Green Plan-IT Application Report for the East Bay Corridors Initiative

Final Report
November, 2018

Prepared by

Pete Kauhanen
Jing Wu
Jennifer Hunt
Lester McKee

CONTRIBUTION NO. 887

SFEI AQUATIC SCIENCE CENTER

4911 Central Ave, Richmond, CA 94804, p: (510) 746-7334, f: (510) 746-7300 www.sfei.org

ACKNOWLEDGEMENTS

The authors wish to acknowledge the U.S. Environmental Protection Agency Region 9 for funding the project and the San Francisco Estuary Partnership for the implementation of the larger Urban Greening Bay Area project. The authors also wish to thank members of the project Technical Advisory Committee (TAC) for their review and technical recommendations on the project. TAC members included: Jill Bicknell, Josh Bradt, Steve Carter, Chris Halford, Kristin Hathaway, Christy Leffall, Joanne Le, Keith Lichten, Elaine Marshall, Dino Marshalonis, Brian Rowley, Cece Sellgren, Mark Shorett, Jeff Sinclair, Chris Sommers, John Steere, Melody Tovar, Luisa Valiela.

Suggested citation:

Kauhanen, P., Wu, J., Hunt, J.A., and McKee, L.J., 2018. Green Plan-IT Application Report for the East Bay Corridors Initiative. A joint technical report of the Environment Informatics Program and the Clean Water Program. Contribution No. 887. San Francisco Estuary Institute, Richmond, California**.**

TABLE OF CONTENTS

1. INTRODUCTION

Regional planning of Green Infrastructure (GI) is an important aspect of building in or retrofitting GI and other green spaces across municipal jurisdictions. This level of planning allows for GI to be implemented according to natural boundaries and builds important partnerships across municipalities. The East Bay Corridors Initiative is a unique partnership across 13 jurisdictions, county and regional agencies, as well as community groups and businesses to plan new housing, create job opportunities, and improve parks and streets with linkages to essential services (ABAG 2016). The Initiative covers a large swath of the East Bay of San Francisco Bay, CA from Rodeo in the North to Union City in the South and focuses on Priority Development Areas (PDAs) and transportation linkages. In addition to the above focus, the Initiative will also look at opportunities for GI implementation across the Corridor. The Resilience priority within the Initiative focuses on sustainable infrastructure including regional GI implementation, green streets, and stormwater/flooding mitigation (ABAG 2016).

The objective of this project was to use GreenPlan-IT, a planning tool developed by the San Francisco Estuary Institute (SFEI), to identify feasible GI locations within the East Bay Corridor footprint. Results from the application of the Site Locator Tool will be used to: 1) identify potential green infrastructure projects for the Corridor's sustainable infrastructure planning efforts, including the development of information for municipal and regional GI Master Plans and Stormwater Resources Plans; and 2) potentially help comply with municipal Stormwater Permit requirements.

GreenPlan-IT is a planning level tool that was developed over the past five years with strong Bay Area stakeholder consultation and designed to support the cost-effective selection and placement of green infrastructure in urban watersheds through a combination of GIS analysis, watershed modeling, optimization techniques, and data visualization. Structurally, GreenPlan-IT comprises four standalone tools: (a) a GIS-based Site Locator Tool that combines the physical properties of different GI types with local and regional GIS information to identify and rank potential GI locations; (b) a Modeling Tool that is built on EPA's SWMM5 (Rossman, 2010) to establish baseline conditions and quantify anticipated runoff and pollutant load reductions from GI sites; (c) an Optimization Tool that uses a cost-benefit analysis to identify the best combinations of GI types and number of sites within a study area for achieving flow and/or load reduction goals; and (d) a tracker tool that is used to track GI implementation and report the cumulative programmatic outcomes for regulatory compliance and other communication needs. The Toolkit package, consisting of the software, companion user manuals, and demonstration report, is available on the GreenPlan-IT web site hosted by SFEI (http://greenplanit.sfei.org/).

