

**The GreenPlan-IT tool kit:  
A Watershed-Scale Planning Tool for  
Green Infrastructure  
in  
Bay Area Watersheds**

Jing Wu, Pete Kauhanen, Jen Hunt, Tony Hale, Lester McKee

San Francisco Estuary Institute

5/26/2015

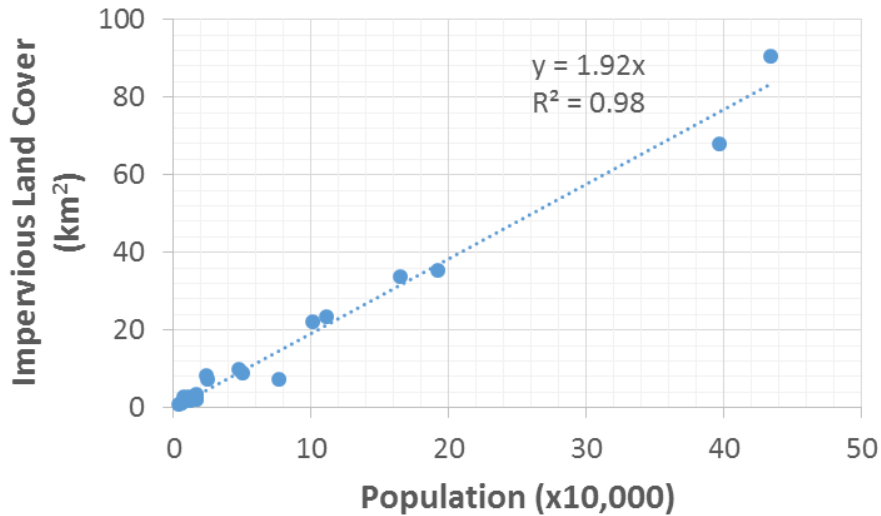
# GreenPlan-IT Overview

---



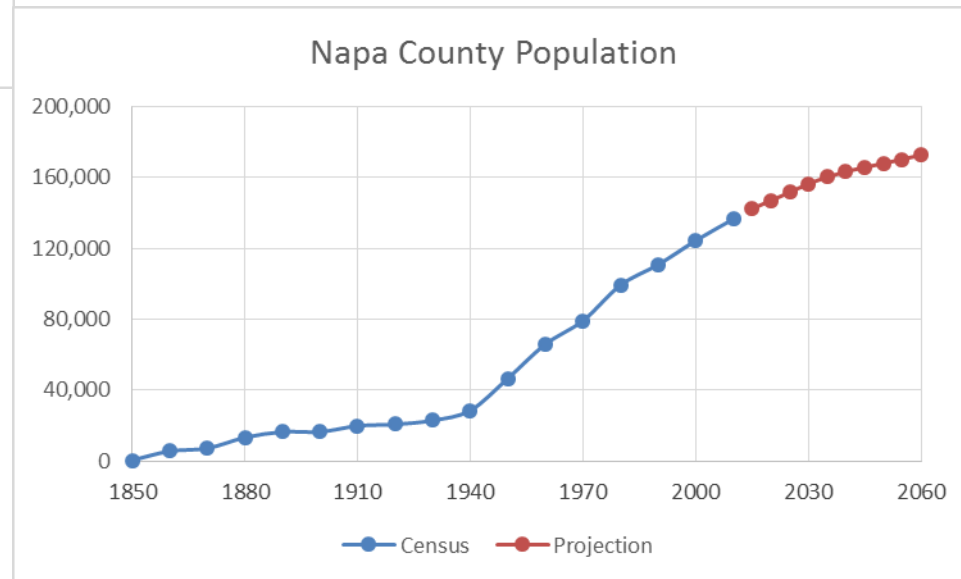
- ❑ Designed to identify optimal GI locations for stormwater management
  
- ❑ Developed with Partner Cities San Jose and San Mateo
  
- ❑ Primary design use: Managing surface runoff and pollutants
  - ❑ But can be enhanced for use on groundwater recharge and other hydrological issues
  
- ❑ Open source, free to be used or further enhanced

# Napa area population challenge



- Every 5,000 people
  - ~1 km<sup>2</sup> of impervious cover

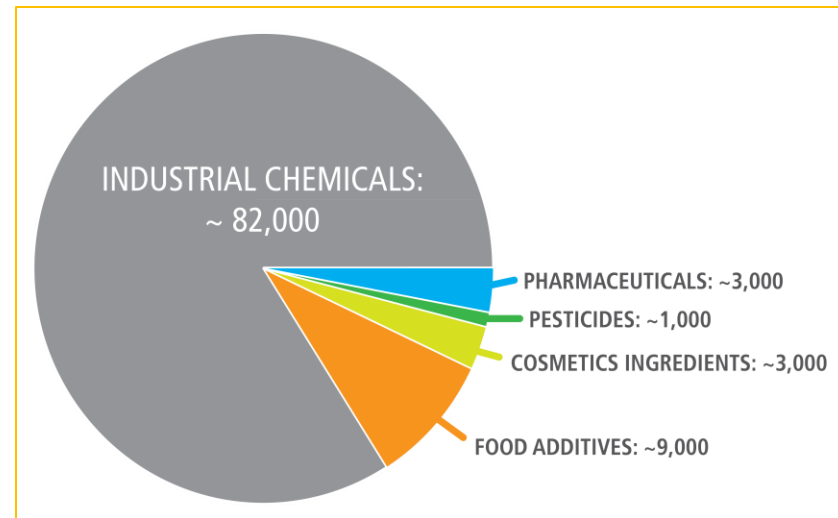
- Over the past 4 decades
  - Added ~5,000 people every 3.5 years



# Emerging Pollutants

## ■ Urban environments

- Import water, food, and materials from the near by rural areas
- Export water, air pollutants, wastes and wastewater to nearby environments
- In the past 30 years, 100,000 new chemicals have been invented
- The 2055 pollutant list has not been invented yet!!



