public beaches on the Westside include Baker and China Beaches in the Sea Cliff drainage area (Richmond Minor Watershed 20-A, CSD Outfalls 005-007) and Ocean Beach (CSD Outfalls 001-003). The applicable strategies to address these needs are discussed below.

Sea Cliff Drainage Area Combined Sewer Discharges

A map of the Sea Cliff Drainage Area is shown in Figure 2.7. Flows from this lower drainage area within the Richmond Watershed are pumped to the Richmond Tunnel. Thus the CSDs in this location (CSD Outfalls 005-007) are hydraulically separated from the other Westside CSDs. The quantity of CSD volume in this area during a typical year is also orders of magnitude less than the volume from CSDs 001 – 004. The Sea Cliff area CSDs constitute 0.2 MG per year of the 236 MG per year of Westside CSD volume during the typical year model run or 0.1% of the total.

Figure 2.7
Sea Cliff Drainage Schematic



Because of its scale and hydraulic isolation, applicable CSD reduction strategies in Sea Cliff are much more localized. The Sea Cliff Area Evaluation Study conducted for the SSIP identified and evaluated several alternatives for reducing CSDs at outfalls 005 – 007 (SSIP-PMC 2013c). The study concluded that the Baker Beach Early Implementation Project (EIP) and upsizing of the force main at Sea Cliff Pump Station No. 2 were the recommended alternatives for addressing CSDs. Table 2.6 summarizes the strategies that are applicable for reducing CSDs at Sea Cliff.

Table 2.6: Strategies to Address Sea Cliff CSD Reduction

Applicable Strategies	Unrefined Project Concept	Notes
New or Retrofit Pump Station	Upsize Sea Cliff Pump Station No. 1	3
	Rehab Sea Cliff Pump Station No. 2 and upsize force main	1, 3
Reroute Flows/Operational Changes	Reroute flows from 18-inch storm sewer to Sea Cliff Pump Station No. 1	1
	Maximize Storage in 6-foot brick sewer	1
	Maximize Storage in 36-inch sewer	1
Increased Conveyance/Pipe Upsizing	Upsize upstream sewers tributary to 6-foot brick sewer	1
	Microtunnel connection from Sea Cliff Pump Station No. 1 to Richmond Transport Tunnel	1
Runoff Reduction/Green Infrastructure	El Camino Del Mar Green Street	1,2
	Beach Terrace Green Infrastructure	1,2

Notes:
1) Refer to Sea Cliff H&H Analysis TM for more information (SSIP-PMC 2013c).
2) Refer to Baker Beach NAR, AAR, CER TMs for more information.
3) Refer to Collection System Validation Report for more information (SSIP-PMC 2013b)

Based on the results of the SSIP Validation, the Condition Assessment, the Sea Cliff Area Evaluation Study, and the Baker Beach EIP analyses, the current recommended approach to address CSDs at Sea Cliff is the following:

- GI projects along El Camino Del Mar (Green Street) and Beach Terrace (Permeable Pavement and Rain Gardens)
- Rehab and the potential replacement with a higher capacity facility at Sea Cliff Pump Station No. 1
- Upsizing of the Sea Cliff Pump Station No. 2 force main

Modeling analyses conducted for the Baker Beach EIP indicated that the green infrastructure improvements could eliminate CSDs at 005 and 006 during the typical year. The Sea Cliff Area Evaluation Study found upsizing of Sea Cliff Pump Station No. 2 to be the most economical option to eliminate CSDs at 007 during the typical year. Improvements may also occur at Sea Cliff Pump Station No. 1. Baker Beach EIP is already funded through SSIP and is in the 35% design phase. Evaluation and improvements to Sea Cliff Pump Stations No. 1 and 2 are already proposed through

SSIP and will be evaluated further outside of UWA. Because SSIP projects have already been proposed that are projected to eliminate CSDs during the typical year at Sea Cliff, Sea Cliff CSD needs are not a focus of the opportunities analysis presented in Section 3.

Ocean Beach Area CSDs

Although the Westside is in compliance with CSD requirements, the SFPUC is evaluating the feasibility of further reducing CSDs to public beaches. The Ocean Beach CSD outfalls include Lake Merced Outfall (CSD-001), Vicente (CSD-002), and Lincoln (CSD-003). Discharges from these outfalls are tied to the level in the Westside T/S Box; therefore, the contributing area to these discharges includes all of the Westside. Flows from the Richmond Watershed reach the Westside T/S Box directly via the Richmond Transport Tunnel or by way of the Old Richmond Tunnel, which conveys flows to the Fulton Street Sewer, and ultimately to the Westside T/S Box. However, flows from the Richmond Transport Tunnel are constrained by a 42-inch pipe at its downstream end to optimize performance of the Richmond Transport Tunnel, and the Old Richmond Tunnel is only partially reactivated. Thus, although changes to flows in the Richmond can impact CSDs 001-003, the Richmond Watershed is less hydraulically connected to Ocean Beach CSDs than the Lake Merced and Sunset Watershed. Figure 2.1 shows a map of the Ocean Beach CSD drainage area. The variability in spatial effectiveness of different strategies is evaluated and quantified further in Section 3.

There are five basic types of wet weather control strategies for reducing CSDs to Ocean Beach: increased Westside Pump Station pumping rates, re-routing flows to Mile Rock outfall, consolidated large-scale CSS storage near the discharge locations, distributed upstream CSS storage, and reduced runoff to the CSS via green infrastructure (including creek daylighting). The applicable strategies to be analyzed for synergistic opportunities in Section 3 are summarized in Table 2.7.

Table 2.7: Potential Strategies to Address Ocean Beach CSD Reduction

Applicable Strategies	Unrefined Project Concept	Notes
New or Retrofit Pump Station	Retrofit Westside PS within existing footprint to maximize decant pumping capacity	1, 2
	Expand Westside PS to increase decant pumping capacity	1, 2
Reroute Flows/Operational Changes	Reactive Old Mile Rock Tunnel and redirect flows to Mile Rock CSD outfall	1
Downstream CSS Storage	Large detention tank near Lake Merced Outfall	1
	Large storage tank between Vicente and Lincoln outfalls	1
Upstream Distributed CSS Storage	Upstream smaller scale detention tanks at opportunity areas	3
Runoff Reduction/Green Infrastructure	Upstream green infrastructure at opportunity areas	3
Creek Daylighting	Daylighting along historical creek paths in opportunity areas	3

Notes:
1) Refer to Collection System Validation Report for more information.
2) Refer to Westside Pump Station NAR and AAR TMs for more information.
3) Opportunity analysis in Section 3 will identify opportune locations for this strategy.

Concurrent to development of the Opportunities Technical Memorandum, the UWA team is conducting an Ocean Beach CSD reduction cost-benefit analysis. The analysis evaluates the cost effectiveness of each strategy at reducing Ocean Beach CSDs and develops cost/benefit curves of integrated alternatives to reduce CSD frequencies and volumes on Ocean Beach. The objective of the analysis is to provide data comprehensive enough to enable SFPUC to effectively consider (1) various CSD frequency and volume reduction options for Ocean Beach and (2) how various combinations of technologies could be employed to meet those reduction options. The results of the analysis will be combined with receiving water quality analyses being conducted by others in SSIP to provide upper management with the information needed to make recommendations regarding Ocean Beach CSD targets.

2.2.2 Flooding

Three high-priority flood problem areas were identified through characterization: Lake Street, 15th and Wawona, and Ingleside. The UWA Strategies to address these challenges are described in this section. These strategies are then further explored in Section 3 to define the most promising opportunities to reduce flooding in these areas. In addition to addressing the three high-priority flood prone areas, UWA will identify opportunities to reduce flooding at all parcels that have model-predicted high or very high flooding risk, regardless of their location. Reducing flooding within the low- and medium-priority flood problem areas identified in Characterization will serve as one of the synergy criteria used to develop opportunities that have the potential to provide multiple benefits.

Lake Street

Based on analysis of flooding during the LOS storm using the CCSF H&H Model, there are two principal problem areas within the Lake Street flooding challenge area. The upstream issue is centered around 2nd Avenue and Lake Street, and the downstream issues are centered around 14th Avenue and Lake Street. Figures summarizing the model output during the LOS storm are shown in Figure 2.8 and Figure 2.9.

The manhole on 2nd Avenue and Lake Street is the point of concentrated flooding for both Presidio Terrace and a small neighborhood north east of Arguello. Based on model results, the combining flows exceed the capacity of the downstream pipe during the LOS storm and the manhole spills. The water flows west along Lake Street, south along 2nd and 3rd Avenues, and reenters the system on California Street between 2nd and 5th Avenues.

There are multiple instances of model-predicted flooding in the area bounded by 14th Avenue, 18th Avenue, Lake Street, and California Street. The most significant flooding occurs along 14th Avenue, where a trunk line from a large portion of Inner Richmond (bounded by Funston, Fulton, Arguello, and Clement) runs up 14th Avenue to combine with the main under Lake Street. At California, the 14th Avenue trunk line splits into two relatively flat pipes, both of which are undersized. The two pipes surcharge and flood 14th Avenue, and the pressurized flow that enters the main under Lake Street also creates flooding on Lake Street. The surface flow goes west along Lake and California, then north at 16th, 17th, 18th, and 19th Avenues. Sixteenth, 17th, 18th, and 19th Avenues slope north towards Lobos Creek, so water that flows onto them ends up flowing into Lobos Creek and does not make it back into the system.

There is also a small amount of flooding on 18th Avenue between Lake and California where a mid-block pipe is smaller than both the upstream and downstream pipes, creating a throttle that backs up flows and causes some minor flooding. The diversion to the Old Richmond Tunnel is at 17th Avenue. Based on the hydraulic grade line in and around Lake Street during the LOS storm, there is available capacity in the Lake Street sewer downstream of the diversion at 17th. Therefore, diverting more flow to Old Richmond Tunnel would likely not provide a significant reduction in flooding at Lake Street, which is primarily caused by constraints upstream of the diversion. Based on this preliminary analysis of the flooding at Lake Street, Table 2.8 summarizes the strategies that are applicable to addressing flooding in this location.

Figure 2.8 Model Output during LOS Storm – 2nd Ave and Lake Street

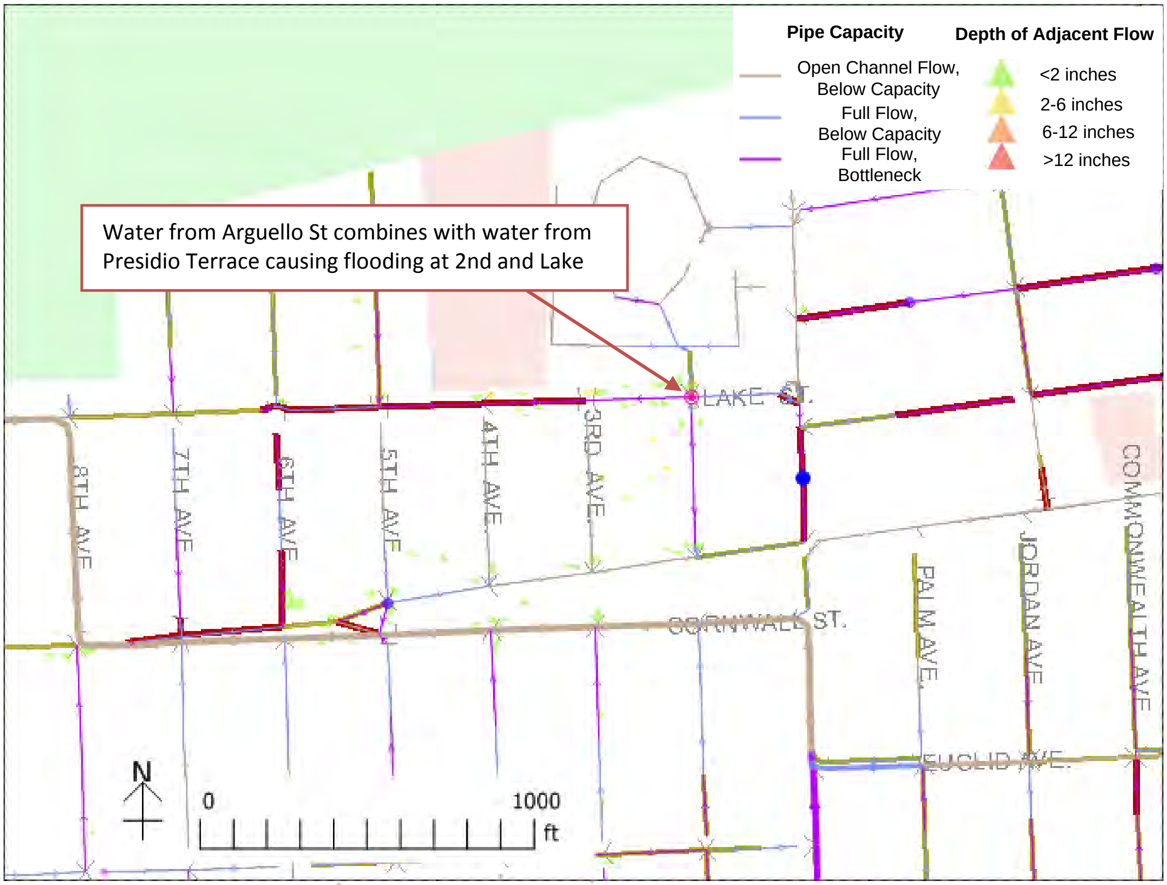


Figure 2.9 Model Output during LOS Storm – 14th and Lake Street

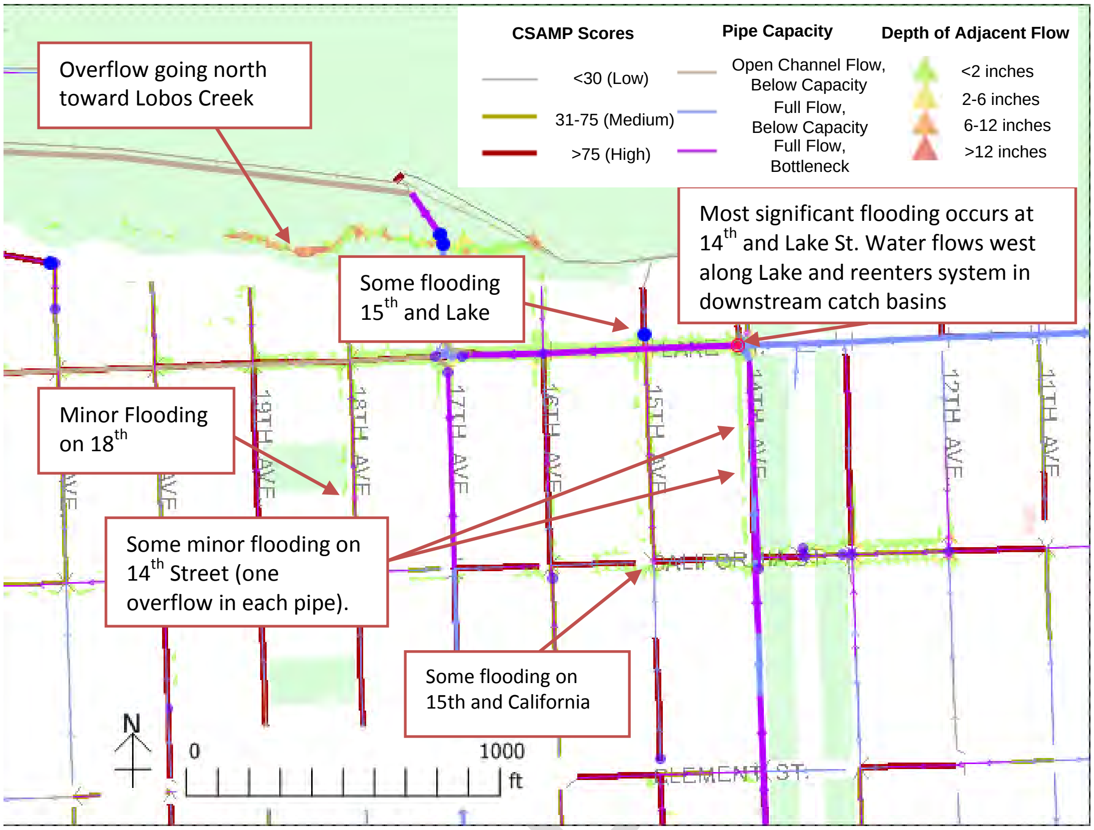


Table 2.8: Potential Strategies to Address Lake Street Flooding

Applicable Strategies	Unrefined Project Concept	Notes
Increased Conveyance	Upsize sewers around 2^{nd} and 6^{th} Avenues on Lake Street	1
	Upsize 14^{th} Avenue and Lake Street sewers upstream of 17^{th} & Lake intersection	1
	Upsize and/or add auxiliary sewers on Lake Street and California Street downstream of 17^{th} Avenue.	2
Reroute Flows/Operational	Raise crosswalks on Lake Street from 16th to 24 Ave to prevent overland flow toward Lobos Creek	3
Upstream Distributed CSS Storage	Provide detention storage at opportunity areas upstream of 14th and Lake (e.g., Inner Richmond)	4
	Provide detention storage at opportunity areas upstream of 2^{nd} and Lake (e.g., Presidio Terrace and Arguello)	4
Runoff Reduction/Green Infrastructure	Implement GI at opportunity areas upstream of 14th and Lake (e.g., Inner Richmond)	4
	Implement GI at opportunity areas upstream of 2^{nd} and Lake (e.g., Presidio Terrace and Arguello)	4

Notes:
1) Based on analysis of LOS results using CCSF H&H Model EHY13_v211.
2) The Lake Street flood control project in the 2010 SSIP package of projects recommended auxiliary sewers along California Streets from 8^{th} Ave to 18^{th} Ave and an upsized sewer on Lake Street from 17^{th} to 24^{th} Avenue.
3) See WWE CIP Richmond Drainage Improvements Phase I and proposed Phase II.
4) Opportunity analysis in Section 3 will identify opportune locations for this strategy.

15^{th} Avenue and Wawona Street

The 15^{th} and Wawona intersection forms a bowl more than 10 feet deep and has no outlet leading away from it. Based on analysis of flooding during the LOS storm using the CCSF H&H Model, there can be stormwater ponding up to several feet deep at this location. The depth of the depression presents a public safety concern; if it fills in a large storm or other event. In 2013, a nearby water main break caused ponding several feet deep, saturating the deep fill soils in the area and causing structural damage to several houses.

Figure 2.10 Water Main Break at 15th and Wawona

Source: sfexaminer.com

The creek valley that formerly ran through the intersection was called "Trocadero Gulch" and drained to Pine Lake. As the area developed, this flow path was broken at the embankment of 19th Avenue and where tunnel spoils from Twin Peaks MUNI tunnel impounded the 15th Avenue intersection. The sewer along this gulch was built in the 1910s and given the same name. Initial review of the model results suggests the entire Trocadero sewer from West Portal station to Sunset Boulevard is at or near capacity. Adding sewer capacity to resolve the flooding would likely require major construction along a significant length of sewer, including about 1,500 feet that would have to be built in an easement or require major rerouting. Modeling results are shown in Figure 2.11, and Table 2.9 presents potential strategies to address flooding.

Figure 2.11 Model Output during LOS Storm – 15th and Wawona

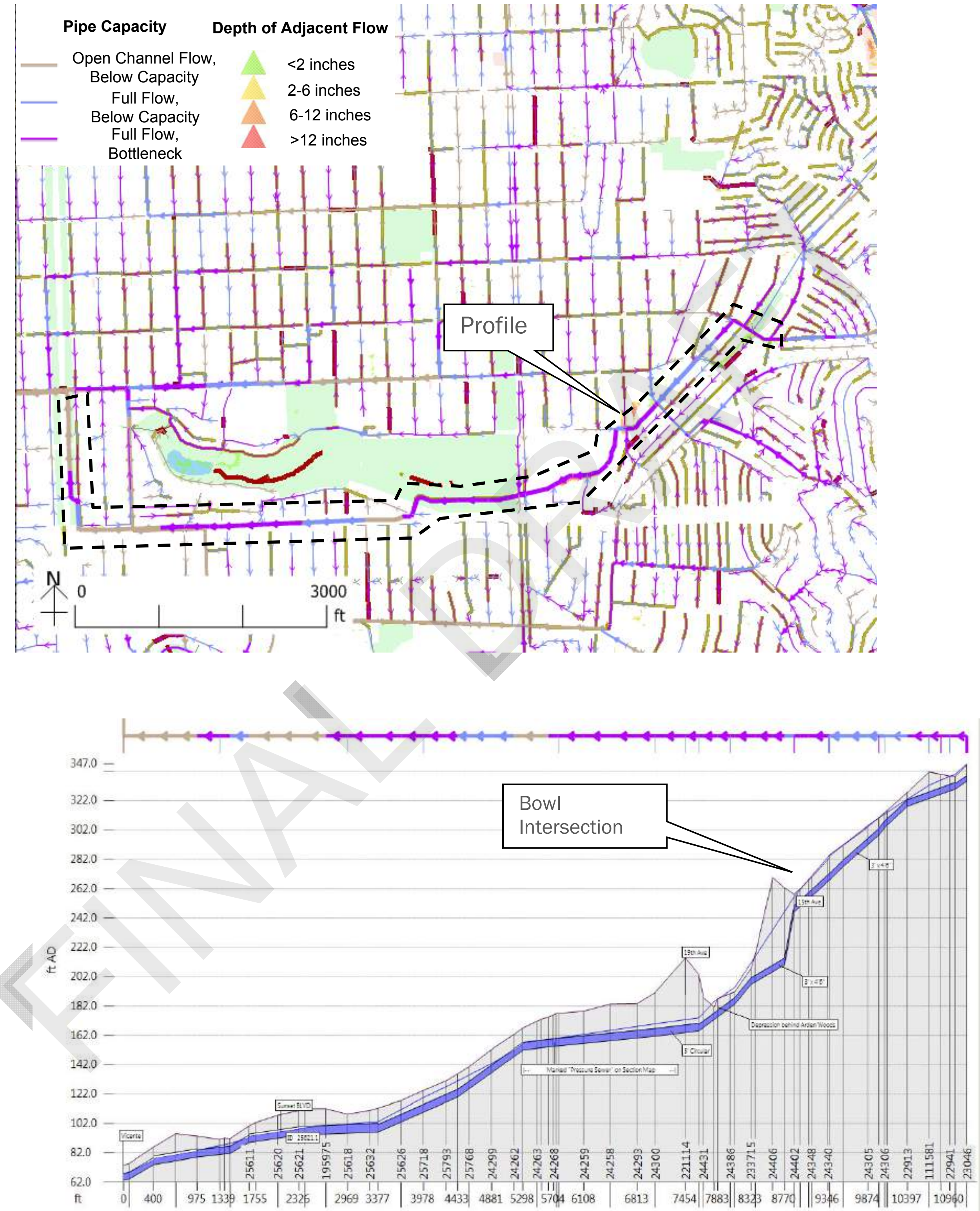


Table 2.9: Potential Strategies to Address 15^{th} and Wawona Flooding

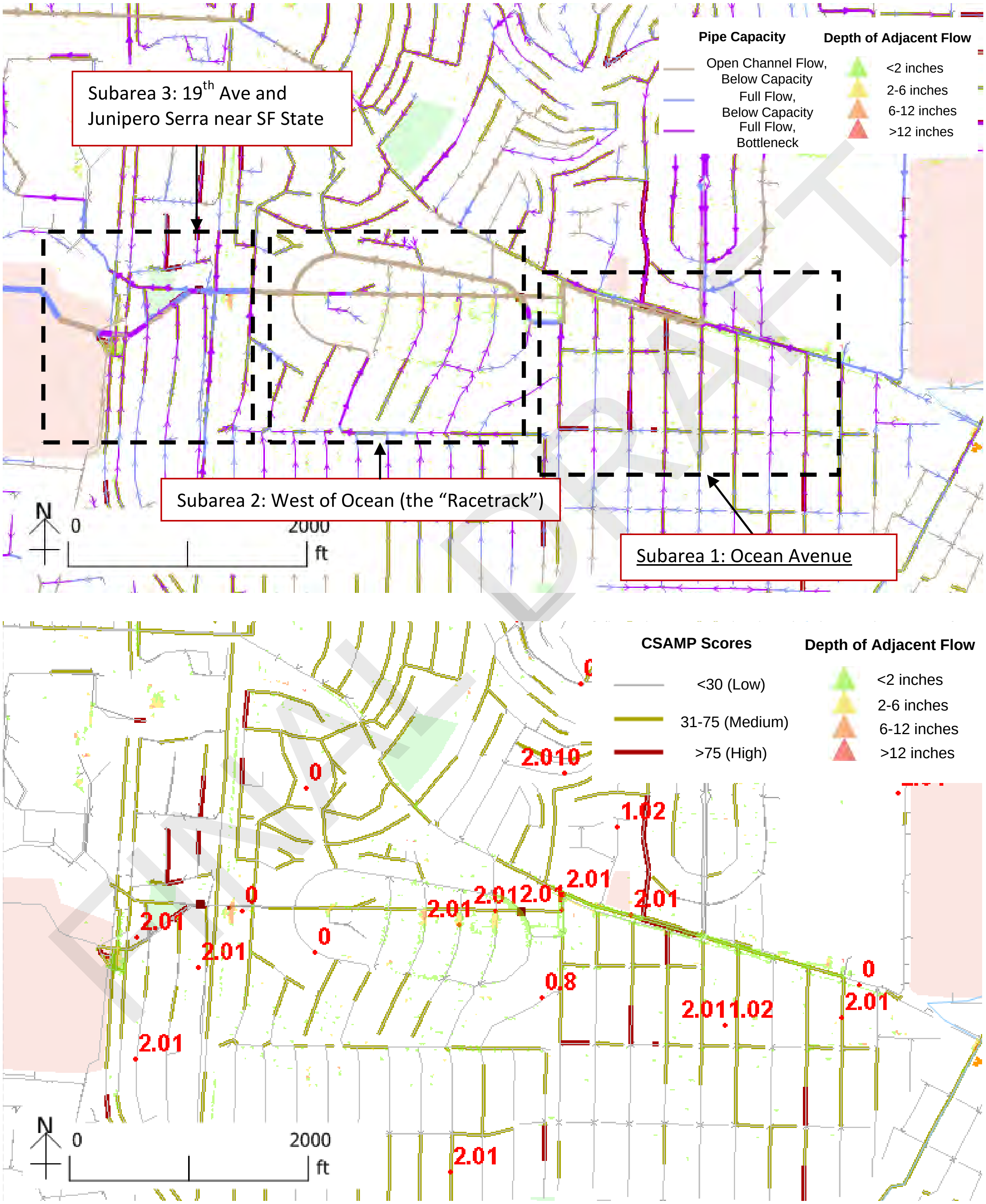
Applicable Strategies	Unrefined Project Concept	Notes
Increased Conveyance	Upsize Trocadero Sewer, multiple locations, about 2 miles total length	1
	Implement auxiliary Trocadero Sewer, approximately 2 miles total length	1
Upstream Distributed CSS Storage	Provide detention tanks at opportunity locations upstream of 15th and Wawona (inline storage less feasible due to steep slopes)	2
Creek Daylighting	Create stormwater flow path via surface channels and piped sections along historical Trocadero Creek alignment from West Portal to Pine Lake, including an overland flow release mechanism at 15^{th} & Wawona "bowl" intersection	2
Runoff Reduction/Green Infrastructure	Disconnect downspouts of houses that drain to Pine Lake Pump Station[3]	
	Implement GI at opportunity locations in 40-F minor watershed between Stern Grove and West Portal MUNI	2

Notes:
1) Based on analysis of LOS results using CCSF H&H Model EHY13_v211.
2) Opportunity analysis in Section 3 will identify opportune locations for this strategy.
3) Due to slopes behind houses, disconnects may need to be directed to the front of the houses. Options will be further evaluated if this opportunity becomes recommended as part of the alternatives analysis.

Ingleside

The Ingleside flood challenge area encompasses most of minor watershed 60-C. The challenges within Ingleside can be broken into three principal areas: (1) Ocean Avenue, (2) West of Ocean (i.e., the "Racetrack"), and (3) 19^{th} Avenue at San Francisco State. This section describes the hydraulic and hydrologic challenges of these areas and the corresponding applicable strategies to address flooding. Figure 2.12 depicts the location of these areas and the model output from the CCSF H&H model during the LOS storm. Table 2.10 summarizes strategies for addressing flooding in the Ingleside area.

Figure 2.12 Model Output during LOS Storm – Ingleside Area



Subarea 1, “Ocean Avenue,” includes flows from City College of San Francisco and the Westwood Park area (“the Peanut” neighborhood) to the north, as well as flows from the Ingleside neighborhood to the south. CCSF and the SFPUC-owned parking lot at the former Balboa Reservoir site consist of about 53 acres northeast of Ocean Avenue that drain primarily to sewer nodes on Phelan and Ocean avenues. Model results indicate that the large volume coming from these areas can result in surcharging along Ocean Avenue from Brighton to Plymouth avenues in the LOS storm.

South of Ocean Avenue contains several undersized sewers that lead to a trunk line with adequate capacity. These smaller residential sewers (typically 12 to 15 inches in diameter) from Harold Avenue through Jules Avenue are surcharging at manhole locations as they cannot accommodate the capacity of residential flows. At Miramar Avenue for example, the 12-inch conduit is conveying 5.67 million gallons per day (MGD), while the capacity is only 4.52 MGD. Within the model, these excess flows continue overland to Ocean Avenue, where they gather along the curb flow line, throughout the length of the street.

Similarly, in Subarea 2, “the Racetrack,” there are several undersized residential sewers on Victoria Street through Entrada Court that lead to a trunk line with adequate capacity. These smaller sewers (typically 12 to 15 inches in diameter) are surcharging at storm sewer inlet locations as they cannot accept residential flows. Victoria Street through Entrada Court have a roadway sump 300 feet south of Urbano Drive that shows the majority of model-predicted flooding with a maximum of 1.24 feet deep.

Subarea 3 includes flooding risk areas near where the Ingleside trunk sewer crosses Junipero Serra and 19th Avenue. One of the flood risk areas identified by the model is a roadway sump adjacent to a curb cut in Junipero Serra. As water runs north in the gutter of Junipero Serra, it enter the concrete pans, flows under the curb, and empties into a street low point adjacent to a street inlet. The second location is at 19th Avenue and Lyndhurst Drive, which shows localized street flooding of 0.65 foot deep at the curb line. The street flows are a result of a 12-inch diameter pipe heading north from Holloway Avenue. The model indicates that the pipe is slightly undersized with max capacity at 2.76 MGD, while flows to the pipe during the LOS storm are 3.16 MGD.

Table 2.10: Potential Strategies to Address Ingleside Flooding

Applicable Strategies	Unrefined Concept	Notes
Increased Conveyance	Upsize smaller residential sewers feeding Ocean Avenue	1
	Upsize smaller sewers feeding Ingleside trunk sewer between Junipero Serra and 19th Avenue	1
	Upsize trunk sewers, per 2010 SSIP recommendations	2, 3
Upstream Distributed CSS Storage	Detention tanks at opportunity locations in 60-C	1
Runoff Reduction/Green Infrastructure	Green Infrastructure at opportunity locations in 60-C	1

Notes:
1) Opportunity analysis in Section 3 will identify opportune locations for this strategy.
2) See *SSIP Collection System Validation Report*.
3) See *Cayuga Subdrainage Flooding Relief Alternatives Analysis TM* (BCM JV 2009).

2.2.3 Existing Structures

In general, efforts outside of UWA will be responsible for further identifying and evaluating projects to address existing structure needs. Table 2.11 summarizes what those efforts are and how each need fits into the UWA process. The majority of the existing structure needs serve as synergy criteria within UWA. Thus, the opportunities analysis presented in Section 3 will use the existing structure needs as a layer to help identify multi-beneficial CSDs and flooding reduction opportunities.

Table 2.11: Strategies to Address Existing Structure Needs

Urban Watershed	SSIP Collection System Existing Structure Needs	Process to Address
Richmond	Condition assessment of force mains and CSD structures.	SSIP CSR to prioritize and evaluate.
	Continued inspection and updated risk-based prioritization of renewal and replacement needs for brick sewers, sewers >36-inch diameter, and tunnels. Assets identified as needing more immediate improvements include 2.8 miles of high-risk major sewers and 1.8 miles of very high-risk major sewers.	R&R Program and SSIP CSR to evaluate. UWA to utilize high-risk sewers as synergy criteria in opportunities analysis.
	Address transient pressure challenges within the Richmond Transport Tunnel.	SSIP to evaluate outside of UWA. UWA to include as synergy criteria in opportunities analysis.
	Minimize collection system odors, particularly near connections to the Richmond Tunnel.	SSIP odor analysis conducted outside of UWA. UWA to utilize areas with odor reduction needs as synergy criteria in opportunities analysis.
Sunset	Address Westside Pump Station force main redundancy.	SSIP to evaluate outside of UWA.
	Condition assessment of force mains and CSD structures.	SSIP CSR to prioritize and evaluate.
	Continued inspection and updated risk-based prioritization of renewal and replacement needs for brick sewers, sewers >36-inch diameter, and tunnels. Assets identified as needing more immediate improvements include 9.1 miles of high-risk major sewers and 1.6 miles of very high-risk major sewers.	R&R Program and SSIP CSR to evaluate. UWA to utilize high risk sewers as synergy criteria in opportunities analysis.
	Minimize collection system odors, particularly at the drop structures along the Lincoln Way Sewer from 40th Avenue to the Great Highway and along La Playa.	SSIP CSR to evaluate and determine priority. Discuss with EHY removal of plug in sewer that causes standing DWF issues. UWA to utilize areas with odor reduction needs as synergy criteria in opportunities analysis.
	Address sewers with maintenance issues and safety concerns such as easement sewers and sewers with high grit/sand deposition.	R&R Program and SSIP CSR to identify. UWA to utilize existing easement sewers as synergy criteria in opportunities analysis.
	Address maintenance challenges at interjurisdictional boundaries (e.g., clogged catch basins along Great Highway and in Golden Gate Park).	SSIP CSR to evaluate and determine priority of potential projects. UWA may make policy recommendations as part of alternatives phase.
Lake	Condition assessment of force mains and CSD structures.	SSIP CSR to prioritize and evaluate.

Urban Watershed	SSIP Collection System Existing Structure Needs	Process to Address
Merced	Continued inspection and updated risk-based prioritization of renewal and replacement needs for sewers >36-inch diameter and tunnels. Assets identified as needing more immediate improvements include 0.5 mile of high-risk major sewers and 0.1 miles of very high risk major sewers.	R&R Program and SSIP CSR to evaluate. UWA to utilize high risk sewers as synergy criteria in opportunities analysis.
	Address transient pressure challenges within the Parkmerced Tunnel.	SSIP CSR to determine priority. UWA to include as synergy criteria in opportunities analysis.
	Protect Lake Merced Transport Tunnel from impacts of coastal erosion.	Continued coordination with SPUR and development of a plan to protect SFPUC assets impacted by coastal erosion on Ocean Beach, particularly the Lake Merced Transport Tunnel.
	Address sewers with maintenance issues and safety concerns, such as the trestle sewer near Rolph Nicol Playground.	SSIP CSR to determine priority. UWA to include as synergy criteria in opportunities analysis.

Note: The pump stations on the Westside will also undergo reliability improvements. Pump station and treatment plant reliability improvements are part of SSIP facility improvements and are not within the collection system purview addressed by UWA. However, UWA may make recommendations regarding capacity upgrades as they relate to collection system performance.

Sources: CSAMP Database (March 2014); Westside Characterization TM (SSIP-PMC 2014a); Interviews with SSIP-PMC Condition Assessment, SFDPW, and SFPUC staff.

3.0 WATERSHED OPPORTUNITIES

The UWA team used the methods described in Section 2 and Appendix A to identify the most relevant and appropriate opportunities to improve the collection system. This section describes the output from this process and presents the full complement of projects, programs, and policies that will form the alternatives to be evaluated in the next phase of work.

3.1 CSD Reduction Opportunities

This section builds on the strategies identified in Section 2.2 to identify the most promising CSD reduction opportunities on the Westside. These opportunities include both capital projects and operational improvements, which would better use existing system resources to improve performance while avoiding construction costs. These opportunities will be analyzed along with programmatic and policy opportunities to create complete watershed solutions.

As the system is in compliance, there are currently no defined CSD reduction targets on the Westside. Thus, further context is warranted to explain the drivers for identifying these types of opportunities. UWA is assessing CSD reduction options as part of the SFPUC Commission's recommendation to evaluate the feasibility of reducing CSDs at public beaches. Westside public beaches (i.e., Ocean, Baker, and China beaches) are most directly impacted by CSD outfalls 001 to 003 and 005 to 007 (i.e., all Westside CSD locations but Mile Rock).

UWA's efforts are one piece of a broader SFPUC effort to assess the feasibility of Westside CSD reduction. The UWA team is contributing to the ongoing feasibility analysis by identifying opportunities and establishing the cost of using various technologies to reduce the volume and frequency of CSDs at Westside outfalls. However, UWA will not generate project recommendations as the assessment of CSD reduction "feasibility" must weigh project costs against water quality benefits. Water quality studies (conducted by others on another SSIP Task Order No. 28 outside of UWA) are still pending. Moreover, the cost-benefit analysis must also weigh the trade-offs of using Southwest Ocean Outfall (SWOO) capacity for Westside CSD reduction rather than retaining the capacity to address unknown regulatory challenges that may arise in the future.[4] UWA will provide technical input as requested by SFPUC to inform this discussion but will not make project recommendations regarding CSD reduction until SFPUC has weighed all pertinent information and provided direction to UWA.

The CSD opportunity analysis presented herein consists of four primary steps described in the following subsections:

- Spatial Effectiveness Analysis – a hydraulic and hydrologic analysis was conducted to establish how the spatial location of watershed projects impacts their effectiveness in reducing CSDs at each Westside CSD outfall.

[4] A hypothetical example would be increased stringency of Bayside discharge requirements.

- Suitability Analysis – the site constraints that impact project implementation feasibility and performance were overlaid using City GIS (Geographic Information System) data to evaluate the suitability of each street and parcel to accommodate watershed projects.
- CSD Reduction Performance Curves – performance curves were generated to establish the relative effectiveness of each applicable strategy at reducing CSD volume and frequency at the Ocean Beach outfalls.
- Triple bottom line (TBL) Overlay – the H&H performance analyses were overlaid with TBL criteria to further identify and refine top opportunities.

3.1.1 Spatial Effectiveness Analysis

Using the CCSF H&H Model, analyses were conducted to evaluate the how the spatial location of watershed projects impacts CSD reduction at each of the CSD outfalls. The analyses focused on evaluating effectiveness of infiltration-based green infrastructure and detention tanks. Figure 3.1 and Figure 3.2 illustrate these results.

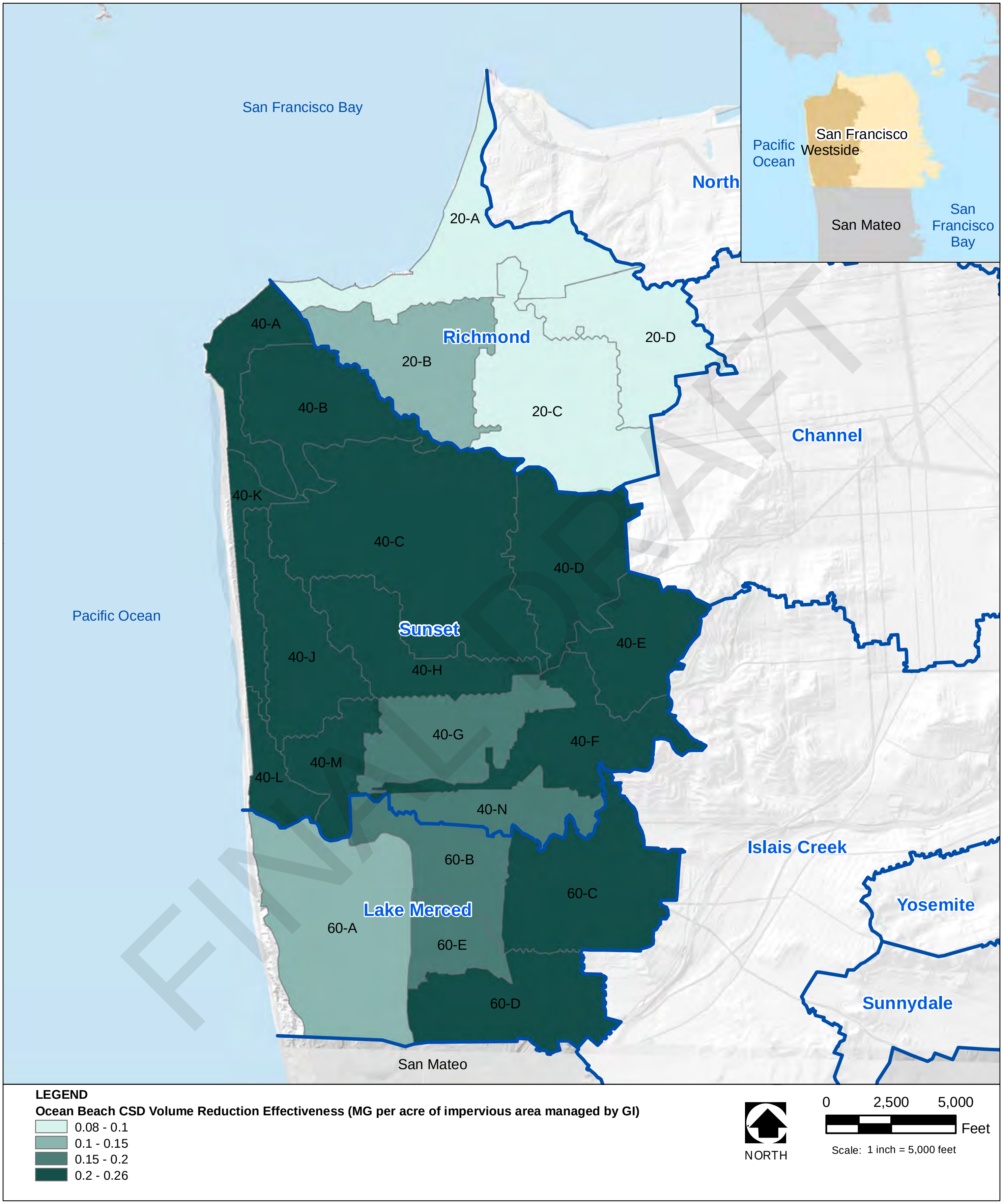


Figure 3.1 Ocean Beach CSD Volume Reduction: GI Effectiveness by Minor Watershed

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Green Infrastructure

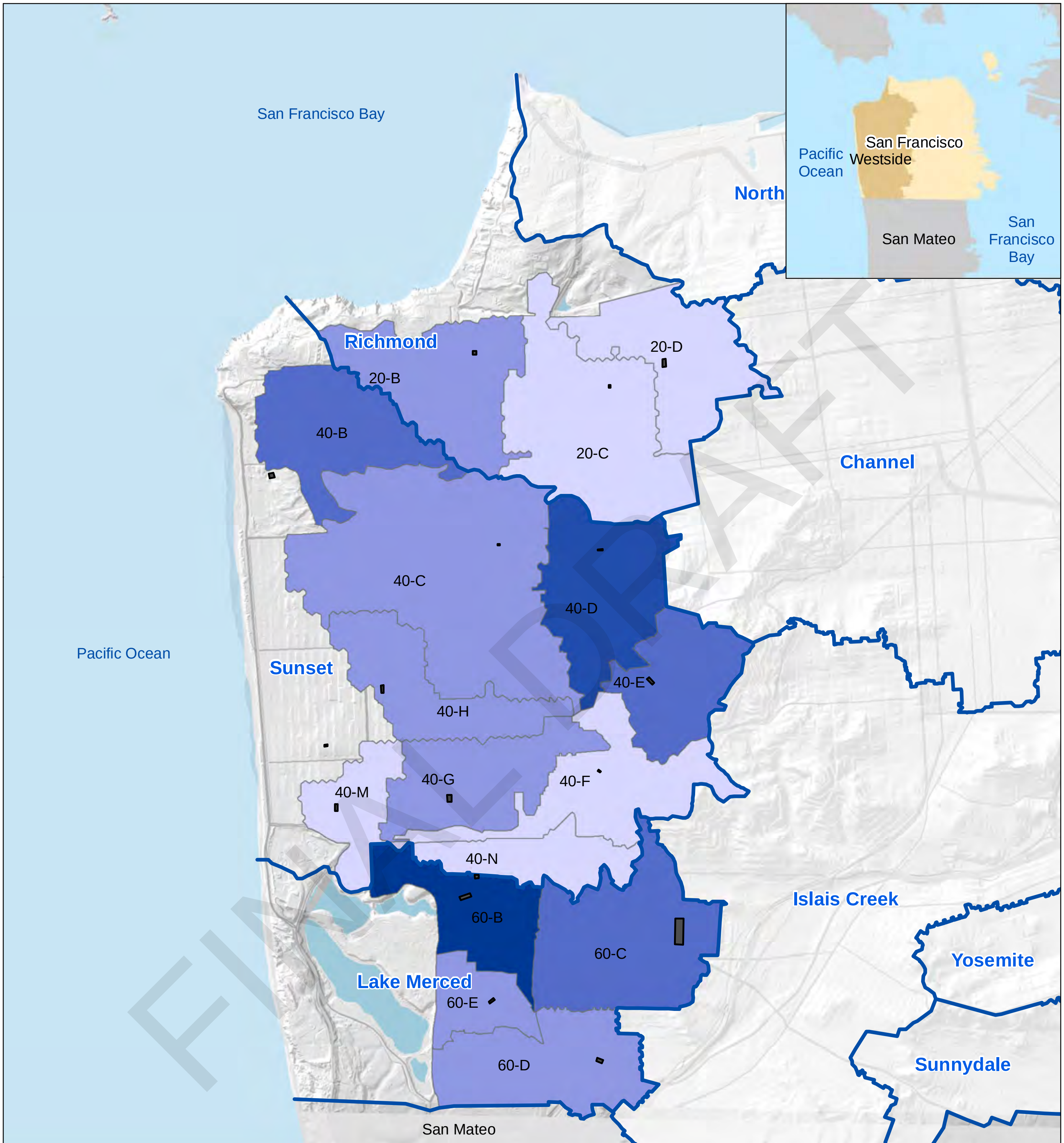
Figure 3.1 presents relative effectiveness by minor watershed of using infiltration green infrastructure to reduce CSD volume on Ocean Beach (CSDs-001 through CSD-003). The metric presented is in terms of CSD volume reduction per impervious area managed by GI, with the darker colors representing increased effectiveness. Due to the location of the Mile Rock Outfall and the designed constriction at the end of the Richmond Transport Tunnel to optimize storage, runoff reduction in Richmond impacts Mile Rock CSD volume more directly than it impacts Ocean Beach CSD volume. Consequently, as shown in the figure, green infrastructure in Sunset and Lake Merced are generally about twice as effective at reducing Ocean Beach CSDs as green infrastructure in Richmond (approximately 200,000 gallons CSD reduction per acre managed versus 100,000 gallons per acre managed). In terms of total CSD volume reduction on Westside (Mile Rock plus Ocean Beach), the effectiveness of GI in Richmond is very similar to the Sunset and Lake Merced metrics (i.e., 200,000 to 250,000 gallons/acre).

The most effective minor watersheds (shown in dark green) are in the Sunset Watershed. Minor watershed 40-A has significantly less CSS area than the other minor watershed, but its effectiveness on a unit basis (CSD volume reduction per impervious drainage management area [DMA]) is similar to highest-performing minor watersheds at around 250,000 gallons/DMA. Preliminary total project cost estimates for SSIP green infrastructure have ranged from $500,000 to $1 million/acre. Using these estimates, GI achieving a reduction of 250,000 gallons of CSD per impervious acre has an estimated cost effectiveness range of $2 to $4 per gallon of CSD reduction.

The GI spatial analysis was intended to be a high-level assessment that informs the search for and identification of top opportunities. These results will be overlaid with the technical suitability information presented in Section 3.1.2 to further inform the opportunities search. As opportunities move toward becoming project concepts in the Alternatives Phase, each concept would be examined more closely to assess its specific performance based on location and design configuration.

Detention Tanks

The spatial analysis also looked at the variability in performance of detention tanks. Detention tanks capture and detain combined sewage, whereas green infrastructure manages stormwater prior to entering the combined system. The results of these analyses are presented in Figure 3.2.



LEGEND

Detention Tank Locations

Ocean Beach CSD Volume Reduction Effectiveness (MG per MG of Detention Storage)

- 0.4 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- 4.0 - 5.0

NORTH

0 2,500 5,000 Feet

Scale: 1 inch = 5,000 feet

Figure 3.2 Ocean Beach CSD Volume Reduction: Detention Tank Effectiveness by Minor Watershed

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Detention tank effectiveness at reducing Ocean Beach CSD volume ranged from a high of 4 MG of CSD reduction per MG of detention storage in 60-B to less than 1 MG of CSD reduction per MG in 20-C, 20-D, 40-J, 40-M, and 40-N. After minor watershed 60-B, minor watersheds 40-B, 40-D, 40-E, and 60-C were the next-most effective at around 2.5 to 3 MG of CSD reduction per MG of detention storage. As a point of reference, project cost estimates for smaller-scale SSIP detention tanks have ranged from $10 to $15/gallon of storage. For a tank achieving 3 MG of CSD reduction per MG of storage, the estimated cost effectiveness would be $3.3 to $5 per gallon of CSD reduction.

The detention facilities were sized to capture the LOS storm, while also balancing performance during the typical year, meaning that they perform for both CSDs and flooding. Potential locations for large detention facilities were identified by applying several suitability metrics to city-owned parcels. Generally, one to two suitable locations were identified per minor watershed. The UWA process of identifying suitable locations for watershed projects, including detention tanks, is described further in the following subsection.

3.1.2 CSD Reduction Suitability Analysis

The UWA team analyzed all streets and parcels in the City for their technical suitability for green infrastructure and detention tank projects.[5] This analysis was performed using citywide GIS data based on rules and methods established as part of the Bayside Opportunities phase. Appendix A includes an explanation of the methodology used. The locations identified as suitable could be effective for either CSD reduction or flooding, depending on the location of needs and the spatial effectiveness as described in Section 3.1.1.

Streetscapes were evaluated for bioretention in sidewalks, bioretention in bulbouts, and permeable pavement. Criteria evaluated for streets included slope and available space based on the sidewalk width as compared to the Better Street Plan recommendations, fire hydrants, bus stop locations, and curbside parking. Figure 3.3 presents the streetscape locations that are suitable for one or more of these project types.

The project types for which parcels were evaluated included bioretention, green and blue roofs, rainwater harvesting, and permeable pavement. The criteria evaluated on parcels included the parcel slope, the roof type, and the impervious area of the parcel. The parcels analyzed included only publicly owned lands, including property of the SFPUC and other city, state, and federal agencies. Figure 3.4 presents the parcel locations that are suitable for one or more of these project types. Appendix C presents the statistics related to suitability for both streets and parcels, and highlights some of the parcel opportunities with the highest potential DMA. Appendix E includes results of site visits and screening analyses at promising SFPUC-owned parcels.

[5] The suitability of conveyance projects to address flooding is discussed in 3.2.2 Flooding Suitability Analysis.

Existing and historic creeks throughout the Westside were also evaluated for suitability and feasibility of green infrastructure projects. Figure 3.5 presents the locations and their suitability. Additional information on creeks based on site visits and initial screening is presented in Appendix D.

Lastly, UWA evaluated suitability of parcels for detention tanks. The parcels analyzed included only publicly owned lands, including property of the SFPUC and other city, state, and federal agencies. Unlike GI, detention tanks can be connected directly to the collection system to capture and detain combined flows. Therefore, location within the combined sewer system was another important consideration when assessing detention tank suitability. The UWA modeling team assessed the hydraulic characteristics of the physically suitable locations to develop a subset of hydraulically preferred locations.[6] These preferred locations became the detention tank sites used in the CSD spatial effectiveness, CSD performance curves, and flooding spatial effectiveness analyses presented herein. The process of selecting the preferred locations is described further in 3.2 Flood Reduction Opportunities. Figure 3.6 displays the suitable and hydraulically-preferred suitable detention tank locations.[7]

Based on system needs and the spatial effectiveness presented in Section 3.1.1, these suitable locations were then overlaid with social and environmental criteria to development a list of the most promising opportunities. However, prior to conducting that overlay, the H&H performance of each CSD reduction strategy identified previously in Section 2.2 was further evaluated. Performance curves were generated to establish the relative effectiveness of each applicable strategy at reducing CSD volume and frequency at the Ocean Beach outfalls. The results of this analysis are presented in the following section.

[6] Within this assessment, preference was given to tank locations with sufficient DMA to warrant scaling up to 2 MG or more. The other suitable locations may be preferred for smaller-scale detention tanks.

[7] The tanks are sited on suitable parcels in good hydraulic locations. However, combined sewage detention may be preferred as linear within the right-of-way, and different GI technologies may be preferred on the parcel. This will be evaluated further during alternatives development.

