Final Report

Market Assessment for Recycled Water

Prepared for

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Market Assessment for Recycled Water

1. Introduction

The Laguna County Sanitation District (LCSD) operates a wastewater treatment facility that has a capacity of 3.2 million gallons per day (mgd). The treatment plant provides secondary treatment for wastewater generated by the community of Orcutt and disposes of the treated effluent by irrigating nearby pastureland. Currently, the treatment facility is undergoing several improvements and upgrades to improve the treated effluent water quality. The facility improvements include upgrading the treatment and disinfection processes such that the effluent will meet regulatory requirements for recycling and will present an opportunity for LCSD to market the recycled water as irrigation water for crops, landscaping, and golf courses.

Marketing the recycled water represents a new opportunity for LCSD, and, as a result, the LCSD requested a market assessment to identify and evaluate the following:

- Regulatory requirements for supplying customers
- Potential customers and volume requirements
- Potential pipeline routes and preliminary cost estimate for constructing, maintaining, and monitoring the recycling system

2. Recycling Facilities

2.1 Treatment Processes

The LCSD wastewater treatment facility treats flow generated by the community of Orcutt. The service area of LCSD is largely residential, with limited commercial establishments contributing wastewater to the collection system. Figure 1 presents a map of the Orcutt area and the location of the LCSD treatment plant.

The treatment facility has an existing capacity of 3.2 million gallons per day (mgd) and will need to eventually expand to an ultimate capacity of 5.0 mgd. The treatment facility currently treats approximately 2.4 mgd. The plant produces undisinfected secondary effluent that is disposed via sprinkler irrigation of approximately 520 acres of pastureland adjacent to the facility. The treated effluent water quality has a total dissolved solids (TDS) concentration of approximately 1,100 milligrams per liter (mg/L) and a chloride concentration of approximately 300 mg/L. The high TDS and chloride concentrations are the result of the widespread use of water softeners, which regenerate at night and produce a waste stream that has a high concentration of both constituents.

The Central Coast Regional Water Quality Control Board (RWQCB) is the regulatory agency that establishes discharge requirements for the LCSD WWTP. Order Number 87-43 specifies the discharge requirements for two different disposal areas totaling approximately 2,500 acres. The areas were distinguished from each other based upon the type of soil underlying each area. Approximately 60 percent of the permitted treatment facility disposal area is

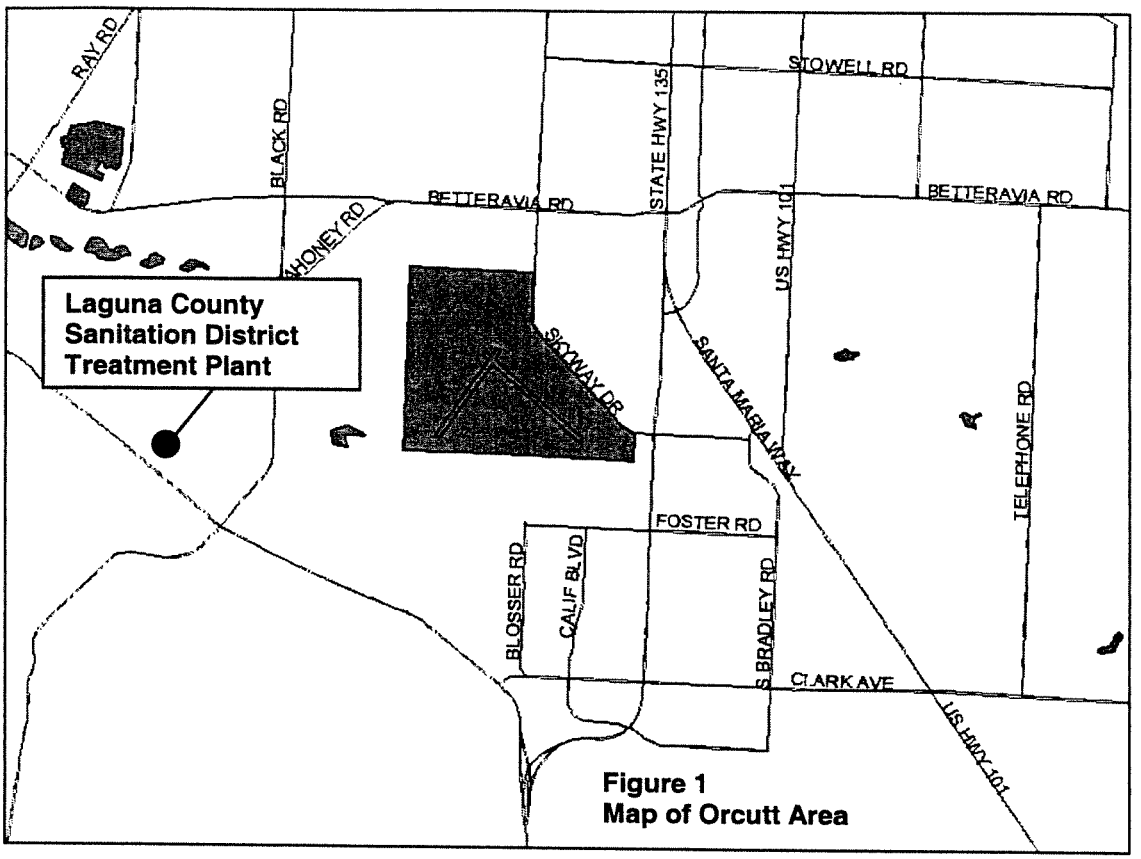

Figure 1
Map of Orcutt Area

underlain with an impervious soil type and perched water zones, while the remaining 40 percent is capable of moderate percolation into the main aquifer. The first area is referred to as the general reclamation area, and the second area is called the Main Recharge Area. The permitted discharge limitations are specified for the general recharge area, with more stringent requirements identified in the permit for the Main Recharge Area. The effluent discharge limitations are as follows:

- TDS
  - General reclamation – 1,200 mg/L
  - Main recharge – 1,000 mg/L
- Chloride
  - General reclamation – 300 mg/L
  - Main recharge – 125 mg/L

Compliance is determined based upon a 12-month running average. In addition, the discharge permit restricts treatment and disposal for general reclamation to a monthly average of 2.4 mgd. Expansion beyond this capacity requires compliance with the discharge limitations for the Main Recharge Area. Of the 2,500 acres once available, approximately 520 acres remain for disposal, almost none of which overlies the Main Recharge Area.

The LCSD has investigated several approaches for reducing the effluent TDS and chloride concentrations. As a result of these efforts, the LCSD is moving forward with the construction and installation of new process units that will reduce TDS and chloride concentrations. The new facilities will include a membrane bioreactor (MBR) and reverse

osmosis (RO), which will treat 100 percent of the nighttime flow stream and without blending will produce an effluent with a TDS concentration of approximately 50 mg/L and a chloride concentration of approximately 25 mg/L.

For several reasons, LCSD is planning to upgrade the rest of the treatment plant to full tertiary treatment simultaneously with or subsequent to the installation of the TDS reduction facilities. Upgrading the LCSD facility to full tertiary treatment will provide a reliable source of non-potable water to Orcutt customers, such as developers and golf courses. The developers in the area have been told that they must purchase the water for new developments and homeowners from the State Project Water (SPW) at a cost of approximately $1,000 per acre-foot (AF). The SPW is significantly more expensive than other local water sources and it may be rationed during extended droughts. The LCSD recycled water will provide an alternative water source to the SPW that will be less expensive to the consumer than the SPW and is unlikely to be rationed. In addition, the water quality of the recycled water is likely to be better than several local sources of water. In addition, the plant upgrade to full tertiary treatment where all the water is sold provides an alternative disposal mechanism for the treatment facility as it expands to its ultimate capacity. Currently, the treatment facility sprinkler system irrigates approximately 520 acres of pastureland to dispose of its treated effluent. Any increases in the volume of treated effluent would require the purchase of additional pastureland; however, the existing permit prohibits the purchase of additional non-rechargeable land to meet increased disposal needs. Because of the opportunities presented, LCSD is proceeding with the implementation of full tertiary treatment at the treatment facility.

The treatment plant influent will be split into two streams and a different level of treatment will be applied to each flow stream. Portions of the daytime flows passing through the existing plant will receive full tertiary treatment and disinfection, while the nighttime flows will receive MBR and RO treatment and disinfection. The plant upgrades will occur in two parallel activities, as follows:

- TDS reduction facilities consisting of MBR and RO will be installed by the end of 2000, producing approximately 0.5 mgd of low TDS effluent

- Tertiary treatment facilities consisting of microfiltration for treating remaining daytime flows may be installed by the end of 2000; implementation is dependent upon the availability of funding

Figure 2 presents a flow diagram of the new and existing treatment processes. As a result of these process improvements, LCSD will likely have a minimum of 0.5 mgd of recycled water available, with a potential of up to the existing flow of 2.3 mgd, by the end of 2000. Additional recycled water will become available to customers as expansion and treatment facility upgrades continue over the next few years.

The water quality of the treated effluent will be the result of blending the two treated flow streams. The treatment train for the nighttime flows will produce an effluent with an approximate TDS concentration of 50 mg/L and a chloride concentration of 25 mg/L. When blended with the daytime flows, the additional treatment will bring LCSD into compliance for effluent TDS concentrations. The chloride concentration will be significantly reduced to approximately 140 mg/L at ultimate capacity, which will be in compliance with Basin Plan Objectives.

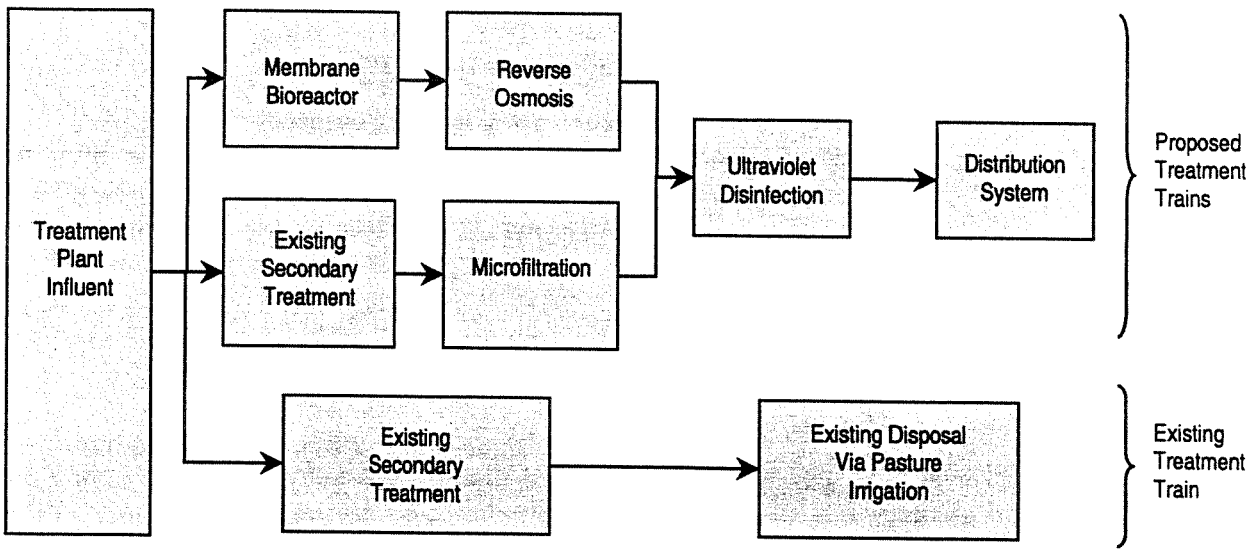

Figure 2: Process Flow Diagram

2.2 Benefits of Recycled Water

Recycled water offers several potential benefits to users. The use of recycled water for non-potable purposes offers the potential of an alternative resource that can be substituted for existing sources of water. By substituting recycled water for the existing non-potable water supply, additional freshwater could potentially be made available to meet other water demands.

Recycled water offers an additional benefit by providing a reliable source of water. Water purveyors, in the event of sustained drought or limited availability of freshwater, may reduce freshwater supplies. Recycled water supplies, on the other hand, are not subject to drought or water-related supply interruptions, thus providing a more reliable source of water for users.

2.3 Title 22 Requirements

Requirements for recycled water projects are governed by several regulatory agencies. Two State agencies have primary responsibility for the regulation of recycled water use in California, the Department of Health Services (DHS) and the RWQCB. Permits containing "water recycling requirements" are issued by the applicable RWQCB for specific reuse projects based upon input from DHS and local health agencies. The LCSD treatment facility currently has a recycling permit that likely can be amended to support marketing the recycled water.

Public health regulation is the responsibility of DHS and local county health departments. In Title 22, Division 4 of the California Administrative Code, Wastewater Recycling Criteria, (Title 22) DHS establishes statewide water reuse criteria that govern the degree of treatment required for each use, and requirements for public notification of recycled water use. DHS has recently issued new regulations for recycled water use for irrigation and similar non-potable uses. The water recycling regulations are designed to require a recycled water

quality that best fits the proposed reuse application without putting the public or the project at risk.

The DHS recycling criteria regulate the use of recycled water and its objective is to protect human health without unnecessarily discouraging wastewater regulation. The regulations include water quality standards, treatment process requirements, sampling and analysis requirements, operational requirements, and treatment reliability requirements. The required degree of treatment increases as the likelihood of human exposure to the recycled water increases, as set forth in Article 3 of Title 22. Based on Title 22, the LCSD treatment plant upgrades for treatment and disinfection will produce disinfected tertiary recycled water that is suitable for the following uses:

- Food crops, including all edible root crops, where the recycled water comes into contact with the edible portion of the crop
- Parks, playgrounds, and school yards
- Residential landscaping
- Unrestricted access golf courses
- Industrial or commercial cooling or air conditioning that involves the use of a cooling tower or evaporative condenser
- Flushing water for toilets and urinals
- Industrial process water that may come into contact with workers
- Industrial boiler feed water
- Fire fighting
- Decorative fountains
- Commercial laundries and car washes
- Soil compaction and dust control
- Cleaning roads, sidewalks, and outdoor work areas

In addition to specifying the types of applications suitable for the LCSD recycled water, Title 22 also specifies requirements for the application of recycled water in a given area. Specifically, Article 4 of Title 22 establishes use area requirements, as follows:

- No irrigation with disinfected tertiary recycled water shall take place within 50 feet of any domestic water supply well, unless conditions of Article 4 are met
- No impoundment of disinfected tertiary recycled water shall take place within 100 feet of any domestic water supply well
- Irrigation runoff shall be confined to the recycled water use area

- Spray, mist, or runoff shall not enter dwellings, designated outdoor eating areas, or food handling areas
- Drinking water fountains shall be protected against contact with recycled water spray, mist, or runoff
- All use areas where recycled water is used that are accessible to the public shall be posted with conspicuous signs
- No physical connection shall be made or allowed to exist between any recycled water system and any separate system conveying potable water
- Recycled water system shall not include any hose bibs; only quick couplers that differ from those used on the potable water system shall be used on the recycled water piping system

To enforce the recycling requirements, the existing permit will be amended by the RWQCB to include LCSD treatment facility and the recycled water customers. The terms of the permit will be applicable to all listed parties, however, some of the requirements will be more applicable to either the supplier or the users. To facilitate cooperation and compliance with the permit, users' agreements will be developed and implemented between LCSD and each user. These agreements delineate specific responsibilities and requirements for each party signing the agreement.

2.4 Local Water Supplies

The Orcutt area is supplied water either through a local water purveyor or through local groundwater wells, as follows:

- City of Santa Maria: Supplies water to businesses and residents of the City of Santa Maria. The City of Santa Maria uses a mix of groundwater and SPW to meet water requirements. The groundwater production costs are approximately $250 per AF, and the cost of SPW is $1,000 per AF. The City of Santa Maria annually purchases approximately 17,200 AF.
- California Cities Water Company (CCWC): Private water purveyor that is a subsidiary of the Southern California Water Company. It obtains the majority of its water supply from 27 wells located throughout the area. The groundwater production costs are approximately $135 per AF. The company purchases approximately 550 AFY of SPW for which approximately $1,000 per AF is paid.
- Locally owned and operated groundwater wells supply water to the remaining demands, such as neighboring farmlands and the Rancho Maria Golf Course. Any new customers in the Orcutt area, such as residences or businesses added through new development, will be required to purchase SPW to meet their potable water needs. In addition, per the Orcutt Community Plan, the water must have a TDS concentration that is no greater than 425 mg/L. This may either be provided through direct deliveries to new developments or through the delivery of offsetting 425 mg/L or less water to the water system serving Orcutt. The LCSD recycled water will provide a potential alternative source of water to these users to meet their non-potable demands.

3. Potential Recycled Water Market

LCSD intends to sell the recycled water produced by the treatment plant upgrades. The LCSD treatment facility will have 0.5 mgd to full flow of recycled water available for customers. The recycled water will be of tertiary quality and suitable for many types of uses. To begin the process of marketing the recycled water, the opportunities and potential customers for the recycled water must be assessed. The LCSD has several options for marketing the recycled water, as follows:

- Sell the water to farmers in the vicinity of the treatment facility
- Convert its adjacent pastureland to agricultural use and lease to farmers. The recycled water would be included as part of the lease, and the price of the lease would reflect the additional benefit of the reliable water supply.
- Market the water to existing or planned developments and customers in the Orcutt area

In the market assessment, the overall potential for recycling in Orcutt is examined, based upon information obtained from the Orcutt Community Plan, dated July 1997. In addition, the opportunities for selling the water to farmers are examined by estimating the acreage requirements, as well as projecting the water quality requirements for the probable crop types. The analysis concludes with an examination of specific customer opportunities, their proximity to the recycling supply, and any retrofit requirements to connect existing customers to the recycling distribution system.

3.1 Potential Agricultural Opportunities

The numerous farms surrounding the LCSD treatment facility present a potential opportunity for marketing recycled water. To better quantify the potential opportunities, the market assessment first determines the irrigation requirements for the crops. Then, the irrigation requirements are used to estimate the farm acreage that can be supported by the plant flows, and the estimate of acreage is used to identify specific opportunities for marketing the recycled water. Irrigating with recycled water also requires an analysis of the water quality to determine whether the water is suitable for the types of crops grown by the local farmers. As a result, the market assessment evaluates the water quality requirements.

3.1.1 Preliminary Irrigation Analysis

The preliminary irrigation analysis examines the system requirements to project the crop acreage that potentially can be irrigated by the available supply, as well as the seasonal storage that will be needed to store surplus supply for use during peak periods of demand.

Crop irrigation requirements are a reflection of the water needs of the plants, as well as the efficiency of the irrigation method used to apply water. The prevalent type of agriculture around Orcutt is row crop farming. Examples of typical row crops are broccoli, celery, strawberries, cabbage, and head lettuce. Pastureland is still present, but is being converted to row crop farming due to market conditions. As a result, irrigation requirements are estimated for row crops and for pasture. Sugar beets are used to represent the row crops, on average, since the evapotranspiration data is the most conservative for sugar beets. In addition, pasture is used to represent grass-type demands, such as parks and golf courses. Evapotranspiration data from the DWR Evapotranspiration Isohyetal maps for the Orcutt

area is used as the monthly reference data, and the irrigation requirements are estimated by applying a Kc factor that corresponds to type of crop to the monthly reference data. The Kc factors are obtained from the United States Department of Agriculture Soil Conservation Service tables, as follows:

- Row crops – 0.75
- Pasture – 0.85

To account for the efficiency of sprinkler irrigation, a 70 percent efficiency factor is applied to the irrigation demands to estimate the irrigation requirements. The projected irrigation demand for pasture is estimated to be 3,900 gallons per acre per day, while the projected demand for row crops is estimated to be 3,500 gallons per acre per day. Table 1 summarizes the evapotranspiration and irrigation estimates for pasture and Table 2 summarizes the results for row crops.

The estimate of irrigation requirements is further refined to account for plant moisture needs that are met by precipitation. Precipitation data is available from the National Oceanic and Atmospheric Administration (NOAA) rain gauge (Gauge number 47946) located at the Santa Maria Airport. Daily precipitation data is available from this gauge that dates back to 1948. Rainfall is generally most abundant when the irrigation requirements are the lowest, and the irrigation requirements are the highest when precipitation is the lowest. The difference between the irrigation requirements and the monthly precipitation represents the potential demand for recycled water. A graph of the projected irrigation requirements for row crops and pasture and the average monthly rainfall is presented in Figure 3. The area between the curves represents the average irrigation requirements for these crops and the potential demand for recycled water.

Table 1
Projected Pasture Irrigation Requirements

Month	Reference Et: Average Day [a] (mm/day)	Computed Et [b]		Projected Irrigation Requirements [c] (in/month)
		Average Day (mm/day)	Average Month (in/month)	
January	1.5	1.3	1.6	2.2
February	2.0	1.7	1.9	2.7
March	2.6	2.2	2.7	3.9
April	3.4	2.9	3.4	4.9
May	4.1	3.5	4.3	6.1
June	4.3	3.6	4.3	6.1
July	4.3	3.6	4.4	6.3
August	4.3	3.6	4.4	6.3
September	3.8	3.2	3.8	5.4
October	2.8	2.4	2.9	4.2
November	2.0	1.7	2.0	2.9
December	1.4	1.2	1.5	2.1
Total (in/yr)	N/A	N/A	37.0	52.9
			Average Day Irrigation (in/day)	**0.1**
			Average Day Irrigation (gpapd)	**3,900**

Notes:
[a] Reference Et from California Department of Water Resources Evapotranspiration Isohyetal Maps
[b] Kc value from United States Department of Agriculture Soil Conservation Service: Kc=0.85
[c] Irrigation requirements computed based upon sprinkler irrigation with an assumed efficiency of 70%

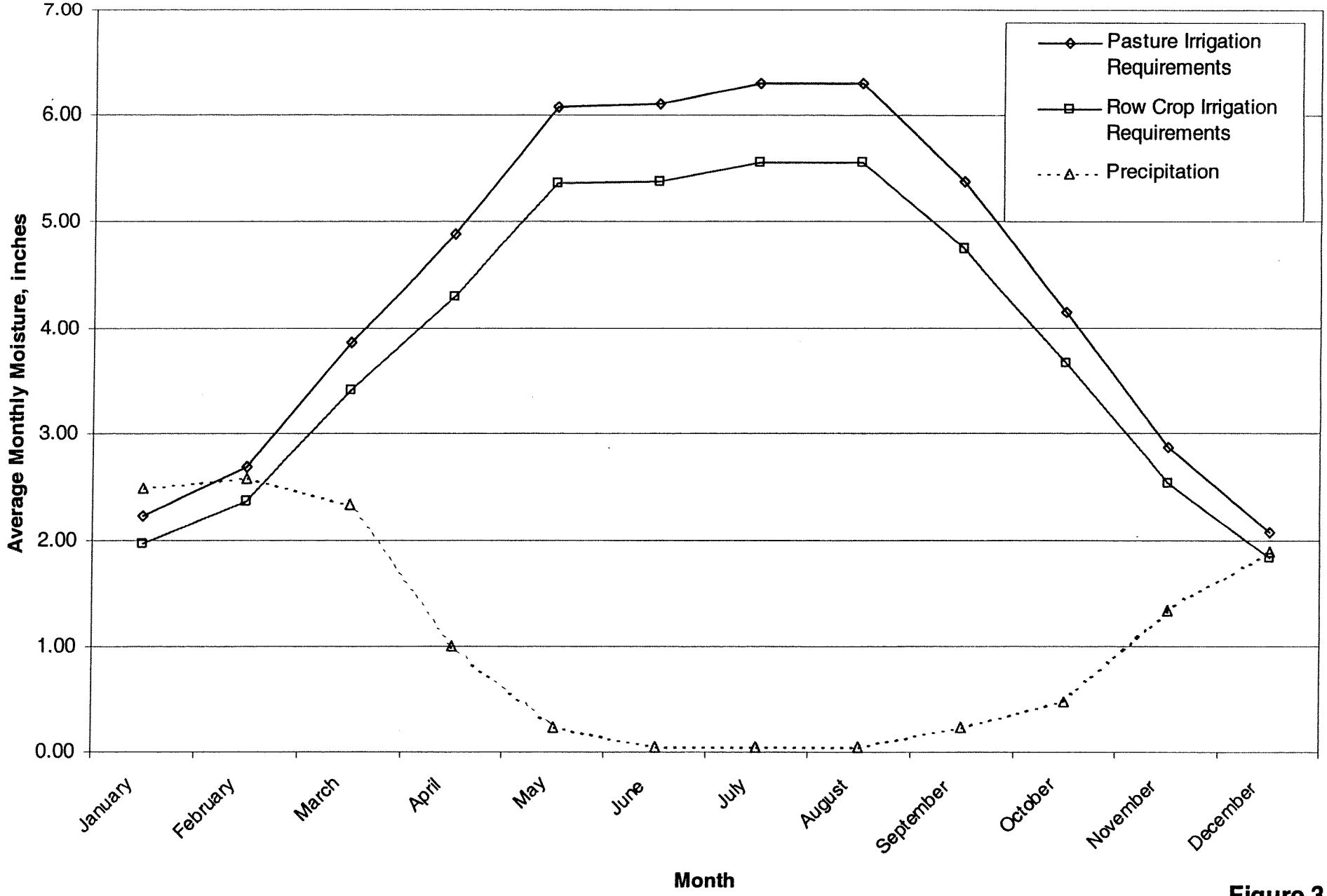

Figure 3
Moisture Curves in the Santa Maria Area

Table 2
Projected Row Crop Irrigation Requirements

Month	Reference Et: Average Day [a] (mm/day)	Computed Et [b]		Projected Irrigation Requirements [c] (in/month)
		Average Day (mm/day)	Average Month (in/month)	
January	1.5	1.1	1.4	2.0
February	2.0	1.5	1.7	2.4
March	2.6	2.0	2.4	3.4
April	3.4	2.6	3.0	4.3
May	4.1	3.1	3.8	5.4
June	4.3	3.2	3.8	5.4
July	4.3	3.2	3.9	5.6
August	4.3	3.2	3.9	5.6
September	3.8	2.8	3.3	4.7
October	2.8	2.1	2.6	3.7
November	2.0	1.5	1.8	2.5
December	1.4	1.1	1.3	1.8
Total (in/yr)	N/A	N/A	32.7	46.7
			Average Day Irrigation (in/day)	**0.1**
			Average Day Irrigation (gpapd)	**3,500**

Notes:
[a] Reference Et from California Department of Water Resources Evapotranspiration Isohyetal Maps
[b] Kc value from United States Department of Agriculture Soil Conservation Service: Kc=0.75
[c] Irrigation requirements computed based upon sprinkler irrigation with an assumed efficiency of 70%

Seasonal storage is an important component of a recycled water system. Many of the demands for recycled water are seasonal in nature, so that the demand for water is lowest in winter and highest in summer, while the recycled flow typically ranges from 2.1 to 2.4 mgd. Seasonal storage increases the system yield by storing unused recycled water from the winter to meet increase summer demand. Currently, LCSD has storage capacity for up to 380 million gallons.

An analysis was performed using projected crop irrigation requirements and average precipitation data to estimate storage volume and average daily demand that the projected recycled flows will support. The analysis estimates storage requirements under various rainfall conditions, including no precipitation and average wet weather, to determine a range of storage requirements. The analysis projects the requirements for storage and demand that potentially will utilize all recycled water generated with average precipitation, and the results are presented in Table 3 for both row crops and pasture. The projected storage volumes assume that no water is carried over to the next year. Also, variations in actual irrigation practices and annual precipitation will affect the actual storage volume required to support system demand, and supplemental water may be necessary to augment the recycled supply during dry years.

Table 3
Storage Analysis

Supply		Storage (MG)	Average Daily Demand (mgd)	Acreage (acres)	
Flow (mgd)	Phase			Row Crops	Pasture
1.0	Initial phase	125	1.3	380	340
2.3	Current treatment plant flow	290	3.1	900	800
3.2	Permitted capacity	390	4.2	1,200	1,100
3.7	Proposed capacity	450	4.8	1,400	1,200
5.0	Ultimate capacity	610	6.5	1,900	1,700

Implementation of the recycling program may not preclude the requirement for fail safe disposal. The implementation of seasonal storage reduces the need for a fail-safe disposal mechanism depending on the volume of off-season water that can be stored; however, without full implementation of storage, disposal requirements for surplus flow will likely still exist in the off-season.

3.1.2 Water Quality Requirements

The LCSD treatment facility has sampled the treatment plant effluent for various constituents. Using these sampling results and the projected levels of treatment from MF-RO, several constituents of concern are evaluated to determine potential impacts upon agricultural users of recycled water. Since pastureland is currently irrigated with the treatment plant effluent, the potential effects of recycled water quality will be evaluated for row crops only, as follows:

- Total dissolved solids (TDS): The TDS of the recycled water, after the MBR-RO effluent is blended with the tertiary treated water, is expected to be less than 700 mg/L. This level of salinity may reduce crop yield for sensitive crops. Most row crops are considered moderately sensitive to TDS concentrations, and strawberries are considered sensitive to higher TDS concentrations. The TDS of water supplied by CCWC ranges from 500 to 980 mg/L, with an average concentration of 725 mg/L that is similar to the projected reclaimed water TDS concentration.

- Chloride: The chloride concentration of the recycled water following blending is expected to be approximately 140 mg/L. Chloride can be phytotoxic under sprinkler irrigation for concentrations higher than 175 mg/L, however, the projected chloride concentration is less than this concentration and should not pose a problem. Strawberries can be sensitive to chloride concentrations when surface irrigation techniques are used; however, the California State Water Resources Control Board Guidance Manual for Irrigating with Recycled Water suggests no restrictions on irrigation if the chloride concentration is less than or equal to 140 mg/L. The chloride concentration for groundwater ranges from 17 to 54 mg/L with an average concentration of 33 mg/L.

- Boron: The boron concentration is expected to be less than 0.5 mg/L. Irrigation guidelines suggest that row crops demonstrate sensitivity to boron toxicity when the boron concentration exceeds 0.5 mg/L, therefore, since boron concentrations are less than 0.5 mg/L, boron toxicity should not pose a problem.

- Sodium Adsorption Ratio (SAR): The sodium hazard of irrigation water is usually expressed as the sodium adsorption ration (SAR). The SAR is expected to be less than 6.5. At the projected levels of irrigation water salinity, this level of SAR should not significantly disperse soil or affect the infiltration rate.

In general, the projected water quality of the recycled water is expected to be suitable for irrigating row crops, as well as pasture. Strawberries may demonstrate sensitivity to irrigation with recycled water; therefore, further analysis should be conducted to determine the specific water quality requirements for each crop type that will be grown, as well as any monitoring requirements for soil structure and cation balance.

3.2 Potential Opportunities in Orcutt

The Orcutt Community Plan identifies existing and planned development within Orcutt, including the size and location of these developments. Using this information, the potential irrigation requirements for residential, commercial, and agricultural land uses with Orcutt are projected and specific opportunities for using the recycled water can be identified.

The Orcutt community is comprised of multiple land use types, ranging from agricultural to light industrial, and each land use type has specific irrigation requirements that can be estimated, by determining the irrigable land for each land use type and projecting the associated moisture requirements. The Irvine Ranch Water District (IRWD) prepared a similar assessment of irrigation requirements. The study is an excellent compilation of data suitable for estimating irrigation needs for similar land use categories and is used to project the Orcutt community irrigation requirements.

To use the IRWD data, a comparison factor is developed to account for climate differences between the communities of Irvine and Orcutt. The comparison factor is determined by comparing the evapotranspiration data for Irvine and Orcutt. Monthly reference evapotranspiration data is available from the California Department of Water Resources (DWR) Evapotranspiration Isohyetal maps for the Orcutt area. The Orcutt data is compared to monthly reference evapotranspiration data for the Irvine area. The highest comparison factor is 1.0 for the month of November; as a result, no scaling will be required to apply the IRWD study data. The potential irrigation requirements for Orcutt are estimated by applying the irrigation requirements from the IRWD study to the various land uses identified in the Orcutt Community Plan.

The IRWD study provides estimates of irrigable land percentages and annual irrigation requirements for each land use category; which is correlated with the Orcutt land use categories. The Orcutt Community Plan land use categories include the following:

- Residential
- Commercial
- Institutional and government
- Educational facilities
- Parks, recreation areas, and open spaces
- Agriculture

The Orcutt irrigation requirements are estimated by applying the data from IRWD to the projected acreage for each land use type identified in the Orcutt Community Plan. Table 4 presents the projected annual consumption for each land use type in acre-feet, the estimated acreage for each land use category, and the associated annual irrigation requirement for each.

The analysis estimates the existing irrigation requirement to be 8,900 acre-feet per year (AFY) for the Orcutt planning area, increasing to 15,100 AFY as a result of future development. The following discussion evaluates each land use category in order to focus attention on the categories that likely represent better opportunities.

Table 4
Annual Irrigation Requirements for Orcutt

Land Use	Annual AF per Gross AC[a]	Total Potential Acreage (Acres)		Annual Irrigation (AFY)	
		Existing	Future[b]	Existing	Future
Residential					
Residential Ranchette	0.6	2,200	2,200	1,300	1,300
Single Family	0.6	5,400	6,400	3,200	3,800
Multiple Family (8 Units/Acre)	1.0	170	170	170	170
Multiple (12.3-20 Units/Acre)	1.0	160	220	160	220
General/Neighborhood Commercial	0.8	30	360	24	290
Institutional/Government	0.9	4	4	3	3
Educational Facilities	2.0	220	220	440	440
Park or Open Space	3.5	100	1,400	350	4,900
Agriculture II [c]	2.2	1,500	1,800	3,300	4,000
Total		9,800	12,800	8,900	15,100

Notes:
[a] Data obtained from IRWD study
[b] Includes existing acreage
[c] Irrigated production acreage.

3.2.1 Residential

The category of residential land use represents a limited opportunity for implementing immediate recycling. The existing residential customers are not dual plumbed to accommodate recycled water and the retrofit requirements for residences will likely be expensive. There are plans, however, for additional housing developments. The new developments will provide single family housing that potentially can be dual plumbed during construction. Currently, dual plumbing in this area is not a requirement, therefore it is unlikely that developers will incorporate this feature. The green belts and landscaping, however, can be irrigated with recycled water. Based upon the projected annual irrigation requirements for these areas, up to 600 AFY of reuse is possible for residential land use.

3.2.2 Commercial

A limited amount of commercial development is planned for Orcutt. These areas frequently have green belts and landscaping that can be irrigated with recycled water. Based upon projected irrigation requirements, up to 300 AFY of reuse is possible for commercial land use.

3.2.3 Institutional and Government

This land use category presents a very limited opportunity for implementing recycling. Approximately 3 AFY of annual irrigation is projected and little future expansion in this land use category is presented in the Orcutt Community Plan. As a result, no further analysis will be conducted for this land use type.

3.2.4 Educational Facilities

This land use category represents a good opportunity for implementing recycling. The existing irrigation requirement is approximately 400 AFY. The Orcutt Community Plan does not identify plans for additional education facilities. However, typically educational facilities represent good opportunities for reuse because of the size of the demand and relatively uncomplicated retrofit requirements.

3.2.5 Parks, Recreation Areas, and Open Spaces

The projected irrigation requirement is approximately 350 AFY for existing parks and open spaces land uses. The Orcutt Community Plan calls for additional development in this land use type. Given this additional development, parks and open spaces potentially will require up to an additional 4,600 AFY of irrigation. This is a total of 4,900 AFY of irrigation demand for existing and future parks and open spaces, which represents a significant opportunity for reuse. This land use category presents a particularly significant opportunity for reuse in that over 90 percent of the potential irrigation demand is in future development. Therefore, the new parks, recreation areas, and open spaces, which includes future golf courses, can be piped during construction to accommodate recycled water, which reduces the cost to implement reuse at these sites.

3.2.6 Agriculture

Within Orcutt, the existing agriculture has a projected irrigation requirement of approximately 3,300 AFY and the Orcutt Community Plan shows future expansion for agriculture land use, which will increase irrigation demand to approximately 4,000 AFY. Agricultural land uses typically present good opportunities for reuse because the retrofit costs for existing customers is low and because farmers usually want large volumes of water. However, many farmers have access to local groundwater, which means that LCSD may have to sell recycled water below the cost to produce the water in order to market to farmers.

3.2.7 Summary of Market Opportunities

Given the various land use types listed in the Orcutt Community Plan, several categories represent good opportunities for reuse and include the following:

- Future single family residential: 600 AFY
- Future commercial: 300 AFY
- Existing and future parks, recreation areas, and open spaces: 4,500 AFY
- Existing and future agriculture: 4,000 AFY

3.3 Potential Customers

The next step in the market assessment is to identify potential customers. From the Orcutt Community Plan, several land use categories have been identified as good marketing opportunities. In addition, the Santa Maria Public Airport District and agriculture located outside of the Orcutt planning area offer similar marketing opportunities. Based on the marketing opportunities, several types of demands are examined further for customers:

- Golf courses
- Parks
- New housing and commercial developments
- Industrial customers
- Large farms

LCSD staff conducted a preliminary review of various local business listings, and the list of potential customers generated includes the following:

- Santa Maria Public Airport District

- Santa Maria Country Club
- Rancho Maria Golf Course
- Waller County Park
- Orcutt Community Plan Key Sites
- Okinite Corporation
- Local farmers neighboring the community of Orcutt

In addition to these potential customers, LCSD can convert its adjacent pastureland to row crop farming, providing a guaranteed water supply in the lease, so that it generates a consistent revenue stream for the LCSD. A map of the area with the location of the potential users is shown in Figure 4.

3.3.1 Santa Maria Public Airport District

The Santa Maria Public Airport District is a separate district from the City of Santa Maria and the community of Orcutt. The District property currently has located on it the Santa Maria airport, the Sunset Ridge 24-acre golf course and approximately 490 acres of farming. The District has plans to develop the existing land uses surrounding the airport by constructing several commercial complexes, as well as a 300-acre golf course. The District is planning to irrigate some of the new development with storm water that is collected and stored in several reservoirs. The District has an existing 23 AF reservoir and is proposing an additional 75 AF reservoir. The projected existing demand for the Sunset Ridge golf course is approximately 100 AFY. The projected future demand for the 300-acre golf course is approximately 1,300 AFY. The District has expressed interest in purchasing all of the recycled water from the LCSD. This potential customer is a good opportunity because the District is willing to take all of the recycled water. The District has existing storage and plans for future storage, as well as agricultural land use, to make use of year-round recycled water supply from LCSD.

3.3.2 Santa Maria Country Club

The Santa Maria Country Club is a privately owned country club and golf course located east of the Santa Maria airport and north of Waller County Park. The Country Club irrigates approximately 90 acres using groundwater from its own well. The reported water use is approximately 1 AF per day for approximately 200 days each year. The Country Club management has expressed interest in purchasing recycled water from LCSD.

3.3.3 Rancho Maria Golf Course

The Rancho Maria Golf Course is a privately owned golf course located on Cabrillo Highway southwest from the Santa Maria airport. It is an eighteen-hole golf course that obtains irrigation water from its own well.

3.3.4 Waller County Park

Waller County Park is located east of the airport and is owned by Santa Barbara County, the same agency that operates the LCSD. Park management reports that the water use is approximately 240 AF from April through September and that the use is approximately 20 AF for the rest of the year. The park represents a good potential customer for the recycled water, which will require approximately 260 AFY of supply.

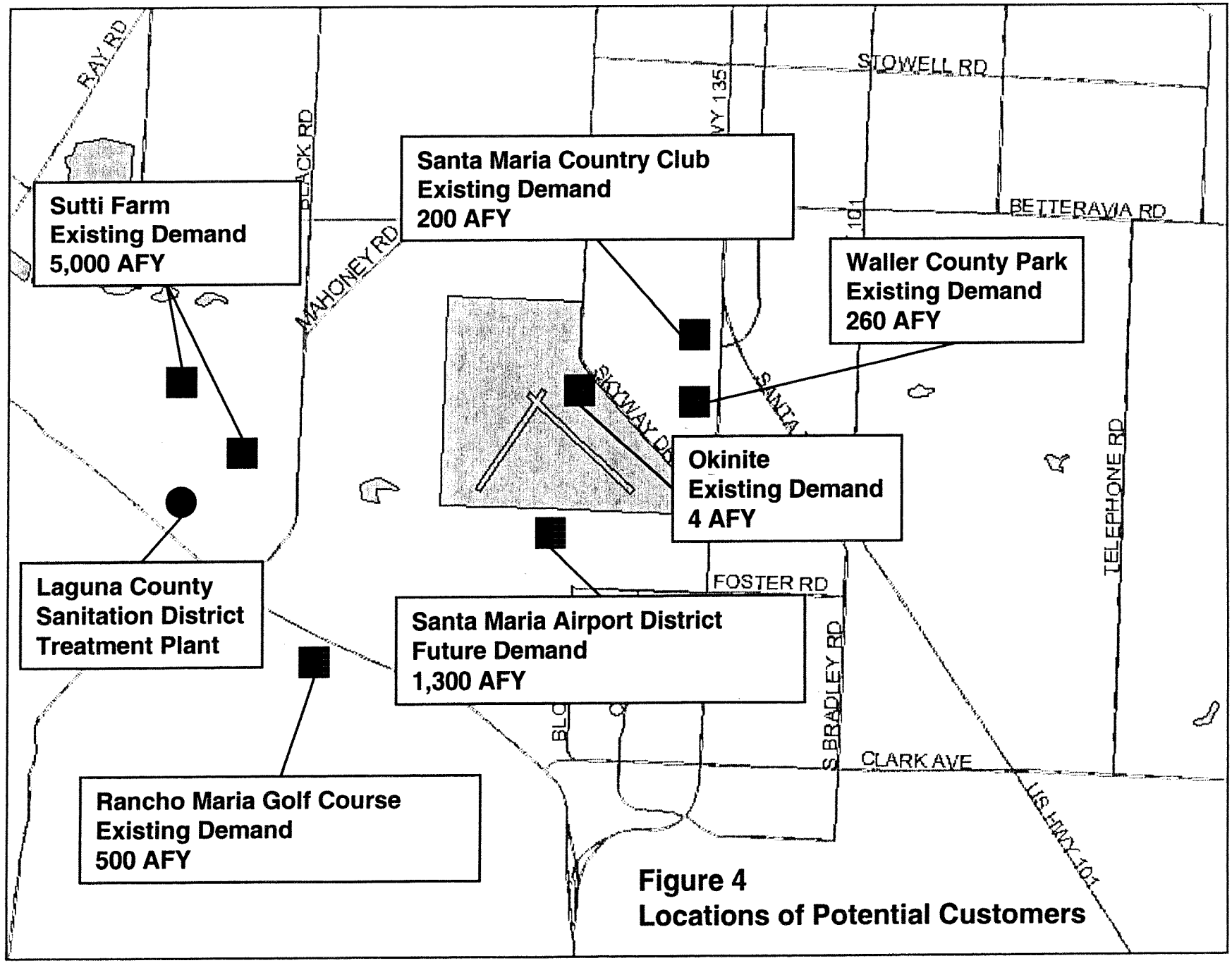

Figure 4
Locations of Potential Customers

3.3.5 Orcutt Community Plan Key Sites

The Orcutt Community Plan contains 43 Key Sites that are principally vacant and under-developed parcels, generally larger than 3 acres. The Key Sites have been identified as having the greatest potential for development that would have a community-wide influence. The planned developments will require water for a variety of applications, several of which will be suitable for reclaimed water. These uses include establishing and maintaining greenbelts and water parks, athletic fields, and gold courses. Several developers have expressed interest in purchasing reclaimed water from LCSD.

3.3.6 Okinite Corporation

The Okinite Corporation is a cable manufacturer located on Skyway Drive. It uses approximately 25,000 gpd of water for approximately 50 days each year, which is approximately 4 AF of use over the 50-day period for an average annual demand of 4 AFY. Company representatives have expressed interest in purchasing recycled water from LCSD.

3.3.7 Local Farmers

Several large farms surround the LCSD. Sutti Farms, Bonetti Farms, and Betteravia Properties encompass approximately 1,800 acres that are immediately adjacent to the LCSD treatment plant and property. LCSD has contacted the owners and, of these farms, the Sutti Farms manager has expressed strong interest to purchase all recycled water from the LCSD. This property is located immediately north of the LCSD treatment plant. The reported summer water use is approximately 4.5 mgd, which is applied to various row crops.

3.3.8 County-Owned Property

As previously discussed, the County owns approximately 520 acres of land, of which approximately 450 acres are currently used for the disposal of treated effluent through sprinkler irrigation. The property is leased as pasture, but can be converted to row crop farming and leased as such. The lease can be prepared to require row crop farming with a guaranteed supply of recycled water. The lease price can be revised to reflect the improved land use, as well as the benefit of a reliable water supply. The projected average annual demand for row crops is approximately 1.8 mgd. Depending upon annual precipitation, the parcel will require between 1.7 and 2.3 mgd of supply in conjunction with the existing seasonal storage to satisfy irrigation requirements. This is insufficient demand to consume the current 2.3 mgd of flow on a consistent basis, as well insufficient for the projected increases in treatment plant capacity.

3.4 Summary

In general, sufficient existing and planned water demands are identified in the market analysis to consume all of the recycled water produced by the LCSD treatment facility. At ultimate capacity, the treatment facility will have approximately 5 mgd of tertiary treated recycled water available. Approximately 1,900 acres of row crops will accommodate all of this flow, which will require approximately 610 MG of seasonal storage. One of the neighboring farmers has expressed interest in acquiring as much as 4.5 mgd (4,000 AFY) of recycled water from April through September and 6 other demands include approximately 2.1 mgd (2,400 AFY) of potential demand. As a result, LCSD has several alternatives for developing a recycling distribution system that are analyzed in further detail.

4. Development of Alternatives

Given the types and locations of the various potential customers, several configurations of the recycling system are possible, depending upon which customers are served by the system. Four potential pipeline alignments are considered as follows:

- Alternative 1: Recycled water supplied to the Santa Maria Public Airport District, Waller County Park, and the Santa Maria Country Club
- Alternative 2: Recycled water Sutti Farms
- Alternative 3: Recycled water supplied to the Santa Maria Public Airport District, Waller County Park, the Santa Maria Country Club, and the Rancho Maria Golf Course

For each alternative, a conceptual layout is presented that consists of a potential pipeline alignment, pipeline sizing and approximate pipe lengths, and the pumping requirements for supplying the water. The conceptual layouts are based upon the following criteria:

- Pipeline sizing: To maintain a minimum of 3 feet per second of flow velocity
- Pump sizing:
  - Pump efficiency – 75 percent
  - Motor efficiency – 95 percent
  - Minimum pipeline pressure – 60 psi

In addition, none of the alternatives include seasonal storage or retrofit requirements. These are discussed separately.

4.1 Alternative 1

Alternative 1 supplies recycled water exclusively to users in the Orcutt community. The key demands in this alternative include the following:

- Santa Maria Public Airport District
- Waller County Park
- The Santa Maria Country Club.

The total potential demand is approximately 2,400 AFY. The distribution system consists of the following:

- Pipeline:
  - 30-inch: 14,000 feet
  - 16-inch: 7,500 feet
  - 10-inch: 2,000 feet
- Pumping:
  - Peak horsepower: 310 Hp
  - Average horsepower: 90 Hp

Figure 5 presents the conceptual layout for Alternative 1.