Source: Muir and Howard (2006)

# Napa area climate change?

---

- Over the past decades annual average rainfall has increased

	Napa State Hospital (046074)	Calistoga (041312)
➤ 1961-1990:	25.1"	37.6"
➤ 1971-2000:	26.5"	38.5"
➤ 1981-2010:	27.7"	40.9"

# Napa area rainfall-runoff challenge

---

- Each 1 km<sup>2</sup> of impervious surface added every 3.5 years for an annual average rainfall of 30” leads to:
  - ~750 Acre-foot less recharge occurs on average
  - ~1.2 cfs less base flow in our creeks occurs on average
  - Increased peak flow runoff capacity needed in stormwater infrastructure



RIDDLE ME THIS...

HOW WILL WE MAINTAIN OR ENHANCE ENVIRONMENTAL QUALITY IN NAPA COUNTY AGAINST SUCH SEEMINGLY FORMIDABLE ODDS?



# Urban opportunity

---



How do we want our urban areas to be designed and function for 2055?

- Water supply and use?
- Stormwater runoff?
- Pollutant production and export?
- Habitat for birds and animals?

Habitat for  
people too!

Just like they were designed in the last 100 years or a new design?



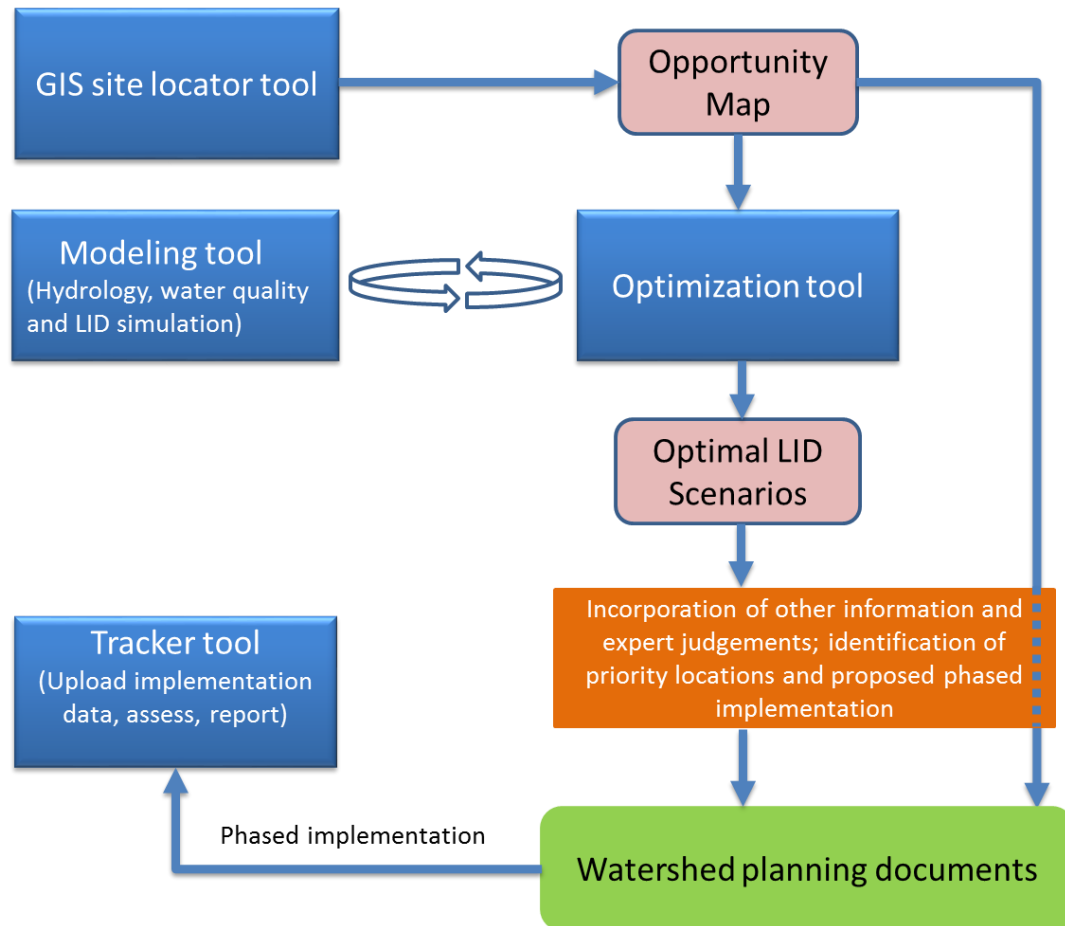
**Green Infrastructure (GI) is a solution that can help us create that new design**

**but we need a shared vision and a shared strategy**

**A plan**

# Introducing GreenPlan-IT

- ❑ A watershed-scale planning tool for municipalities
- ❑ Locate and determine cost effective implementation scenarios



# GreenPlan-IT: Answers Key Questions

---



- ❑ Where are possible locations for GI implementation?
- ❑ Where are effective locations for GI implementation and what quantitative flow and water quality improvements can be achieved?
- ❑ What are the most cost-effective GI combinations for achieving certain reduction goals?

