



Green Stormwater Infrastructure: Requirements and Opportunities

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San Mateo Countywide Pollution Prevention Program

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Presentation Overview

- Overview of C.3.j Requirements for Green Infrastructure (GI)
  - Programmatic Implementation
  - GI Numeric Retrofit Targets
  - “No Missed Opportunities”
  - Annual Reporting
- Evaluating Capital Improvement Projects (CIP) for GSI Opportunities
  - Screening CIP Lists
  - Desktop and Feasibility Analyses

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GI Programmatic Implementation

- Permittees developed GI Plans during MRP 2.0
- Must continue to implement and update as needed
  - Complete updates to related municipal plans
  - Develop funding and funding mechanisms
  - Update GI guidance, details and specifications
  - Implement tools to track and map completed projects
  - Adopt/amend policies, ordinances, and legal mechanisms
  - Conduct outreach, education, and training
- Must continue to look for opportunities to integrate GI into public infrastructure projects

GI Numeric Retrofit Targets / Goals

- Short-term numeric target (during 5-year permit term)
  - 3 acres treated per 50,000 population (up to 5 acres)
  - Can be met on countywide basis (43.31 acres for SM County)
  - If met countywide, each permittee must implement at least one project treating a minimum of 0.2 acres
  - Projects constructed or funded by end of permit term, including road reconstruction projects, count toward target
- Long-term numeric goal to be developed during MRP 3.0
  - Multi-decadal; progress toward goal during each permit term
  - Will allow credit for all GI constructed to date

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GI Numeric Retrofit Requirements

Provision C.3.j.ii.(2); Attachment H, Table H-1

San Mateo County Permittees

Table H-1. Numeric Retrofit Requirements

County	Permittee	2019 US Census Bureau Population Estimate	MRP 3 Provision C.3.j Retrofit Assignment (acres)	County Total (acres)
San Mateo	Atherton	7,137	0.43	43.31
San Mateo	Belmont	26,941	1.62	
San Mateo	Brisbane	4,671	0.28	
San Mateo	Burlingame	30,889	1.85	
San Mateo	Colma	1,489	0.20	
San Mateo	Daly City	106,280	5.00	
San Mateo	East Palo Alto	29,314	1.76	
San Mateo	Foster City	33,901	2.03	
San Mateo	Half Moon Bay	12,932	0.78	
San Mateo	Hillsborough	11,387	0.68	
San Mateo	Menlo Park	34,698	2.08	
San Mateo	Millbrae	22,394	1.34	
San Mateo	Pacifica	38,546	2.31	
San Mateo	Portola Valley	4,568	0.27	
San Mateo	Redwood City	85,925	5.00	
San Mateo	San Bruno	42,807	2.57	
San Mateo	San Carlos	30,185	1.81	
San Mateo	San Mateo	104,430	5.00	
San Mateo	San Mateo County	64,832	3.89	
San Mateo	South San Francisco	67,789	4.07	
San Mateo	Woodside	5,458	0.33	

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GI Numeric Implementation Flexibility

- Can count GI projects constructed since January 1, 2021
- Can “contribute substantially” to GI project(s) outside of a Permittee’s jurisdiction (within its County)
- Can count impervious area treated by non-Regulated Projects and by Regulated Projects that go “above and beyond”
- Can count the impervious area treated for Regulated Road Reconstruction Projects
- Small rural Permittees may collectively submit a proposal for pilot projects investigating alternative GI techniques (due 9/30/23)
- Permittees with ordinances that require Regulated Projects to treat additional area may get a one time 25% reduction credit (up to 1 acre) (report due 9/30/23)

No Missed Opportunities (NMO)

- Per Provision C.3.j.iii, continue to maintain a list of:
  1. GI projects planned for implementation during permit term
  2. Infrastructure projects planned for implementation during the permit term that have potential for GI
- In each Annual Report, submit the list and summary of:
  - Planning or implementation status for each GI project
  - How each public infrastructure project with GI potential will include GI measures to the MEP during the permit term; OR
  - For any public infrastructure project where implementation of GI measures is not practicable, describe project and reasons why
- BASMAA Guidance (2016) developed to assist NMO analyses

