# Grant Progress Report
## Bay Area Green Infrastructure Master Planning Project
## GA# 12-415-550

**Progress Report #** 8

**Reporting Period:** 4/01/2015 to 6/30/2015

**Submittal Date** 8/14/2015

**Grant Agreement No:** 12-415-550
**Project Name:** Bay Area Green Infrastructure Master Planning Project
**Contractor Name:** San Francisco Estuary Partnership / ABAG

I certify under penalty of law that this document and any attachment was prepared by me or under my direction in accordance with the terms and conditions of each Grant Agreement Exhibit. Based on my inquiry of the persons or persons who manage the project, or those directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. All information submitted in this document and all attachments conform to and is in accordance with the state and federal laws and I so here certify with my signature. I am aware that there are significant penalties for submitting false or misleading information.

**Project Director:** JUDY KELLY ____ Judy Kelly – Printed Name ____ Judy Kelly ____ Signature

# Summary of Work Completed To Date

| Work Item | Items for Review | Critical Due Date | Estimated Due Date | Percent Work Complete | Date Submitted |
|---|---|---|---|---|---|
| EXHIBIT A – SCOPE OF WORK TO BE PERFORMED BY THE GRANTEE | | | | | |
| A. | PLANS AND GENERAL COMPLIANCE REQUIREMENTS | | | | |
| 1. | GPS information for Project site and monitoring locations | Day 90 | | 100% | 10/26/13 |
| 2. | Monitoring and Reporting Plan | N/A | N/A | N/A | N/A |
| 2.1 | Project Assessment and Evaluation Plan (PAEP) | Day 90 | | 100% | 10/26/13 |
| 2.2 | Monitoring Plan (MP) | N/A | N/A | N/A | N/A |
| 2.3 | Quality Assurance Project Plan (QAPP) | N/A | N/A | N/A | N/A |
| 2.4 | Proof of Water Quality Data Submission to CEDEN | N/A | N/A | N/A | N/A |
| 3. | Copy of final CEQA/NEPA Documentation | Day 90 | | 100% | 10/26/13 |
| 4. | Public Agency Approvals, Entitlements, or Permits | N/A | N/A | N/A | N/A |
| B. | PROJECT-SPECIFIC REQUIREMENTS | | | | |
| 1. | Project Management | | | | |
| 1.2 | Notification of Upcoming Meetings, Workshops, and Trainings | | 15 Days In Advance | | |
| 2. | TAC | | | | |

| | | | | | |
|---|---|---|---|---|---|
| 2.1 | List of TAC Members, Their Affiliated Organizations, and Their Roles and Responsibilities | | November 2013 | 100% | 12/2/13 |
| 2.2 | Three (3) TAC Meeting Agendas, Sign-In Sheets, and Minutes | | As Needed | 100% | 8/15/14 |
| 2.3 | TAC Status Report | December 31, 2014 | | | 12/31/14 |
| 3. | Toolkit | | | | |
| 3.4 | The Packaged Toolkit | | February 2015 | | 2/17/15 |
| 3.5 | Toolkit Technical Memorandum | April 30, 2015 | | | 4/30/15 |
| 3.6 | List of Communities and Staff Contact Information that Participated in Toolkit Demonstration | | May 2015 | | 05/12/15 |
| 4. | Green Infrastructure Master Plans | | May 2015 | | |
| 4.1 | Preliminary Meeting Minutes and a List of Selected Watersheds | | February 2014 | 100% | 12/31/13 |
| 4.2 | Toolkit Results and Secondary Meeting Minutes | | December 2014 | | 12/31/14 |
| 4.3 | List of Potential LID Retrofit Sites Selected for Field Verification | | December 2014 | | 12/31/14 |
| 4.5 | List of Selected Sites for LID Conceptual Design | | April 2015 | | 11/20/2014 |
| 4.6 | Green Infrastructure Master Plans | | May 2015 | | 05/12/15 |
| 5. | Evaluation of Potential Funding Mechanisms | | | | |
| 5.1 | Meeting Agendas, Sign-In Sheets, and Minutes | | April 2015 | 100% | 05/12/15 |
| 5.2 | In-Lieu Fee Program Memorandum | | May 2015 | 90% | 05/12/15 |
| 6. | Education and Outreach | | | | |
| 6.1 | Website Link | | October 2013 | 100% | 10/26/13 |
| 6.3 | Webinar Material | | July 2015 | | 7/30/15 |
| 6.5 | Project Results Presentation Material | | July 2015 | | |
| EXHIBIT B – INVOICING, BUDGET DETAIL, AND REPORTING PROVISIONS | | | | | |
| A. | INVOICING | | Quarterly | 88% (8/9) | 11/15/14 |
| G. | REPORTS | | | | |
| 1. | Progress Reports within forty-five (45) days following the end of the calendar quarter (March, June, September, and December) | | Quarterly | 88% (8/9) | 2/13/15 |
| 2. | Annual Progress Summaries | | Annually by 9/30 | | 1/13/15 |
| 3. | Natural Resource Projects Inventory (NRPI) Survey Form | Before Final Invoice | | | |
| 4. | Draft Final Project Report | August 31, 2015 | | | |

| | | | | | |
|---|---|---|---|---|---|
| 5. | Final Project Report | October 31, 2015 | | | |
| 6. | Final Project Summary | Before Final Invoice | | | |
| 7. | Final Project Inspection and Certification | Before Final Invoice | | | |

# Progress Report Narrative

GreenPlan Bay Area is a collaborative effort between San Francisco Estuary Partnership (SFEP), San Francisco Estuary Institute (SFEI) and several Bay Area municipalities. SFEI will develop spatial tools which will be used by several Bay Area municipalities to develop plans that identify the optimal combination of Green Infrastructure (GI)/Low Impact Development (LID) features for achieving desirable outcomes at the watershed scale.

The spatial tools, aka GreenPlan-IT, includes four components: a GIS siting tool with user interface to determine site suitability, a watershed model to identify high-yield runoff and pollutant areas ('hot spot'), optimization techniques to search for optimal combinations of LID locations, types and configurations, and a post-processor to compile and display outputs in user-friendly formats.

GreenPlan-IT has been pilot tested in several municipalities/watersheds. The results of GreenPlan-IT have/will serve as the basis for municipal Green Infrastructure Master Plans and/or a list of priority LID sites for each jurisdiction. Conceptual designs have been developed for 8 LID sites/projects. Jurisdictions will also collaborate with ABAG/SFEP to explore potential funding frameworks (such as alternative compliance programs) for LID retrofits.

# Summary of Activities

- TAC meeting of April 2015, minutes attached
- ABAG General Assembly on Green Infrastructure, materials attached
- Webinar invitations sent out, materials attached
- Meetings with Sunnyvale re GreenPlan-IT, meeting minutes attached
- In-Lieu Fee Memo discussed at TAC, memo attached

# Summary of Items for Review

Invoice #8

Project Administration (Cumulative 80 % complete)
Project administration during this quarter has included the completion of Invoice 8, project management including completing the quarterly report, updating the project website, reviewing project deliverables submitted by SFEI and attending team meetings.

Project Design (Cumulative 80 % complete)
Project design included the tasks listed on the attached SFEI quarterly progress report as well as attending development meetings with staff from participating municipalities and SFEI; reviewing documents and providing input.

**Exhibit A Deliverables**
B(G)1 - Progress Reports (Cumulative 88% 8 out of 9 complete) - continues on a quarterly basis no delays or issues to report.
3.5 Toolkit Technical Memo (called GreenPlan-IT Toolkit Demonstration Report)
5.1 and 5.2 In Lieu Fee meeting materials and memo.

**Attachments (submitted separately as PDF file)**

1. SFEI Progress Report #8 (Quarter 8 – April through June 2015)
2. GreenPlan-IT Toolkit Demonstration Report
3. Meeting minutes from SFEI and Sunnyvale re GreenPlan-IT
4. ABAG General Assembly Meeting Announcement, Agenda, Attendees, and San Mateo Presentation
5. TAC Presentation and Meeting Summary
6. GreenPlan-IT Webinar Invitation
7. Alternative Funding options meeting summaries and attendees
8. Funding Mechanisms Memo (aka In-Lieu Fee memo) *Note, memo will be revised in upcoming quarter to reflect comments of expert reviewers*

## Summary of Items in Progress

- Exhibit A - B(G)1 Progress Reports - continues on a quarterly basis; no delays or issues to report.
- SFEP draft final report
- Sunnyvale GreenPlanning Update info
- Outreach activities
- Complete Alternative Funding, In–Lieu Fee memo

## Question for State Board:

Deliverable 6.5 Request to substitute project outreach at September 2015 State of the Estuary Conference and/or the April 2015 General Assembly for the BASMAA outreach event.

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**Green Infrastructure Master Planning Project Quarterly Progress Report**
**Q2 2015 (Progress Report #8)**

## Task 1: Project Assessment and Evaluation Plan

**Work Completed during the Period**

- SFEI staff began working on the final PAEP which will be submitted in August 2015.

## Task 2: Technical Advisory Committee

**Work Completed during the Period**

- SFEI prepared for handheld the final project TAC meeting to discuss final GreenPlan-IT Toolkit output. Meeting PowerPoints and summary are attached.
- In this invoice, we adjusted meeting travel expenses previously billed to task 002. Travel costs were associated with the Toolkit task and were therefore moved from task 2 two task three.

## Task 3: LID Toolkit

**Work Completed during the Period**

- SFEI continued to hold internal meetings to check in on project progress, discuss technical questions, and plan project next steps.
- SFEI staff continued working with the city of San Jose. SFEI staff prepared for and held a final workshop with the city of San Jose and interested stakeholders on April 8. The focus of the meeting was to present the final Toolkit outputs to City staff and other interested parties. The meeting Powerpoint is attached.
- Project consultant Dan Cloak prepared for and attended the April 8 San Jose meeting and continued to work with San Jose and city of San Mateo on developing conceptual designs for both cities.

## Task 4: Green Infrastructure Master Plans

**Work Completed during the Period**

- SFEI finalized a draft demonstration report summarizing the Toolkit genesis, the process of working with the cities of San Jose and San Mateo, and the outcomes of running the Toolkit in the partner communities. The report was posted to the project website.
- SFEI began working with the City of Sunnyvale to implement the GreenPlan-IT Toolkit for the entire city of Sunnyvale and specifically for the Peery Park redevelopment planning process. SFEI held phone conferences with city of Sunnyvale staff on April 22, May 13, June 17 to discuss available data, priority development plans, and other information pertinent to running the Site Locator Tool. All meeting summaries are attached.
- SFEI Incorporated city of Sunnyvale data layers into the toolkit, correcting data layers were needed.

- SFEI staff continued to work on the water quality module of the Toolkit including looking at the SUSTAIN modeling platform for ideas on how to model pollutant reduction from Green Infrastructure implementation.

**Task 5: Education and Outreach**

**Work Completed during the Period**

- SFEI began preparation for the July Toolkit webinar.

Attachment 1. SFEI Progress Report #8

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# Attachment 2: GreenPlan-IT Toolkit Demonstration Report

# GreenPlan-IT Toolkit Demonstration Report

Prepared by

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# Table of Contents

# Executive Summary

GreenPlan-IT is a planning level tool that was developed by SFEP and SFEI with support and oversight from BASMAA to provide Bay Area municipalities with the ability to evaluate multiple management alternatives using green infrastructure for addressing stormwater issues in urban watersheds. GreenPlan-IT combines sound science and engineering principles with GIS analysis and optimization techniques to support the cost-effective selection and placement of GI at watershed scale and help develop quantitatively-derived watershed master plans to guide future GI implementation for improving water quality in the San Francisco Bay and its tributary watersheds.

Structurally, the GreenPlan-IT is comprised of three components: (a) a GIS-based Site Locator Tool to identify potential LID/GI sites; (b) a Modeling Tool that quantifies anticipated watershed-scale runoff and pollutant load reduction from GI sites; and (c) an Optimization Tool that uses cost-benefit analysis to identify the best combinations of GI types and sites within a watershed for achieving flow and/or load reduction goals. The three tool components were designed as standalone modules to provide flexibility and their interaction is either through data exchange, or serving as a subroutine to another tool.

This report provides an overview of the GreenPlan-IT and demonstrates its utility and power through two case studies. The case studies with the City of San Mateo and the City of San Jose explored the use of GreenPlan-IT for identifying feasible and optimal GI locations for mitigation of stormwater runoff. They are provided here to give the reader with an overview of the user application process from start to finish, including problem formulation, data collection, GIS analysis, establishing a baseline condition, LID representation, and the optimization process. Through the case study application process the general steps and recommendations for how GreenPlan-IT can be applied and interpreted are presented.

The case study with City of San Mateo utilized only GIS Site Locator tool to screen potential sites for GI implementation in five discrete watersheds (Borel Creek, Laurel Creek, Leslie Creek, Poplar Creek, San Mateo Creek) as well as multiple unnamed drainages. Using selected regional and local data layers and the City's ranking and weighting and through five optional analyses, the Site Locator Tool was used to identify 18 acres of City-owned property or right-of-way as highly ranked locations for potential GI implementation, 113 acres as moderately ranked, and 11 acres as lower ranked locations. A remote data validation exercise confirmed that many of the sites identified and ranked highly by the locator tool were also sites previously identified as potential GI opportunities by the city of San Mateo.

The case study with City of San Jose used the full Toolkit to support a cost-benefit evaluation of stormwater runoff control. The objective of the case study was to demonstrate the capacities and usability of GreenPlan-IT in identifying feasible and cost-effective LID locations at a watershed

scale. The focus area was a 4300 acre proposed development area within the lower part of the Guadalupe River Watershed. The Site Locator Tool identified possible LID locations that serve as the constraints to optimization process; the Modeling Tool established a representative baseline condition through calibration to local data; and then the Optimization Tool was used to repeatedly run the Modeling Tool to iteratively arrive at the optimized GI scenario that minimized the total cost of management while satisfying water quality and quantity constraints. The results of the application included the cost/benefit associated with a range of flow or loads reduction targets, ranking of sites for specific optimal solutions, and maps showing the distribution of GI within the study area under a specific optimal solution.

The Site Locator Tool has end-user flexibility that results in an iterative tool that can be fine-tuned as questions and goals change or more accurate local data are available. Establishing a representative baseline model is crucial for meaningful results and requires the calibration of Modeling Tool to local data. The Optimization Tool can be very powerful when combined with hydrologic modeling and cost analysis. Successful and meaningful application of the Optimization Tool largely depends on accurate representation of the watershed baseline condition, GI configurations, and the associated GI costs. The cost-effective solutions from the optimization process must be interpreted in the context of specific problem formulation, assumptions, constrains, and optimization goals unique to each application. With the help of this information, decision makers can set realistic goals on how much can be achieved and the level of investment required, as well as determine at what point further investment on GI will yield no improvement on runoff reduction.

# Chapter 1. Introduction

Water quality in the San Francisco Bay and its watersheds is impaired by PCBs, mercury, pesticides and a number of other pollutants associated with stormwater runoff. Reducing stormwater runoff and contaminant loads is complex and relies on costly engineering, especially in highly-developed urban environments. Increasingly, distributed management of stormwater runoff using Green infrastructure (GI) is emerging as a multi-benefit solution that can address both stormwater quality and quantity concerns. Consistent with this trend, and under anticipated new stormwater permit provisions due in 2015, Bay Area local governments will be required to develop and implement watershed-scale green infrastructure plans to achieve quantitative water quality improvements.

A major barrier to regional-scale, widespread implementation of GI is a lack of watershed-based planning regarding where opportunity sites exist for GI retrofits and what constitutes the most cost-effective, achievable, and practical management strategy for achieving water quality targets for local landscapes. Realizing the need for a planning tool to support Bay Area municipalities to strategically plan and implement GI projects at a watershed scale, the State Board funded a research project[1] to develop a Toolkit that meets technical and institutional requirements for successful selection and implementation of GI projects. The resulting Toolkit was branded "GreenPlan-IT". The Toolkit package, consisting of the software, companion user manuals, and this demonstration report, is available on the GreenPlan-IT Web site hosted by SFEI (http://greenplanit.sfei.org/).

This report describes the rationale for developing the GreenPlan-IT Toolkit; explains the Toolkit's design and structure; and demonstrates the Toolkit's capabilities through two case studies. Where appropriate, this report also examines the limitations of the Toolkit and provides recommendations for future enhancements. The additional input data/outputs for the Toolkit are also included in the appendices.

## 1.1 Project Rationale

Surface water degradation resulting from stormwater runoff has been an issue of primary focus for many Bay Area agencies. Despite the recognized effectiveness of GI in protecting water quality and reducing flood risk, and the mandatory implementation of GI under limited circumstances under the current NPDES Stormwater Municipal Regional Permit (MRP), the Bay Area's implementation of GI continues slowly. To date, GI projects are largely placed opportunistically (e.g., where land becomes available), or as demonstration projects, at different points throughout a drainage area, with unknown and likely suboptimal flow and load reduction effectiveness. Little is known about the cumulative effects of implementing hundreds or even

[1] Initiated by San Francisco Estuary Partnership (SFEP), San Francisco Estuary Institute (SFEI), Bay Area Storm Water Management Agencies Association (BASMAA), and partnering municipalities in 2013 through the Proposition 84 Storm Water Grant Program.

thousands of GI projects in Bay Area watersheds, either alone or in well-planned combination with “grey infrastructure” approaches. In addition, future MRPs will likely require local agencies to implement GI to achieve set goals at the watershed scale. Bay Area agencies need a scientifically sound planning tool to help develop quantitatively-derived watershed master plans to guide future GI implementation for improving water quality in the San Francisco Bay and its tributary watersheds.

GreenPlan-IT was developed to meet this critical need. The Toolkit can facilitate identification, evaluation and ranking of potential sites based on their relative feasibility and potential effectiveness in reducing stormwater runoff and pollutant loads. GreenPlan-IT can help Bay Area municipalities to address the following key stormwater management questions:

- Where are the suitable locations for GI implementation within the built-out urban environment?
- Where are the effective locations for GI implementation that could have the greatest potential leverage or effectiveness for reducing peak flow runoff and contaminant loads?
- What quantitative water quality and hydrological improvements can be made with GI approaches?
- What are the most cost-effective GI combinations for achieving certain reduction targets?

GreenPlan-IT combines a GIS screening tool, a publically available modeling platform, and an Optimization Tool to provide users with the ability to evaluate multiple stormwater management alternatives to support their decision making for addressing a variety of issues. The Toolkit can be used to comply with NPDES stormwater permit requirements including the development of an alternative compliance program, as well as addressing loads reduction needs identified in TMDLs. The Toolkit is intended for knowledgeable users familiar with GI and the technical aspects of watershed modeling, and applicable to predominantly urban watersheds. Although designed as a tool for Bay Area stormwater agencies, the tool has broad applicability and could be used by other regions as well.

### 1.2 Overview of GreenPlan-IT Toolkit

The GreenPlan-IT Toolkit is designed to support the cost-effective selection and placement of GI in urban watersheds through GIS analysis, hydrologic modeling and optimization techniques. The Toolkit consists of three components: GIS Site Locator Tool, Modeling Tool, and Optimization Tool. To provide flexibility for the user community and for future updates, the three components were designed as standalone modules and their interaction is either through data exchange, or as a submodule linked to another tool component. Figure 1-1 shows a generalized schematic of the Toolkit. Each tool in the Toolkit performs specific functions and is typically applied in sequence.

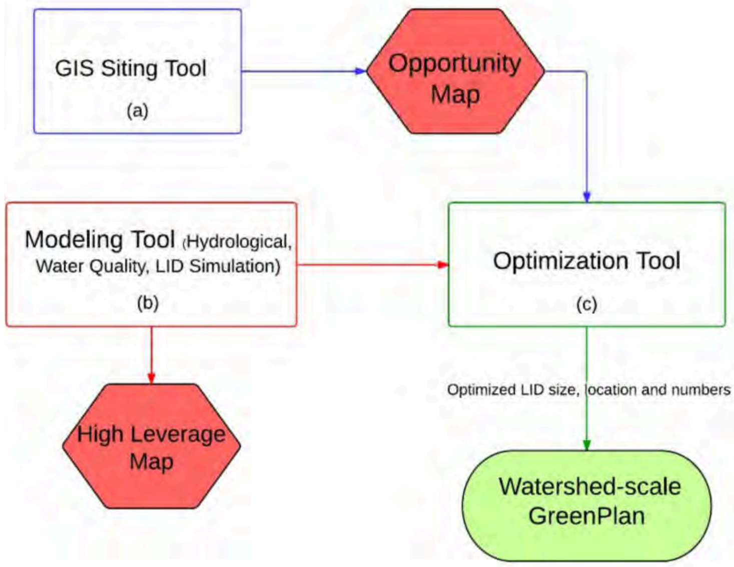


Figure 1-1. Schematic of GreenPlan-IT Toolkit

## GIS Site Locator Tool

The GIS based Site Locator Tool is a screening tool that can be used to identify and rank potential GI locations through GIS analysis. The Tool incorporates many regional, publicly available data layers and builds in five intersecting analyses that require user input data to produce maps of possible GI locations. These analyses are optional, providing end-user flexibility to add local data layers to best identify suitable locations and rankings of GI locations, to produce outputs of different levels of refinement, and to run the analyses with varying levels of data availability. The Site Locator Tool can be fine-tuned iteratively as additional local data or data with better resolution become available.

There are five optional analyses within the Site Locator Tool: the Regional Base Analysis, Locations Analysis, Opportunities and Constraints Analysis, Ownership Analysis, and Knockout Analysis (Figure 1-2). The Tool can be run with any combination or all analyses provided that data are included in each of the analysis tables. Also, there are six GI feature types in the Tool: bioretention, permeable pavement, vegetated swale, stormwater wetlands, wet pond, and infiltration trench. Any combination or all feature types can be selected when running the Tool.

The Regional Base Analysis is hardcoded and can't be modified in the Tool. However, including the Regional Base Analysis in the Tool run is optional. This analysis provides a first estimate of GI possible locations based on regional data sets including depth to groundwater, hydrologic soil type, land use, liquefaction risk, and slope. In the analysis, each regional data set is weighted to reflect relative importance for GI suitability and is binned into relevant value bins which are ranked according to suitability for each GI type. These weights and rank values are then used in a Categorical Weighted Overlay to produce maps of the most suitable areas for each GI type. Since the data are regional in nature, the map outputs are grosser in scale and may remove potential GI locations from the output. Users can experiment by running the Tool with and without the Regional Base Analysis and then compare map outputs or use the base analysis in the Opportunities and Constraints Analysis in a later step.

The Locations Analysis uses regional and local data layers to identify locations for GI implementation for each GI feature type selected. Specified location layers that are identified as potential locations are unioned in order to create a single layer for each GI type that represents all potential locations for that GI type. Onstreet parking, sidewalks, pedestrian trails, parking lots, and parks are example locations for implementing GI. Other potentially good locations could include traffic medians, brown field lots, and undeveloped land.

The Opportunities and Constraints Analysis is an editable table where both regional and local data sets can be added. Each data set is ranked as an opportunity (rank of 1) or a constraint (rank of -1) for GI implementation. Each data layer is then categorized into factors and then individually weighted within its factor. A weight is then assigned to each factor. These values were then used to calculate a final relative rank for each location.

The Ownership Analysis allows the Tool to delineate outputs into public and private possible location. This is only possible if a local ownership data layer exists. The ownership analysis can be important for identification of potential public private partnerships. It can also provide an opportunity to grossly analyze the proportional opportunity between publically and privately own lands.

The Knockout Analysis in the Tool excludes landscape features that should not be included for GI consideration such as wetlands, riparian areas, and tidal areas. Buffer areas can be added to these features as well.

Once GI feature types have been selected and all input tables are filled out and the analyses are selected the Tool runs through each analysis sequentially. The Regional Base Analysis takes the area of interest and excludes all regional areas that were determined not suitable for each GI type. Next, the Locations Analysis intersects the Base Analysis area with all possible GI locations that were specified for each GI type selected. This refines the output to include only locations that are possible, as determined by the Regional Base Analysis, and meet the requirements identified in the Locations Analysis. The Opportunities and Constraints Analysis then applies a relative rank for each location by preforming a nested weighted sum. The Ownership Analysis then applies specified ownership data in order to label each location as either public or private. Lastly the Knockout Analysis removes any areas that are deemed infeasible from the map output.

The Tool produces a KML (Google Earth) and Arc-GIS map with color-coded relative rank of potential GI locations. The developed maps should then be validated via an on screen or field effort to provide verification of the ability for the input data and data ranking to produce real world results. Once validated, these sites, combined with local expert unmapped information such as areas of flooding or high pollutant areas, can serve as a starting point to plan and prioritize placement of GI within a watershed. The identified sites can also used by the Optimization Tool to construct and constrain all potential locations in order to identify most cost-effective combinations for achieving specific management targets.

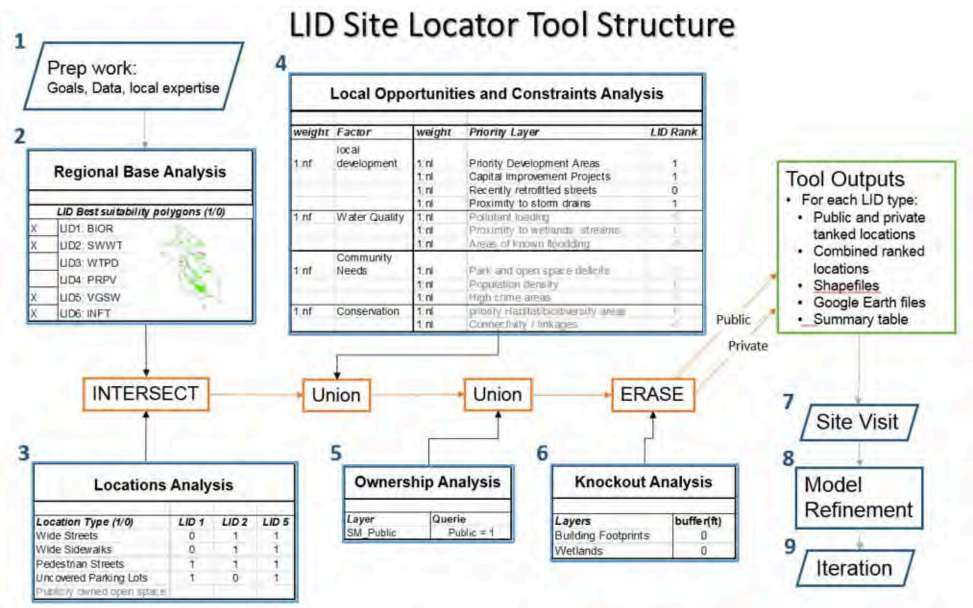


Figure 1-2. Structure of the GIS Site Locator Tool including pre-tool preparation and post tool steps.

## Modeling Tool

The second tool component of the GreenPlan-IT Toolkit is built on a spatially distributed hydrologic and water quality model, [EPA Storm Water Management Model (SWMM) version 5.0](#) (Rossman, 2010), to simulate the generation, fate and transport of stormwater runoff and associated pollutants from the landscape, as well as resulting flow and pollutant loading reduction as they pass through various GIs. The Modeling Tool is used to establish baseline conditions, identify high-yield runoff and pollution areas; and quantify any reduction made from GI implementation across different areas within a watershed. Within the Toolkit, the Modeling Tool serves as a subroutine to the Optimization Tool. At each iteration during the optimization process, the Optimization Tool will commend the Modeling tool to evaluate GI performance and pass that information back. This process progresses step by step marching towards the most cost-effective GI solutions.

### Optimization tool

The third tool is an Optimization Tool which uses an evolutionary optimization technique (Non-dominated Sorting Genetic Algorithm II , Deb, et al 2002) to evaluate the benefits (runoff and pollutant load reductions) and costs associated with various GI implementation scenarios (type, location, number) and identify the most cost-effective options that satisfy user-defined management goals. The Optimization Tool requires the site information generated from the GIS Site Locator tool to form its search space, and uses the Modeling Tool as a subroutine during the search process in an iterative and evolutionary fashion to evaluate the GI performance. Therefore, using the Optimization Tool will require the running of both the Site Locator Tool and Modeling Tool.

## 1.3 GreenPlan-IT Toolkit Application Process

The application of the GreenPlan-IT Toolkit usually begins with the GIS Site Locator Tool, followed by the Modeling Tool, and concludes with the Optimization Tool. Since the Toolkit is constructed in a modular structure with three standalone tools, users can sometime choose to use just the GIS Site Locator Tool to do a preliminary screening on potential GI sites instead of using the full package. However, within the premise of this project, wherever possible, the application of the whole Toolkit is recommended, since optimal placement (achieving the most flow or load reduction) for the least cost is usually in the best interests of the public.

The typical step-by-step process in Toolkit application is as follows: 1) definition of study objectives; 2) data collection; 3) Toolkit setup, and 4) analysis of results. Figure1-3 is a flow diagram illustrating the Toolkit application process. The first step in the setup and application of the Toolkit is a clear definition of the study goals to ensure the most appropriate and useful application. An example of a study objective might be to identify a set of management options that achieve a required level of runoff. The study goals will define the scope and extent of the Toolkit application, including model domain, data needs, runoff and pollutant factors to be simulated, and the optimization evaluation factors and flow or pollutant load reduction targets.

The data collection for the Toolkit application involves a thorough review and compilation of data available for the study area. The Toolkit requires a variety of input data including GIS data, landscape characteristics data, GI data, and monitoring data. Table 1-1 shows a summary of typical data needs for each tool. Because the quality of the Toolkit outputs depends on the quality of input data, locally derived higher-resolution data are desired, wherever possible.

Setting up the Toolkit involves using the data collected to establish a representation of the study area. Since there is no linkage between the Site Locator Tool and Modeling Tool, they can be set up in parallel. In the case of the Modeling Tool, model calibration with local data is needed in order to ensure the establishment of a representative baseline condition. The Optimization Tool then synthesizes information from the Site Locator Tool and Modeling Tool and generates solutions that are looped back to the Modeling Tool for an iterative evaluation. Via this evolutionary search process, the most cost-effective GI solutions are identified according to the user's specific conditions and objectives. The results of the application include the cost/benefit associated with a range of flow or loads reduction targets, ranking of sites for specific optimal solutions, and maps showing the distribution of GI within the study area under a specific optimal solution.

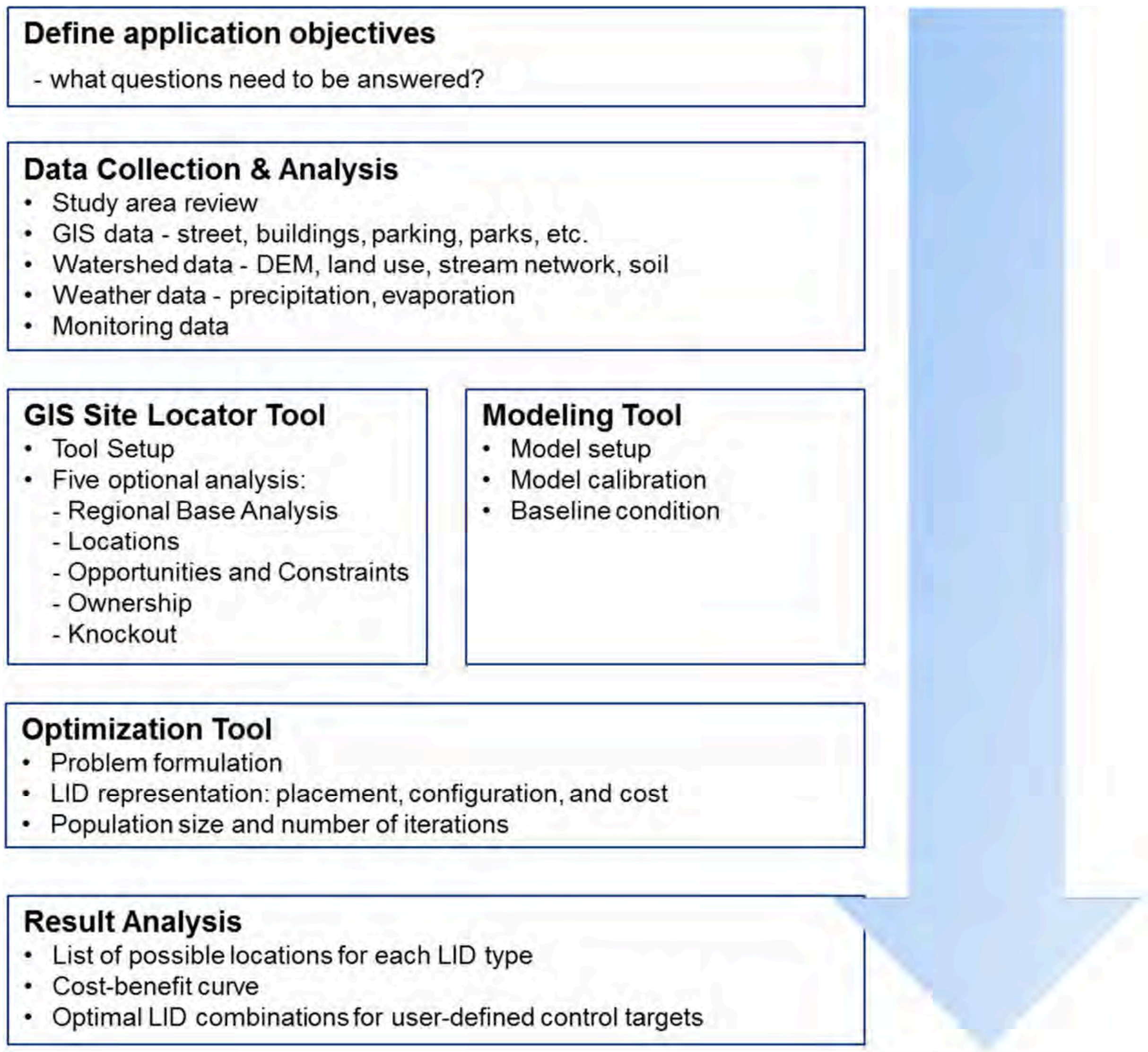


Figure 1-3. GreenPlan-IT Toolkit application process.

Table 1-1 Summary of typical data needs for the Toolkit

| Tool | Data | Usage | Sources |
|---|---|---|---|
| **Site Locator Tool** | Street | Identify opportunities and constraints | Local GIS layers or regional database |
| | Buildings | | |
| | Parking | | |
| | Parks | | |
| | Streams | | |
| | Schools | | |
| **Modeling Tool** | Digital Elevation Data | Delineate study area into smaller subbasins | (http://seamless.usgs.gov/website/seamless/vie wer.php) or local sources |
| | Stream Network | Delineate study area into smaller subbasins | National Hydrography Dataset (NHD) from http://nhd.usgs.gov/data.html |
| | Land Use | Define land use distribution | National Land Cover Dataset (NLCD) (http://seamless.usgs.gov/website/seamless/vie wer.php) or locally derived |
| | Soil Type | Determine the distribution of hydrologic soil group | STATSGO from http://water.usgs.gov/GIS/metadata/usgswrd/XML/muid.xml |
| | Precipitation | Drive runoff simulation | Local rain gages or National Climatic Data Center (NCDC) |
| | Meteorological Data | Required if snow melt is simulated | Local weather stations or NCDC (temperature, wind speed, snow melt) |
| | Evaporation | Support runoff computation | Local weather stations or Californina Irrigation Management Information System (CIMIS) Reference Evapotraspiration |
| | Flow | Calibrate and verify hydrologic simulation | USGS real time data (http://waterdata.usgs.gov/nwis/rt) or local sampling |
| | Water Quality | Calibrate and verify water quality simulation | USGS surface water data (http://waterdata.usgs.gov/nwis/sw) or local sampling |
| **Optimization tool** | LID Cost | Estimate cost of LID scenarios during optimization | Local LID projects and Literature |

# Chapter 2. Case Study: City of San Mateo

## 2.1 City of San Mateo's Sustainable Street Effort

The City of San Mateo was one of three primary municipal partners in the development of the GIS Site Locator Tool. San Mateo is a city on the San Francisco Peninsula with a population of about 100,000 people. When the Green Plan Bay Area project began, the City was in the process of developing a Sustainable Streets Plan. This plan combined two other city planning efforts, a Complete Streets Plan and a Green Streets Plan, into one comprehensive plan. The Complete Streets Plan balances development and redevelopment of all modes of transportation including pedestrian, bicycle, cars, and public transportation in order to create streetscapes accessible to all transportation modes. The Green Streets Plan creates a blueprint for urban greening and returning some more natural watershed function and attributes to the cityscape. One of the primary benefits for urban greening and implementing green infrastructure is to improve the water quality of stormwater runoff that drains to the Bay. In addition, the City also desired other green infrastructure benefits such as beautification, increased areas of urban habitat, and traffic calming that can help reduce the cost to benefit ratio associated with green infrastructure implementation. Together, these plans create a re-visioning of urban streets for planning and integrating transportation modes with urban greening (Figure 2-1).

## 2.2 Case Study Objectives

The Project Team (staff from the City of San Mateo and City of San Jose, other municipalities, BASMAA, and technical advisors) held three meetings to identify Toolkit needs and useful functionality that would be most essential for city planning efforts. Site Locator Tool recommendations from the TAC included adding public/private ownership delineations on map outputs, enabling the Regional Base Analysis an optional part of the Tool, and identifications of useful data layers for running the Tool. Once the beta version of the Site Locator Tool was developed, the development team worked with the City of San Mateo to start the pilot effort.

One of the primary goals for San Mateo was to identify potential GI locations for inclusion in the Sustainable Streets Plan. Since this plan was focused on redeveloping streetscapes, the most useful data pertained to street width, sidewalk width, existing sidewalk planters, and areas of damaged streets and sidewalks that could be considered for future repair. San Mateo plans to capitalize on combining Green Infrastructure with multiple modes of transportation so the City wanted to include existing and potential pedestrian paths (along with streets and sidewalks) as potential GI locations. The City was most interested in identifying locations for bioretention features so this feature type was selected and run through the various analyses. The City elected to include the Regional Base Analysis in the Tool run. This analysis removes locations for consideration that don't meet the base criteria which can result in the exclusion of many locations that could be areas for GI but may need additional engineering.

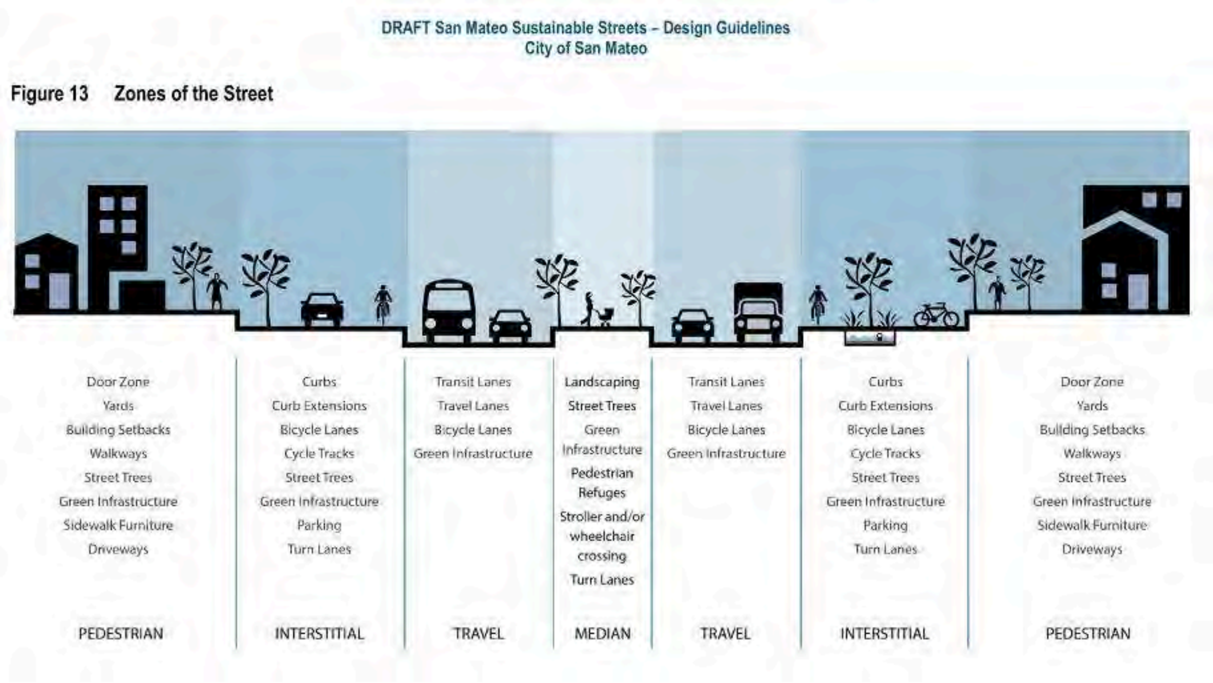


Figure 2-1. Design guidelines for City of San Mateo street zones including planned zones for Green Infrastructure implementation (Courtesy of City of San Mateo).

## 2.2 Project setting

In San Mateo, the GIS Site Locator Tool was demonstrated in five discrete watersheds including Borel Creek, Laurel Creek, Leslie Creek, Poplar Creek, San Mateo Creek, as well as multiple unnamed drainages (Figure 2-2).

## 2.3 Site Locator Tool: Data layers used and decision process

The GIS Site Locator Tool integrates regional and local GIS data and uses these data, through an identification, ranking and weighting process, to locate potential GI locations at a watershed scale. Data accuracy is an important determinant in the accuracy of map outputs produced by the Tool. The quality, scale and accuracy of the input data will determine the quality, scale and accuracy of the output maps. Therefore, it is highly beneficial to use more accurate and local data when available. When using more regional scale data layers for analyses, such as the opportunities and constraints ranking analysis, the user can weight and rank these layers to reflect the confidence in local accuracy of the data. There are many regional GIS data that are included in the Tool (Table 2-1) and additional regional data sets can be added as well. Local data sets can be added to the Tool in order to help identify potential locations that meet the goals and planning needs of each city. Each municipality will identify a set of questions or goals to answer or meet prior to running the Tool. These questions or goals become the drivers for deciding which data sets to include.