# What is Green Infrastructure?

---

- Rain gardens
- Bioswales
- Green roofs
- Tree well planters
- Pervious pavement
- Green walls
- Cisterns



# Locator tool

## Value proposition:

Takes the user from not knowing where to place GI among 10s to 100s thousands of locations to a few thousand feasible locations

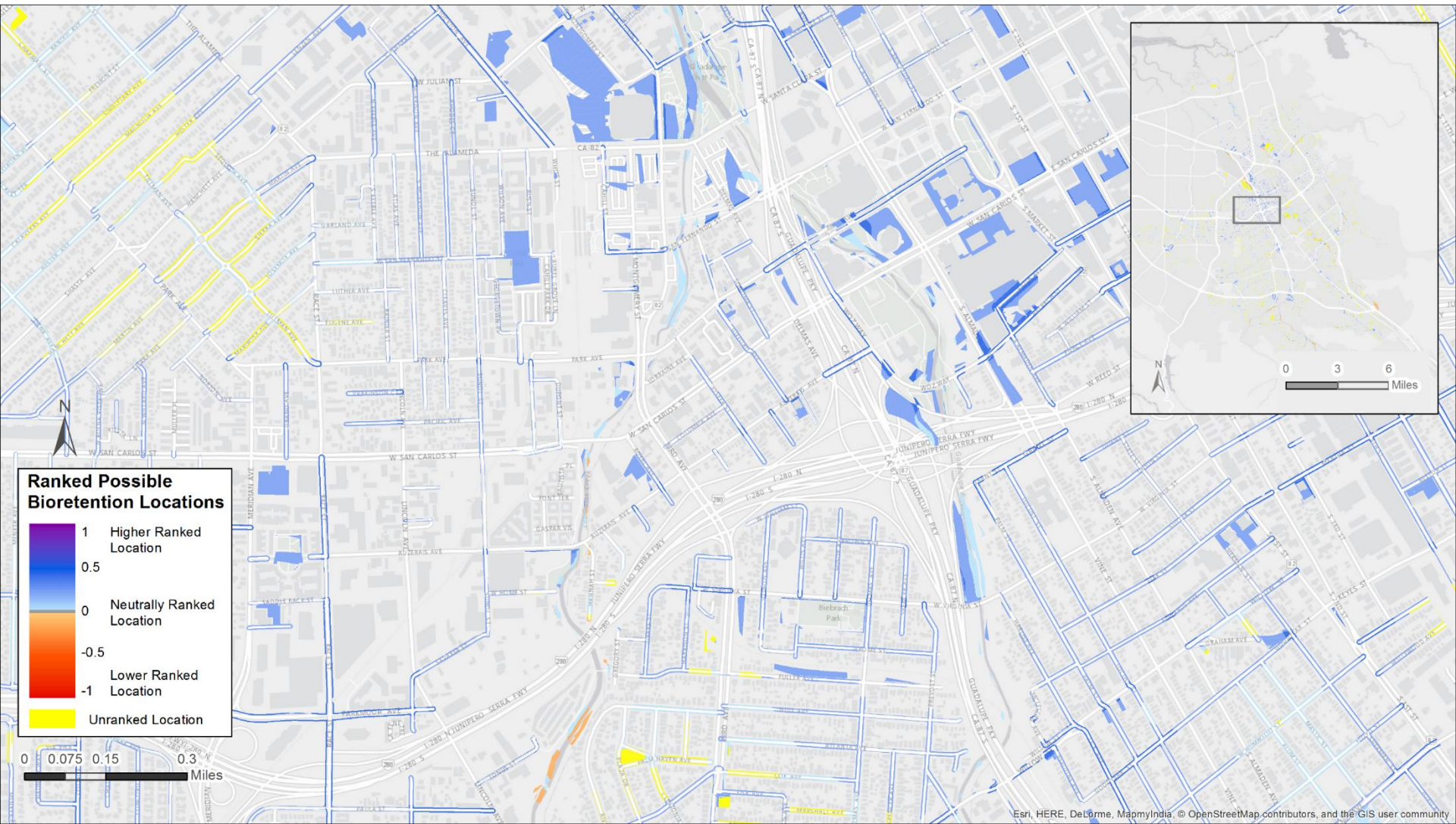
# An Easy Tool Interface



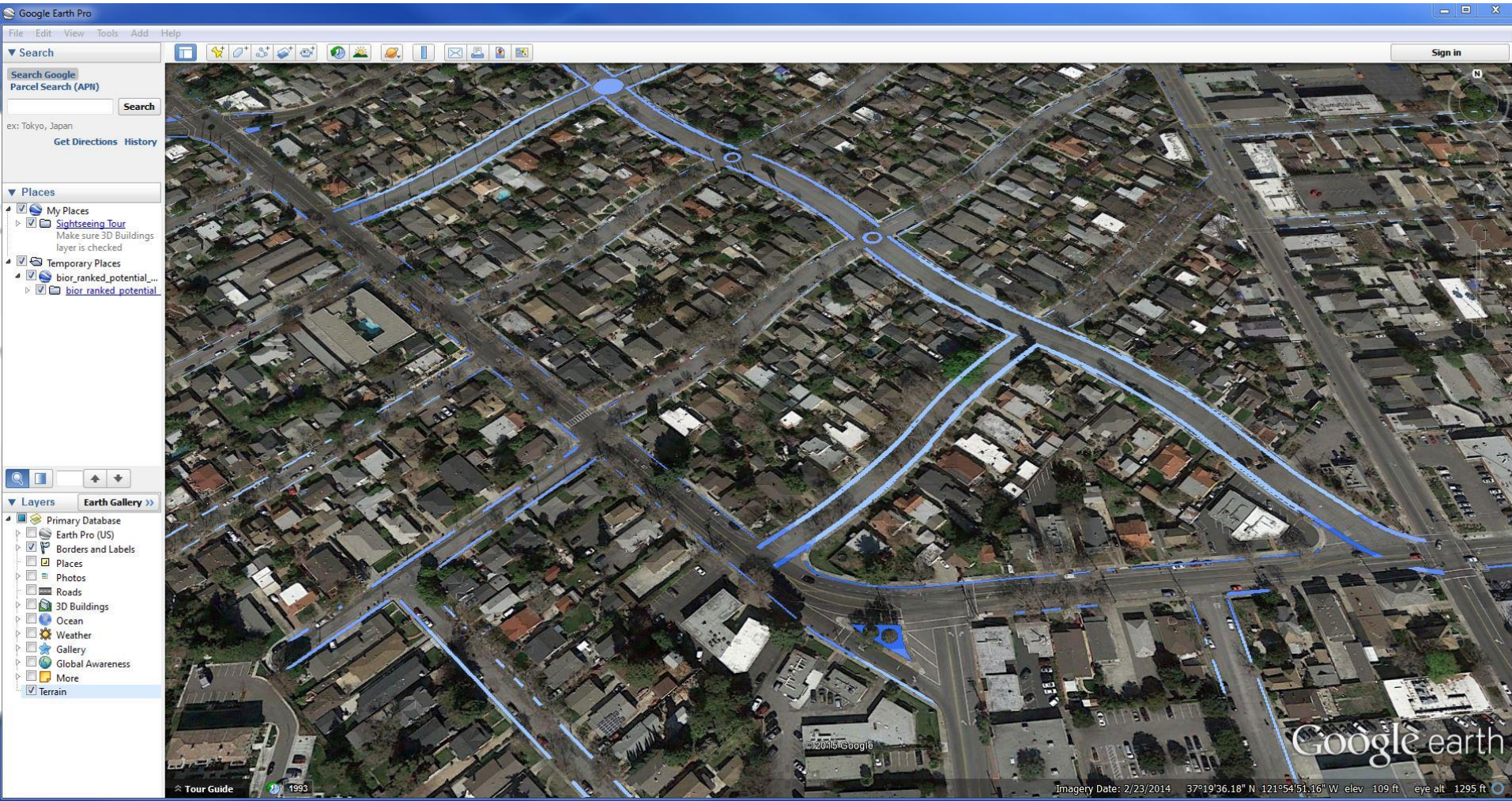
- Organizes local and regional GIS data
- Select only GI types, analysis modules you want to include
- Classifies, adds knockouts and constraints, and ranks the locations according environmental conditions, LID physics, and your priorities

