

# County of San Mateo Green Infrastructure Planning



*Middlefield Road Parking Lot*

Julie Casagrande  
August 18, 2021



# Collaboration



OFFICE OF  
SUSTAINABILITY  
COUNTY OF SAN MATEO

**COUNTY** OF **SAN MATEO**  
PLANNING AND BUILDING



**Lotus Water**  
engineering

# Overview

1. Development of GI Typical Details
2. Unincorporated County Focus Areas
3. Three-Phase GI Feasibility Analysis
4. Lessons Learned

# GI Plan Approved – What Next?

- #1 – Develop GI typical details for DPW engineers and design consultants
- #2 – Conduct pilot GI feasibility analysis and create templates & tools

## Green Infrastructure Plan

County of San Mateo



Approved on: September 17, 2019  
Approved by: Board of Supervisors

Submitted by:  
County of San Mateo  
455 County Center  
Redwood City, CA 94063

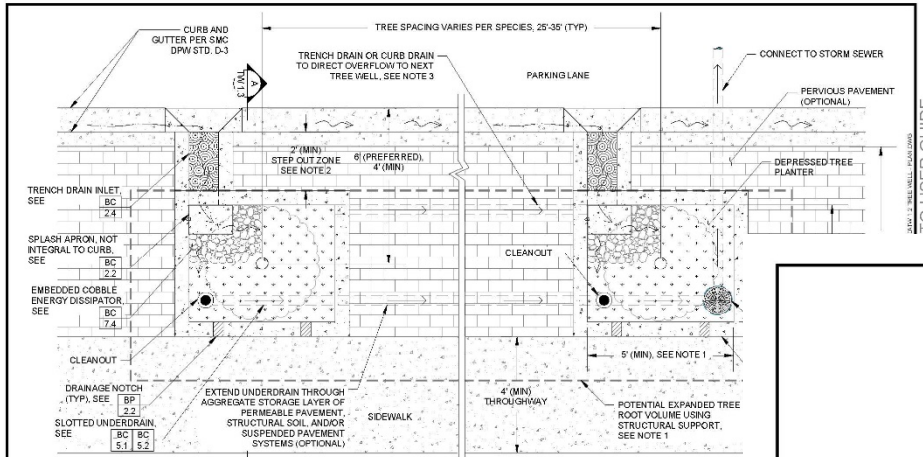




# Typical Details

- Modified typical details from SMCWPPP GI Design Guide (SFPUC) to meet County standards
- Developed new typical details:
  - Bioretention basin for street with valley gutters
  - Connected tree well filters along street parking zone
  - Bioretention edge treatments: metal fencing, wood fencing, seat wall, timber foot bridge, rock-stabilized slope, and compacted soil bench
  - Bioretention inlet with trash capture (curb cut with trash screen in 18" wide trench drain)
  - Bioretention planter barrier for Class 4 bikeway

# Typical Details



## NOTES:

- PREFERRED TREE WELL OPENING SIZE IS 6 FEET BY 6 FEET, BUT CONSTRAINED SITES CAN REDUCE WIDTH TO 4 FEET PROVIDED THEY CAN ACCOMMODATE MINIMUM REQUIRED TREE ROOT VOLUME BY INCREASING LENGTH AND/OR USING STRUCTURAL SOIL, PERVIOUS PAVEMENT, AND/OR SUSPENDED PAVEMENT SYSTEMS UNDER ADJACENT SIDEWALK. IF ADJACENT TO LANDSCAPED AREAS, EXTEND THE BOUNDARY TO BACK OF SIDEWALK TO ALLOW TREE ROOTS TO ACCESS ADJACENT LANDSCAPED AREAS WITH NATIVE SOIL.
- DESIGNER TO SPECIFY MINIMUM SIDEWALK WIDTH BEHIND AND STEP-OUT ZONE IN FRONT OF TREE WELL THAT COMPLIES WITH ALL APPLICABLE AGENCY AND ADA REQUIREMENTS. STEP-OUT ZONE CAN BE ELIMINATED IF PARKING IS PROHIBITED ALONG CURB. SEE DESIGNER NOTES.
- IF CURB DRAIN, I.E. SHALLOW PIPES, ARE USED TO CONVEY SURFACE WATER BETWEEN TREE WELLS, 3 INCH CAST IRON PIPES SHALL BE INSTALLED AND A MINIMUM COVER OF 1-1/2 INCHES OF CONCRETE OVER PIPES SHALL BE PROVIDED. IF TRENCH DRAIN IS USED, THE GRATE SHALL BE ADA COMPLIANT AND HAVE A NON-SLIP SURFACE.

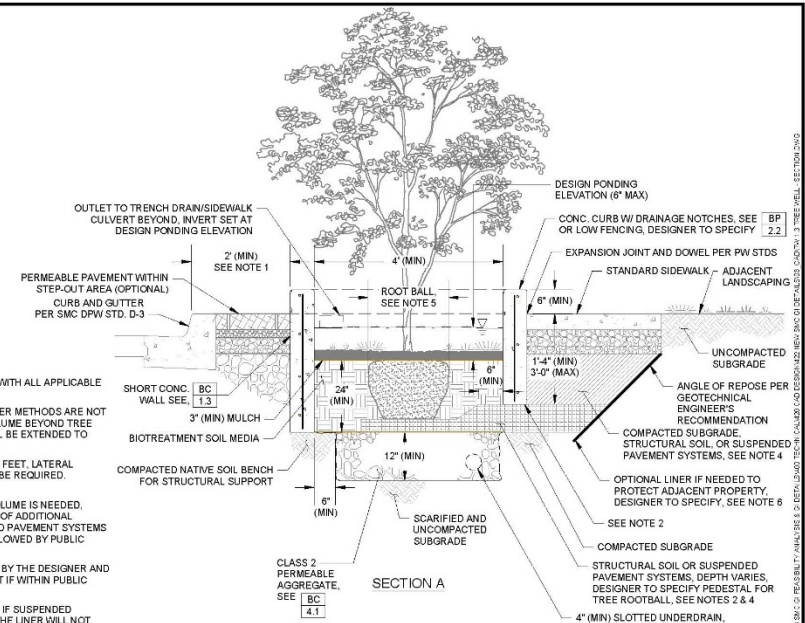


JAMES C. PORTER  
DIRECTOR OF  
PUBLIC WORKS

GREEN INFRASTRUCTURE  
TYPICAL DETAILS  
COUNTY OF SAN MATEO

DATE: 06.2020  
VERSION: 01  
REVISION: N/A

TREE WELL FILTER  
CONNECTED TREE WELLS WITH PARKING  
PLAN



## NOTES:

- STEP-OUT WIDTH SHALL COMPLY WITH ALL APPLICABLE AGENCY AND ADA STANDARDS.
- IF STRUCTURAL SOIL AND/OR OTHER METHODS ARE NOT USED TO EXPAND TREE ROOT VOLUME BEYOND TREE PLANTER, EDGE RESTRAINT SHALL BE EXTENDED TO BOTTOM OF BIOTREATMENT SOIL.
- IF TREE WELL LENGTH EXCEEDS 6 FEET, LATERAL BRACING AND/OR FOOTINGS MAY BE REQUIRED. DESIGNER TO SPECIFY.
- IF ADDITIONAL ROOTABLE SOIL VOLUME IS NEEDED, DESIGNER MAY SPECIFY THE USE OF ADDITIONAL STRUCTURAL SOIL OR SUSPENDED PAVEMENT SYSTEMS UNDER THE SIDEWALK BASE IF ALLOWED BY PUBLIC WORKS.
- ROOT BALL SIZE TO BE SPECIFIED BY THE DESIGNER AND APPROVED BY THE CITY ARBORIST IF WITHIN PUBLIC RIGHT-OF-WAY.
- IF POSSIBLE, DO NOT USE A LINER IF SUSPENDED PAVEMENT SYSTEMS ARE USED. THE LINER WILL NOT ALLOW TREE ROOTS TO GROW INTO THE NATIVE SOIL BEHIND THE SIDEWALK.
- REFER TO DESIGNER NOTES FOR ADDITIONAL DESIGN GUIDANCE.



JAMES C. PORTER  
DIRECTOR OF  
PUBLIC WORKS

GREEN INFRASTRUCTURE  
TYPICAL DETAILS  
COUNTY OF SAN MATEO

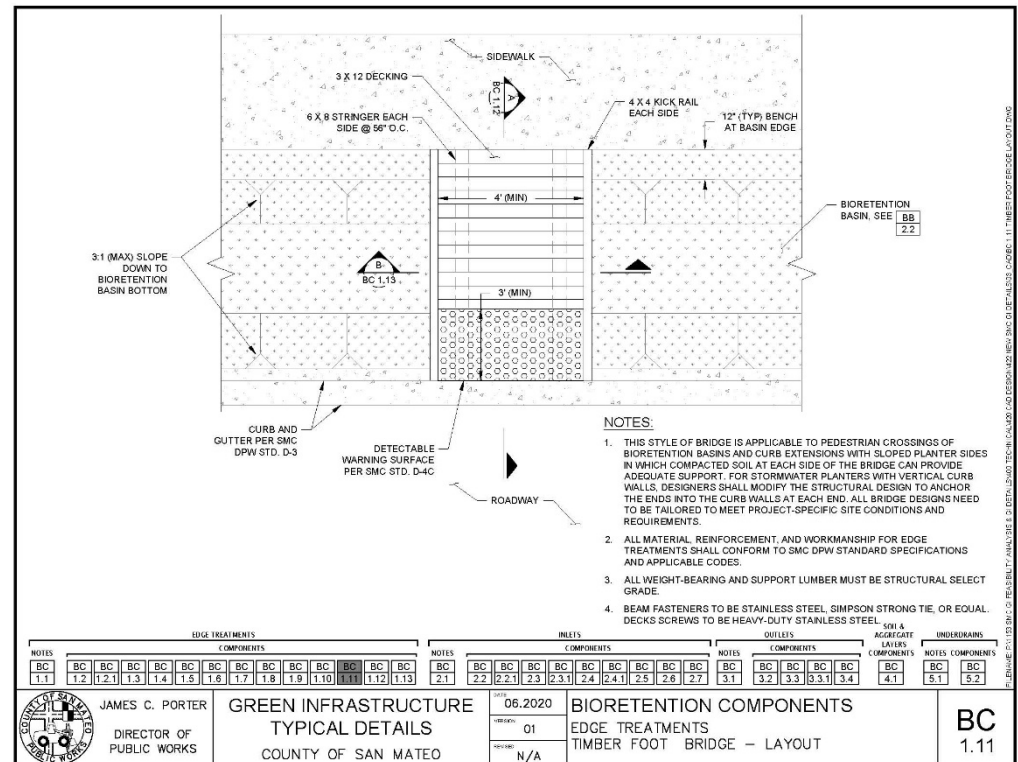
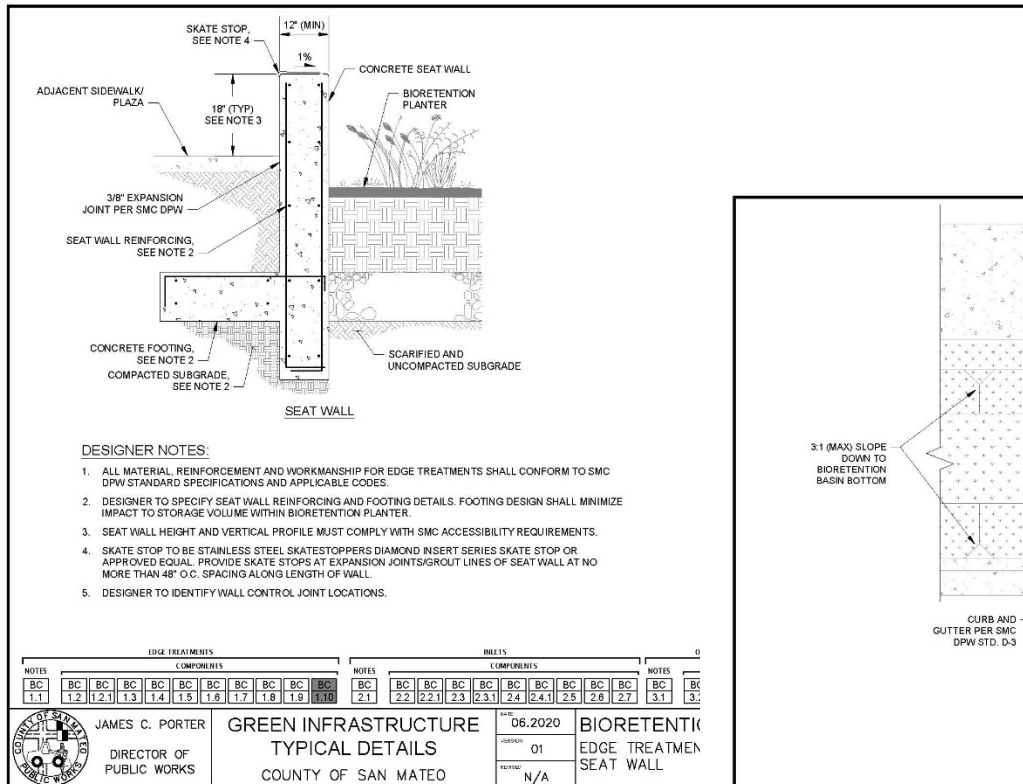
DATE: 06.2020  
VERSION: 01  
REVISION: N/A