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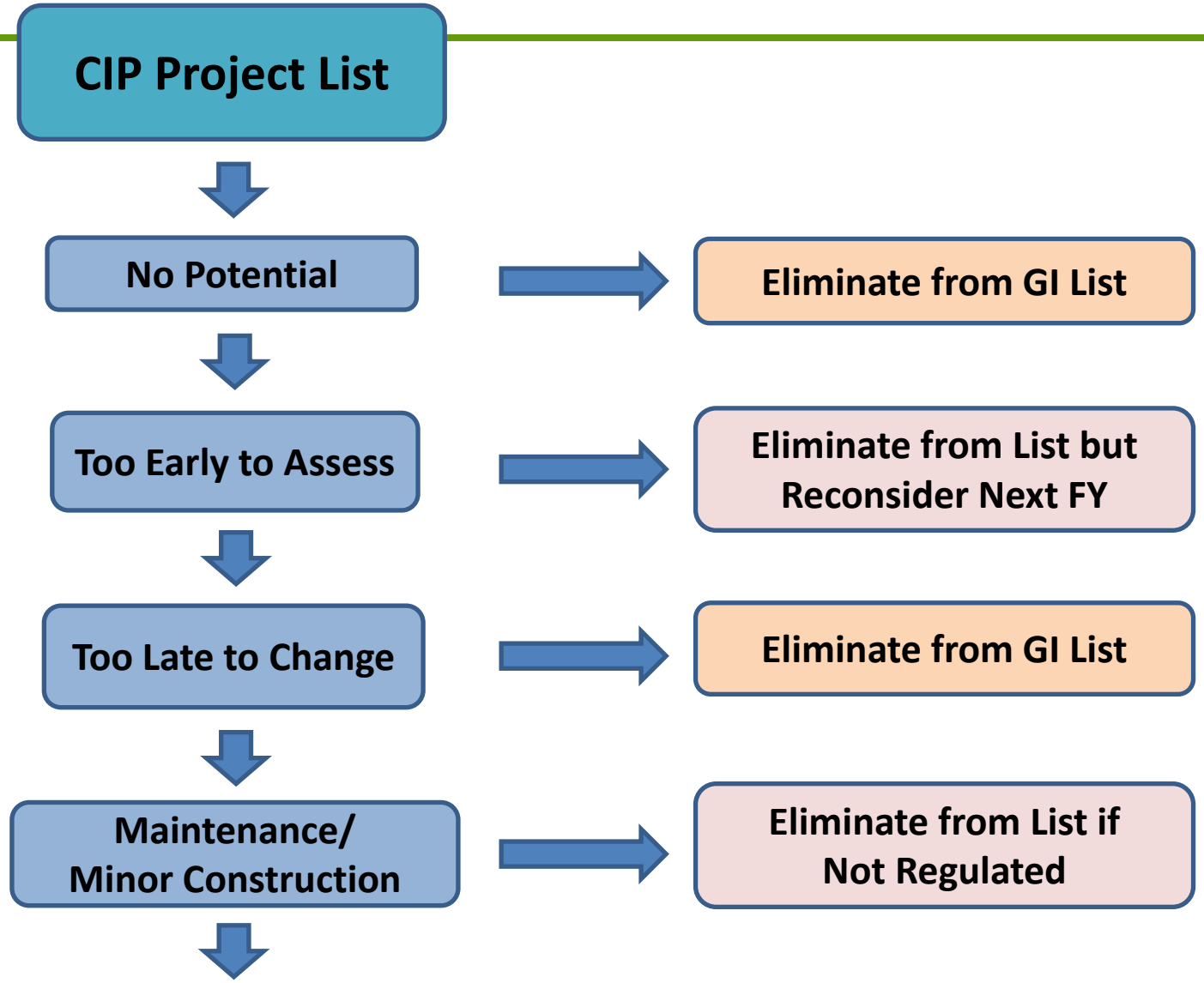
CIP Review Process – Part 1: Initial Screening



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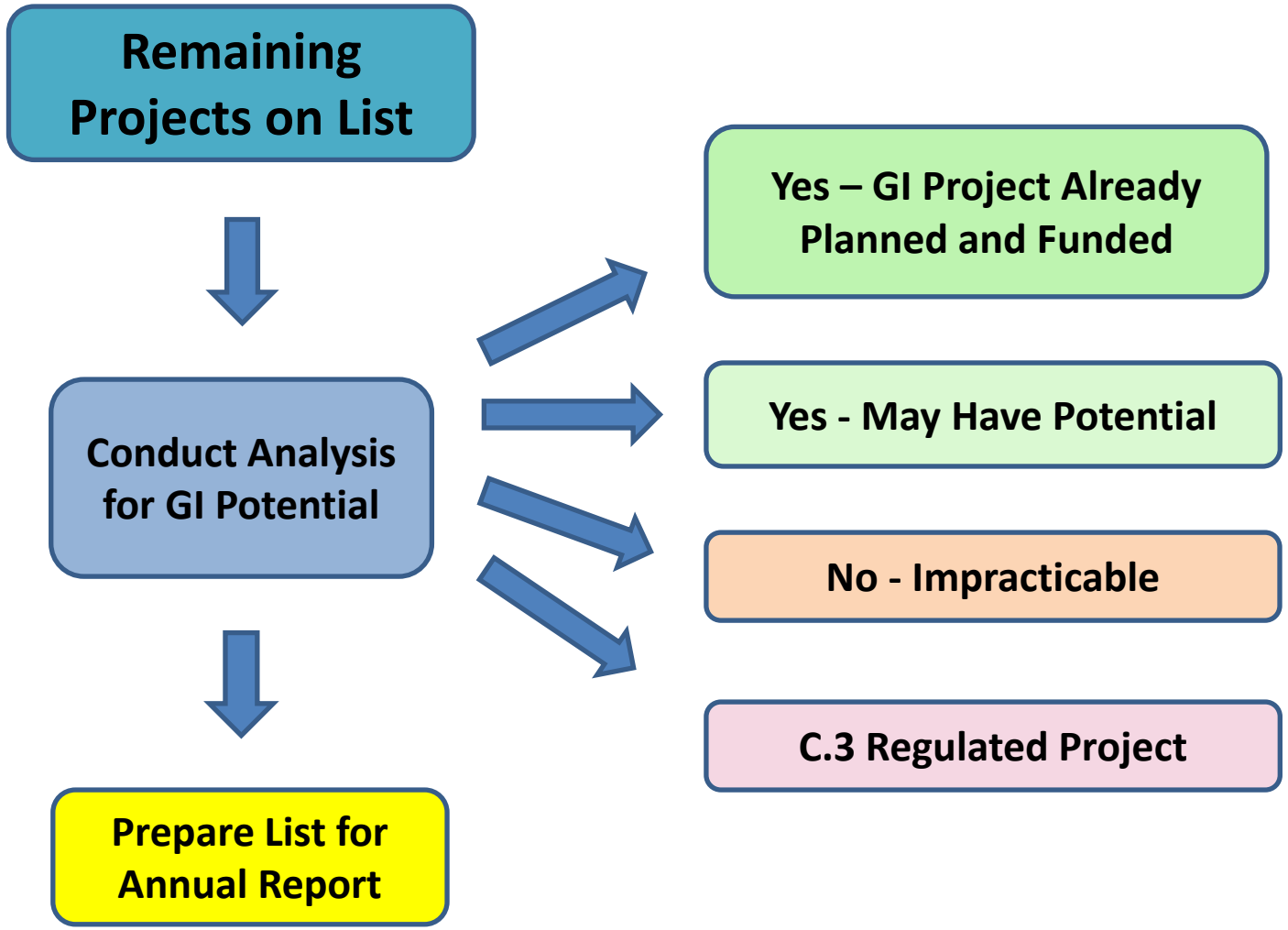
CIP Review Process – Part 2: Assess Potential