This report documents the application of the Site Locator Tool (one module within the GreenPlan-IT Toolkit) in the East Bay Corridor footprint located in the East Bay of the San

Francisco Bay Area. The report describes the input data used in the analysis and key results and findings from the application.

2. PROJECT SETTING

The Association of Bay Area Governments (ABAG) is focusing on their East Bay Corridors Initiative for this case study. The East Bay Corridors Initiative is a collaboration of communities and municipalities, working to create a network of thriving neighborhoods and downtowns (ABAG 2016). Municipalities involved in the corridor include: Albany, Berkeley, Contra Costa County, El Cerrito, Emeryville, Fremont, Hayward, Hercules, Oakland, Richmond, San Leandro, San Pablo, and Union City (Figure 2-1). Like many cities in the Bay Area, these cities are all 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. With this common driver ABAG has leveraged GreenPlan-IT to prioritize, at a regional scale, where investments in green infrastructure may provide the greatest benefit. This analysis can be used as guidance for regional planning as well as for local municipalities as a starting point for their own GI prioritization within their jurisdictions.

2.1 Study Area

The study area for this case study was applied to the East Bay Corridors region. The area covers a length of Bay shore line of roughly 54 miles across most of the East Bay portion of the San Francisco Bay Area. The study area includes Rodeo on the northern extent to Union City on the southern extent of the study area (Figure 2-1). This study area covers many different communities, diverse land use areas, including, residential, commercial, and industrial as well as a high percentage of imperviousness.

2.2 Project Objectives

The aim of this application was to use the GreenPlan-IT toolkit to identify potential GI locations within the East Bay Corridor cities in order to help highlight areas, at the neighborhood, street and intersection scales where GI efforts could be focused. This application can support city scale planning efforts by providing regional recommendations about what priorities could be considered for ranking GI placement. Thus this regional analysis can act as a starting point for some municipalities to run their own analyses.

3. SITE LOCATOR TOOL

The application of the GreenPlan-IT toolkit usually begins with the GIS Site Locator Tool (SLT) to identify and rank potential GI locations based on the physics of GI feature types and physical aspects of the landscape. However, for this application of the tool kit, The Site Locator Tool is