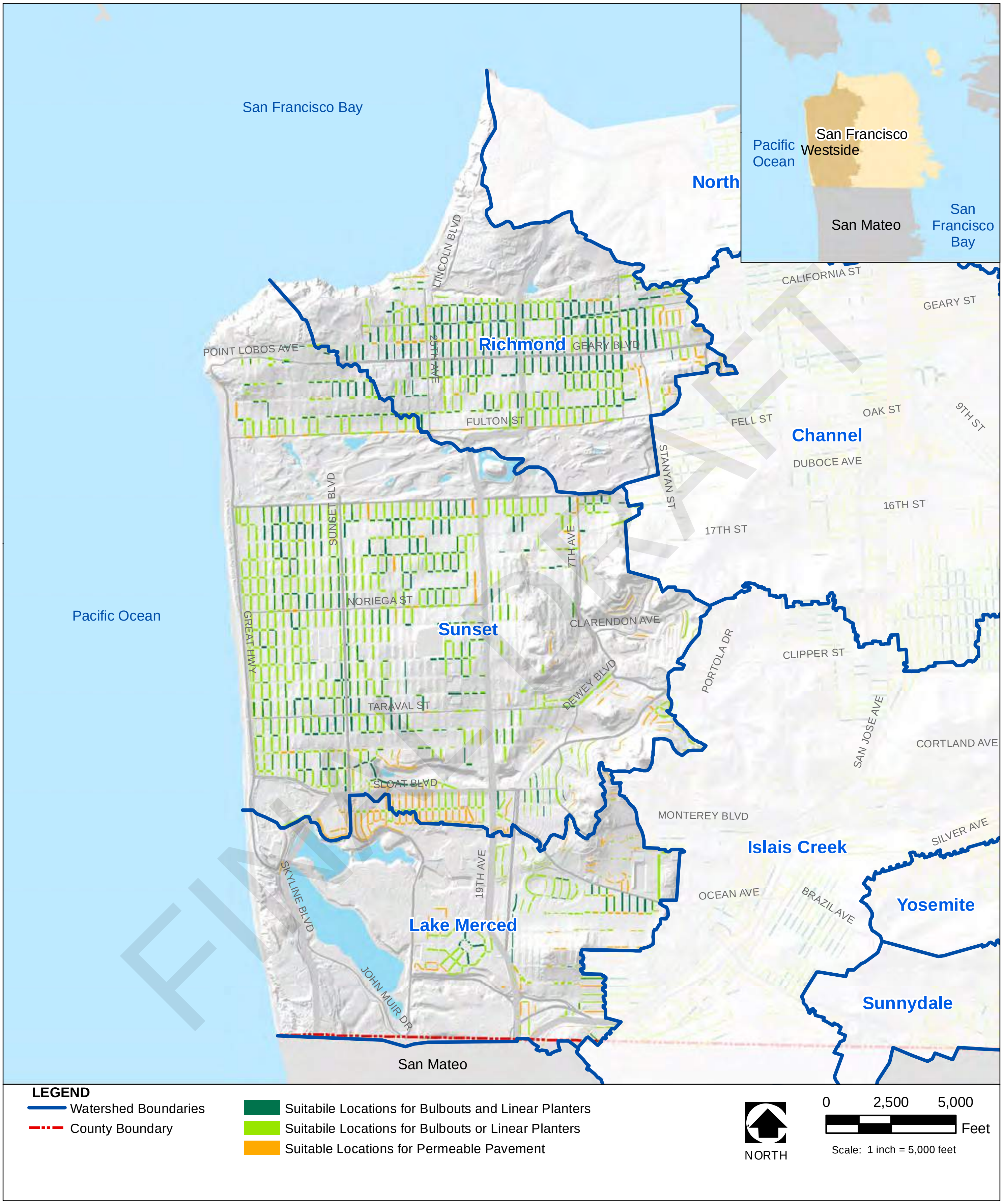

Figure 3.3 GI Suitability: Streetscapes

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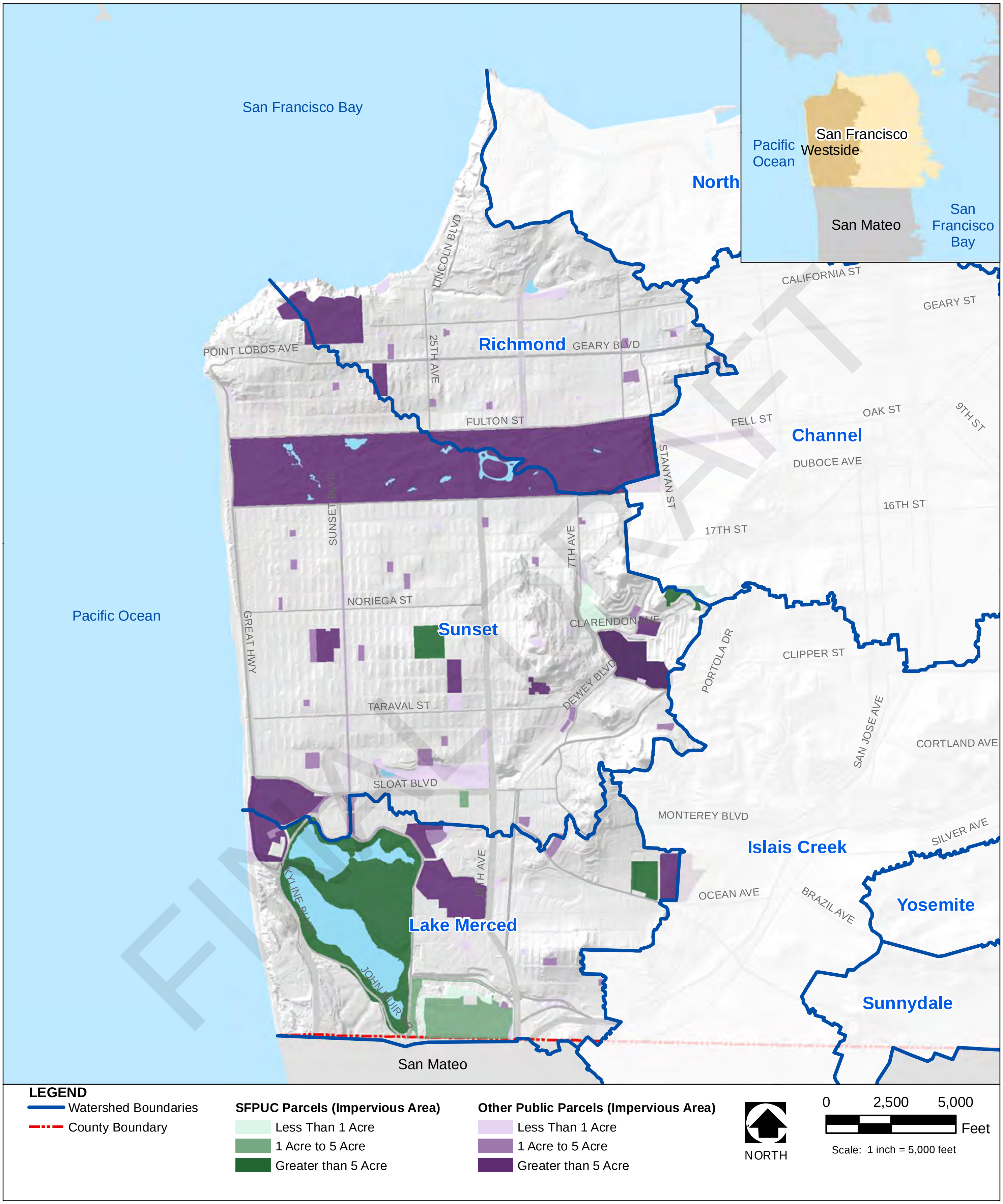
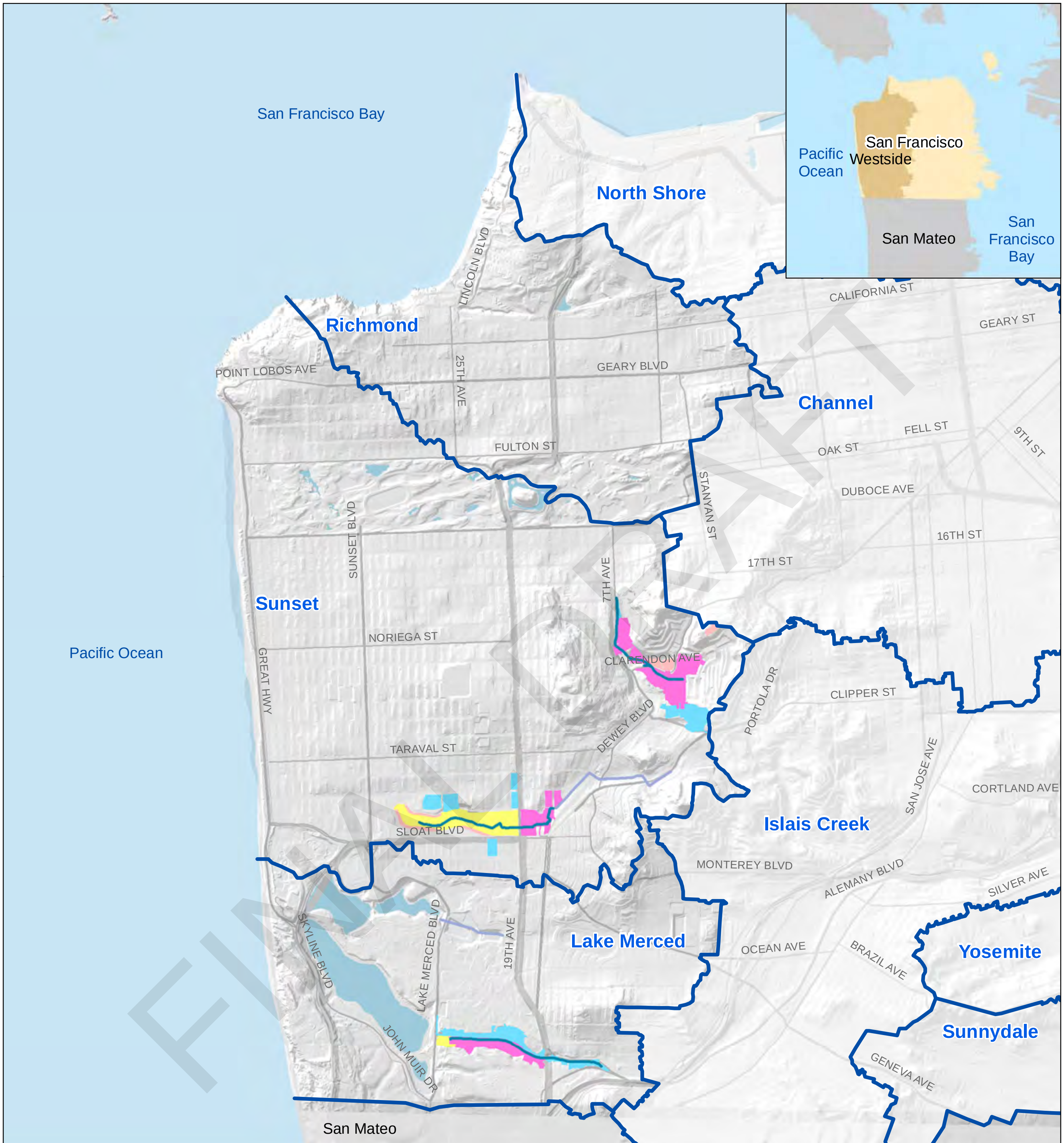


Figure 3.4 Parcels Suitable for GI



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- Creek Opportunity Alignments
- Less Suitabile Creek Opportunities
- DMA Already Separated from System

Drainage Management Area Opportunities

- Highly Feasible
- Medium Feasibility
- Low Feasibility

NORTH

0 2,500 5,000 Feet

Scale: 1 inch = 5,000 feet

Figure 3.5 Creek Daylighting Suitability

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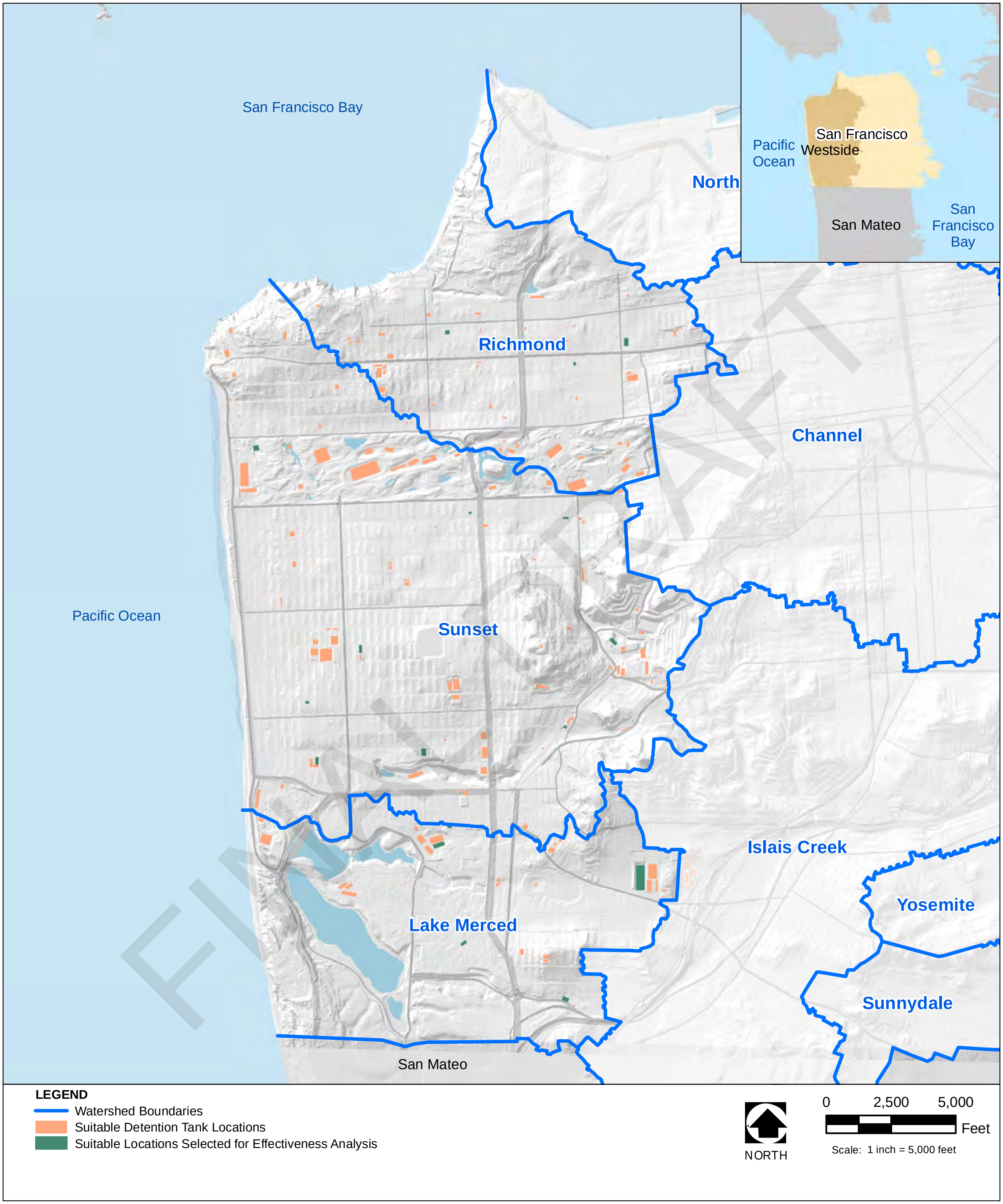

Figure 3.6 Areas Suitable for Detention Tanks

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3.1.3 CSD Reduction Performance by Strategy

As noted at the beginning of Section 3.1, UWA is assisting in evaluating the feasibility of reducing CSDs to public beaches. The public beaches on the Westside include Ocean, Baker, and China Beaches. Because projects have already been initiated through SSIP to reduce CSDs at Baker and China Beaches, the focus of UWA's analysis is on Ocean Beach. To further inform the search for the most promising CSD reduction opportunities, UWA conducted modeling analyses to generate performance curves for the strategies identified in Section 2.2.1. Those strategies are:

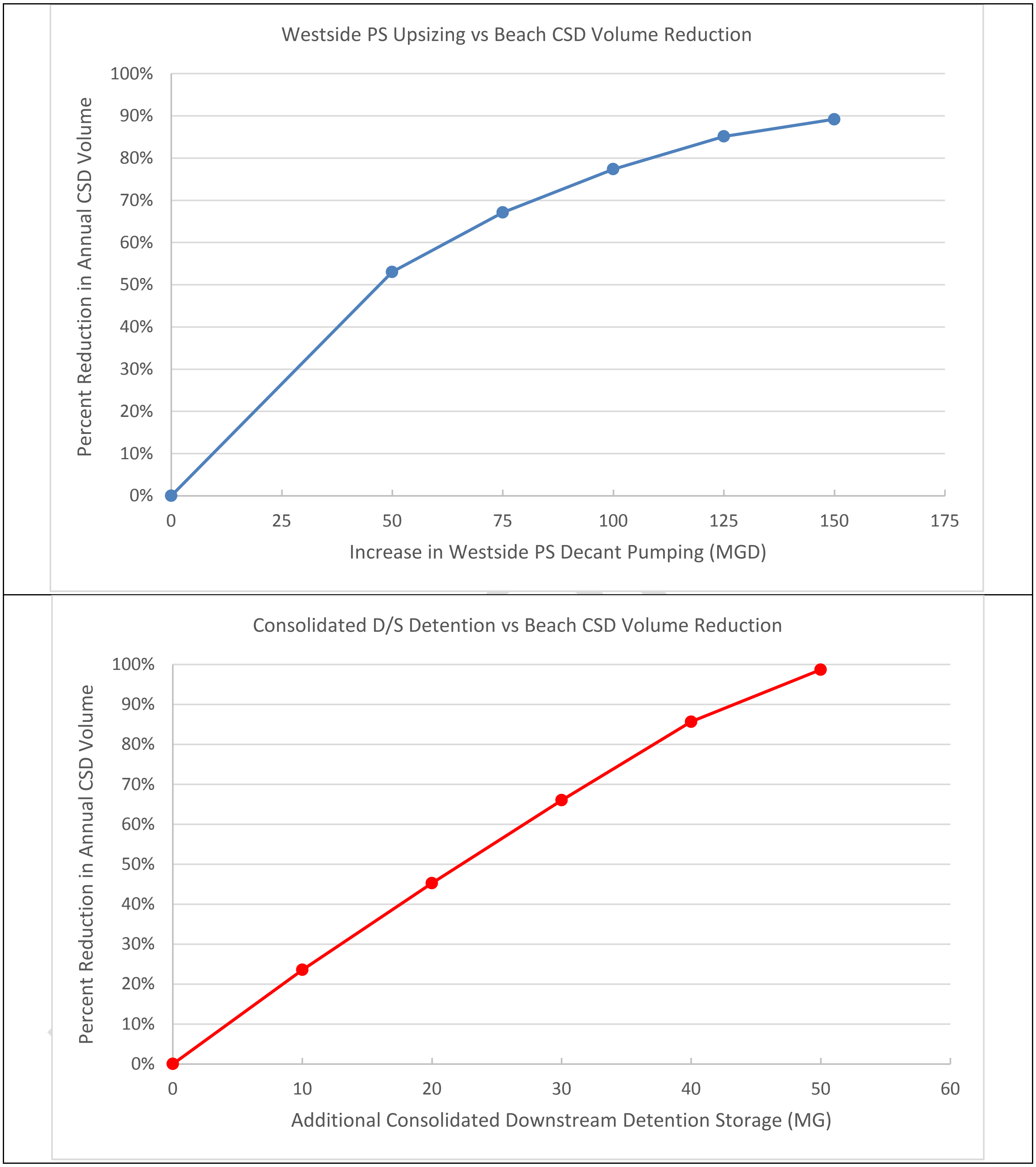
- Increased Westside Pump Station pumping rates;
- Consolidated large-scale CSS storage near the discharge locations;
- Distributed upstream CSS detention storage;
- Reduced runoff to the CSS via green infrastructure; and
- Rerouting of flows to Mile Rock via reactivation of the Old Mile Rock Tunnel.

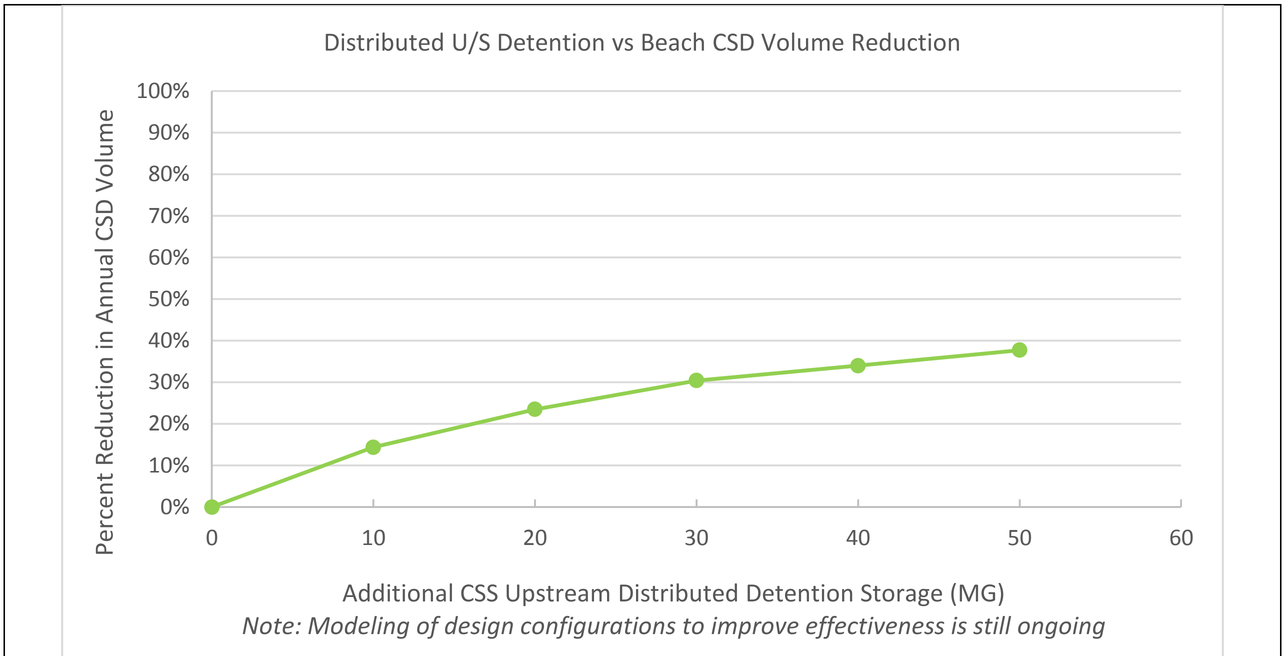
With the exception of rerouting flows to Mile Rock, the strategies could all be scaled up to achieve a higher level of performance (i.e., increased scale equates to increased CSD frequency and volume reduction). Therefore, Figure 3.7 illustrates size versus performance curves for each of these strategies. The UWA team is also analyzing reactivating Old Mile Rock Tunnel to detain combined flows and reroute CSD volume to the Mile Rock CSD outfall.

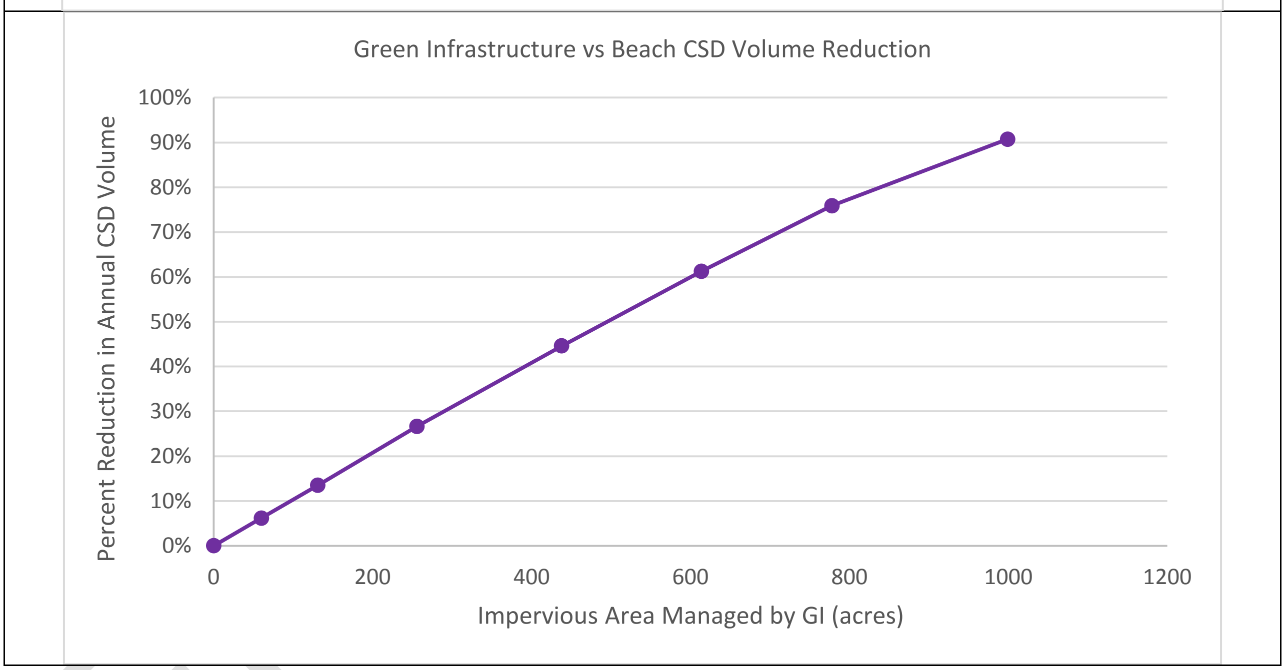
The results presented here represent the first step in a multistep cost-benefit analysis. Next steps (not presented here) include updating costs, creating integrated CSD reduction alternatives, and evaluating the costs and benefits those integrated alternatives. Evaluation of the preferred configuration, costs, and benefits of integrated alternatives is ongoing and will be carried over into the Alternatives Phase of UWA. Therefore, the curves in Figure 3.7 show performance versus the appropriate sizing unit for the technology (e.g., pumping rate for pump station, storage volume for detention tanks, and drainage area for green infrastructure).[8] Each of these sizing units have an associated cost, and ultimately the performance of the technologies (as well as the performance of integrated alternatives) will be presented in terms of cost versus CSD reduction so that different technologies can be more directly compared against one another.

[8] As of model release EHY13_v211, CSD volumes in a typical year were as follows: Ocean Beach = 220.4 MG (Lake Merced = 12.5 MG, Vicente = 83.4 MG, Lincoln = 124.6 MG); Mile Rock = 15.7; Sea Cliff = 0.2 MG. An updated model release is expected prior to the Alternatives phase, which may result in minor changes to these volume estimates.

Figure 3.7 Ocean Beach CSD Reduction Performance by Strategy Type







3.1.4 CSD Opportunities Summary

Table 3.1 and Figure 3.8 summarize the top opportunities identified for each of the three Westside urban watersheds. Each opportunity will be developed into project concepts in the alternatives phase using the same assumptions of performance and costs used in the Bayside Alternatives phase.

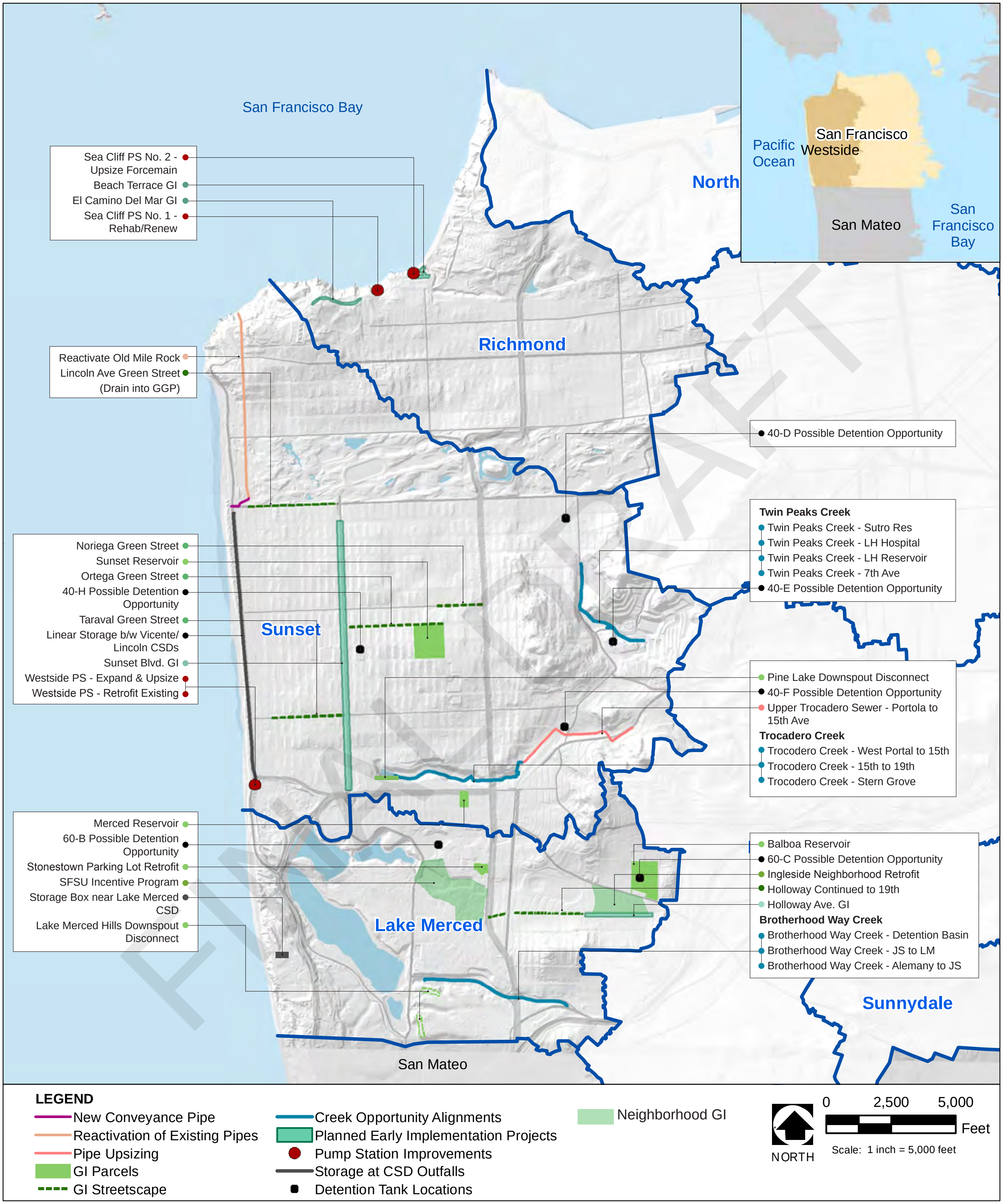


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Figure 3.8 CSD Opportunities Summary

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Table 3.1: List of CSD Reduction Opportunities

Project Name						Location		Technology Type		H+H Performance (Qualitative/Opps)				Cost Synergies			Multi-Benefit Synergies					Additional Information	
Principal LOS Driver	LOS Challenge Area	Strategy Identifier	Concept Identifier	ID	Project Name	Major Watershed	Minor Watershed	Technology Type	Infiltration Category	In Primary Contributing Area to Sensitive Area CSDs	Reduces Flows to Parcels Id'd as High Risk	Reduces Flows to Id'd Flood Prone Areas	Westside Aquifer Recharge or Reduced Potable Demand	Owner	Minimal Maintenance and Utility Conflicts	Interagency Synergies (Funded Planned Projects)	CSAMP (Synergy with R&R of High Risk Asset)	Reduce Odors/Improves O&M	Interagency Synergies (Non-Funded)	EJ/DC	Public Feedback	Site Visit Completed?	Project Description
F	HR	CD	1a	CD-1a	Twin Peaks Creek - Sutro Res	40	D	CD		x	x	x	x	PUC			VH MAJ				WG NC	x	Existing 42" concrete storm sewer, starting from above Sutro Reservoir and under the reservoir, to be connected to existing creek north of Laguna Honda Hospital
F	HR	CD	1b	CD-1b	Twin Peaks Creek - Laguna Honda Hospital	40	D	CD		x	x	x	x	Health	SD		-				WG NC	x	Existing creek north of Laguna Honda Hospital. To be connected with existing storm sewer to the north, and new project to the south
F	HR	CD	1c	CD-1c	Twin Peaks Creek - Laguna Honda Reservoir	40	D	CD		x	x	x	x	**PUC**	OS		VH MAJ				WG NC	x	Construction of diversion structure on an existing storm drain connecting existing LHH creek to Laguna Honda Reservoir to downstream end of reservoir
F	HR	CD	1d	CD-1d	Twin Peaks Creek - 7th Ave	40	D	CD		x	x	x	x	SFUSD/ PUC			VH MAJ		GC		WG NC	x	Downstream end of LH reservoir along 7th Ave (green connection street or through PUC property where there is an existing low marshy area), then through White Crane Springs Community Garden, city owned empty lot (Christmas tree lot) and Garden for the Environment.
R	OB	CD	2a	CD-2a	Brotherhood Way Creek - Lake Merced Detention Basin	60	D	DB		x		x	x	**PUC**	OS		-		GC		WG	x	Existing 30 ft deep area with ex 48" culvert to Lake Merced
R	OB	CD	2b	CD-2b	Brotherhood Way Creek - Junipero Serra to Lake Merced	60	D	CD		x		x	x	PUC DPW	BD	IPIC	-		GC		WG	x	Portion within PUC property along S side of street, captures Junipero Serra DMA
R	OB	CD	2c	CD-2c	Brotherhood Way Creek - Alemany to Junipero Serra	60	D	CD		x		x	x	DPW		IPIC	-		GC		WG	x	Portion within ROW on S side of street, could be extended to capture I 280 DMA
F	W	CD	3a	CD-3a	Trocadero Creek - West Portal to 15th	40	F	CD		x	x	x	x	DPW	-		VH MIN		SS		WG	x	Portion captures base flow from MUNI tunnel drain, could be a storm drain or open channel
F	W	CD	3b	CD-3b	Trocadero Creek - 15th to 19th	40	F	CD		x	x	x	x	Private /Ease	-						WG	x	Portion to link base flow from MUNI tunnel to Pine Lake, and also provide overland flow flood relief from 15th Ave. Route could be on South side of Condos instead, to minimize piped distance
F	W	CD	3d	CD-3d	Trocadero Creek - Stern Grove	40	F	CD		x	x	x	x	RPD	OS		VH MIN		GC		WG	x	Portion with existing grass open channel and dirt open channel, small culverts under footpaths may need to be replaced with larger size
F	IN	DT	1	DT-1	60- C Detention (Balboa Reservoir)	60	C	DT	N/A	x	x	x		**PUC**	PL				ROSE		WG	x	Combined sewage detention tank. Site likely to be sold by PUC for development, however potential to incorporate opportunity into any future project. Needs additional feasibility analysis in Alts phase
R	OB	DT	2	DT-2	60-B Detention (Lowell High School)	60	B	DT	N/A	x				SFUSD						DC			Suitable parcel in a good hydraulic location. However, CSS detention may be preferred as linear in the ROW. Parcel may be preferred for other GI technologies. To be analyzed further during alts development.
F	HR	DT	4	DT-4	40-H Detention (Stevenson Elementary School)	40	H	DT	N/A	x	x	x		SFUSD							SU		Suitable parcel in a good hydraulic location. However, CSS detention may be preferred as linear in the ROW. Parcel may be preferred for other GI technologies. To be analyzed further during alts development.
F	W	DT	5	DT-5	40-F Detention (West Portal Playground)	40	F	DT	N/A	x	x	x		RPD									Suitable parcel in a good hydraulic location. However, CSS detention may be preferred as linear in the ROW. Parcel may be preferred for other GI technologies. To be analyzed further during alts development.
F	HR	DT	6	DT-6	40-E Detention (Laguna Honda Hospital Parking Lot)	40	E	DT	N/A	x	x	x		DPH									Suitable parcel in a good hydraulic location. However, CSS detention may be preferred as linear in the ROW. Parcel may be preferred for other GI technologies. To be analyzed further during alts development.
F	HR	DT	7	DT-7	40-D Detention (Irving/9th Off-Street Parking)	40	D	DT	N/A	x	x	x		City?					ROSE				Suitable parcel in a good hydraulic location. However, CSS detention may be preferred as linear in the ROW. Parcel may be preferred for other GI technologies. To be analyzed further during alts development.
R	OB	GI	1	GI-1	Sunset Reservoir GI	40	C	IT	A	x	x		x	**PUC**					ROSE			x	Mange stormwater from reservoirs that flows out at Pacheco and 28th. Steep slopes are adjacent to outlet, best opportunities are to connect to Ortega concept or a new concept on Pacheco. (See site visit write-up for more detail.)
R	OB	GI	2	GI-2	Merced Reservoir GI	40	N	IT/GS	A	x			x	**PUC**							SU	x	Manage runoff from reservoir on overly-wide, underused Ocean Ave on south edge of site. (See site visit write-up for more detail.)
F	IN	GI	3	GI-3	Balboa Reservoir GI	60	C	RWH/DT	A/B	x	x	x	x	**PUC**	PL	IPIC adjacent					WG	x	PUC planning to develop concept and sell land to developer. Consider Metered Detention RWH design (either save piece of land, easement, or public/private partnership). Potential to capture runoff from adjacent roof and parking lot. (Also see Balboa Rsvr Detention Tank.)
F	IN	GI	7	GI-7	Holloway Green Street Extension - Continued to 19th	60	C	GS		x		x	x	DPW		IPIC	H MIN		GC SS PBS		SU/ WG		Create "College Bikeway" - SFSU/Parkmerced to City College. Constraints: narrow road, not identified as "most suitable" for GI.

Table 3.1: List of CSD Reduction Opportunities

R	OB	GI	8	GI-8	Pine Lake Downspout Disconnect	40	G	DD		x			x	Private			-						Downspout disconnection to known problem area.
R	OB	GI	9	GI-9	Stonestown Green Parking Lot Retrofit	60	B,C	PP		x			x	Private	PL		-			DC	WG		Target extremely large impervious area for runoff reduction.
F	HR	GI	10	GI-10	Noriega Green Street	40	C	GS	A	x	x	x	x	DPW			VH MIN		IN SB SS	-	SU		Matches SB stretch. One block from PUC reservoir. May help address flooding high risk parcel there. Noriega flood prone area is 22nd to 33rd, then again at 40th
R	OB	GI	10	GI-10	SFSU Incentive Program	60	B	PR		x		x	x	State			-			DC	WG		Target large impervious areas with single ownership.
R	OB	GI	11	GI-11	Ortega Green Street	40	H,C	GS	A	x	x		x	DPW			VH MIN		GC ROSE	DC	WG		Possible infiltration gallery site for Sunset Reservoir runoff. One block south of Noriega Invest in Neighborhoods/Sunset Blueprint stretch.
R	OB	GI	12	GI-12	Taraval Green Street	40	J	GS	A	x			x	DPW			H MIN		IN SB	-	SU		Commercial corridor, matches area identified in Sunset Blueprint.
R	OB	GI	13	GI-13	Lincoln Ave Green Street (drain into Golden Gate Park)	40	C, K	BR		x			x	DPW RPD			x	x	SB ROSE	-			SB advocated new entry ways into GGP. Concept would manage Lincoln runoff in GGP, create more of an entry into park in outer avenues.
R	SC	GI	15	GI-15	Baker Beach EIP (El Camino Del Mar Green Street)	20	A	GS	A	x		x		DPW			H MIN		PBS		x		Baker Beach EIP
R	SC	GI	16	GI-16	Baker Beach EIP (Beach Terrace Green Street)	20	A	GS	A	x				DPW GGNRA							x		Baker Beach EIP
R	OB	GI	17	GI-17	Lake Merced Hills Downspout Disconnect	60	D	DD		x			x	Private	OS		-					x	Based on DPW EHY site visits, there may be opportunity to disconnect these areas to existing storm drain system on neighboring gold course.
R	OB	Op	1	Op-1	Reactivate Old Mile Rock	40	A, B, K	Tunnel	N/A	x	x	x		Multipl e									Past concept included overflow connections from Fulton and Lincoln Sewers for LOS Storm to Old Mile Rock
R	SC	PS	1	PS-1	Sea Cliff PS No. 1 - Rehab/Renew	20	A	PS	N/A	x				**PUC**	OS		x						Pump Station rehab/renewal
R	SC	PS	2	PS-2	Sea Cliff PS No. 2 - Upsize Forcemain	20	A	FM	N/A	x				**PUC**			x						Upsize forcemain for pump station
R	OB	PS	3	PS-3	Westside PS - Expand & Upsize	40	L	PS	N/A	x				**PUC**	OS								Expand or upsize pump station to move more flows
R	OB	PS	4	PS-4	Westside PS - Retrofit Existing	40	L	PS	N/A	x				**PUC**	OS		x	x					Retrofit existing pumpstation
R	OB	TS	1	TS-1	Storage Box near Lake Merced CSD	60	A	Tank	N/A	x				GGNRA	OS								Add new storage near CSD outfall to maximize effectiveness of using storage to reduce CSDs.
R	OB	TS	2	TS-2	Linear Storage b/w Vicente/Lincoln CSDs	40	K, L	Linear Storage	N/A	x				GGNRA DPW	OS								Add storage adjacent to Westside T/S in attempt to maximize efficiency of using storage to reduce CSDs.

Legend:

LOS Driver
- R Regulatory
- F Flooding

Strategies
- Pi Increased Conveyance/Pipe Upsizing
- TS Large Scale CSS Storage
- DT U/S Smaller-Scale CSS Storage
- Op Reroute Flows/Operational changes
- GI Runoff Reduction/Green Infrastructure
- CD Creek Daylighting
- PS Pump Station Upsizing (New or Retrofit)

Challenge Area
- OB Ocean Beach CSD:
- SC Sea Cliff CSDs
- L Lake Street
- W Wawona and 15th
- IN Ingleside and Ocean Ave
- HR Other Areas w/ High Risk Flooding Parcels

GI Technology Type
- BR Bioretention
- PP Permeable Pavement
- GS Green Street
- RWH Rainwater Harvesting
- IT Infiltration Trench or Gallery
- DB Detention Basin
- WT Wetland
- CD Creek Daylighting
- PR Programmatic GI
- DD Downspout Disconnect

Owner
- PUC SFPUC
- RPD Rec and Park
- DPH SF DPH
- Ease SFPUC Easement

Interagency
- GC Green Connections
- IN Invest in Neighborhoods
- SB Sunset Blueprint
- MTA MTA bulbout
- HIC High Injury Corridor
- SS Streetscape Street
- PBS Priority Bike Segment
- TC Traffic Calming
- IPIC Interagency Plan Implement:
- IF Interagency Feedback

Public Feedback
- SU SSIP Survey
- WG SSIP Watershed Game
- NC Nature in the City

CSAMP
- H High Risk
- VH Very High Risk
- MAJ Major Pipe
- MIN Minor Pipe

Minimal Conflicts
- PL Parking Lot
- SD Special District (Industrial, etc.)
- BD Boulevard/Low Density Street
- OS Open Space

3.2 Flood Reduction Opportunities

This section builds on the strategies identified in Section 2.2 to identify the most promising flood reduction opportunities on the Westside. These opportunities include both capital projects and will be analyzed in conjunction with programmatic and policy opportunities to create complete watershed solutions. The flooding opportunity analysis consists of four primary steps described in the following subsections:

- Spatial Effectiveness Analysis – modeling analyses using the CCSF H&H Model were conducted to establish how the spatial location of watershed projects impacts their effectiveness in reducing flooding at each flood challenge area.
- Suitability Analysis – the site constraints and technical criteria that impact project implementation feasibility and performance were overlaid to identify opportunity areas for the strategies identified in Section 2.3.2.
- TBL Overlay – the effectiveness and suitability analyses were overlaid with TBL criteria to further identify and refine top opportunities.

3.2.1 Spatial Effectiveness Analysis

Using the CCSF H&H Model, to the UWA team evaluated how the spatial location of watershed projects reduces flooding at each of the flood-prone areas identified in Characterization and overall for the entire Westside. The analyses focused on evaluating effectiveness of infiltration-based green infrastructure and detention tanks. These results of the green infrastructure spatial effectiveness analysis are presented in Figure 3.9.

Green infrastructure effectiveness was measured in terms of total flood volume reduction (gallons) per impervious acre managed. 50 acres of impervious area distributed throughout a minor watershed was converted to drainage area managed by infiltration-based GI. Then, typical year was simulated and flood volume reduction were tabulated. This process was repeated for each minor watershed to generate unit metric estimates for each (gallons of flood reduction per impervious acre managed). Results ranged from a high of 19,000 gallons per acre DMA in minor watershed 40-F to less than a 1,000 gallons/acre in minor watersheds 20-C, 40-C, 40-D, 40-J, 60-A, and 60-C.

Minor watershed 40-F includes the 15th and Wawona flood problem area, which has the highest estimated total LOS flood volume under existing conditions at 1.7 MG. Being immediately upstream of the largest flood volume on the Westside assisted in 40-F performing the best of the minor watersheds.

The results indicate trends that inform the search for opportunities and can be evaluated in more detail during the Alternatives Phase, such as:

- The most upstream minor watersheds were generally the most effective in each major watershed (20-D in Richmond, 40-E and F in Sunset, and 60-D in Lake Merced). Exceptions include 40-H, which is mid-watershed but was relatively effective at reducing downstream flooding at Noriega. The other exception was 60-C, which is at the upstream end of Lake Merced but was relatively ineffective at reducing flooding in Ingleside.

- 20-D was much more effective than 20-C at reducing flooding at Lake Street.
- 40-E was much more effective than 40-D at reducing flooding in the 7th Street flooding area.

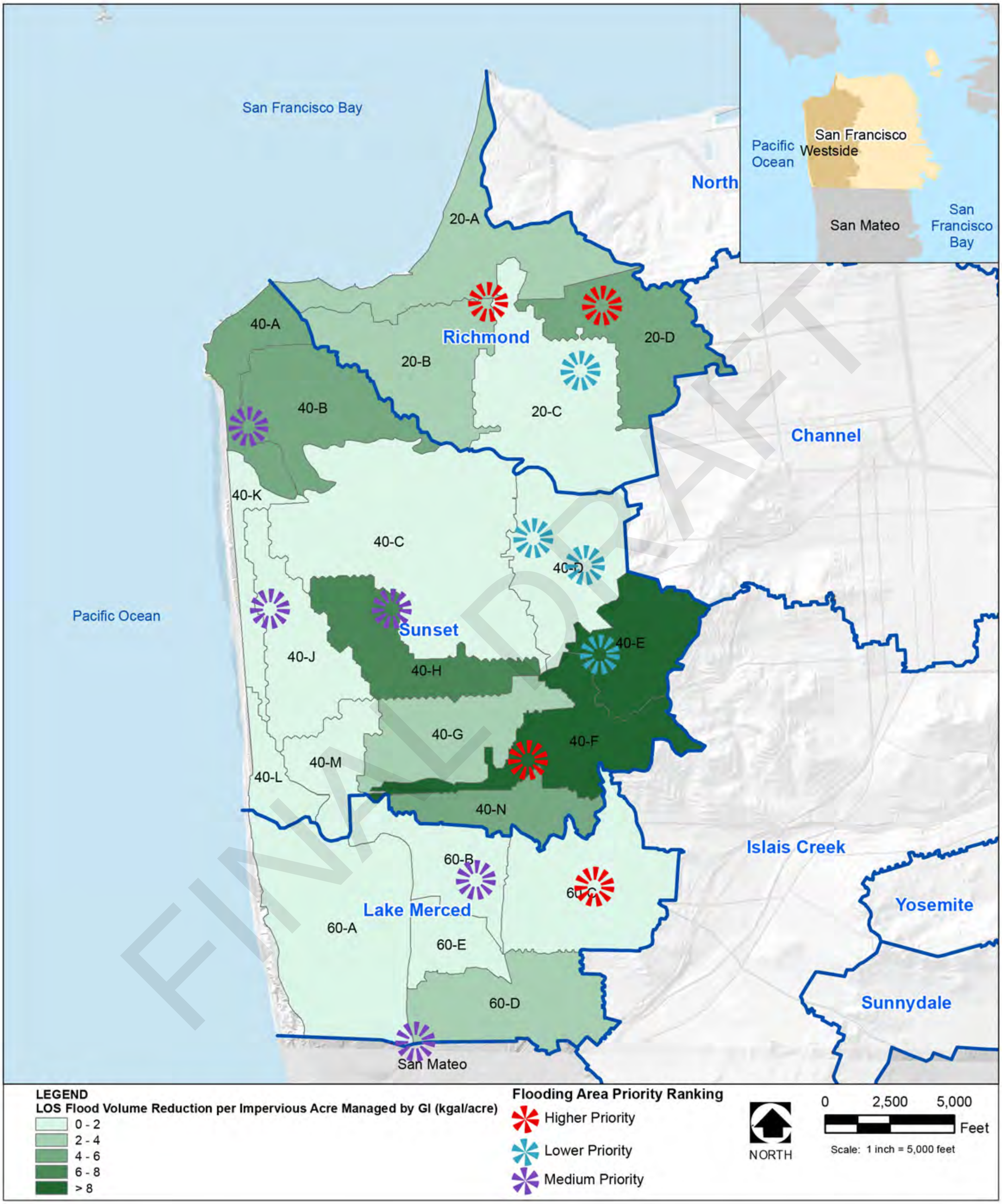

Figure 3.9 Flooding Reduction: GI Spatial Effectiveness by Minor Watershed

Next, the UWA team evaluated detention tank effectiveness. As noted in Section 3.1, the first step was applying the GIS suitability criteria to identify city-owned parcels that were suitable candidates for detention tanks. Typically, one to two parcels were identified in each minor watershed. Next, the UWA modeling team investigated the H&H characteristics of these candidate locations to determine which were most appropriate. A detention tank size of 2 MG was selected for the analyses to achieve CSD and flood reduction responses that would be clearly visible above model noise.

The highest priority when selecting the preferred suitable location was maximizing the function of each detention facility (i.e. making sure each facility will use as much of the storage volume as possible). For this high-level analysis, it was assumed that detention tanks would be sized for the 5-year, 3-hour LOS storm.[9] The total depth of this storm is 1.3 inches. Assuming that 100% of precipitation will become runoff, the minimum contributing area required to fill a 2 MG tank is approximately 65 acres. Therefore, the modeling team prioritized all potential locations that were adjacent to conduits with a tributary area of greater than 65 acres. For minor drainage basins with multiple potential locations that had tributary areas greater than 65 acres, the one with the largest tributary area was selected. It is important to note that some minor drainage basins did not have any locations identified that were adjacent to conduits with tributary areas greater than 65 acres. In this circumstance, the downstream-most location was selected, or the minor drainage basin was determined to be unsuitable for detention.

After the preferred location of each detention facility was selected for each minor drainage basin, the UWA modeling team ran several runs to optimize the facilities for the LOS storm. The objective of the optimization exercise was to have the detention facility capture as much of the LOS peak as possible and use all 2 MG of the detention volume. A new model scenario was created for each minor drainage basin. At the preferred detention location, a storage node was input into the model with a weir connection from the adjacent manhole. An orifice connection was also input into the model allowing the storage node to drain back into the next manhole downstream. The orifice was set to be 1 foot in diameter with a maximum flow rate of 0.33 MGD (6-day drawdown time). Over the course of several runs, the weir elevation was raised or lowered to optimize the facility and the results were recorded.

Results of the analyses were tracked in terms of flood volume reduction in each flood-prone area, as well as overall on the Westside. These results are summarized in Table 3.2 and Figure 3.10.

[9] Note this assumption was made to provide a reasonable sizing methodology for the spatial effectiveness study and does not represent design recommendations.

Table 3.2: Flood Reduction: Detention Tank Effectiveness by Minor Watershed

Flood Prone Area	Existing Flooding (MG)	Flood Reduction Attributed to Detention Tank (MG)															
		20-B	20-C	20-D	40-B	40-C	40-D	40-E	40-F	40-G	40-H	40-M	40-N	60-B	60-C	60-D	60-E
R-2 Cornwall	0.16																
R-3 Geary	0.24																
R-1 Lake	0.57	0.002	0.074	0.319													
S-1 Fulton	0.41		0.025	0.002	0.028		0.025	0.023									
S-3 7th Street	0.35						0.020	0.151									
S-2 Noriega	0.43						0.009	0.013			0.330	0.013	0.009				
S-4 Laguna	0.40						0.019	0.205									
S-5 Wawona	1.68								0.827								
L-3 Junipero	0.52													0.00	0.001		
L-2 Urbano	0.52														0.099		
L-1 Ocean	0.68														0.184		
L-4 Brotherhood	0.45															0.070	
Total Westside Network (MG)	10.465	-		-		0.05			-	0.00			-	-			0.00
Detention Tank Size (MG)	-	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Flood Reduction in Flood Prone Areas (MG) per 1 MG Detention Tank Storage	-	0.001	0.050	0.160	0.014	0.024	0.037	0.196	0.414	0.000	0.165	0.007	0.005	0.000	0.142	0.035	0.000

- low to high efficacy

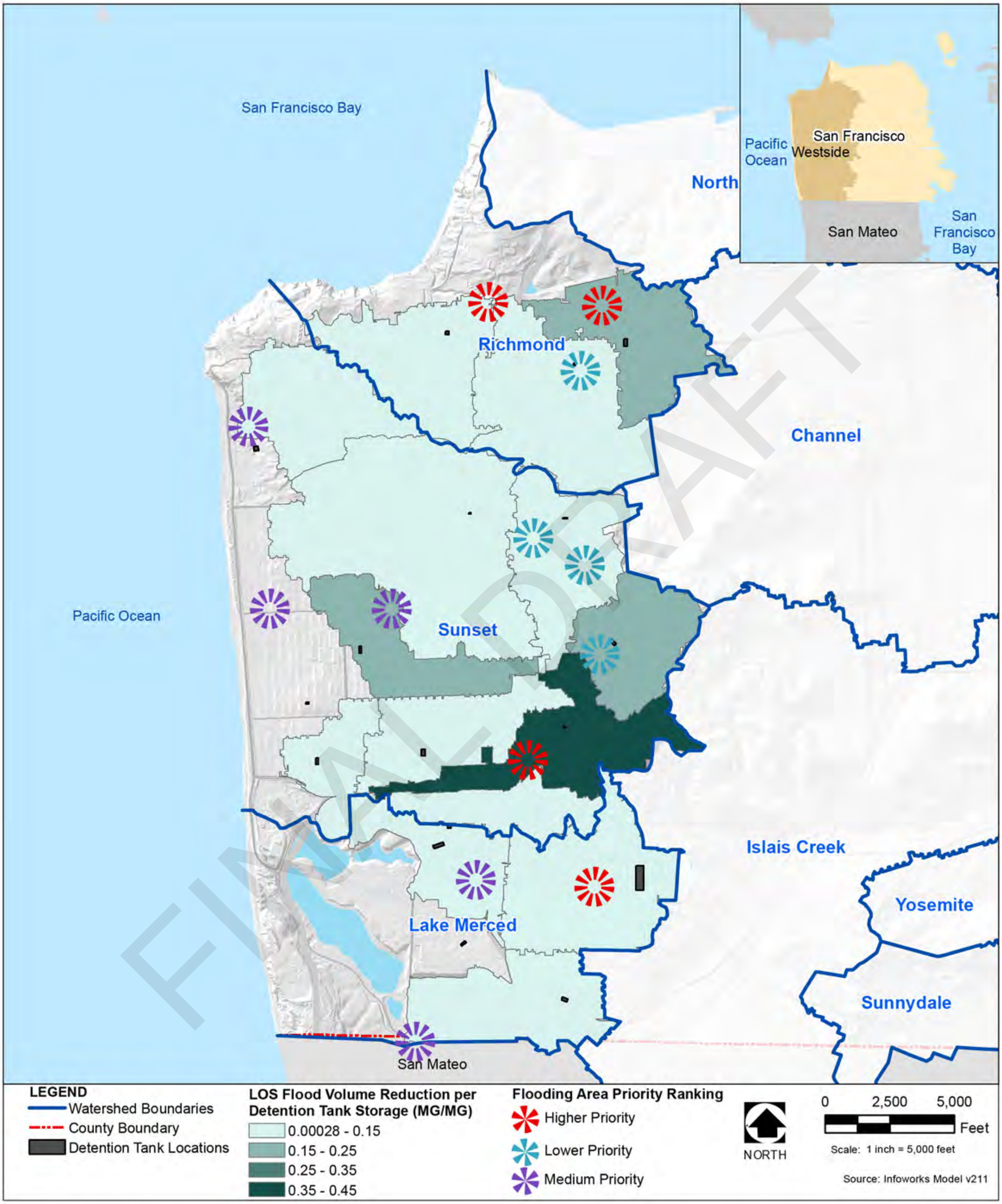

Figure 3.10 Flooding Reduction: Detention Tank Spatial Effectiveness

3.2.2 Flooding Reduction Suitability Analysis

Section 2.3.2 analyzed the flood problem areas to identify the causes of flooding and applicable strategies to address. The suitability analyses build on that information by superimposing technical suitability criteria to highlight the most promising opportunity locations for each strategy. The suitability criteria and identification of opportunity areas for detention tank projects was described in 3.2.1 as part of developing the spatial effectiveness analysis. The results of the suitability analyses for GI and conveyance projects are summarized within this subsection.

