

# Final Project Report for the Demonstration Project in Three Critical Coastal Area Watersheds

by  
Sarah Lowe

SWRCB Agreement No: 06-345-552-2



**SAN FRANCISCO ESTUARY INSTITUTE**

4911 Central Avenue, Richmond, CA 94804

p: 510-746-7334 (SFEI), f: 510-746-7300,

[www.sfei.org](http://www.sfei.org)

This report should be cited as:

Lowe, S. (2011). Final Project Report for the Demonstration Project in Three Critical Coastal Area Watersheds. Report prepared for SWRCB Agreement #06-345-552-2. Contribution No. 655. San Francisco Estuary Institute, Richmond, California.

## **Final Project Report**

**Project Name:** Demonstration Project in Three Critical Coastal Area Watersheds

**SWRCB Grant No:** 06-345-552-2  
**Grant Amount:** \$900,000.00  
**Grant Term:** April 1, 2007 – December 31, 2011  
**Grant Manager:** Danielle Siebal and Tyson Pelkofer  
**Project Location:** Watsonville Sloughs, Fitzgerald Marine Reserve, and Sonoma Creek watersheds

**Grantee Name:** San Francisco Estuary Institute, Oakland, CA  
**Project Director:** Rainer Hoenicke  
**Project Manager/s:** Kat Ridolfi, Meredith Williams, and Sarah Lowe



## II GRANT SUMMARY FORM

Completed Grant Summaries are made available to the public on the State Water Resources Control Board's (SWRCB) website at <http://www.waterboards.ca.gov/funding/grantinfo.html>. Use the tab and arrow keys to move through the form. If field is not applicable, please put N/A in field.

**Date filled out:** 11/28/2011

<b>Grant Information:</b> Please use complete phrases/sentences. Fields will expand as you type.	
1. <b>Grant Agreement Number:</b> 06-345-552-2	
2. <b>Project Title:</b> Demonstration Project in Three Critical Coastal Area Watersheds	
3. <b>Project Purpose - Problem Being Addressed:</b> Development of tools for local government to better implement management measures to control nonpoint source pollution in three Critical Coastal Areas: Watsonville Sloughs, Fitzgerald Marine Reserve, and Sonoma Creek	
4. <b>Project Goals</b>	
a. <b>Short-term Goals:</b> To identify policy tools to help local government to better implement management measures to control nonpoint source pollution; to develop maps and tools for better local land use planning scenarios, identify opportunity areas for restoration of beneficial uses	
b. <b>Long-term Goals:</b> To reduce nonpoint source pollution and remove the CCAs from the 303(d) list of impaired water bodies..	
5. <b>Project Location:</b> (lat/longs, watershed, etc.) Watsonville Sloughs, Fitzgerald Marine Reserve, and Sonoma Creek watersheds	
a. <b>Physical Size of Project:</b> (miles, acres, sq. ft., etc.) Watsonville: 20 sq mi; Sonoma: 166 sq mi; Fitzgerald: 14.44 sq mi	
b. <b>Counties Included in the Project:</b> San Mateo, Santa Cruz, Sonoma	
c. <b>Legislative Districts:</b> (Assembly and Senate) Watsonville: 27 (A), 11 (S); Sonoma: 6 (A), 3 (S); Fitzgerald: 19 (A), 8(S)	
6. <b>Which SWRCB program is funding this grant?</b> Please "X" box that applies.	
<input type="checkbox"/> Prop 13 <input type="checkbox"/> Prop 40 <input checked="" type="checkbox"/> Prop 50 <input type="checkbox"/> EPA 319(h) <input type="checkbox"/> Other	
<b>Grant Contact:</b> Refers to Grant Project Director.	
<b>Name:</b> Rainer Hoenicke	<b>Job Title:</b> Executive Director SFEI/ASC
<b>Organization:</b> San Francisco Estuary Institute	<b>Webpage Address:</b> <a href="http://www.sfei.org">www.sfei.org</a>
<b>Address:</b> 7770 Pardee Lane, 2 <sup>nd</sup> Floor Oakland, CA 94621	
<b>Phone:</b> 510-746-7381	<b>Fax:</b> 510-746-7300
<b>E-mail:</b> <a href="mailto:rainer@sfei.org">rainer@sfei.org</a>	
<b>Grant Time Frame:</b> Refers to the implementation period of the grant.	
<b>From:</b> 4/1/07	<b>To:</b> 12/31/11

**Project Partner Information:** Name all agencies/groups involved with project. Sonoma Ecology Center, Southern Sonoma RCD, Santa Cruz RCD, Central Coast Agricultural Water Quality Coalition, San Mateo County RCD, Association of Bay Area Governments (ABAG), Coastal Watershed Council, John Cloud, Tamara Doan, William Lettis and Associates, Watershed Sciences (Laurel Collins), Southern Sonoma County Resources Conservation District, Watearth (Jennifer Walker)

**Nutrient and Sediment Load Reduction Projection:** (If applicable) N/A

Please provide a hard copy to your Grant Manager and an electronic copy to your Program Analyst for SWRCB website posting. All applicable fields are mandatory. Incomplete forms will be returned.

### III Table of Contents

II GRANT SUMMARY FORM.....	1
III Table of Contents.....	3
IV Executive Summary.....	5
V Problem Statement & Relevant Issues.....	6
VI Project Goals.....	6
VII Project Description.....	6
Project Type.....	6
Project Costs – total costs; matching funds & fund sources;.....	7
Project Task Descriptions.....	7
VIII Public Outreach.....	12
IX Conclusions.....	13
CCA Lessons Learned by Pilot Area.....	13
Sonoma Creek.....	13
Fitzgerald Marine Reserve.....	13
Watsonville Sloughs.....	13
Project Evaluation & Effectiveness – Results of PAEP.....	14
Project Terminated – Why?.....	19
Next Steps.....	19
X Appendices.....	20
References (none).....	20
List of Items Submitted.....	20
List of Sub-contractors.....	21
Tables & Graphs of Summarized Numerical Data (none).....	23
Photos (none).....	23
Peer Reviewed Articles.....	23





## IV Executive Summary

This California State Water Resources Control Board Grant # 06-345-552-2 funded the second phase of the Critical Coastal Areas (CCA) project. Phase II funding helped the San Francisco Estuary Institute (SFEI) and partnering agencies compile and analyze a wealth of information about each of three CCAs: Fitzgerald Marine Reserve (San Mateo County), Sonoma Creek (Sonoma County), and Watsonville Sloughs (Santa Cruz County). The project assisted local government and stewardship agencies in investigating and implementing management measures to control nonpoint source pollution. The waterbodies of the three CCAs each appear on the 303(d) list as impaired for one or more pollutants including sediment, pathogens, pesticides and nutrients.