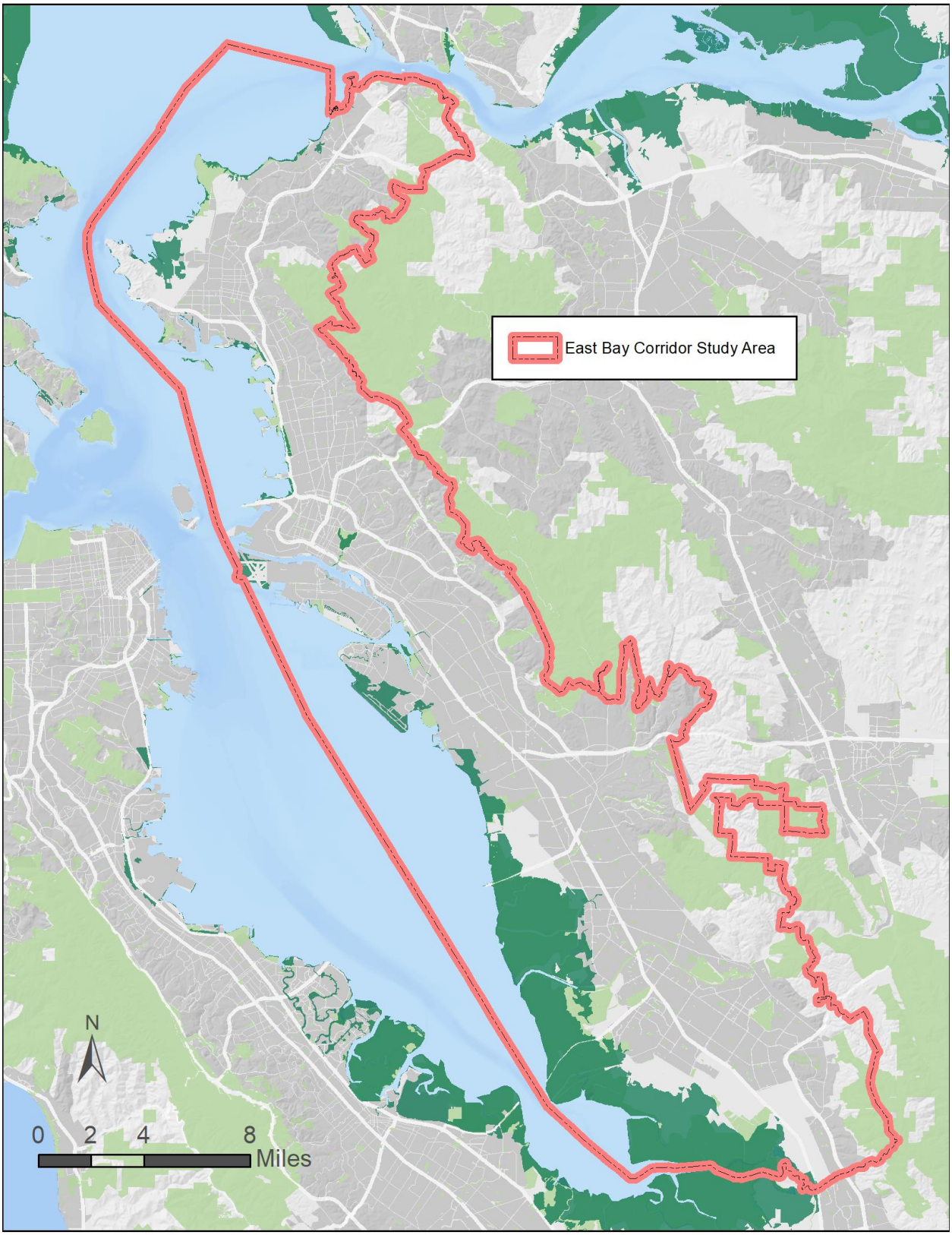

Figure 2-1 East Bay Corridor GreenPlan-IT Study Area.

the only tool used for this regional analysis. The SLT was applied to the entire East Bay Corridors study area. ABAG selected nine GI feature types for the GreenPlan-IT application: bioretention (with an underdrain), bioretention (without an underdrain), permeable pavement, stormwater wetlands, vegetated swales, wet ponds, infiltration trench, tree wells, and flow through planter boxes. A standard size of each feature type was specified and used, using the default sizes described in the default GI size table packaged with the Site Locator Tool available on the GreenPlan-IT website (http://greenplanit.sfei.org/content/greenplan-it-site-locator-tool). The next sections provide an overview of the SLT set up and use.

Table 3-1 GIS layers used in the Site Locator Tool for East Bay Corridors.

Layers:	Analysis:
East Bay Trails	Locations
Bay Trails	Locations
Railroad Right of Way	Locations
Parks	Locations
RHNA Sites	Locations; Opportunities and Constraints Analysis
Open Street Map On Street Parking Estimate	Locations; Ownership
Public Parcels (excluding CPAD)	Ownership
Priority Development Areas	Opportunities and Constraints Analysis
Priority Conservation Areas	Opportunities and Constraints Analysis
Air Quality mitigation Areas	Opportunities and Constraints Analysis
GreenPrint Polluted Streams/Rivers	Opportunities and Constraints Analysis
BAARI Streams	Opportunities and Constraints Analysis
NLCD 2011 Imperviousness	Opportunities and Constraints Analysis
CalEnviroScreen V2 (Air Quality)	Opportunities and Constraints Analysis
CalEnviroScreen V2 (Population Vulnerability)	Opportunities and Constraints Analysis
Berkeley Urban Heat Island Effect	Opportunities and Constraints Analysis
SFEI Green infrastructure Regional Suitability	Opportunities and Constraints Analysis
GreenPrint Vernal Pools and Baylands	Opportunities and Constraints Analysis (Buffered); Knockout
GreenPrint Polluted Waterbodies	Opportunities and Constraints Analysis (Buffered); Knockout
CARI Wetlands	Knockout