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Annual Report Section C.3.j.ii.(2)

Table A – Public Projects Reviewed for Green Infrastructure

C.3.j.ii.(2) ► Table A - Public Projects Reviewed for Green Infrastructure

Project Name and Location[44]	Project Description	Status[45]	GI Included?[46]	Description of GI Measures Considered and/or Proposed or Why GI is Impracticable to Implement[47]
EXAMPLE: Storm drain retrofit, Stockton and Taylor	Installation of new storm drain to accommodate the 10-yr storm event	Beginning planning and design phase	TBD	Bioretention cells (i.e., linear bulb-outs) will be considered when street modification designs are incorporated

GI Included?
Yes, No, or TBD

Table B – Planned Green Infrastructure Projects

C.3.j.ii.(2) ► Table B - Planned Green Infrastructure Projects

Project Name and Location[47]	Project Description	Planning or Implementation Status	Green Infrastructure Measures Included
EXAMPLE: Martha Gardens Green Alleys Project	Retrofit of degraded pavement in urban alleyways lacking good drainage	Construction completed October 17, 2015	The project drains replaced concrete pavement and existing adjacent structures to a center strip of pervious pavement and underlying infiltration trench.

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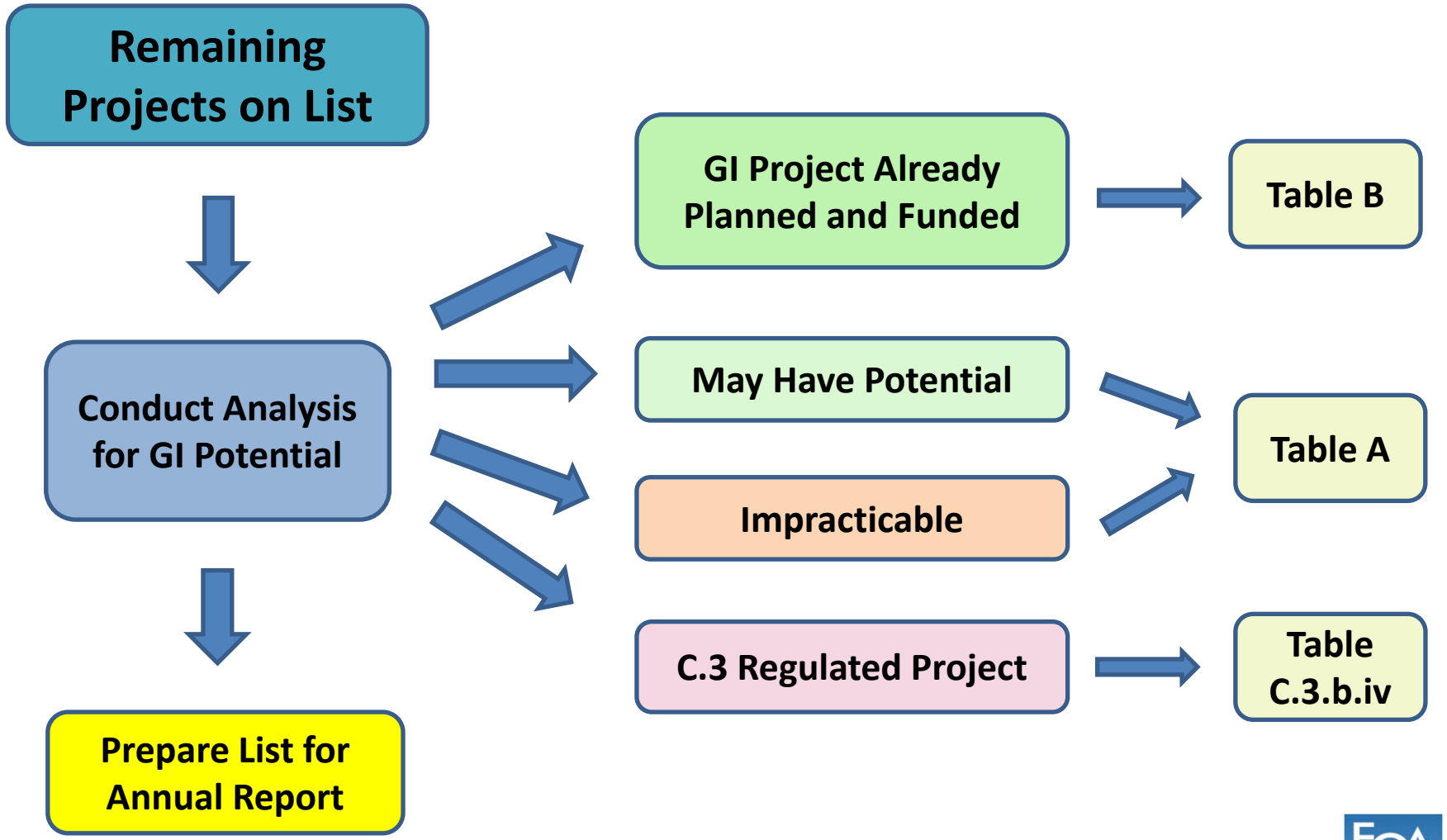
CIP Review Process – Part 2: Assess Potential