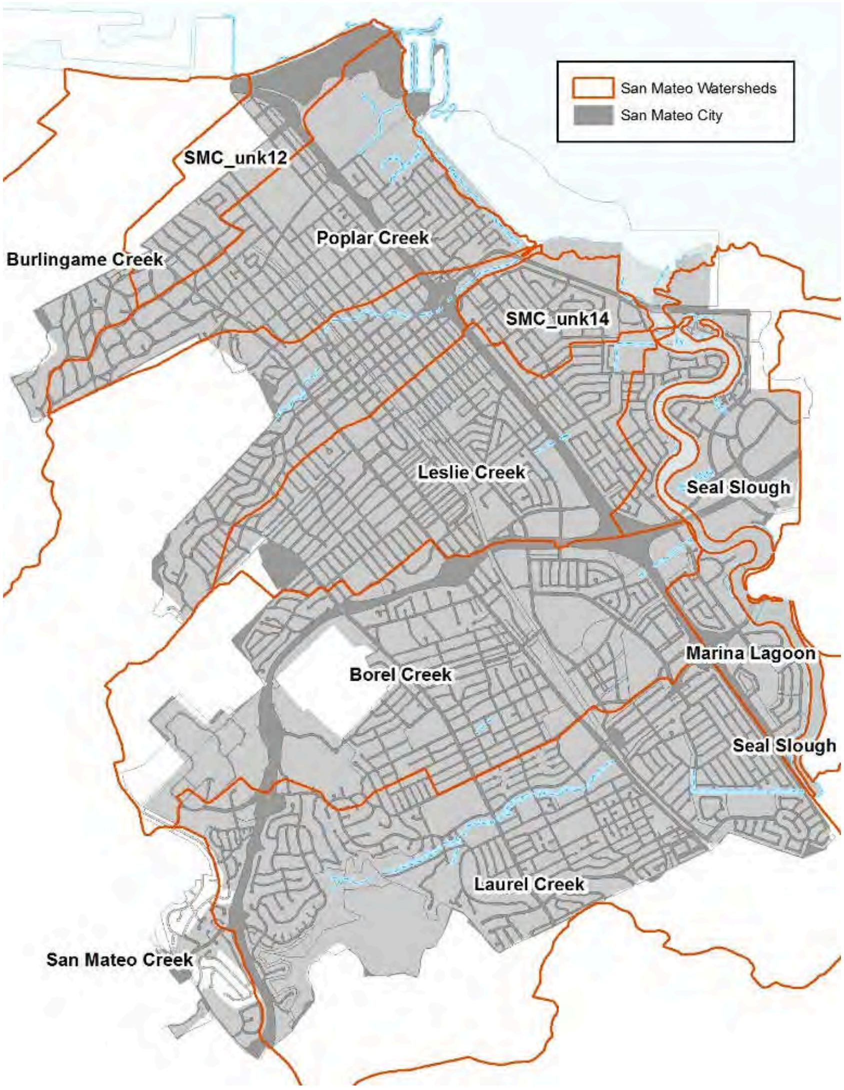


Figure 2-2. Map showing City of San Mateo watersheds and drainage areas included in the demonstration project. Orange lines delineate each watershed boundary. Note that some watershed boundaries are outside the City.

Table 2-1. Regional GIS data layers included in the Site Locator Tool.

| GIS Data Layer Name | GIS Data Layer Description |
|---|---|
| CPAD_2014a2_Holdings | California Protected Areas database released in the first half of 2014 |
| FEMA_NFHL | National Flood Hazard Layers for all BA counties |
| Employment_Investment_areas_SCS | From ABAG's data webpage |
| Priority Development Areas_Current | From ABAG's data webpage. Priority Development Areas (Current) - This feature set contains changes made to Priority Development Areas since the adoption of Plan Bay Area. DO NOT USE this feature set for mapping or analysis related to Plan Bay Area. |
| K_12_Schools | Schools in the bay area (point data) |
| NLCD2011_PercentImpervious | Percent Impervious data from the 2011 National Land Cover Dataset |
| OSM_Buildings | Open Street Map layer for the Bay Area _Late2014 |
| OSM_Libraries | Open Street Map layer for the Bay Area _Late2014 |
| OSM_Parking | Open Street Map layer for the Bay Area _Late2014 |
| OSM_Parks | Open Street Map layer for the Bay Area _Late2014 |
| OSM_Schools | Open Street Map layer for the Bay Area _Late2014 |
| OSM_Streets | Open Street Map layer for the Bay Area _Late2014 |
| R2_CARI_PublicV | California Aquatic Resource Inventory for Region 2 |
| Regional_Bike_Facilities_Bay | Regional bike facilities for the Bay Area |
| RWQC_RB_2 | Region 2 Water Board Boundary |

For the city of San Mateo, the primary driver for implementing GI was the Sustainable Streets Plan. Since this plan focused on streetscape redevelopment, spatial data that quantified street and sidewalk attributes and integrated Complete Street concepts were important data for inclusion in the Tool. The City elected to run each of the Tool analyses including the Regional Base Analysis.

Primary locations identified by the City were public parks, pedestrian trails, wide streets, wide sidewalks, existing planters, and parking lots. The city also identified planning opportunities such as areas planned for redevelopment (PDAs), areas of damaged streets/sidewalks, Greenway Networks, and Regional Bike Facilities as well as constraints to GI implementation including (sidewalks with large trees, fire lanes, and narrow streets. These opportunities and constraints were then categorized into factors such as funding opportunities, local development opportunities, community visibility, and installation feasibility. These factors were then weighted to produce a relative ranking of areas for potential GI implementation,

The City also included a data layer that identified City-owned parcels in the ownership analysis which allowed for a public/private delineation of locations in the map outputs. The last analysis removes areas that are not feasible GI locations such as wetlands, riparian areas, and areas with utility mains close to the surface. The City excluded all areas intersecting existing wetlands and the San Mateo Lagoon in this analysis. Table 2-2 shows the regional and local GIS data layers included in the Site Locator Tool for the City of San Mateo.

## 2.5 Site Locator Tool Results

Running the Site Locator Tool with the City of San Mateo was an iterative and interactive process. The first round of conversations with the City focused on identifying street data that had spatial attributes for measuring existing street with. During subsequent conversations, additional data sets such as existing and potential pedestrian trails, sidewalk with, areas of existing sidewalk planters, and regional bike facilities in or identified as additional data that captured certain aspects of the Sustainable Streets Plan. This progression shows how GIS data layers can be added and removed, rankings and data layer weights can be changed. Additionally the Tool can be rerun by including or excluding any of the analyses. This iterative process can be refined as questions and goals change or more accurate local data are available. Based on selected regional and local data layers and the City’s ranking and weighting of these layers, the Site Locator Tool identified 18 acres of City-owned property or right-of-way as highly ranked locations for potential GI implementation, 113 acres as moderately ranked, and 11 acres as lower ranked locations (Figure 2-3). In total, 142 acres were identified as potential locations for Green Infrastructure. Higher ranked sites were the result of relatively higher factor weights on Priority Development Areas and funding opportunity data layers.

Table 2-2. Local and regional GIS data layers included in the Site Locator Tool for the City of San Mateo.

| GIS Data Layer Name | GIS Data Layer Description | Data Layer Type | Analysis |
|---|---|---|---|
| Sidestreet parking | Side Parking polygons on one lane streets (Where Width from Street Saver data* allowed for the minimum dimentions of lanes, medians and parking spaces for each street type and context from the San Mateo Sustainable Streets report) | Regional/Local | Locations |
| Sidestreet parking | Side Parking polygons on one lane streets (Where There is no Width value from Street Saver data and the minimum dimentions of all street comonants for each street type and context from the San Mateo Sustainable Streets report is assumed) | Regional/Local | Locations |
| Sidestreet parking | Side Parking polygons on multi lane streets (Where Width from Street Saver data* allowed for the minimum dimentions of lanes, medians and parking spaces for each street type and context from the San Mateo Sustainable Streets report) | Regional/Local | Locations |
| Sidestreet parking | Side Parking polygons on multi lane streets (Where There is no Width value from Street Saver data and the minimum dimentions of all street comonants for each street type and context from the San Mateo Sustainable Streets report is assumed) | Regional/Local | Locations |
| Sidewalk | Sidewalk Polygons (Where the width attribute from the San Mateo Sidewalk layer allows for the mimimum dimentions of sidewalk compoents for each street type and context according to the San Mateo Sustainable Streets report and allowed for a LID installation in the sidewalk furniture zone) | Local | Locations |
| Sidewalk | Sidewalk Polygons (Where there is no width attibute from the San Mateo Sidewalk layer, and minimum dimention of sidewalk compoents from the San Mateo Sustainable Streets report are assumed). | Local | Locations |
| Parking lot | Parking Facilities quried from San Mateo's facility polygon layer | Local | Locations |
| Pedestrian Trails | San Mateo's Pedestrian Trail layer buffered 2 ft on both sides (4 ft wide) | Local | Locations |
| Potential Pedestrian Trails | San Mateo's Potential Pedestrian Trail layer buffered 2 ft on both sides (4 ft wide) | Local | Locations |
| Parking_OSM | Parking polygons querried from SF Bay OSM polygons (downloaded in August 2014) | Regional | Locations |
| Parks_OSM | Park polygons querried from SF Bay OSM polygons (downloaded in August 2014) | Regional | Locations |

| GIS Data Layer Name | GIS Data Layer Description | Data Layer Type | Analysis |
|---|---|---|---|
| CPAD_Areas | California Protect Areas Database Polygons for the Bay Area | Regional | Locations |
| Sidewalk planter | Sidewalk Polygons that have a planter width value of 4ft or more | Local | Locations |
| Sidewalk | Sidewalk Polygons that have a width value of 8ft or more | Local | Locations |
| Priority Development Areas | Bay Area Wide Priority Development Areas from ABAG | Regional | Opportunities and Constraints |
| Storm Line | A 25 ft. buffer from the San Mateo Storm Line layer | Local | Opportunities and Constraints |
| Storm Line | A 50 ft. buffer from the San Mateo Storm Line layer | Local | Opportunities and Constraints |
| Catch basin | A 25 ft. buffer from the San Mateo Storm Catch Basin Layer | Local | Opportunities and Constraints |
| Street Trees | A 20 ft. buffer from the San Mateo Urban Tree layer | Local | Opportunities and Constraints |
| large trees ( > 20) | A 30ft buffer around trees that are over 20ft in circumference from the San Mateo Urban Tree layer | Local | Opportunities and Constraints |
| Street Lights | A 15ft buffer around street lights from the San Mateo Street Light layer (+5ft for spatial inacuracies between layers) | Local | Opportunities and Constraints |
| Narrow Street_Fire Running Lanes | A 40 ft. buffer from a selection from the San Mateo Fire Running Lane layer (streets that were less than or equal to 40 ft. wide accounting for spatial inaccuracies in the data layers used) | Local | Opportunities and Constraints |
| Regional Bike Facilities | A 15 ft. buffer from the Bay Wide Regional Bike Facilities Layer from MTC (+ 25ft to account for spacial inacuracies between layers) | Regional | Opportunities and Constraints |
| Streetside parking | A Road polygon later create from San Mateo road centerlines buffered half width of that road (Street Saver data* width) taken from the San Mateo location street layer, where the width from Street Saver data* allows for the minimum width of street components for that particular street type and context as well as the minimum width of a bike lane | Regional/Local | Opportunities and Constraints |
| Damaged Streets | A Road polygon layer (San Mateo road centerline buffered by half of that street's width according to Street Saver data*) where PCI is less than or equal | Local | Opportunities and Constraints |

| GIS Data Layer Name | GIS Data Layer Description | Data Layer Type | Analysis |
|---|---|---|---|
| | to 40, indicating that they are damaged roads and may need to be repaired soon | | |
| Damaged Sidewalk | San Mateo Sidewalk polygons that are indicated as having damaged curbs, gutter and or sidewalks | Local | Opportunities and Constraints |
| GreenWay Network | San Mateo pedestrian priority green way corridor from Ken Chen, Sep 2014 (buffered 85 feet to account for spatial inacuracies and missalignment of layers.) | Local | Opportunities and Constraints |
| Streams | A 500ft buffer from a subset of San Mateo's Stream layer where no Streams intersect San Mateo's Lake layer | Local | Opportunities and Constraints |
| Lakes | A 400ft buffer from San Mateo's Lake polygon layer | Local | Opportunities and Constraints |
| Schools | A 100ft buffer from San Mateo's School polygon layer | Local | Opportunities and Constraints |
| Libraries | A 100ft buffer from San Mateo's Library polygon layer | Local | Opportunities and Constraints |
| City Hall | A 100ft buffer from City Hall polygons selected from San Mateo's Facility polygon layer | Local | Opportunities and Constraints |
| parks | A 100ft buffer from a subset of San Mateo's Facility polygon layer where FACTYPE is = to "PARK" | Local | Opportunities and Constraints |
| City-owned parcels | San Mateo's city owned parcel layer | Local | Ownership |
| CARI Wetlands | CARI Wetland polygons: see http://www.sfei.org/it/gis/cari | Regional | Knockout |
| SM_Lagoon | Lagoon Layer from San Mateo | Local | Knockout |

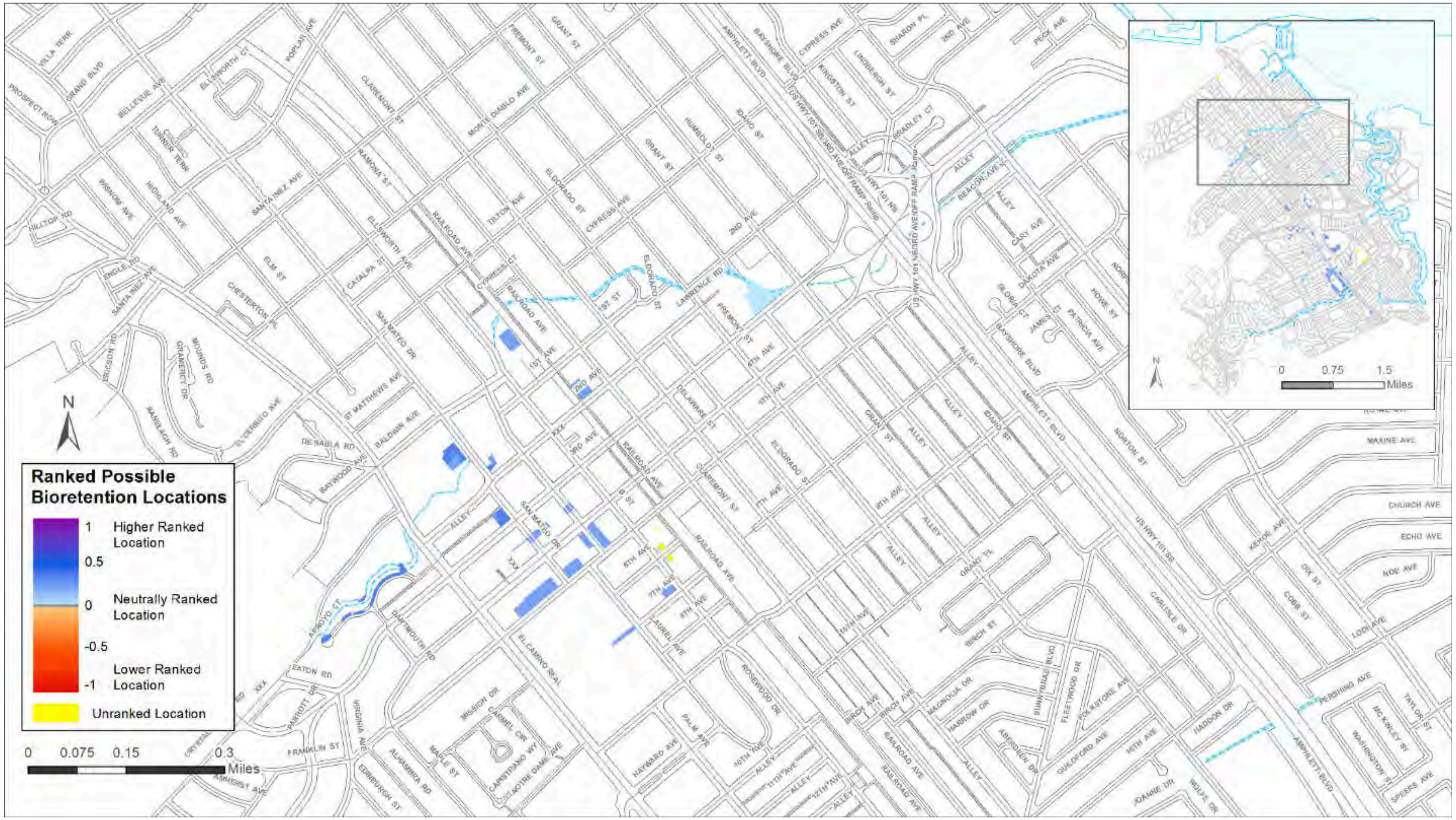

Figure 2-3 Map output of ranked potential bioretention locations in the City of San Mateo. Higher ranked locations are dark blue, lowest ranked locations are red and yellow designates unranked areas due to lacking data in those places

San Mateo and SFEI performed a remote data validation exercise in order to see how the Tool ranked areas previously identified for potential GI implementation. Specifically, Grant Street and Fremont Street were investigated to determine why one street ranked higher than the other. Grant Street was ranked higher than Fremont Street since it had a planned bike lane, which was given a higher weight in the Opportunities and Constraints Analysis. Delaware Street and Bay Meadows were unranked in the output because they were excluded as possible locations due to site characteristics deemed not feasible for implementing GI. Overall, many of the sites identified and ranked highly by the locator tool were also sites that were previously identified as potential GI opportunities by San Mateo. Furthermore, additional high ranked locations were identified which provided the City with additional locations to investigate further and to compare to the current GI plan.

## Chapter 3. Case Study: San Jose's Urban Villages

The city of San Jose is the largest municipality in the Bay area with an area of 180 square miles and a population of over 1 million people (Figure 3-1). Like many cities in the region, San Jose has undergone significant growth over time and experienced environmental issues typically associated with urbanization including increased loadings of sediment, PCBs, mercury, and pathogens. The City is regulated by the Municipal Regional Stormwater NPDES Permit (MRP), and stormwater management is a driver for a number of City activities and area-wide programs.

In compliance with the MRP, the City is currently implementing four green street projects in various stages of construction and design. The City is also continuing to look for opportunities to integrate GI features into existing infrastructure and planning efforts. Envision San Josè 2040, the City's current General Plan promotes the development of Urban Villages (Figure 3-1) which are active, walkable, bicycle-friendly, transit-oriented, mixed-use urban settings for new housing and job growth attractive to an innovative workforce and consistent with the plan's environmental goals. The urban village strategy fosters: 1) Mixing residential and employment activities; 2) Establishing minimum densities to support transit use, bicycling, and walking; 3) High-quality urban design; and 4) Revitalizing underutilized properties with access to existing infrastructure[2]. Within the development area of the proposed Urban Village, the City is planning to retrofit existing facilities and incorporate new stormwater treatment to address stormwater planning needs, MS4 and TMDL requirements, and local stakeholder concerns.

[2] https://www.sanjoseca.gov/index.aspx?NID=1738

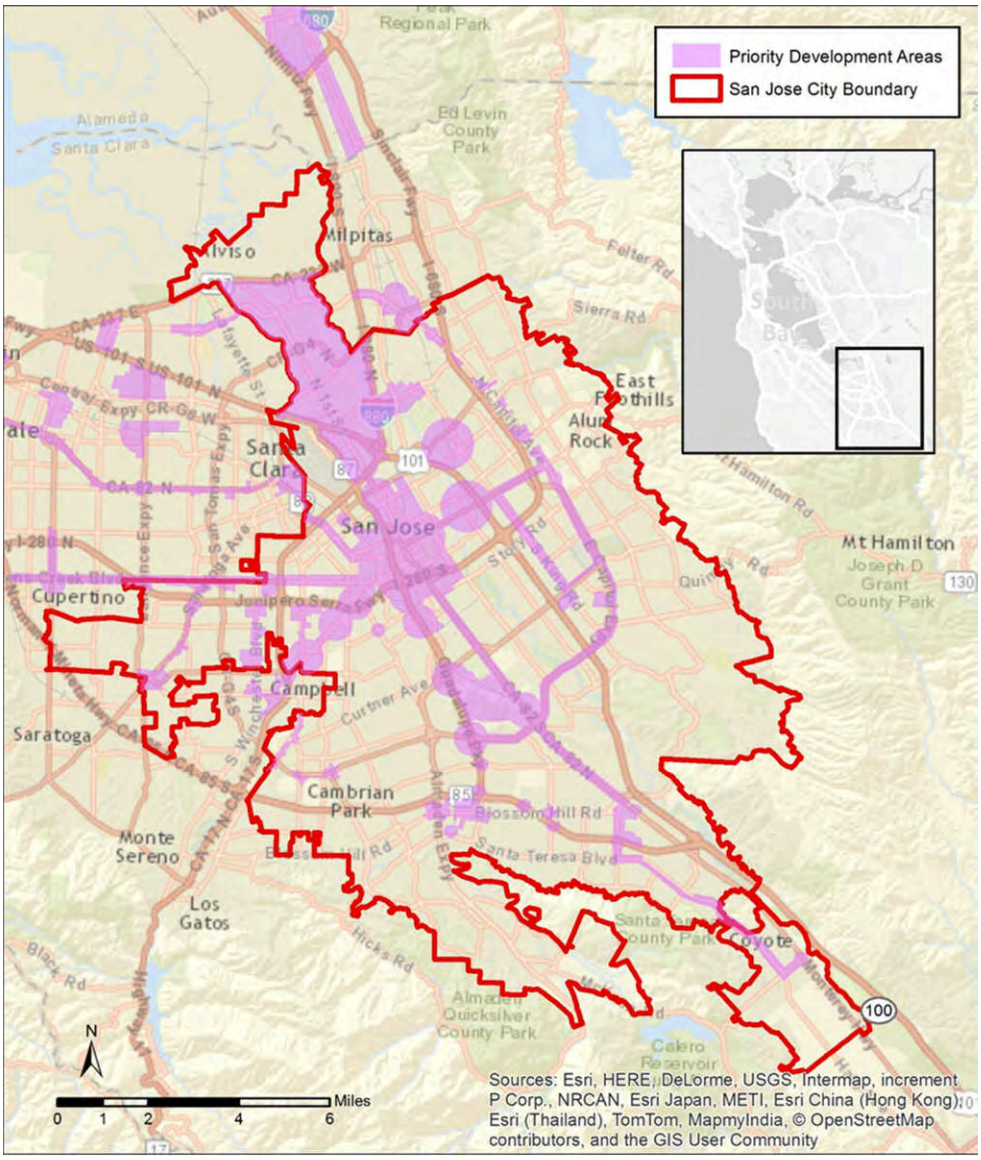


Figure 3-1 City of San Jose and Proposed Urban Villages

## 3.1 Case Study Objective

To plan for current and future effort to incorporate GI at the City's landscape, the City needs a planning tool to help determine areas of opportunities and constraints for implementing GI on a wide scale and embraces the GreenPlan-IT Toolkit as a Tool that meets their needs. In discussions with SFEI, the city staff decided to use the redevelopment of the Urban Village as a case study area to test the applicability of the Toolkit. The objective of the case study was to demonstrate the capacities and usability of the GreenPlan Toolkit in identifying feasible and cost-effective GI locations at a watershed scale. Results from the Toolkit application will be used to: 1) identify specific green infrastructure projects; 2) support the City's current and future planning efforts, such as the development of the San Jose Storm Sewer Master Plan; and 3) help comply with future Stormwater Permit requirements. At the end of the case study, the city staff hope to have opportunity maps of possible GI locations, a cost-effectiveness curve for flow or pollutant reduction, and a workable Toolkit that can be used for future GI planning efforts.

The downtown area and north San Jose were identified as environmentally and fiscally beneficial locations to develop some of the Urban Villages (Figure 3-1). The majority of this proposed new development is located within the lower part of the Guadalupe River Watershed (Figure 3-2). In consultation with the city staff, the lower part of the Guadalupe watershed was selected for the development of a GreenPlan-IT Toolkit case study. Data are available in this watershed to support the full application of the Toolkit.

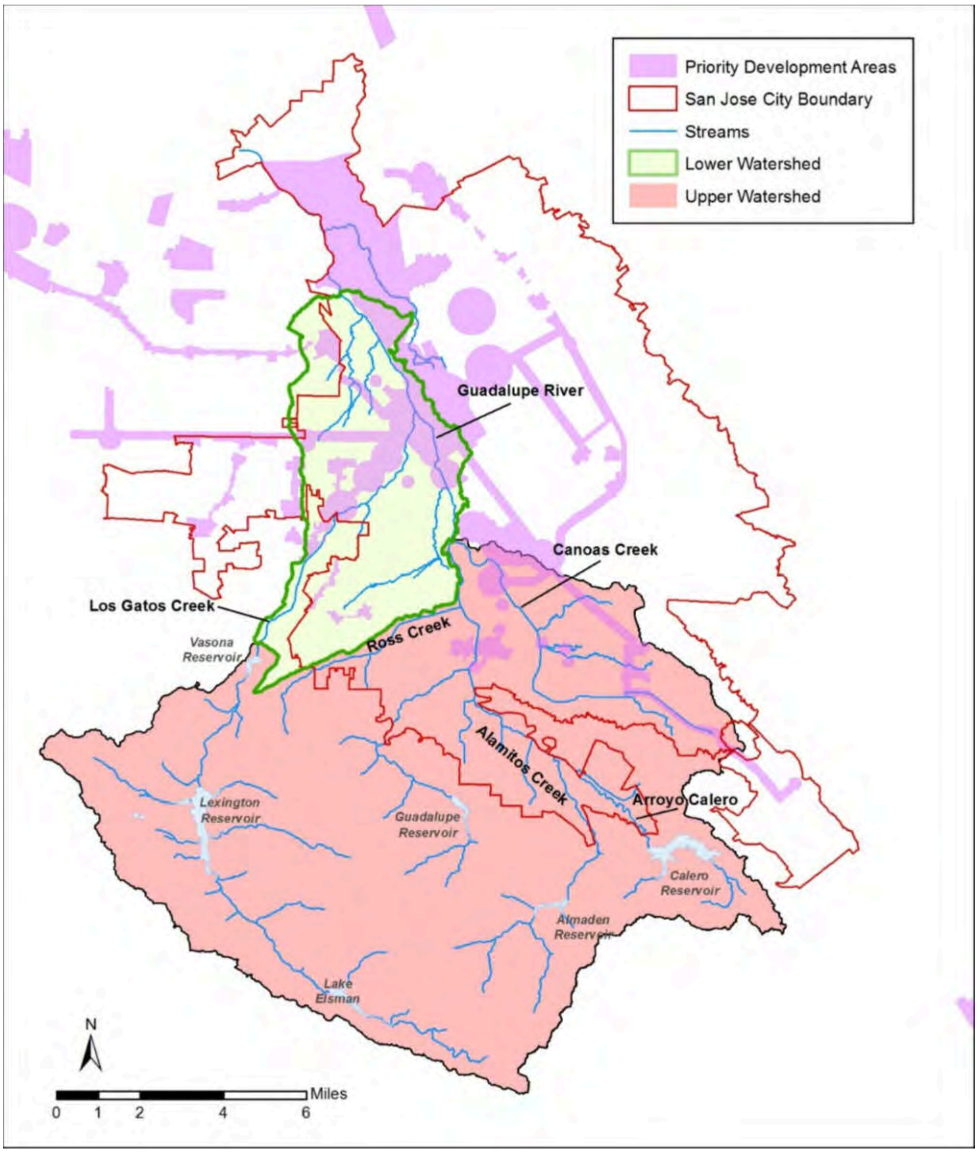


Figure 3-2 Guadalupe River Watershed and Proposed Urban Villages

## 3.2 Project Setting

The Guadalupe River Watershed is located in the Santa Clara Valley basin and drains to Lower South San Francisco Bay (Figure 3-2). The watershed is the fourth largest in the Bay Area with approximately 170 $mi^2$ of total drainage area. Five main tributaries drain to the Guadalupe River. Six water conservation and storage reservoirs in the watershed provide varying amounts of flood control. The Guadalupe Watershed has a mild Mediterranean-type climate generally characterized by moist, cool wet winters and warm dry summers. Rainfall follows a seasonal pattern with a pronounced wet season that generally begins in October or November and can last to April or May, during which an average of 89% of the annual rainfall occurs (McKee et al., 2003).

The primary focus of this case study is downtown San Jose, and accordingly, the watershed boundary was adjusted to exclude upstream watersheds where gauge data are available to be included as boundary conditions for the appropriate streams and/or sub-watersheds (Figure 3-2). The resulting study area is referred herein as the Lower Guadalupe River watershed with an area of 18,613 acres.

## 3.3 Site Locator Tool: Data layers used and decision process

The GIS Site Locator Tool integrates regional and local GIS data and uses these data, through an identification, ranking and weighting process, to locate potential GI locations at a watershed scale. Data accuracy is an important determinant in the accuracy of map outputs produced by the Tool. The quality, scale and accuracy of the input data will determine the quality, scale and accuracy of the output maps. Therefore, it is highly beneficial to use more accurate and local data when available. When using more regional scale data layers for analyses, such as the opportunities and constraints ranking analysis, the user can weight and rank these layers to reflect the confidence in local accuracy of the data. There are many regional GIS data that are included in the Tool (Table 3-1) and additional regional data sets can be added as well. Local data sets can be added to the Tool in order to help identify potential locations that meet the goals and planning needs of each city. Each municipality will identify a set of questions or goals to answer or meet prior to running the Tool. These questions or goals become the drivers for deciding which data sets to include.

Table 3-1. Regional GIS data layers included in the Site Locator Tool.

| GIS Data Layer Name | GIS Data Layer Description |
|---|---|
| CPAD_2014a2_Holdings | California Protected Areas database released in the first half of 2014 |
| FEMA_NFHL | National Flood Hazard Layers for all BA counties |
| Employment_Investment_areas_SCS | From ABAG's data webpage |
| Priority Development Areas_Current | From ABAG's data webpage. Priority Development Areas (Current) - This feature set contains changes made to Priority Development Areas since the adoption of Plan Bay Area. DO NOT USE this feature set for mapping or analysis related to Plan Bay Area. |
| K_12_Schools | Schools in the bay area (point data) |
| NLCD2011_PercentImpervious | Percent Impervious data from the 2011 National Land Cover Dataset |
| OSM_Buildings | Open Street Map layer for the Bay Area _Late2014 |
| OSM_Libraries | Open Street Map layer for the Bay Area _Late2014 |
| OSM_Parking | Open Street Map layer for the Bay Area _Late2014 |
| OSM_Parks | Open Street Map layer for the Bay Area _Late2014 |
| OSM_Schools | Open Street Map layer for the Bay Area _Late2014 |
| OSM_Streets | Open Street Map layer for the Bay Area _Late2014 |
| R2_CARI_PublicV | California Aquatic Resource Inventory for Region 2 |
| Regional_Bike_Facilities_Bay | Regional bike facilities for the Bay Area |
| RWQC_RB_2 | Region 2 Water Board Boundary |

The primary drivers for GI implementation in the City of San Jose are the redevelopment Urban Villages plan and the Stormwater Master plan. As noted previously, the Urban Villages plan focuses redevelopment in downtown San Jose for walkability, bikeability, access to public transit, and employment. The Stormwater Master plan is a large-scale effort to analyze deficiencies in the stormwater drainage network (both storm drain and natural drainage) and provide long-term solutions to the identified deficiencies. The Plan's goals are to improve water quality, provide flood protection, enhance and protect habitat, and increase stormwater infiltration. Together, these plans provide the pathway for future GI implementation.

San Jose also requested that infiltration trenches be added to the RBA. The Santa Clara Valley has suitable soils for infiltration to groundwater and regional large-scale infiltration trenches are being considered as one mechanism for groundwater recharge. This feature type was added and ranked for each of the five existing metrics (slope, depth to groundwater, soil type, land use, and risk of liquefaction) used for determining suitable locations.

During the first analysis for the City, potential locations were focused on parks, city-owned parcels, wide streets, existing sidewalk planters, and parking lots as potential locations for GI implementation. Formulas were developed, using existing City data, to identify streets and sidewalks with appropriate widths for implementation of bioretention features and parking lots greater than 7000 $ft.^2$. The City identified planning opportunities such as areas planned for redevelopment (PDAs), existence of stormwater infrastructure, and planned bikeways as well as constraints to GI implementation including proximity to riparian areas and gas mains. These opportunities and constraints were then categorized into factors (local development opportunities, community needs, conservation, and installation feasibility). These factors were then weighted to produce a relative ranking of areas for potential GI implementation. Community needs and local development opportunities were given the highest weight.

The City also included a data layer that identified City-owned parcels in the ownership analysis which allowed for a public/private delineation of locations in the map outputs (Table 3-2). For the Knockout Analysis, The City excluded all areas intersecting existing wetlands and proximity to other waterbodies (salt ponds, existing percolation ponds, and a 10ft buffer from creek centerlines) as well as existing GI features. The first Tool run included map outputs for bioretention units, permeable pavement, and infiltration trenches. This first run identified approximately 400 acres of moderate to highly ranked areas for potential GI implementation.

After review of the preliminary Tool outputs, city of San Jose staff decided that a second analysis, with modifications made to a few analyses, could help refine their output (Table 3-2). In particular, the City wanted to run the Tool while both including and excluding the Regional Base Analysis (two separate Tool runs). By excluding the RBA, additional locations were included in the analysis and in the map outputs. No new additions were made to the Locations Analysis while there were changes made to the Opportunities and Constraints Analysis. A data layer delineating Urban Villages was added and more heavily weighted in the local development opportunity factor. San Jose's three-year re-pavement plan was also added and the RBA was added and ranked in lieu of running the RBA at the start of the analysis. Constraints were also removed from this analysis and layer and factor weights recalculated. Installation feasibility (existing storm drain infrastructure) was the highest weighted factor followed by local development opportunities, and community needs (planned bike paths). The City also added additional data to the Knockout Analysis including existing salt ponds and building footprints.

Table 3-2 shows the regional and local GIS data layers included in the Site Locator Tool for the City of San Mateo.

| GIS Data Layer Name | GIS Data Layer Description | Data Layer Type | Analysis |
|---|---|---|---|
| Parks | Parks | Local | Locations |
| Sidestreet parking | RdSidPrkng | Local | Locations |
| Sidewalk planter | SidWlkPlntr | Local | Locations |
| Parking lot | OSMprkngMinBld | Regional | Locations |
| City-owned parcels | CtyPrcls | Local | Locations |
| Priority Development Areas | Bay Area Wide Priority Development Areas from ABAG | Regional | Opportunities and Constraints |
| Urban Villages | Areas within the city of San Jose designated for development of urban villages | Local | Opportunities and Constraints |
| Stormwater infrastructure | Locations of stormwater mainlines | Local | Opportunities and Constraints |
| Stormwater infrastructure | Locations of stormwater manholes | Local | Opportunities and Constraints |
| Stormwater infrastructure | Locations of inlets to storm drain network | Local | Opportunities and Constraints |
| Planned bikeways | Layer showing all planned bikeways | Local | Opportunities and Constraints |
| Repavement plan | City of San Jose replacement plan | Local | Opportunities and Constraints |
| CARI wetlands | Wetland locations from CARI | Regional | Knockout |
| Building footprint | San Jose building footprint data layer | Local | Knockout |
| Creek buffer | Santa Clara Valley Water District buffer for existing creeks and riparian areas | Local | Knockout |

| GIS Data Layer Name | GIS Data Layer Description | Data Layer Type | Analysis |
|---|---|---|---|
| Percolation pond | Santa Clara Valley Water District percolation ponds data layer | Local | Knockout |
| Various waterbodies | Other waterbodies for exclusion | Local | Knockout |
| Existing salt ponds | Santa Clara Valley Water District existing salt ponds data layer | Local | Knockout |
| data\SanJoseDatasets.gdb\OM_Inventory | ? | ? | Knockout |
| Schools | San Jose school data layer | ? | Knockout |
| City-owned parcels | San Jose city-owned parcels | Local | |

### 3.5 Site Locator Tool Results

During the last Tool iteration, City staff requested two Tool runs. The first run included the RBA as designed while the second run added the RBA to the Opportunities and Constraints Analysis where it was ranked and weighted. In the second run, the RBA was not included at the start of the analysis. The first run excluded many possible areas that did not meet the criteria underlying the RBA while including the RBA layers in a later analysis, the relative importance of these criteria can be controlled through the weighting process. City staff found the map outputs from the second analysis more helpful in the process of identifying possible GI locations as it allows for viewing all locations but provides the relative ranks for locating highest opportunity sites. Each iteration of the Tool analysis produced a map with ranked possible locations for bioretention, infiltration trench, and pervious pavement implementation (Figure 3-3). For bioretention, using RBA layers for ranking, the final map output had a total of 9840.5 acres ranked from low to high potential. 85.54 acres were highest ranked (a rank greater than 0.4), while 1705.58 acres were moderately ranked (a rank between .4 and .2), 3489.53 acres were ranked relatively low (a rank below .2), and 4559.84 acres were unranked.

Once the final output was produced, City staff reviewed maps through the lens of the Urban Villages planning efforts as well as other GI planning efforts. One way in which the Tool maps can be helpful is to show alternative locations when particular constraints are identified in planned locations. San Jose was exploring 5$^{th}$ Street and Hedding Street as a potential GI location. This location was ranked relatively lower on the map output due to the street not having an existing storm drain. City staff gave storm drain infrastructure the highest categorical weight in the analysis which resulted in the 5th and Hedding Street area being ranked relatively lower. However during review of the map outputs, a more suitable, and relatively higher ranked, location was identified nearby at 6th and Hedding.

This remote ground truthing is an important step in the process. This can also be combined with a field ground truth effort. The field effort provides real world syntax to how the Tool performed and also identifies other opportunities and constraints that the Tool didn't capture (due to lacking data or the weighting process). City staff participated in a field ground truthing effort with the Project team. Three locations were visited: Tully Road and 7th Street, Chynoweth Avenue, and the corner of Round Table Drive and Roeder Road. The Tully Road site was identified by the Tool based on a large road median with curbed boundaries. The median is bordered by a busy three lane road, an access turn lane, and a smaller infrequently used one lane road. Discussions at the site centered on drainage patterns to existing storm drains and the potential opportunity to close the one lane road to create a larger GI feature. The Chynoweth site is already in the planning process for bioretention implementation. Site discussions centered on drainage patterns and where bulb outs could be placed. The corner of Round Table Drive and Roeder Road was selected by San Jose Staff as it was a highly ranked location that fell within an Urban Village area. This location was selected in order to demonstrate how the tool could be used to identify locations that had not previously been identified, that also met many of the city's priorities and criteria for highly suitable locations. Outputs from the Site Locator Tool were used in the Optimization Tool as described below.

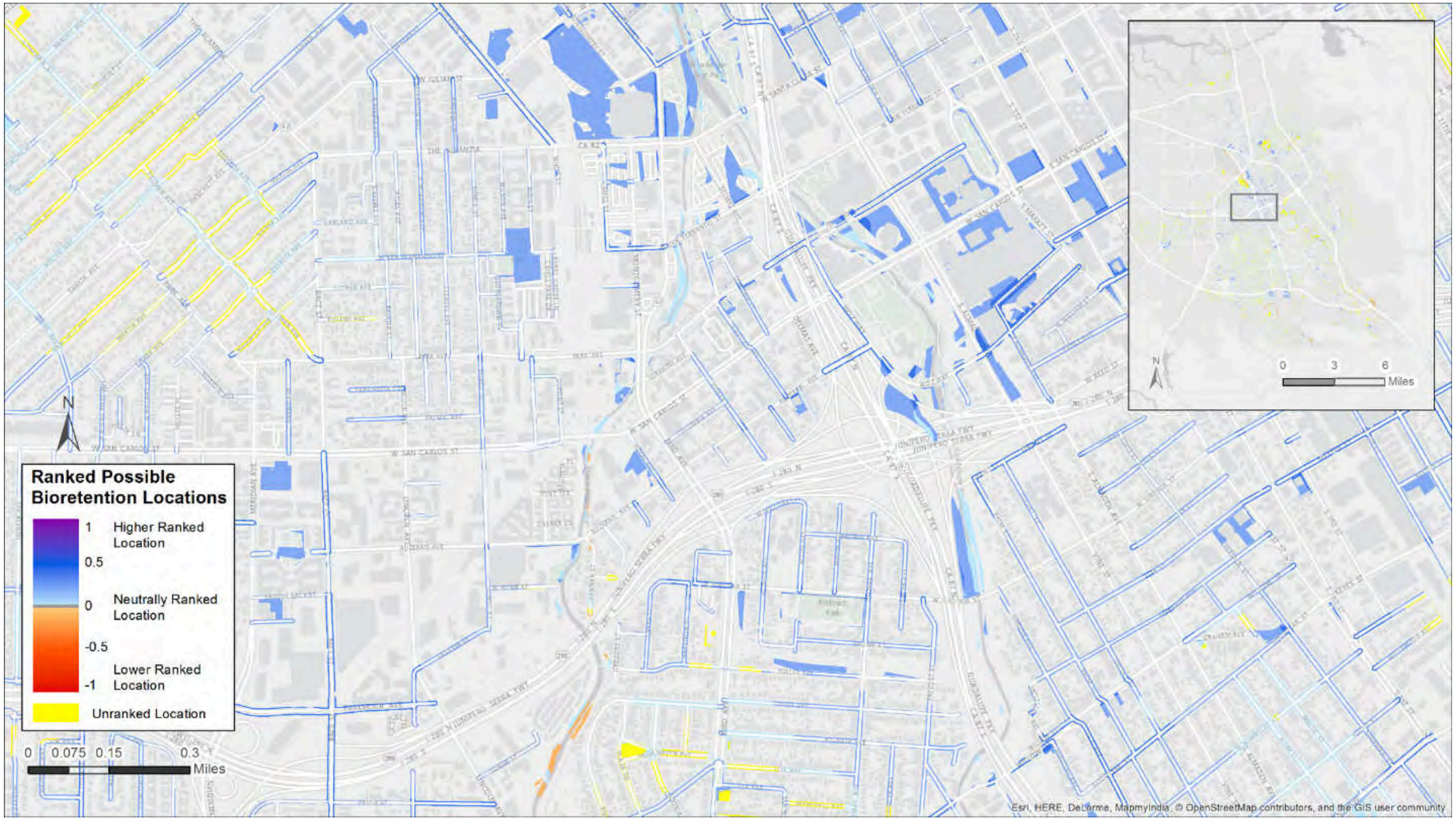


Figure 3.3 Map output of ranked potential bioretention locations in the City of San Jose. Higher ranked locations are dark blue, lowest ranked locations are red and yellow designates unranked areas due to lacking data in those places.