3.1 Data Layers Used

The GIS SLT can integrate GIS data from any scale (national, regional and local) and uses these data, through an identification, ranking and weighting process, to locate potential GI locations. The SLT can accommodate a wide range of data and information. Decisions about which data to include were primarily driven by the goals and planning needs of ABAG as well as the data availability. For this application of the Site Locator Tool national, statewide and regional datasets were used that provided full coverage for the East Bay Corridors study area. Table 3-1 shows the GIS data layers included in the Site Locator Tool for the East Bay Corridor and the analysis that each of them was used for. For more information on the different analyses that occur within the GreenPlan-IT Site Locator Tool see the GreenPlan-IT documentation online (http://greenplanit.sfei.org/books/green-plan-it-siting-tool-technical-documentation).

3.2 Custom Ranking

The custom ranking was determined by a nested weighted overlay of the GIS layers within six factors that were identified as important to ABAG for the regional analysis. These weights were determined by consulting with ABAG staff through an iterative process (Table 3-2). Each of the six factors were assigned a weight that reflected ABAG's regional priorities, and each data layer within them was assigned a weight that sums up to 1 within each factor. Higher weights were given to the data layers that were deemed more important within each factor. These weights were customized and adjusted to reflect local priorities and management goals of ABAG.

ABAG had a number of regional priorities that are reflected in the custom ranking (also referred to as the Opportunities and Constraints Analysis). These priorities, listed in order of importance according to the factor weight used, are: Regional Suitability, Imperviousness, Existing Planning Efforts, Impacts on Conservation, Social Vulnerability, and Exposure. The Social Vulnerability factor primarily used the CalEnviroScreen dataset to rank areas based on aspects such as number of children or elderly, low birth-weight prevalence, asthma emergency visits, educational attainment, linguistic isolation, poverty and unemployment. The Exposure factor was designed to highlight areas where exposure to pollutants was more likely and would cause more health effects by focusing on diesel pollution, as a proxy for airborne transportation related pollutants, and urban heat island effect layers which highlight where higher surface temperatures would compound health effects of these pollutants. Some of the critical layers that were used across factors for the ranking analysis included Priority Development Areas, the CalEnviroScreen results, SFEI's Bay Area Aquatic Resource Inventory, the National Land Cover Dataset 2011 Imperviousness, and SFEI's GI specific Regional Suitability layers, among a number of other regional and statewide datasets.

Table 3-2 shows a complete list of ranking layers and how they were used in the custom ranking. Each data layer is given a weight and categorized within a factor, which in turn has its own weight. Within each factor, layer weights add up to 1. The sum of each unique factor weight also

Table 3-2 Relative weights for GIS data layers applied to the site ranking analysis.

Factor	Factor Weight	Layer Name	Layer Weight	Buffer Type	Buffer (ft)	Rank
Regional Suitability	.5	GI Regional Suitability Layer	1	None	0	1
Imperviousness	0.17	2011 NLCD Percent Imperviousness > 50	0.67	None	0	1
Imperviousness	0.17	2011 NLCD Percent Imperviousness > 75*	0.33	None	0	1
Planning	0.125	Priority Development Areas	0.33	None	0	1
Planning	0.125	Priority Conservation Areas	0.22	None	0	1
Planning	0.125	Air Quality Mitigation Areas	0.22	None	0	1
Planning	0.125	Regional Housing Need Allocation (RHNA) 2014-2022 Vacant Lot Sites	0.11	None	0	1
Planning	0.125	Regional Housing Need Allocation (RHNA) 2014-2022 Parking Sites	0.06	None	0	1
Planning	0.125	Regional Housing Need Allocation (RHNA) 2014-2022 Sites*	0.06	None	0	1
Conservation	0.125	GreenPrint Wetland Vernal Pools and Baylands	0.09	Full	200	-1
Conservation	0.125	GreenPrint Polluted Water Bodies EPA2010 303d	0.09	Full	200	1
Conservation	0.125	GreenPrint Polluted Streams and Rivers EPA2010 303d	0.18	Full	50	-1
Conservation	0.125	GreenPrint Polluted Streams and Rivers EPA2010 303d*	0.09	Full	100	1
Conservation	0.125	BAARI Streams	0.36	Full	50	-1
Conservation	0.125	BAARI Streams*	0.18	Full	100	1
Social Vulnerability	0.042	CalEnviroScreen 2.0 Population Vulnerability > 90	0.25	None	0	1
Social Vulnerability	0.042	CalEnviroScreen 2.0 Population Vulnerability > 80*	0.25	None	0	1
Social Vulnerability	0.042	CalEnviroScreen 2.0 Population Vulnerability > 70*	0.25	None	0	1