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Subsequent Annual Reports

Table A – Public Projects Reviewed for Green Infrastructure

C.3.j.ii.(2) ▶ Table A - Public Projects Reviewed for Green Infrastructure

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EXAMPLE: Storm drain retrofit, Stockton and Taylor	Installation of new storm drain to accommodate the 10-yr storm event	Beginning planning and design phase	TBD	Bioretention cells (i.e., linear bulb-outs) will be considered when street modification designs are incorporated

If project with GI is funded, move to Table B

GI Included?
If No, remove from list
If Yes or TBD, keep on list

Table B – Planned Green Infrastructure Projects

C.3.j.ii.(2) ▶ Table B - Planned Green Infrastructure Projects

Project Name and Location[48]	Project Description	Planning or Implementation Status	Green Infrastructure Measures Included
EXAMPLE: Martha Gardens Green Alleys Project	Retrofit of degraded pavement in urban alleyways lacking good drainage	Construction completed	The project drains replaced concrete pavement and existing adjacent structures to a center strip of pervious pavement and underlying infiltration trench.

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Annual Reports for MRP 3.0 – Added New Table

Table B – Planned Green Infrastructure Projects

C.3.j.ii.(2) ▶ Table B - Planned Green Infrastructure Projects

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EXAMPLE: Martha Gardens Green Alleys Project	Retrofit of degraded pavement in urban alleyways lacking good drainage	Construction completed	The project drains replaced concrete pavement and existing adjacent structures to a center strip of pervious pavement and underlying infiltration trench.

↓

If project with GI is constructed, enter information in new table

↓

C.3.j.v.(1)(a)▶Non-Regulated (Green Infrastructure) Projects Reporting Table – Projects Constructed During the Fiscal Year Reporting Period

Project Location, Street Address	Name of Owner	Project Description	Construction Completion Date	Treatment Measures	Party Responsible for O&M	Hydraulic Sizing Criteria[51]	Total Area Draining to Treatment Measures (ft^2)	Impervious Area Treated (ft^2)	Pervious Area Treated (ft^2)

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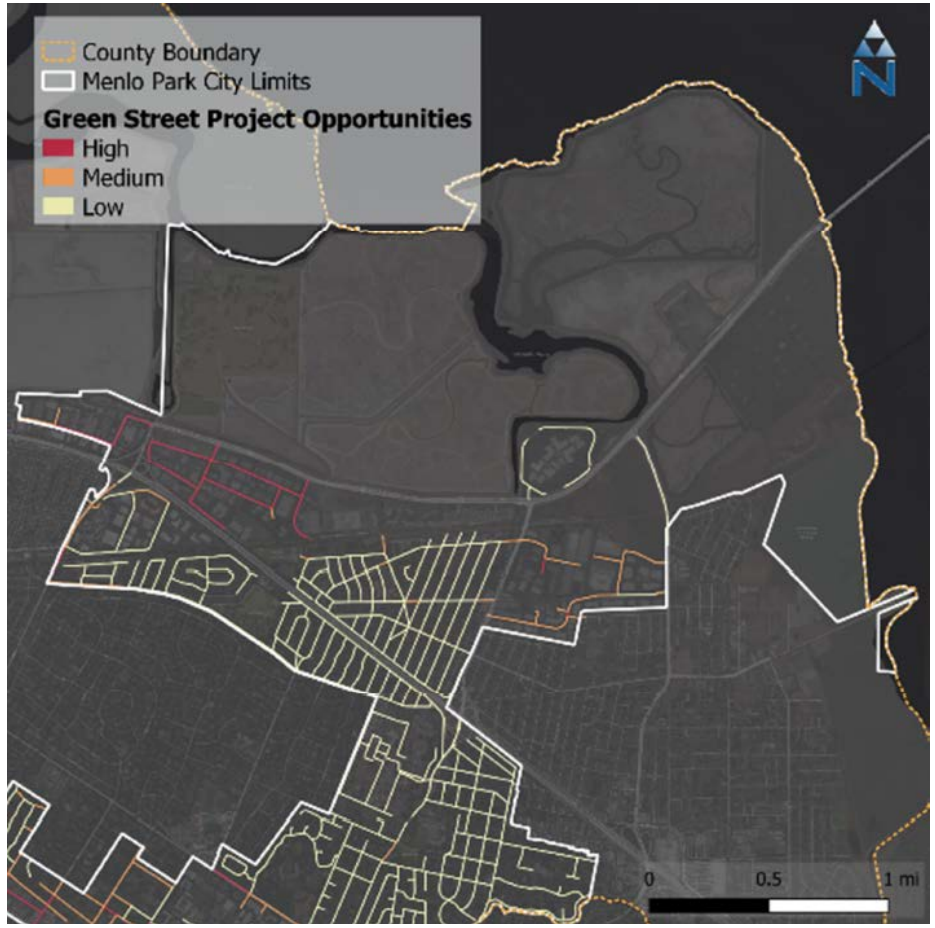
GI Potential Location Identification