## 3.6 Modeling Tool

The application of the Modeling Tool involved input data collection, model setup, model calibration, and finally the establishment of a baseline condition.

### 3.6.1 Data Collection

A large amount of data were collected to support the development of the Modeling Tool. The input data that were used for developing a SWMM5 model of runoff for Lower Guadalupe River watershed are described below.

- Precipitation Data

The Guadalupe River Watershed is instrumented with numerous meteorological and hydrology stations (Figure 3-4). There are 11 precipitation stations operated by the Santa Clara Valley Water District (SCVWD) and the National Oceanographic and Atmospheric Administration (NOAA). There is a pan evaporation station, which is operated by SCVWD, and an evapotranspiration station, which is operated by California Irrigation Management Information Systems (CIMIS). High-resolution precipitation data (15-minute intervals) were obtained from SCVWD for 3 precipitation gauges-RF1, RF125, and RF-131, located within the Lower Guadalupe watershed (Figure 3-3). The rainfall data from 2010 to 2011 was chosen for model calibration, representing average and dry years. Annual rainfall for each precipitation station is shown in Table 3-3. The precipitation records were analyzed and compared and the Thiessen polygon method was used to assign representative weather stations to sub-basins.

- Evaporation Data

Evaporation is not as spatially or temporally variable as precipitation; hence lower resolution data from more remote sources are adequate for modeling evaporation. Monthly evaporation data for year 2010-2011 at Los Alamitos Recharge Facility in San Jose was obtained from SCVWD (Table 3-4). These data were then converted to monthly average in inches/day as required by the SWMM5 model.

- Land Use Data

The SWMM5 model requires input of land use percentages for each segment to define hydrology and pollutant loads. Land use data was were obtained from the Association of Bay Area Governments (ABAG) 2005 land GIS coverage. The coverage contains 11 different land use classifications, which were than aggregated down to six model categories. The aggregated land use groups for the SWMM5 model and their percentages are listed in Table 3-5.

- Percent of Imperviousness

The percent of imperviousness is an import input data set for SWMM5 hydrology simulation. The GIS layer of imperviousness was from National Land Cover Dataset (NLCD) 2011, which covers the entire lower 48 State at a spatial resolution of 30m pixels (http://www.mrlc.gov/nlcd2011.php). The distribution of impervious land use for Lower Guadalupe watershed is shown in Figure 3-5.

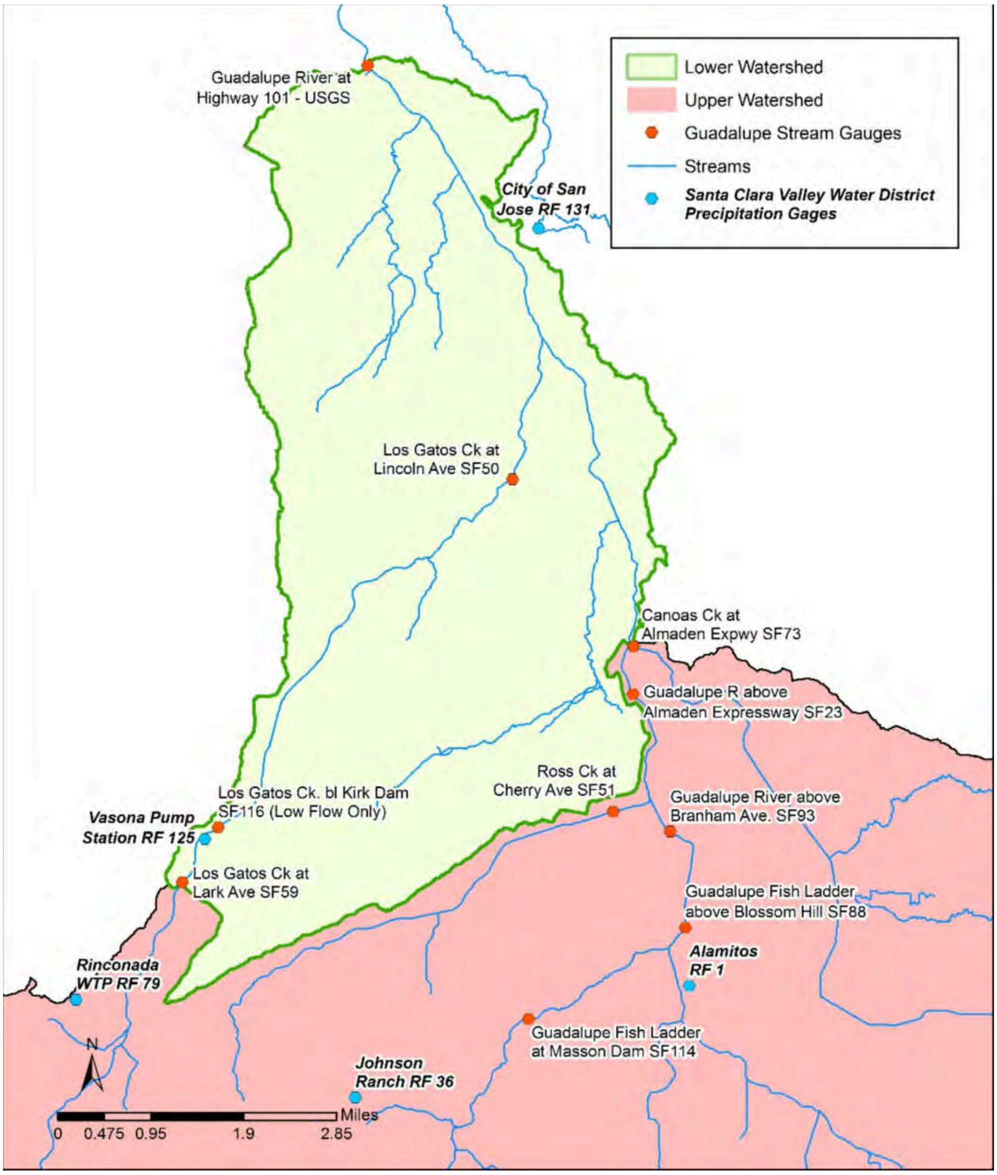


Figure 3-4 Rain gauges and Stream gages in Lower Guadalupe Watershed

Table 3-3 Annual Rainfall (inches) for Precipitation Stations

| Year | Alamitos RF 1 | Vasona Pump Station RF 125 | City of San Jose RF 131 |
|---|---|---|---|
| 2010 | 17.4 | 25.9 | 16.4 |
| 2011 | 12 | 16 | 11 |

Table 3-4 Monthly Evaporation at Los Alamitos Station

| Evaporation | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly (in.) | 0.762 | 1.422 | 1.866 | 2.814 | 3.912 | 4.026 | 4.554 | 4.536 | 3.312 | 1.914 | 1.146 | 0.6 |
| Daily (in./day) | 0.02 | 0.05 | 0.06 | 0.09 | 0.13 | 0.13 | 0.15 | 0.15 | 0.11 | 0.06 | 0.04 | 0.02 |

Table 3-5 Land Use Distribution in Modeled Area

| Land Use | Area (acres) | % of watershed |
|---|---|---|
| Commercial | 3,033 | 16.3 |
| Industrial | 958 | 5.1 |
| Open Space | 971 | 5.2 |
| Residential | 8,217 | 44.1 |
| Transportation | 5,401 | 29 |
| Water | 32 | 0.2 |

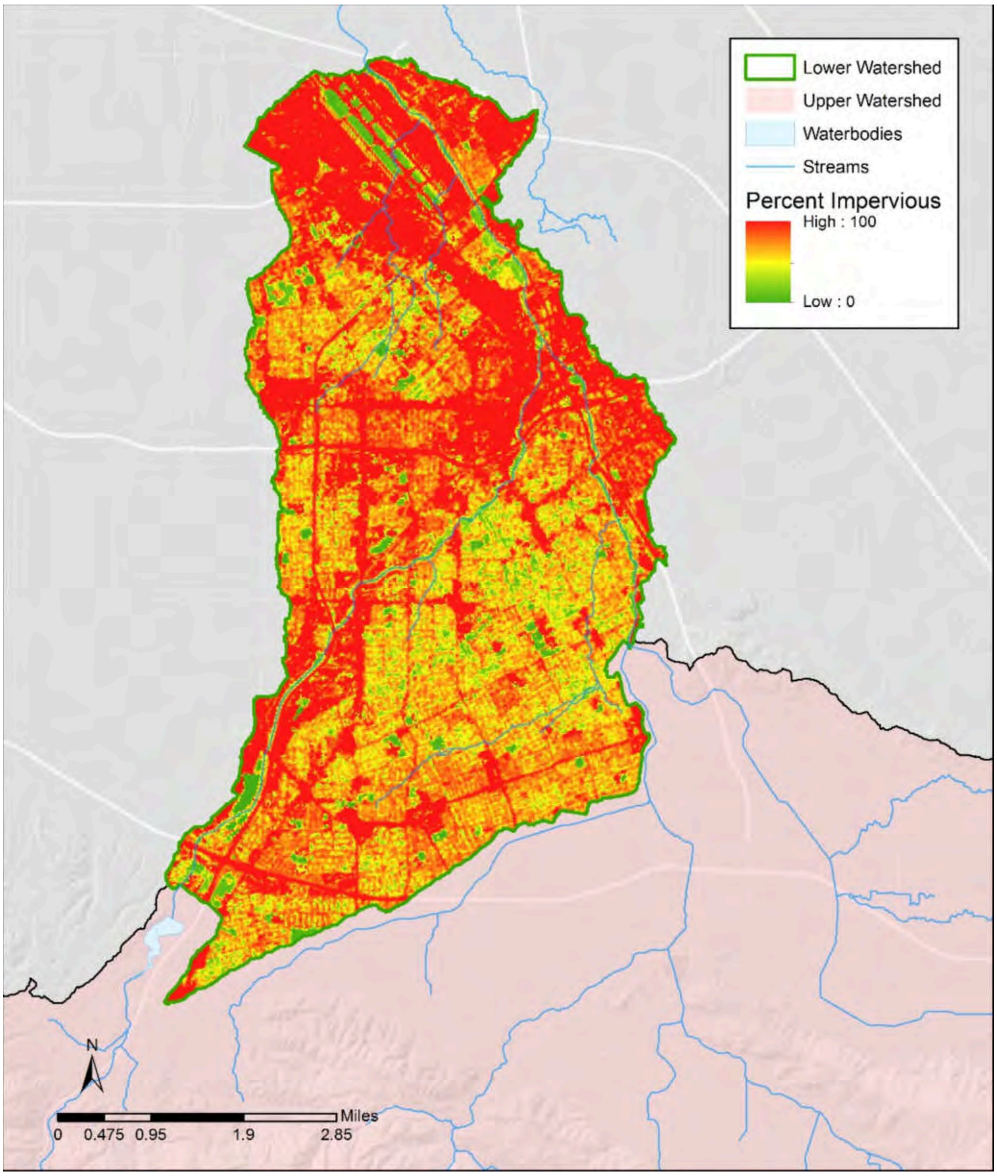

Figure 3-5 Percent of Imperviousness for Lower Guadalupe River Watershed

- Soil Data

Soil data were obtained from the State Soil Geographic Database (STATSGO) and intersected with the subbasin boundary layer to determine the percentages of each soil group for each model segment. STATSGO soils information include the hydrologic soil group (A, B, C, or D) that indicates the ability of the soil to infiltrate water. Soil type can have significant effects on the annual runoff volumes and the peak runoff rates. The Lower Guadalupe River watershed is mainly comprised of D type soils with low infiltration rates and high runoff rates (Figure 3-6).

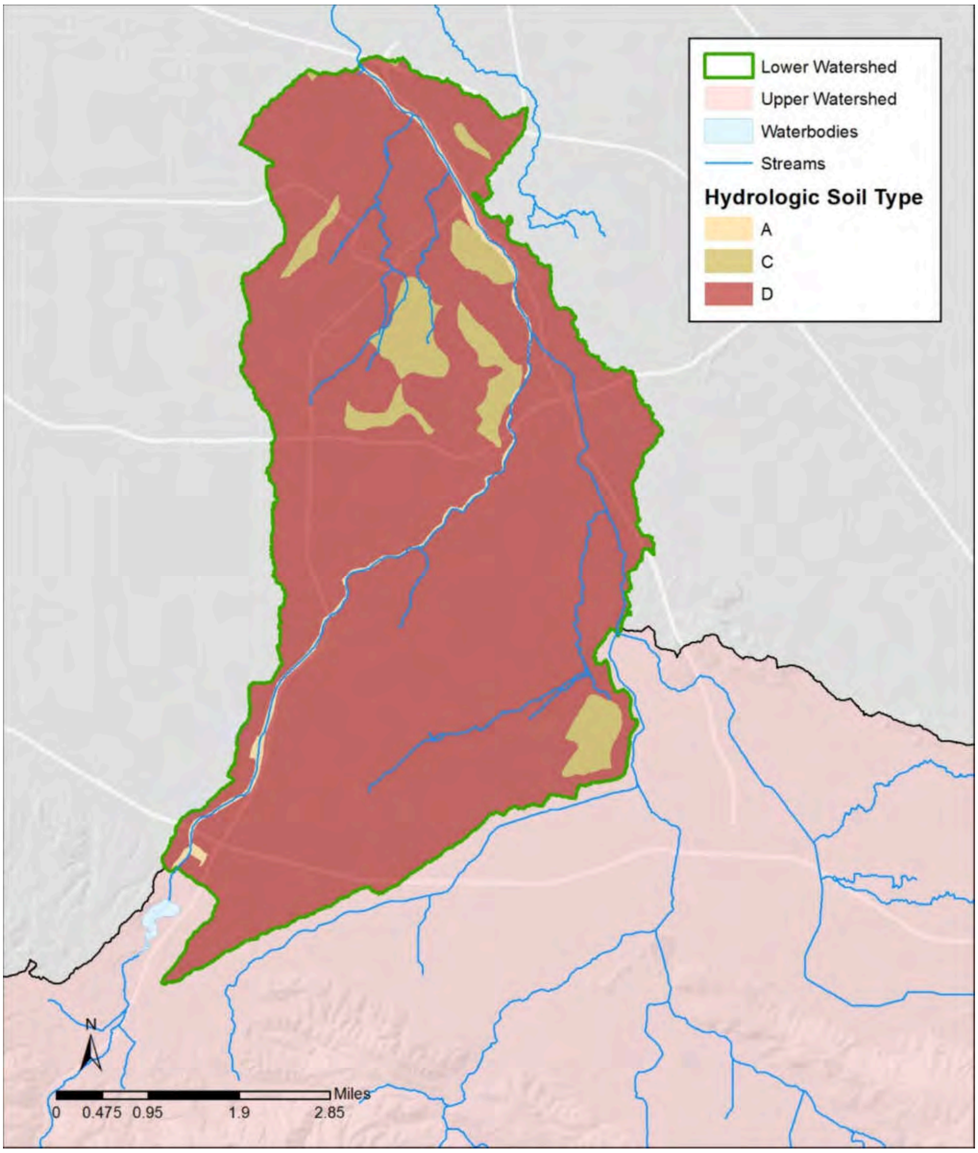

Figure 3-6 Soil Map for Lower Guadalupe River Watershed

- Inflow from Upstream

Flow data for the upstream of the Lower Guadalupe watershed were obtained from three gages at the watershed boundary. Continuous streamflow record (15 minutes interval) from 2010 -2011 was obtained from the SCVWD for stations SF23, SF73, SF59 (Figure 3-4). These data serve as the upstream boundary condition and are input into connected model segments as time series.

- Diversion Data

SCVWD operates a fairly complex water supply system in the Guadalupe River watershed that consists of storage reservoirs, ditches, percolation ponds, and pipelines. Within the modeled area, there are two gauged ditches that divert water from Los Gatos Creek. Daily flow diverted from these ditches was obtained from SCVWD for year 2010-2011. This flow was counted as loss and subtracted from inflow from station SF59.

- Calibration Data

Monitored flow data from 2010 to 2011 at two gages within the model domain were used for model calibration. Daily flow at station SF50 were provided by SCVWD. Flow from the USGS station at highway 101 were downloaded from USGS site http://ca.water.usgs.gov/data/. The USGS station receives water from the entire watershed and is the focal point of model calibration.

### 3.6.2 Model Setup

The first step in setting up the Modeling Tool is to delineate the watershed into smaller, sub-basins (model segments) using topographical data; the model treats each sub-basin as a homogeneous unit. Through a terrain analysis ArcGIS extension called TauDEM, the Lower Guadalupe River watershed was delineated into 150 sub-watersheds, ranging from 11 to 381 acres (Figure 3-7). Model setup also involves land use reclassification, reformatting input data into SWMM5 model formats, assigning the model segments to proper rain gauge, selecting assessment points, and estimating initial model parameters through GIS analysis and literature review. The time step of model simulation was set as 15 minutes, to be consistent with the resolution of precipitation. The model configuration established a representation of Lower Guadalupe River watershed, and model calibration was then followed to ensure the model parameters reasonably represent the watershed condition.

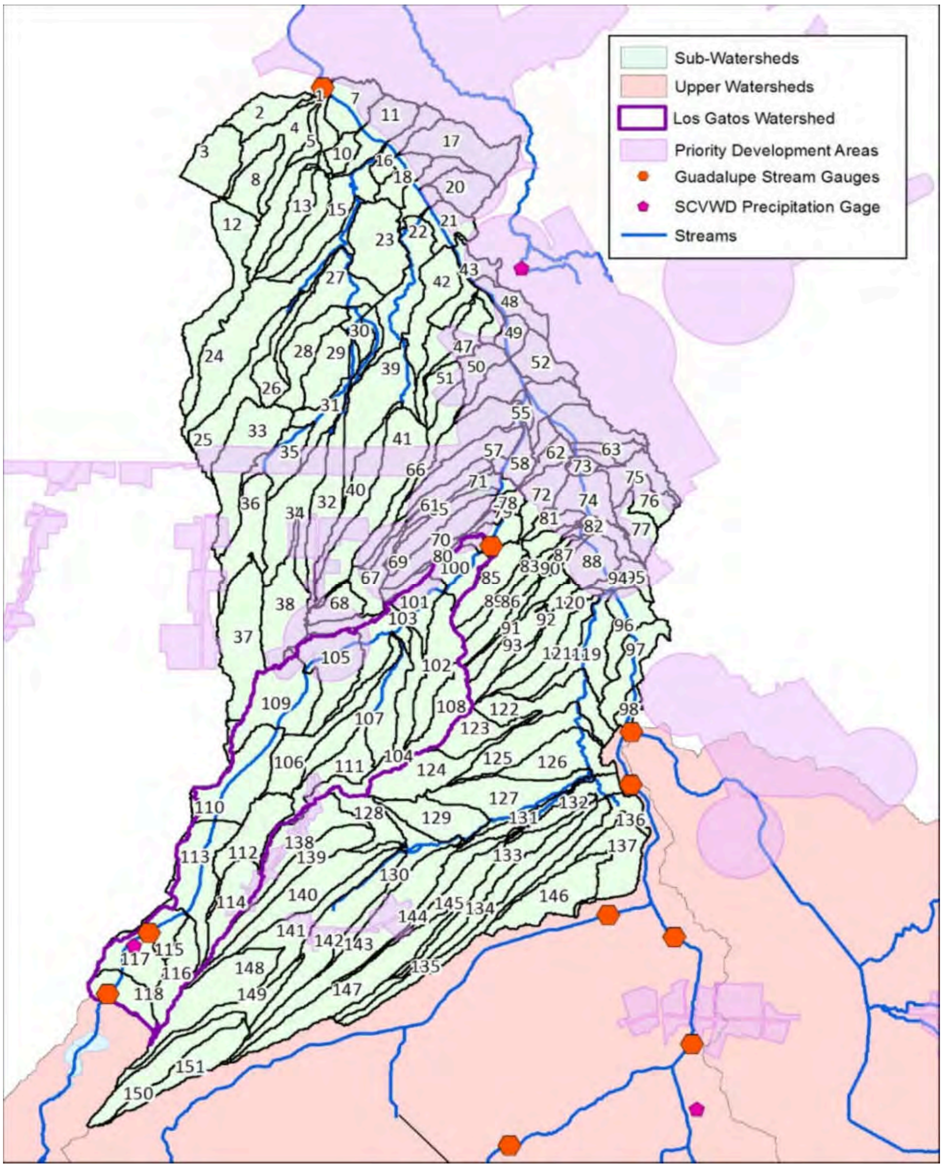

Figure 3-7 Delineated Lower Guadalupe River Watershed

### 3.6.3 Model Calibration

Model calibration is an iterative process of adjusting key model parameters to match model predictions with observed data for a given set of local conditions. Through the model calibration, it is hoped that the resulting model will accurately represent important aspects of the actual system. The model calibration is necessary to ensure that a representative baseline condition is established with a high degree of confidence in its applicability to form the basis for comparative assessment of various management scenarios.

The hydrologic calibration was performed at two stations (Figure 3-6) within Lower Guadalupe River watershed by means of an iterative process of trial and error using logical adjustments of parameters in consultation with local experts and technical advisors. The calibration started at the tributary station SF50 (Los Gatos at Lincoln avenue) to ensure a reasonable estimates of flow from this tributary. After the calibration was completed at this station, the calibration was then performed at the USGS station at Highway 101, near the mouth of the Guadalupe River. The calibration period was from year 2010 to 2011.

- Baseflow

SWMM5 was originally designed to simulate urban wet weather runoff but does include a method of estimating base flow (dry weather flow) (Rassman, 2010). The baseflow for the Lower Guadalupe River was determined from the measured dry weather flow in 2010 and 2011. A constant flow of 5 cfs was added to two nodes in the tributary and produced an appropriate calibration for the USGS gage.

- Calibration Parameters

SWMM5 is associated with a large number of spatially variable parameters that describe the characteristics of individual subbasins. A subset of the model parameters associated with frequent storm events - impervious percentage, subcatchment width, Manning’s roughness, depression storage, and soil infiltration parameters, are sensitive and typically used as hydrologic calibration parameters. The calibration effort was focused on adjusting these parameters until modeled flow rates match the timing, magnitude, and total volume of the observed data.

The percentage of imperviousness turned out to be the most sensitive parameter, strongly influencing both the total volume of runoff and the peak flows. To obtain a good adjustment of the hydrograph, the initial percentage of imperviousness was decreased 10% for each subcatchment. The subcatchment width is an abstract basin parameter computed by dividing the subcatchment area by the travel length. Because of its inherent uncertainty, this parameter was also used as a major tuning parameter. The travel length was increased for all basins (ranging from 50% to 100%) to create a more attenuated response to storm events. These are reasonable adjustment when taking into account the error margin that can be obtained when estimating these parameters (Wickham, et al, 2013). The parameters of depression storage, infiltration and roughness are less impactful and were adjusted within the range of the established values in the literature to help further improve model calibration.

- Hydrologic Calibration Results

The results of the final calibration are provided in Figure 3-8 and Figure 3-9. At both stations, modeled daily flow match the volume and timing of observed data well, but the peaks of biggest storms were consistently over simulated. Several factors could contribute to this. The inflow from the upstream stations makes up the majority of flow in Guadalupe River and heavily impact the calibration at downstream stations (Figure 3-5). The high flow from these stations were extrapolated from flow-stage curves that often are not calibrated or updated with field measurements during the biggest storms due to lack of personnel and sometimes hazardous conditions (SCVWD, personal communication, 2014). As a result, these flow numbers may not be very reliable and could be biased high. The model uses precipitation data from three rain gages and assigns representative stations to sub-basins based on Thiessen polygon method (Figure 3-4). Localized rainfall events, typical in the Guadalupe watershed as characterized by large variation in mean annual precipitation ranging from 48 inches in the headwaters to 14 inches at the Central San Jose, may not be captured and could contribute to the discrepancy between modeled and observed peak flows. In addition, uncertainty in some key input data such as the percent of imperviousness, local soil conditions, and directly connected impervious area could also introduce uncertainty into the model calibration.

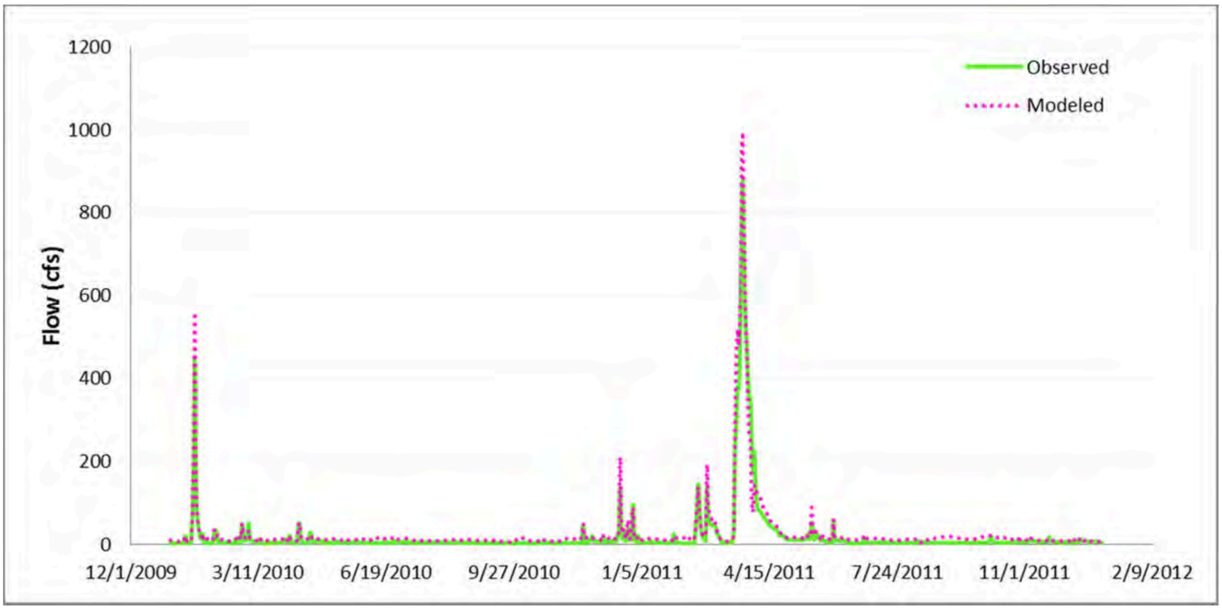


Figure 3-8. Modeled and observed daily flow at Los Gatos Creek, Lincoln Avenue

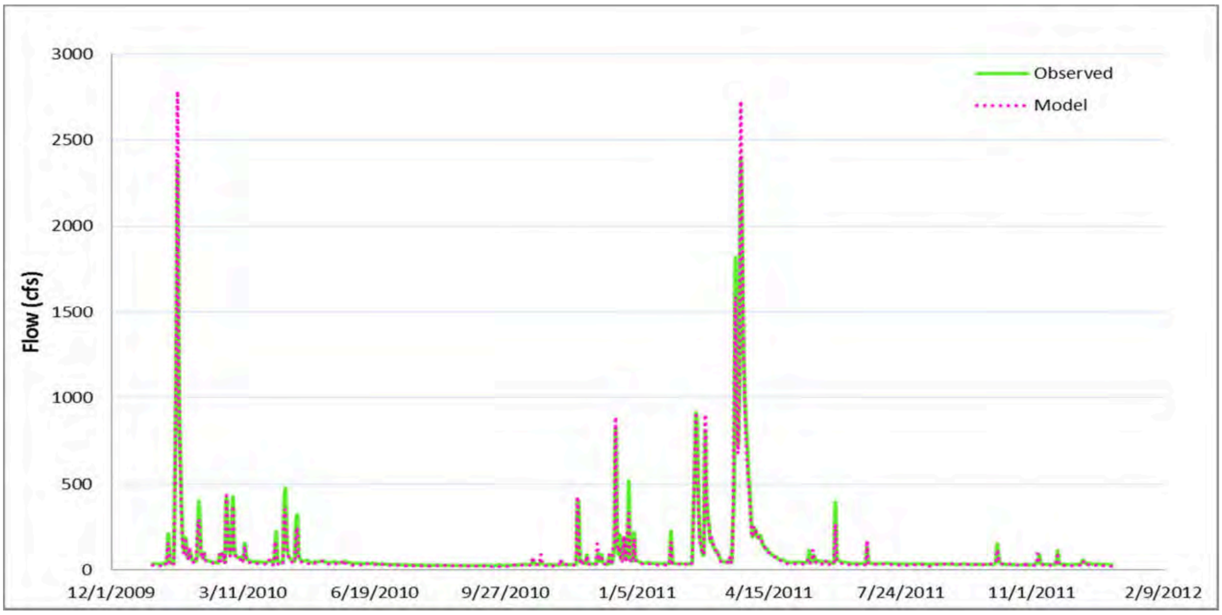


Figure 3-9. Modeled and observed daily flow at USGS station near highway 101

These caveats accepted, the accuracy of the model calibration was also quantified based on the calculated mean error for the modeled and observed storm volume and Nash–Sutcliffe model efficiency (Nash and Sutcliffe, 1970). Both statistics are well within acceptable criteria, indicating an overall good hydrologic calibration; a first indication that the model calibration is quite sufficient to support the GI application.

Table 3-6. Statistics for evaluation model calibration

| Statistics | Model results | Criteria |
|---|---|---|
| Difference in storm volume | -4% | < 10% |
| Model efficiency | 0.97 | >=0.7 |

As another indication, flow cumulative frequency curves can be used to analyze and compare the fraction of the time that flows are less than or equal to a given flow rate for the simulated versus measured data. Such curves show the flow characteristics of a stream throughout the range of discharge, without regard to the sequence of occurrence. The frequency curve of simulated daily flow (log scale) closely matches that of observed data in most parts except in low flow condition (Figure 3-10), again indicating a good hydrologic calibration. The under-simulation of low flow was not deemed critical for this particular application because the focus of management actions and goals will be on reducing runoff from storm events, not baseflow.

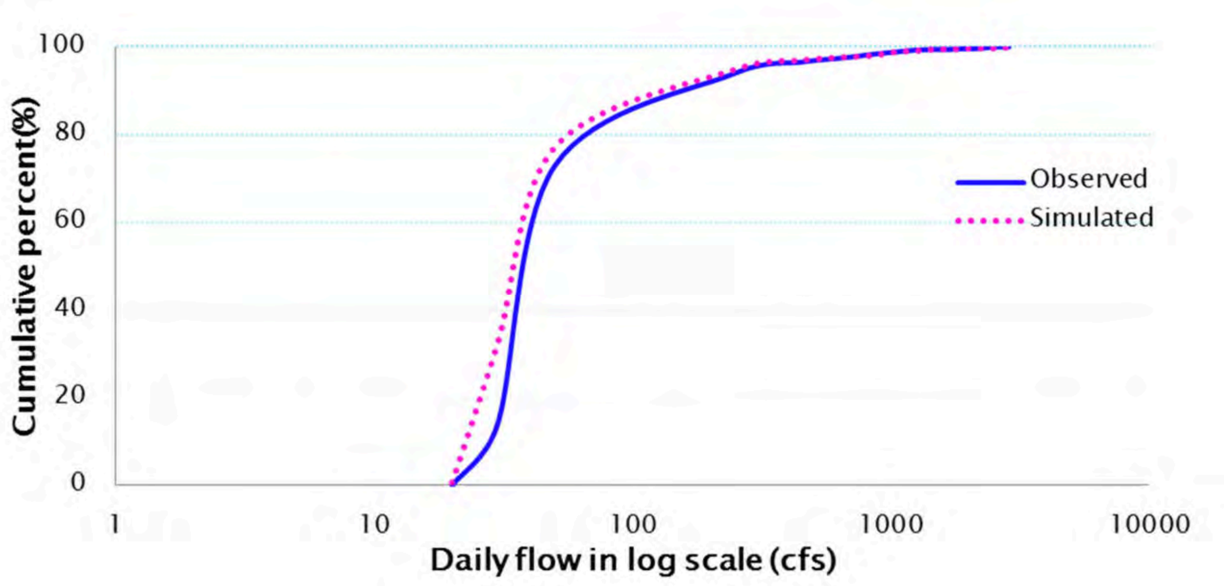


Figure 3-10. Daily Flow Duration Curve at USGS station near highway 101

### 3.6.4 Baseline Condition

The model baseline represents the existing rainfall-runoff response of the study area and a reference point from which any stormwater improvement from management actions can be measured. With reasonably good hydrologic calibration, the calibrated model now represents a baseline condition that is reflective of existing landscape features and behavior, and capable of adequately responding to critical rainfall conditions. Because it forms the basis for comparative assessment of various GI scenarios, establishing a representative baseline condition with a high level of confidence is critical and becomes especially important where cost-benefit optimization of future management objectives is a primary focus of the modeling effort (USEPA 2009).

The runoff distribution for the baseline condition is shown in Figure 3-11. The runoff production in Lower Guadalupe River watershed ranges from 3.7 in to 18 in. In general, the runoff production is correlated well with the percent of imperviousness, with more runoff from more urbanized areas as the soil's infiltration capacity is reduced by increased imperviousness.

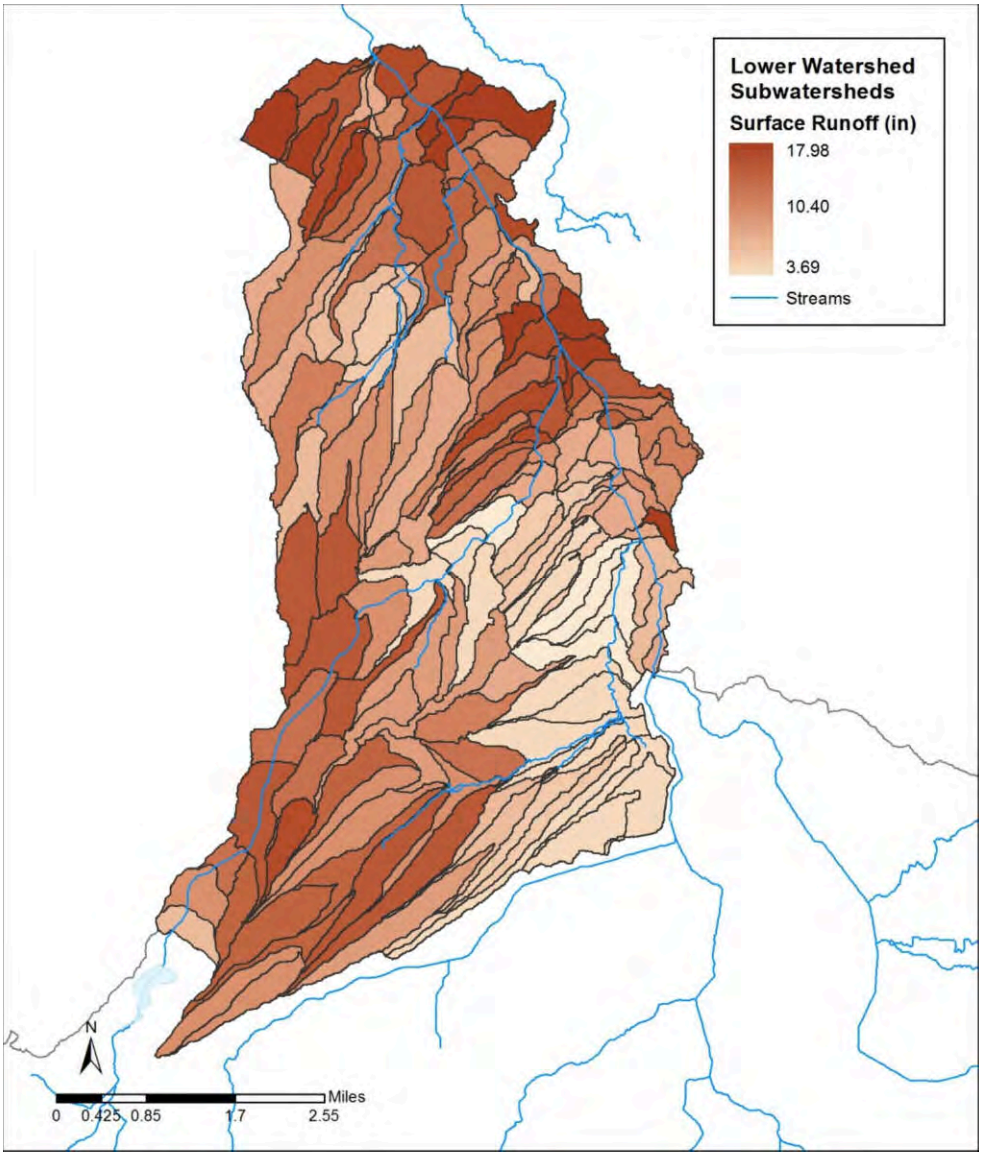


Figure 3-11. Surface Runoff Distribution for Baseline Condition

## 3.7 Optimization Tool

As the last tool in the Toolkit application, the Optimization Tool repeatedly runs the Modeling Tool to iteratively arrive at the optimized GI scenario. The objective of the Optimization Tool is to determine GI locations, types, and design configurations that minimize the total cost of management while satisfying water quality and quantity constraints. Currently, three GI feature types - bioretention, infiltration trench, and permeable pavement were built in the Tool, as recommended by the project Technical Advisory Committee (TAC). The major steps of this application includes formulating optimization problem, selecting critical storm, designing GI representation, and assigning GI cost.

### 3.7.1 Focus Area

Downtown San Jose, a primary focus area for redevelopment, was selected from the Lower Guadalupe watershed to demonstrate the application of the Optimization Tool. The selected watershed covers 53 model segments with a total area of 4300 acres (Figure 3-12). The Optimization Tool was to identify cost-effective GI combinations and distributions for the selected area, for which future GI retrofit and implementation are planned to offset the impact of the new development.

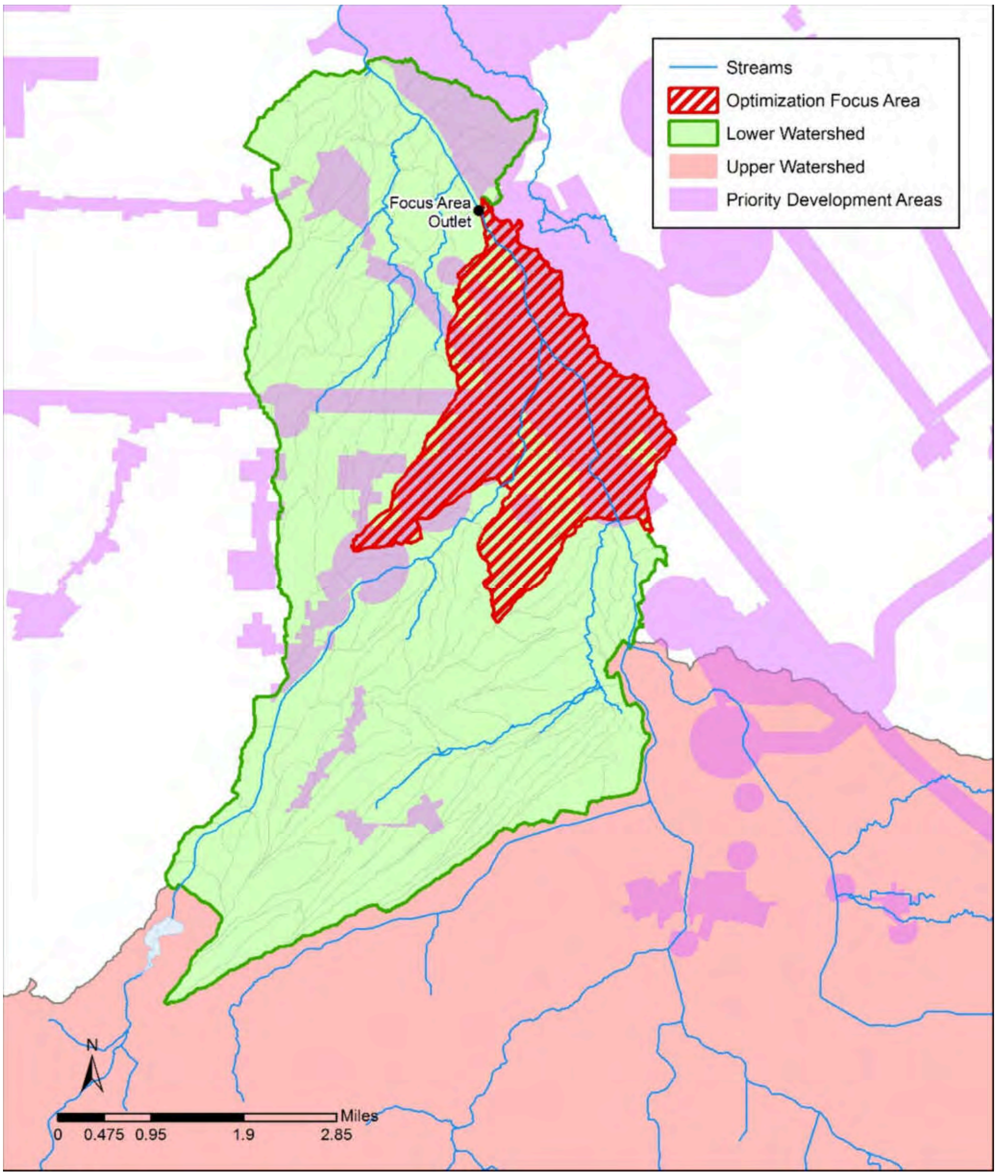


Figure 3-12. Optimization Focus Area

### 3.7.2 Optimization Problem Formulation

The application of the Optimization Tool began with the formulation of optimization problem, which requires the determination of management targets and selection of assessment point and decision variables.

