OPTIMAL SELECTION AND PLACEMENT OF GREEN INFRASTRUCTURE AND TRACKING PROGRESS FOR URBAN WATERSHEDS

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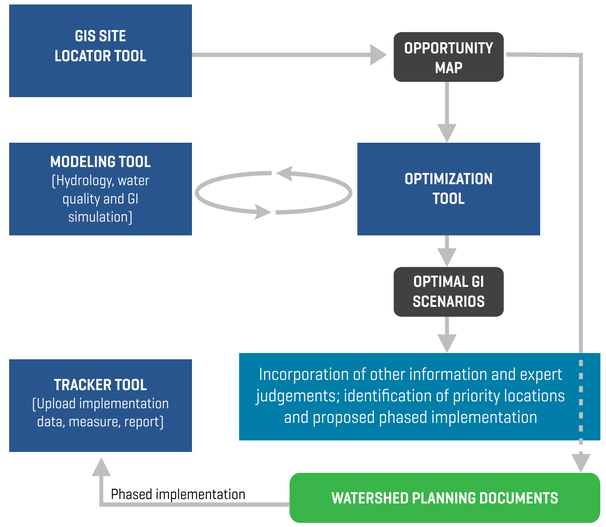
Reducing stormwater runoff and contaminant loads in urban environment is complex and relies on costly engineering. Increasingly, Green Infrastructure (GI) is emerging as a multi-benefit solution that can address both stormwater quality and quantity concerns, but challenges remain as how to identify where opportunity sites exist for GI retrofits and what constitutes the most cost-effective management strategy for achieving desired management goals.

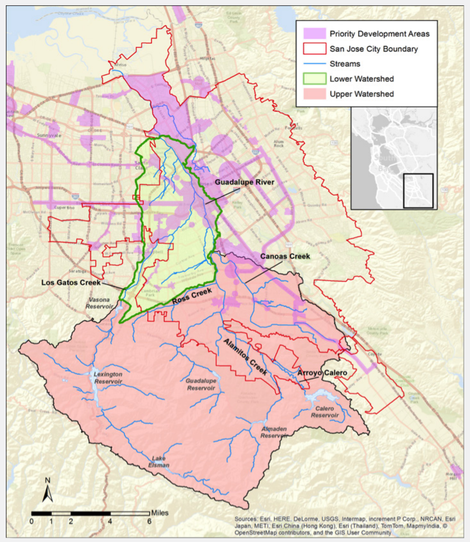
To help address these challenges, a planning level tool - GreenPlan-IT, was developed that was centered on watershed modeling and optimization techniques. SWMM was used to establish baseline conditions and quantify anticipated runoff and pollutant load reduction from GI sites. An evolutionary optimization technique (NSGA-II) was applied to identify optimal combinations of GI among many options identified through a GIS site locator tool that minimize the total cost of management while achieving water quality and quantity goals. As municipalities begin to complete phased implementation of GI, a Tracker Tool will be used to record the effectiveness of GIs on ground estimated through SWMM and track progress towards goals. Together, these four tools can ensure GI features are properly located, tracked, and credited.

GreenPlan-IT was applied to City of San Jose to support a cost-benefit evaluation of stormwater runoff control, and is currently being applied to four cities in San Francisco Bay area to support their GI planning needs. The GreenPlan-IT can be used to comply with NPDES stormwater permit requirements and address load reduction needs identified in TMDLs. The toolkit has broad applicability and could be used by stormwater agencies across the nation.

GREENPLAN-IT OVERVIEW

- GIS site locator tool to assess feasible opportunities for GI at the watershed scale
- Modeling tool to simulate runoff and pollution production and GI performance, as well as to support reasonable assurance analysis
- Optimization tool to identify cost-effective GI scenarios for flow and load reductions
- Tracker tool to record, display and aggregate information to track GI implementation progress in relation to TMDL goals



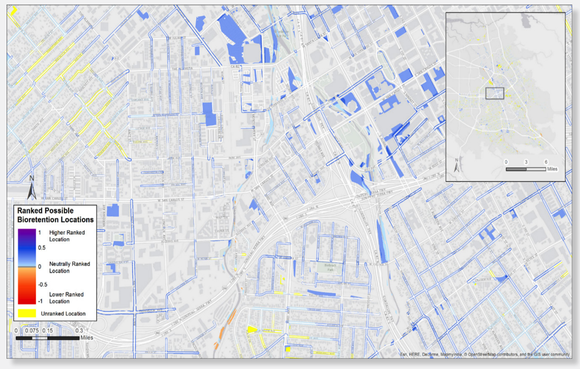


GreenPlan-IT was applied to City of San Jose to demonstrate its capacities and usability in identifying feasible and cost-effective GI locations for PCB control. The focus area was a 4300 acre proposed development area within Lower Guadalupe River Watershed.