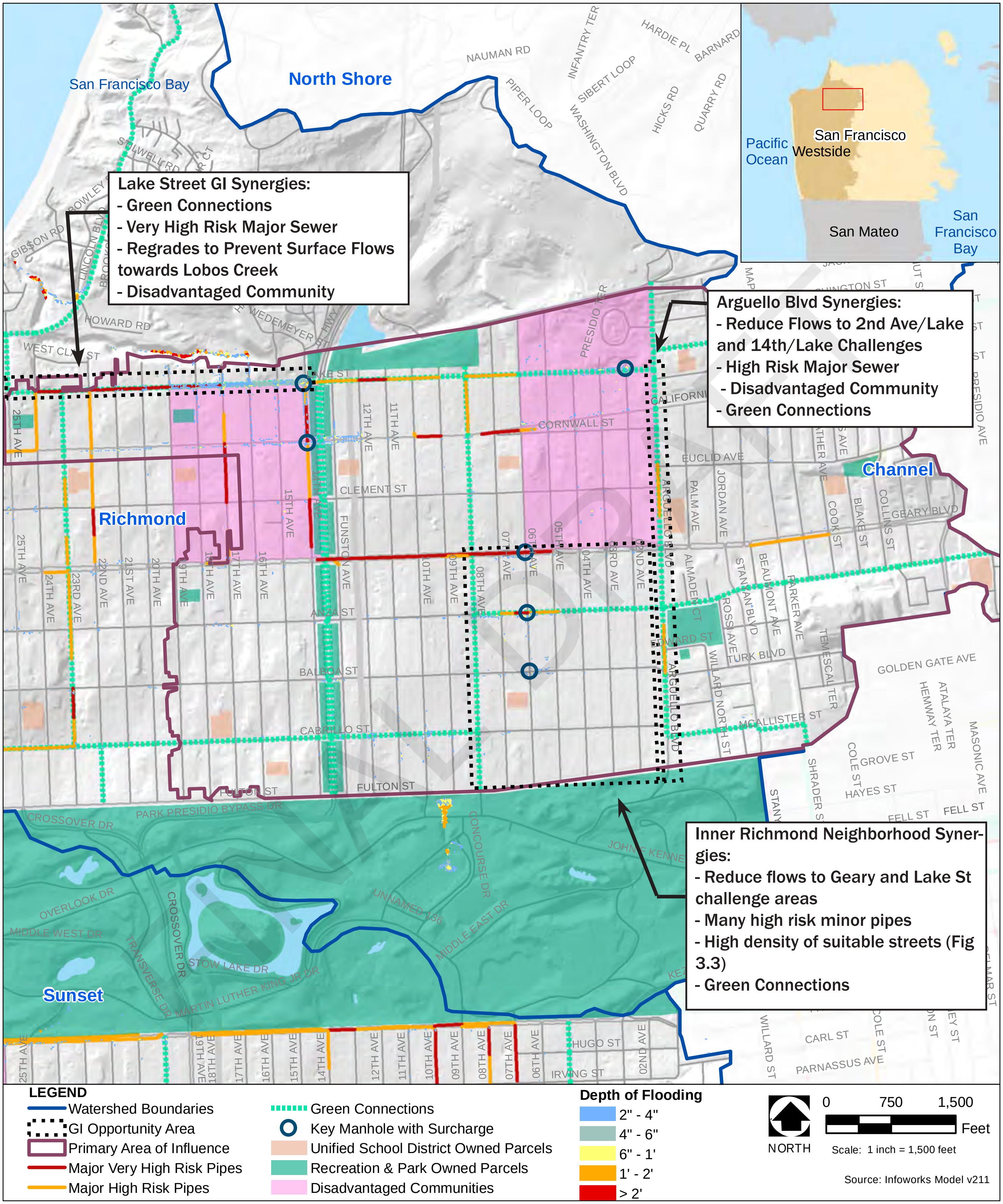

Figure 3.11 GI Suitability: Lake St Flooding

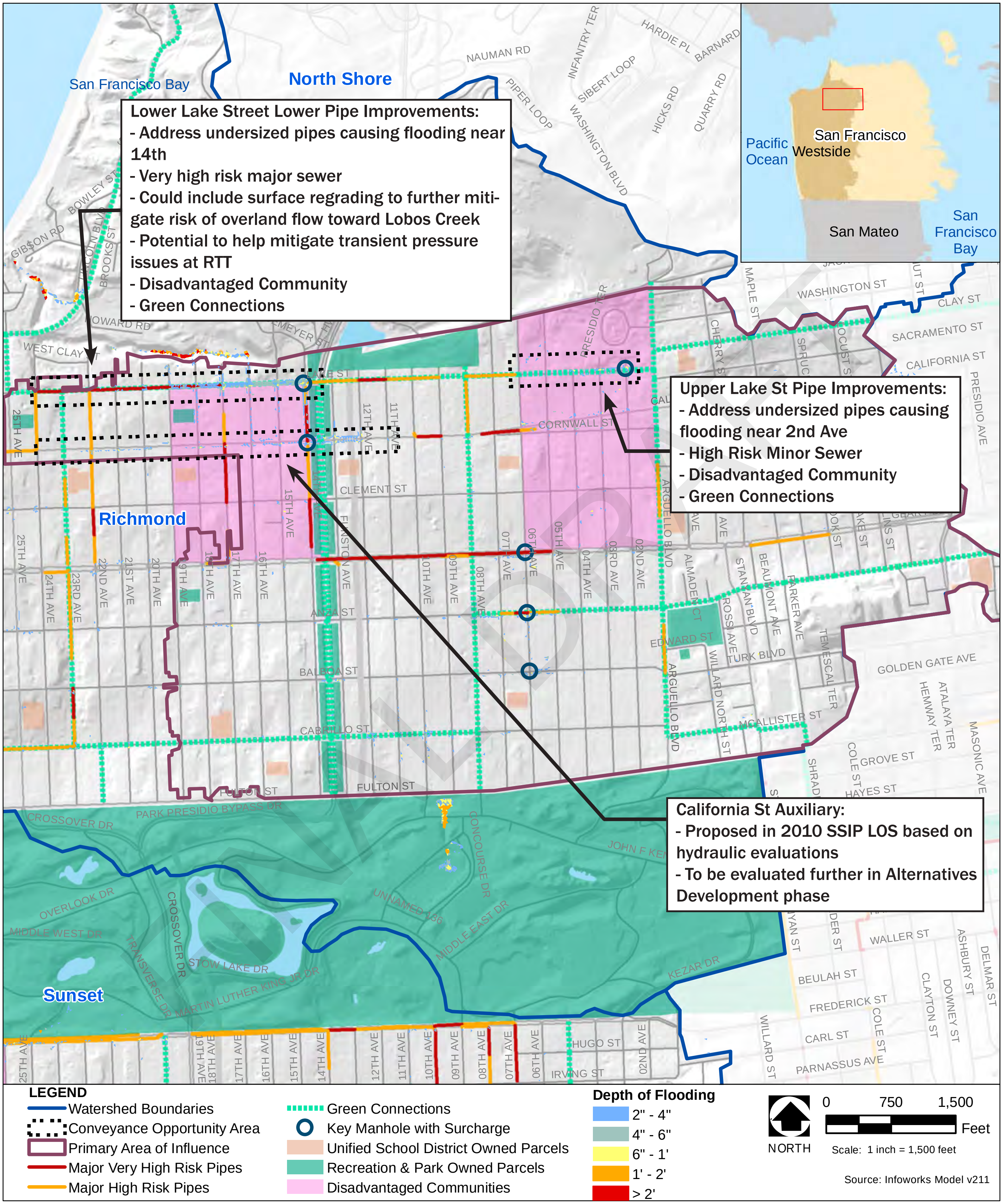

Figure 3.12 Conveyance Suitability: Lake St Flooding

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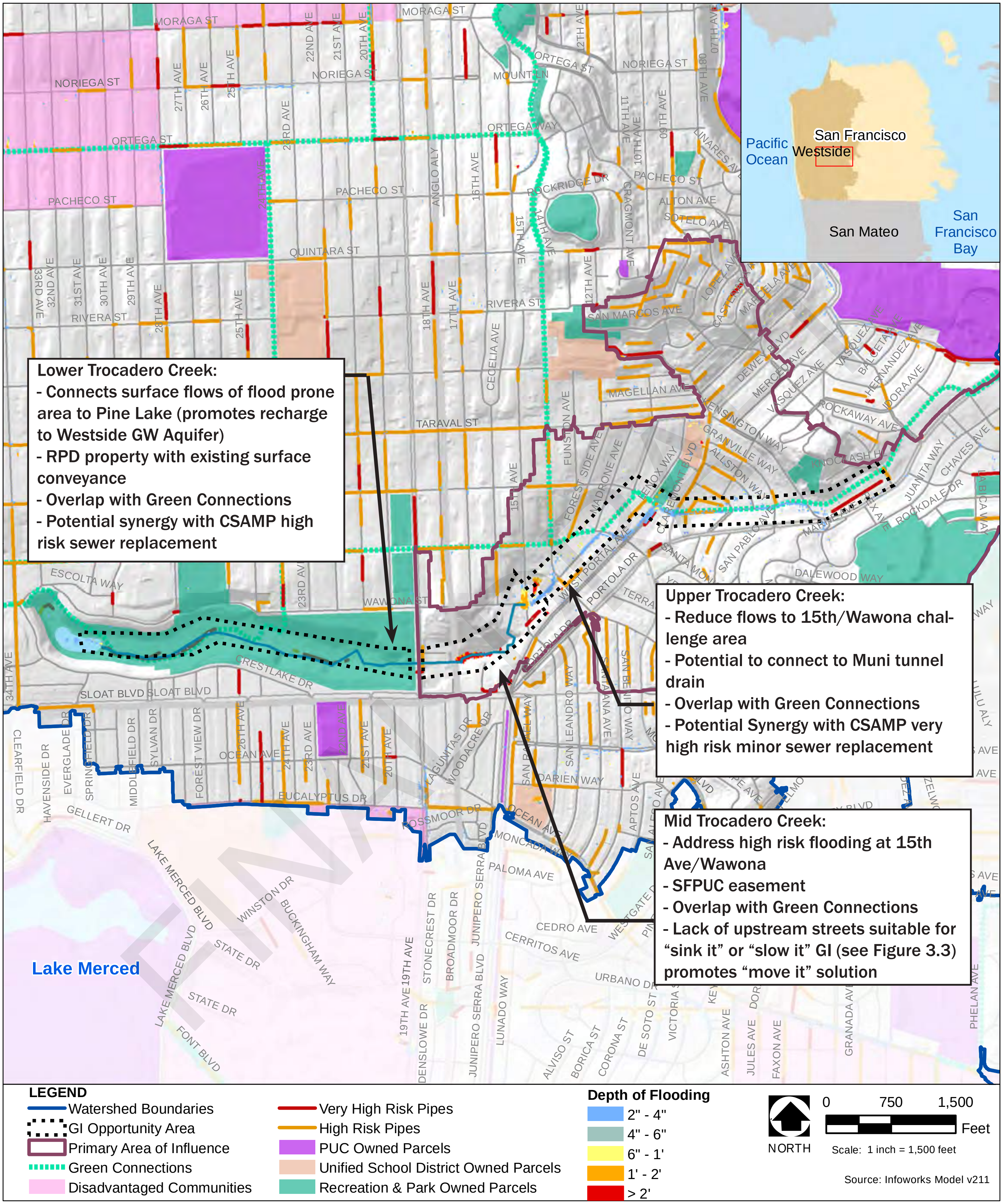

Figure 3.13 GI Suitability: Wawona St Flooding

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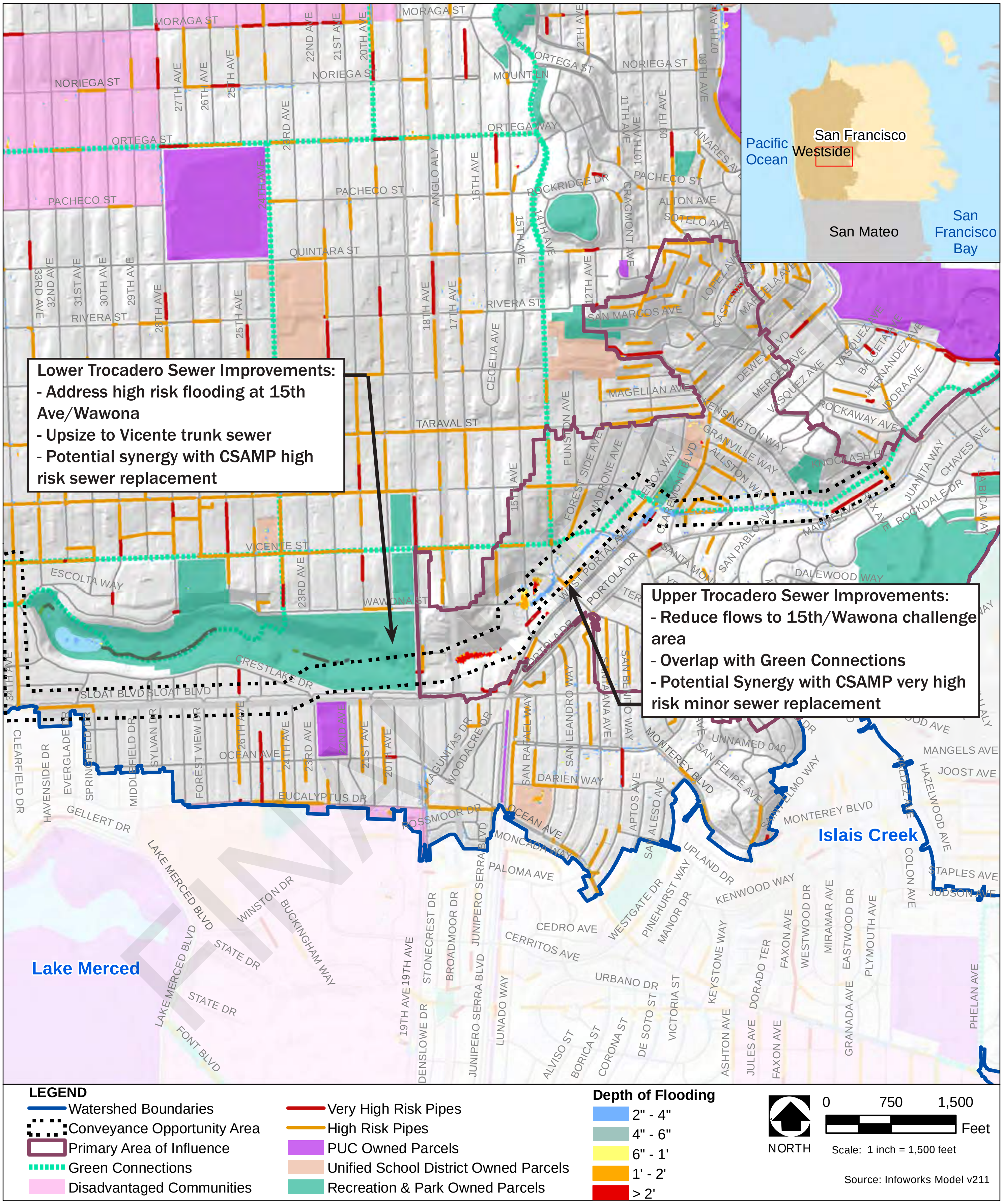

Figure 3.14 Conveyance Suitability: Wawona St Flooding

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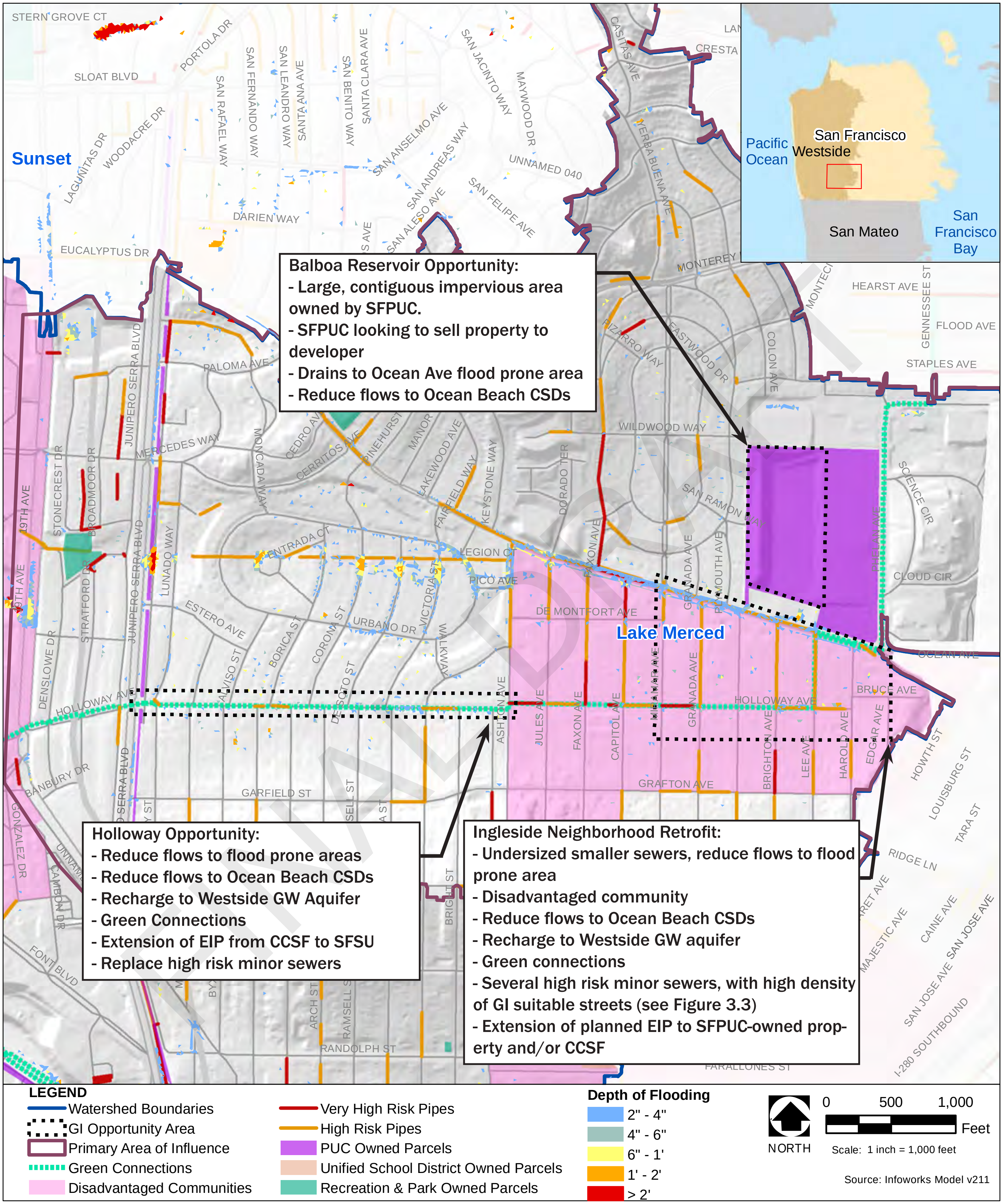

Figure 3.15 GI Suitability: Ingleside Flooding

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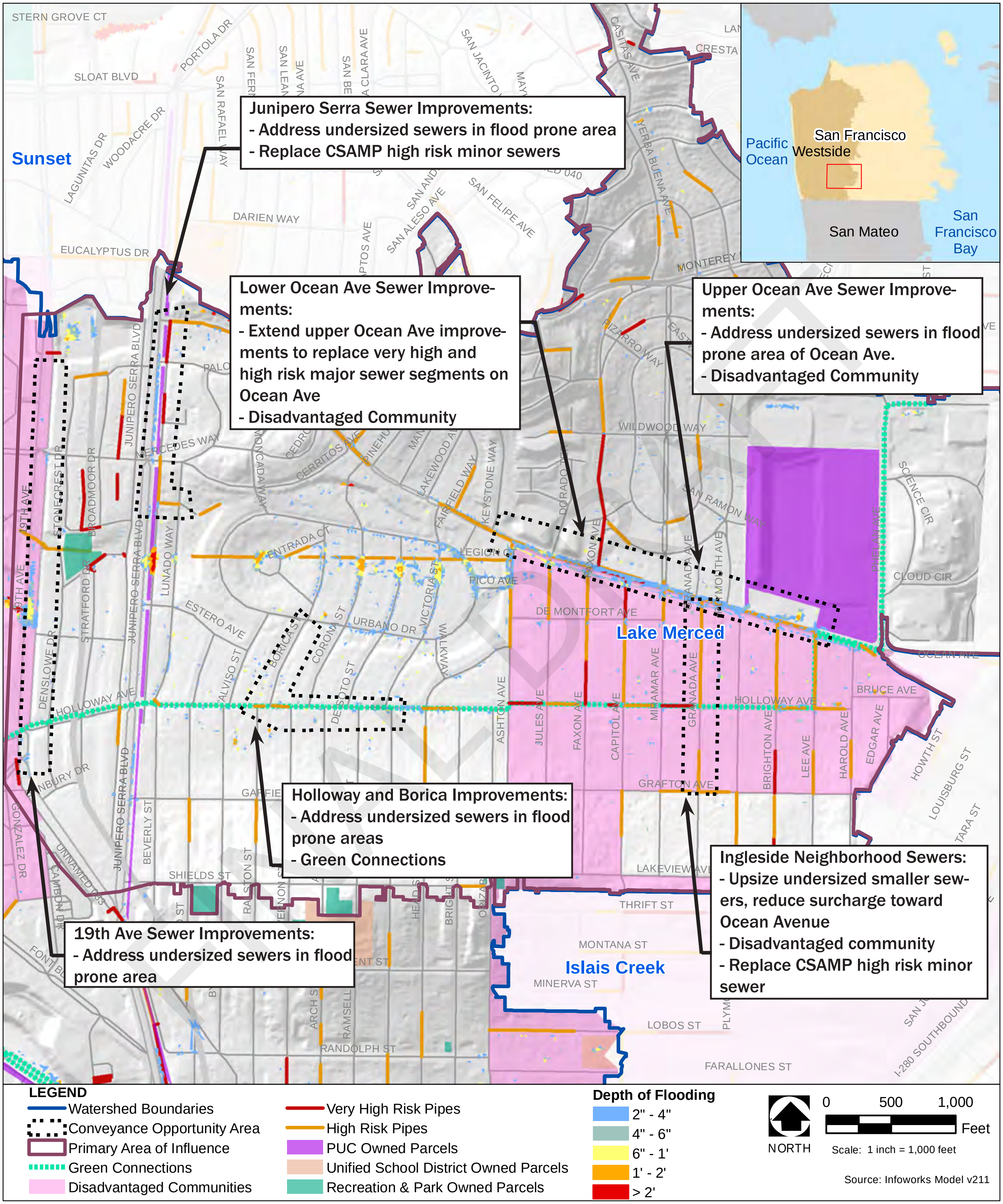

Figure 3.16 Conveyance Suitability: Ingleside Flooding

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3.2.3 Flood Reduction Opportunities Summary

Table 3.3 lists top flood reduction opportunities for each of the three Westside urban watersheds, and each opportunity will be further developed into project concepts in the alternatives phase using the same performance and cost assumptions used in the Bayside Alternatives phase. The location of these opportunities, which may be the same as the CSD opportunities presented in Section 3.1.4, are shown in Figure 3.17.

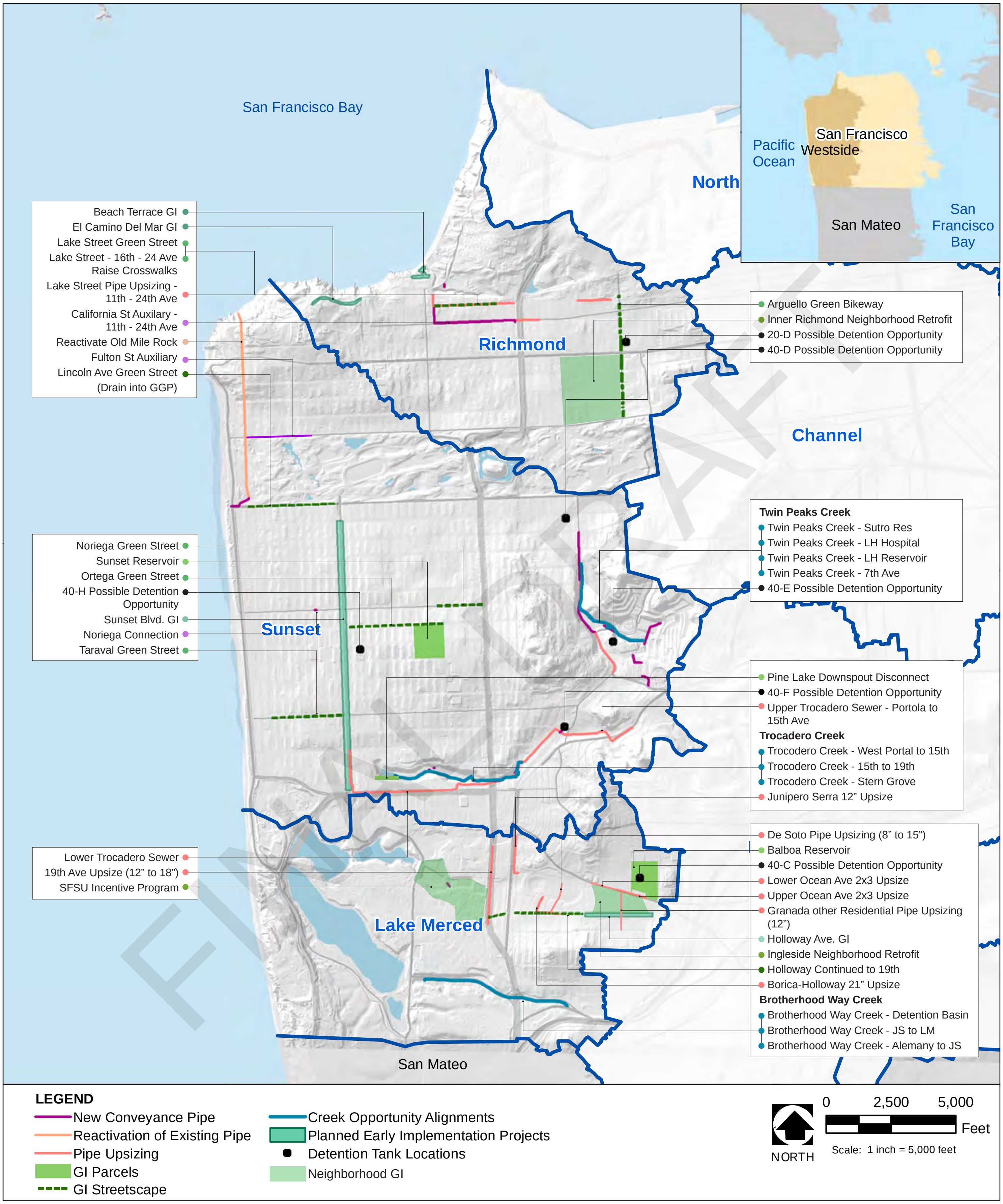

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Figure 3.17 Flood Reduction Opportunities

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SEWER SYSTEM IMPROVEMENT PROGRAM

Table 3.3: Flood Reduction Opportunities

Project Name						Location		Technology Type		H+H Performance (Qualitative/Opps)				Cost Synergies			Multi-Benefit Synergies					Additional Information	
Principal LOS Driver	LOS Challenge Area	Strategy Identifier	Concept Identifier	ID	Project Name	Major Watershed	Minor Watershed	Technology Type	Infiltration Category	In Primary Contributing Area to Sensitive Area CSDs	Reduces Flows to Parcels Id'd as High Risk	Reduces Flows to Id'd Flood Prone Areas	Westside Aquifer Recharge or Reduced Potable Demand	Owner	Minimal Maintenance and Utility Conflicts	Interagency Synergies (Funded Planned Projects)	CSAMP (Synergy with R&R of High Risk Asset)	Reduce Odors/Improves O&M	Interagency Synergies (Non-Funded)	EJ/DC	Public Feedback	Site Visit Completed?	Project Description
F	HR	CD	1a	CD-1a	Twin Peaks Creek - Sutro Res	40	D	CD		x	x	x	x	PUC			VH MAJ				WG NC	x	Existing 42" concrete storm sewer, starting from above Sutro Reservoir and under the reservoir, to be connected to existing creek north of Laguna Honda Hospital
F	HR	CD	1b	CD-1b	Twin Peaks Creek - Laguna Honda Hospital	40	D	CD		x	x	x	x	Health	SD		-				WG NC	x	Existing creek north of Laguna Honda Hospital. To be connected with existing storm sewer to the north, and new project to the south
F	HR	CD	1c	CD-1c	Twin Peaks Creek - Laguna Honda Reservoir	40	D	CD		x	x	x	x	**PUC**	OS		VH MAJ				WG NC	x	Construction of diversion structure on an existing storm drain connecting existing LHH creek to Laguna Honda Reservoir to downstream end of reservoir
F	HR	CD	1d	CD-1d	Twin Peaks Creek - 7th Ave	40	D	CD		x	x	x	x	SFUSD/ PUC			VH MAJ		GC		WG NC	x	Downstream end of LH reservoir along 7th Ave (green connection street or through PUC property where there is an existing low marshy area), then through White Crane Springs Community Garden, city owned empty lot (Christmas tree lot) and Garden for the Environment.
R	OB	CD	2a	CD-2a	Brotherhood Way Creek - Lake Merced Detention Basin	60	D	DB		x		x	x	**PUC**	OS		-		GC		WG	x	Existing 30 ft deep area with ex 48" culvert to Lake Merced
R	OB	CD	2b	CD-2b	Brotherhood Way Creek - Junipero Serra to Lake Merced	60	D	CD		x		x	x	PUC DPW	BD	IPIC	-		GC		WG	x	Portion within PUC property along S side of street, captures Junipero Serra DMA
R	OB	CD	2c	CD-2c	Brotherhood Way Creek - Alemany to Junipero Serra	60	D	CD		x		x	x	DPW		IPIC	-		GC		WG	x	Portion within ROW on S side of street, could be extended to capture I 280 DMA
F	W	CD	3a	CD-3a	Trocadero Creek - West Portal to 15th	40	F	CD		x	x	x	x	DPW	-		VH MIN		SS		WG	x	Portion captures base flow from MUNI tunnel drain, could be a storm drain or open channel
F	W	CD	3b	CD-3b	Trocadero Creek - 15th to 19th	40	F	CD		x	x	x	x	Private /Ease	-						WG	x	Portion to link base flow from MUNI tunnel to Pine Lake, and also provide overland flow flood relief from 15th Ave. Route could be on South side of Condos instead, to minimize piped distance
F	W	CD	3d	CD-3d	Trocadero Creek - Stern Grove	40	F	CD		x	x	x	x	RPD	OS		VH MIN		GC		WG	x	Portion with existing grass open channel and dirt open channel, small culverts under footpaths may need to be replaced with larger size
F	IN	DT	1	DT-1	60- C Detention (Balboa Reservoir)	60	C	DT	N/A	x	x	x		**PUC**	PL				ROSE		WG	x	Combined sewage detention tank. Site likely to be sold by PUC for development, however potential to incorporate opportunity into any future project. Needs additional feasibility analysis in Alts phase
F	L	DT	3	DT-3	20-D Detention (Roosevelt Middle School)	20	D	DT	N/A		x	x		SFUSD			-	-	-	-	SU		Suitable parcel in a good hydraulic location. However, CSS detention may be preferred as linear in the ROW. Parcel may be preferred for other GI technologies. To be analyzed further during alts development.
F	HR	DT	4	DT-4	40-H Detention (Stevenson Elementary School)	40	H	DT	N/A	x	x	x		SFUSD							SU		Suitable parcel in a good hydraulic location. However, CSS detention may be preferred as linear in the ROW. Parcel may be preferred for other GI technologies. To be analyzed further during alts development.
F	W	DT	5	DT-5	40-F Detention (West Portal Playground)	40	F	DT	N/A	x	x	x		RPD									Suitable parcel in a good hydraulic location. However, CSS detention may be preferred as linear in the ROW. Parcel may be preferred for other GI technologies. To be analyzed further during alts development.
F	HR	DT	6	DT-6	40-E Detention (Laguna Honda Hospital Parking Lot)	40	E	DT	N/A	x	x	x		DPH									Suitable parcel in a good hydraulic location. However, CSS detention may be preferred as linear in the ROW. Parcel may be preferred for other GI technologies. To be analyzed further during alts development.
F	HR	DT	7	DT-7	40-D Detention (Irving/9th Off-Street Parking)	40	D	DT	N/A	x	x	x		City?					ROSE				Suitable parcel in a good hydraulic location. However, CSS detention may be preferred as linear in the ROW. Parcel may be preferred for other GI technologies. To be analyzed further during alts development.
R	OB	GI	1	GI-1	Sunset Reservoir GI	40	C	IT	A	x	x		x	**PUC**					ROSE			x	Mange stormwater from reservoirs that flows out at Pacheco and 28th. Steep slopes are adjacent to outlet, best opportunities are to connect to Ortega concept or a new concept on Pacheco. (See site visit write-up for more detail.)
F	IN	GI	3	GI-3	Balboa Reservoir GI	60	C	RWH/DT	A/B	x	x	x	x	**PUC**	PL	IPIC adjacent					WG	x	PUC planning to develop concept and sell land to developer. Consider Metered Detention RWH design (either save piece of land, easement, or public/private partnership). Potential to capture runoff from adjacent roof and parking lot. (Also see Balboa Rsvr Detention Tank.)
F	L	GI	4	GI-4	Arguello Green Bikeway	20	D	GS	A - D		x	x		DPW			H MAJ		GC SS PBS	DC	WG / SU		Green street project concept. Needs further analysis and coordination with analysis done for EIP NAR.
F	L	GI	5	GI-5	Inner Richmond Neighborhood Retrofit	20	C	PR	A		x	x		--			VH MAJ		ROSE		SU		Target streets for GI and pipe improvements where high risk CSAMP pipes exist in neighborhood area bounded by Geary to Fulton, Funston to Arguello.
F	IN	GI	6	GI-6	Ingleside Neighborhood Retrofit	60	C	PR		x	x	x	x	DPW			VH MIN		ROSE	DC	WG		Target suitable streets with majority of high risk CSAMP pipes in neighborhood area bounded by Ocean to Holloway, Ashton to Harold. (Note: N/S streets may also be opportunity to connect Holloway to CCSF or Balboa via GI).

Table 3.3: Flood Reduction Opportunities

F	IN	GI	7	GI-7	Holloway Green Street Extension - Continued to 19th	60	C	GS		x		x	x	DPW		IPIC	H MIN		GC SS PBS		SU/ WG		Create "College Bikeway" - SFSU/Parkmerced to City College. Constraints: narrow road, not identified as "most suitable" for GI.
F	HR	GI	10	GI-10	Noriega Green Street	40	C	GS	A	x	x	x	x	DPW			VH MIN		IN SB SS	-	SU		Matches SB stretch. One block from PUC reservoir. May help address flooding high risk parcel there. Noriega flood prone area is 22nd to 33rd, then again at 40th
R	OB	GI	10	GI-10	SFSU Incentive Program	60	B	PR		x		x	x	State			-			DC	WG		Target large impervious areas with single ownership.
R	OB	GI	11	GI-11	Ortega Green Street	40	H,C	GS	A	x	x		x	DPW			VH MIN		GC ROSE	DC	WG		Possible infiltration gallery site for Sunset Reservoir runoff. One block south of Noriega Invest in Neighborhoods/Sunset Blueprint stretch.
R	OB	GI	13	GI-13	Lincoln Ave Green Street (drain into Golden Gate Park)	40	C, K	BR		x			x	DPW RPD			x	x	SB ROSE	-			SB advocated new entry ways into GGP. Concept would manage Lincoln runoff in GGP, create more of an entry into park in outer avenues.
F	L	GI	14	GI-14	Lake Street Green Street	20	B,C	GS	A		x	x		DPW			VH MAJ		GC PBS	DC	WG		Concept in combination with brick sewer replacement and elevated crosswalk project, reduce overflow potential to Lobos Creek
R	SC	GI	15	GI-15	Baker Beach EIP (El Camino Del Mar Green Street)	20	A	GS	A	x		x		DPW			H MIN		PBS		x		Baker Beach EIP
R	OB	Op	1	Op-1	Reactivate Old Mile Rock	40	A, B, K	Tunnel	N/A	x	x	x		Multipl e									Past concept included overflow connections from Fulton and Lincoln Sewers for LOS Storm to Old Mile Rock
F	L	Op	2	Op-2	Lake Street Crosswalks - 16th - 24 Ave Raise Crosswalks	20	B	Grading	N/A		x	x		DPW			VH MAJ		GC PBS TC	DC	WG		Concept in combination with Lake Street Green Street and brick sewer replacement, reduce overflow potential to Lobos Creek
F	L	Pi	1	Pi-1	Lake Street Pipe Upsizing - 2nd to 6th	20	D	Pipe	N/A		x	x		DPW			-			DC			Upsize Lake Street to alleviate surcharging of high risk sewer. Post this recommendation, sewer collapsed in this location.
F	L	Pi	2	Pi-2	Lake Street Pipe Upsizing - 11th to 24th Ave	20	B, C	Pipe	N/A		x	x		DPW			VH MAJ			DC	WG		Upsize high risk brick sewer, coordinate with raised crosswalk project to prevent surface flows toward Lobos Creek
F	L	Pi	3	Pi-3	California St Auxiliary - 11th to 24th Ave	20	B, C	Pipe	N/A			x		DPW			-			DC	WG		Proposed auxiliary sewer to alleviate Lake Street flooding and potentially slow flows into head end of RTT (From SSIP 2010 LOS)
F	W	Pi	4	Pi-4	Upper Trocadero Sewer Upsizing - Portola to 15th Ave	40	F	Pipe	N/A		x	x		DPW			VH MIN						Reduce excess stormwater to 15th/Wawona, overlaps with green connections, synergy with CSAMP high risk minor sewer.
F	W	Pi	5	Pi-5	Lower Trocadero Sewer Upsizing -15th Ave to Vicente	40	G	Pipe	N/A		x	x		DPW			H MIN						Address flooding by provide add'l capacity from 15th/Wawona to downstream trunk sewer.
F	IN	Pi	6	Pi-6	19th Ave Pipe Upsizing (12" to 18")	60	B	Pipe	N/A			x		DPW									Address undersized sewers in flood prone area.
F	IN	Pi	7	Pi-7	Junipero Serra Pipe Upsizing (12")	60	C	Pipe	N/A			x		DPW									Upsize to alleviate surcharging of high risk sewer at Mercy High School.
F	IN	Pi	8	Pi-8	Upper Ocean Ave Pipe Upsizing (2x3)	60	C	Pipe	N/A		x	x		DPW						DC			Upsize Ocean Ave trunk sewer in flood prone area. Synergy with CSAMP high risk pipes and in disadvantaged community.
F	IN	Pi	9	Pi-9	Lower Ocean Ave Pipe Upsizing (2x3)	60	C	Pipe	N/A		x	x		DPW						DC			Extend Ocean Ave improvements to capture CSAMP major VH/H risk sewers
F	IN	Pi	10	Pi-10	Granada other Residential Pipe Upsizing (12")	60	C	Pipe	N/A		x	x		DPW						DC			Upsizing of smaller sewers to the south feeding Ocean Ave. Needs more evaluation of specific pipe segments in alts development.
F	IN	Pi	11	Pi-11	De Soto Pipe Upsizing (8" to 15")	60	C	Pipe	N/A			x		DPW									Upsize local sewers that are causing excess stormwater to collect in low point of Racetrack neighborhood.
F	IN	Pi	12	Pi-12	Borica-Holloway Pipe Upsizing (21")	60	C	Pipe	N/A			x		DPW									Upsize local sewers that are causing excess stormwater to collect in low point of Racetrack neighborhood. Potential synergy with green connections and opportunity to extend EIP along Holloway.
F	HR	Pi	13	Pi-13	Fulton St Auxiliary	40	B	Pipe	N/A		x	x		DPW			x						Auxiliary sewer to address flooding near Fulton (Proposed in 2010 SSIP). Needs re-evaluation with respect to Old Richmond Tunnel and OMR recommendations and priority of reduction CSDs at Ocean Beach.
F	HR	Pi	14	Pi-14	Noriega Connection	40	J, H	Pipe	N/A		x	x		DPW									Finish crossover connection that was never completed

Legend:

LOS Driver
R Regulatory
F Flooding

Challenge Area
OB Ocean Beach CSD:
SC Sea Cliff CSDs
L Lake Street
W Wawona and 15th
IN Ingleside and Ocean Ave
HR Other Areas w/ High Risk Flooding Parcels

Strategies
Pi Increased Conveyance/Pipe Upsizing
TS Large Scale CSS Storage
DT U/S Smaller-Scale CSS Storage
Op Reroute Flows/Operational changes
GI Runoff Reduction/Green Infrastructure
CD Creek Daylighting
PS Pump Station Upsizing (New or Retrofit)

GI Technology Type
BR Bioretention
PP Permeable Pavement
GS Green Street
RWH Rainwater Harvesting
IT Infiltration Trench or Gallery
DB Detention Basin
WT Wetland
CD Creek Daylighting
PR Programmatic GI
DD Downspout Disconnect

Owner
PUC SFPUC
RPD Rec and Park
DPH SF DPH
Ease SFPUC Easement

Interagency
GC Green Connections
IN Invest in Neighborhoods
SB Sunset Blueprint
MTA MTA bulbout
HIC High Injury Corridor
SS Streetscape Street
PBS Priority Bike Segment
TC Traffic Calming
IPIC Interagency Plan Implement:
IF Interagency Feedback

Public Feedback
SU SSIP Survey
WG SSIP Watershed Game
NC Nature in the City

CSAMP
H High Risk
VH Very High Risk
MAJ Major Pipe
MIN Minor Pipe

Minimal Conflicts
PL Parking Lot
SD Special District (Industrial, etc.)
BD Boulevard/Low Density Street
OS Open Space

3.3 Programmatic Opportunities (Non-Capital Projects)

In addition to specific capital projects, there are also opportunities to address LOS needs through programmatic approaches, including incentive programs. The programmatic opportunities described in this section target impervious cover types on the Westside. Programs provide an additional tool for the SSIP to encourage stormwater management on private parcels, which account for 88% of the impervious cover in the Westside CSS. Programs may include incentives, grants, stewardship programs, or community collaborations designed to address surface drainage and collection system needs to complement capital projects.

The Westside combined sewer service area covers 9,677 acres and includes streets, buildings, hardscapes, and landscapes. Streets account for 31% of the Westside CSS (2,974 acres). The SFPUC, other City agencies, and private utilities have jurisdiction to locate infrastructure in these rights-of-way. Parcels make up the remaining 69%, including roofs (2,374 acres), hardscapes (1,607 acres), and landscapes. This impervious cover is the focus of programmatic opportunities on parcels. Table 3.4 shows parcels within the Westside CSS by land use and ownership.

3.3.1 Parcel Analysis

The UWA team analyzed the parcel data in terms of land use and ownership characteristics by impervious cover type to determine the best opportunities to target incentive programs. Residential properties account for 78% (3,090 acres) of the impervious cover in the Westside CSS. The next-largest categories are open space and commercial, which account for 8% and 6%, respectively (306 and 252 acres). In terms ownership, private parcels account for 88% of the impervious cover in the Westside CSS. The next-largest categories are City (Non-PUC) with 7% (270 acres) and the SFPUC with 3% (104 acres).

Table 3.4: Westside Combined Sewer System Parcels by Land Use and Ownership

Land Use			Ownership	
Category	**Parcels**		**Category**	**Parcels**
Residential	56,010		SFPUC	22
Commercial	1,780		Other City	320
Government/Institution	345		SF Unified School District	50
Industrial	11		State	82
Parking Lot	23		Federal	4
School	72		Private	58,793
Open Space	740			
Other	290			

Roofs

The largest impervious cover outside of the rights-of-way in the Westside is rooftops, with more that 88% privately owned. The Sunset Watershed has the largest total rooftop acreage of 1,437 acres, with 1,380 acres under private ownership. The average rooftop is 0.04 acres, and the largest rooftop is 15.6 acres on San Francisco Recreation and Parks Department open space in the Sunset Watershed. Residential rooftops make up the largest percentage of roof area in the Westside CSS at 86%, followed by commercial rooftops (6%). Table 3.5 breaks down the Westside rooftop data. The table shows total roof acreage for the Westside CSS and watersheds, as well as statistics for the private parcels, including the total acreage, the mean roof area, and max area. The max area indicates the largest roof area in each watershed.

Table 3.5: Westside Roof Area Statistics

Watershed	Total Area (ac)	Private Total Area (ac)	Private Mean Area(1) (ac)	Private Mean Area(1) (sf)	Private Max Area (ac)
Lake Merced	382.0	356.1	1.03	44,683	5.01
Richmond	556.0	541.9	0.35	15,076	2.00
Sunset	1,436.5	1,380.3	0.22	9,609	4.68
WESTSIDE	**2,374.5**	**2,278.2**	**0.04**	**1,565**	**5.01**

(1) Excludes roof area outside of lower and upper 1% thresholds.

Hardscapes

Parcel hardscapes make up the smallest percentage of impervious cover on the Westside, of which almost three-quarters are located on private property. The Sunset Watershed has the largest hardscape parcel acreage, but Lake Merced has the largest average parcel hardscape area. The San Francisco Recreation and Parks Department owns the largest single hardscaped area in the Westside (130 acres in Sunset). Residential land use accounts for the largest portion of hardscape area (65%), followed by open space (17%), commercial (7%) and schools (6%). The average hardscape area for the Westside CSS is equal to 900 square feet.

Table 3.6 shows the total area of hardscapes across the Westside CSS, as well as the total area, mean hardscape area, and max hardscape area for the privately owned hardscapes.

Table 3.6: Westside Hardscape Area Statistics

Watershed	Total Area (ac)	Private Total Area (ac)	Private Mean Area(1) (ac)	Private Mean Area(1) [sf]	Private Max Area (ac)
Lake Merced	354.6	255.3	1.17	50,837	13.35
Richmond	233.5	203.4	0.25	10,984	3.85
Sunset	1,018.9	758.5	0.16	7,071	3.74
WESTSIDE	**1,607.0**	**1,217.2**	**0.02**	**821**	**13.35**

(1) Excludes hardscape area outside of lower and upper 1% thresholds.

Special Consideration

Certain owners have special considerations in terms of programmatic opportunities due to the potential for managing multiple properties with one owner and providing education.

Open Space

Open space makes up one-quarter of the Westside CSS parcels, accounting for over 300 acres of impervious cover. The San Francisco Recreation and Parks Department manages most of those parcels, including 200 acres of impervious cover. Major open spaces under their jurisdiction include Golden Gate Park, Lincoln Park, Stern Grove, and Pine Lake. In many cases, these impervious areas may be adjacent to landscaped areas that could provide opportunities for managing stormwater.

Schools

The San Francisco Unified School District owns 50 parcels in the Westside CSS that account for 91 acres of impervious cover in the Westside CSS. SFPUC could work with the San Francisco Unified School District to develop a strategy for managing this impervious area, especially in those areas that most benefit the sewer system. In addition to stormwater benefits, schools provide a unique opportunity to educate our youth and parents about water and wastewater resources. The public has also expressed interest in projects at these locations through the Urban Watershed Planning Games.

3.3.2 Parcel Suitability

Multiple stormwater management technologies can be applied to parcels. For roofs, the size, slope, age of the building, and construction type all factor into the suitability for stormwater management interventions. Most of this data is not readily available as part of the parcel data. To assess their potential, the team used the size of a roof as the limiting factor. Roofs are considered suitable if they meet the suitability criteria for parcels described in Appendix A, Section A.3 and have an area greater than 1,000 square feet.

Table 3.7 shows parcel suitability by land use, and Table 3.8 shows parcel suitability by ownership.

Table 3.7: Suitability by Land Use

Land Use		Roofs			Hardscape		
Category	Total Parcels	Total Area (ac)	Suitable Parcels (#)	Suitable Area (ac)	Total Area (ac)	Suitable Parcels (#)	Suitable Area (ac)
Residential	56,010	2,041	14	18	1,049	9	9
Commercial	1,780	149	17	24	105	18	69
Government/Institution	345	52	171	50	62	228	53
Industrial	11	2	10	2	1	3	0
Parking Lot	23	0	1	0	2	22	2
School	72	65	65	65	96	57	95
Open Space	740	41	61	37	267	413	258
Other	290	25	195	22	25	158	17
WESTSIDE TOTAL	**59,271**	**2,374**	**534**	**218**	**1,607**	**908**	**503**

1. "Parking Lot" denotes parcels designated solely as parking lots, and may exclude additional parking lots on parcels with other land uses.
2. Only roofs greater than or equal to 1,000 sf (0.02 ac) were considered suitable for roof technologies.

Table 3.8: Suitability by Ownership

Ownership		Roofs			Hardscape		
Category	Total Parcels	Total Area (ac)	Suitable Parcels (#)	Suitable Area (ac)	Total Area (ac)	Suitable Parcels (#)	Suitable Area (ac)
SFPUC	22	15	7	13	89	16	88
Other City	320	43	44	40	228	147	218
SF Unified School District	50	36	39	35	55	46	55
State	82	2	2	2	18	74	18
Federal	4	0	1	0	0	1	0
Private	58,793	2,278	441	128	1,217	624	125
WESTSIDE	**59,271**	**2,374**	**534**	**218**	**1,607**	**908**	**503**

1. Only roofs greater than or equal to 1,000 sf (0.02 ac) were considered suitable for roof technologies.

3.3.3 Westside Incentive Programs

Using the Westside parcel data, the UWA team matched the incentive program analysis from the Bayside to develop Westside participation goals for the four proposed incentive programs.

- Sustainable Roof Grant Program: Targets non-SFPUC owners to retrofit their properties with a green or blue roof.
- Watershed Improvement Grant Program: Targets large-scale commercial, institutional, and multi-residential properties with greater than 0.5 acre of impervious cover for stormwater management retrofits.
- Residential Stormwater Grant Program: Provides incentives for single-family and two- to four-unit residential properties to implement stormwater management technologies such as downspout disconnection, pavement removal, and rain gardens.
- Stormwater Audit Resource Program: Provides technical assessments of properties to help property owners determine if there are stormwater retrofit opportunities and potential eligibility for incentives.

The incentive program eligibility, suitability, estimated feasibility, and participation are shown in Table 3.9.

Table 3.9: Westside Incentive Program Opportunities

PROGRAM	Eligibility	Suitability	Estimated Feasibility	Estimated Participation
Sustainable Roof Program Multiple incentives for green and blue roofs	All Land Use Types	Impervious area greater than 1600 SF	50% of Suitable	
Parcels [#]	59,240	470	235	99
Impervious Acres [ac]	2,358	156	78	46.5
Watershed Improvement Program Large subsidies for single time projects, institutions, commercial, multi-residential	Multi-Residential (5+ units), Commercial, Institutional, Industrial, Parking, Schools, Open Space	Impervious area greater than 0.5 acres	75% of Suitable	
Parcels [#]	10,566	139	104	36
Impervious Acres [ac]	1,127	464	348	54
Residential Stormwater Program Subsidy and technical services for residential stormwater management	Residential (SF, 2 unit, 3-4 unit)	Impervious area greater than 1000 SF	30% of Suitable	
Parcels [#]	54,879	54,686	16,406	212
Impervious Acres [ac]	3,021	2,570	771	9
Stormwater Audit Program Technical services for assessing stormwater management opportunities and incentive eligibility	All Land Use Types			

Maps illustrating the eligible, suitable, and sample participation for each program are shown in Figure 3.18, Figure 3.19, and Figure 3.20.

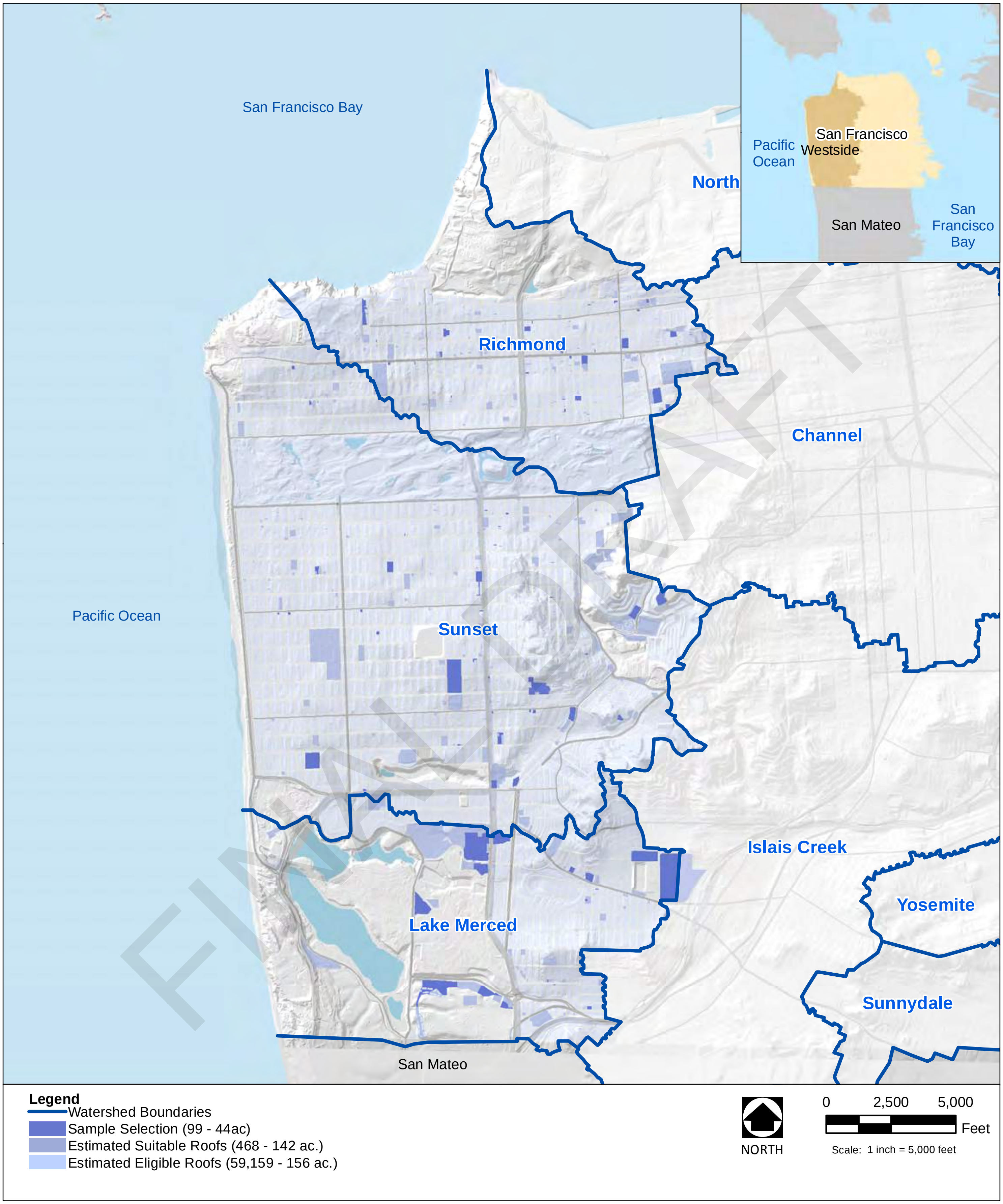


Figure 3.18 Sustainable Roof Program Estimated Participation

San Francisco Water Power Sewer
Services of the San Francisco Public Utilities Commission

San Francisco Public Utilities Commission Sewer System Improvement Program
Westside Drainage Basin Urban Watershed Opportunities
FINAL DRAFT Technical Memorandum (February 2015)

SSIP PMC
SEWER SYSTEM IMPROVEMENT PROGRAM

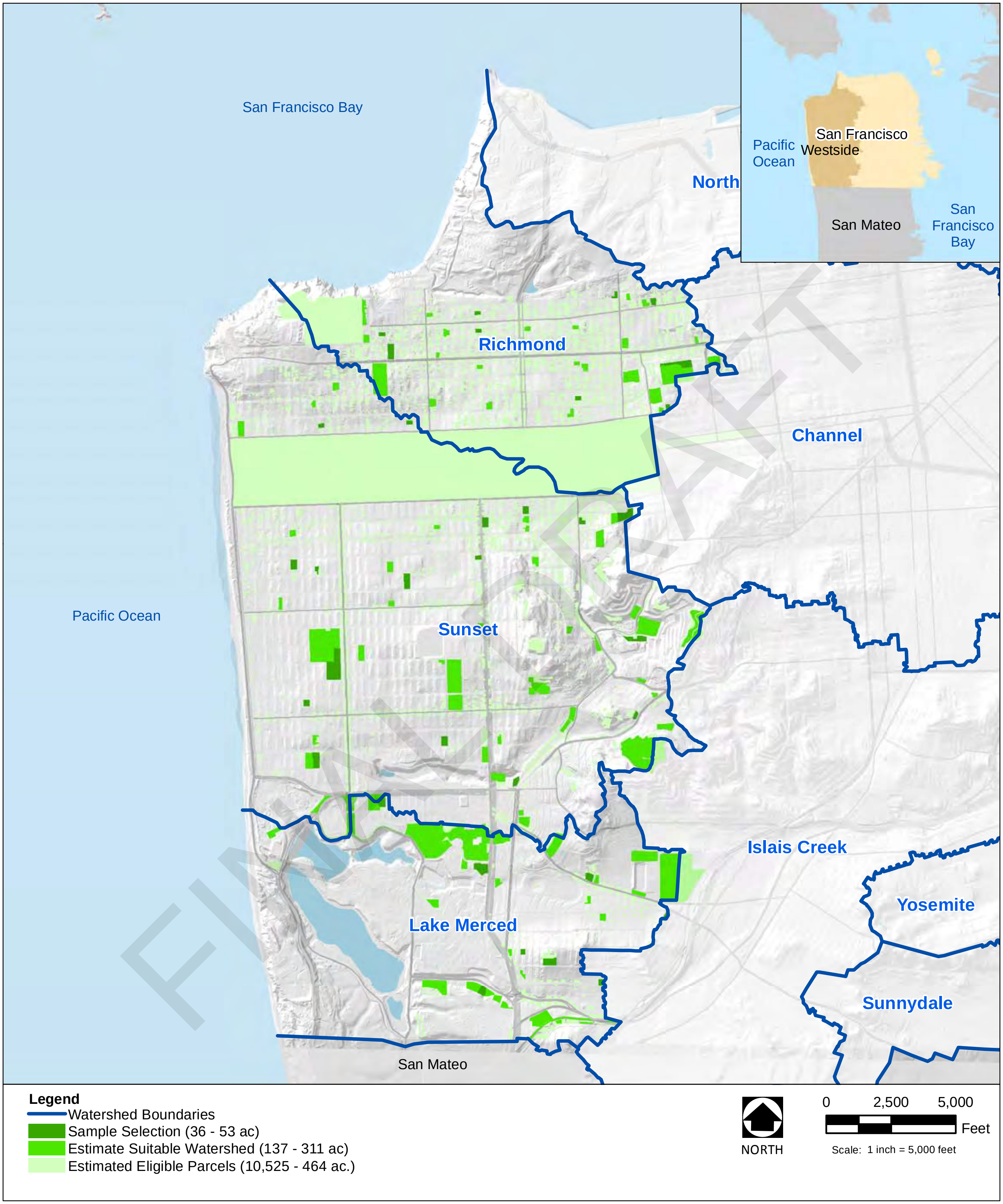


Figure 3.19 Watershed Improvement Grant Program Estimated Participation

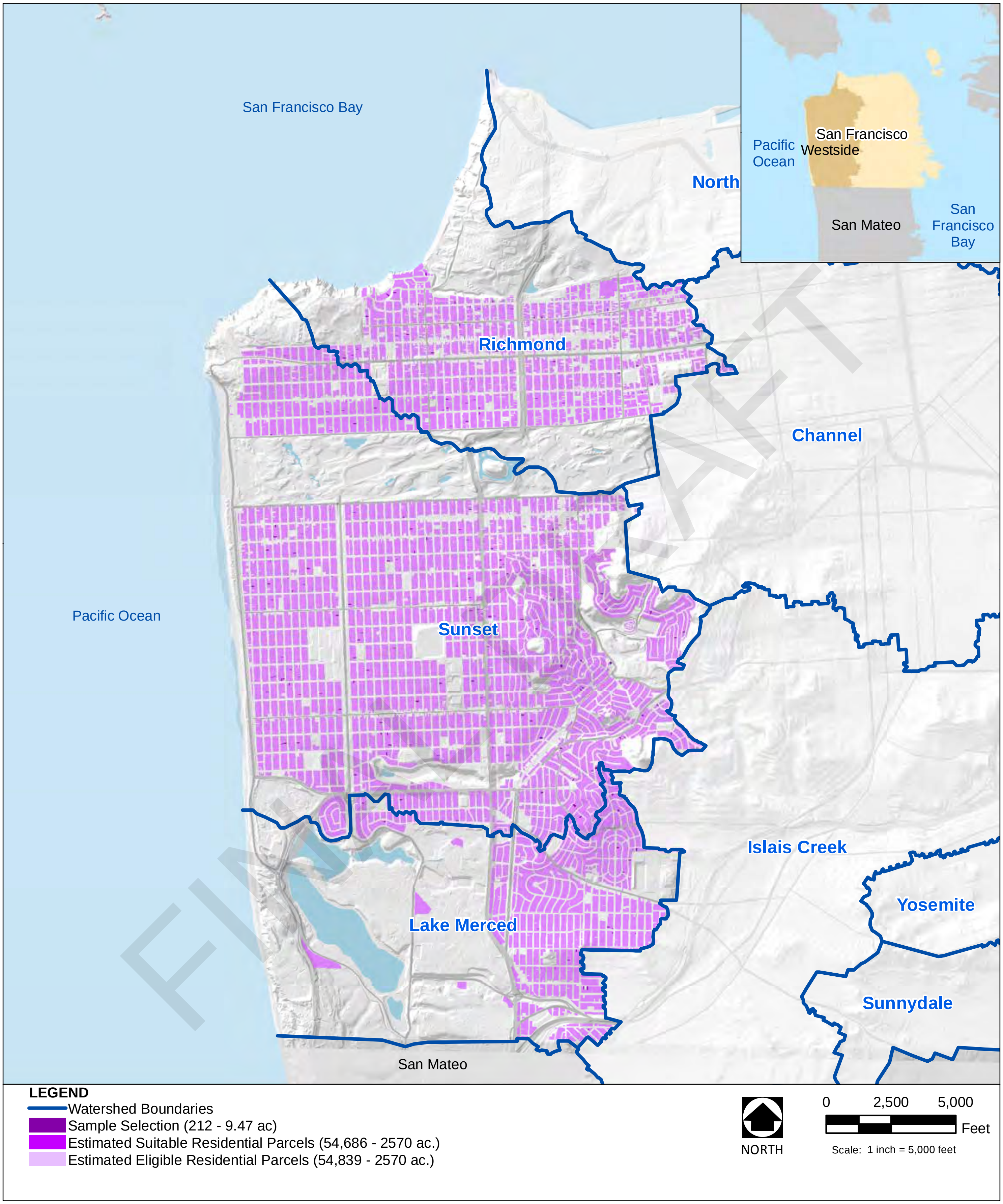


Figure 3.20 Residential Stormwater Program Estimated Participation

San Francisco Water Power Sewer
Services of the San Francisco Public Utilities Commission

San Francisco Public Utilities Commission Sewer System Improvement Program
Westside Drainage Basin Urban Watershed Opportunities
FINAL DRAFT Technical Memorandum (February 2015)

SSIP PMC
SEWER SYSTEM IMPROVEMENT PROGRAM

Incentive programs phasing includes a year-long pilot to test the programs and three 5-year implementation phases. During these phases, the number of projects and correlating performance increases as technical knowledge increases and interest grows. The Sustainable Roof Program has an average of 6 projects per year, the Watershed Improvement Program has an average of 2 per year, and the Residential Stormwater Program has an average of 13 projects per year.

Table 3.10: Westside Incentive Program Opportunities Phasing

PROGRAM	Pilot (2017)	Year 1-5 (2018-2022)	Year 6-10 (2023-2027)	Year 11-15 (2028-2032)	TOTAL	Avg/Yr (16)
Sustainable Roof Program		3/year	5/year	8/year		
Parcels [#]	3	16	32	48	99	6
Impervious Acres [ac]	1.5	7.5	15	22.5	46.5	3
Watershed Improvement Program		2/year	3/year	3/year		
Parcels [#]	1	7	14	14	36	2
Impervious Acres [ac]	2	10	21	21	54	3
Residential Stormwater Program		10/year	15/year	15/year		
Parcels [#]	7	56	74	74	212	13
Impervious Acres [ac]	0.3	2.2	3	3	8.5	1
Stormwater Audit Program		12/year	16/year	20/year		

Cost of Incentive Programs

One benefit of implementing projects through programmatic incentives is that the costs are shared between the utility and landowners. With incentive programs, the SFPUC would have responsibility for a portion of design and construction costs along with full responsibility for inspections and program administration. The property owner would be responsible for the majority of design and construction costs as well as all maintenance. Detailed cost estimates were developed to account for the design and construction costs, operations and maintenance for the estimated 30-year life of these projects, City inspections to ensure continued performance, and City staff to administer the programs. Table 3.11 summarizes the estimated implementation costs for the incentive programs on the Westside, and Table 3.12 shows the relative costs for implementing projects with equivalent performance through SFPUC capital projects or an incentive program approach.

