Green Street Feasibility Analysis: Assessing Public Roadway Projects

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San Mateo Countywide
Water Pollution Prevention Program
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Overview

- Types of GI and Today's Focus
- Tools and guidance materials
- Desktop assessment
- Field assessment
- Example project

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Types of GI and Focus of Presentation

- **Types of Green Infrastructure (GI) Projects**
  - LID/Parcel-Based – similar to C.3 Regulated Projects
  - Regional Projects – large drainage area, may be multi-jurisdictional
  - Green Streets – GI in street right-of-way
- **Green Street GI Options**
  - Bioretention
    - Stormwater Curb Extension
    - Stormwater Planter
    - Tree Well Filter
  - Pervious Pavement
  - Infiltration Trench or Chambers

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Green Street Useful Tools and Guidance

Assessment Tools

- C/CAG SSMP:
  Stormwater Curb Extension Feasibility Tool for intersections
- County of San Mateo:
  GI Site Assessment Guidance - Green Street Projects

Guidance Materials

- Green Infrastructure Design Guide

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Desktop Assessment Steps and Tools

1. Use SSMP On-line Project Viewer; Google Maps, Earth and Street View with history to get information about the site
2. Obtain utility plans for site underground utilities
3. Get plans from recent development projects to leverage up-to-date information gathered by others
4. Look at municipal plans for the area: transportation, specific/area, long-range, development, parking, trees
5. Historic ecology maps for info on soil, vegetation & creeks (SSMP Viewer also has soil information)
6. Checklists and/or Tools

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GI Checklist – Desktop Assessment Topics

- Prior to Site Visit
- What to Bring to a Site Visit
- Assemble a Site Map – data
- Compile site-specific data
- Consider GI design criteria

GI Site Assessment

Guidance - **Green Street Project**

Prior to site visits
- ☐ Assemble site map
- ☐ Compile site specific data
- ☐ Consider important GI design criteria

What to bring to a site visit
- ☐ Field Equipment
- ☐ Site map
- ☐ GI Site Assessment Field Form

Assemble a **site map** with the following data:
- ☐ right-of-way boundary
- ☐ transit stops
- ☐ contours (2017 LiDAR)
- ☐ storm drain network (inlets, catch basins, manholes)
- ☐ utilities as available (water, sewer, laterals, gas, power, telec
- ☐ well heads
- ☐ labeled streets
- ☐ aerial imagery
- ☐ water system network
- ☐ north arrow

Compile the following **site specific data**:

Street Class:	
Driving lanes:	
Parking:	Yes/No
Longitudinal Road Slope:	%
Soil Type:	HSG A, B, C/D
Depth to GW:	feet
Groundwater Recharge Area:	Yes/No
Known Contaminated Area:	Yes/No
Upstream of Flood Prone Stream:	Yes/No
Upstream of TMDL water(s):	Yes/No
PCB Area of Interest:	Yes/No
Co-Located Project/Plan:	Project name, status
Sea Level Rise Inundation Area:	Yes/No

Consider GI **design criteria**:

Typical GI Facility Types	stormwater planter, stormwater curb extensions, rain gardens, pervious pavement, tree wells
Typical Sizing Ratios (% of DMA - Drainage Management Area)	4% for stormwater planter, 50% for pervious pavement, 0.005% tree well
Setback & Design Requirements	Curb ramps must be compliant with accessibility standards 2-3' step out zone adjacent to street parking Minimum sidewalk width: 5.5' minimum, recommended 6'-16' Curb extensions & bulbouts cannot extend over potable water mains 100' from water supply wells 3' horizontal setback from edge of GI facility to water assets 5' from centerline of trees to water assets no encroachment on hydrant access 12" vertical separation between facility bottom and lateral pipes 10' separation from seasonal high groundwater when infiltrating

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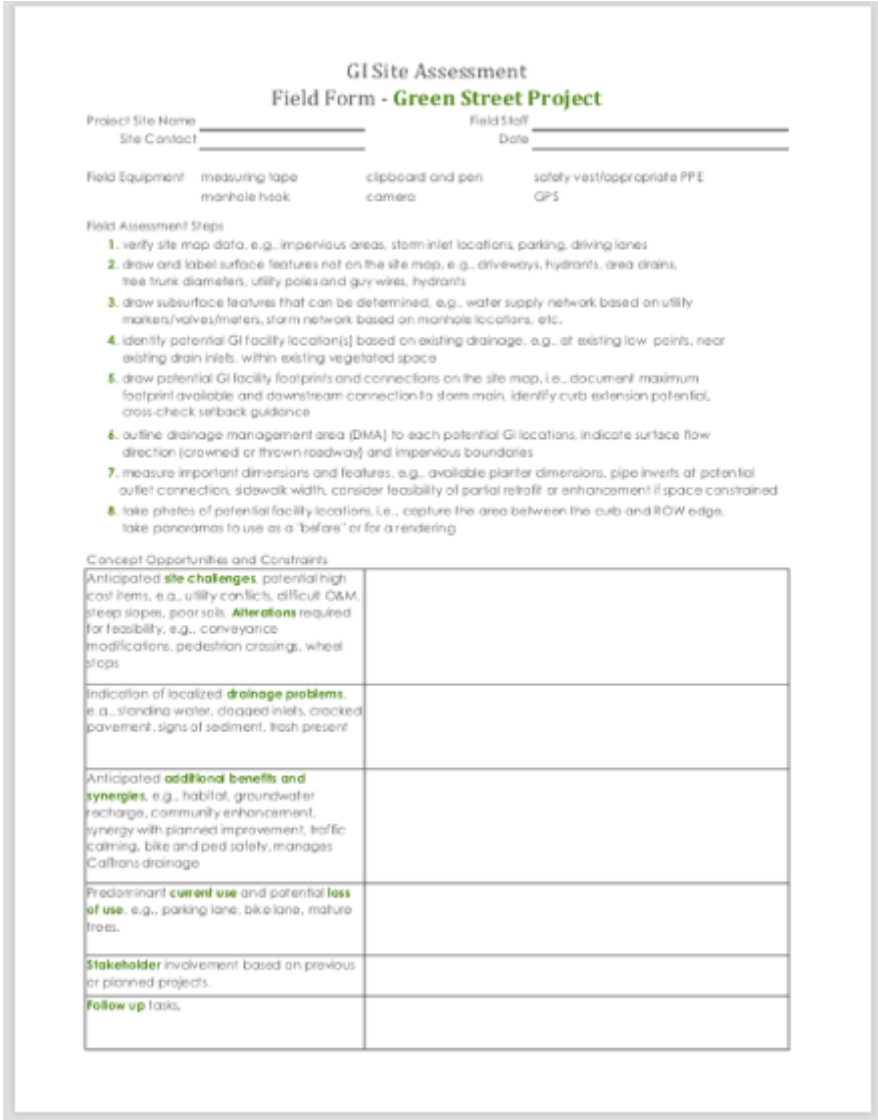
Courtesy of the County of San Mateo