A screenshot of the "Siting Tool" software interface. The window has a blue title bar and a white background. It is divided into several sections. At the top left, there is a section for "Output Directory" with a text field containing a file path and a folder icon. Below that is "Area of Interest" with a dropdown menu set to "San Jose" and a "Custom Area of Interest" field. The "LID Types" section contains a list of checkboxes: Bioretention (checked), Infiltration Trench (checked), Permeable Pavement (checked), Storm Water Wetlands (unchecked), Vegetated Swale (unchecked), and Wet Pond (unchecked). Below this are "Select All", "Unselect All", and "Add Value" buttons. The "Modules" section has a list of checkboxes: Location Analysis (checked), Opportunities and Constraints Analysis (checked), Ownership Analysis (checked), and Knockout Analysis (checked). It also has "Select All", "Unselect All", and "Add Value" buttons. Below the modules is a checkbox for "Include Base Analysis" which is checked. At the bottom, there are five optional table fields: "Locations Table", "Opportunities and Constraints Table", "Ownership Table", "Knockout Table", and "LID Size Table", each with a text field and a folder icon. At the very bottom of the window are buttons for "OK", "Cancel", "Environments...", "<< Hide Help", and "Tool Help". On the right side of the window, there is a "Modules" section with text descriptions for each module: "Location Analysis", "Opportunities and Constraints Analysis", "Ownership Analysis", and "Knockout Analysis".

# Outputs - Maps and Tables



# Viewable in Google Earth





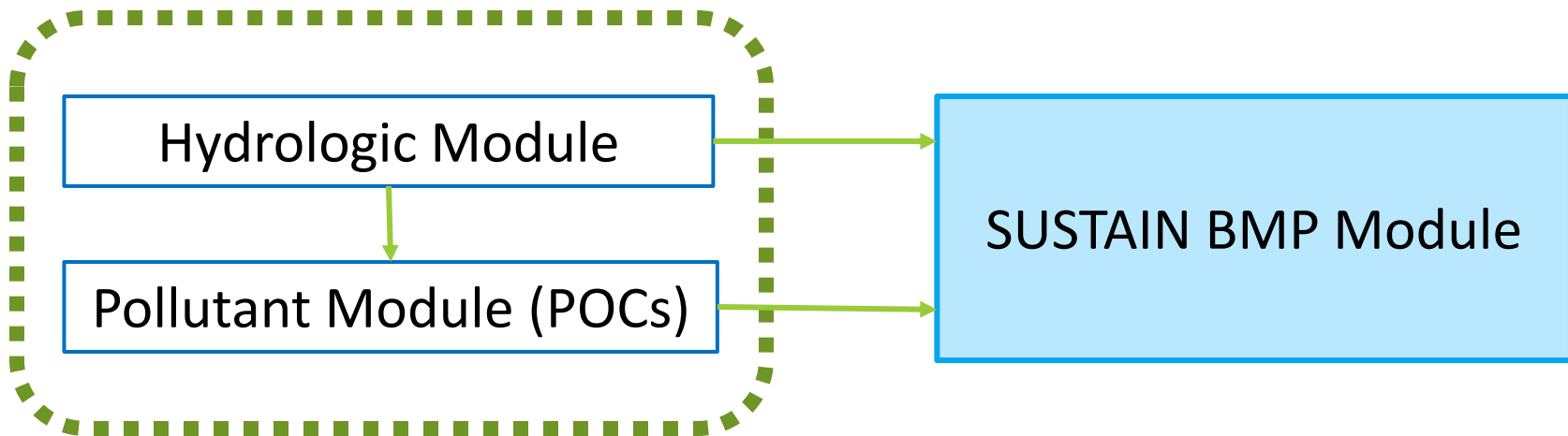
# Modeling tool

## Value proposition:

Provides the user with the ability to compare runoff and water quality conditions before and after GI buildout