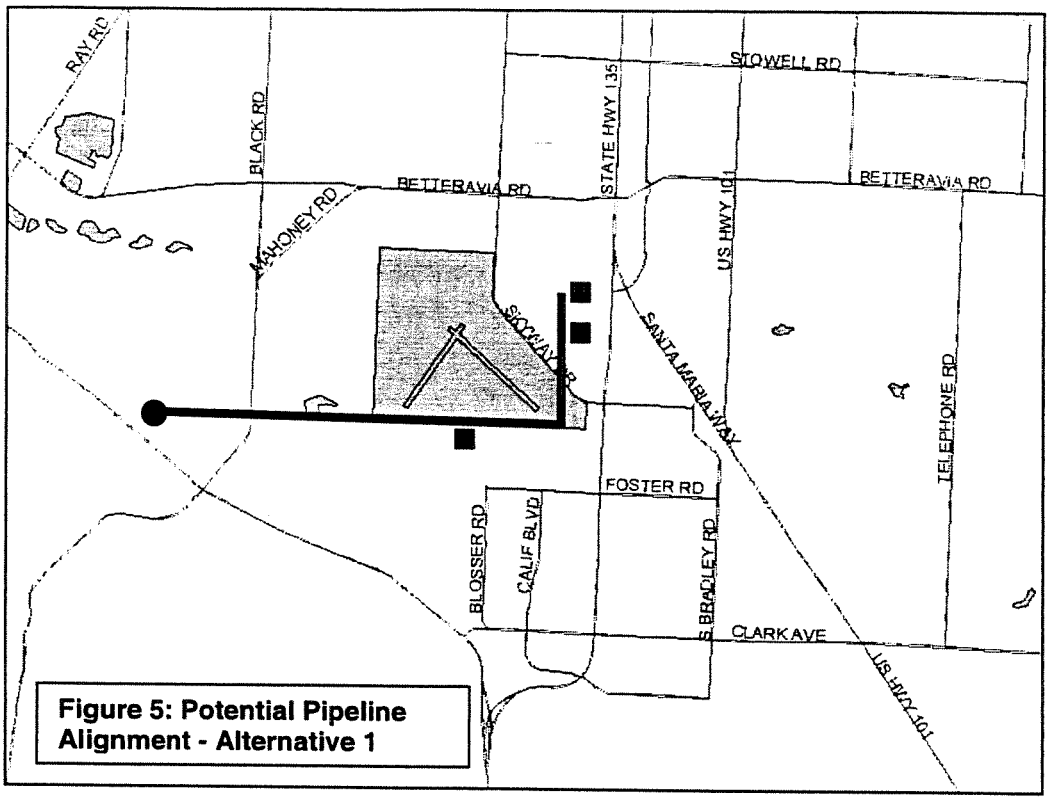

Figure 5: Potential Pipeline Alignment - Alternative 1

4.2 Alternative 2

Alternative 2 conveys all of the treatment plant tertiary effluent to Sutti Farm, which has a reported average annual demand of approximately 5,000 AFY. In addition, Bonetti Farms and Betteravia Properties are potential demands, but their water demand is not available for this analysis and, therefore, is not included.

The distribution system consists of two pipeline alignments, one proceeding to the northwest and the other proceeding to the southeast. The pipeline sizing is based upon conveying approximately 60% of the flow to the northwest portion, while the remaining 40 percent will be conveyed to the southeast property. The distribution system consists of the following:

- Pipelines
  - Northwest: 30-inch -- 6,100 feet
  - Southeast : 24-inch -- 3,300 feet
- Pumping:
  - Peak horsepower: 250 Hp
  - Average horsepower: 80 Hp

Figure 6 presents the conceptual layout for Alternative 2.

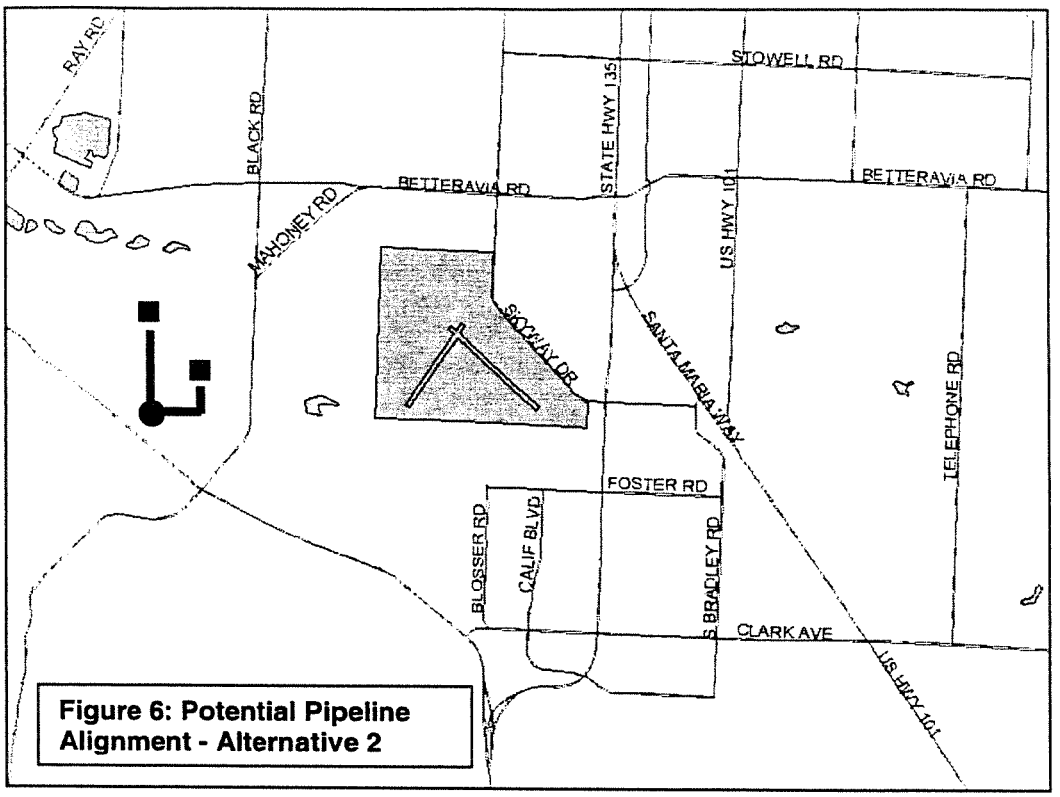

Figure 6: Potential Pipeline Alignment - Alternative 2

4.3 Alternative 3

Alternative 3 is similar to Alternative 1, with the addition of 1 user and approximately 500 AFY of demand. The key potential demands include the following:

- Alternative 1 demands
- The Rancho Maria Country Club

The total average annual demand is approximately 2,900 AFY. The major pipeline alignment from Alternative 1 is repeated in Alternative 3, with the addition of a lateral pipeline that conveys recycled water to the golf course. The distribution system consists of the following:

- Pipeline:
  - 30-inch: 14,000 feet
  - 16-inch: 7,500 feet
  - 14-inch: 10,300 feet
  - 10-inch: 2,000 feet
- Pumping:
  - Peak horsepower: 410 Hp
  - Average horsepower: 120 Hp

Figure 7 presents the conceptual layout for Alternative 3.

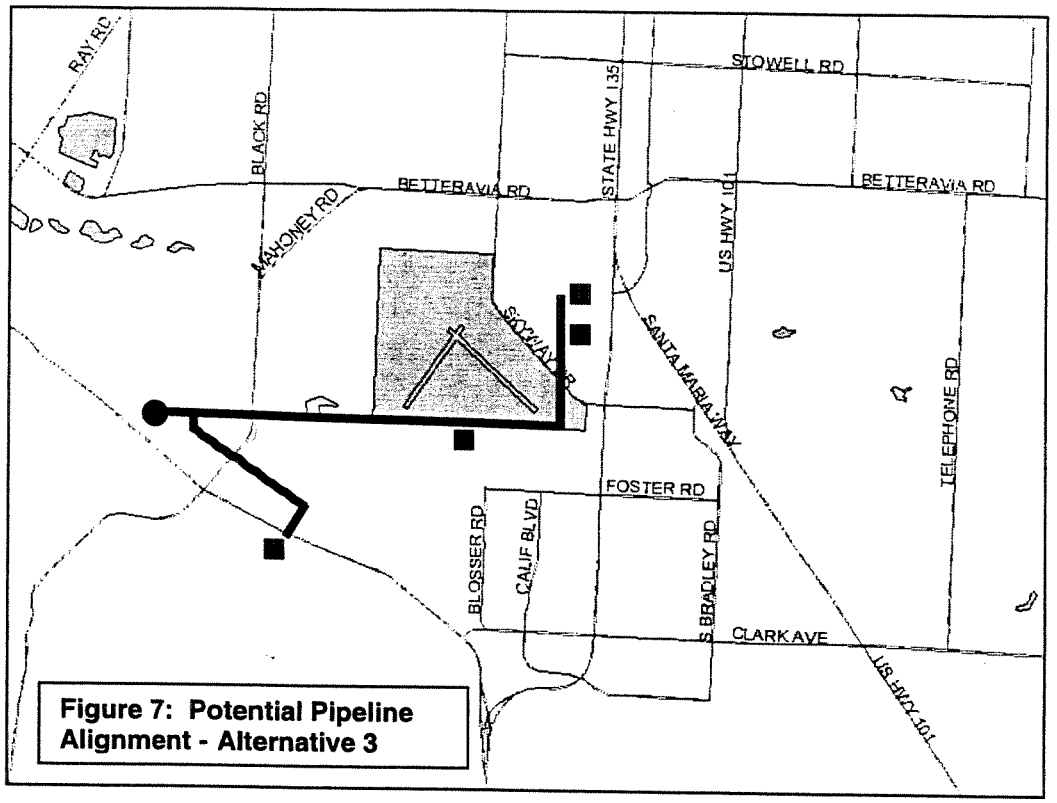

Figure 7: Potential Pipeline Alignment - Alternative 3

4.4 Retrofit Requirements

Retrofit requirements are approximately $1,000 per AF of connected demand for existing demands. The retrofit requirements for future demands will be negligible since those demands can be constructed with recycled water in mind. Therefore connecting to recycled water supply will be a relatively simple matter. For the existing demands, the retrofit requirements become more complex. Based upon conversations with green keepers from several golf courses, including Pebble Beach, the cost to convert golf courses to recycled water typically ranges from $200,000 to $400,000, although this estimate can be significantly higher depending upon how much of the irrigation system is affected by the conversion.

4.5 Summary

Using the key components of each alternative, project costs are prepared, which include the following:

- Capital costs
- Operation and maintenance costs
- Present worth

The cost opinion is prepared using similar project experience and estimating guides. The conveyance system cost estimate includes the cost to construct and operate the pump station, including both the mechanical and electrical components of the pumps, as well as the pipeline. The estimate does not include the cost to obtain the rights-of-way for the pipelines. The following unit costs are used to estimate the pipeline costs:

- 30-inch: $180/LF

- 24-inch: $145/LF
- 16-inch: $100/LF
- 14-inch: $90/LF
- 8-inch: $60/LF
- 4-inch: $35/LF

The following assumptions are used to develop the O & M costs:

- Loaded labor rate – $30 per hour
- Electric: Power costs to pump water. Rate – $0.06 per kWhr

Present worth is based upon a 6 percent interest rate and a 25-year timeframe. Table 5 presents a summary of the cost estimate for each alternative. The summary includes the following for each alternative:

- A list of potential users that are assumed to be supplied with the alternative
- Total average annual demand
- Capital costs for pipelines and pump stations
- Operation and maintenance costs for labor and material, as well as electricity
- Present worth of the alternative
- Unit cost

The cost estimate, as defined by the American Association of Cost Engineers, is "an Order of Magnitude Estimate." This is an approximate estimate made without detailed engineering data, and it is normally expected that an estimate of this type would be accurate within +50 percent or –30 percent. The construction cost estimates have been prepared for guidance in project evaluation from the information that is available at the time the opinion is prepared. The final costs of the project and the resulting feasibility will depend on the final project scope, including market conditions, actual site conditions, and other variable factors. As a result, the final project costs will vary from the cost estimates presented herein.

Table 5
Cost Summary

Users	Demand (AFY)	Capital Costs ($)		O&M Costs ($)		Present Worth [1] ($)	Unit Cost ($/AF)
		Pipeline	Pumping	Labor & Materials	Electrical		
Alternative 1 Santa Maria Public Airport District, Waller County Park, and Santa Maria Country Club	2,400	4,887,500	711,600	24,100	55,200	7,563,000	220
Alternative 2 Sutti Farm	5,000	2,255,800	474,400	36,300	66,600	4,046,000	60
Alternative 3 Santa Maria Public Airport District, Waller County Park, Santa Maria Country Club, and Rancho Maria Golf Course	2,900	6,213,600	771,600	24,100	75,000	8,252,000	220

Notes:
[1] Present worth is based on 6% interest rate over 25 years.

5. Implementation

LCSD has a variety of available opportunities to market the recycled water. Given unlimited resources and funding, all of the potential customers could be incorporated into a marketing effort for implementation. However, LCSD has a limited pool of capital with which to construct the water recycling system and a finite staff of personnel to operate, maintain, and monitor the system. Therefore, an implementation plan is needed that focuses marketing efforts on the most promising and cost-effective potential customers. LCSD has two additional requirements that should be addressed by the implementation plan. First, recycled water customers are needed as soon as production begins at the LCSD treatment facility. Second, customers should generate revenue in order to repay funding sources and to fund additional construction or expansion of the water recycling system. To implement the LCSD water-recycling program, an approach is required that allows LCSD to focus on both the short-term and the long-term water recycling requirements.

To focus marketing efforts, the alternatives are evaluated, taking into consideration the following issues:

- Cost and difficulty to connect the potential customers
- Consistency of demand and storage requirements to meet seasonal peaks
- Potential to generate revenue
- Potential for future growth

Of the 3 alternatives presented and discussed, Alternative 2 appears to be the most cost effective alternative. Alternative 2 supplies recycled water to Sutti Farms, which is a potential customer that has expressed interest in taking all of the recycled water from the LCSD treatment plant. The demand is located in close proximity to the treatment facility, and several other large farms are located in the vicinity. The retrofit requirements for the agricultural users should be low. The summertime demand should be sufficient to consume of all the recycled water generated by the proposed capacity of 3.7 mgd, assuming that adequate seasonal storage is provided to store unused recycled water in the winter. The revenue from this customer is likely to be low, since the alternative water supply is pumped groundwater.

In Alternatives 1 and 3, the potential demands are likely to generate a higher revenue stream, but the capital cost to construct a conveyance system into Orcutt, as well as the retrofit costs for several demands, is significantly higher than for Sutti Farms. The additional cost is offset by the potential for growth in Orcutt, since the Orcutt Community Plan details future growth that likely can use recycled water. New future users provide the opportunity for increased revenue as demand for recycled water increases. Since the cost of the alternative source of water is SPW, rates can be negotiated with new users that generate revenue for LCSD.

One of the alternatives suggested in Section 3.3.8 is to convert the County owned pastureland to agricultural use and lease it to farmers, with the price for the recycled water included as part of the lease price. This alternative offers an immediate revenue stream for the LCSD, and can potentially be used year-round as a fail-safe disposal site. However, the County owned property is too small to accommodate all of the future treatment plant effluent, regardless of the type of crop grown on the property. Therefore, this alternative

cannot satisfy all of the long-term needs for LCSD, but offers some immediate advantages that should be investigated further.

Based upon this analysis, LCSD should implement Alternative 2, as follows:

- Develop, negotiate, and obtain a signed user agreement with Sutti Farms, as well as other interested farms in the vicinity of the treatment facility
- Design the conveyance facilities to supply Sutti Farms with recycled water
- Generate revenue to repay funding sources and to fund expansion into Orcutt and the Santa Maria Public Airport District

November 2009

Recycled Water System Analysis

Rancho Maria Golf Course

Prepared by: Bruce Jones, EIT
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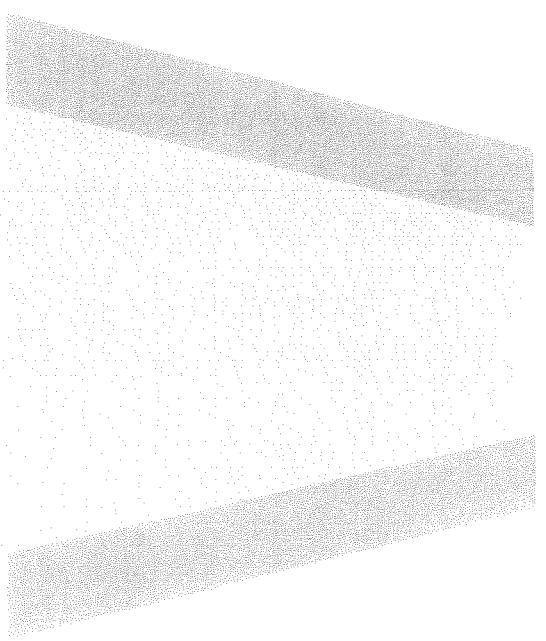
Prepared for: Martin Wilder,
Laguna County Sanitation District



Penfield & Smith

W.O.: 17854.01

EXECUTIVE SUMMARY

Laguna County Sanitation District (District) operates a wastewater reclamation plant (WWRP) located in Orcutt California. Wastewater is treated to the tertiary level and distributed via a pump station located at the plant to various end-users. It is the intent of the District to work with the Rancho Maria Golf Course in order to deliver recycled water for golf course irrigation. It is presently understood that the District intends to supply Rancho Maria with recycled water for irrigation of fairways and site landscaping while tee boxes and greens will continue to be irrigated with fresh water from the golf course's existing well. An agronomic study was prepared in May 2009 by CH2MHill. It is not the intent of this report to verify or further analyze the findings of the agronomic study.

A hydraulic study has been conducted to determine feasibility of implementing a dual-plumbed irrigation system for the golf course, providing well water to tees and greens and recycled water to fairways and site landscaping. The peak daily demand for irrigation of the Rancho Maria Golf course is 660,000 gallons per day. Demand for recycled water is estimated at a peak daily demand of about 425,000 gallons by the CH2MHill agronomic study. This would be delivered to the site through the Phase II recycled water main, designed to provide 1,000 gallons per minute to Rancho Maria.

Three alternatives for recycled water distribution systems were analyzed in this report. All three alternatives maintain the golf course's current operating procedures and parameters, including system pressure, watering schedule and flow. The analysis determined all three options were feasible from a hydraulic perspective. Easement and property rights, utility separation, environmental impacts and potential cost was also analyzed for each alternative. Based on the analysis, alternative 1 is the recommended alternative as it has the lowest construction cost and the least environmental impact.

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INTRODUCTION

Purpose

The purpose of this report is to determine the feasibility of proposed distribution system alternatives through analysis of the required pipe size, required booster pump capacity, preliminary cost comparison, and environmental impacts. The intent is to document the findings for use in the preparation of final construction plans.

Project Setting

The Laguna County Sanitation District (District) operates a wastewater reclamation plant (WWRP) serving the community of Orcutt and portions of unincorporated area of southern Santa Maria. The plant is located at the end of Dutard Road, west of Black Road. The district currently collects, treats, and disposes of approximately 2.1 million gallons of wastewater per day. Wastewater is generated primarily from domestic sources with minor contributions from commercial establishments. All of the water is recycled and is currently used for irrigation purposes.

The proposed Phase II pipeline will connect to the existing Phase I pipeline at the intersection of Black Road and Dutard Road and provide recycled water to the Rancho Maria Golf Course as show in Figure 1. The pipeline is designed with sufficient capacity to provide Rancho Maria with 1000 gallons per minute of recycled water.

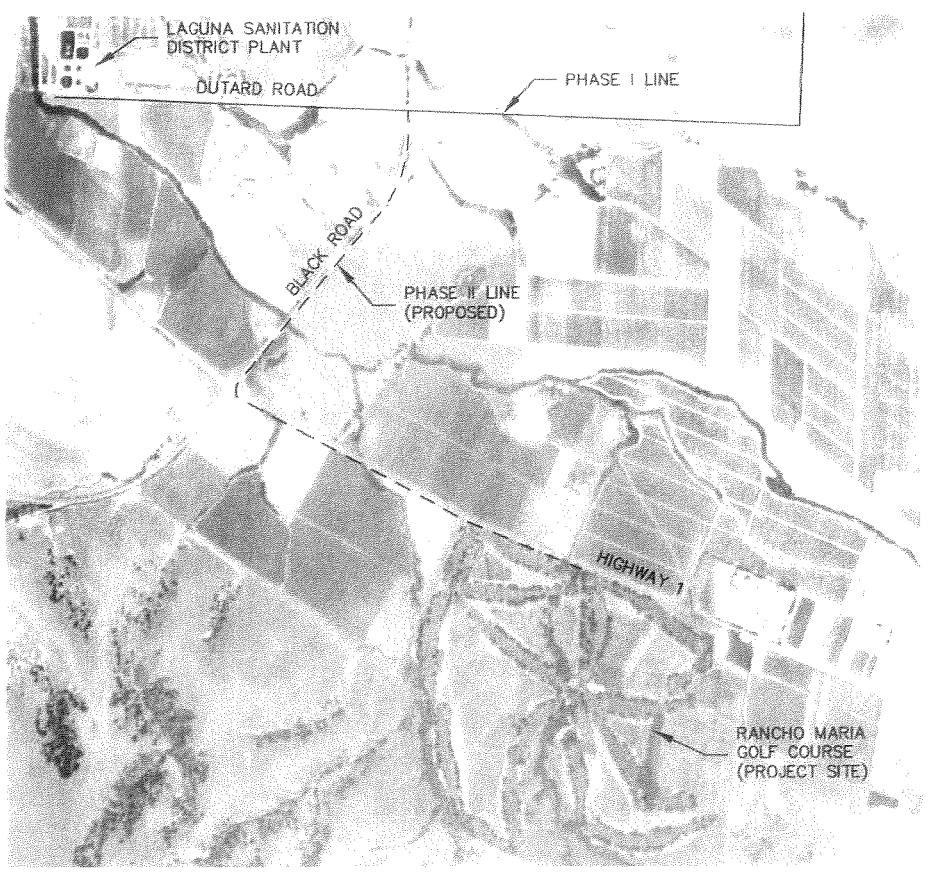


FIGURE 1. VICINITY MAP

EXISTING FACILITIES

Wastewater Reclamation Plant

The District's wastewater reclamation plant is rated for 3.7 mgd and is regulated by the Regional Water Quality Control Board in San Luis Obispo, under Waste Discharge Requirements and Master Reclamation Permit Order 01-042. Effluent is treated to disinfected tertiary levels and includes screening, primary clarification, biofiltration, secondary clarification, membrane filtration (including reverse osmosis for a portion of the flow), and ultraviolet (UV) irradiation. Reverse osmosis concentrate is disposed into a Class 1, non-hazardous injection well. Permeate is currently used to irrigate District land, as well as provide water to farming operations at the Santa Maria Airport. A new 16-inch pipeline to the SMP oilfield is currently under design.

Recycled Water Pump Station

The District's recycled water pump station, located at the treatment plant, is equipped with three vertical turbine pumps that draw water from an open reservoir. The variable frequency drive (VFD) controlled pumps rotate in operating sequence, with two pumps running in parallel together during normal operation, and all three pumps running in parallel if needed. It is noted that the District is currently constructing a 1 million gallon above ground tank to provide additional storage for the recycled water. This project will construct one additional 1 MG tank, leaving 2 additional 1 MG tanks for future projects. Ultimate buildout has identified a need for a total storage volume of 4 MG. This will slightly increase capacity of the existing pump station due to the difference in water level elevation between the in-ground reservoir and proposed above ground tank. The District does not currently have a source of backup power for the pump station.

The pump station is programmed to maintain 105 psi at the District's recycled water pump station, with a maximum flow rate of 2,500 gpm. Based on pump information provided by the District, the pump station could operate with an outlet pressure up to approximately 115 psi while maintaining a maximum flow of 2,500 gpm; however, the District has expressed concern with raising pressure at the treatment plant as existing above ground piping that feeds the long-term storage reservoir downstream from the treatment plant has a minimal pressure rating. The District plans on replacing the above ground piping with buried C900 piping as a future project.

Rancho Maria Irrigation System

The existing irrigation system at Rancho Maria Golf Course is shown below in figure 2. The system is supplied by well water and consists mostly of 4-inch PVC pipe. The system draws about 660,000 gallons per day from an on-site well. The well pump feeds two storage ponds with a combined storage volume estimated at 1,000,000 gallons and a potable water tank. Pond 10 holds an estimated 190,000 gallons and is located at the tee box for Hole 10. Pond 6 holds an estimated 810,000 gallons and is located at the tee box for Hole 6. Pond volumes will be confirmed by a supplemental survey. A pump at each pond supplies the golf course irrigation system. The greens and tee boxes are irrigated by automatic sprinklers, while the fairways are irrigated by moveable sprinkler heads which are manually repositioned. The typical watering pattern for the golf course is shown below in Table 1.

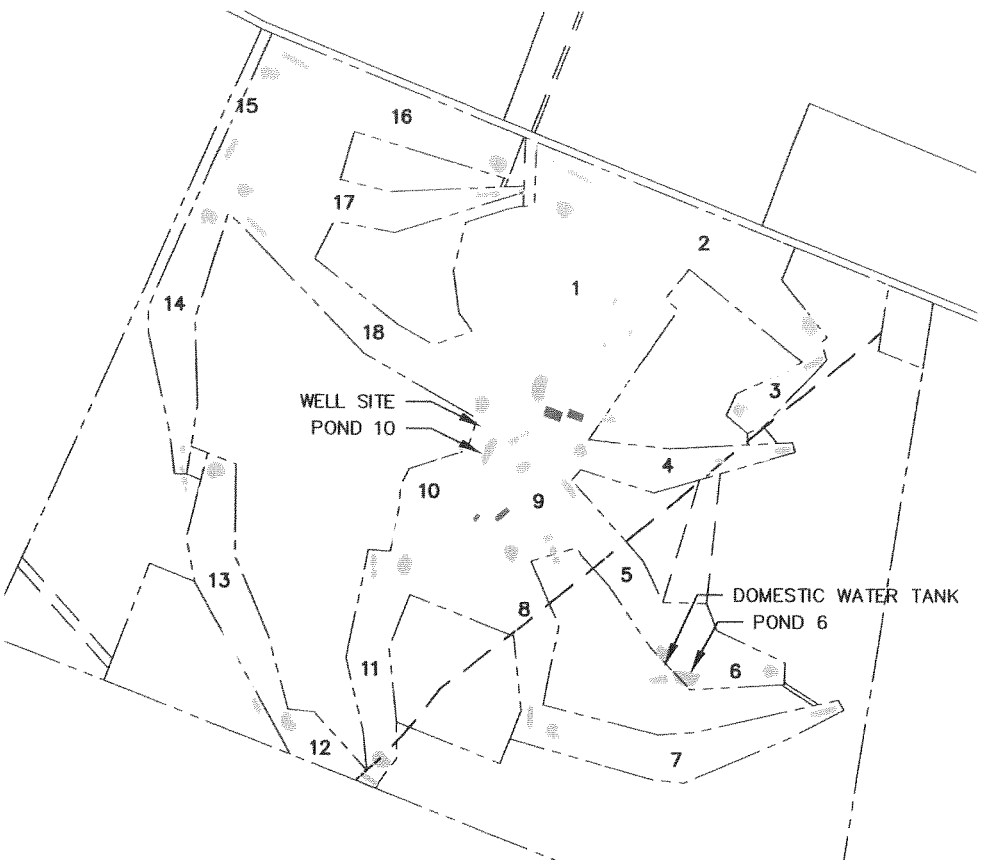


FIGURE 2. SITE MAP

Time Period	*Fairways*	*Tee Boxes*	*Greens*	*Landscaping*
8 PM to 3 AM	On	On	Off	Off
3 AM to 6 AM	Off	Off	On	Off
6 AM to 8 AM	Off	Off	Off	On

TABLE 1. EXISTING IRRIGATION SYSTEM SCHEDULE

PROPOSED ALTERNATIVES

Phase II Offsite Distribution Line

The Phase II pipeline system will run approximately 1.5 miles from the Phase I pipeline at the Dutard Road/Black Road intersection to the Rancho Maria Golf Course. The line will terminate at the intersection of Highway 1 and the Rancho Maria entrance road. The Phase II line will be 12-inch PVC under Black Road and 12-inch HDPE under Highway 1. This pipeline will be capable of providing the Rancho Maria Golf Course with approximately 1,000 gallons per minute of recycled water. The actual supply may vary due to demand from other customers in the system. Controls will be installed allowing the blending of well water in the storage ponds in the event the District is unable to deliver 1,000 gallons per minute.

The offsite distribution line includes a tee at the golf course driveway. A flowmeter will be installed near the golf course entrance. All piping and equipment downstream from the flowmeter is considered the onsite irrigation system and is intended to be operated and maintained maintained by the golf course.

Onsite Irrigation System

Three Alternatives have been considered for the proposed recycled water distribution system; shown in Attachment A. All elevations utilized and included in this analysis are based on aerial topographic information. All existing irrigation location information is approximate and based on discussions with the Rancho Maria Golf Course maintenance division.

Design Criteria

Recycled water is to be pumped to the Rancho Maria site at a rate of 1,000 gallons per minute with an estimated peak daily demand of 425,000 gallons. The system is expected to see pressure of about 105 psi at the District's recycled water pump station. The system pressure at the outlet of the transmission line varies based on alternative distribution system layouts.

Each alternative is designed to irrigate the fairways with recycled water through the existing irrigation system. A second system will be installed to irrigate the tee boxes and greens with fresh water. Using the existing system for recycled water irrigation will reduce costs due to a lower number of lateral reconnections. Cross connections between the systems can be provided to allow either water source to act as a backup, in the case of well pump failure, or insufficient recycled water supply. All proposed cross connections will be in accordance with state public health requirements. In addition, adequate separation must be maintained between the existing piping to the potable water storage tank and proposed irrigation piping.

Design pressure limits are as follows:

- No significant pressure change in the existing distribution system
- Maximum pressure of 100 psi in proposed distribution system
- Minimum pressure of 40 psi in proposed distribution system

Existing System Analysis

Existing system pressures were measured from the fairway sprinkler couplers during morning irrigation. Measurements were taken at the lowest elevations on the golf course at fairways 1, 15, and 17; and at the highest elevations on the golf course at fairways 7 and 12. Operating system pressures were measured ranging from 65 psi at fairway 12, to 115 psi at fairway 1. These measurements correspond with existing system deficiencies, including insufficient pressure at higher elevations and pipe ruptures at lower elevations. Additional system deficiencies include low pressure out of the Pond 10 pump possibly due to impeller wear and no automatic control of the Pond 6 pump.

The existing irrigation network was modeled using Bentley Systems WaterCAD V8 XM software. Demands were based on the existing irrigation operations described in the Rancho Maria Irrigation System section on page 3. Existing ground elevations over the pipe were used to set model elevations. The existing system model was calibrated to pressure test data of the existing system during irrigation. Pumps were sized based on the existing pumps with the pump at Pond 10 reduced to 70% efficiency to represent the loss of capacity at the existing pump due to wear on the system. Analysis of the existing system found that friction head losses due to the small diameter of the irrigation pipe and high flow rates accounted for a large portion of the head loss in the system. This reduces pressures across the system which leads to low supply at higher elevations but also reduces potential damage to the system at lower elevations where pressures are highest.

An extended period model of the existing system provided details for the analysis of water level in the storage ponds. The model showed that Pond 10 experiences a draw down to 85% capacity while the larger Pond 6 experiences a draw down to 67% capacity. The system requires about 6 hours after the end of the irrigation cycle to return both ponds to 100% capacity. These observations in the model reflect the condition of current operations at the golf course as described by maintenance staff.

Proposed System Analysis

The Alternatives were analyzed for supply pressures from the wastewater reclamation plant and required onsite pump sizes. The analysis found pressures from the plant to be sufficient to reach the proposed recycled water onsite storage in every alternative. The pump size analysis showed large variation in pump requirements. Proposed pump sizes range from 40HP to 140HP between the different alternatives. Pump size and configuration specific to each alternative is described in the Design Alternative Physical Descriptions section on page 7. See Appendix C for detailed calculations of supply pressures and proposed pump sizes.

The Proposed Alternative 1 irrigation network was modeled using Bentley Systems WaterCAD V8 XM software. The Alternative 1 model was built from the existing system model to retain system calibration as all of the existing pumps and piping will be utilized in the proposed system. New pump sizes were added based on the pump size calculations in Appendix C. The proposed irrigation mains for well water irrigation used 4-inch PVC to reproduce the effects of head loss observed in the existing system. This allowed system pressures to be obtained at proposed irrigation sprinklers to closely match the pressures currently seen by existing irrigation sprinklers, minimizing a need for change in irrigation procedures.

Pressures for the existing and proposed system at selected holes are shown in Table 2. Pressures and flow for the recycled water main are identical to the pressures in the existing system, as the same system is used. Currently, the golf course experiences high system pressures at Holes 1-4 and 15-18, and low system pressures at Holes 5-9 and 10-14. The proposed piping for the well water system will address deficiencies by splitting the golf course into two hydraulic zones. The upper zone will have pressure supplied by a booster pump to increase the pressure currently seen in the system. The lower zone will be fed only by pressure from the well pump which will decrease the pressure currently seen by the system. This results in decreased maintenance and increased reliability.

Sample Location	*Existing Well Water*	*Proposed Recycled Water*	*Proposed Well Water*
Hole 1	105.8	105.8	71.7
Hole 7	81.3	81.3	71.9
Hole 12	41.7	41.7	72.2
Hole 16	77.5	77.5	77.2

TABLE 2. MODELED SYSTEM PRESSURES

Storage pond level information for the existing and proposed systems are shown in Table 3. The proposed system model also shows a reduction in the percent draw down of the existing ponds. In Alternative 1 the ponds are used for recycled water storage, which can be provided at a greater flow rate than fresh water from the onsite well. An extended period model of the Alternative 1 system showed improvements in the draw down of volume and required fill time. The model showed that Pond 10 experiences a draw down to 88% capacity, while the larger Pond 6 experiences a draw down to 88% capacity. The system requires about 1 hour after the end of the irrigation cycle to return both ponds to 100% capacity. The additional source of recycled water to supplement the existing well water supply will lead to a reduction in pond drawdown and refill time for all three alternatives.

Sample Location	*Storage Pond 6*	*Storage Pond 10*
Existing Max Drawdown	67%	85%
Proposed Max Drawdown	88%	88%
Existing Refill Time	1 hour	6 hours
Proposed Refill Time	1 hour	1 hour

TABLE 3. STORAGE POND LEVELS

Design Alternative Physical Descriptions

The variations in the alternatives are based primarily on the method of recycled water storage and the number, location, and size of required pump facilities. The alternatives are described in detail below and the layouts of the three alternative distribution systems are shown in Attachment A.

Alternative 1

Alternative 1 installs a 12 inch recycled water line from the Phase II line to Pond 10. A new 40 HP pump station would bring recycled water from Pond 10 to Pond 6 through the existing transmission line. The existing pump stations would draw recycled water from the storage ponds and the existing irrigation system would be used for recycled water irrigation of the fairways.

Well water would feed a new irrigation system to irrigate the greens and tees. Pressure would be provided to lower elevations by gravity and to higher elevations through a new 60 HP pump station. A new line would be also required from the well to the potable water tank. This alternative best accommodates supplementing recycled water with well water and blending of the two water sources.

Alternative 2

Alternative 2 installs a 12 inch recycled water line from the Phase II line to a dry pond adjacent to the Hole 15 fairway. The pond was used for irrigation storage for Rancho Maria previous to the construction of Ponds 6 and 10. Some clearing and grading would be required in the proposed pond site. A new 140 HP pump station would draw recycled water from the storage pond and supply the recycled water irrigation system. A 60 HP booster pump in the recycled water irrigation system would provide pressure to fairways at higher elevations. The existing irrigation system would be used for recycled water irrigation.

Well water would be pumped to the existing storage ponds and potable water tank per the existing conditions. The two existing pump stations would draw water from the ponds to feed a new well water irrigation system for the greens and tees to be installed as part of this alternative.

Alternative 3

Alternative 3 installs a 12 inch recycled water line from the Phase II line to a proposed tank just south of the maintenance yard. Recycled water from the tank would feed the existing irrigation system with pressure provided to the fairways at lower elevations by gravity and pressure provided to the fairways at higher elevation through a new 80 HP pump station. The existing irrigation system would be used for recycled water irrigation.

Well water would be pumped to the existing storage ponds and potable water tank per the existing conditions. The two existing pump stations would draw water from the ponds to feed a new well water irrigation system for the greens and tees to be installed as part of this alternative.

PROPOSED ALTERNATIVE CONSIDERATIONS

Three preliminary system distribution alternatives have been identified based on storage and supply of recycled water and integration with the existing system. Beyond the hydraulic analysis, additional considerations include: existing easements, utility separation requirements, environmental review and requirements, and cost comparison.

Existing Easements

According to the approximate location of existing irrigation lines and a preliminary boundary and easement study, some of the existing irrigation lines are outside of the Rancho Maria property boundary and utility easements. While it is the intent to construct the new irrigation line parallel to the existing irrigation line, all new pipelines must be installed within the Rancho Maria property or easements. This consideration does not lead to significant cost differences between the three proposed alternatives.

Utility Separation Requirements

In accordance with the State of California Department of Health Services Guidance Memo No. 2003-02, the separation requirement for recycled water main with potable water is dependent on the level of treatment for the recycled water. Recycled water treated to the tertiary level and irrigation water lines must be located a minimum of 4 feet from existing potable water lines (horizontal distance, outside of pipe to outside of pipe). This consideration does not lead to significant cost differences between the three proposed alternatives.

Environmental Review and Requirements

The alternatives have been reviewed for environmental concerns by Padre Associates, Inc. The following environmental concerns have been provided.

- Alternative 1: Preferred, no additional impacts compared to the other two alternatives.
- Alternative 2: Tiger Salamanders are likely to be present in the vicinity of the proposed storage pond.
- Alternative 3: Storage tank area has not been surveyed for archeological resources.

Cost Comparison

Cost estimates prepared for this analysis are intended only to compare alternatives. These cost estimates ***do not*** represent total anticipated cost to construct the proposed recycled water distribution system. Estimates were prepared to determine the cost difference between alternatives, and do not include items likely to be of similar cost regardless of final design, such as: permits & agency review, contingencies & bonding, and mobilization.

The largest cost in all three alternatives is the installation of the new 4-inch well water line. This cost is approximately $245,000 and does not vary significantly between alternatives. The cost of installation of the 12-inch recycled water transmission line is also a large cost and varies from $100,000 for alternative 1; $110,000 for alternative 2; and $150,000 for alternative 3. The proposed pumps, tanks, and storage ponds provide the remaining large cost items at $64,000 for alternative 1; $86,000 for alternative 2; and $122,000 for alternative 3. A detailed cost breakdown for each alternative is included in Attachment B.

CONCLUSIONS & RECOMMENDATIONS

Alternative Selection Summary

Table 4 identifies items recommended for consideration in order to determine the preferred alternative for the proposed recycled water distribution system.

Decision Item	Alternative 1	Alternative 2	Alternative 3
Comparison Cost	$523,000	$574,000	$671,000
Environmental Impacts	Limited	Potentially Significant	Limited
Site Grading Required	No	Yes	Yes
Recycled Water Storage	Yes	Yes	Yes
Well Water Storage	No	Yes	Yes
Total Pump Houses	4	4	3

TABLE 4. ALTERNATIVE SELECTION SUMMARY

Alternative 1:

- Lowest cost
- Most limited environmental impacts with no site grading
- No well water storage for irrigation purposes
- Well water may be used to supplement recycled water supply

Alternative 2:

- Second lowest cost
- Potential environmental impact in the proposed pond
- Requires the installation of a new 140 HP pump which is much larger than the pumps required for the other alternatives

Alternative 3:

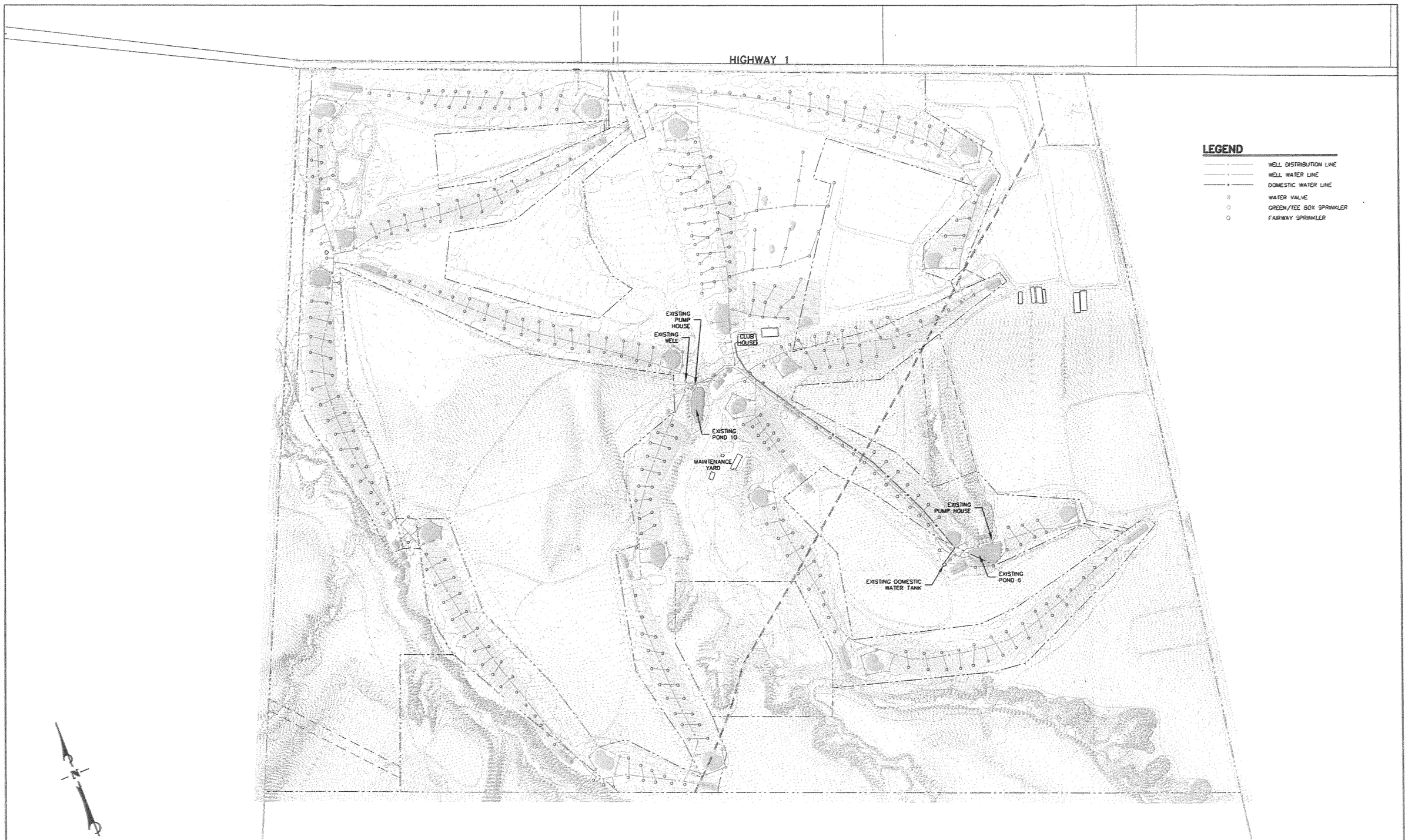
- Highest cost
- Limited environmental impacts but requires some site grading
- The reduced number of pump houses required will reduce operational costs

Recommendation

The results of the analysis calculations show that the proposed dual-plumb system will improve the capacity of the system without substantial change in pressure throughout the site. Analysis of the alternative considerations shows that alternative 1 is lowest in cost and more easily allows supplementing recycled water with well water and blending of the two water sources.

It is recommended that the proposed recycled water distribution system be a dual-plumb system designed to the alternative 1 layout.