Table 3.11: Westside Incentive Program Cost Summary

	PUC Program Cost	Acres Managed [ac]	Number of Projects
Sustainable Roof Program	$ 16,456,044	47	99
Watershed Improvement Program	$ 11,993,054	54	36
Residential Stormwater Program	$ 3,787,873	9	212
Stormwater Audit Program	$ 1,735,006		
TOTAL PUC Cost	$ 33,971,976	109	347
Average Cost Per Acre Managed	$ 311,670		
	PUC Average Annual Cost	$ 2,123,249	

Table 3.12: Cost Estimate Comparison: SFPUC Capital vs. Incentive Program

	PUC Program Contribution	PUC Capital	PUC Program	Acres Managed
Sustainable Roof Program		$ 82,804,075	$ 16,456,044	47
Capital Cost	30%	$ 75,998,261	$ 15,313,082	
O&M	0%	$ 6,805,814		
Inspections	100%		$ 237,600	
Program Staff	100%		$ 753,200	
Program Start Up	100%		$ 152,162	
Watershed Improvement Program		$ 68,174,972	$ 11,993,054	54
Capital Cost	30%	$ 56,925,149	$ 11,469,993	
O&M	0%	$ 11,249,823		
Inspections	100%		$ 86,400	
Program Staff	100%		$ 280,711	
Program Start Up	100%		$ 155,951	
Residential Stormwater Program		$ 9,115,752	$ 3,787,873	9
Capital Cost	30%	$ 8,355,635	$ 1,683,598	
O&M	0%	$ 760,117		
Inspections	100%		$ 339,200	
Program Staff	100%		$ 1,612,913	
Program Start Up	100%		$ 152,162	
Stormwater Audit Program			$ 1,735,006	
Program Staff	100%		$ 1,735,006	
TOTAL PUC Cost		$ 160,094,800	$ 33,971,976	109
Average Cost Per Acre Managed		$ 1,468,760	$ 311,670	
Percentage		100%	21%	

3.3.4 New Programmatic Opportunities for the Westside

The Westside has ideal infiltration characteristics overlying sandy soils that percolate into the Westside Groundwater Basin. SFPUC could consider programmatic collaborations with existing programs or new ones on the Westside to increase infiltration and groundwater recharge.

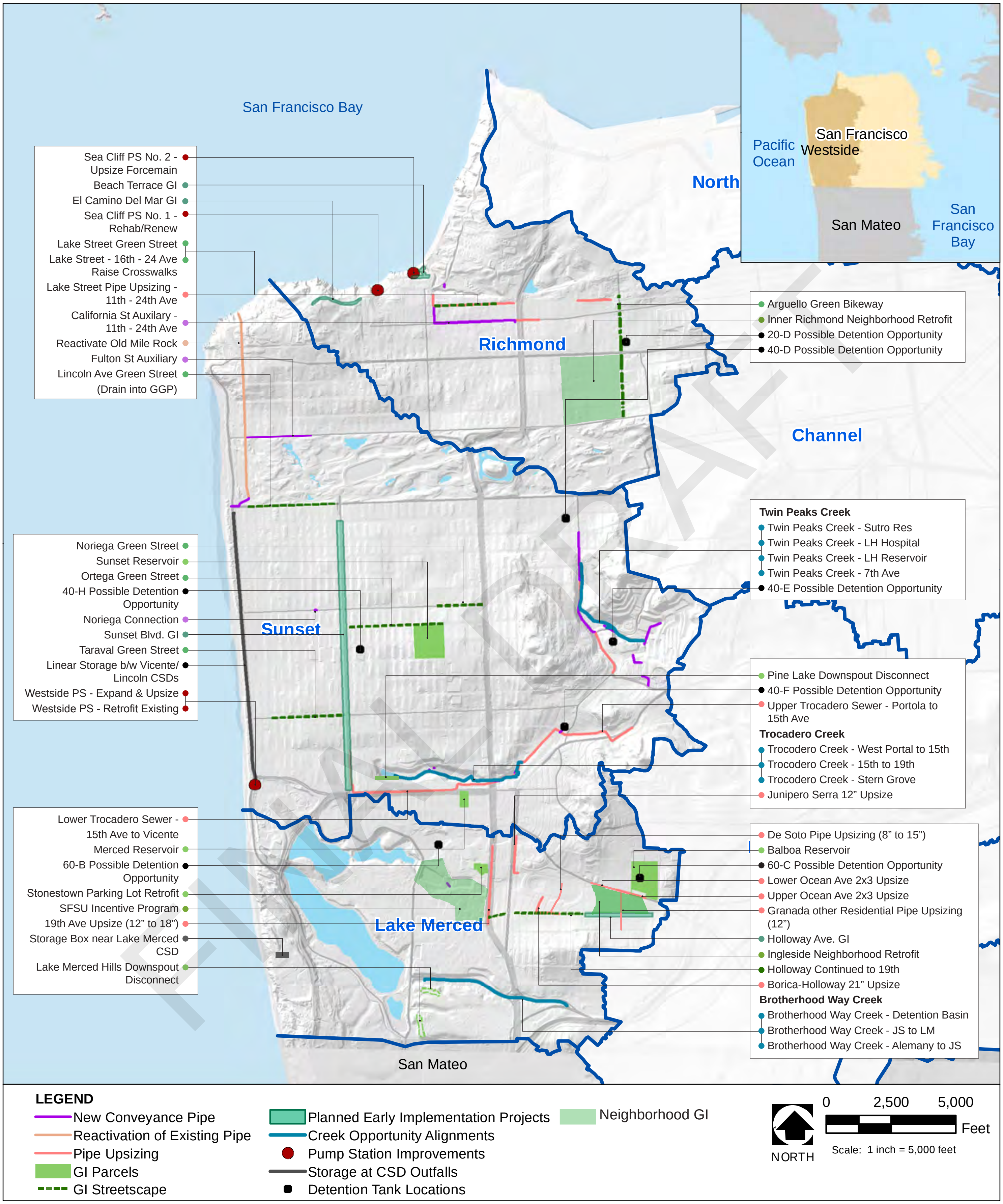
- Roadway Diets: Of the 388 miles of roadways on the Westside, more than 150 miles are classified as residential streets with wide sidewalks or wide right-of-ways per Section 2.6.1 of the Westside Drainage Basin Urban Watershed Characterization Technical Memorandum. A programmatic approach could be developed to reclaim this excess space for stormwater infiltration practices and neighborhood improvements.
- Permeable Streets: Friends of the Urban Forest's Sidewalk Landscaping program helps residents install sidewalk gardens to beautify, increase property values, and better manage stormwater. A programmatic collaboration with Friends of the Urban Forest could be developed to install improved standard sidewalk tree planting gardens designed to manage runoff from the adjacent street and sidewalk.
- Residential Stewards: Take advantage of the momentum on the Westside to increase permeability of residential properties, including Supervisor Katy Tang's Front Yard Ambassadors Program, and increase support for pavements removals, downspout disconnects, and other practices to increase infiltration.
- Stormwater as a Resource: Encourage groundwater recharge and non-potable reuse in collaboration with SFPUC Water. Support their Grant Assistance for Alternate Water Source Projects and work together to develop additional opportunities.

3.4 Policy and Business Practice Opportunities

The UWA policy and business practice opportunities are meant to enhance the performance and contribute to the resiliency of the Citywide Alternative. The UWA team identified policy issues relevant to improving function and performance of the collection system and surface drainage through staff interviews and data analysis. Manager interviews are ongoing to determine interest and priority among these ideas and to identify others that are important to the collection system function. Those opportunities that emerge as strong priorities should be considered for inclusion in future Strategic Business Plan policy work with SFPUC WWE staff leads to continue development and implementation of those opportunities.

3.5 Summary of Opportunities

The opportunities identified in the preceding subsections indicate both collection system needs and the suitability of opportunities at various locations. Based on the information presented in the previous subsections, the most promising Westside Opportunities to address collection system needs are presented in Figure 3.21 and Table 3.13.



San Francisco Water Power Sewer
Services of the San Francisco Public Utilities Commission

Figure 3.21 Westside Opportunities

San Francisco Public Utilities Commission Sewer System Improvement Program
Westside Drainage Basin Urban Watershed Opportunities
FINAL DRAFT Technical Memorandum (February 2015)

Table 3.13: Westside Opportunities Summary

Project Name						Location		Technology Type		H+H Performance (Qualitative/Opps)				Cost Synergies			Multi-Benefit Synergies					Additional Information	
Principal LOS Driver	LOS Challenge Area	Strategy Identifier	Concept Identifier	ID	Project Name	Major Watershed	Minor Watershed	Technology Type	Infiltration Category	In Primary Contributing Area to Sensitive Area CSDs	Reduces Flows to Parcels Id'd as High Risk	Reduces Flows to Id'd Flood Prone Areas	Westside Aquifer Recharge or Reduced Potable Demand	Owner	Minimal Maintenance and Utility Conflicts	Interagency Synergies (Funded Planned Projects)	CSAMP (Synergy with R&R of High Risk Asset)	Reduce Odors/Improves O&M	Interagency Synergies (Non-Funded)	EJ/DC	Public Feedback	Site Visit Completed?	Project Description
F	HR	CD	1a	CD-1a	Twin Peaks Creek - Sutro Res	40	D	CD		x	x	x	x	PUC			VH MAJ				WG NC	x	Existing 42" concrete storm sewer, starting from above Sutro Reservoir and under the reservoir, to be connected to existing creek north of Laguna Honda Hospital
F	HR	CD	1b	CD-1b	Twin Peaks Creek - Laguna Honda Hospital	40	D	CD		x	x	x	x	Health	SD		-				WG NC	x	Existing creek north of Laguna Honda Hospital. To be connected with existing storm sewer to the north, and new project to the south
F	HR	CD	1c	CD-1c	Twin Peaks Creek - Laguna Honda Reservoir	40	D	CD		x	x	x	x	**PUC**	OS		VH MAJ				WG NC	x	Construction of diversion structure on an existing storm drain connecting existing LHH creek to Laguna Honda Reservoir to downstream end of reservoir
F	HR	CD	1d	CD-1d	Twin Peaks Creek - 7th Ave	40	D	CD		x	x	x	x	SFUSD/ PUC			VH MAJ		GC		WG NC	x	Downstream end of LH reservoir along 7th Ave (green connection street or through PUC property where there is an existing low marshy area), then through White Crane Springs Community Garden, city owned empty lot (Christmas tree lot) and Garden for the Environment.
R	OB	CD	2a	CD-2a	Brotherhood Way Creek - Lake Merced Detention Basin	60	D	DB		x		x	x	**PUC**	OS		-		GC		WG	x	Existing 30 ft deep area with ex 48" culvert to Lake Merced
R	OB	CD	2b	CD-2b	Brotherhood Way Creek - Junipero Serra to Lake Merced	60	D	CD		x		x	x	PUC DPW	BD	IPIC	-		GC		WG	x	Portion within PUC property along S side of street, captures Junipero Serra DMA
R	OB	CD	2c	CD-2c	Brotherhood Way Creek - Alemany to Junipero Serra	60	D	CD		x		x	x	DPW		IPIC	-		GC		WG	x	Portion within ROW on S side of street, could be extended to capture I 280 DMA
F	W	CD	3a	CD-3a	Trocadero Creek - West Portal to 15th	40	F	CD		x	x	x	x	DPW	-		VH MIN		SS		WG	x	Portion captures base flow from MUNI tunnel drain, could be a storm drain or open channel
F	W	CD	3b	CD-3b	Trocadero Creek - 15th to 19th	40	F	CD		x	x	x	x	Private /Ease	-						WG	x	Portion to link base flow from MUNI tunnel to Pine Lake, and also provide overland flow flood relief from 15th Ave. Route could be on South side of Condos instead, to minimize piped distance
F	W	CD	3d	CD-3d	Trocadero Creek - Stern Grove	40	F	CD		x	x	x	x	RPD	OS		VH MIN		GC		WG	x	Portion with existing grass open channel and dirt open channel, small culverts under footpaths may need to be replaced with larger size
F	IN	DT	1	DT-1	60- C Detention (Balboa Reservoir)	60	C	DT	N/A	x	x	x		**PUC**	PL				ROSE		WG	x	Combined sewage detention tank. Site likely to be sold by PUC for development, however potential to incorporate opportunity into any future project. Needs additional feasibility analysis in Alts phase
R	OB	DT	2	DT-2	60-B Detention (Lowell High School)	60	B	DT	N/A	x				SFUSD						DC			Suitable parcel in a good hydraulic location. However, CSS detention may be preferred as linear in the ROW. Parcel may be preferred for other GI technologies. To be analyzed further during alts development.
F	L	DT	3	DT-3	20-D Detention (Roosevelt Middle School)	20	D	DT	N/A		x	x		SFUSD			-	-	-	-	SU		Suitable parcel in a good hydraulic location. However, CSS detention may be preferred as linear in the ROW. Parcel may be preferred for other GI technologies. To be analyzed further during alts development.
F	HR	DT	4	DT-4	40-H Detention (Stevenson Elementary School)	40	H	DT	N/A	x	x	x		SFUSD							SU		Suitable parcel in a good hydraulic location. However, CSS detention may be preferred as linear in the ROW. Parcel may be preferred for other GI technologies. To be analyzed further during alts development.
F	W	DT	5	DT-5	40-F Detention (West Portal Playground)	40	F	DT	N/A	x	x	x		RPD									Suitable parcel in a good hydraulic location. However, CSS detention may be preferred as linear in the ROW. Parcel may be preferred for other GI technologies. To be analyzed further during alts development.
F	HR	DT	6	DT-6	40-E Detention (Laguna Honda Hospital Parking Lot)	40	E	DT	N/A	x	x	x		DPH									Suitable parcel in a good hydraulic location. However, CSS detention may be preferred as linear in the ROW. Parcel may be preferred for other GI technologies. To be analyzed further during alts development.
F	HR	DT	7	DT-7	40-D Detention (Irving/9th Off-Street Parking)	40	D	DT	N/A	x	x	x		City?					ROSE				Suitable parcel in a good hydraulic location. However, CSS detention may be preferred as linear in the ROW. Parcel may be preferred for other GI technologies. To be analyzed further during alts development.
R	OB	GI	1	GI-1	Sunset Reservoir GI	40	C	IT	A	x	x		x	**PUC**					ROSE			x	Mange stormwater from reservoirs that flows out at Pacheco and 28th. Steep slopes are adjacent to outlet, best opportunities are to connect to Ortega concept or a new concept on Pacheco. (See site visit write-up for more detail.)
R	OB	GI	2	GI-2	Merced Reservoir GI	40	N	IT/GS	A	x			x	**PUC**							SU	x	Manage runoff from reservoir on overly-wide, underused Ocean Ave on south edge of site. (See site visit write-up for more detail.)
F	IN	GI	3	GI-3	Balboa Reservoir GI	60	C	RWH/DT	A/B	x	x	x	x	**PUC**	PL	IPIC adjacent					WG	x	PUC planning to develop concept and sell land to developer. Consider Metered Detention RWH design (either save piece of land, easement, or public/private partnership). Potential to capture runoff from adjacent roof and parking lot. (Also see Balboa Rsvr Detention Tank.)

Table 3.13: Westside Opportunities Summary

F	L	GI	4	GI-4	Arguello Green Bikeway	20	D	GS	A - D		x	x		DPW			H MAJ		GC SS PBS	DC	WG / SU		Green street project concept. Needs further analysis and coordination with analysis done for EIP NAR.
F	L	GI	5	GI-5	Inner Richmond Neighborhood Retrofit	20	C	PR	A		x	x		--			VH MAJ		ROSE		SU		Target streets for GI and pipe improvements where high risk CSAMP pipes exist in neighborhood area bounded by Geary to Fulton, Funston to Arguello.
F	IN	GI	6	GI-6	Ingleside Neighborhood Retrofit	60	C	PR		x	x	x	x	DPW			VH MIN		ROSE	DC	WG		Target suitable streets with majority of high risk CSAMP pipes in neighborhood area bounded by Ocean to Holloway, Ashton to Harold. (Note: N/S streets may also be opportunity to connect Holloway to CCSF or Balboa via GI).
F	IN	GI	7	GI-7	Holloway Green Street Extension - Continued to 19th	60	C	GS		x		x	x	DPW		IPIC	H MIN		GC SS PBS		SU/ WG		Create "College Bikeway" - SFSU/Parkmerced to City College. Constraints: narrow road, not identified as "most suitable" for GI.
R	OB	GI	8	GI-8	Pine Lake Downspout Disconnect	40	G	DD		x			x	Private			-						Downspout disconnection to known problem area.
R	OB	GI	9	GI-9	Stonestown Green Parking Lot Retrofit	60	B,C	PP		x			x	Private	PL		-			DC	WG		Target extremely large impervious area for runoff reduction.
F	HR	GI	10	GI-10	Noriega Green Street	40	C	GS	A	x	x	x	x	DPW			VH MIN		IN SB SS	-	SU		Matches SB stretch. One block from PUC reservoir. May help address flooding high risk parcel there. Noriega flood prone area is 22nd to 33rd, then again at 40th
R	OB	GI	10	GI-10	SFSU Incentive Program	60	B	PR		x		x	x	State			-			DC	WG		Target large impervious areas with single ownership.
R	OB	GI	11	GI-11	Ortega Green Street	40	H,C	GS	A	x	x		x	DPW			VH MIN		GC ROSE	DC	WG		Possible infiltration gallery site for Sunset Reservoir runoff. One block south of Noriega Invest in Neighborhoods/Sunset Blueprint stretch.
R	OB	GI	12	GI-12	Taraval Green Street	40	J	GS	A	x			x	DPW			H MIN		IN SB	-	SU		Commercial corridor, matches area identified in Sunset Blueprint.
R	OB	GI	13	GI-13	Lincoln Ave Green Street (drain into Golden Gate Park)	40	C, K	BR		x			x	DPW RPD			x	x	SB ROSE	-			SB advocated new entry ways into GGP. Concept would manage Lincoln runoff in GGP, create more of an entry into park in outer avenues.
F	L	GI	14	GI-14	Lake Street Green Street	20	B,C	GS	A		x	x		DPW			VH MAJ		GC PBS	DC	WG		Concept in combination with brick sewer replacement and elevated crosswalk project, reduce overflow potential to Lobos Creek
R	SC	GI	15	GI-15	Baker Beach EIP (El Camino Del Mar Green Street)	20	A	GS	A	x		x		DPW			H MIN		PBS		x		Baker Beach EIP
R	SC	GI	16	GI-16	Baker Beach EIP (Beach Terrace Green Street)	20	A	GS	A	x				DPW GGNRA							x		Baker Beach EIP
R	OB	GI	17	GI-17	Lake Merced Hills Downspout Disconnect	60	D	DD		x			x	Private	OS		-					x	Based on DPW EHY site visits, there may be opportunity to disconnect these areas to existing storm drain system on neighboring gold course.
R	OB	Op	1	Op-1	Reactivate Old Mile Rock	40	A, B, K	Tunnel	N/A	x	x	x		Multipl e									Past concept included overflow connections from Fulton and Lincoln Sewers for LOS Storm to Old Mile Rock
F	L	Op	2	Op-2	Lake Street Crosswalks - 16th - 24 Ave Raise Crosswalks	20	B	Grading	N/A		x	x		DPW			VH MAJ		GC PBS TC	DC	WG		Concept in combination with Lake Street Green Street and brick sewer replacement, reduce overflow potential to Lobos Creek
F	L	Pi	1	Pi-1	Lake Street Pipe Upsizing - 2nd to 6th	20	D	Pipe	N/A		x	x		DPW			-			DC			Upsize Lake Street to alleviate surcharging of high risk sewer. Post this recommendation, sewer collapsed in this location.
F	L	Pi	2	Pi-2	Lake Street Pipe Upsizing - 11th to 24th Ave	20	B, C	Pipe	N/A		x	x		DPW			VH MAJ			DC	WG		Upsize high risk brick sewer, coordinate with raised crosswalk project to prevent surface flows toward Lobos Creek
F	L	Pi	3	Pi-3	California St Auxiliary - 11th to 24th Ave	20	B, C	Pipe	N/A			x		DPW			-			DC	WG		Proposed auxiliary sewer to alleviate Lake Street flooding and potentially slow flows into head end of RTT (From SSIP 2010 LOS)
F	W	Pi	4	Pi-4	Upper Trocadero Sewer Upsizing - Portola to 15th Ave	40	F	Pipe	N/A		x	x		DPW			VH MIN						Reduce excess stormwater to 15th/Wawona, overlaps with green connections, synergy with CSAMP high risk minor sewer.
F	W	Pi	5	Pi-5	Lower Trocadero Sewer Upsizing -15th Ave to Vicente	40	G	Pipe	N/A		x	x		DPW			H MIN						Address flooding by provide add'l capacity from 15th/Wawona to downstream trunk sewer.
F	IN	Pi	6	Pi-6	19th Ave Pipe Upsizing (12" to 18")	60	B	Pipe	N/A			x		DPW									Address undersized sewers in flood prone area.
F	IN	Pi	7	Pi-7	Junipero Serra Pipe Upsizing (12")	60	C	Pipe	N/A			x		DPW									Upsize to alleviate surcharging of high risk sewer at Mercy High School.
F	IN	Pi	8	Pi-8	Upper Ocean Ave Pipe Upsizing (2x3)	60	C	Pipe	N/A		x	x		DPW						DC			Upsize Ocean Ave trunk sewer in flood prone area. Synergy with CSAMP high risk pipes and in disadvantaged community.
F	IN	Pi	9	Pi-9	Lower Ocean Ave Pipe Upsizing (2x3)	60	C	Pipe	N/A		x	x		DPW						DC			Extend Ocean Ave improvements to capture CSAMP major VH/H risk sewers
F	IN	Pi	10	Pi-10	Granada other Residential Pipe Upsizing (12")	60	C	Pipe	N/A		x	x		DPW						DC			Upsizing of smaller sewers to the south feeding Ocean Ave. Needs more evaluation of specific pipe segments in alts development.
F	IN	Pi	11	Pi-11	De Soto Pipe Upsizing (8" to 15")	60	C	Pipe	N/A			x		DPW									Upsize local sewers that are causing excess stormwater to collect in low point of Racetrack neighborhood.
F	IN	Pi	12	Pi-12	Borica-Holloway Pipe Upsizing (21")	60	C	Pipe	N/A			x		DPW									Upsize local sewers that are causing excess stormwater to collect in low point of Racetrack neighborhood. Potential synergy with green connections and opportunity to extend EIP along Holloway.

Table 3.13: Westside Opportunities Summary

F	HR	Pi	13	Pi-13	Fulton St Auxiliary	40	B	Pipe	N/A		**x**	**x**		DPW			**x**						Auxiliary sewer to address flooding near Fulton (Proposed in 2010 SSIP). Needs re-evaluation with respect to Old Richmond Tunnel and OMR recommendations and priority of reduction CSDs at Ocean Beach.
F	HR	Pi	14	Pi-14	Noriega Connection	40	J, H	Pipe	N/A		**x**	**x**		DPW									Finish crossover connection that was never completed
R	SC	PS	1	PS-1	Sea Cliff PS No. 1 - Rehab/Renew	20	A	PS	N/A	**x**				**PUC**	OS		**x**						Pump Station rehab/renewal
R	SC	PS	2	PS-2	Sea Cliff PS No. 2 - Upsize Forcemain	20	A	FM	N/A	**x**				**PUC**			**x**						Upsize forcemain for pump station
R	OB	PS	3	PS-3	Westside PS - Expand & Upsize	40	L	PS	N/A	**x**				**PUC**	OS								Expand or upsize pump station to move more flows
R	OB	PS	4	PS-4	Westside PS - Retrofit Existing	40	L	PS	N/A	**x**				**PUC**	OS		**x**	**x**					Retrofit existing pumpstation
R	OB	TS	1	TS-1	Storage Box near Lake Merced CSD	60	A	Tank	N/A	**x**				GGNRA	OS								Add new storage near CSD outfall to maximize effectiveness of using storage to reduce CSDs.
R	OB	TS	2	TS-2	Linear Storage b/w Vicente/Lincoln CSDs	40	K, L	Linear Storage	N/A	**x**				GGNRA DPW	OS								Add storage adjacent to Westside T/S in attempt to maximize efficiency of using storage to reduce CSDs.

Legend:

LOS Driver
R Regulatory
F Flooding

Challenge Area
OB Ocean Beach CSDs
SC Sea Cliff CSDs
L Lake Street
W Wawona and 15th
IN Ingleside and Ocean Ave
HR Other Areas w/ High Risk Flooding Parcels

Strategies
Pi Increased Conveyance/Pipe Upsizing
TS Large Scale CSS Storage
DT U/S Smaller-Scale CSS Storage
Op Reroute Flows/Operational changes
GI Runoff Reduction/Green Infrastructure
CD Creek Daylighting
PS Pump Station Upsizing (New or Retrofit)

GI Technology Type
BR Bioretention
PP Permeable Pavement
GS Green Street
RWH Rainwater Harvesting
IT Infiltration Trench or Gallery
DB Detention Basin
WT Wetland
CD Creek Daylighting
PR Programmatic GI
DD Downspout Disconnect

Owner
PUC SFPUC
RPD Rec and Park
DPH SF DPH
Ease SFPUC Easement

Interagency
GC Green Connections
IN Invest in Neighborhoods
SB Sunset Blueprint
MTA MTA bulbout
HIC High Injury Corridor
SS Streetscape Street
PBS Priority Bike Segment
TC Traffic Calming
IPIC Interagency Plan Implementa
IF Interagency Feedback

Public Feedback
SU SSIP Survey
WG SSIP Watershed Game
NC Nature in the City

CSAMP
H High Risk
VH Very High Risk
MAJ Major Pipe
MIN Minor Pipe

Minimal Conflicts
PL Parking Lot
SD Special District (Industrial, etc.)
BD Boulevard/Low Density Street
OS Open Space

The principal opportunities identified are discussed below.

3.5.1 Richmond Watershed

The Baker Beach EIP and Sea Cliff Pump Station No. 2 force main improvements are promising opportunities to reduce CSDs to Baker Beach and China Beach. Latest modeling results using the CCSF H&H model (EHY13_v211) show zero CSD events during the typical year after these improvements.

Replacing the aging brick sewers along Lake Street provides an opportunity to address pipes with very high-risk CSAMP scores while also addressing localized flooding. Street regrading on Lake Street to prevent surface flows toward Lobos Creek could be coupled with green street improvements along this proposed Green Connections street. The contributing area to Lake Street consists of several wide, flat streets suitable for GI with underlying sandy soils conducive to infiltration. Some opportunities in this contributing area include implementing GI within the disadvantage community area of Inner Richmond either along the Green Connections street of Arguello or as part of a neighborhood-wide retrofit targeting the numerous GI suitable streets with high-risk CSAMP pipes.

3.5.2 Sunset Watershed

Early analyses indicate that upsizing the Westside Pump Station would be the lowest cost strategy to reduce Ocean Beach CSDs, at about $1 to $1.50 per gallon of CSD reduction per year compared to $2 to $4 per gallon using runoff reduction or detention options. Further evaluation during the Alternatives Phase and as part of the parallel CSD cost-benefit analysis will refine these values. Moreover, use of SWOO capacity for CSD reduction rather than retaining for uncertain future regulatory challenges needs to be assessed further. Reactivation of the Old Mile Rock Tunnel to slow and redirect flows away from the Westside T/S Box is an option that has been proposed previously and needs to be further investigated during the Alternatives Phase.

Preliminary analyses indicate that infiltration-based GI is a more expensive CSD reduction solution than pump station upgrades, but may provide additional benefits such as recharge to Westside Groundwater Basin, reduced flooding risk, connection of green spaces, and habitat/community enhancement. Key infiltration opportunities include managing runoff from SFPUC's Sunset and Merced Manor reservoirs. The Laguna Honda/Twin Peaks creek daylighting provides an opportunity to reduce CSDs and downstream flooding while addressing aging infrastructure and supporting a proposed plan to connect several green spaces and community gardens along this corridor. The creek path also uses existing creek and detention features on SFPUC property and along SFPUC rights-of-way.

The 15th Avenue and Wawona flood-prone area is characterized by runoff from steep streets collecting in a large bowl intersection that blocks the natural flow path of excess stormwater. Opportunities include providing a pathway for the overland flow to continue downstream past 15th Avenue via a combination of surface channels and piped sections along the historical creek path. By taking advantage of existing creek and detention features within SFPUC right-of-way and San Francisco Recreation and Park Department property, this opportunity could contribute to adding flows to Pine Lake and the Westside Groundwater Basin. The steeper, more residential upstream portion of the creek path—from the West Portal Muni Station to the 15th Ave/Wawona intersection— represents the less feasible segment of the path to daylight. However, there may be opportunities along this segment to add DMA by capturing runoff from the Muni tunnel stormwater drain, the Muni station itself, West Portal Elementary School, or West Portal Playground.

3.5.3 Lake Merced

SFPUC's plan to redevelop the former site of the Balboa Reservoir may provide an opportunity for rainwater harvesting with detention or another larger-scale stormwater management tool to help reduce Ocean Beach CSDs and downstream flooding along Ocean Avenue. Large parcels with extensive hardscape, such as Lowell High School and Stonestown Mall, provide opportunities to reduce runoff through infiltration in settings with fewer space constraints than streetscape right-of-way. The adjacent San Francisco State University has implemented numerous green infrastructure projects, and there may be potential to build on these efforts, separating more campus areas from the CSS. The SFPUC right-of-way adjacent to Brotherhood Way and existing detention basin on SFPUC property at the downstream end, provide an opportunity for daylighting along this historical creek path.

Opportunities to address Ingleside flooding include runoff reduction at the Balboa Reservoir site noted earlier, as well as pipe upsizing improvements along Ocean Avenue, throughout the Ingleside neighborhood, and down to 19^{th} Avenue. Improvements should also consider necessary means to mitigate the transient pressures that have caused safety and flooding challenges from the head-end of the Parkmerced Tunnel to the Lake Merced three-compartment sewer.

3.5.4 Programs and Policies

The Westside Drainage Basin is a good candidate for programmatic and policy-led stormwater initiatives due to its conducive physical characteristics (e.g., lower density, wide streets, flat terrain, and sandy soils) and existing momentum from neighborhood greening efforts (e.g., Front-Yard Ambassadors, Sunset Blueprint, Friends of the Urban Forest sidewalk landscaping, Nature in the City San Miguel Bioregional Park). Using the Westside parcel data, the UWA team matched the incentive program analysis from the Bayside to develop Westside participation goals for the four proposed incentive programs.

- Sustainable Roof Grant Program: Targets non-SFPUC owners to retrofit their properties with a green or blue roof.
- Watershed Improvement Grant Program: Targets large-scale commercial, institutional, and multi-residential properties with greater than 0.5 acre of impervious cover for stormwater management retrofits.
- Residential Stormwater Grant Program: Provides incentives for single-family and two- to four-unit residential properties to implement stormwater management technologies like downspout disconnection, pavement removal and rain gardens.
- Stormwater Audit Resource Program: Provides technical assessments of properties to help property owners determine if there are stormwater retrofit opportunities and potential eligibility for incentives.

Based on Westside characteristics, UWA identified additional programmatic opportunities for the SFPUC to consider that would increase infiltration and groundwater recharge. The additional programs (or collaborations with existing programs) include the following:

- Roadway Diets: Of the 388 miles of roadways on the Westside, more than 150 miles are classified as residential streets with wide sidewalks or wide right-of-ways per Section 2.6.1 of the Westside Drainage Basin Urban Watershed Characterization Technical Memorandum. A programmatic approach could be developed to reclaim this excess space for stormwater infiltration practices and neighborhood improvements.
- Permeable Streets: Friends of the Urban Forest's Sidewalk Landscaping program helps residents install sidewalk gardens to beautify, increase property values and better manage stormwater. A programmatic collaboration with Friends of the Urban Forest could be developed to install standard sidewalk tree planting gardens designed to manage runoff from the adjacent street and sidewalk. In addition, the permeable pavement standards adopted by the City could be applied within parking lanes as part of a more widespread interagency pilot project.
- Residential Stewards: Take advantage of the momentum on the Westside to increase permeability of residential properties, including Supervisor Katy Tang's Front Yard Ambassadors Program, and increase support for pavements removals, downspout disconnects, and other practices to increase infiltration.
- Stormwater as a Resource: Encourage groundwater recharge and non-potable reuse in collaboration with SFPUC Water. Support their Grant Assistance for Alternate Water Source Projects and work together to develop additional opportunities.

The specific technologies to implement at GI opportunity locations (capital or programmatic) will be investigated further during alternatives development. Technologies that are not specifically discussed within the strategies defined in Appendix A, but which warrant additional consideration during alternatives development, include sub-street infiltration galleries and modified tree wells. Small-scale sub-street infiltration is being demonstrated as part of the Baker Beach EIP. However, larger-scale systems may prove even more cost effective, and there are opportunities on the Westside to test this (e.g., as a method to capture and infiltrate runoff from Sunset Reservoir). In regards to modified tree wells, SFPUC has been developing a policy for the last couple of years related to using trees as a stormwater best management practice. There are pros and cons to using trees as a stormwater management tool, and, relative to Bayside, the Westside provides a better opportunity to pilot test different options in support of formulating policy recommendations.

4.0 NEXT STEPS

With the development of the opportunities presented in Section 3, the UWA team has created the component parts for assembling watershed alternatives. The UWA team will evaluate the alternatives based on their ability to achieve LOS, and the results of that analysis will inform the final recommendations of the UWA process. This subsection describes the remaining steps that the UWA team will perform to develop those alternatives, evaluate them, produce a recommended alternative, and ultimately prioritize groups of project concepts within the recommended alternative for implementation.

4.1 Project Concept Development

As the first step of the Alternatives Phase, the UWA team will define opportunities in greater detail and develop them into project concepts (feasible opportunities with defined locations, technologies, cost, and benefits) that work with different watershed alternatives. The UWA team will design alternatives to meet LOS in each watershed, and project concepts will be sized to achieve the required performance. The refinement of project concepts includes specific quantification of hydraulic performance for excess flow and CSD criteria as appropriate.

After project concepts are more clearly defined, the UWA team will then evaluate the cost-effectiveness of each project concept, which will influence the selection of projects for inclusion in various alternatives.

4.2 Alternatives Development

Alternatives development will be an iterative process based on the ability of alternatives to meet LOS. Different alternatives will highlight and contrast various ways of solving the same watershed needs. The UWA team intends to workshop with SFPUC to develop several types of alternatives that will adequately represent the full spectrum of reasonable LOS solutions.

4.3 Alternatives Evaluation

The UWA team will evaluate watershed alternatives for performance and verify that each given alternative will indeed satisfy LOS needs. Should an alternative fail to do so, the UWA team will refine that alternative by either adjusting the details of its constituent project concepts or adding/swapping project concepts until the alternative can achieve the performance required. Determination of whether an alternative meets LOS includes qualitative review, hydraulic modeling, and the application of the risk analysis developed specifically for the UWA.

After an alternative has met all LOS, it will be evaluated for its TBL performance. The TBL indicates performance of an alternative with respect to social, environmental, and economic benefits.

4.3.1 Qualitative Review

Alternatives will be reviewed qualitatively for all nonhydraulic and nonquantitative LOS. This includes the requirements for reliability and redundancy, provision of community benefits, and adherence to sea level rise design consideration for new facilities. This review ensures that every alternative includes projects to meet needs that do not have quantitative targets and principally involves close coordination with the lead entities for these LOS, such as the Collection System Reliability Program, climate change team, and community benefits team.

4.3.2 CSD Performance Evaluation

Because the system is currently in compliance, there are no defined CSD reduction targets on the Westside. However, as part of SFPUC Commission recommendations, the UWA team will contribute to development of a CSD reduction cost-benefit analysis to assist the SFPUC in evaluating the feasibility of further reducing CSDs to public beaches on the Westside. UWA's efforts will focus on establishing the cost of using various technologies to reduce the volume and frequency of CSDs at Westside outfalls but will not include project recommendations. Project recommendations and assessment of CSD reduction feasibility must weigh project costs against water quality benefits. Water quality studies (conducted outside of UWA) are still ongoing and pending. Moreover, the cost-benefit analysis must also weigh the trade-offs of using SWOO capacity for Westside CSD reduction rather than retaining the capacity to address different wet-weather regulatory challenges that may arise in the future. UWA will provide technical input as requested by SFPUC to inform this discussion but will not make project recommendations regarding CSD reduction until SFPUC has weighed all pertinent information and provided direction to UWA on the CSD LOS.

Additional benefits that might accrue in association with CSD reduction options evaluated by UWA will be quantified and noted in the summarized results. For example, it may be noted that green and grey watershed CSD projects may have some benefits related to flood reduction, community enhancement, groundwater recharge, or habitat enhancement. These benefits will not be aggregated into a single score or ranking because the total cost-benefit of such an option is dependent on the water quality and systemwide wet weather performance considerations noted above.

4.3.3 Flooding Performance Evaluation

The UWA team will assemble the identified projects per alternative in the CCSF H&H model and perform analysis for the LOS storm to determine performance of the alternative for excess stormwater considerations. H&H model output includes 2D surface flow that the UWA team uses to evaluate compliance with LOS related to excess stormwater management. As described in the Westside Characterization Technical Memorandum, the UWA team performed risk analyses to assess the potential for risk of both property damage and personal injury during the LOS storm based on factors such as land use, depth of flooding, and flow velocity on the surface. The UWA team's goal is to remove all instances of high and very high risk during the LOS storm in the high priority flooding areas. A long-term scenario may be also be evaluated that removes all instances of high and very high risk across the entire Westside. Every alternative will be required to meet this same performance requirement. Alternatives that do not will be reconfigured and reevaluated.

The analysis will include sensitivity testing and adherence with model starting conditions and assumptions confirmed by SFPUC management on March 5, 2014. Direction provided by management includes the following:

- The SSIP LOS Storm is 1.3 inches in 3 hours, historically known as the 5-year, 3-hour storm.
- Hydraulic model simulations of this storm will use transport/storage structures at dry-weather flows.
- Sensitivity analyses will be conducted (particularly at locations of known flooding) under a range of potential operating/hydraulic conditions that may occur coincident with the LOS storm.
- These conditions may include tidal elevation, rainfall patterns, antecedent system conditions such as back-to-back storms, or other conditions that lead to box full conditions.
- The intent is to cost-effectively maximize the resilience of the proposed projects to potential system conditions that may be coincident with the LOS storm.

4.3.4 Triple Bottom Line Evaluation

TBL is a method of evaluation that analyzes the social, environmental, and financial costs and benefits of proposed projects or alternatives. It provides a quantitative and qualitative means to evaluate various benefits that the SFPUC has determined are integral to its planning approach. The TBL analysis will be applied to each watershed alternative after it has been verified that an alternative meets all LOS. All benefits evaluated through TBL have been reviewed and vetted by the SFPUC and SSIP PMC to ensure that they capture critical decision points for the Commission to evaluate projects and alternatives. The Westside Alternatives Technical Memorandum will provide an accounting of TBL evaluation for each alternative.

During the Alternatives Phase, the UWA team will present the hydraulic performance and cost for each alternative as well as the extent to which that alternative is consistent with public feedback, which will be shown through TBL analysis.

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APPENDICES

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APPENDIX A

OPPORTUNITIES METHODOLOGY

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APPENDIX A: OPPORTUNITIES METHODOLOGY

Methods and Rationale for Identifying Opportunities

This subsection outlines the methods and rationale for identifying a range of opportunities (i.e., potential operational improvements, capital projects, programs and policies) to resolve known collection system challenges in the Bayside basin.

Because most system needs are related to wet-weather performance, the UWA team began by analyzing wet-weather challenges experienced during the LOS storm (excess stormwater) and identifying opportunities to address those challenges. These opportunities were also analyzed for their contribution to structural challenges, including reliability and redundancy. For instance, specific pipes were recommended as opportunities for increasing capacity, storage, or conveyance because of their likely inclusion in the Collection System Division's Rehabilitation and Replacement (R&R) program.

The UWA team performed a detailed analysis of system characteristics to identify the type of opportunities that would best address each system challenge. Hydraulic deficiencies can be addressed through operational improvements, runoff reduction, or increased storage and conveyance in the collection system. Capital projects, including both grey and green infrastructure, can directly implement stormwater and wastewater management strategies, while programs and policies are tools that can spur implementation of these strategies by both the public and private sector.

As capital project opportunities were developed to address existing wet-weather and structural challenges, criteria related to sea level rise, environmental justice, and cost-effectiveness were used to screen out nonperforming candidates. Viable opportunities with the potential to also provide community benefits and nonpotable reuse were prioritized above equivalent opportunities without the potential for such benefits.

A.1 Defining Opportunity Areas

Opportunity areas are surface and underground locations within areas of influence to an urban watershed challenge that appear to be suitable for the implementation of a technology that can address that challenge. Potential opportunity areas were established by delineating the areas of influence for existing wet weather and structural challenges. Other LOS needs were met by following appropriate process and procedures (i.e., following procedural LOS) as opportunities were developed to address the wet-weather and structural challenges. The key to defining the potential opportunity areas is to establish the locations where improvements can successfully address a known challenge.

In regard to wet-weather challenges, excess stormwater is the dominant consideration because any solution implemented at a scale to resolve the excess stormwater challenge is expected to also positively contribute toward the CSD reduction targets; the exception would be a solution that relied heavily on increased conveyance without also adding sufficient downstream detention, retention, and/or treatment capacity. Thus, the major excess stormwater areas within the Bayside

Drainage Basin (Table 2.3 in the Westside Drainage Basin Watershed Opportunities Technical Memorandum) define the principal wet weather opportunity areas. Existing structural challenges not located within wet-weather opportunity areas were added to expand the Bayside opportunity areas to cover all wet-weather and structural challenges.

The CCSF Hydrologic and Hydraulic (H&H) model version EHY13_v199 is the primary analytical tool that the UWA team used to define areas of influence and opportunity areas for wet weather challenges. The CCSF H&H model includes a two-dimensional (2D) module that represents surface terrain features such as the roadway, curbs, sidewalks, and building boundaries as a complement to the one-dimensional (1D) pipe/manhole/diversion/pump representations. Model output includes a representation of surface flow on a 2D mesh when portions of the underground system reach capacity, as well as CSD events and volumes. The UWA team used CCSF H&H model 1D and 2D simulation results to identify existing wet-weather challenges in the collection system.

The UWA team crafted a method for confirming wet-weather challenges and identifying opportunity areas through the use of the CCSF H&H model[10] and two additional datasets:

- Characterization of excess stormwater management challenges based on the potential flooding risk analysis layers for property damage and personal injury from excess stormwater on the 2D mesh. (The methods for these risk analyses and the results are described in detail in the Bayside Characterization Technical Memorandum.)
- Historical flood claims data

The following example illustrates how the UWA team applied this method for the 17th and Folsom area in Channel watershed:

1. Identify areas within each watershed that have been categorized as "High" and "Very High" risk parcels for potential damage to property or human injury based on the risk analysis. Corroborate areas of "High" and "Very High" risk against historical flood claims to verify accuracy of the model results and risk analysis process. The historical flood claim data was used with caution because some of the claim data may have occurred during storms that were much larger than the LOS storm. This data generally confirmed the hydraulic deficiency of the system in a given area.

   Figure A.1 shows "High" and "Very High" risks in the 17th and Folsom area overlaid with historical flood claims. Green and blue dots show flood claims; red and orange polygons show risk analysis output.

[10] Historical flooding data such as SFDPW Storm Watch and 311 calls were some of the methods used to calibrate the CCSF H&H model.

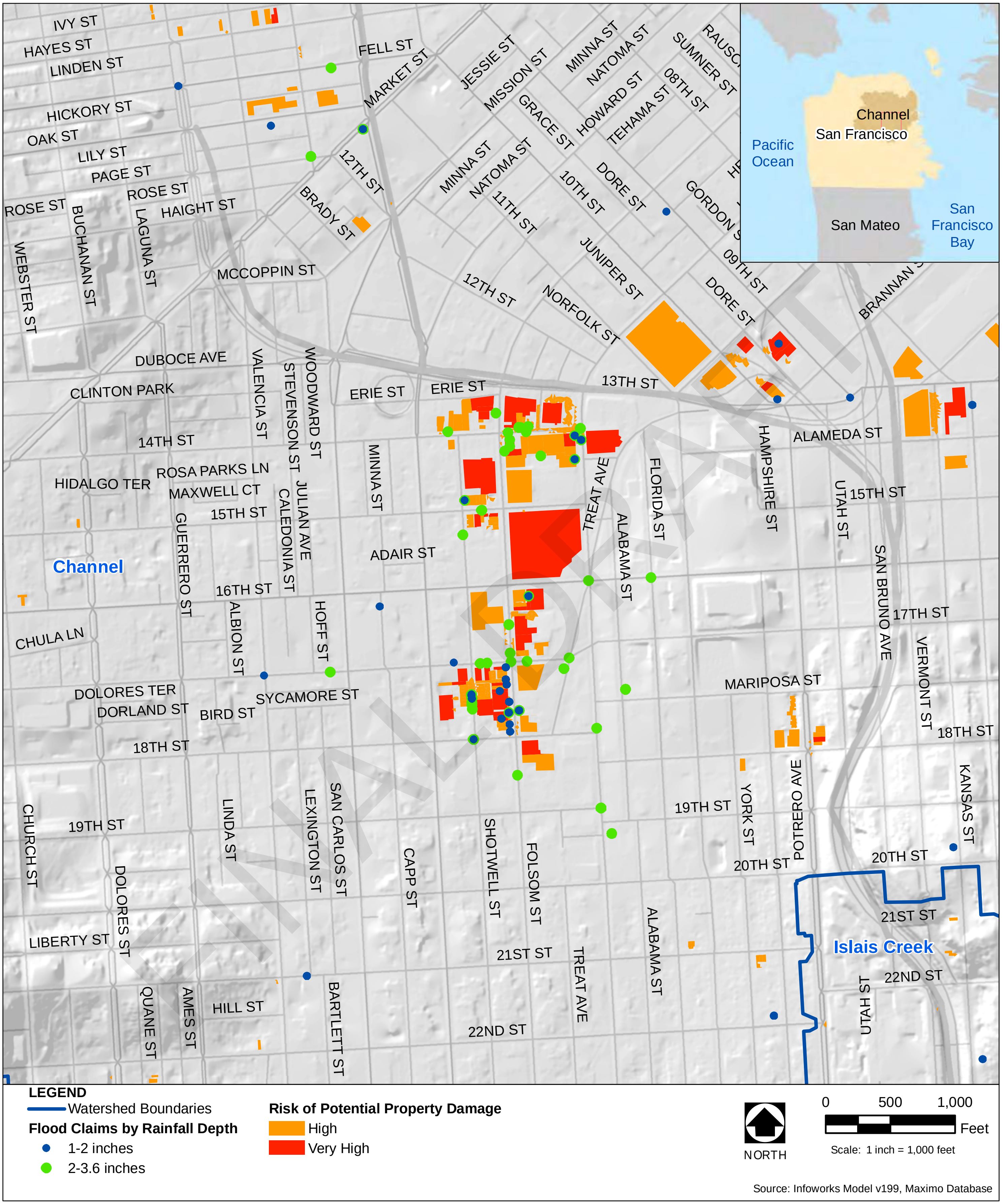

Figure A.1 Risk Analysis Output with Flood Claims

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2. Analyze the HGL. Within each of these areas, the CCSF H&H model simulation results were studied to understand the dynamic behavior of HGL in the sewer pipe system and study the transport of any excess flows on the 2D surface. Reviewing the HGL dynamics in conjunction with the 2D model results helped build confidence in the model's predictive capability for overland flow on this terrain.
3. The UWA team used the dynamics of the HGL in the pipes to identify any conveyance deficiencies that caused combined sewer excursions (flow emanating onto the surface from manholes when the HGL exceeds the ground elevation) to the surface or where stormwater was unable to enter the system due to elevated HGL. The transport of excess flows on the surface was examined and documented to confirm that excess flows are adjacent to properties that were identified as "High" and "Very High" risk. This process allowed for the removal of risk areas that occurred due to error in the ground model or changes in the surface system (e.g., where a resident built a raised wall or fence at the property line).

This detailed review improved confidence in the risk analysis output and allowed the UWA team to focus on generating combined sewage management opportunities in areas with hydraulic deficiencies that caused excess flows. Further, this review also provided the ability to customize the selection of opportunities most effective for addressing specific challenges based on analysis of the cause of each challenge. All opportunities on which the SFPUC could potentially spend ratepayer dollars must be spent on improvements to the services that the agency provides, as regulated by CA Prop 218.

Figure A.2 shows the overland flows on the 2D mesh during the peak of the LOS storm. The black arrows show the direction of the overland flows routing on the 2D mesh.

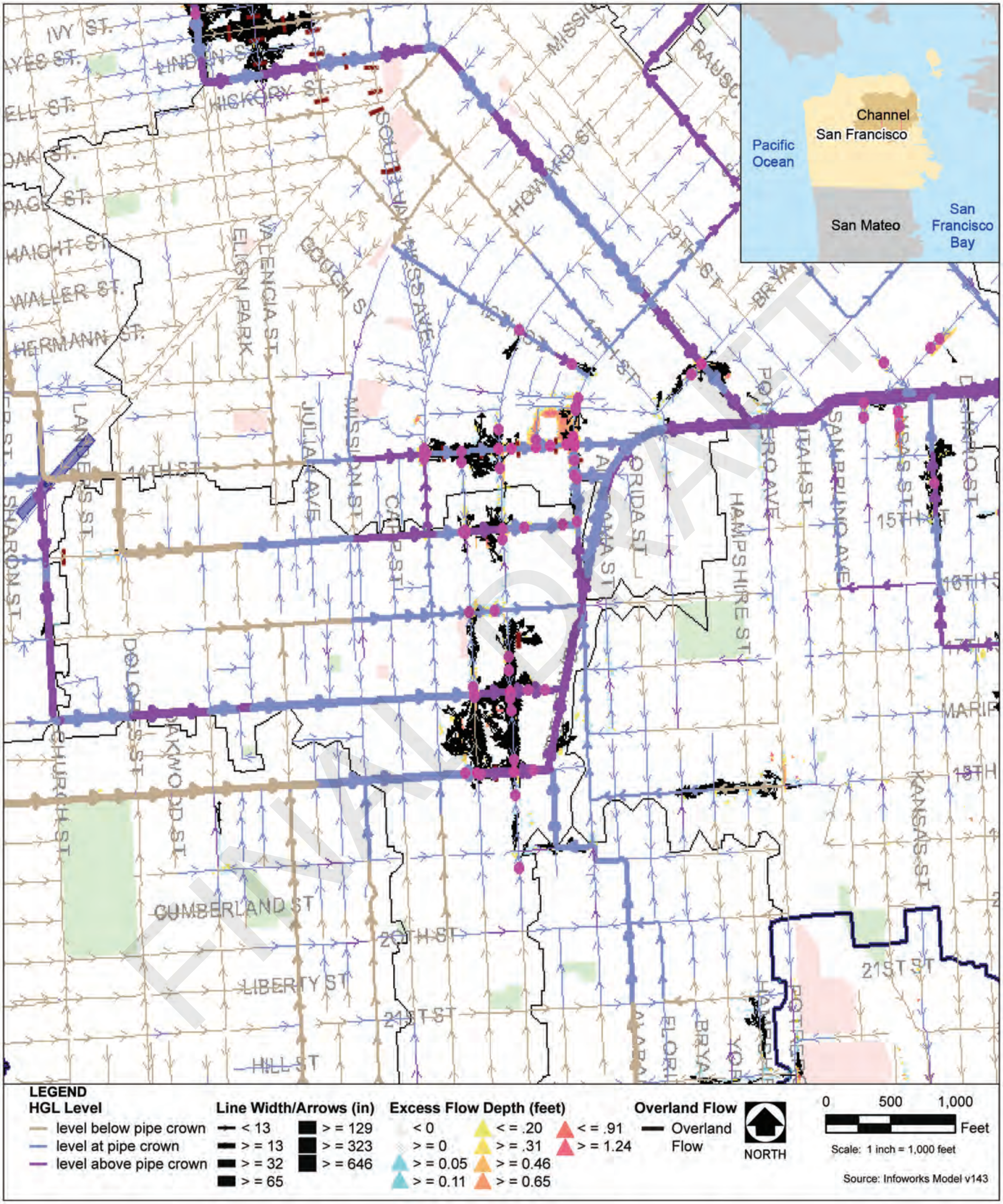

Figure A.2 CCSF H&H Model Output at Peak of LOS storm

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Prioritizing Opportunities: Consideration of Interagency and Public Feedback

Interagency and public feedback also help identify opportunity areas in addition to wet weather and structural aspects. In particular, long-term city goals and priorities identified from other CCSF agencies represent broad opportunity locations to develop multiple benefit projects, which is an explicit LOS strategy (Table 2.1, LOS 3B4 in the Westside Drainage Basin Watershed Opportunities Technical Memorandum). The consideration of public feedback is another input explicitly tied to the LOS strategy to engage the public in locating infrastructure projects (Table 2.1, LOS 3B5 in the Westside Drainage Basin Watershed Opportunities Technical Memorandum). As such, the results of interagency coordination and public outreach are broad opportunity areas that the UWA considered in developing applicable opportunities to meet wet weather and structural needs, described in Subsection 2.3.2.

Interagency Priorities and Feedback

Through meetings with members of the interagency working group, other CCSF agencies provided potential project synergies and potential conflicts. Given that funding for project design and construction has yet to be approved as part of Phase 2 of the SSIP, the potential for interagency coordination focused on long-term priorities. These include priorities for pedestrian safety improvements, segments of the bicycle network, proposed green connections or open space improvements, and other projects from area or transit improvement plans. These priorities serve as additional information to differentiate and prioritize opportunities to solve wet weather and structural challenges. Figure A.3 illustrates these interagency layers in North Shore. Appendix A illustrates these layers for the Bayside Drainage Basin.

Figure A.3 Sample of Long Term Interagency Priorities: North Shore

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Incorporating Public Outreach into the UWA Process

As part of the public outreach process, the UWA team collected four main types of feedback through three Urban Watershed Planning Workshops (June 1 Channel and North Shore Urban Watershed Planning Workshop, July 19 Channel and North Shore Urban Watershed Planning Workshop for youth, and November 17 Southeast Watersheds Planning Workshop) and various online and iPad Surveys. These include:

- Technology and project type preferences
- Location preferences
- Values or benefit preferences
- Project ideas

The UWA team used this information to differentiate and prioritize different opportunities to solve wet weather and structural challenges.

Urban Watershed Planning Workshops

Three participatory community workshops in the form of an interactive planning game were held for Bayside Watersheds during the Opportunities Phase. The workshops focused on stormwater management challenges and potential solutions, and on providing an opportunity for participants to:

- become aware of stormwater management challenges specific to that watershed;
- understand the cost, benefits, and trade-offs of different solutions;
- provide input on planning priorities and solution preferences; and
- generate project ideas for further analysis.

Figure A.4 through Figure A.7 illustrate the public project concepts that emerged from the Urban Watershed Planning Workshops. As explained in Subsection 2.3.3, the UWA team considered the locations of these public project concepts as well as technology preferences and rationale for proposing project concepts (e.g., benefit preferences). Full reports of the Southeast and Channel/North Shore workshops are included in Appendix A.

Online and iPad Surveys

The UWA team administered three online surveys for each of the Bayside Watersheds: North Shore, Channel, and the Islais Creek, Yosemite, and Sunnydale watersheds grouped together as the Southeast watersheds. The surveys asked identical questions. Survey input was collected through an online survey via interactive website (available for the duration of the survey period at http://sfwater.org/urbanwatersheds) or through in-person feedback using door-to-door multi-lingual intercept surveys. For the survey, the UWA team received the following responses:

- North Shore: 560 submittals

- Channel: More than 750 submittals
- Southeast Watersheds: More than 2,100 submittals

Figure A.5 illustrates the location preferences for green streets from the online and iPad surveys, based on density of pins respondents place on an interactive map, similar to Google Maps. These findings, qualitative input that reinforced them, and project location suggestions are discussed further in Appendix B.

As a result, the UWA team considered these specific locations as well as general technology and benefit preferences in the development of opportunities. It will also do so in the Alternatives Phase and TBL analysis.