Recommendations from the Technical Advisory Committees during Phase I of this project formed the basis of the work elements for Phase II including: the development of historical ecology maps and factsheets for the three CCAs, detailed maps of current drainage systems in the three CCAs (in GIS), development of a low impact development (LID) leadership group to assist with coordination of LID implementation efforts around the Bay Area, local agency involvement in various types of planning and conservation actions to improve Beneficial Uses within the CCA regions, a paper on public policy options for improving water quality within the CCAs, a paper on a GIS-based methodology (and tool) to identify and evaluate potential focus areas for LID in the Bay Area.

LID, as a project- and program-related element, has broad relevance and is worthy of public policy evaluation in each of the three pilot CCAs. Unlike what has become known as “best management practices” to reduce pollutants in stormwater runoff, LID is based on a broader design approach that can enhance the ability of developed landscapes to protect surface and ground water quality, maintain the integrity of aquatic living resources and ecosystems, and preserve the physical integrity of surrounding habitats. Through appropriate site design, LID either maintains or creates a hydrologically functional landscape that mimics a more natural hydrologic regime. Since one focus of LID is to reduce runoff volumes where natural runoff patterns have been significantly modified, the various techniques considered for LID implementation can have multiple benefits, among them reduction of pollutant loads reaching surface water bodies.

Some common LID solutions include a mix of landscape-level changes such as replacing pavement with permeable pavers; reducing impermeable surfaces on a specific site; harvesting rainwater in cisterns of various capacities and using harvested water at times of high demand; establishing water-smart landscaping; planting rain gardens; retrofitting built-out cities with stormwater planters, curb extensions, and similar treatment and infiltration systems; unearthing stormwater pipes and restoring natural creek channels and floodplains, and/or providing more naturalistic flood control channels.

The general conclusion from the research conducted in this project is that there are few, but in some cases fairly strong, impediments to implementing LID in new or redevelopment projects in the three pilot CCAs, and that there are many opportunities to improve policies to increase the amount of LID within a jurisdiction.

In the six years since the conception, design, and implementation of Phase II of the CCA project, a significant design effort has taken place by the California State Water Resource Control Board in collaboration with the California Wetland Monitoring Workgroup toward the development of a watershed-based assessment framework for compensatory wetlands mitigation in California. Known as the 1.2.3 Framework, this approach now provides a far more comprehensive analytical framework which meets the goals of the long-term Performance and Effectiveness Evaluation Approach originally outlined for this project, while also providing regulators and managers with a broader set of tools to evaluate nonpoint source pollution assessment, prevention, and reduction, using a watershed approach. The approach is being adopted by the EPA and the California State Water Resource Control Board.

## V Problem Statement & Relevant Issues

The Critical Coastal Areas (CCA) Program is a non-regulatory planning tool to coordinate the efforts of multiple agencies and stakeholders, and direct technical, scientific, and funding resources to CCAs. The program's goal is to ensure that effective nonpoint source management measures are implemented to protect or restore coastal water quality in CCAs. This project assisted agencies in the development of watershed-based action plans in three pilot areas of the San Francisco Bay Area and the Central Coast as a part of the state's Nonpoint Source Implementation Plan. The pilot areas were: Fitzgerald Marine Reserve on the Pacific coast of San Mateo County, the Sonoma Creek Watershed, and Watsonville Slough in Santa Cruz County. The waterbodies of the three CCAs each appear on the 303(d) list as impaired for one or more pollutants including sediment, pathogens, pesticides and nutrients. This project worked with local stakeholders towards broad-scale implementation of management measures to reduce impairment from nonpoint sources. This project is the second phase of a larger effort funded by a 319(h) grant (SWRCB Agreement #05-309-250-0, 2006-2007).

## VI Project Goals

**Short-term Goals:** To identify policy tools to help local government implement management measures to control nonpoint source pollution; to develop maps and tools for local land use planning scenarios, to identify opportunity areas for restoration of beneficial uses that can lead to conceptual and specific project designs.

**Long-term Goals:** To reduce nonpoint source pollution and remove the CCAs from the 303(d) list of impaired water bodies.

## VII Project Description

Recommendations from the Technical Advisory Committees during Phase I and II of this project formed the basis of the work elements for Phase II including:

1. Convening a Low Impact Development (LID) Leadership Group to assist with coordination of LID implementation efforts around the Bay Area
2. Maps and factsheets about the historical ecology and current resources in the three CCAs
3. GIS maps of current drainage systems for the three CCAs available through the Bay Area Aquatic Resources Inventory (BAARI).
4. Local agency involvement in various types of planning and conservation actions to improve Beneficial Uses within the CCA regions
5. Paper on public policy options for improving water quality within the CCAs
6. Paper on an approach for evaluating the long-term performance and effectiveness of management measures to improve water quality in the CCAs
7. Paper on a GIS- and scenario-based modeling tool (developed through this project) to identify and evaluate potential focus areas for LID in the Bay Area

## Project Type

This project covered several project types including Planning, Research, Monitoring and Assessment, and Load Reduction. The long-term project *outcome* includes Beneficial Use Improvement and Protection.

## Project Costs – total costs; matching funds & fund sources;

This project (funded by the Coastal Nonpoint Source Program, Proposition 50 funds) was awarded a total of \$900,000. Minimum Matching Funds Required (20% of total project costs) was \$224,000. The following matching funds were applied to this project for a total match of \$250,000.

Amount	Funding Source	Project Description
\$200,000	U.S. EPA, Section 319(h) CWA	Phase I, Critical Coastal Areas Program, Initial Assessment
\$20,000	National Park Service, Recreational Trails Program	Trail Rehabilitation and Removal Design
\$30,000	Local and Federal Agency In-Kind Staff Contributions	CCA Phases I and II, stakeholder meetings, tech transfer, project selection participation
TOTAL MATCH: \$250,000		

The 319(h) matching funds were fully applied to this match and were part of contract #05-309-250-0 between SFEI and the State Water Resources Control Board, executed in May, 2006. The National Park Service funds were also applied and constitute a reliable cost-share source.