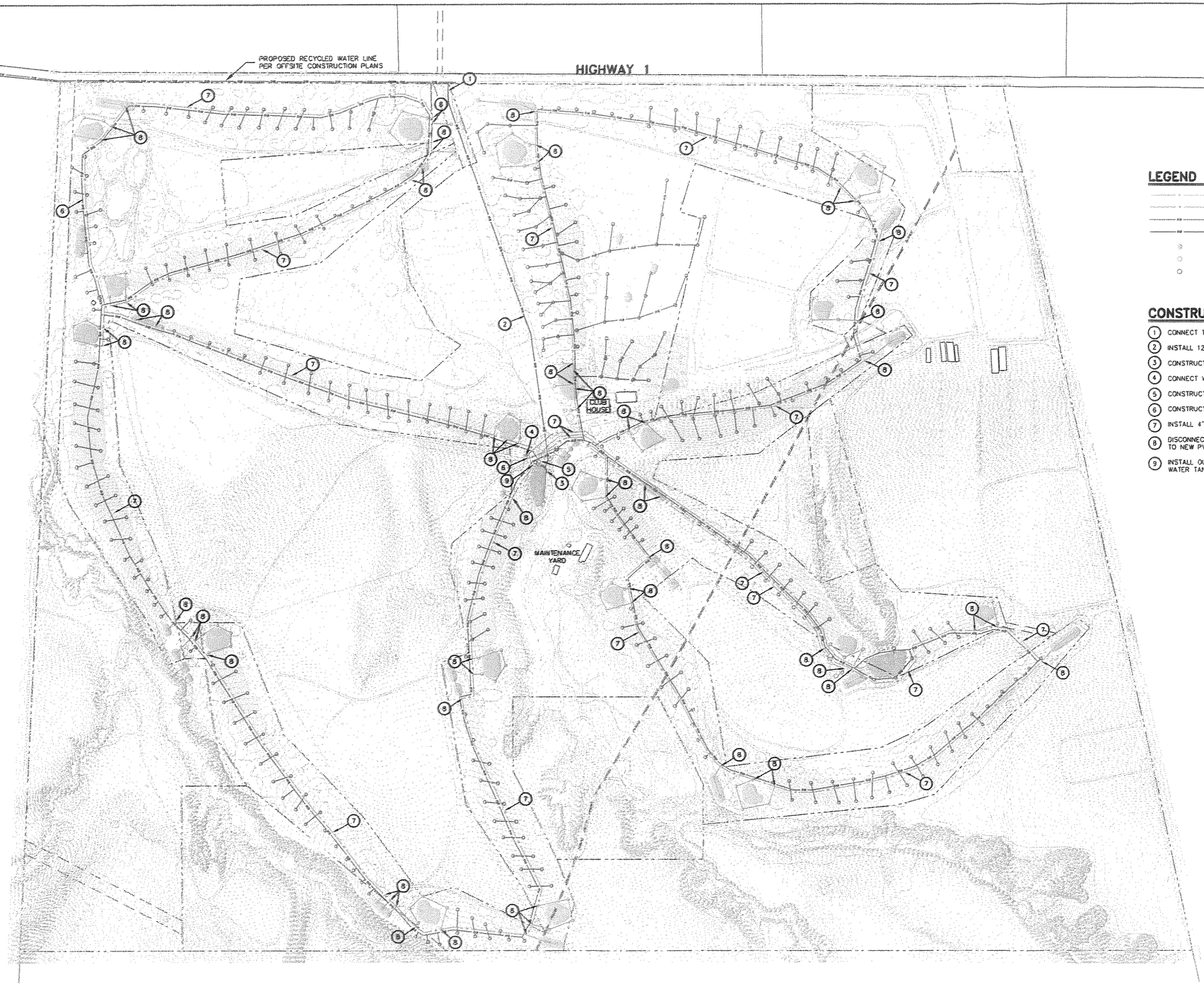
ATTACHMENT A: EXHIBITS



Penfield & Smith
Engineering · Surveying · Planning
· Construction Management ·
210 Cross Drive, Suite A, Santa Maria, CA 93454
Phone: (805) 925-2345 Fax: (805) 925-7338

EXISTING WATER DISTRIBUTION SYSTEM

RANCHO MARIA GOLF COURSE, ORCUTT, CALIFORNIA
SEPTEMBER 18, 2009



LEGEND

- WELL DISTRIBUTION LINE
- WELL WATER IRRIGATION LINE
- RECYCLED WATER IRRIGATION LINE
- RECYCLED WATER MAIN
- WATER VALVE
- WELL WATER SPRINKLER
- RECYCLED WATER SPRINKLER

CONSTRUCTION NOTES

1. CONNECT TO EXISTING RECYCLED WATER MAIN
2. INSTALL 12" PVC RECYCLED WATER MAIN
3. CONSTRUCT RECYCLED WATER OUTLET STRUCTURE
4. CONNECT WELL DIRECTLY TO NEW 4" IRRIGATION LINE
5. CONSTRUCT PUMP HOUSE
6. CONSTRUCT IRRIGATION WATER IN-LINE BOOSTER PUMP
7. INSTALL 4" PVC PIPE
8. DISCONNECT LATERAL FROM EXISTING PIPE AND ATTACH TO NEW PVC PIPE
9. INSTALL OUTLET FROM IRRIGATION WATER TO RECYCLED WATER TANK FOR BLENDING CONTROL

SCALE: 1"=200'
0 200 400 600

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· Construction Management
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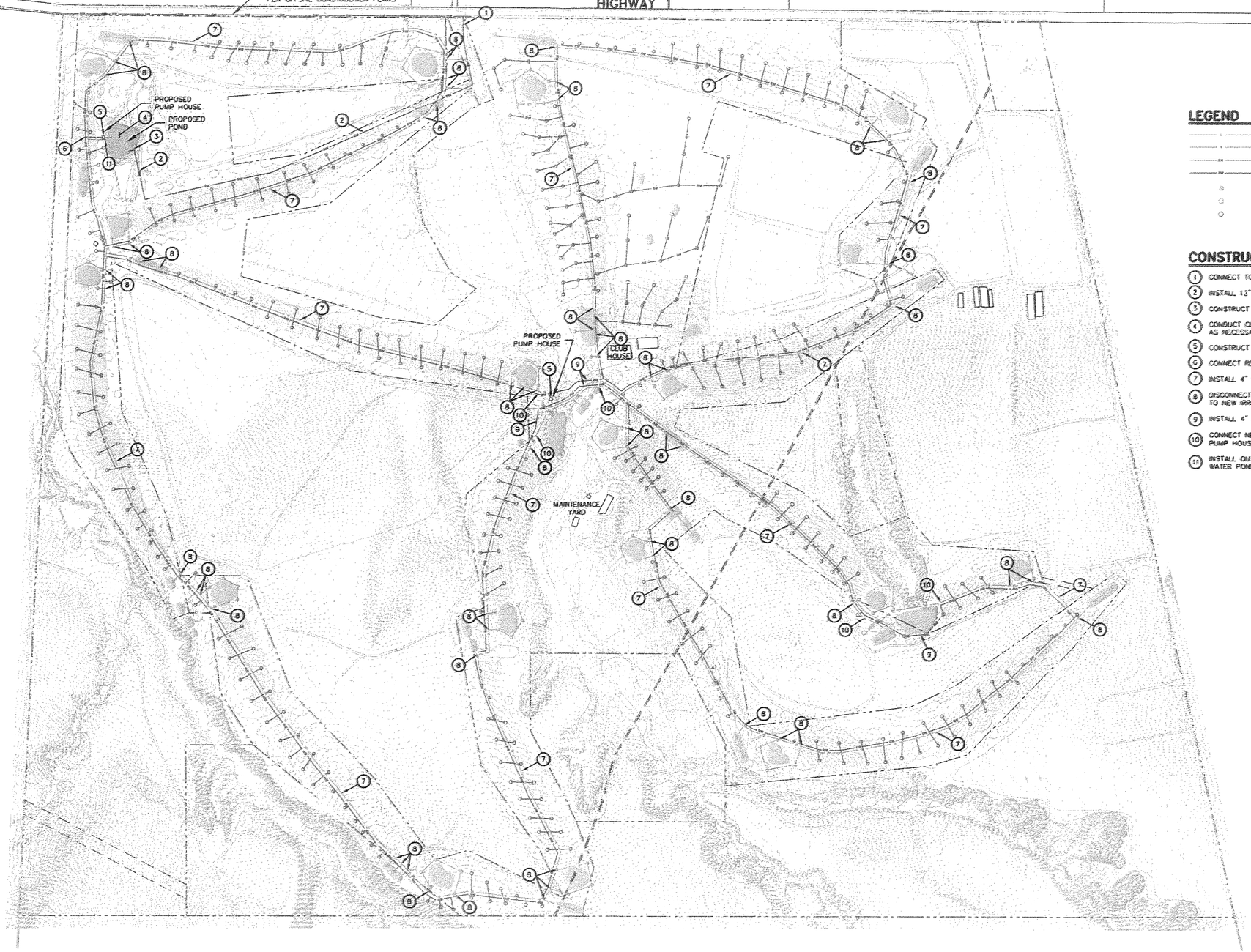
PROPOSED WATER DISTRIBUTION SYSTEM
ALTERNATIVE 1

RANCHO MARIA GOLF COURSE, ORCUTT, CALIFORNIA
SEPTEMBER 18, 2009



LEGEND

- WELL DISTRIBUTION LINE
- WELL WATER IRRIGATION LINE
- RECYCLED WATER IRRIGATION LINE
- RECYCLED WATER MAIN
- WATER VALVE
- WELL WATER SPRINKLER
- RECYCLED WATER SPRINKLER

CONSTRUCTION NOTES

1. CONNECT TO EXISTING RECYCLED WATER MAIN
2. INSTALL 12" PVC RECYCLED WATER MAIN
3. CONSTRUCT OUTLET HEADWALL
4. CONDUCT CLEARING AND GRADING OPERATIONS IN POND AS NECESSARY FOR IMPROVEMENTS
5. CONSTRUCT PUMP HOUSE
6. CONNECT RECYCLED WATER TO EXISTING IRRIGATION PIPE
7. INSTALL 4" PVC IRRIGATION PIPE
8. DISCONNECT LATERAL FROM EXISTING PIPE AND ATTACH TO NEW IRRIGATION PVC PIPE
9. INSTALL 4" PVC RECYCLED WATER PIPE
10. CONNECT NEW 4" PVC IRRIGATION PIPE TO EXISTING PUMP HOUSE SYSTEM
11. INSTALL OUTLET FROM IRRIGATION WATER TO RECYCLED WATER POND FOR BLENDING CONTROL

SCALE: 1"=200'
0 200 400 600

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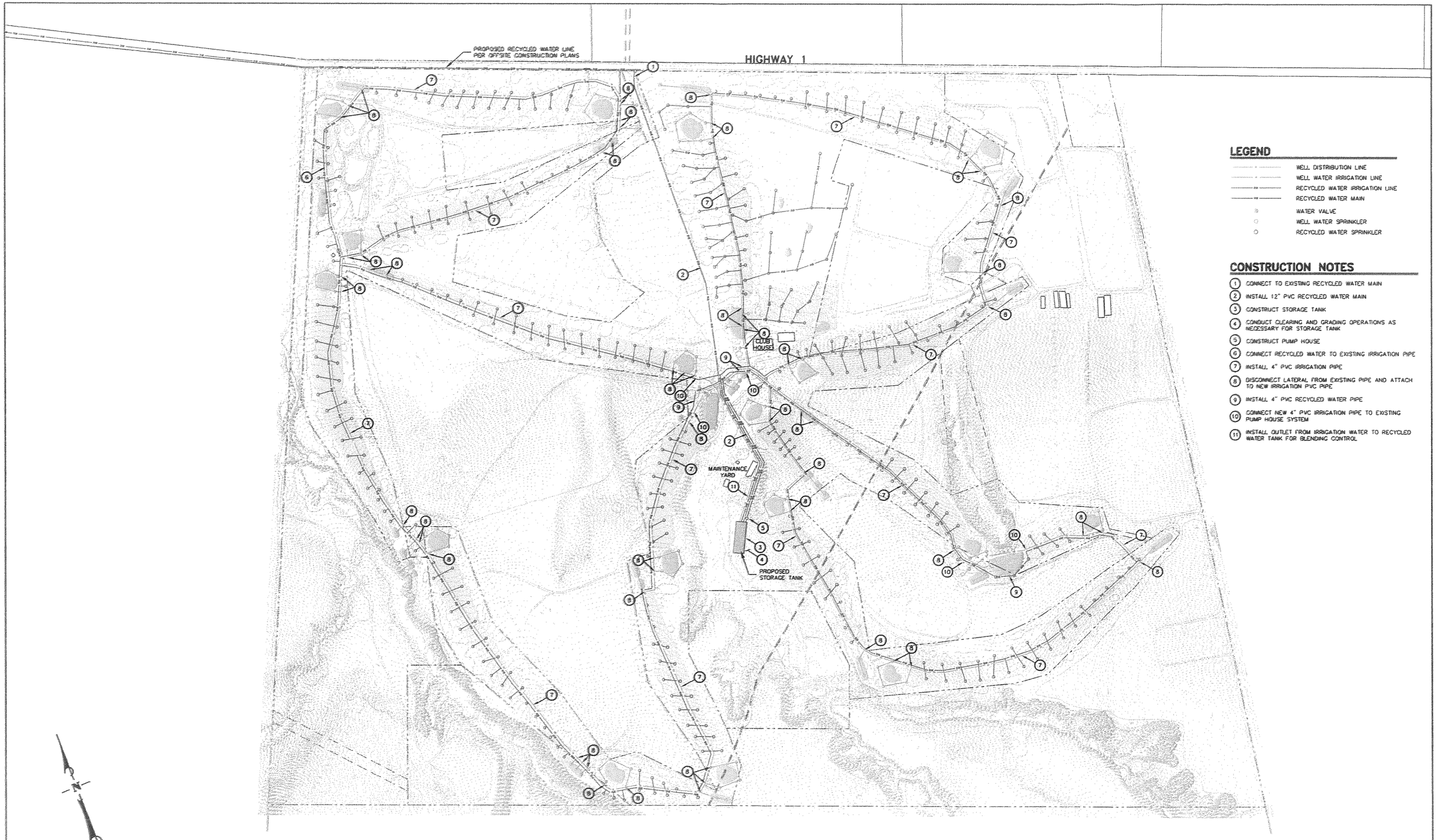
PROPOSED WATER DISTRIBUTION SYSTEM
ALTERNATIVE 2

RANCHO MARIA GOLF COURSE, ORCUTT, CALIFORNIA
SEPTEMBER 18, 2009



LEGEND

- WELL DISTRIBUTION LINE
- WELL WATER IRRIGATION LINE
- RECYCLED WATER IRRIGATION LINE
- RECYCLED WATER MAIN
- WATER VALVE
- WELL WATER SPRINKLER
- RECYCLED WATER SPRINKLER

CONSTRUCTION NOTES

1. CONNECT TO EXISTING RECYCLED WATER MAIN
2. INSTALL 12" PVC RECYCLED WATER MAIN
3. CONSTRUCT STORAGE TANK
4. CONDUCT CLEARING AND GRADING OPERATIONS AS NECESSARY FOR STORAGE TANK
5. CONSTRUCT PUMP HOUSE
6. CONNECT RECYCLED WATER TO EXISTING IRRIGATION PIPE
7. INSTALL 4" PVC IRRIGATION PIPE
8. DISCONNECT LATERAL FROM EXISTING PIPE AND ATTACH TO NEW IRRIGATION PVC PIPE
9. INSTALL 4" PVC RECYCLED WATER PIPE
10. CONNECT NEW 4" PVC IRRIGATION PIPE TO EXISTING PUMP HOUSE SYSTEM
11. INSTALL OUTLET FROM IRRIGATION WATER TO RECYCLED WATER TANK FOR BLENDING CONTROL

SCALE: 1"=200'
0 200 400 600

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PROPOSED WATER DISTRIBUTION SYSTEM
ALTERNATIVE 3

RANCHO MARIA GOLF COURSE, ORCUTT, CALIFORNIA
SEPTEMBER 18, 2009

ATTACHMENT B: COST COMPARISON

RANCHO MARIA RECYCLED WATER IRRIGATION RETROFIT ALTERNATIVES
PRELIMINARY ALTERNATIVE COMPARISON
(THIS COMPARISON DOES NOT REPRESENT TOTAL PROJECT COST)

Penfield & Smith Engineers Inc.
W.O. 17854.01
17-Aug-09
BY: RBJ

		Unit Prices		Alternative System 1		Alternative System 2		Alternative System 3	
Item #	Descrription	Unit of Measure	Unit Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost
Proposed Watering Operations									
1	Water Main Connection	EA	$400.00	1	$400	1	$400	1	$400
2	12" PVC Water Main (In Road)	LF	$65.00	1408	$91,520	57	$3,705	1407	$91,455
	12" PVC Water Main (Out of Road)	LF	$60.00	172	$10,320	1734	$104,040	824	$49,440
3	Headwall	EA	$4,000.00	--	--	1	$4,000	--	--
	Storage Tank	SF	$85,000.00	--	--	--	--	1	$85,000
4	Clearing and Grading For Pond	SF	$0.03	--	--	15050	$452	--	--
	Clear and Grading For Storage	SF	$0.03	--	--	--	--	7500	$225
	Connect well to 4" PVC Irrigation Line	EA	$250.00	1	$250	--	--	--	--
5	Pump House	EA	Varies	1	$32,120	1	$49,520	0	--
	Irrigation In-line Booster Pump	EA	Varies	1	$32,120	1	$32,120	1	$37,120
6	Irrigation Connection	EA	$250.00	--	--	2	$500	2	$500
7	4" PVC Irrigation	LF	$12.00	20111	$241,332	20130	$241,560	20816	$249,792
8	Disconnect Existing Connect New 4" PVC Irrigation	EA	$90.00	65	$5,850	63	$5,670	63	$5,670
9	4" PVC Recycled Water	LF	$12.00	--	--	1000	$12,000	1000	$12,000
10	Connect New 4" PVC Irrigation to	EA	$100.00	--	--	5	$500	5	$500
11	Install Outlet Irrigation to Recycled Water Pond	EA	$4,500.00	$1	$4,500	1	$4,500	1	$4,500
	Subtotal			**$418,412**		**$458,967**		**$536,602**	
25% Contingency				**$104,603.00**		**$114,741.63**		**$134,150.50**	
TOTAL				**$523,015**		**$573,708**		**$670,753**	

Notes:
*All Connections and disconnections are assumed to be the same price and are lumped together for unit costs.
**35% markup for possible replacement of existing utilities
***All RS Means unit costs are marked up 7.9% per santa barbara county

Item #	Description		Unit of Measure	Unit Cost	Quantity	Total Unit Cost	Source of Prices
1	Water Main Connection	4" Tee & Coupler & Labor For Connections	EA	$35.00	1	$37.77	*RS Means 31 11 13.25 8100 (Labor, Home Depot Materials)
		Added Pipe for Connection	EA	$64.09	5	$320.46	RS Means Standard for 4"PVC Pipe (#2)
		Total Cost				$358.23	
2	12" PVC Water Main (In Road)	Asphalt	LF	$51.00	1	$5.60	RS Means 32 12 16.13 1050
		Sawcut	LF	$2.48	1	$2.48	RS Means 02 41 19.25
		12" PVC Pipe, Dia Class 150, AWWA C900	LF	$29.00	1	$29.00	RS Means 33 11 13.25 4560
		Trenching 6' to 10' deep, 3/4 C.Y.	LF	$3.82	1	$3.82	RS Means G1030 805 1325
		Native Backfill	LF	$12.35	1	$12.35	RS Means 31 23 23.13
		Sand Bedding	LF	$6.15	1	$6.15	RS Means 31 23 23.16 0200
		Total Cost				$64.09	7.9% Santa Barbara Markup
	12" PVC Water Main (Out of Road)	1" deep Bluegrass Sod, Over 8 M.S.F.	LF	$0.37	1	$0.37	RS Means 32 92 23.10 0020
		12" PVC Pipe, Dia Class 150, AWWA C900	LF	$29.00	1	$29.00	RS Means 33 11 13.25 4560
		Trenching 6' to 10' deep, 3/4 C.Y. Excavator	LF	$3.82	1	$3.82	RS Means G1030 805 1325 (Interpolate)
		Native Backfill	LF	$12.35	1	$12.35	RS Means 31 23 23.13
		Sand Bedding	LF	$6.15	1	$6.15	RS Means 31 23 23.16 0200
		Total Cost				$55.77	7.9% Santa Barbara Markup
3	Headwall/ Water Outlet Structure	Headwall	EA	$3,600.00	1	$3,600.00	RS Means G3030 310 4500
		Rip-Rap Dumped Stone	Ton	$41.00	3	$123.00	RS Means 02 41 13.70 0400
		Total Cost				$3,965.00	7.9% Santa Barbara Markup
	Storage Tank		SF	$50,000.00	1	$50,000.00	
4	Clearing and Grading For Pond		SF	$1,050.00	2.29568E-05	$0.03	*RS Means 31 13 13.10 0300
	Clear and Grading For Storage Tank		SF	$1,050.00	2.29568E-05	$0.03	*RS Means 31 13 13.10 0300
	Connect well to 4" PVC Irrigation Line	4" Tee & Coupler & Labor For Connections	EA	$35.00	1	$35.00	RS Means 31 11 13.25 8100 (Labor, Home Depot Materials)
		Added Pipe for Connection	EA	$10.23	10	$102.30	RS Means Standard for 4" PVC Pipe (#7 & #9)
		Total Cost				$137.30	*7.9% Santa Barbara Markup

Notes:

*All RS Means unit costs are marked up 7.9% per santa barbara county and are factored into the total cost or the individual line items

Item #	Description		Unit of Measure	Unit Cost	Quantity	Total Unit Cost	Source of Prices
5	Pump System	75 HP to 2500 GPM	EA	$25,100.00	1	$25,100.00	RS Means 22 11 23.10 3190
		100 HP to 3000 GPM	EA	$30,100.00	1	$30,100.00	RS Means 22 11 23.10 3220
		150 HP to 4000 GPM	EA	$42,500.00	1	$42,500.00	RS Means 22 11 23.10 3240
		6" Check Valve	EA	$1,250.00	1	$1,250.00	RS Means 33 12 16.10 3714
		6" Gate Valve	EA	$1,025.00	2	$2,050.00	RS Means 33 12 16.10 3814
		10' x 12' 4" Thick concrete pad + reinforcing steel +forming	EA	$720.00	1	$720.00	RS Means 03 30 53.40 5001, 03 21 10.60 0600, 03 11 13.65 3000
		10' x 12' Manufactured Shed Structure	EA	$3,000.00	1	$3,000.00	Home Depot
		Total Cost	Add Pump type cost to			$7,020.00	*7.9% Santa Barbara Markup
6	Irrigation Connection	4" Tee & Coupler & Labor For Connections	EA	$35.00	1	$35.00	RS Means 31 11 13.25 8100 (Labor, Home Depot Materials)
		Added Pipe for Connection	EA	$10.23	10	$102.30	RS Means Standard for 4" PVC Pipe (#7 & #9)
		Total Cost				$137.30	*7.9% Santa Barbara Markup
7	4" PVC Irrigation	Chain Trencher, 12 H.P., Operator Walking	LF	$1.53	1	$1.53	RS Means 31 23 16.14 0700
		Hand Back-fill including compaction	LF	$2.23	1	$2.23	RS Means 31 23 16.14 1700
		4" AWWA Class 150 PVC Pipe	LF	$5.35	1	$5.35	RS Means 33 11 13.25 2180
		1" deep Bluegrass Sod, Over 8 M.S.F.	LF	$0.37	1	$0.37	RS Means 32 92 23.10 0020
		Total Cost				$10.23	*7.9% Santa Barbara Markup
8	Disconnect Existing Connext New 4" PVC Irrigation	4" Tee & Coupler & Labor For Connections	EA	$35.00	1	$37.77	*RS Means 31 11 13.25 8100 (Labor, Home Depot Materials)
		Added Pipe for Connection	EA	$10.23	5	$51.14	RS Means Standard for 4"PVC Pipe (#7 & #9)
		Total Cost				$88.91	
9	4" PVC Recycled Water	Chain Trencher, 12 H.P., Operator Walking	LF	$1.53	1	$1.53	RS Means 31 23 16.14 0700
		Hand Back-fill including compaction	LF	$2.23	1	$2.23	RS Means 31 23 16.14 1700
		4" AWWA Class 150 PVC Pipe	LF	$5.35	1	$5.35	RS Means 33 11 13.25 2180
		1" deep Bluegrass Sod, Over 8 M.S.F.	LF	$0.37	1	$0.37	RS Means 32 92 23.10 0020
		Total Cost				$10.23	*7.9% Santa Barbara Markup
10	Connect New 4" PVC Irrigation to Pump House	4" Tee & Coupler & Labor For Connections	EA	$35.00	1	$35.00	RS Means 31 11 13.25 8100 (Labor, Home Depot Materials)
		Added Pipe for Connection	EA	$10.23	5	$51.14	RS Means Standard for 4"PVC Pipe (#7 & #9)
		Total Cost				$86.14	
11	Install Outlet Irrigation to Recycled Water Pond	Headwall	EA	$3,600.00	1	$3,600.00	RS Means G3030 310 4500
		Rip-Rap Dumped Stone	Ton	$41.00	3	$123.00	RS Means 02 41 13.70 0400
		Total Cost				$4,017.12	*7.9% Santa Barbara Markup

Notes: *All RS Means unit costs are marked up 7.9% per santa barbara county and are factored into the total cost or the individual line items

ATTACHMENT C: EXISTING WELL AND PUMP DATA

FLOYD V. WELLS, INC.
1337 W. BETTERAVIA RD.
SANTA MARIA, CA 93455
(805) 925-8626

INVOICE NUMBER: 0012864-IN
INVOICE DATE: 05/15/2003
ORDER NUMBER:
ORDER DATE:
CUSTOMER NO: RAN220

SOLD TO:

RANCHO MARIA GOLF CLUB, INC.
1950 CASMALIA, RFD #2
SANTA MARIA, CA 93455

CUSTOMER P.O.: VERBAL
TERMS: NET 30

ITEM DESCRIPTION	ORDERED	UNIT	PRICE	AMOUNT
50HP VERTICAL TURBINE WELL PUMP				
*****INSTRUCTIONS*****				
1. CHECK PUMP, NEEDS TO BE PULLED				
2. PULL VT PUMP, TAKE TO SHOP FOR INSPECTION				
3. INSTALL SUBMERSIBLE LOANER PUMP IN WELL				
4. REPAIR / REPLACE DOWNHOLE EQUIPMENT AS REQUIRED AND REINSTALL				
*****WELL/PUMP DATA*****				
WELL DIAMETER: 12" STEEL				
WELL DEPTH: 658 FT				
STATIC LEVEL: 227 FT				
PUMP MAKE: L&B / INGERSOLL				
PUMP HP: 50 HP				
COL / IC SIZE: 6" x 2" x 1.187"				
COL LENGTHS: 20' & 10'				
PUMP SETTING: 280 FT				
SUCTION PIPE: 6" x 10'				
PUMP DESCRIPTION: 10M41-8 STAGE				
IMPELLER NO: EC2366				
IMPELLER DIA: BY MFG				
FLOW GPM: 580 GPM				
HEAD FEET: 285 FT HEAD				
*****MATERIALS*****				
INNER COLUMN 2.0 X 1.187 X 20'	13.000	EACH	$226.00	$2,938.00
INNER COLUMN 2.0 X 1.187 X 10'	1.000	EACH	$128.00	$128.00
COLUMN PIPE T&C 6" X 20' ELS	9.000	EACH	$204.00	$1,836.00
10" BELL SUCTION BUSHING	2.000	EACH	$38.41	$76.82

Rancho Maria G.C.
1950 Hwy 1
Santa Maria, CA 92455

Ref: Our Job # 3292 and 3293 Rancho Santa Maria
Customer P.O. # ___

Station Requirements:

Quantity 1 Jockey Pump 3 HP 3600 Rpm
Quantity 2 Main Pump 25 Hp 3600 Rpm
580 Gallons Per Minute Total System Flow
100 PSI Discharge Pressure
6" Discharge Flange Size

Power Requirements:
460 Volt 3 Phase 60 Hz 52 KVA

Pump Station Model # CLCP-500-3-3600-VFD

Station Total #1	$	23,210.00
Station Total #2	$	23,210.00
Total Stations	$	46,420.00

Station to Include :
1. PLC Analog Controls
2. Nema 4 Enclosure with Air Conditioner and Dryer
3. Individual Pump Silent Check Valves
4. 200 Amp Main Disconnect
5. Allen Bradley 1336 VT Series Drive
6. Line Reactor
7. Flowmeter
8. Automatic Alternation
9. Pumpwatch Software
10. Individual Phase Failure Safety
11. Loss of Prime Safety
12. Low Discharge Pressure Safety
13. High Pump Temperature Safety
14. Warranty Labor Billing not to Exceed $ 35.00 and Hour
15. PM Contract by Represenative (To include 3 year extended warranty on controller) $ 1,500.00
Three Visits Per Year/ One Visit Every 120 Days

Both Stations to Be Delivered at the Same Time C.O.D.

Freight is Included In Price at $2,000.00 .

TOTAL	$	47,920.00

STARTUP IS INCLUDED

10717 HARRY HINES BLVD. DALLAS, TEXAS 75220 (214) 357-1320 FAX (214) 357-5861

ATTACHMENT D: HYDRAULIC CALCULATIONS

Existing System Analysis

Existing Pumps

Well Pump:	Single 50HP
Lake 6 Pump:	Dual 25HP with 5HP Jockey (providing reduced pressures)
Lake 10 Pump:	Dual 25HP with 5HP Jockey (no automated control)

Existing Storage

Pond 6 Storage:	108,000	cf
Pond 10 Storage:	25,000	cf

Annual Water Demands

Annual Demand:	175	mgy
Peak Daily Demand:	0.7	mgd

Fairway Water Demands

Number of Sprinklers (8pm-3am):	26	
Unit Demand:	32	gpm/unit
Total Demand:	832	gpm
Qpump=	832	gpm
Daily Duration:	7	hr
Daily Demand=	0.349	mgd

Tee Box Water Demands

Number of Sprinklers (8pm-3am):	8	
Unit Demand:	28	gpm/unit
Total Demand:	224	gpm
Qpump=	224	gpm
Daily Duration:	7	hr
Daily Demand=	0.094	mgd

Green Water Demands

Number of Sprinklers (3am-6am):	28	
Unit Demand:	28	gpm/unit
Total Demand:	784	gpm
Qpump=	784	gpm
Daily Duration:	3	hr
Daily Demand=	0.141	mgd

Irrigation Water Demands

Number of Sprinklers (6am-8am):	20	
Unit Demand:	32	gpm/unit
Total Demand:	640	gpm
Qpump=	640	gpm
Daily Duration:	2	hr
Daily Demand=	0.077	mgd

Alternative 1 - Transmission Line Outlet Pressure

PhysicalSystem

Pressure at LCSD Plant:	105	psi
Head at LCSD Plant:	242.5	ft
Elevation at LCSD Plant:	172	ft
Elevation at Pond 10:	266	ft
Elevation head Loss	-94.0	ft

Friction Head Loss

Hazen-Williams Constant:	130	
Pipe Diameter:	12	in
Pipe Length:	14,900	ft
Flowrate:	1,000	gpm
Flowrate=	2.84	fps
Friction Head Loss=	-37.8	ft

Fitting Head Loss

Number of Gate Valves:	6	
Gate Valve K:	0.2	
Gate Valve Head Loss=	-0.1	ft
Number of 90° Bends:	15	
90° Bend K:	0.9	
90° Bend Head Loss=	-0.8	ft
Number of Tees:	1	
Tee K:	1.8	
Tee Head Loss=	-0.1	ft

Outlet Pressure

Flow (Residual) Head	109.8	ft
Flow (Residual) Pressure	47.5	psi
Static Head	148.5	ft
Static Pressure	64.3	psi

Alternative 1 - Pond 10 Pump

Pump TDH

Pond 6 Elevation	330 ft
Minimum Discharge Pressure:	20 psi, per Engineer
Minimum HGL at discharge=	376 ft
Pump House Elevation:	267 ft
Hazen-Williams Constant:	140
Pipe Size:	6 inch
Maximum Pipe Length:	1800 ft
Pipe Flow:	220 gpm (PHD)
Head Loss=	7.11 ft
Minimum Pressure=	40.0 psi
Critical TDH=	116.3 ft

Pump Size:

Brake Horsepower = $\frac{\text{Qpump x TDHcritical}}{\text{3956 x pump efficiency}}$

Qpump:	832 gpm
Critical TDH:	116 ft
Pump Efficency:	0.7 assumed
Pump size =	34.94 HP
Pump Selection	40 HP Pump

Alternative 2 - Transmission Line Outlet Pressure

PhysicalSystem

Pressure at LCSD Plant:	105	psi
Head at LCSD Plant:	242.5	ft
Elevation at LCSD Plant:	172	ft
Elevation at Proposed Pond:	215	ft
Elevation head Loss	-43.0	ft

Friction Head Loss

Hazen-Williams Constant:	130	
Pipe Diameter:	12	in
Pipe Length:	14,500	ft
Flowrate:	1,000	gpm
Flowrate=	2.84	fps
Friction Head Loss=	-36.8	ft

Fitting Head Loss

Number of Gate Valves:	6	
Gate Valve K:	0.2	
Gate Valve Head Loss=	-0.1	ft
Number of 90° Bends:	15	
90° Bend K:	0.9	
90° Bend Head Loss=	-0.8	ft
Number of Tees:	1	
Tee K:	1.8	
Tee Head Loss=	-0.1	ft

Outlet Pressure

Flow (Residual) Head	161.8	ft
Flow (Residual) Pressure	70.1	psi
Static Head	199.5	ft
Static Pressure	86.4	psi

Alternative 1 - Well Water Booster Pump

Pump TDH

Maximum Sprinkler Elevation:	370	ft
Minimum Operating Pressure:	40	psi, per Engineer
Minimum HGL at discharge=	462	ft
Minimum Sprinkler Elevation:	265	ft
Maximum Operating Pressure:	80	psi, per Engineer
Maximum HGL at discharge=	450	ft
Booster Pump Elevation:	270	ft
Head at Booster Pump:	140.00	ft
Booster Pump HGL=	410.00	ft
Hazen-Williams Constant:	140	
Pipe Size:	4	inch
Maximum Pipe Length:	2500	ft
Pipe Flow:	416	gpm (PHD)
Head Loss=	231.28	ft
Maximum Pressure=	185.6	psi
Minimum Pressure=	40.0	psi
Critical TDH=	283.7	ft

Pump Size:

Brake Horsepower = $\frac{\text{Qpump x TDHcritical}}{\text{3956 x pump efficiency}}$

Qpump:	416	gpm
Critical TDH:	284	ft
Pump Efficency:	0.7	assumed
Pump size =	42.61	HP
Pump Selection	60 HP Pump	

Alternative 2 - Proposed Pond Pump

Pump TDH

Maximum Sprinkler Elevation:	270	ft
Minimum Operating Pressure:	40	psi, per Engineer
Minimum HGL at discharge=	362	ft
Minimum Sprinkler Elevation:	215	ft
Maximum Operating Pressure:	80	psi, per Engineer
Maximum HGL at discharge=	400	ft
Pump House Elevation:	220	ft
Hazen-Williams Constant:	140	
Pipe Size:	4	inch
Maximum Pipe Length:	3000	ft
Pipe Flow:	416	gpm (PHD)
Head Loss=	277.54	ft
Maximum Pressure=	184.0	psi
Minimum Pressure=	40.0	psi
Critical TDH=	419.9	ft

Pump Size:

Brake Horsepower = $\frac{\text{Qpump x TDHcritical}}{\text{3956 x pump efficiency}}$

Qpump:	832	gpm
Critical TDH:	420	ft
Pump Efficency:	0.7	assumed
Pump size =	126.16	HP
Pump Selection	140	HP Pump

Alternative 2 - Booster Pump

Pump TDH

Maximum Sprinkler Elevation:	370	ft
Minimum Operating Pressure:	40	psi, per Engineer
Minimum HGL at discharge=	462	ft
Minimum Sprinkler Elevation:	265	ft
Maximum Operating Pressure:	80	psi, per Engineer
Maximum HGL at discharge=	450	ft
Booster Pump Elevation:	265	ft
Head at Booster Pump:	92.00	ft
Booster Pump HGL=	357.00	ft
Hazen-Williams Constant:	140	
Pipe Size:	4	inch
Maximum Pipe Length:	2500	ft
Pipe Flow:	416	gpm (PHD)
Head Loss=	231.28	ft
Maximum Pressure=	185.6	psi
Minimum Pressure=	40.0	psi
Critical TDH=	336.7	ft

Pump Size:

Brake Horsepower = $\frac{\text{Qpump x TDHcritical}}{\text{3956 x pump efficiency}}$

Qpump:	416	gpm
Critical TDH:	337	ft
Pump Efficency:	0.7	assumed
Pump size =	50.57	HP
Pump Selection	60 HP Pump	

Alternative 3 - Transmission Line Outlet Pressure

PhysicalSystem

Pressure at LCSD Plant:	105	psi
Head at LCSD Plant:	242.5	ft
Elevation at LCSD Plant:	172	ft
Elevation at Proposed Tank:	295	ft
Elevation head Loss	-123.0	ft

Friction Head Loss

Hazen-Williams Constant:	130	
Pipe Diameter:	12	in
Pipe Length:	15,500	ft
Flowrate:	1,000	gpm
Flowrate=	2.84	fps
Friction Head Loss=	-39.3	ft

Fitting Head Loss

Number of Gate Valves:	6	
Gate Valve K:	0.2	
Gate Valve Head Loss=	-0.1	ft
Number of 90° Bends:	15	
90° Bend K:	0.9	
90° Bend Head Loss=	-0.8	ft
Number of Tees:	1	
Tee K:	1.8	
Tee Head Loss=	-0.1	ft

Outlet Pressure

Flow (Residual) Head	79.3	ft
Flow (Residual) Pressure	34.3	psi
Static Head	119.5	ft
Static Pressure	51.7	psi

Alternative 3 - Booster Pump

Pump TDH

Maximum Sprinkler Elevation:	370	ft
Minimum Operating Pressure:	40	psi, per Engineer
Minimum HGL at discharge=	462	ft
Minimum Sprinkler Elevation:	265	ft
Maximum Operating Pressure:	80	psi, per Engineer
Maximum HGL at discharge=	450	ft
Booster Pump Elevation:	265	ft
Head at Booster Pump:	30.00	ft
Booster Pump HGL=	295.00	ft
Hazen-Williams Constant:	140	
Pipe Size:	4	inch
Maximum Pipe Length:	2500	ft
Pipe Flow:	416	gpm (PHD)
Head Loss=	231.28	ft
Maximum Pressure=	185.6	psi
Minimum Pressure=	40.0	psi
Critical TDH=	398.7	ft

Pump Size:

Brake Horsepower = $\frac{\text{Qpump x TDHcritical}}{\text{3956 x pump efficiency}}$

Qpump:	416	gpm
Critical TDH:	399	ft
Pump Efficency:	0.7	assumed
Pump size =	59.89	HP
Pump Selection	80	HP Pump

FlexTable: Junction Table (Existing Model.wtg)

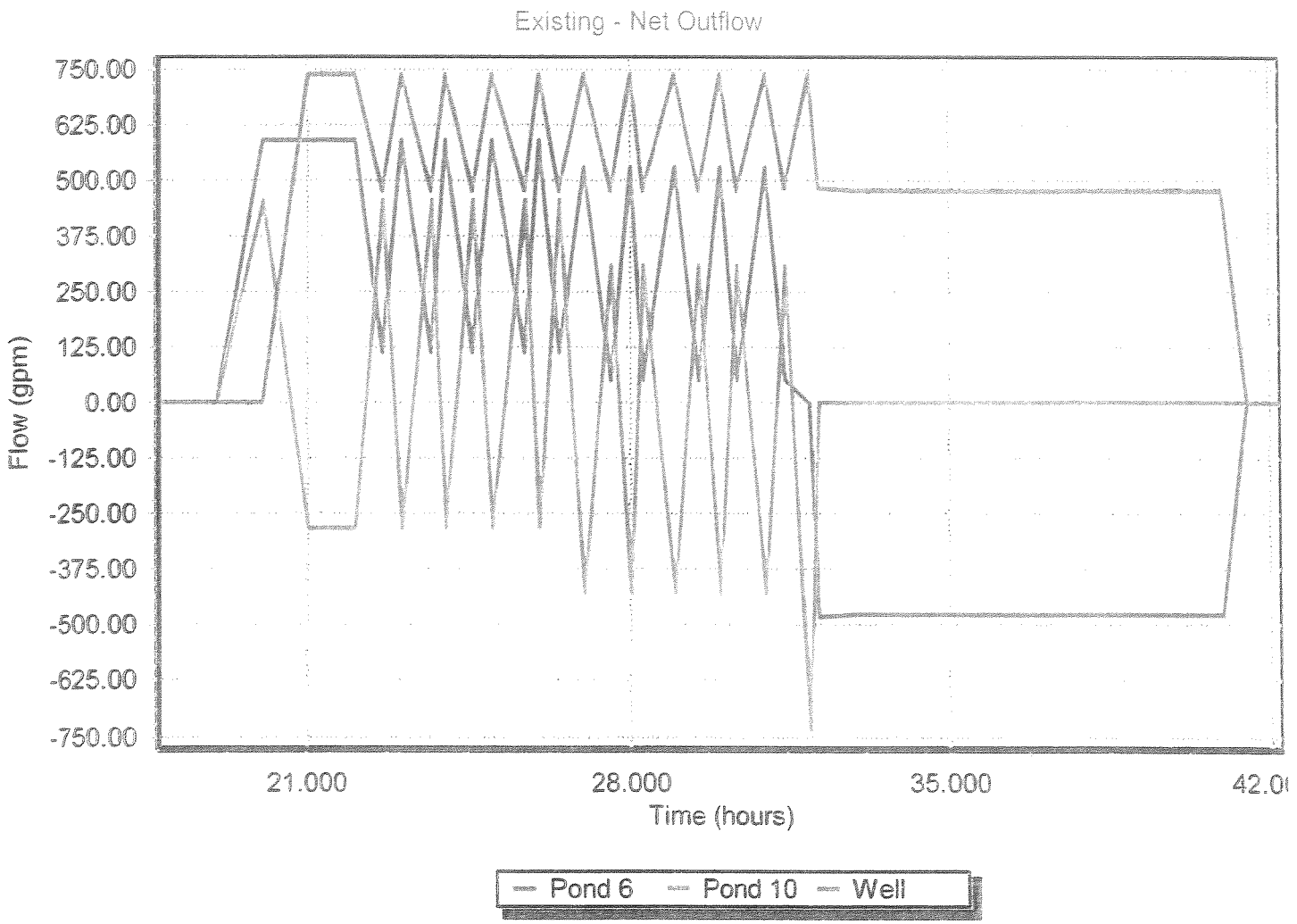
Current Time: 0.000 hours

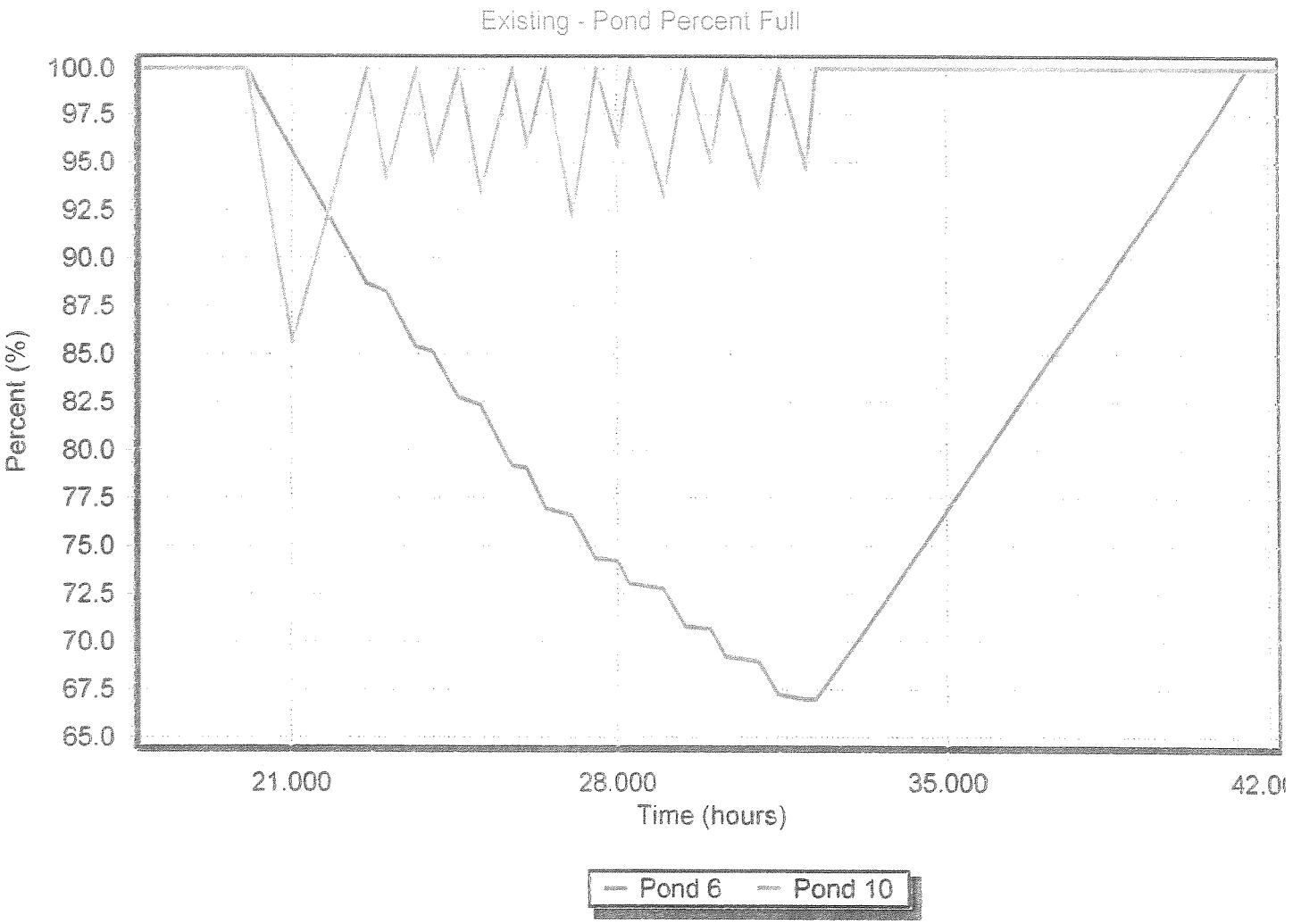
Label	Elevation (ft)	Pressure (psi)	Zone
Hole 1	241.00	105.8	Existing
Hole 2	222.00	111.9	Existing
Hole 4	260.00	93.4	Existing
Hole 7	364.00	81.3	Existing
Hole 9	270.00	98.0	Existing
Hole 12	361.00	41.7	Existing
Hole 15	219.00	75.8	Existing
Hole 16	225.00	77.5	Existing
Hole 17	227.00	80.6	Existing
Hole 18	234.00	80.5	Existing
Pump 6	331.00	104.9	Existing
Pump 10	267.00	94.9	Existing

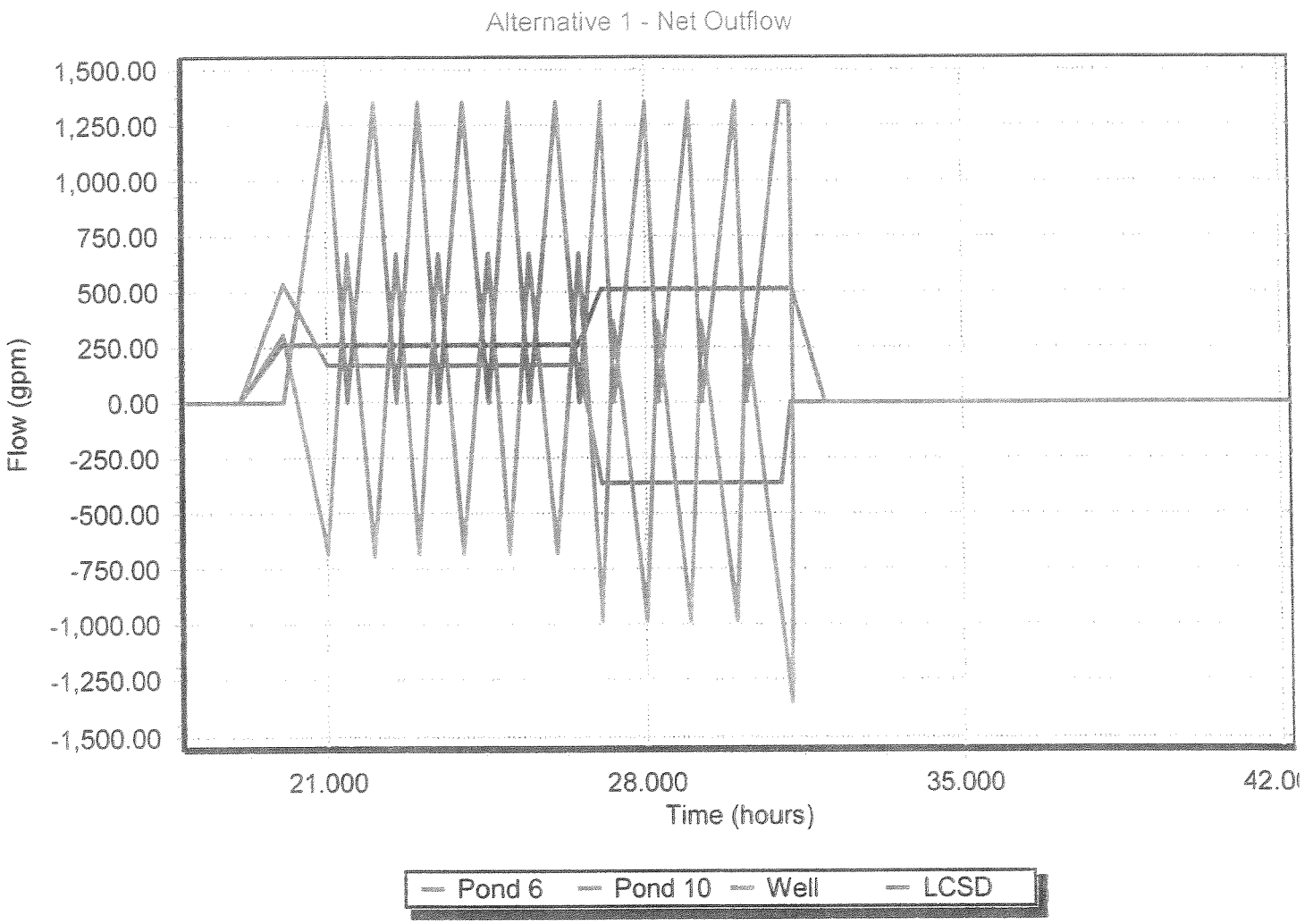
FlexTable: Junction Table (proposed model.wtg)

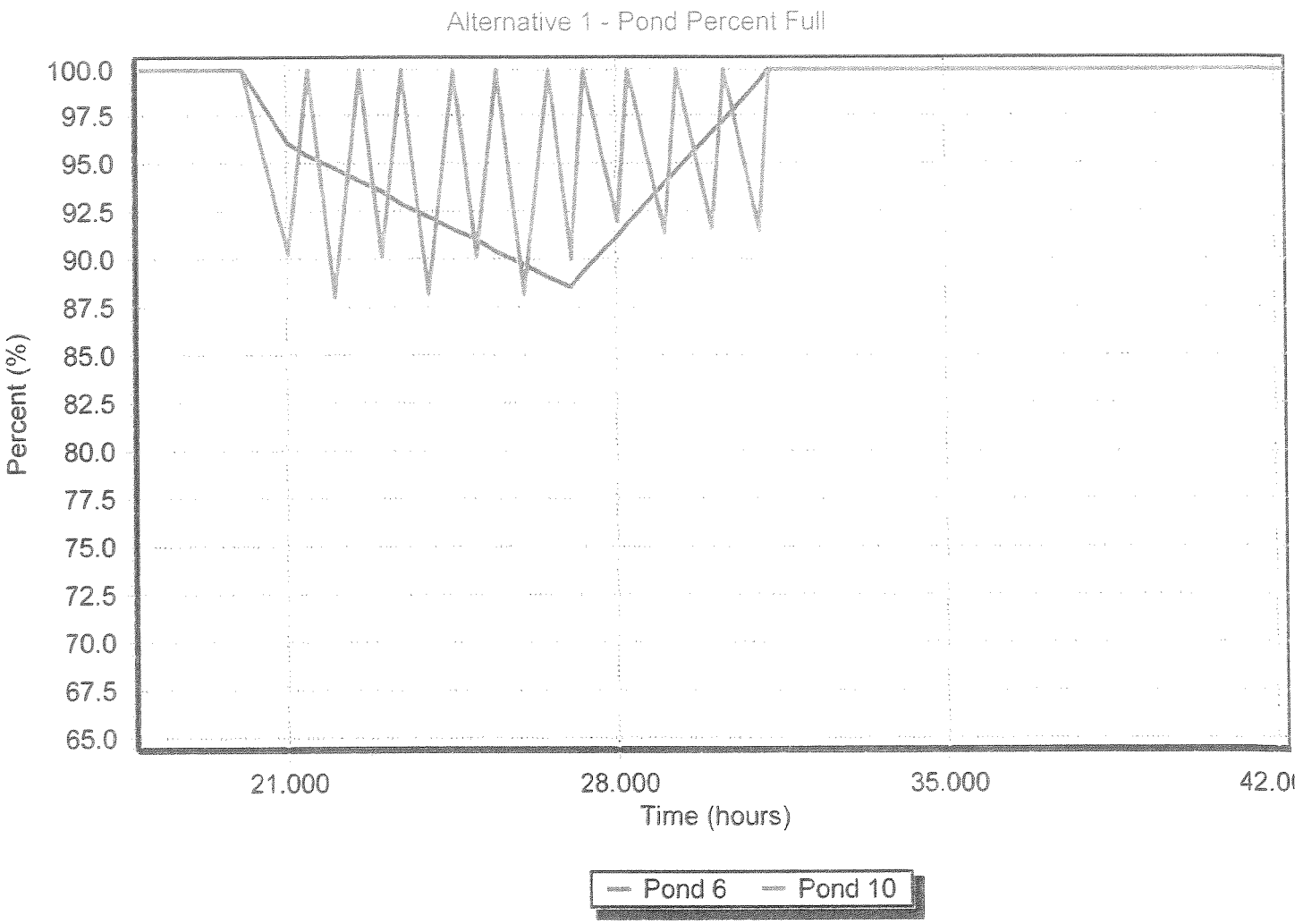
Current Time: 0.000 hours

Label	Elevation (ft)	Pressure (psi)	Zone
Hole 1	241.00	71.7	Well
Hole 1	241.00	105.8	Recycle
Hole 2	222.00	79.6	Well
Hole 2	222.00	111.9	Recycle
Hole 4	260.00	93.4	Recycle
Hole 7	364.00	71.9	Well
Hole 7	364.00	81.3	Recycle
Hole 9	270.00	59.3	Well
Hole 9	270.00	98.0	Recycle
Hole 12	361.00	72.2	Well
Hole 12	361.00	41.7	Recycle
Hole 13	294.00	99.9	Well
Hole 14	238.00	72.0	Well
Hole 15	219.00	75.8	Recycle
Hole 16	225.00	77.2	Well
Hole 16	225.00	77.5	Recycle
Hole 17	227.00	80.6	Recycle
Hole 18	234.00	73.7	Well
Hole 18	234.00	80.5	Recycle
Pump 6	331.00	104.9	Recycle
Pump 10	267.00	94.9	Recycle
Well	270.00	59.6	Well
Well Booster	270.00	113.3	Well


Existing - Net Outflow
750.00
625.00
500.00
375.00
250.00
125.00
0.00
-125.00
-250.00
-375.00
-500.00
-625.00
-750.00
Flow (gpm)
21.000
28.000
35.000
Time (hours)
Pond 6
Pond 10
Well


Existing - Pond Percent Full
100.0
97.5
95.0
92.5
90.0
87.5
85.0
82.5
80.0
77.5
75.0
72.5
70.0
67.5
65.0
Percent (%)
21.000
28.000
35.000
Time (hours)
Pond 6
Pond 10


Alternative 1 - Net Outflow
1,500.00
1,250.00
1,000.00
750.00
500.00
250.00
0.00
-250.00
-500.00
-750.00
-1,000.00
-1,250.00
-1,500.00
Flow (gpm)
21.000
28.000
35.000
Time (hours)
Pond 6
Pond 10
Well
LCSD


Alternative 1 - Pond Percent Full
100.0
97.5
95.0
92.5
90.0
87.5
85.0
82.5
80.0
77.5
75.0
72.5
70.0
67.5
65.0
Percent (%)
21.000
28.000
35.000
Time (hours)
Pond 6
Pond 10

Laguna County Sanitation District Recycled Water Agronomic Investigation Final Report

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Laguna County Sanitation District

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REVIEWED BY: Mary Vorissis, CH2M HILL
Terry Foreman, CH2M HILL

DATE: February 10, 2009

Introduction

Laguna County Sanitation District's (LCSD) Waste Discharge Requirements and Master Recycling Permit allow for recycled water reuse involving irrigation of landscaping, crop and pastureland on District property; approved user sites as they become available; and other uses that are approved by the Regional Water Quality Control Board (RWQCB). LCSD is in the process of developing a project to deliver recycled water to Rancho Maria Golf Course (RMGC), in the Orcutt/Santa Maria area. RMGC currently uses groundwater taken from an on-site well for irrigation purposes and use of groundwater could be eliminated or reduced with the transition to a recycled water supply.