TREE WELL FILTER  
CONNECTED TREE WELLS WITH PARKING –  
SECTION

NOTES: PLAN SECTION  
TW 1.1 TW 1.2 TW 1.3

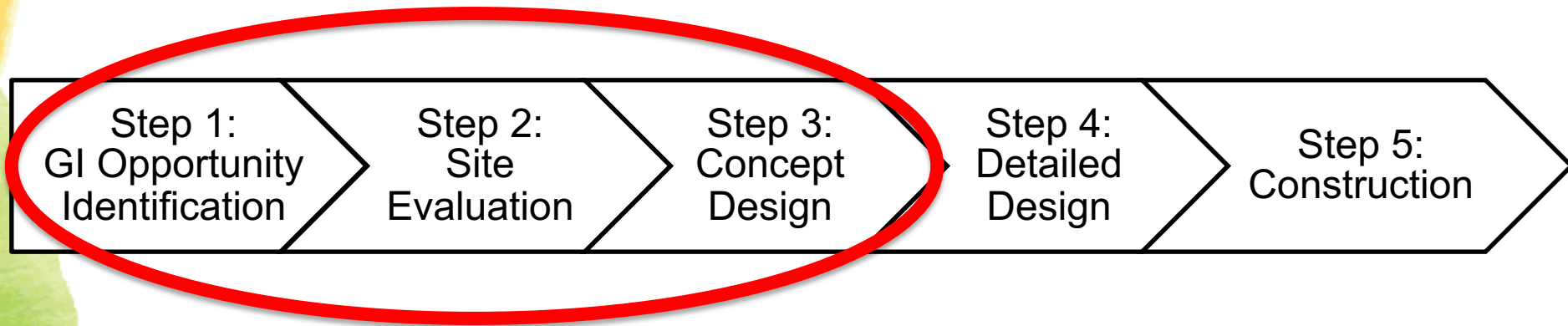
TW  
63

# Typical Details



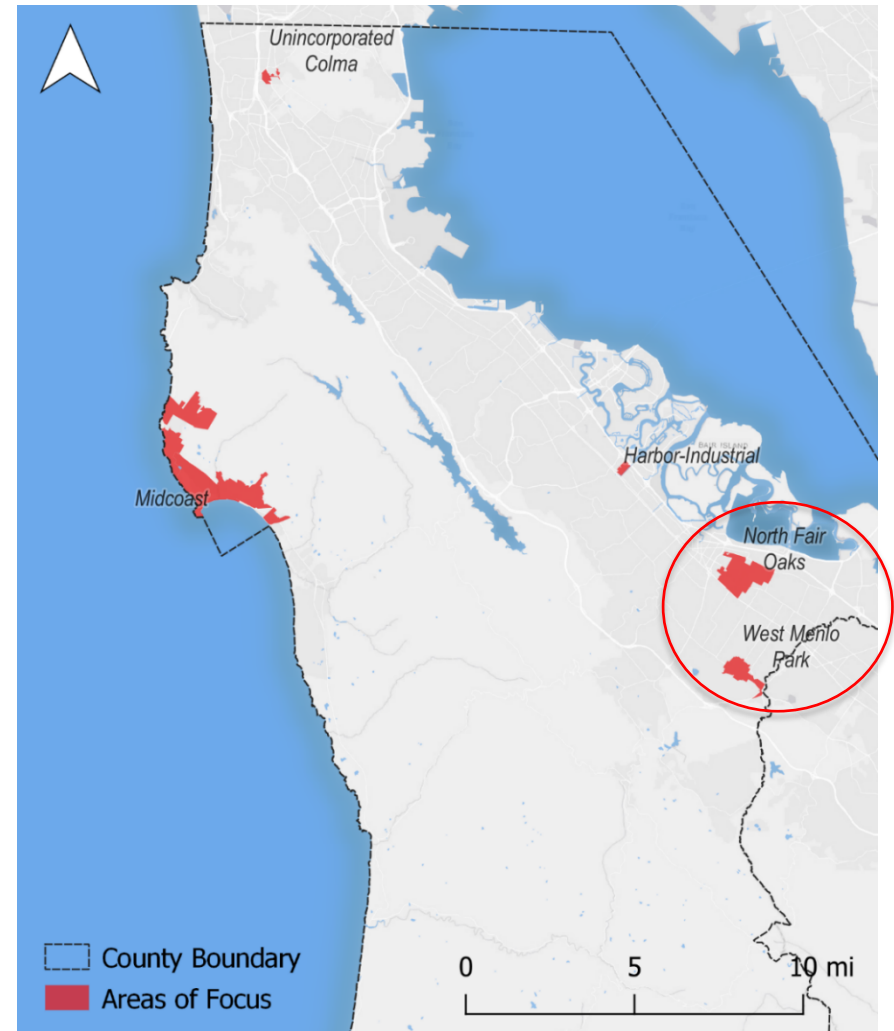
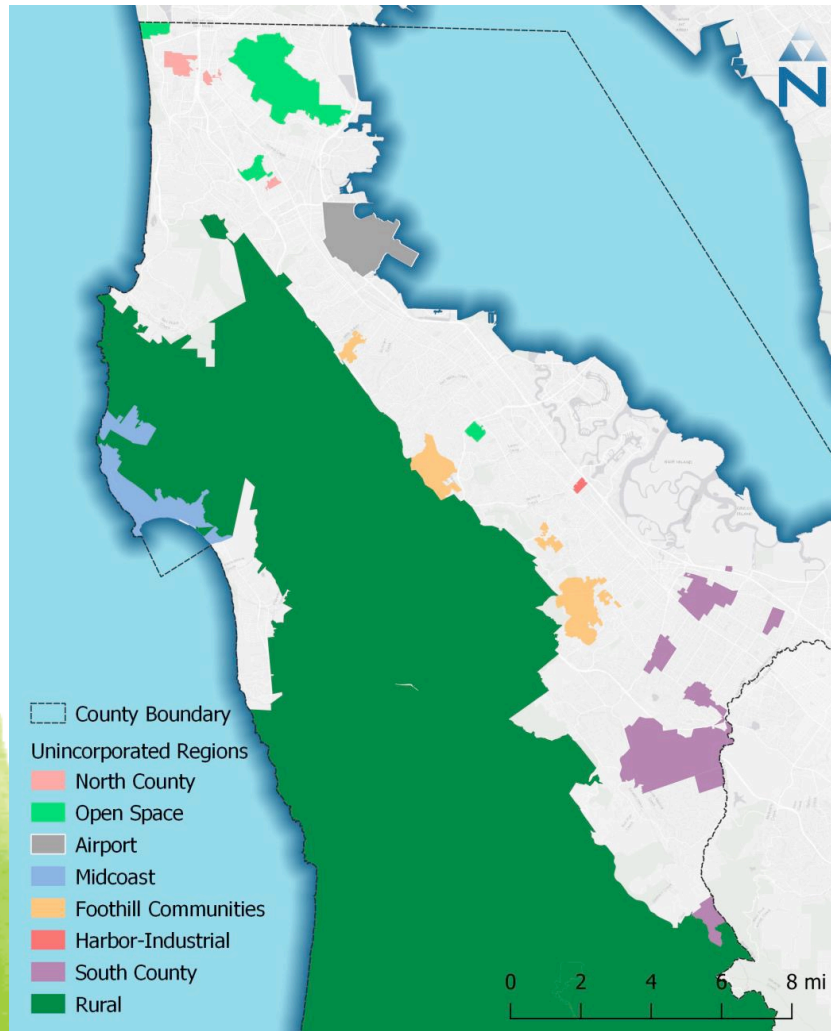
# GI Implementation Plan

- Process from County GI plan:





# Unincorporated San Mateo County Focus Areas



# County GI Opportunities

## Planned DPW Road Projects



## Redevelopment Frontage/Priority Commercial Areas



# GI Feasibility Analysis Three Phase Approach

## 1: Desktop Analysis

- Google Earth
- Google Street View
- Utility maps
- Topo surveys
- As-built plans
- Existing soils data

## 2: Field Assessment

- Create aerial base maps
- Flag missing data
- Conduct site visits and measurements
- Conduct new surveys & testing as needed:
  - Spot topo survey
  - Soil testing
  - Utility locating

## 3: Concept Development

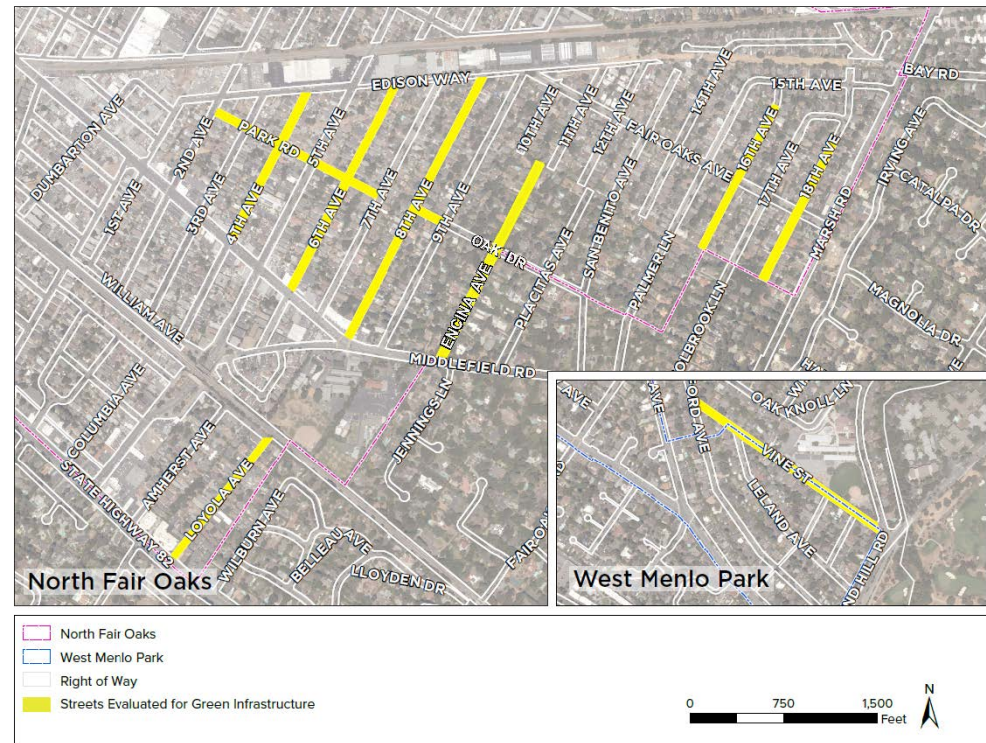
- Concept fact sheets:
  - Description
  - GI locations, types, and sizing
  - DMAs
  - Estimated benefits
  - Key constraints/considerations
  - High level costs
  - O&M needs and high level costs



