FINAL REPORT

GROUNDWATER RECHARGE POLICIES AND PROJECTS (Component 6)

Northern Santa Cruz County Integrated Regional Water Management

Integrated Regional Water Management Implementation Grant

State Water Resources Control Board

Agreement No. 07-507-550-2

Prepared by:
Santa Cruz County Environmental Health Services

Submitted to:
Regional Water Management Foundation
State Water Resources Control Board

February 2013

Grant Agreement No.: 07-507-550-2

Grant Agency: California State Water Resources Control Board

Grant Program: Integrated Regional Water Management Program

Total Grant Award: $12,500,000

Grantee: Regional Water Management Foundation

Agreement Period: July 1, 2007 – May 1, 2013

Component Project No.: 6

Component Title: Groundwater Recharge Policies and Projects

Subgrantee/Component Lead: Santa Cruz County Environmental Health Services

Component Grant Award: $378,107

Matching Funds Total: $107,780

Watershed: Aptos Creek, San Lorenzo River, Arana Gulch

Project Type: Water Conservation, Reliability Enhancement, and Recycling

Funding for this project has been provided in full or in part through an agreement with the State Water Resources Control Board. The contents of this document do not necessarily reflect the views and policies of the State Water Resources Control Board, nor does mention of trade names or commercial products constitute endorsement or recommendation for use. (Gov. Code, § 7550; 40 CFR 31.20)

GRANT SUMMARY

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

Date filled out: 6/30/2008; updated 11/15/2012

Grant Information:
1. **Grant Agreement Number:** 07-507-550-0, as amended 07-507-550-2
2. **Project Title:** NORTHERN SANTA CRUZ COUNTY INTEGRATED REGIONAL WATER MANAGEMENT PLAN – COMPONENT 6, GROUNDWATER RECHARGE POLICIES AND PROJECTS
3. **Project Purpose – Problem Being Addressed:** Santa Cruz County relies on local surface and groundwater sources to meet residential, commercial and agricultural water demand. Groundwater provides approximately 80% of the water supply; several local water districts rely exclusively upon groundwater. The principal supply aquifers are in overdraft, a result of groundwater extraction exceeding natural recharge. Precipitous declines in groundwater levels are evident. The declines threaten long-term supply viability. Adverse impacts include: increased supply costs (pumping; treatment), contamination from salt water intrusion in coastal areas, and reductions in summertime baseflow in local streams adversely impacting aquatic ecosystems. Local land use practices, particular the increase in impervious surface area occurring with urban/sub-urban development, have significantly decreased natural recharge rates and volumes. The purpose of this project is to support local efforts to increase groundwater recharge through 1) the design and implementation of recharge project pilot-projects at targeted locations and 2) the adoption of County ordinance(s) that protect or restore groundwater recharge capacity.
4. **Project Goals** **Short-term Goals:** 1) Design and implement projects that capture, treat, and route stormwater runoff for use as recharge. 2) Develop and adopt ordinance(s) that protect or restore groundwater recharge capacity.
Long-term Goals: Demonstrate feasibility of retrofit recharge projects, and provide regulatory requirements for implementation of these types of projects.
5. **Project Location**: (lat/longs, watershed, etc.) Polo Grounds Park: (EAST) 36.981241, -121.87682; (WEST) 36.97915,-121.88133; Scotts Valley Library: 37.04936, -122.02857; Brommer Park: 36.97028, -121.97389
a. **Physical Size of Project**: (miles, acres, sq. ft., etc.) Polo Grounds Park (EAST) 0.13 acres / (WEST) 0.37 acres)

b. **Counties Included in the Project:** Santa Cruz

c. **Legislative Districts:** (Assembly and Senate) Assembly 27 and Senate 15

6. **Which SWRCB program is funding this grant?** Please "X" box that applies.

☐ Prop 13 ☐ Prop 40 ☒ Prop 50 ☐ EPA 319(h) ☐ Other

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Grant Time Frame: Refers to the implementation period of the grant.

From: 7/1/2007

To: 3/31/2012

Project Partner Information: Regional Water Management Foundation, Santa Cruz County (EHS, DPW and Planning), City of Scotts Valley, Scotts Valley Water District

Nutrient and Sediment Load Reduction Projection: N/A

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1.0 EXECUTIVE SUMMARY

In 2008, the State Water Resources Control Board (SWRCB) awarded the Santa Cruz Integrated Regional Water Management (IRWM) region a $12.5m grant to implement high priority water resource projects identified in the region's IRWM Plan (SWRCB Grant Agreement No. 07-507-550-0). This grant award funded the implementation of 16 components; some components feature multiple purposes and projects. Collectively the principal goals of the grant were to improve local water supply reliability, improve water quality, enhance watersheds and habitats, improve stormwater management, promote environmental stewardship, and support local IRWM efforts. The Regional Water Management Foundation (RWMF) was the grantee; local agency partners (sub-grantees) provided the lead role in the implementation, oversight and management of their respective components (projects).

The County of Santa Cruz, Environmental Health Services served the lead agency on Component 6 of the IRWM grant which implemented groundwater recharge projects pilot projects and policies to promote groundwater recharge. Santa Cruz County relies on local surface and groundwater sources to meet residential, commercial and agricultural water demands. Regionally, groundwater provides approximately 80% of the water supply; over 60,000 residents are supplied by water districts that rely exclusively upon groundwater. The region's principal water supply aquifers are in overdraft, a result of long-term groundwater extraction rates exceeding natural recharge. Precipitous declines in groundwater levels are evident. Ongoing declines threaten long-term viability of some aquifers as a source of groundwater supply. Adverse impacts include: increased supply costs (pumping; treatment), contamination from salt water intrusion in coastal areas, and reductions in base flow in local streams adversely impacting aquatic ecosystems. Changes in local land use, particularly the increase in impervious surfaces (e.g., asphalt, pavement, buildings) accompanying urbanization and suburban development, has reduced rainfall infiltration into the land surface resulting in substantial decreases in groundwater recharge rates and volumes.

The purpose of this project is to support local efforts to increase groundwater recharge through 1) the identification of locations (parcels) suitable for recharge; 2) development of stormwater recharge (SWR) designs to capture, treat and direct stormwater runoff for groundwater recharge; 3) construction pilot SWR projects at targeted locations; and, 4) support the development and adoption of a County stormwater runoff and pollution control ordinance to protect and restore groundwater recharge and provide a regulatory mechanism for greater groundwater recharge protection.