## Project Task Descriptions

This project focused on several fronts to develop different nonpoint source pollution prevention opportunities including 1) convening regional workgroups to coordinate on pollution prevention planning measures, 2) developing detailed maps for use by regional planners, managers, and conservation scientists, 3) developing implementation plans for specific pollution reduction projects in the CCAs, 4) developing map-based planning tools for investigating potential areas for LID development, and 5) writing guidance documents related to these efforts. Below is a short summary of each project task and associated deliverables.

### 1. Establish Technical Oversight and Review Team.

A technical oversight team was convened for this project and included participants from the Coastal Commission, the San Francisco Bay Regional Water Quality Control Board, the Association for Bay Area Governments, and SFEI.

The project's subcontractor, the Association for Bay Area Governments, took the lead to work further with local governments and stakeholders towards broad-scale implementation of management measures to reduce and impairment from nonpoint sources. They convened a LID Leadership Group and held several consensus building meetings. The Bay Area Planning Directors' Association Fall 2010 meeting was organized to bring together planning, public works and other professionals who have the opportunity to integrate LID into their projects. Participants learned from seasoned public and private sector professionals who have successfully employed LID about the tools and techniques they are using to accommodate new growth while protecting watersheds; conserving water and energy; preventing stormwater pollution and flooding; and enhancing streetscapes and parks.

The Association for Bay Area Governments also conducted one focused study: a rain-barrel giveaway program survey to see which Bay Area municipalities had rain barrel give away programs. These programs are part of public education outreach projects to increase awareness about stormwater recovery measures that can help reduce excessive urban runoff and pollutant loads to streams and the Estuary.

**2. Develop assessment and forecasting framework, including desired certainty for load reduction or total maximum daily load (TMDL) target achievement and desired beneficial use protection and restoration targets.**

The three CCA Technical Advisory Committees met several times over a 6-month period (2007-2008) to discuss a framework for addressing pollutant load reduction efforts within each pilot CCA and develop a list of data development needs for each CCA (Task 2.3 priority data development list submitted 1/31/2008):

- A) Fitzgerald Marine Reserve
  - 1) Baseline water quality information, including sediment, nutrients, pesticides, pathogens, and other contaminants.
  - 2) Effectiveness of best management practices for rural land uses and prioritized list of sites for implementation (to assess highest return on investment for load reduction at the site specific level).
  - 3) Current land use data
  
- B) Watsonville Sloughs
  - 1) Detailed hydrology of the watershed including bathymetry, water balance, storm hydrographs, and drainage.
  - 2) Inventory of BMPs implemented on agricultural and rural residential land that affects water quality, including maintenance records
  - 3) Prioritized list of projects not completed after 2003 Watershed Conservation and Enhancement Plan and the necessary information to complete those projects.
  
- C) Sonoma Creek
  - 1) Sediment delivery by land use incorporating increased drainage density from artificial drainage infrastructure
  - 2) Quantitative effect of impervious surfaces on groundwater recharge and flooding
  - 3) GIS map of groundwater recharge areas and vernal pools

These data development needs were at the core of partner agency efforts even as new funding organized and re-prioritized the focus of project elements under this agreement.

**Fitzgerald CCA:**

The San Mateo County RCD developed a Nonpoint Source Watershed Assessment report by updating the initial report developed during Phase I of the CCA project (SWRCB grant #05-309-205-0) and making its technical content more accessible to the general public and focusing on opportunities to improve water quality in the Fitzgerald CCA. The report address all three of the data development needs developed by the regional committee (listed above) and provides background information and characterization of the Midcoast watersheds on the San Mateo County, California and covers climate, land use, demographics, hydrology, water quality conditions, and regional pollution prevention programs and plans. The intent of the report was to form the basis for and to direct the development of an Action Plan to address potential and known nonpoint source pollution impacts and improve water quality conditions in and around the Fitzgerald Marine Reserve CCA. The report is available on the San Mateo County RCD's website at: [http://www.sanmateorcd.org/ccca.html#Project\\_Documents](http://www.sanmateorcd.org/ccca.html#Project_Documents).

**Watsonville CCA:**

In 2008, the Land Trust of Santa Cruz County began a collaborative process with local partners, including the Santa Cruz County RCD, Watsonville Wetlands Watch, U.S. Fish and Wildlife Service, the Central Coast Agricultural Water Quality Coalition, the County of Santa Cruz, and local agricultural operators and private landowners, to acquire the properties now known as Watsonville Slough Farms. The Land Trust

and local agencies developed a draft Inventory Assessment Report for the Watsonville Sloughs Farms providing science-based maps, data, and information on the location of existing natural resource features and the relative ecological condition of the property. The information provides a baseline reference by which future observations can be compared and used to develop a Plan for the property and identify potential solutions to enhance the natural habitat and sustain agricultural production. The report can also be used to assist the Land Trust of Santa Cruz County and the Technical Advisory Committee to prioritize conservation practice implementation and funding. The draft report was submitted to the Grant Manager and is available at SFEI upon request.

More recently, the Land Trust of Santa Cruz County worked with cooperating local government, public and private landowners, special district, and other stakeholders to develop and release a report, in May 2011, on how to protect the county's natural resources over the next 25 years. The "Conservation Blueprint" is a regional planning document that assesses the health of the county's environment and makes recommendations on actions. Karen Christensen (Executive Director, Resource Conservation District of Santa Cruz County) was on the Conservation Blueprint Steering Committee as well as was a recipient of project funds from this grant to coordinate local agencies to develop restoration projects in the Watsonville CCA. The Technical Advisory Committee coordination meetings and recommendations that came out of those meetings, during Phase I and II of this CCA project, contributed to the Land Trust's report. Learn more about the Land Trust and the Blueprint at: <http://www.landtrustsantacruz.org/blueprint/>

### **3 Develop map of historical drainage networks and related habitat conditions and augment current maps developed under Phase 1 where required.**

SFEI historical ecology staff developed historical maps showing aggregates of 1940s aerial photos, changes in coastlines, vegetation (where possible), and stream channel networks. The maps were vetted and approved by stakeholders in each pilot area, in addition to Coastal Commission and Regional Board staff. A factsheet was developed for each CCA, which were met with enthusiastic responses by the review committees with requests for more detailed reports to guide implementation of opportunity areas. The factsheets are available at the CCA project's webpage <http://www.sfei.org/node/1188>

SFEI historical ecology staff continued to work with a subcontractor, the Sonoma Ecology Center, describing historical hydrology and wetland habitats within the Sonoma CCA to improve the resolution and validity of historical information behind the regional map. Staff reviewed and responded to comments on draft GIS layers from the project sub-contractor at the Sonoma Ecology Center. These datasets were finalized along with a report describing their current status, caveats for use, and next steps for further development of the GIS layers. This report responds to and summarizes the challenges encountered in developing these historical maps: a more limited historical dataset led to substantial uncertainty associated with historical interpretation and mapping of a number of features, and some disagreement among project partners about mapping decisions. Because of the uncertainty about the historical conditions SFEI staff decided that these data were not substantiated enough for public release. These datasets have been and will continue to be used internally at SFEI, but will not be distributed publicly at this time.