- Management targets

The determination of management targets is the first step in formulating an optimization problem. These management targets can be based on flow and/or water quality. For example, a management target for flow can be a desired reduction in average annual volume, peak discharge, or exceedance frequency. For this case study, no specific reduction targets were defined, and the overall management targets are to reduce total runoff volume for a design storm event. Therefore, a full range of control targets from 0 -100% were explored, and the optimization was to identify optimal solutions for any possible targets within the range.

- Assessment point

An assessment point is the location in the study basin where runoff or pollutant loading reduction will be evaluated relative to optimization goals. The assessment point for this study is the outlet of the study area (Figure 3-12).

- Decision variables

To run the optimization analysis, the user must define decision variables that will be used to explore the various possible GI configurations. For this analysis, the decision variables are defined as the number of fixed-size units of the distributed GI types. In the Lower Guadalupe San Jose case study, the total number of decision variables ended up as 159 (53 basins*3 GI types). For each applicable GI type, the decision variable values range from zero to a maximum number of potential sites, which were identified by the GIS Site Locator Tool. The decision variables were also constrained by the total area that can be treated by GI within each sub-basin. Through the discussion with the project Technical Advisory Committee (TAC), a 4% "rule of thumb" (defined as GI design at four-percent of the project area to capture 100% stormwater volume of a design storm) was used to size GI for this study. During the optimization process, the combined numbers of GI were forced to be less or equal to the maximum numbers calculated by applying this 4% rule.

### 3.7.3 Design Storm

The setup of the Optimization Tool also required the selection of a typical precipitation year for use in comparing alternatives and assessing downstream impacts. At the recommendation of the City of San Jose, a 2-year storm with 24-hour duration was selected to drive the simulation process. The storm has a total rainfall of 1.86 inches, according to Santa Clara County's drainage manual (Santa Clara County, 2007). The distribution of the storm was derived from a normalized rainfall pattern recommended by the manual for use in the San Jose area (Figure 3-13). To be consistent with the resolution of the storm event, the time step in the Modeling Tool as used by the optimization engine was also set at 5 minutes, different from the 15-minute time steps used in the model calibration.

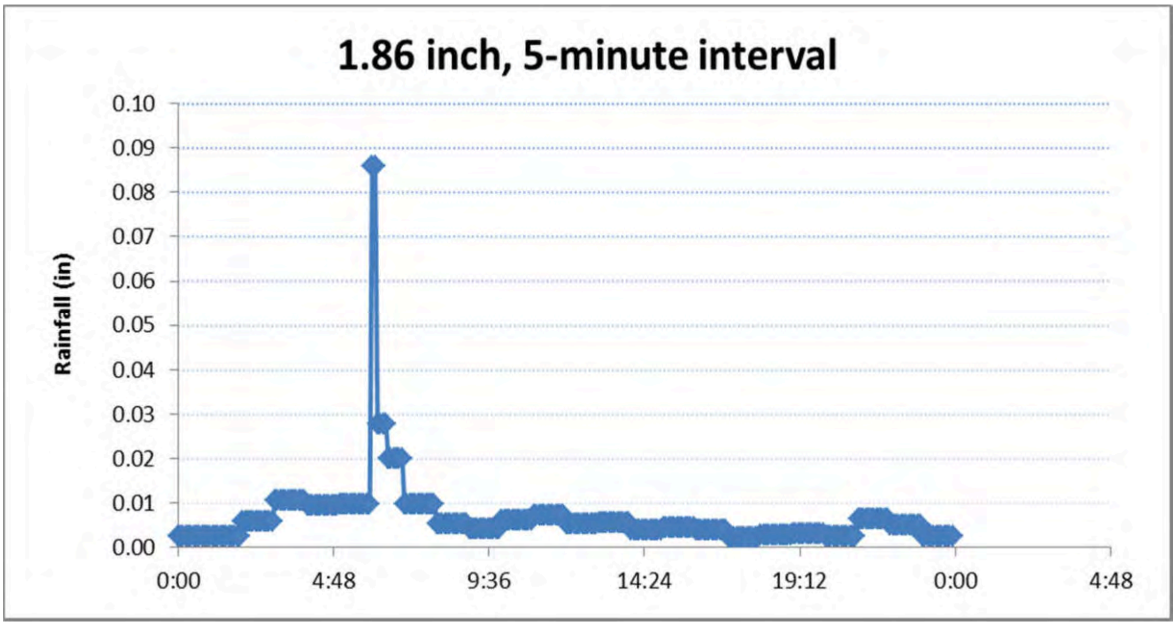


Figure 3-13. Distribution of San Jose 2-year Storm Event with 24-hour Duration

### 3.7.4 GI Representation

Three GI types - bioretention, infiltration trench, and permeable pavement were included for optimization. Each GI type was assigned a typical size and design configuration that remained unchanged during the optimization process. The decision variables were the number of each GI type within each sub-basin and changing in size of GIs was implicitly reflected through the change of number of GIs implemented. Table 3-5 summarizes key design parameters for each GI feature.

Table 3-6 GI configurations used in Optimization Tool

| Parameter | Bioretention | Infiltration Trench | Peamable Pavement |
|---|---|---|---|
| **Physical Configuration** | | | |
| Surface area (ft^2) | 1000 | 500 | 5000 |
| Surface depth (in) | 12 | 12 | N/A |
| Growing Media depth (n) | 18 | N/A | N/A |
| Storage Depth (in) | 12 | 36 | 12 |
| Underdrain | Yes | Yes | Yes |
| **Infiltration** | | | |
| Suction head (in) | 24 | N/A | N/A |
| Conductivity (in/hr) | 5 | N/A | N/A |
| Effective porosity | 0.437 | N/A | N/A |
| Field capacity | 0.105 | N/A | N/A |
| Wlting point | 0.047 | N/A | N/A |
| Void ratio | 0.5 | 0.5 | 0.18 |
| Underdrain infiltration rate (in/hr) | 0.14 | 0.14 | 0.14 |
| Initial media saturation (%) | 15 | N/A | N/A |
| Peamability (in/hr) | N/A | N/A | 100 |

### 3.7.5 GI Cost

Local sources were used to derive capital cost data for GI on public rights of way. The reliable cost information for each GI feature is critical for identifying optimal solutions, because the optimization process and solutions are highly sensitive to the cost function. A unit cost approach was used to calculate the total cost associated with each GI scenario formed in the optimization process, in which cost per square feet of surface area was specified for each GI type and the total cost of any GI scenario was calculated as:

Total cost = $\sum(number\ of\ each\ LID\ type * unit\ cost * \ surface\ area\ of\ each\ LID\ type)$

Implementing GI at the landscape scale would incur many costs ranging from traffic control, construction, to maintenance and operation. For this project, the costs considered were construction, design and engineering, and maintenance and operation (with 20 year lifecycle). GI cost information for various GI types were collected from literature review, contacting local stormwater agencies, as well as reviewing similar studies in other regions. In general, only limited cost information was available, and these costs vary greatly from site to site due to varying characteristics, different design/configuration, and other local conditions/constrains (Table 3-7). After consulting with the TAC and stakeholders, the cost for bioretention was estimated as $104/square foot (sf) surface area, infiltration trench as $90/sf surface area, and permeable pavement $34/ sf surface area. These cost estimates were used to form the cost function in the Optimization Tool, which were evaluated through the optimization process at each iteration.

Table 3-7 GI unit costs from different sources

| Bioretention | | | | |
|---|---|---|---|---|
| Sources | Construction cost(sf) | Design cost | Annual M &O cost* | Total cost (SF) |
| **San Jose** | | **25%** | **$7.00** | **$104** |
| BASAMAA report | $89 -$297 | 25.0% | $2.83 | $118 -$435 |
| WA BMP database | $31.60 | 67% | $1.27 | $78.17 |
| SPASS | $118.00 | $19 | | $137.00 |
| Literature Value | $2 -$69 | | 1-11% | |

| Infiltration Trench | | | | |
|---|---|---|---|---|
| Sources | Construction cost(sf) | Design cost | Annual M &O cost* | Total cost (SF) |
| **San Jose** | | **22%** | **$4000/quarter mile** | **$176*** |
| WA BMP database | | | | $95.95 (90) |
| Literature Value | $ 14 -$65 | | 5 -20% | |

| Permeable Pavement | | | | |
|---|---|---|---|---|
| Sources | Construction cost(sf) | Design cost | Annual M &O cost* | Total cost (SF) |
| **San Jose** | | **22%** | **$4000/quarter mile** | **$34** |
| WA BMP database | $14.41 | 63% | $0.02 | $23.89 |
| Literature Value | $8 -$37 | | 1-2% | |

### 3.7.6 Optimization Results

Consistent with Site Locator Tool analysis, two scenarios were run with the Optimization Tool: with base analysis and without base analysis. With each scenario, the optimization procedure was run for 200 iterations, each with 100 solutions. After which, the optimization converged to final optimal solutions and the process was stopped. The entire process took about 2 hours of computer time from start to finish – a run time deemed reasonable by the TAC; a good tradeoff between spatial resolution and model usability.

- Cost-effectiveness curve

The optimization process outputs the optimal solutions along a cost-effectiveness curve. The curve relates the levels of runoff removal efficiency to various combinations of GI throughout the watershed and their associated cost. Figure 3-14 and Figure 3-15 show the cost-effectiveness curve for scenario with/without base analysis, respectively. For each scenario, all 20,000 individual solutions are plotted together, with the optimum solutions that form the left- and upper-most boundaries of the search domain highlighted in red. Each point on the graph represents one combination of the number of bioretention units, Infiltration Trench, and permeable pavement for each subarea within the study area.

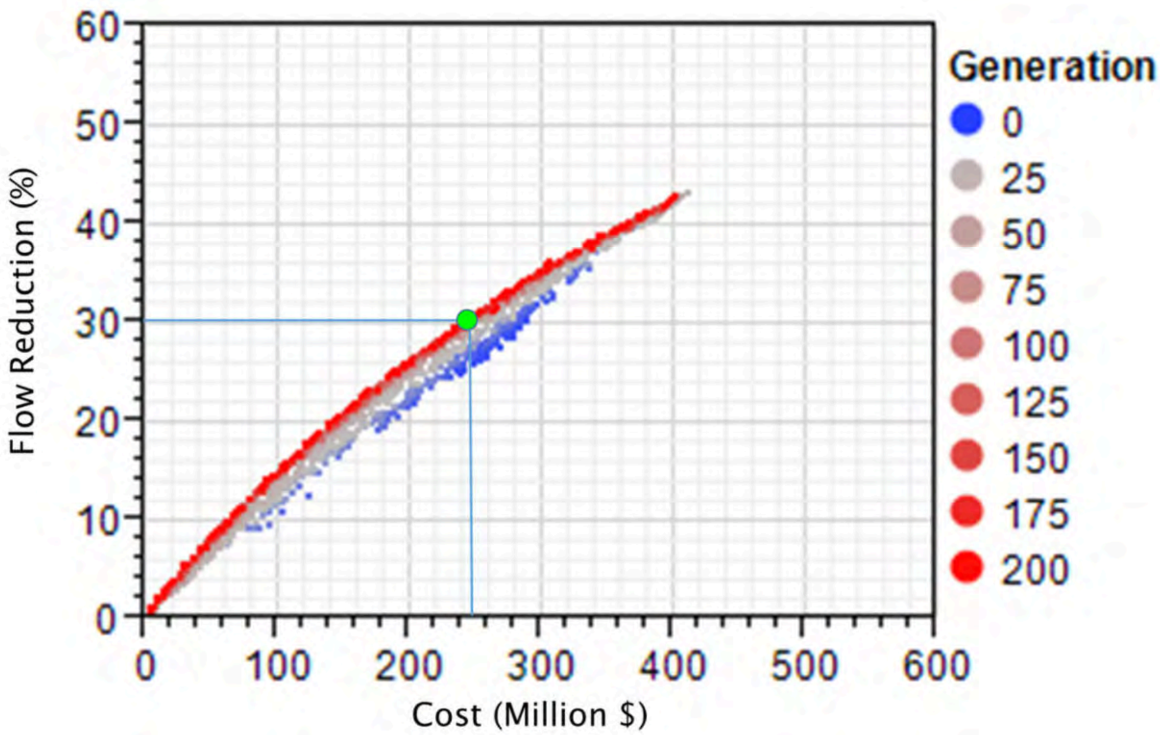


Figure 3-14. Cost-Effectiveness Curve for Scenario with Base Analysis

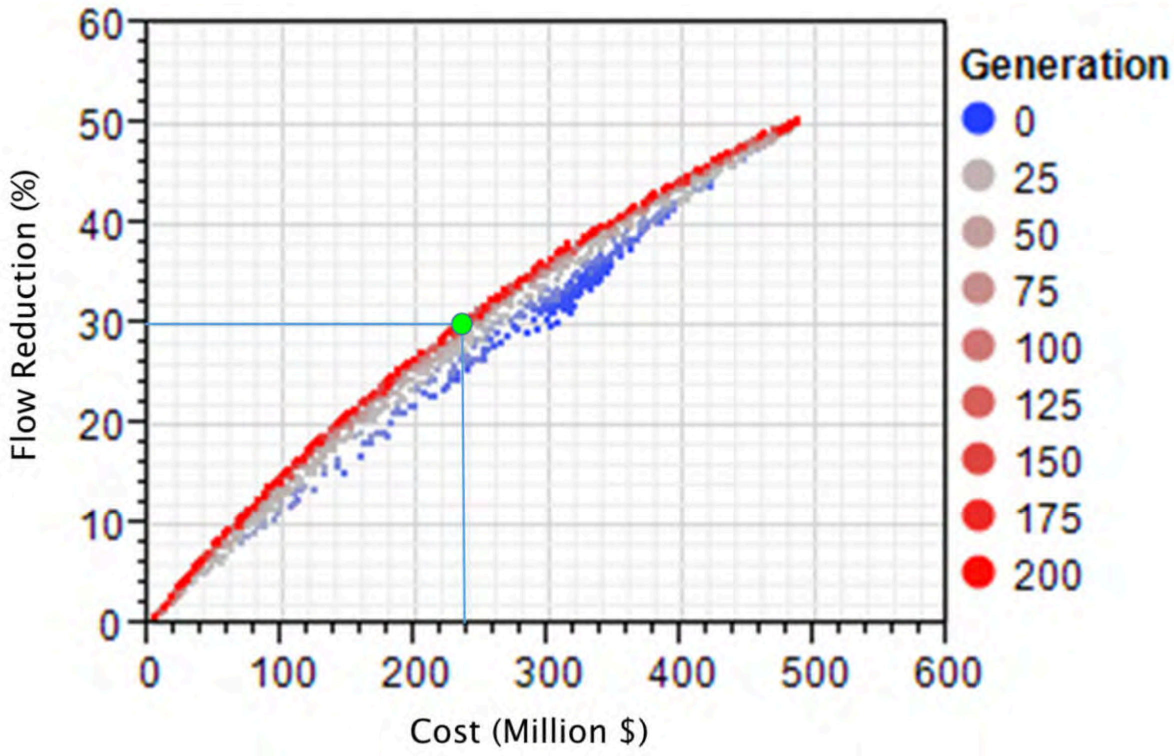

Figure 3-15. Cost-Effectiveness Curve for Scenario without Base Analysis

The cost-effectiveness curve suggests that there exists a largely linear relationship between level of implementation (represented as total cost) and runoff volume reduction, and the maximum achievable runoff volume reduction at the outlet of study area, given the objectives and constraints associated with the study, is approximately 43 percent for with base analysis (Figure 3-13) and 50 percent for without base analysis (Figure 3-14). With the help of this information, decision makers can set realistic goals on how much can be achieved and the level of investment required, as well as determine at what point further investment on GI will yield no improvement on runoff reduction. Between the two scenarios, more GIs (and thus higher cost) will be required for the with base analysis to achieve the same level of runoff reduction (i.e. 30% reduction), as the base analysis excluded some potential sites for more efficient GI types bioretention and infiltration trench, and the optimization was forced to pick more of less efficient types (incurring more cost) to make up the difference. While the cost distribution does not provide specific information about the spatial locations of actual GI features nor the actual cost of build out, knowing the types of practices associated with each point along the cost-effectiveness curve provides insight into the reasoning and order of selecting individual practices.

Of the two scenarios, the City is primarily interested in the scenario without base analysis. Therefore, the discussion of optimization results from here on was focused on this one only.

- Example scenario – 30% reduction

The optimal combinations of GI types and numbers for user-defined reduction goals along the cost-effective curve can be specified. Take the example of a 30% runoff reduction goal, the optimal combination of GI types identified through the optimization process is listed in table 3-8. In total, 3300 GIs will be needed to treat the 4300 acre focus area with a price tag of $240 million based on the model assumptions of GI design and unit cost. The number of each GI type needed for achieving certain reduction goal is generally determined by the collective factors of GI design, cost and potential feasible locations. The actual cost would be much less than the $220 M price tag given the opportunity to reduce unit costs through standardized designs batched implementation, implementation with other road related or drainage related projects, public-private partnerships, reduced need to upsize existing grey infrastructure, and many other benefits not accounted for such as increased property values, reduced heat and other benefits.

Table 3-8 The Number of GI identified for 30% Runoff Reduction

| Subcatchment | Bioretention | %Imprv Treated | Infiltration Trench | %Imprv Treated | Permeable Pavement | %Imprv Treated | Total LIDs | Total %Imperv Treated |
|---|---|---|---|---|---|---|---|---|
| S43 | 15 | 17 | 6 | 3 | 0 | 0 | 21 | 20 |
| S44 | 0 | 0 | 10 | 6 | 0 | 0 | 10 | 6 |
| S45 | 20 | 14 | 28 | 10 | 3 | 11 | 51 | 35 |
| S46 | 57 | 37 | 0 | 0 | 0 | 0 | 57 | 37 |
| S47 | 50 | 38 | 5 | 2 | 0 | 0 | 55 | 39 |
| S48 | 0 | 0 | 51 | 38 | 0 | 0 | 51 | 38 |
| S49 | 2 | 2 | 34 | 20 | 0 | 0 | 36 | 23 |
| S50 | 79 | 60 | 84 | 32 | 0 | 0 | 163 | 93 |
| S51 | 22 | 20 | 75 | 34 | 0 | 0 | 97 | 54 |
| S52 | 102 | 59 | 129 | 37 | 0 | 0 | 231 | 96 |
| S53 | 73 | 48 | 137 | 45 | 0 | 0 | 210 | 93 |
| S54 | 78 | 33 | 161 | 34 | 0 | 0 | 239 | 68 |
| S55 | 10 | 19 | 2 | 2 | 0 | 0 | 12 | 21 |
| S56 | 106 | 67 | 91 | 29 | 0 | 0 | 197 | 96 |
| S57 | 92 | 39 | 245 | 52 | 0 | 0 | 337 | 91 |
| S58 | 46 | 40 | 113 | 50 | 0 | 0 | 159 | 90 |
| S59 | 30 | 60 | 16 | 16 | 0 | 0 | 46 | 76 |
| S60 | 113 | 56 | 160 | 40 | 0 | 0 | 273 | 96 |
| S61 | 64 | 38 | 14 | 4 | 0 | 0 | 78 | 42 |
| S62 | 36 | 46 | 3 | 2 | 0 | 0 | 39 | 48 |
| S63 | 0 | 0 | 2 | 1 | 0 | 0 | 2 | 1 |
| S64 | 0 | 0 | 11 | 14 | 0 | 0 | 11 | 14 |
| S65 | 0 | 0 | 17 | 14 | 0 | 0 | 17 | 14 |
| S66 | 1 | 0 | 84 | 17 | 0 | 0 | 85 | 18 |
| S67 | 52 | 31 | 16 | 5 | 0 | 0 | 68 | 36 |
| S68 | 1 | 1 | 4 | 2 | 0 | 0 | 5 | 2 |
| S69 | 46 | 29 | 136 | 43 | 0 | 0 | 182 | 72 |
| S70 | 50 | 24 | 91 | 22 | 0 | 0 | 141 | 46 |
| S71 | 35 | 70 | 17 | 17 | 0 | 0 | 52 | 87 |
| S72 | 0 | 0 | 24 | 7 | 0 | 0 | 24 | 7 |
| S73 | 5 | 13 | 0 | 0 | 0 | 0 | 5 | 13 |
| S74 | 7 | 3 | 5 | 1 | 0 | 0 | 12 | 5 |
| S75 | 6 | 4 | 20 | 6 | 0 | 0 | 26 | 10 |
| S76 | 41 | 34 | 109 | 45 | 0 | 0 | 150 | 78 |
| S77 | 28 | 20 | 28 | 10 | 0 | 0 | 56 | 31 |
| S78 | 5 | 9 | 20 | 18 | 0 | 0 | 25 | 27 |
| S79 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| S80 | 1 | 1 | 47 | 16 | 0 | 0 | 48 | 16 |
| S81 | 0 | 0 | 40 | 24 | 0 | 0 | 40 | 24 |
| S82 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| S83 | 6 | 8 | 0 | 0 | 0 | 0 | 6 | 8 |
| S84 | 15 | 22 | 2 | 1 | 0 | 0 | 17 | 24 |
| S85 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 |
| S86 | 0 | 0 | 4 | 1 | 0 | 0 | 4 | 1 |
| S87 | 3 | 7 | 0 | 0 | 0 | 0 | 3 | 7 |
| S88 | 0 | 0 | 4 | 1 | 0 | 0 | 4 | 1 |
| S89 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 |
| S90 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| S91 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| S92 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| S93 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| S94 | 0 | 0 | 8 | 9 | 0 | 0 | 8 | 9 |
| S95 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |

The number of GI features identified for 30% runoff reduction were then overlaid with the map produced by the Site Locator Tool to help pinpoint optimal GI locations and prioritize GI implementation within the PDA. Figure 3-16 to Figure 3-18 show the distribution of optimal GI features across the PDA for bioretention, infiltration trench, and permeable pavement, respectively. The number labeled on the maps are the optimal GI features needed for each sub-basin, corresponding to the number in Table 3-7. These sites were then ranked based on the ranking assigned by the Site Locator Tool and other expert judgements that may not have been spatially quantifiable as inputs to the Locator Tool. The municipalities can incorporate these maps and site ranking into their planning documents to guide their long-term GI implementation effort.

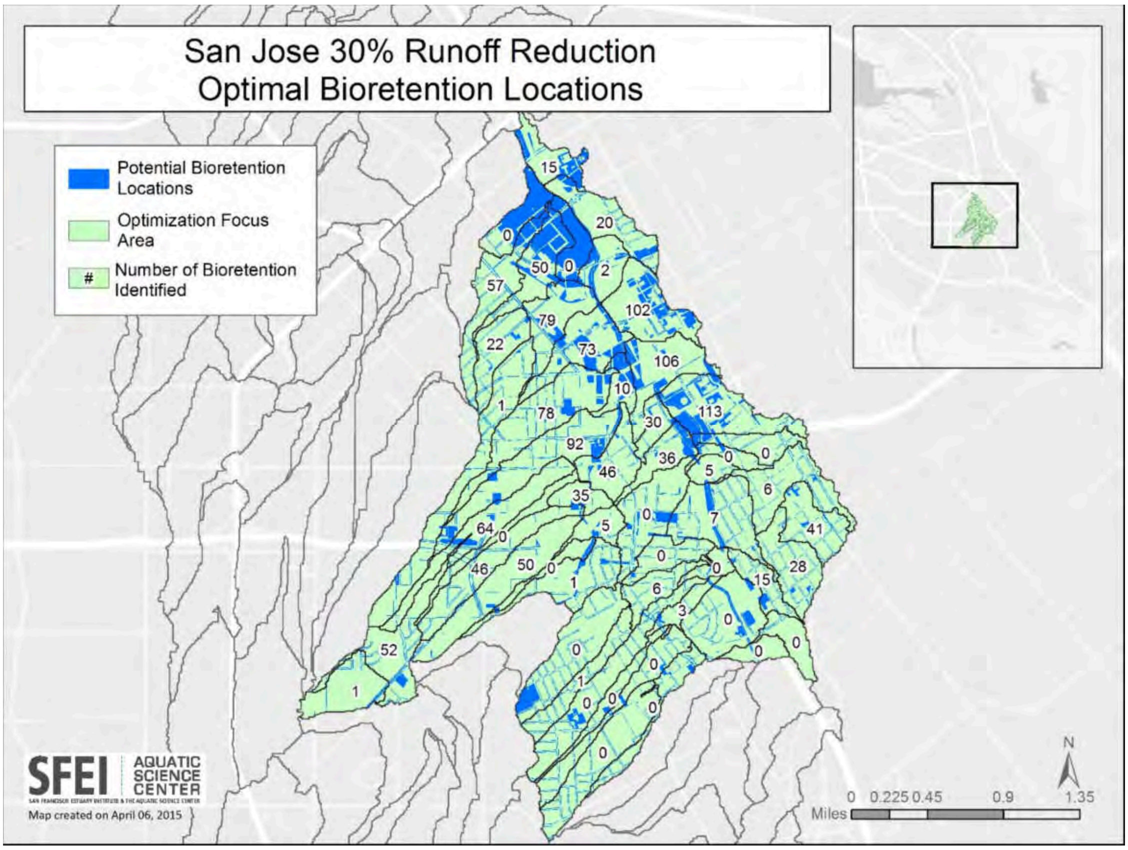


Figure 3-16 Optimal Bioretention Sites for 30% Runoff Reduction

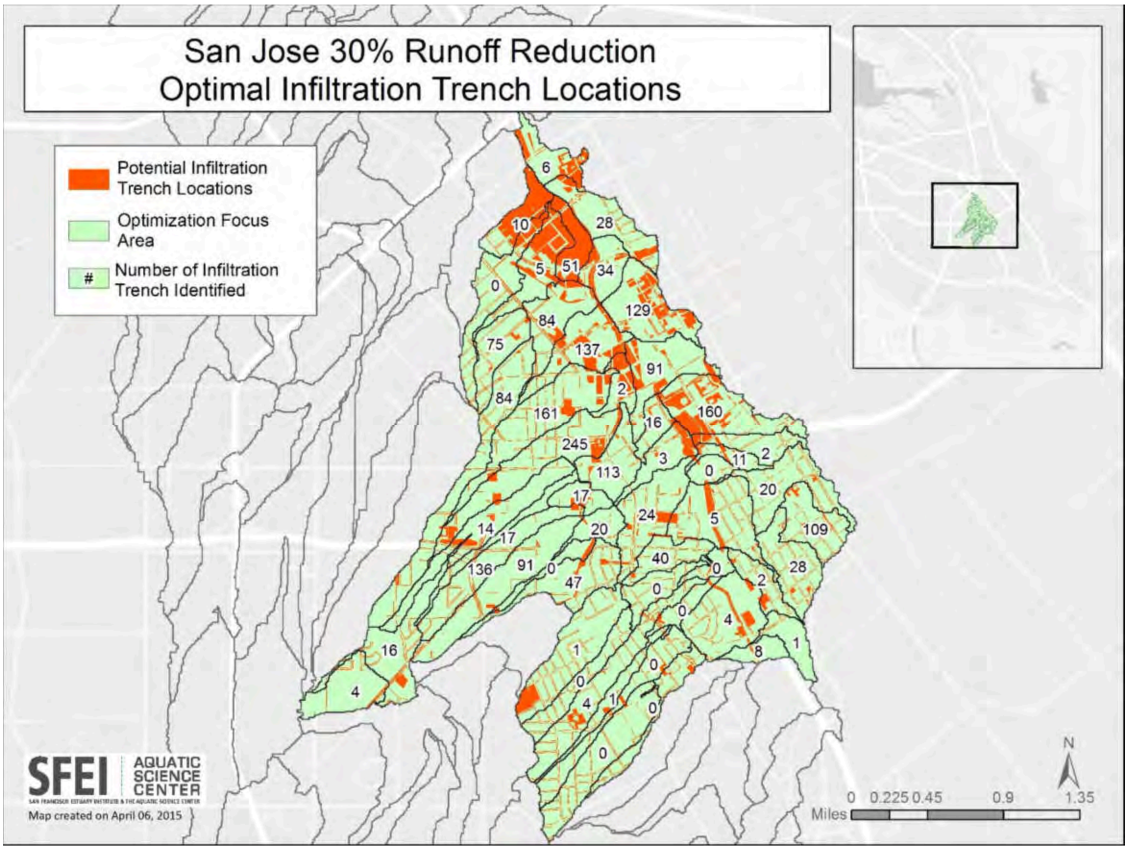

Figure 3-17 Optimal Infiltration Trench Sites for 30% Runoff Reduction

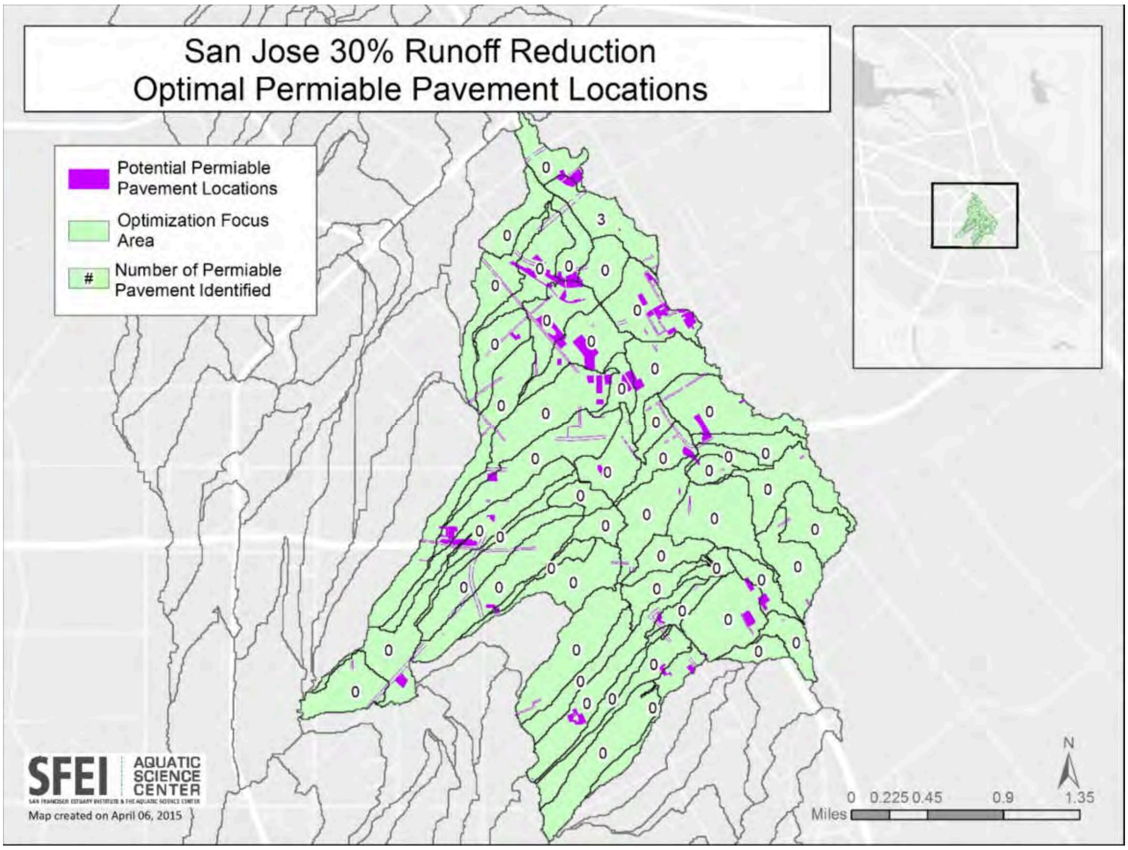


Figure 3-18 Optimal Permeable Pavement Sites for 30% Runoff Reduction

It is important to emphasize that users must interpret the optimization results in the context of specific problem formulation, assumptions, constrains, and optimization goals unique to this case study. If one or more assumptions are changed, for example, the optimization target was designed as reducing peak flow instead of total volume, the optimization might have resulted in a completely different set of solutions in terms of GI selection, distribution, and cost. It also should be noted that because of the large variation and uncertainty associated with unit GI cost information, the total cost associated with various reduction goals calculated form the unit cost do not necessarily represent the true cost of an optimum solution for the basin evaluated and are not transferable to other basins. Rather, these cost should be interpreted as a common basis to evaluate and compare the relative performance of different GI scenarios. The Optimization Tool provides a framework to identify optimal solutions for addressing stormwater management issues at the watershed level.

- Comparison with Results from Site Locator Tool

For the study area, the preliminary GIS screening through the Site Locator Tool identified 23,600 potential sites for GI implementation. These sites could serve as a starting point for GI planning and form the basis for the application of the Optimization Tool. Through the optimization process, not only were the number of sites reduced down to 3300, but the optimal combinations of GI were also identified. (Figure 3 -16). More importantly, the use of the Optimization Tool can provide users with critically needed quantification on cost and benefit (reduction) associated with various management options to help them in finding informed and optimal solutions. Therefore, the application of the full Toolkit is always preferred when sufficient data are available to support the development of the Modeling and Optimization Tools.

3.7.7 Sensitivity Analysis

Previous studies (USEPA 2011, State of Washington 2013) suggested that the optimal process and solutions are highly sensitive to GI cost. A sensitivity test was run to test sensitivity of optimal solutions to GI unit cost estimates. The unit cost for each GI type was changed (Table 3-9), and the optimization procedure was similarly run for 200 iterations with a population size of 100.

Table 3-9 GI unit cost for sensitivity analysis

| LID Features | Old Cost ($/sf) | New Cost ($/sf) |
|---|---|---|
| Bioretention | $104 | **$150** |
| Infiltration Trench | $90 | **$45** |
| Permeable Pavement | $34 | **$20** |

As expected, the sensitivity results suggest that assumptions made with GI cost were highly influential on the optimization modeling results. Varying the unit cost, at the same level of reduction results in different price tags and GI combinations or vice versa (Figure 3-19). For instance, at the 30% runoff reduction level, the total price tag will be $220 million with the original unit cost, but $200 million with the new cost. And the optimal combinations of GI types and numbers are also different. Therefore, reliable and accurate local cost information should be used to drive the optimization process, wherever possible.

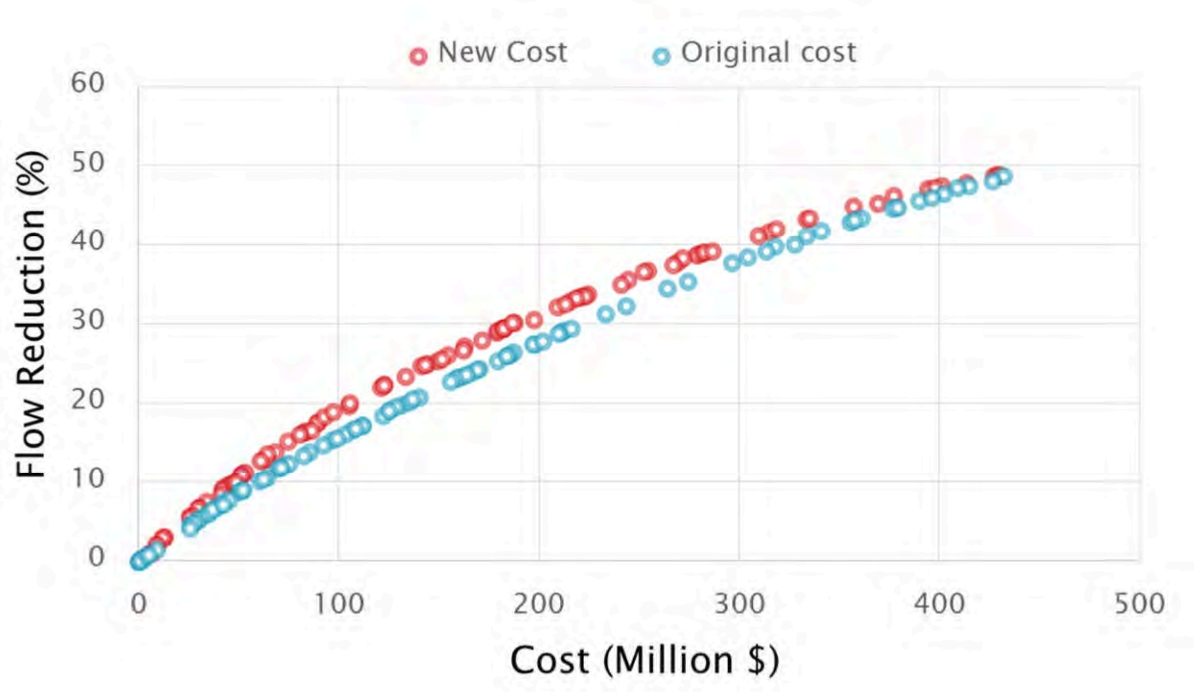


Figure 3-19. Optimal Fronts of Sensitivity Tests

# Chapter 4. Discussion and Recommendations

The GreenPlan-IT Toolkit is a planning level tool that provides users with the ability to evaluate the cost effectiveness of GI for addressing stormwater management in urban watersheds. The case study in City of San Mateo demonstrated how the GIS Site Locator tool was used to screen potential sites for GI implementation, while case study in San Jose PDA highlighted the power and utility of the Toolkit and demonstrated how to use the Toolkit to support a cost-benefit evaluation of stormwater runoff control. The two case studies provide useful and practical information that can help managers to understand and evaluate the benefits of GI in urban watersheds.

As illustrated by the San Jose case study, the application of the Toolkit requires careful formulation of the management questions and the optimization objectives. Setting up the Modeling Tool requires deciding on the appropriate spatial scale such as the number of sub-catchments and resolution used to represent GI, as well as the input data collection, model calibration, and development of the baseline condition. The Optimization Tool can be very powerful when combined with hydrologic modeling and cost analysis. Successful and meaningful application of the Optimization Tool largely depends on accurate representation of the watershed baseline condition, GI configurations, and the associated GI costs. The sensitivity analysis demonstrated that the optimization process is highly sensitive to GI cost data used in selecting solutions, and as a result, sensitivity analysis and evaluation of cost control measures or economies of scale are recommended wherever the Toolkit is applied. This section discusses the lessons learned from these case studies, identifies major data gaps, and makes recommendation on future enhancements.

## 4.1 Lessons learned

The case studies presented in this report provide useful and practical guidance for conducting similar studies in other watersheds. The lessons learned from these case studies could benefit potential GreenPlan-IT users.

- Determination of Spatial Scale

The first challenge in any modeling study is to determine how detailed the model needs to be in order to properly represent the system. The model should only be as complex as necessary to address modeling objectives and answer the management questions. In the context of optimization for GI placement, the study area should be delineated into sub-basins that are small enough to be meaningful for guiding GI implementation while not adding extra burden on model run time. There will always be a trade-off between model spatial resolution and run time. Different choices might be made by first time users versus seasoned users.

- Importance of Model Calibration

The model baseline is the foundation upon which all subsequent analyses depend and is crucial for meaningful results. The importance of a representative baseline model highlights the importance of model calibration. In the San Jose case study, a significant amount of effort was invested to calibrate SWMM using a weight-of-evidence approach to ensure the baseline model adequately represents the existing watershed conditions. Future users of the Toolkit should always bear this in mind and invest effort in model calibration with local data to ensure the meaningful application of the Toolkit.

- Interpretation of Optimization Results

The Optimization Tool performs iterative searches to identify cost-effective solutions. The search process is dependent on the problem formulation, model assumptions, GI cost and GI treatment effectiveness. Therefore, the cost-effective solutions from the optimization process would very much depend on the user-defined goals and assumptions and must be interpreted within the context that defines each specific application. The application of GreenPlan-IT Toolkit must also be accompanied by an intimate understanding of the study area and all influential factors that affect local stormwater management in order to ensure meaningful interpretation of optimization outcomes.

- Consideration of Optimization Run-time

The total number of iterative runs needed for the optimization process to converge to the optimal solutions is dependent on the number of decision variables, model simulation period, and the complexity of the model (number of sub-basins and stream neatwork). More model runs usually leads to longer computation time. For the San Jose case study, it took about two hours for the optimization process to reach optimal solutions after 200 runs, and this short computation time is largely benefited from a very short simulation period (24 hours). If the Optimization Tool is applied to a large watershed with many feasible GI sites and a complex stream network and the optimization process is based on long-term continuous simulation, a large amount of computation time will be needed to reach the optimal solutions. In general, the computational efficiency can be achieved through reducing the number of decision variables, simulation time, and complexity of the problem.

## 4.2 Data Gaps

The GreenPlan-IT Toolkit is a data-driven tool whose performance is dependent on the availability and quality of the data that support it. Through the two case studies, major data gaps for each tool were identified.