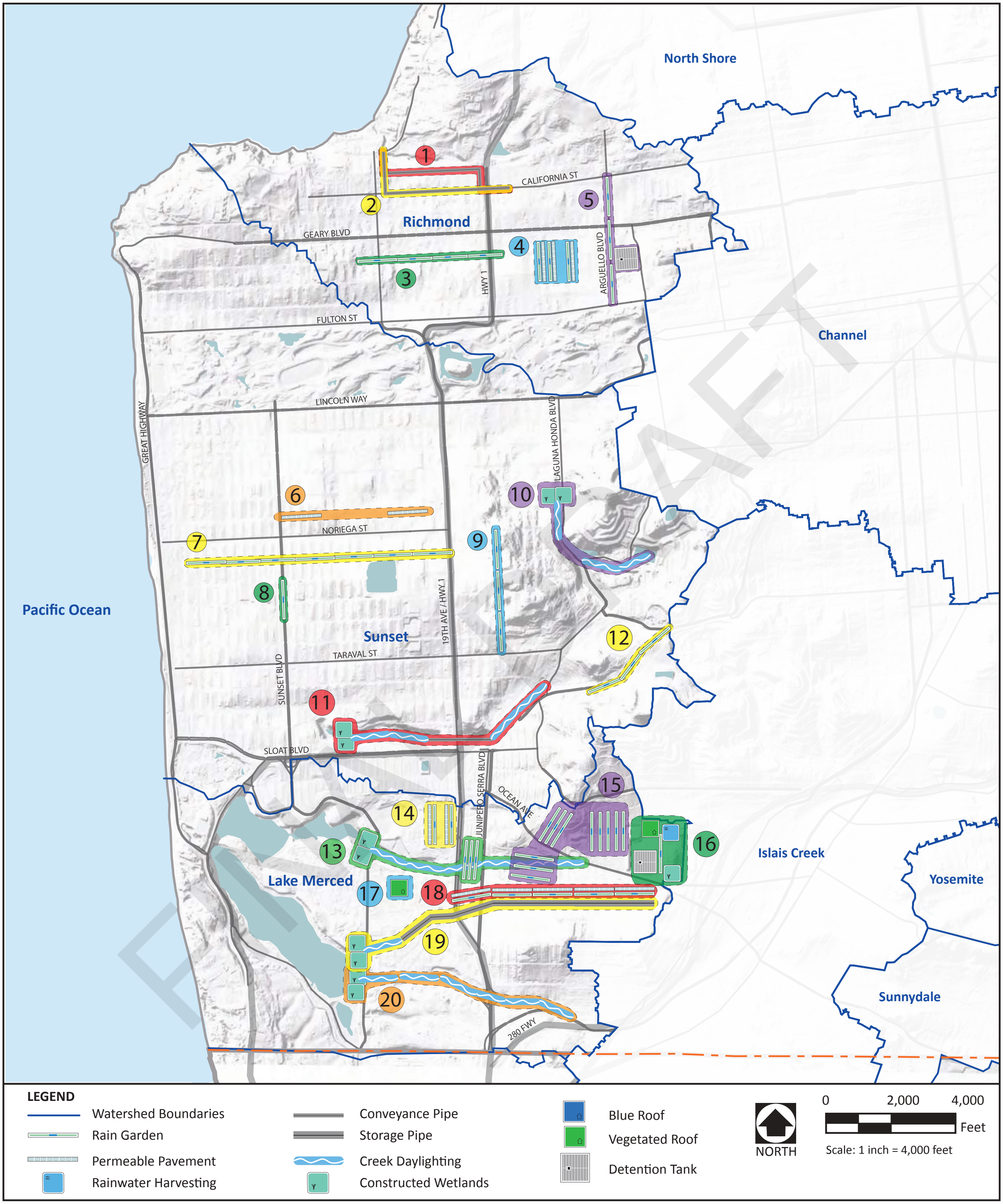

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Figure A.4 Project Ideas from the Urban Planning Workshop

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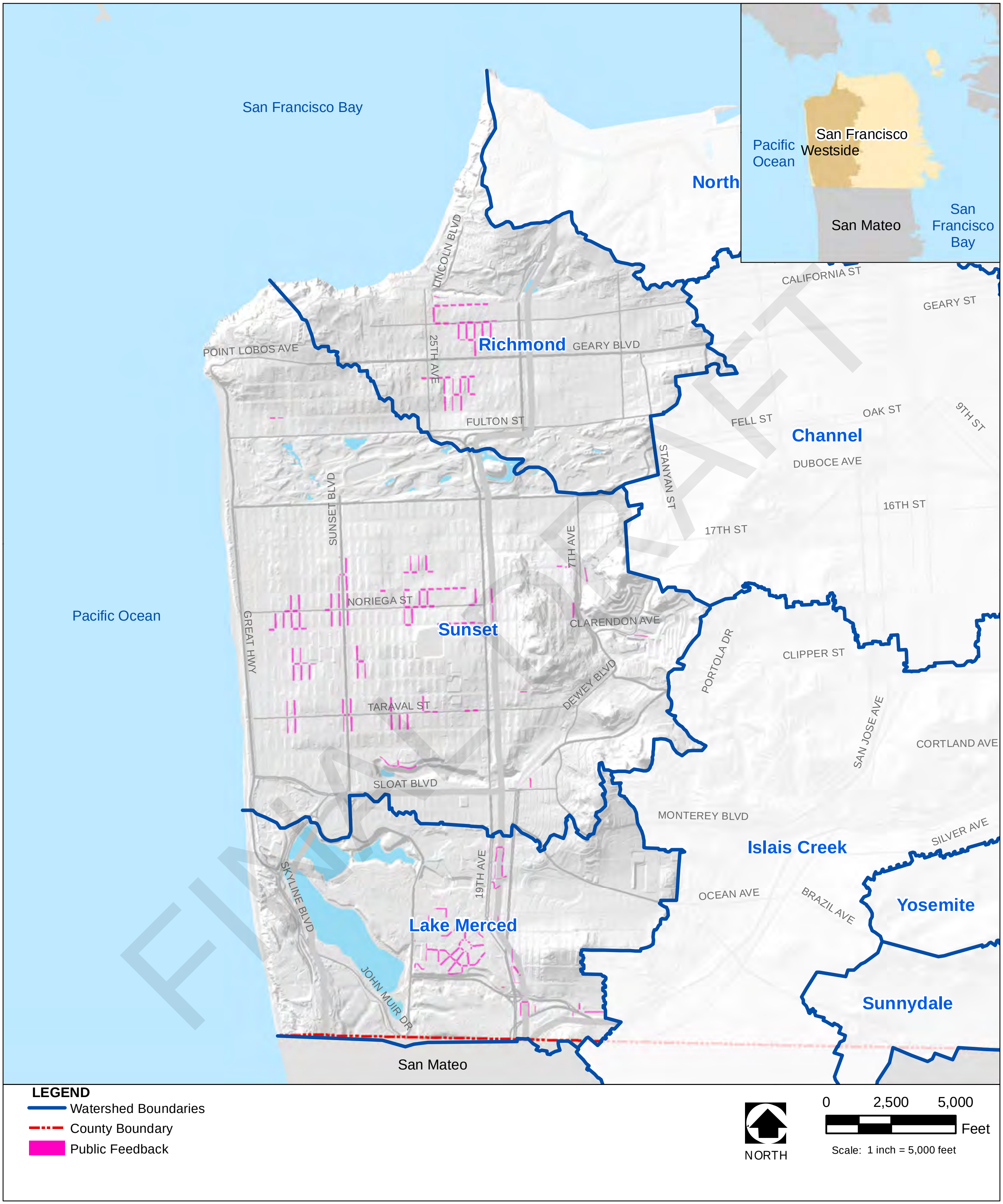

Figure A.5 Proposed Green Street Suggestions

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A.2 Combined Sewage Management Project Opportunity Development

The combined sewer system project opportunities include all major collection system components such as pipe replacement or upsizing, linear or parcel storage facilities, new or upsized pump stations, and gate and outfall improvements. Before considering these capital improvement opportunities, the UWA team referenced the Bayside Operations Evaluation Study to identify methods of achieving the LOS goals by adjusting the operation of existing infrastructure to the extent feasible with minimal investment relative to new capital projects. Combined system capital project opportunities were then developed using the method described in this subsection.

During the Alternatives Phase of the UWA, the same performance goals and approach used to evaluate existing system operation will be used to optimize the project concepts that result from the opportunities analysis.

Capital Opportunities Development

The UWA team used the CCSF H&H model 2D output and potential flooding risk analysis for property damage and personal injury to help identify combined sewage management project opportunities to meet LOS goals not achieved through system-wide operational improvements.

After the conveyance deficiencies were identified and validated by empirical data, the UWA team compared these deficient pipe segments against the CSAMP dataset to identify priority improvement opportunities based on existing asset risk scores and remaining useful life. CSAMP evaluates the likelihood of failure for pipes within the collection system and includes information about each pipe such as age, material, remaining life, and condition based on inspection if available. If the CSAMP score indicates that a pipe is at high risk of failure, the score is used to prioritize replacement projects. Specifically, in cases where either of two pipes could be upgraded to address a system deficiency and only one was deemed high risk by the CSAMP dataset, then that pipe was prioritized as an opportunity. The CSAMP dataset was accessed October 17, 2013, for use in this analysis. As an example, Figure A.9 shows the potential flooding risk analysis for property damage and personal injury in the 17th & Folsom area, indicating the conveyance deficiencies. This figure also shows CSAMP score for the pipes in the 17th & Folsom area. This figure presents the opportunities to replace high- and medium-risk pipes and improving the conveyance and storage capacity of the system and reducing or minimizing the flooding risk. The dark red pipes indicate high risk in CSAMP; the green pipes indicate medium likelihood of failure in CSAMP.

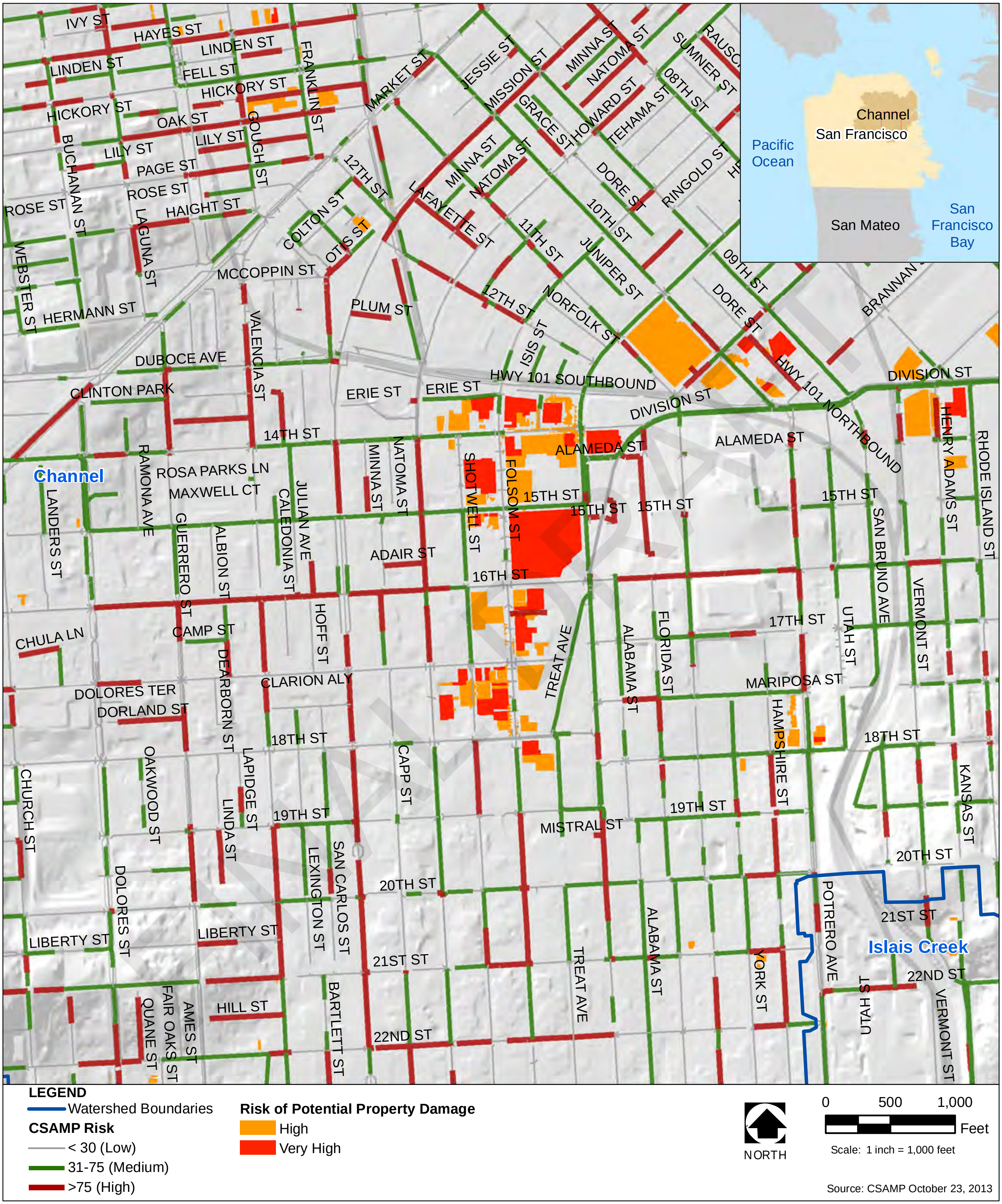

Figure A.6 CSAMP Dataset Example

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The UWA team identified two types of opportunities for replacing the deficient pipe segment that CSAMP dataset indicates as a high risk score or low remaining useful life:

1. *Pipe Upsizing for Increased Conveyance*: Pipe upsizing to increase conveyance is applicable in cases where the downstream system has available capacity and no excess stormwater management challenges. The sizing of the increased conveyance may lead to higher peak flows entering the downstream system, potentially causing or exacerbating downstream hydraulic deficiencies. However, combining this opportunity type with other upstream management opportunities can minimize excess flow impacts downstream. Larger pipes can lead to lower velocities in dry-weather flow conditions, with a potential for causing or increasing odor or sediment deposition. The H&H model will be used to evaluate the impact of pipe upsizing to dry-weather flow velocities. Additionally, a design consideration for such upsized pipes can include a smaller dry-weather flow channel. A smaller dry weather flow channel, referred as "cunette," is typically seen in many large pipes in the San Francisco's combined sewer pipes.
2. *Pipe Upsizing for Linear Storage*: This opportunity can address localized excess stormwater when the downstream system has both limited conveyance capacity and excess flows on surface. Linear storage can remove excess flows from the surface in the local or upstream area by providing increased storage within the system; however, a flow-controlled release could regulate flows so as to not overwhelm the downstream system.

In addition to the pipe replacement opportunities, the UWA team also identified the following opportunities:

1. *Detention Vaults*: Detention vaults can prove to be good opportunities if the excess stormwater management challenges in the area are significant, the downstream system has limited capacity, and a public parcel suitable for storing combined sewer flows is available. A vault can be constructed under the parcel to detain the combined sewer flows and address the excess stormwater management challenges in the area. Generally, parcels such as parks, open space, or parking lots provide good opportunities for building an underground detention vault. The detention vaults can be drained via gravity or pumped to the downstream system, depending on the depth and dimensions of the detention vault. The size of detention vaults in alternative analysis will determine the method of draining the detention vault (pumping or gravity) and of estimating the required pumping capacity. The detention vaults can have a potential issue with solid accumulation and odor, and they may require regular maintenance for cleaning. The maintenance costs for detention vaults will be included in the alternative analysis. Furthermore, design of the detention vaults will include considerations to reduce or eliminate solid accumulation and odor

using a flushing system (using nonpotable sources if feasible and cost-effective) or other maintenance methods.

2. *New Conveyance*: New conveyance is considered as an opportunity when either upsizing an existing pipe is not feasible or when the existing system is not fully built out in the area. A flow diversion is an example of new conveyance in which some or all flow from an upstream area is diverted via a new conveyance to a different drainage path or downstream system.
3. *New and/or Retrofit of Existing Pump Stations*: Providing new pumping units or retrofitting existing pump stations to increase capacity is included as an opportunity in areas with an excess stormwater management challenge. All additional pumping capacity opportunities must be checked to ensure CSD issues are no exacerbated.
4. *Pipe Rehabilitation*: Pipe rehabilitation is considered only for large pipes where the capacity is reduced due to sedimentation. Sedimentation can also cause odor issues, so rehabilitation in these locations could also provide odor reduction benefit. Rehabilitation is essentially relining the pipe. It can increase the conveyance capacity of the pipe, thereby potentially reducing the tendency for sediment deposition, relieving upstream excess stormwater challenges, and improving odor issues along the pipe length. It can also increase the useful life of the pipe infrastructure. An example of an opportunity for pipe rehabilitation includes the North Point Main pipe.
5. *Flow Control Elements*: Flow control elements are considered opportunities when the storage capacity in pipes upstream of an area with excess stormwater management challenges is not fully used in the LOS storm. Flow control methods include an orifice, sluice gate, or smaller-diameter pipe segment that would hold back more flows in the upstream pipe system and potentially reduce the peak HGL in the downstream system, thereby mitigating excess surface flows in the downstream system.
6. *Flow Isolation*: Flow isolation opportunities provide benefits when gravity pipes drain to a downstream system that has a higher HGL during the peak of the LOS storm, thereby causing a backwater condition that results in reduced flow to, or even backflow from, the higher HGL system. Flow isolation includes flap valves that would allow gravity flow downstream but not allow backflow from higher HGL segments downstream, thereby hydraulically isolating the upstream area under high-flow conditions. Examples where this opportunity can reduce excess stormwater management challenges include the low-lying South of Market (SoMa) area by isolating from the higher HGL of the Channel system, low-lying Toland Street area by isolating from higher HGL of the Islais Creek system, and the North Point Main that can backflow into Channel system during the peak of the LOS storm. Flow isolation is most effective when combined with other opportunities (e.g., increased conveyance, storage, stormwater

management) to eliminate excess flows in the area intended to be isolated.

7. *CSD Outfall Capacity Increase*: There are several areas in the Bayside watersheds where the ground level is lower than the surrounding area's ground level or lower than the CSD outfall weirs. In such cases, opportunities like conveyance or storage may provide limited benefit in addressing excess stormwater management challenges in the LOS storm. Where these areas are also close to the CSD outfalls, an opportunity to increase the capacity of CSD outfalls and lower the HGL during the peak of the storm can be beneficial. Each CSD outfall capacity expansion opportunity will need to be evaluated further to ensure that the benefits of reducing excess stormwater management challenges in the LOS storm are not negated by an increase in CSD volume or events and adherence to the federal combined sewer overflow policy's Nine Minimum controls is not compromised. In such a case, regulatory analyses notification and permit approvals would be required.
8. *Surface Regrading to Reroute Flows*: While this is not a combined sewage opportunity, streets are part of the conveyance system during large storms. In some locations, excess flows cross the street curb or crosswalks and enter properties, despite available downstream sewer system capacity. Raising curbs or crosswalks near these locations would allow the excess surface flows to be conveyed on the street surface for a short distance before entering back into the sewer main, thereby eliminating potential property damage or injury risks. This opportunity should also be combined with other opportunities to eliminate excess stormwater management challenges in the area.
9. *Raising Street Grade in Low-Lying Areas*: An additional method for utilizing street surfaces to alleviate excess flow is to raise the street grade. If the street grade is below the peak HGL in low-lying areas, it may be more feasible to raise the street grade than to lower the HGL because the hydraulics in low-lying areas are controlled by the elevation of system outfalls and the levels in nearby T/S boxes. In these cases, raising the street grade above the peak HGL addresses excess flow issues and reduces ponding. Any opportunity to raise street grade would need to be evaluated in the context of what would be required of adjacent properties, for example, flood proofing of subsurface or first floor spaces.
10. *Wet-Weather Flow Diversion:* An additional opportunity recommended by SFPUC Operations includes diversion of wet-weather flows. Some of these opportunities allow conveying wet-weather flows to a T/S box or larger downstream system that has storage available. SFPUC Operations provided several locations where diverting wet-weather flows is feasible. These wet-weather diversion opportunities will be evaluated further with other opportunities.

In addition to these capital opportunities within the collection system, there are other opportunities to improve the efficacy of CSD structures in controlling solids and floatables. Consistent with the U.S. Environmental Protection Agency's Combined Sewer Overflow Control Policy the City's National Pollutant Discharge Elimination System (NPDES) permit requires that the City continue to implement measures to control solid and floatable materials in CSDs, including ensuring that overflow structures are baffled or other means are used to reduce the volume of floatable materials in CSDs and that solid and floatable materials captured in the transport/storage structures are removed prior to discharge. An evaluation of Bayside CSD structures identified the potential to improve floatable and solids removal through implementation of the following types of projects:

1. *Providing or Improving Baffling*: Some CSD diversion structures require modifications to provide more appropriate baffling or to improve performance of existing baffles. Optimization of existing baffle walls and installation of new baffle walls would include consideration of (but not be limited to) baffle wall location (e.g., turbulence level, velocity of flow, flow direction), impact on upstream HGL, optimal wall dimension and angle, alternative baffling arrangements tailored to provide more efficient treatment, and alternative baffling technologies (e.g., permeable baffle/launders).
2. *Improving Flow Release Methods*: Butterfly valves are operated at several CSD outfall locations to help prevent flooding during wet weather. When these valves are opened, flow and built-up sediments are more easily released, which can impact discharge quality. In these cases, it may be feasible to replace butterfly gates with inflatable weirs (i.e., short weir with an adjustable top for control) to help impede sediments from releasing through the outfall. This opportunity, however, may impact hydraulic control and would need to involve a detailed review of hydraulic impacts and risks of flooding to ascertain the feasibility of replacing butterfly valves with weirs. Baffle wall performance should also be reviewed when considering improvements to flow release methods to ensure optimal baffling upstream of the weirs.
3. *Eliminating Outfall Discharges*: This opportunity may be considered for reconfiguring discharge locations to eliminate the use of CSD structures at locations where optimization of the existing structure is not feasible or appropriate. Evaluation of these opportunities would include hydraulic modeling to ensure they do not result in an increase in frequency or volume of CSD. Sea-level rise will also be considered and any consequent hydraulic impacts addressed. Regulatory notification and approval may be required to implement these changes.
4. *Rerouting Dry Weather Flow Paths*: At three CSD locations, Marin Street, Selby Street, and Beach Street outfalls, a pipe connects with and discharges into the outfall pipe downstream of baffle walls. Rerouting the flow at these locations would eliminate the pipe's susceptibility of overflowing to the outfall, or would enable all flows through those outfalls

to pass under a baffle, thereby increasing the potential for floatable removal. Evaluation of these opportunities would include determining diversion options and consideration of impacts to the system's hydraulic conditions. Reconfiguration of CSD and outfall structures will also be considered.

The UWA team has identified a number of opportunities to dry-weather system challenges related to odor. Challenges related to hydrogen sulfide and other malodorous sewer compounds can be addressed in different ways and at various locations in the sewer system. Strategies can be implemented at pumping stations as well as at key locations in the CSS. The following strategies comprise opportunities to address odor challenges and may be recommended as a part of UWA alternatives.

1. *Chemical Dosing:* Several methods of chemical dosing function to either inhibit the formation of the problematic compounds or eliminate the problematic compounds after they are formed. Chemicals can be added that affect positive chemical reactions such as precipitating out hydrogen sulfide and inhibiting biological activity. Compounds typically added include basic chemicals (to counteract acidity) and nitrate. Oxygen and air can also be injected into the system. The specific methods and patterns of dosing vary, depending on the balance of chemicals involved as well as the properties of the sewer system at the locations of odor challenges. Dosing can occur both at pumping stations and at key locations in the sewer network.
2. *Sewer Structure Modification/Retrofit*: Sewer components can be retrofitted or reconstructed to intercept dry-weather flow or redirect it in ways that will reduce odor emanation from the system. SFPUC Operations provided several locations where reconstruction of sewer structures to divert or manage dry weather flow can potentially reduce odor, as listed below. These locations will be evaluated with the strategies recommended in the odor analysis study.
    - Connect 21-inch pipe on Baker St to 15-inch pipe Marina Boulevard in North Shore watershed
    - Construct a drop structure in the 8.5-foot pipe on Sansome Street and Embarcadero to eliminate waterfall in North Shore watershed
    - Reactivate dry weather dropout on 72-inch Laguna Street to eliminate waterfall in North Shore watershed
    - Divert dry weather flow from 60-inch pipe at 4th & Brannan Street to the 78-inch pipe at King and 4th Street in Channel watershed
    - Construct a drop structure in the 21-inch pipe on 4th and Berry Street to eliminate waterfall in Channel watershed
    - Divert dry weather flow in 7.5-foot pipe at Brannan Street directly to the T/S box in Channel watershed

3. *Forced ventilation*: Forced ventilation is an option to collect and treat sulfide after it has formed. Sewerage systems can be ventilated naturally or by inducing negative pressure to force air to emanate at strategic locations where it can be treated or managed. Natural ventilation is often insufficient to counteract hydrogen sulfide–related problems and may under certain conditions make challenges worse. Applying forced ventilation to remove all hydrogen sulfide requires constructing specialized gas-stripping structures; for example, applying deep-shaft aeration of the water in combination with forced ventilation and off-gas treatment.
4. *Changes to pumping operations:* Pump operation can be adjusted to achieve continuous flow rather than intermittent. This may require replacing constant flow pumps with variable frequency drives. The constant flow will contribute to preventing sulfide formation in both the wet wells and in downstream force mains and/or gravity pipes.

These opportunities can also be categorized into five types of projects:

- Conveyance Project Types (Figure A.7 and Figure A.8)
  - New Conveyance
  - New or Upsizing Existing Pump Station
  - CSD Outfall Capacity Increase
  - Pipe Upsizing for Increased Conveyance
  - Pipe Rehabilitation
  - Raising Street Grade
- Storage Project Types (Figure A.9)
  - Pipe upsizing for Linear Storage
  - Detention Vaults
- System Flexibility (Figure A.10)
  - Flow Control Elements
  - Flow Isolation
  - Surface Regrading to Reroute Flows
  - Wet-Weather Flow Diversion
- Outfall Improvements (Figure A.11)
  - Improved Baffling
  - Improved Flow Release Methods
  - Outfall Discharge Elimination (not shown in figure)
  - Increased Baffled Flow (not shown in figure)
- Odor Improvements
  - Chemical Dosing
  - Sewer Structure Modification/Retrofit
  - Forced Ventilation
  - Changes to Pumping Operations

Figure A.7
Conveyance Project Types

Conveyance type projects increase the capacity of the system to transport flow and manage peak storm levels more effectively. Conveyance projects are most appropriate where the downstream system has available capacity and no excess flows.

New Pump Station

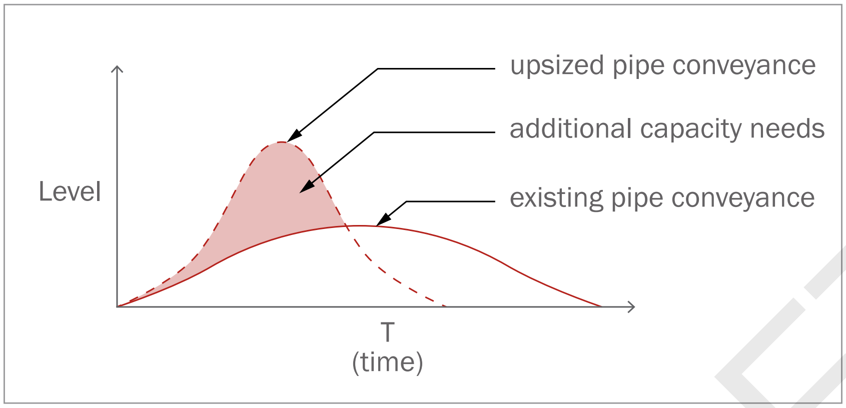
New Conveyance

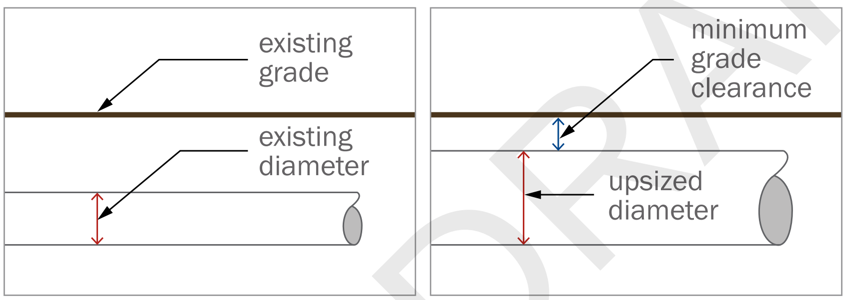
CSD Outfall Capacity Increase

Before *After*

Figure A.8
Conveyance Project Types (cont.)

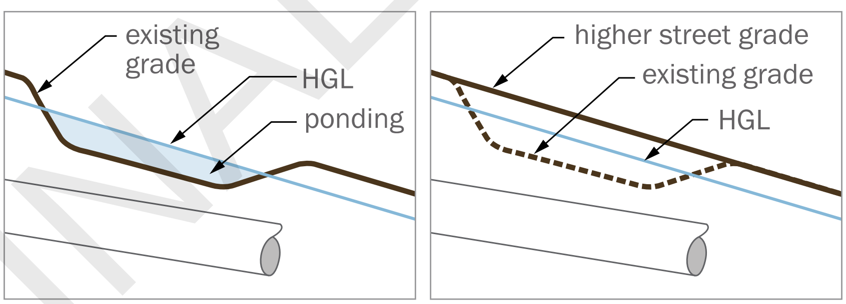
Pipe Upsizing for Increased Conveyance





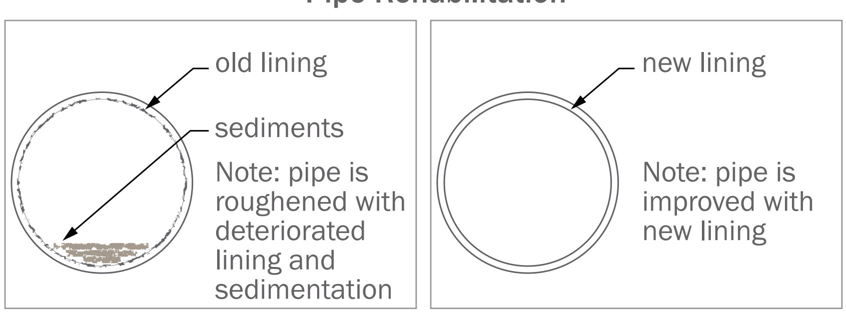
Before *After*

Raising Street Grade



Before *After*

Pipe Rehabilitation

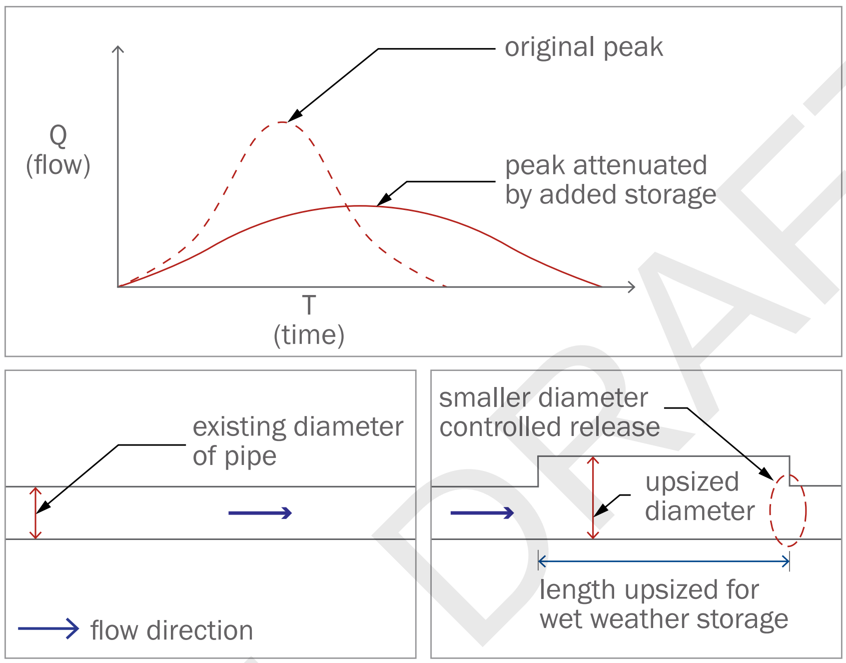


Before *After*

Figure A.9
Storage Project Types

Detention vaults can be drained via gravity or pumped to the downstream system depending on the depth and dimensions of the detention vault. The detention vaults can have a potential issue with solid accumulation and odor, and may require regular maintenance for cleaning. Design of the detention vaults will include considerations to reducing or eliminating solid accumulation and odor using flushing system or other maintenance methods.

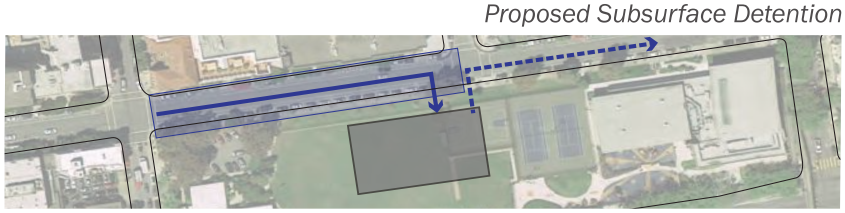
Pipe Upsizing for Linear Storage



Before *After*

Detention Vaults

Proposed Subsurface Detention



DMA Plan

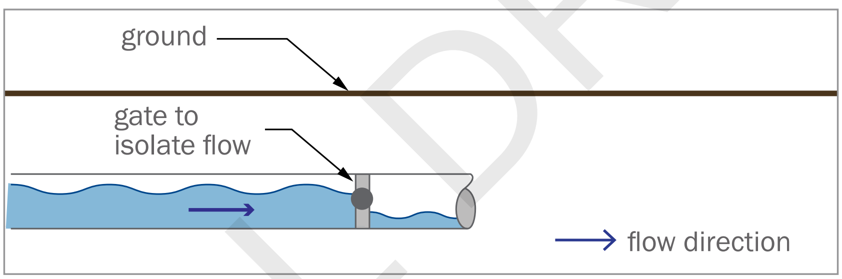
technology footprint
DMA (simplified example)
flow direction

Figure A.10
System Flexibility

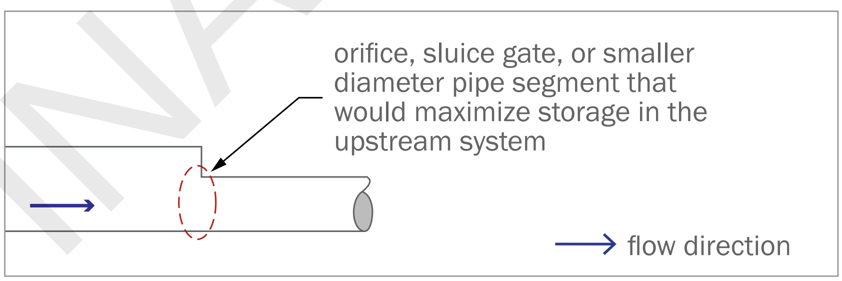
Projects that provide increased system flexibility allow for more control during storm events. These projects act to redistribute or redirect flow in such a way that system capacity is maximally utilized and excess flow is reduced.

New Pump Station

Flow Isolation



Flow Control Elements



Surface Regrading to Reroute Flows

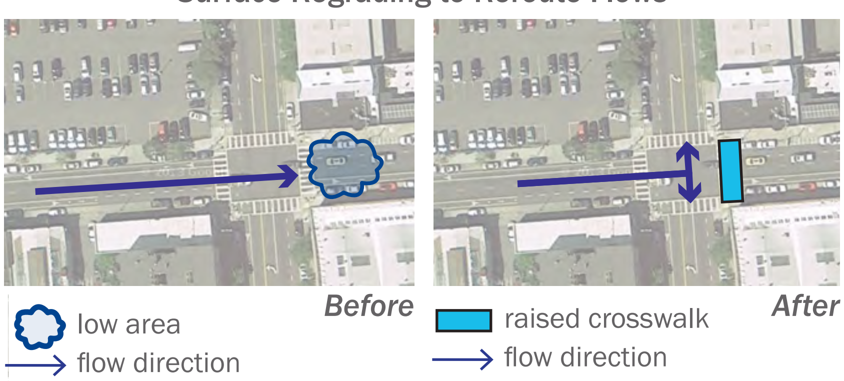
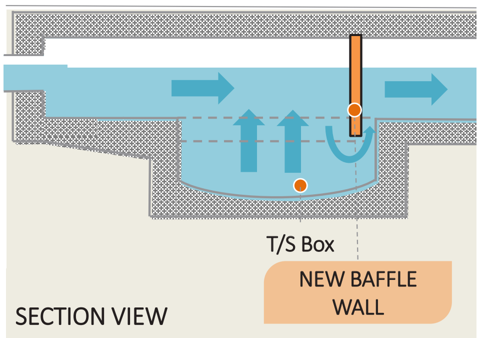


Figure A.11
Outfall Configuration Improvements

The figures below illustrate projects for (1) Providing or Improving Baffling and (2) Improving Flow Release Methods. It should be noted that (3) Eliminating Outfall Discharges and (4) Rerouting Dry Weather Flow Paths project types are not shown in the following figures.

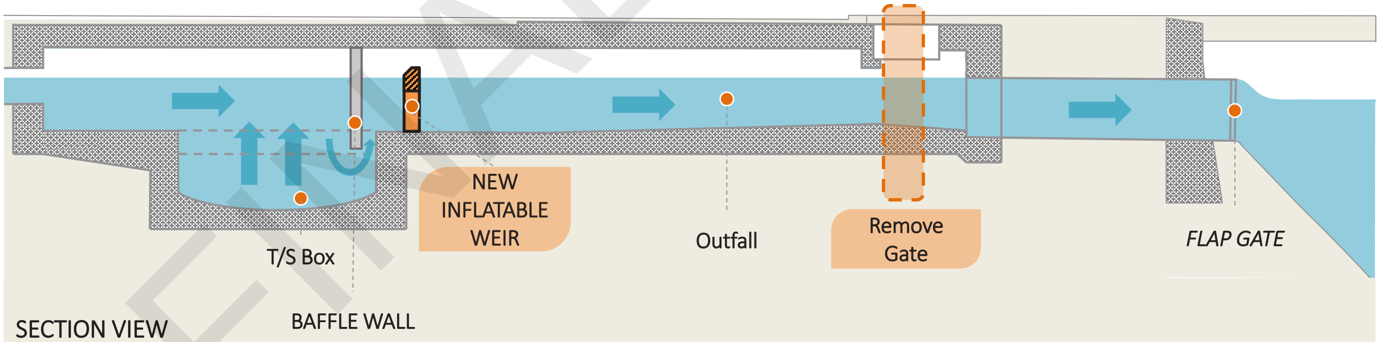
Each structure is constructed differently and will require different modifications. The following figures serve as examples of potential modifications.

1. Providing or Improving Baffling



CSD diversion structures require modifications to provide more appropriate baffling or to improve performance of existing baffles.

2. Improving Flow Release Methods



When butterfly valves are opened, flow and high-concentration sediments are more easily released. It may be feasible to replace butterfly valves with inflatable weirs to help impede sediments from releasing through the outfall.

A.3 Stormwater Runoff Management Project Opportunities Development

As discussed in the Bayside Characterization Technical Memorandum, the urbanization of San Francisco has greatly transformed both the land surface and the hydrologic regime of stormwater runoff. As the amount of impervious area (e.g., roadways, sidewalks, parking lots, and rooftops) has increased from a few sparse rock outcroppings under historical conditions to more than 70% in the Bayside CSS today, the amount of stormwater infiltration and evapotranspiration has decreased while surface runoff has increased. The result is a “flashy” urban watershed response that produces higher peak flows sooner after rainfall occurs. During large storm events, this can lead to excess stormwater and combined sewer discharges. The surface stormwater management opportunities discussed in this subsection can reduce or delay surface runoff to help mitigate challenges where the system receives a greater rate of surface runoff than it can accommodate. In addition, the visible nature of these surface opportunities allows them to enhance urban aesthetics and provide community benefits. This sustainable approach of implementing green infrastructure to manage stormwater results in integrated solutions with a lower impact on the natural hydrology of the existing environment.

Stormwater Management: Retention vs. Detention

The surface improvements discussed in this subsection mitigate the “flashy” urban watershed response by reducing or delaying surface runoff. If an improvement reduces surface runoff to the sewer system, it is a retention-based improvement. This reduction in surface runoff can be achieved in areas of favorable soil conditions through infiltration. Regardless of soil conditions, retention can also be accomplished through onsite storage and reuse systems. If an improvement delays surface runoff to the sewer system, then it is a detention-based improvement. This delay in surface runoff is achieved by temporarily storing surface runoff and later discharging back into the system, thereby reducing peak flow rates.

Retention-based improvements completely remove surface runoff from entering the collection system, providing peak flow reduction to mitigate excess stormwater management challenges and combined sewer discharges. Moreover, they reduce the total volume that enters the system and thus reduce treatment volumes. Additionally, retention-based improvements that rely on infiltration to reduce runoff help recharge groundwater basins and have lower capital costs because, unlike detention-based improvements, they do not require an additional underdrain system to return flow to the collection system. Where feasible, retention is preferred over detention as a stormwater management strategy.

Due to the cost and complexity of reuse systems, surface improvements in this analysis rely on infiltration wherever possible to reduce surface runoff. Unfortunately, many areas throughout the city are infiltration-constrained. Infiltration can be hazardous to both people and the environment in areas of known high groundwater and bedrock, landslide or liquefaction hazards, or Bay fill. Additionally, infiltration is not feasible in areas with suspected poor soil permeability (i.e., less than 0.5 inches per hour) or above underground transportation. Table A.1 summarizes infiltration constraints used in this planning level analysis; the constraints are shown on Figure

A.12. The UWA team used citywide planning-level data to estimate likelihood of infiltration. However, any project design process should include proper geotechnical evaluation for site-specific infiltration potential. In areas where geotechnical evaluation proves that infiltration is in fact not advisable, detention-based surface improvements with underdrains or reuse systems are required.

Table A.1: Infiltration Constraints

Infiltration Constraints
Shallow groundwater or bedrock (<4 ft from surface)
Landslide Hazard
Liquefaction Hazard
Poor Soil Permeability (<0.5 in/hr)
Underground Transportation (BART, SF Muni)

Figure A.12 Infiltration Constraints Map

San Francisco Water Power Sewer
Services of the San Francisco Public Utilities Commission

San Francisco Public Utilities Commission Sewer System Improvement Program
Westside Drainage Basin Urban Watershed Opportunities
FINAL DRAFT Technical Memorandum (January 2015)

SSIP
SEWER SYSTEM IMPROVEMENT PROGRAM

Stormwater Management Opportunity Analysis Methods

To determine the most favorable locations for surface stormwater management improvements, the UWA team evaluated opportunities in three categories:

- Streetscapes
- Creek Daylighting
- Parcels

For each of these categories, the UWA team followed a three-step process to consider physical suitability, prioritize suitable locations, and analyze physical feasibility:

- **Physical Suitability Analysis** determines the most suitable locations with GIS analysis that evaluates slope and spatial availability.
- **Prioritization Analysis** prioritizes the most suitable locations by identifying ownership and land use, if applicable, as well as synergies with system needs, interagency priorities, and public feedback.
- **Physical Feasibility Analysis** verifies the physical feasibility of the potential projects with Google Earth and develops an inventory of specific opportunities.

Figure A.13 illustrates the process used to identify and prioritize stormwater runoff opportunities. It also illustrates that some elements of feasibility analysis will occur during the Alternatives Phase as the UWA team refines opportunities into project concepts.

Figure A.13
Example of Streetscape Feasibility Process

1. Determine which technology types are suitable for each street segment.

Highly Suitable Permeable Paving Street Segment

Highly Suitable Bulbout Planter Street Segment

Highly Suitable Sidewalk Planter Street Segment

2. Prioritize street segments that are suitable for multiple technology types.

Highly Suitable Permeable Paving Street Segment

Highly Suitable Bulbout Planter Street Segment

Highly Suitable Sidewalk Planter Street Segment

3. Overlay system needs, interagency, and public feedback data.*
Further prioritize street segment opportunities based on potential project synergies and DMA size.

Sidewalk Planter Street Segment Opportunity (≥3 ac)

Bulbout Planter Street Segment Opportunity (≥3 ac)

**Interagency and Public Feedback Prioritization Process discused in Section 2.3.1*

Streetscape Opportunities

Thirty percent of impervious area within the Bayside CSS exists within the right-of-way (ROW). In these areas, several types of infrastructure could manage stormwater and contribute to SSIP LOS. Opportunities within streetscapes include all surface improvements within the public ROW that reduce or delay surface runoff. Due to the spatial constraints of existing streetscapes within San Francisco, the UWA team considered two technologies: bioretention facilities and permeable pavement. Depending on soil conditions and site-specific needs, these technologies can be designed as either retention- or detention-based. Because current site conditions are not fully defined and may change in the future, further investigation should be conducted to assess actual soil characteristics and associated design needs during project development. For further design flexibility, technologies can also be implemented in combination to best manage stormwater while enhancing the existing streetscape. Technology combinations are discussed in Section 3.2.1.

<u>Technology Types</u>

Bioretention Facilities

Bioretention facilities are landscaped areas used to collect, filter, and either delay or infiltrate surface runoff from adjacent streetscapes. The engineered soil media and vegetation in these facilities reduce runoff pollutants through phytoremediation and also delay or potentially reduce surface runoff through controlled percolation, evapotranspiration, and potentially infiltration. If infiltration is constrained, bioretention facilities are designed with an underdrain system to return flow slowly into the collection system. These detention-based facilities are often considered "flow-through" facilities. Because all other siting requirements are the same for detention and retention facilities, both are considered bioretention facilities in this document. In the Alternatives Phase, the infiltration constraints will determine if a project concept is performing retention or detention functions, thereby affecting the estimated hydraulic performance.

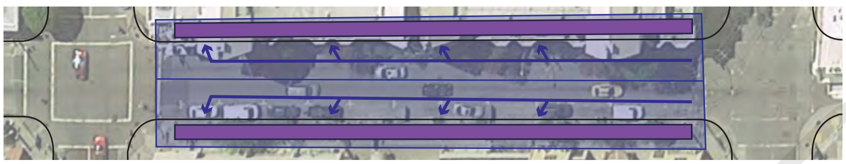
According to current City policy as outlined in the Better Streets Plan, different types of bioretention facilities can be integrated into any street type in San Francisco. When used to manage stormwater runoff from an existing streetscape, they need to be located where surface runoff can flow directly into them. This is generally in the furnishing zone– the portion of the sidewalk used for street trees, landscaping, transit stops, and benches –when located within the sidewalk or at the downstream end of a street in a curb extension or bulbout. To analyze opportune locations for bioretention facilities within the existing streetscape, the UWA team divided the facilities into two categories:

- **Sidewalk Planters**: Linear detention or retention planters located linearly along a sidewalk in the furnishings zone. The furnishing zone is discussed in further detail later in this subsection (Figure A.14).
- **Bulbout Planters:** Both detention and retention bioretention facilities located in curb extensions or bulbouts at the downstream end of the area managed. The area managed is discussed in further detail later in this subsection (Figure A.15).

Figure A.14
Streetscape Technology Type Example: Flow-through Bioretention/Sidewalk Planter

Proposed Flow-Through Sidewalk Planter

Sidewalk planters are located within the edge of the sidewalk along the length of the street. They capture stormwater that would otherwise enter a catchbasin as it travels along the curb. They are typically planted and can serve retention or detention functions. Bioretention planters allow stormwater to infiltrate into the ground, whereas flow-through planters have an underdrain or otherwise allow stormwater to enter the sewer system after traveling through the planter.



DMA Plan

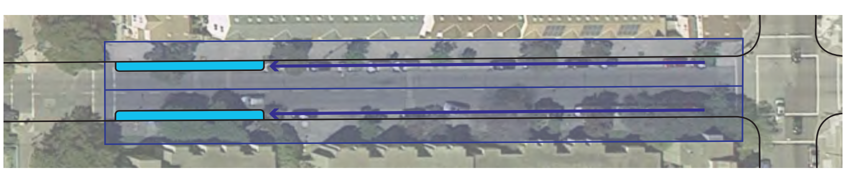
technology footprint
drainage management area
flow direction

Flow-Through Sidewalk Planter in El Cerrito, CA

Figure A.15
Streetscape Technology Type Example: Bioretention/Flow-through Planter Bulbout

Proposed Bioretention Bulbout

Bulbouts are typically located at the downstream end of a street within the parking lane. They capture stormwater from the street that would otherwise enter a catch basin. They are generally planted and can be designed with either a retention or detention function. Bioretention planters, or rain gardens, allow stormwater to infiltrate into the ground, whereas a flow-through planter has an underdrain or otherwise allows stormwater to enter the sewer system after traveling through the planter.



DMA Plan

technology footprint
drainage management area
flow direction

Bioretention Bulbout

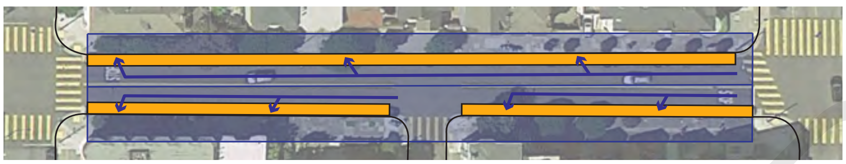
Permeable Pavement

Permeable pavement, also referred to as pervious pavement, is an alternative to standard pavement that can delay or potentially infiltrate surface runoff (Figure A.16). Unlike standard pavement, permeable pavement allows water to percolate through its surface. Runoff is then stored in the underlying base rock before infiltrating into the native soil or discharging into the collection system via an underdrain.

Figure A.16
Streetscape Technology Type Example: Permeable Pavement

Proposed Permeable Paving on the Street and Sidewalk

Permeable pavement is typically located in the parking lane or portions of the sidewalk. It captures stormwater from the street and sidewalk that would otherwise enter a catch basin. It is useful in locations where space for planters is not available or desired. Permeable pavement can be designed with either a retention or detention function to allow stormwater to infiltrate into the ground or enter the sewer system if designed with an underdrain.



DMA Plan

technology footprint
drainage management area
flow direction

Permeable Paving in Santa Monica, CA

Prioritizing Streetscape Technologies

In analyzing locations for surface improvements in areas where runoff reduction was determined to provide an appropriate contribution to solving system needs, the UWA team prioritized locations where bioretention facilities were deemed feasible. This is because bioretention offered the following benefits, which are all related to LOS criteria:

- Lower capital cost per gallon of stormwater managed
- Favorable public feedback
- Potential to combine with habitat restoration
- Potential to combine with traffic calming

Due to the dense urban environment in San Francisco, available space for bioretention facilities can be limited. As a result, many locations require the use of multiple technologies to fully manage the stormwater runoff from the LOS design storm. This is discussed in further detail in Subsection 0.

Streetscape Opportunity Evaluation Process

The UWA team used the following three-step process to identify the most promising ROW locations and technologies that together provide streetscape runoff reduction opportunities:

Step 1: Physical Suitability Analysis

The UWA team used a Geographic Information Systems (GIS) analysis to identify street segments with adequate drainage management area (DMA), ideal slope characteristics, and sufficient available space to accommodate sidewalk planters, bulbout planters, or permeable pavement.

Drainage Management Area

The first step of the streetscape analysis was to identify the DMAs, which represent the area, or subcatchment, that drains to each potential improvement. For most San Francisco streetscapes, the potential DMA of a street segment is the area defined by the crown of the street, the adjacent parcel line, and the two drainage inlets at the adjacent intersections. These boundaries typically define one side of a city block. The UWA team estimated the catchment area for individual street segments to begin to identify the opportunities for the largest benefit to the CSS.

Slope

The UWA team used light detection and ranging (LIDAR) data to estimate and categorize the prevalent slope of each street segment. The team then categorized the street segments by slope according to Table A.2. Street segments with lower slope have greater design flexibility and thus are considered more suitable. According to the *SDG BMP Fact Sheets,* bioretention facilities on slopes greater than 5% will require check dams or other flow control devices to curb flow and function properly. While technically possible, this type of design increases costs. Street segments with slopes less than or equal to 5% are considered highly suitable for bioretention.

Similar to bioretention facilities, permeable pavement requires a low enough slope to allow surface water to percolate into the surface. Unlike bioretention facilities, surface flow cannot be slowed by vegetation or check dams within the path of travel for vehicles or pedestrians. This requires that slopes be 2% or less for a street to be considered highly suitable for permeable pavement; however, as shown in Table A.2, streets with greater slopes are not considered infeasible based solely on slope. Table A.3 and Figure A.17 show the breakdown of street slopes within Bayside.

Table A.2: Street Segment Slope Categories

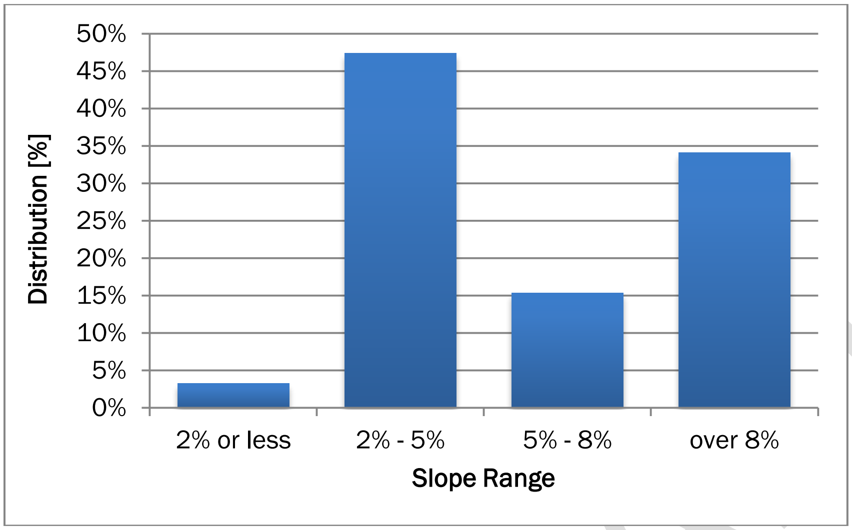
Slope Category (Majority by area))	Linear	Bulbout	PP
0-2%			
2-5%			
5-8%			
8%+			

Highly Suitable
Moderately Suitable
Somewhat Suitable (Limited)

Table A.3: Street Slope Distribution in Westside Drainage Basin

Slope Range	Blocks [#]	% of Total [%]
2% or less	726	3%
2%–5%	10,653	47%
5%–8%	3,453	15%
over 8%	7,672	34%
WESTSIDE	**22,504**	**100%**

Figure A.17: Street Slope Distribution in Westside Drainage Basin



Available Space

Available space requirements vary for permeable pavement, sidewalk planters, and bulbout planters.

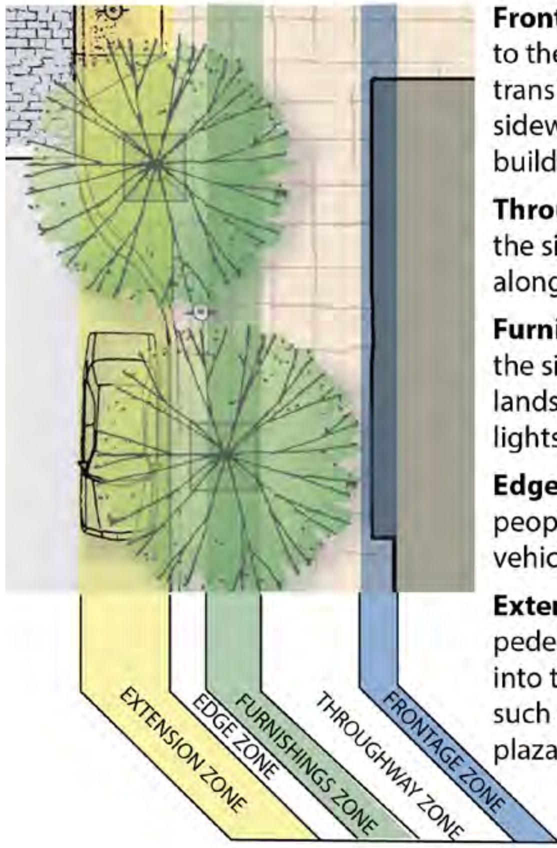
Permeable Pavement

According to the Stormwater Design Guidelines (SFPUC 2009b), the sizing ratio for permeable pavement is 3:1, which translates to 25% of the total DMA. Due to this large sizing ratio, permeable pavement facilities will often occupy the entire parking lane and often a portion of the traffic lane. Because the Better Streets Plan recommends avoiding permeable pavement on traffic lanes for streets classified as arterials or collectors and concrete bus pads, the UWA team considered street segments of arterial and collector streets and street segments with bus stops as infeasible for permeable pavement. Due to its design flexibility, the UWA team considered all remaining street segments as highly suitable for available space.

Sidewalk Planters

According to the Better Streets Plan, sidewalk planters that manage streetscape DMAs should be located within the furnishing zone of the streetscape. The Better Streets Plan breaks the sidewalks within the city into five zones as described in Figure A.18. These zones vary in width based on their Better Streets Plan street type, as summarized in Table A.4. Taking the minimum total sidewalk width for each street type as the sum of its five individual minimum zone widths, the UWA team determined which street segments had additional room to accommodate at least a 3-foot-wide sidewalk planter. Assuming the curb location is fixed, the UWA team also determined the maximum available width for a sidewalk planter on each street segment.

Figure A.18 Better Streets Plan Sidewalk Zones



Frontage Zone: The area adjacent to the property line where transitions between the public sidewalk and the space within buildings occur.

Throughway Zone: The portion of the sidewalk for pedestrian travel along the street.

Furnishing Zone: The portion of the sidewalk used for street trees, landscaping, transit stops, street lights, and site furnishings.

Edge Zone: The area used by people getting in and out of vehicles parked at the curbside.

Extension Zone: The area where pedestrian space may beextended into the parking lane, via features such as bulb-outs with mid-block plazas.

Table A.4: Better Streets Plan Sidewalk Zone Widths

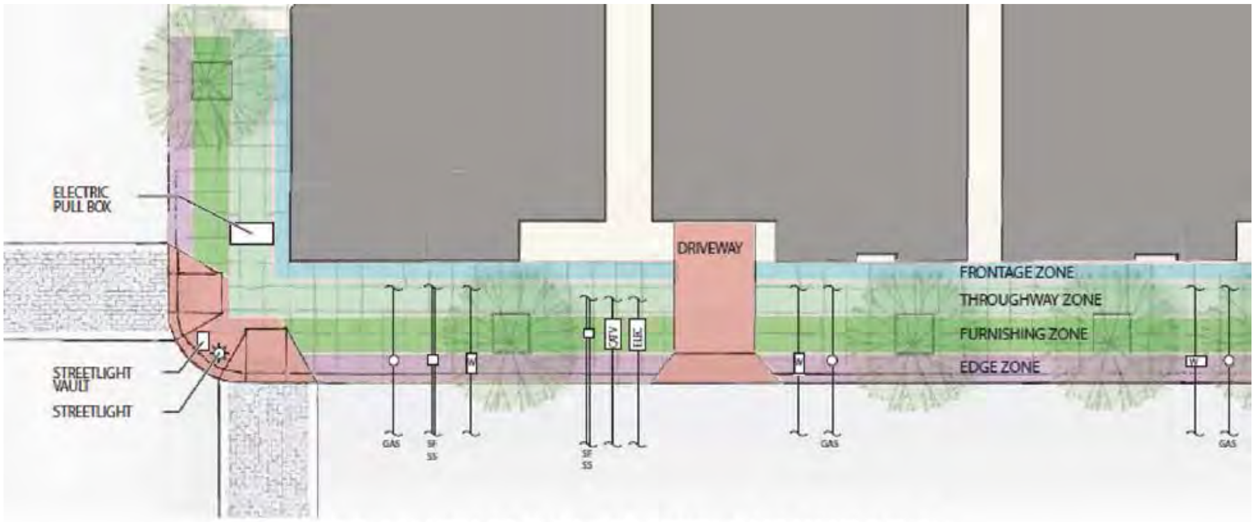
BSP Street Type	Edge[1]	Furnishings	Throughway	Frontage	Limiting Sidewalk Width[1]
Downtown commercial	2	3	9	2	16
Ceremonial	2	3	9	2	16
Shared public way	2	3	4	0	9
Paseo	2	3	4	0	9
Alley	2	3	4	0	9
Industrial	2	3	6	1.5	12.5
Neighborhood residential	2	3	6	1.5	12.5
Commercial throughway	2	3	9	2	16
Neighborhood commercial	2	3	9	2	16
Mixed-Use	2	3	9	2	16
Parkway	2	3	9	2	16
Park Edge	2	3	9	2	16
Multi-way boulevard	2	3	9	2	16
Downtown residential	2	3	9	1.5	15.5
Residential throughway	2	3	6	1.5	12.5

1 Required dimension assumes parallel curbside parking in accordance with the SFDPW's Sidewalk Landscaping Permit guidelines.
2 All units measured in feet.