### **4 Map existing drainage systems, including storm drains, riparian areas, wetlands, and near coastal/bay resources.**

Maps of modern-day drainage systems in the three CCAs were completed early in this project (completed and submitted in 2008) including storm drains, riparian areas, wetlands, and near coastal/bay resources. These maps contain more detail than previous maps and were designed to be used by planning and management agencies to investigate ways to reduce urban runoff and associated pollutant loads and other beneficial uses such as flood attenuation. All newly mapped drainage systems were reviewed and approved by the project's steering committee. All the GIS layers, in addition to pdf's of each map are

available to partners on the CCA project's webpage <http://www.sfei.org/node/1188>. The data were generated following the methodology developed under separate funding under the Wetland and Riparian Areas Monitoring Program. The mapping methodology and standards for are available at: [www.sfei.org/baari](http://www.sfei.org/baari). The drainage system for this project were incorporated into the Regional Bay Area Aquatic Resources Inventory (BAARI) and are available through the [California Wetland Tracker](#).

Since the 2008 project deliverable, SFEI (using other funding sources) continued to improve its Bay Area Aquatic Resources Inventory (BAARI) map through field work and integration of local information. CCA watersheds were included in these update efforts as they are located within the geographic scope of BAARI (except for the Watsonville CCA). Some updates to the Watsonville drainage network were done, but the majority of updates were made to the Sonoma Creek watershed. SFEI worked with Watershed Sciences and Fugro William Lettis and Associates (FWLA) who have done significant work in the watershed to include field verified stream network information into BAARI. Multiple meetings and on-line comparisons of datasets were done to integrate the three maps. The most current version of BAARI can be viewed at [www.californiawetlands.net](http://www.californiawetlands.net).

**5 Identify and prioritize sites in applicable CCAs, namely, Fitzgerald Marine Reserve and Watsonville Slough, where cost-effective control options may provide the greatest pollution reduction and prevention and beneficial use restoration.**

The CCA steering committees prioritized projects that would produce the most benefit at the lowest cost in terms of resources and disturbance of the existing landscape. The most thorough assessment occurred in Watsonville where a list of potential restoration projects, identified during a watershed planning process in 2003, was updated to include the current status of each project (e.g. which projects were completed, which projects were started but need a continuous source of funding or other resources to continue, and which were never started). An Inventory Assessment Report for the Watsonville Sloughs Farms was also developed by local agencies that included updated, science-based maps and information on the location of existing natural resource features and the relative condition of candidate properties. The report will be used to assist the Land Trust of Santa Cruz County and the Technical Advisory Committee to prioritize conservation efforts. In the Fitzgerald CCA, two grants were awarded to the San Mateo County Resource Conservation District (RCD) during the timeframe of this project that addressed the pollution reduction/beneficial use protection goals for that region. In Sonoma, the Southern Sonoma County RCD and Sonoma Ecology Center worked with the Water Board and stakeholders to devise strategies for joint implementation of the recent sediment TMDL and the Watershed Enhancement Plan.

It should be noted that during the State of California's budget freeze (2008-2010) this project was temporarily stopped. During this time a significant federal grant to implement sediment TMDL projects in the Sonoma CCA was awarded to our subcontracting partners, in addition to the two grants (mentioned above) that were awarded to the San Mateo County Resource Conservation District (RCD) to address pollution reduction projects in that CCA. Because the new grants were addressing pollution reduction efforts in two of the three CCAs, some funding for this task was shifted to a new task (under task 6.1) to develop a methodology to identify appropriate areas for implementation of low impact development (LID) projects using GIS and modeling techniques (Deviation Request Form dated May 6<sup>th</sup>, 2010).

**Fitzgerald CCA:**

In the Fitzgerald pilot area, the project subcontractor, San Mateo County Resource Conservation District (RCD), received two significant grants to implement a volunteer water quality monitoring program throughout the pilot area starting in September 2008, and an expansion of the existing Livestock and Land Program that has been very successful in Santa Cruz and Monterey Counties. In addition, the county's public works department worked with SFEI staff to develop a proposal for urban BMP implementation and microbial source tracking in all the sub-watersheds that drain the ASBS. That project, combined with the two awarded to the RCD constitute the priority projects identified for the Fitzgerald CCA.

**Watsonville CCA:**

The Resource Conservation District of Santa Cruz County (Santa Cruz County RCD) took the lead on working with local government and agencies to design and implement three high priority projects on site, as identified by the TAC. Project sites were located on the Land Trust of Santa Cruz County's newly acquired parcels in the Watsonville Sloughs watershed. The projects included 1) construction of a sediment basin at a highly erodible area to prevent material from entering Harkins slough; 2) construction of a sediment basin to prevent agriculturally derived sediment from entering sensitive California red-legged frog habitat; and 3) improvement of an existing pond to promote red-legged frog breeding, and restoration of 1 acre of upland habitat to improve frog upland habitat.

**Sonoma CCA:**

Because local agencies in the Sonoma CCA were already working on the pollution reduction planning and implementing projects, funding allocated to work with this CCA in this agreement (#06-345-552-2) was reallocated to CCA project task 6.1 (as mentioned above). The Sonoma Watershed Enhancement Plan subcommittee was a pre-existing workgroup tasked with developing and updating a Watershed Enhancement Plan with the same goals set for the CCA Action Plan under this grant agreement. Local agencies were already developing projects to reduce nonpoint source pollution in the watershed. For example: in Sonoma Creek, the Sonoma Ecology Center submitted a proposal, in partnership with Vineyard Workers Services, to the Sonoma Paradiso Foundation, to develop a stewardship group in the "Springs" area, the most densely populated reach of Sonoma Creek just north of the city of Sonoma. Work was also initiated on designing a project on Sonoma Creek's alluvial fan in Kenwood, funded by the Sonoma County Water Agency. The Kenwood fan was identified as one of the three "opportunity areas" for restoration in our recent historical ecology broadsheet submitted under this grant. The project will result in flood and sediment reduction, habitat restoration, and groundwater recharge.