- Results of CIP review
- GI Plan opportunity maps
- Stormwater Resource Plan
- Sustainable Streets Master Plan
- Prioritized lists of roads or parking lots for maintenance
- Safe Routes to School or Active Transportation Plans



Source: City of Menlo Park GI Plan

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GI Feasibility Screening Process

- Purpose:
  - Quick analysis to rule out locations with obvious constraints
- Helpful tools:
  - Google Maps/Earth/Street View
  - Maps/GIS layers: jurisdiction boundaries, topography, utilities
- Characteristics to look for (sides of street may differ):
  - Right-of-way (specifically street and sidewalk) width
  - Sidewalk/planter strip/curb & gutter configuration
  - Presence of bike lanes

GI Feasibility Screening Process

- Characteristics to look for (continued):
  - Extent of on-street parking and parking demand
  - Evidence of utilities (power lines, vaults)
  - Presence and size of street trees
  - Available open or landscaped areas
  - Location of storm drain inlets
- Assess drainage patterns
- Identify potential locations for and types of GSI
  - Most types will require a nearby storm drain connection

Locations of GI in ROW

GSI Type	Typical Cross-Sectional Width	Typical Locations within ROW to Consider	Connection to Storm Drain Needed?
Stormwater planter	3.0’ (min) without tree 4.0’ (min) with tree	• Sidewalk Zone • Medians or islands • Parking Zone	Yes
Stormwater curb extension	6.5’ typ. (4.0 min) with 3’ (min) flat bottom and 4:1 (3:1 max) side slopes if used	• Parking zone	Yes
Rain garden	7’ min with additional 4:1 (3:1 max) side slopes	• Wide shoulders • Parking zone • “Leftover” spaces • Roundabouts	Usually
Infiltration trench or gallery	Varies, depends on available space	• Roadways • Parking zone • Driveway	No
Tree well	N/A	• Sidewalk zone • Parking zone	Usually
Pervious pavement	N/A	• Parking zone • Sidewalk zone • Plazas • Low-traffic road/alley	No, but preferred

Adapted from: San Mateo County GI Feasibility Analysis Guidebook (2022)

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Types of Bioretention in the Streetscape

Stormwater Planter

Credit: EOA

Stormwater Curb Extension

Credit: EOA

Tree Well Filter/ Pervious Pavement

Credit: ICPI

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Types of Bioretention in the Streetscape

Credit: EOA, Inc.

Two-way, raised, separated bikeway with stormwater planter (Emeryville, CA)

Credit: SMCWPPP

Stormwater curb extension in Safe Routes to School improvements (San Mateo, CA)

Types of Bioretention in the Streetscape

Tree Well Filter

Credit: DeepRoot Green Infrastructure

Suspended Pavement System with Silva Cells under Pervious Pavement (Palo Alto, CA)

Tree Well Filter

Credit: StormTree

Open box tree well filter (StormTree)

Tree Well Filter

Credit: EOA, Inc.

Suspended Pavement System with Structural Soil under sidewalk (Emeryville, CA)

Other Types of GI Measures in the Streetscape

Pervious Pavement

Credit: EOA, Inc.

Credit: EOA, Inc.

Stormcrete Pre-cast Pervious Concrete Slabs
(Berkeley, CA)

Example of GI in Road Reconstruction Project

Transformation of Hacienda Ave, Campbell

- Reconstructed pavement
- 63 bioretention areas
- Traffic calming bulb-outs at intersections
- Bike lanes
- Safer sidewalks
- 60 street trees

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Example Screening Analysis Spreadsheet

County of San Mateo Green Infrastructure Screening Analysis

Legend						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.
Street	**From**	**To**	**Sidewalk, curb and gutter?**	**Paved Sidewalk ?**	**Paved Shoulder ?**	**Unpaved Shoulder?**	**Overhead Powerlines?**	**Street Trees**	**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	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
Fourth Avenue	Dead End	Spring Street/County line	Yes	Yes	No	No	Yes - on one side	Yes - but only in bulb outs	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	Limited GI feasiblity 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	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	Large bulbouts at Edison and 6th 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 - 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	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	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).
Eighth Avenue	Fair Oaks Ave	Bay Road/County Line	Yes - on 700 block. Valley gutter on	Yes	No	No	Yes - on one side	No	No	50	A-6B / A-6F Sequoia Tract - no parking, sidewalk	Low parking demand on 700 block. 800 block-parking on sidewalk.	Low GI opportunity streets. Difficult with valley gutter. No storm drain inlets. Only opportunity would be to replace concrete parking/sidewalk zone with PP for one block between Spring and Bay.
Sixteenth Avenue	Dead End	Fifteenth Ave	Some - at north end at 15th	Some - at north end at 15th	Some	Mostly	Yes - on one side	Yes	At Fair Oaks Ave	55 (south of Fair Oaks Ave) 60 (north of Fair	A-6F Sequoia Tract - unpaved shoulder	Roundabout with tree at Fair Oaks Ave. Chicane at 755 16th.	Bioretention possible in areas near storm drain line. Otherwise PP in Shoulder. No SD connection for Fair Oaks/15th Avenue block makes anything but self-treating PP or small, shallow stormwater planters within parking zones that won't require underdrain connections.