The purpose of this project is to ensure that: 1) impacts to RMGC vegetation are minimized or avoided following transition to a recycled water irrigation source; and 2) the proposed implementation approach allows for easy integration into the current RMGC irrigation and turfgrass management program. Source waters and on-site soils were evaluated and RMGC staff were interviewed in the process of developing irrigation and landscape management recommendations. Management options for consideration include selection of salt tolerant turf and landscape plants; management of recycled water with an appropriate leaching fraction to prevent salt buildup in soils; blending of recycled water with potable water to a defined salinity target; and dual plumbing of fairways and greens with a potable supply to greens. Each of these options has specific facility and operations requirements that are discussed.

Ranch Maria Golf Course Description

Vegetation and Irrigation Water Management

The irrigation system at RMGC supplies water to approximately 86 irrigated acres. Irrigated areas at RMGC are shown in Figure 1, with acreage for each area quantified in Table 1. Greens comprise about 2.3 acres or a little less than 3 percent of the total irrigated area. Although tees were not delineated independently, assuming tee areas are equivalent to

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green areas would suggest that about 5 percent of the total irrigated area is managed for green and tee irrigation.

A single well with a 50 hp vertical turbine pump is currently the sole water supply at RMGC. Water is delivered from the well located near the club house to either Pond 10 (adjacent to Hole 10) or to Pond 6 (adjacent to Hole 6). Booster pump stations at each pond (15 hp end suction centrifugal) are used to draw water from the pond and pressurize the irrigation system. The front nine holes (i.e., southern one-half of golf course) are supplied from Pond 6 and the back nine holes (i.e., northern one-half of golf course) are supplied from Pond 10 (see Photo 10). The irrigation distribution and application system is a mixture of automatic sprinklers generally covering tees and greens and manually moved sprinklers connected to quick couplers installed along the distribution piping. The typical schedule for irrigation during the peak summer period is as follows:

7:00 pm to 2:30 am	Tees and large fairways
2:30 am to 4:30 am	Greens
4:30 am to 8:00 am	Additional small fairways

Information about the RMGC irrigation system, irrigation operational procedures, turfgrass and landscape plants, site soils and drainage issues is summarized in Table 2. In summary, irrigation occurs daily on the greens and tees with irrigation to fairways alternating every other day. Turf grass at RMGS includes a mixture of cool and warm season grasses but is dominated by perennial ryegrass (*Lolium perenne*) on fairways and by annual bluegrass (*Poa annua*) on greens and tees. Photos 1 and 2 show turfgrass on greens and fairways.

Soils and Drainage

General information on RMGC soils was evaluated using published Natural Resource Conservation Service (NRCS) Soil Survey data to aid in understanding potential site drainage issues (Soil Survey for Northern Santa Barbara Area). Table 3 provides information about soils associated with each hole on the golf course, and Appendix A provides a general soils map, interpretation maps for soil saturated hydraulic conductivity (K_s) and drainage class, and official soil series descriptions for the dominant soils. Primary soils at the site include soils belonging to the Betteravia, Botella, Corralitos, Elder, Pleasanton, and Tierra series. The soil expected to have the greatest drainage limitation (rated with both low K_s and less than a "well drained" drainage class) is the Tierra loam, which encompasses approximately the southern half of RMGC. This soil consists of loam surface soils overlying clay to heavy clay loam subsoils. After substantial rain, water ponds in depressions in areas with Tierra soils and soils can become waterlogged (see Photos 3 and 5). Although rated with a "well drained" drainage class, the Botella clay loam also has low K_s in a portion of the profile which may impair drainage. This soil is mapped over a small portion of the northwest corner of RMGC and consists of silty clay loam surface soils overlying silty clay loam to sandy clay subsoils.

As part of this work, soils of RMGC fairways and greens were sampled and analyzed for salinity. Sampling locations and methodology are shown in Table 4 (Photo 11 shows soil sampling on a green). Areas for sampling were selected to identify differences in well drained and poorly drained greens and fairways, which were identified by RMGC staff. Sampling occurred on December 18, 2008, two days following a storm that delivered one-quarter inch of rain to the site. Samples were shipped the following day (December 19,

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2008) to A&L Western Laboratories, Modesto, CA for salinity analysis. Results are tabulated in Table 5 and shown graphically in Figures 2 through 7. These results are discussed further in the RMGC Water Quality Interpretations section.

According to staff, the greens on Holes 4 and 8 are poorly drained, while greens on Holes 1 and 16 drain well. This anecdotal information was substantiated by the presence of a clay layer, which was observed at a depth of 9 to 11 inches in soils of greens 4 and 8, and which was not observed in the well drained greens on Holes 1 and 16. The greens on Holes 4 and 8 are on Tierra loam soils, which have a clay layer at a depth of 6 to 43 inches that would impede water movement. On the other hand, the greens on Holes 1 and 16 are on soils classified as Betteravia loamy sands, which have a loamy sand texture to a depth of 26 inches and, therefore, no restriction to water movement.

According to RMGC staff, the fairway on Hole 18 has the greatest drainage problem on the golf course, and has frequent standing water, while the fairway on Hole 11 is well drained. Fairway soils on Hole 18 are classified as either Pleasanton sandy loam or Corralitos loamy sand. Corralitos soils have a sandy texture to a depth of 60 inches, with no restrictive layer, and they are somewhat excessively drained. Pleasanton surface soils are sandy loams that are underlain by cobbly clay loam at a depth of 32 to 39 inches. Based on soil characteristics published in the soil survey and observed in the field, soils on the Hole 18 fairway should transmit water readily. However, the fairway receives a substantial amount of run-on during storms and when areas that drain to this hole are over-irrigated, according to RMGC staff. Therefore, site hydrology and irrigation management may explain staff's observations.

The Hole 11 fairway has no drainage problems, according to RMGC staff. Soils underlying the fairway are classified as Gullied land and Tierra loam. This hole receives no water run-on from upgradient areas and run-off rate can be very high (Table 3). Soil texture of composite samples was estimated to be sandy clay loam, based on hand-texturing when preparing the samples for analysis. Based on hydrology and soil texture, the fairway on Hole 11 would not be expected to have problems with drainage. Thus, neither of the fairway soils sampled are likely to have problems with soil permeability; other fairways that occur on Tierra soils and have substantial clay content may need to be further evaluated to get a better indication of irrigation management needs on soils with greater permeability problems. Additional soils information for each hole is provided in Table 3, and notes on field observations for each hole are documented in Appendix B.

Two greens on the golf course have artificial drainage: the green on Hole 6 is a USGA sand bedded green with built-in drainage; the green on Hole 5 has a "herringbone" subsurface drainage, and during the summer RMGC staff indicated there is a sometimes a green herringbone pattern observed on the green. There is artificial drainage on two fairways: one pipe drain on Hole 13, and a drain with a sump pump in front of the green on Hole 15 (see Photo 7). In addition, a drainage ditch has been constructed on the west side of Hole 5 to reduce the amount of runoff to Holes 5 and 4 (see Photo 7); and near the Hole 16 tee, a pipe discharges water to a culvert that crosses under the highway on the northwest corner of the site (see Photo 8).

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Irrigation Water Quality Evaluation

Recycled water and groundwater quality data were provided by LCSD, RMGC, and other recycled water purveyors. These data are summarized in Table 6 with graphical comparisons presented in Figures 8 and 9. In general, the LCSD recycled water has higher salinity levels (but lower hardness) than the groundwater source currently used for irrigation at RMGC, but has lower salinity levels than most other recycled water sources in the area. The only recycled water source with lower salinity levels is that produced by the California Men's Colony.

Golf course superintendents and recycled water purveyors from the Central Coast area were contacted through a telephone survey in order to gather practical observations and management implications from other local golf courses utilizing recycled water for irrigation. A total of 14 different golf courses were contacted and information was retrieved about the use of recycled water on nine of those courses. Conversation records from those interviews are presented in Appendix C, and a summary of information that was gathered follows below.

The two golf courses contacted that receive City of Santa Barbara recycled water (Montecito Country Club and Santa Barbara Golf Club) deliver potable water to greens and recycled water to fairways. Water chemistry of both recycled water and potable water is shown in Table 6. The Santa Barbara Golf Club started out sending recycled water to greens. After problems were encountered with salt impacts to the turfgrass, they began blending with potable water but have since shifted exclusively to potable water on greens. Within areas irrigated with recycled water, some salt sensitive plants that receive direct overspray contact show damage to foliage. However, the salinity of the City of Santa Barbara recycled water (1127 mg/L Total Dissolved Solids (TDS) and 1.72 dS/m) is substantially higher than that of the LCSD recycled water (741 mg/L TDS and 1.47 dS/m).

The three golf courses receiving recycled water from Goleta Sanitary District all use potable water for irrigation of greens according to the contact at the Goleta Water District, who is the water supplier. (Note that Goleta Sanitary District is the wholesaler, and Goleta Water District is the retailer of recycled water.) The salinity of the Goleta Sanitary District recycled water (1086 mg/L TDS) is similar to that of the City of Santa Barbara recycled water (1127 mg/L TDS) and, again, is substantially higher than the LCSD recycled water (741 mg/L TDS).

Recycled water produced by the County of San Luis Obispo County Service Area (CSA) 18 is used for irrigation on about 25 percent of the San Luis Obispo Country Club area, excluding greens. Salinity problems are encountered in areas receiving recycled water, due to the tight clay soils and impaired drainage. The salinity and specific salt concentrations of the County of San Luis Obispo recycled water (1000 mg/L TDS; 250 mg/L sodium; 218 mg/L chloride) are higher than the LCSD recycled water (741 mg/L TDS; 171 mg/L sodium; 195 mg/L chloride).

City of San Luis Obispo recycled water is delivered to the Laguna Lakes Golf Course, where it is used for irrigation of the entire 9-hole course. This golf course has had some challenges with salt management, due to recycled water quality and poor drainage within the pushup greens. Gypsum application accompanied by nighttime over-irrigation and leaching is practiced once per month on the greens to manage salts. They blend groundwater and

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recycled water to achieve an EC of 1.34 dS/m[1], which is slightly lower than the EC of LCSD water, which is 1.47 dS/m.

The Cypress Ridge Golf Course in San Luis Obispo County receives recycled water from a small WWTP, which serves 378 homes. Recycled water is blended with groundwater within an on-site lake/reservoir. This golf course is not having any salinity problems with the use of recycled water, but the water quality is unknown and, with blending, the recycled water is only a small fraction of the total water supply.

The Dairy Creek Golf Course (DCGC) receives recycled water from the California Men's Colony (CMC) WWTP and uses the water for irrigation of the entire golf course, with no problems. All greens are United States Golf Association (USGA) sand bedded greens with good drainage, and the quality of recycled water is high. The CMC recycled water (646 mg/L TDS; 114 mg/L sodium; 175 mg/L chloride) has lower salinity and specific salt concentrations than the LCSD recycled water (741 mg/L TDS; 171 mg/L sodium; 195 mg/L chloride).

General conclusions from these interviews suggest a few common issues:

- Good drainage is key to managing salts from recycled water irrigation, and USGA sand bedded greens have fewer problems than pushup greens;
- Most golf courses in the area exclude recycled water from irrigation of greens. but most golf courses are also receiving recycled water at higher salinity levels than the LCSD recycled water; and
- Recycled water with higher salinity levels than the LCSD water is being effectively used for irrigation of fairways at several sites.

The only golf course interviewed that is successfully utilizing unblended recycled water for irrigation of greens is the DCGC.

Rancho Maria Golf Course Water Quality Interpretations

The LCSD recycled water quality was evaluated for potential salinity and specific ion toxicity problems for turfgrass and other landscape plants within the golf course and possible soil infiltration hazard. Water quality assessments followed guidelines from Water Quality for Agriculture (Ayers and Westcot, 1989), Wastewater Reuse for Golf Course Irrigation (USGA, 1994), and Salt-Affected Turfgrass Sites: Assessment and Management (Carrow and Duncan, 1998). Results are summarized below.

Salinity

High salt content in soil solution can make it difficult for sensitive plants to take up water and can damage plants on a cellular level. The monthly average TDS content of LCSD recycled water ranged from about 700-830 mg/L and averaged 741 mg/L with an average electrical conductivity (EC) of 1.47 dS/m for the period 2006-2008 (Table 6 and Figure 8). While salinity in LCSD recycled water is substantially lower than most other recycled water sources in the vicinity, these salinity levels will still result in slight to moderate use restrictions. Measures to manage salinity might include blending to reduce salinity levels in

[1] Electrical Conductivity Unit Conversions: 1 dS/m = 1 mmhos/cm = 1,000 μmhos/cm

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the irrigation water, regular leaching to reduce salt buildup in the plant root zone, and/or improvement of drainage on greens and fairways to allow higher leaching fractions. Potential implications for leaching fractions and/or blending ratios to manage salinity within plant tolerance levels are discussed in following sections.

The EC tolerance thresholds for RMGC vegetation are provided in Table 7. Specific vegetation range in tolerance, from sensitive to tolerant. The dominant grass species used on the tees and greens (annual bluegrass) is considered salt sensitive while the dominant fairway grass (perennial ryegrass) is considered moderately salt tolerant.

Irrigation of the annual bluegrass that dominates the greens would likely require some special salinity management measures, in particular for the poorly drained greens. Table 5 shows that, at the time of sampling in December 2008, EC_e in soils of well drained greens (0.6 dS/m) was less than the EC_w of the groundwater irrigation source (0.94 dS/m) and well below the threshold EC_e of annual bluegrass (1.5 dS/m). On the other hand, soil EC_e of poorly drained greens was greater than EC_e of well drained greens at each depth increment. The average soil EC_e for poorly drained greens (1.3 dS/m) was slightly below the threshold EC_e for annual bluegrass (1.5 dS/m). Using the observed ratio of EC_{GW}:EC_e and assuming the same irrigation management, it is estimated that if LCSD recycled water were being used for irrigation of greens, the average soil EC_e in poorly drained greens would have been approximately 2.0 dS/m (versus 1.3 dS/m), thus exceeding the threshold EC_e for annual bluegrass (1.5 dS/m). Salinity impacts to sensitive turfgrass species, such as annual bluegrass, could potentially be avoided by increasing the amount of irrigation water applied to the greens to flush salts below the root zone. Because the salinity of LCSD recycled water is at the tolerance threshold for annual bluegrass, however, irrigation would need to be carefully managed in order to avoid turfgrass damage from salinity. For example, in order for application of a leaching fraction to be successful, the soil's hydraulic conductivity would need to be great enough to accept the additional water without ponding, generating runoff, or perching water in the plant root zone. Further testing on the greens would be important to ensure adequate drainage when a leaching fraction is applied, especially on poorly drained greens that have a clay layer at the 9 to 11 inch depth.

EC_e for both well drained and poorly drained fairway soils was similar and averaged 4.2 dS/m across all depth increments, a level considered slightly saline. This is far greater than the threshold EC_e for annual bluegrass and Kentucky bluegrass; near the threshold EC_e for common bermudagrass; and less than the threshold EC_e for perennial ryegrass, tall fescue, and kikuyugrass. High salinity levels in fairway soils would be expected to adversely impact growth of annual bluegrass and Kentucky bluegrass, even when utilizing groundwater for irrigation. Using the observed ratio of EC_{GW}:EC_e for fairway soils, and assuming no change in irrigation management, it is estimated that if LCSD recycled water were being used for irrigation of fairways, soil EC_e of fairways on Holes 18 and 11 would have been approximately 6.6 dS/m (versus 4.2 dS/m) or slightly above the threshold EC_e for perennial ryegrass (6.5 dS/m). RMGC staff indicated that fairways are being managed to eliminate tall fescue and kikuyugrass where they occur and are overseeded with perennial ryegrass following treatment. Photo 9 shows the Hole 14 fairway following treatment to control kikuyugrass. Other management options may need to be considered in order to ensure turfgrasses are grown that can tolerate the salinity levels expected in LCSD recycled water.

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Since soil sampling occurred in December and followed a 0.25 inch rain event, salinity profiles might show lower salt impact than if sampling had occurred in the late summer months following the highest water demand period with low rainfall.

Specific Ion Toxicity

Specific ions such as sodium, chloride, and boron are all either micronutrients or growth stimulants at low concentrations but can be toxic to plants at higher concentrations. The impact of specific ion toxicity is generally more of an issue for woody plants than for herbaceous plants. The long term accumulation of these ions in plant tissue and damage by foliar absorption where plants receive irrigation overspray onto their leaves can have a detrimental affect on these sensitive plants. General salinity management is more of a driving concern with grasses than is specific ion toxicity since regular mowing typically removes ions accumulated in plant tissue.

The average concentrations of these specific ions in the LCSD recycled water are: 171 mg/L (7.5 meq/L) sodium; 195 mg/L (5.5 meq/L) chloride; and 0.38 mg/L boron. Boron is well below levels that restrict use on any but the most sensitive of plants. However, some leaf injury from sodium and/or chloride could be expected on a range of sensitive trees, especially in locations where irrigation water sprays up onto tree leaves. Observations from the Santa Barbara Golf Club show that leaf contact of the recycled water does produce foliar damage on leaves that are contacted for several tree species but that the whole plant is not affected. LCSD recycled water has a slightly higher sodium concentration but a substantially lower chloride concentration than recycled water from City of Santa Barbara. Most landscape trees lining fairways and roughs at RMGC are mature and do not come in contact with irrigation spray. However, in some areas, young trees have been planted (e.g. along Hole 2) or shrub cover is near the ground surface (e.g., along Hole 14), and lower foliage in these areas may intercept irrigation spray. Potential management measures to avoid leaf injury where overspray is a concern might include installing lower trajectory sprinkler heads in locations where tree foliage contact can be avoided.

Soil Infiltration Hazard

High sodium content in fine-textured soils can cause destruction of soil structure, dispersion and reduced ability for water to infiltrate the soil. The sodium hazard is more severe when sodium is the dominant ion in solution (i.e., calcium and magnesium levels are low) and EC is low. The sodium hazard is predicted by evaluating the sodium adsorption ratio (SAR), which is defined in irrigation water as:

$$SAR = \frac{[Na]}{\sqrt{\frac{([Ca]+[Mg])}{2}}} \qquad (1)$$

where [Na], [Ca], and [Mg] are expressed in meq/L concentrations

The relative soil infiltration hazard due to sodium is presented in Figure 9 for both the existing groundwater source at RMGC and the LCSD recycled water. While the SAR of the LCSD is higher, EC is also higher and both water sources fall into the same low to no risk category. Some infiltration hazard could result from large amounts of freshwater irrigation or rainfall following irrigation using LCSD water. However, this low risk could be

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controlled if problems arise by periodic application of gypsum to improve soil structure and support leaching of sodium through the root zone.

Leaching Requirement

To prevent salt buildup from becoming excessive within the plant root zone, irrigation can be managed to apply more water than is required by the plant, in order to move a portion of the excess salts below the root zone. In order to estimate leaching requirement, both EC of the irrigation water and the EC tolerance threshold of the plant must be known. Leaching fractions were calculated using the following equation (Ayers and Westcot, 1989):

$$LF = \frac{EC_w}{5(EC_e) - EC_w} \quad (2)$$

where LF = leaching fraction

EC_w = EC of irrigation water (dS/m)

EC_e = Plant threshold EC of soil saturation paste extract (dS/m)

For irrigation of greens where salt tolerance is low and hence leaching fractions would be highest, Table 8 is used show the range of anticipated leaching requirements using irrigation water ranging in salinity levels between that of the LCSD recycled water and the RMGC groundwater source. These calculations suggest that a leaching fraction of 14 percent is required when using the RMGC groundwater source and the leaching fraction would need to be increased to 24 percent under irrigation using a 100 percent LCSD recycled water source. The ability of greens and/or fairways to accept an additional 10 percent of applied water and adequately drain the leaching fraction away would need to be established before relying simply on increased irrigation application and leaching fraction to manage salinity.

Potential Blending Options

One potential option for management of salinity impacts would be to target a specific blending ratio between the LCSD recycled water and the RMGC groundwater source. A range of blending ratios and their resulting blending EC_w values are shown in Table 8. In order for a blended water source to be in the range of the California Men's Colony recycled water EC_w (estimated at 1.28 dS/m) used on the Dairy Creek course, the blending ratio would have to be approximately 2:1 recycled water to groundwater. Assuming no change in irrigation management and a transition from the RMGC groundwater source to a blended water with EC_w of 1.28 dS/m, the average soil EC_e in poorly drained greens might be expected to increase to 1.8 dS/m (versus 1.3 dS/m) with the average soil EC_e in fairways increasing to 5.7 dS/m (versus 4.2 dS/m). With minor improvements in drainage of the poorly drained greens and/or scheduled leaching events on the greens, it should be possible to manage soil EC_e below the 1.5 dS/m threshold of the annual bluegrass.

Irrigation Water Budget Evaluation

Water deliveries at RMGC have not been metered in the past so data on total applied irrigation volumes is based on anecdotal information. According to RMGC staff, annual applied irrigation volumes are about 175 MG (537 ac-ft) and peak daily irrigation volumes

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are approximately 700,000 gallons per day based on pond volumes and daily refilling operations.

Irrigation water budgets were prepared to evaluate the fluctuation in irrigation volumes from month to month and to aid in understanding the application efficiency and leaching fractions under current operations. An estimated average monthly irrigation water budget is presented in Table 9 and is based on estimated turfgrass evapotranspiration rates and average precipitation from a local CIMIS station (Station 165, Sisquoc, near Santa Maria). Irrigation application efficiency was estimated at 60 percent, which is on the lower end of typical golf course efficiency, based on the older irrigation system with manual move sprinkler operations and widely spaced sprinklers. Annual leaching fraction requirements were estimated at 14 percent based on the water quality data presented previously in Table 8. Results of this water budget estimate an annual irrigation demand of 176 MG, which is very close to the estimate provided by RMGC staff.

Although flow meter data were not available, electricity usage data was obtained from meters at each pump station location. The annual distribution of monthly irrigation volumes was estimated using the monthly electricity records and normalizing the distribution for an annual delivery of 175 MG. Estimated average daily irrigation demands for each month were then compared to those presented in the existing system water budget as shown in Figure 11. Average daily demands by the two methods produce similar results indicating that RMGC is operating irrigation applications in close coordination with climatic demands throughout the year. These average daily flows will be useful for LCSD in developing a system-wide water budget for balancing recycled water deliveries with irrigation demands.

Recycled Water Management Alternatives

Based on evaluation of available information, there are three primary alternatives for utilizing LCSD's recycled water at RMGC.

1. Dual plumb for delivery of groundwater to tees and greens and recycled water to fairways.

Description: This alternative would require conveyance and pumping modifications at RMGC to allow independent delivery of the LCSD recycled water from the ponds and the RMGC groundwater sources from the wells. Since all tees, greens, and fairways are connected to the same distribution system, there are two piping/operation alternatives that could be investigated:

1) Irrigation could be scheduled with greens and tees irrigated at different times than fairways using the existing irrigation piping network. Recycled water would be supplied to the irrigation ponds and groundwater would be piped into the irrigation mainlines downstream of the ponds with air gaps or double check valves for cross-connection control. An allowance for some freshwater flushing of the system at the end of fairway irrigation sets and before tee and green irrigation sets would be required with this alternative to purge recycled water prior to irrigation of greens and tees; or

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2) The fairway and green/tee piping systems would be disconnected and a parallel piping network would be installed across the golf course to connect the groundwater supply directly into the greens and tees irrigation piping. Recycled water would be delivered to the irrigation ponds and the existing pumping and irrigation systems would be used to irrigate the fairways exclusively with recycled water. For either of these options, modifications to the groundwater pumping system may be required.

Irrigating fairways with 100 percent recycled water should pose no problems for turfgrass. Other golf courses in the area irrigate fairways with recycled water having higher salinity than LCSD recycled water, with no adverse effects. Assuming the dominant turfgrass species is perennial ryegrass, a leaching fraction of about 5 percent would be necessary to flush excess salts through the root zone, assuming an EC_e threshold of 6.5 dS/m. RMGC already applies a leaching fraction of about 14 percent (Table 9), so leaching is probably adequate to control salinity under the current irrigation management. If more sensitive turfgrass species are present (for example, Kentucky bluegrass), irrigation management may need to be adjusted to ensure no salinity impacts occur to those species, or overseeding with more salt-tolerant species, such as perennial ryegrass, should be considered.

RMGC has expressed concern with respect to irrigation overlap, where irrigation of the fairway on some holes also wets the adjacent green. On greens receiving overspray, RMGC believes salinity problems could occur if greens are irrigated with 100 percent recycled water. Because greens would continue to be watered daily using potable water, salinity in overspray would be diluted and flushed through the root zone; therefore, no turfgrass performance problems would be anticipated. The irrigation system could be modified to reduce overlap if monitoring indicates that salinity impacts are occurring.

Pros: Benefits of this alternative include lower salt management requirements for the tees and greens than other alternatives and a high level of LCSD recycled water beneficial reuse.

Cons: Most costly capital improvement option. Modifications likely required to groundwater well pump and motor with piping and valving modifications required at each irrigation pond. More complex irrigation operations required by RMGC staff to ensure careful sequencing of water delivery to each irrigation area.

2. Implement a blending program sending blended water to all irrigated areas on the course.

Description: With this alternative, LCSD recycled water and RMGC groundwater would both be delivered to the irrigation ponds at a defined blending ratio. The only changes to irrigation operations would be increased irrigation deliveries to greens and fairways to achieve a higher leaching fraction, and coordination of blending ratios between the two water sources.

Salinity levels in LCSD recycled water are already relatively low, compared to that of other recycled water producers in the area. By blending recycled water with groundwater, salinity levels can be further reduced to levels that are not anticipated to cause salinity impacts to turfgrass on either greens or fairways, assuming drainage is adequate on greens to allow for flushing of salts through the root zone. Improved drainage on poorly drained greens and tees, however, may be required.

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Pros: Only minor irrigation operational changes with a moderate level of LCSD recycled water beneficial reuse.

Cons: Uncertain costs of drainage improvements.

3. Proceed with sending unblended recycled water to all irrigated areas on the course.

Description: Under this alternative, LCSD recycled water would be delivered to the irrigation ponds and the RMGC groundwater well would no longer be used for irrigation. The only change to irrigation operations would be increased irrigation deliveries to achieve a higher leaching fraction. Improved drainage on poorly drained greens and tees is likely required.

Pros: Greatest level of LCSD recycled water beneficial reuse. Minor irrigation operational changes.

Cons: Highest level of uncertainty for response of greens and tees to increased irrigation water salinity.

Recommended Alternative Alt 2 ?

Based on the information gathered to date, our recommendation is to start the program with a blended water source. This would allow LCSD to vary the blending ratio as more information is gathered on the ability of RMGC to manage changes in irrigation water salinity on this site over time. This alternative also would allow RMGC to accept the LCSD recycled water with only minor irrigation operational changes.

An initial 2:1 RW:GW blending ratio is recommended for irrigation during the peak irrigation season months (April through September) to obtain an irrigation water EC_w similar to that used on the Dairy Creek course (estimated to be about 1.28 dS/m). It is important to recognize that the Dairy Creek course has USGA sand greens and RMGC has mostly pushup greens with native soils that will be more drainage limited. The field work presented in this report revealed that all greens sampled have sandy soils, but poorly drained greens have a clay layer at a depth of 9 to 11 inches. Poorly drained greens at RMGC may need additional drainage improvements with this alternative.

Blending ratios during the lower water demand periods (October through March) could possibly be increased to a higher RW:GW ratio when lower turf water demands allow more effective leaching events to be conducted. This alternative would require regular monitoring of soil salinity to track the build-up of salts in the soil profile and the effectiveness of leaching events.

As part of the plan to implement this alternative, we recommend that the following monitoring and evaluation activities be conducted:

- Add flow metering to the well pump and each of the irrigation pumps for better tracking of applied irrigation volumes

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- Develop and implement a water and soil salinity monitoring program with sampling on a quarterly basis at a minimum during the year prior to start-up and during the initial two years of operation. Monitoring should include regular inspections to ensure that recycled water does not run off irrigated areas and into nearby drainages.
- Evaluate the drainage limitations of each green and tee systematically prior to start-up to better understand drainage issues that might arise and to focus sampling efforts.
- Develop a leaching operations plan in coordination with RMGC to specify methods, schedules, and/or triggers for needing defined leaching events.
- Develop a contingency plan for adjusting RW:GW blending ratios or making drainage improvements to address any emerging salinity management issues.
- Identify specific landscape trees and shrubs that fall into the salt sensitive category that might receive overspray and develop a plan for preventing overspray or taking other avoidance or mitigation measures. Since fairway shrubs and trees depend on water applied through turfgrass irrigation, little if any recycled water is expected to be intercepted by foliage. No impacts to plant performance are expected; however, EC thresholds were not identified for all species present along fairways (e.g., pines). Monitoring should be performed and the irrigation system and/or management should be modified if foliage is damaged from irrigation spray or soil salinity.

Other issues that also need to be addressed as part of LCSD's planning for water delivery to RMGC include:

- Developing a monthly water balance between recycled water supply and irrigation demand to determine delivery rates to RMGC under a range of blending ratios
- Evaluating operational storage requirements to balance recycled water supply and demand on a daily basis
- Developing a blending coordination strategy and determining instrumentation and control requirements for coordination of LCSD recycled water and RMGC groundwater deliveries to the irrigation ponds

We believe that this plan would allow both LCSD and RMGC a large amount of flexibility in adjusting operations as necessary to meet the needs of both parties.

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Tables

TABLE 1
Irrigated Areas at Rancho Maria Golf Course

Irrigated Areas	Area (acres)
Fairways [a]	65.4
Greens	2.3
Driving Range	8.0
Additional Areas [b]	10.2
Total	85.9

[a] Includes tees but excludes greens.

[b] Includes irrigated areas in between fairways and around clubhouse.

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TABLE 2

Rancho Maria Golf Course Landscaping, Irrigation System, and Site Characteristics

Irrigated Area	Vegetation	Irrigation System	Water and Turf Management	Soil Characteristics	Drainage Issues
Greens	Cool season grasses: Annual Bluegrass	Automatic pop-up sprinklers	Automatic irrigation on timer. Mowing occurs daily.	Cups are moved daily and holes are filled with a sandy commercial greens mix. Consequently, soils underlying greens are now predominantly sand.	See notes in Appendix B.
Tees	Cool season grasses: Annual Bluegrass, Perennial Ryegrass Warm season grasses: Common Bermudagrass	Automatic pop-up sprinklers	Automatic irrigation on timer. Mowing occurs daily.	--	--
Fairways, Roughs	Cool season grasses*: Annual Bluegrass, Kentucky Bluegrass, Perennial Ryegrass, Fescue Warm season grasses: Common Bermudagrass, Kikuyugrass RMGC is actively managing against tall fescue and kikuyugrass, by applying chemical control.	Manual-move sprinklers connected to quick couplers located along buried irrigation piping	During high demand periods, irrigation frequency is every other night, with-half fairways/roughs irrigated one night and the other half watered the following night . Irrigation duration is not consistent, and can vary from about one-half hour to several hours (1/2 to ¾ hour is optimal). Mowing occurs daily.	See soils maps in Appendix A	Drainage problems may occur on Fairways 4, 7, 9 and the driving range (see notes in Appendix B)
Ornamental/ natural landscaping	Fairways are lined with trees that include: Pines (Monterey, Torrey, Italian stone, and Canary Island); Eucalyptus (Citriodora, Nicholi,	Mixed	Not specifically managed; incidental runoff to roughs and landscape areas provides water	See soils maps in Appendix A	

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TABLE 2

Rancho Maria Golf Course Landscaping, Irrigation System, and Site Characteristics

Irrigated Area	Vegetation	Irrigation System	Water and Turf Management	Soil Characteristics	Drainage Issues
	Sideroxylon); Sycamore; Myoporeum; Cypress (Monterey, Leylandii); Coast Redwood; Olive; Poplar (Nigra); California Oak; Ash; Willow; Brazilian pepper; Palm; Juniper (Torolosa)				
Driving Range	Grasses include annual bluegrass and perennial ryegrass. Overseeding occurs regularly.	Tee area: Automatic pop-up sprinklers Landing area: Manual-move sprinklers connected to quick couplers located along buried irrigation piping	Not watered regularly during summer. Watered longer but less frequently than other areas (about twice per week).	See soils maps in Appendix A	Water drains toward highway, ponds then runs down path next to Hole 2, then drains off site east of the green on Hole 2.

Notes:

*Information received from RMGC was inconsistent with respect to cool season turfgrass species present. Initial information received indicated that annual bluegrass and Kentucky bluegrass were present on golf course fairways. More recent information from the RMGC groundskeeper indicated that fairway turfgrass species do not include bluegrass.

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TABLE 3
Soil Characteristics Associated with Individual Holes at the RMGC. Data were obtained from the NRCS Soil Survey for Northern Santa Barbara Area, California.

Hole Number	Soil Map Unit Description	Soil Characteristics			
		Typical Profile	Available Water Capacity (in./in.)	Drainage	Limitations
1, 4, 9	BnB2, Betteravia loamy sand, dark variant, 0 to 5 percent slopes, eroded	0 - 26 in.- loamy sand 26 - 38 in. - sandy loam 38 -50 in. - sandy loam 50-61 in. - loamy sand	0.06-0.08 0.04-0.06 0.10-0.12 0.06.0.08	Well drained K_{sat} of most limiting layer: 0.06-0.20 in/hr Surface runoff: Medium Occasional very brief flooding, Dec-Apr	Sprinkler irrigation: Strong limitations due to lcos, cos, s or ls in surface; AWC<2" to 40"
1, 2	EdC2, Elder sandy loam, 2 to 9 percent slopes, eroded	0 to 23 inches: sandy loam 23 to 35 inches: sandy loam 35 to 72 inches: fine sandy loam	0.10-0.14 0.10-0.14 0.14-0.16	Well drained K_{sat} of most limiting layer: 1.98-5.95 in/hr Surface runoff: Very low Brief, occasional flooding, Nov-Mar	Sprinkler irrigation: Moderate limitations due to AWC from 2"-6"
2, 3	BmC, Betteravia loamy sand, 2 to 9 percent slopes	0 to 36 inches: loamy sand 36 to 50 inches: cemented 50 to 65 inches: sandy clay loam 65 to 80 inches: sr to loamy sand to sandy clay loam	0.06-0.09 -- 0.12-0.16 0.10-0.14	Moderately well drained K_{sat} of most limiting layer: 0 Surface runoff: High No flooding or ponding	Sprinkler irrigation: Limitations due to lcos, cos, s or ls in surface; AWC <2" to 40", slopes >2% Moderate shrink-swell potential at 50-65 inch depth
3	CtA, Corralitos sand, 0 to 2 percent slopes	0 to 20 inches: sand 20 to 60 inches: sand	0.05-0.08 0.05-0.08	Somewhat excessively drained K_{sat} of most limiting layer: 5.95-19.98 in/hr Surface runoff: Very low Very brief, occasional flooding, Jan-Apr	Sprinkler irrigation: Strong limitations due to lcos, cos, s or ls in surface, AWC <2" to 40"
4	BoD2, Botella loam, 2 to 15 percent slopes, eroded	0 to 9 inches: loam 9 to 65 inches: clay loam 65 to 76 inches: sandy clay loam	0.14-0.16 0.16-0.19 0.15-0.18	Well drained K_{sat} of most limiting layer: 0.20-0.57 in/hr Surface runoff: High No ponding or flooding	Sprinkler irrigation: Moderate limitations due to slopes of 6 to 15% Moderate shrink-swell potential at 9-65 inch depth

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TABLE 3
Soil Characteristics Associated with Individual Holes at the RMGC. Data were obtained from the NRCS Soil Survey for Northern Santa Barbara Area, California.

Hole Number	Soil Map Unit Description	Soil Characteristics			
		Typical Profile	Available Water Capacity (in./in.)	Drainage	Limitations
4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14	TrE3, Tierra loam, 5 to 30 percent slopes, severely eroded	0 to 6 inches: loam 6 to 43 inches: clay 43 to 62 inches: clay loam	0.13-0.16 0.02-0.04 0.15-0.18	Moderately well drained K_{sat} of most limiting layer: 0-0.06 in/hr Surface runoff: Very high No ponding or flooding	Sprinkler irrigation: Strong limitations due to AWC <2" to 40" and slopes >15% High shrink-swell potential at 6-43 inch depth
10, 11	GuE, Gullied land	0 to 60 inches: variable	--	-- No ponding or flooding	
14, 15, 17, 18	PnC, Pleasonton sandy loam, 2 to 9 percent slopes	0 to 32 inches: sandy loam 32 to 39 inches: cobbly clay loam 39 to 66 inches: very cobbly loam	0.10-0.12 0.15-0.17 0.08-0.11	Well drained K_{sat} of most limiting layer: 0.20-0.57 in/hr Surface runoff: Medium No ponding or flooding	Sprinkler irrigation: Moderate limitations due to AWC from 2"-6" Moderate shrink-swell potential at 32-39 inch depth
15, 16, 17	BtC, Botella clayloam, 2 to 9 percent slopes	0 to 9 inches: clay loam 9 to 41 inches: silty clay loam 41 to 76 inches: sandy clay loam	0.17-0.19 0.16-0.19 0.15-0.18	Well drained K_{sat} of most limiting layer: 0.20-0.57 in/hr Surface runoff: High No ponding or flooding	Sprinkler irrigation: No limitations Moderate shrink-swell potential throughout
16, 17, 18	CuC, Corralitos loamy sand, 2 to 9 percent slopes	0 to 32 inches: loamy sand 32 to 60 inches: sr to loamy sand to sand	0.06-0.10 0.06-0.10	Somewhat excessively drained K_{sat} of most limiting layer: 5.95-19.98 in/hr Surface runoff: Very low No ponding or flooding	Sprinkler irrigation: Strong limitations due to lcos, cos, s or ls in surface, AWC <2" to 40"

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TABLE 4
Soil Sampling Locations and Methodology

Drainage Class of Fairway or Green	Hole(s) Sampled	Depths Sampled (inches)	Sample Collection Methods
Well drained green	1 and 16	0-4 4-8 8-12	For each green, 4 sampling locations were selected at random. Samples were collected using an Oakfield soil probe, and combined to obtain 1 composite sample for each depth increment. To ensure sufficient sample volume was obtained, two well drained greens needed to be sampled and combined.
Poorly drained green	4 and 8	0-4 4-8 8-12	For each green, 4 sampling locations were selected at random. Samples were collected using an Oakfield soil probe, and combined to obtain 1 composite sample for each depth increment. To ensure sufficient sample volume was obtained, two poorly drained greens needed to be sampled and combined.
Well drained fairway	11	0-4 4-8 8-12 12-18	Three sampling locations were selected from just in front of the tee, midway down the fairway, and in back of the green, to be representative of conditions across the entire fairway. Samples were obtained for each depth increment using a 2-1/2-inch bucket auger. The 3 samples were combined in a plastic bag for each depth increment, mixed thoroughly, then a portion was removed for analysis.
Poorly drained fairway	18	0-4 4-8 8-12 12-18	Three sampling locations were selected from just in front of the tee, midway down the fairway, and in back of the green, to represent conditions across the entire fairway. Samples were obtained for each depth increment using a 2-1/2-inch bucket auger. The 3 samples were combined in a plastic bag for each depth increment, mixed thoroughly, then a portion removed for analysis.