The Southern Sonoma County RCD and Sonoma Ecology Center continue to coordinate on updating the regional Watershed Enhancement Plan.

**Long-term Performance Evaluation and Effectiveness Evaluation Approach:**

As originally designed, the Long-term Performance Evaluation and Effectiveness Evaluation Approach for the three CCA watersheds was to evaluate the performance of the previously submitted Monitoring Plan, which was designed to make specific connections to land and water management issues that drive non-point source (NPS) pollution and impairment issues, and to provide tools to enable local government and stakeholders to take ownership of a long-term management process.

In the six years since the conception, design, and implementation of the CCA Demonstration project, a significant design effort has taken place by the California State Water Resources Control Board in collaboration with the California Wetland Monitoring Workgroup toward the development of a watershed-based assessment framework for compensatory wetlands mitigation in California. Known as the 1.2.3 Framework, this approach now provides a far more comprehensive analytical framework which meets the goals of the Long-term Performance and Effectiveness Evaluation Approach, while also providing regulators and managers with a much broader set of tools to identify, design, and evaluate mitigation projects not only in regard to aquatic habitat, but also related to preventing and reducing other human-induced stressors on the biological, physical, and chemical integrity of water, using a watershed approach.

**6 Enable local government agencies to expand forecasting models to include additional Management Measures and BMPs and to provide guidance to developers and land use decision-makers for cumulative impact analysis and selection of most cost-effective avoidance and mitigation steps.**

- 6.1 Provide implementation “how-to-guidance” to local government agencies to apply a systematic and science-based approach for beneficial use protection, restoration, and mitigation.

Low impact development (LID) has the potential to reduce the negative effects of stormwater runoff through engineered techniques that seek to emulate natural processes, e.g. bioretention, vegetated swales, constructed wetlands, etc. To date, Bay Area stormwater managers have tended to implement LID projects on an opportunistic basis. As environmental management planning migrates to the watershed scale, managers will need tools that can locate areas where implementation of LID projects is likely to be successful and best utilized. Using landscape-level datasets for the SF Bay Area, including the Bay Area Aquatic Resource Inventory (BAARI), SFEI developed a GIS modeling approach to identify suitable areas for LID implementation. The level of suitability (based on expert advice) for a project relies on the key landscape characteristics, including slope, soils, land use, liquefaction potential, and depth to groundwater, in addition to proximity to wetlands and cleanup sites. In tandem with the site suitability tool, SFEI developed a conceptual model for the Bay Area that explains how LID can potentially improve water quality and reduce stormwater runoff by filtering contaminants and providing retention capability. A third task was a hydrologic modeling demonstration that quantifies the effect on the hydrograph when LID treatments are implemented in Sonoma watershed. This demonstration uses total suitable areas for LID treatments output from the site suitability tool. Results of this effort are summarized in the following technical memo along with the GIS data (in geodatabases for both ArcGIS 9.x and 10.x) on DVD (sent to Grant Manager and *available from SFEI upon request*): Kass, J., Walker, J., Cayce, K., Senn, D. and Williams, M. (2011). *White Paper on Regional Landscape Characterization for Low Impact Development Site Suitability Analysis*. SWRCB Agreement #06-345-552-0. Contribution No. 653. San Francisco Estuary Institute, Richmond, California.

- 6.3 Provide an analysis of policy options (“white paper”) for local government to enhance incentives for private and public landowners to participate in implementation and testing. Submit analysis of policy and incentive options to Grant Manager.

ABAG and SFEI completed a white paper on public policy options for water quality improvements in the CCAs (July 2011). The draft document was reviewed by several stakeholder agencies including the Coastal Commission and the California Water and Land Use Planning group who provided valuable feedback. The final document is available on SFEI’s website at: <http://www.sfei.org/node/3910> and is cited as: The Association of Bay Area Governments and the San Francisco Estuary Institute (2011). *White Paper on Public Policy Options for Water Quality Improvements in the Critical Coastal Areas*. Report prepared for SWRCB Agreement #06-345-552-0. Contribution No. 645. San Francisco Estuary Institute. Richmond. California.

## **VIII Public Outreach**

Public outreach efforts for this project include the convening of workgroups, stakeholder meetings, and the development of guidance documents as outlined in the Project Description section above. Project team members from ABAG and SFEI contributed regular updates and insights as the project progressed to the California Land and Water Use Partnership and participated in local stakeholder group meetings until December 18, 2008, when the project was suspended.



## IX Conclusions

### CCA Lessons Learned by Pilot Area

The general conclusion from the research conducted is that there are few, but in some cases fairly strong, impediments to implementing LID in the three pilot CCAs, and there are many opportunities to improve policies to increase the amount of LID within a jurisdiction. Foremost, it is the cost of retrofits in already developed areas relative to the uncertain benefits that stand in the way of broad-scale application. Many of the lessons learned are detailed in a publication summarizing our project work, contained in the proceedings of the American Society of Civil Engineers, entitled Low Impact Development 2010 – Redefining Water in the City (Hoenicke et al., 2010). Below is a list of successes and challenges met in each pilot area.

#### Sonoma Creek

##### Successes

- Tools including historical ecology and modern storm drain maps, etc.

##### Challenges

- Focus of the CCA program as a non-regulatory and technology transfer effort in an area with approved implementation plans for restoring impaired water bodies under Section 303(d) of the Clean Water Act.
- Desire of local entities to identify self-directed actions and de-emphasize involvement from more regional entities. Importance of individuals and agency “champions” (lack thereof)
- Jurisdictional vacuum outside of both BCDC’s and the California Coastal Commission’s jurisdiction

#### Fitzgerald Marine Reserve

##### Successes

- Relationships have been forged and nurtured, and partnerships sustained
- Completed a final Watershed Assessment and other tools including historical ecology and fine-grained drainage network, including stormdrains.
- Local support that has engaged both local government and Midcoast communities through education, outreach, workshops

##### Challenges

- Specificity offered at the outset about what products are needed and by when, who will be tasked to develop them, and how they (products and people) will be funded (funding is essential!)
- Quantity (and accessibility) of water quality or other formal data suitable for assessment
- Definitions of roles for a steering committee and consultants—should have been laid out early and revisited often (determine pilot project structure early)