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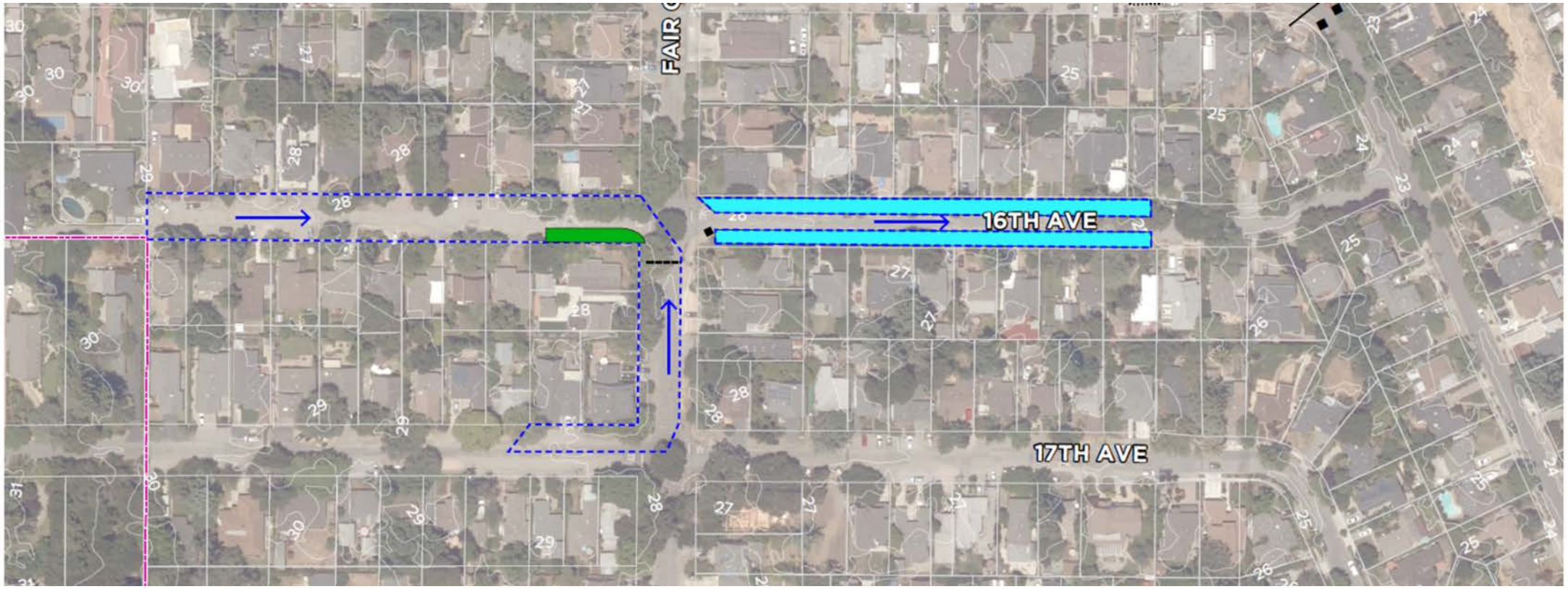
Detailed Desktop Analysis

- If desktop screening step identifies potential for GSI:
  - Create a base map with topographic contours, right-of-way and parcel boundaries, and available utility information.
  - Estimate drainage management area boundaries to potential GSI locations and determine if there is sufficient space
  - Evaluate infiltration conditions, based on soil type/data, depth to groundwater, constraints from nearby structures/utilities
- If determined to be infeasible, document findings and end analysis

Detailed Desktop Analysis Example



City County Boundary
Parcels
Catch Basin
Storm Drain
Trench Drain
Valley Gutter
Managed Area
Flow Direction
Bioretention
Pervious Pavement

Map courtesy of Lotus Water
Prepared for San Mateo County

0 175 350 Feet

Example Summary of Desktop Analysis:

16th Avenue (unincorporated San Mateo County)