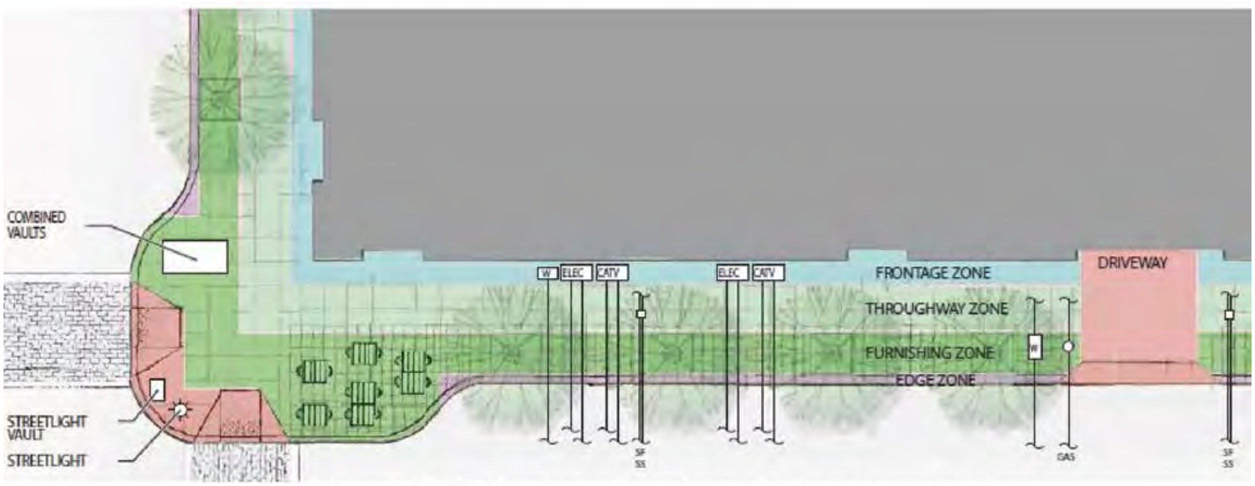
To determine the area available for a planter, the UWA team also estimated the available length along each street segment. This length was estimated as the total street segment length minus physical obstructions, which include:

- **Fire hydrants**: According to the *Interdepartmental Policy Relating to the Placement of Fire Hydrants with Respect to Distance to Curb* memorandum of understanding (San Francisco Fire Department 2011), a clear line of sight must be maintained around fire hydrants, which the UWA team interpreted as a 5-foot no-landscaping radius around all fire hydrants. Thus, the UWA team estimated 10 feet of linear obstruction for every fire hydrant within a given street segment.
- **Bus stops**: Because location-specific bus stop length data were unavailable, the team estimated 75 feet of linear obstruction per bus stop.
- **Driveways and utility crossings**: Because driveway and utility crossing data were unavailable at the citywide scale, the team estimated their occurrence by land use type. Because residential neighborhoods have substantially more driveways, with utility boxes often within the adjacent furnishing zone (Figure A.19), the UWA team estimated approximately 10 feet of linear obstruction per residential parcel. In nonresidential zones, because there are relatively few driveways, and utility boxes are generally located outside of the furnishing zones (Figure A.19), the team assumed that linear obstructions from driveways and utility crossings in these areas are negligible (for the purpose of GIS analysis).

Figure A.19 Better Streets Plan Utility Location Schematic



Recommended Utility Locations for Residential (Neighborhood and Throughway) Street Types



Recommended Utility Locations for All Other Street Types (Including Downtown Residential)

Table A.5 summarizes these linear obstruction assumptions. By subtracting the total length of linear obstruction from the total length of the DMA, the UWA team estimated the total available length for sidewalk planters along a given DMA. The team then calculated the available space in terms of total area and as a percentage of the DMA.

Table A.5: Linear Obstruction Assumptions

Obstruction Type	Unit Obstruction Length [ft]
Fire Hydrant	10
Bus Stop	75
Driveway/Utility Crossing	10

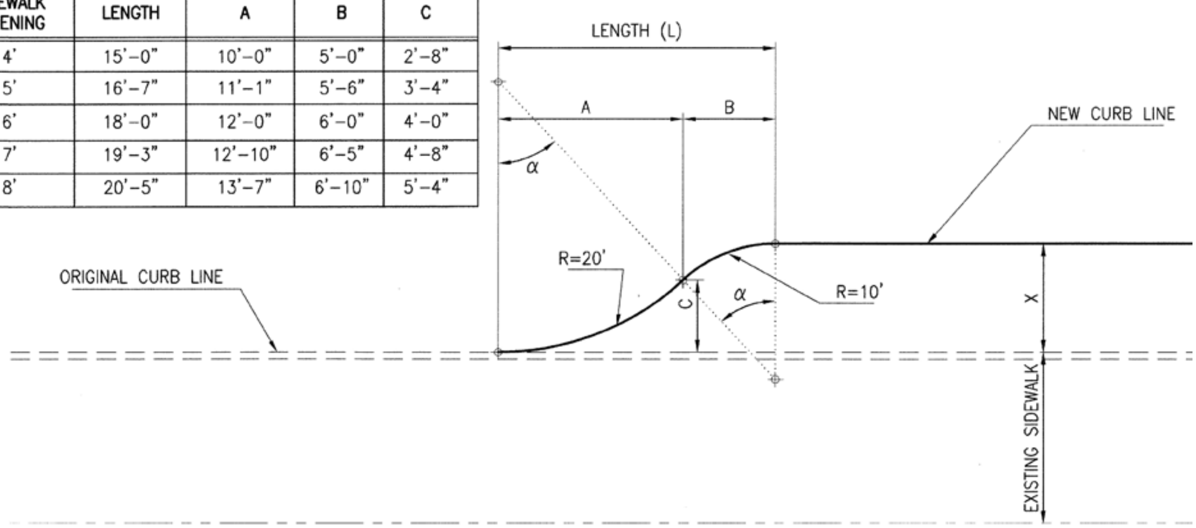
Using the sizing criteria from the *CCSF Hydrologic and Hydraulic Model Documentation Technical Memorandum*, the UWA team categorized street segments for sidewalk planters by amount of available space. Any street segment estimated to have sufficient available space to at least fully manage typical-year storm events that contribute to combined sewer discharges (5% of the total potential DMA) is considered highly suitable.

Bulbout Planters

Bulbout planters are located in curb extensions (aka bulbouts), typically at the downstream end of a block at an intersection. Due to their encroachment into the roadway, bulbout planters change the curb line of the streetscape. The Department of Public Works requires a 20-foot turn radius to accommodate street-sweeping vehicles, as shown in Figure A.20. For a standard 6-foot-wide bulbout, this translates to a minimum length of 18 feet on each end of the bulbout transition, which makes mid-block bulbouts less desirable from a spatial efficiency standpoint. Thus, the UWA team focused on corner bulbouts with adequate space between the corner and the first curb-line obstruction or driveway. However, mid-block bulbouts can be feasibility-checked on a case-by-case basis in subsequent phases of work, particularly on extremely long blocks where a single corner bulbout planter cannot fulfill the 5% sizing requirement.

Figure A.20 San Francisco Department of Public Works Curb Bulb Standard Plan

SIDEWALK WIDENING	LENGTH	A	B	C
4'	15'–0"	10'–0"	5'–0"	2'–8"
5'	16'–7"	11'–1"	5'–6"	3'–4"
6'	18'–0"	12'–0"	6'–0"	4'–0"
7'	19'–3"	12'–10"	6'–5"	4'–8"
8'	20'–5"	13'–7"	6'–10"	5'–4"



Because there are very few existing under-used bulbouts in the city, these opportunities primarily occur in existing curbside parking spaces or bus stops designated for removal by the San Francisco Municipal Transportation Agency. Thus, the UWA team deemed street segments without existing curbside parking as infeasible because these spaces are usually occupied by travel lanes. Additionally, the UWA team considered segments with existing bus stops (not planned for removal) at end of block as infeasible.

To estimate available space within the remaining street segments, the UWA team first calculated available width as the sum of the maximum available existing sidewalk width (total sidewalk width minus the first four individual minimum zone widths, per Table A.4), the edge zone, and a 6-foot extension zone. The team then estimated available length using the same physical obstruction assumptions made for sidewalk planters (using 3 feet as a minimum width for a planter). If the available area was at least 60% of the minimum required to manage the LOS storm, then the UWA team considered the DMA highly suitable for bulbout planters. This 60% corresponds to 100% of the available area required to manage the typical year storm; per the *CCSF Hydrologic and Hydraulic Model Documentation Technical Memorandum,* the LOS storm requires a larger technology footprint (8% of DMA) than does the typical-year storm (5% of DMA). The available area threshold was set below 100% of that needed to manage the LOS storm because a corner bulbout is well suited to pair with other technologies such as permeable pavement in the parking lane. Table A.6 summarizes the categorization and associated available space criteria for all three stormwater management project types. The top three sections pertain to physical attributes and obstructions that impact a street's available space. The bottom two sections define the levels of suitability assigned to a street based on the quantity of available space relative to total DMA and required bulbout length.

Table A.6: Available Space Suitability Criteria for Streetscape Technologies

Linear Bioretention Available Space Criteria[1]	
Sidewalk Less Than Limiting Width (varies by BSP type)	
8%+ of Total DMA	
5-8% of Total DMA	
3-5% of Total DMA	
0-3% of Total DMA	

Bulbout Bioretention Available Space Criteria[1]	
Downstream Bus Stop; no TEP	
Downstream Bus Stop; TEP Location	
No Curbside Parking	
60%+ of Required Bulbout Length	
30-60% of Required Bulbout Length	
0-30% of Required Bulbout Length	

Permeable Pavement Available Space Criteria	
Bus Stop	

[1] Percent values represent available space as a percentage of either:
(a) Total DMA
(b) Required bulbout length

Highly Suitable
Moderately Suitable
Somewhat Suitable (Limited)
Infeasible

Abbreviations: BSP = Better Streets Plan; TEP = Transit Effectiveness Program

Step 2: Prioritization Analysis

The UWA team prioritized street segments with highly suitable slope characteristics and sufficient available space to manage the entire LOS storm. Remaining street segments were considered when identifying opportunities that employ multiple technologies. The UWA team used synergies between the highly suitable street segments and the following data sources to prioritize locations for further analysis.

- **System Needs:** These include locations where stormwater runoff management could mitigate excess stormwater and CSD challenges by reducing surface runoff.
- **Interagency Priorities:** These include long-term interagency priorities that represent general opportunities to incorporate stormwater runoff management into projects that provide multiple benefits (see maps and sources in Appendix A). To identify these opportunity areas, the UWA team

overlaid suitable locations for streetscape and parcel projects with the following socioeconomic, interagency coordination, and public feedback data layers:

- Environmental justice areas of concern
- Disadvantaged communities
- Pedestrian high-injury corridors
- Streets identified for streetscape redesign
- Portions of the bicycle network with low comfort levels
- Portions of the bike network on flat, low-traffic streets
- Proposed Green Connections (and alternative routes)
- Open space priority areas
- Additional interagency priorities from coordination meetings
- Public project concepts from the Urban Watershed Planning Workshop
- Pipes with CSAMP risk scores over 75 (identified for rehabilitation or replacement)

- **Public Feedback:** Through public outreach, the UWA team compiled data about public preferences for technology types, locations, community values and benefits, as well as specific opportunities proposed during public workshops (Figure A.4). In general, the public favors bioretention facilities to permeable pavement, which is consistent with the UWA team approach of focusing first on bioretention opportunities, then supplementing with permeable pavement as needed to meet minimum performance standards.

Step 3: Physical Feasibility Analysis

In order to determine the physical feasibility of street segments selected for further investigation, the UWA team visually inspected each opportunity through Google Earth street view. During this inspection, the team determined if there was sufficient available space for bioretention or permeable pavement to manage runoff that street segment per minimum performance requirements. The results of this analysis are discussed in Section 3. The team then catalogued all feasible opportunities that managed over 3 acres of DMA as priority opportunities. See Appendix C for all opportunities, including those under 3 acres.

Creek Daylighting

The daylighting of historical creeks or the creation of new "creek-like" surface conveyance channels along non-historical alignments has the potential to alleviate localized excess stormwater and CSDs in the Bayside Drainage Basin, restore urban ecology, and revitalize the surrounding environment. The premise of creek daylighting is that runoff that is currently routed into the underground collection system can be rerouted into surface channels where flows would be managed before being discharged to either a water body or the CSS. Any new discharges to Waters of the U.S. would need to be thoroughly evaluated from a regulatory perspective to ensure compliance with the City's Phase II Municipal Stormwater Permit. The channel itself would contain infrastructure elements as necessary to conform to the urban environment. In some cases, the proposed daylighted alignment would approximate a historical creek alignment within the boundaries of available space (e.g., open public land and excess width in the ROW); in others, it would be a new channel location.

The UWA team assessed the feasibility of creek daylighting opportunities for the five urban watersheds of the Bayside Drainage Basin. Regarding creek form within the urban San Francisco context, creek daylighting opportunities range from more "urban" to more "naturalized." A more urban creek would typically have a rectangular channel with hardscape walls in the ROW, sometimes with limited public accessibility. A more naturalized creek would typically have a softer channel form with laid-back sides made of natural materials, located on parcels with greater public accessibility and greater efforts to restrict inflows to cleaner flow sources (e.g., rooftops and landscape). Figure A.21 shows examples of urban and naturalized creeks. Creek daylighting opportunities may be short reaches entirely contained within the ROW or on a parcel, or they could be longer alignments that include both ROW and parcel segments. All creek daylighting opportunities, regardless of whether they discharge to Waters of the U.S., would need to provide some retention, detention, or conveyance benefits.

Creek channels will be designed to safely convey a set peak flow rate in proportion to the available DMA and physical space for the reach. As necessary, an overflow, underflow, or diversion scheme will be engineered to prevent excessive flows from entering the channel. After a proposed alignment is established, rainfall events up to the 100-year event will be explicitly tested in a detailed H&H model to ensure that the system functions safely under extreme conditions. No additional risk will be imposed on any neighboring properties. Additionally, extensive public outreach would be conducted to ensure that the neighborhood was in support of a potential project.

Regarding regulatory implications of potentially creating a new MS4 outfall, a new water body that discharges to the Bay, or just a stormwater conveyance channel that discharges back to the sewer system, the UWA team will continue ongoing coordination with regulatory experts to evaluate regulatory implications, which continue to evolve through case law and new legislation.

The remainder of this subsection describes the UWA team's approach for identifying, evaluating, and prioritizing creek daylighting opportunities. Figure A.22 depicts components of the first two steps: Opportunities Identification and Feasibility Evaluation. Because creek daylighting projects are generally large scale and therefore among the most expensive green infrastructure technologies under consideration, the UWA team broke the feasible daylighting opportunities down into smaller reaches to accommodate a phased implementation approach. The most beneficial and constructible reaches within a full potential alignment were prioritized as the best starting points from which to potentially build longer, more continuous creek daylighting projects in the future.

Figure A.21
Examples of Urban and Naturalized Creek Daylighting Opportunity Types

Proposed Creek Daylighting (urban)

Creek Daylighting in Zurich, Switzerland

Proposed Creek Daylighting (naturalized)

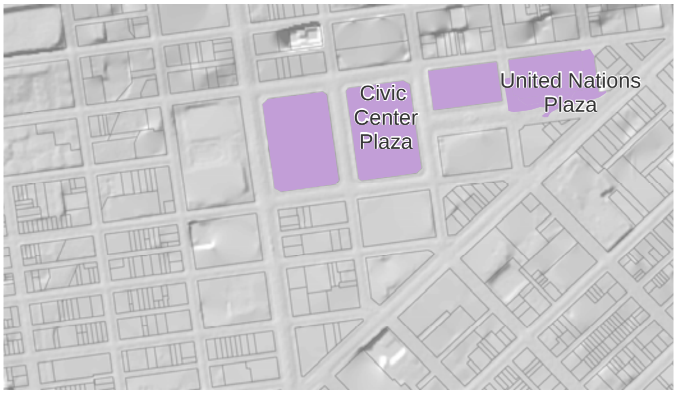
Mill River Park and Greenway, CT

DMA Plan

technology footprint
drainage management area

Creek daylighting opportunities are typically located along historical creek channels or existing drainage paths. They can be within a parcel, in the ROW, or spanning combinations of parcels and ROW. They capture stormwater from within the drainage area that would otherwise enter a drain or catch basin. "Urban" daylighted creeks have rectangular channels with hard-scape walls and are located in the ROW, sometimes with limited public accessibility. "Naturalized" daylighted creeks have a softer channel form with laid back sides made of natural materials. They are located on parcels with greater public accessibility and greater efforts are made to restrict inflows to cleaner flow sources such as rooftops and landscape.

Figure A.22
Creek Daylighting Opportunity Identification and Feasibility Evaluation Components



Large DMA Opportunities

Identify parcels or clusters of parcels that could drain to a given creek daylighting opportunity with large potential effective DMA (DMA weighted by percent impervious versus pervious area). For example, Civic Center Plaza and several adjacent large rooftops could potentially drain to a creek daylighting opportunity in the Civic Center area.

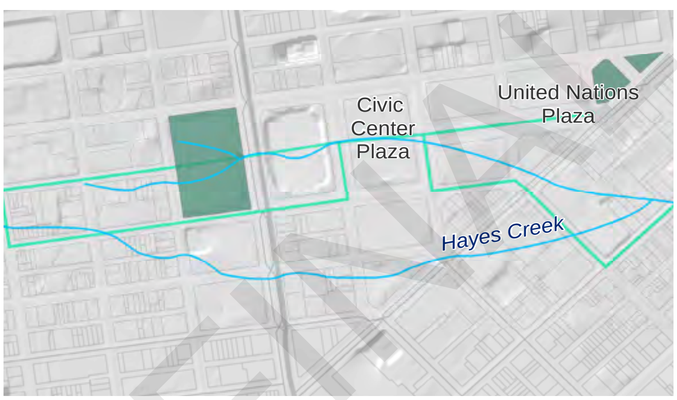
Identified Parcel DMA

Excess Stormwater Challenge Contributing Area

Determine if managing the DMA identified above could potentially mitigate excess flow challenges before proceeding to feasibility analysis. For example, the Civic Center DMA lies within an area contributing to excess flow challenge areas in SoMa and the Inner Mission.

Identified Parcel DMA

Excess Stormwater Challenge Contributing Area



Potential Alignment Ideas

Identify potential alignments emanating from large DMAs, including but not limited to historical creek paths and UWA Urban Watershed Planning Game results. For example, historical Hayes Creek ran through the Civic Center District and UWA Planning Game participants proposed a creek daylighting project along this alignment.

Historic Creeks

Creek Daylighting

Constructed Wetlands Parcel Locations

Suitability Output

Evaluate site suitability from streetscape and parcel analysis.

Civic Center Alignment

Streetscape DMA suitable for Sidewalk Bioretention

Bioretention and Infiltration Suitable

Bioretention Suitable, Infiltration Infeasible

Parcel Bioretention Suitability

High

Moderate

Low

Limited

Infeasible

Identifying Creek Daylighting Opportunities

Nearly all historical creeks in the Bayside Drainage Basin now flow within San Francisco's CSS (SSIP-PMC, 2013a). Runoff that historically became creek flow now enters the CSS at dispersed locations, block by block and catch basin by catch basin. Therefore, the best prospects for capturing and diverting large flows to creek daylighting opportunities, without separating entire sections of the CSS, are to find large parcels from which runoff can be captured before it enters the CSS. These parcels may or may not occur along historical creek alignments.

The UWA team began identifying creek daylighting opportunities by screening Bayside parcels for large DMA opportunities, such as large open spaces, school campuses, and large parking lots and rooftops. Starting with large DMAs helps to ensure that opportunities have the potential to provide the larger-scale benefits that could justify the inherent larger-scale investment required for creek daylighting. In addition to surface runoff from large DMAs, the UWA team also identified springs and sump pump flows as potential continuous low-flow sources.

The UWA team then screened these large DMAs for opportunities that would address LOS needs. The UWA team only carried forward opportunities with the potential to reduce excess flow challenges. As described in the *Bayside Drainage Basin Characterization Technical Memorandum* (SSIP-PMC, 2013a), all areas that potentially reduce excess flow challenges also reduce CSD challenges.

Once large DMAs that could address LOS needs were identified, the UWA team looked for potential creek alignments within, along, or emanating from each DMA. The team examined potential alignments, including historical creek paths, results from the summer and fall 2013 UWA Watershed Planning Workshops, ideas from existing creek daylighting investigations, and other paths with plausible topography. Existing investigations included Low Impact Design (LID) Basin Analyses (M&E et al 2009a, M&E et al 2009b, MWH 2009, RMC 2009), academic research papers (Cheng 2010, Griffith 2006, Jencks and Leonardson 2004, Jensen 2008, Norgaard 2013), and communications with SFPUC staff and local creek daylighting enthusiasts (Braswell 2012, Jencks 2013, Sherk 2013).

Feasibility Evaluation

The UWA team evaluated the feasibility of potential creek daylighting alignments based on spatial suitability, channel slope, and stormwater management potential. A more detailed description of each of these criteria follows.

- *Spatial suitability:* To identify preliminary candidate locations, the team reviewed output from the parcel and streetscape linear planter GIS suitability analyses, which were conducted for other green infrastructure types in this technical memorandum but contain many of the same suitability criteria. The team then manually verified sufficient space on parcels or sufficient available street or sidewalk width, as well as a manageable number of driveway crossings, bus stops, and other longitudinal interruptions for streetscape settings. The team considered available street width as the excess width within the ROW beyond 12-foot driving lanes, 8-foot parking lanes, and 5-foot bike lanes. While the threshold for the feasible number of driveway crossings, which affects project cost and continuity, may vary based on the specific project, the team generally considered it to be three to five driveways per 600-foot block.

- *Channel slope:* The team used output from a topography-based GIS flow path analysis and manual elevation verification to ensure a continuous downhill slope along proposed alignments.
- *Stormwater management and discharge plan:* After determining whether a given alignment would discharge to the CSS or to a water body, the UWA team identified stormwater management parcel opportunities along the alignment or at its terminus to ensure that the alignment would address LOS needs (if discharging to the CSS) or meet MS4 regulatory requirements (if discharging to a water body).

This preliminary feasibility evaluation yielded a cursory list of creek daylighting opportunity locations. For the prioritized opportunities, a more in-depth feasibility analysis will be conducted during the Alternatives Phase.

<u>Prioritization of Opportunities</u>

The UWA team broke down preliminarily feasible creek daylighting opportunities into smaller reaches and prioritized them according to a variety of factors, including effective DMA, alignment location, water quality of source flow, excursion risk, discharge location, potential synergies, community benefits, and non-potable base flow. A more detailed description of these factors follows.

- *Effective DMA:* The UWA team quantified the effective DMA by weighting the percent impervious area versus pervious area for each reach, and it then prioritized those with the greatest effective DMA because they have the potential to yield the greatest hydraulic benefits.
- *Alignment location:* The team prioritized parcel alignments over streetscape alignments because they typically allow a more naturalized channel and lower cost.
- *Source flow water quality:* The team prioritized DMAs that would yield generally cleaner runoff (e.g., open spaces, rooftops). Water quality treatment may be required for certain reuse opportunities.
- *Excursion risk:* Excursions are flow emanating onto the surface from manholes when the HGL exceeds the ground elevation. For this analysis, the UWA team assumed that excursions up to a surface flow depth of 18 inches could be prevented from entering a creek channel by reasonable design elements. Excess flow locations and depths under existing conditions were determined by the CCSF H&H model version EHY13_v199. As implementation of SSIP projects lowers HGL in locations prone to excess flow challenges, the feasibility of certain historical alignments that are currently excluded due to excursion risk may be revisited. The UWA team used the following criteria to evaluate the impacts of excursions entering the channel on creek daylighting opportunities:

- Reaches that discharge to a water body: Excursions resulting from storms up to the 100-year storm shall be prevented from entering the channel. An excursion that enters a creek discharging to a water body constitutes a Clean Water Act violation. While the 100-year storm is not a regulatory threshold, it represents a high level of protection against possible excursions.
- Reaches that discharge to the CSS: Excursions resulting from storms up to the LOS storm shall be prevented from entering the channel.

- *Discharge location:* The UWA team prioritized reaches with the potential to discharge to a water body over those that discharge to the CSS, provided that reasonable design measures could protect the reach from risk of excursion up to the 100-year storm and normal pollution prevention measures would be implemented for the discharge. Keeping water out of the CSS has benefits related to reducing energy and treatment costs in addition to mitigating flood risk and reducing CSD.
- *Interagency project synergies and community benefits:* The UWA team identified potential project synergies and community benefits, including planned green connections, planned capital improvements, and bicycle and pedestrian priorities (see Section 2.2.6 for a more detailed discussion of community benefits). The team prioritized opportunities with greater potential for synergies and additional benefits consistent with public feedback. Due to the long horizon of creek daylighting projects, potential synergies will be re-evaluated later in the planning process if the opportunity is carried forward.
- *Base flow:* The UWA team identified potential nonpotable baseflow sources, including sump flows, springs, and other clean year-round flows that currently drain or are pumped to the CSS. This criterion provides additional system benefits such as eliminating the need for landscape irrigation and reducing resources expended on treating clean water that would otherwise be conveyed to a treatment plant. Redirection of non-potable base flow from the CSS as a source for creek daylighting presumes the water is of appropriate quality for the intended alternative use. Thorough testing of source water quality (e.g., sump pumping from building basements and BART or MUNI stations) would be conducted prior to developing these opportunities.

Parcel Opportunities

While the SFPUC has established mechanisms and procedures to work in the ROW, there are transaction costs and challenges to working in a location that serves multiple purposes and contains a wide range of infrastructure. Implementing projects on parcels also has implementation challenges depending on ownership, but transaction costs can be mitigated by lower construction costs due to fewer utility conflicts, no traffic control, and fewer hard infrastructure elements. In some instances, purchasing a parcel may be instrumental to a project's feasibility, acquisition costs notwithstanding. For example, parcels may present opportunities to site larger-scale stormwater runoff management project types, such as constructed wetlands or subsurface detention for either stormwater or combined sewage, as described above. Given that parcels contain almost 70% of impervious surfaces in the Bayside, parcels offer abundant stormwater runoff management opportunities.

Technology Types

Whereas available streetscape technologies are dictated by the linear configuration of sidewalks and streets, parcels offer more flexible options for surface runoff technology types based on size, spatial availability, and more diverse management areas (e.g., areas at ground-level as well as rooftops). As a result, the UWA team considered four initial technology types for parcel opportunities. These technology types apply to opportunities for capital projects as well as programmatic opportunities discussed below. In the Alternatives Phase, additional technology types or combinations of technologies may be considered based on more site specific evaluation and use of the H&H model.

Bioretention Facilities or Constructed Wetlands

Bioretention facilities are landscaped areas used to collect, filter, and either delay or infiltrate surface runoff from adjacent areas. Within parcels, suitable locations for these facilities include underutilized areas in downstream zones at the ground level. These areas may be either pervious, such as within existing landscape or open space area, or impervious, such as parking lots or other hardscape area. General suitability criteria were determined to be similar to streetscape bioretention in terms of slope, infiltration, drainage direction, and available space. Figure A.23 and Figure A.24 illustrate examples of how bioretention could be integrated within a parcel opportunity.

These locations may also be suitable for constructed wetlands or other multifunctional, multi-technology project types. In some cases, these would entail a change of existing land use; for example, if a parking lot is removed for a larger constructed wetland. Parcels were also evaluated for potential as constructed wetlands as part of the creek daylighting analysis, as described in the previous subsection.

Permeable Pavement

Permeable pavement, or pervious pavement, is an alternative to standard pavement that can delay or potentially infiltrate surface runoff by allowing water to percolate into the surface. Potential opportunity parcels for permeable pavement are characterized by large ground-level impervious areas with low slope. Figure A.23 and Figure A.24 illustrate examples of how permeable pavement could be integrated within a parcel opportunity. These are also locations where subsurface retention or detention may be an option.

Blue and Green Roofs

Runoff reduction can also be achieved on rooftops via blue and green roofs. Both roof technology types collect and manage stormwater that falls on rooftops. Water is allowed to pond, gradually being released into the sewer system, or it is utilized by plants on the rooftop through evapotranspiration. On blue roofs, stormwater is stored in tray systems or on the roof itself with a series of check dams, whereas green or vegetated roofs are covered with vegetation planted in soil media. Vegetation provides added benefits of creating habitat and improving insulation, but also incurs greater construction and maintenance costs than blue roofs. Parcels with large roof areas and sufficient structural integrity are suitable candidates for blue and green roof opportunities. Figure A.25 and Figure A.26 illustrate examples of how green and blue roofs, respectively, could be integrated within a parcel opportunity.

Rainwater Harvesting and Downspout Disconnect

Rainwater harvesting is the practice of collecting and storing rainwater from impervious areas, particularly rooftops, for later use. This technology not only provides an alternative water supply but also prevents stormwater from entering the collection system, thereby reducing runoff and peak flows. Downspout disconnection allows stormwater from rooftops to disperse into the ground rather than enter the combined system. Parcels with large rooftops and available surface area that is both appropriately sized and sloped to accommodate storage facilities (e.g., cisterns) are considered suitable for rainwater harvesting. Exposed downspouts are critical for feasibility, and that consideration may be field investigated on an individual basis during the subsequent feasibility analysis. Figure A.27 and Figure A.28 provide examples of rainwater harvesting and downspout disconnection, respectively.

Subsurface Retention or Detention Structures

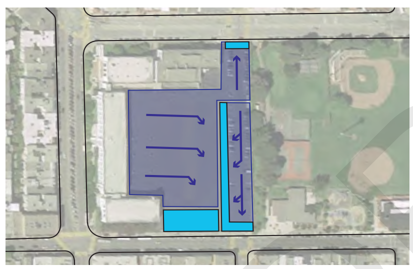
In locations where there is no use for collected stormwater, subsurface retention or detention structures may be desirable, especially in locations where an existing or new use would be programmed for the surface. In general, these technology types collect and store stormwater underground to either infiltrate into the ground or slowly return to the collection system. Figure A.29 and Figure A.30 illustrate constructed wetlands and subsurface detention, respectively.

Figure A.23
Parcel Technology Type Example: Bioretention/Permeable Pavement Active Hardscape

Proposed Bioretention Active Hardscape

For bioretention/permeable paving active hardscapes, bioretention planters or permeable pavement is located at the downstream end of impervious surfaces. They capture stormwater from a parcel that would otherwise enter a drain or catch basin. The planters or pavement can be designed with either a retention or detention function to allow stormwater to infiltrate into the ground or enter the sewer system if designed with an underdrain. They are located to allow for continued use of a playground or other active hardscape such as sports courts or plazas.

technology footprint
DMA (simplified example)
flow direction



DMA Plan

Active Hardscape at Mint Plaza, SF

Figure A.24
Parcel Technology Example: Bioretention/Permeable Pavement Parking Lot

Proposed Bioretention in the Parking Lot

For bioretention/permeable paving parking lots, bioretention planters or permeable pavement is located at the downstream end of impervious surfaces. They capture stormwater from a parcel that would otherwise enter a drain or catch basin. The planters or pavement can be designed with either a retention or detention function to allow stormwater to infiltrate into the ground or enter the sewer system if designed with an underdrain.

DMA Plan

technology footprint
DMA (simplified example)
flow direction

Bioretention in a Parking Lot

Figure A.25
Parcel Technology Type Example: Green Roof

Proposed Green Roof

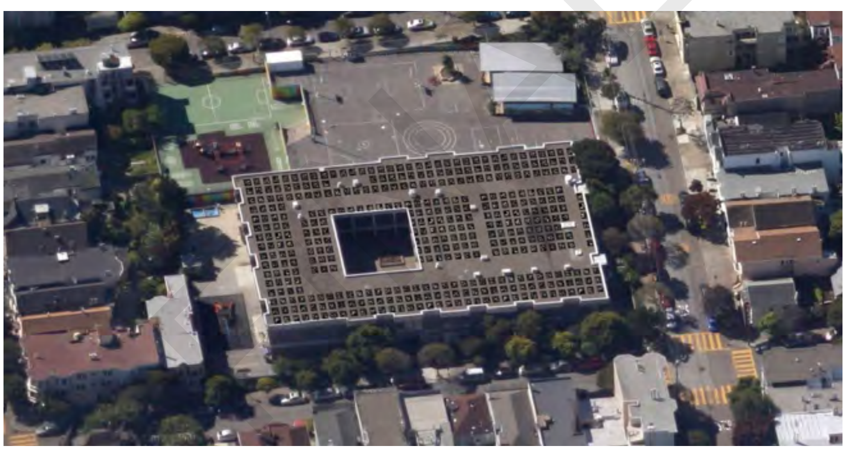
Green roofs, manage stormwater that comes from rooftops. Green roofs collect water that is used by plants or allow water to pond on the rooftop, then slowly released to the sewer system. Green roofs have added benefits and costs that come from adding plants to the roof.

technology footprint
DMA

DMA Plan

California Academy of Sciences, SF

Figure A.26
Parcel Technology Type Example: Blue Roof



Proposed Blue Roof

Blue roofs, like green roofs, manage stormwater that comes from rooftops. Blue roofs collect water in trays or allow water to pond on the rooftop, then slowly released to the sewer system. Blue roofs are less expensive due to avoided costs from adding plants to the roof.

technology footprint
DMA

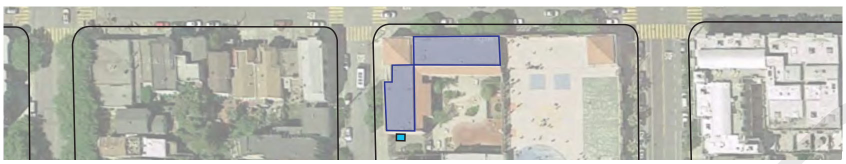
DMA Plan

Blue Roof in Essex, CT

Figure A.27
Parcel Technology Type Example: Rain Water Harvesting

Proposed Rainwater Harvesting

Rainwater harvesting is the practice of collecting rainwater from impervious surfaces such as roofs and patios and re-using for non-potable applications, such as irrigation or toilet flushing. The collected stormwater is stored in rain barrels or cisterns, which may be located on rooftops, above ground, or below ground. In addition to offsetting the amount of potable water applied to non-potable uses, this technology also diverts relatively clean water from entering the combined system. Rainwater harvesting can also be a favorable alternative for infiltration-constrained locations.



DMA Plan

technology footprint
DMA
← flow direction

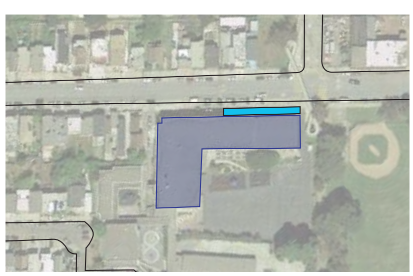
Rainwater Harvesting

Figure A.28
Parcel Technology Type Example: Downspout Disconnect

Proposed Downspout Disconnect

Downspout disconnection prevents stormwater collected on rooftops from entering the combined system. By disconnecting downspouts slightly above the ground surface allowing it to infiltrate into the ground. Disconnected downspouts can also potentially be incorporated into rainwater harvesting systems, by rerouting collected rainwater to rain barrels or cisterns.

technology footprint
DMA
← flow direction



DMA Plan

Downspout Disconnect

Figure A.29
Parcel Technology Type Example: Constructed Wetland

Proposed Constructed Wetlands

Constructed wetlands capture and treat stormwater runoff from single or multiple parcels. They are located in large open areas to accomodate stormwater runoff from the entire non-infiltration area of one or more parcels. They can also restore wildlife habitat and pose other environmental benefits.

technology footprint
DMA (simplified example)
flow direction

DMA Plan

Crissy Field, San Francisco

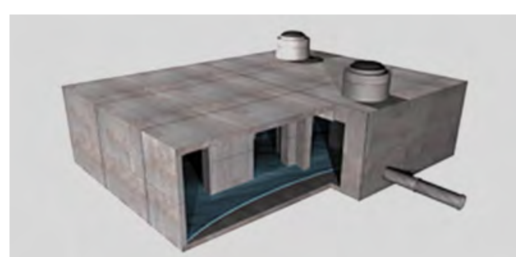
Figure A.30
Parcel Technology Type Example: Subsurface Stormwater Detention/Retention

Proposed Subsurface Detention

Stormwater detention/retention tanks allow for temporary storage of stormwater. Because they are relatively large, these tanks are placed under non-building uses such as parks and parking lots. For detention, they can return stormwater to the combined sewer system. For retention, they can also be designed to allow for infiltration. Both types can also be used as a part of rain water harvesting.

DMA Plan

technology footprint
DMA (simplified example)
flow direction



Subsurface Detention Tank (stormcapture.com)

Technology Combinations

In addition to these basic technology types, combinations of technologies can manage stormwater runoff. As is the case with streetscapes, parcel opportunities are ultimately constrained by existing development and the configuration of the surrounding built environment. Therefore, a combination of technology types may be required to fully manage the stormwater runoff from the LOS design storm within the constraints of the parcel's available space and physical characteristics.

<u>Parcel Opportunity Evaluation Process</u>

Similar to the streetscape opportunities analysis, the UWA team followed a three-step process to evaluate parcel characteristics and identify locations for stormwater runoff reduction opportunities. Because the implementation of projects on parcels has an added layer of complexity due to ownership, this analysis evaluates ownership and land use to inform whether projects could be implemented directly as capital projects or with a programmatic approach. The latter is further discussed in Subsection 2.3.4, Programs.

Step 1: Physical *Suitability Analysis*

This process consists of a GIS analysis that identifies parcels with ideal slope characteristics and sufficient available space to individually accommodate each technology type. Parcel attributes considered in this analysis include:

- Drainage Management Area
  - Parcel Size
- Slope
- Impervious Area
- Available Space
  - Rooftop Area
  - Hardscape Area

Drainage Management Area

DMA represents the area that each surface improvement is designed to fully or partially manage. For most parcels, the DMA is assumed to be the impervious area within the entire parcel property.

Slope

The UWA team estimated the average slope of each parcel using LIDAR data. The team then categorized slopes according to Table A.7. While slope requirements vary by technology type, DMAs with lower slope have greater design flexibility and are therefore generally considered more suitable for all technology types. Because bioretention facilities on slopes greater than 5% require check dams or similar flow control measures, all DMAs with an average slope less than or equal to 5% on 15 % of the parcel are considered highly suitable for bioretention. Slopes between 5% and

10% on 85% of a parcel are considered only somewhat suitable due to increased design considerations. Because permeable pavement does not have the option of slowing flow with surface obstructions so that it can percolate through the surface, the pavement must be built with slopes of 2% or less, requiring a parcel to exhibit large relatively flat areas to be considered highly suitable for permeable pavement (more than 15% of the parcel with slope less than or equal to 5% slopes). Similar to bioretention, rainwater harvesting also requires moderate slopes less than 5% so that flow velocity is low enough for stormwater to be captured and stored. Because blue and green roofs can be installed independent of ground-level surface conditions, they are not subject to specific slope requirements of the parcel. Instead, roof slope affects the suitability for blue and green roofs. In general, blue roofs require flat roofs that allow stormwater to pool, often in tray systems placed on the roof. A larger range of roof slopes can accommodate green roofs, as described in Table A.8. Figure A.31 shows the distribution of roof slopes in the Westside Drainage Basin.

Table A.7: Parcel DMA Slope Categories

Planter Slope Criteria (Non-Building Area)*	
≥15% of parcel w/ slope ≤ 5%	Highly Suitable
<15% of parcel w/ slope ≤ 5%	Somewhat Suitable (Limited)
≥98% of parcel w/ slope ≥ 10%	Infeasible
Permeable Pavement Slope Criteria (Non-Building Area)*	
≥12.5% of parcel w/ slope ≤ 5%	Highly Suitable
<12.5% of parcel w/ slope ≤ 5%	Infeasible
Rainwater Harvesting Slope Criteria (Non-Building Area)*	
≥15% of parcel w/ slope ≤ 5%	Highly Suitable
<15% of parcel w/ slope ≤ 5%	Somewhat Suitable (Limited)
≥98% of parcel w/ slope ≥ 10%	Infeasible
Blue Roof Slope Criteria	
Roof w/ slope ≤ 2%	Highly Suitable
Roof w/ slope >2%	Infeasible
Green Roof Slope Criteria	
Roof w/ slope <2%	Infeasible
Roof w/ slope 2-15%	Highly Suitable
Roof w/ slope 16-25%	Moderately Suitable
Roof w/ slope 26-45%	Somewhat Suitable (Limited)
Roof w/ slope >45%	Infeasible

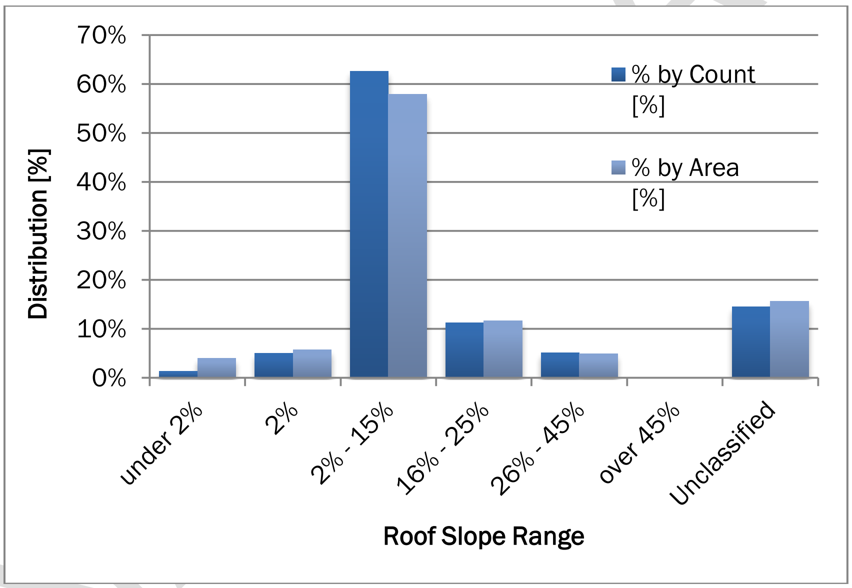
* Percent of parcel that must meet slope criteria

- Highly Suitable (green)
- Moderately Suitable (yellow)
- Somewhat Suitable (Limited) (orange)
- Infeasible (red)

Table A.8: Roof Slope Distribution in Westside Drainage Basin

Slope Range	Roof Count [#]	Roof Area [ac]	% by Count [%]	% by Area [%]
under 2%	814	95	1%	4%
2%	2,972	136	5%	6%
2%–15%	37,090	1,375	63%	58%
16%–25%	6,710	277	11%	12%
26%–45%	3,042	117	5%	5%
over 45%	23	2	0%	0%
Unclassified	8,620	372	15%	16%
WESTSIDE	**59,271**	**2,374**	**100%**	**100%**

Figure A.31: Roof Slope Distribution in Westside Drainage Basin



Notes:

1. Only includes roofs greater than or equal to 1,000 sf (0.02 ac).
2. Excludes roofs on parcels outside CSS areas.

Impervious Area

Because precise geospatial data pertaining to parcel land cover was not readily available, approximations were necessary to estimate impervious and roof areas. Using data provided by the San Francisco Department of Public Works, the UWA team assumed roof area to be equal to each parcel's associated building footprint. The team then derived non-roof impervious (hardscape) areas from analyzing land cover raster data. These approximations have been applied as an initial broad filter as part of the automated process for determining suitable parcel locations with respect to available space. The possibility to revisit and reclassify individual opportunity locations may occur in subsequent manual processes during the feasibility analysis and alternatives development tasks.

Available Space

Available space requirements vary by each technology type and must be separately assessed for each. To achieve economies of scale and identify high-impact capital improvement projects, the UWA team initially filtered parcels to exclude small residential and commercial parcels less than 1 acre. The following subsections describe the process and considerations used by the UWA team to estimate the available space for each technology in each DMA.

Bioretention Facilities and Constructed Wetlands

Per the *CCSF Hydrologic and Hydraulic Model Documentation Technical Memorandum* sizing criteria for managing excess flow, the criterion for minimum available space was set to 8% of total DMA. Since the criterion for managing excess flow is greater than 5% of DMA for managing CSDs, any bioretention facility sized for excess flow will also fulfill CSD requirements. To provide design flexibility and account for the uncertainties related to impervious coverage discussed above, parcels with 50% or more non-roof area are considered to have sufficient available space for bioretention facilities.

Depending on existing uses, parcels suitable for bioretention facilities may be suitable for constructed wetlands. In most cases, this would require a change in use to accommodate a larger footprint. This option may be considered in further detail in the Alternatives Phase and with the creek daylighting analysis to identify flows sufficient to sustain a wetland.

Permeable Pavement

Per sizing requirements in the *Stormwater Design Guidelines* (SFPUC 2009b), permeable pavement must be sized at a minimum 25% of its total DMA. To account for possible physical obstructions and other field constraints, the team assumed that half of all existing impervious hardscape can potentially be replaced with permeable paving. Therefore, only parcels where impervious hardscape area represents at least 50% of total parcel area are considered to be highly suitable with respect to adequate available space for permeable pavement.

Green and Blue Roofs

Available space for rooftop technologies is defined by overall rooftop area and moreover depends on architectural and mechanical building details with respect to roof drainage, load-bearing strength, and DMA. In the absence of this granular building information, it is infeasible to precisely determine available rooftop area beyond simply identifying roof slope and parcels where estimated total rooftop area constitutes at least 50% of total parcel area as the most suitable opportunity locations for green and blue roofs. Future project planning and design phases will need to more specifically evaluate structural capacity and the extent of roof DMA that can be managed on existing buildings. For this analysis, the UWA team estimates that 80% of a roof area could be managed by blue or green roofs.

Rainwater Harvesting and Downspout Disconnect

Similar to green and blue roofs, assessing a parcel's available space for rainwater harvesting facilities is contingent on understanding specific building and rooftop characteristics. The UWA team approximated available space by categorizing parcels whose rooftop area is a minimum 50% of total parcel area as suitable opportunity locations for rainwater harvesting and downspout disconnect.

Step 2: *Prioritization Analysis*

The UWA team analyzed potential synergies between the highly suitable parcels and the following data sources to prioritize parcel opportunities for further analysis. The same analysis was done for streetscape opportunities as detailed above.

- **System Needs:** areas where surface improvements would help mitigate excess stormwater
- **Interagency Projects:** potential project synergies
- **Public Feedback:** feedback on favored technologies and general locations for potential projects

Step 3: *Feasibility Analysis*

Parcel projects have an added layer of feasibility related to implementation. Since the SFPUC does not have control of parcels it does not own, ownership and jurisdiction influence feasibility. The evaluation of public parcels under different jurisdictions for capital improvement opportunities is discussed below. Private, as well as non-PUC public parcels, are considered in Section 2.3.4, Programs.

To identify opportunities for capital projects on parcels, the UWA team evaluated the suitability of parcels on public land in three groups: 1) parcels under SFPUC ownership, 2) parcels under other CCSF ownership, and 3) parcels under state or federal ownership. While public parcels present a general opportunity to manage surface runoff, the UWA team targeted evaluation of parcels for capital projects where the specific location of the parcel justifies a capital project as opposed to a targeted program that could manage the equivalent impervious area from a variety of locations (e.g., St. Mary's Park could be an important location for subsurface detention coupled with surface runoff reduction as opposed to the management of a total of five impervious acres on parks distributed across the Islais Creek urban watershed).

To identify these specific locations, the team identified parcels near combined sewer system needs that also called for additional runoff reduction and parcels with large impervious areas (more than 1 acre of impervious surface).

A.4 Programs

Programs include potential SFPUC or City incentives, SFPUC-funded grants, or existing stewardship programs that may be designed to address surface drainage and collection system needs to complement capital projects. An example is a downspout disconnection incentive program that is quantified to address LOS. Programs will have a targeted performance, eligibility requirements, and costs (including staff) associated with implementation. The UWA team evaluated programmatic opportunities for potential inclusion in watershed alternatives to be carried forward into the Alternatives Phase.

Program Goals

Incentive and grant programs provide an additional tool for the SFPUC to use in achieving the SSIP goals of runoff reduction to address excess stormwater and CSDs. SFPUC jurisdiction is limited to SFPUC property and the ROW, which make up approximately 30% of the City. The remaining 70% of the City falls under private ownership (e.g., residential, commercial, or industrial properties) or other City/state public property, all of which contribute stormwater to the combined system. The City passed the Stormwater Management Ordinance in 2010 requiring properties undergoing construction to manage their stormwater on site; however, the regulation only applies to the approximately 1% of properties that undergo development or redevelopment each year. For this reason, programs can provide a mechanism for the SFPUC to encourage stormwater management in those areas that are not affected by the ordinance, thus reducing the burden on the combined sewer system, often at a reduced cost that is shared with the property owner.

Programs identified in the UWA, therefore, have three main goals:

1. Manage impervious cover on properties not subject to the Stormwater Design Guidelines (SFPUC 2009b).
2. Manage above and beyond the Stormwater Design Guidelines requirements for public and private projects.
3. Educate residents and businesses about the combined sewer system challenges and stormwater management tools.

Programs Role in Achieving LOS Goals

UWA programs have the potential to contribute to meeting LOS goals on a watershed scale in many ways, bolstering hydrologic and hydraulic performance, as well as addressing community benefits and supporting long-term sustainability for the system. Each program will provide a unique set of quantifiable benefits and in aggregate will address LOS goals in the following ways:

LOS 1: Provide a Compliant, Reliable, Resilient, and Flexible System that can respond to Catastrophic Events

- Manage stormwater in the watersheds contributing to permitted CSD discharges

LOS 2: Integrate Green and Grey Infrastructure to Manage Stormwater and Minimize Flooding

- Target program activities in areas that experience flooding or contribute to CSD activations on public beaches

LOS 3: Provide Benefits to Impacted Communities

- Create jobs through program administration

- Activate job growth for green consultants by increasing projects in the private market
- Target Environmental Justice and Community Benefit neighborhoods

LOS 4: Modify the System to Adapt to Climate Change

- Allow for incremental change through implementation
- Respond as needs change over the life of the program by increasing or reducing funding without redefining the program

LOS 5: Achieve Economic and Environmental Sustainability

- Share stormwater management costs with public and private entities

LOS 6: Maintain Ratepayer Affordability

- Phase in programs and funding period to provide flexibility
- Provide incentives/linkages to potential stormwater fee/rate changes

<u>Existing SFPUC Incentives and Grant Programs</u>

The SFPUC currently operates various stewardship activities that include incentive and grant programs to encourage San Francisco residents and community groups to implement stormwater management and nonpotable reuse strategies on their own properties or through community-based neighborhood projects. Specifically, they encourage onsite stormwater management for properties without planned improvements and in sectors of the city where the regulatory requirements of the Stormwater Management Ordinance do not apply (i.e., small residential properties and most right-of-way retrofits). These activities represent an existing commitment to programmatic incentives by the SFPUC, and also provide potential models for SSIP incentives. Some of these programs could be used with minor modifications to address LOS. The following programs are current or recent subsidies provided by the SFPUC:

The *Rainwater Harvesting Subsidy Program* provided subsidies to homeowners to harvest rainwater on their properties. It sold out each of the four years it was available, and the program invested $70,000 reaching hundreds of homeowners. Through the program, the SFPUC sold 780 rainbarrels and 190 cisterns, and it gave away others at raffles and promotional events. These total more than 97,000 gallons of storage. The Urban Watershed Management Program is currently in the process of redesigning the program for future seasons.

The *Urban Watershed Stewardship Grants Program* provides grants to community-based projects that help manage stormwater using green infrastructure or pavement removal. The program has been operating since 2010 and has granted more than $1 million dollars. More than $500,000 of the grants was spent on San Francisco's public schools for rainwater harvesting programs, removal of impervious surfaces, and creation of outdoor classrooms and a watershed stewardship curriculum. More than 20 San Francisco Unified School District schools have rainwater harvesting systems as a result. The other $540,000 has been awarded to community groups for the removal of impervious surfaces and the installation of green infrastructure technologies in the streets of San Francisco.

The *Large Alternate Water Source Grant Program* provides grants to large retail users to implement onsite treatment and use of nonpotable water, including rainwater, stormwater, graywater, and foundation drainage, to reduce or offset the use of potable water. The grant program provides up to $250,000 for projects that encompass more than 100,000 square feet and implement onsite reuse to replace either all toilet-flushing demands or 40% of overall water demands; or up to $500,000 for district-scale projects that consist of two or more parcels that share treated alternate water sources and replace at least 3 MG per year of the project's potable water use. The SFPUC is currently accepting the first round of applications for the program.

The *Laundry to Landscape Graywater Program* encourages nonpotable water reuse. It subsidizes the cost of a laundry-to-landscape kit and provides technical assistance in the form of a workshop, in-home assistance, and a copy of the San Francisco Graywater Design Manual for Outdoor Irrigation.

The *Grant Assistance Program for Floodwater Management* encourages San Francisco property owners to install physical barriers or implement plumbing modifications that will minimize floodwater intrusion. The SFPUC has approximately $250,000 available in Fiscal Year 2013–2014 for reimbursement-eligible San Francisco property owners for two types of projects: flood barrier projects and sewer backflow preventer projects.

The *Low Impact Design and Nonpotable Reuse Grants Program* provided grants to support projects taking steps to reduce the inflow to the City's sewer system as well as those taking steps to provide for the beneficial reuse of stormwater, graywater, or wastewater for nonpotable uses. Grant funds were available for any institutional, residential, or commercial project that reduced the volume of flow to the City's sewer system or receiving water bodies, incorporating either a minimum of 10,000 gallons of rainwater storage capacity or 5,000 gallons per day of low-energy graywater or wastewater treatment and reuse capacity. This program is on hold due to funding limitations, but there is interest to continue the program if funds become available.

Mechanisms for Implementing Programs

Utilities commonly use incentives to encourage stormwater management on private properties, including grants, rebates, design services, development incentives, and stormwater fee discounts. The three types relevant to the SFPUC's SSIP are grants, rebates, and potentially design or installation services, described below. These incentive types could be used to encourage implementation of stormwater management in areas where, although the SFPUC does not have the jurisdiction to build or maintain projects, they would provide benefits to the collection system. These types of incentives are typically funded through operating dollars.

Grants

City funding to private owners to implement approved stormwater management designs based on performance criteria and suitability. Grants are typically awarded as a lump sum or cost per square foot of approved facility.

Upfront Rebates

Partial funding of contractor services or materials provided to private owners, thereby cutting their cost for implementing approved stormwater management technologies.

Reimbursement Rebates

Partial reimbursement funding for implementing approved stormwater management technologies based on identified collection system benefit.

The SFPUC Water Conservation Program has experience employing rebate mechanisms.

Design Services

Technical assistance for qualified property owners to develop stormwater management plans and specifications based on identified collection system benefit.

Other Mechanisms Not Considered Applicable for UWA

Other common mechanisms to incentivize stormwater management do not directly apply to the SSIP and UWA process. Although these may be appropriate for the SFPUC to consider in the future, they will not be analyzed further in the UWA process:

- *Development incentives:* These are nonmonetary benefits for developers, such as fast track reviews or zoning upgrades.

  As part of the Stormwater Management Ordinance, all building permits must have signoff from the SFPUC before issuance. To provide development incentives, the SFPUC would need to work with the City family, and in particular the Planning Department, which administers zoning and permits, to determine shared goals and then proceed with legislation. The Stormwater Management Ordinance already requires new and redevelopment to manage stormwater onsite, limiting the value of this type of incentive.

- *Stormwater fee discounts:* Billing discounts for reducing the amount of stormwater entering the combined sewer system.

  SFPUC doesn't currently charge ratepayers separately for stormwater services, but in the future if a stormwater fee is implemented, this mechanism could be considered. This effort is currently under development through the 5-year rate study conducted by the SFPUC's Finance Division.

<u>Case Studies</u>

Several cities across the country provide incentives for stormwater management projects. These typically address different land uses and impervious cover types, as well as provide technical assistance to encourage quality participation.

Large-Scale Stormwater Improvement Programs

These examples provide grants to commercial, institutional, and multi-family parcel owners to retrofit properties to manage stormwater on site.

- The Portland Community Watershed Stewardship Grant (1995–present) awards grants up to $10,000 for community projects to create green space, improve stormwater function, and provide environmental education.
- New York City Green Infrastructure Grant Program (2011–present) awards grants to fund design and construction costs of green infrastructure projects that manage 1 inch of stormwater runoff from impervious area through blue roofs, rain gardens, green roofs, porous pavement or rainwater harvesting in the combined sewer area. The Department of Environmental Protection will award up to $6 million for 2014 grantees.
- The Philadelphia Stormwater Management Incentives Program (2012–present) awards grants up to $100,000 per impervious acre managed to nonresidential properties to manage 1 inch of stormwater runoff on site through green stormwater management practices.

Residential Stormwater Programs

These examples address residential properties through a range of incentive mechanisms.

- The Seattle Residential Rainwise Program (2010–present) provides rebates in targeted combined sewer overflow basins for residents to install rain cisterns or rain gardens using trained contractors endorsed by the City for installation.
- The Washington D.C. RiverSmart Homes Program (2008–present) provides home audits and contractor installation of approved stormwater management facilities with resident co-pay to the contractor.

Eco Roof Programs

These examples provide grants to incentivize green roofs for multiple property types.

- The Portland Ecoroof Program (2009–present) provides an incentive of up to $5 per square foot of Ecoroof projects, if approved.
- The Chicago Green Roof Program (2005–2007) provided $5,000 grants for green roof projects on sites less than 10,000 square feet.
- The Chicago Green Roof Improvement Fund (2006–2008) targeted a specific district in downtown Chicago, providing up to $100,000 for projects that covered at least 50% of the roof.

Technical Assistance Programs

- Blue Water Baltimore: Water Audit Program (2010–present) performs water audits on homes, institutions, and businesses within target watersheds and provides recommendations for improvements, as well as opportunities to qualify for financial incentives.

Some of the key lessons learned from other city's experiences include:

- Programs should be straight forward and simple to pursue.

- Diversify the incentive mechanisms to reach different stakeholders.
- Smaller programs can achieve more impact by defining boundaries around areas that would realize the most benefits from implementation.
- Dedicated administrative support ensures successful implementation.
- Providing design standards helps owners with project installation.
- Accounting for maintenance and inspection practices is critical for long-term success.