#### Watsonville Sloughs

##### Successes

- Provided necessary burst of energy and resources to keep the ideas and projects of the 2003 plan moving forward where they might have otherwise been stalled due to lack of resources and momentum
- Review of the 2003 Enhancement Plan’s remaining list of projects and analysis of remaining implementation roadblocks, identifying those that needed leadership or more resources to proceed, and learning from successfully implemented projects

- Regional activities were also jump-started due to the infusion of CCA resources: the interest in conducting a hydrology study, regular stewardship meetings, a region-wide historical ecology study, and effort to map current riparian and wetland areas
- Developed historical ecology and modern storm drain maps as foundation for preliminary assessments of restoration as well as evaluation of runoff reduction opportunities and approaches
- Part-time coordinator to organize working groups and get pieces of the action plan drafted

#### Challenges

- Issues with non-local consultants
- Confusion about scope of project (distinct from 2003 Enhancement Plan)
- Financial hardship of local agencies

### **Project Evaluation & Effectiveness – Results of PAEP**

The Project's Assessment and Evaluation Plan (PAEP) had three main goals (listed below). Each of these goals were met by the project (or were modified - with the authorization of the Grant Manager) as described in section VII above.

*Goal 1: Apply the methodology developed in the initial 319(h) and other, related work efforts to evaluate alternative development and associated management scenarios and develop the necessary data to calibrate appropriate models for scenario-planning.*

*Goal 2: Select a minimum of three specific pollutant control, prevention, and mitigation measures in each of the three CCAs, prepare design specifications and assist local government in preparing bid documents, and develop evaluation plan for intermediate and long-term effectiveness monitoring by local government under multiple environmental conditions.*

*Goal 3: Enable local government agencies and other stakeholders to use and maintain management and land use scenario planning tools to test and implement additional Management Measures and Best Management Practices as funding becomes available.*

The specific project outcomes, indicators and targets listed in the Project Performance Measures table of the Project Assessment and Evaluation Plan (PAEP) were met (or not met) as described in the following Project Results table.

**Project Results Table:** This table includes the project performance measures as described in Table 1 of the PAEP and a brief discussion of the project's results for each project goal.

Task Category	Project Goals	Desired Outcomes	Output Indicators	Outcome Indicators	Measurement Tools and Methods	Targets
Planning, Research, Monitoring and Assessment	1. Select a minimum of three specific pollutant control, prevention, and mitigation measures in each of the three CCA pilot areas	1. Initial candidate list of specific MMs and BMPs for each watershed for evaluation based on predictive models populated with appropriate data. 2. Final candidate list for development of design plans and bid documentation.	1. Broad consensus on implementation projects, design plans 2. Completed bid specifications and/or design plans for a minimum of three implementation projects in each watershed.	1. Consensus from key landowners and other land use decision makers that the targeted areas are the best areas for NPS pollution reduction 2. Consensus that design specifications are feasible and sufficient to meet load reduction goals	N/A	Nine project designs ready to be implemented as soon as funding becomes available.
<p><b>Results - how the outcomes, indicators, and targets were met (or not)</b></p> <p>Each CCA committee developed documents that outlined nonpoint source pollution issues of greatest concern for their pilot areas. Those documents, the data compilation and development efforts conducted under this project, and the collaborative efforts to prioritize them allowed the committees to identify and design at least three pollution reduction and beneficial use restoration projects within each pilot area with the consensus of the local community. Some projects had sufficient momentum to be implemented during this project period. All pilot areas had participation and input by key landowners – both public and private.</p> <p>Watsonville CCA: designed at least three projects for the Watsonville Sloughs through this grant and (with additional funding sources) was able to begin implementation.</p> <p>Fitzgerald CCA: through additional grant funding awarded during the time this project was frozen, because of the CA budget freeze (2008-2010), San Mateo County RCD was able to design and start implementation of three pollution reduction projects.</p> <p>Sonoma CCA: Local agencies were already developing projects to reduce nonpoint source pollution in the watershed. In Sonoma Creek, a proposal was submitted to develop a stewardship group in the “Springs” area, work was also initiated on designing a project on Sonoma Creek’s alluvial fan in Kenwood, The project will result in flood and sediment reduction, habitat restoration, and groundwater recharge. The Department of Parks and Recreation designed a specific road retirement and stabilization program in areas under their jurisdiction.</p> <p>During the State of California’s budget freeze (2008-2010) this project was temporarily stopped. During that time, a significant federal grant to implement sediment TMDL projects in the Sonoma CCA was awarded to our subcontracting partners, in addition to the two grants, mentioned in section <i>VII Project Description</i>- task 5 (pg. 10) above, that were awarded to the San Mateo County Resource Conservation District (RCD) to address pollution reduction projects in that CCA. Because the new grants were addressing pollution reduction efforts in two of the three CCAs, some funding for this task was shifted to a new task (under task 6.1) to develop a methodology to identify appropriate areas for implementation of low impact development (LID) projects using GIS and modeling techniques (Deviation Request Form dated May 6th, 2010).</p> <p>See the Project Description - Task 5 (page 10 above) for more details on the projects developed for each CCA. Individual project designs and other documentation were submitted under folder 5.1 of the final project deliverables DVD (submitted with the final project invoice).</p>						

Task Category	Project Goals	Desired Outcomes	Output Indicators	Outcome Indicators	Measurement Tools and Methods	Targets
Planning, Research, Monitoring and Assessment	2. Enable local government agencies and other stakeholders to use and maintain management and land use scenario planning tools to test and implement additional MMs and BMPs	1. Staff and private land owners involved in land use, land management, and restoration decisions are using “how-to” guide and predictive tools in the majority of project review and approval cases	1. Good-excellent ratings in workshops and training sessions 2. Broad participation in updates to LCPs and General Plans or incorporation of tools into environmental review procedures. 3. Frequent requests for information and participation in process from outside groups	1. Ability of decision-makers and/or their staff to update implementation guidance document as additional information is developed. 2. Guidance and predictive tools are used in environmental review and permitting. 3. Policies and appropriate codes and land-use regulations are adjusted to reflect findings.	To be determined with Project Manager	1. Key local government staff members and private landowners are familiar with MM and BMP selection and evaluation tools/guidance. 2. Majority of agencies incorporate tools into their business practices.
<p><b><u>Results - how the outcomes, indicators, and targets were met (or not)</u></b></p> <p>This project contributed to better coordination of regional efforts to address nonpoint source pollution in the three CCAs. The CCA committees worked with local agencies and stakeholders and, in several cases, developed (or participated in the development of) several planning documents aimed at regional guidance and/or summaries of current information related to nonpoint source pollution reduction within the three CCAs. In all three pilot areas, local decision-makers were able to effectively use the guidance developed under this grant to begin implementation of appropriate management and restoration measures.</p> <p>Management planning documents developed by the CCAs include: 1) Watsonville CCA: Inventory Assessment Report for the Watsonville Sloughs Farms; 2) Fitzgerald CCA: Nonpoint Source Watershed Assessment report; 3) Sonoma CCA: Sediment TMDL document and the Watershed Enhancement Plan (though these were not deliverables under this agreement because of the project modification mentioned above (Deviation Request Form dated May 6th, 2010)). See the Project Description - Task 2 (page 8 above) for more details about these guidance documents.</p>						