In June 2009, a technical advisory committee (TAC) convened to provide guidance on the initial site selection criteria and considerations for enhancing recharge. It was determined the potential SWR facilities should be limited to parcels that were: 1) located in a primary groundwater recharge areas, as designated by the County, and; 2) publically-owned. The County based an initial site screening upon those two criteria and conducted further assessment of potential parcels based site-specific features affecting its recharge potential (e.g., land-use, development, topography, limited geotechnical analysis). Based upon parcel assessments, three locations were selected for recharge facilities, they were: 1) Polo Grounds Regional County Park in the community of Aptos; 2) Brommer Street Park in the community of Live Oak; and, c) the Scotts Valley library in the city of Scotts Valley. At each site, the designs were completed for recharge facilities that capture stormwater runoff, provide partial treatment of the runoff either through bioswales or engineered treatment, and direct the flow to an

engineered facility (e.g., seepage pits; infiltration gallery) to enhance percolation to groundwater. In response to a November 2009 request for proposals issued by the County, two engineering firms were awarded design contracts for the three locations: Fall Creek Engineering for the design of the Polo Grounds and Brommer Street Park facilities, and Ifland Engineers for the Scotts Valley Library facility.

A recharge facility was designed and constructed at the new Scotts Valley Library. The facility collects roof and parking lot runoff and directs it through water quality treatment units to an underground recharge chamber consisting of gravel bed with two, 48" perforated pipes. The Scotts Valley facility has a calculated storage volume of 3,300 acre-feet and can support an estimated 2 to 5 acre-feet of recharge per year. Construction of the Scotts Valley facility was completed in late 2010 and was accomplished using funds from the City of Scotts Valley; no Proposition 50 funds were used for that facility's construction.

The second and third facilities designed and constructed were the east and west Polo Grounds County Park projects. Similar designs were employed at each site, which consisted of capturing field and parking lot runoff, routing it through a bioswale to filter the runoff, then directing flow to four-foot diameter, 30-foot deep, gravel-filled seepage pits. Construction of the Polo Grounds facilities was completed in the spring of 2012. The estimated annual recharge volumes for the east and west facilities are 5.0 and 9.3 acre-feet per year, respectively.

A fourth facility was designed for the Brommer Street Park. Similar to the Polo Grounds design, the Brommer facility captures field and parking lot runoff, routing it through a bioswale to capture silt and sediment and provide partial biological treatment, before conveyance to gravel filled seepage pits. The Proposition 50 IRWM grant only had sufficient funding for the construction of two groundwater recharge facilities; the County determined the grant funds were best utilized at the two facilities at the Polo Grounds (east and west) which provided comparatively greater recharge potential due to site characteristics. Construction of the Brommer recharge facility remains a priority for the County. The County plans to construct this site in the near future (2013 - 2014) as part of a countywide low impact development (LID) program with funding from the County and the State Water Board's Storm Water Grant Program.

On March 6, 2012, the Santa Cruz County Board of Supervisors adopted a runoff and pollution control ordinance. Among other elements, the ordinance requires that all new and re-development projects must mitigate adverse environmental impacts of stormwater and urban runoff by controlling the volume, rate and pollutant load of runoff that would be in excess of pre-development conditions, including maintaining pre-development groundwater recharge.

2.0 PROBLEM STATEMENT

Approximately 80% of the useable water supply in Santa Cruz County is derived from aquifers. Several large water districts in the County, including the Scotts Valley and Soquel Creek water districts, rely solely upon groundwater. Water supplies are insufficient to meet existing demand, and each of the three major groundwater basins in the county is in a state of overdraft as a result of long-term groundwater extraction rates exceeding natural recharge. Changes in local land use, particularly the increase in impervious, paved surface area accompanying urbanization and suburban development, has reduced rainfall infiltration into land surfaces resulting in substantial decreases in groundwater recharge rates and volumes. Development (the construction of structures or covering of the native soil with artificial surfaces) within the county has impacted the groundwater aquifers in two important ways; 1) groundwater is extracted from the aquifers for potable use to support urban and rural development and agricultural and 2) impervious surfaces from development cap the ground surface and prevent aquifer recharge.

Rarely does a single residential or commercial development project significantly impact recharge, but rather it is through the cumulative impact of development that results in significant impacts. The net result is that aquifers have become overdrafted (i.e. the water stored in an aquifer is depleted over time). It is estimated that between 500 and 1,000 acre-feet per year of historic recharge capacity in the Scotts Valley area has been lost due to the increase in impervious surfaces as result of development.[1] Consequences of aquifer overdraft include increased pumping costs, drying-up of shallow wells (requiring costly replacements), decreased stream base flow and corresponding impacts to riparian habitat, decreased groundwater quality, and under certain circumstances, seawater intrusion and land subsidence. Ongoing declines in groundwater levels threaten long-term viability of some aquifers as a source of accessible, affordable groundwater supply. Adverse impacts of declining groundwater levels include: increased supply costs (pumping; treatment), contamination from salt water intrusion in coastal areas, and reductions in base flow in local streams adversely impacting aquatic ecosystems.

In addition to reducing the amount of natural recharge an aquifer would receive, development also increases the amount of runoff to local drainages and storm drains often leading to modification of the natural receiving water bodies. Traditionally, a typical development practice has been to route stormwater off-site, as quickly as possible, through drainage pipes and other conveyances. The volume of stormwater runoff from a developed site (e.g., residence or business) is typically much greater, often a three to four-fold increase, over an undeveloped site that allows for rainfall infiltration; term hydromodification describes this effect. Hydromodification refers to activities that change (typically increasing) the velocity, volume, and timing and of runoff. Effects of hydromodification may include increased erosion, sediment loading of streams, chemical and organic contamination of receiving water bodies, impairment of aquatic habitat, increased strain on drainage infrastructure and possibly flooding of local drainage systems.

[1] Phase I Conjunctive Use and Enhanced Aquifer Recharge Project. 2011. Kennedy / Jenks Consultants.

Much effort is currently focused on addressing these problems through new development standards. However, Santa Cruz County is an area with low development rates and the new standards will have marginal benefit. The County is also looking to retrofit existing facilities to promote enhanced recharge, and this project will serve as case studies to that purpose.

This project addresses two aspects of the groundwater overdraft issue. First, existing facilities can be retrofitted to capture and retain runoff to promote enhanced recharge. The approach was one of the high-priority strategies identified in the *Conjunctive Use and Enhanced Aquifer Recharge* study also funded by the Santa Cruz IRWM Proposition 50 grant (Component 3). This approach is consistent with low impact development (and re-development) designs, strategies, and practices endorsed by the U.S. Environmental Protection Agency and other local, state, and federal agencies. Second, new and re-development standards can be developed or amended to better protect and restore groundwater recharge.