Factor	Factor Weight	Layer Name	Layer Weight	Buffer Type	Buffer (ft)	Rank
Social Vulnerability	0.042	CalEnviroScreen 2.0 Population Vulnerability > 60*	0.25	None	0	1
Exposure	0.042	CalEnviroScreen 2.0 Diesel Pollution > 90	0.125	None	0	1
Exposure	0.042	CalEnviroScreen 2.0 Diesel Pollution > 80*	0.125	None	0	1
Exposure	0.042	CalEnviroScreen 2.0 Diesel Pollution > 70*	0.125	None	0	1
Exposure	0.042	CalEnviroScreen 2.0 Diesel Pollution > 60*	0.125	None	0	1
Exposure	0.042	Urban Heat Island Effect > 52C	0.125	None	0	1
Exposure	0.042	Urban Heat Island Effect > 48C*	0.125	None	0	1
Exposure	0.042	Urban Heat Island Effect > 43C*	0.125	None	0	1
Exposure	0.042	Urban Heat Island Effect > 39C*	0.125	None	0	1

*Overlap between layers in these cases is intentional in order to boost the ranking in areas that have a greater need for the benefit. In other cases, such as streams overlap of positive and negatively ranked buffers, layers overlap in a way that results in a ring of higher ranked areas around the layer features.

adds up to 1. This allows for a maximum rank value of 1 under the condition where all ranking layers overlap a location and positively impact the rank. Each layer either positively or negatively impacts the rank of the location it overlaps, indicated by a "1", if it positively impacts the score, or a "-1", if it negatively impacts the score. Lastly, each layer has the option of being buffered, indicated by a type other than "None" and by a specified amount of feet, recorded under "Buffer (ft)".

3.3 Site Locator Tool Outputs

Running the Site Locator Tool for the entire East Bay Corridors boundary was an iterative and interactive process of adding and subtracting data layers and adjusting weights at each step as ABAG staff reviewed the preliminary results against their own thoughts and needs. Five iterations of ranking and adjustment were made for applying the tool to the study area extent. Based on the ranking and weighting of the GIS layers, the potential locations for each of GI features were identified and ranked (see bioretention as an example in Figure 3-1).

As a summary example of the output information, a total of 16,000 public acres were identified as opportunity locations for implementation of bioretention with underdrain in the Corridor footprint. Of these 16,000 acres, 1400 acres were ranked higher based on the goals and priorities identified by ABAG for this analysis. There was also a total of 3400 private acres identified as