- GIS data

The placement opportunities for GI define the extent to which GI can beneficially impact flow volume. In each of the case study, limitations were placed on the locations available for GI placement, which in turn led to a definition of the maximum potential effectiveness of the GI in controlling runoff volume. Some of these limitations were physical constraints of the landscape that were derived during the engineering and design process. Other limitations were defined based on land use or ownership criteria resulting from the local decision making process. The restrictions placed on GI must be understood in order to evaluate the management scenarios.

- Monitoring data

Developing the Modeling Tool to establish a representative baseline requires the calibration of the model with monitoring data. For the San Jose case study, there were good precipitation time series, long-term flow monitoring data at a number of gages, and good spatial data to characterize land use and impervious cover to support model development. While in the San Mateo case study, lack of monitoring data limited the full utilization of the Toolkit. Lack of monitoring data, in particular water quality data, and general quality issues associated with model input data will be a major hurdle when applying the Toolkit to other watersheds in the Bay Area.

- GI cost information

As demonstrated by the sensitivity analysis of the San Jose case study, the optimization strongly depended on the available GI cost information, and uncertainties in local cost data can greatly influence the management conclusions. GI cost could vary widely from one location to another, influenced by site-specific factors such as physical characteristics, constrains, and local economy. For the San Jose case study, there was very limited information available on GI cost, most of which was for bioretention and little for infiltration trench or permeable pavement. The understanding and utilization of the optimization results must take this limitation into account. To ensure a meaningful application of the Toolkit, reliable local cost information must be collected to drive the optimization process. While it is important to have accurate cost information for each GI type, it is the relative cost difference between GI types that determines what constitutes the optimal GI types and combinations. Therefore, it is crucial to have reliable estimates on relative cost difference between various GI types and interpret the price tags associated with each GI scenario as the relative merits of one scenario verse another, not as the true cost of implementation.

### 4.3 Future Steps/Enhancements

The case studies showcased in this report were focused on stormwater volume control and represent the first phase of the GreenPlan-IT Toolkit development. To develop a tool that is comprehensive and flexible enough to handle a variety of situations and address a wide range of management questions, the Toolkit needs to be continuously evolving. Future enhancements on the Toolkit are identified through experiences and insights gained from the Toolkit development, case studies, and discussion with the TAC and stakeholders.

- Site Locator Tool

During the next development stage, more GI types could be included in order to develop a wide range of management alternatives. In addition to new GI types, some cities may also be interested in keeping centralized regional facilities such as enlarged bioretention as an option to supplement GI implementation. A diverse set of management options should be evaluated through the Toolkit to provide solutions to a wide range of stormwater management problems. Such additional features could then be considered within the modeling and optimization tool components thus keeping the tool flexible enough to address multiple endpoints such as drinking water supply augmentation or storm sewer master planning. Furthermore, changes to the Site Locator Tool's Opportunities and Constraints ranking functionality would allow for final ranked locations to contain information showing the reasons it was ranked high or low. Additional work could be done to allow for final outputs to be exported automatically to PDF formats as well as improving current KMZ/ Google Earth format functionality. Moreover, guidance and/or models could be developed to help municipalities create potential location layers needed in the Location Analysis of the Site Locator Tool.

- Water quality simulation/optimization

Currently, SWMM5 lacks mechanisms to simulate water quality reduction through GI implementation. This deficit is the reason why water quality simulation/optimization was not performed for the San Jose case study. Developing methodology and corresponding modules to quantify the pollutant removal efficacy for various GI types will be the first major task for future enhancements. EPA's SUSTAIN modeling system includes a BMP module that uses a first-order decay approach to estimate the GI performance on pollutant removal. Incorporating this first-order method or use the module directly can be one way to tackle the water quality problems.

- Flexibility in Optimization Tool

The current setup of the Optimization Tool is tailored to the setting of the San Jose case study to expedite the tool development. Many important decision variables such as the total number of iterative runs and the size of the population were predetermined and coded in the tool programs. Next phase of the tool development should make key decision variables of an optimization problem as user-defined inputs to provide flexibility for broad applicability. Having users define these variables will also help them better understand how the tool functions.

- Improved cost function.

A major weakness in the current cost information is associated with cost data being derived from pilot scale one-off implementations. Future improvements of the cost function could include reasonable project batching scales (3- and 4-way intersections redevelopments that include multiple GI features, blocks or multi-block scale redevelopments, neighborhood scale redevelopments, and combinations of GI feature types (e.g. perviois pavement in concert with small and large bioretention)).

- Additional case studies of different settings

The Toolkit was applied to two case studies to demonstrate its power and utility. Additional applications of the Toolkit at other watershed settings will not only provide much needed insights on what the region needs, but also in the process will help improve/refine the Toolkit functionalities to meet these needs.

## Chapter 5. References

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Attachment 3: Meeting minutes from SFEI and Sunnyvale GreenPlan-IT Coordination

# 2015-04-22 Meeting notes: discussion with Sunnyvale

## In attendance

Pete Kauhanen

Elaine Marshall

Jen Hunt

## Discussion items

| Item | Notes |
| --- | --- |
| Needs | • Most helpful would be the opportunities area map output  supply this to the consultant; early approval from the city council by end of May<br>• 2 specific streets for improvement - see what opportunities for GI<br>• Peery Park a 400 acre within sunnyvale - 95% industrial - ripe for redevelopment; large demand for new office park<br>• ID visions and goals for area<br>• walkable, streetscape design standards, bike lanes, sidewalks, street crossing, bulb outs<br>• some areas don't have sidewalks but will put<br>• |
| Timing | • city plan  due on Sept<br>• Map end of May |

## Action items

- [ ]

# 2015-05-13 Meeting notes: Meeting with Sunnyvale

## Attendees

- Jen Hunt
- Pete Kauhanen
- Elaine Marshall

## Discussion items

| Item | Notes |
|---|---|
| GI types | • Types that are in compliance with the MRP. Biorentition is the priority type<br>• Run the tool with large scale infiltration basins?<br>• permeable pavement and biorention |
| Data Layers | • Data layers showing very wide streets?<br>• Street condition? |

## Action items

- [x] Pete Kauhanen to find definition of storm water wetland
- [x] Mary to see what type of data layer is the sidewalk layer
- [x] Mary to send planned street attributes
- [x] Pete Kauhanen to send ranking tables from SJ and SM

# 2015-06-17 Meeting notes: Sunnyvale meeting to discuss Toolkit

## In attendance

Pete Kauhanen

Elaine Marshal

Jen Hunt

## Discussion items

| Item | Notes |
|---|---|
| Data Layers for inclusion | • SFEI to consider digitizing the future bike lane layer<br>• SFEI to pull out El Camino from the major route data layer since the city is working on a planning effort there and let it be double counted<br>• move previous lid locations to the knockout analysis<br>• Need to look more closely at the flood hazards layer to see if we can pull out areas of high flood risk<br>• Take a closer look at peery park data and make sure they are good<br>• permeable pavement and biorentention and infiltration trench |
| Data layer weights/ranks | • SFEI to take a first cut at developing the o&C table.  Get first out to sunnyvale by July 13 and then consider what next steps |

## Action items

- [ ] @sunnyvale to send updated new digitized peery park data layers
- [ ] @sunnyvale to check on timing of available future bike lane data layer
- [x] Pete Kauhanen look into the pavement layer for number of lanes available and see if that would be helpfule
- [ ] @sunnyvale to send standard road width specs

Attachment 4: ABAG General Assembly meeting announcement, agenda, attendees, and San Mateo Presentation

# Green Streets and Infrastructure Strategies:

## Sharing Best Practices Around Creating Complete Communities, Drought Protection, and Water Management

### Spring General Assembly and Business Meeting

## April 23, 2015

**NOTE NEW TIME**

3:00 -7:30 p.m.

**Oakland Asian Cultural Center**
**380 9th Street, Suite 290**
**Oakland**

### LOOK INSIDE

Agenda and Registration Information

**Association of Bay Area Governments**

# Green Streets and Infrastructure Strategies:

## Sharing Best Practices Around Creating Complete Communities, Drought Protection, and Water Management

## Spring General Assembly and Business Meeting

***ABAG Delegates to adopt Annual Budget: Quorum Required***

***Growing Smarter Together Awards Presentation***

## April 23, 2015 • 3:00 -7:30 p.m.

**Oakland Asian Cultural Center**
**380 9th Street, Suite 290, Oakland**

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# Green Streets and Infrastructure Strategies:

## Sharing Best Practices Around Creating Complete Communities, Drought Protection, and Water Management

**April 23, 2015**

**SPRING GENERAL ASSEMBLY AND BUSINESS MEETING**

Oakland Asian Cultural Center • 380 9th Street, Suite 290, Oakland

## AGENDA

**2:30 Registration**

**3:00 Welcome**

ABAG President and City of Clayton Councilmember **Julie Pierce**

Host City Welcome Council President Councilmember **Lynette Gibson McElhaney,** City of Oakland

**3[illegible]0 Opening Keynote**

**David Sedlak**, Professor, Department of Civil & Environmental Engineering, UC Berkeley
Co-director of Berkeley Water Center

**2050: The Year We Completed Our Urban Water Transformation**

Climate change, population growth, and concerns about water quality are putting pressure on the Bay Area's water system. As a result, future investments in urban water infrastructure likely will involve new technologies that radically alter water management. Drought resistant water sources must be developed. Urban drainage systems need to be upgraded to improve water quality while simultaneously preventing flooding. Bay Area communities have to prepare for the effects of increasing sea level. By imagining a future in which local governments have already transitioned to a more resilient, sustainable water system, we gain insight into some of the steps that must be taken to avoid the economic, social and environmental damage associated with a failure to address the coming changes.

**3[illegible]0 Preparing for 2050:**

**What water protective/conserving initiatives local governments & water districts are doing to prepare**

- Learn how municipalities plan and construct Green Streets to treat stormwater.
- Learn about General Plan Chapters and associated policies to protect creeks and other waterways.
- Share policies and ordinances that implement Green Streets and protect water resources.
- Learn how to finance infrastructure improvements in your jurisdiction -- Voter initiatives, Assessment Districts, and other measures to finance infrastructure.

Moderator: Supervisor **Karen Mitchoff**, Contra Costa County

**Steve Ritchie,** Assistant General Manager Water Enterprise, San Francisco Public Utilities Commission (SFPUC)

**Larry Patterson**, City Manager, City of San Mateo

**Sandi Potter**, Environmental Review & Comprehensive Planning Manager, Sonoma County, Former Mayor El Cerrito

**Jay Jasperse**, Chief Engineer, Sonoma County Water Agency

**4:50 Caucuses for Participants**

Three breakout sessions for jurisdictions of similar populations (small cities and towns, older suburbs, and larger cities) to discuss common challenges, opportunities, and relevant best practices.

**4:50 San Mateo Sustainable Streets Plan Presentation**

**Ken Chin**, Public Works Project Manager, City of San Mateo

**6:00 Business Meeting**

**6:30 Dinner and Annual Growing Smarter Together Awards**

Cover Photos: *Rob Woodson & ABAG Files*

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# Spring 2015 General Assembly and Business Meeting

**Online Packet | Agenda (PDF)**

**ABAG General Assembly**

**Thursday, April 23, 2015; 2:30 to 7:30 PM**

**Oakland Asian Cultural Center**

388 9th Street (Pacific Renaissance Plaza), Suite 290

# Green Streets and Infrastructure Strategies: Sharing Best Practices Around Creating Complete Communities, Drought Protection, and Water Management

**2:30 Registration**

**3:00 Welcome**

ABAG President and City of Clayton **Councilmember Julie Pierce**

**Host City Welcome**

**Councilmember Lynette Gibson McElhaney**, Council President, City of Oakland (invited)

**3:10 Opening Keynote**

**David Sedlak**, Professor, Department of Civil & Environmental Engineering, UC Berkeley
Co-director of Berkeley Water Center

***"2050: The Year We Completed Our Urban Water Transformation"***

Climate change, population growth, and concerns about water quality are putting pressure on the Bay Area's water system. As a result, future investments in urban water infrastructure likely will involve new technologies that radically alter water management. Drought-resistant water sources must be developed. Urban drainage systems need to be upgraded to improve water quality while simultaneously preventing flooding. Bay Area communities have to prepare for the effects of increasing sea level. By imagining a future in which local governments have already transitioned to a more resilient, sustainable water system, we gain insight into some of the steps that must be taken to avoid the economic, social and environmental damage associated with a failure to address the coming changes.

**3:40 Panel: Preparing for 2050**

***What water protective/conserving initiatives local governments & water districts are doing***

- Learn how municipalities plan and construct Green Streets to treat stormwater.
- Learn about General Plan Chapters and associated policies to protect creeks and other waterways.
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**Jay Jasperse**, Chief Engineer, Sonoma County Water Agency

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**4:50 San Mateo Sustainable Streets Plan Presentation**

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**6:00 Business Meeting**

**6:30 Dinner and Annual Growing Smarter Together Awards**

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## Spring 2015 General Assembly and Business Meeting

# Online Packet

Online Packet
Agenda (PDF)
Videos

1. **Oro Loma Horizontal Levee Project**

   The sea level in San Francisco Bay is rising, and climate change promises more extreme storms. To prepare for more flooding and wet weather, those in charge of the shoreline infrastructure now in harm's way are making plans, and one of them involves a 10-acre experiment on a field adjacent to the Oro Loma and Castro Valley wastewater treatment and purification plant in San Lorenzo. SFEP is a partner.

   - Fact Sheet: 4-Page Phone-Friendly
   - Project Overview: 8-pages

2. **David Sedlak's Speech and Introduction**

   - Sonoma County Riparian Corridor (RC) Combining District (2014)

- Sonoma County Water Efficient Landscape Ordinance (2009)

3. **Enhanced Infrastructure Finance District (EIFD) legislation (SB 628)**

   - League of California Cities legislative summary (PDF)

4. **Groundwater Legislation**

   - SGMA Fact Sheet (PDF)
   - Timeline (PDF)


101 Eighth St. Oakland CA 94607
(510) 464-7900 Contact Us

Association of Bay Area Governments

# ABAG General Assembly

## Registration List by Name

Spring 2015

| Name | Reg # | Organization | Title | Lunch | Paid | Cost | Balance |
|---|---|---|---|---|---|---|---|
| Acosta, Tony | 230 | City of Union City | City Manager | Sea Food | 75 | 75 | 0 |
| Adams, Charlie | 353 | ABAG | Interim Finance Director | Steak | 0 | 0 | 0 |
| Adams, Gillian | 365 | ABAG | Senior Regional Planner | No meal | 0 | 0 | 0 |
| Adams, Terry | 340 | ABAG | Interim Communications | Sea Food | 0 | 0 | 0 |
| Altman, Eric | 355 | City of American Canyon | Planning Commisisoner | Sea Food | 125 | 125 | 0 |
| Bacon, Vinnie | 282 | City of Fremont | Councilmember | Vegetarian | 95 | 95 | 0 |
| Battenberg, Cynthia | 231 | City of San Leandro | Community Development | Sea Food | 75 | 75 | 0 |
| Baudrimont, Adrien | 386 | ABAG | Assessment Intern | No meal | 0 | 0 | 0 |
| Bay, Duane | 338 | ABAG | Assistant Planning Directo | Steak | 0 | 0 | 0 |
| Berg, Jennifer | 341 | ABAG | BayREN Project Manager | Sea Food | 0 | 0 | 0 |
| Bernald, Mary-Lynne | 296 | City of Saratoga | Councilmember | Sea Food | 95 | 95 | 0 |
| Biddle, Don | 297 | City of Dublin | Councilmember | No meal | 95 | 95 | 0 |
| Bonilla, Rick | 292 | City of San Mateo | Councilmember | Steak | 95 | 95 | 0 |
| Bradt, Joshua | 346 | ABAG | Watershed Specialist, Pro | Steak | 0 | 0 | 0 |
| Braunstein , David | 377 | City of Belmont | Mayor | No meal | 95 | 95 | 0 |
| Brechwald, Dana | 334 | ABAG | Resilience Planner | Steak | 0 | 0 | 0 |
| Campbell, Carmela | 233 | City of Union City | Planning Manager | Steak | 75 | 75 | 0 |
| Carlson, Ken | 313 | City of Pleasant Hill | Mayor | Steak | 95 | 95 | 0 |
| Carroll, Kelly | 378 | West Valley Clean Water | Program Manager | No meal | 95 | 95 | 0 |
| Castro, Fred | 326 | ABAG | Clerk of the Board | Steak | 0 | 0 | 0 |
| Chan, Susanna | 293 | City of Los Altos | Public Works Director | Steak | 95 | 95 | 0 |
| Charles, Wally | 339 | ABAG | Administrative Assistant | Sea Food | 0 | 0 | 0 |
| Chavez, Cindy | 275 | Santa Clara County Board | Supervisor | Steak | 95 | 95 | 0 |
| Chin, Kenneth | 364 | City of San Mateo | Project Manager II | No meal | 0 | 0 | 0 |
| Chion, Miriam | 330 | ABAG | Planning & Research Dire | Sea Food | 0 | 0 | 0 |
| Clark, Chris | 317 | City of Mountain View | Councilmember | No meal | 0 | 0 | 0 |
| Cooper, Brent | 362 | City of American Canyon | Community Development | Steak | 125 | 125 | 0 |
| Cox, Deborah | 262 | City of San Leandro | Councilmember | Steak | 95 | 95 | 0 |
| Craig, Burton | 234 | City of Monte Sereno | Councilmember | Sea Food | 95 | 95 | 0 |
| Dickson, Charlotte | 343 | CA Center for Public Heal | Sr Policy Director Norther | Vegetarian | 0 | 0 | 0 |
| Donahue, Scott | 379 | City of Emeryville | Councilmember | Sea Food | 95 | 95 | 0 |
| Droste, Lori | 344 | City of Berkeley | Councilmember | No meal | 95 | 95 | 0 |
| Dunbar, John | 236 | Town of Yountville | Mayor | Sea Food | 95 | 95 | 0 |
| Duncan, Emily | 237 | City of Union City | Councilmember | No meal | 95 | 95 | 0 |
| Dutra-Vernaci, Carol | 276 | City of Union City | Mayor | Sea Food | 0 | 0 | 0 |
| Eklund, Pat | 238 | City of Novato | Mayor Pro Tem | Sea Food | 95 | 95 | 0 |
| Ervin, Karen | 371 | City of Pacifica | Mayor | Steak | 95 | 95 | 0 |
| Evanoff, Mark | 239 | City of Union City | Interim Deputy City Mana | Sea Food | 75 | 75 | 0 |
| Ezzy Ashcraft, Marilyn | 367 | City of Alameda | Councilmember | Sea Food | 95 | 95 | 0 |
| Fabry, Matt | 298 | County of San Mateo | | No meal | 190 | 95 | 95 |
| Farmer, Casey | 368 | Office of Councilmember | Policy Director | No meal | 0 | 0 | 0 |
| Ferguson, Guy | 263 | City of Fremont | Management Analyst | Steak | 95 | 95 | 0 |
| Flores, John | 372 | City of Oakland | Interim City Administrator | Sea Food | 95 | 95 | 0 |
| Friedman, Mark | 291 | City of El Cerrito | Mayor | No meal | 95 | 95 | 0 |
| Garcia, Leon | 240 | City of American Canyon | Mayor | Sea Food | 95 | 95 | 0 |
| Gharib, Nancy | 383 | No Violation, Inc. | Account Manager | Sea Food | 125 | 125 | 0 |
| Gibson McElhaney, Lyn | 283 | City of Oakland | Councilmember/Council P | No meal | 0 | 0 | 0 |
| Gilmore, Tonya | 241 | City of Orinda | Senior Management Anal | Sea Food | 95 | 95 | 0 |
| Goddard, Renee | 273 | Town of Fairfax | Vice Mayor | Vegetarian | 95 | 95 | 0 |
| Grayson, Timothy | 242 | City of Concord | Mayor | Steak | 95 | 95 | 0 |
| Gupta, Ph.D., Dr. Prade | 299 | City of South San Francis | Councilmember | Vegetarian | 0 | 0 | 0 |
| Haggerty, Scott | 348 | County of Alameda | Supervisor | Steak | 95 | 95 | 0 |
| Hampton, David | 260 | City of Rio Vista | Vice Mayor | Steak | 95 | 95 | 0 |

| Name | Reg # | Organization | Title | Lunch | Paid | Cost | Balance |
|---|---|---|---|---|---|---|---|
| Harper, Wade | 311 | City of Antioch | Mayor | Sea Food | 95 | 95 | 0 |
| Harrison, Bill | 277 | City of Fremont | Mayor | Steak | 0 | 0 | 0 |
| Harvey, Susan | 295 | City of Cotati | Councilmember | Sea Food | 95 | 95 | 0 |
| Herrera Spencer, Trish | 300 | City of Alameda | Mayor | Sea Food | 0 | 0 | 0 |
| Hudson, Dave | 243 | City of San Ramon | Councilmember | Steak | 95 | 95 | 0 |
| Hughes, Norm | 264 | City of Fremont | Public Works Director | Steak | 75 | 75 | 0 |
| Hunt, Curtis | 244 | City of Vacaville | Vice Mayor | Steak | 95 | 95 | 0 |
| Hutar, Nancy | 245 | City of Fremont | Consultant | Sea Food | 95 | 95 | 0 |
| Isaac, Justin | 381 | ABAG | Supply Clerk | Vegetarian | 0 | 0 | 0 |
| Jackson, Jessica | 301 | City of Mill Valley | Councilmember | Sea Food | 95 | 95 | 0 |
| Jasperse, Jay | 316 | Sonoma County Water Ag | Chief Engineer & Director, | No meal | 0 | 0 | 0 |
| Johnson, Cameron | 246 | City of San Carlos | Vice Mayor | Sea Food | 95 | 95 | 0 |
| Johnson, Victoria | 349 | City of Alameda | Director of Housing and C | No meal | 95 | 95 | 0 |
| Kelly, Doug | 265 | Town of San Anselmo | Vice Mayor | Steak | 95 | 95 | 0 |
| Kelly, Judy | 332 | ABAG | Director, SFEP | Sea Food | 0 | 0 | 0 |
| Kho, Karen | 302 | StopWaste: Energy Coun | Senior Program Manager | Sea Food | 75 | 75 | 0 |
| Kinney, Rich | 266 | City of San Pablo | Vice Mayor | Steak | 95 | 95 | 0 |
| Kleinschmidt, Kirk | 345 | Kaiser Permanente | Director Government Rela | Sea Food | 0 | 0 | 0 |
| Krebs, Jennifer | 327 | ABAG | Principal Environmental | Vegetarian | 0 | 0 | 0 |
| Kroll, Cynthia | 336 | ABAG | Chief Economist | Sea Food | 0 | 0 | 0 |
| Kurrasch, Art | 310 | Housing Authority of the C | Chair, Board of Commissi | Sea Food | 95 | 95 | 0 |
| Kwak, Alina | 267 | City of Fremont | Management Analyst II | Steak | 75 | 75 | 0 |
| Larson, Heather | 272 | StopWaste | Green Building Program | Sea Food | 0 | 0 | 0 |
| Lee, Benny | 284 | City of San Leandro | Councilmember | Steak | 75 | 75 | 0 |
| Leffall, Christy | 337 | ABAG | Regional Planner | Sea Food | 0 | 0 | 0 |
| Lewis, Elizabeth | 229 | Town of Atherton | Vice Mayor | Steak | 95 | 95 | 0 |
| Liao, Tom | 247 | City of San Leandro | Deputy Community Devel | Sea Food | 75 | 75 | 0 |
| Lopez, Corina | 274 | City of San Leandro | Councilmember | Sea Food | 75 | 75 | 0 |
| Lounds, Darin | 303 | Housing Consortium of th | Executive Director | Sea Food | 75 | 75 | 0 |
| Lovell, Justin | 347 | City of South San Francis | Assistant to the City Mana | Steak | 95 | 95 | 0 |
| Luce, Darcie | 376 | ABAG | Administrative Environme | No meal | 0 | 0 | 0 |
| Luce, Mark | 369 | County of Napa | Supervisor - District 2 | Steak | 95 | 95 | 0 |
| Lyman, Greg | 285 | City of El Cerrito | Mayor Pro Tem | Sea Food | 95 | 95 | 0 |
| Mackenzie, Jake | 356 | City of Rohnert Park | Councilmember | Steak | 95 | 95 | 0 |
| Malloy, Joan | 248 | City of Union City | Economic and Community | No meal | 95 | 95 | 0 |
| Martinez, Eduardo | 278 | City of Richmond | Councilmember | Steak | 95 | 95 | 0 |
| Martin-Milius, Tava | 235 | City of Sunnyvale | Vice Mayor | Steak | 95 | 95 | 0 |
| Matthews, Jamie | 249 | City of Santa Clara | Mayor | Steak | 95 | 95 | 0 |
| McCoy, Sherry | 286 | City of Hercules | Mayor | Steak | 95 | 95 | 0 |
| McGallian, Tim | 268 | City of Concord | Planning Commissioner | Steak | 75 | 75 | 0 |
| Mehra, Sailesh | 380 | City of South San Francis | Senior Planner | Sea Food | 95 | 95 | 0 |
| Mei, Lily | 304 | City of Fremont | Councilmember | Steak | 75 | 75 | 0 |
| Mieler, Danielle | 331 | ABAG | Resilience Program Coor | No meal | 0 | 0 | 0 |
| Mitchoff, Karen | 315 | County of Conta Costa | Supervisor | No meal | 0 | 0 | 0 |
| Mitchoff, Karen | 314 | Contra Costa County | Supervisor | No meal | 0 | 0 | 0 |
| Morrison, Carl | 385 | Bay Area Flood Protection | Executive Director | Sea Food | 125 | 125 | 0 |
| Moy, Kenneth | 324 | ABAG | Legal Counsel | Steak | 0 | 0 | 0 |
| Munoz, Polo | 350 | MidPen Housing | Project Manager | Steak | 75 | 75 | 0 |
| Nagraj, Adhi | 250 | BRIDGE Housing Corpora | Senior Project Manager | Sea Food | 75 | 75 | 0 |
| Natarajan, Anu | 320 | MidPen Housing Corporat | Director of Policy & Advoc | Vegetarian | 125 | 125 | 0 |
| Navarro, Tyrone | 363 | City of American Canyon | Planning Commisisoner | Sea Food | 125 | 125 | 0 |
| Ng, Eileen | 319 | County of Alameda - Nate | Operations Chief | No meal | 125 | 125 | 0 |
| Nguyen, Cliff | 269 | City of Fremont | Urban Initiatives Manager | Steak | 95 | 95 | 0 |
| Nihart, Mary Ann | 357 | City of Pacifica | Councilmember | Sea Food | 95 | 95 | 0 |
| Novenario, Cedric | 294 | City of Los Altos | Transportation Manager | Steak | 95 | 95 | 0 |
| Onoda, Teresa | 321 | Town of Moraga | Councilmember | Sea Food | 95 | 95 | 0 |
| Patterson, Elizabeth | 287 | City of Benicia | Mayor | Vegetarian | 95 | 95 | 0 |
| Patterson, Larry A. | 358 | City of San Mateo | City Manager | No meal | 0 | 0 | 0 |
| Paul, Brad | 335 | ABAG | Deputy Executive Director | Sea Food | 0 | 0 | 0 |
| Paul, Darcy | 251 | City of Cupertino | Councilmember | Steak | 95 | 95 | 0 |
| Paul, Wesley | 359 | | | Steak | 125 | 125 | 0 |

| Name | Reg # | Organization | Title | Lunch | Paid | Cost | Balance |
|---|---|---|---|---|---|---|---|
| Phillips, Eve | 252 | City of Orinda | Councilmember | Sea Food | 95 | 95 | 0 |
| Pierce, Barbara | 253 | City of Redwood City | Councilmember | Steak | 95 | 95 | 0 |
| Pierce, Julie | 312 | City of Clayton | ABAG President and Cou | Steak | 0 | 0 | 0 |
| Pilch, Nick | 318 | City of Albany | Councilmember | Sea Food | 95 | 95 | 0 |
| Potter, Debbie | 305 | City of Alameda | Community Development | Vegetarian | 95 | 95 | 0 |
| Potter, Sandi | 306 | County of Sonoma Permit | Environmental Review & | Sea Food | 0 | 0 | 0 |
| Putnam, Elizabeth | 360 | City of American Canyon | Planning Commisisoner | Vegetarian | 125 | 125 | 0 |
| Quinto, Gabriel | 288 | City of El Cerrito | Councilmember | Steak | 95 | 95 | 0 |
| Rabbitt, David | 307 | County of Sonoma | ABAG Vice President and | Steak | 95 | 95 | 0 |
| Rapport, Ezra | 329 | ABAG | Executive Director | Steak | 0 | 0 | 0 |
| Reed, Ursula | 279 | City of San Leandro | Councilmember | Sea Food | 75 | 75 | 0 |
| Rice, Katie | 373 | County of Marin | Supervisor | No meal | 0 | 0 | 0 |
| Ritchie, Steve | 351 | San Francisco Public Utilit | Assistant General Manag | No meal | 0 | 0 | 0 |
| Russo Cutter, Pauline | 352 | City of San Leandro | Mayor | Vegetarian | 0 | 0 | 0 |
| Rutherford, Vicki | 323 | ABAG | Communications/Graphic | Steak | 0 | 0 | 0 |
| Sampayan, Bob | 289 | City of Vallejo | Councilmember | Steak | 95 | 95 | 0 |
| Sayoc, Marico | 280 | Town of Los Gatos | Councilmember | Vegetarian | 95 | 95 | 0 |
| Scandone, Ceil | 374 | ABAG | | No meal | 0 | 0 | 0 |
| Schultze-Allen, Peter | 370 | EOA Inc. | Senior Scientist | No meal | 0 | 0 | 0 |
| Sedlak, David | 281 | UC Berkeley | Professor, Department of | Vegetarian | 0 | 0 | 0 |
| Sedlak, Meg | 290 | San Francisco Estuary Ins | Environmental Scientist | Vegetarian | 0 | 0 | 0 |
| Shorett, Mark | 387 | ABAG | Regional Planner | No meal | 0 | 0 | 0 |
| Simpson, Laura | 261 | City of Concord | Planning Manager | Sea Food | 95 | 95 | 0 |
| Sommer, Wendy | 308 | StopWaste: Energy Coun | Deputy Executive Director | Sea Food | 75 | 75 | 0 |
| Storer, Robert | 254 | Town of Danville | Councilmember | No meal | 95 | 95 | 0 |
| Sweeney, Caitlin | 333 | ABAG | Senior Environmental Spe | No meal | 0 | 0 | 0 |
| Tabet, George | 384 | No Violation, Inc. | Marketing Director | Sea Food | 125 | 125 | 0 |
| Tse, Bryan | 328 | ABAG | Senior Supply Clerk | Steak | 0 | 0 | 0 |
| Tsen, V. Fei | 354 | Tsen & Associates | President | Steak | 75 | 75 | 0 |
| Twa, David | 255 | Contra Costa County | County Administrator | Sea Food | 95 | 95 | 0 |
| von Borck, Jessica | 256 | City of Fremont | Assistant City Manager | Sea Food | 95 | 95 | 0 |
| Waldeck, Gary | 257 | Town of Los Altos Hills | Mayor | Steak | 95 | 95 | 0 |
| Walker, Victoria | 271 | City of Concord | Director of Community an | Sea Food | 95 | 95 | 0 |
| Warner, Jason | 375 | Ora Loma Sanitary Distric | General Manager | No meal | 0 | 0 | 0 |
| Wheeler, Kristie | 258 | City of Fremont | Planning Manager | Sea Food | 95 | 95 | 0 |
| Williams, Michelle M. | 322 | ABAG | Registration Coordinator | Sea Food | 0 | 0 | 0 |
| Winter, Marty | 259 | City of Belvedere | Councilmember | No meal | 95 | 95 | 0 |
| Wolff, Gary | 382 | StopWaste | Executive Director | Sea Food | 95 | 95 | 0 |
| Wong, Hing | 366 | ABAG | Senior Regional Planner | Steak | 0 | 0 | 0 |
| Wong, Sandy | 309 | County of San Mateo | Executive Director of C/C | No meal | 190 | 95 | 95 |
| Works, Rose | 342 | Kaiser Permanente | Sr Government Relations | Vegetarian | 0 | 0 | 0 |
| Zapata, Chris | 270 | City of San Leandro | City Manager | Vegetarian | 75 | 75 | 0 |
| Zipay, Bernie | 361 | City of American Canyon | Planning Commisisoner | Steak | 125 | 125 | 0 |
| Zippert, Leah | 325 | ABAG | Communications Officer | Steak | 0 | 0 | 0 |

**Total Number of Registrations 158**

# SUSTAINABLE STREETS PLAN

## CITY OF SAN MATEO

ABAG GENERAL ASSEMBLY

APRIL 23, 2015

DEPARTMENT OF PUBLIC WORKS
STEWARDS OF THE INFRASTRUCTURE AND ENVIRONMENT

# Overview

Background

Sustainable Streets Plan

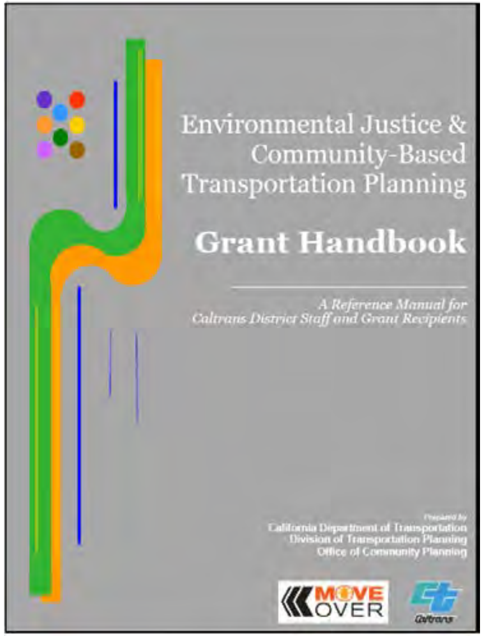
- Goals and Policies
- Recommended Programs
- Recommended Projects

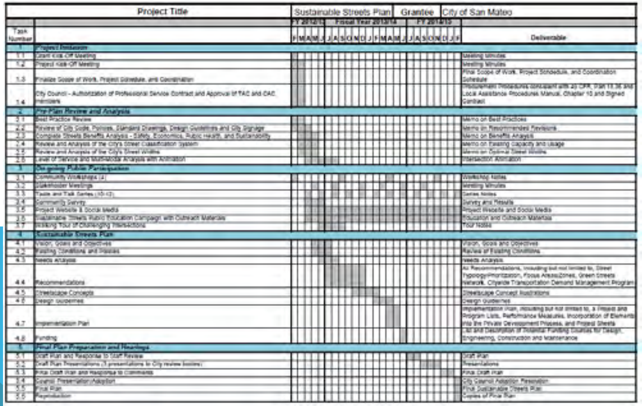
Next Steps

# PROJECT BACKGROUND

Caltrans Community-Based Transportation Planning Grant

- $300k Grant + $184k Local Match
- February 2013 – February 2015



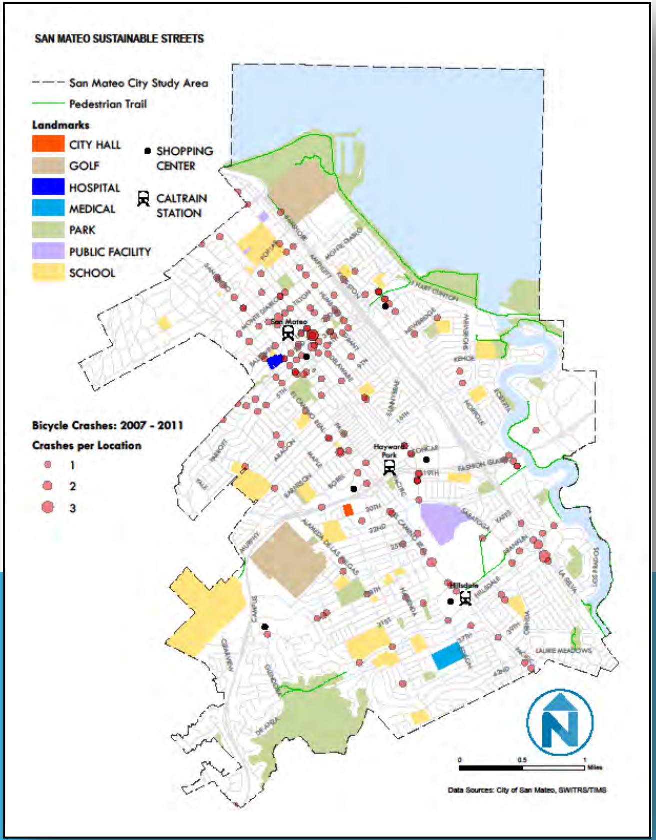
# DEFINITIONS

- **Complete Streets** are safe, comfortable, and convenient for travel for everyone, regardless of age or ability and includes motorists, pedestrians, bicyclists, and public transportation riders.

- **Green Streets** have enhanced stormwater runoff improvements that capture, slows, filters, and potentially infiltrates stormwater runoff. (Defined by the San Mateo County Sustainable Green Streets and Parking Lots Design Guidebook)

# EXISTING CONDITIONS & RESEARCH

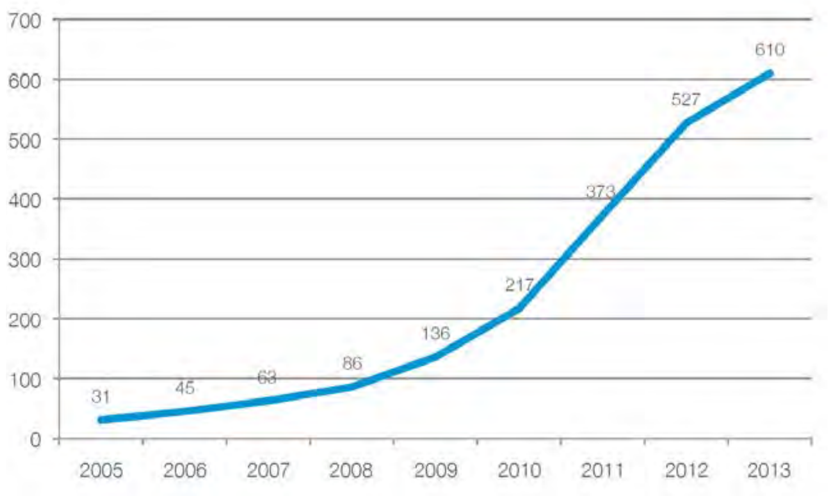
- Local Context/Existing Conditions
  - Existing plans and policies
  - Municipal Code
  - Current transportation conditions and trends



# Existing Conditions & Research

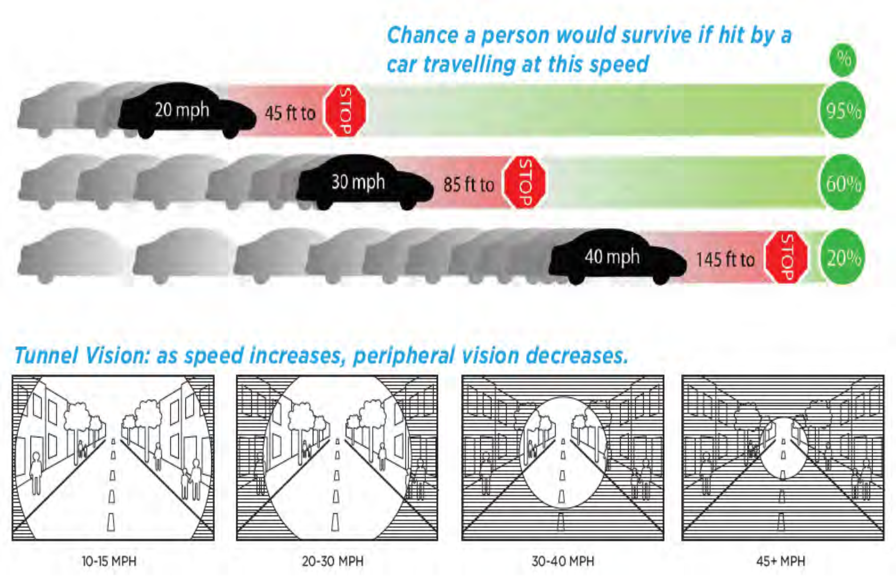
- Teaming with the National Complete Streets Coalition
- Taking best practices from communities nationwide

Number of Complete Streets Policies Nationwide, 2005-2013



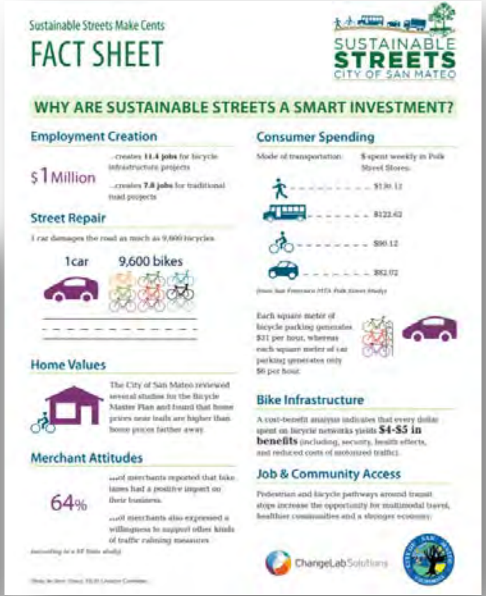
# Existing Conditions & Research

- Complete Streets Best Practices and Impacts
  - Public health benefits
  - Increased mobility, access, and safety
  - Reduced congestion and emissions
  - Opportunities for Green Streets
    - Reduced costs
    - Advancement of sustainability initiatives
  - Economic impacts



# PUBLIC OUTREACH

- Three workshops
- Community survey
- Taste and Talk Series
- Fact sheets



Sustainable Streets Make Cents

FACT SHEET

SUSTAINABLE STREETS CITY OF SAN MATEO

WHY ARE SUSTAINABLE STREETS A SMART INVESTMENT?