Checklist – Field Form Topics

1. Verify site map data
2. Draw and label features
3. Draw subsurface features
4. Identify potential GI locations
5. Draw potential GI locations
6. Outline catchment areas
7. Measure important features
8. Take photos of potential locations



GI Site Assessment

Field Form - **Green Street Project**

Project Site Name _____ Field Staff _____

Site Contact _____ Date _____

Field Equipment: measuring tape; clipboard and pen; safety vest/appropriate PPE; manhole hook; camera; GPS

Field Assessment Steps

1. verify site map data, e.g., impervious areas, storm inlet locations, parking, driving lanes
2. draw and label surface features not on the site map, e.g., driveways, hydrants, area drains, tree trunk diameters, utility poles and guy wires, hydrants
3. draw subsurface features that can be determined, e.g., water supply network based on utility markers/valves/meters, storm network based on manhole locations, etc.
4. identify potential GI facility location(s) based on existing drainage, e.g., at existing low points, near existing drain inlets, within existing vegetated space
5. draw potential GI facility footprints and connections on the site map, i.e., document maximum footprint available and downstream connection to storm main, identify curb extension potential, cross-check setback guidance
6. outline drainage management area (DMA) to each potential GI locations, indicate surface flow direction (crowned or thrown roadway) and impervious boundaries
7. measure important dimensions and features, e.g., available planter dimensions, pipe inverts at potential outlet connection, sidewalk width, consider feasibility of partial retrofit or enhancement if space constrained
8. take photos of potential facility locations, i.e., capture the area between the curb and ROW edge, take panoramas to use as a "before" or for a rendering

Concept Opportunities and Constraints

Anticipated **site challenges**, potential high cost items, e.g., utility conflicts, difficult O&M, steep slopes, poor soils. **Alterations** required for feasibility, e.g., conveyance modifications, pedestrian crossings, wheel stops	
Indication of localized **drainage problems**, e.g., standing water, clogged inlets, cracked pavement, signs of sediment, trash present	
Anticipated **additional benefits and synergies**, e.g., habitat, groundwater recharge, community enhancement, synergy with planned improvement, traffic calming, bike and ped safety, manages Caltrans drainage	
Predominant **current use** and potential **loss of use**, e.g., parking lane, bike lane, mature trees.	
Stakeholder involvement based on previous or planned projects.	
Follow up tasks.	

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Field Assessment

The Six S's of Field Assessment:

- Soil
- Slope
- Space
- Sediment
- Stakeholders
- Subsurface infrastructure

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Soil – Criteria and Challenges

Low permeability soils usually require use of an underdrain.

- Soil classification can be a proxy for underdrain requirement
  - A, B, C, D classifications can be found on USGS soil maps
  - A&B soils are more sandy and will infiltrate faster
  - C&D soils are more clayey and probably require an underdrain
- Saturated hydraulic conductivity (Ksat)
  - Below 1.5 inches per hour can be a threshold for underdrain requirement
- Depth to groundwater
  - Minimum 5-foot separation to seasonal high groundwater level (otherwise use impervious liner at bottom)
- Contaminated soil and groundwater
  - Check if site is in current or past industrial areas, any records of soil cleanup efforts, etc. If soil/water contamination is a concern, a liner may be required.

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Slope – Criteria and Challenges – Part 1

- Longitudinal roadway slope affects bioretention system design
  - On streets with slopes over 4%, bioretention systems should be broken into cells with check dams creating flatter sections in each cell
  - 2% maximum slope within bioretention cells
  - 8% maximum roadway slope for bioretention

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Slope – Criteria and Challenges – Part 2

- Lateral/cross slope of crowned roadways affects designs of stormwater curb extensions and stormwater center medians
  - Severely crowned streets minimize available area for bioretention
  - Difficult to use center medians and islands
  - Maximize use of planter strips/medians to widen the system
  - Consider using area under sidewalks for additional widening space
  - Slope from sidewalk to roadway can affect depth of system
  - Flush curbs can reduce the drop from roadway to bioretention area
  - Curbs and fencing may be needed for deep systems