# The Modeling “Engine”

## □ EPA’s SWMM model

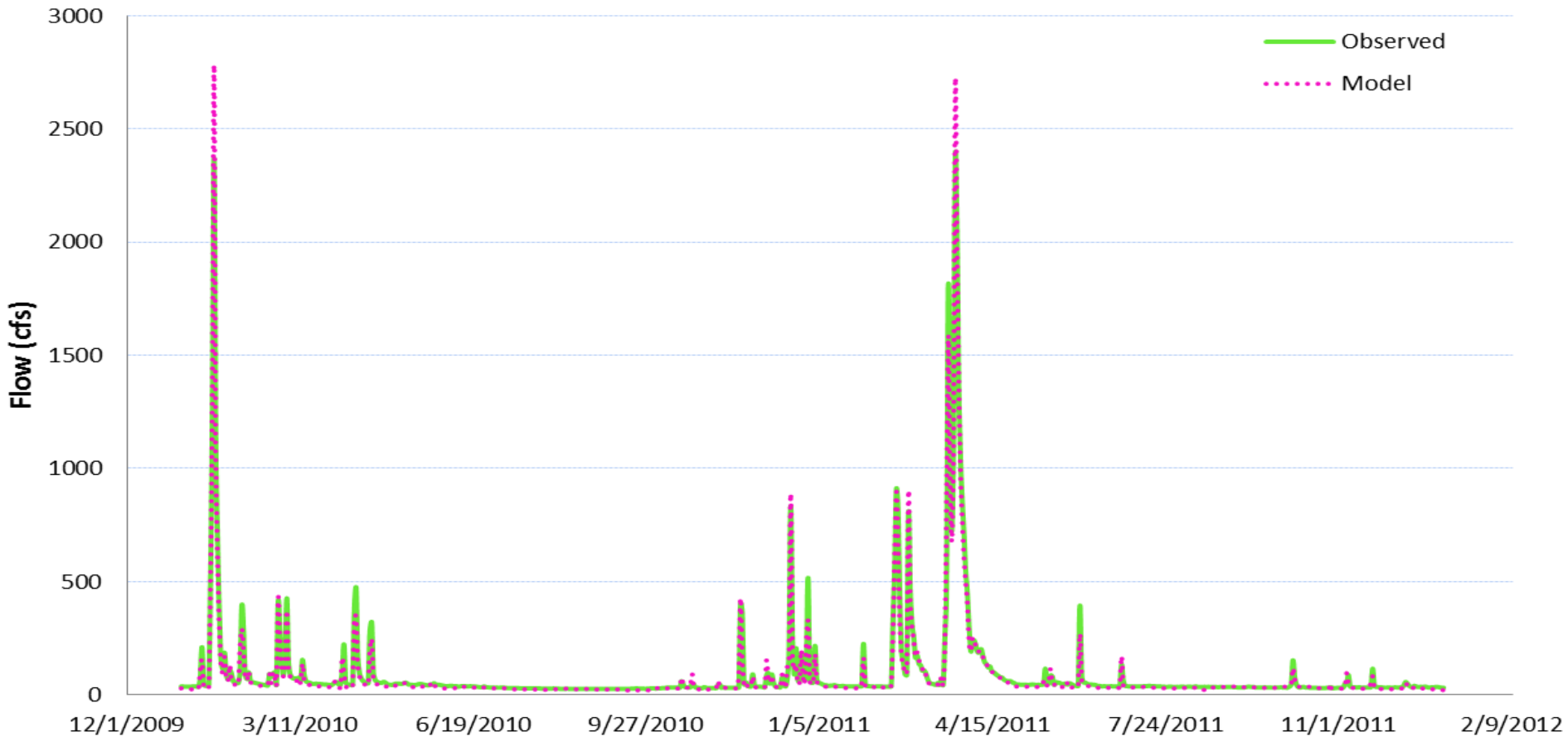


- Establish baseline condition
- ID critical pollutant and runoff source areas
- Quantify flow and pollutant load reduction from various GI scenarios