**Employment Creation**

$1 Million

...creates **11.4 jobs** for bicycle infrastructure projects

...creates **7.8 jobs** for traditional road projects

**Street Repair**

1 car damages the road as much as 9,600 bicycles

1car 9,600 bikes

**Home Values**

The City of San Mateo reviewed several studies for the Bicycle Master Plan and found that home prices near trails are higher than home prices farther away

**Merchant Attitudes**

64%

...of merchants reported that bike lanes had a positive impact on their business.

...of merchants also expressed a willingness to support other kinds of traffic calming measures

**Consumer Spending**

Mode of transportation / $ spent weekly in Polk Street Stores

Each square meter of bicycle parking generates $31 per hour, whereas each square meter of car parking generates only $6 per hour

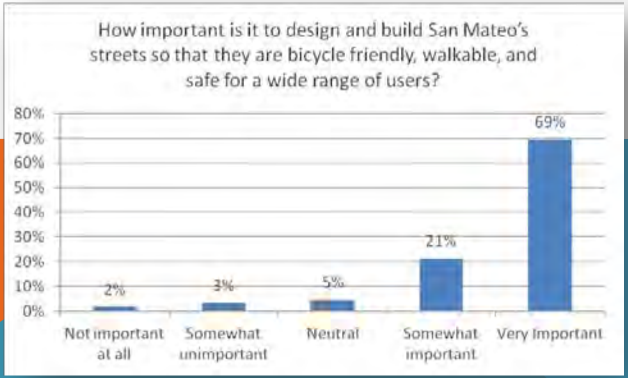
**Bike Infrastructure**

A cost-benefit analysis indicates that every dollar spent on bicycle networks yields **$4-$5 in benefits** (including, security, health effects, and reduced costs of motorized traffic).

**Job & Community Access**

Pedestrian and bicycle pathways around transit stops increase the opportunity for multimodal travel, healthier communities and a stronger economy.

ChangeLab Solutions




# Stakeholder Walking Tour

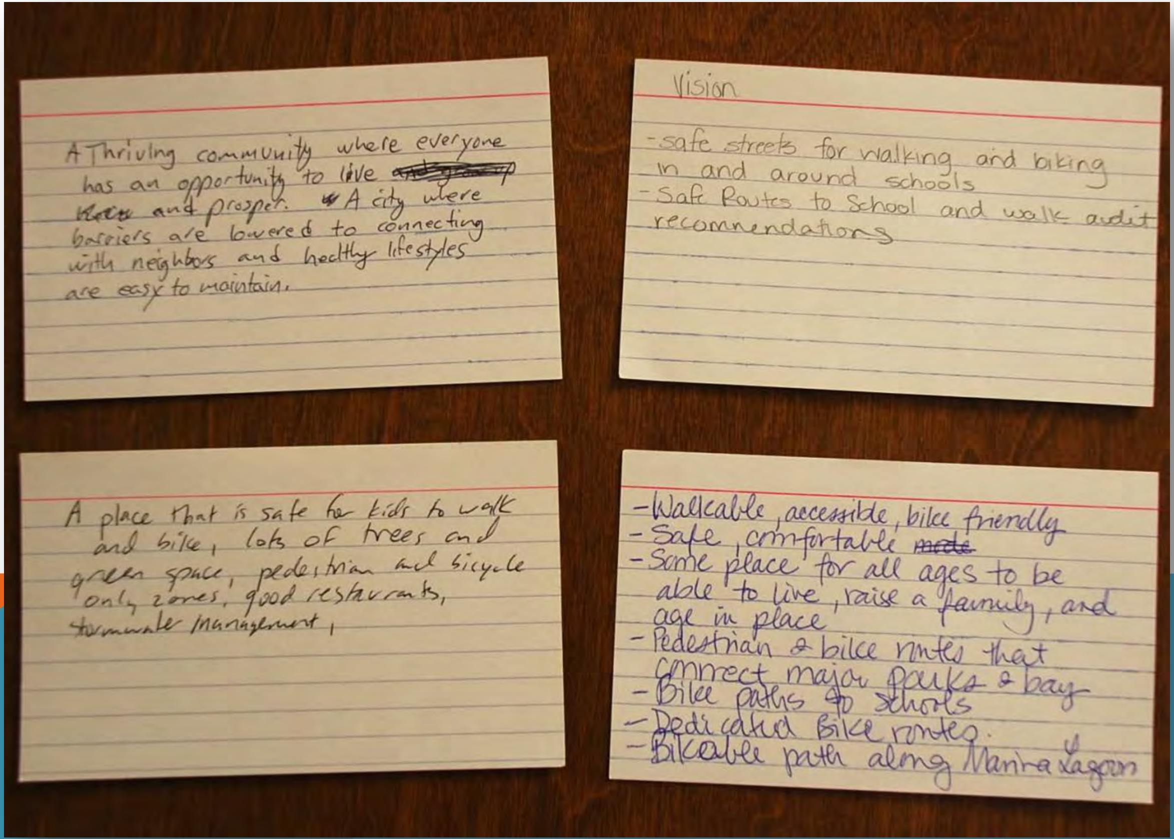

January 2014

# COMMUNITY DESIGN WORKSHOP


September 2013

# Community Vision

Thriving community… Opportunity to live and prosper… connect with neighbors… healthy lifestyles




Safe streets for walking biking to schools

Safe for kids to walk and bike, lots of trees and green space…

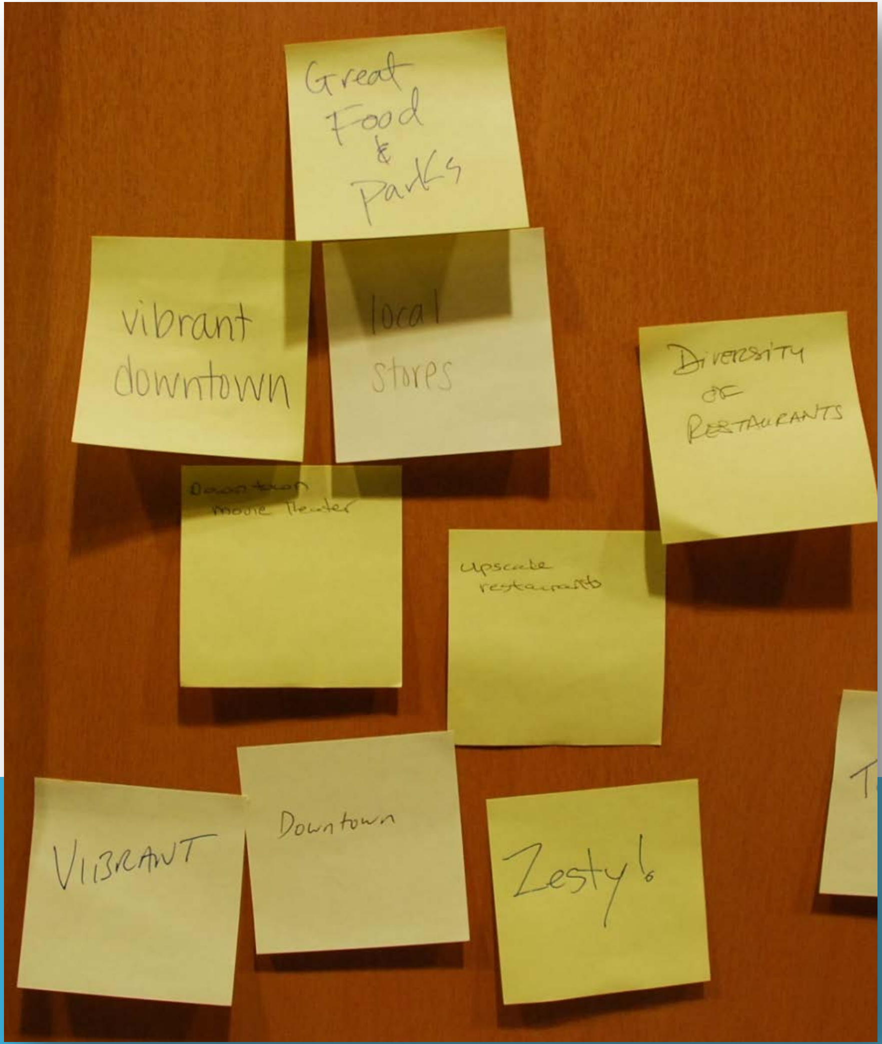
Walkable, accessible, bike-friendly place for all ages to live, raise a family and age in place

September 2013

# Community Values

- Community/Friendship
- Environment/Parks/Beauty
- Vibrant Downtown
- Safety
- Location
- Weather/Climate
- Walkable/Transit Access
- Healthy
- Family

September 2013



# WORKSHOP #2: RECOMMENDATIONS

- Review of draft recommendations
  - Goals
  - Design guidelines
  - Performance metrics
  - Green infrastructure
  - Design process
- Design Exercise


# Taste & Talk Speaker Series


- Sex and Neuroscience
- Keys to Complete Streets
- Green Streets
- Transportation Network
- Health
- Parking
- Bike and Pedestrian Solutions
- Public Space
- Economic Benefits
- Wrap-Up

SUSTAINABLE STREETS
CITY OF SAN MATEO

# Project Website

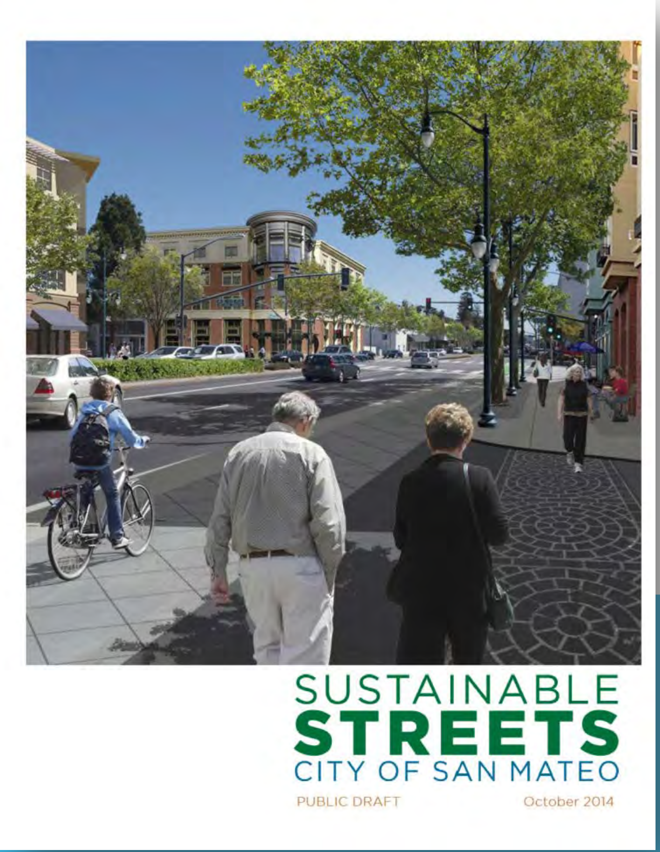
www.sustainablestreetssanmateo.com

# SUSTAINABLE STREETS PLAN

DEPARTMENT OF PUBLIC WORKS
STEWARDS OF THE INFRASTRUCTURE AND ENVIRONMENT

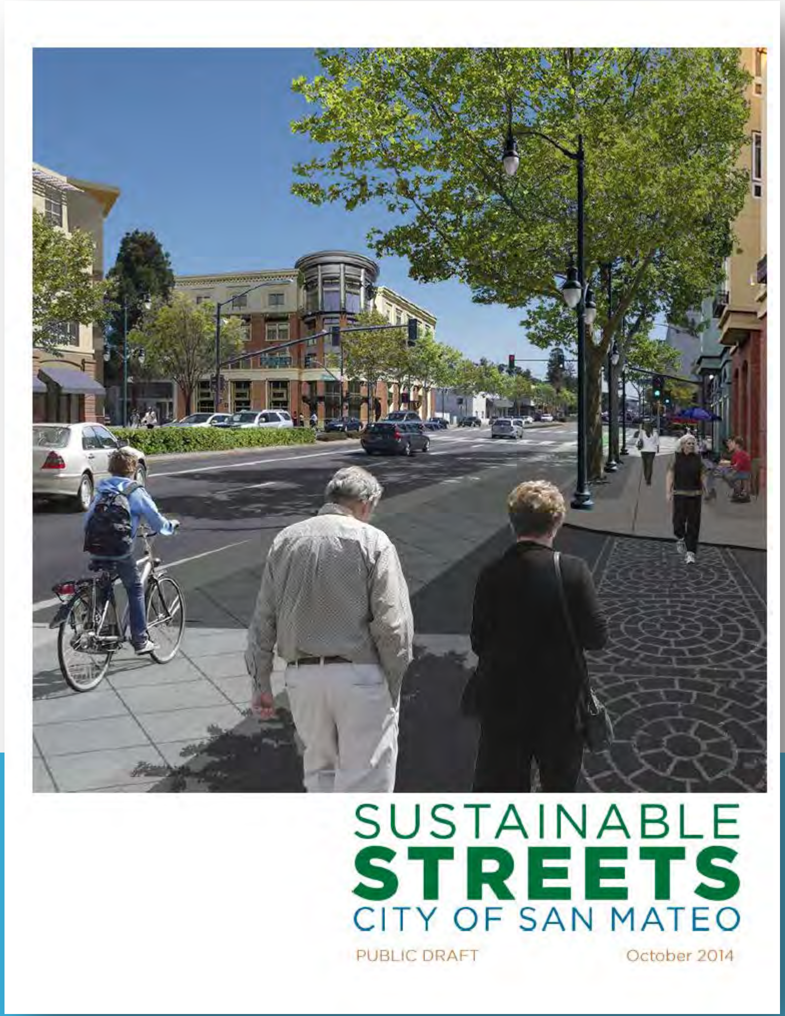
# Draft Sustainable Streets Plan

- Download at www.sustainablestreetssanmateo.com/downloads/
- 3 Main Components
  - Sustainable Streets Plan
  - Appendices
  - Street Design Guidelines



# Plan Components

- Vision, Goals, Objectives and Policies
- Design Guidelines
- Recommended Programs
- Recommended Projects



# Vision

*"A transportation system that is sustainable, safe, and healthy and supports a sense of community and active living, where walking, bicycling, and transit are integral parts of daily life."*

*"Roadways that are comfortable and convenient for the breadth of travel choices and that improve water quality and reduce other environmental impacts while creating more vital places that fit with desired community character."*

# GOALS

- Goal 1: Safety and Vision Zero
- Goal 2: Mobility
- Goal 3: Infrastructure and Support Facilities
- Goal 4: Programs
- Goal 5: Equity
- Goal 6: Implementation

# Highlighted Goals & Policies

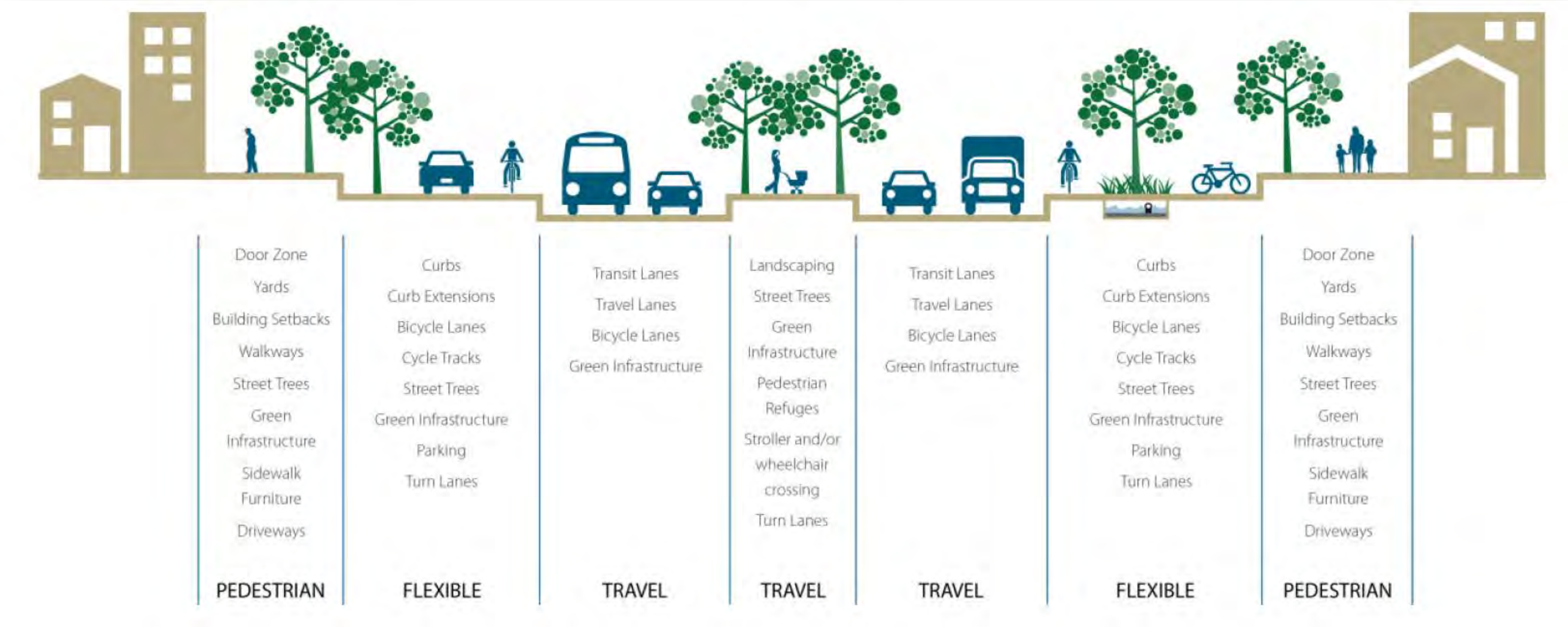
- Goal 1: Safety and Vision Zero - To ensure that human life and health are paramount and take priority over mobility and other road traffic system objectives, improve safety through the design and maintenance of sidewalks, streets, intersections, and other roadway improvements such as signage, lighting, and landscaping, as well as best practice programs to enhance and improve the overall safety.
- Goal 6: Implementation – Implement the Sustainable Streets Plan over the next 20 years.

# Highlighted Goals & Policies

Policy 3.A.2 – Adopt the NACTO Urban Street Design Guide and Bikeway Design Guide as a supplement to the Sustainable Streets Design Guidelines and the California Manual for Uniform Traffic Control Devices.

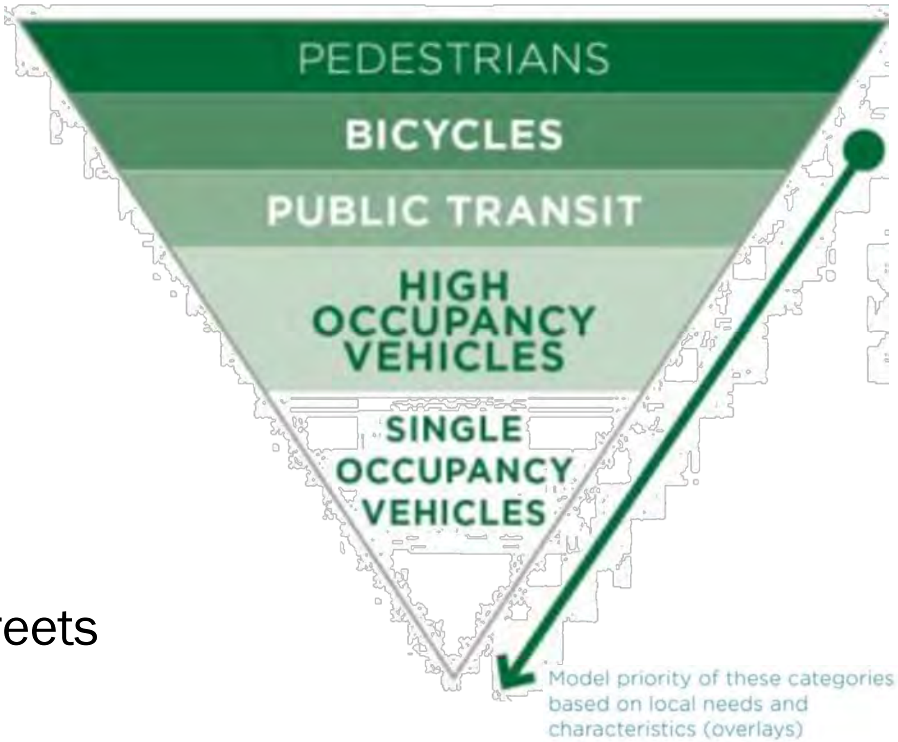
Policy 3.D.1 – Manage stormwater runoff using green infrastructure from 10% of roadway segments citywide and from 20% of roadway segments within the Downtown and PDAs within the City by the year 2050.

# Realms of the Street

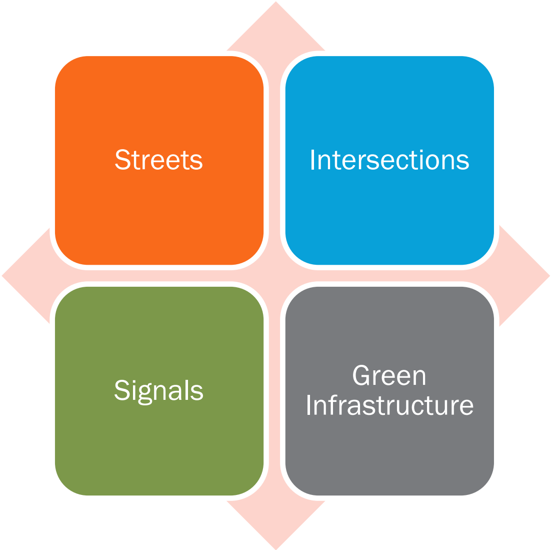


# Street Design Principles

- Pedestrians are top priority
- Local priorities above regional needs
- Accommodation for all users
- Safety through design
- Action, observation, improvement
- Sustainable Streets include Green Streets
- Design proactively, not reactively

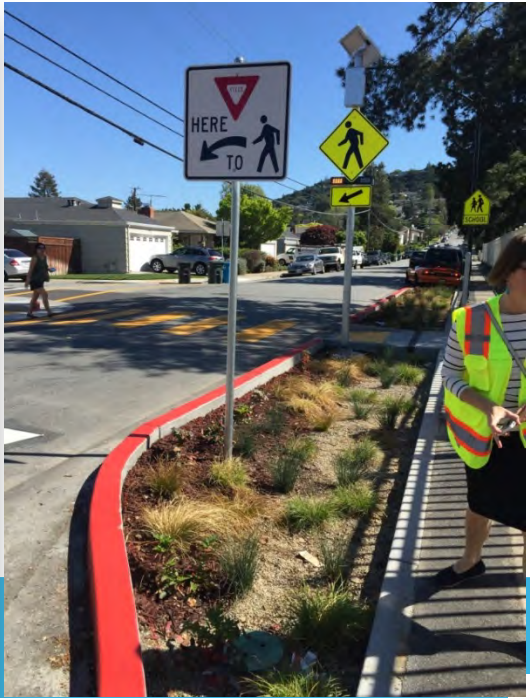


# Intersection Design Principles




- Make Intersections Compact and Simple
- Analyze Intersections as a Network
- Design Intersections Using Space and Time
- Build for the Present, Accommodate the Future
- Manage Speed Through Intersections
- Minimize Delay for All Modes

# Green Infrastructure Examples

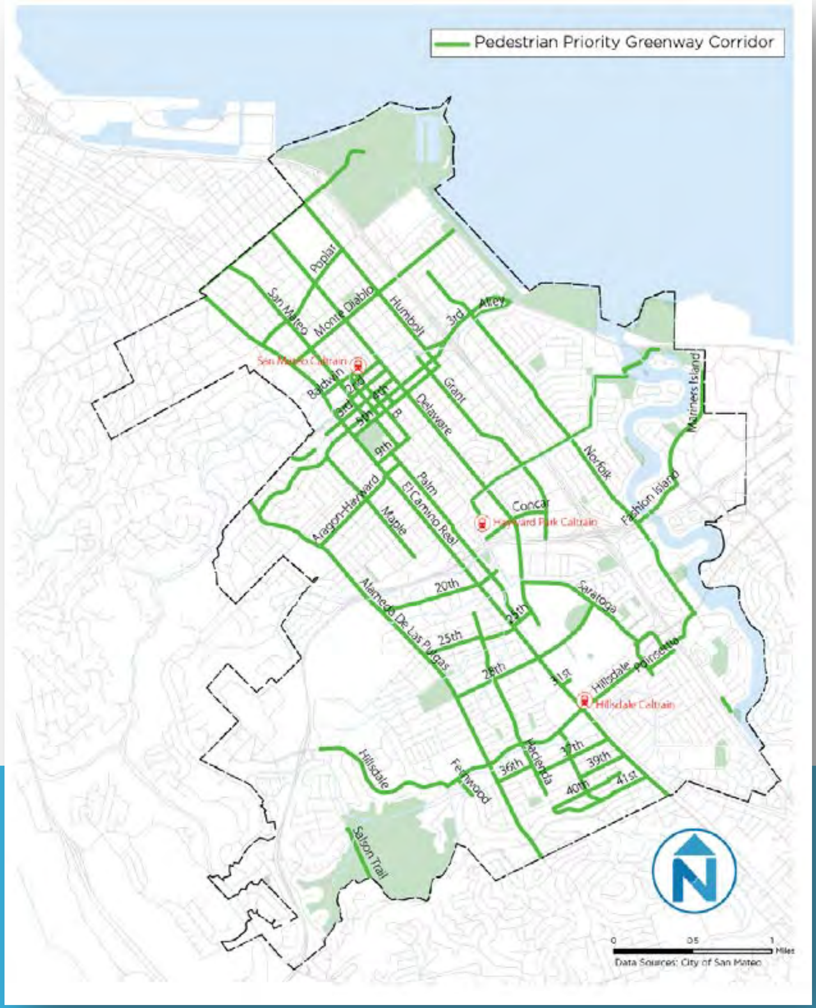






SUSTAINABLE STREETS
CITY OF SAN MATEO

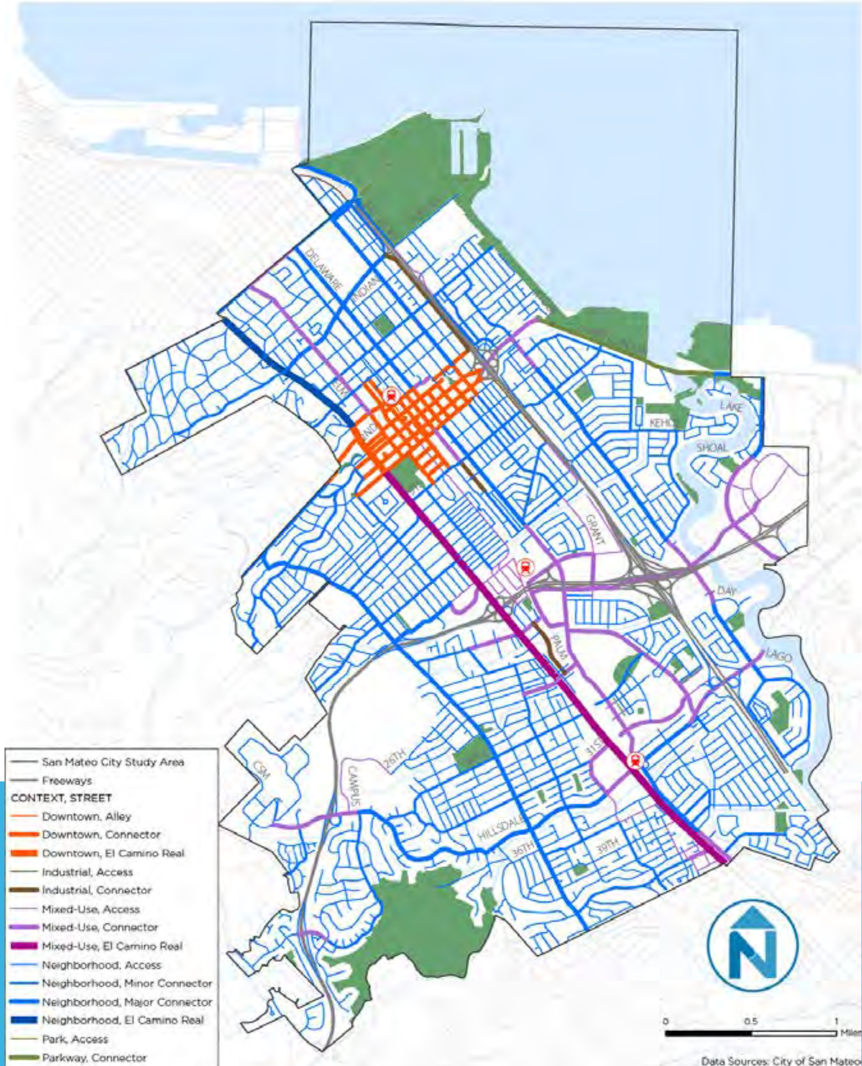
# Overlays

- Pedestrian Greenway Network
- Suggested Routes to Schools
- Bicycle Priority Streets
- Transit Streets
- Freight Routes
- Caltrain Station Areas
- Downtown San Mateo
- Emergency Routes

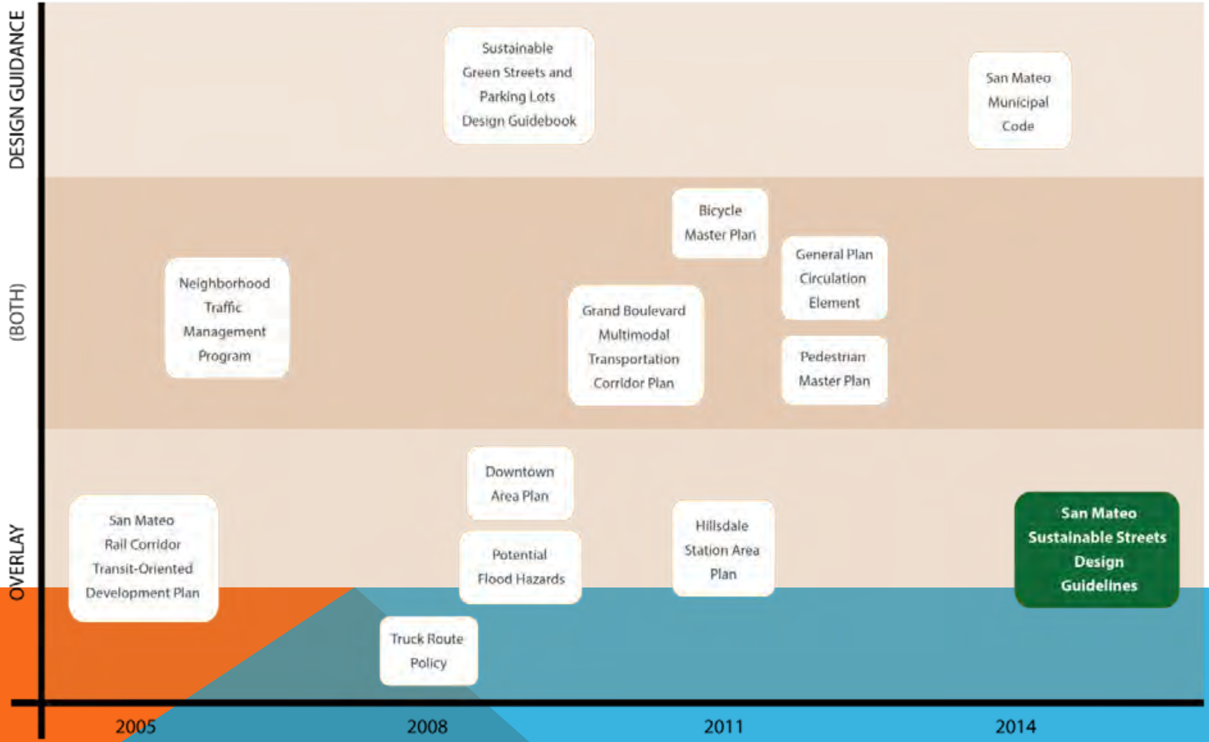


# DESIGN GUIDELINES

- Establish a framework for the classification of streets (typologies and overlays)



# Design Guidelines




- Establish specific design principles and guidance
- Integrate green infrastructure

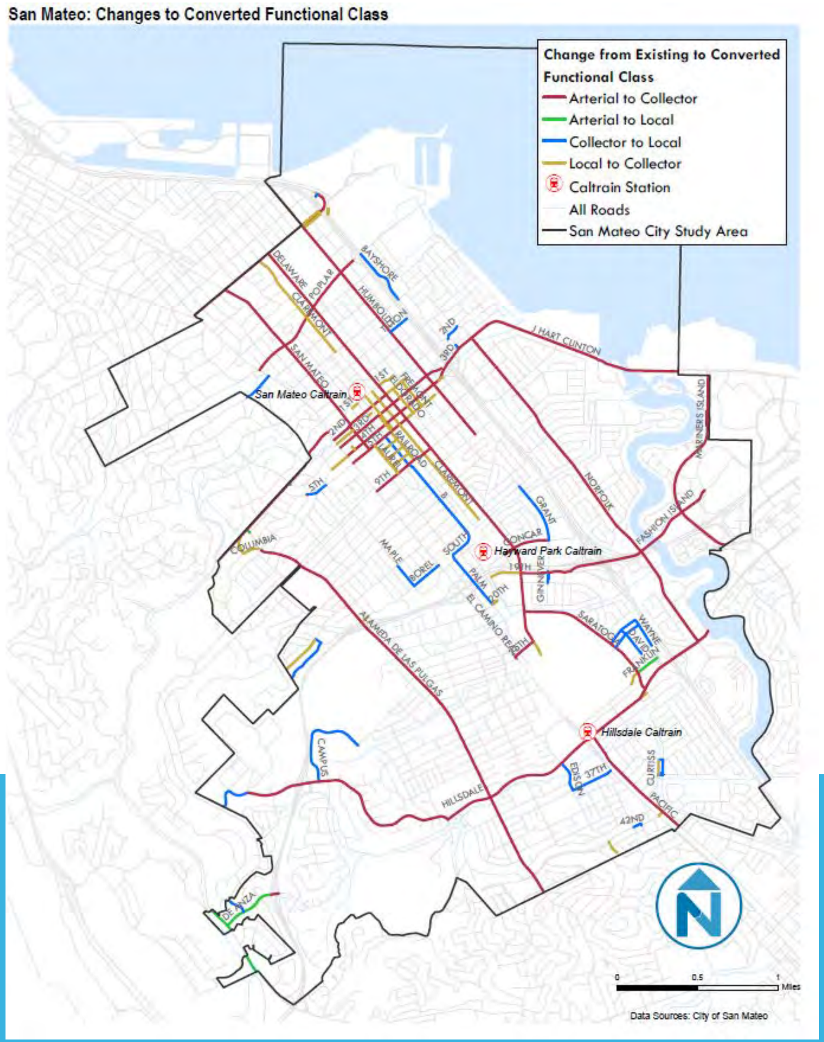
# Design Guidelines

- Street Classification Revisions

FIGURE D- 9 ACTUAL ADT RELATIVE TO STREET CLASSIFICATION LIMITS

| | BELOW | WITHIN | ABOVE |
|---|---|---|---|
| Freeway | 100% | 0% | 0% |
| Arterial | 78% | 22% | 0% |
| Collector | 11% | 86% | 2% |
| Local | 43% | 30% | 28% |

Source: City of San Mateo. Based on sample of ADT values from throughout the city.



# Vision Zero

- “No loss of life is acceptable” on San Mateo streets
- Emphasis on complete streets and traffic calming to reduce injury incidence and severity

# Level of Service (LOS)

- LOS emphasizes automobile trips
- SB 743 – Removal of LOS from California Environmental Quality Act (CEQA) analysis
- Recommendation - Replace LOS analysis with Vehicle Miles Traveled (VMT) per Capita analysis

# Performance Metrics

- **Citywide:** measuring citywide trends related to sustainable transportation
- **Development:** measuring the multimodal success and impacts of new development projects
- **Corridor:** measuring multimodal performance of new sustainable streets projects on a corridor level

# Sustainable Streets Fee

- The existing Transportation Improvement Fee is based exclusively on private development impacts on congestion, measured using LOS.
- Recommendation - that the city replace the current Transportation Improvement Fee with a Sustainable Streets Fee that would focus on projects that support the goals of the Plan by improving conditions for all modes.

# Citywide TDM Program

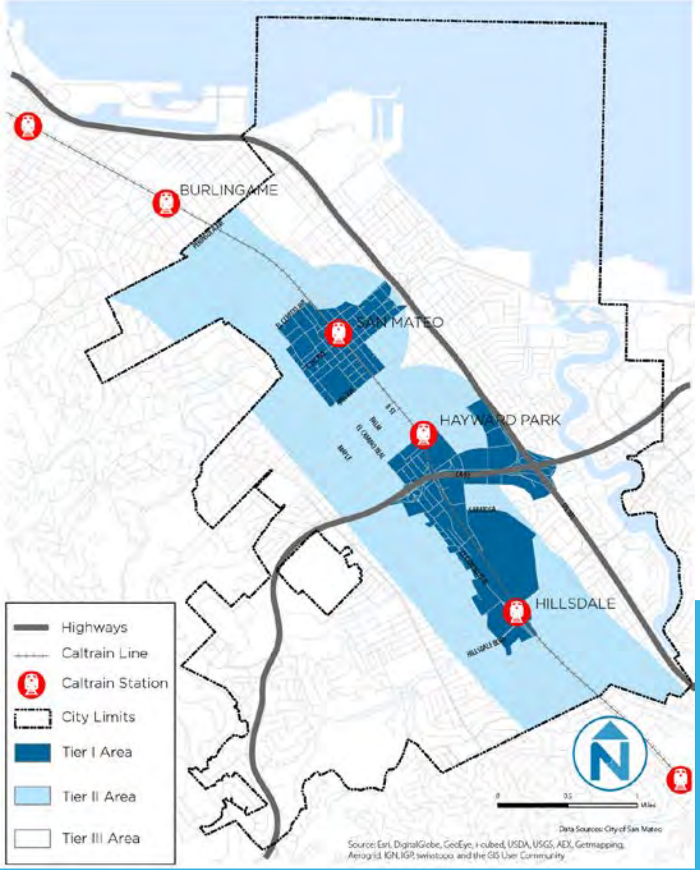
- Transportation Demand Management (TDM) programs reduce vehicle trips and parking demand by promoting use of a variety of transportation options, shifting travel by mode and time of day
- Proposed Citywide TDM Plan

# CITYWIDE TDM PROGRAM

Trip Reduction Targets

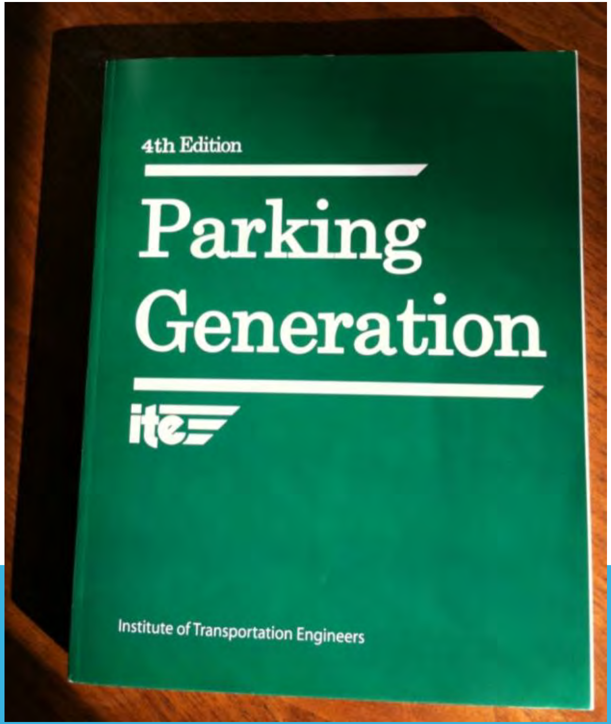
- Tier I – 25%
- Tier II – 15%
- Tier III – 10 %

Combination between Programs and Infrastructure



# PARKING REQUIREMENTS

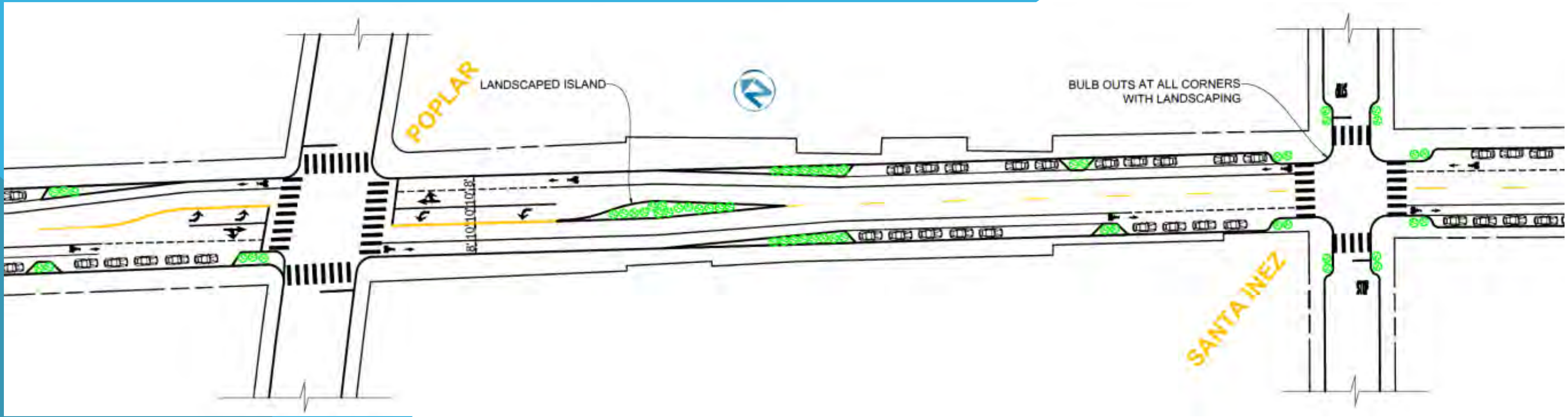
- Consider either reducing or eliminating minimum parking requirements in the Tier I and Tier II TDM focus areas.
- Setting maximum parking requirements.