# Desktop Analysis – DPW Planned Projects

NORTH FAIR OAKS AREA PROJECT PRIORITY LIST

Combined Priority (Drainage, PCI, & Survey)	Street	Prioritization Category
1	Edison Way (5 <sup>th</sup> Avenue to end) as one project.	Drainage
2	Edison Way – 1 <sup>st</sup> to 5 <sup>th</sup> Avenues	
3	11 <sup>th</sup> Avenue	
4	12 <sup>th</sup> Avenue	
5	2 <sup>nd</sup> Avenue	
6	Fair Oaks Avenue	
7	9 <sup>th</sup> Avenue	
8	Oak Drive	
9	Placitas Drive	PCI 0 to 40
10	7 <sup>th</sup> Avenue – Fair Oaks Ave to Spring St	
11	3 <sup>rd</sup> Avenue	
12	14 <sup>th</sup> Avenue	
13	15 <sup>th</sup> Avenue, a.k.a. Palmer Lane	PCI 41 to 55
14	Amherst Avenue	
15	10 <sup>th</sup> Avenue	
16	San Benito Avenue	
17	7 <sup>th</sup> Avenue – Park Road to Edison Way	PCI 55 & Above
18	7 <sup>th</sup> Avenue – Middlefield Rd to Park Road	
19	Loyola Avenue	
20	Encina Avenue	
21	16 <sup>th</sup> Avenue	
22	8 <sup>th</sup> Avenue	
23	Park Road	
24	18 <sup>th</sup> Avenue	
25	4 <sup>th</sup> Avenue	
26	6 <sup>th</sup> Avenue	
27	17 <sup>th</sup> Avenue	



1: Desktop Analysis

2: Field Assessment

3: Concept Development



# Desktop Analysis – DPW Planned Projects

## County of San Mateo Green Infrastructure Screening Analysis

Beige = Streets north/east of railroad tracks that may not be part of the analysis.

Green = Potential GI feasibility - further analysis recommended.

Yellow = Limited GI feasibility - further analysis not recommended.

Legend

### NORTH FAIR OAKS

Street	From	To	Sidewalk, curb and gutter?	Paved Sidewalk?	Paved Shoulder?	Unpaved Shoulder?	Overhead Powerlines?	Street Trees	School?	Storm drain inlets on street?	ROW width (ft)	Road Standards	Notes	Initial GI Feasibility Assessment
Fourth Avenue	William Ave	Edison Way	Most	Yes - some are not paved on 400 and 500 block	No	No - some on 400 and 500 block	Yes - on one side	Yes - north of Middlefield - on 400 and 500 block	Yes - Everest High School on 400 block	No	60	A-3 Urban Residential Collector or Minor Commercial	Generally a high level of imperviousness of the streetscape including parcel frontages	PP in parking lane on 300 block might be good because there are few trees. Might be able to install tree well filters or bioretention near intersections where there is a storm drain line (at Middlefield or Edison). Curb extensions at Middlefield intersection could overlap existing red curb to minimize parking loss. Could potentially combine with PP in parking lanes to treat all ROW runoff. Potential opportunity to large stormwater planter and pedestrian improvements in front of Everest High School where there is already red curb and poor landscaping if we could run SD pipe through school parking lot to connect to SD main in 5th Ave.
Fourth Avenue	Dead End	Spring Street/County Line	Yes	Yes	No	No	Yes - on one side	Yes - but only in bulb outs	No	No	60	A-3 Urban Residential Collector or Minor Commercial	Big tree in center island on 600 block - empty island next to it. Middle class. Some businesses. A lot of impervious surface on parcels draining to street. High	Limited GI feasibility if utilities are under parking lane. Might be able to install tree well filters or bioretention at Fair Oaks Ave intersection where there is a storm drain line. Fair Oaks intersection looks like only viable place for bioretention. Large mature trees on last/northernmost block will make GI difficult.
Sixth Avenue	Semicircular Road	Edison Way	Yes - on 300 and 400 block	Yes on 300 and 400 blocks. Some of 500 block.	No	No	No! Underground on 300 block? Yes on 400 and 500 blocks.	No on 300. Yes on 400	No	Yes - on 300 block and at Park.	60	A-3 Urban Residential Collector or Minor Commercial	400 and 500 blocks have mid-block chicanes with trees and curbs (and some parking behind). Fenced chicane at both ends of the neighborhood.	Large bulbouts at Edison and 8th could become stormwater curb extensions where there is an adjacent storm drain inlet. Bulbouts and barricade area are good opportunity areas for bioretention. No storm drain connections near chicanes limit the opportunities those areas could provide.
Sixth Avenue	Dead End	Bay Road/County Line	Yes	Yes	No	No	Yes - on one side	No	No	No - only at Spring Street	60 (south of Spring St) 50 (north of Spring St)	A-3 Urban Residential Collector (S of Spring) A-6F Sequoia Tract (N of Spring) no parking, sidewalk	Low parking demand on 700 block. Valley gutter on 800 block with parking on sidewalk.	Limited GI feasibility. GI in PP in parking lane and possibly Tree Well Filters at Spring Street where there is a storm drain inlet? (Confirm)
Eighth Avenue	Middlefield Road	Edison Way	No	No	Some - more pave shoulders on 500 block.	Mostly. Some perpendicular parking in shoulders (wider).	Yes - on one side	Yes	No	No	60	A-6F Sequoia Tract - unpaved shoulder	400 and 500 blocks have mid-block chicanes with trees and curbs (some with no parking behind). Fenced chicane at both ends of the neighborhood. Tree in roundabout at Oak Street. Large area behind chicanes on 600 block.	Large bulbouts at Edison and 8th could become bioretention. Storm drain inlet adjacent on 8th. PP isn't recommended in heavy tree coverage areas so patchwork PP parking areas may not be worthwhile. Also, it looks like PP parking areas will accept run-on and thus need overflow connections. Size of bioretention at Edison is limited by driveway locations on 8th but could potentially wrap bioretention around corners (on Edison).

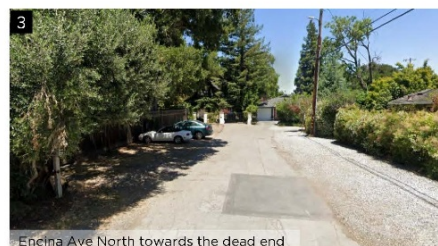
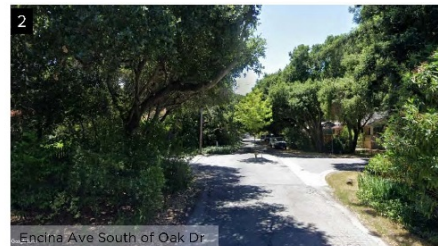
1: Desktop Analysis

2: Field Assessment

3: Concept Development

# Desktop Analysis – DPW Planned Projects

SMC GI Potential within Planned Project Encina Avenue - Green Infrastructure Feasibility			
Planned Project Description	Encina Avenue between Middlefield Road and the Encina Ave dead end will consist of 18' roadways and 6" curbs within county lines		
Road Type	A-6F Sequoia Tract. Existing: 60-ft right-of-way, 18-ft roadway, large shoulder		
GI Opportunities Evaluated	<ul style="list-style-type: none"><li>• Bioretention</li><li>• Permeable Pavement</li></ul>		
GI Plan Prioritization	Medium		
Site Conditions	Soil	unknown	
	Groundwater	>10-ft	
Drainage	<ul style="list-style-type: none"><li>• Slopes northeast with a high point at Middlefield Road and low point at the Encina Ave dead end</li><li>• Run-on from both directions along Oak Drive drain onto Encina Ave</li><li>• No storm drain mains along or adjacent to Encina Ave</li><li>• Majority of road appears to drain onto gravel shoulders fronting properties</li></ul>		
Utility Conflicts	<ul style="list-style-type: none"><li>• Sanitary sewer (size unknown) in the western half of the roadway</li><li>• Fire hydrant located at the northeastern corner of Encina Ave and Oak Dr</li><li>• Fire hydrant at the northwestern portion of the Encina Ave dead end</li><li>• Water main buried under shoulder along western side of Encina Ave</li><li>• Gas main buried under east side of Encina Ave</li></ul>		
GI Evaluated	Bioretention	There is space at the southwestern corner and northeastern corner of Encina Ave and Oak Dr for bioretention to manage run-on and drainage from the upper half of the DMA. Both sides of the dead end on Encina Ave also have sufficient space for bioretention. However, it appears relocation of water and gas mains around the bioretention areas would be required. Additionally, the eastern shoulder consists of mature vegetation that may render the location infeasible for bioretention.	
	Pervious Pavement	Pervious pavement may be feasible in the western shoulder of Encina Ave beginning midblock between Middlefield and Oak Dr, and extending to the dead end of Encina Ave. The existing shoulder mostly consists of decomposed granite open space at various widths. The eastern shoulder consists of mature vegetation that may render the location infeasible for pervious pavement.	
GI Performance	Total street area managed		2.3 acres
	Pervious Pavement		0 sf
	Bioretention	Total Planter Area	4,420 sq ft
		Sizing Ratio	4.0 %
	Parking Loss	-13 spaces converted to bioretention (6 perpendicular and 7 parallel)	
Design Criteria	Pervious Pavement Width		NA
	Bioretention Width		Varies 12-18 feet
GI Feasibility	In general, there appears to be space for bioretention facilities that can adequately manage roadway runoff, however, if underdrains are needed, and thus overflow connections to storm drain mains, this street is not suitable for GI. Pervious pavement areas would also require storm drain connections if they are managing run-on from adjacent roadway and parcels. Lastly, the need to relocate water and gas mains around the bioretention facilities likely makes this street unsuitable for bioretention.		