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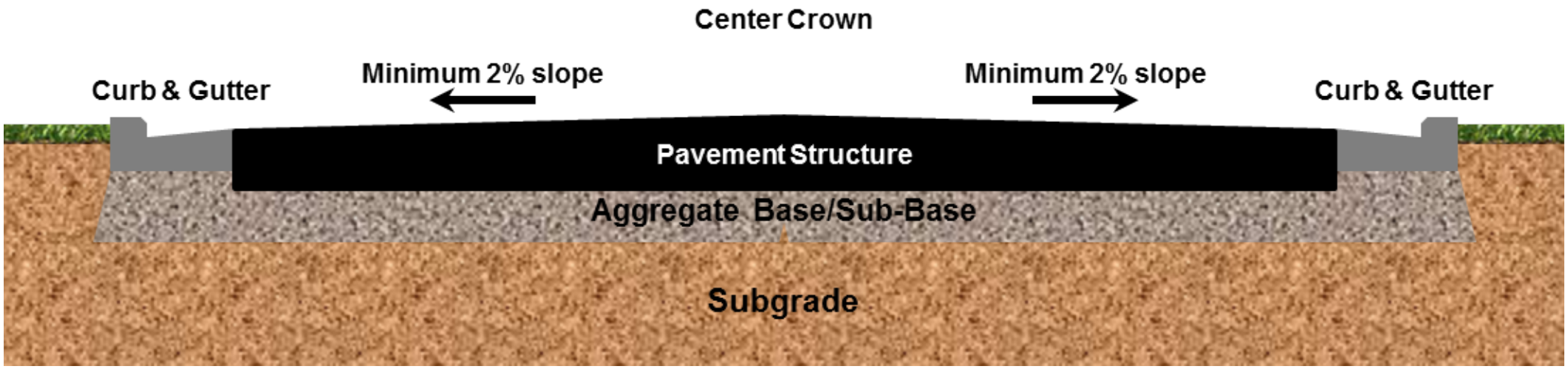
Flat Roadway Crown



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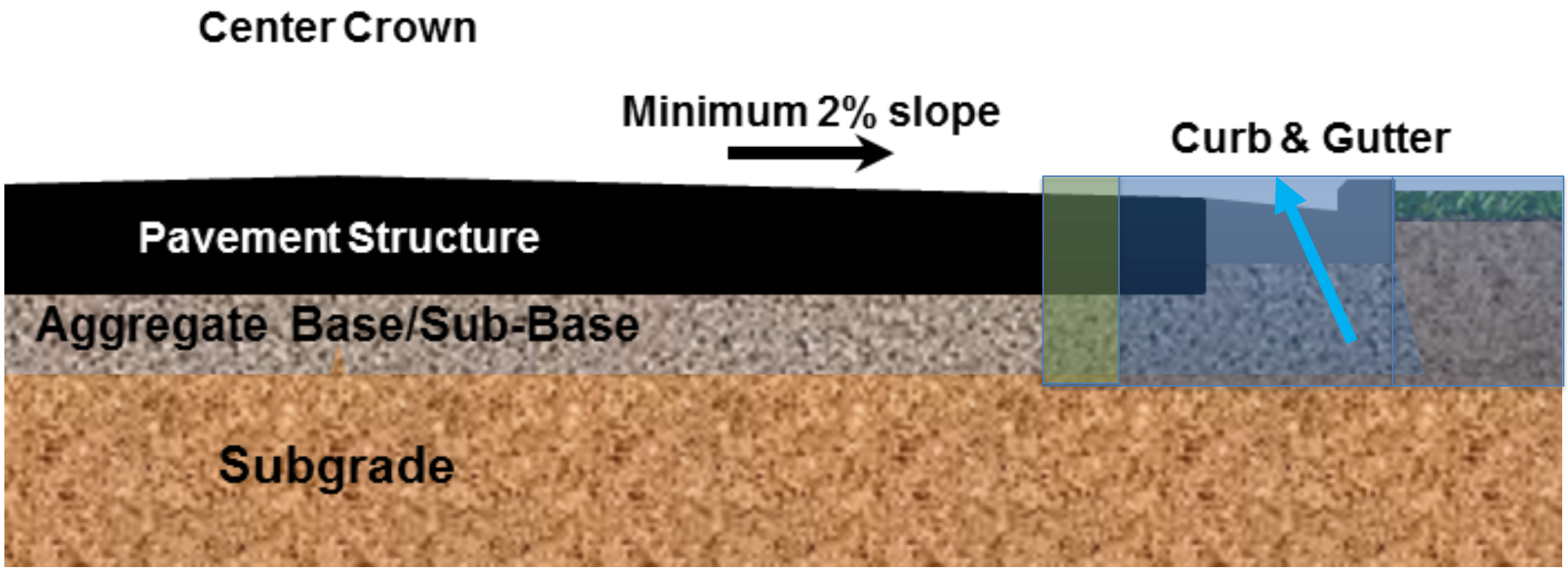
Flat Roadway Crown