# Model Calibration

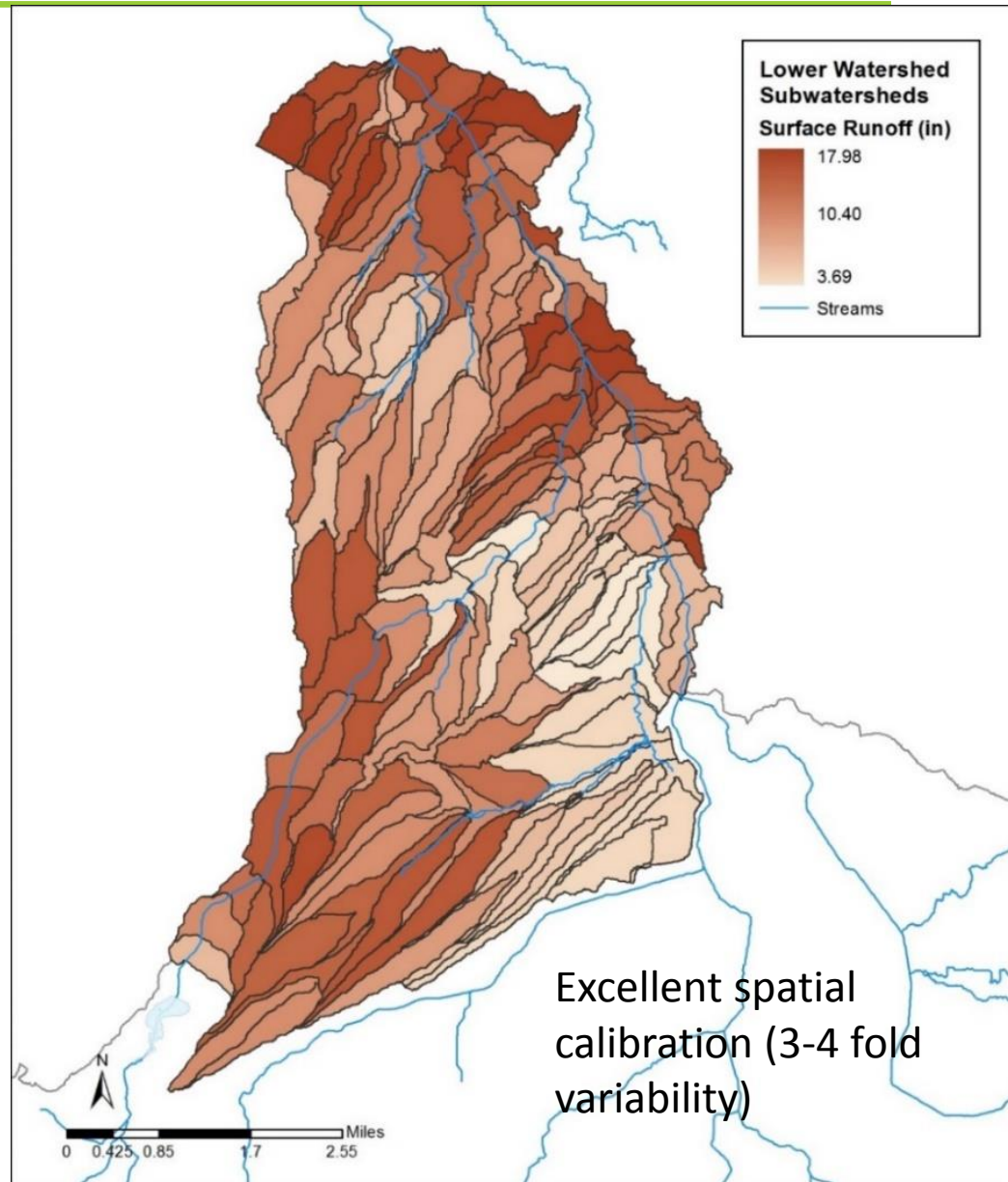


- Excellent calibration for both flow timing and magnitude



# What is the Model output used for?

- Set stage for Green Infrastructure cost-effectiveness optimization
- Ready for Reasonable Assurance Analysis