SMC GI Potential within Planned Project 16th Avenue - Green Infrastructure Feasibility			
Planned Project Description	16th Avenue between the County boundary and where existing curb and gutter starts will be improved with 18-foot roadway and 6-inch bands		
Road Type	A-6F Sequoia Tract. Existing: 60-ft right-of-way, 18-ft roadway, large shoulder		
GI Opportunities Evaluated	• Pervious Pavement (Parking Zone) • Bioretention		
GI Plan Prioritization	Medium		
Site Conditions	Soil	unknown	
	Groundwater	>10-ft	
Drainage	• Slopes north with high point at County boundary and low point at 15th Ave • Single inlets on north side of intersection with Fair Oaks Ave • Trench drain located on Fair Oaks Ave on east side of 16th Ave		
Utility Conflicts	• Sanitary sewer (size unknown) in roadway		
GI Evaluated	Bioretention	There is space within the shoulder of 16th Ave for a bioretention facility at the intersection with Fair Oaks Ave. The trench drain collects runoff from Fair Oaks Ave and part of 17th Ave which can be directed to the bioretention planter. The bioretention underdrain can be connected to the adjacent storm drain system. Locations of underground utilities can affect feasibility and sizing of bioretention areas.	
	Pervious Pavement	Pervious pavement may be feasible in the shoulder of 16th Ave north of Fair Oaks Ave. The large shoulder is currently comprised of decomposed granite and other paving. A valley gutter can be installed at the edge of the pervious pavement to direct excess runoff downstream to the existing curb and gutter system. Locations of underground utilities and large tree roots can affect feasibility of pervious pavement systems. If the pervious pavement can be designed as a self-treating facility and minimize the amount of runoff from adjacent surface draining onto it, an underdrain connection to a storm drain may not be necessary.	
GI Performance	Total street area managed		1.5 acres
	Pervious Pavement		18,000 sf
	Bioretention	Total Planter Area	-1,800 sq ft
		Sizing Ratio	4.0 %
	Parking Loss		-4 spaces at intersection with Fair Oaks Ave
Design Criteria	Pervious Pavement Width		Varies 8 - 18 feet
	Bioretention Width		15 feet
GI Feasibility	Bioretention within the shoulder of 16th Ave at Fair Oaks Ave can feasibly manage runoff from 16th Ave, Fair Oaks Ave, and part of 17th Ave. North of Fair Oaks Ave pervious pavement in the shoulder can provide management of the shoulder area. A sanitary sewer is located in the street, however it likely does not impact siting GI in the shoulder.		

16th Ave View South from Fair Oaks Ave

16th Ave North of Fair Oaks Ave

16th Ave North of Fair Oaks Ave

Prepared by Lotus Water for San Mateo County

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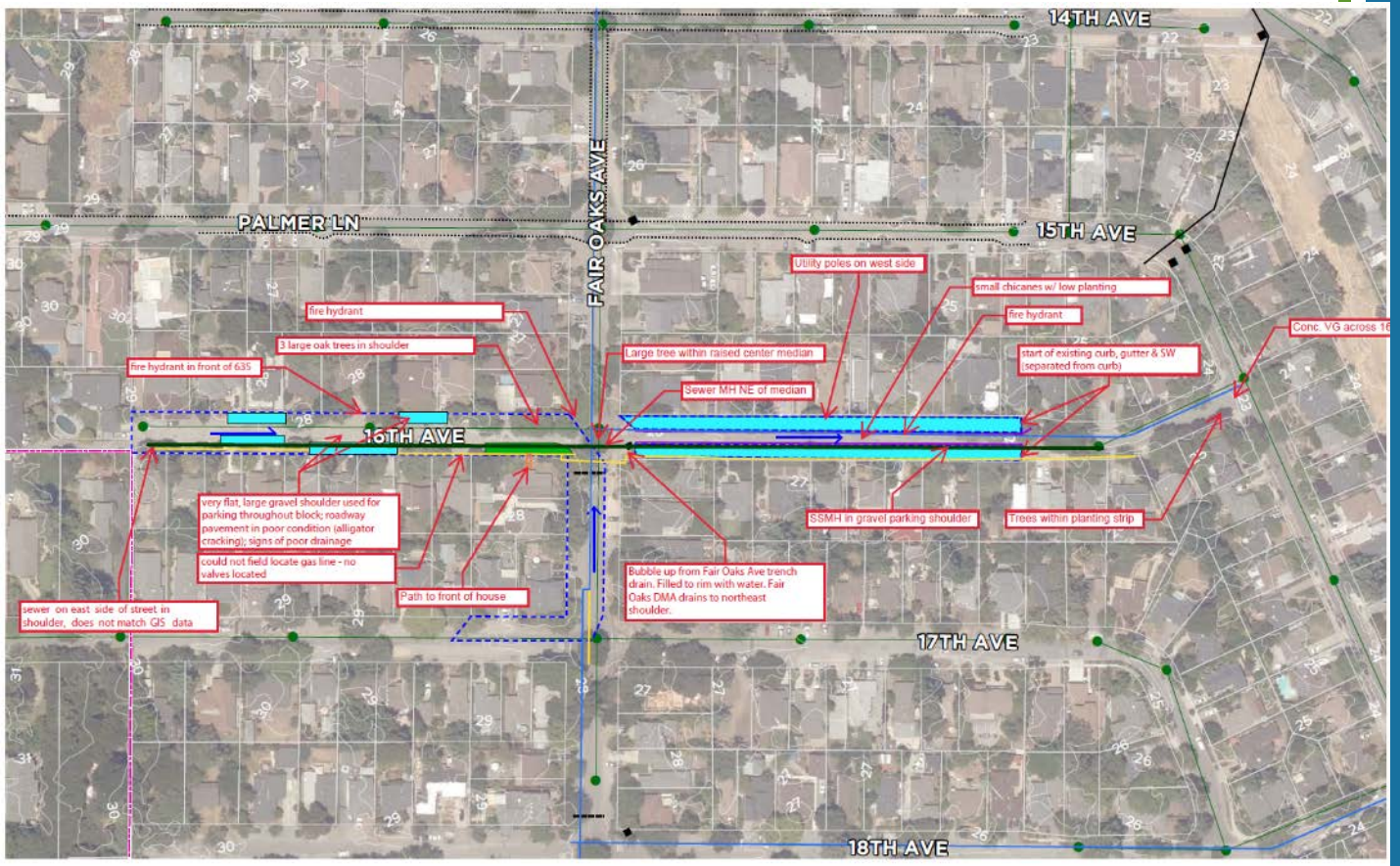
Field Assessment