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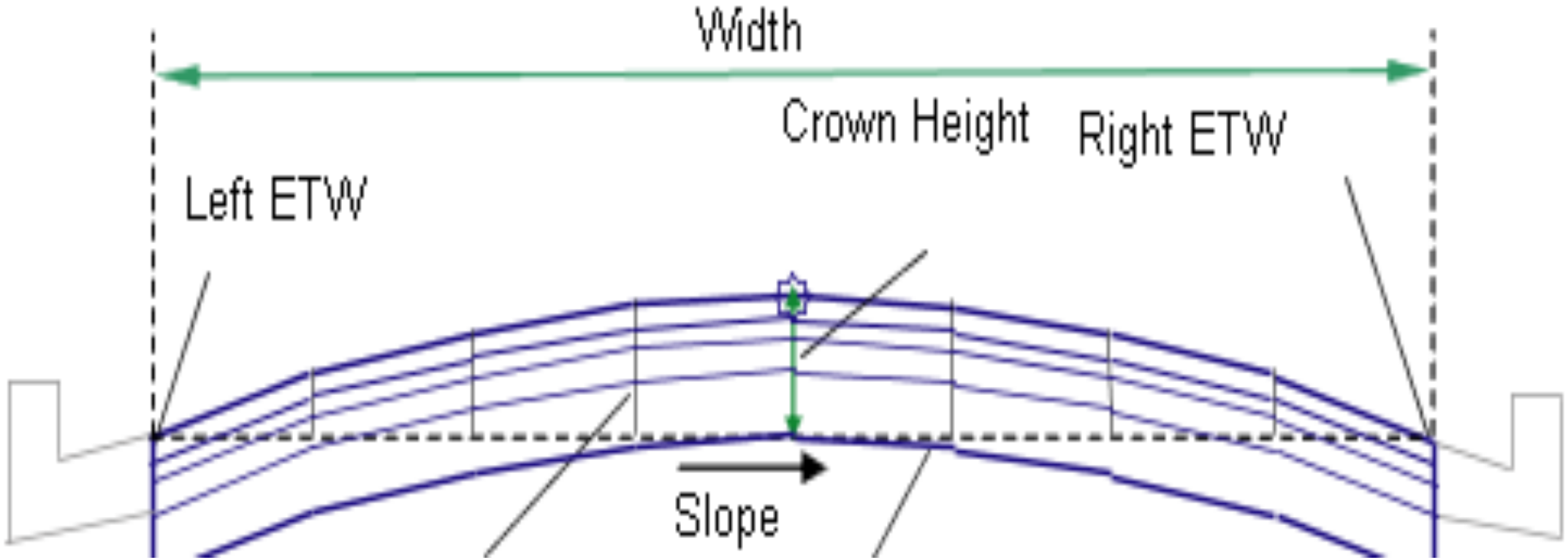
Steep Roadway Crown



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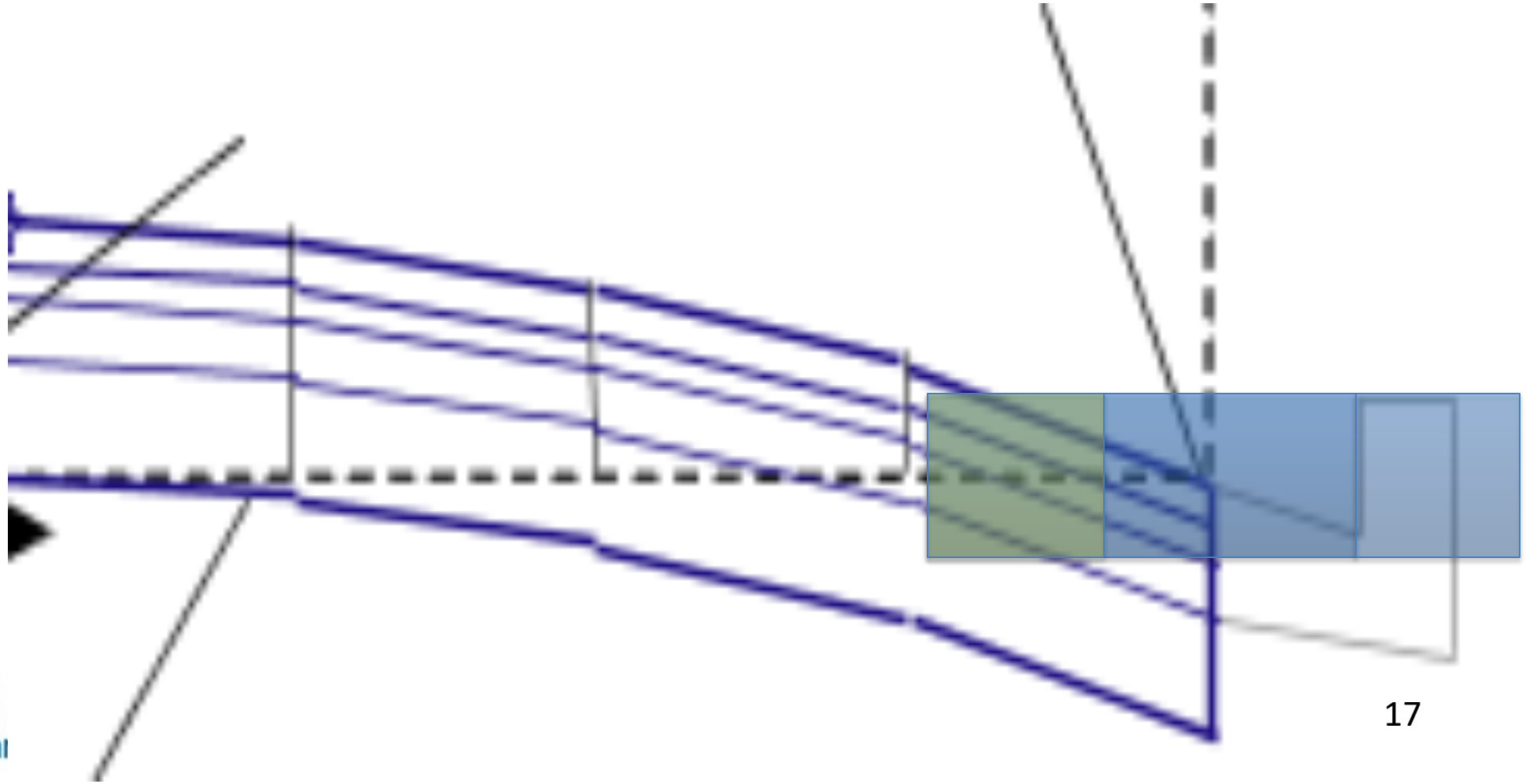
Stormwater Curb Extension – Sloped Street



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STOP
30


TRAFFIC
CIRCLE


TRAFFIC CIRCLE
TRAFFIC

Space – Criteria and Challenges

Space for stormwater control measures?