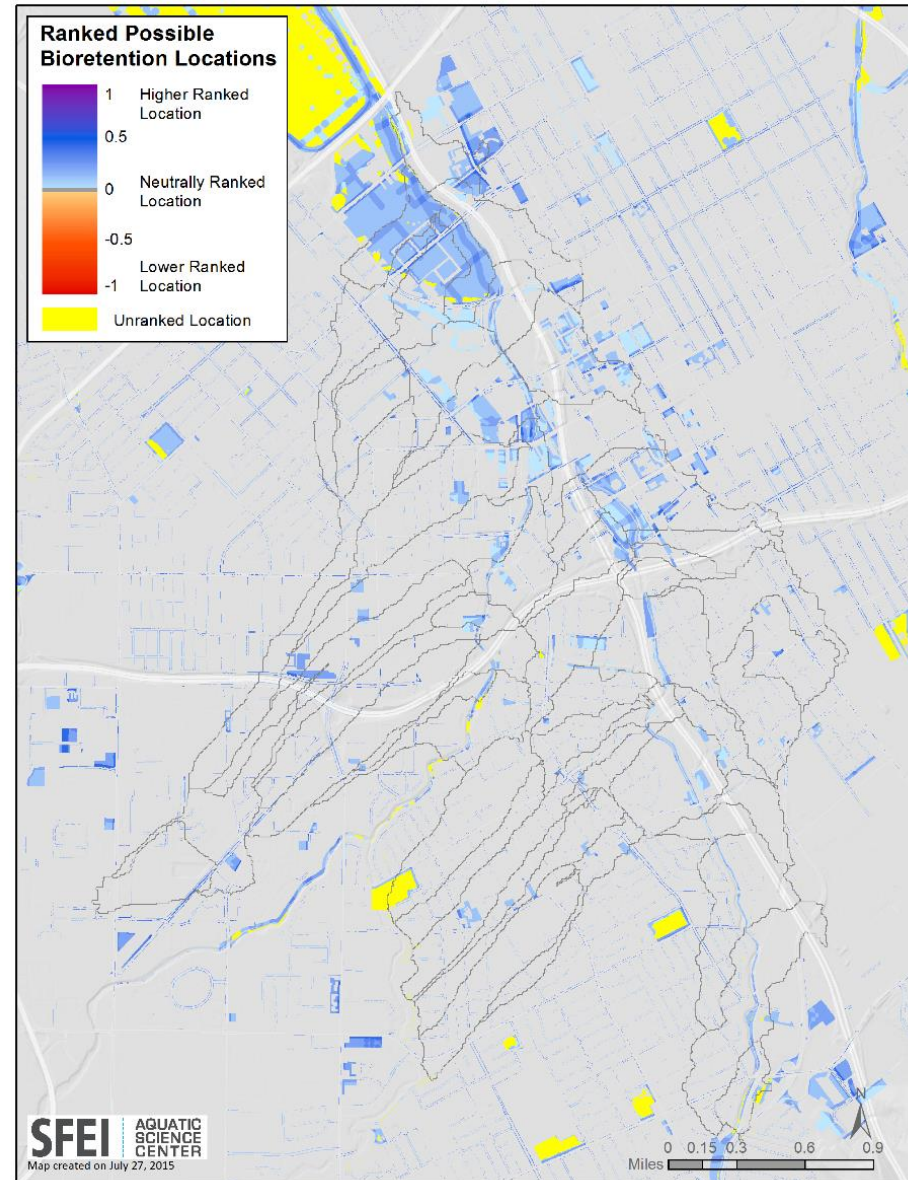
# Optimization tool

**Value proposition:**

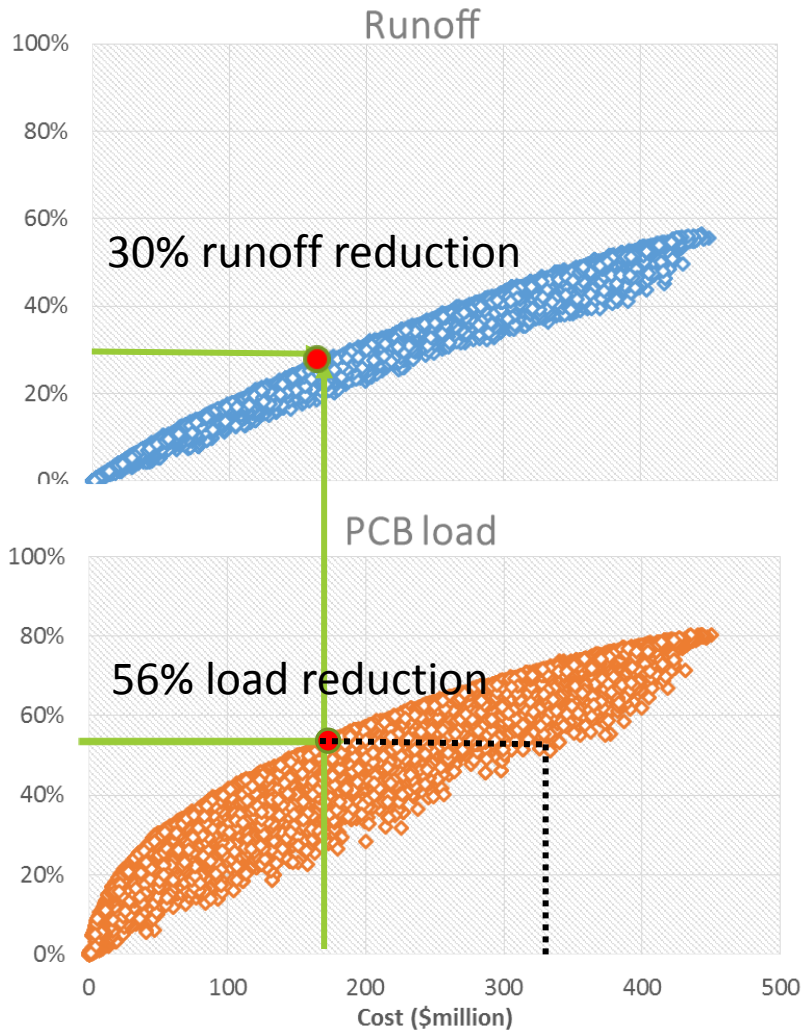
**Take the user from thousands of feasible locations to 100s of optimal locations**

# Thousands of Possible Sites...

- But what are the most cost-effective Green Infrastructure combinations?
  
- ...and at what price?

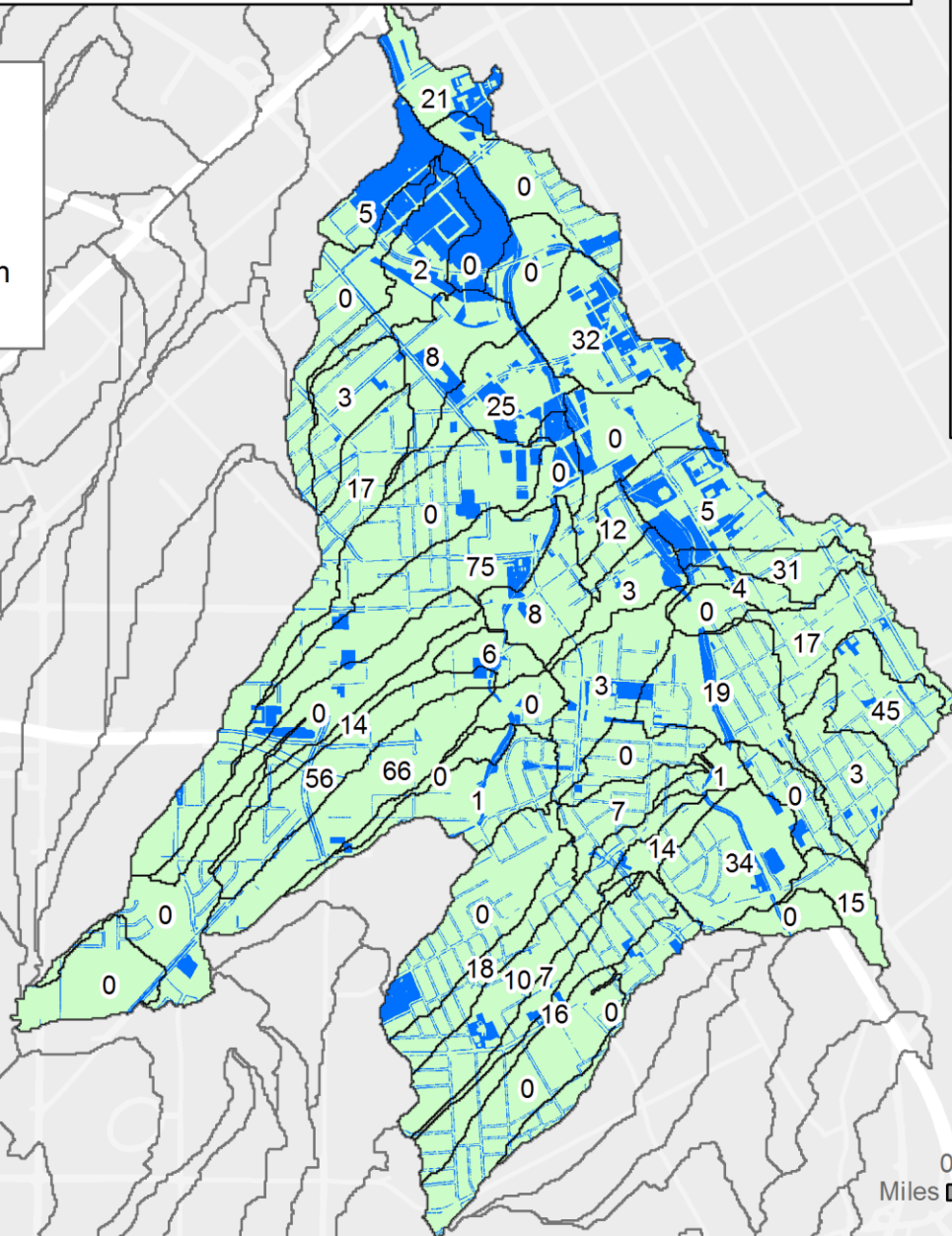
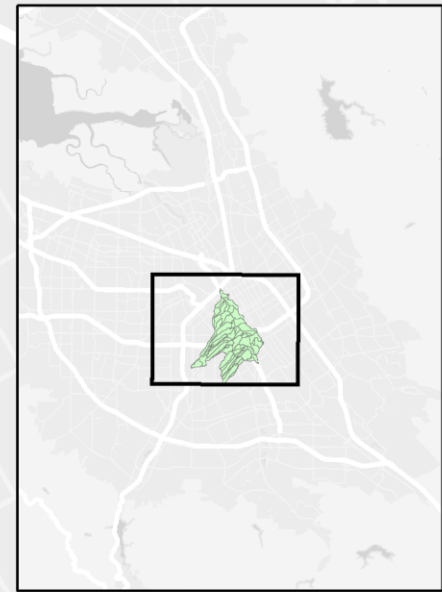
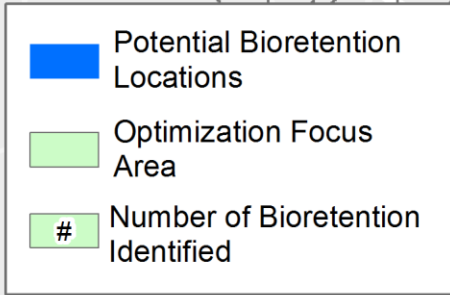