3.0 PROJECT GOALS

The goal of this project is to enhance groundwater recharge through the design and construction of small scale facilities that capture, treat and recharge stormwater runoff to the underlying aquifer while reducing hydromodification and water quality impacts. Further, successful project designs and implementation will serve as demonstration projects and be promoted as examples for use in other areas of the county. Additionally, the County will review and adopt policies for the protection of and enhancement of groundwater recharge. In striving towards this goal, the County completed the following:

1. Identified locations (parcels) with high recharge potential based upon site conditions;
2. Designed stormwater recharge (SWR) facilities that capture, treat and retain stormwater runoff for groundwater recharge. The projects are intended to recharge aquifers while also reducing excess runoff and the resulting adverse impacts to streams, receiving water bodies, aquatic habitats, and drainage infrastructure.
3. Constructed SWR pilot projects at targeted locations. The implemented projects will serve as demonstration projects to evaluate the effectiveness in capturing and recharging runoff. The lessons learned from these pilot projects can be applied to future groundwater enhancement and protection projects throughout the County.
4. Reviewed and updated County policies, programs and ordinances to enhance requirements and incentives for protection of and restoration of groundwater recharge during the design and construction of new development and remodel projects.

4.0 PROJECT DESCRIPTION

A description of the project including project funding and costs are provided in this section, along with a discussion of the engineering and construction methodology, a discussion of the pollutants removed, and a comparison of existing and new data. Photographs taken before, during and after construction are provided in Appendix 1.

4.1 Project Type

This is a groundwater recharge project that designed and constructed small-scale projects to collect, treat, and retain stormwater runoff for groundwater infiltration.

4.2 Project Cost

The total project cost was $485,887. The costs funded by this SWRCB grant totaled $378,107. The costs paid by the County totaled $107,780. The County of Santa Cruz received grant funds for agency personnel working on this project. Consultants, contractors, and engineering firms receiving grant funds include: Ifland Engineers; Fall Creek Engineering; Contractor Compliance and Monitoring, Inc.; and, the Don Chapin Company. The grant funded the completion of engineering plans for four stormwater retention facilities. The grant funded the construction of two facilities.

4.3 Site Selection

The County of Santa Cruz, Water Resource Division staff, with input from a technical advisory committee (TAC) of representatives from County Public Works, County Environmental Health Services, County geologist, local water districts and U.C. Santa Cruz academics, developed initial site selection criteria. The Santa Cruz County previously designated and mapped 54,000 acres as Primary Groundwater Recharge zones. These zones were identified based upon the presence of sandy, permeable and transmissive soils that more readily infiltrates water into the underlying aquifers. The initial site selection criteria for potential recharge sites required that sites were: 1) located in primary groundwater recharge zones, and 2) publically owned. Requiring parcels to be publically owned was to minimize any potential schedule delays due to obtaining access agreements and additional costs to acquire right-of-ways. Locating the SWR facilities in primary recharge zones was to ensure the geologic and soil conditions are favorable to the infiltration and percolation of rainfall and stormwater runoff into groundwater basins. In addition, potential SWR sites within the primary recharge zones, parcels were screened and evaluated based upon land-use type and other site specific features. A limited geotechnical analysis was completed at each site to ensure suitability. Based upon parcel assessments, three locations were selected for recharge facilities. The sites included: 1) Polo Grounds Regional County Park in the community of Aptos; 2) Brommer Street Park in the community of Live Oak; and, 3) the Scotts Valley library in the city of Scotts Valley.

4.4 Scotts Valley Library Site

Scotts Valley is a small city with a population of 11,850 located in the Santa Cruz Mountains that relies exclusively upon groundwater for its water supply. Extensive development in the city has significantly reduced groundwater recharge to the underlying Santa Margarita and Lompico groundwater aquifers, the primary water supply for the Scotts Valley Water District. Prior studies identify retrofitting existing infrastructure to improve recharge as an effective means of restoring lost recharge capacity, and the construction of the new Scotts Valley Library located at 251 Kings Village Road provided an opportunity to incorporate the recharge facility into the project.

Several factors led to the Scotts Valley Library site being chosen for the location of a groundwater recharge project. Most importantly, the Library is located in the Camp Evers area of the City, a priority zone for recharge because the Santa Margarita aquifer directly overlies the Lompico aquifer in this area[2]. 75% of the existing project site consisted of impervious surface, primarily a 22,728 square foot building and parking lot. Runoff from the site previously sheet flowed to the stormdrain system and left the site without any treatment, detention or retention. Finally, the Library was about to undergo a major remodeled, which provided an opportunity to incorporate the recharge facility into the Library's larger project's designs.

Ifland Engineering was awarded the design contract for this recharge facility; designs were completed in the fall of 2010. The groundwater recharge system was designed to capture and treat runoff from the site's roof and parking lot prior to infiltrating into the underlying soils, and ultimately into the aquifer below. The designs feature two, 139-foot long, 48-inch perforated ADS pipes set in a stone trench. The designs include two water quality treatment units, one at the inlet to the retention system and the other located at the overflow structure east of the existing drain inlet within the valley gutter. The water quality treatment units are designed to prevent debris and garbage from entering the retention system and begin the removal process of oils and other pollutants prior to entering the retention system. Combined with the stone trenches and ADS pipes the technical analysis indicated that runoff would be adequately treated prior to entering the groundwater and aquifer below.

This project was successfully constructed in the fall and winter of 2010 by the City of Scotts Valley. Construction was funded by the City, no grant or local match funds were used for construction at this site (this enabled the County to construct two facilities at the Polo Grounds, as described below). The City modified the recharge facility designs. While roof and parking lot runoff were still captured and routed through treatment units, the volume of the recharge gallery was reduced. Designs called for two, 48-inch diameter, 139-foot ADS pipes. As constructed, the length of the pipes was reduced to 66-feet to include a total capacity of 3,300 cubic feet, which is slightly over half of the original estimated volume of 6,000 cubic feet. As built, the facility will capture and retain a 2-year storm event, and detain stormwater runoff from a 10-year storm with a 5-year release rate. Total draw down time for the facility is estimated at 9.6 hrs. Additional performance details are discussed below.