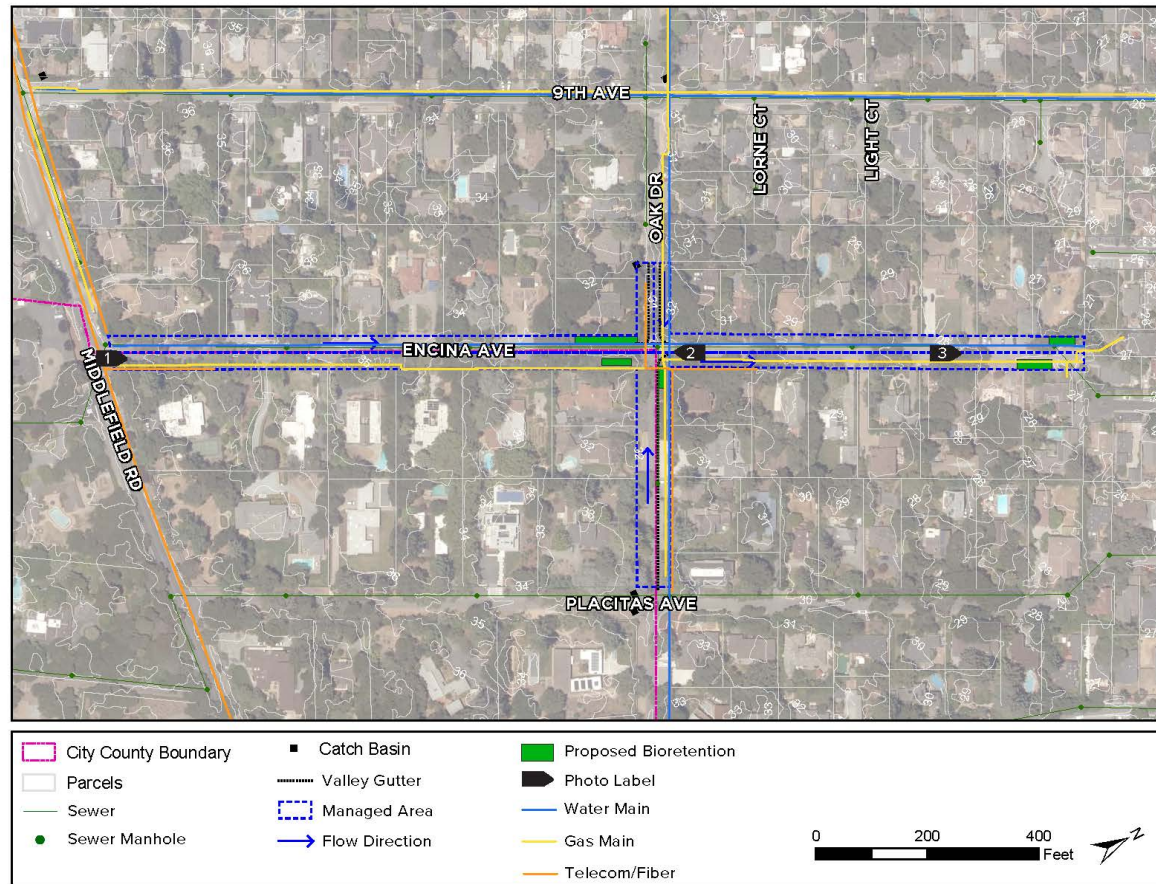
1: Desktop Analysis

2: Field Assessment

3: Concept  
Development



# Desktop Analysis – DPW Planned Projects

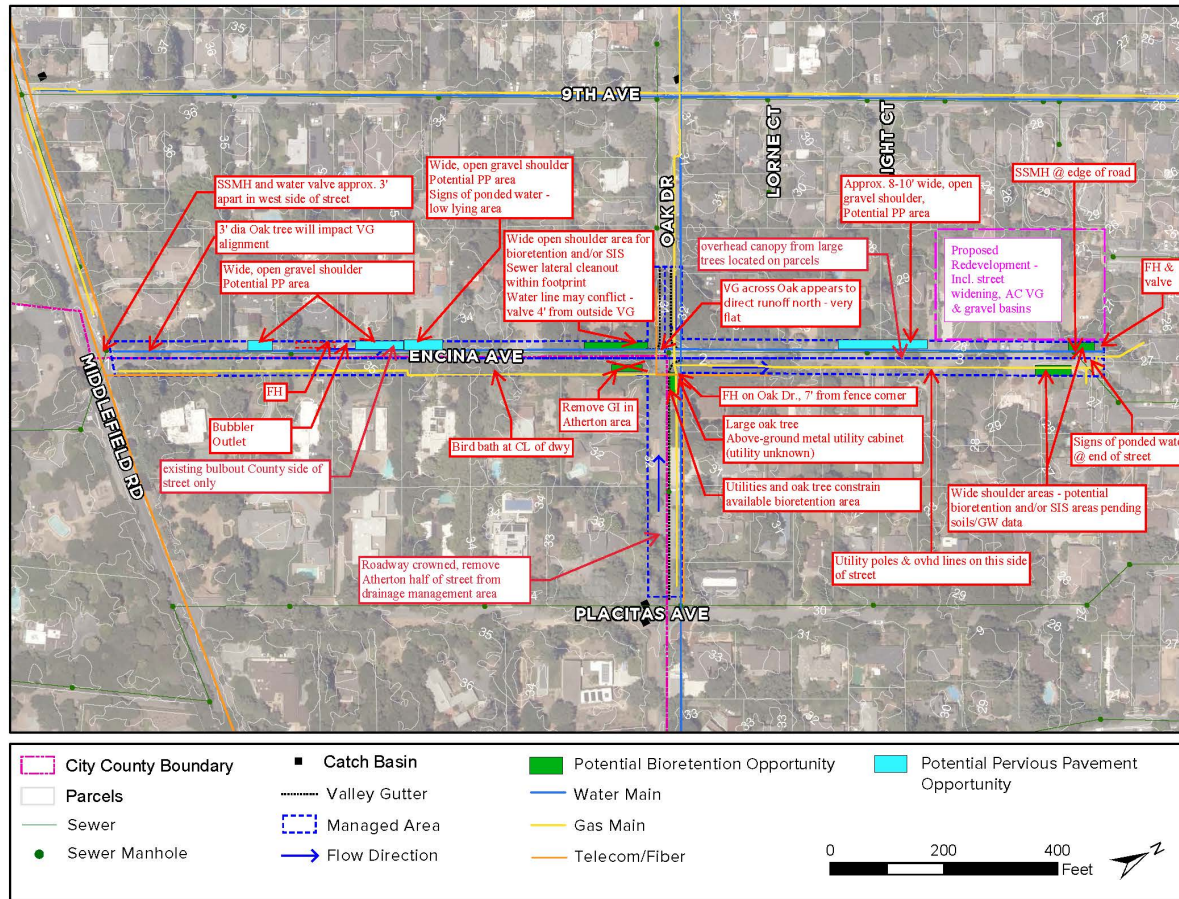


1: Desktop Analysis

2: Field Assessment

3: Concept  
Development

# Field Assessment – DPW Planned Projects



1: Desktop Analysis

2: Field Assessment

3: Concept  
Development



# Concept Design – DPW Planned Projects

San Mateo County Green Infrastructure Feasibility Assessment

## Encina Avenue



### Concept Description

Encina Avenue is a two-block stretch of road, within unincorporated County of San Mateo and City of Atherton limits. Both blocks will undergo roadway improvements to restore and repave the 18-foot travel path. Additionally, the southern block nearest to Middlefield Road will include 6-inch wide flush curbs while the northern block near the roadway dead end will include 2-foot wide concrete valley gutters to manage surface runoff.

This concept proposes to incorporate stormwater infiltration galleries along Encina Avenue within the County boundary. The proposed green infrastructure will consist of a bioretention area to capture surface runoff and provide pretreatment prior to draining to infiltration galleries located under the roadway. The

infiltration galleries have been sized to drawdown the design volume with 48 hours to meet C.3 requirements. The infiltration gallery sizing assumes that this facility consists of a 72-90" deep gallery with open-graded aggregate and a perforated distribution pipe along the top. Proprietary systems consisting of chambers or other structural elements may be used to increase the storage volume per footprint. The bioretention facilities only provide pretreatment (i.e. sediment and debris capture) and thus have not been sized to treat the entire drainage management area per C.3 requirements. Alternative pretreatment facilities, including proprietary systems, should be evaluated in the future design phase.

This project will manage runoff from approximately 1.6 acres of roadway along Encina Ave.

### General Site Information

Neighborhood  
*North Fair Oaks*  
GI Integration Opportunity  
*Planned Roadway Improvements*  
Road Type  
*Local Neighborhood Road*

### Facility Information

Drainage Management Area  
*1.6 acres*  
Bioretention Area / Storage Volume  
*736 sf / 0.03 ac-ft*  
Infiltration Gallery Area / Storage Volume  
*1,773 sf / 0.11 ac-ft*

### Additional Project Benefits

- » *Vegetation and habitat in bioretention facilities*
- » *Reduced ponding*

1: Desktop Analysis

2: Field Assessment

3: Concept  
Development

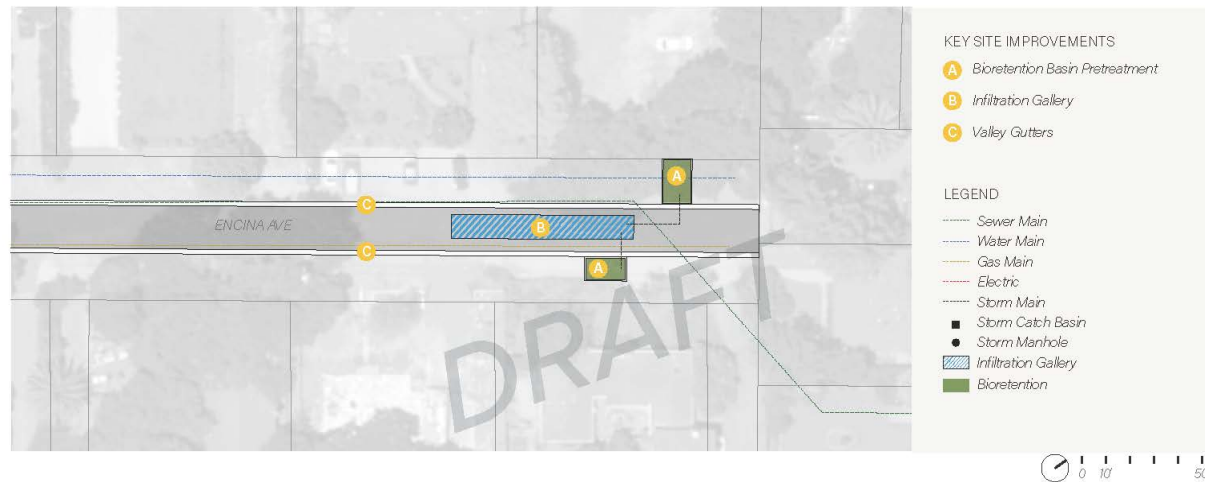


# Concept Design – DPW Planned Projects

San Mateo County Green Infrastructure Feasibility Assessment

## Encina Avenue

### Concept Detail 1: Encina Avenue End Block



### Site Elements



1: Desktop Analysis

2: Field Assessment

3: Concept  
Development

# Concept Design – DPW Planned Projects



COUNTY OF SAN MATEO



## Planning-Level Cost Estimate

DESCRIPTION	UNIT COST	UNIT COST	QUANTITY	SUBTOTAL
Utilities Protection/Relocation	\$60,000	LS	1	\$60,000
Sawcutting Pavement	\$12	LF	140	\$1,680
Roadway Demo, Excavation & Offhaul	\$12	SF	760	\$9,120
Excavation & Offhaul	\$80	CY	830	\$66,400
Planter Flush Curb & 36" Sidewalls	\$200	LF	260	\$52,000
Biotreatment Soil Media	\$260	CY	41	\$10,631
Underdrains	\$10	SF	740	\$7,400
Drain Rock Subbase	\$170	CY	27	\$4,634
Bioretention Plantings & Mulch	\$25	SF	740	\$18,500
Infiltration Gallery Aggregate, Connections	\$22	CF	4,700	\$103,400
Stockpile and Backfill Soil	\$16	CY	220	\$3,518
Geotextile Fabric	\$2	SF	1,799	\$3,598
Irrigation System	\$29,600	LS	1	\$29,600
CONSTRUCTION SUBTOTAL				<b>\$370,000</b>
Traffic Control (5% Construction)				\$18,500
Mobilization (10% construction)				\$37,000
Contingency (30% construction)				\$111,000
Design Fees (20% total)				\$107,000
TOTAL PROJECT COST (DESIGN + CONSTRUCTION)				<b>\$644,000</b>

### Notes:

1. This is a planning-level cost estimate (\$2021) for design and construction. Soft costs for County administration and project management and post-construction operations and maintenance are not included. Other factors that may affect the cost of future construction include escalation and market conditions.
2. This cost estimate does not include the costs of standard roadway or transportation improvements that may be included in the overall project and are not immediately adjacent to the proposed GI facilities.
3. The cost for utility protection/relocation is a planning-level cost estimate that assumes \$10,000 per each parcel with utility laterals impacted by the project. More information about the lateral size, depth, condition and exact location will be required to refine this cost during the future design phase.
4. The design fees for larger projects with construction subtotals greater than \$1 million are assumed to be 15%. The design fee was linearly scaled up for smaller projects to a maximum of 20% for projects with construction subtotal of \$0.5 million or less.