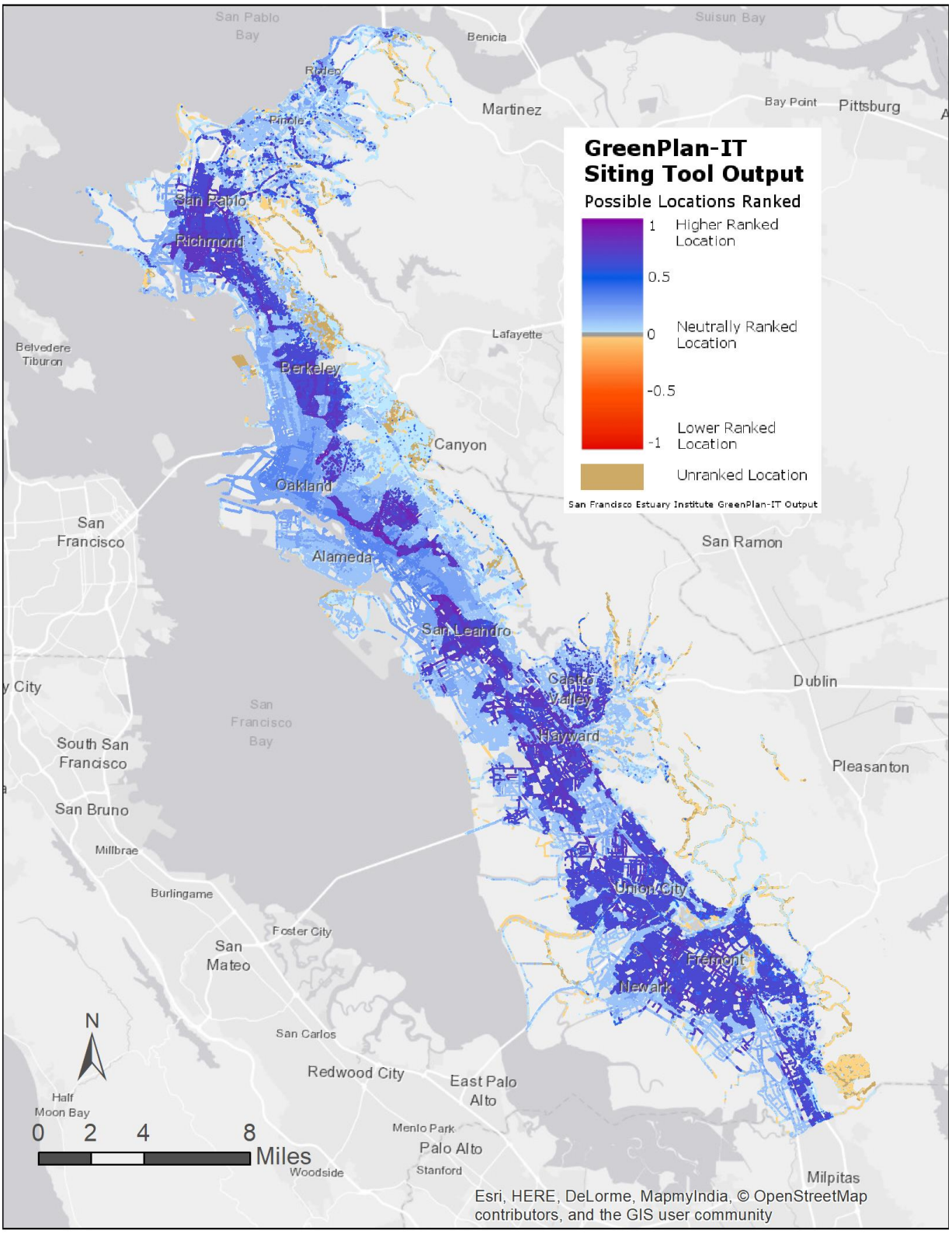

Figure 3-1 Ranked potential locations for bioretention within East Bay Corridors study area.

bioretention with underdrain opportunity locations of which 590 acres were ranked higher. These rankings are relative within the analysis and should be assessed independently. Also the determination of 'highly ranked' is arbitrary and planning staff can make their own determination based on the distribution of rankings and the number of sites needed to meet programmatic goals.

These locations provide a starting point for GI planning at a regional scale and help with prioritizing funding and planning efforts, as well as implementation efforts of individual municipalities. This effort also represents an effort to account for additional benefits of GI, beyond stormwater runoff slowing, filtration, and infiltration. This is accomplished by taking additional benefits into account in the factors used in ranking of potential locations, including factors of Social Vulnerability, Conservation and Exposure. This regional analysis is particularly powerful as it helps to identify areas of possible collaboration across municipalities as they create more local and refined analyses within their own jurisdictions. Furthermore, these outputs were used, in the format of large printed maps, in a number of meetings with relevant municipalities, hosted by ABAG, in order to foster interaction and prioritization. Corridor partners looked at the maps and marked areas for discussion and potential collaboration.