[2] Phase I Conjunctive Use and Enhanced Aquifer Recharge Project. 2011. Technical Memorandum 1A. Kennedy / Jenks Consultants

Figure 1 - Scotts Valley Library before construction

Figure 2 - Scotts Valley Library during construction

Figure 3 – Silt and Grease Trap (water quality treatment unit – Scotts Valley Library)

Figure 4 - Scotts Valley Library after construction

4.5 Polo Grounds Regional County Park

The Polo Grounds Regional County Park is located at 2255 Huntington Avenue in the unincorporated community of Aptos. The overall project drainage area is approximately 12 acres, and consists of several sports fields, a restroom, a maintenance facility, and two parking lots. The Polo Grounds Park was selected for a recharge facility because it overlies the Purisima formation, a key water supply aquifer for the mid-Santa Cruz County area and the Soquel Creek Water District. The site slopes gradually downward from east to west at an average grade of 2%, and the majority of stormwater runoff sheet flows over the existing parking lots, and sports fields, and is ultimately captured in several catch basins. Some stormwater runoff is collected in a road side grass and earthen swale and captured in a road side catch basin. The catch basins divert water to outfalls above Valencia Creek.

A limited geotechnical investigation found interbedded silty sand, sandy silt, and clayey silt to total depths. Although relatively thin, the interbedded silty sand layers were identified as having potential for groundwater recharge provided that enough permeable layers are intercepted by the recharge facilities.

A design contract was awarded to Fall Creek Engineering to design two separate facilities at the Polo Grounds County Park – named the east and west facilities. The designs were completed in the summer of 2011 along with all necessary permits and clearances. A construction contract was awarded to the Don Chapin Company for construction in the fall of 2011. Construction began shortly thereafter and continued through March of 2012.

The Polo Grounds east and west projects utilize a similar design to affect groundwater recharge. Each design collects runoff from parking lots and ball fields, routes the runoff through a bioswale to a distribution box, then finally to four-foot diameter, 30-foot deep, gravel filled seepage pits. Prior to construction, runoff from these areas were conveyed to outfalls above Valencia Creek via hard pipe, resulting in significant erosion. The basis of design of the recharge facilities reflects the Santa Cruz County Department of Public Work's Design Criteria and the California Stormwater Quality Association (CASQA) "Stormwater Best Management Practices (BMPs) for New Development and Redevelopment Handbook". Section 5.7 of this handbook titled, "BMP Fact Sheets", was used a guide in the design of the recharge facilities.

4.5.1 Polo Grounds East

The Polo Grounds east drainage area is approximately 1.06 acres. The majority of runoff is shallow, overland flow (sheet flow) from an asphalt parking lot and several grass areas. The designs for the east project consisted of a bioswale located adjacent to a parking lot to receive sheet-flow runoff. Runoff captured by the bioswale infiltrates into the soil, and then is captured by a twelve-inch sub-surface drain pipe. The pipe directs runoff to a distribution box that equally directs flow to twelve, four-foot diameter, 30-foot deep seepage pits. The seepage pits are filled with 1-½ inch drain rock, and the pits contain an inspection riser that reaches to the ground surface. The pits were backfilled with soil to existing grade and the soil was compacted. The facilities have been designed to recharge runoff from approximately 95% of all storm events occurring in the east Polo Ground area. Excess runoff occurring during very large storm events will overflow to the existing drainage system to the outfall above

Valencia Creek (more information described below). This facility was successfully constructed during the winter of 2011 – 2012. Selected before, during and after construction pictures are presented below, please refer to Appendix 1 for a full set of project pictures.

Figure 5 - Polo Grounds East post-construction during storm (1/20/2012)

Figure 6 - Polo Grounds East post-construction (June 2012)

4.5.2 Polo Grounds County Park – West

The Polo Grounds west drainage area is approximately 6.57 acres. The majority of runoff in the area sheet flows from asphalt and gravel parking lots, the paved road, and several grass and unvegetated (bare soil) sports fields. The designs for the east project consisted of a bioswale located adjacent to a parking lot to receive sheet-flow runoff. Runoff captured by the bioswale infiltrates into the soil, and then is captured by a twelve-inch sub-surface drain pipe. The pipe directs runoff to a distribution box that equally directs flow to twenty, four-foot diameter, 30-foot deep seepage pits. The seepage pits are filled with 1-½ inch drain rock, and the pits contain an inspection riser that reaches to the ground surface. The pits were backfilled with soil to existing grade with compacted soil. The facilities have been designed to recharge runoff from approximately 90% of all storm events occurring in this area of the park. Excess runoff resulting from very large and infrequent storms will overflow to the existing outfall above Valencia Creek. This facility was successfully constructed during the winter of 2011 – 2012. Select before, during and after construction pictures are presented below, please refer to Appendix 1 for a full set of project pictures.

Figure 7 - Polo Grounds West during construction

Figure 8 - Polo Grounds West post-construction stormwater capture (January 2012)

4.6 Brommer Street Park

Brommer Park is located at the corner of 30th Avenue and Brommer Street, in the Live Oak area of Santa Cruz County. The site was identified as having high recharge potential based upon its geology and because it overlies the Purisima formation (Purisima unit A), an important water supply aquifer for the City of Santa Cruz and the Soquel Creek Water Districts. The land use and site characteristics are compatible for a recharge facility. The project drainage area is approximately 1 acre, and consists of a baseball field, tennis courts, a small playground, a restroom, a maintenance facility, and a parking lot. Existing runoff from the park is conveyed by pipe to Rodeo Creek with no opportunity for treatment or recharge.

Plans and specifications were completed for the Brommer recharge facility by Fall Creek Engineering. The design concept for this site is the same as for the Polo Grounds projects – i.e., capture parking lot and park grounds runoff, route the runoff through a bioswale/vegetated swale, to a distribution box, and then to gravel filled seepage pits. The system is designed to recharge runoff from approximately 99% of all storm events occurring over the park. The Proposition 50 IRWM grant only had sufficient funding for the construction of two groundwater recharge facilities; the County determined the grant funds were best utilized at the two facilities at the Polo Grounds (east and west) which provided comparatively greater recharge potential due to site-specific characteristics. Construction of the Brommer recharge facility remains a priority for the County. The County will construct this site in the near future (2013 - 2014) as part of a countywide low impact development (LID) implementation program with funding support from the County and the State Water Board's Storm Water Grant Program.

4.7 Stormwater Runoff Reduction Estimates

The Rational Runoff Method[3] and a recharge estimating procedure (Appendix 4) were used to calculate peak runoff rates and to estimate of peak runoff reduction and recharge at the Polo Grounds and Scotts Valley sites for different rainfall durations and depths. The Rational Runoff Method is a commonly used method of determining peak discharge from small drainage areas (< 300 acres); it is often used to develop design-storm peak discharge values[4]. This method is particularly useful in urban and suburban areas with homogenous watershed conditions and produces the most accurate results for drainages with high percentages of impervious surfaces (e.g., paved parking lots).