1: Desktop Analysis

2: Field Assessment

3: Concept  
Development



# Concept Design – DPW Planned Projects

San Mateo County Green Infrastructure Feasibility Assessment

## Encina Avenue

### Typical Anticipated Maintenance Needs & Costs

Regular maintenance is needed to ensure that each part of the GI asset continues to function properly and perform its design intent over its full lifespan. Proper post-construction maintenance is essential in sustaining the health, appearance and function of these engineered systems. The tables below list typical maintenance, rehabilitation, and replacement activities required for each type of GI over a 30-year lifespan. The budgetary maintenance costs and estimated labor hours shown on the right assume that the County has set up a GI maintenance program and organizational structure that defines roles and responsibilities, tracks maintenance activity, and trains staff on proper maintenance methods and techniques. The estimated maintenance costs and hours utilize the SFPUC's GI Maintenance Model and assume 2021 hours and an hourly wage of \$81.

GI FACILITY COMPONENT	STORMWATER CURB EXTENSIONS		
	REGULAR MAINTENANCE (per monthly visit)	REHABILITATION (per annual visit)	REPLACEMENT (per 30 year lifespan)
Mobilization/Demobilization/ Reporting	Preparation, travel, and setup time. Complete standard maintenance form.	Preparation, travel, and setup time. Complete standard maintenance form.	
Inlet & Outlet Low-Flow Channel	Clean debris & sediment from flow path. Reset/replace armoring rock as needed	Clean debris & sediment from flow path. Reset/replace armoring rock as needed	Excavate & rebuild
Splash Pad / Forebay (stone or concrete)	Clean out debris & sediment	Clean out debris & sediment Re-level concrete pad	Excavate & rebuild
Planting	Trim/prune	Replace diseased and dead plants	Full replanting
Mulch (wooden or stone)	Remove sedimentation with flat-head shovel. Spot mulch	Add new layer of mulch (wooden) Even out and fill bare patches (stone)	Add new layer of mulch
Weeds and Trash	Remove	Remove	
Soil Media	Regrade and stabilize any eroded areas	Aeration and tilling	Excavate and replace media
Aggregate Subgrade Layer			Excavate, wash, & replace
Structural Elements (e.g., curbs, curb walls, check dams)		Repair chips & cracks in concrete Regrade/reset stone elements	May not be necessary
Irrigation System	Adjust and test head patterns	Replace broken or malfunctioning heads, valve boxes, and piping	May not be necessary
Underdrain and Cleanouts	Clear obstructing debris	Snake or jet pipe	Excavate & replace the underdrain system

### Estimated Annual Maintenance Budget Required: \$6,200

Bioretention Planters  
\$3,400

Infiltration Gallery  
\$2,800

### Estimated Labor Hours: 40 hrs

Bioretention Planters  
25 hours

Infiltration Gallery  
15 hours

1: Desktop Analysis

2: Field Assessment

3: Concept  
Development

# Concept Design – DPW Planned Projects



## Typical Anticipated Maintenance Needs & Costs (cont.)

GI FACILITY COMPONENT	INFILTRATION GALLERY		
	REGULAR MAINTENANCE (per monthly visit)	REHABILITATION (per annual visit)	REPLACEMENT (per 30 year lifespan)
Mobilization/Demobilization/ Reporting	Preparation, Travel, and Setup Time. Complete standard maintenance form.	Preparation, Travel, and Setup Time. Complete standard maintenance form.	
Inlet & Outlet	Remove debris and any other blockages.	Remove debris and any other blockages.	
Perforated Distribution Pipe		Flush system from upstream cleanouts.	If system is not draining within 48 hours after end of wet weather event, drain system via pumping, clean perforated piping and gravel media, and excavate soil walls of unlined subsurface infiltration system to expose clean soils.
Monitoring Wells	Replace damaged or missing caps.	Replace broken pipe housing.	

## Additional Considerations

This project concept is presented for discussion only. This project concept is planning-level and subject to revision as additional information becomes available. Factors to be considered during design of this project include but are not limited to the following:

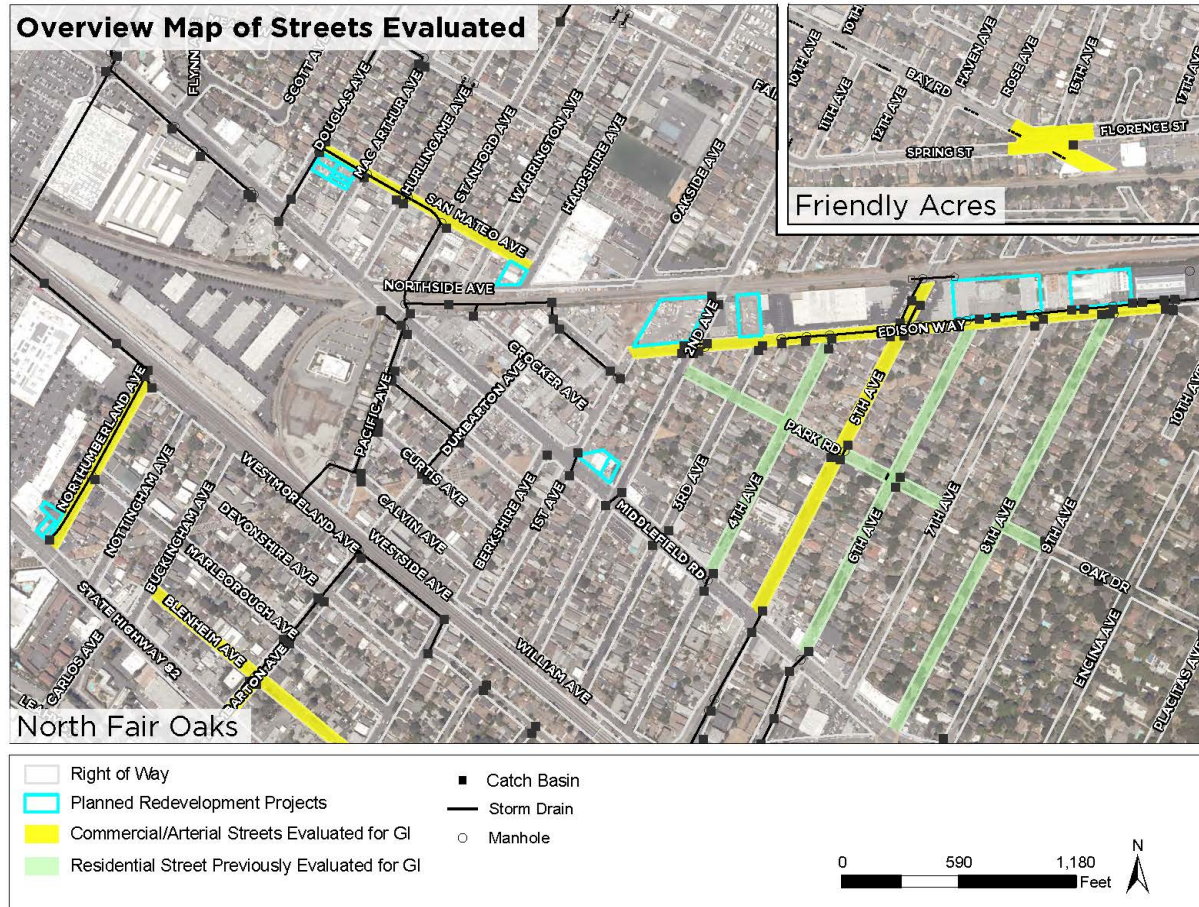
- » Infiltration Potential. Infiltration tests performed in the North Fair Oaks neighborhood with the borehole method yielded corrected infiltration rates of 0.6 inches per hour on the southern half of Encina Ave, and approximately 0.75 inches per hour on the northern half. The bioretention and infiltration gallery facilities should be sized and designed to ensure drawdown within 48 hours.
- » High Flow Bypass. Encina Ave does not have a storm drain, therefore the bioretention facilities must be designed to passively bypass larger flows that exceed the capacity of the infiltration galleries. This can be achieved with curb cut outlets to the street at the overflow elevation.
- » Utility Conflict. Initial utility assessments were conducted for sanitary sewer, storm sewer, gas mains, and water mains. Green infrastructure facilities are proposed in configurations that minimize disruption of existing utilities. County staff indicated the water main along the west side of Encina Ave will be replaced in the near future which can be coordinated with the proposed location of bioretention facilities.
- » Private Run-on. A desktop analysis of driveways along Encina Ave indicates approximately 22,400 square feet of private driveways drain towards the roadway along Encina Ave. This additional area increases the drainage area by 15%. Opportunities to increase facility sizing to account for this additional runoff should be evaluated during design development.

1: Desktop Analysis

2: Field Assessment

3: Concept  
Development

# Desktop Analysis – Redevelopment/ Frontage



1: Desktop Analysis

2: Field Assessment

3: Concept  
Development



# Desktop Analysis – Redevelopment/Frontage

County of San Mateo Green Infrastructure Screening Analysis for Commercial Streets

NORTH FAIR OAKS													Green = High Potential GI Feasibility - further analysis recommended.	Green = Moderate Potential GI Feasibility - further analysis recommended.	Yellow = Limited GI Feasibility - further analysis not recommended.
Street	From	To	Sidewalk, curb and gutter?	Paved Shoulder?	Bike lanes?	Onstreet Parking?	Overhead Powerlines?	Street Trees	School?	Storm drain inlets on street? (ft)	ROW width (ft)	Road Standards	Redevelopment	Notes	Initial GI Feasibility Assessment
Edison Way	1st Ave	2nd Ave	Curb and gutter on both sides; continuous paved sidewalk on north side, mix of paved and gravel for sidewalk area on south side.	Yes	No	Yes	Partially along north side	No	No	Yes, two at 2nd Ave intersection	50-60	A-3 Urban Residential Collector or Minor Commercial	North side of street	Sanitary Sewer and Water Main on south side of Edison in street	Not much space for Pervious Pavement (PP) because roadway is only 20-ft wide with 6-ft parking lanes. Existing bulbout at southwest corner of 2nd and Edison intersection good location for bioretention if no utility interference. Potential SCE (SCE) at northwest corner of 2nd and Edison. However, small drainage area since Edison is so flat. Opportunity for tree wells along sidewalk in front of new development on north side.
Edison Way	2nd Ave	5th Ave	Curb and gutter on both sides; continuous paved sidewalk on north side, mostly unpaved sidewalk area on south side.	Yes	No	Yes	Yes along south side of street	Very few	No	Yes, at intersections with 2nd and 3rd Ave	55	A-3 Urban Residential Collector or Minor Commercial	North side of street	Sanitary Sewer and Water Main on south side of Edison in street	Bulbout at southeast corner of 3rd and Edison good opportunity for bioretention. Fire hydrant may interfere with feasibility of bioretention at southwest corner of 3rd and Edison. Opportunity for bioretention or tree wells along sidewalk in front of new development on north side. 10x120-ft area of unpaved sidewalk along south side between 2nd and 3rd Ave could be suited to bioretention.
Edison Way	5th Ave	9th Ave	Transitions to valley gutter after intersection. Some curb along north side, no curb along south side. No sidewalk.	Along north side; south side is unpaved	No	Yes	Yes along south side of street	Yes	Yes	Yes	60	A-6F Sequoia Tract - unpaved shoulder	North side of street	Sanitary Sewer and Water Main on south side of Edison in street. North half of street is an easement (parcel APN 093541999)? Landscaped center median near 3282 Edison Way.	PP in parking lane outside of valley gutter on north side of street. There are large street trees in the adjacent curbside planters, but parking lane is 10-ft wide. Large bulbout at eastern corner of intersection between 7th Ave and Edison, and 9th Ave and Edison are good opportunities for bioretention.
5th Ave	Middlefield Road	CalTrain Tracks	Yes	Yes	No	Yes - red curb in front of commercial near Middlefield and in front of Everest High School	Yes, mainly along eastern roadside	Yes	Yes, Everest Public High School	Yes, at intersections	65	A-3 Urban Residential Collector or Minor Commercial	None	Wide street - two driving lanes and two parking lanes within 65-ft ROW. Storm main in street. Sewer on NW side of street in street. Record drawings show 6-inch sanitary sewer and 6-inch water main on west side of street. Gas line on east side of street in sidewalk.	Bioretention/raingarden opportunity in landscaping area at entrance to Everest High School. Space for PP in parking lanes. SCEs at southeastern corner of intersections with Park and Edison - southwestern corners have fire hydrants. Potential bioretention at northeast corner bulbout at intersection with Edison if doesn't interfere with tree roots.
Middlefield Rd	1st Ave	2nd Ave	Yes	Yes	No	Yes, angled parking on north side; parallel parking on south side	Yes	No	No		80	A-4 Arterial, Commercial and Industrial Street	North side of street	Utilities in parking strip on north side of street.	Could expand width of sidewalk for planter strip and/or tree wells. Could create a SCE at intersection with 1st Ave where there is a storm drain inlet. Could convert leftover parking areas between angled spaces into bioretention planters if storm drain main is extended to Middlefield. Potentially a lot of utility conflicts due to street being an arterial.
El Camino Real	Northumberland Ave	Center St	Yes	Yes	No	Yes, parallel parking.	Yes, north side	No	No		110	Highway 82 - 6 lanes + onstreet parking; median and/or center turn lane	North side of street - hotel proposed	Crosswalk across El Camino Real at Northumberland intersection; bus stop near this intersection on north side	Caltrans maintains street so special agreement would have to be developed for County to locate and maintain GI; also, very large street would be hard to treat with GI features within ROW, would likely need to provide large facility within adjacent parcel to get adequate size.
Northumberland Ave	El Camino Real/State Highway 82	Westmoreland Ave	Yes	Yes	No	Yes, parallel parking on both sides	Yes	Some	No	Yes, at intersections	50	A-3 Urban Residential Collector or Minor Commercial	West side of street - hotel proposed	Sewer may be in sidewalk on west side of street.	PP in parking lanes. Setback sidewalk and add bioretention or street trees in front of redevelopment. SCE at east corner of intersection with Marlborough Ave where there is a storm drain. Potential curb extensions, bioretention area at intersection with Westmoreland Ave.
Blenheim Ave	Buddingham Ave	Berkshire Ave	Yes	Yes	No	Yes, parallel parking on both sides	Yes	Few	No	Only at intersection with Dumbarton	55-60	A-3 Urban Residential Collector or Minor Commercial	Joe mentioned rezoning of properties in this area	Dips located approximately midblock	PP opportunity in parking strip of either side or road. SCEs at intersection with Dumbarton. 25-ft travelway. No storm inlets at intersection with Buddingham Ave.