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TABLE 5
Soil Analytical Results

Location	Depth (inches)	SAR	EC (dS/m)	Na	Ca	Mg	Cl	B
				(meq/L)				
	0-4	1.3	0.6	1.9	2.6	1.8	0.8	0.1
Well Drained Green	4-8	1.6	0.5	2.2	2.1	1.6	0.4	0.1
(Holes 1 and 16)	8-12	1.9	0.6	2.7	2.4	1.8	0.7	0.1
	Average	***1.6***	***0.6***	***2.3***	***2.4***	***1.7***	***0.6***	***0.1***
	0-4	1.5	0.8	2.7	3.7	2.9	1.2	0.2
Poorly Drained Green	4-8	2.5	1.3	5.8	6.1	5	1.6	0.2
(Holes 4 and 8)	8-12	2.7	1.7	7.4	7.9	6.6	2	0.2
	Average	***2.2***	***1.3***	***5.3***	***5.9***	***4.8***	***1.6***	***0.2***
	0-4	2.1	2.5	7.7	14.9	12.8	1.5	0.2
	4-8	3.3	4.3	17.1	25.6	26.9	3.4	0.2
Well Drained Fairway	8-12	4.9	5.5	25.5	24.1	30.1	8.3	0.2
(Hole 11)	12-18	5.2	5.7	26.7	23.7	29.4	11.5	0.1
	Average	***3.9***	***4.5***	***19.3***	***22.1***	***24.8***	***6.2***	***0.2***
	0-4	3	4.6	16.3	26	31.7	5.1	0.2
	4-8	2.7	4	13.1	23.9	24.2	4.2	0.1
Poorly Drained Fairway	8-12	3	4	14.3	24.6	22.5	5.1	0.1
(Hole 18)	12-18	4.4	3.4	16.4	12.9	14.9	6.3	0.1
	Average	***3.3***	***4.0***	***15.0***	***21.9***	***23.3***	***5.2***	***0.1***

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TABLE 6
Irrigation Water Quality Chemistry

Constituent	Rancho Maria Golf Course Groundwater (Grab Aug-08)	Rancho Maria Golf Course Holding Pond (Grab Aug-08)	Laguna County Sanitation District Recycled Water (Avg 2006-2008)	Goleta Sanitary District Recycled Water (Avg 2007)	City of Santa Barbara Recycled Water (Potable Water) (Avg 2002-2007)	County of San Luis Obispo Recycled Water	California Men's Colony Recycled Water (Avg 2007)
Total Dissolved Solids (TDS; mg/L)	468	417	741	1086	1127 (573)	1000	646
Electrical Conductivity (dS/m)	0.944	0.833	1.47 [a]		1.72 (0.960 [b])		
SAR	1.5	1.4	5.0		3.3		
Adjusted SAR	3.3	3.1	9.5		7.7		
Sodium (mg/L)	65	59	171		151 (41)	250	114
Calcium (mg/L)	83	86	53		88 (86)	36	
Magnesium (mg/L)	36	38	27		45 (40)	29	
Potassium (mg/L)	4.0	3.8	16		20 (2.4)		
Chloride (mg/L)	50	50	195		285 (23)	218	175
Nitrate-N (mg/L)	1.5	1.1	~~14~~ 31		3.1 (0.14)		10.6
Nitrite-N (mg/L)	ND	ND	1.4				
Boron (mg/L)	0.14	0.10	0.38				
Total Phosphorus (mg/L)	0.04	0.03	0.77				3.5
Sulfate (mg/L)	210	220	181				
Ammonia-N (mg/L)	ND	ND	17				

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TABLE 6
Irrigation Water Quality Chemistry

Constituent	Rancho Maria Golf Course Groundwater (Grab Aug-08)	Rancho Maria Golf Course Holding Pond (Grab Aug-08)	Laguna County Sanitation District Recycled Water (Avg 2006-2008)	Goleta Sanitary District Recycled Water (Avg 2007)	City of Santa Barbara Recycled Water (Potable Water) (Avg 2002-2007)	County of San Luis Obispo Recycled Water	California Men's Colony Recycled Water (Avg 2007)
pH	7.3	7.7	7.5	7.1	8.0 (8.05)		
Hardness (mg/L CaCO3)	360	370	235		415 (377)		163.3
Total Alkalinity (mg/L CaCO3)	180	180	167		238 (176)		
Bicarbonate Alkalinity (mg/L)	180	180	167				
Carbonate Alkalinity (mg/L)	ND	ND	ND				
Total Suspended Solids (TSS; mg/L)			1.9	1.6			

Notes:

[a] Missing values estimated from TDS data for completing the 2006-2008 data set.

[b] Estimated from TDS data.

ND – non detect

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TABLE 7
Salinity Thresholds for RMGC Vegetation

Plant Common Name	Plant Botanical name	Tolerance to Salt Spray/Soil Salinity [a]	EC_e [b] (dS/m)
	Cool Season Grasses		
Annual bluegrass	*Poa annua*	S/S	1.5
(dominant green and tee grass)			
Kentucky bluegrass	*Poa pratensis*	S/S	3
Perennial ryegrass	*Lolium perenne*	M/M	6.5
(dominant fairway grass)			
Fescue	*Festuca* spp.	T to M/M	6.5 (tall fescue)
	Warm Season Grasses		
Common bermudagrass	*Cynodon dactylon*	T/T	4.3
Kikuyu grass	*Pennisetum clandestinum*	/T	8
	Trees		
Monterey pine	*Pinus radiata*		
Torrey pine	*Pinus torreyana*		
Italian stone pine	*Pinus pinea*		
Canary Island pine	*Pinus canariensis*		
Eucalyptus	*Eucalyptus citriodora*		
	Eucalyptus nicholii		
	Eucalyptus sideroxylon		
Sycamore	*Platanus* spp.		
Myoporum	*Myoporum* spp.		
Monterey cypress	*Cupressus macrocarpa*		
Leylandii	X *Cupressocyparis leylandii*		
Coast redwood	*Sequoia sempervirens*		
	Var. Aptos Blue	S/S	2
	Var. Los Altos	M/M	4
Olive	*Olea europaea*	/S	2
Poplar	*Populus* spp.		
California oak (live oak)	*Quercus agrifolia*		

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TABLE 7
Salinity Thresholds for RMGC Vegetation

		T/T	6
Ash	*Fraxinus* spp.	/M	4
Willow	*Salix* spp.		
Brazilian pepper	*Schinus terebinthifolius*		
Palm		Varies from M to T, depending on species	4-6
Juniper	*Juniperus*	H/T	6

[a] Tolerance values from Wu and Dodge (2005). Tolerance to salt spray was defined by the observations of salt stress symptoms on leaves of plants receiving the following ranges of specific ion concentrations in irrigation water: (H) no salt stress symptoms at 600 mg/L Na and 900 mg/L Cl; (T) no salt stress symptoms at 200 mg/L Na and 400 mg/L Cl; (M) salt stress symptoms observed in 10% or less of leaves at 200 mg/L Na and 400 mg/L Cl; (S) salt stress symptoms observed in 20% or more of leaves at 200 mg/L Na and 400 mg/L Cl.

[b] Threshold EC_e represents the salinity level at which shoot growth begins to decline below that of a nonsaline condition. Values for grass species are averages reported in Carrow and Duncan (1998). Values for tree species where no quantitative EC threshold was found in the literature were estimated as follows: T (tolerant) EC_e =6; M (moderately tolerant) EC_e = 4; S (low tolerance) EC_e = 2.

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TABLE 8
Calculated Annual Average Leaching Fractions and Blending Ratios for Irrigation of Greens

	Blended EC_w (dS/m)[a]						
	1.47	**1.40**	**1.30**	**1.20**	**1.10**	**1.00**	**0.90**
EC_e Target [b]	1.50	1.50	1.50	1.50	1.50	1.50	1.50
ET (in) [c]	50.0	50.0	50.0	50.0	50.0	50.0	50.0
AW (in) [d]	66.1	64.9	63.3	61.8	60.4	59.1	58.4
LR	24%	23%	21%	19%	17%	15%	14%
Blending Ratio (RW:GW) [a]	1:0	6.2:1	2.1:1	0.9:1	0.4:1	0.1:1	0:1

[a] Blending ratios and blended EC_w values calculated using LCSD RW EC of 1.472 dS/m and a RMGC GW EC of 0.944 dS/m.

[b] The EC_e target corresponds to the average ECe threshold value for annual bluegrass.

[C] Evapotranspiration (ET) is roughly estimated from CIMIS climate zone average ET_o.

[d] Applied water (AW) is the sum of irrigation and rainfall.

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TABLE 9

Agronomic Evaluation of Plant Water Requirements

Month	*ETo (in)*	*P (in)*	*ETc (in)*	*Peff (in)*	*NIWR Turf (in)*	*GIWR w/o LF (in)*	*GIWR w/ LF (in)*	*Monthly Water Demand (ac-ft)*	*Average Daily Flow (mgd)*
Jan	2.12	1.96	1.91	0.86	1.0	1.7	2.0	15	0.15
Feb	2.49	1.68	2.24	0.76	1.5	2.5	2.9	21	0.24
Mar	3.88	1.25	3.49	0.62	2.9	4.8	5.6	40	0.42
Apr	4.25	1.59	3.83	0.79	3.0	5.1	5.9	42	0.46
May	5.99	1.21	5.39	0.66	4.7	7.9	9.2	66	0.69
Jun	6.26	0.64	5.63	0.36	5.3	8.8	10.2	73	0.80
Jul	6.34	0.20	5.71	0.07	5.6	9.4	10.9	78	0.82
Aug	5.81	0.00	5.23	0.00	5.2	8.7	10.1	73	0.76
Sep	4.68	0.00	4.21	0.00	4.2	7.0	8.2	58	0.63
Oct	3.46	0.97	3.11	0.47	2.6	4.4	5.1	37	0.39
Nov	2.37	0.68	2.13	0.31	1.8	3.0	3.5	25	0.27
Dec	1.79	1.66	1.61	0.72	0.9	1.5	1.7	12	0.13
Total	49.43	11.84	44.49	5.62	38.9	64.8	75.3	540	
		K_C	Irrigated Area (acres)			Annual Irrigation Demand			
Cool Season Grass		0.90	86			540 AC-FT			
Normal Depth of Soil Moisture Depletion (in)			0.6			176 MG			
LF			14%						
Total Leaching Requirement (in)			10.6						
Combined Irrigation Efficiency			60%						

Notes and Definitions:

Kc - crop coefficient

ETo - reference grass evapotranspiration

ETc - crop evapotranspiration (ETo x Kc turf)

P - average precipitation

Peff - effective precipitation (calculated using SCS method w/ monthly P, ETc, and effective soil water storage)

NIWR - net irrigation water requirements (ETc - Peff)

GIWR w/o LF - gross irrigation water requirements without leaching fraction (NIWR / (combined irrigation efficiency))

LF - leaching fraction (assumed no additional leaching fraction required based on water quality and incidental leaching)

Total Leaching Requirement = GIWR w/ LF - GIWR w/o LF

GIWR w/ LF = GIWR w/o LF / (1 - LF)

Normal Depth of Soil Moisture Depletion is often 50% of AWHC over the rooting zone depth

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Figures

FIGURE 1
Irrigated Areas
Rancho Maria Golf Course
Irrigation

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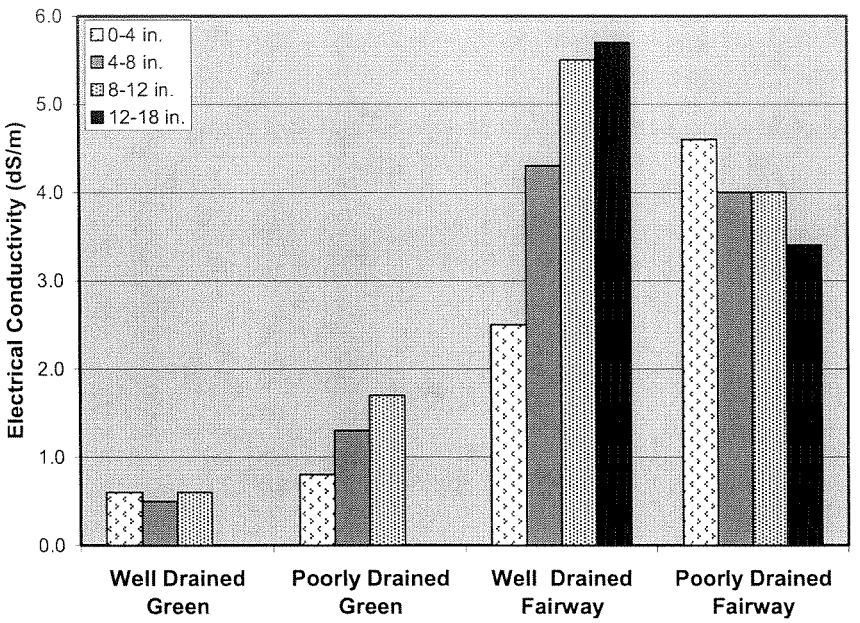

FIGURE 2. ELECTRICAL CONDUCTIVITY IN SOILS OF REPRESENTATIVE WELL DRAINED AND POORLY DRAINED GREENS AND FAIRWAYS AT RMGC.

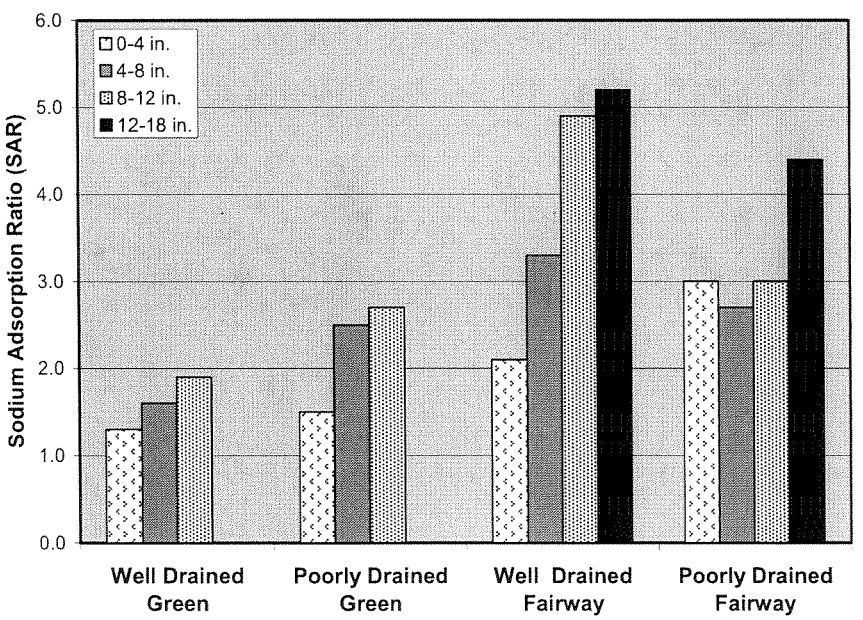

FIGURE 3. SODIUM ADSORPTION RATIO IN SOILS OF REPRESENTATIVE WELL DRAINED AND POORLY DRAINED GREENS AND FAIRWAYS AT RMGC.

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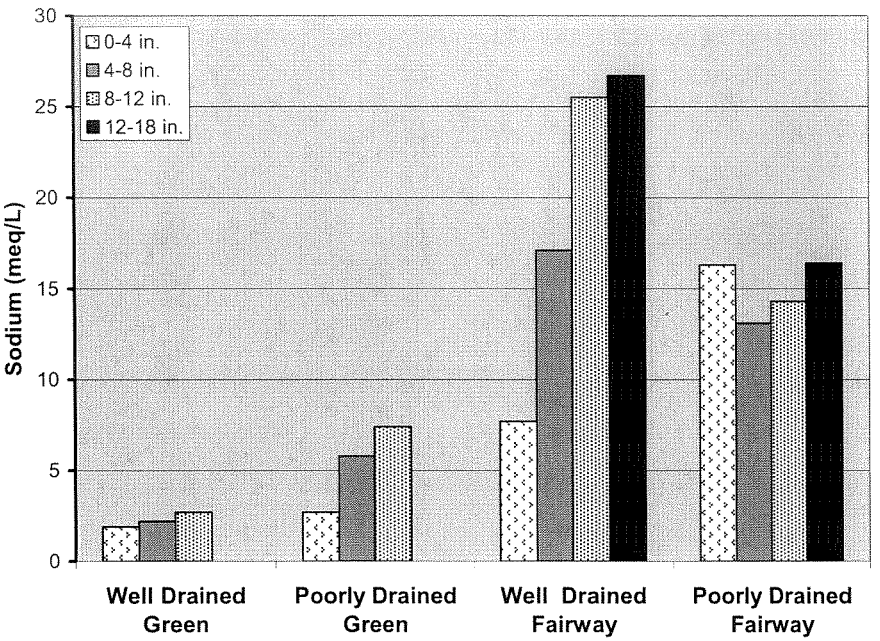

FIGURE 4. SODIUM CONCENTRATION IN SOILS OF REPRESENTATIVE WELL DRAINED AND POORLY DRAINED GREENS AND FAIRWAYS AT RMGC.

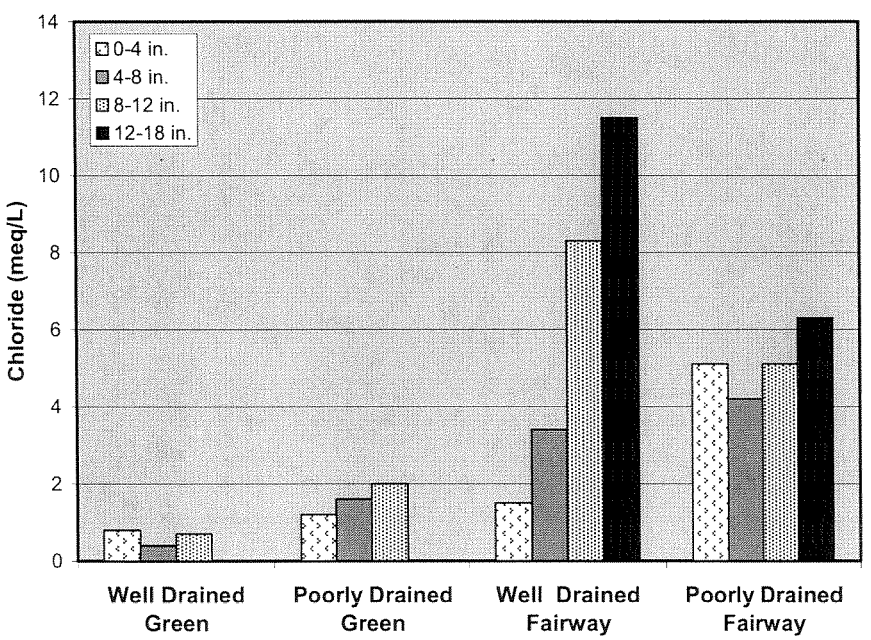

FIGURE 5. CHLORIDE CONCENTRATION IN SOILS OF REPRESENTATIVE WELL DRAINED AND POORLY DRAINED GREENS AND FAIRWAYS AT RMGC.

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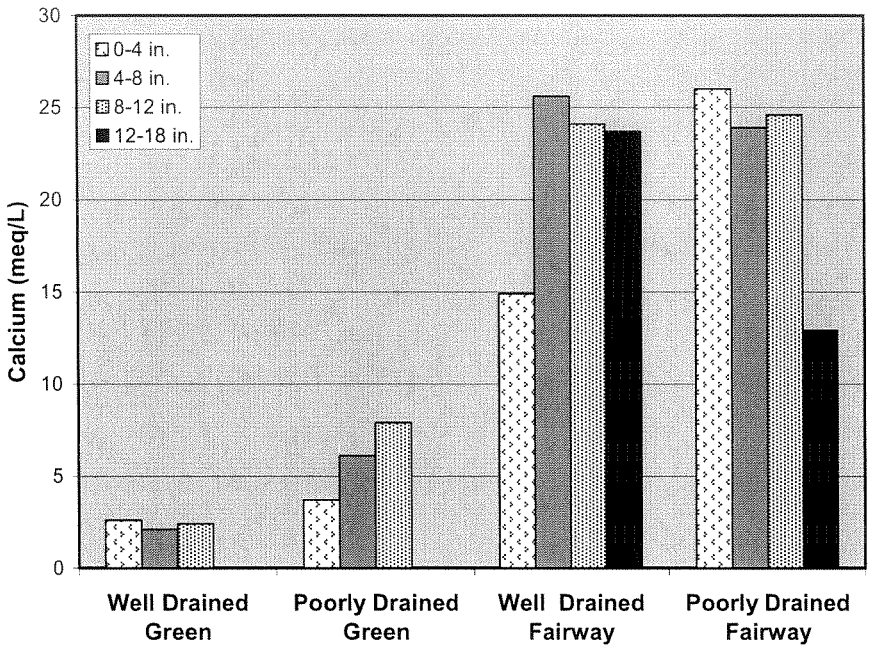

FIGURE 6. CALCIUM CONCENTRATION IN SOILS OF REPRESENTATIVE WELL DRAINED AND POORLY DRAINED GREENS AND FAIRWAYS AT RMGC.

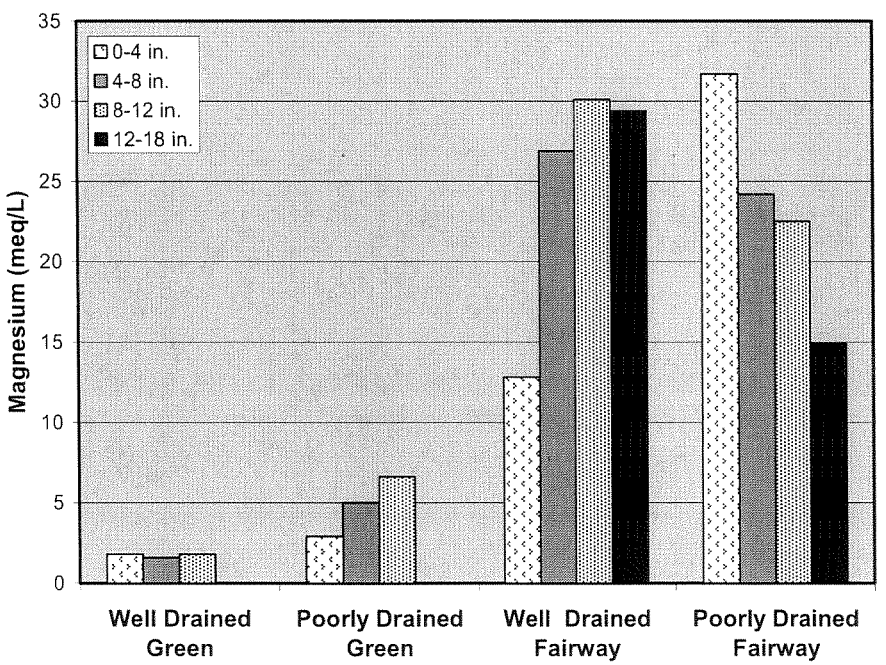

FIGURE 7. MAGNESIUM CONCENTRATION IN SOILS OF REPRESENTATIVE WELL DRAINED AND POORLY DRAINED GREENS AND FAIRWAYS AT RMGC

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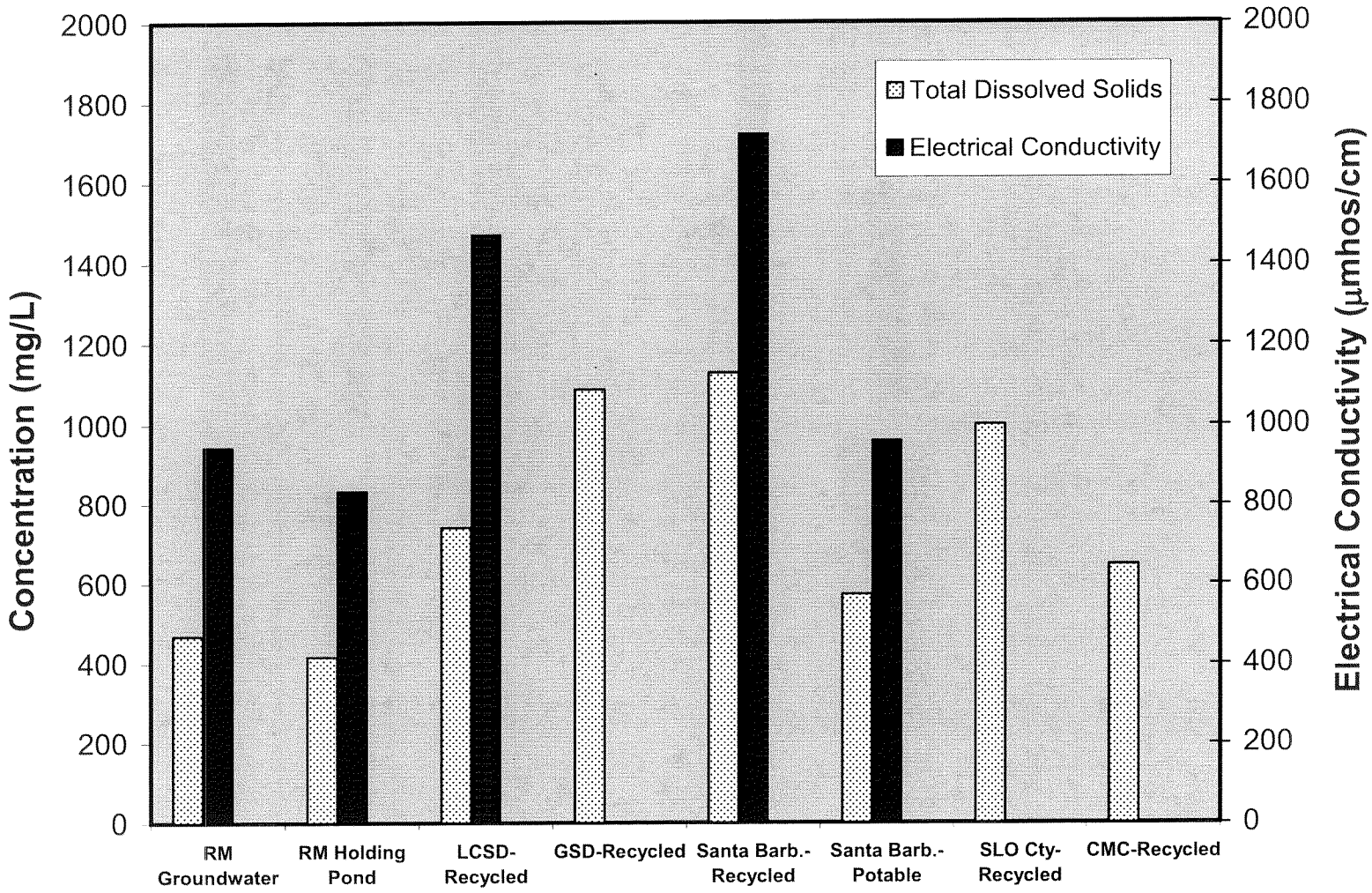

FIGURE 8. TDS AND EC COMPARISON ACROSS WATER SOURCES.

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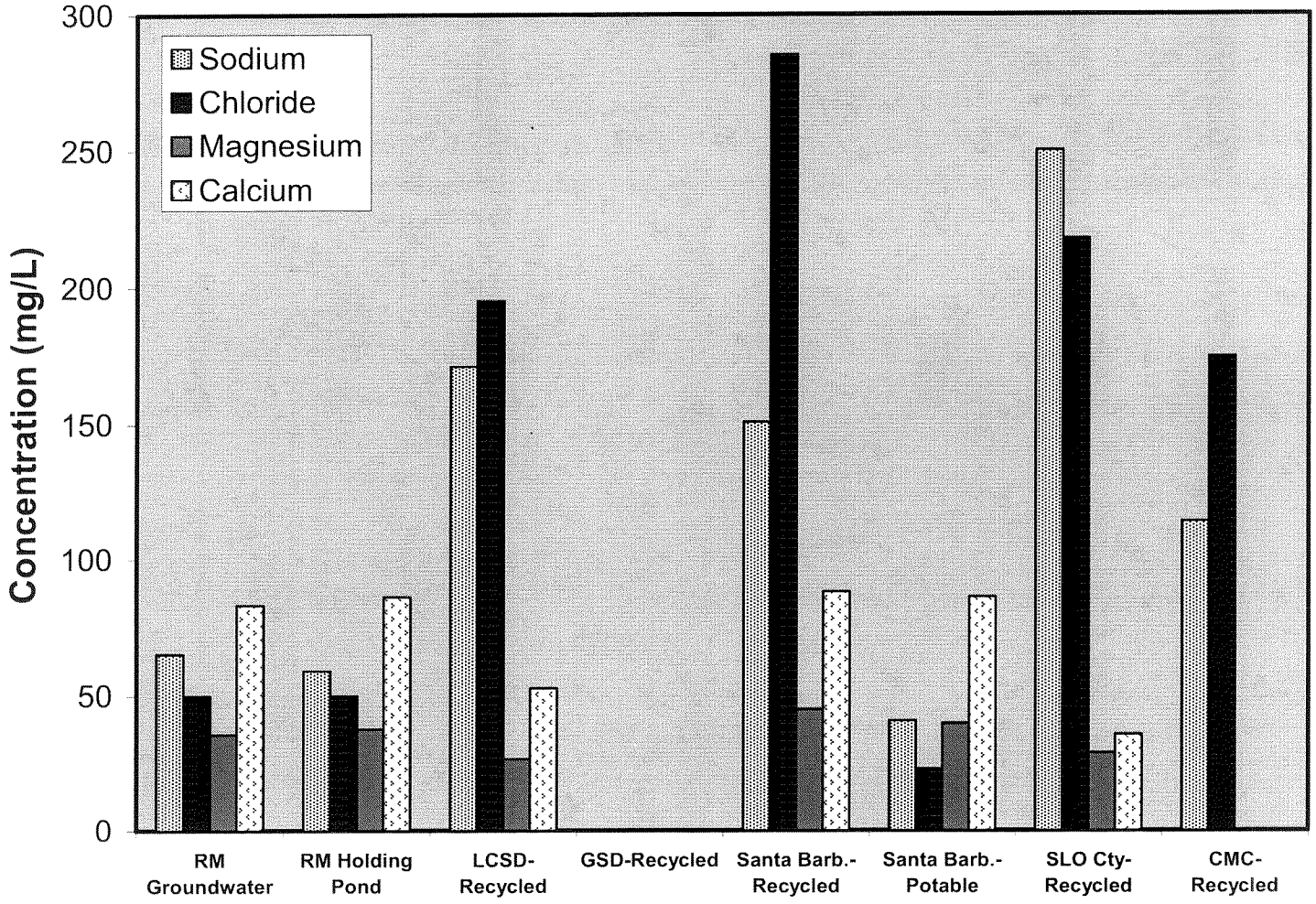

FIGURE 9. SODIUM, CHLORIDE, MAGNESIUM, AND CALCIUM COMPARISON ACROSS WATER SOURCES

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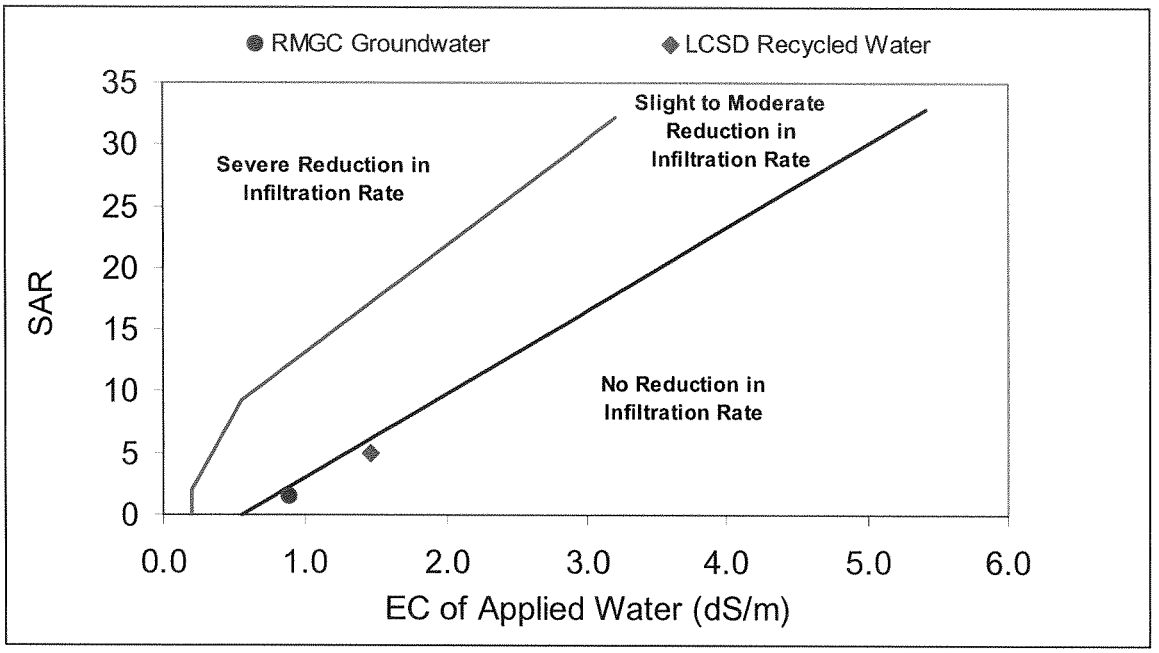

FIGURE 10. SOIL INFILTRATION HAZARD DUE TO SODIUM LEVELS IN IRRIGATION WATER.

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Photos

Photo 1. *Turfgrass on Green 5 Composed of Annual Bluegrass*

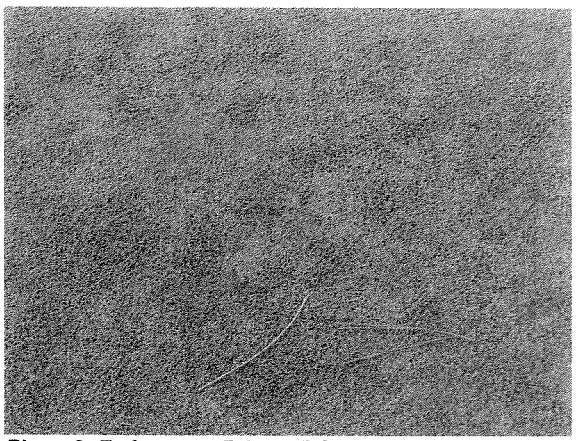

Photo 2. *Turfgrass on Fairway 5 Composed Predominantly of Perennial Ryegrass*

Photo 3. *Water Ponding in Depressions on 4 Fairway Following a Rain Event the Previous Day.*

Photo 4. *Constructed Ditch to West of Hole 5 Reduces Run-on to Holes 5 and 4*

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Photo 5. *Hole 14 Tee is Posted as Wet Following a Rain Event the Previous Day.*

Photo 6. *Marty Wilder on Hole 13 Fairway.*

Photo 7. *Drain on 5 Fairway in Front of Green*

Photo 8. *Pipe Drain Discharges from Northwest Corner of Site on Hole 16 Toward Culvert at Road*

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Photo 9. *Hole 14 Fairway was Treated to Eliminate Kikuyugrass (brown area). Following treatment, areas are overseeded with perennial ryegrass.*

Photo 10. *Pond 10 Water is Utilized for Irrigation of Greens, Tees and Fairways on Southern Half of Golf Course.*

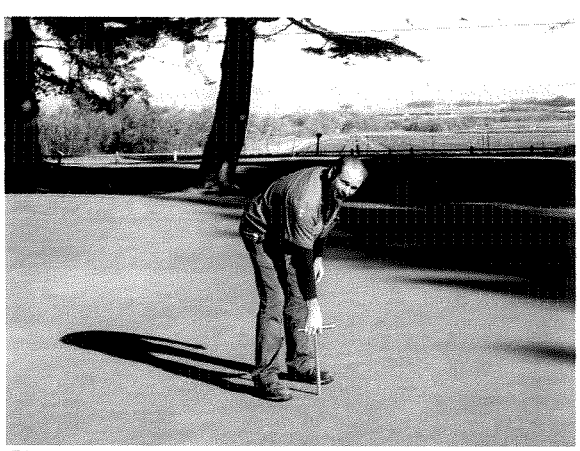

Photo 11. *RMGC Groundskeeper, Rich, Obtains a Soil Sample from Green 4 Using Oakfield Probe.*

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Appendix A – NRCS Soil Maps and Interpretations

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729400
729600
729800
730000
730200
730400
730600
3862400
3862200
3862000
3861800
3861600
3861400
3861200
3861000
e 1
HWY 166
EtC
PnC
CuC
EdC2
BnC
BnE2
CtA
BoD2
CtF
CuD CuE
TrE3
TrE3
CuE
CuD
ThC
N
Meters
0 100 200 400 600
Feet
0 500 1,000 2,000 3,000

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- Very limited
- Somewhat limited
- Not limited
- Not rated or not available

Political Features

Municipalities
- Cities
- Urban Areas

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails

Roads
- Interstate Highways
- US Routes
- State Highways
- Local Roads
- Other Roads

MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 10N

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Northern Santa Barbara Area, California
Survey Area Data: Version 6, Jan 3, 2008

Date(s) aerial images were photographed: 9/3/1994

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Disposal of Wastewater by Rapid Infiltration

Disposal of Wastewater by Rapid Infiltration— Summary by Map Unit — Northern Santa Barbara Area, California						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (rating values)**	**Acres in AOI**	**Percent of AOI**
BmC	Betteravia loamy sand, 2 to 9 percent slopes	Somewhat limited	Betteravia (85%)	Slope (0.50)	0.6	0.2%
BnB2	Betteravia loamy sand, dark variant, 0 to 5 percent slopes, eroded	Somewhat limited	Betteravia variant (85%)	Flooding (0.60)	40.5	15.6%
BoD2	Botella loam, 2 to 15 percent slopes, eroded	Very limited	Botella (85%)	Slope (1.00)	1.1	0.4%
				Slow water movement (1.00)		
BtC	Botella clay loam, 2 to 9 percent slopes	Very limited	Botella (85%)	Slow water movement (1.00)	13.8	5.3%
				Slope (0.50)		
ChF	Chamise shaly loam, 15 to 45 percent slopes	Very limited	Chamise (85%)	Slope (1.00)	0.0	0.0%
				Slow water movement (1.00)		
CtA	Corralitos sand, 0 to 2 percent slopes	Somewhat limited	Corralitos (85%)	Flooding (0.60)	10.5	4.1%
CuC	Corralitos loamy sand, 2 to 9 percent slopes	Somewhat limited	Corralitos (85%)	Slope (0.50)	22.7	8.8%
CuD	Corralitos loamy sand, 9 to 15 percent slopes	Very limited	Corralitos (85%)	Slope (1.00)	0.3	0.1%
EdC2	Elder sandy loam, 2 to 9 percent slopes, eroded	Somewhat limited	Elder (85%)	Flooding (0.60)	14.2	5.5%
				Slope (0.50)		
				Slow water movement (0.32)		
GuE	Gullied land	Not rated	Gullied land (85%)		18.0	6.9%
			Unnamed (10%)			
			Unnamed (5%)			
PnC	Pleasanton sandy loam, 2 to 9 percent slopes	Very limited	Pleasanton (85%)	Slow water movement (1.00)	22.9	8.8%
				Slope (0.50)		

Disposal of Wastewater by Rapid Infiltration— Summary by Map Unit — Northern Santa Barbara Area, California						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (rating values)**	**Acres in AOI**	**Percent of AOI**
Rs	Riverwash	Very limited	Riverwash (85%)	Flooding (1.00)	0.2	0.1%
				Depth to saturated zone (1.00)		
TnC	Tierra sandy loam, 2 to 9 percent slopes	Very limited	Tierra (85%)	Slow water movement (1.00)	0.4	0.2%
				Slope (0.50)		
TrE3	Tierra loam, 5 to 30 percent slopes, severely eroded	Very limited	Tierra (85%)	Slow water movement (1.00)	113.8	43.9%
				Slope (1.00)		
Totals for Area of Interest (AOI)					258.9	100.0%

Disposal of Wastewater by Rapid Infiltration— Summary by Rating Value		
Rating	**Acres in AOI**	**Percent of AOI**
Very limited	152.5	58.9%
Somewhat limited	88.4	34.1%
Null or Not Rated	18.0	6.9%

Description

Rapid infiltration of wastewater is a process in which wastewater applied in a level basin at a rate of 4 to 120 inches per week percolates through the soil. The wastewater may eventually reach the ground water. The application rate commonly exceeds the rate needed for irrigation of cropland. Vegetation is not a necessary part of the treatment; thus, the basins may or may not be vegetated. The thickness of the soil material needed for proper treatment of the wastewater is more than 72 inches. As a result, geologic and hydrologic investigation is needed to ensure proper design and performance and to determine the risk of ground-water pollution.

Soil properties are important considerations in areas where soils are used as sites for the treatment and disposal of organic waste and wastewater. Selection of soils with properties that favor waste management can help to prevent environmental damage.

Municipal wastewater is the waste stream from a municipality. It contains domestic waste and may contain industrial waste. It may have received primary or secondary treatment. It is rarely untreated sewage. Food-processing wastewater results from the preparation of fruits, vegetables, milk, cheese, and meats for public consumption. In places it is high in content of sodium and chloride. The effluent in lagoons and storage ponds is from facilities used to treat or store food-processing wastewater or domestic or animal waste. Domestic and food-processing wastewater is very dilute, and the effluent from the facilities that treat or store it commonly is very low in content of carbonaceous and nitrogenous material; the content of nitrogen commonly ranges from 10 to 30 milligrams per liter. The wastewater from animal waste treatment lagoons or storage ponds, however, has much higher concentrations of these materials, mainly because the manure has not been diluted as much as the domestic waste. The content of nitrogen in this wastewater generally ranges from 50 to 2,000 milligrams per liter. When wastewater is applied, checks should be made to ensure that nitrogen, heavy metals, and salts are not added in excessive amounts.

The ratings are based on the soil properties that affect the risk of pollution and the design, construction, and performance of the system. Depth to a water table, ponding, flooding, and depth to bedrock or a cemented pan affect the risk of pollution and the design and construction of the system. Slope, stones, and cobbles also affect design and construction. Saturated hydraulic conductivity (Ksat) and reaction affect performance. Permanently frozen soils are unsuitable for waste treatment.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect agricultural waste management. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or

expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

729400
729600
729800
730000
730200
730400
730600
3862400
3862200
3862000
3861800
3861600
3861400
3861200
3861000
e 1
HWY 166
BtC
PtC
CuC
Rs
EdC2
BnC
BnB2
CtA
BoD2
ChF
CuD
CuE
TrE3
TrE3
CuE
CuD
ThC
N
Meters
0
100
200
400
600
Feet
0
500
1,000
2,000
3,000

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- Excessively drained
- Somewhat excessively drained
- Well drained
- Moderately well drained
- Somewhat poorly drained
- Poorly drained
- Very poorly drained
- Not rated or not available

Political Features

Municipalities
- Cities
- Urban Areas

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails

Roads
- Interstate Highways
- US Routes
- State Highways
- Local Roads
- Other Roads

MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 10N

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Northern Santa Barbara Area, California
Survey Area Data: Version 6, Jan 3, 2008

Date(s) aerial images were photographed: 9/3/1994

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Drainage Class

Drainage Class— Summary by Map Unit — Northern Santa Barbara Area, California				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BmC	Betteravia loamy sand, 2 to 9 percent slopes	Moderately well drained	0.6	0.2%
BnB2	Betteravia loamy sand, dark variant, 0 to 5 percent slopes, eroded	Well drained	40.5	15.6%
BoD2	Botella loam, 2 to 15 percent slopes, eroded	Well drained	1.1	0.4%
BtC	Botella clay loam, 2 to 9 percent slopes	Well drained	13.8	5.3%
ChF	Chamise shaly loam, 15 to 45 percent slopes	Well drained	0.0	0.0%
CtA	Corralitos sand, 0 to 2 percent slopes	Somewhat excessively drained	10.5	4.1%
CuC	Corralitos loamy sand, 2 to 9 percent slopes	Somewhat excessively drained	22.7	8.8%
CuD	Corralitos loamy sand, 9 to 15 percent slopes	Somewhat excessively drained	0.3	0.1%
EdC2	Elder sandy loam, 2 to 9 percent slopes, eroded	Well drained	14.2	5.5%
GuE	Gullied land	Well drained	18.0	6.9%
PnC	Pleasanton sandy loam, 2 to 9 percent slopes	Well drained	22.9	8.8%
Rs	Riverwash	Excessively drained	0.2	0.1%
TnC	Tierra sandy loam, 2 to 9 percent slopes	Moderately well drained	0.4	0.2%
TrE3	Tierra loam, 5 to 30 percent slopes, severely eroded	Moderately well drained	113.8	43.9%
Totals for Area of Interest (AOI)			258.9	100.0%

Description

"Drainage class (natural)" refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized-excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained, and very poorly drained. These classes are defined in the "Soil Survey Manual."

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

LOCATION BETTERAVIA CA

Established Series
Rev. GES/LCL
11/73

BETTERAVIA SERIES

The Betteravia series is a member of the sandy, mixed, thermic family of Haplic Durixeralfs. Typically, Betteravia soils have brown, strongly acid, loamy sand A1 horizons, light yellowish brown, strongly acid, loamy sand A2 horizons, light yellowish brown and reddish yellow, neutral, weakly cemented B2tsi horizons that grade to reddish brown, neutral IIB and IIIB horizons.

TAXONOMIC CLASS: Sandy, mixed, thermic Haplic Durixeralfs

TYPICAL PEDON: Betteravia loamy sand - annual grasses and forbs, formerly cultivated. (Colors are for dry soil unless otherwise noted.)

Ap--0 to 10 inches; brown (10YR 5/3) loamy sand, dark brown (10YR 3/3) moist; weak medium granular structure; soft, very friable, nonsticky, nonplastic; many fine and very fine roots; common very fine tubular and many very fine interstitial pores; strongly acid (pH 5.1); abrupt wavy boundary. (0 to 10 inches thick)

A12--10 to 20 inches; brown (10YR 5/3) loamy sand, dark brown (10YR 3/3) moist; massive; soft, very friable, nonsticky, nonplastic; common very fine roots; many very fine interstitial and many very fine tubular pores; strongly acid (pH 5.1); clear wavy boundary. (9 to 15 inches thick)

A2--20 to 36 inches; light yellowish brown (10YR 6/4) light loamy sand, yellowish brown (10YR 5/4) moist; massive; soft, very friable, nonsticky, nonplastic; few very fine roots; many very fine tubular and many very fine interstitial pores; strongly acid (pH 5.2); abrupt wavy boundary. (1 to 20 inches thick)

B21tsi--36 to 41 inches; light yellowish brown (10YR 6/4) weakly cemented sandy loam, brown (7.5YR 4/4) moist; massive; very hard, very firm, slightly sticky, slightly plastic; does not slake and softens only slightly after prolonged wetting; common very fine tubular and many very fine interstitial pores; few moderately thick clay films as bridges, colloid stains on mineral grains; neutral (pH 6.7); clear wavy boundary. (4 to 7 inches thick)

B22tsi--41 to 50 inches; reddish yellow (7.5YR 6/6) weakly cemented heavy sandy loam, strong brown (7.5YR 5/6) moist; massive; very hard, firm, slightly sticky, slightly plastic; does not slake on wetting, not quite as cemented or firm as B21tsi horizon; common very fine tubular and many very fine interstitial pores; few thick clay films as bridges and lining pores, colloid stains on mineral grains; neutral (pH 7.0); clear wavy boundary. (7 to 11 inches thick)

B23t--50 to 56 inches; reddish yellow (7.5YR 6/6) heavy sandy clay loam, strong brown (7.5YR 5/6) moist; moderate medium angular blocky structure; hard, very firm, sticky, plastic; few very fine tubular and few very fine interstitial pores; many thick clay films lining pores; neutral (pH 7.0); clear wavy boundary. (5 to 20 inches thick)

IIB31t--56 to 65 inches; reddish brown (5YR 5/4) heavy sandy loam, reddish brown (5YR 4/4) moist; massive; hard, firm, slightly sticky, slightly plastic; many very fine interstitial pores; common thin clay films lining pores; about 2 percent quartzitic gravel; neutral (pH 7.1); clear wavy boundary. (0 to 12 inches thick)

IIIB32--65 to 80 inches; reddish brown (5YR 5/4) light loamy sand, reddish brown (5YR 4/4) moist; massive; soft, friable, nonsticky, nonplastic; many very fine interstitial pores; few thin clay films line pores; neutral (pH 7.0); 5 percent quartzitic gravel. (0 to several feet thick)

NOTE: All A horizons have had much rodent activity. All B horizons except IIIB32 horizon have common, small, less than 6mm. black concretions.

TYPE LOCATION: Santa Barbara County, California; west of Santa Maria, 3/8 mile west of Blosser Road on Betteravia Road, 180 feet north and 140 feet east; central south portion NW 1/4 NW 1/4 sec. 28, T.10N., R.34W.