The Rational Runoff Method was utilized to estimate pre-construction runoff volumes:

$$Q = C*i*A$$

Where:

Q = peak rate of runoff in cubic feet per second (cfs)
C = rational runoff coefficient (dimensionless units)

[3] Thomas Dunne, Luna B. Leopold, Water in Environmental Planning (W.H. Freeman and Company, 1978), 298

[4] USGS, 2006. Scientific Investigations Report 2005-5254.

i = rainfall intensity in inches per hour (in/hr)
A = drainage area in acres (ac)

The rational runoff coefficient (C) represents the percentage of rainfall that becomes runoff. The coefficient value is a function land use/types of surface, hydrologic soil type and drainage basin slope; these factors have a fundamental affect on the time distribution and peak rate of runoff. Coefficient values have evolved through trial and error over more than a century of use; coefficient value tables are published by the American Society of Civil Engineers and American Public Works Association as well as by state and local agencies.

Determining which coefficient (C) to utilize requires the knowledge and judgment of the engineer based upon the site specific factors. At the Polo Grounds, the composite runoff coefficient was determined from a weighted average of runoff coefficients of each of the surfaces (2% sloped grass=0.08, dirt lot=0.15, gravel lot=0.25, asphalt=0.8) located in the project drainage areas. Peak runoff into the recharge facilities did not change as a result of project implementation (i.e., for a given rainfall intensity the runoff coefficient and drainage area remain constant). However, runoff is captured by the bioswale and directed to the seepage pits reducing the amount of offsite runoff and increasing recharge.

Estimating the volume of the post-construction runoff reduction and increased recharge was accomplished using a performance estimating procedure developed by the project engineer. A detailed description of this methodology is provided in Appendix 4.

This approach provides a conservative estimate of the amount of water that is redirected to the recharge system versus discharging offsite. This method produces conservative estimates because it assumes that all of the rainfall occurs within short durations (1 to 3 hours) resulting in higher intensities than normally seen in the County. In actuality, many rainfall events are expected to occur over a longer duration and thus have lighter intensities allowing more runoff to be captured. Nevertheless, estimating runoff volume and capture using the method provides useful insight into how the recharge systems should perform.

Table 1 - Stormwater Runoff Volume Reduction Estimate – Polo Grounds (1 hour rainfall duration)

Site	Rainfall Depth (in)	Rainfall Duration (hr)	Intensity (in/hr)	Pre-Construction Runoff Volume (Gallons)	Volume Recharged (Gallons)	Post-Construction Runoff Volume (Gallons)	Reduction in Runoff Volume to Valencia Creek (%)
Polo Grounds West	0.4	1	0.4	18,098	18,098	0	100
	0.8	1	0.8	36,196	31,241	662	86
	1.2	1	1.2	54,294	31,241	23,053	58
	1.6	1	1.6	72,392	31,241	41,151	43
	2.8	1	2.8	126,686	31,241	95,445	25
Polo Grounds East	0.4	1	0.4	5,714	5,714	0	100
	0.8	1	0.8	11,429	11,429	0	100
	1.2	1	1.2	17,143	16,256	888	95
	1.6	1	1.6	22,857	16,256	6,602	71
	2.8	1	2.8	40,000	16,256	23,745	41

1-Hour Storm Duration. The results indicate that a stormwater runoff volume reduction of the one (1) hour storm events will range from 25% to 100 % for 2.8 to 0.4 inches of rainfall in the west system and

will range from 41% to 100% for the 2.8 to 0.4 inches of rainfall on the east system. Both systems will substantially reduce the discharge volume from the park for all 1-hour significant rainfall events. It is important to note that intensities of over 0.4 inches per hour are relatively uncommon, and this example is the most conservative estimate.

Table 2 - Stormwater Runoff Volume Reduction Estimate – Polo Grounds (2 hour rainfall duration)

Site	Rainfall Depth (in)	Duration (hr)	Intensity (in/hr)	Pre-Construction Runoff Volume (Gallons)	Volume Recharged (Gallons)	Post-Construction Runoff Volume (Gallons)	Reduction in Runoff Volume to Valencia Creek (%)
Polo Grounds West	0.4	2	0.2	18,098	18,098	0	100
	0.8	2	0.4	36,196	36,196	0	100
	1.2	2	0.6	54,294	54,159	68	100
	1.6	2	0.8	72,392	61,485	10,713	85
	2.8	2	1.4	126,686	61,485	65,007	49
Polo Grounds East	0.4	2	0.2	5,714	5,714	0	100
	0.8	2	0.4	11,429	11,429	0	100
	1.2	2	0.6	17,143	16,427	702	96
	1.6	2	0.8	22,857	16,427	6,321	72
	2.8	2	1.4	40,000	16,427	23,179	42

2-Hour Storm Duration. As the storm duration extends to 2 hours the ability of the recharge system to retain water increases substantially given the reduction in rainfall intensity. The west and east systems can accommodate 85% and 72%, respectively, of the runoff volume occurring from the 1.6 inch 2-hour event, which exceeds that 95% percent annual return event for the area.

Table 3 - Stormwater Runoff Volume Reduction Estimate- Polo Grounds (3 hour rainfall duration)

Site	Rainfall Depth (in)	Duration (hr)	Intensity (in/hr)	Pre-Construction Runoff Volume (Gallons)	Volume Recharged (Gallons)	Post-Construction Runoff Volume (Gallons)	Reduction in Runoff Volume to Valencia Creek (%)
Polo Grounds West	0.4	3	0.13	18,098	18,098	0	100
	0.8	3	0.27	36,196	36,196	0	100
	1.2	3	0.40	54,294	54,142	51	100
	1.6	3	0.53	72,392	71,335	352	100
	2.8	3	0.93	126,686	90,732	34,569	73
Polo Grounds East	0.4	3	0.13	5,714	5,714	0	100
	0.8	3	0.27	11,429	11,429	0	100
	1.2	3	0.40	17,143	16,598	523	97
	1.6	3	0.53	22,857	16,598	6,047	74
	2.8	3	0.93	40,000	16,598	22,618	43

3-Hour Storm Duration. In a 3-hour event, the west and east systems can retain 100% and 74% of the 1.6 inches (95% annual event) of runoff from the drainage areas.