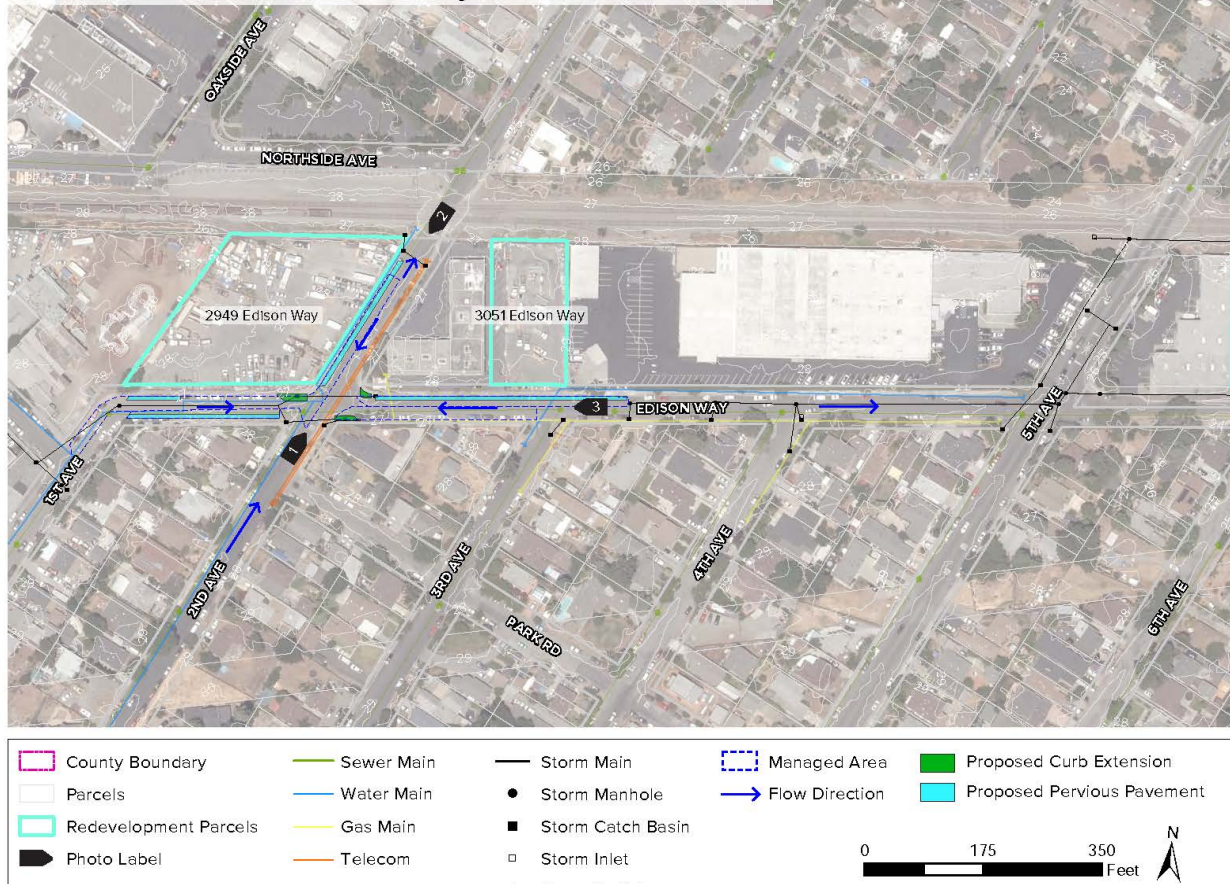
1: Desktop Analysis

2: Field Assessment

3: Concept Development

# Desktop Analysis – Redevelopment/Frontage

GI Potential Within: Edison Way (1st Ave to 5th Ave)



1: Desktop Analysis

2: Field Assessment

3: Concept  
Development



# Desktop Analysis – Redevelopment/Frontage

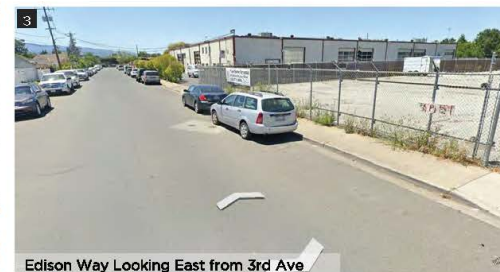
SMC GI Potential within Planned Project Edison Way (1st Ave to 5th Ave) - Green Infrastructure Feasibility			
Planned Project Description	Two parcels (2949 Edison Way and 3051 Edison Way) are slated for development. Both projects will provide a minimum 8-foot sidewalk.		
Road Type	A-3 Urban Residential Collector/Minor Commercial. 55-foot right-of-way.		
GI Opportunities Evaluated	• Stormwater Curb Extension (Parking Zone) • Pervious Pavement (Parking Zone)		
GI Plan Prioritization	High		
Site Conditions	Soil	unknown	
	Groundwater	10-20 feet	
Drainage	• Edison Way drains towards 2nd and 5th Ave with a high point at 3rd Ave. • 1st through 5th Ave drain north • Catch basins at the intersections with 2nd through 5th Ave collect runoff from Edison Way and the Avenues south of Edison.		
Utility Conflicts	• Sanitary sewer on south side of Edison Way • 6-inch AC water main 7-feet from north curb on Edison between 1st and 2nd Ave • Water main on north side of Edison in sidewalk east of 3rd Ave • PG&E Gas line on south side of Edison Way east of 2nd		
GI Evaluated	Stormwater Curb Extension	The Intersection of 2nd Ave and Edison Way has opportunities for curb extensions on the northwest, northeast, and southeast corners where utilities can be avoided. Existing catch basins at each corner can provide a connection for underdrains and overflows. Special DPW approval may be needed to allow for curb extensions less than 3-feet away from the water main on the northwest corner. Sanitary sewer located 6-feet from the south curb of Edison prohibits curb extensions on the southwest side of Edison Way.	
	Pervious Pavement	Pervious pavement appears feasible in the parking lane of Edison Way on the north side of the street with setbacks from water mains. A gas main east of 2nd Ave prevents feasibility for pervious pavement on the south side of Edison Way.	
GI Performance	Total street area managed		0.58 acres
	Pervious Pavement		6,200 square feet
	Bioretention	Total Planter Area	775 square feet
		Sizing Ratio	4.0 %
	Parking Loss		4 spaces at Edison and 2nd Intersection
Design Criteria	Pervious Pavement Width		8 feet (Incl. gutter and flush curb)
	Curb Extension Width		5-9 feet (9 ft where planter strip proposed)
GI Feasibility	Redesign of the 2nd and Edison Way intersection can incorporate stormwater curb extensions and can provide improved pedestrian safety with reduced crossing distances. Where sidewalk widening is planned, stormwater curb extensions can be designed to provide wider bioretention areas that encroach into the planting strip. Pervious pavement can be installed along the frontages of the proposed developments to provide additional stormwater runoff management where utilities do not conflict.		



2nd Ave Looking North Towards Edison Way



2nd Ave Looking South



Edison Way Looking East from 3rd Ave

1: Desktop Analysis

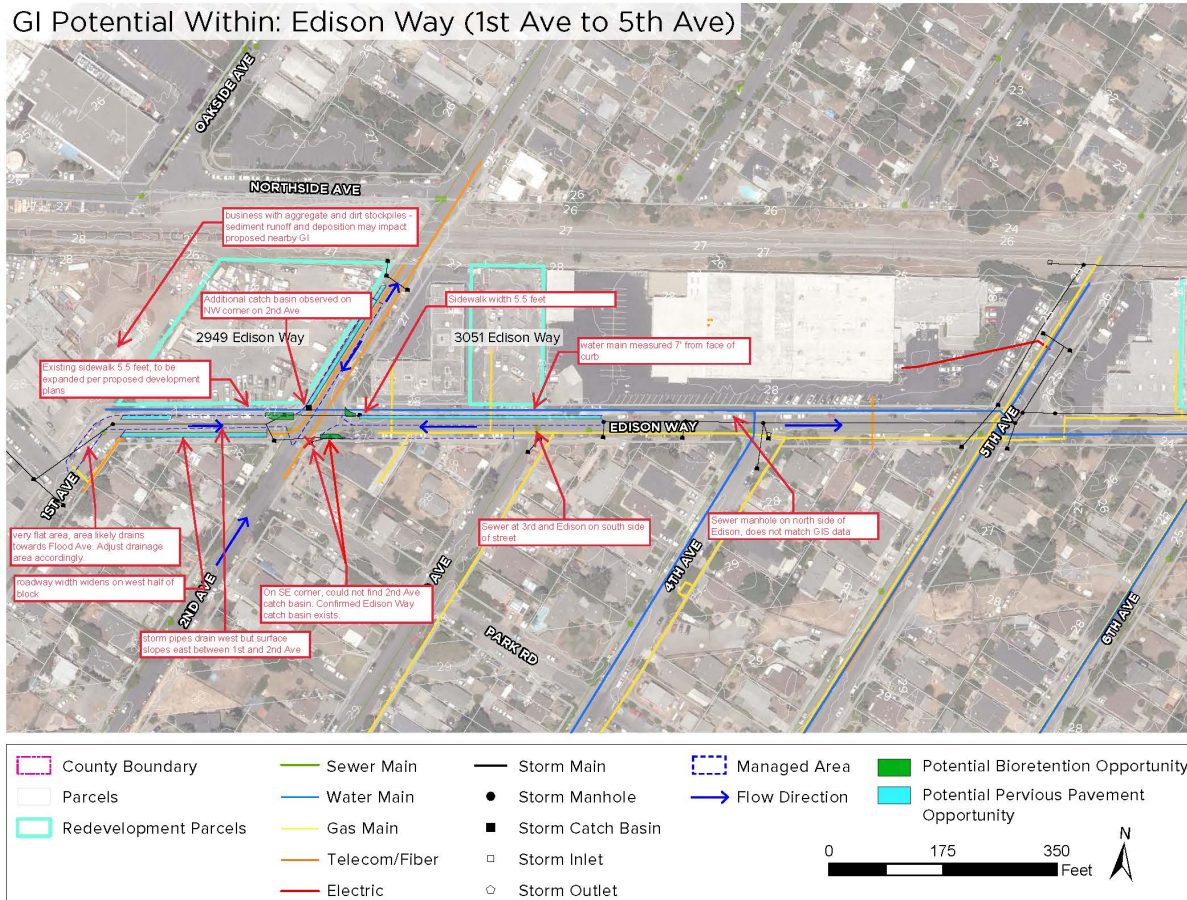
2: Field Assessment

3: Concept Development



# Field Assessment – Redevelopment/Frontage

GI Potential Within: Edison Way (1st Ave to 5th Ave)