- Red curb zones? (ask your fire department and DOT)
- Removal of on-street parking? (ask the neighbors)
- Space underground? (ask your arborist and utilities)
- Space overhead? (ditto)
- Space behind the sidewalk and/or on adjacent parcels?
- Consider using space under sidewalks and parking lanes
- Size of the Drainage Management Area (DMA)
  - Impervious areas within the Right of Way (Roadway, Sidewalk, Shoulder etc.)
  - Impervious areas outside of the Right of Way (Parcels, Driveways etc.)

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Sediment– Criteria and Challenges

- Sediment can clog bioretention systems and increase the maintenance burden
- Sources of sediment:
  - Industrial land uses in the area may create high sediment loads in the roadway – mining/gravel pits, concrete plants, landscape yards with soil and aggregate
  - Leaf load from street trees
  - Roadway volume can be a proxy for tire and brake sediment
  - Trash loads in high-generating land use areas (retail & schools)
  - Construction site vehicles can track sediment into roadways
  - Erosion from exposed soil areas nearby

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Stakeholders – Types and Challenges

- Land uses
- Adjacent Private and/or Public parcel owners
- Users/Uses of the Project Right of Way
  - Events/Commons/Gathering
  - Street Trees/Landscaping
  - Modes of Travel
    - Heavy vehicles (e.g. garbage/recycling, commercial & fire-fighting)
    - Pedestrians, wheelchairs and sight-impaired
    - Cyclists
    - Skateboarders/scooters
    - Public transportation
    - Cars

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Subsurface Infrastructure– Types & Challenges

- Underground utilities affect design, construction & cost
  - Storm and sanitary sewer lines
  - Power lines, pipes and vaults
  - Water – for bioretention irrigation and protecting supply lines
  - Communication - joint trench
  - Transportation vents and tunnels
  - Fuel storage tanks not on maps
- Underground resources/challenges
  - Soil volume – find ways to increase volume and use native soils
  - Tree roots – protect - can require hand digging

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SCOPING STRATEGIES

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Scoping Strategies

- Look for underground infrastructure indicators:
  - Vaults, vents and meter boxes
  - Hydrants
  - Utility poles
  - Tree roots
- Initial DMA sizing
  - Through the curb drains
  - Driveways/parking areas
  - Catch basins/inlets
  - Roof leaders

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Scoping Tips

- Collect site information before moving to the design phase
- Start early
- Pothole twice as much as normal
- Use ground penetrating radar and LIDAR data
- Look for opportunities
- Coordinate with other departments and utility providers
- Stack multiple ecosystem benefits
- Work with stakeholders
- Communicate goals

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CCAG- SSMP:
STORMWATER CURB EXTENSION TOOL

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Page 1 of the SCE Tool

STORMWATER CURB EXTENSION FEASIBILITY

The following worksheet is for assessing the feasibility of bioretention stormwater curb extensions at intersections. This page provides instructions and examples of the maps/images needed to complete the assessment. The feasibility criteria page outlines the sizing and design criteria, and provides visual examples of where to make the measurements at an intersection. The intersection opportunity assessment sheet includes a checklist and suggestions for maps/images to facilitate the assessment.

This tool is intended to provide guidance based on typical constraint criteria. Jurisdictions may employ a feasibility process and criteria, including sizing and design guidance, that differ from those presented in this tool.

Page 1 - Introduction and Setup

- Identify an intersection for assessment or refer to the suggested priority locations from the CCAG Sustainable Streets Master Plan project viewer located here: http://ccag-gis.paradigmh2o.com/maps/CCAG%20Sustainable%20Streets%20Master%20Plan.
- On the CCAG Sustainable Streets Master Plan online map, navigate to the street being assessed. Ensure the map layers for Catch Basins, Flow Path and Catchments are turned on. Take a screenshot of the intersection and drop the photo into the applicable photo field.
- Starting from the northern corner, working clockwise, label the corners of the intersection: A, B, C, D. Repeat adding a 1 and 2 to each lettered corner.
- Take a screenshot of Google Maps street view with the street being assessed as the main view. Repeat from the opposite side of the intersection. Drop the photos into the applicable photo fields. Label each intersection in correspondence with the labels applied in the previous step.

Page 2 - Feasibility Criteria

- Review the design and sizing criteria on page 2.
- Review the minimum width table.
- Note: feasibility criteria and minimum widths are intended to be "typical" and may differ by jurisdiction.

Page 3 - Intersection Assessment

- Complete tables on page 3 to evaluate each corner of the intersection and determine if a curb extension is recommended.

Page 4 - Assessment Footnotes

- Footnotes for the assessment table are provided here for additional support in completing page 3.

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Intersection of Bayswater Ave and Anita Road in Burlingame, CA

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CCAG Sustainable Streets Master Plan

English

Info and Tools

Map themes

Map

Map Layers

- CCAG Sustainable Streets Master P
  - Municipal Boundaries
  - Existing Planned Projects Oppor
  - New Project Opportunities - High
  - Detailed Prioritization Scores for
  - Existing Planned Project Opportu
  - Catch Basin Delineation
    - Storm Drains
    - Catch Basins
    - Flow Path
    - Catchments - All
- Background Layers
  - Bing Satellite
  - Bing Roads
  - Bing Gray Canvas
  - Google Satellite
  - Google Map

Layer order

Object identification: Active Layer

Mode: navigation. Shift/rectangle or mouse wheel for zooming.