Physical Suitability Analysis

Building on the parcel suitability analysis described in the Parcel Opportunities subsection, the UWA team identified lands under private ownership or under the jurisdiction of other City, state, and federal agencies. To identify suitable areas for managing impervious surfaces on these parcels, the UWA team evaluated impervious cover, broken into rooftop and hardscape, and analyzed specific hardscape uses such as parking and athletic fields. The team analyzed impervious areas based on land use type to determine suitability for potential programs. Section 3 describes the results of this analysis, including the amount and type of impervious area owned by the SFPUC, other city agencies, state and federal entities, and private owners.

To evaluate the efficacy of specific program opportunities, the UWA team estimated the hydraulic benefits from potential programs by randomly selecting parcels from the pool of feasible, eligible parcels based on an estimated participation rate.

A.5 Policies, Regulations, and Business Practices

Whereas the programmatic incentives described above allow property owners to choose whether they would like to participate, policies and regulations require landowners or the SFPUC to comply. This section also includes new business practices, which are commitments by the SFPUC to change, and ultimately improve, internal operations.

SFPUC Policies and Regulations

SFPUC uses policies and regulations to involve private landowners in better management of water and wastewater resources. The UWA team, therefore, identified specific policies and regulations that can complement SSIP capital projects in meeting SSIP LOS.

The SFPUC has already implemented the following policies and regulations to improve watershed health and reduce the burden on the collection system:

- Since the passage of the *Stormwater Management Ordinance* in 2010, the program has developed a robust project review process for private developments. As of January 2014, the program has contacted more than 400 potential projects that may need to follow the stormwater design guidelines (SDGs). Of these, over 110 projects have submitted stormwater control plans, received guidance on green infrastructure approach and technical assistance, and been evaluated through an ongoing design review and approvals process.

- For those sites where compliance with the ordinance is difficult or cost-prohibitive, the SFPUC is developing procedures for SDG onsite modified compliance and expects to complete that effort this year. This will allow sites with limited space or subsurface constraints to comply onsite with a modified retention/detention ratio. Following this effort, the SFPUC will consider other mechanisms for modified compliance, including fee in lieu, offsite compliance, and stormwater banking.
- The SFPUC also partnered with the Board of Supervisors to support the development of the San Francisco *Onsite Water Reuse Ordinance*, which was adopted by the San Francisco Board of Supervisors in September 2012. The ordinance creates a regulatory framework and streamlined permitting process for commercial, multi-family, and mixed-use developments in San Francisco to collect, treat, and reuse water for toilet flushing, irrigation and other nonpotable uses.
- The SFPUC Wastewater Capacity Charge requires property owners proposing new connections or additional demands for wastewater collection to pay a capacity charge to help offset the cost of facilities to serve these additional needs.
- Residential wastewater service charges are based on a flow factor percentage of the water meter assumed to return to the sewer as wastewater. Customers can apply for a Flow Factor Adjustment if they believe more than 10% of water is used for irrigation or other reuse and not returned to the sewer.
- The SFPUC rate study is analyzing the potential to restructure the wastewater rates in order to separate sewage and stormwater fees. This separation allows for future credit opportunities for properties that manage their stormwater onsite. The study recommends continuing to explore the potential of a wet-weather-related charge, including additional analysis and outreach to engage public interest, as well as implementing a grant program to collect information about the performance of green infrastructure.
- The District Scale study is an Urban Watershed Management Program – Water Enterprise partnership with the goal of allowing buildings to move nonpotable water across property lines for beneficial reuse. The inter-enterprise team amended the San Francisco nonpotable ordinance to allow this in October 2013.

<u>Case Studies</u>

Similar to San Francisco, several cities across the country passed stormwater management ordinances requiring new development and redevelopment to manage stormwater on site. Cities also use policy and regulations to achieve stormwater management goals. Some of the examples through regulation and policy include:

- Portland's Mandatory Downspout Disconnect (1999) required owners of eligible properties located in mandatory program areas to disconnect their downspouts within one year following written notice from the city. The city achieved an 86% completion.

- Toronto Green Roof By-law (2010–present) requires green roofs for all new development above 200 square meters. Coverage requirement ranges from 20 to 60% of the available roof space, and the law affects all new application made after January 31, 2010.
- Seattle's floor-area-ratio bonus offers a floor-area-ratio bonus in its building code. Developers may build an extra 3 square feet per square foot of green roof they construct without additional permits.
- Portland's floor-area-ratio bonus offers the same bonus as Seattle and a grant reimbursement of up to $5 per square foot for reducing stormwater infrastructure with a green roof.
- Minneapolis's Stormwater Credit is provided to any building that improves their onsite stormwater management. Properties receive a 50% credit against mandated stormwater usage fees paid to the city.

Some of the key lessons learned from other cities' experiences include:

- While a mandatory approach worked to achieve high participation rates in a short period of time, a voluntary approach is more successful in meeting goals of community engagement and education (Amber Clayton, City of Portland Environmental Services, Mandatory vs. Voluntary Downspout Disconnect)
- Providing tools and resources to assist landowners is important for voluntary or mandatory programs

<u>SFPUC Business Practices</u>

Ultimately, the SFPUC is responsible for the collection, treatment, and discharge of the City's wastewater. Along with programs and policies to enhance these functions, changes to SFPUC's own business practices and procedures can better manage water and wastewater resources and infrastructure. Optimizing staff and resources can be an opportunity to better manage water resources, sometimes without additional capital investments.

Considering the existing policies and practices, as well as lessons learned from other City's experience, Chapter 3 outlines opportunities for policies, regulations, and new business practices to compliment the capital projects and programmatic opportunities.

APPENDIX B

DRAFT PUBLIC OUTREACH SUMMARY MEMORANDA

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SSIP
SEWER SYSTEM IMPROVEMENT PROGRAM

Memorandum

To: **SSIP Urban Watershed Assessment Project Management Team**

Cc: **SSIP Community Benefits Team**

From: **SSIP PMC Communications Team**

Subject: **Westside Watersheds Outreach Metrics Report – UWA Characterization and Opportunities Phases**

Date: **11.25.2014**

Background

The Urban Watershed Assessment (UWA) team has completed the Characterization and Opportunities Phases of public outreach for the Westside Watersheds, which include Richmond, Sunset and Lake Merced watersheds. The main objectives of the outreach are to: 1) educate the public on the Sewer System Improvement Program and Urban Watershed Assessment planning process; 2) gather stakeholder input on grey and green infrastructure technology preferences, potential project locations, and values; and 3) engage a broad cross-section of San Francisco stakeholders representing geographic, racial, ethnic, and income diversity; residents; employees; and business owners.

Outreach conducted in the Characterization Phase provided the community with the opportunity to learn more about San Francisco's sewer system challenges and needs in the city's three Westside Watersheds and how the Urban Watershed Assessment planning process will help address such challenges as localized flooding, aging infrastructure, seismic safety and reliability, and water quality in the Bay and Ocean. The main outreach activities included:

- Westside Informational Open House – June 12, 2014
- Westside Characterization Webinar – August 6, 2014
- In-person during stakeholder meetings, tabling events and tours – Ongoing

Outreach conducted in the Opportunities Phase focused on interactive engagement opportunities for the public to help brainstorm future grey and green infrastructure upgrades to San Francisco's combined sewer system. The main outreach activities included:

- Urban Watershed Planning Game Workshop – September 13, 2014
- Online and in-person door-to-door/intercept Westside Watersheds Opportunities Survey (www.westside.metroquest.com) – May 20, 2014 – September 22, 2014
- In-person feedback during stakeholder meetings, tabling events and tours – Ongoing

Notification of these opportunities was announced through multiple techniques, including email notification, biweekly wastewater e-newsletter, social media, distribution of postcards, staffing tables at neighborhood events citywide and generating media attention through press releases. Notification and input opportunities were available in English, Chinese, and Spanish, including translation of the entire Westside Opportunities Survey website and iPad intercept survey.

Stakeholder meetings and outreach throughout both phases included personal email notification of events, phone calls, interviews and in-person meetings. The UWA Team contacted more than 70 community groups and individuals throughout the process and met with four neighborhood associations (Lincoln Park Neighborhood Association, Lake Merced Task Force, Forest Hill Neighborhood Association and Sunnyside Neighborhood Association).

The UWA Team deployed a survey team to conduct in-person door to door and intercept surveys. Given the high percentage of single family residences within the Lake Merced, Richmond, and Sunset Watershed Districts, the bulk of surveys were conducted through door-to-door canvassing. Survey representatives made additional efforts to obtain feedback from residents living within areas designated as disadvantage communities. These areas are listed below:

Richmond

- Inner Richmond Farmers'Market - Clement St. between 2nd and 4th Ave.
- Neighborhoods between Fulton and Lake Streets - 25th Ave. and Arguello Blvd. Lake Merced

Sunset

- Sunset Recreation Center - 2201 Lawton St.
- Golden Gate Park – Near baseball fields along Martin Luther King Jr. Dr.
- Inner Sunset Farmers' Market - 8th Ave. between Judah and Irving St.)
- Neighborhoods between Noriega and Taraval Streets - Sunset Blvd and 19th Ave.
- Neighborhoods between Kirkham and Noriegna - Sunset Blvd and 19th Ave.
- Neighborhoods between Irving and Lawton Streets - 43rd Ave. and Sunset Blvd.

Lake Merced

- Neighborhoods between Ocean Ave. and Grafton Ave./ Garfield St.
- Westwood Park
- Stonestown Galleria - 3251 20th Ave.
- San Francisco State University - 1600 Holloway Ave.

More than 80 members of the public participated in public meetings and stakeholder meetings. The team also received over 1400 Westside Watersheds Opportunities survey submittals, hosted a webinar presentation to approximately 20 individuals, and distributed approximately 1000 postcards throughout the watersheds during intercept survey outreach, community events and stakeholder meetings. A summary of the public input collected through these outreach efforts are summarized in the "Westside Community Input Summary Report, 2014" found at sfwater.org/urbanwatersheds.

The following memorandum reports on the public engagement performance metrics for the UWA Westside Characterization and Opportunities Phases. The use of these outcome-based metrics are in response to the SFPUC Environmental Justice Policy 09-0170; Community Benefits Res. 11-0006 policy; and the 2012 Commission endorsed policy to "inform, engage, and empower stakeholders and neighborhood partners during the whole life cycle (planning, design, and construction)."

Outcome-based performance metrics are designed to measure performance in respect to best management practices for public participation in government planning processes.

Outcome-Based Performance Metrics for Public Engagement and Outreach

This section provides an overview of the public engagement performance metrics defined for the Urban Watershed Assessment and reports on the results of their application to the outreach conducted for the Westside Watersheds during the UWA Characterization and Opportunities Phase. These measures are grouped into three objectives:

- **Information** – Inform the public early, clearly, and continuously using a variety of methods to involve and engage.
- **Equity** – Provide equitable access to information and decision-making.
- **Responsiveness** – Incorporate and address feedback into the technical and decision-making process.

Each of the performance measures include indicators that define the metric, target or activity for each metric, and results in a table that summarizes whether the indicator/target was achieved.

Performance Metric Reporting Tables

INFORMATION

Ample Notification			
Indicator 1	**Target/Activity**	**Result**	**Attainment Status**
Affected parties feel that ample notice was provided of public meetings	Notification more than 2 weeks to event; Email, meetings, social media, collateral materials, phone call invitations to community representatives	Notification exceeded minimum deadline	
June 12 Open House	Notice by 5/29/14	Sent 5/20/14	
August 6 Webinar	Notice by 7/23/14	Sent 7/15/14	
Online/Intercept Survey	Ongoing	Sent 5/20 – 9/10	
September 13 Planning Game	Notice by 8/30/14	Sent 8/5/2014	
Stakeholder Meetings	N/A	N/A	N/A

Comment(s): The public workshop and online survey were notified together through emails, SSIP e-newsletters, flyers and postcards. The survey was promoted in meeting notices starting with the open house. Below is a summary of key notices and their reach:

Westside Open House eBlast
Date Sent: 5/20/2014
Sent: 4,772
Opened: 1,515 (32.4%)

Westside Watersheds Webinar Story in Sewer eNews
Date Sent: 7/15/2014
Sent: 4,072
Opened: 1,094 (27.2%)
Link Clicks: 22

Westside Watersheds Webinar Story in Sewer eNews
Date Sent: 7/30/2014
Sent: 4,052
Opened: 1,191 (29.7%)
Link Clicks: 19

Planning Game Westside Watershed eBlast
Date Sent: 8/5/2014
Sent: 4,103
Opened: 1,182 (29.1%)

Facebook Paid Advertising
Dates Ran: (8/19/2014 – 8/25/2014) & (9/2/2014-9/8/2014)
Total reach: 10,502 San Francisco residents
Total engagement: 152 ad clicks

Facebook Unpaid Post
Unpaid #TriviaTuesday themed post on SFWater Facebook page promoting the event.
Total reach: 249 Francisco residents
Total engagement: 7 post clicks

Diverse Methods to Engage			
Indicator 2	**Target/Activity**	**Result**	**Attainment Status**
Participants are involved using multiple techniques	Four separate techniques are used to involve the public	Five total separate methods used to involve the public	●
June 12 Open House	Public meeting	Approximately 30 participants	●
August 6 Webinar	Online	20 participants	●
Online/Intercept Survey	Online and in-person	More than 1400 participants	●
September 13 Planning Game	Public meeting	Approximately 50 participants	●
Stakeholder Meetings	In-person meetings, emails and phone calls	Reached 70 community groups	●

Comment(s): The public workshop, webinar, stakeholder meetings and online/intercept survey provided a diverse and broad range of opportunities for the public to participate in the process. This allowed the public to choose how they would like to participate according to their level of interest, time commitment and comfort with different formats and technologies.

Valuable to Participants			
Indicator 3	**Target/Activity**	**Result**	**Attainment Status**
Value of method used - Reported amount of learning from participants	50% of participants agree the method was of value in learning and capturing their input	Average of 78.5%	●
June 12 Open House	50%	No data captured	N/A
August 6 Webinar	50%	No data captured	N/A
Online/Intercept Survey	50%	67%	●
September 13 Planning Game	50%	90%	●
Stakeholder Meetings	50%	No data captured	N/A

Comment(s): The overall attainment status is achieved. Value is measured by those reporting they learned “a lot” or “some” through feedback surveys. The primary intent of webinar, open house and stakeholder meetings is to inform and get the word out.

Performance Metric Reporting Tables

EQUITY

Accessibility of Information			
Indicator 4	**Target/Activity**	**Result**	**Attainment Status**
Access to information and participation opportunities by persons with disabilities	100% of meetings, events are accessible to persons with disabilities	Achieved 100%	●
June 12 Open House	Yes	Yes	●
August 6 Webinar	Yes	Yes	●
Online/Intercept Survey	Yes	Yes	●
September 13 Planning Game	Yes	Yes	●
Stakeholder Meetings	No data captured	No data captured	N/A
Comment(s): The open house and planning game venues were ADA compliant. Stakeholder meetings were held at locations convenient for stakeholders to attend.			

Convenience of Meetings – Transportation			
Indicator 5	**Target/Activity**	**Result**	**Attainment Status**
Convenience of meetings and events to public transportation	100% of meetings are within 1/8 mile of transit stop	Achieved 100%	●
June 12 Open House	Yes	Yes	●
August 6 Webinar	N/A	N/A	N/A
Online/Intercept Survey	N/A	N/A	N/A
September 13 Planning Game	Yes	Yes	●
Stakeholder Meetings	No data captured	No data captured	N/A
Comment(s): Limited parking was available at the open house and planning game and the location was transit accessible via MUNI 16, 28, 29, 71 and N-Judah Street Line. Stakeholder meetings were held at locations convenient for stakeholders to attend.			

Convenience of Meetings – Location			
Indicator 6	**Target/Activity**	**Result**	**Attainment Status**
Convenience of meetings and events locations	Event/meeting was held at a convenient location	Achieved through a variety of locations to participate	●

June 12 Open House	Central Westside location with parking and transit options	SF County Fair Bldg location met as targeted	●
August 6 Webinar	Available at any location with computer/internet access	Met as targeted	●
Online/Intercept Survey	Available at any location with computer/internet access; Canvassing at multiple locations in each watershed	Canvassing at community events, markets, public parks, street intercepts, transit stops, libraries and door-to-door	●
September 13 Planning Game	Central Westside location with parking and transit options	SF County Fair Bldg location met as targeted	●
Stakeholder Meetings	Held at locations/times as requested by stakeholders	Met as requested	●

Comment(s): Although no data was captured on participants' opinion on the convenience of the open house and workshop location at the SF County Fair Bldg in Golden Gate Park, the location is well-known and central within the Westside Watersheds. The webinar and online survey provided opportunities for the community to participate at home, work or the location of their choosing.

Convenience of Meetings – Time

Indicator 7	Target/Activity	Result	Attainment Status
Convenience of meetings and events times	Event/meeting was held at a convenient time during non-workday hours	Achieved through multiple event times and ongoing online access	●
June 12 Open House	Early evening mid-week meeting	Thursday 5:30 – 7:30 PM	●
August 6 Webinar	Ongoing availability	Lunch hour and recorded for ongoing online access	●
Online/Intercept Survey	Available 4 weeks	Available for 18 weeks	●
September 13 Planning Game	Held on a non-workday and during the daytime for safety and participant availability	Saturday 10:00 AM–1:30 PM	●
Stakeholder Meetings	Upon Request	Met as requested	●

Comment(s): Although no data was captured on participants' opinion on the convenience of the time for each event, the online survey and webinar was available for participants to engage at their convenience if they could

not attend the open house. The 3.5 hour workshop format required the event be held on a Saturday morning to address work week schedule conflicts and late night safety concerns. Lunch was provided.

Availability of information in languages other than English			
Indicator 8	**Target/Activity**	**Result**	**Attainment Status**
Availability of information in languages other than English	Information is provided in languages other than English where the population comprises a high proportion of non-English speakers; Translators are available at public mtgs.	Yes – Spanish, Chinese	●
June 12 Open House	Spanish, Chinese upon request	No translation required	N/A
August 6 Webinar	Available upon request	No translation required	N/A
Online/Intercept Survey	Spanish, Chinese	Yes – Spanish, Chinese	●
September 13 Planning Game	Spanish, Chinese upon request	Chinese translators available at meeting - No translation required	●
Stakeholder Meetings	Available upon request	No translation required	N/A
Comment(s): UWA fact sheet and postcards are available in Spanish and Chinese at public meeting/events. Chinese and Spanish translators conducted intercept surveys throughout the watersheds. Chinese translator was available at the meeting but was not needed.			

Geographic Distribution			
Indicator 9	**Target/Activity**	**Result**	**Attainment Status**
Geographic dispersion of involvement	At least one meeting or event located within the Westside Watersheds	Specialized efforts targeted within Westside Watersheds	●
June 12 Open House	Location central to the three Westside Watersheds	Yes – SF County Fair Bldg, Golden Gate Park (Richmond/Sunset Watersheds)	●

August 6 Webinar	Online	Yes – Online	●
Online/Intercept Survey	Approximately 400 online/intercept surveys per watershed (targeting disadvantaged communities)	Yes – see comment below	●
September 13 Planning Game	Location central to the three Westside Watersheds	Yes – SF County Fair Bldg, Golden Gate Park (Richmond/Sunset Watersheds)	●
Stakeholder Meetings	Locations chosen by stakeholders	Yes, as requested	●

Comment(s): Fourteen individuals completed the survey for the June 12 Open House. Below are the watershed zip codes as reported:

- 4 respondents (28.6%) indicated a Richmond zip code
- 7 respondents (50%) indicated a Sunset zip code
- 2 respondents (14.3%) indicated a Lake Merced zip code
- 1 respondent (7.1%) indicated Islais Creek zip code

In addition to online surveys submitted by the public, intercept surveyors conducted surveys with residents who lived within each of the three Westside Watersheds (Richmond, Sunset and Lake Merced) and were accompanied by Chinese or Spanish translators. Of the 1435 who submitted an online/intercept survey, participants reported the following watershed zip codes (note not all participants record their zip):

- 380 respondents (26.5%) indicated a Richmond zip code
- 389 respondents (27.1%) indicated a Sunset zip code
- 396 respondents (27.6%) indicated a Lake Merced zip code
- 270 respondents (18.8%) did not indicate a zip code

The workshop was located central in the three Westside Watersheds and near the Richmond/Sunset Watersheds boarder with transit access from all Westside Watershed neighborhoods. Below is a summary of the breakdown of reported zip codes from the participants at the planning game:

- 3 respondents (7%) reported a Richmond zip code
- 14 respondents (34%) reported a Sunset zip code
- 5 respondents (12%) reported a Lake Merced zip code
- 9 respondents (22%) reported a Bayside zip code
- 10 respondents (24%) reported non-SF or blank

Diversity – Racial Distribution

Indicator 10	**Target/Activity**	**Result**	**Attainment Status**

Diversity of participants in public engagement events	Target reflects census racial distribution demographics of the specific Westside Watersheds with the goal of reaching at least 50% of each census demographic number	All demographics were represented in the survey. African Americans were underrepresented at the planning game.	🟡
June 12 Open House	N/A	N/A	N/A
August 6 Webinar	N/A	N/A	N/A
Online/Intercept Survey	Census demographics for each Watershed	Met 5 out of 5 targets (at least 50% of census)	🟢
	R S LM	R S LM	🟢
African American	2% 2% 8%	3% 3% 7%	🟢
Asian American/Pacific Islander	38% 48% 43%	26% 38% 33%	🟢
Caucasian	49% 40% 31%	54% 44% 31%	🟢
Hispanic/Latino	7% 6% 14%	10% 8% 16%	🟢
Other	4% 4% 4%	7% 6% 9%	🟢
September 13 Planning Game	Census demographics Westside watersheds	Met 4 out of 5 targets (at least 50% of census)	🟡
African American	2.8%	0%	🟡
Asian American/Pacific Islander	44.5%	30%	🟢
Caucasian	41.0%	57.5%	🟢
Hispanic/Latino	7.7%	7.5%	🟢
Other	4.0%	5.0%	🟢
Stakeholder Meetings	N/A	N/A	N/A

Comment(s): As indicated above, the Westside Watersheds demographic was achieved for the online/intercept surveys. However, African Americans were underrepresented for the September 13 planning game, however the representation deficit was made-up through surveys. Survey participants from the Open House indicated Asians/Pacific Islanders (5) and Caucasians (9), however there was not a large enough sample size for metrics analysis.

Diversity – Age Distribution			
Indicator 11	**Target/Activity**	**Result**	**Attainment Status**
Diversity of participants in public involvement events	Target reflects census racial distribution demographics of the specific Westside Watersheds with the goal of reaching at least 50% of each census demographic number	19 and under were underrepresented in survey and planning game	🟡

June 12 Open House	N/A	N/A	N/A
August 6 Webinar	N/A	N/A	N/A
Online Intercept Survey	Census demographic for each watershed	Met all 4 targets (at least 50% of census)	●
AGE	R S LM	R S LM	
19 & Under	16% 17% 23%	4% 7% 8%	●
20 - 24	8% 7% 12%	12% 14% 29%	●
25 - 39	27% 23% 20%	37% 33% 21%	●
40 - 54	21% 22% 19%	28% 24% 24%	●
Over 55	27% 30% 26%	19% 22% 18%	●
September 13 Planning Game	Census demographic for Westside Watersheds	Met 4 out of 5 targets (at least 50% of census)	●
19 & Under	18%	0%	●
20 - 24	8%	14.6%	●
25 - 39	24%	26.8%	●
40 - 54	21%	24.4%	●
Over 55	29%	34.1%	
Stakeholder Meetings	N/A	N/A	N/A

Comment(s): All targets for age demographics were met for both the workshop and survey, with the exception of those reporting 19 & under. It should be noted, the online survey and planning game is most appropriate for high school ages and above so underrepresentation is expected. Specialized outreach methods may need to be utilized if the 19 & under category is determined to be a target group.

Diversity – Household Income Group Distribution

Indicator 12	**Target/Activity**	**Result**	**Attainment Status**
Diversity of participants in public involvement events	Target reflects census racial distribution demographics of the specific Westside Watershed with the goal of reaching at least 50% of each census demographic number	Slight underrepresentation of Under $25,000 in survey and planning game. Over $150,000 underrepresented in survey	●
June 12 Open House	N/A	N/A	N/A
August 6 Webinar	N/A	N/A	N/A

Memorandum

Online/Intercept Survey	Census demographics for each Westside Watershed			Met 3 out of 5 targets (at least 50% of census)			🟡
INCOME	R	S	LM	R	S	LM	
Under $25,000	49%	13%	15%	4%	11%	15%	🟡
$25,000 - $50,000	2%	15%	15%	24%	22%	21%	🟢
$50,000 - $100,000	38%	28%	26%	23%	23%	22%	🟢
$100,000 - $150,000	7%	19%	19%	8%	18%	11%	🟢
Over $150,000	4%	24%	24%	20%	8%	8%	🟡
Online and Intercept Survey	Census demographics for each watershed			Met 4 out of 5 targets (at least 50% of census)			🟡
Under $25,000	30%			12%			🟡
$25,000 - $50,000	9%			13%			🟢
$50,000 - $100,000	33%			23%			🟢
$100,000 - $150,000	14%			21%			🟢
Over $150,000	15%			10%			🟢
Stakeholder Meetings	N/A			N/A			N/A

Comment(s): Under $25,000 in Richmond Watershed surveys. Over $150,000 was underrepresented in Sunset and Lake Merced Watersheds surveys.

Performance Metric Reporting Tables

RESPONSIVENESS

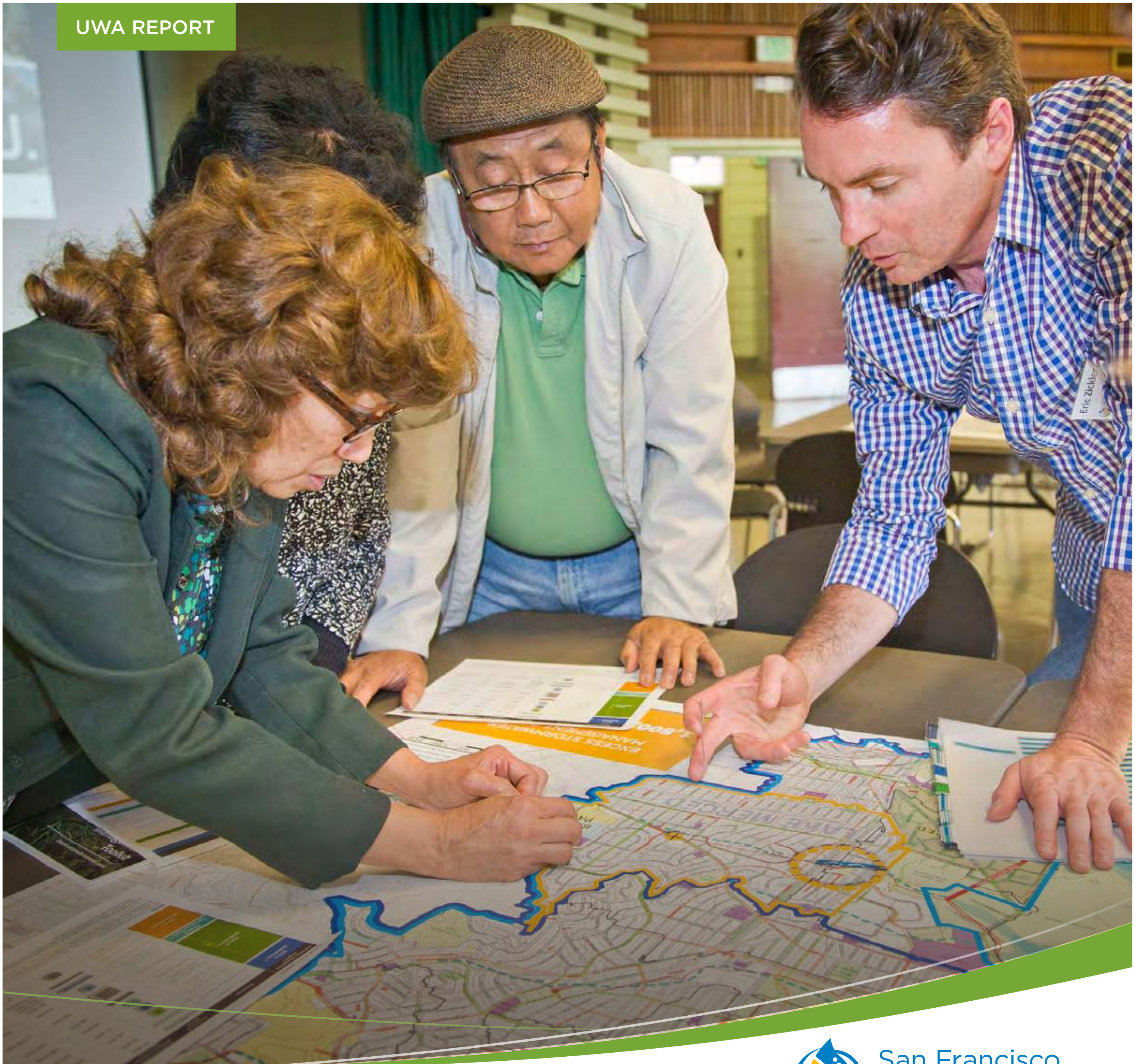
Engagement feedback informing technical product			
Indicator 13	**Target/Activity**	**Result**	**Attainment Status**
Engagement feedback informing technical product	Feedback directly reflected in project process and product	Community input was considered in the development of Opportunities (see Westside Drainage Basin Opportunities TM)	●
June 12 Open House	Informational only	N/A	N/A
August 6 Webinar	Informational only	N/A	N/A
Online/Intercept Survey	Yes	Yes – Reflected in Opportunities	●
September 13 Planning Game	Yes	Yes – Reflected in Opportunities	●
Stakeholder Meetings	Informational only	N/A	N/A
Comment(s): Two methods were used to collect input into the technical process. The remaining methods are informational and awareness initiatives.			

Organizations and individuals feel that their input was considered			
Indicator 14	**Target/Activity**	**Result**	**Attainment Status**
Organizations and individuals feel that their input was considered	Percentage of individuals and organizations feel that their input was considered	No data captured	**N/A**
Comment(s): The team will consider capturing data on this metric during the Alternatives Phase.			

Next Steps

The next round of public outreach and engagement for the Westside will be for the Westside Watersheds Alternatives Phase. Efficiencies, cost savings, lessons learned, and addressing gaps in attainment from the previous round will be applied. This summary is intended to be shared with decision-makers, used to inform outreach and engagement practices, and influence the development of UWA alternatives in the next phase of the planning effort.

UWA REPORT



San Francisco
Water Power Sewer
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SEWER SYSTEM IMPROVEMENT PROGRAM | Grey. Green. Clean.

Westside Community Input Summary Report

URBAN WATERSHED WORKSHOP AND SURVEY RESULTS | Richmond, Sunset, & Lake Merced Watersheds

Winter 2014-2015

Introduction

The Urban Watershed Assessment (UWA) is the Sewer System Improvement Program's planning process that will shape the next generation of collection system improvements. San Francisco has eight distinct urban watersheds, five on the Bayside (North Shore, Channel, Islais Creek, Yosemite and Sunnydale) and three on the Westside (Richmond, Sunset and Lake Merced). Each has its own unique sewer system challenges and potential solutions. This comprehensive plan will guide investments for the next 20+ years of sewer and stormwater management upgrades to address sewer system challenges in each of San Francisco's urban watersheds.

This Summary UWA Report highlights key community input collected during the Opportunities Phase of work for the Westside Watersheds. The report provides a snapshot of the project ideas generated during the Urban Watershed Assessment Community Workshop Planning Game on September 13, 2014 and feedback on green infrastructure that was collected through the online and inperson survey between May 20, 2014 - September 22, 2014. Project ideas and survey feedback will be considered by the SFPUC and evaluated for technical feasibility and cost effectiveness as part of the Urban Watershed Assessment process.

Workshop Purpose & Objectives

The purpose of this phase of outreach for the Westside Watersheds is to understand the values the community has for managing stormwater to reduce flooding and combined sewer discharges (CSD), and identify project ideas generated by the community for further technical analysis. The workshop focused on stormwater management challenges and potential solutions in the three Westside watersheds. The workshop provided an opportunity for participants to:

- Understand the cost, benefits and trade-offs of different solutions;
- Provide input on planning priorities and solution preferences; and
- Generate project ideas for further analysis


Workshop participants playing the Planning Game

San Francisco's Urban Watersheds

Approximately 50 members of the public representing the (Westside) watershed participated in the workshop at the San Francisco County Fair Building in Golden Gate Park. The workshop included a presentation on the characteristics of the Westside Watersheds followed by small group breakout teams to "play" the Urban Watershed Planning Game.

Each group worked as a team to meet the stormwater management goals of their watershed challenge area to reduce flooding and combined sewer discharges. Participants were given game pieces representing different green and grey stormwater management technologies, and then "played" pieces to achieve excess stormwater management targets and reduce combined sewer discharges at beaches within the budget provided. The game wrapped up with a discussion of potential solutions and voting on favorite ideas, after which each team presented their top recommendations to the larger group.

> "It was a fun way to have everyone involved in the process and learn about the issues involved."
>
> ~ workshop participant

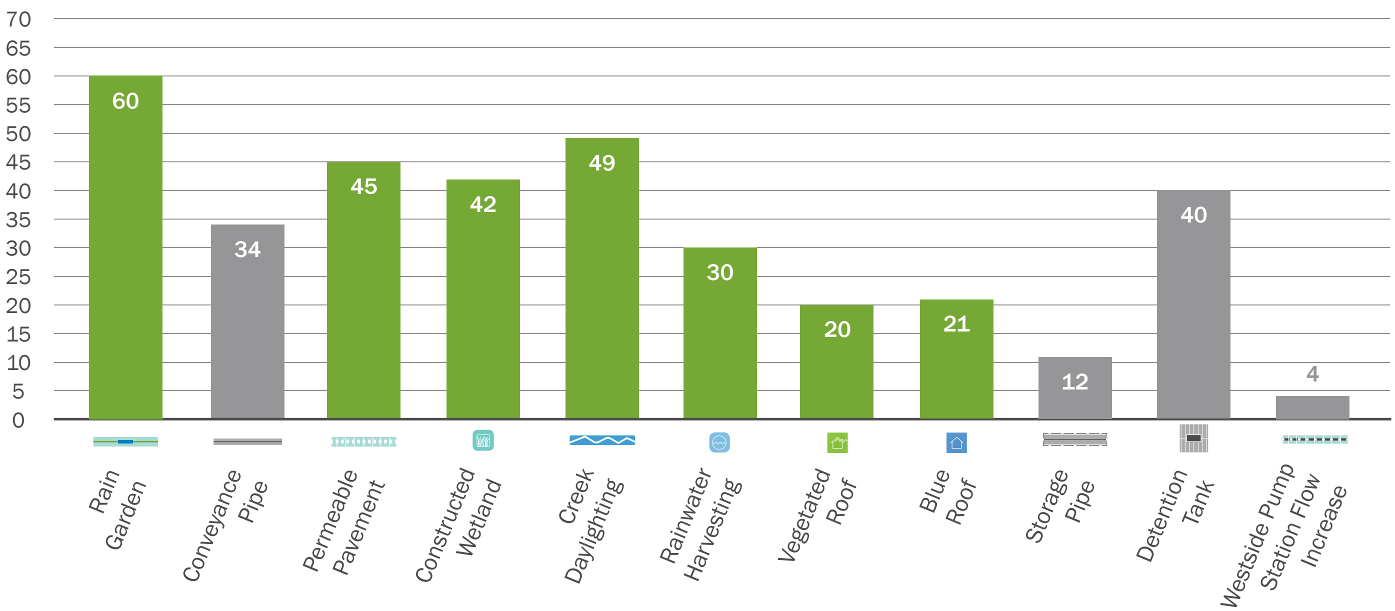
Workshop Results

Technologies and Project Types

All teams proposed watershed solutions that featured a blend of green and grey technologies. Rain gardens, creek daylighting and permeable pavement were the top three technologies chosen. The chart below lists the number of times each stormwater management technology was used during the workshop. Most teams prioritized solving flooding stormwater challenges first, but also tried to address combined sewer discharges with remaining funds. Many teams looked for project synergies, such as installing rain gardens and permeable pavement when aging pipes are repaired, which would provide multiple green infrastructure benefits while being cost-effective.

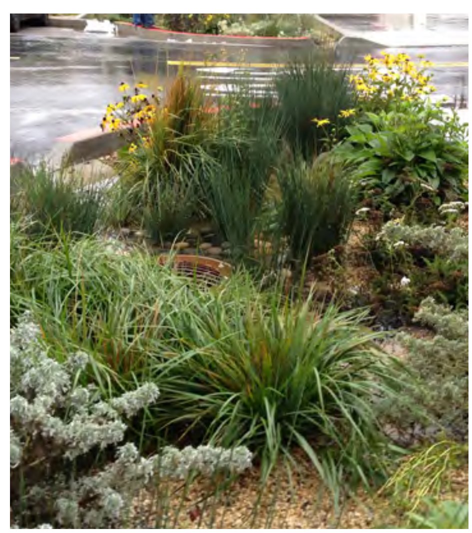
Game board showing community member's project ideas for the Lake Merced Watershed

Technology Preferences: Number of Times a Type of Game Piece was Played



Creek Daylighting

Permeable Pavement



Rain Garden

Project Locations

Streets were the most popular location for projects due to their visibility and multiple social and environmental benefits. Schools were the second most popular project location based on an interest in designing projects that provide educational and water reclamation opportunities. Many projects were also located in parks where teams built green corridors linking parks for habitat connectivity and recreational opportunities.

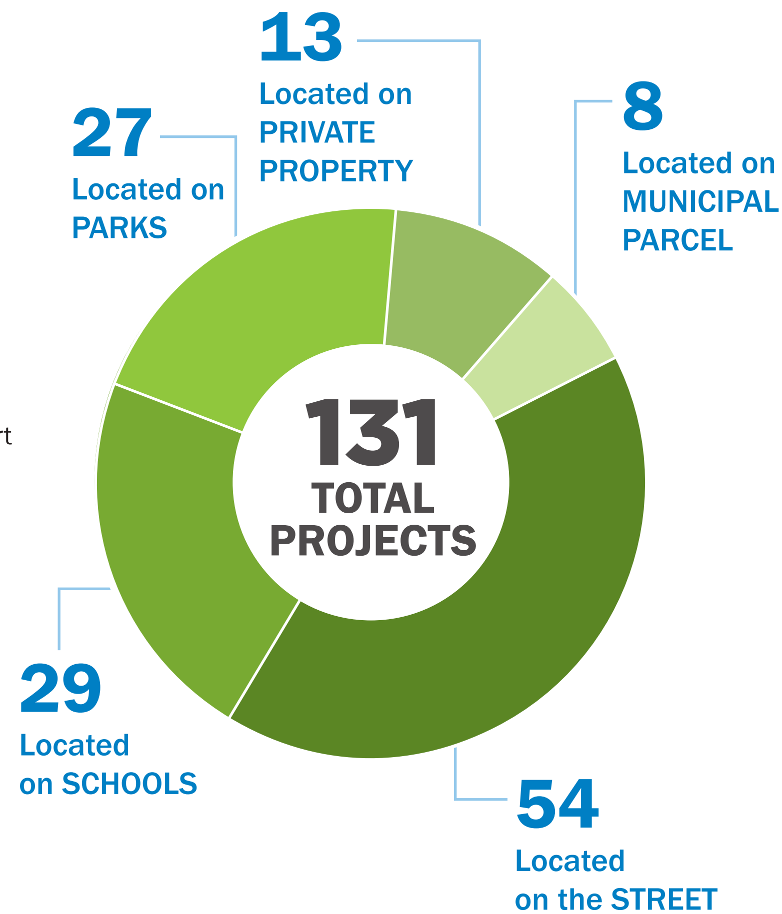
Community Values

After selecting green and/or grey technologies to address stormwater management challenges, participants were asked to explain the reasoning behind their project idea so that the UWA Team could better understand community values in decision making processes. Participants noted they also played green technologies with the goals of beautifying neighborhoods, providing educational opportunities and improving habitat connectivity and open space. Other benefits mentioned included water reuse projects and reducing combined sewer discharges on recreational beaches (see chart below).

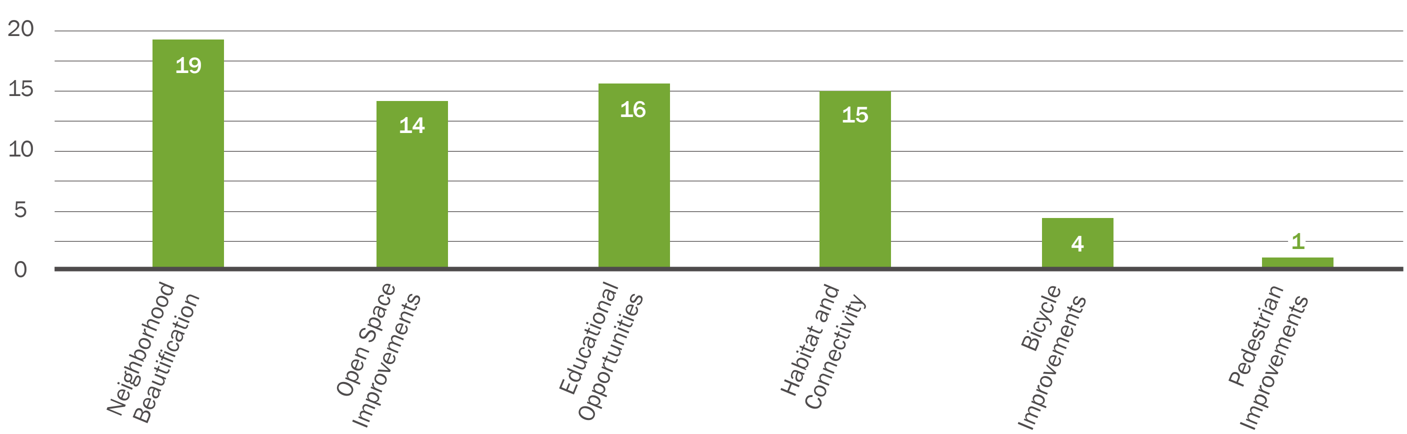
Workshop Feedback

One-third of the participants submitted feedback rating the workshop experience through an online follow-up survey. More than 90% of respondents reported their overall experience at the workshop was very positive (71%) or positive (18%). Ninety-four percent indicated that they learned a great deal (44%) or a fair amount (50%) about sewer infrastructure and stormwater management challenges in San Francisco. Most participants (94%) felt the planning game was an effective tool for generating potential projects for San Francisco's watersheds.

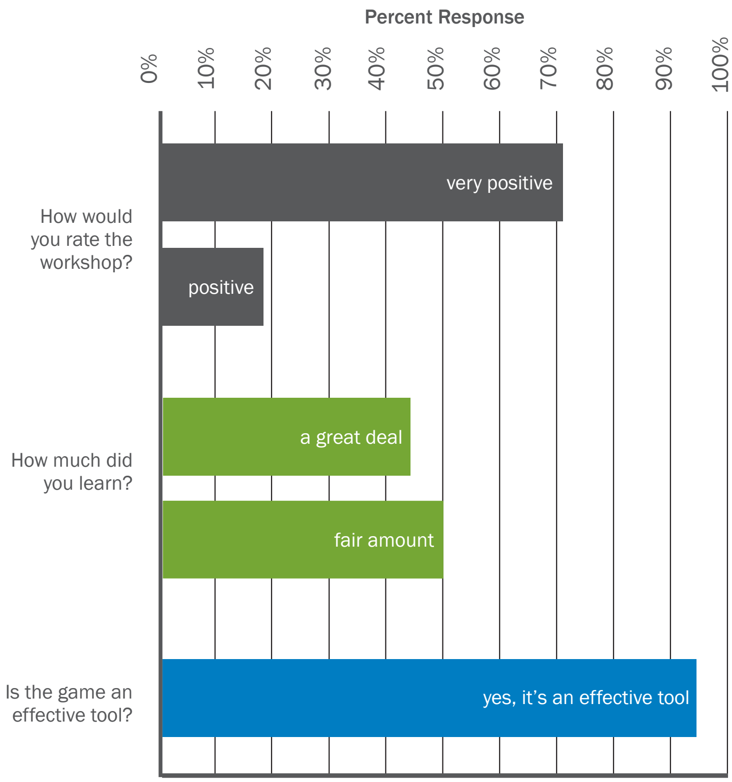
Location Preferences



Number of Times a Benefit was Mentioned as a Project Justification



Workshop Feedback Results



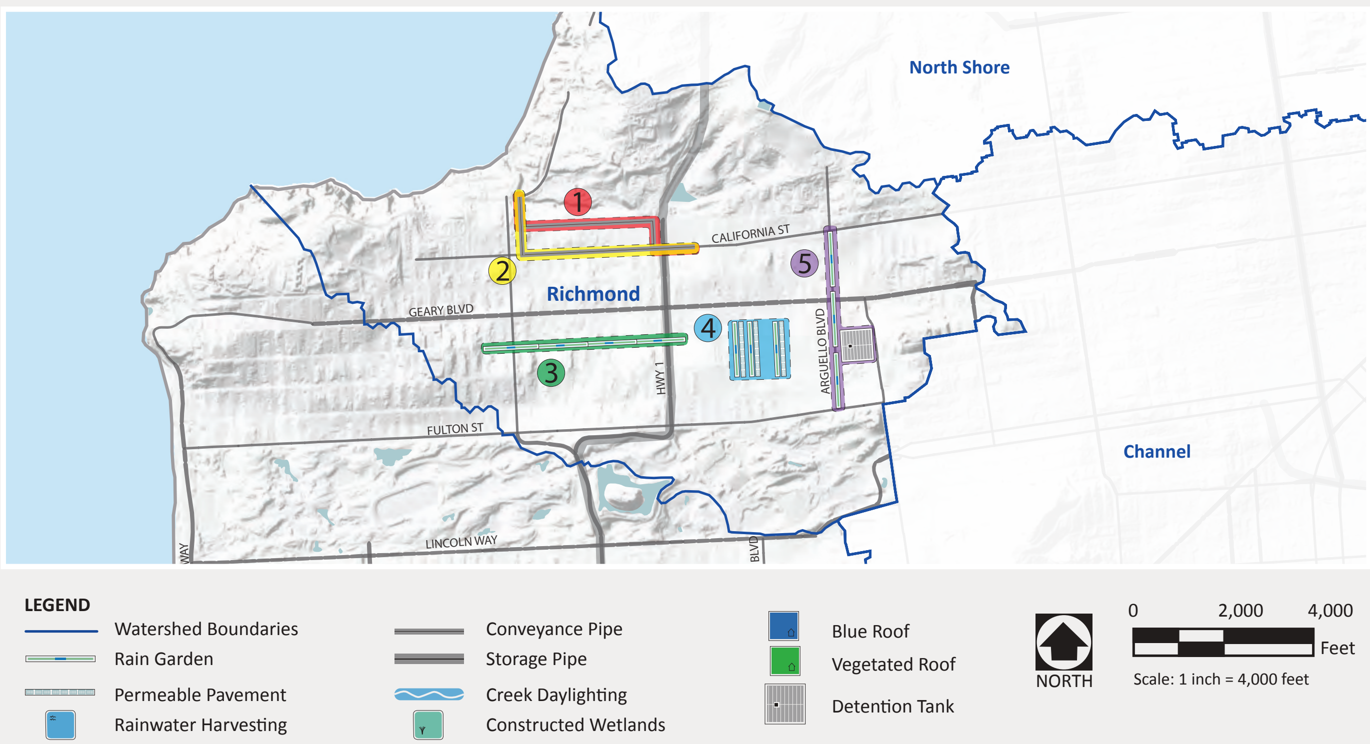
Workshop participants playing the Planning Game

Project Ideas for Consideration

The game yielded a number of site and technology-specific project ideas from the community participants. The table and map (next page) shows the top project ideas brainstormed for the three watersheds. These brainstormed ideas will be added to concepts generated by the SFPUC project team and other City agency partners. All concepts will be analyzed based on stormwater performance and community, environmental and economic considerations during the Urban Watershed Assessment process. The SFPUC will also assess technical feasibility and cost effectiveness.

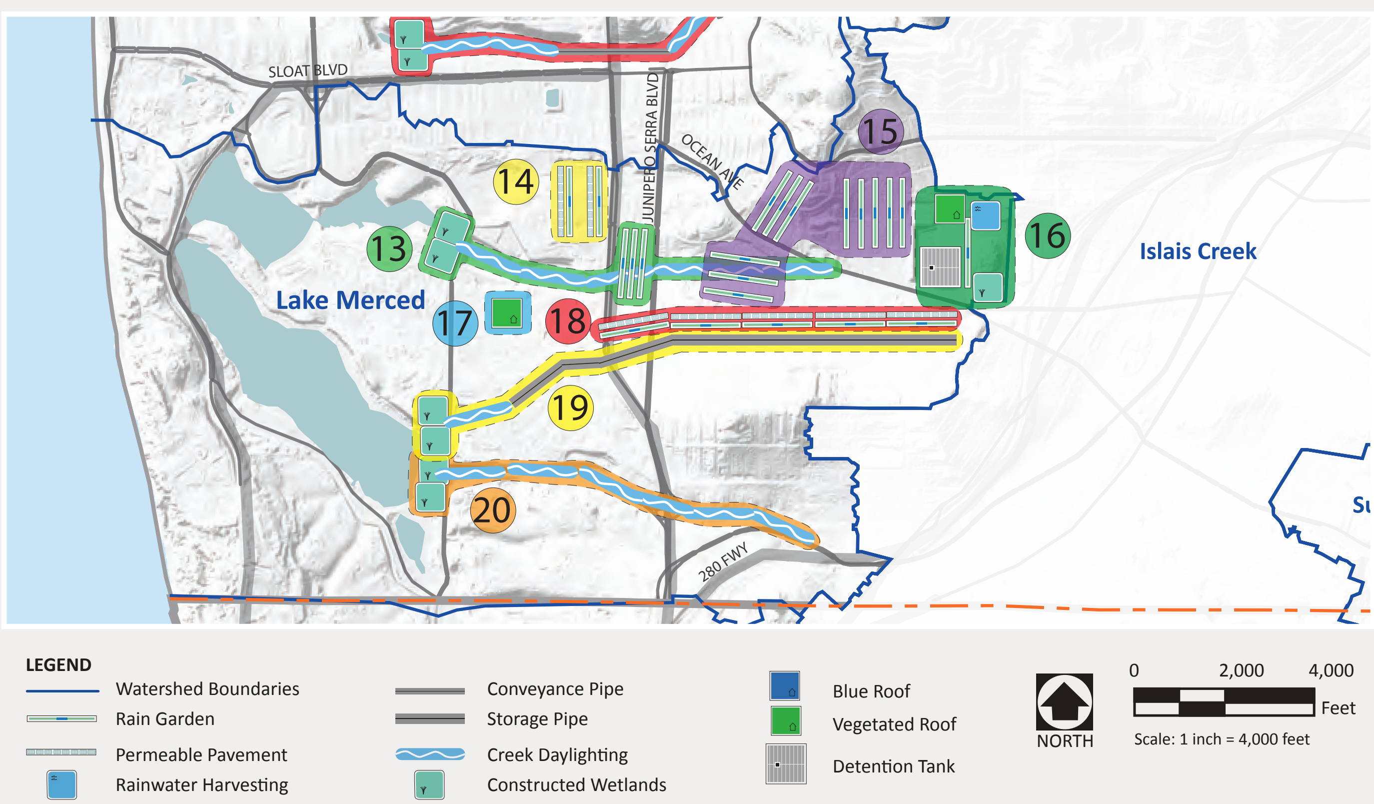
Richmond Watershed Top Project Ideas and Map

Project Name	Location and Description	Technologies
1 Conveyance Pipes along Lake Street	Install conveyance pipes along California from 11th to 14th Avenue, along Lake Street to 24th, and then along 24th Avenue from California to Richmond Tunnel.	Conveyance Pipes
2 Conveyance Pipes along California Street	Install conveyance pipes along California Street from 11th Avenue to 24th Avenue and along 24th Avenue from California Street to Richmond Tunnel at Camino Del Mar.	Conveyance Pipes
3 Anza Street Rain Gardens	Install rain gardens along Anza Street from 12th Avenue to 26th Avenue.	Rain Gardens
4 Repair, Replace, and Retrofit	Where sewer is slated for replacement along 5th, 7th, & 8th Avenues between Cabrillo and Balboa Streets, install permeable pavement and rain gardens during construction.	Rain Gardens, Permeable Paving
5 Arguello Boulevard Green Corridor	Install rain gardens along Arguello Boulevard from Fulton Street to California Street, and install a detention tank at Rossi Playground.	Rain Gardens, Detention Tank



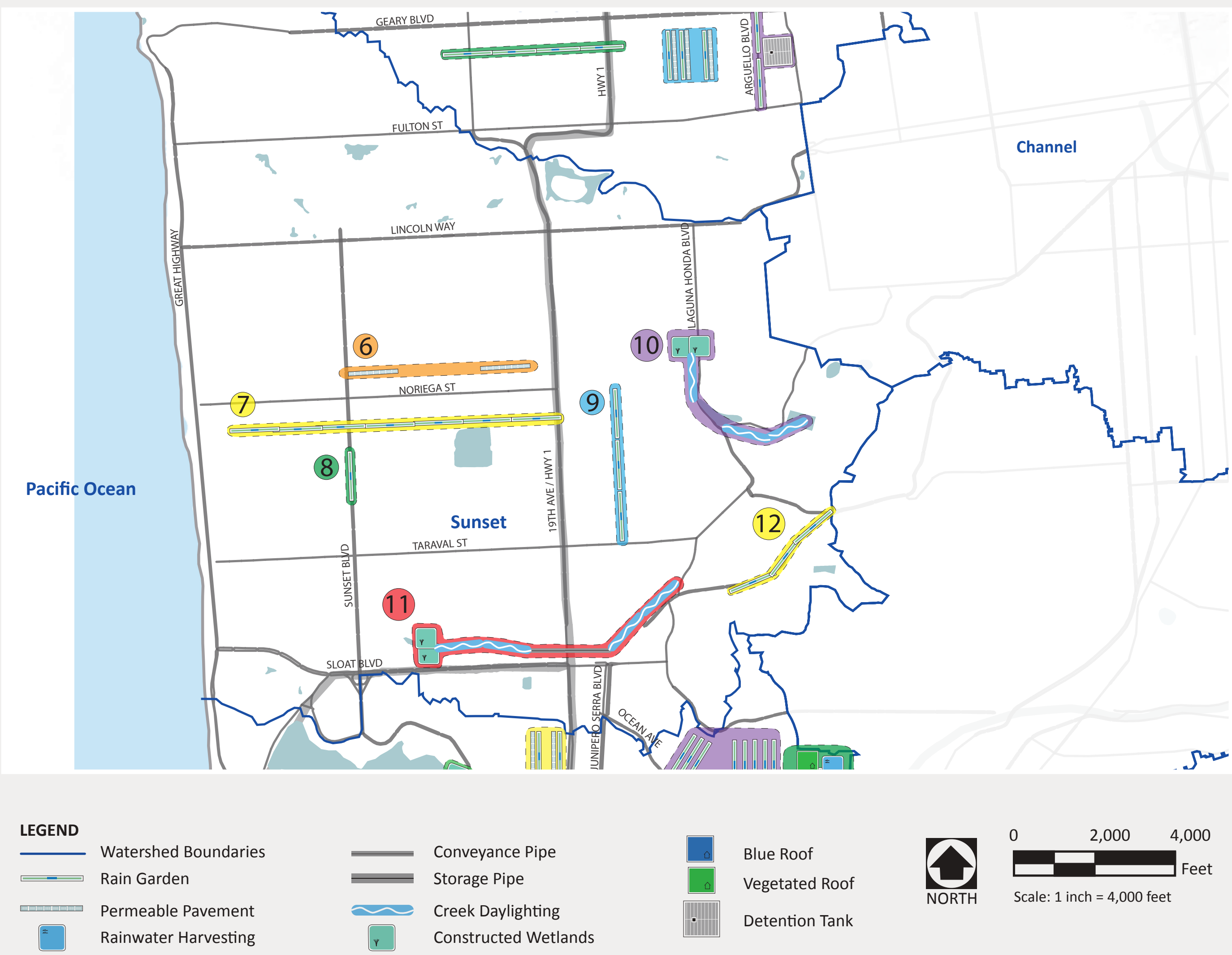
Lake Merced Watershed Top Project Ideas and Map

Project Name	Location and Description	Technologies
13 Creek Daylighting through San Francisco State University (SFSU)	Daylight creek along historic path from Jules Avenue at Ocean Avenue to constructed wetlands/Lake Merced near State Drive. Install rain gardens in low-lying area along Beverly Street, Broadmoor/Stratford, and Stonecrest/Denslowe from Winston Drive to Wyton Lane.	Creek Daylighting, Constructed Wetlands, Rain Gardens
14 Stonestown Mall Zero Runoff Demonstration Project	Rain Gardens and Permeable Pavement in parking lot of Stonestown Mall.	Rain Gardens
15 Lake Merced Neighborhoods Downspout Disconnect Program	Create and promote a residential downspout disconnection program throughout Lake Merced Watershed neighborhoods, including Westwood Park and Merced Heights.	Rain Gardens
16 Balboa Park/City College Retrofit	Combination of rainwater harvesting for irrigation storage, vegetated roofs for educational value at school buildings, and detention tank under campus parking lot. Install rain gardens throughout campus and rain gardens and constructed wetlands in park for roadway runoff management.	Rain Gardens, Detention Tank, Rainwater Harvesting, Vegetated Roof, Constructed Wetlands
17 SFSU Demonstration Vegetated Roof	Demonstration of vegetated roof on SFSU's science building.	Vegetated Roof
18 Holloway Green Corridor	Install rain gardens and permeable pavement along Holloway from Harold Avenue to 19th Avenue/Highway 1.	Rain Gardens and Permeable Pavement
19 Holloway Avenue Storage and Park Merced Creek	Install storage pipes along Holloway Street from Harold to 19th Avenue, then along Serrano Drive within Park Merced, direct outfall into daylit creek within Villa Merced Park, flowing into constructed wetlands, then into Lake Merced.	Storage Pipe, Creek Daylighting, Constructed Wetlands
20 Creek Daylighting along Brotherhood Way	Daylight creek along historic path through Brotherhood Way Open Space and continue along Brotherhood Way west of open space to constructed wetlands before discharging to Lake Merced.	Creek Daylighting, Constructed Wetlands



Sunset Watershed Top Project Ideas and Map

Project Name	Location and Description	Technologies
6 Moraga Street Permeable Pavement	From 21st to 25th and from 32nd to Sunset Boulevard, where sewer is slated for replacement, repave with permeable pavement.	Permeable Pavement
7 Ortega Street Green Street	Install rain gardens along Ortega Street from 19th Avenue to 46th Avenue.	Rain Gardens
8 Sunset Boulevard Green Street	Install rain gardens along Sunset Boulevard median between Pacheco Street and RiveraStreet--adjacent to Sunset Playground and several schools--to manage stormwater in existing open space.	Rain Gardens
9 14th Avenue Green Corridor	Install rain gardens along 14th Avenue from Noriega Street to Taraval Street, connecting to public transit and Herbert Hoover Middle School.	Rain Gardens
10 Creek Daylighting at Laguna Honda	Daylight historic creek from Sutro Reservoir through park and city parcel to Laguna Honda Boulevard, and from Laguna Honda Boulevard into wetlands at Lawton Street.	Creek Daylighting, Constructed Wetlands
11 Creek Daylighting + Conveyance to Pine Lake	Daylight historic creek along W. Portal Avenue to Junipero Serra Boulevard, then send it to conveyance pipes under Arden Wood & Stern Grove, then daylight it within park along historic path from 24th Avenue to Pine Lake.	Creek Daylighting, Constructed Wetlands, Conveyance Pipes
12 Portola Drive Green Street	Install Rain Gardens along Portola Drive from Kensington Way to Laguna Honda Boulevard.	Rain Gardens



Westside Survey Results

The Westside Watersheds green infrastructure survey was available online from May 20 to September 22, 2014. Responses were collected directly through the online survey as well as through iPad surveys throughout the three Westside Watersheds. The survey provided the opportunity for participants to:

- Learn about the sewer system challenges and green infrastructure technologies that may be used to help manage stormwater
- Provide input on technology preferences and rate ancillary benefits of green technologies
- Identify locations for green street projects for further analysis

More than 1400 surveys responses were collected online and through iPad surveys. Overall, rainwater harvesting, rain gardens and pavement to plants incentive programs were the top rated green infrastructure technologies. The pavement to plants incentive program is a program like the SFPUC's Sidewalk Garden Project and the District 4 Front Yard Ambassador Program that provide incentives for residents to transform concrete sidewalks and yards into drought-tolerant gardens that also infiltrate stormwater.