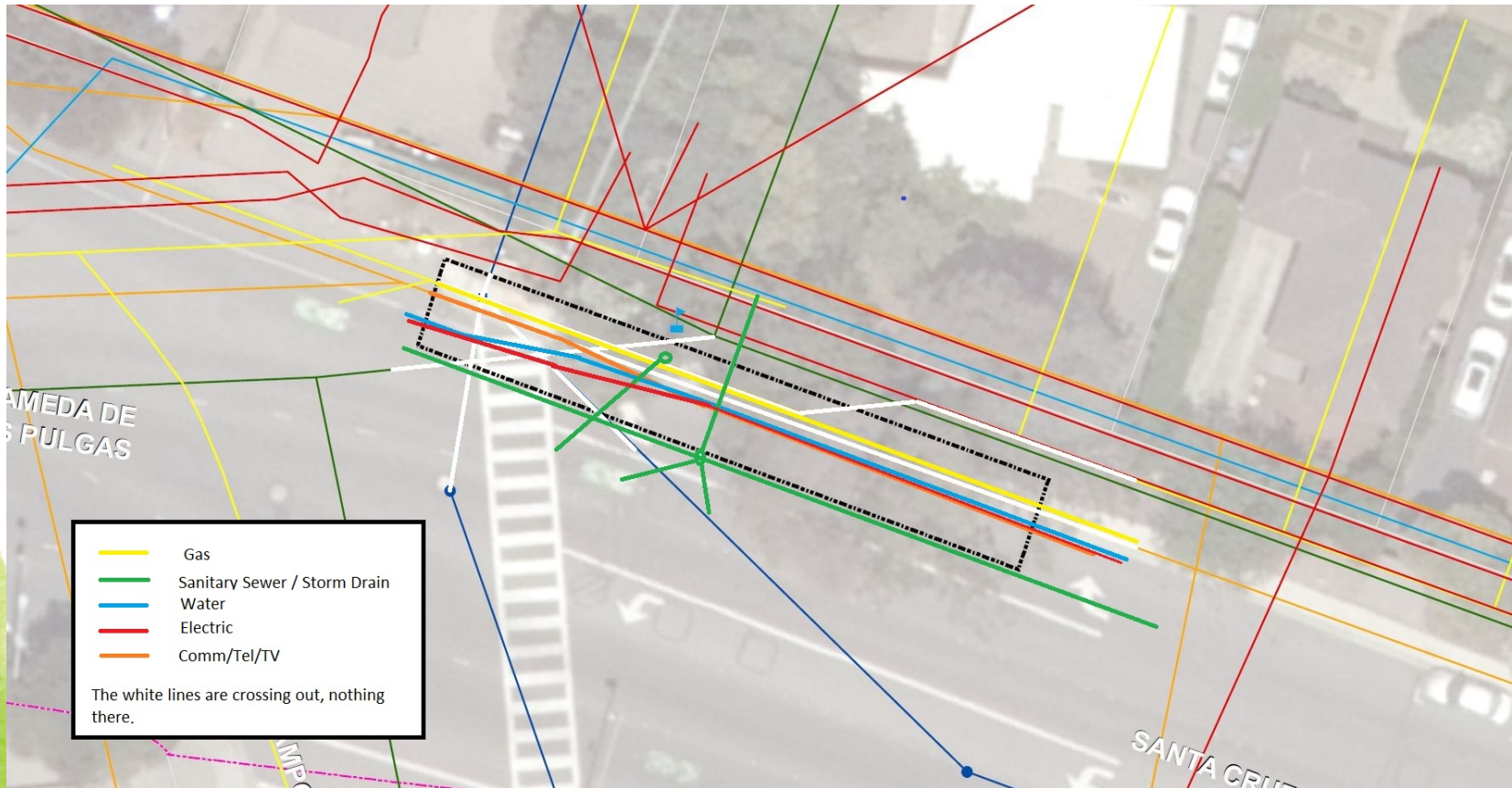


1: Desktop Analysis

2: Field Assessment

3: Concept Development

# Field Assessment – Redevelopment/Frontage



1: Desktop Analysis

2: Field Assessment

3: Concept  
Development



# Concept Design – Redevelopment/Frontage

San Mateo County Green Infrastructure Feasibility Assessment

## Edison Way (between 1st & 5th Avenues)



### Concept Description

Edison Way has several parcels that are redeveloping between 1st Ave and 9th Ave, including 2949 Edison Way which is proposing to build a 7-story residential development. This project envisions streetscape and frontage improvements to be constructed in concert with the redevelopment. Proposed improvements include integrating green infrastructure such as pervious pavement and stormwater curb extensions to collect and infiltrate stormwater runoff from the roadway and sidewalk.

Pervious pavement is proposed on both sides of the street between 1st and 3rd Ave which will delineate street parking and manage runoff from the adjacent roadway. The proposed pervious pavement will minimize runoff generated from impervious areas by capturing and infiltrating stormwater runoff.

Stormwater curb extensions are proposed at the intersection of Edison Way and 2nd Ave to improve pedestrian safety through decreased crossing distance and greater visibility for oncoming cars. Curb extensions will include bioretention planters that will capture and infiltrate stormwater runoff from the roadway and sidewalks. These planters will also be integrated with street improvements between 1st and 5th Avenue to provide traffic calming and shade for pedestrians along sidewalks.

This project will manage runoff from approximately 0.7 acres of impervious roadway and sidewalk area.

### General Site Information

#### Neighborhood

North Fair Oaks

#### GI Integration Opportunity

Two large private developments will be required to improve/wide sidewalks

#### Road Type

Urban Residential Collector,  
Minor Commercial

### Facility Information

#### Drainage Management Area

0.69 acres

#### Bioretention Area / Storage Volume

1,200 sf / 0.05 ac-ft

#### Pervious Pavement Area / Storage Volume

3,900 sf / 0.04 ac-ft

### Additional Project Benefits

- » Pedestrian safety improvements with reduced crossing distance
- » Vegetation and trees provide habitat and shade

1: Desktop Analysis

2: Field Assessment

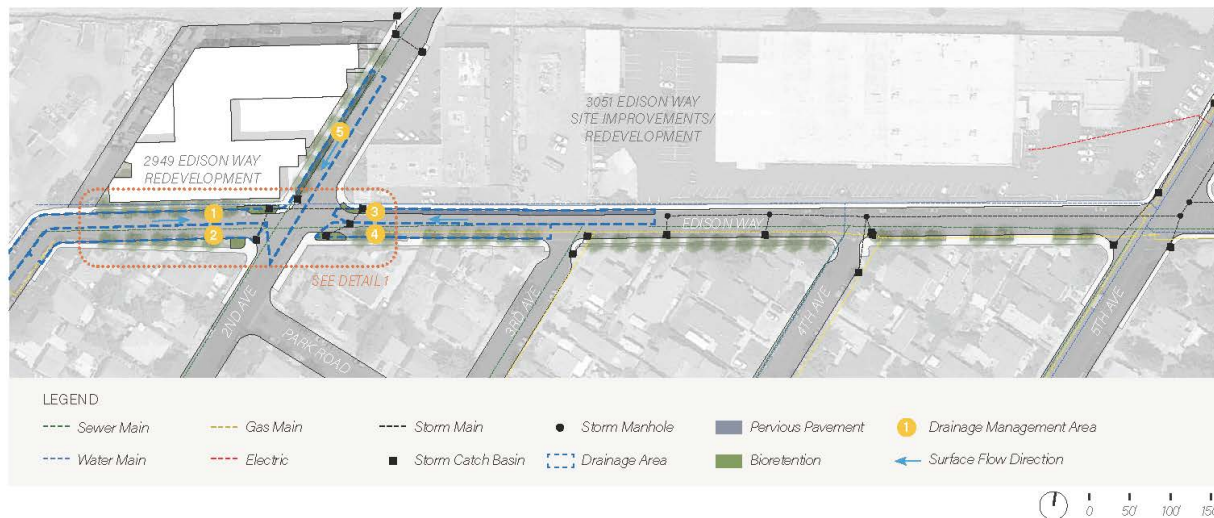
3: Concept  
Development



# Concept Design – Redevelopment/Frontage



Conceptual Site Layout Plan: Edison Way (between 1st & 5th Avenue), North Fair Oaks



Green Infrastructure Sizing

DMA	Managed Area*	Proposed GI	GI Footprint
1	6,964 ft <sup>2</sup>	Bioretention Bulbout	440 ft <sup>2</sup>
2	5,230 ft <sup>2</sup>	Bioretention Planter	215 ft <sup>2</sup>
3	6,751 ft <sup>2</sup>	Pervious Pavement	2,865 ft <sup>2</sup>
		Bioretention Bulbout	186 ft <sup>2</sup>
4	4,925 ft <sup>2</sup>	Bioretention Bulbout	333 ft <sup>2</sup>
5	5,160 ft <sup>2</sup>	Pervious Pavement	1,083 ft <sup>2</sup>

1: Desktop Analysis

2: Field Assessment

3: Concept Development

# Concept Design – Redevelopment/Frontage

San Mateo County Green Infrastructure Feasibility Assessment

## Edison Way (between 1st & 5th Avenues)

### Concept Detail 1: Edison Way & 2nd Avenue



### Site Elements



6

1: Desktop Analysis

2: Field Assessment

3: Concept Development

# Concept Design – Redevelopment/Frontage



COUNTY OF SAN MATEO



Lotus Water  
engineering

## Planning-Level Cost Estimate

DESCRIPTION	UNIT COST	UNIT COST	QUANTITY	SUBTOTAL
Utilities Protection/Relocation	\$99,000	LS	1	\$99,000
Sawcutting Pavement	\$12	LF	2,200	\$26,400
Concrete Demo, Excavation & Offhaul	\$11	SF	8,400	\$92,400
Landscaping Soil	\$130	CY	310	\$40,300
Planter Curb & 36" Sidewalls	\$165	LF	300	\$49,500
Curb and Gutter	\$42	LF	200	\$8,400
Biotreatment Soil Media	\$260	CY	40	\$10,400
Underdrains	\$10	SF	1,630	\$16,300
Drain Rock Subbase	\$170	CY	30	\$5,100
Bioretention Plantings & Mulch	\$25	SF	800	\$20,000
Catch Basin Relocation	\$8,300	EA	2	\$16,600
Storm Drain Connections	\$7,800	EA	5	\$39,000
Bioretention Curb Inlet	\$1,500	EA	3	\$4,500
Flush Curb Ribbon	\$62	LF	490	\$30,400
Curb Ramps	\$6,250	EA	23	\$143,800
Crosswalk Striping	\$2,100	EA	10	\$21,000
Sidewalk Repair	\$15	SF	30	\$500
Irrigation System	\$16,000	EA	4	\$64,000
Traffic Sign Relocation	\$1,100	EA	9	\$9,900
New Sidewalk	\$15	SF	6,810	\$102,200
Pervious Concrete (inc. base aggregate)	\$26	SF	4,700	\$122,200
Landscaping Plantings & Mulch	\$12	SF	4,300	\$51,600
Trees	\$1,600	EA	33	\$52,800
CONSTRUCTION SUBTOTAL				<b>\$1,026,000</b>
Traffic Control (5% construction)				\$51,300
Mobilization (10% construction)				\$103,000
Contingency (30% construction)				\$308,000
Design Fees (15% total)				\$223,000
TOTAL PROJECT COST (DESIGN + CONSTRUCTION)				<b>\$1,711,000</b>

### Notes:

1. This is a planning-level cost estimate (\$2021) for design and construction. Soft costs for County administration and project management and post-construction operations and maintenance are not included. Other factors that may affect the cost of future construction include escalation and market conditions.
2. This cost estimate does not include the costs of standard roadway or transportation improvements that may be included in the overall project and are not immediately adjacent to the proposed GI facilities.
3. The cost for utility protection/relocation is a planning-level cost estimate that assumes \$10,000 per each parcel with utility laterals impacted by the project. More information about the lateral size, depth, condition and exact location will be required to refine this cost during the future design phase.
4. The design fees for larger projects with construction subtotals greater than \$1 million are assumed to be 15%. The design fee was linearly scaled up for smaller projects to a maximum of 20% for projects with construction subtotal of \$0.5 million or less.
5. This concept includes sidewalk and streetscape improvements on the south side of Edison Way between 2nd and 5th Avenue that do not include green infrastructure. These improvements include new sidewalk and curb ramps across Edison Way as well as on perpendicular streets.