Coordinate: -13618819.4520218 1: 1128

SSMP Project Viewer Map - Closeup

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Page 2 of the SCE Tool

STORMWATER CURB EXTENSION - FEASIBILITY CRITERIA

Intersection of Burlingame Ave and Park Road in Burlingame, CA

TABLE 1 - SIZING AND DESIGN CRITERIA

CURB EXTENSION SIZING	
Width	Standard: 6 ft
	Typical: 6 - 7 ft (not including 1 ft setback from curb)
Length[1]	Minimum: 20 ft
	Typical: 20 - 25 ft
Sidewalk Through-way Width	Minimum: 5 ft
DMA Sizing Ratio	Range: 2.5%-5%
	Typical: 4%
DESIGN RESTRICTIONS[2]	
Fire Hydrants	Can't encroach on access
Bus Pad	
Driveway	Must have 2 ft of separation from curb ext.
Existing Roadway Width	Can't be less than corresponding minimum width in Table 2
DESIGN CONSTRAINTS	
Water Main	3 ft of horizontal separation
Duct Bank[3]	
Mature Trees[4]	Outside drip-line or 10x diameter at breast height
Power Poles[5]	Can't be located within planter
Catch Basins	If bulbout will be underdrained, there must be a catch basin at intersection
Bus Stop	Must be room to move bus stop to before bulbout
Existing Sidewalk Width	Meets ADA code (5 ft through-way width)

1 - Assumes 5 ft tangent after S-curve.
2 - Costs to address these constraints often make stormwater curb extension infeasible.
3 - PG&E requirement, can obtain variance to protect in place through gravel layer.
4 - If tree obstructs line of sight at intersection, risks encroaching on power lines, or is in poor condition, then it may need removal and therefore should not be considered a constraint.
5 - Curb extension design can be adjusted to avoid pole. May reduce sizing ratio and increase cost.

TABLE 2 - MINIMUM ROADWAY WIDTH CRITERIA

Roadway Type	Min. Allowed Width of Travel Lane Nearest to Curb Ext. (ft)	Min. Curb-to-Curb Roadway Width for Curb Extensions[6]	
		2-Lane Road	4-Lane Road
Residential	10	34	54
Transit Route	11	36	58
Freight Route or Industrial	12	38	62
Residential + Bike Lane[7]	15	44	74

6 - Assumes extensions on both sides of roadway with min. width of 6 ft and a 1 ft setback from face of curb.
7 - Assumes bike lane on both sides of roadway. If only on one side, subtract 5 ft from the total width needed.

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CCAG Sustainable Streets Master Plan

English

Info and Tools

Map themes

Map

Map Layers

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  - Google Satellite
  - Google Map