Table 4 - Stormwater Runoff Volume Reduction - Scotts Valley Library

Rainfall Depth (in)	Rainfall Duration (hours)	Intensity (in/hr)	Pre-Construction Runoff (Gallons)	Volume Recharged (Gallons)	Post-Construction Runoff Volume (Gallons)	% Runoff Reduction
0.4	1	0.40	13,261.50	13,261.50	0.00	100
0.8	1	0.80	26,523.00	26,523.00	0.00	100
1.2	1	1.20	39,784.50	27,251.00	12,533.50	68
1.6	1	1.60	53,046.01	27,251.00	25,795.01	51
2.8	1	2.80	92,830.51	27,251.00	65,579.51	29
0.4	2	0.20	13,261.50	13,261.50	0.00	100
0.8	2	0.40	26,523.00	26,523.00	0.00	100
1.2	2	0.60	39,784.50	29,818.00	9,966.50	75
1.6	2	0.80	53,046.01	29,818.00	23,228.01	56
2.8	2	1.40	92,830.51	29,818.00	63,012.51	32
0.4	3	0.13	13,261.50	13,261.50	0.00	100
0.8	3	0.27	26,523.00	26,523.00	0.00	100
1.2	3	0.40	39,784.50	32,385.00	7,399.50	81
1.6	3	0.53	53,046.01	32,385.00	20,661.01	61
2.8	3	0.93	92,830.51	32,385.00	60,445.51	35

The Scotts Valley Library system, designed to capture only the 2-year storm event, has comparatively less storage volume than do the Polo Grounds systems. Nevertheless, the Scotts Valley Library system is estimated to reduce runoff between 29% and 100% for a given storm duration and intensity. Considering that a storm intensity of about 0.4 inches/hr is an average storm for the County, the system should capture between 81% and 100% of runoff from an average storm.

4.8 Pollutant Load Reduction

During dry weather, pollutants such as sediment, nutrients, oil, grease, and various heavy metals accumulate on paved surfaces such as roads and parking lots. When the storms occur, rainfall runoff transports these pollutants directly to the storm drain system which transport the pollutants to receiving waters (local streams, Monterey Bay) where they can impact beneficial uses. The primary purpose of this project was to construct facilities to improve recharge, but pollutant reduction is likely a secondary benefit. The recharge systems were constructed near the downgradient end of paved roads and parking where stormwater is treated in bioswales (Polo Grounds) or treatment units (Scotts Valley) before discharging to the recharge seepage pits (Polo Grounds) or recharge gallery (Scotts Valley).

Because runoff from the Polo Grounds Park is conveyed through a bioswale it has greater potential for pollutant reduction than does the Scotts Valley system that only utilizes engineered treatment units.

The vegetated bioswale acts to filter and treat pollutants biologically as runoff infiltrates, whereas the Scotts Valley treatment unit relies only on physical separation of pollutants (i.e. debris, trash, sediment) with little opportunity for treatment of pollutants such as oil and grease.

The estimated pollutant load reduction (Removal Rate) in typical bioretention swales, such as those installed at the Polo Grounds, has been studied by researchers at the University of Maryland (Davis et. al.) in conjunction with Prince George's County Department of Environmental Resources (PGDER) [5]. They performed several bioretention field and laboratory experiments, yielding the results and estimates presented below:

Table 5 - Typical Pollutant Removal Rates

Pollutant	Removal Rate
Total Phosphorous	70 - 83%
Metals (Cu, Zn, Pb)	93 - 98%
Total Kjeldahl Nitrogen	68 - 80%
Total Suspended Solids	90%
Organics	90%
Bacteria	90%

4.9 Estimates of Groundwater Recharge

County staff or the project's design engineers generated estimates of the amount of groundwater recharge for each of the projects. Estimates for the Polo Grounds systems were generated using historical rainfall records, whereas those for Scotts Valley were estimated based on rainfall that occurred after implementation. As part of the design of this project, the engineer performed a rainfall distribution analysis using 116 years of historic rainfall data. The data was sorted, ranked and classified by rainfall depth. The results indicate that over the historical period, 90% of the storms are less than or equivalent to 1.2" per day. As such, the engineers used 1.2" as design criteria, and conservatively assumed that only 85% of the runoff from those rainfall events would be captured and directed to recharge by the recharge facilities. Values for the Scotts Valley system were generated by using actual rainfall amounts from both the 2010-2011 and 2011-2012 water years. Rainfall amounts are from the Felton rain gage, which is likely an over-estimate for the amount of rainfall that occurred at the site because annual average rainfall values in Felton are greater than in Scotts Valley. Since those values

[5] Prince George's County Department of Environmental Resources (PGDER), 1993. Design Manual for Use of Bioretention in Storm water Management. Division of Environmental Management, Watershed Protection Branch. Landover, MD.

[5] Davis, A.P., Shokouhian, M., Sharma, H., and Minani, C., 1998. Optimization of Bioretention Design for Water Quality and Hydrologic Characteristics.

were daily, we made an assumption that the storms occurred over a 6-hour period to generate intensities (and thus runoff values). The estimated recharge volumes are presented below in Table 7:

Table 6 - Recharge Estimates by Facility

Facility	Recharge Estimate (AFY)
Polo Grounds West	9.3
Polo Grounds East	5
Scotts Valley Library	2 to 5
Brommer Park	1.3

4.10 Post-Construction Observations

Following construction of the recharge facilities, County staff has had the opportunity to visit the sites during several storm events to observe the facilities function. During those visits staff made the following observations:

- Runoff is being captured according to the project designs at each facility
- A the Polo Grounds sites, runoff is collecting in the bioswales during storm events, which completely draw-down within 48 hours after a storm event
- At the Polo Grounds sites, runoff is infiltrating through the bioswale, and is being directed to the seepage pits from the distribution box, as designed
- Runoff in excess of the conveyance capacity of the facilities is being directed to the storm drain system
- At the Polo Grounds sites, soil above the seepage pits settled, causing some of the inspection risers and boxes to shift or sink. County staff and the contractor remedied those situations where they occurred
- A sonic sounder may not be the best instrument for monitoring water elevations in the seepage pits because the stand pipe in the seepage pits is not perfectly vertical, which can result in measurement error. The County determined the data from the first rounds of sampling were unreliable, and as such, is not included in this report.

4.11 Groundwater Recharge Ordinance

On March 6, 2012 the Santa Cruz County Board of Supervisors adopted a Runoff and Pollution Control ordinance. The ordinance prohibits non-stormwater discharges into the storm drain system along with appropriate enforcement procedures and actions. The ordinance also addresses construction erosion and sediment control, post construction runoff from new development and redevelopment projects, and implementation of design standards for specific development and redevelopment projects. Specifically related to this project, the ordinance requires that all new and re-development projects must meet mitigate impacts by controlling the volume, rate and pollutant load of runoff that would be in excess of pre-development conditions, including maintaining pre-development groundwater recharge. The ordinance also requires property owners to maintain stormwater management facilities,

and the agreement to do so must be recorded on the property's deed. A copy of the adopted ordinance is included in Appendix 2 of this report.