1: Desktop Analysis

2: Field Assessment

3: Concept  
Development



# Concept Design – Redevelopment/Frontage

San Mateo County Green Infrastructure Feasibility Assessment

## Edison Way (between 1st & 5th Avenues)

### Typical Anticipated Maintenance Needs & Costs

Regular maintenance is needed to ensure that each part of the GI asset continues to function properly and perform its design intent over its full lifespan. Proper post-construction maintenance is essential in sustaining the health, appearance and function of these engineered systems. The tables below list typical maintenance, rehabilitation, and replacement activities required for each type of GI over a 30-year lifespan. The budgetary maintenance costs and estimated labor hours shown on the right assume that the County has set up a GI maintenance program and organizational structure that defines roles and responsibilities, tracks maintenance activity, and trains staff on proper maintenance methods and techniques. The estimated maintenance costs and hours utilize the SFPUC's GI Maintenance Model and assume 2021 hours and an hourly wage of \$81.

**Estimated Annual Maintenance Budget Required: \$5,600**

**Stormwater Curb Extensions**  
\$4,300

**Pervious Pavement**  
\$1,300

**Estimated Labor Hours: 45 hrs**

**Stormwater Curb Extensions**  
35 hours

**Pervious Pavement**  
10 hours

STORMWATER CURB EXTENSIONS			
GI FACILITY COMPONENT	REGULAR MAINTENANCE (per monthly visit)	REHABILITATION (per annual visit)	REPLACEMENT (per 30 year lifespan)
Mobilization/Demobilization/Reporting	Preparation, travel, and setup time. Complete standard maintenance form.	Preparation, travel, and setup time. Complete standard maintenance form.	
Inlet & Outlet Low-Flow Channel	Clean debris & sediment from flow path. Reset/replace armoring rock as needed	Clean debris & sediment from flow path. Reset/replace armoring rock as needed	Excavate & rebuild
Splash Pad / Forebay (stone or concrete)	Clean out debris & sediment	Clean out debris & sediment. Re-level concrete pad	Excavate & rebuild
Planting	Trim/prune	Replace diseased and dead plants	Full replanting
Mulch (wooden or stone)	Remove sedimentation with flat-head shovel. Spot mulch	Add new layer of mulch (wooden). Even out and fill bare patches (stone)	Add new layer of mulch
Weeds and Trash	Remove	Remove	
Soil Media	Regrade and stabilize any eroded areas	Aeration and tilling	Excavate and replace media
Aggregate Subgrade Layer			Excavate, wash, & replace
Structural Elements (e.g., curbs, curb walls, check dams)		Repair chips & cracks in concrete. Regrade/reset stone elements	May not be necessary
Irrigation System	Adjust and test head patterns	Replace broken or malfunctioning heads, valve boxes, and piping	May not be necessary
Underdrain and Cleanouts	Clear obstructing debris	Snake or jet pipe	Excavate & replace the underdrain system

PERVIOUS PAVEMENT			
GI FACILITY COMPONENT	REGULAR MAINTENANCE (per monthly visit)	REHABILITATION (per annual visit)	REPLACEMENT (per 30 year lifespan)
Mobilization/Demobilization/Reporting	Preparation, travel, and setup time. Complete standard maintenance form.	Preparation, travel, and setup time. Complete standard maintenance form.	
Pervious Wearing Course	Sweep and vacuum	Pressure washing. Repair damaged surface	Plane off & rebuild
Aggregate Subgrade Layer			Excavate, wash & replace.
Structural Containment Walls			Demo & rebuild if necessary
Underdrain, Cleanouts, and Outlet	Clear obstructing debris	Snake or jet pipe	Excavate & replace the underdrain

1: Desktop Analysis

2: Field Assessment

3: Concept Development

# Concept Design – Redevelopment/Frontage



## Additional Considerations

This project concept is presented for discussion only. This project concept is planning-level and subject to revision as additional information becomes available. Factors to be considered during design of this project include but are not limited to the following:

- » Infiltration Potential. Infiltration tests performed in the North Fair Oaks neighborhood with the borehole method found infiltration rates ranging from 0.6 to 1.2 inches per hour. A geotechnical investigation associated with redevelopment at 2949 Edison Way indicated infiltration rates less than 0.2 inches per hour. This concept design assumes a design infiltration rate of 0.2 inches per hour, however site specific testing should be conducted during design development. This concept design assumes elevated underdrains will be utilized in the pervious pavement and bioretention aggregate layers to maximize infiltration and ensure drawdown within 48-hours.
- » Utility Conflict. Initial utility assessments were conducted for sanitary sewer, storm drain, water, and electrical. Sanitary sewer main conflicts were found on the south side of Edison Way between 2nd Ave and 9th Ave; water main conflicts were found on the portion of the north side between 1st and 2nd Ave, and storm drain on the north side between 3rd Ave and 5th Ave. These sites were precluded from GI considerations, and proposed GI footprints may be modified based on field visits.
- » Vehicular Access. New corner curb returns will need to be designed to accommodate the turning movements of emergency vehicles, delivery trucks, buses (if street is on bus route), and other vehicles designated by the County.
- » Private Run-on. A desktop analysis of driveways along Edison Way indicates approximately 4,780 square feet of private driveways drain towards the roadway between 1st and 5th Ave. This additional area increases the drainage area by 16%. Opportunities to increase facility sizing to account for this additional runoff should be evaluated during design development.

1: Desktop Analysis

2: Field Assessment

3: Concept  
Development

# Lessons Learned

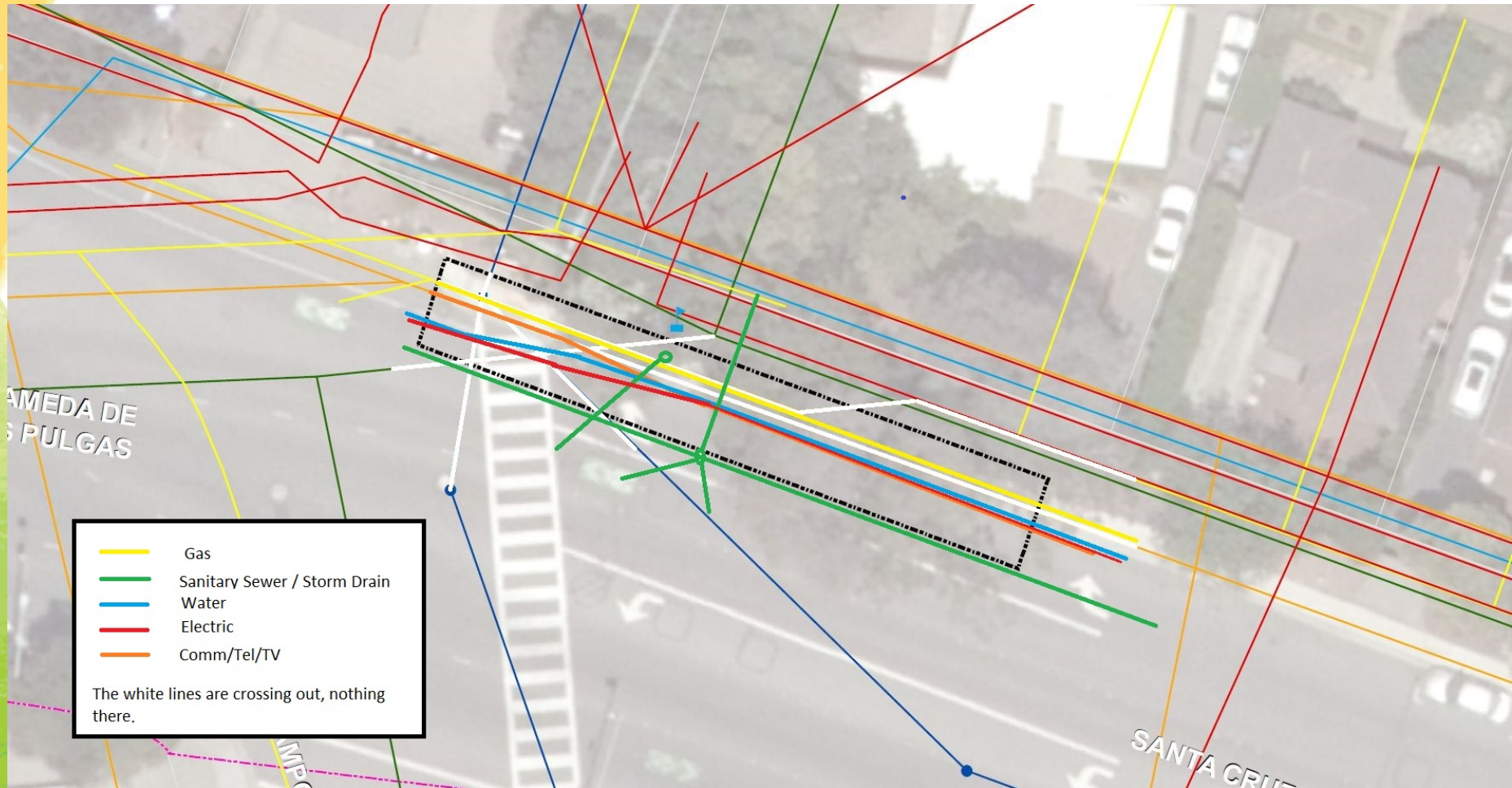
- Existing utilities (especially gas, water, and sewer) pose a major challenge to installation of GI in County ROW
- County residential areas have other significant constraints that limit GI feasibility:
  - Lack of storm drain mains to connect to underdrains
  - Poorly draining soils and high groundwater in some areas that limit infiltration options
  - Large mature trees within unimproved shoulder areas
- Potential solutions may include subsurface infiltration galleries in some areas and pervious pavement/gravel pave in parking/shoulder areas



# Next Steps

- Details, templates, and process will serve as guide for in-house GI feasibility assessment and design
- Helpful for communicating funding needs and constraints to upper management and BOS
- Pilot pre-treatment bioretention with infiltration gallery
- Continue to look for opportunities to leverage redevelopment and develop process for extended reach/in lieu compliance (ID O&M responsibility & agreements, structure/funding mechanism)
- Green street opportunities limited – support development of regional framework and regional project prioritization

# Questions?



# Thank You



*Carlos Street, Moss Beach*

[jcasagrande@smcgov.org](mailto:jcasagrande@smcgov.org)