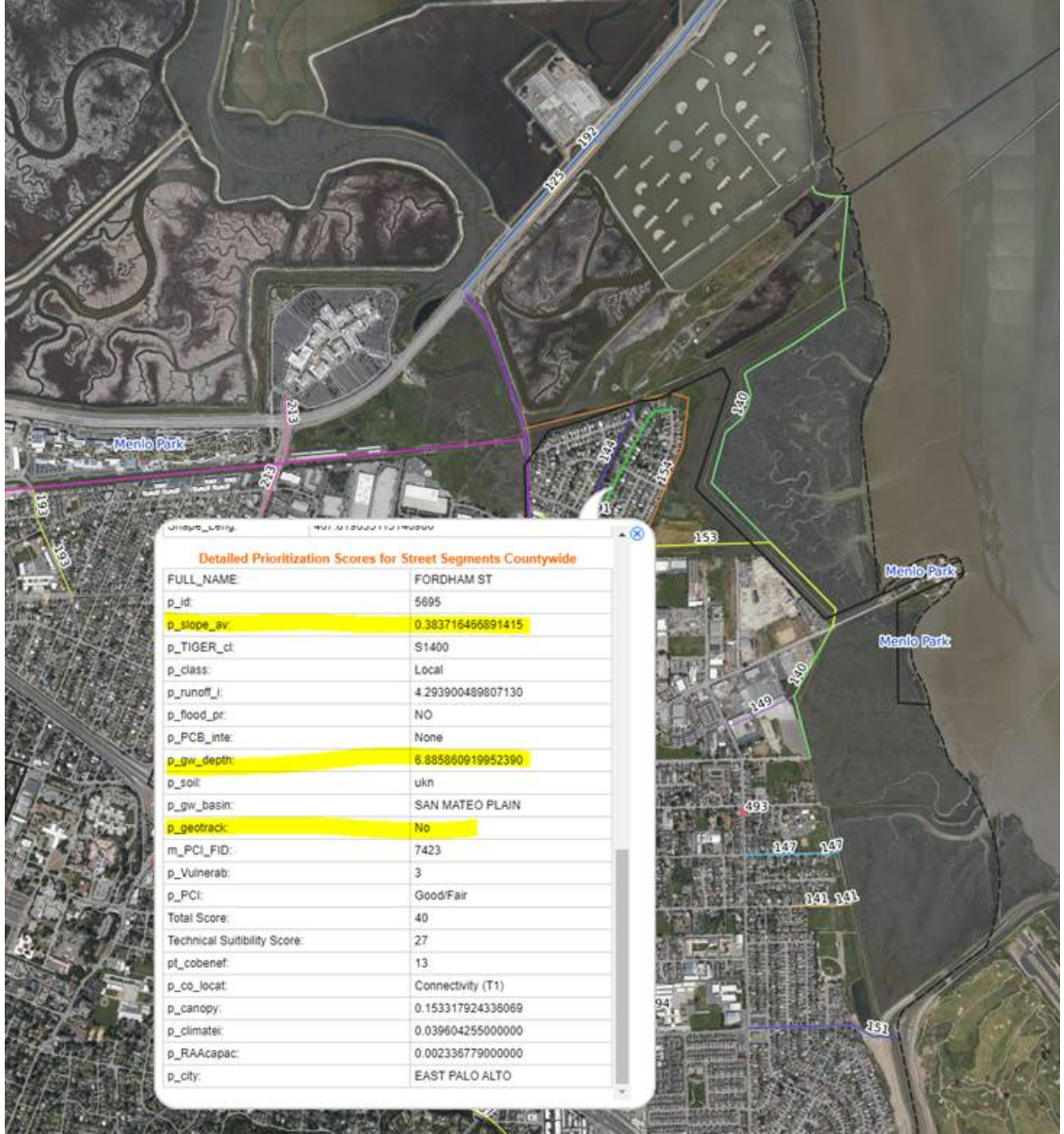
Layer order

Object identification: Active Layer

Mode: navigation. Shift/rectangle or mouse wheel for zooming.

Coordinate: -13618819.4520218 1: 1128

Street Information Box from the CCAG SSMP Map



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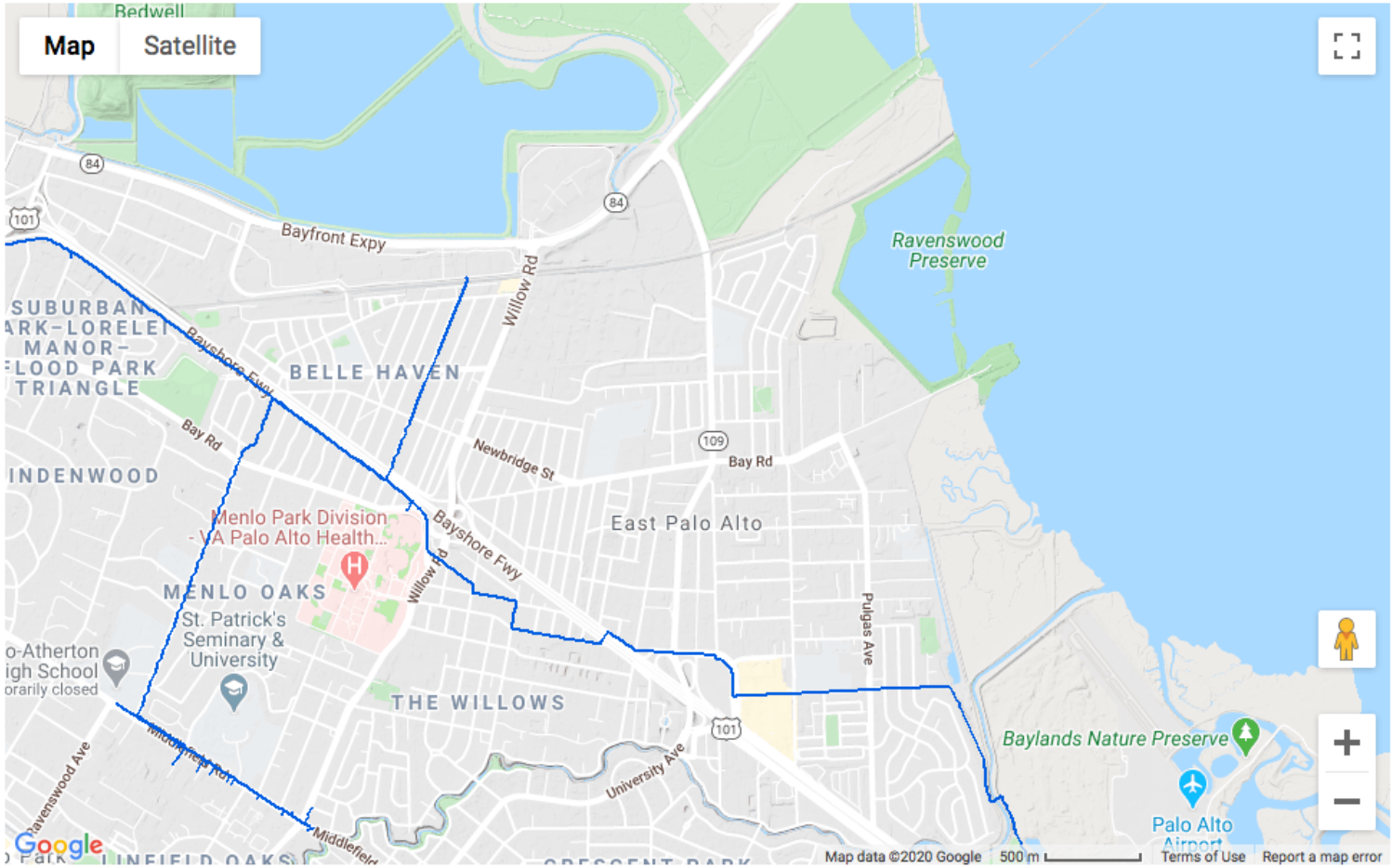
The following interactive map shows pipelines in your neighborhood:



ADDRESS

Enter Address

VIEW GAS SAFETY RESOURCES

We have a complete inspection and monitoring program. The program helps ensure the safety of our natural gas transmission pipeline system. Learn about our plan for safer, more reliable gas service from the following resources:

Download Gas Safety Plan (PDF, 3.6 MB) >

Download Get The Facts: Pipeline Safety (PDF, 216 KB) >

Visit Hydrostatic Pipeline Testing >

PG&E Gas Pipeline Map

Page 3 of the SCE Tool

STORMWATER CURB EXTENSION - INTERSECTION OPPORTUNITY ASSESSMENT

CCAG Map Photo Insert Here

Google Maps Street View #1 Insert Here

Google Maps Street View #2 Insert Here

STREET DETAILS	
Primary Street Being Assessed	Fordham St., East Palo Alto
Street Type [a]	Residential
Available Width (ft) [b]	6.5 and 10 ft

ADDITIONAL NOTES

The northern stretch of Fordham Street (between A2 and B1) has approximately 6.5' available width for a curb extension, while the southern stretch of Fordham Street (between C2 and D1) has approximately 10' available width for a curb extension. Purdue Street does not have enough available width for curb extensions.