The County designated and mapped 54,000 acres as Primary Groundwater Recharge zones. Areas mapped as Primary Groundwater Recharge zones cannot be subdivided into parcels smaller than 10 acres. The intent of this regulation is to ensure that these areas remain free from development and the associated impervious surfaces that could impede recharge, and to reduce the potential for water quality impacts from septic systems.

5.0 PUBLIC OUTREACH

Public outreach for the overall Northern Santa Cruz County IRWM Implementation grant occurred on multiple occasions since the award of the grant. In 2008, at the kickoff of the grant, there were outreach efforts to local newsprint media (GoodTimes, Santa Cruz Sentinel) which resulted in articles on the IRWM effort and the funded projects. A summary of this project (Component 6), and the other components funded by this grant, is posted on the Santa Cruz IRWM website (SantaCruzIRWMP.org) and the Regional Water Management Foundation website (rwmf.org). There have been several public presentations on the local IRWM efforts and the funded projects. These include presentations in 2008 and 2009 (Chris Coburn, Santa Cruz County) at Blue Circle events which is an informal forum for local agencies, watershed and other non-governmental groups and concerned citizens to meet and exchange views on natural resource issues affecting residents living in the County's watersheds.

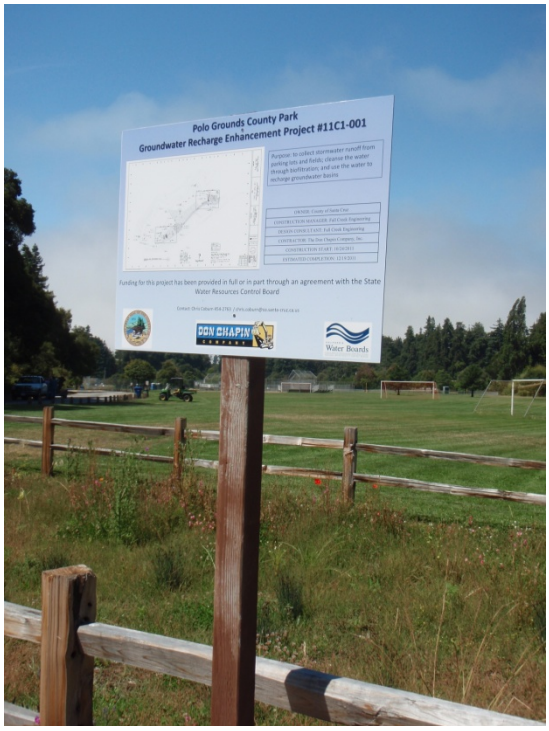

Figure 9 - Project Signage at Polo Grounds

Outreach to public agencies included coordination with the Santa Cruz County Environmental Health Services and Santa Cruz County Public Works. In November 2008, Santa Cruz IRWM representatives presented to the Central Coast Regional Water Quality Control Board on the projects funded by this grant. On multiple occasions, the IRWM partner agencies (including Santa Cruz County Environmental Health) convened with interested local agencies, as well as the County Board of Supervisors, to review current and future IRWM efforts. Various informal meetings and discussions on the recharge projects (Component 6) were held with affected County and City agencies to seek site approval and discuss potential project types, schedule and proposed locations. Also periodic meetings were held with affected County and City agencies to keep them informed as to the project status (preliminary and final project design and pre-construction meetings.)Oral and written project status reports were given to the County Water Advisory Commission and Board of Supervisors at public meetings. The technical advisory committee consisted of representatives from County Public Works, County Environmental Health Services, local water districts and U.C. Santa Cruz academics.

Signs were erected at the project sites that identified project name, description and purpose, a site plan, project start and end dates, project owner, contract manger, designer, contractor, funding source and project contact information.

6.0 CONCLUSIONS

The goal of this project was to enhance groundwater recharge in Santa Cruz County through the design and construction of small scale facilities to capture, treat and recharge stormwater runoff to the underlying aquifer while reducing hydromodification and water quality impacts. This implementation of this project successfully advanced that goal. Four sites were designed; three sites were constructed (two with Proposition 50 IRWM grant funds). The successful completion of these projects allows them to serve as examples for the future implementation of small scale recharge facilities in other areas of the county. In addition, the Runoff and Pollution Control ordinance adopted by the Santa Cruz County Board of Supervisors in 2012 provides for greater protection of and enhancement of groundwater recharge.

6.1 Project Assessment and Evaluation

At the outset of this component, a Project Assessment and Evaluation Plan (PAEP) was developed to assist in identifying and clarifying the goals, outcomes, targets of this effort. The template for the PAEP was provided by the SWRCB. The PAEP includes a Project Performance Measures Table intended to facilitate an evaluation of the project's progress in meeting its stated goals, outcomes, and targets. The Project Performance Measures table from the PAEP is included below for reference below (Table 7).

Table 7 - Project Performance Measures Table

Component Goal (Objective)	Desired Outcomes	Output Indicators (implementation indicators)	Outcome Indicators (status and trends indicators)	Measurement Tools and Methods	Targets
Increase groundwater recharge in Santa Cruz County	1. Identify locations suitable for recharge pilot projects 2. Design small-scale groundwater recharge projects 3. Implement small-scale groundwater recharge projects 4. Develop and adopt County-level policies to protect and enhance groundwater recharge 5. Identify effective recharge project designs/facilities and promote for use at other primary groundwater recharge locations throughout the County 6. Reduced peak runoff from project drainage area	1. Areas suitable for groundwater recharge are mapped 2. Primary groundwater recharge locations are targeted for acquisition or acquire permission to construct recharge projects/facilities 3. Number of recharge projects designed 4. Number of recharge projects implemented 5. Updated groundwater recharge and stormwater management policy 6. Summary report with recommendations for future aquifer recharge and protection 7. Peak runoff reduction estimates	1.Implementation of effective recharge project designs/facilities 2. Increase in capacity and volume of groundwater recharge 3. Acquisition of primary recharge properties 4. Approved groundwater/storm-water policies adopted and enforced by County 5. Photo documentation 6. Reduced peak runoff	1. Constructed project effectiveness monitoring and evaluation 2. Estimation of the new additional recharge (AFY) 3. Runoff estimation methodology prepared by Fall Creek Engineering	1. Two constructed groundwater recharge projects by 3/31/2012 2. Estimates of recharge benefits from each project. Target is to increase recharge by at least 50% or to predevelopment levels. 3. Adoption of County policies and ordinances protecting and enhancing groundwater recharge by 3/31/2012 4. 50% reduction in estimated peak runoff

6.1 Goal

Increase Groundwater Recharge – this goal was met through the construction of three separate recharge facilities with a combined estimated increase of up to 20 acre-feet per year.