RANGE IN CHARACTERISTICS: Depth to the cemented Bsi horizon contact is 24 to 40 inches. The mean annual soil temperature is about 62 degrees F. and the soil temperature usually is not below 47 degrees F. at any time. The soil between depths of 10 and 30 inches is usually dry all of the time from about late May until about late December and is moist in some or all parts all the rest of the year. Rock fragments are lacking in the upper horizons and are present as resistant gravel up to 20 percent in some IIB or IIIB or IIIC horizons. The A1 horizon is brown to light brownish gray (10YR 5/3, 6/3, 6/2) and is sand, loamy sand or loamy fine sand. It averages less than 1 percent organic matter in all parts. This horizon is strongly or very strongly acid. In most pedons the A2 horizon is indistinct and is higher in value by 1 unit or less than adjacent horizons. Some pedons have a distinct A2 horizon 1 to 3 inches thick that is higher in value than adjacent horizons by more than 1 unit. The A2 horizons are sand or loamy sand and are strongly or very strongly acid. The B2tsi horizon has an abrupt upper boundary and a clear or gradual lower boundary. It is brown to reddish brown (10YR 5/3, 6/4, 5/4; 7.5YR 5/4, 6/6, 5/6; 5YR 5/4, 6/6, 5/6). Hue of 5YR is lacking in some pedons and is confined to the lower part of the horizon in all other pedons. The B2tsi horizon is sandy loam or sandy clay loam and approximately 15 to 25 percent clay. It is very hard and very firm in some or all parts and is firm and hard in the remaining part. All of this horizon is brittle and does not slake in water though it softens appreciably upon wetting. It is slightly acid or neutral. The upper boundary of the argillic horizon coincides with the upper boundary of the cemented horizon or it occurs within the cemented horizon or at the base of the cemented horizon. The argillic horizon is in part in the IB horizon or is wholly within the IIB and/or IIIB horizon. The IIBt horizon is brown to reddish yellow (7.5YR 5/4, 6/6, 5/6; 5YR 5/4, 4/4, 5/6, 4/6, 6/6). It is sandy loam or sandy clay loam and is neutral or mildly alkaline. Lower horizons are designated IIIB or IIIC and range from loamy sand to sandy clay loam. These horizons are neutral to moderately alkaline, but lack free lime.

COMPETING SERIES: These are the Arlington, Carlsbad, Garey, and Narlon series. Arlington soils have a coarse-loamy argillic horizon above the duripan. Carlsbad soils have many prominent concretions and lack an argillic horizon. Garey soils slake upon wetting. Narlon soils lack a duripan and have a clayey argillic horizon.

GEOGRAPHIC SETTING: The Betteravia soils are nearly level to moderately sloping and are on terraces at elevations of 100 to 800 feet. They formed in sandy eolian deposits that overlie stratified terrace deposits of fine texture. The climate is dry subhumid mesothermal with warm dry summers and cool moist winters. Mean annual precipitation is 13 to 18 inches. Average January temperature is 50 degrees F., average July temperature is 63 degrees F., and mean annual temperature is 57 degrees F. The freeze-free season is 310 to 340 days.

PRINCIPAL ASSOCIATED SOILS: These are the competing Garey soils and the Marina, Oceano, and Sorrento soils. Marina and Oceano soils lack cementation and have lamellae. Sorrento soils have a mollic epipedon and lack an argillic horizon.

DRAINAGE AND PERMEABILITY: Moderately well drained; very slow to medium runoff; very slow permeability.

USE AND VEGETATION: Used for range and urban use and for growing irrigated pasture and special irrigated crops. Uncultivated areas have a cover of annual grasses and forbs with a few shrubs and scattered live oak trees.

DISTRIBUTION AND EXTENT: West portion of Santa Barbara County, California. The soils are inextensive.

MLRA OFFICE RESPONSIBLE: Davis, California

SERIES ESTABLISHED: Santa Barbara County, California, 1973.

REMARKS: The Betteravia soils were formerly classified as (medial) Noncalcic Brown soils. They are also regarded as "hardpan soils." The control section is to the top of the duripan.

OSED scanned by SSQA. Last revised by state on 11/73.

National Cooperative Soil Survey
U.S.A.

LOCATION BOTELLA CA

Established Series
Rev. GES-LCL-RWK-KP
06/2001

BOTELLA SERIES

The Botella series consists of very deep, well drained soils that formed in alluvial material from sedimentary rocks. Botella soils are in valley bottoms and on alluvial fans and have slopes of 0 to 15 percent. The mean annual precipitation is about 18 inches and the mean annual air temperature is about 58 degrees F.

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, thermic Pachic Argixerolls

TYPICAL PEDON: Botella silty clay loam, cultivated field. (Colors are for dry soil unless otherwise noted).

Ap--0 to 9 inches; gray (N 5/) silty clay loam, black (10YR 2/1) moist; moderate medium subangular blocky structure; very hard, friable, sticky and plastic; common very fine roots; few very fine interstitial, common very fine, fine and medium tubular pores; moderately acid (pH 6.0); gradual smooth boundary. (8 to 24 inches thick)

BAt--9 to 14 inches; gray (N 5/) silty clay loam, black (10YR 2/1) moist; weak coarse prismatic structure parting to moderate medium angular blocky; extremely hard, firm, sticky and plastic; common very fine roots; few very fine interstitial and common very fine, few fine tubular pores; few thin clay films line tubular pores; moderately acid (pH 6.0) gradual wavy boundary. (0 to 8 inches thick)

Bt1--14 to 28 inches; gray (10YR 5/1) silty clay loam, black (10YR 2/1) moist; weak coarse prismatic structure parting to strong medium angular blocky; extremely hard, firm, very sticky, and very plastic; common very fine roots; few very fine interstitial and many very fine tubular pores; common thin clay films on faces of peds; slightly acid (pH 6.4) gradual smooth boundary. (8 to 16 inches thick)

Bt2--28 to 41 inches; gray (10YR 5/1) silty clay loam, black (10YR 2/1) moist; strong medium angular blocky structure; extremely hard, firm, very sticky and very plastic; common very fine roots; few very fine interstitial and common very fine tubular pores; many thin clay films on faces of peds and lining tubular pores; neutral (pH 6.8); gradual smooth boundary. (6 to 14 inches thick)

2Bt3--41 to 59 inches; gray (10YR 5/1) heavy sandy clay loam, very dark grayish brown (2.5Y 3/2) moist; moderate medium angular blocky structure grading to weak near bottom of horizon; extremely hard, friable, sticky and plastic; few very fine roots; few very fine interstitial and many very fine, common fine tubular pores; common black organic stains; common moderately thick clay films on faces of peds, continuous moderately thick clay films line tubular pores; slightly acid (pH 6.2); clear smooth boundary. (0 to 18 inches thick)

2Bt4--59 to 65 inches; light brownish gray (10YR 6/2) light sandy clay; dark grayish brown (10YR 4/2) moist; weak coarse angular blocky structure; very hard, firm, very sticky and very plastic; few very fine roots; common very fine interstitial, common very fine and few fine tubular pores; many very dark

brown (10YR 2/2) moderately thick clay films line pores; slightly acid (pH 6.2); clear smooth boundary. (0 to 10 inches thick)

2BCt--65 to 76 inches; gray (10YR 6/1) heavy sandy clay loam, very dark grayish brown (10YR 3/2) moist; massive; very hard, friable, sticky and plastic; few very fine roots; few very fine interstitial common very fine, few fine tubular pores; few moderately thick clay films line tubular pores; moderately acid (pH 6.0).

TYPE LOCATION: Santa Barbara County, California; about 2.2 miles east of Los Alamos, .65 mile north of U.S. Highway 101 on Alisos Canyon Road, .2 mile northwest; equivalent to the north portion of NE 1/4, NW 1/4, section 34, T.7 N., R.32 W.

RANGE IN CHARACTERISTICS: The solum is more than 32 inches thick. The soil between depths of 4 and 12 inches becomes moist in some part in November or early December and remains moist until May. Mean annual soil temperature is 59 to 64 degrees F. Shale fragments or other rock fragments generally make up less than 15 percent of the solum, except some areas have up to 25 percent shale fragments on the surface. The solum is slightly alkaline to moderately acid. Base saturation is 75 to 95 percent. Organic matter is 2 to 6 percent in the upper 20 inches and decreases gradually to about 1 percent or less at a depth of 30 inches.

The A horizon is gray, dark gray, very dark gray, very dark grayish brown or very dark brown (10YR 5/1, 5/2, 5/3, 4/1, 4/2, 3/1, 3/2, 2/2 or N 5/, N 3/, 2.5Y 4/2, 3/2). It is sandy loam, loam, clay loam or silty clay loam. The transition from the A horizon to the B horizon is gradual and most pedons have an BA horizon or a AB horizon or both.

The Bt horizon is gray, dark gray, very dark gray, dark grayish brown, very dark grayish brown or brown (10YR 5/1, 5/2, 5/3, 4/1, 3/1, 4/2, 3/2, 4/3, 3/3, 2.5Y 4/2, 3/2, N 5/, N 4/, N 3/). In most pedons value or chroma or both increase one unit in the lower part of the B2t horizon. This horizon is clay loam, silty clay loam or sandy clay loam, and has about 6 to 10 percent more total clay than the A horizon. It has weak to strong angular blocky, subangular blocky or prismatic structure.

The C horizon is light gray, light brownish gray or grayish brown (10YR 7/1, 7/2, 7/3, 6/1, 6/2, 5/2, N 7/, N 6/, 2.5Y 7/2, 6/2, 5/2). This horizon is dominantly loam, clay loam, or sandy clay loam. In some pedons there are some strata of sandy loam and fine sandy loam of minor thickness. Some pedons do not have a C horizon.)

COMPETING SERIES: These are the Arujo(T), Chico(T), Corona, Elkhorn, Havala, Lockwood, McCoy and Saltcanyon series. Arujo and McCoy soils are underlain by a paralithic contact. Chico soils have a solum more than 80 inches deep and do not have a lithologic discontinuity and a C horizon. Corona soils are moderately well drained and effervescent throughout. Elkhorn soils have shot or concretions in the Bt horizon. Havala soils do not have lithologic discontinuities, and organic matter is less than 1 percent from 10 to 20 inches deep. Lockwood soils have 15 to 35 percent shale and other rock fragments in the A horizon and 15 to 60 percent rock fragments below a depth of 40 inches. Saltcanyon soils have mean January soil temperatures that average below 47 degrees F., do not have slightly acid and moderately acid reactions within the profile, do not have lithologic discontinuities, and have soil moisture that is dry sooner and moist sooner in the year.

GEOGRAPHIC SETTING: Botella soils are in small valley bottoms and on small alluvial fans and have gradients of 0 to 15 percent. They formed in alluvium derived from stream terraces and dark colored upland soils formed in residuum from sedimentary rocks. Elevations are 50 to 2100 feet. The

climate is subhumid mesothermal with dry warm to cool summers and cool wet winters. Mean annual precipitation ranges from 12 to 25 inches. Average July temperature is 62 to 72 degrees F, average January temperature is about 47 to 50 degrees F, and mean annual temperature is about 57 to 62 degrees F. The average frost-free season is 250 to 350 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Betteravia, Clear Lake, Crow Hill, Elder, Los Osos, Santa Lucia, and Zamora soils. Betteravia soils have less than 1 percent organic matter in the A horizon and some weak silica cementation in the lower part of the profile. Clear Lake soils have clay textures with intersecting slickensides and are poorly drained. Crow Hill and Santa Lucia soils do not have Bt horizons and are underlain by a lithic contact of hard shale. Elder soils do not have Bt horizons and have less than 18 percent clay. Los Osos soils have a paralithic contact at depths of 24 to 40 inches. Zamora soils do not have mollic epipedons and have A horizons that are hard or very hard and massive when dry.

DRAINAGE AND PERMEABILITY: Well drained; low to high runoff; moderately slow permeability.

USE AND VEGETATION: Used for growing field, forage, truck crops, and orchards and nonirrigated grain pasture, hay, and range. Uncultivated areas have a cover of annual grasses and forbs with scattered oak trees and coastal sagebrush in some areas.

DISTRIBUTION AND EXTENT: Coastal valley of central and south-central California. MLRAs are 14, 15, 17 and 19. The soils are of moderate extent.

MLRA OFFICE RESPONSIBLE: Davis, California

SERIES ESTABLISHED: Santa Barbara County (Santa Ynez Area), California, 1927.

REMARKS:
The 2Bt4 horizon (59 to 65 inches) was re-entered in 2001 after it was lost during scanning to an electronic file.

National Cooperative Soil Survey
U.S.A.

LOCATION CORRALITOS CA

Established Series
Rev. GWH-RCH-TDC
4/93

CORRALITOS SERIES

The Corralitos series consists of deep, somewhat excessively drained soils that formed in recent sandy alluvium derived from acid sandstone and related rocks. Corralitos soils are on alluvial fans and in small valleys and have slopes of 0 to 15 percent. The mean annual precipitation is about 20 inches and mean annual air temperature is about 58 degrees F.

TAXONOMIC CLASS: Mixed, thermic Typic Xeropsamments

TYPICAL PEDON: Corralitos loamy sand - rangeland. (Colors are for dry soil unless otherwise noted).

A11--0 to 8 inches; brown (10YR 5/3) loamy sand, dark brown (10YR 4/3) moist; single grained; loose; many very fine, common fine and few medium and coarse roots; many very fine and fine interstitial pores; medium acid (pH 6.0); abrupt wavy boundary. (3 to 10 inches thick)

A12--8 to 20 inches; grayish brown (10YR 5/2) loamy sand, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable, nonsticky and nonplastic; common very fine and fine roots, and few medium and coarse roots; many very fine and fine interstitial pores and many very fine, fine, and medium tubular pores; medium acid (pH 6.0); gradual irregular boundary. (6 to 13 inches thick)

A13--20 to 32 inches; grayish brown (10YR 5/2) loamy sand, dark brown (10YR 4/3) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine, fine, medium, and coarse roots; many very fine and fine interstitial and many fine and common medium tubular pores; medium acid (pH 6.0); gradual irregular boundary. (7 to 12 inches thick)

C1--32 to 49 inches; light brownish bray (10YR 6/2) light loamy sand, dark yellowish brown (10YR 4/4) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine, fine, medium, and coarse roots; many very fine and fine interstitial pores and many very fine, fine, and medium tubular pores; medium acid (ph 6.0); abrupt wavy boundary. (10 to 18 inches thick)

C2---49 to 72 inches; pale brown (10YR 6/3) loamy sand, yellowish brown (10YR 5/4) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine and fine and few medium roots; many very fine and fine interstitial and few very fine and fine tubular pores; medium acid (pH 6.0). (10 to 14 inches thick

TYPE LOCATION: Santa Barbara, California; 3 1/4 miles east along the north edge of San Antonio Valley from the Lompos-Casmalia road intersection and 1.8 miles north on side road, east of road fork.

RANGE IN CHARACTERISTICS: The mean annual soil temperature is about 60 to 65 degrees F and the soil temperature usually is not below 47 degrees F at any time. The mean winter soil temperature is about 54 to 58 degrees F and the mean summer soil temperature is about 65 to 70 degrees F. The soil

between depths of about 12 and 35 inches is usually dry all of the time from late April or May until November or early December and is moist in some or all parts all the rest of the year.

Rock fragments are mostly of gravel size and make up less than 15 percent of the soil and in most pedons less than 5 percent of soil. Textures are sand, loamy sand, fine sand or loamy fine sand to a depth of 40 inches or more. Dominant sand sizes are medium and fine sand. Coarse and very coarse sand combined is less than 35 percent. The profile is stratified, but strata finer than loamy fine sand are lacking to a depth of more than 40 inches. The soil is dominantly slightly to strongly acid but some strata in some pedons are neutral.

The A horizon is brown to pale brown (10YR 5/3, 5/2, 6/2, 6/3). Organic matter is less than 1 percent in most parts.

The C horizon is light gray to light yellowish brown (10YR 7/2, 7/1, 7/3, 6/2, 6/3, 6/4). Weakly expressed buried A horizons are present in a few pedons. Buried horizons of contrasting texture and color are present below a depth of 40 inches in some pedons.

COMPETING SERIES: These are the Arnold, Briones, Calhi, Delhi and Tujunga series in the same family and the Baywood and Oceano series. Arnold soils have a paralithic contact 40 to 60 inches below the surface and lack stratification. (See Remarks). Baywood soils have a mollic epipedon. Briones soils have a paralithic contact 20 to 40 inches below the surface. Calhi soils are moderately to very strongly alkaline below a depth of 10 inches. Delhi soils lack rock fragments and stratification, and the mean summer and mean winter soil temperatures differ by about 25 to 35 degrees F. Oceano soils have lamellae and lack stratification. Tujunga soils have more than 35 percent coarse and very coarse sand and mean summer and mean winter soil temperatures differ by more than 15 degrees F. Also, Tujunga soils are slightly acid to mildly alkaline and have 5 to 35 percent rock fragments.

GEOGRAPHIC SETTING: The Corralitos soils are on alluvial fans and in small valleys at elevations of 25 to 1,000 feet. Slopes are 0 to 15 percent. The soils formed in recent sandy alluvium derived from acid sandstone and related sources. The climate is dry subhumid mesothermal with dry somewhat foggy summers and cool moist winters. Mean annual precipitation is 12 to 30 inches. Average January temperature is 50 to 52 degrees F, average July temperature is 62 to 66 F, and mean annual temperature is 57 to 60 degrees F. The frost-free season is 250 to 330 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Antioch, Cortina, Elder, Las Flores, Metz and Pico soils and the competing Arnold soils. Antioch and Las Flores soils have a fine textured argillic horizon. Cortina soils are loamy and have more than 35 percent rock fragments. Elder and Pico soils are sandy loam and have a mollic epipedon. Metz soils are stratified with strata finer than loamy fine sand.

DRAINAGE AND PERMEABILITY: Somewhat excessively drained; slow runoff; rapid permeability. Some areas subject to localized flooding and deposition. Channels and other flood control measures now protect some areas.

USE AND VEGETATION: Used for range, dryland crops, urban development, and for growing truck crops, alfalfa, citrus, and other fruits under irrigation. Uncultivated areas have a cover of annual grasses, forbs, coyotebush, other shrubs, and a few live oak trees.

DISTRIBUTION AND EXTENT: Small coastal valleys from central California southward. The soils are moderately extensive.

MLRA OFFICE RESPONSIBLE: Davis, California

SERIES ESTABLISHED: Santa Cruz County (Pajaro Valley Area), California, 1908.

REMARKS: This description represents a change in the type location which was formerly in Santa Cruz County. Corralitos was not mapped in Santa Cruz County during the soil survey completed in 1976. This does not change the concept of the series. Soils of the Laguna series are now dominantly included in the Corralitos series. Continued study is needed to establish acceptable differentia between the Corralitos and Arnold series. Arnold soils are underlain by soft sandstone at depths of 40 inches or more.

Last revised by the state on 11/77.

National Cooperative Soil Survey
U.S.A.

LOCATION ELDER CA

Established Series
Rev. GES/LCL/RWK/KP
06/2001

ELDER SERIES

The Elder series consists of very deep and deep, well drained soils that formed in alluvial material derived from mixed rock sources. Elder soils are on alluvial fans and in flood plains and have slopes of 0 to 15 percent. The mean annual precipitation is about 20 inches and the mean annual air temperature is about 58 degrees F.

TAXONOMIC CLASS: Coarse-loamy, mixed, superactive, thermic Cumulic Haploxerolls

TYPICAL PEDON: Elder fine sandy loam, barley field. (Colors are for dry soil unless otherwise noted.)

Ap--0 to 8 inches; dark gray (10YR 4/1) fine sandy loam, very dark gray (10YR 3/1) moist; moderate medium and coarse granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine and fine interstitial and few very fine tubular pores; about 10 percent gravel; moderately acid (pH 6.0); clear smooth boundary. (6 to 10 inches thick)

A--8 to 23 inches; dark gray (10YR 4/1) sandy loam, very dark gray (10YR 3/1) moist; weak fine and medium granular structure; hard, very friable, slightly sticky and slightly plastic; common very fine roots; many very fine interstitial, common very fine and fine, and many medium tubular pores; about 10 percent gravel; slightly acid (pH 6.5); gradual wavy boundary. (14 to 22 inches thick)

AC--23 to 35 inches; gray (10YR 5/1) sandy loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; many very fine interstitial and tubular pores; few thin colloidal stains on mineral grains; much mixing of A and C horizon material due to rodent activity; about 10 percent gravel; a thin discontinuous gravel layer at the base of this horizon; slightly acid (pH 6.5); clear wavy boundary. (4 to 12 inches thick)

2C--35 to 72 inches; light brownish gray (10YR 6/2) fine sandy loam, grayish brown (10YR 5/2) moist; massive; hard, very friable, sticky and slightly plastic; few very fine roots; many very fine interstitial and very fine and fine tubular pores; few thin colloidal stains on mineral grains; 1-inch wavy continuous silty clay loam band, dark grayish brown (10YR 4/2) dry, very dark grayish brown (10YR 3/2) moist at 45 inches, similar but thinner 1/4 to 1/2 inch bands at 51 and 57 inches; neutral (pH 7.0).

TYPE LOCATION: Santa Barbara County, California; 3.5 miles southeast of Los Alamos, on Highway 101, 1.1 miles northeast of Barham Ranch buildings in field of Canada del Comasa; equivalent to the center of the SE1/4 NW1/4 section 36, T. 7 N., R. 32 W. (projected).

RANGE IN CHARACTERISTICS: The mean annual soil temperature is 59 degrees to 65 degrees F. and usually the soil temperature in winter is not below 47 degrees F. The soil between depths of about 8 and 25 inches is usually dry all the time from late April or May until November or early December and usually is moist in some or all parts all the rest of the year. The soil has 1 to 4 percent organic matter

that decreases irregularly to a depth of 20 to 30 inches or more. The 10- to 40-inch control section and usually all parts of the profile are sandy loam, coarse sandy loam, fine sandy loam or light loam and have less than 18 percent clay. The average combined silt, very fine sand, and clay is less than 50 percent. Weak to distinct stratification is present. Rock fragments in the control section are commonly 2 to 15 percent and range up to 35 percent. Shale fragments and gravel are usually less than 1/2 inch in diameter.

The A horizon is 2.5Y 5/2, 4/2; 10YR 3/1, 4/1, 4/2, 5/1, 5/2. This horizon is slightly alkaline to moderately acid and the base saturation is 75 to 100 percent. It has weak or moderate granular or subangular blocky or angular blocky structure in most pedons. In some pedons, the soil is massive and dry consistence is slightly hard.

The C horizon is 2.5Y 4/2, 6/2, 6/4; 10YR 4/2, 5/3, 5/4, 5/6, 5/8, 6/2, 6/3, 6/4; 7.5YR 5/2, 5/4. It is slightly acid to slightly alkaline and is not calcareous. A buried A horizon is present in some pedons below a depth of 30 to 40 inches. It is not a contrasting texture.

COMPETING SERIES: These are the Hustabel, Nord and Russian series in the same family and the Arroyo Seco, Ballard, Greenfield, Hanford, Pico, Reiff, and Vina series. Arroyo Seco and Pico soils have mollic epipedons less than 20 inches thick. Ballard and Greenfield soils have a argillic horizon. Greenfield and Hanford soils have an ochric epipedon. Hustabel soils are calcareous throughout with buried A horizons. Nord soils are calcareous below depths of 5 to 10 inches and are moderately to very strongly alkaline in the C horizon. Reiff soils are hard and massive and lack some of the properties of a mollic epipedon. Russian soils are dry from June to October and have more than 50 percent combined clay, silt, and very fine sand in the particle size control section. Vina soils are hard and massive in the A horizon and have 18 to 30 percent clay in the 10- to 40-inch section.

GEOGRAPHIC SETTING: Elder soils are on alluvial fans and flood plains. Elevations are 20 to 1,500 feet. The soils formed in moderately coarse textured alluvium derived from sedimentary, granitic, and basic igneous rock sources. Slopes are 0 to 15 percent. The climate is dry, subhumid mesothermal with warm, dry summers and cool, wet winters. The mean annual precipitation is 12 to 35 inches. The average January temperature is about 48 degrees F. and about 56 degrees along the coast of California; the average July temperature is about 65 degrees F.; the average annual temperature is about 57 degrees to 61 degrees F. Freeze-free season is 175 to 300 days and as high as 350 days along the coast of California.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Arroyo Seco and Hanford soils and the Arnold, Botella, Corralitos, Chamise, Crow Hill, Danville, Salinas, and San Andreas soils. Arnold and Corralitos soils are sandy and lack a mollic epipedon. Botella, Chamise, and Danville soils have an argillic horizon. Crow Hill and San Andreas soils have a paralithic contact at depths of less than 40 inches. Salinas soils have more than 18 percent clay.

DRAINAGE AND PERMEABILITY: Well-drained; negligible to low runoff; small areas adjacent to drainageways often subject to overflow during severe storms; moderately rapid permeability.

USE AND VEGETATION: With irrigation, Elder soils are intensively used for growing truck, field, and forage crops. Dry areas are used for growing small grain, hay, and small amounts of other crops. Uncultivated areas have a cover of annual grasses and forbs with scattered live oak.

DISTRIBUTION AND EXTENT: Central Valley and valleys of the Coast Range in California, MLRAs 14, 15, and 19. The soils are extensive.

MLRA OFFICE RESPONSIBLE: Davis, California

SERIES ESTABLISHED: Red Bluff Area, California, 1910.

REMARKS: The definition has been widened to include most of the soils that are in the same family. The Elder series includes most of the soils formerly placed in the Molinos and Visalia series. Differentia based on kind of rock source of the alluvium are discontinued.

National Cooperative Soil Survey
U.S.A.

LOCATION PLEASANTON CA

Established Series
Rev. LEW/GMK
01/2003

PLEASANTON SERIES

The Pleasanton series is a member of the fine-loamy, mixed, thermic family of Mollic Haploxeralfs. Typically, Pleasanton soils have grayish brown, slightly acid or neutral, gravelly fine sandy loam A horizons; brown, neutral, gravelly sandy clay loam B2t horizons; and gravelly fine sandy loam C horizons.

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, thermic Mollic Haploxeralfs

TYPICAL PEDON: Pleasanton gravelly fine sandy loam - cultivated. (Colors are for dry soil unless otherwise noted.)

Ap--0 to 9 inches; grayish brown (10YR 5/2) gravelly fine sandy loam, very dark grayish brown (10YR 3/2) moist; massive; hard, friable, slightly sticky, slightly plastic; many very fine, common fine and medium roots; common very fine and fine interstitial pores; slightly acid (pH 6.3); abrupt smooth boundary. (5 to 10 inches thick)

A1--9 to 21 inches; grayish brown (10YR 5/2) gravelly fine sandy loam, very dark grayish brown (10YR 3/2) moist; massive; hard, friable, slightly sticky, slightly plastic; many very fine, common fine and medium roots; common very fine and fine interstitial pores; neutral (pH 6.8); clear smooth boundary. (10 to 14 inches thick)

B2t--21 to 48 inches; brown (10YR 4/3) gravelly sandy clay loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; very hard, friable, sticky, plastic; common very fine and fine roots; many very fine and fine, few medium tubular pores; common moderately thick clay films on peds and in pores; neutral (pH 7.3); gradual wavy boundary. (12 to 32 inches thick)

B3--48 to 64 inches; brown (10YR 4/3) gravelly loam; dark brown (10YR 3/3) moist; weak medium subangular blocky structure; very hard, friable, sticky, plastic; few very fine roots; many very fine, common fine pores; few thick and few thin clay films on peds and in pores; neutral (pH 7.3); gradual wavy boundary. (8 to 20 inches thick)

C1--64 to 72 inches; yellowish brown (10YR 5/4) gravelly fine sandy loam near gravelly loam, dark yellowish brown (10YR 4/4) moist; weak blocky structure; hard, friable, sticky, slightly plastic; many very fine, common fine, few medium pores; few thin clay films on peds and in pores; slightly alkaline (pH 7.4).

TYPE LOCATION: Alameda County, California; about 5 miles SE of the center of Livermore; SE1/4 NE1/4 NE1/4 sec. 24, T.3S., R.2E. Altamont Quad. lat.37 degrees N. 39 minutes, 45 seconds, long 121 W. 41 minutes, 48 seconds.

RANGE IN CHARACTERISTICS: Solum thickness to the bottom of the B horizon is 60 inches. The

soils become moist in November or early December and remain moist until May. Mean annual temperature is about 59 degrees to 64 degrees F.

The A horizon is dark grayish brown, grayish brown, or brown in 10YR or 7.5YR hue. It is moderately acid to neutral (pH 6.0-7.0).

The B horizon is brown to light yellowish brown in 10YR or 7.5YR hue. It is loam, sandy clay loam or clay loam and is gravelly or cobbly in some pedons. It ranges from slightly acid to slightly alkaline.

The C horizon is gravelly fine sandy loam or loam. It is neutral or mildly alkaline and is slightly calcareous in some pedons.

COMPETING SERIES: These are the Arbuckle, Burchell, Coarsegold, Jacinto, Modesto, Perkins, Ramona, Rescue, Sobrante, Trimmer, Whitney and Zamora series. Arbuckle and Ramona soils have A1 horizons with either moist value of more than 3.5 or organic carbon of less than 0.7 percent throughout the upper 4 inches. Burchell and Modesto soils are somewhat poorly drained and are mottled in the lower horizons. Coarsegold, Perkins and Rescue soils have hue of 5YR or 2.5YR in the Bt horizon. Jacinto soils have hue of 2.5Y. Sobrante soils have a lithic contact at depths of less than 40 inches. Trimmer and Whitney soils have a paralithic contact at depths of less than 40 inches. Zamora soils are fine-silty.

GEOGRAPHIC SETTING: The Pleasanton soils are on nearly level to gently sloping alluvial fans and terraces at elevations of less than 2,400 feet. They are in a subhumid, mesothermal climate with hot, dry summers and cool, moist winters. Mean annual precipitation ranges from 12 to 39 inches. Average January temperature is 48 degrees F.; average July temperature is about 73 degrees F.; mean annual temperature is about 59 degrees F.; and the freeze-free season is about 220 to 300 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Arbuckle soils and the Corning, Livermore, Newville, Positas, and Sorrento soils. Corning, Newville and Positas soils have clay argillic horizons. Livermore soils are very gravelly throughout. Sorrento soils lack an argillic horizon.

DRAINAGE AND PERMEABILITY: Well-drained; slow to medium runoff; moderately slow permeability.

USE AND VEGETATION: The soils are used for dry farmed grain and grain hay, wine grapes, deciduous fruits, nuts, roses and row crops. Vegetation is annual grasses and forbs with scattered oaks.

DISTRIBUTION AND EXTENT: The soils occur in the valleys of the Coast Range, Central Valley, and intermountain valleys of southern California. They are moderately extensive.

MLRA OFFICE RESPONSIBLE: Davis, California

SERIES ESTABLISHED: Livermore Area, California, 1910.

REMARKS: The soils formerly were classified as (medial) Noncalcic Brown soils.

The activity class was added to the classification in January of 2003. Competing series were not checked at that time. - ET

ADDITIONAL DATA: Three pedons sampled in Alameda County, CA: The type location S60CA-001-001 and two taxadjunct pedons, S78CA-001-000 (mesic) and S79CA-001-000 (isofrigid?).

OSED scanned by SSQA. Last revised by state on 10/74.

National Cooperative Soil Survey
U.S.A.

LOCATION TIERRA CA

Established Series
Rev. GES/GMK/RWK
02/97

TIERRA SERIES

The Tierra series consists of deep, moderately well drained soils that formed in alluvial materials from sedimentary rocks. Tierra soils are on dissected terraces and low hills and have slopes of 2 to 50 percent. The mean annual precipitation is about 18 inches and the mean annual air temperature is about 58 degrees F.

TAXONOMIC CLASS: Fine, smectitic, thermic Mollic Palexeralfs

TYPICAL PEDON: Tierra loam, annual grasses, formerly cultivated. (Colors are for dry soil unless otherwise noted.)

Ap--0 to 7 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; massive; hard, friable, slightly sticky and slightly plastic; many very fine roots; common very fine interstitial and common very fine and medium tubular pores; strongly acid (pH 5.5); gradual smooth boundary. (5 to 10 inches thick)

A12--7 to 11 inches; gray (10YR 5/1) loam, very dark gray (10YR 3/1) moist; massive; hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine interstitial, many very fine interstitial and many very fine tubular pores; medium acid (pH 6.0); abrupt smooth boundary. (5 to 14 inches thick)

B21t--12 to 16 inches; very dark grayish brown (10YR 3/2) clay, very dark brown (10YR 2/2) moist; moderate coarse prismatic structure; very hard, very firm, very sticky and very plastic; few very fine roots concentrated along faces of peds; few very fine interstitial and few very fine tubular pores; many moderately thick clay films on faces of peds, continuous thin clay films lining pores; slightly acid (pH 6.5); gradual smooth boundary. (4 to 20 inches thick)

B22t--16 to 25 inches; dark brown (10YR 4/3) clay (not as fine as horizon above), dark brown (10YR 3/3) moist; weak coarse prismatic structure and moderate medium angular blocky; very hard, very firm, very sticky and very plastic; few very fine roots on faces of peds; few very fine interstitial and few very fine tubular pores; continuous thin clay films on faces of peds and lining pores; slightly acid (pH 6.5); gradual smooth boundary. (8 to 12 inches thick)

B3t--25 to 43 inches; light brownish gray (10YR 6/2) heavy clay loam, grayish brown (10YR 5/2) moist; many larger prominent mottles of reddish brown (5YR 5/4, 4/4); moderate medium angular blocky structure; very hard, firm, sticky and plastic; few very fine roots; few fine interstitial and common very fine and fine tubular pores; many thin and few moderately thick clay films on faces of peds, few moderately thick clay films lining tubular pores; moderately alkaline (pH 8.0); clear smooth boundary. (15 to 20 inches thick)

C--43 to 62 inches; pale brown (10YR 6/3) clay loam, dark brown (10YR 4/3) moist; many large

prominent mottles of reddish brown (2.5YR 5/4) and yellowish brown (10YR 5/4); strong medium angular blocky structure; very hard, firm, sticky and plastic; few very fine interstitial and tubular pores; common thin very dark brown clay films on faces of peds and joints; mildly alkaline (pH 7.5).

TYPE LOCATION: Santa Barbara County, California; 2 1/4 miles south of Guadalupe; 0.9 mile west on Brown Road from intersection with California Highway No. 1 and 1,980 feet south of Brown Road.

RANGE IN CHARACTERISTICS: Usually the soil between the depths of about 5 and 15 inches is continuously moist from November until late April or May and is dry all the rest of the year. The mean annual soil temperature is 59 degrees to 64 degrees F. The mean summer soil temperature is about 68 degrees F., and the mean winter soil temperature is about 57 degrees F. Except for some C horizons deep in the profile, the amount of rock fragments is low, less than 15 percent.

The A1 horizon is gray to very dark gray or grayish brown to dark grayish brown, or brown (10YR 5/1, 4/1, 3/1, 5/2, 4/2; N 5/, 2.5Y 5/1, 5/2, 5/3). It is loamy sand to clay loam, but in most pedons it is fine sandy loam or loam. This horizon is massive and is hard or very hard in some or all parts. It has 1.5 to 5 percent organic matter. It is slightly to strongly acid and has base saturation of 50 to 75 percent.

The A2 horizon is gray, light gray, light brownish gray, white, pale brown, or very pale brown and has one or two units of value higher than the A1 horizon and in most pedons, one to three units higher than the B2t horizon.

The upper part of the B2t horizon is grayish brown, dark grayish brown or very dark grayish brown. The lower part of the B2t horizon is light brownish gray, grayish brown, yellowish brown, dark yellowish brown, pale brown or brown. Hue is dominantly 10YR in all of the B2t horizon, but 2.5Y hue is included. The exterior of the peds has lower value and lower chroma, with generally less staining and lighter and brighter color in the lower part. This horizon has 35 to 50 percent clay, an abrupt upper boundary and has 15 to 30 percent more clay (absolute) than the A horizon. The B2t horizon has moderate to strong prismatic structure in the upper part and weak to moderate prismatic or moderate to strong prismatic structure in the upper part and weak to moderate prismatic or moderate to strong angular blocky structure in the lower part. Some pedons have coarse mottles or blotches of brighter colors, particularly in the lower part of this horizon. The B2t horizon is neutral to medium acid and in most pedons becomes less acid as depth increases. Base saturation is more than 75 percent in most or all parts. The lower less acid as depth increases. Base saturation is more than 75 percent in most or all parts. The lower boundary of the Bw5 horizon is gradual or there is a B3 horizon 15 to 30 inches thick.

The C horizon has hue of 2.5Y or 10YR and dry value of 6 or 7. It is sandy loam, loam, clay loam or sandy clay loam and is slightly hard to very hard when dry. In some pedons, some or all of this horizon is weakly cemented and dense. It is medium acid to moderately alkaline and in a few pedons has free lime in disseminated or segregated form.

COMPETING SERIES: These are the Kimball, Milpitas, Newville, Nicolaus and Positas series. Kimball soils lack an A2 horizon and have hue of 5YR or 2.5YR in the B2t horizon. Milpitas soils have chroma of 4 or more in all parts of the B2t horizon. Newville soils lack an A2 horizon and have chroma of 4 or more in all parts of the B2t horizon. Nicolaus soils are underlain by a weakly cemented layer. Positas soils have a hue of 7.5YR or 5YR and a chroma of 3 or more in the upper part of the B2t horizon.

GEOGRAPHIC SETTING: Tierra soils are gently sloping to steep and are on dissected terraces and low hills at elevations of 100 to 1,200 feet. Slopes are 2 to 50 percent. The series formed in weakly

consolidated somewhat stratified old alluvium interspersed with beds of sandstone. The climate is subhumid mesothermal with cool moist winters and cool dry summers. The mean annual precipitation is 12 to 25 inches. Mean annual temperature is about 57 degrees to 59 degrees F., average January temperature is about 52 degrees F., and average July temperature is about 63 degrees F. The average frost-free season is 200 to 300 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Arnold, Chamise, Los Osos, San Andreas, and Santa Lucia soils and the competing Positas soils. Arnold soils are sand throughout the profile. Chamise and Los Osos soils have a mollic epipedon. San Andreas and Santa Lucia soils have a mollic epipedon and lack an argillic horizon.

DRAINAGE AND PERMEABILITY: Moderately well drained; slow to rapid runoff; very slow permeability.

USE AND VEGETATION: Used for grazing and growing small grains and small areas of large number of crops. Many cultivated areas have reverted to grass. Vegetation dominantly is annual grasses and forbs.

DISTRIBUTION AND EXTENT: Areas within 30 miles of the coast in central and south-central California. The soils are of moderate extent.

MLRA OFFICE RESPONSIBLE: Davis, California

SERIES ESTABLISHED: Monterey County (Salinas Area), California, 1925.

National Cooperative Soil Survey
U. S. A.

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HWY 166
BtC
FtC
Rs
CuC
EdC2
BmC
BnB2
CtA
BoD2
ChF
CuD
CuE
TrE3
TrE3
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CtD
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N
Meters
0
100
200
400
600
Feet
0
500
1,000
2,000
3,000

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- <= 4.0413
- > 4.0413 AND <= 8.325
- > 8.325 AND <= 28
- > 28 AND <= 61.3949
- > 61.3949 AND <= 92
- Not rated or not available

Political Features

Municipalities

- Cities
- Urban Areas

Water Features

- Oceans
- Streams and Canals

Transportation

- Rails

Roads

- Interstate Highways
- US Routes
- State Highways
- Local Roads
- Other Roads

MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 10N

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Northern Santa Barbara Area, California
Survey Area Data: Version 6, Jan 3, 2008

Date(s) aerial images were photographed: 9/3/1994

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Saturated Hydraulic Conductivity (Ksat)

Saturated Hydraulic Conductivity (Ksat)— Summary by Map Unit — Northern Santa Barbara Area, California				
Map unit symbol	**Map unit name**	**Rating (micrometers per second)**	**Acres in AOI**	**Percent of AOI**
BmC	Betteravia loamy sand, 2 to 9 percent slopes	41.9171	0.6	0.2%
BnB2	Betteravia loamy sand, dark variant, 0 to 5 percent slopes, eroded	61.3949	40.5	15.6%
BoD2	Botella loam, 2 to 15 percent slopes, eroded	3.4508	1.1	0.4%
BtC	Botella clay loam, 2 to 9 percent slopes	2.7000	13.8	5.3%
ChF	Chamise shaly loam, 15 to 45 percent slopes	4.0413	0.0	0.0%
CtA	Corralitos sand, 0 to 2 percent slopes	92.0000	10.5	4.1%
CuC	Corralitos loamy sand, 2 to 9 percent slopes	92.0000	22.7	8.8%
CuD	Corralitos loamy sand, 9 to 15 percent slopes	92.0000	0.3	0.1%
EdC2	Elder sandy loam, 2 to 9 percent slopes, eroded	28.0000	14.2	5.5%
GuE	Gullied land		18.0	6.9%
PnC	Pleasanton sandy loam, 2 to 9 percent slopes	8.3250	22.9	8.8%
Rs	Riverwash	92.0000	0.2	0.1%
TnC	Tierra sandy loam, 2 to 9 percent slopes	1.9942	0.4	0.2%
TrE3	Tierra loam, 5 to 30 percent slopes, severely eroded	1.2668	113.8	43.9%
Totals for Area of Interest (AOI)			258.9	100.0%

Description

Saturated hydraulic conductivity (Ksat) refers to the ease with which pores in a saturated soil transmit water. The estimates are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity is considered in the design of soil drainage systems and septic tank absorption fields.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

The numeric Ksat values have been grouped according to standard Ksat class limits.

Rating Options

Units of Measure: micrometers per second

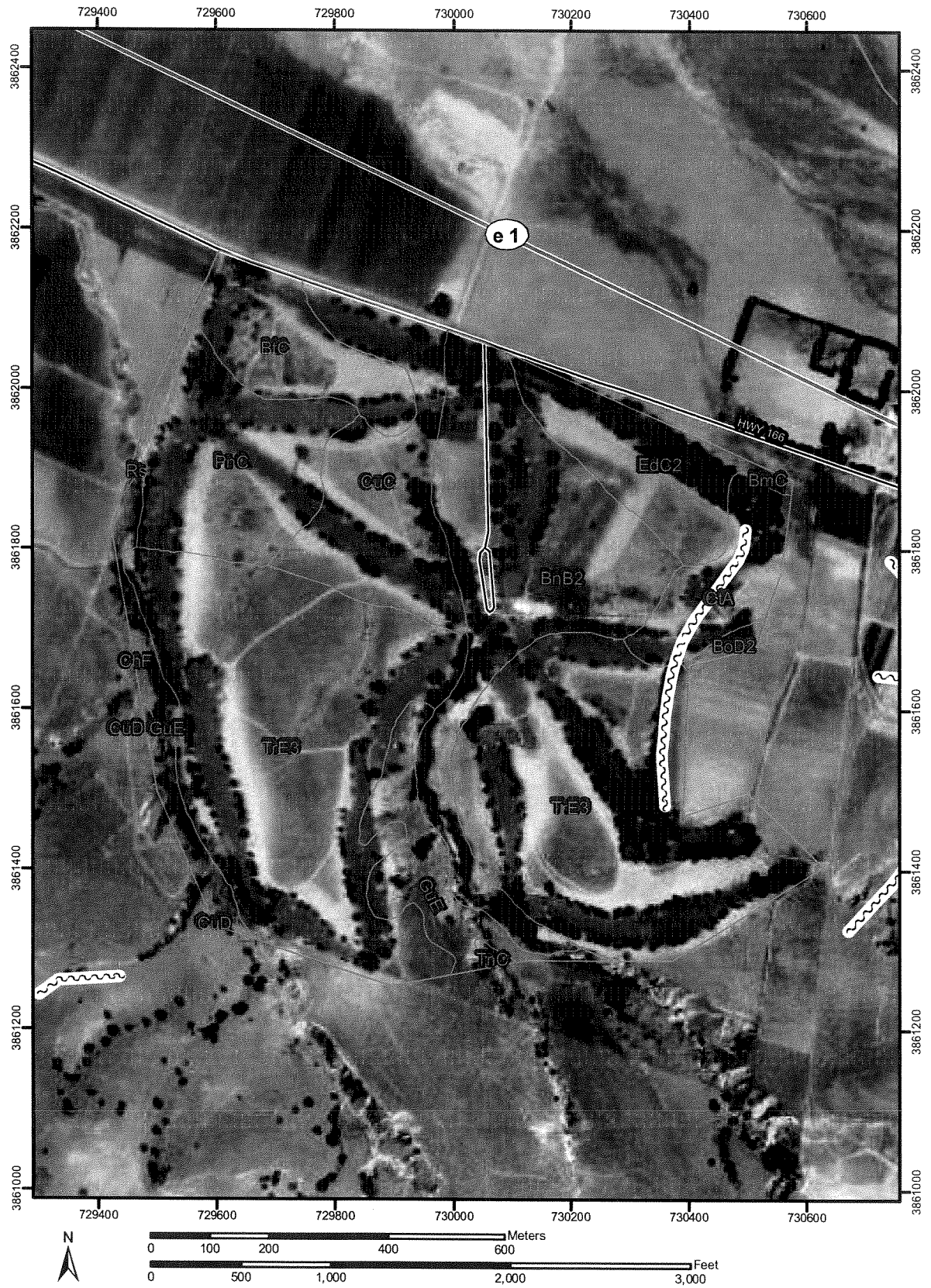
Aggregation Method: Dominant Component

Component Percent Cutoff: *None Specified*

Tie-break Rule: Slowest

Interpret Nulls as Zero: No

Layer Options: All Layers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MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features

Municipalities
- Cities
- Urban Areas

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails

Roads
- Interstate Highways
- US Routes
- State Highways
- Local Roads
- Other Roads

MAP INFORMATION

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Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 10N

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Northern Santa Barbara Area, California
Survey Area Data: Version 6, Jan 3, 2008

Date(s) aerial images were photographed: 9/3/1994

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Northern Santa Barbara Area, California (CA672)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
BmC	Betteravia loamy sand, 2 to 9 percent slopes	0.6	0.2%
BnB2	Betteravia loamy sand, dark variant, 0 to 5 percent slopes, eroded	40.5	15.6%
BoD2	Botella loam, 2 to 15 percent slopes, eroded	1.1	0.4%
BtC	Botella clay loam, 2 to 9 percent slopes	13.8	5.3%
ChF	Chamise shaly loam, 15 to 45 percent slopes	0.0	0.0%
CtA	Corralitos sand, 0 to 2 percent slopes	10.5	4.1%
CuC	Corralitos loamy sand, 2 to 9 percent slopes	22.7	8.8%
CuD	Corralitos loamy sand, 9 to 15 percent slopes	0.3	0.1%
EdC2	Elder sandy loam, 2 to 9 percent slopes, eroded	14.2	5.5%
GuE	Gullied land	18.0	6.9%
PnC	Pleasanton sandy loam, 2 to 9 percent slopes	22.9	8.8%
Rs	Riverwash	0.2	0.1%
TnC	Tierra sandy loam, 2 to 9 percent slopes	0.4	0.2%
TrE3	Tierra loam, 5 to 30 percent slopes, severely eroded	113.8	43.9%
Totals for Area of Interest (AOI)		258.9	100.0%

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729600
729800
730000
730200
730400
730600
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3862200
3862000
3861800
3861600
3861400
3861200
3861000
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HWY 166
BtC
PnC
CuC
RS
EdC2
BmC
BnB2
CtA
BoD2
ChF
CuD
CtE
TrE3
TrE3
CtE
CtD
TnC
N
Meters
0
100
200
400
600
Feet
0
500
1,000
2,000
3,000

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- Limitations
- No limitations
- not rated or not available

Political Features

Municipalities
- Cities
- Urban Areas

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails

Roads
- Interstate Highways
- US Routes
- State Highways
- Local Roads
- Other Roads

MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 10N

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Northern Santa Barbara Area, California
Survey Area Data: Version 6, Jan 3, 2008

Date(s) aerial images were photographed: 9/3/1994

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Sprinkler Irrigation (CA)

Sprinkler Irrigation (CA)— Summary by Map Unit — Northern Santa Barbara Area, California						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (rating values)**	**Acres in AOI**	**Percent of AOI**
BmC	Betteravia loamy sand, 2 to 9 percent slopes	Limitations	Betteravia (85%)	Lcos, cos, s or ls in surface (1.00)	0.6	0.2%
				WEG = 1 or 2 (1.00)		
				AWC < 2" to 40" (1.00)		
				Surface K-factor >.32 and slopes > 2% (1.00)		
BnB2	Betteravia loamy sand, dark variant, 0 to 5 percent slopes, eroded	Limitations	Betteravia variant (85%)	Lcos, cos, s or ls in surface (1.00)	40.5	15.6%
				WEG = 1 or 2 (1.00)		
				AWC < 2" to 40" (1.00)		
BoD2	Botella loam, 2 to 15 percent slopes, eroded	Limitations	Botella (85%)	Slopes 6 to 15% (0.78)	1.1	0.4%
BtC	Botella clay loam, 2 to 9 percent slopes	No limitations	Botella (85%)		13.8	5.3%
ChF	Chamise shaly loam, 15 to 45 percent slopes	Limitations	Chamise (85%)	Slopes > 15% (1.00)	0.0	0.0%
				AWC < 2" to 40" (1.00)		
CtA	Corralitos sand, 0 to 2 percent slopes	Limitations	Corralitos (85%)	Lcos, cos, s or ls in surface (1.00)	10.5	4.1%
				WEG = 1 or 2 (1.00)		
				AWC < 2" to 40" (1.00)		
CuC	Corralitos loamy sand, 2 to 9 percent slopes	Limitations	Corralitos (85%)	Lcos, cos, s or ls in surface (1.00)	22.7	8.8%
				WEG = 1 or 2 (1.00)		
				AWC < 2" to 40" (1.00)		

Sprinkler Irrigation (CA)— Summary by Map Unit — Northern Santa Barbara Area, California						
Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (rating values)	Acres in AOI	Percent of AOI
CuD	Corralitos loamy sand, 9 to 15 percent slopes	Limitations	Corralitos (85%)	Lcos, cos, s or ls in surface (1.00)	0.3	0.1%
				WEG = 1 or 2 (1.00)		
				AWC < 2" to 40" (1.00)		
				Slopes 6 to 15% (0.78)		
EdC2	Elder sandy loam, 2 to 9 percent slopes, eroded	Limitations	Elder (85%)	AWC from 2 - 6" (0.53)	14.2	5.5%
GuE	Gullied land	Not rated	Gullied land (85%)		18.0	6.9%
			Unnamed (10%)			
			Unnamed (5%)			
PnC	Pleasanton sandy loam, 2 to 9 percent slopes	Limitations	Pleasanton (85%)	AWC from 2 - 6" (0.62)	22.9	8.8%
Rs	Riverwash	Not rated	Riverwash (85%)		0.2	0.1%
			Unnamed (15%)			
TnC	Tierra sandy loam, 2 to 9 percent slopes	Limitations	Tierra (85%)	AWC < 2" to 40" (1.00)	0.4	0.2%
TrE3	Tierra loam, 5 to 30 percent slopes, severely eroded	Limitations	Tierra (85%)	AWC < 2" to 40" (1.00)	113.8	43.9%
				Slopes > 15% (1.00)		
Totals for Area of Interest (AOI)					258.9	100.0%

Sprinkler Irrigation (CA)— Summary by Rating Value		
Rating	Acres in AOI	Percent of AOI
Limitations	226.8	87.6%
No limitations	13.8	5.3%
Null or Not Rated	18.2	7.0%

Description

This interpretation shows the degree and kind of soil limitations that affect sprinkler irrigation of soils. The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the irrigation method. "No limitations" indicates that the soil has features that are very favorable for the irrigation method. Good performance and very low maintenance can be expected. "Limitations" indicates that the soil has some features that are favorable for the irrigation method and some that are unfavorable. This interpretation identifies only the most significant limitations for any given soil. The limitations listed can be overcome or minimized by special planning, design, or installation. Fair to poor performance and moderate to high maintenance can be expected, depending on the number of limitations and the severity of each limitation.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which a soil feature is not a limitation (0.00).