- Develop Field Map
  - Aerial imagery
  - Right-of-way and parcel boundaries
  - LiDAR contours
  - Storm drain networks
  - Other utilities (water, sewer, electric, telecom)
  - Preliminary drainage delineation
- Conduct Field Visit
  - Confirm assumptions and resolve inconsistencies
  - Note potential causes of infeasibility
  - Determine additional information needed on existing conditions



Map courtesy of Lotus Water
Prepared for San Mateo County

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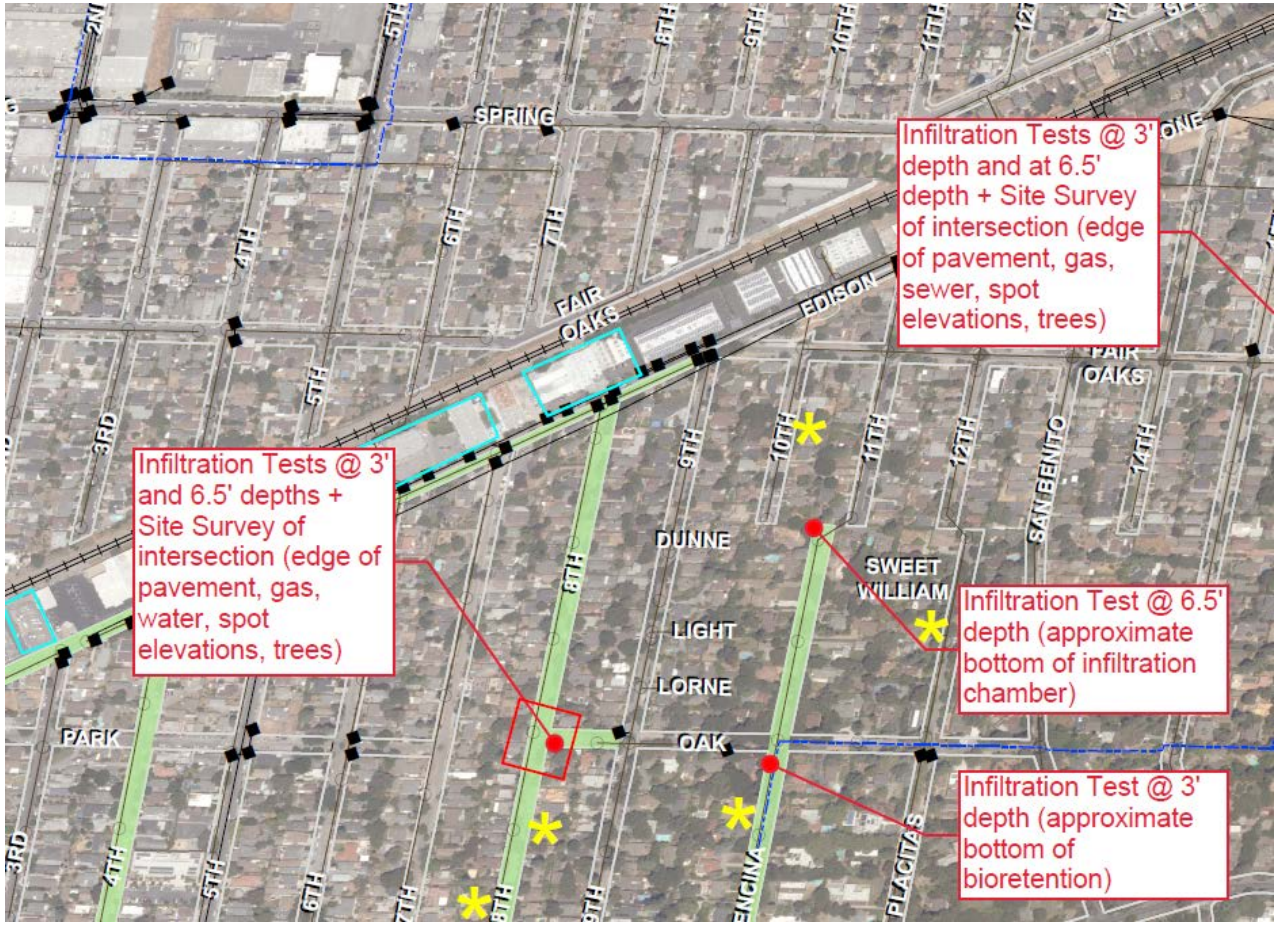
Field Assessment

- Existing Conditions Investigations
  - Borings and infiltration tests
  - Topographic and site feature surveys
  - Utility locating
  - Tree condition assessments by City Arborist
- Additional Data Collection
  - Soil testing, site survey, and utility locating services may be needed
- Documentation of Results
- Concept Development
  - Facilitates development of cost estimate and obtaining funding



Map courtesy of Lotus Water
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For More Information:

- SMCWPPP GI Design Guide
  https://www.flowstobay.org/data-resources/resources/green-infrastructure-design-guide/
  - Appendix 7 – BASMAA Guidance for Sizing Green Infrastructure Facilities in Street Projects
- BASMAA Guidance for Identifying Green Infrastructure Potential in Municipal Capital Improvement Program Projects
  - To be posted on www.flowstobay.org permittee resources page

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Questions?

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