Task Category	Project Goals	Desired Outcomes	Output Indicators	Outcome Indicators	Measurement Tools and Methods	Targets
Planning, Research, Monitoring and Assessment	3. Coordinate and maximize shared resources between related projects including Pajaro Valley IRWMP, Sonoma Valley Watershed Management projects etc.	1. Resources are maximized in the most effective and efficient manner across projects in all 3 CCA pilot areas	1. Frequent participation in related project meetings and updates at CCA gatherings or joint meetings	1. Cross-referenced work plans and implementation projects		1. Action Plan development incorporates findings and resources from complementary efforts
<p><b>Results - how the outcomes, indicators, and targets were met (or not)</b></p> <p>It was not possible to directly coordinate or maximize shared resources between CCA's in this project partly because the timing or nature of the projects did not warrant it, or because of policy or other barriers. As a result this project addressed coordination and policy issues identified through the CCA committees' work in the <i>White Paper on Public Policy Options for Water Quality Improvements in the Critical Coastal Areas</i>.</p> <p>The authors of the paper observed that certain public policies and government practices create incentives for innovation and coordination in environmental management while others create barriers to the implementation of programs like the CCAs. Another observation in the paper was the way in which land use policy can cut across several land uses (such as LID policies). Formally instituting low impact development (LID) techniques as standard operating procedure is an example of a public policy that can be employed across a range of land uses. Through appropriate site design using retention, detention, and/or infiltration, LID sites mimic a more natural hydrologic regime. For instance, using permeable pavement in a parking lot and treating excess stormwater runoff in a bio-swale increases infiltration of rain and removes pollutants from runoff before the runoff enters the stormwater system. The recommendations included in the white paper are intended to serve as reference for local agencies to better manage their water resources.</p> <p>The final white paper is available on SFEI's website at:  <a href="http://www.sfei.org/node/3910">http://www.sfei.org/node/3910</a></p>						

Task Category	Project Goals	Desired Outcomes	Output Indicators	Outcome Indicators	Measurement Tools and Methods	Targets
Load Reduction and Beneficial Use Protection	4. Apply the methodology developed in the initial 319(h) and other, related work efforts to evaluate alternative development and associated management scenarios and develop the necessary data to calibrate appropriate models for scenario-planning.	1. Community-derived set of watershed “health” goals (incl. TMDL targets) based on picture of the past, present, and change. 2. Identification of opportunity areas within each watershed where MMs and BMPs provide the “greatest bang for the buck.” 3. Broadly understandable predictive models to predict scenarios under alternative land use and mgt. scenarios 4. Identification of pathways of pollutants and better understanding of historic-current landscape changes that affect NPS pollution	1. Broad stakeholder involvement by key decision-makers and community leaders and survey participation. 2. Estimated load reduction and beneficial use recovery/protection predictions for each of the initial candidate implementation projects 3. Clear definitions of acceptable uncertainties associated with load reductions and anticipated use protection targets 4. Updated digital maps useful for conceptualizing implementation opportunities.	1. Broadly accepted watershed goals. 2. Clear understanding by decision-makers of how areas were identified and derived where MMs and BMPs provide the greatest environmental benefits based on empirical data.	Watershed Goal-Setting Methodology, as adapted from Baylands Ecosystem Habitat Goals Project ( <a href="http://www.sfei.org/sfbaygoals/index.html">http://www.sfei.org/sfbaygoals/index.html</a> ).	1. 100% of watershed areas is digitally characterized to be used in identification of implementation opportunity areas. 2. 100% of land use decision-makers and participating private landowners (or representative groups) are capable of understanding the use of the scenario-playing tools.
<p><b>Results - how the outcomes, indicators, and targets were met (or not)</b></p> <p>This project developed historical maps showing aggregates of 1940s aerial photos, changes in coastlines, vegetation, and stream channel networks. Additionally detailed modern-day drainage networks were mapped for the three CCA’s including storm drains, riparian areas, wetlands, and near coastal/bay resources. Other funding sources allowed SFEI to update the drainage networks for most of the Bay Area resulting in one of the most detailed modern-day drainage maps in California. The modern-day drainage network data were incorporated into the Regional Bay Area Aquatic Resources Inventory (BAARI) and are available through the California Wetland Tracker at: <a href="http://www.californiawetlands.net/">http://www.californiawetlands.net/</a> The historical data, developed for each CCA, are available upon request through SFEI, and the factsheets, developed for the project task deliverable, are available at: <a href="http://www.sfei.org/node/1188">http://www.sfei.org/node/1188</a></p> <p>This project also developed a GIS-based methodology to identify areas that may be best suited for low impact development. This tool can be used for management scenario planning for municipalities around the Bay Area.</p> <p>SFEI developed a conceptual model for the Bay Area that explains how LID can potentially improve water quality and reduce stormwater runoff by filtering contaminants and providing retention capability. Using landscape-level metrics available through the Bay Area Aquatic Resource Inventory maps (BAARI), SFEI also developed a GIS modeling approach to identify suitable areas for LID implementation. A third task was a demonstration of a hydrologic model that quantifies the effect on the hydrograph when LID projects are implemented at the watershed scale.</p> <p>Results of the LID planning tool development effort were summarized in the project’s <i>White Paper on Regional Landscape Characterization for Low Impact Development Site Suitability Analysis</i>. The Bay Area LID leadership group is using these tools in selection and implementation of “green infrastructure” projects to extend far beyond the boundaries of the three CCA pilot areas.</p>						

### **Project Terminated – Why?**

This project was not terminated. However this project was temporarily stopped in the middle of the project performance period (from 2008-2010) because of the State of California's extended budget freeze, which resulted in a no-cost extension of the agreement through December 31st 2011. Because of the extended project period, keeping momentum with our project partners was difficult. In addition, changes in staff at SFEI over this extended time period resulted in the project having three different project managers.