The results of the application included a map of feasible GI sites across the City, the cost/effectiveness associated with a range of flow/PCB reduction targets, and maps showing the distribution of GI within the study area under a specific optimal solution. These results will be used to identify specific green infrastructure projects; support the City's current and future planning efforts, such as the development of the San Jose Storm Drain Master Plan; and help comply with future Stormwater Permit requirements.

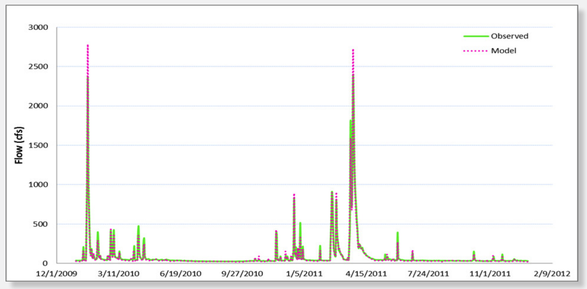
LOCATOR TOOL

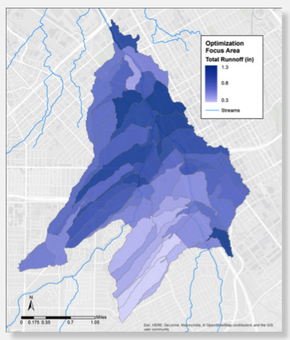
- Identify feasible GI locations through a series of GIS analyses
- Produce opportunity maps for various GI types to assist the municipal planning effort
- Provide boundary conditions for the optimization process

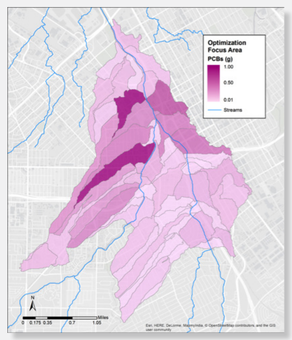


MODELING TOOL

- Built on EPA SWMM
- Simulate flow and pollutant generation from landscape
- Quantify anticipated watershed-scale runoff and pollutant load reduction from GI sites
- Calibrated for flow and PCB to set stage for optimization
- Established baseline condition to serve as a reference point from which any GI scenarios can be measured

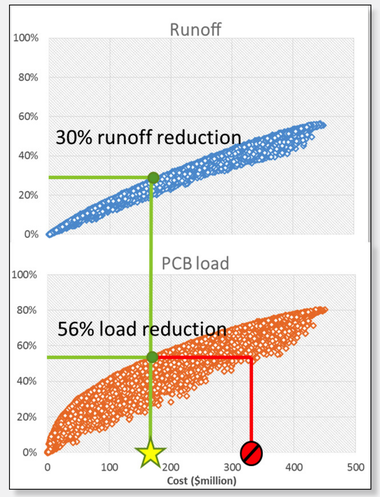


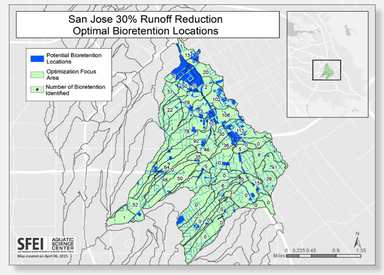




OPTIMIZATION TOOL

- Based on an evolutionary optimization technique NSGA-II
- Employ three GI types in current structure: Bioretention, Infiltration Trench, and Permeable Pavement
- Determine optimal combinations of GI locations, types, and numbers that minimize the total cost of management while maximizing water quality and quantity reductions
- Utilize the site information generated from the GIS Site Locator tool and run the Modeling Tool in an iterative and evolutionary fashion to arrive at the optimal GI scenario
- Produce cost-effectiveness curves for flow and PCB loads and spatial distributions of GI for any given optimal scenario





TRACKER TOOL

- Record and display information about GI implementation for individual sites
- Aggregate information across multiple sites within city or any area of interest
- Generate standardized reports to track progress and demonstrate regulatory compliance