# Institutionalization & Education

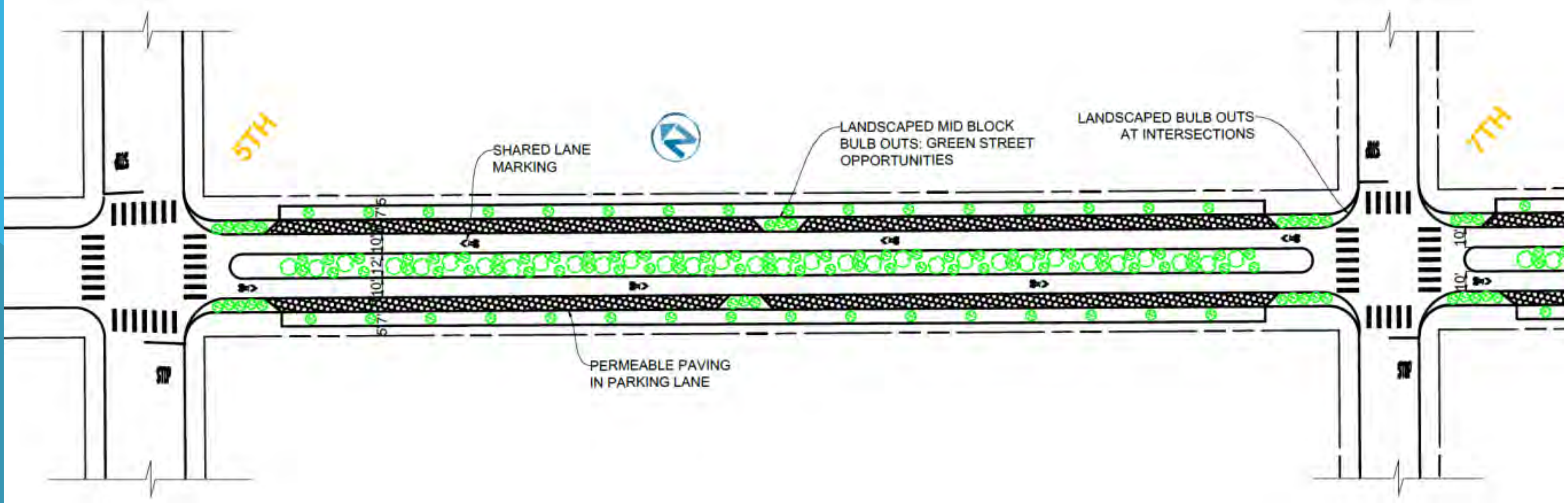
- Revisions to Municipal Code
- Passage of Complete Streets ordinance
- Adoption of new street classification system, design guidelines, methodologies, and evaluation metrics
- Staff and public educational programs

# NORTH SAN MATEO DRIVE




- Road diet (four lanes to two)
- Landscaped curb extensions, islands, and mid-block bulb outs
- New bicycle lanes
- Intersections: curb extensions and high visibility crosswalks to reduce pedestrian crossing distances and vehicular speeds

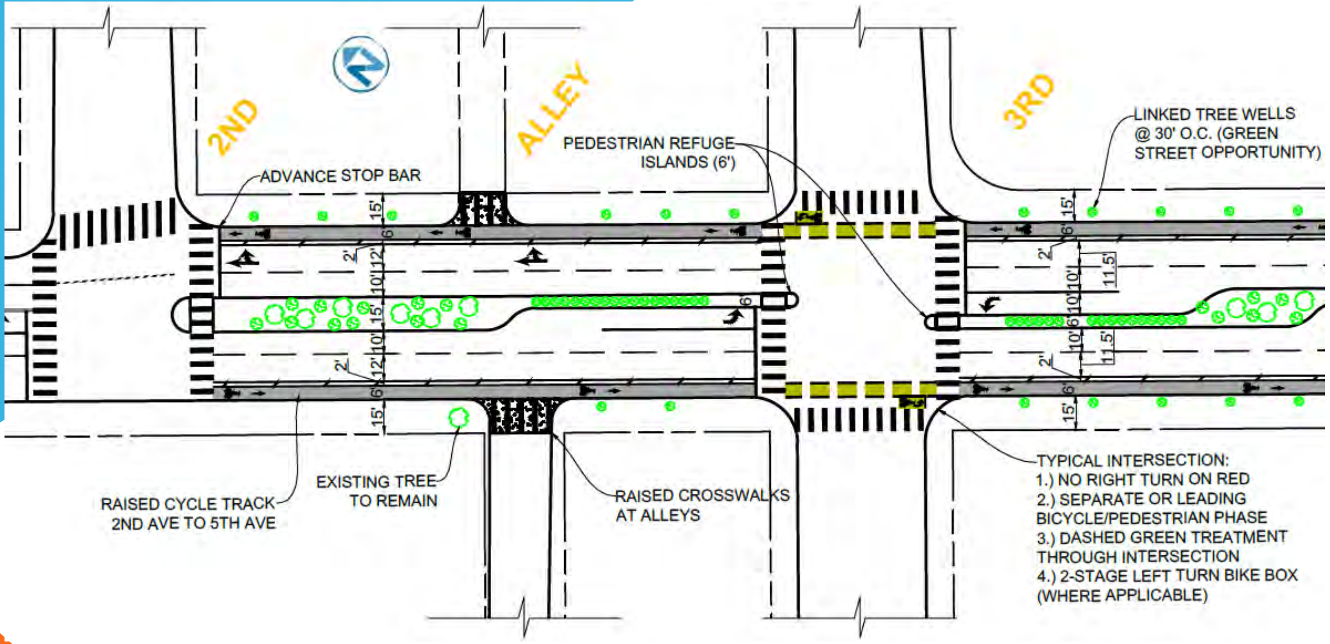
# SOUTH GRANT STREET




- Mid-block bulb outs, curb extensions at intersections, and green infrastructure elements
- Wide landscaped median between 5th and 9th Avenues
- Shared lane marking stencils (bike "sharrows")
- High visibility pedestrian crossing markings

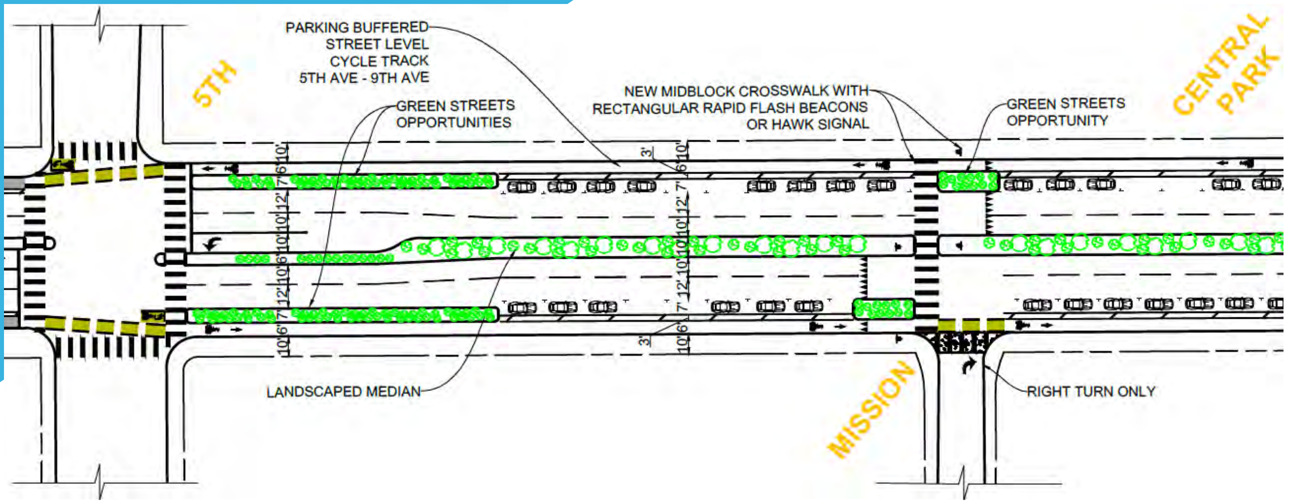
# EL CAMINO REAL

- Vision to improve bicyclist and pedestrian safety while still accommodating current and anticipated levels of vehicular travel, transit, and parking
- Road diet (six lanes to four)
- Extended sidewalks
- Raised one-way cycle tracks

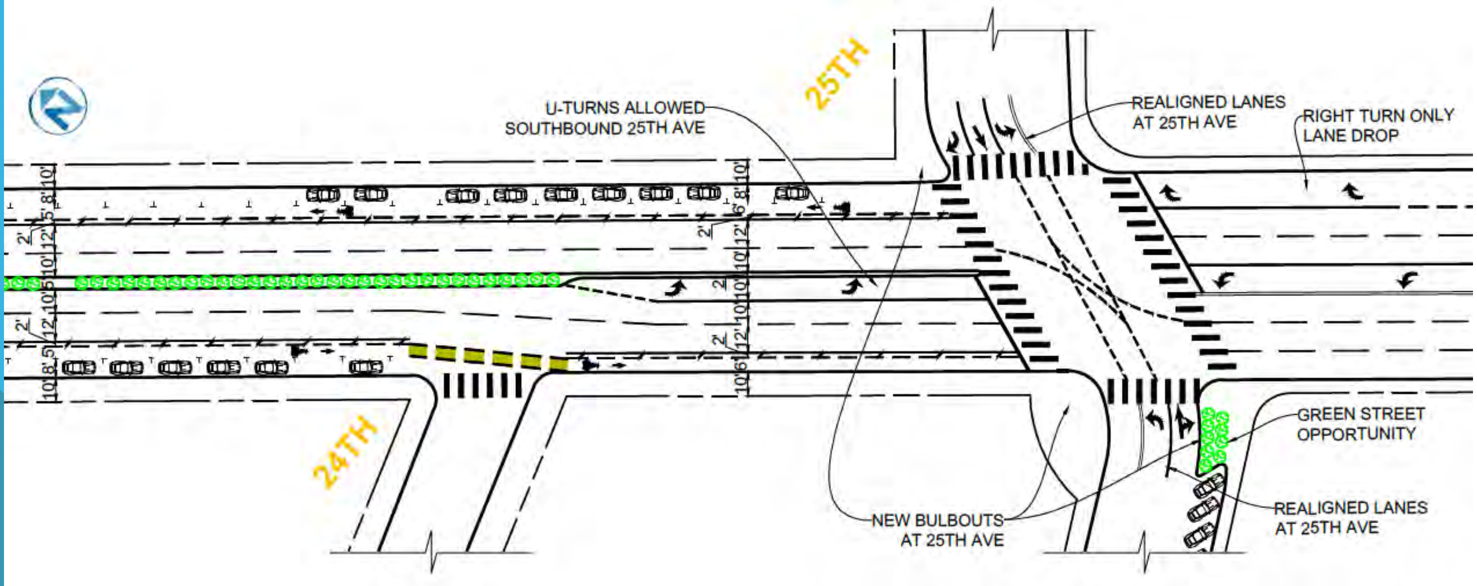


# EL CAMINO REAL

- High visibility crosswalks
- Pedestrian refuge islands
- Managed conflict points (including green pavement markings, stop-control devices, and high-visibility signage)
- Separate or leading bicycle/pedestrian signal phases
- Two-stage left turn bike boxes, where applicable

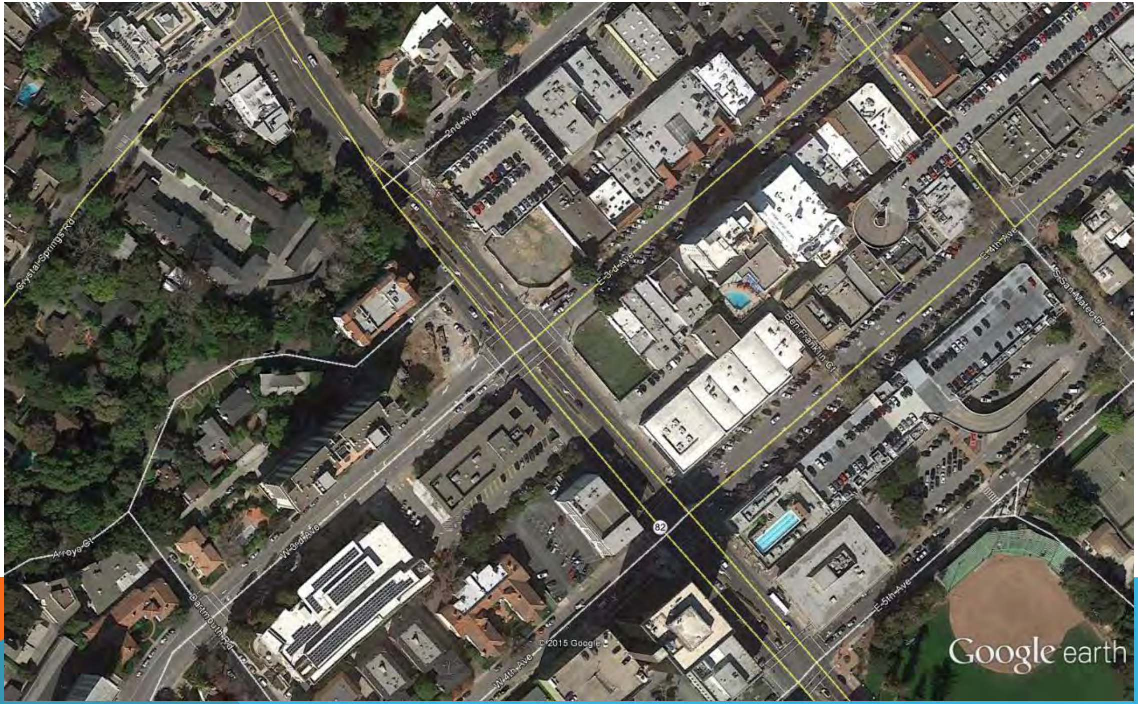


# EL CAMINO REAL




- New landscaped median
- Buffered bicycle lanes
- New mid-block crossing at 22nd Avenue

# 3RD AND EL CAMINO REAL



# EL CAMINO REAL

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# EL CAMINO REAL

# Next Steps

City Council Acceptance

February 17, 2015

Green Infrastructure Plan

September 2015

Environmental Review and General Plan Update

January 2016

# For Additional Information

Ken Chin, Project Manager

kchin@cityofsanmateo.org

650-522-7313

www.sustainablestreetssanmateo.com

# Attachment 5: TAC Presentation and Meeting Summary

# GreenPlan Bay Area TAC

April 29, 2015

## Welcomes

- Introductions

2

## Meeting Overview

- Planning Efforts in San Mateo and San Jose
- Discussion on Lessons Learned from San Mateo and San Jose
- Alternative Compliance Discussion
- GreenPlan-IT Overview & Who Should Come to Webinar

3

## Grant Deliverables

- Develop GreenPlan-IT (prior TAC meetings on its development)
- Watershed Scale LID identification in City Planning Efforts in 3 watersheds
- Alternative Compliance next steps for Bay Area
- Outreach on GreenPlan-IT (Webinar) and Conferences (State of the Estuary)

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# San Jose

## San Jose Pilot Study

- Urban Villages
- Storm Sewer Master Plan
- MRP 2.0 & San Jose

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## Who's involved?

San Jose:

- Jared Hart
- Bryan Apple
- Napp Fukuda
- Sharon Newton
- James Stettler
- Casey Hirosaki
- Suzanne Thomas

GreenPlan Team:

- Jing Wu
- Pete Kauhanen
- Jen Hunt
- Lester McKee
- Josh Bradt
- Jennifer Krebs
- Consultants

6

## Urban Villages

- Close to transit or in PDAs
- New sustainably focused areas
- Pedestrian friendly
- Well suited for GI implementation

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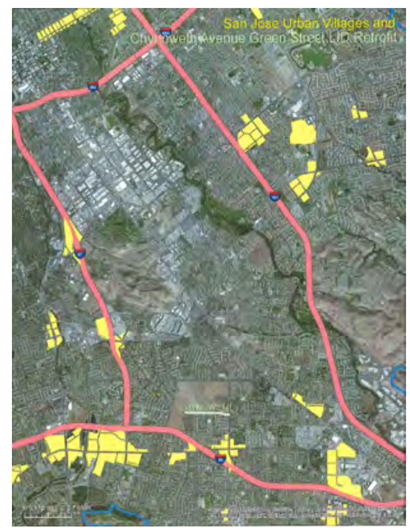
## Urban Villages




8

San Jose (last)

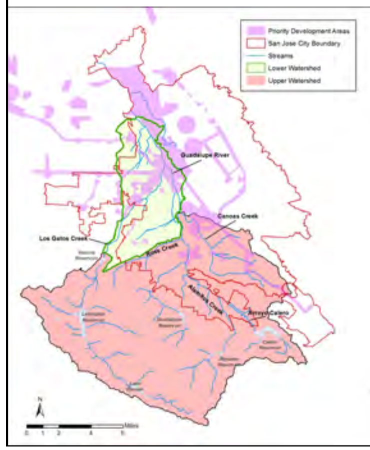
## Storm Sewer Master Plan

9

- Objectives of the Plan
- Constructing LID facilities to meet capacity goals
- Using Green Plan-IT tool to identify potential CIP locations
- Incorporating Green Plan-IT outputs into future planning efforts

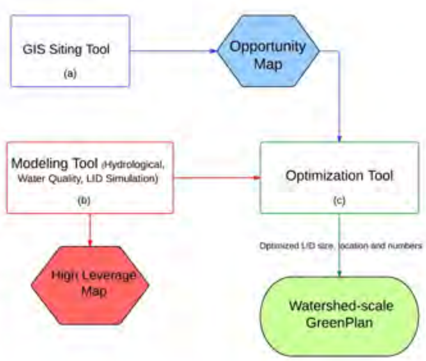
SFEI

## GreenPlan-IT in San Jose



- Objective - identify feasible and cost-effective GI locations in the lower Guadalupe River watershed
- Full Toolkit applied
  - Site Locator Tool
  - Hydrologic Model
  - Optimization Tool

## GreenPlan-IT Overview




## Site Locator Tool Application

An iterative process – run the tool, review outputs, refine with new data/ranking

**First Run**

- No ranking
- Decided how to utilize different layers
  - Ranking vs Knockout
- Rough location layers
  - Wide sidewalks
  - On street parking
  - Public parcels etc.
- Development of the Site Locator Tool

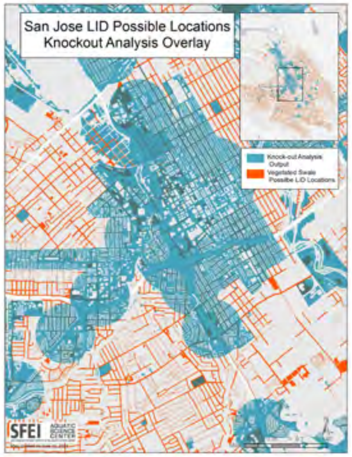
**Second Run**

- The Site Locator Tool process was streamlined
- Included ranking module
- Worked with the city to determine how to utilize local layers
  - WebEx meetings

**Final Run**

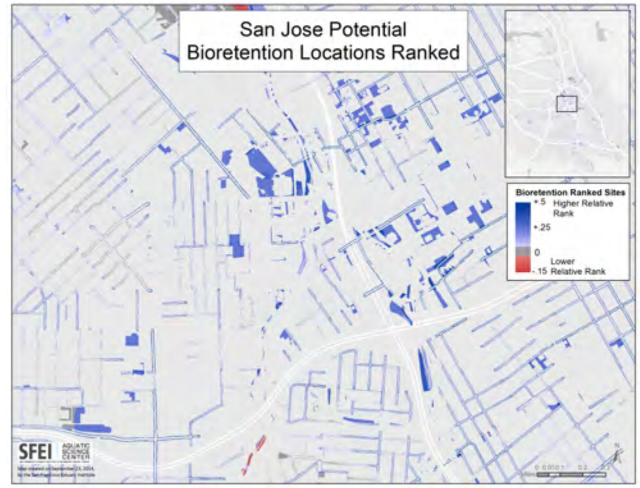
- Adjusted Ranking table
  - Removed some layers
  - Added Urban Villages as an opportunity
- Base Analysis as an opportunity
- Better GI locations
  - Side Walk Planters
- Differentiate between unranked and neutral rank
- Added in additional knockouts (Salt Ponds, infrastructure)

## First Site Locator Tool Run

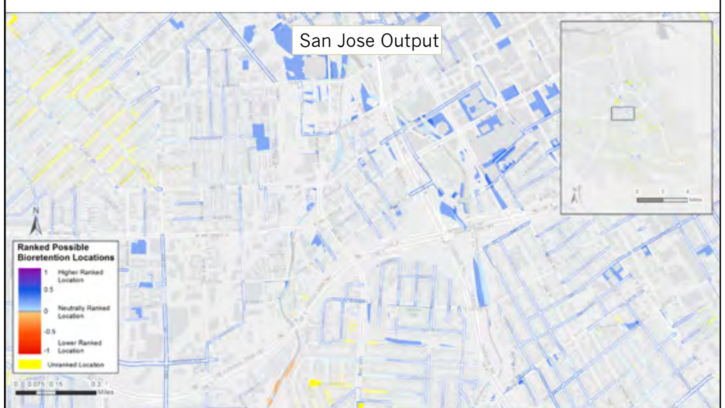




## Second Site Locator Tool Run




## Final Site Locator Tool Run

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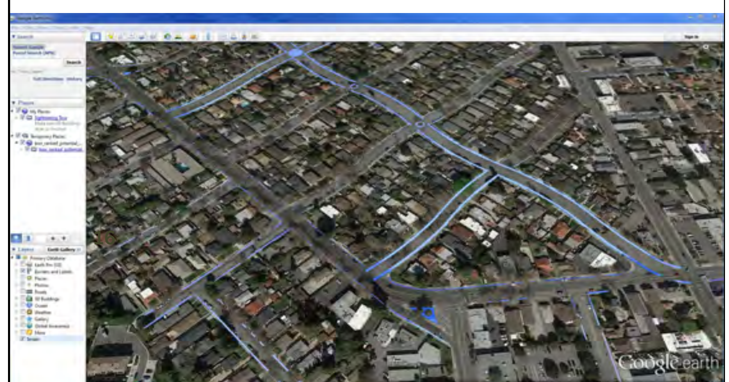
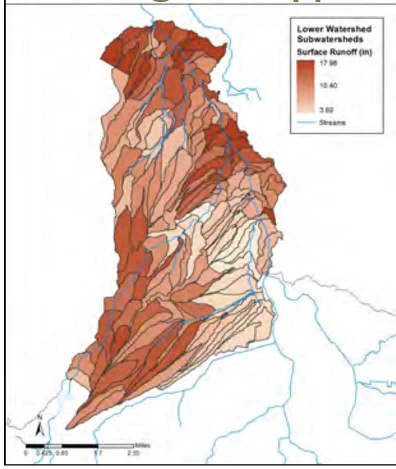


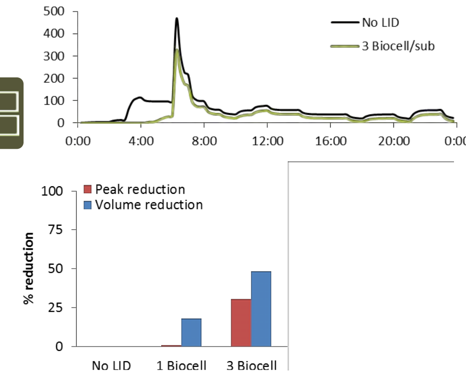
## Modeling Tool Application




- Identify effective locations for GI implementation that could have the greatest potential leverage for reducing runoff volume
- Establish baseline condition

## Modeling Tool Application

- Quantify flow and water quality reduction from various GI scenarios from 150 sub-basins




## Optimization Tool Application

- 10s of thousands of possible sites identified by Site Locator Tool ….
- Imagine if a City had to find these without an automated process!
- but what are the most cost-effective GI combinations among them for achieving certain reduction goal?
- ..and at what price?

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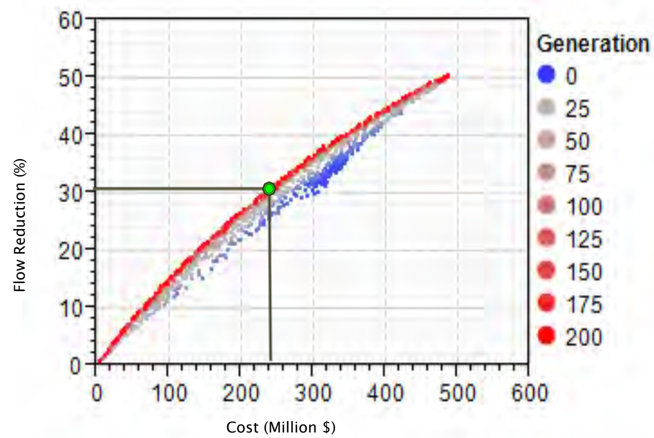
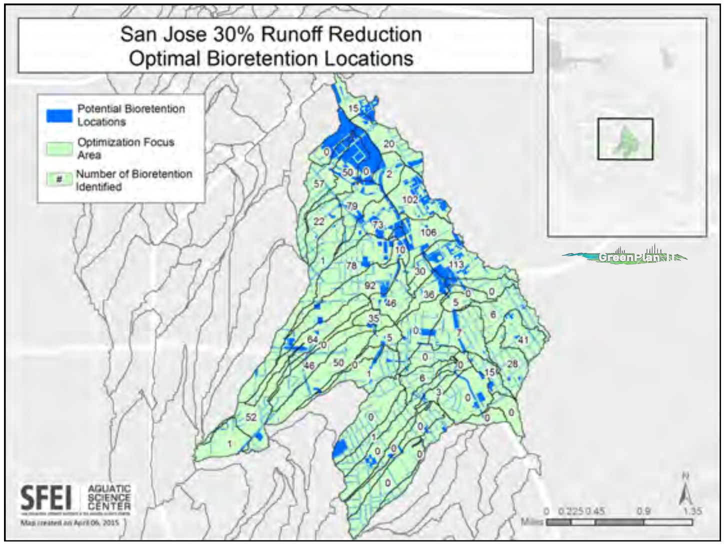
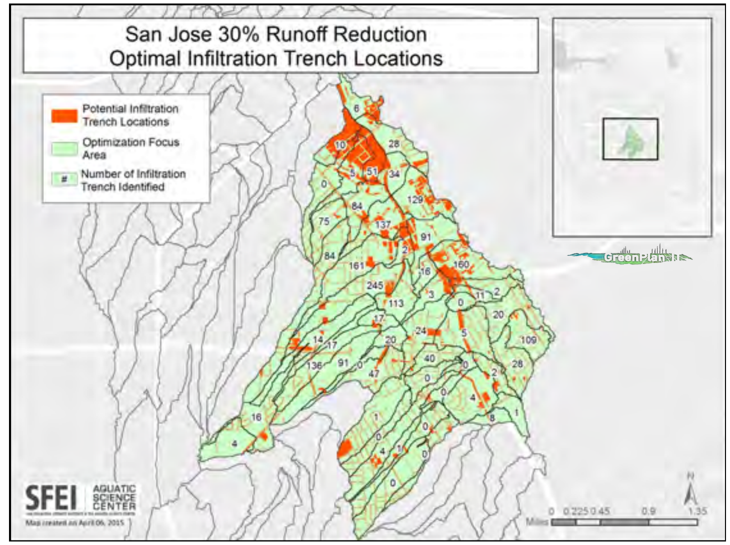
## Cost–effectiveness Curve



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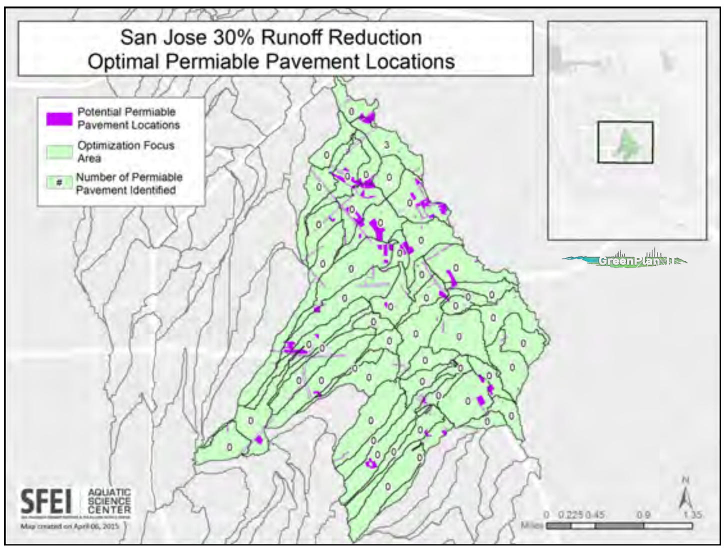


San Jose/SCVURPPP

## SCVURPPP & San Jose – Lessons Learned

- By San Jose stepping up as a pilot partner they are now well positioned for developing the GI watershed master plan per the next MRP
  - Iterative interactive development
  - Best to apply all the tool kit not just locator tool
  - Stormdrain master plan – blueprint for the urban village

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## MRP 2.0 Requirements

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- Prepare a Green Infrastructure Plan, including:
  - Mechanism to prioritize and map areas for potential projects over various timeframes (e.g., GreenPlanIT tool)
  - Outputs: prioritization criteria, maps, lists of projects
  - Projections for amount of impervious surface to be retrofitted over 5, 10, 25, and 50-yr horizons
  - Process for tracking and mapping completed projects
  - Guidelines, design details, and standard specs
  - Planning documents linked to GI Plan
  - Work plan to complete prioritized projects
  - Evaluation of prioritized project funding mechanisms

## MRP 2.0 & San Jose

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- GreenPlan Bay Area products:
  - GreenPlanIT tool to prioritize and map areas
  - Outputs: prioritization criteria, maps, lists of projects
- Guidelines, design details, specs
  - Design/construction drawings for current grant-funded green street projects
  - Regional products
- Planning documents linked to GI Plan:
  - Storm Drain Master Plan
  - Urban Village Plans?
  - Urban Forestry Plan?
  - Complete Streets Plan?

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## San Jose Q & A

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SFEP

## City of San Mateo

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San Mateo

## Who's involved

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- Ken Chin, San Mateo Public Works Project Manager
- Jocelyn Walker, San Mateo Public Works Assistant Engineer
- Matt Fabry, resident and C/CAG
- Jessica Alba, Nelson\Nygaard
- Pete Kauhanen, SFEI GreenPlan-IT Developer
- Jen Hunt, SFEI Project Manager
- Lester McKee, SFEI Project Lead
- Josh Bradt, SFEP Environmental Planner
- Jennifer Krebs, SFEP Project Manager

## Sustainable Streets Plan

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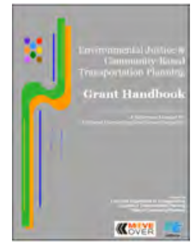
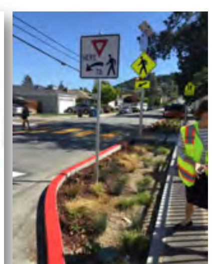



- Caltrans Community Based Transportation Planning Grant
- February 2013 – February 2015

## Sustainable Streets Plan

- Policy 3.D.1 – Manage stormwater runoff using green infrastructure from 10% of roadway segments citywide and from 20% of roadway segments within the Downtown and PDAs within the City by the year 2050.



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## GreenPlan-IT Site Locator Tool in San Mateo

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- San Mateo: initial partner
- Iterative process to improve both Tool and City outputs
- Worked with city staff and the TAC (municipalities and BASMAA) to identify planning needs of the site locator tool

## First Site Locator Tool Run


- Preliminary ranking
- Preliminary GI location layers
  - Side street parking
  - Wide sidewalks
  - Wide planters
  - Pedestrian trials
  - Parks
  - Parking Lots

## Final Site Locator Run


- Better potential GI location layers
  - Incorporated street dimensions from the Sustainable Streets Plan for each street type
- Adjusted Ranking table
  - Buffer distances
  - Weighting

Private Output


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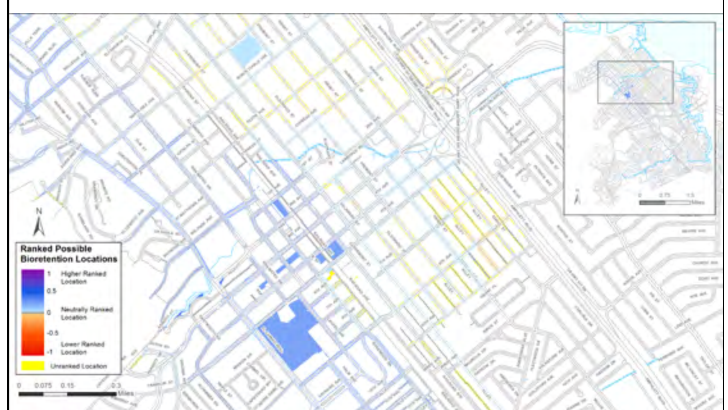
Public Output

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San Mateo Output


37

San Mateo Output


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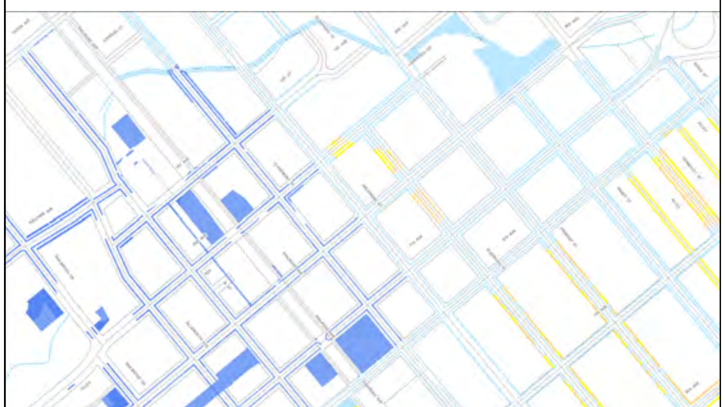

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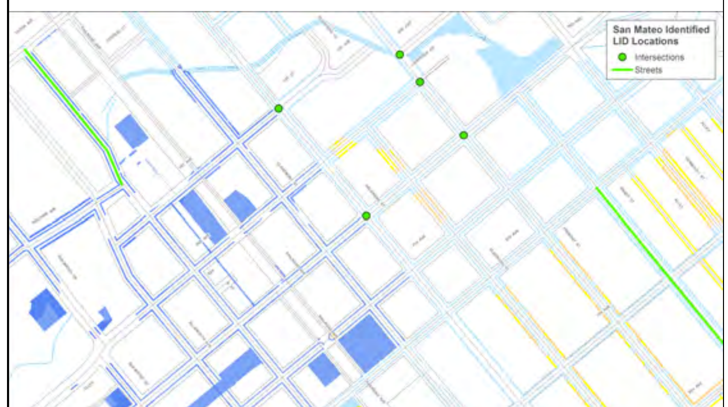


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San Mateo

## San Mateo Lessons Learned

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- First Sustainable Streets plan in Bay Area
- Links Green Streets with Complete Streets
- What can others learn from San Mateo

## Sustainable Streets Plan & Additional Next Steps

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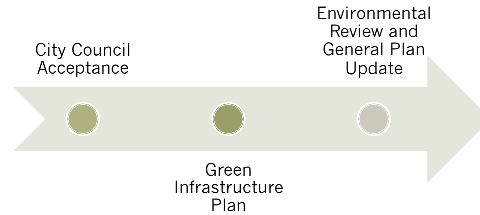


- Impact Fees and funding issues
- Adapting to MRP 2.0

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## Break

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## Break Out Discussion

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- What did San Jose or San Mateo do that would work in your city/county?
- What aspects of the planning effort wouldn't work in your city/county?
- Given what you know about MRP 2.0, what would you need as outputs from GreenPlan-IT to make it work in your city/county?

SFEP

## Alternative Compliance

- SFEP has small amount of money to explore what would help cities/ counties develop programs
- Water Board is more flexible under MRP 2.0 than MRP 1
- Question for group: what would help you?

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## Key Issues

- Do GreenPlan Outputs in City Plans qualify as starting points for local programs? (identification of receiving sites)
- Roles for cities, counties, others to get programs off the ground
- Fee Calculation – design, construction, maintenance (include all?)
- Reporting
- Other ???

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## Roles

| What | Who? |
|---|---|
| GreenPlan | City/County |
| Site Design | City/County/Developer |
| Site Matching | City/County/Developer |
| Project Budget | City/County |
| Maintenance Agreement | Developer |

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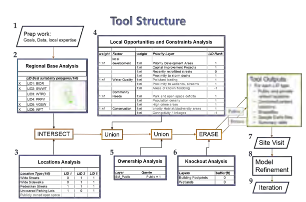
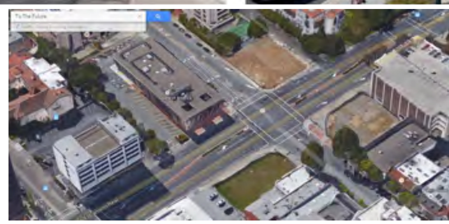
SFEI

## Webinar

- June 11th Morning at SFEI
- Why attend
- Who should attend




## With This Tool We Can Green The Future



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## Thanks

- Josh Bradt 510-622-5048 jbradt@waterboards.ca.gov
- Jennifer Krebs 510-622-2315 jkrebs@waterboards.ca.gov

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# GreenPlan Bay Area
# Technical Advisory Committee
# Meeting Notes
# Wednesday, April 29, 2015

**In Attendance:**

SFEP: *Jenifer Krebs, Josh Bradt*; SFEI: *Lester McKee, Pete Kauhanen*; City of San Mateo: *Ken Chin*; City of San Jose: *Suzanne Thomas, Jeff Sinclair*; City of Oakland*: Becky Tuden, Kristin Hathaway*; City of Richmond: *Joanne Le*; City of Sunnyvale: *Elaine Marshall*; City of Fremont: *Shannon Young*; EOA: *Jill Bicknell, Peter Schultz-Allen*; CCAG: *Matt Fabry*; ABAG: *Mark Shorett*; USEPA: *Luisa Valiela*; Water Board: *Keith Lichten*; Dan Cloak Environmental: *Dan Cloak*

**Welcomes/Introductions**

**Review Agenda/Meeting Purpose**

**San Jose GI Planning Overview (Suzanne T & Jeff S, Pete K & Lester M, Jill B)**

- SJ staff discussed opportunities for integrating GreenPlan-IT outputs with planning efforts underway: 1) Urban Villages and 2) San Jose Storm Sewer Master Plan (SSMP). The Urban Village plans (in City's General Plan) will increase walkability and concentrate commercial/residential land use in Priority Development Areas. GI plans are useful as these Urban Village areas undergo street redesigns and infrastructure improvements. The SSMP will ID capital improvement projects to upgrade the capacity from a 3yr-storm to a 10-year storm. GI can help City achieve water quality and capacity goals. GreenPlan-IT can ID potential retrofit locations.
- Pete reviewed SFEI's process for implementing the GreenPlan-IT tool in San Jose. Keith asked about the criteria for "knockouts" applied in the San Jose process. Pete responded that the City wanted to focus on the PDA public right-of-way, so wetlands and building footprints were excluded. Pete also touted the inclusion of .KML files as tool outputs enabling GoogleEarth view of the GP-IT output locations. Lester noted that while it would be useful to have city catch-basin GIS layers to gain higher resolution in the modeling component, this is a planning level tool. It's possible to achieve greater and greater resolution, but the trade-off comes in very lengthy modelling run times. Lester added this has been a learning process with excellent participation from the partner cities as the tool was iteratively developed.
- Closing comments on San Jose discussion was reaffirmation from staff that the Storm Drain Master Plan and the Urban Village plans would benefit from the GreenPlan-IT findings. Jill suggested that San Jose is now well on its way to comply with the GI planning requirements in current MRP 2.0 language. She also mentioned other related SJ planning efforts under development: Green Alleys program and Complete Streets design standards. Krtistin asked how institutional knowledge can help guide GP-IT outputs? Lester said institutional knowledge can help focus analyses on known problem areas.

**San Mateo Sustainable Streets Plan Overview (Ken C, Pete K)**

- Ken described the complex planning process that combines Complete Street and Green Street principles. This effort had huge public outreach component, and a large number of tasks to manage. Plan recommends City goal of using GI on 10% of roadways citywide and on 20% of roadways within the downtown PDA. Pete reviewed SFEI's process and outcomes for

GreenPLan-IT analyses. Ken's major lessons learned were the dearth of local GIS data sets and benefits of the KML file formats in the tool. Keith asked if the resolution outputs are sufficient for planning. Matt suggests additional work is necessary to meet MRP 2.0: where are optimal locations for WQ? How much load reduction is possible? The SSP is driven by other priorities. Ken says that San Mateo has now taken a huge "baby-step" in GI implementation planning with these the next steps: secure funding, standard drawings, design work, and pass off to PW to build and Parks to maintain.