The soil properties and qualities important in design and management are the sodium adsorption ratio, depth to a seasonal high water table, available water capacity, saturated hydraulic conductivity (Ksat), wind erodibility, water erodibility, slope, and flooding. The soil properties and qualities that influence construction are the content of stones, depth to bedrock or a cemented pan, bulk density, the sodium adsorption ratio, salinity, and soil reaction. The properties and qualities that affect performance of the irrigation system are depth to bedrock or a cemented pan, bulk density, the sodium adsorption ratio, salinity, and soil reaction. Permanently frozen soils are not suitable for irrigation.

This interpretation was developed by the NRCS Soils Staff in Davis, California. The interpretation was developed with assistance from the NRCS Resource Technology Staff in Davis, California, and received further technical review from irrigation specialists at UC-Davis.

IMPORTANT: This interpretation is not designed or intended to be used in a regulatory manner.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

Appendix B – Drainage Notes from Field Visit to RMGC

Notes from December 17, 2008 field visit:

Driving range: It is regularly overseeded. RMGC overseeds with species that have fast germination: perennial and annual ryegrass. Back area (toward highway) contains bermuda and kikuyu grass. Water drains toward highway, ponds then runs off down path next to Hole 2, then drains off site east of Green #2. Tree species on the west side of driving range include pines and cypress.

Hole 1: Drains from south to north, from tee toward green, fairway contains oaks.

Hole 2: Has young trees planted at perimeter; foliage could potentially intercept sprinkler water. It looks like Roundup is applied at the base of trees to keep grass from growing against base of trees; some spray drift may have hit some of the bottom foliage on one tree. Water is directed down path on the south side of Hole 2 and there is limited run-on. East of the green, the ground was wet, and there were lots of mushrooms.

Hole 3: Per RMGC staff, hardpan soils exist here. Soil puddles if watered for more than about 15 minutes. Irrigation is every other day in the summer and infrequently in the winter. Water runs off the green, and fairway is poorly drained.

Hole 4: Site gets run-on at a couple of points. A drainage with willows contributes run-on in front of the tee. Other run-on occurs in front of the green. Water drains into a ditch east of the clubhouse and drains offsite through ag fields (now weeds). Green #4 buckles/heaves when wet. Standing water was observed on fairways, and near green was cordoned off to prevent carts from driving across saturated areas.

Hole 5: A ditch was created on the west side of Hole 5 to help keep water off Hole 5 and 4. RMGC staff, Green #5 has a herringbone subsurface drainage, and when the green gets dry in the summer you can see a green herringbone pattern. A potable water tank is located between Green #5 and Tee #6.

Hole 6: Pond 6 is located in front of the tee. Green #6 is the USGA sand green with built-in drainage.

Hole 7: Drains toward the green. The green heaves and the hole gets sloppy when wet (per RMGC staff).

Hole 8: Green heaves when wet per RMGC staff. There was standing water at places in the fairway.

Hole 9: Soils clayey, per RMGC staff. Water drains toward Pond 10 and ultimately into ditch that discharges into ag fields next to club house. Gets run-on from off-site.

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Hole 10: Green doesn't lift but gets mushy. Per RMGC staff, it seems like there is a surface tension in the soil when it is wet, such that once you break through it you sink down into the soil.

Hole 11: Per RMGC staff, Hole 11 is well-drained. Based on topography, water probably runs off. Doesn't get any run-on; all runoff originates on the fairway.

Hole 12: Soils are very hard when dry and staff speculates they have a lot of clay. Fairway was wet in front of green.

Hole 13: Gully to the west of Holes 12 and 13. Per staff, Hole 13 Green has 1 pipe drain. Fairway was wet.

Hole 14: Fairway was wet. There is microtopography across the fairways, and water tends to pond in the depressions. Longest hole; ½ of #14 gets watered every other night in summer.

Hole 15: In front of green, there is a large drain with a sump pump to discharge water out of the drain. Runoff is directed into a culvert that passes under highway near Hole 16 tee.

Hole 16 and 17: Water drains across the fairway and into culvert near tee.

Hole 18: Stays wettest of the holes per staff. Gets run-on from offsite. The fairway is pretty flat and water accumulates.

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Appendix C - Recycled Water User Interview Summaries

The following section summarizes telephone interviews conducted with other recycled water suppliers and superintendents of golf courses that are utilizing recycled water in proximity to RMGC.

RICK DANIEL
708-6840

Santa Barbara

City of Santa Barbara Public Works, Bill Ferguson. Provided a one-page summary of water quality of blended and potable water supply. Golf courses are dual plumbed, with potable water being used on greens. The City provided partial funding for initial upgrades, but golf courses are responsible for maintaining. Santa Barbara water is hard, and people use water softeners, which adds to salt problem. They blend recycled water with potable water during peak irrigation season, to achieve a chloride content of less than 300 mg/L.

Montecito Country Club, Bill Herbert. The golf course is just over 100 acres total and uses recycled water on about 60 acres. Potable water is used for irrigation of greens; recycled water is used for fairways, roughs, landscaping, and tees. Their fairways are kukuyugrass; trees are cypress, Monterey pine, oak; also has agapanthus and bedding plants. Greens are primarily modified pushup type. He does not do any flushing on either the greens or other areas, and they don't have any problem to speak of with salts. Golf course is on a slope and soils are "kind of rocky clay." No overspray problems on shrub/tree foliage. He thinks his success may be due in part to the fact that they don't irrigate too much (about 10 minutes per night) and they reduce fertilizer application because nutrients are in the recycled water. He provided the following data for recycled water he samples:

	March 2005	April 2008
EC	1.8 dS/m	1.28 dS/m
TDS	1158 mg/L	819 mg/L
Sodium	8 meq/L	

Santa Barbara Golf Club, Rick Daniel. They started out with applying recycled water to greens; grass couldn't tolerate the salt so they started blending with potable. They are about to finish a $550K project where they are upgrading the irrigation lines. They started with a 2.5" line for a quick coupler. They switched to a valve with 4 heads, but there is inadequate pressure. So they are switching out the 2.5" main lines with 6" and 4" lines to increase pressure. Now only potable water is applied to greens, which are predominantly *Poa annua* (started with bentgrass). They have 5 pushup greens left, they are switching to USGA sand greens. Native greens are the first to show damage.

Even with all potable water on greens, they still need to flush occasionally. Once per month they put out about 5 portable sprinklers to irrigate the greens only, and they irrigate overnight. They don't apply gypsum or other amendment when they flush. Almost overnight the greens look better.

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The fairways are a mix of kukuyugrass and bermudagrass. Fairways are OK on recycled water, but the recycled water is itself blended by the provider. Anywhere recycled water hits shrubs/trees, the foliage dies (not the whole plant). Monterrey pine is not affected; poplars, sycamores, ficus, liquid amber and ash are sensitive to salt hitting foliage.

Mark Reed is the new manager (same phone number), and he has an agronomy background. They send tissue/soil samples to a Dr. York in Valencia, PA for testing and recommendations. August and September are the hard months for irrigation management.

Goleta

Goleta Sanitary District, Kamil Azoury, General Manager. Annual recycled water report was supplied by Kathleen Werner. Sanitary district produces water only. Goleta Water District is purveyor.

Goleta Water District, Ginger Kaufman. They do not report water chemistry, since water is produced by Goleta Sanitary District, whose chemistry data should be representative of what is delivered to golf courses. They deliver water to Glen Annie Golf Club, Sandpiper Golf Course and Ocean Meadows Golf Course. No blending occurs by the water district. She knows that for the most part, all courses use potable water on greens, although Ocean Meadows may put recycled water on a few.

CRCOTT/SM LCSD

Sunset Ridge Golf Resort, Keith Moles. They use strictly potable water. About a year and a half ago they used recycled water briefly, but quit using it because grass couldn't tolerate high salt content. When they used recycled water, they would either have to mix city water with it or "wash it in" with clean water.

San Luis Obispo

County of San Luis Obispo (County Service Area 18) John Beaton. The County operates a small treatment plant that services one development and delivers water exclusively to the San Luis Obispo Country Club. The treatment plant produces disinfected secondary water. The water is discharged to a blending pond on the golf course, where the effluent is mixed with groundwater. This water is used to irrigate only one area of the golf course, and the discharge is permitted by the Regional Board. John Beaton thinks that about 80K gallons per day are delivered. The golf course also gets water supplied by Golden State, and the source of that water is groundwater. Beaton believes that the golf course may have one onsite well that does not produce potable water, but this water may also be used for irrigation purposes. According to Beaton, TDS in the effluent is about 1000 mg/L; Na is approximately 250 mg/L; chloride is approximately 218 mg/L; calcium and magnesium were sampled in 1999 and those values were 36 and 29 mg/L, respectively.

San Luis Obispo Country Club, Joe Tompkins. They do not use recycled water on greens, only potable. They use recycled water on about 25% of the golf course: fairways, rough, interior. They have a problem with salts on these areas, but soil is adobe clay. Therefore, leaching is also not an option and they wait each year for the rains to come and flush salts down. He emphasized the need to look at soil structure.

City of San Luis Obispo (Laguna Lake Golf Course), Todd Bunte. Laguna Lake is a 9 hole golf course with 20 acres being intensely managed turf. They have pushup greens, so have

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problems with salts. They blend recycled water with water from 2 groundwater wells. Their groundwater is nonpotable with high magnesium and an EC of about 1.76 dS/m. They blend to achieve an EC of 1.34 dS/m. Their recycled water is 1.13 dS/m. The best scenario for them was when greens were irrigated with potable water. They started using recycled water when the city went to tertiary treatment. Once per month they apply calcium carbonate (he may have meant gypsum [calcium sulfate]) to the greens and then run low flow sprinklers all night. Their grass is mixed bentgrass and *Poa annua*.

Cypress Ridge Golf Course, Mike Scott. They have an onsite sewer plant serving the 18-hole golf course and 378 homes. The plant is operated by others. The golf course has about 100 acres of turf and 90 acres of native vegetation. The plant produces about 160K gpd, but the golf course only gets about 60K gpd. There is a 25 acre lake by the 18th hole that receives recycled water as well as water derived from groundwater wells. He thinks the pond holds about 93 AF, so the recycled water is just a small fraction of what's there. They don't have any problems, but others do - for example, San Luis Country Club has to "flush like crazy all the time." Courses that have problems have pushup greens; USGA sand greens are fine. He said folks use chemicals as basically a soil amendment to help get rid of salts: Aquaduct, Revolution, Caltrisol. Best scenario for greens is to use potable water. He also uses Trimmit herbicide for specific control of *Poa annua*.

California Men's Colony

California Men's Colony WWTP, Bob Barlogio. Indicated the WWTP meets all discharge requirements and there are no problems. No problems with recycled water use on golf courses they deliver to; only feedback from golf courses is that they wish the algal blooms could be cut down. He will send data via fax.

Morro Bay and Dairy Creek Golf Course, Tommy Massey. For the Morro Bay Golf Course, groundwater is used for irrigation and there are no problems with salts. Dairy Creek Golf Course has 18 holes and about 105 irrigated acres. Only recycled water is used and they have no problems. All greens are 11-year-old USGA sand greens with good drainage. Fairways are hybrid Bermuda, and pretty salt tolerant. Recycled water is obtained from the California Men's Colony wastewater treatment plant.

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COUNTY OF SANTA BARBARA

Laguna County Sanitation District

Final
Mitigated Negative Declaration

Recycled Water Distribution Main (Phase 2)

09NGD-00000-00021

February 18, 2010

PROJECT PROPONENT:

Laguna County Sanitation District
620 Foster Road
Santa Maria, California 93455
Contact: Martin Wilder - (805) 739-8755

PREPARED BY:

Padre Associates, Inc.
1861 Knoll Drive
Ventura, California 93003
Contact: Matt Ingamells – (805) 644-2220

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ATTACHMENTS

A Response to Comments

1.0 INTRODUCTION

1.1 PURPOSE AND LEGAL AUTHORITY

The California Environmental Quality Act (CEQA) requires that local, regional, and state agencies and special purpose districts prepare an Initial Study to identify potential environmental impacts associated with discretionary actions. An Initial Study is generally used to determine if significant impacts would occur, and to determine the need for preparation of either a Negative Declaration or further analysis in an EIR. The Laguna County Sanitation District has prepared this Initial Study for the proposed Recycled Water Distribution Pipeline (Phase II) Project to comply with the provisions of CEQA.

1.2 PROJECT PROPONENT

Laguna County Sanitation District
620 West Foster Road
Santa Maria, California 93455
Contact: Mr. Martin Wilder, P.E., Utilities Manager

1.3 PROJECT LOCATION

The proposed project is located in unincorporated northern Santa Barbara County, within the Santa Maria Valley, southwest of the City of Santa Maria. A regional location map is provided as Figure 1.

1.4 BACKGROUND

The Laguna County Sanitation District (District) provides municipal wastewater collection, treatment and disposal for the unincorporated community of Orcutt and unincorporated portions of the city of Santa Maria as well as some incorporated areas of the city of Santa Maria (see Figure 1). The District's wastewater treatment plant (Plant) is located at the western terminus of Dutard Road (Figure 2), on Assessor's Parcel Nos. (APNs) 113-240-005 and –015 (20.0 and 157 acres, respectively).

The District has always recycled its wastewater for beneficial uses. Originally, the water was used for growing sugar beets later processed into sugar at the Holly Sugar processing plant. The sugar plant closed in the 1980's and at that time the District acquired several hundred acres for the irrigation of pasture for grazing beef cattle. Improvements to the District's Plant were completed in 2004, which included additional treatment facilities to allow re-use of the tertiary-treated (recycled) wastewater for food crops, landscape irrigation and other uses which may involve human contact. Currently, the District provides recycled water to the Santa Maria Public Airport District and an oil company for steam injection. The proposed project involves expanding the distribution of recycled water to the Rancho Maria Golf Course for irrigation purposes.

1.5 PROJECT OBJECTIVES

The objective of the project is to provide additional opportunities to discharge recycled water, while providing a water resources benefit. The primary benefit is to reduce groundwater usage of the Santa Maria Groundwater Basin, by providing recycled water as a substitute for existing users of groundwater.

1.6 PROJECT APPROVALS AND PERMITS

Project implementation may require the District to obtain permits and/or other forms of approval from Federal and State agencies. These agencies may include, but are not limited to, the following:

1.6.1 Federal Agencies

- Army Corps of Engineers - Clean Water Act Section 404 permit (drainage crossings).
- U.S. Fish and Wildlife Service - Section 7 Consultation under the Endangered Species Act (potential impacts to California red-legged frog and California tiger salamander).

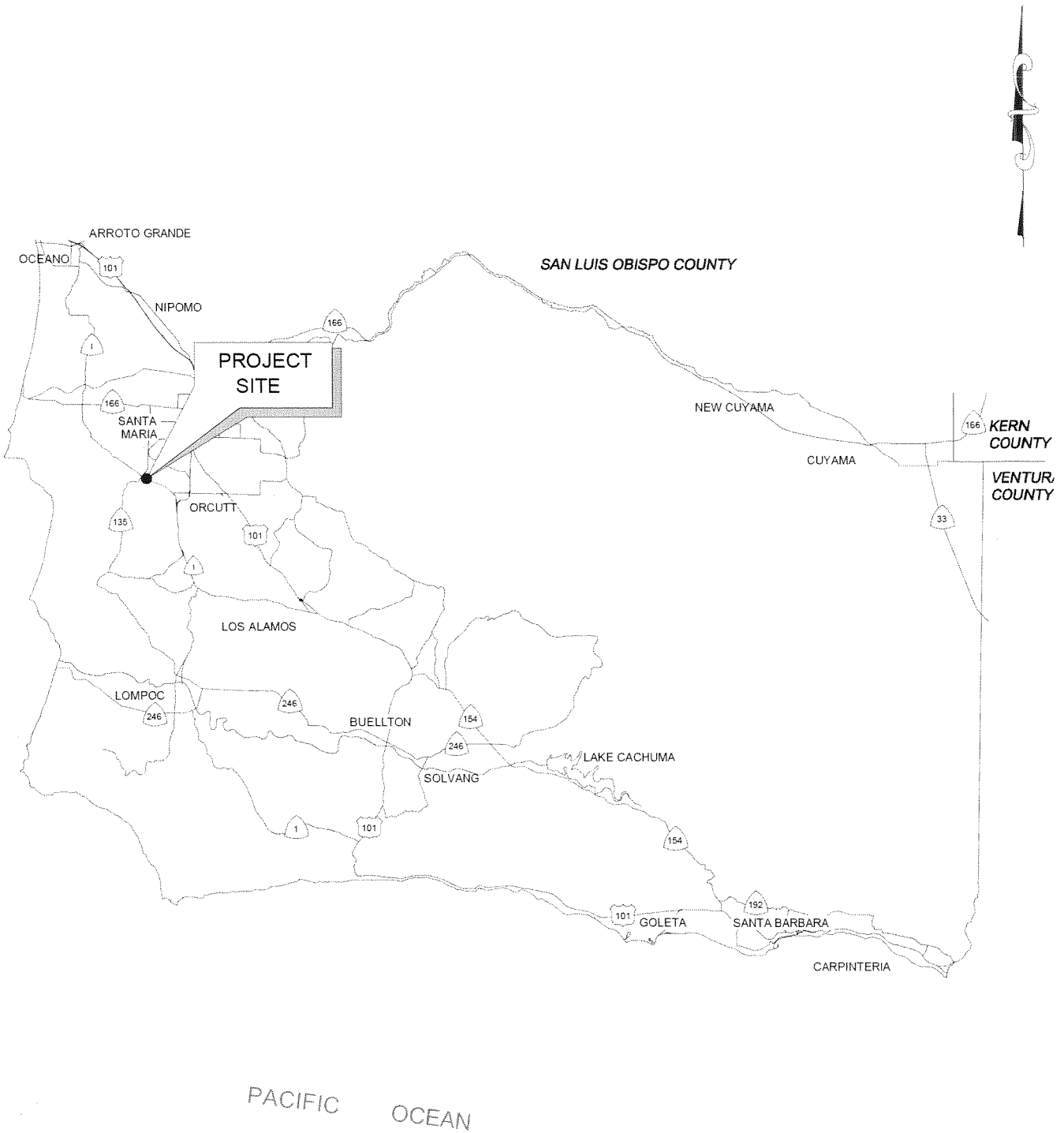
1.6.2 State Agencies

- Department of Fish and Game - Streambed Alteration Agreement (drainage crossings).
- Regional Water Quality Control Board - 401 Water Quality Certification (associated with Corps permit).
- Regional Water Quality Control Board – coverage under the construction storm water discharge general permit.
- Department of Transportation – encroachment permit for pipeline installation within the Highway 1 right-of-way.

1.6.3 Local Agencies

- Santa Barbara County Public Works, Transportation – roadway encroachment permit

The District has contacted the Corps of Engineers and U. S. Fish and Wildlife Service to identify potential issues of concern that may arise during the permitting process. This MND includes mitigation measures to minimize potential impacts to waters of the U. S. and special-status species, and to ensure regulatory permits are obtained and complied with.



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Laguna County Sanitation District

REGIONAL LOCATION MAP
FIGURE 1

BACK OF COLOR FIGURE

June 2009
Project No. 0802-2091

padre associates, inc.
ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS

Laguna County Sanitation District

NORTHERN PIPELINE ALIGNMENT
FIGURE 2

September 2009
Project No. 0802-2091

padre associates, inc.
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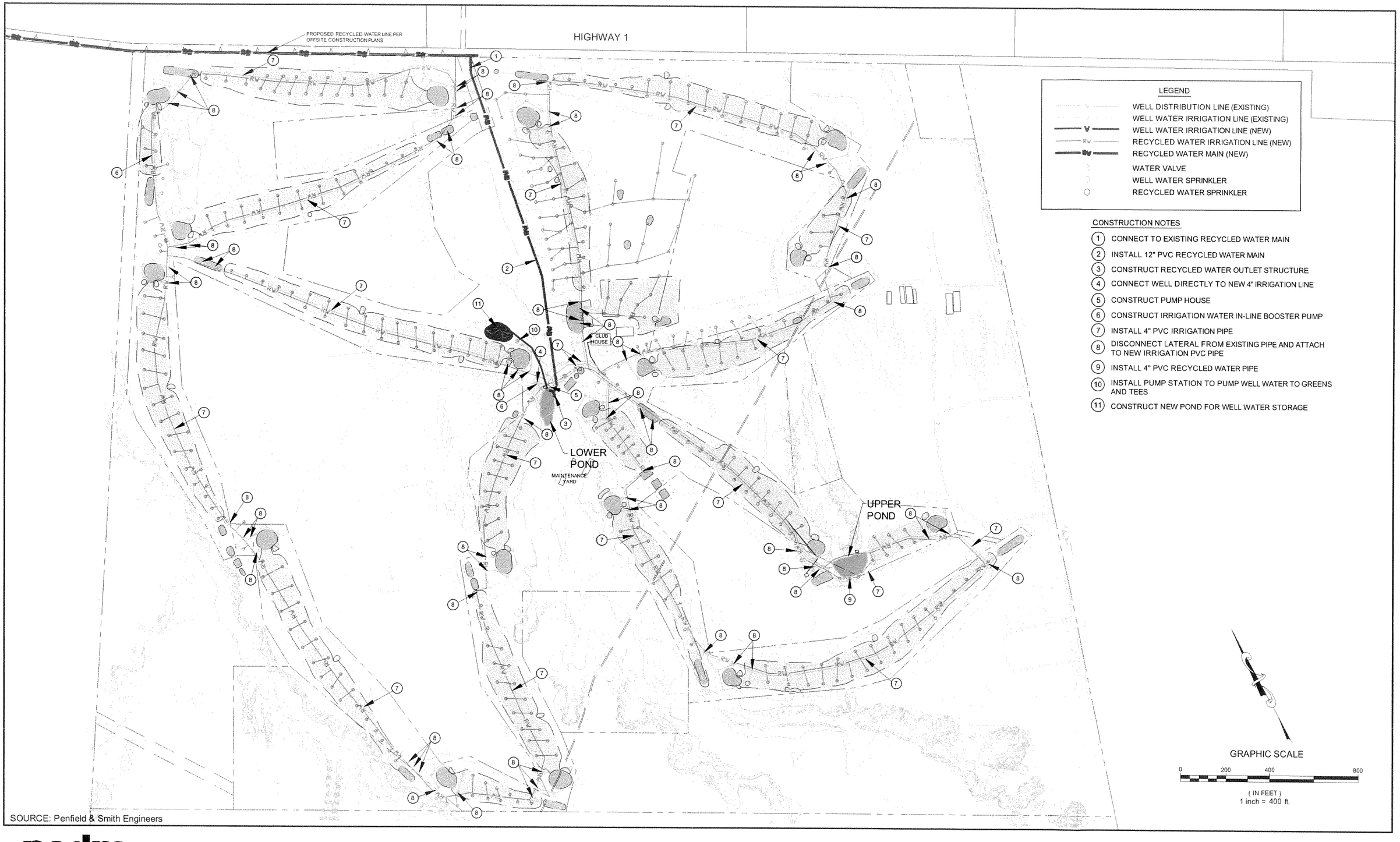
Laguna County Sanitation District

SOUTHERN PIPELINE ALIGNMENT
FIGURE 3

December 2009
Project No. 0802-2091



SOURCE: Penfield & Smith Engineers

padre associates, inc.
ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS
Laguna County Sanitation District

IRRIGATION SYSTEM IMPROVEMENTS
AT THE RANCHO MARIA GOLF COURSE
FIGURE 4

2.0 PROJECT DESCRIPTION

2.1 PROJECT CHARACTERISTICS

This project involves installation of approximately 10,500 feet of buried 12-inch diameter polyvinyl chloride (PVC) pipe between an existing "T" fitting from the Phase 1 project at the Dutard Road/Black Road intersection and the Rancho Maria Golf Course. The pipeline would extend south on Black Road (approximately 4,200 feet), east along Highway 1 (approximately 4,800 feet), and along the existing entrance road (approximately 1,500 feet) within the Rancho Maria Golf Course to an existing irrigation reservoir. The pipeline would be located within the public right-of-way along Black Road and Highway 1 (under pavement or the adjacent roadway shoulder), and buried to a minimum depth of 3 feet.

Currently, the Rancho Maria Golf Course is irrigated with well water, and a distribution system is in place, including two irrigation storage reservoirs and a storage tank. Recycled water would be discharged to an existing irrigation reservoir (lower pond, see Figure 4). Due to the sensitivity of grasses used for tees and greens (primarily annual blue grass) to salinity, a separate irrigation system would be installed within the golf course to ensure these areas are irrigated exclusively with groundwater. The existing well pump would continue to feed the existing storage tank and a new ~~150,000~~ 200,000 gallon storage reservoir to be constructed adjacent to the 18th green (see Figure 4). A new pump station would pressurize the new irrigation main line (with lateral lines and sprinkler heads) which would be installed throughout the golf course to provide well water to each tee and green. The new reservoir would provide about 3 days of well water storage for the greens and tees in the event the well is out of service.

The existing outlet from the well to the existing storage reservoir (lower pond) would provide well water to supplement recycled water when recycled water is not available in sufficient quantity. The District's recycled water pipeline would feed the existing lower pond and a new pump station would feed this water to the existing reservoir (upper pond, see Figure 4). The existing pump stations and piping located at the lower and upper ponds would be used to irrigate each fairway with recycled water.

2.2 CONSTRUCTION METHODS

The recycled water pipeline would be generally installed using conventional open cut (trench) and cover methods, using a trenching machine, excavator, backhoe, wheeled loaders, rollers, paving machine and heavy-duty trucks. The roadway surface would be replaced when affected by trenching, including a cement slurry over the pipe and new asphalt.

The pipeline would cross Orcutt Creek approximately 25 feet upstream of the Black Road bridge using either conventional trenching methods or jack-and-bore methods. Trenching would require temporary stream flow diversion during pipeline installation. Groundwater would be encountered during trenching across Orcutt Creek and possibly during excavation of sending and receiving pits used for jack-and-bore installation. Groundwater (if encountered) would be pumped from the excavation area, clarified and discharged to Orcutt Creek. The pipeline would cross other drainages within the existing roadway fill and avoid existing roadway culverts. Disturbance of these drainages would not occur. The pipeline would be installed under Highway 1 near the Black Road intersection using boring and jacking methods, unless the California Department of Transportation allows cut and cover methods.

Traffic control would be provided by the selected construction contractor, and may include flagmen and signage. Black Road and Highway 1 would remain open during pipeline installation, but Black Road may be reduced to a single traffic lane.

2.3 SCHEDULE AND PHASING

It is anticipated that pipeline installation within roadways would require approximately 60 work days, over a 4 month period. Pipeline installation within the Rancho Maria Golf Course would occur during the same period, but may be delayed to avoid peak golfing periods.

Work within Orcutt Creek (if required) would be scheduled during the dry season to minimize stream flow diversion requirements. Work hours would be limited to 7 a.m. to 4 p.m. Monday through Saturday, except when working adjacent to residences or during critical tasks such as boring under Highway 1.

3.0 ENVIRONMENTAL SETTING

3.1 EXISTING LAND USE

The pipeline alignment lies within the public right-of-way along Black Road and Highway 1. Portions of the pipeline within the Rancho Maria Golf Course would be located on APN 113-250-014 (129.6 acres), which has a land use designation and zoning designation of Recreation (REC). Areas immediately adjacent to the Rancho Maria Golf Course have been designated as Key Site 21 and residential development (Rancho Maria Estates) has been considered here.

Areas along the Black Road portion of the alignment are primarily grazing lands, with row crops along Highway 1. However, the area east of Black Road has a land use and zoning designation of Residential Ranchette (RR-20, 1 unit per 20 acres), and could be developed in the future.

3.2 OTHER PENDING AND APPROVED DEVELOPMENT

3.2.1 Infrastructure Projects

The Laguna County Sanitation District plans to install another recycled water pipeline in cooperation with Santa Maria Pacific LLC. The pipeline would be approximately seven miles long and extend easterly from the end of the District's Phase 1 recycled water line at the Santa Maria Public Airport District's westerly property line to Blosser Road and southerly through Orcutt to Graciosa Road. This other pipeline project is not a part of the Recycled Water Distribution Main project and is not addressed in this Initial Study because it has a separate funding source and implementation schedule.

Replacement of the Black Road bridge over Orcutt Creek is included in the County's 2005-2010 Capital Improvement Plan. However, funding has not been secured and this project may be delayed for several years.

3.2.2 Land Development Projects

Fourteen development projects are under review or have been approved within the Orcutt Community Plan area:

1. Rice Ranch (Keysite 12): 725 unit residential project on 626 acres – initial phase under construction;
2. Stonegate (Keysite 17): 44 unit residential project on 7.91 acres – under construction;
3. Orcutt Creek (Keysite 10): 16 unit residential project on 9.28 acres – approved in 2005;
4. Old Mill Run (Keysite 20): 60 unit residential project on 19.2 acres – under construction;
5. ~~Orcutt Plaza (Keysite 25): 220,779 square feet of commercial on 22.23 acres – approved;~~
6. Steve Lebard (Keysite 18): 7,771 square feet of restaurant and office on 1.25 acres – approved;

7. Orcutt Union: 66,831 square feet of retail, office, restaurant and residential on 7.8 acres – under construction;
8. Hope Community Church: 29,373 square foot church on 10.43 acres – approved;
9. Evergreen Shopping Center: 61,598 square feet retail and office space on 4.37 acres – approved;
10. Orcutt Marketplace (Keysite 1): 306,100 square feet of retail on 23.9 acres – approved;
11. SB Clark LLC (Keysite 3): 313 unit residential project on 147 acres – under review;
12. Harp Springs (Keysite 8): 44 unit residential project on 20.43 acres – under construction;
13. Jensen's Crossing/Cobblestone Creek (Keysite 5): 112 unit residential project on 48.63 acres – under construction;
14. Mesa Verde (Keysite 6): 64 unit residential project 45.21 acres – under construction.

Section 15355 of the State CEQA Guidelines states that "cumulative impacts refers to two or more individual effects which when considered together are considerable or which compound or increase other environmental impacts." Further, "the individual effects may be changes resulting from a single project or a number of separate projects", and "the cumulative impact from several projects is the change in the environment which results from the incremental impact of the project when added to other closely related past, present, and reasonably foreseeable probable future projects." "Cumulative impacts can result from individually minor but collectively significant projects taking place over a period of time."

4.0 POTENTIALLY SIGNIFICANT EFFECTS CHECKLIST

The following checklist indicates the potential level of impact and is abbreviated as follows:

Potentially Significant Impact: A fair argument can be made, based on the substantial evidence in the file. That an effect may be potentially significant.

Less than Significant Impact with Mitigation: Incorporation of mitigation measures has reduced an effect from a Potentially Significant Impact to a Less Than Significant Impact.

Less than Significant Impact: An impact is considered adverse but does not exceed a significance threshold.

No Impact: There is adequate supporting documentation that the impact does not apply to the subject project.

Reviewed Under Previous Document: The analysis contained in a previously adopted/certified environmental document adequately addresses this issue and is summarized in the discussion below. The discussion should include reference to the previous documents, a citation of the page or pages where the information is found, and identification of mitigation measures incorporated from those previous documents.

4.1 AESTHETICS/VISUAL RESOURCES

Will the proposal result in:	Potentially Significant	Less than Significant with Mitigation	Less than Significant	No Impact	Reviewed Under Previous Document
a. The obstruction of any scenic vista or view open to the public or the creation of an aesthetically offensive site open to public view?				X	
b. Change to the visual character of an area?				X	
c. Glare or night lighting which may affect adjoining areas?				X	
d. Visually incompatible structures?				X	

Setting:

The pipeline alignment is located in an area designated as "moderate" scenic value by the Open Space Element of the Santa Barbara County Comprehensive Plan. The alignment would be located within the right-of-way of State Highway 1, which has been designated a Category 6 scenic corridor by the Comprehensive Plan, meaning "moderately scenic, major capacity, secondary distribution route". Key Site 22 of the Orcutt Community Plan is located immediately east of the pipeline alignment, and is considered to contain panoramic open spaces which contribute to the semi-rural character of Orcutt, and provides a scenic gateway to west Orcutt from Highway 1 (Santa Barbara County, 1997).

The area along the pipeline alignment is dominated by grazing lands, row crops and fallow agricultural lands. In addition, Orcutt Creek and associated wetlands provide a natural component to the primarily agricultural viewshed. Portions of the alignment within the Rancho Maria Golf Course are located along landscaped access roads, within a "links" style golf course with undeveloped areas between fairways. Overall, the visual character of the project area is rural.

Views of the pipeline alignment are limited to motorists on Black Road and Highway 1, which is estimated at about 1,100 average daily trips on Black Road and 2,400 average daily trips on Highway 1 (Rincon Consultants, 2007a). In addition, there is one residence located 850 feet north of Highway 1 which has a view of the pipeline alignment. Golf course users would also have views of the pipeline alignments within the golf course.

Impact Discussion:

a. All proposed facilities would be underground, and would not block views or create an aesthetically offensive site.

b. Pipeline installation activities would be visible to motorists on Black Road and Highway 1, and users of the Rancho Maria Golf Course. However, these activities would be short-term (4 months total) and would be similar to road maintenance activities and would not alter the visual character of the project area.

c. The project does not involve any night lighting or glare-producing reflective surfaces.

d. The project does not involve the construction of any above-ground structures.

Mitigation and Residual Impact:

No mitigation is required. The project would not create any project-specific aesthetic impacts or contribute to cumulative impacts.

4.2 AGRICULTURAL RESOURCES

Will the proposal result in:	Potentially Significant	Less than Significant with Mitigation	Less than Significant	No Impact	Reviewed Under Previous Document
a. Convert prime agricultural land to non-agricultural use, impair agricultural land productivity (whether prime or non-prime) or conflict with agricultural preserve programs?				X	
b. An effect upon any unique or other farmland of State or Local Importance?			X		

Setting:

An Important Farmland map for the project area was obtained from the California Department of Conservation. Lands designated as prime farmland, statewide-importance farmland and unique farmland are located along the pipeline alignment, west of Black Road, and north and south of Highway 1. The pipeline alignments within the Rancho Maria Golf Course has been designated as developed lands (non-farmland).

Impact Discussion:

a. Pipeline installation would be limited to the public right-of-way along Black Road and Highway 1, no loss of farmland would occur. Pipeline installation activities would produce dust which could affect productivity of adjacent crops. However, standard dust control measures developed by the Santa Barbara County Air Pollution Control District have been incorporated into the project and would prevent impairment of agricultural productivity.

b. Trenching across Orcutt Creek (if required) may require temporary ground disturbance outside the County right-of-way (side-cast materials, flow diversion berms and creek access), and may impact up to 0.2 acres of lands designated as prime farmland. However, affected lands would be mostly located within the bank or streambed of Orcutt Creek, and no loss of farmland or prime agricultural soils would occur. This area is not cultivated and no crop losses would occur.

Mitigation and Residual Impact:

No mitigation is required. The project would not result in impacts to agricultural resources or contribute to cumulative impacts.

4.3 AIR QUALITY

Will the proposal result in:	**Potentially Significant**	**Less than Significant with Mitigation**	**Less than Significant**	**No Impact**	**Reviewed Under Previous Document**
a. The violation of any ambient air quality standard, a substantial contribution to an existing or projected air quality violation including, CO hotspots, or exposure of sensitive receptors to substantial pollutant concentrations (emissions from direct, indirect, mobile and stationary sources)?			X		
b. The creation of objectionable smoke, ash or odors?			X		
c. Extensive dust generation?			X		
Greenhouse Gases	**Significant?**		**No Classification**		
d. Emissions equivalent to or greater than 25,000 metric tons of CO2 per year from both stationary and mobile sources during long-term operations?			X		

Setting:

The project site is located in Santa Barbara County within the South Central Coast Air Basin (SCCAB) which encompasses three counties: San Luis Obispo, Santa Barbara and Ventura. The Santa Barbara County portion of the SCCAB periodically fails to meet air quality standards and is a designated "non-attainment" area for the State 8-hour ozone standard and State particulate matter (PM_{10}) standard.

Air pollution control is administered on three governmental levels. The U.S. Environmental Protection Agency (EPA) has jurisdiction under the Clean Air Act, the California Air Resources Board (CARB) has jurisdiction under the California Health and Safety Code and the California Clean Air Act, and the Santa Barbara County Air Quality Pollution District (SBCAPCD) shares responsibility with the CARB for ensuring that all State and Federal ambient air quality standards are attained within the Santa Barbara County portion of the SCCAB.

The SBCAPCD adopted the 2007 Clean Air Plan in August 2007. This Plan addresses maintenance of the Federal 8-hour ozone standard and attainment of the State 1-hour ozone standard. Overall, air quality in Santa Barbara County is improving, as the number of County exceedances of the State 1-hour ozone standard has declined from 37 days in 1990 to three or less in recent years.

The closest air quality monitoring station, and most representative of the project site is the Santa Maria Station, located 4.7 miles north-northeast of the pipeline alignment. The most recent ambient air quality data from the Santa Maria Station is presented in Table 1.

Table 1. Summary of Ambient Air Quality Data

Pollutant	2006	2007	2008
Ozone			
Highest 1-Hour concentration (ppm)	0.064	0.065	0.072
Highest 8-Hour concentration (ppm)	0.063	0.055	0.064
Number of State Exceedances (8-Hour>0.070 ppm)	0	0	0
Number of Federal Exceedances (8-Hour>0.085 ppm)	0	0	0
Particulate Matter less than 10 microns (PM10)			
Highest Sample (micrograms/cubic meter)	56.0	80.5	87.0
Number of State Exceedances (Samples>50)	1	10	32
Particulate Matter less than 2.5 microns (PM2.5)			
Highest Sample (micrograms/cubic meter)	13.7	18.7	15.3
Number of Federal Exceedances (Samples>35)	0	0	0

Impact Discussion:

a. The Santa Barbara County Planning and Development Department (2008) has developed a threshold to determine the significance of long-term air emissions under the California Environmental Quality Act. This threshold is 25 pounds per day of ozone precursors (reactive organic compounds [ROC] and oxides of nitrogen [NOx]). No quantitative thresholds have been established for short-term, construction-related air quality impacts.

Short-Term. The proposed project would generate air pollutant emissions as a result of construction activities, primarily exhaust emissions from heavy-duty trucks, worker vehicles and heavy equipment. It was assumed that 10 truck trips (20 one-way trips) and 10 worker trips (20 one-way trips) would occur on a typical work day. Estimated project daily and total emissions are listed in Table 2. Due to their small magnitude and duration, project emissions are considered a less than significant air quality impact.

Table 2. Construction Emissions

Source	Pounds per Typical Day			
	ROC	NO_x	CO	PM_{10}
Equipment exhaust	6.0	90.0	40.7	5.3
On-road vehicles	0.4	6.7	4.0	0.3
Fugitive dust	0.0	0.0	0.0	161.8
Total	6.4	96.7	44.7	167.4

In addition, the following dust control measures have been incorporated into the project's plans and specifications:

During clearing grading, earthmoving or excavation:

- Water trucks or sprinkler systems shall be used in sufficient quantities to prevent dust raised from leaving the site.
- The entire area of disturbed soil shall be wet down, sufficient to form a crust, after each day's activities cease.
- Trucks hauling earth materials shall be covered.
- Soil stockpiled for more than two days shall be covered, kept moist, or treated with soil binders to minimize dust generation.

After clearing, grading, earthmoving or excavation is completed:

- The entire area of disturbed soil shall be treated to prevent wind pickup of soil. This may be accomplished by seeding and watering until a grass cover has been established and/or by applying soil binders, and/or by wetting the area sufficiently to form a crust on the surface and prevent transport of dust off-site.

During pipeline installation:

- Water trucks or sprinkler systems shall be used in all areas of vehicle movement in sufficient quantities to prevent dust raised from leaving the site. As a minimum, this will include wetting down these areas in late morning and after work is completed for the day.
- Trucks hauling earth materials shall be covered.
- Soil stockpiled for more than two days shall be covered, kept moist, or treated with soil binders to minimize dust generation.
- Increased watering frequency will be required whenever the wind speed exceeds 15 mph.

Implementation of additional dust control measures:

- The contractor shall designate a person or persons to monitor the dust control program and to order increased watering, as necessary, to prevent transport of dust offsite. Their duties shall include holiday and weekend periods when work may not be in progress. The name and telephone number of such persons shall be provided to the Air Pollution Control District prior to initiation of construction.

Long-Term. The proposed project is limited to installation and operation of a buried recycled water pipeline. Following pipeline installation, emissions producing activities would be limited to periodic inspections by District staff. Such inspections would generate about one vehicle trip per month, and vehicle emissions would be less than the threshold of significance for ozone precursors (25 pounds per day). In addition, carbon monoxide (CO) levels are relatively low in the project area, and the project would not contribute to the formation of a CO hotspot.

b. The exhaust of diesel-powered construction equipment and trucks may be considered as odorous by sensitive individuals. Only one residence is located along the pipeline alignment (850 feet north of Highway 1) and may be affected. However, most construction would occur along roadways supporting diesel truck traffic, and the project would not substantially increase diesel exhaust odors at affected residences.

c. Pipeline installation activities (excavation, soil stockpiling, backfilling) would generate dust. However, dust control measures have been incorporated into the project (see above). Therefore, impacts would be less than significant.

d. Following Executive Order S-3-05 in June 2005, which declared California's particular vulnerability to climate change, the California Global Warming Solutions Act of 2006 (AB 32) was signed by Governor Arnold Schwarzenegger on September 27, 2006. Greenhouse gases (GHGs) are defined as any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include, but are not limited to, water vapor, carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N2O). These greenhouse gases lead to the trapping and buildup of heat in the atmosphere near the earth's surface, commonly known as the Greenhouse Effect. There is increasing evidence that the Greenhouse Effect is leading to global warming and climate change.

In response to global warming, AB 32 requires the CARB to adopt a statewide greenhouse gas emissions limit equivalent to the statewide GHG emissions levels in 1990 to be achieved by 2020 and requires the CARB to adopt rules and regulations to achieve the maximum technologically feasible and cost-effective GHG emission reductions. In June 2008, CARB developed a Draft Scoping Plan for Climate Change, pursuant to AB 32. This Draft Scoping Plan proposes a comprehensive set of actions designed to reduce overall carbon emissions in California, improve our environment, reduce our dependence on oil, diversify our energy sources, save energy, and enhance public health while creating new jobs and enhancing the growth in California's economy.

Senate Bill 97, enacted in 2007, amends the CEQA statute to clearly establish that greenhouse gas emissions and the effects of GHG emissions are appropriate for CEQA analysis. It directs the California Office of Planning and Research (OPR) to develop guidelines addressing the analysis and mitigation of greenhouse gas emissions by July 1, 2009 and for the California Resources Agency to certify and adopt the CEQA Guidelines by January 1, 2010.