Top Rated Green Infrastructure Technologies

(rated out of 5 stars)

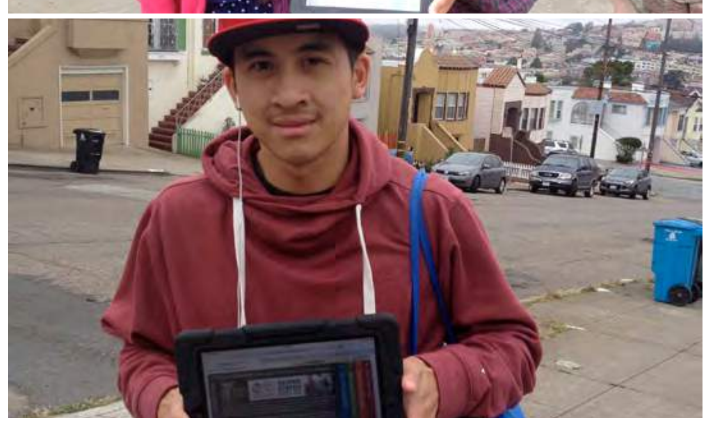
Watershed	Lake Merced	Richmond	Sunset	Unknown	Overall
Rainwater Harvesting	4.32	4.40	4.35	4.23	4.34
Rain Garden	4.31	4.19	4.20	4.34	4.25
Pavement to Plants	4.09	4.22	4.12	4.16	4.15
Constructed Wetland	4.08	3.99	4.00	4.01	4.02
Creek Daylighting	3.83	3.72	3.79	3.92	3.80
Permeable Paving	3.73	3.83	3.76	3.87	3.79
Vegetated Roof	3.81	3.76	3.71	3.49	3.72
Blue Roof	3.51	3.59	3.56	3.19	3.50

Overall, survey respondents ranked neighborhood beautification, open space improvements, and educational opportunities as the top three additional benefits of green infrastructure they value most. However, respondents from each watershed rated these benefits differently (see chart below).

Benefits of Green Infrastructure Most Valued

(ranked out of 6)

Watershed	Lake Merced	Richmond	Sunset	Unknown	Overall
Neighborhood Beautification	1	4	1	1	1
Improve Open Space	3	2	2	2	2
Educational Opportunities	2	3	3	5	3
Pedestrian Improvements	5	1	4	4	4
Improve Habitat	4	5	5	3	5
Bicycle Improvements	6	6	6	6	6

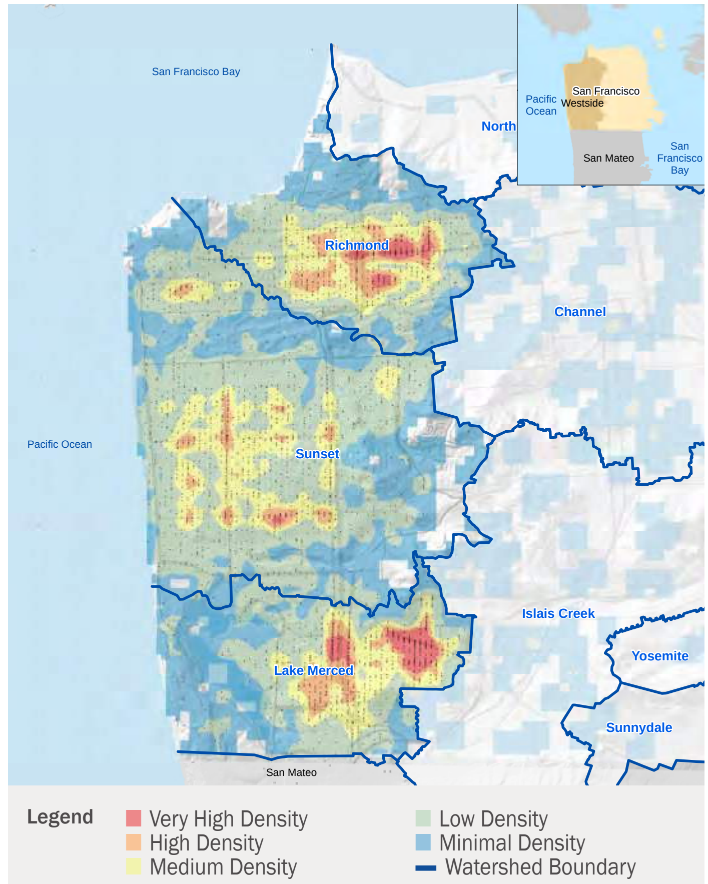


Workshop participants submitting a Westside Watershed Green Infrastructure Survey

Green Street Locations

Participants were also asked to suggest up to three locations for green streets to help manage stormwater using green infrastructure, primarily rain gardens and permeable pavement. To the right is a heat map of the most popular project locations.

Most Popular Project Locations Heat Map



Next Steps

Project ideas generated through the workshop and survey will be reviewed and considered for further analysis based on several factors including site suitability and feasibility. These project ideas will be analyzed during the Opportunities Phase and will feed directly into the Alternatives Phase (see project development process chart above).

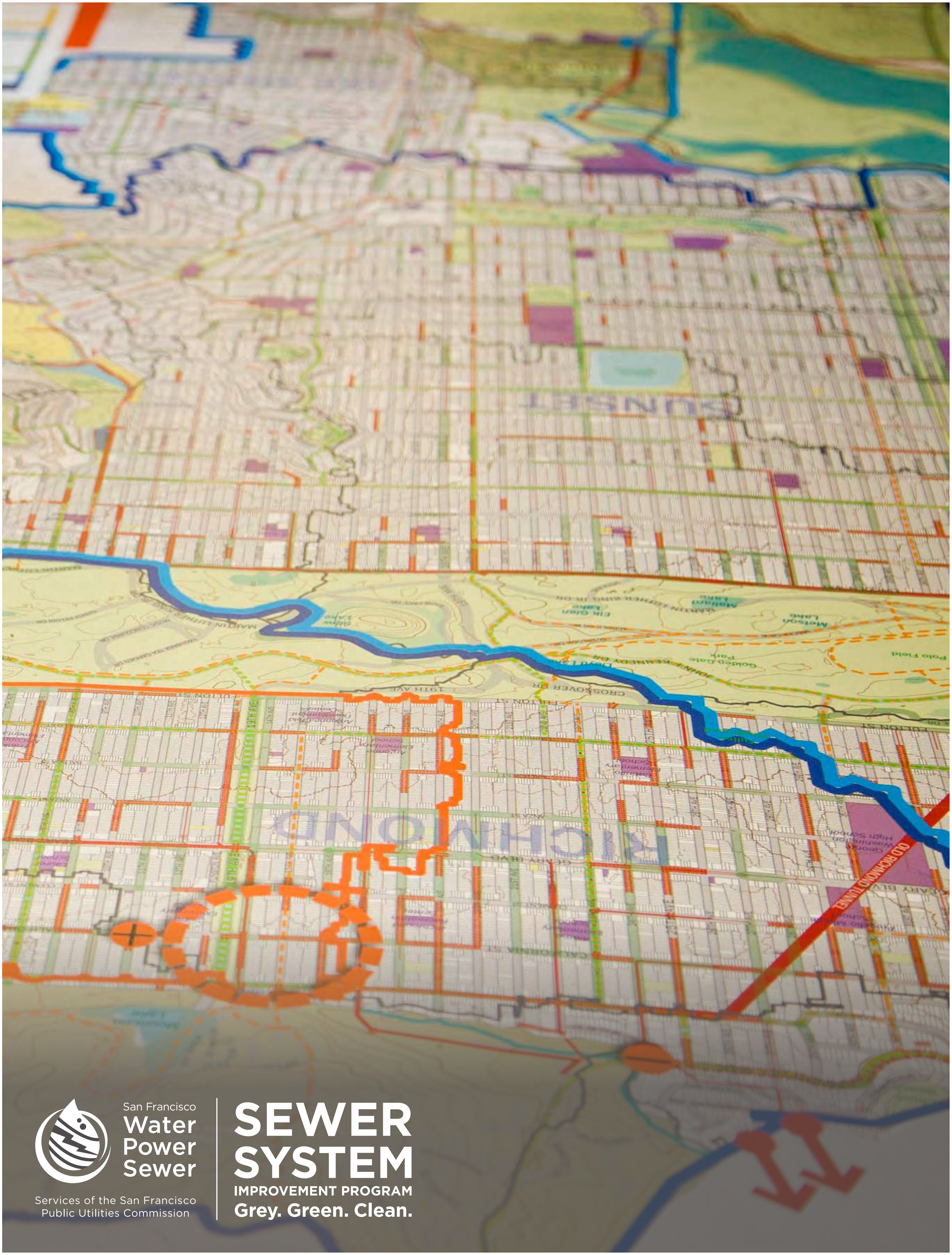
Please visit **sfwater.org/urbanwatersheds** for more information about upcoming meetings, educational materials and project updates.

Urban Watershed Assessment Project Development Process Chart

Watershed Charecterization → Watershed Opportunities *(* Current Phase for Westside Watersheds)* → Develop Project Alternatives → Evaluate Project Alternatives → Recomend and Implement Citywide Projects, Programs and Policies

"Very engaging, good way to get input from multiple stakeholders."

— WORKSHOP PARTICIPANT



San Francisco
Water
Power
Sewer

Services of the San Francisco
Public Utilities Commission

SEWER SYSTEM

IMPROVEMENT PROGRAM

Grey. Green. Clean.

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APPENDIX C

GREEN INFRASTRUCTURE OPPORTUNITIES SUMMARY

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Table C.1: Street Slope Distribution in Westside Drainage Basin

Slope Range	Blocks [#]	% of Total [%]
2% or less	726	3%
2%–5%	10,653	47%
5%–8%	3,453	15%
over 8%	7,672	34%
WESTSIDE	**22,504**	**100%**

Figure C.1: Street Slope Distribution in Westside Drainage Basin

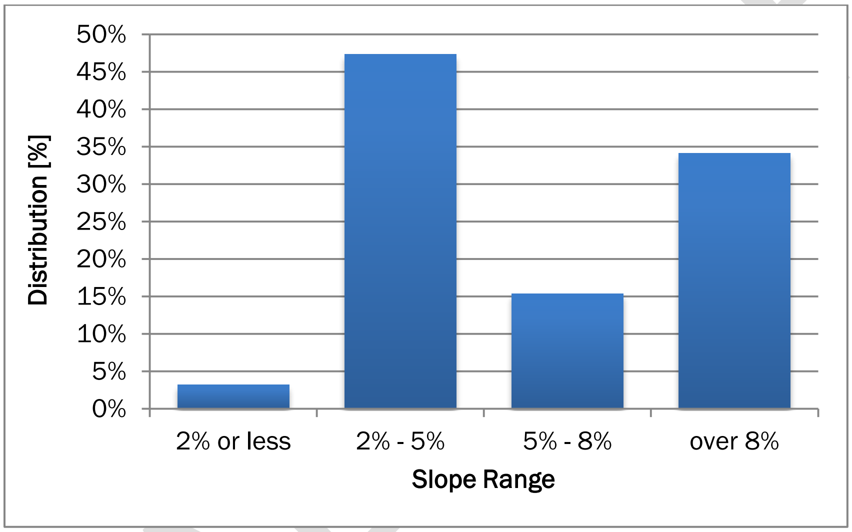

Table C.2: Street Suitability by Technology Type – Lake Merced Watershed

	LAKE MERCED		
GI Technology	Blocks (#)	Total Area (ac)	Proportion of Total[1] (%)
PP Only	233	35.8	14%
Bulbout Only	5	1.2	0%
Linear BR Only	20	7.3	3%
PP + Bulbout	97	19.4	8%
PP + Linear	88	13.8	6%
Bulbout + Linear	5	1.6	1%
PP + Bulbout + Linear	48	13.5	5%
Unsuitable	652	157.0	63%
TOTAL	1,148	249.6	15%

[1] Expressed relative to watershed total street DMA, except for the final row, which is expressed relative to Westside total street DMA.

Table C.3: Street Suitability by Technology Type – Richmond Watershed

	RICHMOND		
GI Technology	Blocks (#)	Total Area (ac)	Proportion of Total[1] (%)
PP Only	117	19.1	5%
Bulbout Only	13	3.9	1%
Linear BR Only	27	5.9	2%
PP + Bulbout	309	82.9	22%
PP + Linear	78	15.7	4%
Bulbout + Linear	21	6.9	2%
PP + Bulbout + Linear	300	112.6	30%
Unsuitable	475	126.2	34%
TOTAL	1,340	373.2	22%

[1] Expressed relative to watershed total street DMA, except for the final row, which is expressed relative to Westside total street DMA.

Table C.4: Street Suitability by Technology Type – Sunset Watershed

	SUNSET		
GI Technology	Blocks (#)	Total Area (ac)	Proportion of Total[1] (%)
PP Only	295	56.7	5%
Bulbout Only	45	19.2	2%
Linear BR Only	46	9.2	1%
PP + Bulbout	726	242.6	23%
PP + Linear	201	44.3	4%
Bulbout + Linear	27	9.6	1%
PP + Bulbout + Linear	436	137.4	13%
Unsuitable	2,020	524.3	50%
TOTAL	3,796	1,043.4	63%

[1] Expressed relative to watershed total street DMA, except for the final row, which is expressed relative to Westside total street DMA.

Table C.5: Street Suitability by Technology Type – Westside Drainage Basin

	WESTSIDE		
GI Technology	Blocks (#)	Total Area (ac)	Proportion of Total (%)
PP Only	645	111.6	7%
Bulbout Only	63	24.3	1%
Linear BR Only	93	22.3	1%
PP + Bulbout	1,132	344.9	21%
PP + Linear	367	73.9	4%
Bulbout + Linear	53	18.1	1%
PP + Bulbout + Linear	784	263.6	16%
Unsuitable	3,147	807.6	48%
TOTAL	6,284	1,666.2	100%

[1] Expressed relative to watershed total street DMA, except for the final row, which is expressed relative to Westside total street DMA.

Table C.6: Roof Slope Distribution in Westside Drainage Basin

Slope Range	Roof Count [#]	Roof Area [ac]	% by Count [%]	% by Area [%]
under 2%	814	95	1%	4%
2%	2,972	136	5%	6%
2%–15%	37,090	1,375	63%	58%
16%–25%	6,710	277	11%	12%
26%–45%	3,042	117	5%	5%
over 45%	23	2	0%	0%
Unclassified	8,620	372	15%	16%
WESTSIDE	**59,271**	**2,374**	**100%**	**100%**

Figure C.2: Roof Slope Distribution in Westside Drainage Basin

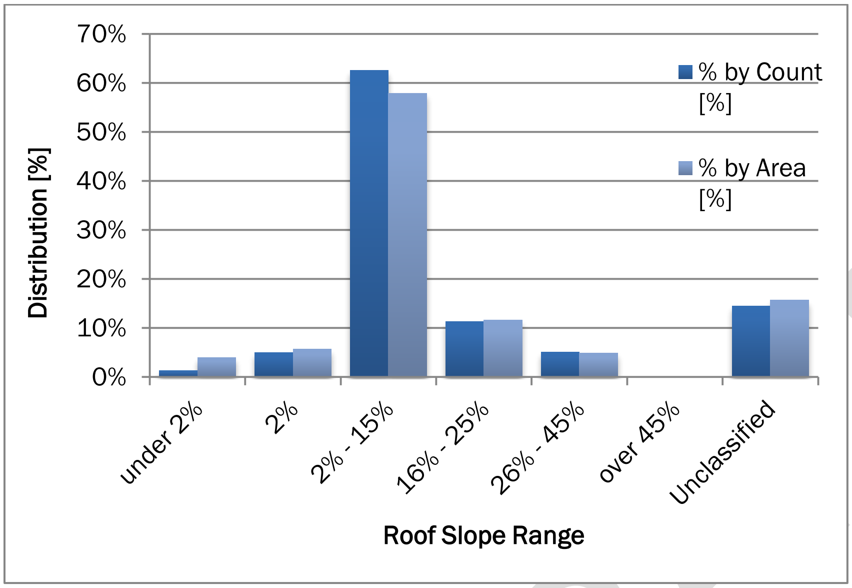

Table C.7: Parcel Suitability by Ownership Type – SFPUC (>1 acre impervious)

APN	Parcel Name	Watershed	Parcel Area (ac)	Rooftop (ac)	Hard -scape (ac)	Imper -vious (ac)	Technologies	LOS Synergy Count
2842 007	Laguna Honda Hospital	Sunset	75.10	10.70	24.30	35.00	BR / PP / RWH / RfB / RfG	1
2107 001	Sunset Reservoir Water Facilities	Sunset	34.44	0.10	27.73	27.83	BR / PP / RWH / RfB / RfG	1
3180 001	Balboa Park Reservoir Water Facilities	Lake Merced	30.34	1.10	26.20	27.30	BR / PP / RWH / RfB / RfG	2
2719C011	Twin Peaks Reservoir	Sunset	20.32	2.71	2.67	5.37	BR / RWH	2
7206 001	Central Pump Station/Merced Manor Reservoir	Sunset	4.92	0.23	2.67	2.89	BR / PP / RWH / RfB / RfG	1
7380 036	Lake Merced Park	Lake Merced	109.63	0.27	1.06	1.33	BR / PP / RWH / RfG	0
TOTAL	Number of Parcels = 6		274.76	15.10	84.63	99.73		1

Table C.8: Parcel Suitability by Ownership Type – Other City (>1 acre impervious)

APN	Parcel Name	Watershed	Parcel Area (ac)	Rooftop (ac)	Hard -scape (ac)	Impervious (ac)	Technologies	LOS Synergy Count
1700 001	Golden Gate Park	Sunset	1023.4	15.56	130.95	146.51	BR / PP / RWH / RfB / RfG	1
3179 010	City College	Lake Merced	57.54	11.84	27.03	38.87	BR / PP / RWH / RfB / RfG	3
2094 005	Giannini, A. P. Middle School	Sunset	23.13	2.64	7.78	10.42	BR / PP / RWH / RfB / RfG	1
1313 029	Lincoln Park	Richmond	112.03	1.61	8.32	9.93	BR / PP / RWH / RfG	1
2736 002	Sutro Reservoir Water Facilities	Sunset	11.78	0.19	7.44	7.63	BR / PP / RWH / RfB / RfG	1
3266A001	Aptos Playground	Lake Merced	7.59	1.43	2.39	3.82	BR / PP / RWH / RfB / RfG	1
2094 004	West Sunset Playground	Sunset	8.08	1.06	1.95	3.01	BR / PP / RWH / RfB / RfG	1
PARK SUBL	UNKNOWN	Lake Merced	10.46	0.00	2.71	2.71	BR / RWH	1
2946A001	Stanford Heights Reservoir Water Facilities	Sunset	3.69	0.03	2.60	2.63	BR / PP / RWH	1
7281 002	San Francisco Zoo	Sunset	2.84	0.00	2.53	2.53	BR / PP / RWH	1
1915 001	Sunset Playground	Sunset	3.29	0.43	1.10	1.53	BR / PP / RWH / RfB / RfG	1
7281 005	San Francisco Zoo	Lake Merced	2.93	0.26	1.19	1.45	BR / PP / RWH / RfG	1
7380 040	3.1 Foot Gap Parcel	Lake Merced	1.60	0.48	0.81	1.29	BR / PP / RWH / RfG	1
1140A001	Angelo J. Rossi Playground	Richmond	6.17	0.37	0.82	1.19	BR / PP / RWH / RfG	1
2456 001	South Sunset Playground	Sunset	3.72	0.06	1.10	1.16	BR / PP / RWH / RfB / RfG	1
2979 013A	West Portal Playground	Sunset	1.91	0.37	0.75	1.12	BR / PP / RWH / RfG	1
TOTAL	Number of Parcels = 16		1280.2	36.32	199.49	235.81		1

Table C.9: Parcel Suitability by Ownership Type – State/Fed (>1 acre impervious)

APN	Parcel Name	Watershed	Parcel Area (ac)	Rooftop (ac)	Hard -scape (ac)	Imper -vious (ac)	Technologies	LOS Synergy Count
7298 005	Lowell High School	Lake Merced	23.43	4.31	8.85	13.15	BR / PP / RWH / RfB / RfG	2
2194 001	Lincoln, Abraham High School	Sunset	16.18	4.50	4.58	9.07	BR / PP / RWH / RfB / RfG	1
1574 001	Washington, George High School	Richmond	15.87	3.07	5.25	8.32	BR / PP / RWH / RfB / RfG	2
2336 028	Hoover, Herbert Middle School	Sunset	8.22	1.46	3.74	5.20	BR / PP / RWH / RfB / RfG	1
7298 008	Undedicated Street (Winston Dr)	Lake Merced	7.05	0.49	4.02	4.51	BR / PP / RWH / RfG	2
7281 004	San Francisco Zoo	Lake Merced	7.79	1.37	2.92	4.30	BR / PP / RWH / RfB / RfG	0
1461 001	Presidio Middle School	Richmond	3.31	1.19	2.09	3.29	BR / PP / RWH / RfG	2
2154 001	Stevenson, Robert Louis Elementary School	Sunset	3.32	1.13	1.95	3.07	BR / PP / RWH / RfB / RfG	1
7147 024A	Undedicated St (51 San Diego)	Lake Merced	4.06	0.00	2.91	2.91	BR / PP / RWH	1
3256 001	Sloat, Commodore Elementary School	Sunset	3.24	1.10	1.62	2.72	BR / PP / RWH / RfG	1
7074 050	Ortega, Jose Elementary School	Lake Merced	3.02	0.84	1.76	2.60	BR / PP / RWH / RfB / RfG	1
1105 001	Wallenberg, Raoul High School	Richmond	2.64	0.99	1.37	2.36	BR / PP / RWH / RfB / RfG	2
2979 014	West Portal Elementary School	Sunset	2.68	0.77	1.56	2.32	BR / PP / RWH / RfB / RfG	1
1061 049	Roosevelt, Theodore Middle School	Richmond	2.18	0.93	1.23	2.15	BR / PP / RWH / RfB / RfG	1
1888 001	Key, Francis Scott Elementary/Early Education	Sunset	2.09	0.70	1.37	2.08	BR / PP / RWH / RfB / RfG	1
2455 001	Ulloa Elementary School	Sunset	3.87	1.43	0.64	2.07	BR / PP / RWH / RfB / RfG	1
2684 011	Clarendon Elementary School	Sunset	2.90	0.87	1.10	1.97	BR / PP / RWH / RfB / RfG	1
2425 008	Feinstein, Dianne Elementary School	Sunset	2.06	0.81	1.15	1.96	BR / PP / RWH / RfB / RfG	1
7284 005	UNKNOWN	Lake Merced	5.88	0.00	1.91	1.91	BR / RWH	0
1773 001	Jefferson Elementary School	Sunset	2.04	0.85	1.03	1.88	BR / PP / RWH / RfB / RfG	1
1876 002	Lawton Alternative School	Sunset	2.09	0.82	0.99	1.81	BR / PP / RWH / RfB / RfG	1
7298 006	Lowell High School	Lake Merced	8.00	0.55	1.18	1.73	BR / PP / RWH / RfB / RfG	2
1579 001	Lafayette Elementary School	Sunset	1.71	0.71	0.99	1.70	BR / PP / RWH / RfB / RfG	2
1627 012	Argonne Elementary School	Richmond	1.57	0.71	0.83	1.54	BR / PP / RWH / RfB / RfG	1
1858 006	Yu, Alice Fong Alternative School	Sunset	1.80	0.68	0.82	1.51	BR / PP / RWH / RfG	1
1620 027	S.F. County Special Education School	Richmond	1.69	0.59	0.87	1.47	BR / PP / RWH / RfB / RfG	1
7105 001	Sheridan Elementary School/Preschool	Lake Merced	1.62	0.77	0.67	1.44	BR / PP / RWH / RfB / RfG	2
1797 007	Walden House	Sunset	1.38	0.52	0.86	1.38	BR / PP / RWH / RfB / RfG	2
2005 002	Noriega Early Education School	Sunset	1.40	0.57	0.79	1.36	BR / PP / RWH / RfB / RfG	1
2370 074	Independence High School	Sunset	1.38	0.56	0.79	1.36	BR / PP / RWH / RfB / RfG	2
1067 044	Early Education Administration	Richmond	1.19	0.28	0.92	1.20	BR / PP / RWH / RfB / RfG	1
1411 005	Alamo Elementary School	Richmond	1.38	0.70	0.48	1.18	BR / PP / RWH / RfB / RfG	1
1761 040	Pcc/Big Picture San Francisco	Sunset	1.10	0.26	0.81	1.07	BR / PP / RWH / RfB / RfG	1
TOTAL	Number of Parcels = 33		148.1	34.5	62.0	96.6		1

APPENDIX D

CREEK DAYLIGHTING FEASIBILITY SUMMARY

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APPENDIX D: CREEK DAYLIGHTING FEASIBILITY SUMMARY

Creek Daylighting Site Visit and Feasibility Analysis Results

This appendix summarizes site visit and feasibility analysis for creek daylighting in the Westside Drainage Basin. In this analysis, the UWA team named potential creek daylighting alignments – both along historical creek paths as well as other locations – according to the closest historical creek system. A summary of results is provided in Figure 3.5. Additional information on the creek segments is summarized in Table D.1 and Table D.2.

Table D.1: Westside Creek Daylighting Feasibility Summary

Project Name			Location			Configuration			Tier I DMA		Tier 2 DMA		Tier 3 DMA		
ID	Project Name	GIS Creek Segment Name	Street or Parcel	Starting Intersection or Parcel Cross-Street	Ending Intersection or Parcel Cross-Street	Proposed Conveyance Type	Length	Slope	Pervious (Acres)	Impervious (acres)	Pervious (acres)	Impervious (acres)	Pervious (acres)	Impervious (acres)	Project Description
CD-1a	Twin Peaks Creek - Sutro Res	1_Sutro Res culvert to Clarendon Ave culvert	Laguna Honda Hospital	Dellbrook Ave	Clarendon Ave	existing creek	1,187	4%	4.3	5.3			0.3	2.8	From Sutro Reservoir to existing creek
CD-1b	Twin Peaks Creek - LH Hospital	2_Clarendon Ave culvert to LH Reservoir	Clarendon Ave	Clarendon Woods Ave	Laguna Honda Reservoir	existing pipe	433	2%	21.1	13.9	9.7	9.1			Existing creek north of Laguna Hospital
CD-1c	Twin Peaks Creek - LH Reservoir	3a_LH Reservoir to White Crane Springs	Laguna Honda Reservoir	Clarendon Rd	White Crane Springs	proposed pipe	1,541	1%					3.8	3.5	Piped connection from existing creek to LH Reservoir to d/s end of reservoir
CD-1d	Twin Peaks Creek - 7th Ave	3b_White Crane Springs to Garden for the En	7th Ave	White Crane Springs	Garden for the Env	proposed creek	1,785	2%	12.6	0.5					D/s end of LH reservoir down 7th Ave to Kirkham (green connection street)
CD-2a	Brotherhood Way Creek - Alemany to JS	1_Alemany to Junipero Serra	Brotherhood	Alemany	Junipero Serra	proposed creek	1,993	4%			6.8	4.4			
CD-2b	Brotherhood Way Creek - JS to LM	2_Junipero Serra to Thomas More Way	Brotherhood	Junipero Serra	Thomas More Way	proposed pipe	606	1%	0.9	2.2	0.5	1.2			
		3_Thomas More Way to Holy Trinity Church	Brotherhood	Thomas More Way	Holy Trinity Church	proposed creek	2,180	5%	8.7	12.1	15.8	1.4			
CD-2c	Brotherhood Way Creek - Detention Basin	4_Holy Trinity Church to Detention Basin	Brotherhood	Holy Trinity Church	Detention Basin	proposed pipe	990	2%	4.5	3.3	6.9	3.2			
CD-3a	Trocadero Creek - West Portal to 15th	Tunnel Drain to 15th/Wawona	Wawona	Ulloa	15th Ave	proposed pipe	2,138	4%							Lower creek feasibility due to slopes, driveways, and utilities. Unless can connect to Muni tunnel drain, a CSS pipe concept is more likely, which is included in the conveyance solutions.
CD-3b	Trocadero Creek - 15th to 19th	1_15th/Wawona through ridge	Wawona	15th Ave	Arden Woods	proposed pipe	462	3%	4.2	4.3					
		2_Ridge to Arden Wood spring	Sewer ROW	Arden Woods	Spring	proposed step pools	485	12%	1.1	0.4					
		3_Arden Wood spring to detention basin	Sewer ROW	Spring	Detention Basin	proposed creek	371	12%	5.5	1.4					
CD-3c	Trocadero Creek - Stern Grove	4_Across 19th Ave	Sewer ROW	Det Basin	Stern Grove	proposed pipe	778	2%	7.0	4.5					
		5_SGPLP 1 (drop structure)	Stern Grove	Drop Structure	Drop Structure	proposed drop structure	113	31%							
		6_SGPLP 2 (drop structure to fish pond)	Stern Grove	Drop Structure	Fish Pond	proposed creek	463	5%			5.8	0.8			
		7_SGPLP 3 (fish pond to sed basin)	Stern Grove	Fish Pond	Sed Basin	existing creek	1116	1%			2.3	2.6			
		8_SGPLP 4 (sed basin to path)	Stern Grove	Sed Basin	Lake Path at Parking Lot	proposed creek	784	5%			12.7	2.9			
		9_SGPLP 5 (path to lake)	Pine Lake	Lake Path	Lake	existing creek	1257	2%					5.7	4.6	
					Totals		***18,682***		***69.9***	***47.9***	***60.5***	***25.6***	***9.8***	***10.9***	
							Twin Peaks		38.0	19.7	9.7	9.1	4.1	6.3	86.9
							Brotherhood		14.1	17.6	30.0	10.2	0.0	0.0	71.9
							Trocadero		17.8	10.6	20.8	6.3	5.7	4.6	65.8

Table D.2: Summary of Westside Creek Feasibility Site Visits and Screening Analyses

Creek	Channel alignment description	LOS needs addressed	Additional benefits / synergies	Length (ft)	DMA_{eff} (ac)	DMA description	Historic Creek?	Discharge Location	Detention (CSS) / Treatment (MS4) Area?	Main Reason to Consider	Notes
Trocadero Creek	From high priority flooding area near 15th and Wawona, trenchless storm sewer through small ridge to Arden Wood existing(?) detention basin, out to 19th Ave via 15 ft ROW easement on Scottish Rite Temple parcel, under 19th Ave, through drop structure down into Stern Grove, then using existing and new channels / swales and detention / sedimentation basins to Pine Lake. See Pine Lake Concept 1 and 2 pdfs for more detailed information. Could also start at Arden Wood detention basin (eliminate DMA on other side of ridge), but without flood reduction at 15th and Wawona, may not be worth cost as a UWA project	-Reduce flooding in high priority flooding area near 15th and Wawona -Reduce CSDs in sensitive areas	-Contribute to Pine Lake water level (needed/desired?)	5800 (or 8,000 including pipe from tunnel drain)	Tier 1: 16* Tier 2: 13 Tier 3: 6 Total: 35 * SGPLP (20 ac) not counted as proposed DMA - already drains to Pine Lake	-Tier 1: Roofs, parking lots, and grounds of Arden Wood, SF Waldorf High School, West Portal Lutheran Church and School, The Grove aparments, Scottish Rite Masonic Center; rooftop disconnects in the bowl bounded by 14th-Wawona-16th-Vicente* (Stern Grove-Pine Lake Park not counted as proposed DMA - already drains to Pine Lake) -Tier 2: Merced Manor Reservoir (700' pipe); Carl Larsen Park (1,400' pipe); Parkside Square (adjacent), Edgewood School (adjacent) -Tier 3: Rooftop disconnects adjacent to Stern Grove-Pine Lake Park * NOTE: Will be looking for more potential DMA (sewer separation) in contributing area to 15th and Wawona flooding area.	yes	Pine Lake	Existing sedimentation basin in Pine Lake Park (treatment)	Reduce flooding, increase Pine Lake level, daylight historic creek	Excursion issues in Arden Wood detention basin area, 2 pipes would need to be installed using Horizontal Directional Drilling (HDD) - through berm on southwest side of Wawona & 15th bowl, under 19th Ave
Laguna Honda Creek	Alignment A: From existing Culvert 2 outlet (southwest of Olympia and Dellbrook - see 6-27-2012 memo), continuing south of Clarendon in existing channel, into existing Culvert 1 to cross under Clarendon, then into Laguna Honda Reservoir. Alignment B: Piped from eastern corner of Laguna Honda Reservoir around Laguna Honda, then creek through the White Crane Springs Community Garden, ending at the Garden for the Environment for detention / irrigation. Explored idea of continuing on to GGP (Big Rec Fields / Arboretum), but would require ~2700' piping (no obvious path for a creek for that stretch - residential with many driveways).	-Reduce flooding in low priority flooding areas next to Laguna Honda Reservoir and possibly as far north as 7th Ave and Lawton in Inner Sunset -Reduce CSDs in sensitive areas	-Utilize SFPUC property (reservoir) -Address the broken brick sewer spilling into Laguna Honda, -Create habitat corridor (part of San Miguel Hills idea)	Align A: 1,600 Align B: 3,300	Align A Tier A1: 27 Tier A2: 12 Tier A3: 8 Total: 46 Align B: 4	Alignment A -Tier A1: Sutro Reservoir roof, Midtown Terrace Playground, northern half of Laguna Honda Hospital buildings and parking lots, south side of Clarendon Ave -Tier A2: Southern half of Laguna Honda Hospital and Juvenile Probation Department buildings and parking lots -Tier A3: Twin Peaks (covered) Reservoir (1000' dist, 300' drop), residential area north of Clarendon Ave Alignment B: Hillside east of Laguna Honda Reservoir and 7th Ave to Moraga, White Crane Springs Community Garden	yes	Alignment A: Laguna Honda Alignment B: CSS	Alignment A: create detention within channel before Culvert 1 Alignment B: Detention under northern end of White Crane Springs or Garden for the Environment	Alignment A: low cost - formalize existing creek and access, reduce mild flooding, infrastructure synergy Alignment B: either irrigation water for Garden for the Environment, or to get water to the Arboretum (irrigation / wter feature)	All components of creek system already in place. Project would formalize system, add DMA (mostly LH Hospital and Juv Probation Dept). Detention area south of Clarendon Ave is huge with very sandy soils - likely that flows would never reach Laguna Honda.
Brotherhood Way Creek (LM-4)	South of Brotherhood Way from Alemany Blvd to Lake Merced Blvd, terminating in a detention basin east of Lake Merced Blvd. Most runoff will infiltrate and enters Lake Merced as groundwater; however, there is an existing culvert between the detention basin and Lake Merced. Nick has found (in the field) the inlet and outlet.	-Reduce CSDs in sensitive areas	-Add flows to Lake Merced, contribute to water level	6,100	Tier 1: 22* Tier 2: 19 Total: 41 * Detention basin (1 ac) not counted as proposed DMA - already drains to Lake Merced	-Tier 1: Southern side of BHW ROW west of Junipero Serra to Grace Community Church, adjacent churches, schools (Almavia of SF, St. Thomas Moore Catholic School, Congregation Beth Israel Judea, Brandeis Hillel Day School, Calvary Armenian Congregational Church, Lake Merced Church of Christ, KZV Armenian School / Armenian Community Center, Grace Community Church, Holy Trinity Greek Orthodox Church) buildings and parking lots -Tier 2: Northern side of BHW and upstream hillside; southern side of Brotherhood Way adjacent to Holy Trinity Greek Church; southern half of Brotherhood Way and BHW Open Space east of Junipero Serra; potential for runoff from Alemany, I-280 (not included in these numbers)	yes	Detention basin east of Lake Merced Blvd	Existing depressed area / detention basin east of Lake Merced Blvd	historic creek, increase Lake Merced level	PUC owns 50' wide strip of land south of BHW ROW (east of JS); however, many church and school driveways encroach.

APPENDIX E

SFPUC RESERVOIRS SITE VISIT SUMMARY

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DRAFT MEMORANDUM

To: SSIP PMC Program Team

From: Robert Dusenbury

Subject: Westside UWA Opportunities – Drinking Water Reservoirs

Date: November 17, 2014

Background

A site visit was conducted on November 7, 2014 by the PMC to evaluate opportunities to manage stormwater runoff from three City reservoirs: Balboa, Merced Manor, and Sunset. Balboa Reservoir has never actually held any water, and a master plan is now being completed for a mixed use development on that parcel, which is currently serving as an overflow parking lot mainly for City College of San Francisco (CCSF). The other two reservoirs are active, and the rooftop areas are prime management opportunities because in both cases a large impervious area drains to a single discharge point where stormwater could be intercepted and rerouted to large-scale stormwater management features.

Potential management opportunities were evaluated during the site visits based on visual observation and inspection. A cursory desktop analysis was then performed to further evaluate and document these opportunities. This analysis focused on locating various stormwater management technologies in feasible locations at a scale adequate to manage effectively the runoff from each reservoir. A summary of the drainage management areas (DMAs) and the most promising opportunities to manage those areas are presented below.

Analysis Results

Merced Manor Reservoir

The Merced Manor Reservoir rooftop is 1.85 acres, the associated building and driveway another 0.35, and the remaining grassy area another 2.9 acres. The site investigation identified two primary stormwater management opportunities:

- An intensive green street on Ocean Avenue, most likely requiring bioretention and infiltration galleries to manage the large quantity of available stormwater; or
- Rerouting the reservoir rooftop runoff into a new pipe that gravity drained to Pine Lake

The first opportunity involves following the gradient of the site and directing all runoff from the parcel to Ocean Avenue, where an extra wide, low-traffic street could be put on a “road diet” to create room for an intensive green street, which would extend for almost a mile west down to Sunset Boulevard. This stretch of roadway contains an abundance of underutilized pavement, a consistent 2-2.5%

slope, and a manageable amount of utilities, although there is a large sewer main on Meadowbrook Drive that turns west onto Ocean Avenue and north onto Springfield Drive towards Sloat Boulevard. The 60-foot wide roadway has room for a green street retrofit while maintaining the two existing drive aisles and the parking lanes on either side of the street. Additionally, the transverse blocks to the north drain southerly, and 15 acres of additional DMA could be rerouted to the project area by bypassing the catch basins at each intersection with Ocean Avenue. The existing drainage infrastructure at Lakeshore Plaza did not appear amenable to rerouting runoff from that site. This stretch of roadway should be analyzed for synergy opportunities with other planned projects and planning efforts.

Alternatively, the reservoir rooftop discharge point could be rerouted into a new separate storm pipe that runs northerly into Stern Grove then turns south until reaching Pine Lake. The total pipe length would be approximately 3,200 feet. There is an existing sewer easement along the southern slope of Stern Grove with an above-ground sewer pipe on supports. There is also an existing creek-like channel running westerly through the valley of Stern Grove, but it would not have capacity to handle the runoff from the Merced Manor Reservoir without significant upsizing. There is a naturalized forebay to the east of Pine Lake that could be analyzed for its ability to receive waters from the reservoir and provide pretreatment prior to discharge into Pine Lake. The high cost of installing a new pipeline and the fact that this alternative does not include any new green infrastructure lower its cost-effectiveness.

The Merced Manor rooftop is open to the public and is actively used as a recreational area. Thus, in situ management options on the rooftop are not a credible option.

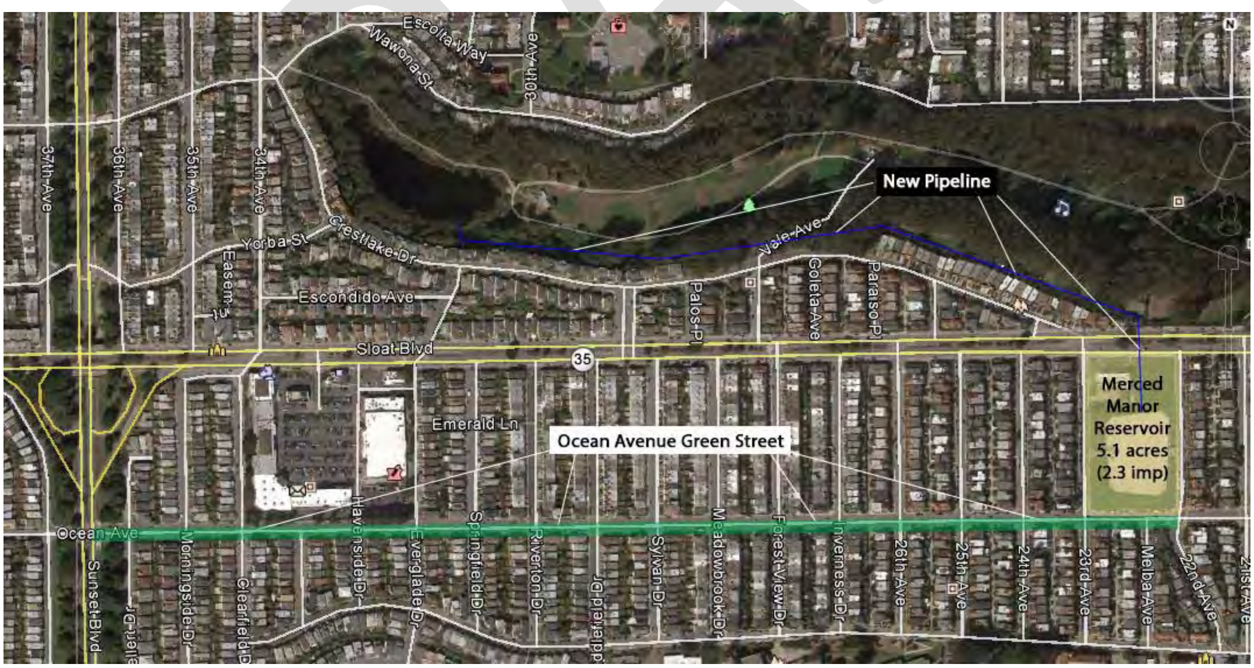


Figure 1: Balboa Reservoir and Nearby Management Opportunities

Balboa Reservoir

The lower reservoir parking lot contains approximately 15 acres of land with no significant infrastructure onsite, except the asphalt parking surface. The site is currently planned for redevelopment, which will entail compliance with the Stormwater Management Ordinance as expounded in the Stormwater Design Guidelines (SDG). The site investigation focused on additional opportunities to go above and beyond the SDG requirements, which include:

- Integrating stormwater management function into the master plan currently under development in a manner that would exceed the minimum requirements; or
- Retaining a portion of the lower reservoir land and construct a multi-functional community feature that would manage run-on from adjacent DMA

The first opportunity could be pursued through a public-private partnership with a willing developer. The City could either include the prescribed stormwater management function as part of the land deal, which might depress the sale price slightly, or offset financial impacts on the developer by expediting the entitlement process or granting other development considerations (e.g., increased density).

The natural gradient of the site flows to the southwest, thus providing an opportunity to manage run-on from the north and the east. The adjacent parcels to the east, both owned by CCSF (see Attachment 1 for a plat of these parcels), provide the largest opportunity to collect stormwater from offsite. They contain approximately 11.5 acres of impervious area, mostly parking lot. The northern portion is currently a parking lot, although CCSF has plans to develop that land with multiple structures, and that development would be subject to the SDG requirements. The southern portion was recently developed with a new college building that has a green roof, and the manholes in the surrounding parking lot indicate a separate storm sewer that could potentially be rerouted from discharging to the combined sewer.

Riordan High School is located to the north. There are approximately five acres of parking lot, driveway and athletic fields that sheet flow to the south. There is a large drain inlet in the southwest corner of the driveway/parking lot area, and this collection point could be rerouted fairly easily to the northeast corner of the lower reservoir parcel. Based on visual inspection through a fence, the track and field area appears to sheet flow to the south onto the lower reservoir parcel, but this would have to be confirmed with campus staff. The campus buildings appear to have internal downspouts so rerouting rooftop runoff is likely not feasible due to the expense and disruption.

Figure 2: Balboa Reservoir and Adjacent DMAs

<u>Sunset Reservoir</u>

Sunset reservoir has a rooftop area of 26 acres, providing a very large amount of impervious area draining to a single point. The management opportunities in the surrounding neighborhood are fairly constrained, however, by steep grade and limited space. Abraham Lincoln High School is catty-corner to the southeast of the reservoir, but is on the other side of a local peak and on the other side of the reservoir from the drainage discharge point, which is on the western side near the intersection of 28th Avenue and Pacheco Street. Starting at 28th Avenue and heading south, Ortega Street has a manageable slope and a wide roadway; however, a repaving project was recently completed here and there is no extra width with the new dedicated bicycle lanes in both directions. An infiltration gallery might be feasible, although recent completion of the repaving project renders that unlikely; preliminary sizing calculations showed that approximately five blocks of the street would need to be retrofit. There is a large collection of open space about ½ mile downgradient to the west, including Ortega Library, Sunset Elementary School, and Saint Ignatius College Preparatory. While the cost of installing new pipe for that distance through City streets would be very high, there may be opportunities to store and reuse water in that area. Perhaps the best management opportunities at this reservoir are on the rooftop itself (e.g., a “blue roof” system of pans adhered to the rooftop). The northern half of the reservoir is home to a large solar panel installation, which would need to be considered when evaluating rooftop management options. Managing the surrounding landscape area does not seem a worthwhile pursuit.

Figure 3: Sunset Reservoir and Nearby Management Opportunities

Sutro Reservoir

Sutro reservoir was also evaluated for management opportunities, but it was discovered that runoff from the reservoir is currently routed to a nearby City parcel where it naturally attenuates. This nearby parcel is being explored as a potential creek daylighting project opportunity where additional DMA could be routed to that parcel.

Conclusions and Recommendations

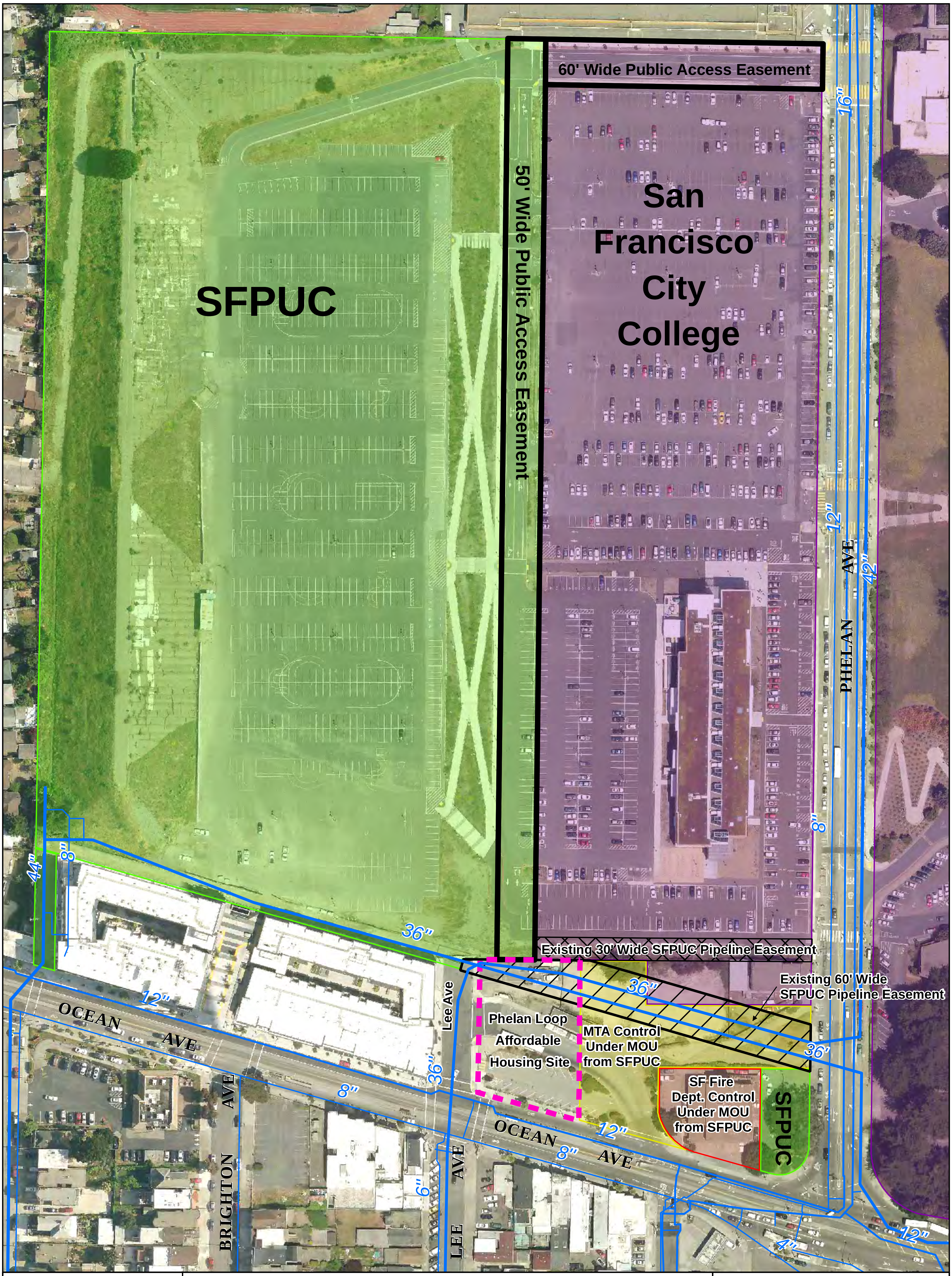
Merced Manor appears to have the best offsite management opportunity, with a green street on Ocean Avenue the preferred option for further investigation. It is recommended that this option be carried forward in the UWA Opportunities Analysis.

Being the parcel owner, SFPUC is in a position to control certain aspects of the proposed redevelopment at the Balboa Reservoir. Internal coordination is recommended to determine if the SFPUC wishes to pursue stormwater management performance above and beyond the SDG requirements for future development at this site, understanding that heightened stormwater requirements will likely result in a cost impact on the sale of the parcel. Heightened stormwater requirements could take the form of either higher performance for the proposed redevelopment itself and/or retaining roughly an acre of the parcel to construct a large community feature with intensive stormwater function.

Sunset Reservoir offers a tremendous amount of impervious drainage area that can diverted from a single point; however, the management options in the surrounding neighborhood are highly constrained. It is recommended that rooftop management options, such as a pan retention system, be pursued at this site.

ATTACHMENT 1

Balboa Reservoir Plat



N

1:1,500

1 inch = 125 feet

Feet
0 40 80 120 160

Public Access Easement

60' WIde SFPUC Pipeline Easement

30' Wide SFPUC Pipeline Easement

Phlean Loop
Affordable Housing Site

Existing SFPUC Pipelines

SFPUC

San Francisco City College

MTA Control Under
MOU from the SFPUC

SF Fire Dept. Control
Under MOU from SFPUC

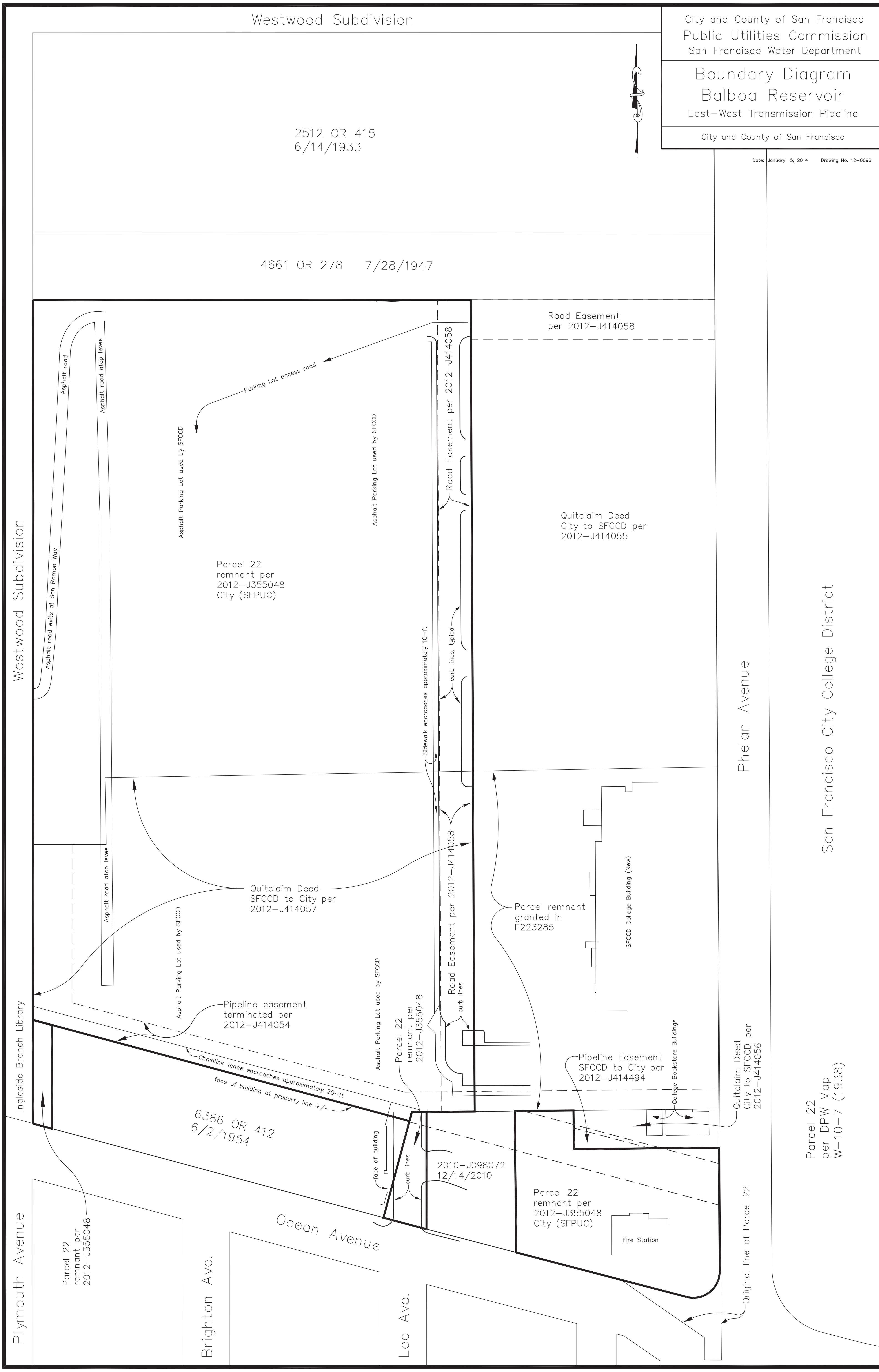
Aerial Photo Flown in 2012

Hetch Hetchy
Regional Water System
Services of the San Francisco Public Utilities Commission

REAL ESTATE SERVICES

Balboa Reservoir

Date: 10/19/2012



City and County of San Francisco
Public Utilities Commission
San Francisco Water Department
Boundary Diagram
Balboa Reservoir
East-West Transmission Pipeline
City and County of San Francisco
Date: January 15, 2014 Drawing No. 12-0096
Westwood Subdivision
2512 OR 415
6/14/1933
4661 OR 278 7/28/1947
Road Easement
per 2012-J414058
Parking Lot access road
Asphalt road
Asphalt road atop levee
Asphalt Parking Lot used by SFCCD
Road Easement per 2012-J414058
Quitclaim Deed
City to SFCCD per
2012-J414055
Parcel 22
remnant per
2012-J355048
City (SFPUC)
Westwood Subdivision
Asphalt road exits at San Ramon Way
curb lines, typical
Sidewalk encroaches approximately 10-ft
Phelan Avenue
San Francisco City College District
Quitclaim Deed
SFCCD to City per
2012-J414057
Parcel remnant
granted in
F223285
SFCCD College Building (New)
Pipeline easement
terminated per
2012-J414054
Ingleside Branch Library
Parcel 22
remnant per
2012-J355048
curb lines
Pipeline Easement
SFCCD to City per
2012-J414494
College Bookstore Buildings
Quitclaim Deed
City to SFCCD per
2012-J414056
Chainlink fence encroaches approximately 20-ft
face of building at property line +/-
6386 OR 412
6/2/1954
face of building
2010-J098072
12/14/2010
Parcel 22
remnant per
2012-J355048
City (SFPUC)
Fire Station
Parcel 22
per DPW Map
W-10-7 (1938)
Original line of Parcel 22
Ocean Avenue
Plymouth Avenue
Brighton Ave.
Lee Ave.