# Example Optimal Solution



- Note the difference in relative cost!
- Random acts of kindness will cost us twice as much

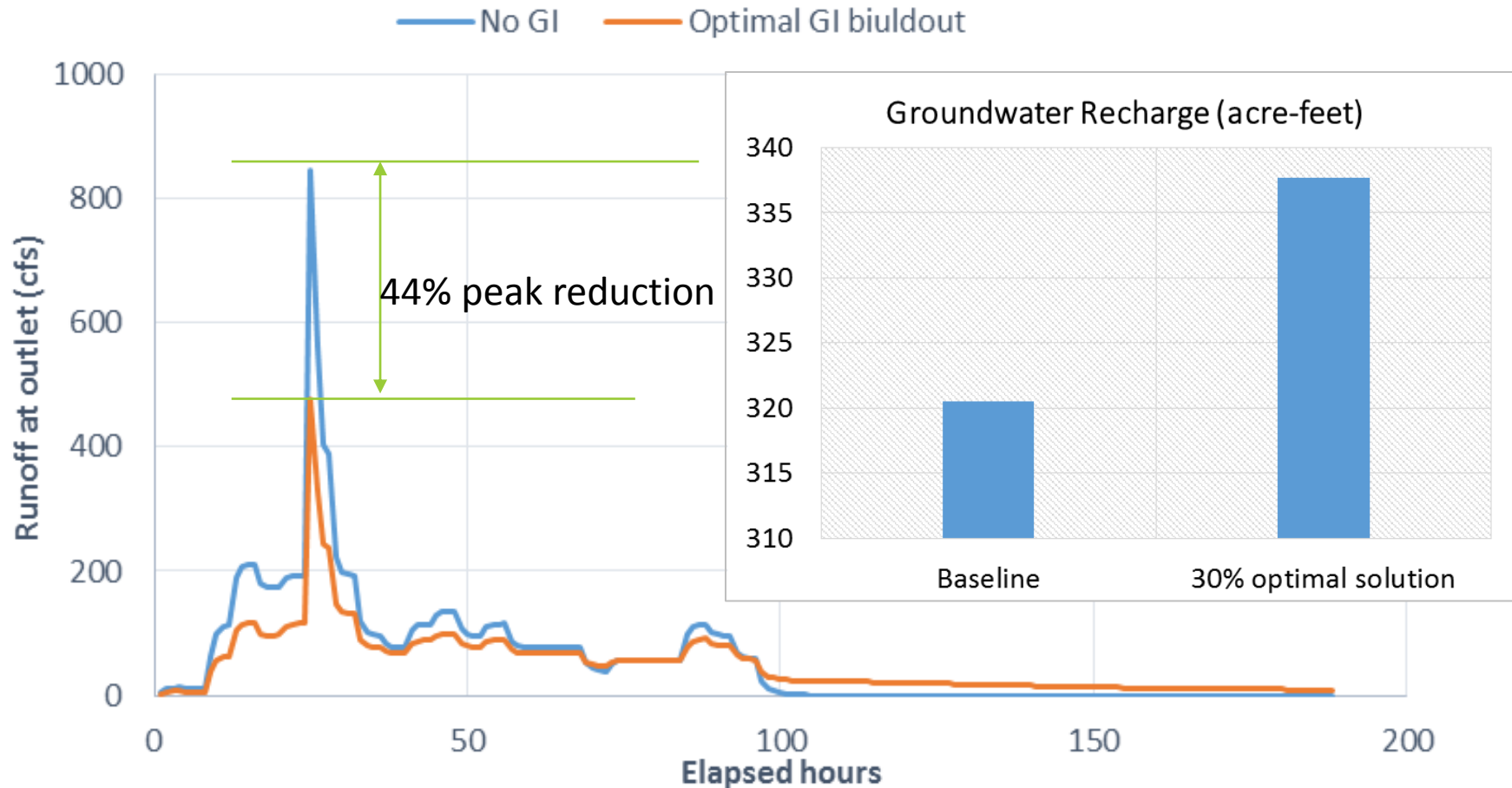
# Optimal Bioretention Locations for 30% Runoff & 56% PCB Load Reduction





# Programmatic Outcomes!

- 44% peak flow reduction
- 5.5 million gallons of additional recharge



# GreenPlan-IT Tool Summary

---

- **Designed to meet municipal planning needs!**
  - Identifies and ranks feasible locations for GI
  - Models hydrology, groundwater, and contaminants
  - Identifies best GI implementation scenarios at lowest cost
  - Provides the basis for a reasonable assurance analysis

# Toolkit Download & Documentation

<http://greenplanit.sfei.org/>

- ✓ Toolkit
- ✓ User manual
- ✓ Toolkit requirements
- ✓ Demonstration report