### **Next Steps**

None. SFEI staff intends to continue its participation on the LID leadership group and is assisting implementing agencies, cities, and counties under various other funding sources to collect appropriate performance data that may, at some point, be used to calibrate and validate various forecasting models able to predict the beneficial outcomes of LID projects at the watershed scale. SFEI has no plans to continue working with project partners on any specific nonpoint source planning or management committees. However, regional agencies within the CCAs continue to work on LID and other pollution reduction efforts.

## X Appendices

### References (none)

N/A

### List of Items Submitted

Work Item	Items for Review #	Due Date	% of Work Complete	Date Submitted
<b>Exhibit A</b>	<b>A. PLANS AND COMPLIANCE REQUIREMENTS</b>			
1	GPS information for Project site and monitoring locations	Day 90	100%	7/20/2007
2	Project Assessment and Evaluation Plan (PAEP)	Day 30	100%	4/30/2007
2	Non Point Source Pollution Reduction Project Follow-up Survey Form	12/15/07 12/15/08 12/15/10	100% 0% 0%	1/16/2008
3	Monitoring Plan	Day 90	100%	7/20/2007
3	Monitoring Reports	Quarterly	0%	N/A
4	Quality Assurance Project Plan (QAPP exemption request)	Day 90	100%	7/20/2007
5	Copy of final CEQA/NEPA Documentation	5/1/2007		N/A
6	Land Owner Agreement(s)	As needed		N/A
7	Applicable Permits	As needed		N/A
	<b>B. WORK TO BE PERFORMED BY GRANTEE</b>			
1.1.1	Project Team Members	4/30/2007	100%	5/4/2007
1.1.2	Sub-agreements for Project Partners	6/30/2007	100%	5/4/2007
1.1.3	TAC Members and Role Statement	11/30/2007	100%	7/22/2008
2.1	Preliminary Summary of Targets for Load Reductions and Goals	9/30/2007	100%	4/21/2008
2.3	Priority List	11/30/2007	100%	1/31/2008
3.3	List of Opportunity Areas in 3 CCAs	4/30/2008	100%	7/22/2008
4.2	Updated GIS Maps	4/30/2008	100%	7/22/2008
5.1.4	Long-term Performance Evaluation and Effectiveness Monitoring Plans	10/31/2011	100%	12/29/2011
6.1	LID GIS Data and Methods Technical Memo	11/30/2011	100%	12/14/2011
6.3	White Paper on Policy and Incentive Options	7/31/2011	100%	8/8/2011
<b>Exhibit B</b>	<b>A. Invoicing</b>	Quarterly	70%	10/21/2008
	<b>F. REPORTS</b>			
1	Grant Summary Form	Day 90	100%	8/22/2007
2	Progress Reports by the twentieth (20th) of the month following the end of the calendar quarter (March, June, September, and December)	Quarterly	100%	Qtrly
3	Natural Resource Projects Inventory (NRPI) Project Survey Form	Before Final Invoice	100%	12/28/2011
4	Draft Project Report	12/01/2011	100%	12/15/2011
5	Final Project Report	12/01/2011	0%	12/29/2011



## List of Sub-contractors

**Contractor Association of Bay Area Governments**

Principle Jennifer Krebs  
Address San Francisco Estuary Partnership  
1515 Clay Street, Suite 1400  
Oakland, CA 94612  
Phone 510-622-2315  
E-mail jkrebs@waterboards.ca.gov

**Contractor Agricultural Water Quality Coalition**

Principle Chris Goodson  
Address Santa Cruz County Watershed Coordinator  
417 Windsor St.  
Santa Cruz, CA 95062  
Phone 831 227-5404  
E-mail goodsonwq@yahoo.com

**Contractor Coastal Watershed Council**

Principle Tamara Doan  
Address Director of Programs  
PO Box 1459  
Santa Cruz, CA 95061  
Phone 831 464-9200  
E-mail tdoan@coastalws.org

**Contractor Fugro William Lettis and Associates**

Principle Janet Sowers  
Address 1777 Botelho Drive, Suite 262  
Walnut Creek, CA 94596  
Phone 925 395-6070  
E-mail sowers@lettis.com

**Contractor Dr. John Cloud (Consultant)**

Principle Dr. John Cloud  
Address 1915 Kalorama Road NW, Apt. 603  
Washington, DC 20009

**Contractor Resource Conservation District of Santa Cruz County**

Principle Kelli Camara  
Address Program Manager II

820 Bay Avenue, Suite 128  
Capitola, CA 95010  
Phone (831) 464-2950 x 15  
E-mail kcamara@rcdsantacruz.org

**Contractor Sonoma Ecology Center**  
Principle Rebecca Lawton  
Address Geologist, Research Program Manager  
20 East Spain Street  
Sonoma, CA 95476  
Phone 707-996-0712, x116  
E-mail Becca@sonomaecologycenter.org

**Contractor San Mateo County Resource Conservation District**  
Principle Kellyx Nelson  
Address Executive Director  
625 Miramontes Street  
Half Moon Bay, CA 94019  
Phone 650 712-7765  
E-mail kellyx@sanmateorcd.org

**Contractor Southern Sonoma Resource Conservation District**  
Principle Susan Haydon  
Address Assistant District Manager  
1301 Redwood Way, Suite 170  
Petaluma, CA 94954  
Phone 707 794-1242 x5  
E-mail Susan.haydon@ssrcrd.org

**Contractor Watearth, Inc.**  
Principle Jennifer J. Walker  
Address PO Box 537  
Oakland, CA 94604  
E-mail jwalker@watearth.com

**Contractor Watershed Sciences**  
Principle Laurel Collins (Consultant)  
Address 1128 Fresno Ave.  
Berkeley, Ca 94707  
E-mail laurelgene@comcast.net

## Tables & Graphs of Summarized Numerical Data (none)

N/A

## Photos (none)

N/A

## Peer Reviewed Articles

Hoenicke, Rainer, M. Williams, K. Ridolfi, J. Oram, K. Van Velsor, J. Krebs, and S. Ziegler. 2010. *Forecasting Multiple Watershed-level Benefits of Alternative Storm Water Management Approaches in the Semi-arid Southwest: Required Tools for Investing Strategically*. San Francisco Estuary Institute, Oakland, CA. <http://www.sfei.org/sites/default/files/LID%20Conference%20-%20Final.pdf>