- Q & A followed with discussion of funding approaches not just for capital costs but also for O&M. Matt suggested consideration of the Adopt-A-Block concept, example of Green Street support program in Portland. Becky asked about the proposed Impact Fees, that Ken said the City would amass from developers to make bike/ped (estimated at $180M) and GI improvements. Becky suggested the City use outside contractors to build the facilities because municipal staff may not have necessary training. Peter S-A suggested the City consider Urban Forestry perspective where street trees planted in Silva Cell technology could provide high-level storm water management without really changing existing O&M practices.

**Breakout Session:**
**What would/wouldn't work in your city? What GP-IT outputs needed to achieve MRP 2.0?**

- Oakland (Kristin): San Mateo Plan is really good. Tool is limited by data available, needs consistency. The MRP timing is difficult, different cities have different initiatives. Cross-departmental coordination is valuable. Fee would be great but goal needs to be established prior. We want MTC to fund GI measures. Parks Department may not be ready to take on maintenance without adequate funding/personnel.
- Sunnyvale (Elaine): See GP-IT application specifically for 400 acre Peery Park project already underway. GP-IT could also be used citywide. Sees need for ensuring maintenance costs are specifically addressed in plans. San Mateo got good upper management support, did great education/outreach, and had good interdepartmental coordination.
- Fremont (Shannon): Need to GI master Plan before maintenance planning, however PW Department challenged to adequately maintain existing streets. Lots of concern regarding maintenance, especially irrigation. Developer concerns about giving up more land for GI. There is a break point where C3 is too costly. Emergency vehicle access is also critical to maintain. Plant lists with maintenance requirements are needed.

**Alternative Compliance – Group discussion on: What is needed to move this forward?**

- Elaine – The math is the challenge. What does it cost to comply on-site versus what it would cost to pay into a central fee accrual system?
- Matt – alternative compliance policy – came up with a $/gal cost for stormwater. Like Dan is saying – unless you have large sizing – its more feasible to manage on site – only a small % of sites would not be able to do it on sites – more need an ongoing fee system to do stuff in the public right-of-way. Need to adopt a county wide impact fee – imposed by the county agency - Portland changes an impact fee based on the linear frontage length and increased vehicle trips generated – some kind of nominal fee for businesses – need to pool it at the countywide level – then you would have enough money to do real things. Could or would be in addition to doing things on-site.
- Elaine – what would be the political process? Voter approval?

- Kristin – Green Bond funding – source of funding? A meeting about financing?
- Becky – GI need to be shoehorned into the PDAs – alternative compliance for PDA…
- Matt – water board might have an expectation to have a tracking system to links the fee back to the equivalent mitigation?

Summary: Alternative compliance is worth exploring, but nexus studies needed to develop costs/fees and program needs to be well defined – there will be few regional projects – so individual project will be the trend, and may be hard to track/manage/report– Offsite in the public right-of-way fits the definition of a regional project – but it should be a regional green infrastructure plan for many smaller GI projects—perhaps City's should do all the work first and create a fee to recoup costs after the fact.

**GreenPlan-IT Webinar Planning**

Group discussed upcoming (June 11) GreenPlan-IT training webinar. Debate over who the appropriate audience should be at this stage: high-level management, stormwater managers, or GIS specialists? Perhaps split into 2 webinars? A subgroup of Peter, Jill, Luisa, Elaine, Shannon, Joanne, and Matt volunteered to help with the Webinar planning/design.

Attachment 6: GreenPlan-IT Webinar Invitation

## Krebs, Jennifer@Waterboards

**From:** Jen Hunt <jhunt@sfei.org>
**Sent:** Monday, June 01, 2015 2:45 PM
**To:** Elaine Marshall; 'Ken Chin; Jocelyn Walker; Jared Hart; Shannan Young; 'Dan Cloak; Chad Davisson; 'Pam Lung; 'Carol Mahoney; Emily Alter; Mike Carlson; John Steere; bledesma@zone7water.com; Pete Kauhanen; Sam@epa.gov; 'Melody Tovar; Liang Lee; Afshin Rouhani; napp.fukuda@sanjoseca.gov; Jeff Sinclair; Rebecca Tuden; csell; maval; Matt Fabry (mfabry@smcgov.org); Hathaway, Kristin; Luisa, Valiela; Jill Bicknell; Peter Schultze-Allen; Lichten, Keith@Waterboards; Bradt, Josh@Waterboards; Krebs, Jennifer@Waterboards; geoff; arleen; csommers; Lucile Paquette; bmendenhall@valleywater.org; Ait-Lasri, Rachid@Waterboards; Biruk Imagnu; tburroughs@cityofberkeley.info; tclay@cityofberkeley.info; Lester McKee; Jing Wu
**Subject:** Green Plan-IT Webinar Date Change to Wednesday July 29 10 AM to 11:30 AM

Hello Everyone,

We are planning a webinar to showcase the features of the Green Plan-IT Toolkit. This Toolkit was developed in collaboration with SFEP, a technical advisory committee, and municipal partners under the Green Plan Bay Area project which was funded by the State Water Resources Control Board. We have completed the first phase of Toolkit development and would like to introduce the Toolkit as well as its features and functions. The webinar will focus on technical aspects of the Toolkit and will be geared towards technical users (e.g. GIS staff, modelers, planners and other technical staff). We will send out meeting information as the date approaches.

Due to scheduling conflicts, we have changed the date for the webinar from Thursday, June 11 to Wednesday July 29. The webinar will be from 10 AM to 11:30 AM and will be simulcast online.

Please sign up here if you plan to participate in the webinar on line. We can provide in person seating for those who do not have web access - please contact me know if you would like to participate in person. It would be great to get the word out so please share with other interested parties.

Hope you can make it and please contact me with any questions.

Regards,

Jen

Jen Hunt
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Attachment 7: Alternative Funding Options meeting summaries, and attendees

## Deliverable 5.1 Meeting Agendas Sign-In Sheets, and Minutes for Evaluation of Potential Funding Mechanisms

Funding Mechanisms for Green Infrastructure
Meeting 1
Thursday, August 7, 2014

*In attendance: Kenneth Moy (ABAG Legal Counsel); Jennifer Krebs (SFEP Senior Environmental Planner); Josh Bradt (SFEP Environmental Planner)*

- Discussed potential SW mgmt. funding mechanisms
    - Establish Special Districts on Watershed level to assess drainage/runoff benefits
        - Requires authorizing legislation
            - State level?
            - Local level?
- Reviewed Alternative Compliance guidelines in MRP 1.0

Funding Mechanisms for Green Infrastructure
Meeting 2
Thursday, April 9, 2015

*In attendance: Kenneth Moy (ABAG Legal Counsel); Jennifer Krebs (SFEP Senior Environmental Planner); Josh Bradt (SFEP Environmental Planner)*

- Revisited idea of Watershed Assessment Districts
    - Nexus with PROP 218 Stormwater exemption effort (*JB to get more info to Ken*)
        - Existing case where Mitigation exemption is being challenged (*KM to research*)
    - PAYS structure may be good example where $$ for energy/water conservation improvements are repaid thru user surcharge (*KM to provide info*).
- Alt Comp/In-Lieu regulations in MRP can be trumped thru Legislature directive
- For Watershed Assessment District or Alt Com plan the challenges are:
    - Aligning jurisdictional boundaries/maps
    - Identifying receiving projects
    - Special District fees would need to be collected until critical mass
        - Developers to pre-commit to join district?
    - District needs to develop cost/benefit analyses to determine fee structure (if incorrect, municipality may not recoup internal costs)
        - Could take years/decades to get needed projects & costs
    - Alternatively, city could build/expend first then recoup thru special district, but these outlays are usually bond funded which may be risky to sell after the fact
    - Sub-regional bonds not typical
- New distributive/dispersive paradigm: equates distributed water re/use (parcels/neighborhoods with cisterns) to distributed energy generation (parcels with solar panels)
- Peggy Rismanchi (Clark Howatt's replacement) at ABAG may be helpful
- Justin (new FAN person) looking to make program more of a policy driver.

Funding Mechanisms for Green Infrastructure
Meeting 3 (Part of April 28, 2015 TAC meeting)

**In Attendance:** SFEP: *Jenifer Krebs, Josh Bradt*; SFEI: *Lester McKee, Pete Kauhanen*; City of San Mateo: *Ken Chin*; City of San Jose: *Suzanne Thomas, Jeff Sinclair*; City of Oakland*: Becky Tuden, Kristin Hathaway*; City of Richmond: *Joanne Le*; City of Sunnyvale: *Elaine Marshall*; City of Fremont: *Shannon Young*; EOA: *Jill Bicknell, Peter Schultz-Allen*; CCAG: *Matt Fabry*; ABAG: *Mark Shorett*; USEPA: *Luisa Valiela*; Water Board: *Keith Lichten*; Dan Cloak Environmental: *Dan Cloak*

**Alternative Compliance – Group discussion on: What is needed to move this forward?**

- Elaine Marshall – The math is the challenge. What does it cost to comply on-site versus what it would cost to pay into a central fee accrual system?
- Matt Fabry – alternative compliance policy – came up with a $/gal cost for stormwater. Like Dan Cloak is saying – unless you have large sizing – it's more feasible to manage on site – only a small % of sites would not be able to do it on site – more need an ongoing fee system to do stuff in the public right-of-way. Need to adopt a county wide impact fee – imposed by the county agency - Portland changes an impact fee based on the linear frontage length and increased vehicle trips generated – some kind of nominal fee for businesses – need to pool it at the countywide level – then you would have enough money to do real things. Could or would be in addition to doing things on-site.
- Elaine Marshall – what would be the political process? Voter approval?
- Kristin Hathaway – Green Bond funding – source of funding? A meeting about financing?
- Becky Tuden– GI needs to be shoehorned into the PDAs – alternative compliance for PDA…
- Matt Fabry – Water Board might have an expectation to have a tracking system to link the fee back to the equivalent mitigation?

**Summary:** Alternative compliance is worth exploring, but nexus studies are needed to develop costs/fees and program needs to be well defined – there will be few regional projects – so individual projects will be the trend, and may be hard to track/manage/report– Offsite in the public right-of-way fits the definition of a regional project – but it should be a regional green infrastructure plan for many smaller GI projects—perhaps City's should do all the work first and create a fee to recoup costs after the fact.

Attachment 8: Funding Mechanisms Memo (aka In-Lieu Fee memo)

# Green Infrastructure Funding Mechanisms

## Executive Summary

This memorandum details funding strategies available to municipal governments to hasten widespread implementation of Green Infrastructure (GI) in the public right-of-way. The next Municipal Regional Permit will require municipalities to develop drainage area-specific GI plans. These plans will be critical for local governments and the general public to understand the scope of estimated costs, benefits, and implementation timescale (decades at least). The total cost of GI practices includes capital (design, engineering, construction) and annual (operations and maintenance and replacement)costs, which may require different sources of funding. The memorandum briefly describes a number of potential GI funding strategies being used or proposed by some Bay Area jurisdictions. These include: 1) stormwater assessment fees, 2) long-term debt instruments, 3) sales tax measures 4) special benefit districts, 5) motor vehicle registration fees, and 6) grants. Once a jurisdiction develops its GI plan(s), the associated cost estimates may guide the direction(s) taken to secure needed funds.

The memorandum closes with in-depth descriptions of municipal Alternative Compliance (AC) program options, which allow a developer flexibility to build or contribute to an off-site GI project when unable meet stormwater management requirements within the regulated project site or when it is more beneficial to provide stormwater treatment or flow controls off-site. AC program options include: 1) off-site mitigation (private to private), 2) off-site mitigation (private to public), and 3) payment in-lieu (private to public). Each option comes with obligations for municipal staff.

# Green Infrastructure Funding Mechanisms

## Benefits of Green Infrastructure

Municipal governments across the country and in the San Francisco Bay Area are beginning to recognize and realize the variety of benefits derived from Green Infrastructure (GI)[1] practices. When widely dispersed throughout a watershed, GI practices can improve water quality while reducing runoff volumes and rates entering the storm sewer system, local waterways, and ultimately the San Francisco Bay and Pacific Ocean. Depending on where and how it is implemented, GI also promotes infiltration and groundwater replenishment, neighborhood beautification, reduced heat island effects, and increased pedestrian safety.

To date, jurisdictions with combined sanitary and stormwater sewer systems[2] are typically the nation's most advanced municipal GI practitioners. Many are legally mandated to reduce wet-weather overflows that overwhelm treatment plants and discharge untreated effluent directly to receiving waters. Because the sanitary sewer element is a public utility generating enterprise funds, cities with these combined systems are financially well-positioned to undertake GI. It is important to note that most of California municipalities have separate sewer systems and the California Constitution requires voter or property-owner approval of stormwater utility rates, significantly hampering the ability to fund green infrastructure in much of the state.

## Increasing GI Implementation

The San Francisco Bay Regional Water Quality Control Board (Water Board) favors Low Impact Development (LID) design and stormwater treatment practices (such as GI), mandating these measures for new and redevelopment projects of a certain size threshold ("Regulated Project") in its Municipal Regional Stormwater Permit (MRP). Typical road reconstruction projects are exempt from LID treatment unless widening for additional traffic lane(s) is involved. MS4[3] jurisdictions in the Bay Area have generally not yet adopted widespread use of GI within the public right-of-way as standard operating procedure, in large part due to lack of comprehensive GI planning and funding.

To hasten widespread GI implementation, the Water Board's draft MRP 2.0 orders the development of actionable municipal GI plans by permittees (due with the 2019 Annual Report). This requirement and timeline recognizes the internal challenges of adjusting municipal planning and public works operations to include GI as a widespread practice. Comprehensive GI planning entails: watershed analyses, revisions to existing policies and plans, design standards development, capital improvement planning, outreach and education, and identifying funding sources for long-term implementation.

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[1] The term Green Infrastructure is used to denote landscape-based drainage practices that disconnect impervious surface conveyance to restore a more natural (pre-development) hydrograph

[2] These cities include: New York, Philadelphia, Washington, DC, Chicago, Seattle, Portland, and San Francisco

[3] MS4 means "municipal separate storm sewer systems"

Once GI plans are developed, municipalities will have a better sense of the associated programmatic costs and implementation timescale (realistically 50 to 100 year plans to reach pollution and/or runoff reduction targets). Ideally GI plans will be integrated into local public works departments' capital improvement plans that identify advanced funding needs for specific street, sidewalk, and storm drain infrastructure rehabilitation projects. Public right-of-way GI retrofits are usually more cost-effective when designed and implemented as a portion of a larger capital improvement project rather than as a stand-alone endeavor.

## POTENTIAL SOURCES OF GI PROGRAM FUNDING

Funding is a critical issue in the realization of local governmental GI plans. When considering life-cycle costs of GI practices relative to conventional public right-of-way improvements, GI pencils-out favorably due to its multi-benefit nature and diminishing O&M burden over time. Municipalities must account for the added GI planning, design, engineering, and construction costs on the front end, as well as ongoing maintenance over the long term. There are a variety of approaches and resources available to local governments to help finance these up-front and long-term investments. A few examples are briefly discussed below:

### STORMWATER ASSESSMENT FEES

Many Bay Area municipalities have enacted assessments on real properties contributing stormwater runoff to the municipal storm drain infrastructure. These property-related fees are typically based on estimates of impervious area and land use type. These revenues usually can only be expended for stormwater quality protection and conveyance activities, including MRP required programs and stormwater infrastructure capital improvements, operations, and maintenance. Currently, most stormwater assessment fees are at their maximum allowable ceiling and do not fully cover the costs of MRP compliance.

Voters or property owners must approve establishment of or increases to these fees or special taxes as per Proposition 218[4]. This can be a difficult hurdle as evidenced by a 2012 ballot initiative in Contra Costa County that failed to add an additional fee to property taxes to increase funding for local stormwater pollution prevention programs. However, in the same year, 70% of Santa Clara County

[4] The **Stormwater Initiative (Assembly Bill 1362- Omnibus Act Amendment)** seeks to pass a Constitutional Amendment through the State Legislature with a November 2016 ballot measure allowing voters to designate stormwater as a utility on par with drinking water, wastewater, and refuse services (all exempt from Proposition 218 requirements). If approved, local stormwater agencies could establish or raise rates in a manner similar to water and wastewater districts. The ballot measure, by itself, will not raise revenues—a local public process would be required to: 1) establish the "utility", 2) determine scope and level of services, and 3) determine rates and rate structures. Allowable stormwater utility expenditures could include: watershed and GI planning; environmental restoration, capital improvements, operations & maintenance, and outreach and education. Communities could

voters passed a special tax for *the* ***Santa Clara Valley Water District's Safe, Clean Water and Natural Flood Protection Program***. This is a continuation of the pre-existing special tax from the sun-setting Clean, Safe Creeks plan. The new funding structure will generate an estimated $700M over its lifetime, which automatically sunsets on June 20, 2028.

### Long-Term Debt Instruments – General Obligation Bonds/Certificates of Participation

Debt financing is a way for local agencies to borrow money up-front against the stream of revenue projected over the life of the program. This approach provides a large injection of capital which can greatly accelerate GI implementation, storm drain pipeline rehabilitation, and public right-of-way improvements.  Both General Obligation (GO) Bonds (secured and voter approved) and Certificates of Participation (COPs) (not secured and not voter approved) are popular methods of funding physical improvements intended to last longer than the repayment period. While these mechanisms have low interest repayment rates, they do incur administrative costs and are typically restricted to funding capital costs rather than planning and O&M activities, and require dedicated revenue streams for repayment.

SCVWD will use a combination of debt financing and pay-as-you-go funding to pay for the Safe, Clean Water and Natural Flood Protection program's capital projects. Approximately 21% of capital project costs are anticipated to be funded through debt financing via the issuance of COPs. Total debt service over the life of the program comprises repaying the principal borrowed ($121 million) and interest on the borrowed money ($43 million), assuming a 3.2 percent fixed interest rate over a 14 year horizon. In addition, to free up more funds early in the program, staff is working with the District's financial advisor to construct a debt service payment assumption where debt service payments are low in the early years and higher in the later years.

The City of Berkeley's ***Citywide Watershed Management Plan*** identified over $200M of needed funding for recommended improvements, including GI as well as upgrades and rehabilitation of aging storm drain pipelines.  In 2012, Berkeley voters passed Measure M – a $30M GO Bond to fund five years of street repaving and rehabilitation and the installation of green infrastructure as part of street work. The debt service on this bond is to be paid by an annual property tax at a rate of about $0.0159 per $100 on estimated assessed valuation over a 30 year horizon.

### Development Impact Fees

Local governments may enact a development impact fee that is paid by an applicant seeking approval for a development project, if the fee is exacted for the purpose of defraying all or a portion of the cost of public facilities related to the development project.  Municipalities must carefully prepare and enact a development impact fee program to ensure it meets the requirements in California Government Code §§ 66000-66025 (the Mitigation Fee Act).  Under state law, a development impact fee is not a tax or special assessment, and therefore is not subject to voter approval. However, if the development impact fee is found to not relate to the impact created by development, or to exceed the reasonable cost of providing the public service, then the fee may be declared a special tax subject to approval by a two-thirds majority of voters. As an example of how a development impact fee may be used to fund GI, the City of San Mateo's Sustainable Streets Plan recommends replacing the city's existing Traffic Impact Fee program (fee assessed to developers to fund roadway O&M to mitigate vehicle trips generated) with a Sustainable Streets Fee that would focus more specifically on intermodal improvements and GI. A fee of this type could not cover the costs attributable to existing deficiencies in public facilities, but it could cover the costs attributable to the increased demand for public facilities reasonably related to the development project in order to achieve an adopted level of service that is consistent with the municipality's general plan.

### Special Benefit Districts

Entire watersheds or sub-basins could be established as special benefit districts, where properties within the district are assessed to fund stormwater management programs that provide direct benefit to that watershed or subbasin. The watershed unit may be particularly effective and equitable as programs can be tailored to address specific priorities identified within that watershed and would include the diverse socio-economic demographics from the hills to the flatlands that are typical to an urban watershed.

### Motor Vehicle Registration Fees

Since approved by voters in 2010, an annual fee of ten dollars ($10) is imposed on motor vehicles registered in San Mateo County for transportation-related traffic congestion and water pollution mitigation programs. The revenue is estimated at $6.7 million annually over a 25 year period. Per the Expenditure Plan, 50% of the net proceeds will be allocated to cities/county for local streets and roads and 50% will be used for countywide transportation programs such as transit operations, regional traffic congestion management, water pollution prevention, and safe routes to school. Timing is important, however, since the 2010 passage of Proposition 26 now makes such a Motor Vehicle Registration Fee a "tax", requiring a 2/3 approval threshold.

### Grants

Federal, State, and Regional grant programs have awarded funding to local governments to support Green Infrastructure efforts around San Francisco Bay. Some of these programs include:

- US Environmental Protection Agency: San Francisco Bay Water Quality Improvement Fund
- CA Water Resources Control Board: 319(h) Non-Point Source Implementation Program
- CA Department of Water Resources: Integrated Regional Water Management Program Implementation Grants
- One Bay Area Grant Program – Metropolitan Transportation Commission
- Caltrans Planning Grants – used by City of San Mateo for Sustainable Streets Plan
- Alameda County Measure B – used by City of Emeryville for a bike-ped project with GI measures.
- State of CA Parks and Open space grants – used by City of Emeryville for rails to trails projects and park projects with GI measures.
- Urban Forestry planning grants – used by City of Palo Alto for Urban Forestry Master Plan that

includes GI discussion? Need to confirm with Walter Passmore

- Strategic Growth Council has had multiple funding options related to GI, Urban Greening and then the Sustainable Communities Affordable Housing grants, assume will be more as they dole out Cap & Trade money

What about potential for climate change adaptation funding? Cap & Trade revenue? Transportation funds (there is one pot of transportation funds, called Transportation Alternatives that allows GI, other pots less so)

## Alternative Compliance Programs

The San Francisco Bay Regional Water Quality Control Board's MRP 1.0 and (proposed) MRP 2.0 allow permittees to provide Alternative Compliance (AC) options to Regulated Project proponents. AC programs can be beneficial to both the developer community (flexibility for off-site treatment when it is infeasible on-site or beneficial for other reasons) and local governments (greater options for retrofit of priority public right-of-way locations). Ultimately the local neighborhood and watershed are beneficiaries since these projects are mandated to provide a net environmental benefit. Although the AC option has been available since 2009[5], no municipal AC programs have been launched. To further encourage the AC option in MRP 2.0, the Water Board has proposed relaxing some of its original stipulations, now allowing off-site AC projects to be completed within 3 years of the end of the Regulated Project construction without penalty and up to 5 years with Executive Officer approval. It is recommended that municipal GI planning efforts take place prior to rolling out long-range Alternative Compliance (AC) programs to better steer GI funding and projects towards priority locations.

### Alternative Compliance Frameworks

This section describes the municipal internal frameworks needed to establish a viable AC program. There are a variety of AC program choices available to a municipality, which must determine if its program will: 1) assist in brokering between private entities, or 2) direct off-site mitigation efforts to the public right-of-way (or both?). A greater level of internal planning is needed if the municipality wants to lead developers to pre-determined public sites or establish a Payment In-Lieu program. The tables below further explain the municipal and developer roles associated with various AC program options.

[5] Countywide stormwater permits that preceded the MRP (i.e., adopted in 2001-2003) included a provision that allowed Permittees to establish "waiver" programs under which a project proponent could request a waiver of on-site treatment based on demonstration of "impracticability or infeasibility" if equivalent treatment was provided at another location or at a regional facility. This provision was essentially a precursor to the current Alternative Compliance provision in the MRP (C.3.e.i), which prescribes AC options and supersedes any previous waiver programs established by Permittees.

## Regulated Project Compliance Hierarchy/Options[6]

1) On-site Compliance – Developer designs & installs required stormwater controls on-site.

| Municipality Role | Developer Role |
|---|---|
| - reviews and approves developer compliance<br>- inspect installation<br>-<br>- conducts on-site O&M inspections once every five years to ensure correct operation of controls. | - demonstrate full compliance on-site<br>- maintains controls in operating condition or transfers requirement and information to new property owner. |

2) Developer-driven Off-site Mitigation (private/private) – use off-site project to fulfill entire runoff/pollutant reduction volume or remaining volume after partial on-site management.

| Municipality Role | Developer Role |
|---|---|
| - verify on-site infeasibility<br>- review on-site & off-site plans<br>- inspect on-site & off-site installation<br>-<br>- conducts on-site & off-site O&M inspections once every five years to ensure correct operation of controls. | - must document infeasibility<br>- ID locations for off-site<br>- prepare plans,<br>- secure property rights<br>- construction<br>- maintains controls in operating condition or transfers requirement and information to new property owner. |

3) Municipality-facilitated (Regional) Off-Site Mitigation (private/public) – developer builds off-site project on public land (right of way or environmentally sensitive area) at site(s) suggested/determined by municipality.

| Muni Role | Developer Role |
|---|---|
| - verify on-site infeasibility<br>- IDs priority areas & potential projects<br>- works with developer to select site | - must document infeasibility<br>- IDs locations for off-site<br>- prepares plans |

[6] These tables come directly from the Center for Watershed Protection, Inc.'s ***Guidance For Developing an Off-Site Stormwater Compliance Program in West Virginia: Local Stormwater Program Development in Accordance With The West Virginia General Permit For Stormwater Discharges From Small Municipal Separate Storm Sewer Systems***, prepared in 2012 for the West Virginia Department of Environmental Protection.

| | |
|---|---|
| (meeting community-watershed goals)<br>- reviews on-site & off-site plans<br>- may assist with securing property rights, approvals, permits<br>- inspects installation<br>- conducts on-site O&M inspections once every five years to ensure correct operation of controls.<br>- maintains controls depending on agreement | - secures property rights<br>- constructs project and controls<br>- maintains controls in operating condition, pays for hired contractor to perform maintenance, pays Municipality a maintenance fee, or has no maintenance obligation and Municipality performs maintenance. |

4) Payment In-Lieu (private/public) – developer pays fee to cover cost of municipality implementing and maintaining project off-site in the public right-of-way or on municipal property.

| Muni Role | Developer Role |
|---|---|
| - IDs priority areas and potential projects,<br>- sets payment in lieu rate<br>- assesses and collects fee from developer<br>- plans off-site project<br>- constructs off-site project<br>- maintains off-site project<br>- administers In-Lieu program<br>- conducts on-site O&M inspections once every five years to ensure correct operation of controls | - documents on-site infeasibility<br>- pays in-lieu fee for construction cost and pro-rated maintenance cost for 20 years or agreed upon term. |

## FRAMEWORK FOR DEVELOPING ALTERNATIVE COMPLIANCE PROGRAMS IN THE CENTRAL COAST REGION[7]

In-lieu fees would allow a municipality to fund 1:1 or aggregate mitigation off-site projects justified under technical infeasibility and/or a watershed planning approach. Additionally, establishing a fee-in-lieu rate allows developers to estimate their off-site treatment/retention costs in advance and make informed choices regarding whether to seek AC options or implement full on-site compliance requirements. The next section proposes a methodological framework to assist municipalities establish fee-in-lieu programs tailored to their specific watershed requirements and community needs.

[7] The remaining sections of this memorandum are taken directly from Violetta Pristel's California State University, Monterey Bay graduate thesis entitled, ***An Alternative Compliance Framework for Stormwater Management in the Central Coast Region***. Submitted in the fall of 2013, this document provides a thorough examination of the benefits and risks of various AC strategies and uses the City of Watsonville's AC Program as a case study.

## Methodological framework for fee-in-lieu programs

The methodological framework for fee-in-lieu programs consists of a series of program framing questions and a methodology to illustrate the process of establishing a program.

The following series of questions aim to assist municipalities build their own program framework tailored to their watershed, community needs, administrative capacity, and benefit-risk tradeoffs:

- Demand for alternative compliance
  - Are developers or on-site property owners predicted to have a high, medium or low demand for off-site compliance?
  - Is demand expected to be consistent or sporadic?
- Project scale
  - Is off-site retention/treatment volume/flow predicted to be large, medium or small?
  - Will off-site projects be 1:1 or aggregate mitigation (mitigation of off-site retention/treatment volume/flow from more than one regulated project)?
- Program scale
  - Will alternative compliance be implemented under a site-specific technical infeasibility condition, or under a watershed planning approach such as a Watershed Plan, Regional Plan, and/or Urban Sustainability Area?
  - Will AC be allowed only in specific areas of the municipality such as: a downtown area or Priority Development Area?
- Land availability and constraints
  - Will off-site projects be located on public and/or private property?
  - What are the constraints to land availability (e.g., low soil infiltration rates, steep slopes, sensitive habitat, willing land owners, and community support)?
- Maintenance
  - Will the municipality or private property owners be responsible for long term operation and maintenance?
  - Does the municipality allow private property owners to maintain stormwater controls in the public right of way?
  - Is there liability to the municipality for allowing private property owners to maintain stormwater controls in the public right of way? (e.g., What if someone becomes ill from West Nile virus from a mosquito born in a stormwater planter in the public ROW?)
  - Does the municipality require training/qualifications (such as Bay-Friendly) for privately contracted landscape maintenance crews performing maintenance of stormwater controls in the public right of way?
  - How does the municipality oversee proper maintenance of privately maintained stormwater controls in the public right of way beyond the every five year inspection?
  - How long does the the private property owner have to maintain the stormwater controls? What if the municipality decides to rebuild the street in 10 years and eliminate the stormwater control?
  - Who replaces privately maintained stormwater controls in the public right of way

when they are damaged by third parties who are unable to pay? (For example, a crash in the roadway by an uninsured motorist.)

- Jurisdiction
  - Will off-site projects be located solely within a municipality's jurisdictional boundary or will projects outside the jurisdiction also be considered?
  - Will the municipality form partnerships or agreements with other municipalities, counties, or agencies?
  - Is there a municipal preference (when possible) for stormwater control measures to be located on the frontage of the project invoking AC? (This could provide for easier and lower cost maintenance for the developer since their landscape maintenance contractor may be at the site anyway maintaining landscaping on the private property or frontage, such as street trees.)
- Mitigation type
  - What types of Stormwater Control Measures (SCMs) will be allowed at off-site projects?
  - What are the design requirements for the SCMs?
  - What are the operation, maintenance, and monitoring requirements of the SCMs?
  - Will the trading currency be runoff reduction volume or another unit of measure?
  - Is C.3.d sizing possible at the on-site location but not at the off-site location and if so what will the muni report as the justification to the Water Board for infeasibility? The T.O. currently only allows for a region-wide analysis and rationale for why C.3.d sizing isn't possible at some GI locations. If a muni goes ahead with an AC program and the region-wide rationale hasn't yet been developed, then that may restrict the muni's AC program. Additionally that region-wide rationale may not consider a unique situation in a muni's area.
  - Will the MRP 2.0 allow for non-LID measures such as Filterra and Media Filters to be used for PROW projects when C.3.d sizing is found to be infeasible and if so, would they also be allowed for AC projects?
  - What quantitative analysis will be used to evaluate off-site compliance?
  - What pollutants are generated on-site versus off-site and how will a "net environmental benefit" be calculated?
- Prioritization criteria
  - What criteria will be used to prioritize off-site locations, to maximize benefits and minimize risks?
  - How will the criteria be weighted?
- Fee calculation
  - Will in-lieu fees be estimated using a pre-determined rate or will fee payment be determined on a project-by-project basis?
  - Will a fee rate be based on a pre-established portfolio of off-site mitigation projects or a 'typical' SCM installation?
  - Can in-lieu fees pay for pre-existing municipal projects or does the off-site public project have to be built after the AC agreement has been approved? If so, what type of dollars are used: today's or actual?
  - What SCM life-cycle costs and life span will be used to estimate fees?
  - Can maintenance costs legally be included in an in-lieu fee?
  - What level of detail (and cost) will be required in the nexus study typically

developed in order to add an in-lieu fee to a municipal master fee schedule?

- Fee schedule
  - Will the fee schedule be a one-time payment (representing the cost of construction and operation and maintenance in perpetuity) or an annual fee paid by the on-site property owner (amortized over the project's lifespan)?

## Methodology

A common fee-in-lieu scenario is the flat rate fee approach, with the fee based on a 'typical' Stormwater Control Measure (SCM) installation or a pre-established portfolio of off-site projects. Two major tasks for municipalities establishing either type of program are the estimation of the fee rate and identification of potential off-site locations. A flow diagram (Fig. 1) outlines a methodology to accomplish the tasks which begin with predictions of typical off-site retention volume requirements (runoff retention volume is the trading currency), identification of allowable SCMs, and estimation of SCM space requirements. ([Peter] Why not use square footage of impervious area as the currency instead? This would line up with the "greened acres" metric that is being considered for the GI Planning process and tracking tool. The fee would be $/sq.ft. of impervious area to be treated which is something that the developer can easily calculate as opposed to some water volume amount. It seems to me that water volume is more important for cities concerned with CSOs. Also the calculation for the replacement area will be easier using square footage since the two amounts - on-site DCIA needing treatment and off-site DCIA area to be treated - would be the same if the pollutant loading for both areas is the same.)

Municipalities may choose to identify an inventory of potential off-site projects and base their fee rate on average costs of these projects or may choose to base their fee rate on the cost of a typical SCM and implementation scenario. Framing questions on land availability and constraints, jurisdiction, project and program scale, and associated spatial data will assist municipalities in identifying potential off-site projects or a typical SCM implementation scenario. The objective of the site prioritization criteria is to maximize benefits and minimize risks of off-site projects and weighting criteria will assist municipalities to select projects tailored to their watershed and community needs. When a regulated project requires off-site compliance, the in-lieu fee is calculated by multiplying the flat fee rate (cost/gallon/time) by the off-site retention volume.

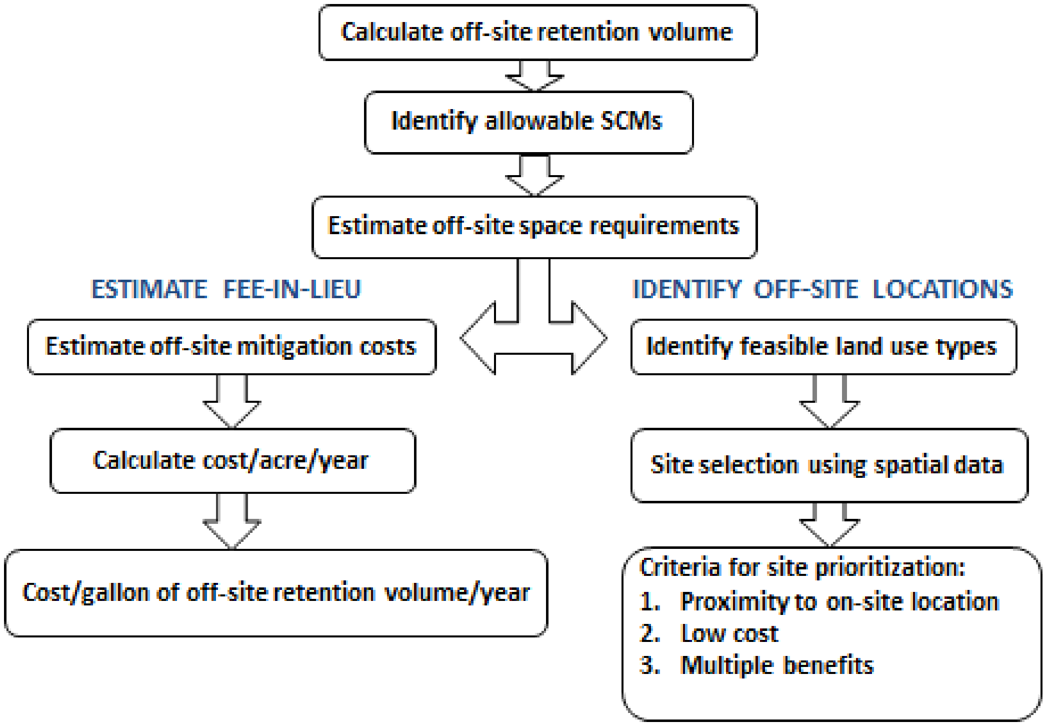


Figure 1: Methodology for fee-in-lieu estimation and off-site location identification. Ideally, off-site locations would be identified prior to the need for AC. Potential projects at the off-site locations would then be used to estimate mitigation costs and calculate in-lieu fees.

The fee amount required to mitigate an off-site retention volume should ideally reflect the life cycle costs of a typical off-site project or the average life cycle costs of an inventory of potential projects. Cost categories for fee-in-lieu programs will depend on program characteristics and may include:

- Design and engineering costs (e.g., grading plans, installation plan)
- Construction costs (e.g., materials, equipment usage, labor)
- Operation and maintenance costs (e.g., periodic (at least 20 years) maintenance tasks such as pruning, weeding, sediment removal, trash removal, mulch replenishment, may include replacement costs). According to Philadelphia, about 53% of maintenance cost for GI was weeding.
- Land costs (e.g., easement purchases, opportunity costs (the foregone opportunity to use the land for another purpose)).
- Overhead costs (e.g., program administration, site identification, project management, site inspections, building and administrative overhead, equipment acquisition and maintenance, interest on loans, accounting fees, insurances, and taxes) (WVDEP 2012).

## Recommendations for AC programs in the Central Coast Region

Pristel recommends that municipalities in the Central Coast Region use fee-in-lieu payment as the main funding mechanism for their AC programs with runoff reduction as their trading currency. Ideally, AC programs maximize environmental and economic benefits and minimize compliance and financial risks. Design challenges include optimizing flexibility and reducing uncertainty and transaction costs. To overcome these challenges she recommends that municipalities identify off-site locations prior to demand, develop prioritization and weighting criteria for off-site projects, and build safeguards into programs to reduce environmental and socioeconomic risks. Further research at the regional level is recommended to assist municipalities develop their fee- in-lieu programs.

The primary recommendation is for municipalities to plan ahead to identify potential off-site locations prior to AC demand. Municipalities can get ahead of AC demand and maximize benefits by identification of prioritized locations that have been through a basic feasibility assessment for AC and can be used to meet compliance as well as watershed and community objectives. Planning allows municipalities to use AC to achieve broader community goals such as the integration of comprehensive community greening objectives. For example, many communities would like to see street landscaping to enhance existing highly urban areas of their community but have no money for implementation. By planning AC sites, AC dollars can be used to fulfill multiple objectives including stormwater mitigation, greener communities, improved streets, enhanced economic vitality, and green infrastructure networks (Inglis 2013). Planning ahead is also vital for watershed plans and in-lieu fee estimation, and to avoid the scramble to implement off-site projects within the allocated time period.

It is recommended that municipalities develop prioritization and weighting criteria for off-site projects to streamline AC program administration, minimize transaction costs and uncertainty, and maximize cost-benefits. The hierarchy of mitigation projects will depend on many factors (e.g., AC demand, availability of sites, and watershed priorities) and municipalities should tailor prioritization criteria to environmental and community needs; however, a general mitigation hierarchy is suggested below:

1) In-kind projects in PROWs within the jurisdiction fronting the regulated project when also meeting other prioritization criteria;
2) In-kind projects in Public Right-of-Ways (PROWs) within the jurisdiction;
2) In-kind projects on other public land within the jurisdiction;
3) In-kind projects on private property within the jurisdiction;
4) In-kind projects on public land outside the jurisdiction;
5) Out-of-kind projects on public land, inside or outside the jurisdiction.

Municipalities would be wise to conduct planning to identify potential off-site locations on publicly owned land that meet basic technical and other site criteria requirements. AC program transaction costs may be reduced using public lands and ROWs are preferred due to the potential for reducing off-site project maintenance costs (e.g., municipalities already maintain ROWs and there is potential to involve neighboring private owners in maintenance tasks. [Peter - This idea needs to be discussed further].) Also public ROWs may be the ideal size for anticipated AC demands (i.e., small off-site mitigation requirement are predicted).

It is recommended that municipalities with higher AC demand aggregate (Peter - this is called “mitigation banking” and also needs more discussion in this document) 2 or 3 fee collections to implement larger and potentially more cost effective projects and to reduce the maintenance burden of many small off-site projects. Where larger off-site locations are not feasible (e.g., due to soil or cost constraints) municipalities may consider locating off-site project outside their jurisdiction. Out-of-kind projects (Peter - I think this is related to the issue of different kinds of pollutants at the on-site and off-site locations) typically have a higher risk of inadequate mitigation and it is recommended that municipalities use out-of-kind projects only when watershed priorities and cost-benefit tradeoffs have been considered.

It is recommended municipalities build safety factors into their AC programs to further reduce environmental and socioeconomic risks. These may include:

- more stringent requirements (Does this mean that on-site treatment should be favored or required in this situation?) for on-site locations in sensitive areas (e.g., higher trading ratios) to avoid ‘hot spot’ development;
- 
- development of trading ratios to create net environmental benefits;
- only allow mitigation types with known costs;
- use an annual fee schedule rather than one-time fee payments. (Peter - annual fees may be more difficult and expensive to manage than a one-time fee especially when the property owner changes – if it’s through a property tax assessment, that may require special legal authority.)

It is recommended that further research be conducted at the regional level to assist municipalities with their AC programs. Information and research gaps identified include:

- examples of legal agreements, MOUs, etc. between AC parties (e.g., municipality and developer, municipality and other municipalities);
- better cost information broken out into planning, design, construction, and operation and maintenance to improve in-lieu fee estimation;
- better cost data for different AC scenarios (e.g., for new development, redevelopment, different soils);
- better understanding of methodologies to determine cost-benefits of out-of kind mitigation;
- metrics suitable for local climate to translate mitigation units into common trading currency (e.g., In the Central Coast Region, X amount of stormwater volume equals Y amount of riparian restoration). [Peter - Can you take out Central Coast Region references and put in SF Bay Area examples?]
- better understanding of methodologies to develop trading ratios;
- better understanding of how to assess cumulative risks of unmitigated runoff at parcel scale and watershed scale.