6.2 Outcomes

Outcomes describe the desired result, impact or consequence of the project. For these projects, the desired outcomes include the various steps in the projects process – from site selection through to project construction.

1. Identify locations suitable for recharge pilot projects – with input from the TAC, the County's geologist identified locations that would likely be suitable for projects based on geology. That list was narrowed to parcels in public ownership. Parcels were screened and evaluated based upon land-use type and site specific features. Once the three project locations were identified, a limited geotechnical analysis was completed at each site to ensure suitability.
2. Design small-scale groundwater recharge projects – four recharge facilities were designed and permitted
3. Implement small-scale groundwater recharge projects – two separate facilities were constructed with grant funds; a third facility was constructed without grant funds.
4. Develop and adopt County-level policies to protect and enhance groundwater recharge – On March 6, 2012, the County Board of Supervisors adopted a policy that protects groundwater recharge.
5. Identify effective recharge project designs / facilities and promote for use at other primary groundwater recharge locations throughout the County – monitoring of the projects has indicated that they are functioning as desired, and similar designs have been considered for pending grant-funded programs (DWR- Prop. 84 stormwater grant). Lessons learned from these projects include the need to adequately compact soil over the seepage pits to avoid settling and distortion of the stand pipe. Conversely, heavy equipment use within bioswales should be minimized to limit compaction of those soils. Additional water quality monitoring should provide information about effectiveness in terms of pollutant reduction.
6. As described above, runoff was reduced from each of the constructed facilities by capturing runoff and directing it to some type of recharge feature (seepage pit, gallery).

6.3 Output Indicators

Output indicators are the discrete products that can be counted as a means of evaluating the outcomes described above. For this grant, outputs include various mapping, the actual number of projects constructed, and the final, adopted groundwater policy.

1. Areas suitable for groundwater recharge are mapped – complete – the County has a GIS layer consisting of primary groundwater recharge zones
2. Primary groundwater recharge locations are targeted for acquisition or acquire permission to construct recharge projects/facilities – not applicable – we purposefully chose to locate facilities at publicly owned properties to avoid need for acquisition or agreements

3. Number of recharge projects implemented – three constructed and a fourth ready for construction with approved designs and permits pending funding
4. Draft and final revised groundwater recharge policy – completed
5. Summary report with recommendations for future aquifer recharge and protection – complete with acceptance of this report
6. Peak runoff reduction estimates – we estimate that between 25% and 100% of runoff is captured and directed for recharge by these projects. For a typical high-intensity storm of 0.4inches / hour, that percentage increase to between 80 and 100 percent.

6.4 Targets

Targets are ideally a quantified expression of what we hoped to achieve by implementing these projects. The targets focused on the goal of implementing projects and improving recharge.

1. Two constructed groundwater recharge projects – exceeded with the construction of 3 facilities
2. Estimates of recharge benefits from each project. Target is to increase recharge by at least 50% or to predevelopment levels – runoff reduction estimates (described above) indicate that between 25% and 100% of runoff is captured and directed for recharge by these projects. For a typical high-intensity storm of 0.4inches / hour, that percentage increase to between 80 and 100 percent.
3. Adoption of County policies and ordinances protecting and enhancing groundwater recharge – the Runoff and Pollution Control Ordinance was adopted on March 6, 2012 by the County Board of Supervisors.
4. 50% reduction in estimated peak runoff – depending on the a storm's duration and intensity and the size of the facility in relation to the drainage area, we estimate between 25 and 100% reduction in peak runoff. For an average storm of 0.4 inches / hour, that estimate increases to between 80 and 100%.

6.2 Next Steps

The County plans to construct the Brommer recharge facility in the near future (2013 - 2014) as part of a countywide low impact development (LID) program with funding from the County and the State Water Board's Storm Water Grant Program.

APPENDICES

Appendix 1 – Photos before, during, and after construction

Appendix 2 – Santa Cruz County Runoff and Pollution Control Ordinance

Appendix 3 - List of Sub-Contractors

Fall Creek Engineering – Polo Grounds and Brommer facilities design, construction inspection
P.O.Box 7894
Santa Cruz, CA 95061
Tel: (831) 426-9054
Fax: (831) 426-4932
www.fallcreekengineering.com

The Don Chapin Company – Polo Ground facility construction
560 Crazy Horse Canyon Road
Salinas, CA, 93907-8434
Tel: (831) 449-2373
FAX: (831) 449-0700
http://www.donchapin.com/

Contractor Compliance and Monitoring, Inc. (CCMI) – labor compliance services
635 Mariners Island Blvd., Suite 200
San Mateo, CA 94404
Tel: (650) 522-4403
FAX: (650) 522-4202
http://www.ccmi-tpa.com/

Ifland Engineering – Scotts Valley facility design
5200 Soquel Avenue, Suite 101
Santa Cruz, CA 95062
Tel: (831) 426-5313
Fax: (831) 426-1763
www.iflandengineers.com

Appendix 4 – Performance Estimating Procedure

Appendix 5 – List Items for Submittal

Work Item	Item for Review #	Date Submitted
Exhibit A	1.1 GPS Information	4/20/2010
	1.2 Project Assessment and Evaluation Plan (PAEP)	7/2/2008
	Annual assessment of PAEP	12/15/2009
		12/14/2010
		12/15/2011
		12/14/2012
	1.6 Copy of CEQA/NEPA Documentation	3/10/2011
	1.8 Landowner Agreement(s)	N/A; County owned property
	1.9 Applicable Permits	Sept 2011 Prog Report
	2.6.1 Locations for Recharge Projects, Bid and Award Process	12/2009 (design); 7/2011 (construction)
	2.6.2 Plans and specifications for Recharge Projects	90% Plans Feb 2011; 100% Plans Aug 2011
	2.6.3 Photo Documentation of Construction of Recharge Projects	Feb-13
	2.6.4 Copies of Adopted Policies	Feb-13
Exhibit B	6.2 Grant Summary Form	7/2/2008
	6.3 NRPI	Mar-13
	6.4 Draft Component Report	2/15/2013
	6.5 Final Component Report	2/27/2013