4-CORNER ASSESSMENT	A1	A2	B1	B2	C1	C2	D1	D2
Section 1 - Feasibility	Curb extension not recommended at corner if any of the boxes below are checked							
Does not receive any stormwater runoff	☐	☐	☐	☐	☐	☐	☐	☐
Underdrain needed and no storm drain at intersection	✓	✓	☐	☐	☐	☐	☐	☐
Water main on same side of street with dia ≥ 12 inch	☐	☐	☐	☐	☐	☐	☐	☐
Less than 20 ft from start of corner to first driveway [c]	☐	☐	☐	☐	☐	☐	☐	☐
Roadway width is less than minimum required	☐	☐	☐	✓	✓	☐	☐	✓
Major gas transmission pipeline on same side of street [d]	☐	☐	☐	☐	☐	☐	☐	☐
Bus stop with concrete pad within footprint	☐	☐	☐	☐	☐	☐	☐	☐
Longitudinal street slope > 5%	☐	☐	☐	☐	☐	☐	☐	☐
Large duct bank (≥ 3 ft) within proposed footprint	☐	☐	☐	☐	☐	☐	☐	☐
Electrical/telecom vault within proposed footprint	☐	☐	☐	☐	☐	☐	☐	☐
Section 2 - Constraints	Curb extension not recommended at corner if 3 or more of the boxes below are checked							
Duct bank within proposed footprint	☐	☐	☐	☐	☐	☐	☐	☐
Electrical/telecom vault on sidewalk adjacent to proposed footprint	☐	☐	☐	☐	☐	☐	☐	☐
Sewer main below proposed footprint	☐	☐	☐	☐	☐	☐	☐	☐
Water main < 12 inch dia within proposed footprint	☐	☐	✓	✓	☐	☐	☐	☐
Fire hydrant at corner	☐	☐	☐	☐	☐	✓	☐	☐
Depth to groundwater or bedrock < 10 ft	☐	☐	✓	✓	☐	✓	✓	☐
Open Geotracker cleanup site within 200 ft [e]	☐	☐	☐	☐	☐	☐	☐	☐
Drainage area to curb extension < 1000 sqft	☐	☐	☐	☐	☐	☐	☐	☐
Mature tree ≥ 6 inch dia within 20 ft of corner	☐	☐	☐	☐	☐	✓	☐	☐
Recommended for Curb Extension	**no**	**no**	**yes**	**no**	**no**	**no**	**yes**	**no**

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A
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Report a problem

Page 3 of the SCE Tool

STORMWATER CURB EXTENSION - INTERSECTION OPPORTUNITY ASSESSMENT

CCAG Map Photo Insert Here

Google Maps Street View #1 Insert Here

Google Maps Street View #2 Insert Here

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Water main on same side of street with dia ≥ 12 inch	☐	☐	☐	☐	☐	☐	☐	☐
Less than 20 ft from start of corner to first driveway [c]	☐	☐	☐	☐	☐	☐	☐	☐
Roadway width is less than minimum required	☐	☐	☐	✓	✓	☐	☐	✓
Major gas transmission pipeline on same side of street [d]	☐	☐	☐	☐	☐	☐	☐	☐
Bus stop with concrete pad within footprint	☐	☐	☐	☐	☐	☐	☐	☐
Longitudinal street slope > 5%	☐	☐	☐	☐	☐	☐	☐	☐
Large duct bank (≥ 3 ft) within proposed footprint	☐	☐	☐	☐	☐	☐	☐	☐
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Electrical/telecom vault on sidewalk adjacent to proposed footprint	☐	☐	☐	☐	☐	☐	☐	☐
Sewer main below proposed footprint	☐	☐	☐	☐	☐	☐	☐	☐
Water main < 12 inch dia within proposed footprint	☐	☐	✓	✓	☐	☐	☐	☐
Fire hydrant at corner	☐	☐	☐	☐	☐	✓	☐	☐
Depth to groundwater or bedrock < 10 ft	☐	☐	✓	✓	☐	✓	✓	☐
Open Geotracker cleanup site within 200 ft [e]	☐	☐	☐	☐	☐	☐	☐	☐
Drainage area to curb extension < 1000 sqft	☐	☐	☐	☐	☐	☐	☐	☐
Mature tree ≥ 6 inch dia within 20 ft of corner	☐	☐	☐	☐	☐	✓	☐	☐
Recommended for Curb Extension	**no**	**no**	**yes**	**no**	**no**	**no**	**yes**	**no**

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STORMWATER CURB EXTENSION - ASSESSMENT FOOTNOTES

4-Corner Assessment Table Footnotes:

a) Typical street classes include local, collector, and arterial, but jurisdictions may have more specific standard street types.
b) Determine the available width for a curb extension by taking the existing curb-to-curb width of the street and subtracting the minimum curb-to-curb roadway width in Table 2 on page 2. Divide the result by 2.
c) Length measurements should be taken from the extension of property line at the intersection to the identified obstruction. If the propety line is not known, measure lengths from the start of the curve at the corner.
d) Available at: https://www.pge.com/en_US/safety/how-the-system-works/natural-gas-system-overview/gas-transmission-pipeline/gas-transmission-pipelines.page.
e) Geotracker website for contamination constraints: https://geotracker.waterboards.ca.gov/map/.

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Questions?

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