4. SUMMARY

The GreenPlan-IT Toolkit is a planning level tool that provides users with the ability to evaluate the possible placement of various types of GI for addressing redevelopment and resiliency needs as well as stormwater management needs in urban watersheds. The GIS SLT was used to identify a list of feasible, ranked locations for nine GI feature types in the East Bay Corridors footprint. These outputs provided ABAG and participating partners with information on where GI could be placed in the landscape based on landscape and GI physics and ranked based on regional priorities. The map outputs from the SLT can be compared and overlaid with maps of flooding, trash build up areas, planned capital projects, funding sources, and community needs as the basis for GI planning. The outputs can also be used for any municipal GI planning needs e.g. Stormwater Resource Plans.

This kind of systematic approach has been found to be important for providing regional planners and local municipalities with the consistent evidence and outputs they need to begin their GI planning. The outputs of the GreenPlan-IT application can provide important information and a strong data basis for planning and prioritizing GI implementation efforts in relation to other competing planning needs.

The GreenPlan-IT toolkit is versatile, robust, and flexible to meet a range of planning, community, resilience, and stormwater management needs. Below is a brief summary of the project:

- The Site Locator Tool was applied in the East Bay Corridor footprint which stretched from Rodeo to Union City. Regional and some local data were utilized to build factors which provided the basis for ranking potential GI locations based on ABAG and partner planning priorities.
- The Site Locator Tool was run for nine GI feature types across the East Bay Corridor.
- For the most common type of GI, bioretention with underdrain, 16,000 acres of public and 3,400 acres of private areas were identified as potential locations. Of these areas, 1,400 acres of public and 590 acres of private areas were, relatively, more highly ranked (rank of 0.5 or greater). (Note that rankings are relative within an analysis and should be assessed independently).
- The Site Locator Tool map outputs were used at Corridor planning meetings to help with discussion on GI collaboration opportunities across municipal boundaries.

5. REFERENCES

ABAG 2016. East Bay Corridors Initiative Priorities 2015-16. Prepared by ABAG. https://abag.ca.gov/planning/corridors.html

BASMAA 2017. Bay Area Reasonable Assurance Analysis Guidance Document. Prepared by Geosyntec Consultants and Paradigm Environmental. Project Number WW2282, June 30th 2017. http://basmaa.org/Announcements/bay-area-reasonable-assurance-analysis-guidance-document

Gilbreath, A.N., Hunt, J.A., Yee, D., and McKee, L.J., 2017. Pollutants of concern reconnaissance monitoring final progress report, water years 2015 and 2016. A technical report prepared for the Regional Monitoring Program for Water Quality in San Francisco Bay (RMP), Sources, Pathways and Loadings Workgroup (SPLWG), Small Tributaries Loading Strategy (STLS). Contribution No. 817. San Francisco Estuary Institute, Richmond, California. http://www.sfei.org/sites/default/files/biblio_files/SFEI%20WY2016%20POC%20monitorng%20report%20FINAL%20June2017.pdf

McKee, L.J. Gilbreath, N., Hunt, J.A., Wu, J., and Yee, D., 2015. Sources, Pathways and Loadings: Multi-Year Synthesis with a Focus on PCBs and Hg. A technical report prepared for the Regional Monitoring Program for Water Quality in San Francisco Bay (RMP), Sources, Pathways and Loadings Workgroup (SPLWG), Small Tributaries Loading Strategy (STLS). SFEI Contribution No. 773. San Francisco Estuary Institute, Richmond, CA. http://www.sfei.org/sites/default/files/biblio_files/MYSR%20Final%20Report.pdf

Rossman, L. A (2010). Storm Water Management Model User's Manual, Version 5.0, U.S. Environmental Protection Agency. Office of Research and Development. EPA/600/R-05/040.