Equipment and vehicles used to install the proposed recycled water pipeline would emit greenhouse gases (primarily carbon dioxide), and may contribute to global climate change. As noted by the SBAPCD and OPR, there are currently no adopted thresholds for measuring the significance of a project's cumulative contribution to global climate change. Considering the small amount of construction-related emissions and short construction period, the project's contribution to global climate change is expected to be minimal.

Cumulative Impacts:

Projects not having an appreciable affect on existing emissions and not exceeding established thresholds for long-term air quality impacts for NOx and/or ROC emissions are considered as not having the potential to result in significant cumulative air quality impacts.

Mitigation and Residual Impact:

No significant impacts were identified; therefore, mitigation is not required. Residual impacts would be less than significant.

4.4 BIOLOGICAL RESOURCES

Will the proposal result in:	Potentially Significant	Less than Significant with Mitigation	Less than Significant	No Impact	Reviewed Under Previous Document
Flora					
a. A loss or disturbance to a unique, rare or threatened plant community?		X			
b. A reduction in the numbers or restriction in the range of any unique, rare or threatened species of plants?				X	
c. A reduction in the extent, diversity, or quality of native vegetation (including brush removal for fire prevention and flood control improvements)?		X			
d. An impact on non-native vegetation whether naturalized or horticultural if of habitat value?			X		
e. The loss of healthy native specimen trees?				X	
f. Introduction of herbicides, pesticides, animal life, human habitation, non-native plants or other factors that would change or hamper the existing habitat?				X	

Will the proposal result in:	Potentially Significant	Less than Significant with Mitigation	Less than Significant	No Impact	Reviewed Under Previous Document
Fauna					
g. A reduction in the numbers, a restriction in the range, or an impact to the critical habitat of any unique, rare, threatened or endangered species of animals?		X			
h. A reduction in the diversity or numbers of animals onsite (including mammals, birds, reptiles, amphibians, fish or invertebrates)?			X		
i. A deterioration of existing fish or wildlife habitat (for foraging, breeding, roosting, nesting, etc.)?		X			
j. Introduction of barriers to movement of any resident or migratory fish or wildlife species?			X		
k. Introduction of any factors (light, fencing, noise, human presence and/or domestic animals) which could hinder the normal activities of wildlife?			X		

Setting:

The following discussion is based on the results of biological surveys and a preliminary wetland delineation conducted along the pipeline alignment and at the Rancho Maria Golf Course by Padre Associates biologists on May 28, 2009.

Vegetation. Vegetation within the right-of-way along Black Road and Highway 1 is managed to prevent wildfire and includes mowing and occasional herbicide application. Dominant species are non-native weedy species including rip-gut grass (*Bromus diandrus*), slender wild oats (*Avena barbata*), summer mustard (*Hirschfeldia incana*), cheese weed (*Malva parviflora*) and red-stem filaree (*Erodium cicutarium*). In addition, several patches of iceplant (*Carpobrotus edulis*) occur within the right-of-way. Native vegetation within the right-of-way is limited to scattered patches of coyote brush (*Baccharis piluaris*) and arroyo willow (*Salix lasiolepis*) riparian forest. Coyote brush also occurs near the proposed groundwater reservoir site. Arroyo willow riparian forest occurs along the pipeline alignment at the Orcutt Creek crossing and where tributaries of Orcutt Creek cross or parallel Black Road and Highway 1 (pipeline STA 40+60 to 41+60, 44+00 to 49+00, 55+50 to 59+50, 69+50 to 71+00) .

Seasonal pools occur just outside the eastern right-of-way fence, where drainages cross under Black Road (pipeline STA 14+39, 26+20, 28+34). These areas typically support rabbits-foot grass (*Polypogon monspeliensis*), curly dock (*Rumex crispus*), and saltgrass (*Distichlis spicata*). Larger seasonal pools occur immediately west of Black Road and supported curly dock, western ragweed (*Ambrosia psilostachya*) and Italian ryegrass (*Lolium multiflorum*) at the time of the May 28, 2009 field survey.

Sensitive Habitats. Arroyo willow riparian forest is considered rare by the California Department of Fish and Game Natural Diversity Data Base and occurs along the pipeline alignment (see vegetation description).

Special-Status Plant Species. Special-status plant species are defined as either listed as endangered or threatened under the Federal or California Endangered Species Acts, or rare under the California Native Plant Protection Act, or considered to be rare or of scientific interest (but not formally listed) by Santa Barbara County, resource agencies, professional organizations (e.g., Audubon Society, California Native Plant Society [CNPS], The Wildlife Society), and the scientific community.

The literature search conducted for this impact analysis indicates that 17 special-status plant species have been reported within 5 miles of the proposed pipeline alignment. The literature search included biological studies completed for the New County Jail Subsequent EIR, Orcutt Community Plan EIR and Rancho Maria Estates Specific Plan EIR. Table 3 lists these species, their current status, and the nearest known location relative to the pipeline alignment.

A botanical survey was conducted by Padre Associates biologists along the pipeline alignment on May 28, 2009 to identify special-status species that may be affected. No special-status plant species or suitable habitat for such species were observed within or adjacent to the project impact area. Excluding the Orcutt Creek crossing, the pipeline alignments are located within disturbed roadway corridors or landscaped areas (golf course).

Table 3. Special-Status Plant Species of the Project Area

Species	Status	Nearest Location	Potential to Occur near Pipeline
Hoover's bent grass (*Agrostis hooveri*)	List 1B	Graciosa Ridge, 5.0 miles to the southeast (CNDDB, 2009)	Very low, not observed during field surveys
La Graciosa thistle (*Cirsium loncholepis*)	FE, ST, List 1B	La Graciosa, two miles to the southeast (CNDDB, 2009)	Very low, not observed during field surveys
Dune larkspur (*Delphinium parryi ssp. blochmaniae*)	List 1B	South Orcutt, 4.3 miles to the southeast (CNDDB, 2009)	Very low, no suitable habitat, not observed during field surveys
Blochman's leafy daisy (*Erigeron blochmaniae*)	List 1B	Black Road, 2.7 miles to the north (CNDDB, 2009)	Very low, no suitable habitat, not observed during field surveys
Lompoc yerba santa (*Eriodictyon capitatum*)	FE, SR, List 1B	Orcutt Oilfield, 5 miles to the southeast (CNDDB, 2009)	Very low, no suitable habitat, not observed during field surveys
Blochman's groundsel (*Senecio blochmaniae*)	List 4, E	Sandhill chaparral: 1.0 miles northeast of the recycled water pipeline alignment at the golf course entrance (Rindlaub et al., 1995)	Very low, no suitable habitat, not observed during field surveys
Curly-leaved monardella (*Monardella undulata*)	List 4	Sandhill chaparral: 1.0 miles northeast of the recycled water pipeline alignment at the golf course entrance (Rindlaub et al., 1995)	Very low, no suitable habitat, not observed during field surveys
Eastwood's spineflower (*Chorizanthe angustifolia* var. *eastwoodiae*)	E	Sandhill chaparral: 1.0 miles northeast of the recycled water pipeline alignment at the golf course entrance (Rindlaub et al., 1995)	Very low, no suitable habitat, not observed during field surveys

Table 3. Continued

Species	Status	Nearest Location	Potential to Occur near Pipeline
Large-flowered linanthus (*Leptosiphon [Linanthus] grandiflorus*)	List 4	About 0.6 miles east of the pipeline alignment, at Black Road/Dutard Road intersection (Rindlaub et al., 1995)	Very low, no suitable habitat, not observed during field surveys
Purisima manzanita (*Arctostaphylos purissima*)	List 1B	Sandhill chaparral: 1.0 miles northeast of the recycled water pipeline alignment at the golf course entrance (Rindlaub et al., 1995)	Very low, no suitable habitat, not observed during field surveys
San Luis Obispo wallflower (*Erysimum capitatum* ssp. *lompocense*)	List 4	Sandhill chaparral: 1.0 miles northeast of the recycled water pipeline alignment at the golf course entrance (Rindlaub et al., 1995)	Very low, no suitable habitat, not observed during field surveys
Sand mesa manzanita (*Arctostaphylos rudis*)	List 1B, E	Sandhill chaparral: 1.0 miles northeast of the recycled water pipeline alignment at the golf course entrance (Rindlaub et al., 1995)	Very low, no suitable habitat, not observed during field surveys
Wooly marbles (*Psilocarphus brevissimus*)	LC-W	Vernal pools: 0.6 miles east of the pipeline alignment, at Black Road/Dutard Road intersection (Rindlaub et al., 1995)	Very low, no suitable habitat, not observed during field surveys
Water starwort (*Callitriche marginata*)	LC-W	Vernal pools: 0.6 miles east of the pipeline alignment, at Black Road/Dutard Road intersection (Rindlaub et al., 1995)	Very low, no suitable habitat, not observed during field surveys
Waterwort (*Elatine brachysperma*)	LC-W	Vernal pools: 0.6 miles east of the pipeline alignment, at Black Road/Dutard Road intersection (Rindlaub et al., 1995)	Very low, no suitable habitat, not observed during field surveys
Blochman's dudleya (*Dudleya blochmaniae ssp. blochmaniae*)	List 1B	2,000 feet southwest of the pipeline terminus at the irrigation reservoir (LFR Levine-Fricke, 2005)	Very low, no suitable habitat, not observed during field surveys
Kellogg's horkelia (*Horkelia cuneata ssp. sericea*)	List 1B	2,000 feet southwest of the pipeline terminus at the irrigation reservoir (LFR Levine-Fricke, 2005)	Very low, no suitable habitat, not observed during field surveys

Status Codes:

E	Endemic to the Santa Barbara County region (Wiskowski, 1988)
List 1B	Plants rare, threatened or endangered in California and elsewhere (California Native Plant Society)
List 4	Plants of limited distribution, a watch list (California Native Plant Society)
LC-W	Local concern-wetlands (Wiskowski, 1988)
FE	Federally listed as Endangered (USFWS)
SR	California listed as Rare (CDFG)
ST	California listed as Threatened (CDFG)

Wetlands. The U.S. Army Corps of Engineers (Corps) has jurisdiction over waters of the United States (U.S.) under the authority of the Section 404 of the Clean Water Act. The limit of jurisdiction in non-tidal waters extends to the ordinary high water mark and includes all adjacent wetlands. Waters of the U.S. are defined as:

"All waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide; including all interstate waters including interstate wetlands, all other waters such as intrastate lakes, rivers, streams, mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation or destruction of which could affect interstate or foreign commerce."

Wetlands Definitions. The Corps and U.S. Environmental Protection Agency define wetlands as:

> "Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas."

Santa Barbara County has adopted the USFWS wetland definition (Santa Barbara County, 2008):

"Wetlands must have one or more of the following attributes:

- At least periodically, the land support predominantly hydrophytes, that is plants adapted to moist areas;
- The substrate is predominately undrained hydric soil; and
- The substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season each year."

Corps-defined wetlands are determined to be present if evidence of each of three criterion are observed (prevalence of hydrophytic vegetation, presence of hydric soils, and wetland hydrology).

Findings. A preliminary wetland delineation was conducted at the proposed Orcutt Creek pipeline crossing, and all three wetland criteria (prevalence of hydrophytic vegetation, presence of hydric soils, and wetland hydrology) were found. Therefore, both Corps-defined and County-defined wetlands occur at the crossing. At least a portion of the seasonal pools along Black Road meet the County wetland definition criteria.

Wildlife. The project area is currently or has historically been under cultivation. However, Orcutt Creek and its tributaries provide aquatic habitat for amphibians, including Pacific chorus frog (*Pseudoacris regilla*) and California red-legged frog (*Rana aurora draytonii*). California red-legged frog has been reported from ~~the~~ both existing irrigation reservoirs (upper and lower ponds) ~~near Hole 10~~ at the Rancho Maria Golf Course. Seasonal pools occur along Black Road near Dutard Road, and support California tiger salamander (*Ambystoma californiense*) and western spadefoot toad (*Spea hammondii*). California tiger salamander also occurs at the Rancho Maria Golf Course, and may breed in a seasonal pond near Hole 15.

Fence lizard was the only reptile or amphibian observed during field surveys. Other common species such as gopher snake, pacific rattlesnake, alligator lizard, terrestrial garter snake, and kingsnake may also occur in the vicinity of the pipeline alignment.

Birds observed included turkey vulture, cliff swallow, western bluebird, mourning dove, killdeer, spotted towhee, California towhee, crow, house finch, song sparrow, red-winged blackbird, Brewer's blackbird and lesser goldfinch. The most common species observed were cliff swallow which were nesting under the Orcutt Creek bridge and at a building west of Black Road.

Mammals observed during the field survey were limited to coyote, raccoon, California ground squirrel, opossum and pocket gopher.

Wildlife Corridors. Wildlife migration corridors are generally defined as connections between habitat patches that allow for physical and genetic exchange between otherwise isolated animal populations. Migration corridors may be local, such as those between foraging and nesting or denning areas, or they may be regional in nature. Migration corridors are not unidirectional access routes; however, reference is usually made to source and receiver areas in discussions of wildlife movement networks.

"Habitat linkages" are migration corridors that contain contiguous strips of native vegetation between source and receiver areas. Habitat linkages provide cover and forage sufficient for temporary inhabitation by a variety of ground-dwelling animal species. Wildlife migration corridors are essential to the regional ecology of an area as they provide avenues of genetic exchange and allow animals to access alternative territories as fluctuating dispersal pressures dictate.

The pipeline alignments are located in the Santa Maria Valley, most of which supports agriculture and residential development. Wildlife habitats mostly occur in the surrounding hills and mountains, including the Sierra Madre Mountains to the north, and Casmalia Hills and Solomon Hills to the south. In the project area, wildlife habitat is limited to patches within the agricultural landscape, mostly along drainages and in seasonal wetlands. Orcutt Creek and its tributaries may provide a movement corridor for small mammals, as it provides habitat and cover in an area dominated by short-rotation row crops.

Drift fence surveys conducted at the Rancho Maria Golf Course indicate California tiger salamander migrates from upland refuges to breeding pools in the project area. A known California tiger salamander breeding pool occurs just west of Black Road approximately 100 feet from the pipeline alignment, and this species may cross Black Road during migration.

Special-Status Wildlife Species. The potential for special-status wildlife species to occur in the vicinity of the project sites was determined by review of sight records from other environmental documents and range maps including Rincon Consultants (2008), Hunt & Associates (2000), Padre Associates (2000), Zeiner et al. (1988, 1990a, 1990b), and Lehman (1994). The literature search included biological studies completed for the Orcutt Community Plan EIR, Rancho Maria Estates Specific Plan EIR and Santa Maria Airport Business Park Specific Plan EIR. Table 4 lists special-status wildlife species that have the potential to occur within the project site for at least a portion of their life cycle.

Table 4. Special-Status Wildlife Species of the Project Region

Species	Status	Nearest Reported Location	Potential to Occur near Pipeline Alignment
Vernal pool fairy shrimp (*Branchinecta lynchi*)	FT	Santa Maria Airport property, 2 miles to the east (Rincon, 2007b)	Moderate: may occur in occur in the seasonal pond near Hole 15 at the Rancho Maria Golf Course and seasonal pools west of Black Road
Monarch butterfly (*Danaus plexippus*)	SA	Pioneer Park, 1.8 miles to the east (Meade, 1999)	Low: small eucalyptus grove occurs east of Black Road near Dutard Road, but too small to support a winter roost

Table 4. Continued

Species	Status	Nearest Reported Location	Potential to Occur near Pipeline Alignment
California red-legged frog (*Rana aurora draytonii)*	FT, CSC	Both existing Irrigation reservoirs ~~near Hole 10~~ at Rancho Santa Maria Golf Course (LFR Levine-Fricke 2005, PCR 2003); Orcutt Creek near Black Road (Padre, 2000); seasonal pond west of Black Road (Hunt & Associates, 2000)	Observed
California tiger salamander (*Ambystoma californiense*)	FE, CSC	Seasonal pond west of Black Road (Hunt & Associates, 2000); northern portion of the Rancho Maria Golf Course, may breed in the seasonal pond near Hole 15 (VJS Biological Consulting, 2005)	High: may occur in burrows on roadway embankment along Black Road
Western spadefoot toad (*Spea hammondii*)	CSC	About 2,000 west of Black Road (Hunt & Associates, 2000)	Moderate: may occur in seasonal ponds along Black Road near pipeline alignment
Southwestern pond turtle (*Actinemys marmorata pallida*)	CSC	Orcutt Creek, 300 feet downstream of Black Road (Hunt & Associates, 2000)	Observed
Silvery legless lizard (*Anniella pulchra pulchra*)	CSC	Sandy hills west of Black Road (Hunt & Associates, 2000)	Low: no suitable habitat along pipeline alignments
Coast horned lizard (*Phrynosoma coronatum ssp. frontale)*	CSC	Key Site 30, 3.2 miles to the east (Rindlaub et al., 1995)	Low: no suitable habitat along pipeline alignments
Burrowing owl (*Athene cunicularia*)	CSC	Betteravia Road, 2.3 miles to the north-northeast (CNDDB, 2009)	Low: no suitable habitat along pipeline alignments
Cooper's hawk (*Accipiter cooperii*)	WL	Rancho Maria Estates site, adjacent to golf course (LFR Levine-Fricke, 2005)	Moderate: may forage along Orcutt Creek near pipeline crossing
White-tailed kite (*Elanus leucurus*)	FP	Rancho Maria Estates site, adjacent to golf course (LFR Levine-Fricke, 2005)	Moderate: may forage in wetlands along Black Road
California horned lark *(Eremophila alpestris actia*)	WL	Key Site 22, 0.5 miles to the north (Rindlaub et al., 1995)	Low: no suitable habitat along pipeline alignments
Loggerhead shrike (*Lanius ludovicianus*)	CSC	Key Site 22, 0.5 miles to the north (Rindlaub et al., 1995)	Low: no suitable habitat along pipeline alignments
American badger (Taxidea taxus)	CSC	Black Road, 0.3 miles to the north (CNDDB, 2009	Low: no suitable habitat along pipeline alignments

Status Codes:
CSC California Species of Special Concern (CDFG)
FP Fully protected (Fish and Game Code)
FE Federal Endangered (USFWS)
FT Federal Threatened (USFWS)
SA Special animal (CDFG)
WL Watch list (CDFG)

Impact Discussion:

a. A trenched pipeline crossing of Orcutt Creek would result in the temporary removal of approximately 0.10 acres of arroyo willow riparian forest (within the Black Road right-of-way). Additional areas of this plant community occurs in close proximity to the pipeline alignment and may be inadvertently removed during pipeline installation. If the pipeline crossing of Orcutt Creek is conducted using jack-and-bore methods, excavation of sending and receiving pits may result in the removal of a smaller amount of arroyo willow riparian forest. The project-related temporary loss of this sensitive habitat is considered a significant impact.

b. The pipeline alignments are located within the paved or mowed roadway shoulder and within manicured turfgrass of the golf course. The proposed groundwater reservoir site supports non-native grasses and iceplant. Habitat for special-status plant species is lacking. No special-status plant species were observed or likely to occur along the pipeline alignments; therefore, no impacts to these species would occur.

c. Pipeline installation would require temporary removal of native vegetation, but would be limited to approximately 0.05 acres of coyote brush scrub and 0.10 acres of arroyo willow riparian forest. Coyote brush scrub is a common plant community and adapted to disturbance. This plant community would colonize the area disturbed by pipeline installation, and no long-term loss would occur. As discussed in part a. above, loss of arroyo willow riparian forest is considered a significant impact.

d. Non-native vegetation affected by the proposed project would be limited to non-native weedy species along the mowed roadway shoulder and manicured turfgrass at the golf course. This vegetation has minimal habitat value and would re-colonize the roadway shoulder following pipeline installation. Any turfgass disturbed at the golf course would be replaced. Impacts would be less than significant.

e. Tree removal would be limited to willows at the Orcutt Creek pipeline crossing. These trees are not mature and would not be considered specimen trees.

f. No chemicals, animals, human habitation or invasive plants would be associated with project implementation.

g. **Vernal Pool Fairy Shrimp**. This species may occur in seasonal pools near the pipeline alignment, and pipeline installation may result in inadvertent discharge of earth materials into these pools. This impact is considered potentially significant.

California Red-legged Frog. This species is known from Orcutt Creek (and possibly its tributaries) and ~~the~~ existing irrigation reservoirs (upper and lower ponds) ~~near Hole 10~~. California red-legged frog may be adversely affected by temporary habitat removal and habitat degradation (turbidity and siltation) at the Orcutt Creek crossing, and may suffer mortality by construction equipment working within or adjacent to Orcutt Creek and its tributaries (see Figure 2), and the irrigation reservoir. This impact is considered potentially significant.

The existing irrigation reservoirs ~~lower ponds~~ currently contain~~s~~ groundwater, and introduction of recycled water ~~into this pond~~ may degrade water quality and adversely affect California red-legged frog. However, California red-legged frog currently occurs in recycled water storage ponds operated by the District, which has the same water quality as proposed for the lower pond at the golf course. Therefore, impacts to California red-legged frog associated with water quality changes are not expected.

California Tiger Salamander. This species is well documented in the project area, and spends much of its time in upland retreats (typically small mammal burrows). Virtually all ground disturbance associated with pipeline installation would occur within the paved shoulder along roadways or manicured turfgrass at the golf course (where burrowing mammals are controlled). Therefore, pipeline installation is unlikely to disturb upland retreats for California tiger salamander. However, avoidance of utilities buried under the roadway and other considerations may require disturbance of the unpaved shoulder and possibly embankments that may support upland retreats. Ground squirrel burrows are located near the proposed groundwater reservoir site, and California tiger salamander may be disturbed during reservoir construction. Construction-related disturbance of this species is considered a significant impact.

Western Spadefoot Toad. This species may occur in seasonal pools along the pipeline alignment (pipeline STA 14+39, 26+20, 28+34), and may be adversely affected by adjacent construction equipment operations. Impacts may include inadvertent deposition of earth materials into the pool, and burrow collapse caused by vibration and adjacent excavation. This impact is considered potentially significant.

Southwestern Pond Turtle. This species has been reported from Orcutt Creek and may be adversely affected by temporary loss of habitat and flow diversion at the pipeline crossing. This impact is considered potentially significant.

Cooper's Hawk and White-tailed Kite. These species may forage in the project area. However, the small area of habitat loss (0.1 acres of riparian forest) would not affect the foraging success of these species. Therefore, impacts are considered less than significant.

h. The project-related loss of habitat would be minimal and temporary, as all facilities would be buried. Construction-related disturbance (noise, vibration, equipment activity) would be limited in scale and duration (a few days at any one location). Therefore, a reduction in diversity or substantial reduction in numbers of wildlife is not expected.

i. Trenching and flow diversion within Orcutt Creek would result in the temporary loss of 0.10 acres of riparian habitat and County-defined wetlands. Affected habitat is an important resource in the area, which is predominately agricultural in nature. Therefore, the deterioration of fish and wildlife habitat is considered a potentially significant impact.

j. Orcutt Creek may be used as a corridor by wildlife moving through the area as it provides nearly continuous habitat and cover. Habitat removal and stream diversion associated with a trenched crossing of Orcutt Creek (if required) may affect local wildlife movements. However, no barriers to wildlife would be involved and no work would occur at night, when most wildlife movement occurs. Therefore, impacts to wildlife movement are considered less than significant.

k. Pipeline installation would primarily occur along roadways in an agricultural area, with existing lighting (vehicle headlights), fencing and domestic animals. The project would not introduce any additional factors which may hinder normal activities of wildlife. Impacts are considered less than significant.

Mitigation and Residual Impact:

BIO-1 Regulatory Permits. The District shall obtain all applicable regulatory permits (see Section 1.6) for construction work within waters of the U.S. and waters of the State (Orcutt Creek and tributaries), prior to the initiation of work in these areas. The District shall fully comply with the conditions of these permits including the biological opinion.

Plan Requirements and Timing: Copies of regulatory permits shall be included in the project specifications. **MONITORING**: The District inspector shall ensure compliance with each permit condition.

BIO-2 Sensitive Habitat/Native Vegetation/Wetlands. The following measures shall be fully implemented to minimize and offset adverse effects to arroyo willow riparian forest along the pipeline alignments:

- Temporary fencing and/or flagging shall be used to delineate the work area within and adjacent to Orcutt Creek and its tributaries, to minimize inadvertent damage to vegetation;
- In coordination with regulatory permits, riparian vegetation removed by pipeline installation activities shall be replaced in-kind;

Plan Requirements and Timing: Fencing/flagging shall be delineated on the construction plans. A revegetation plan shall be developed and submitted to regulatory agencies for approval. **MONITORING**: The District inspector shall ensure each mitigation requirement is fully implemented.

BIO-3 California Red-legged Frog. The following measures shall be fully implemented to prevent take of California red-legged frog:

- A pre-construction survey(s) shall be conducted by a qualified biologist to determine the presence of California red-legged frog and southwestern pond turtle in the immediate vicinity of proposed pipeline installation activities and irrigation reservoir construction.
- If California red-legged frog is found within the work area prior to construction and they are considered at risk of mortality, they shall be relocated to suitable habitat in the project area by a qualified biologist under the authorization of a Biological Opinion issued by the U.S. Fish and Wildlife Service.
- A qualified biologist shall monitor construction activities on a periodic basis and survey for California red-legged frog, and relocate any individuals at risk of mortality to suitable habitat in the project area.

- A pre-construction meeting with the biological monitor, selected construction contractor and District inspector shall be held prior to the initiation of construction to ensure the contractor is familiar with required protective measures (MND mitigation measures, permit conditions) and develops methods to implement these measures;
- Existing surface flow in Orcutt Creek shall be diverted away from the work area prior to excavation or other heavy equipment activity as needed to minimize use of heavy equipment in surface water.
- The biological monitor shall be present during flow diversion activities, and rescue California red-legged frog tadpoles under the authorization of the Biological Opinion, and relocate them to suitable undisturbed habitat.
- Pumps used to divert surface flow around the Orcutt Creek pipeline crossing shall be fitted with screens on the intakes to prevent entrainment of California red-legged frog tadpoles.

Plan Requirements and Timing: The above mitigation requirements shall be included in a California red-legged frog management plan to be approved by the U.S. Fish and Wildlife Service during Endangered Species Act consultation. The pre-construction survey(s) and pre-construction meeting shall be completed no more than 2 weeks prior to the initiation of construction. **MONITORING**: The District shall ensure field surveys are conducted and provide a qualified biological monitor to verify each mitigation requirement is fully implemented.

BIO-4 California Tiger Salamander and Vernal Pool Fairy Shrimp. The following measures shall be fully implemented to prevent take of these species:

- Silt fencing (with the bottom edge securely buried) or equivalent solid barrier shall be used along the pipeline installation corridor when adjacent to seasonal pools to prevent incidental discharge of earth materials and inadvertent damage to tiger salamander and fairy shrimp breeding habitat.
- A California tiger salamander protection and relocation program shall be developed and approved by the U.S. Fish and Wildlife Service, to be implemented in the event this species is found on-site. The relocation program should be developed as part of endangered species consultation required under the Federal Endangered Species Act.
- A pre-construction meeting with the project biologist, selected construction contractor and District inspector shall be held prior to the initiation of construction to ensure the contractor is familiar with required protective measures (MND mitigation measures, permit conditions) and develops methods to implement these measures;
- A pre-construction inspection(s) (using a fiber optic scope, or equivalent) of all burrows within 20 feet of the pipeline installation and reservoir construction footprints (excavation, staging and access areas) and within 1,000 feet of known breeding pools shall be conducted by a qualified biologist to determine the presence of California tiger salamander in the immediate vicinity of proposed pipeline installation activities.

- If California tiger salamander are found during burrow inspections, the U.S. Fish and Wildlife service shall be contacted, all pipeline installation activities within 100 feet of the burrow shall be postponed and the California tiger salamander protection and relocation program implemented. Pipeline installation in the vicinity of the occupied burrow shall be postponed until the individual salamander(s) has been relocated.
- Any excavations (including pipe trenches) left open over night during the period from October 15 through March 15 shall be inspected by a qualified biologist to identify California tiger salamander prior to initiation of work the following morning. Any salamanders found shall be relocated according to the approved relocation program.

Plan Requirements and Timing: The California tiger salamander protection and relocation program shall be developed and approved by the U.S. Fish and Wildlife Service, as part of endangered species consultation required under the Federal Endangered Species Act. The pre-construction inspection(s) and pre-construction meeting shall be completed no more than 2 weeks prior to the initiation of construction. Silt fencing (or equivalent) adjacent to breeding pools shall be installed prior to burrow inspections. **MONITORING**: The District shall ensure the relocation program is developed and approved, field surveys are conducted and relocation of salamanders is completed.

BIO-5 Western Spadefoot Toad. The following measures shall be fully implemented to prevent take of this species:

- Any spadefoot toads found during California tiger salamander surveys shall be relocated to suitable mammal burrows near seasonal pools.

Plan Requirements and Timing: The above mitigation requirement shall be included in the project specifications. **MONITORING**: The District shall ensure the relocation program is developed and approved, field surveys are conducted and relocation of spadefoot toads is completed.

BIO-6 Pond Turtle. The following measures shall be fully implemented to prevent take of this aquatic reptile:

- Any pond turtles found during California red-legged frog surveys shall be relocated by the project biologist to suitable habitat in Orcutt Creek, if considered to be at risk of mortality.

Plan Requirements and Timing: The above mitigation requirement shall be included in the project specifications. **MONITORING**: The District shall ensure field surveys are conducted and pond turtles are relocated as required.

Full implementation of the above mitigation measures would reduce project-specific and cumulative impacts to biological resources to a level of less than significant.

4.5 CULTURAL RESOURCES

Will the proposal result in:	Potentially Significant	Less than Significant with Mitigation	Less than Significant	No Impact	Reviewed Under Previous Document
Archaeological Resources					
a. Disruption, alteration, destruction, or adverse effect on a recorded prehistoric or historic archaeological site (note site number below)?				X	
b. Disruption or removal of human remains?				X	
c. Increased potential for trespassing, vandalizing, or sabotaging archaeological resources?				X	
d. Ground disturbances in an area with potential cultural resource sensitivity based on the location of known historic or prehistoric sites?		X			
Ethnic Resources					
e. Disruption of or adverse effects upon a prehistoric or historic archaeological site or property of historic or cultural significance to a community or ethnic group?				X	
f. Increased potential for trespassing, vandalizing, or sabotaging ethnic, sacred, or ceremonial places?				X	
g. The potential to conflict with or restrict existing religious, sacred, or educational uses of the area?				X	

Setting:

Regional Prehistoric Overview. Southern California's prehistory begins with Paleo-Indian period, currently thought to span roughly 12,000 to 8,000 Before Present (B.P.) (Moratto, 1984). The few known Paleo-Indian sites are comprised almost entirely of flaked stone tools including scrapers, choppers and large projectile points. The Early Period (8000 to 3350 B.P.) is represented by a marked increase in the number of sites, and a new technology in the form of handstones and millingstones, which indicates a shift to a primarily seed processing subsistence economy. The Middle Period (3350 to 800 B.P.) is marked by a shift in the economic/subsistence focus from plant gathering and the use of hard seeds, to a more generalized hunting- gathering adaptation, with an increased focus on acorns. The Late Period (800 B.P. to contact) was a period of localization, specialization and adaptation. Late Period sites have produced a large variety of material goods including small finely chipped projectile points, bone tools, stone, shell and bone ornaments, steatite bowls and objects, and shell beads that may have acted as currency (King, 1990).

Regional Ethnographic Overview. The project area lies within the historic territory of the Native American Indian group known as the Chumash. The Chumash occupied the region from San Luis Obispo County to Malibu Canyon on the coast, and inland as far as the western edge of the San Joaquin Valley, and the four northern Channel Islands (Grant, 1978). The Chumash are subdivided into factions based on distinct dialects. The Purisimeño occupied the Santa Maria Valley.

Chumash society developed over the course of some 9,000 years and achieved a level of social, political and economic complexity not ordinarily associated with hunting and gathering groups (Greenwood, 1972). The prehistoric Chumash are believed to have maintained one of the most elaborate bead money systems in the world, as well as one of the most complex non-agricultural societies (King, 1990).

Applegate (1975) lists the following three villages as having been located within a few miles of the project APE:

- Ahwapsh – translated as "in the nettles" and located along Solomon-Orcutt Creek.
- Anaquwuk – no translation, also located along Solomon-Orcutt Creek.
- Lehlele – translated as the swan and located near Guadalupe Lake to the west.

Spanne (2004) notes that it is probable that one or more of the above listed villages occasionally used the general project area.

The Chumash aboriginal way of life ended with Spanish colonization. As neophytes brought into the mission system they were transformed from hunters and gatherers into agricultural laborers and exposed to diseases to which they had no resistance. By the end of the Mission Period in 1834, the Chumash population had been decimated by disease and declining birthrates. Population loss as a result of disease and economic deprivation continued into the next century.

Today many people claim their Chumash heritage in Santa Barbara County. In general, they place high value on objects and places associated with their past history, especially burials, grave goods, and archaeological sites.

Record Search. A Phase I archaeological survey and record search was conducted for the project by Conejo Archeological Consultants (2009). A record search was conducted at the Central Coast Information Center (CCIC) housed at the University of California, Santa Barbara on March 17, 2009. The CCIC record search identified five pre-historic archaeological sites and three isolates within a one-half mile radius:

- **CA-SBA-1159** is a low density lithic scatter covering approximately 50 by 50 meters (165 by 165 ft.) (Romani and Toren, 1995). CA-SBa-1159 is located at the outer edge of the 0.5-mile radius from the project Area of Potential Effect (APE) and would not be affected by the proposed project.
- **CA-SBa-2714** was first recorded as a complex lithic scatter diffusely scattered along the top of a dune ridge in a fallow zucchini field (Steidl and Steidl, 1994). A subsurface investigation concluded that CA-SBA-2714 is eligible for listing on the National Register of Historic Places (Roper, 1995). CA-SBa-2714 would not be affected by project implementation.

- **CA-SBa-2731** consists of a low-density lithic scatter of chert flakes located in a cow pasture (Toren et al., 1995a). CA-SBA-2731 was recorded in 1995 during the survey of Key Site 22 for the Orcutt Community Plan, and would not be affected by the proposed project.
- **CA-SBa-2732** It is described as a low-density lithic scatter of chert flakes in a cow pasture. Toren et al. (1995b) notes that CA-SBA-2732 and 2731 and Isolate 22-5, "may all be part of one large low density lithic scatter along the north bank of Orcutt Creek. No artifacts were noted between these two sites and the isolated find, but the grass cover was very thick..." CA-SBa-2732 would not be affected by the proposed project.
- **CA-SBa-2733/H** consists of a low density scatter of chert flakes and historic artifacts, which were recorded in an irrigated cow pasture by Toren et al. (1995b). Spanne (2004) found no evidence that CA-SBa-2733/H extended across Highway 1 onto the golf course property and neither did Conejo's current investigation. Therefore, the proposed project should not affect CA-SBa-2733/H.
- **Isolate 591** consists of two fragments of chert located on the north side of Orcutt Creek between Black Road and CA-SBa-2731 (Toren & Santoro, 1995). Isolate 591 would not be affected by the proposed project.
- **Isolate 592** is a single flake of cherty sandstone located on the north side of Highway 1 (Toren & Santoro, 1995). Isolate 592 is located adjacent to the project APE, and would not be affected by the proposed project. However, the isolate may be indicative of other buried cultural resources in the area.
- **Isolate RME-1** was described by Spanne (1980) as follows: "A single flake of brownish-tan Monterey Chert was observed on the surface at the margin of the 11th fairway just north of the putting surface. A thorough search of the surrounding area failed to reveal any additional cultural materials." Spanne resurveyed the isolate location again in 2004 and found no signs of cultural resources and noted that that the area had been disturbed.

  Isolate RME-1 would not be affected by the proposed project. In addition, the isolate is located within a disturbed context (an area graded during construction of the golf course) and by itself does not meet the eligibility requirements for listing on the National Register. However, the isolate may be indicative of other buried cultural resources in the area. Note: Isolate RME-1 is not recorded at the CCIC and, therefore, does not have an assigned isolate number.

The Native American Heritage Commission was contacted to conduct a file search to identify any sacred lands in the project area. The file search failed to identify any cultural resources within the immediate project area.

Field Investigation. Conejo Archeological Consultants conducted an archaeological survey of the proposed APE on May 19, 2009. The survey was linear in nature covering approximately 12,200 feet. Where feasible, a 33 foot-wide corridor was surveyed along each proposed pipeline alignment. The objective of the survey was the visual detection of prehistoric and historic resources, including lithic debris and aboriginal artifacts, midden deposits, archaeological features, historical-era foundations or refuse, and other evidence of past land use.

No archaeological resources were noted during Conejo's current survey or past surveys conducted in the area. Evidence of Site CA-SBa-1169H was not found as it was well outside of the project APE. Isolate RME-1 was not found during the field investigation.

Native American Consultation. The following Chumash contacts were mailed a project description letter dated March 20, 2009 and asked to respond with any comments or concerns regarding the project:

- Alva-Padilla, Adelina, Chair Woman, Santa Ynez Tribal Elders Council
- Angulo, Richard
- Armenta, Vincent, Santa Ynez Band of Mission Indians
- Arredondo, Frank
- Cohen, Sam, Tribal Administrator, Santa Ynez Band of Mission Indians
- DeSoto, Ernestine
- Garcia, Janet, Chairperson, Coastal Band of the Chumash Nation
- Lotah, Dr. Kote & Lin A-Lul'Koy, Owl Clan
- Napoleone, Diane
- Ruiz, John
- Vigil, Chief Mark Steven, San Luis Obispo County Chumash Council

A telephone call was received by Conejo Archeological Consultants from Freddy Romero of the Santa Ynez Reservation who indicated that the general project area should be considered very sensitive for Native American resources. Mr. Romero indicated that he was going to do more background research on the project area and he also requested a map showing where the pipeline would be laid within the Rancho Maria Golf Course. The map was mailed to Mr. Romero on June 11, 2009. In a second telephone conversation on June 18, 2009, Mr. Romero requested the following:

- The Chumash monitor should have the authority to temporarily halt or redirect project construction in the event that potentially significant cultural resources are exposed;
- A copy of the final monitoring report should be sent to the Santa Ynez Band of Mission Indians;
- The Native American representative should be retained in the unexpected event that archaeological resources are exposed during construction.

- The Santa Ynez Band of Mission Indians should be notified if human remains are discovered.

As of February 19, 2010 ~~June 26, 2009~~, no other Native American responses have been received.

Impact Discussion:

a. Based on the results of the record search and field survey, the extent of previous ground disturbance associated with roadway and golf course construction and maintenance, and the fact that project earth disturbance would be limited to previously disturbed soils, no significant disruption or other adverse effects to known archaeological sites are anticipated.

b. Impacts to known archeological sites would not occur; therefore, disruption or removal of human remains is not anticipated.

c. The proposed project would not result in an increase in population or increased access to archeological sites. Therefore, an increased potential for trespassing, vandalism or sabotage is not anticipated.

d. Although no significant disruption or other adverse effects to known archaeological sites are anticipated, unknown buried cultural resources may be adversely affected by project-related excavation.

e. No prehistoric or historic archeological sites or properties of historic or cultural significance would be adversely affected by the proposed project. However, see Section 4.10 for an assessment of impacts to historic structures.

f. No ethnic, sacred or ceremonial places occur in the vicinity of the project; therefore, no adverse effects are expected.

g. The proposed project would not result in an increase in population or increased access to ethnic, sacred or ceremonial places. Therefore, an increased potential for trespassing, vandalism or sabotage is not expected.

Mitigation Measures and Residual Impacts:

To minimize potentially significant impacts to archeological resources, the following measures shall be implemented:

1. At the commencement of the Recycled Water Distribution Pipeline (Phase II) Project, an archaeologist shall provide construction workers associated with earth-disturbing procedures an orientation on cultural resources and directions as to what steps are to be taken if a find is encountered.

2. A professional archaeologist and Chumash representative shall be retained to monitor all trenching within 100 feet of CA-SBa-2733/H and Isolates 582 and RME-1. The archaeologist in consultation with the Native American monitor shall have the authority to temporarily halt or redirect project construction in the event that potentially significant cultural resources are exposed. Based on monitoring observations and the actual extent of project disturbance, the lead archaeologist shall have the authority to refine the monitoring requirements as appropriate (i.e., change to spot checks, reduce or increase the area to be monitored) in consultation with the District. A monitoring results report shall be provided to the District and the CCIC.
3. In the event that archaeological resources are unearthed during project construction, all earth disturbing work within the vicinity of the find must be temporarily suspended or redirected until an archaeologist has evaluated the nature and significance of the find pursuant to Phase 2 investigations of the County Archeological Guidelines. If the find is determined to significant, the site shall be subject to a Phase 3 mitigation program consistent with the County Archeological Guidelines. After the find has been appropriately mitigated, work in the area may resume. A Chumash representative shall be retained to monitor any mitigation work associated with Native American cultural material.
4. If human remains are unearthed, State Health and Safety Code Section 7050.5 requires that no further disturbance shall occur until the County Coroner has made the necessary findings as to origin and disposition pursuant to Public Resources Code Section 5097.98. If the remains are determined to be of Native American descent, the coroner has 24 hours to notify the Native American Heritage Commission.

Plan Requirements/Timing: These conditions shall be included in the project plans and specifications. **MONITORING**: The District on-site inspector shall ensure the measures are fully implemented.

Full implementation of the above mitigation measures would reduce project-specific and cumulative impacts to cultural resources to a level of less than significant.

4.6 ENERGY

Will the proposal result in:	Potentially Significant	Less than Significant with Mitigation	Less than Significant	No Impact	Reviewed Under Previous Document
a. Substantial increase in demand, especially during peak periods, upon existing sources of energy?			X	~~X~~	
b. Requirement for the development or extension of new sources of energy?				X	

Impact Discussion:

a. ~~The proposed project would require pumping recycled water from the Wastewater Treatment Plant to the Rancho Maria Golf Course and from the irrigation reservoir to landscaped areas at the golf course, which would consume energy (electricity). However, treated wastewater is currently pumped to off-site spray disposal areas, and groundwater is pumped from the irrigation reservoir to landscaped areas at the golf course. Therefore, the proposed project would not substantially increase pumping requirements or related energy consumption.~~

a. Currently, most of the recycled water produced by the wastewater treatment plant is sprayed on pasture land. Project implementation would result in pumping recycled water to the Rancho Maria Golf Course instead of pasture land, with no substantial increase in energy consumption by the District. Based on preliminary estimates by the project engineer, energy consumption associated with irrigation water pumping at the Golf Course would decrease, primarily due to the reduction in use of the existing well pump. Overall, the project would not result in a substantial increase in energy demand, such that energy impacts are considered less than significant.

b. The project would not require or induce new development or extension of existing sources of energy.

Mitigation and Residual Impact:

No mitigation is required. No cumulatively considerable or residual impacts are anticipated.

4.7 FIRE PROTECTION

Will the proposal result in:	Potentially Significant	Less than Significant with Mitigation	Less than Significant	No Impact	Reviewed Under Previous Document
a. Introduction of development into an existing high fire hazard area?				X	
b. Project-caused high fire hazard?				X	
c. Introduction of development into an area without adequate water pressure, fire hydrants or adequate access for fire fighting?				X	
d. Introduction of development that will hamper fire prevention techniques such as controlled burns or backfiring in high fire hazard areas?				X	
e. Development of structures beyond safe Fire Dept. response time?				X	

Setting:

The pipeline alignment is located within the maintained roadway right-of-way (mowed and/or sprayed periodically), and within irrigated turfgrass and landscaping at the golf course. Therefore, fire hazard is considered low.

Impact Discussion:

a. The proposed project does not include any development or structures, and would not directly or indirectly lead to new development.

b. The proposed project does not involve any ignition sources and activities would be concentrated in mowed or irrigated areas. No increase in fire hazard is anticipated.

c. The proposed project does not include any development or structures.

d. The proposed project does not include any development or structures, and would not hamper fire prevention activities.

e. The proposed project does not involve any structures.

Mitigation and Residual Impact:

No mitigation is required. No cumulatively considerable or residual impacts are anticipated.

4.8 GEOLOGIC PROCESSES:

Will the proposal result in:	Potentially Significant	Less than Significant with Mitigation	Less than Significant	No Impact	Reviewed Under Previous Document
a. Exposure to or production of unstable earth conditions such as landslides, earthquakes, liquefaction, soil creep, mudslides, ground failure (including expansive, compressible, collapsible soils), or similar hazards?				X	
b. Disruptions, displacements, compaction or overcovering of the soil by cuts, fills, or extensive grading?				X	
c. Permanent changes in topography?				X	
d. The destruction, covering or modification of any unique geologic, paleontologic, or physical features?				X	
e. Any increase in wind or water erosion of soils, either on or off the site?				X	
f. Changes in deposition or erosion of beach sands or dunes, or changes in siltation, deposition or erosion which may modify the channel of a river, or stream, or the bed of the ocean, or any bay, inlet or lake?		X			
g. The placement of septic disposal systems in impermeable soils with severe constraints to disposal of liquid effluent?				X	
h. Extraction of mineral or ore?				X	
i. Excessive grading on slopes of over 20%?				X	
j. Sand or gravel removal or loss of topsoil?				X	
k. Vibrations, from short-term construction or long-term operation, which may affect adjoining areas?			X		
l. Excessive spoils, tailings or over-burden?				X	

Setting:

Based on the Geologic Map of the Santa Maria and Twitchell Dam Quadrangles (Dibblee, 1994), the proposed pipeline alignment is underlain by recent alluvium (along Orcutt Creek) and Holocene-age older alluvium, wind deposited sand. The Santa Maria Fault is located approximately 5 miles east of alignment, and is considered inactive.

Impact Discussion:

a. Based on the Seismic Safety and Safety Element of the Santa Barbara County Comprehensive Plan, the proposed pipeline alignment is located in areas assigned low problem ratings for liquefaction, slope stability, tsunami, expansive soils, soil creep, and compressible-collapsible soils and a moderate problem rating (lowest rating) for seismic-tectonic. The proposed alignment is nearly level, such that landslides and slope stability is not an issue. The immediate project area has been assigned a low-moderate overall geologic problems index. The proposed project would not include any structures; therefore, no persons would be exposed to geologic hazards.

b. Earth work associated with the proposed project would be limited to trenching to install the pipeline, no extensive grading, cuts or fills would occur.

c. The ground surface would be restored following pipeline installation, with no permanent change in topography.

d. Based on the Seismic Safety and Safety Element of the Santa Barbara County Comprehensive Plan, no Areas of Special Geologic Interest occur in the project area. A search of the University of California Museum of Paleontology data base indicates vertebrate fossils (mako shark, tiger shark, great white shark, baleen whales) have been found in the Careaga Formation in the Orcutt area. Project-related trenching would not affect the Careaga Formation. Overall, no impacts to unique geologic, paleontologic, or physical features would occur.

e. The project does not involve hillside grading or other components that would increase soil erosion.

f. Pipeline installation may involve stream diversion and trenching within Orcutt Creek which would result in short-term increases in erosion and siltation.

g. The proposed project would not involve the placement of septic systems.

h. The proposed project does not involve the extraction or processing of minerals or ore.

i. No grading of slopes is proposed.

j. Excavation associated with pipeline installation would occur within previously disturbed areas (roadway shoulder) and would not result in the loss of topsoil.

k. Vibration would be generated by heavy equipment during pipeline installation activities, and may be detected at one residence (850 feet to the north) for a few days. However, due to the small scale and duration of the project, and the small number of persons affected, vibration impacts are considered less than significant.

l. No spoils would be generated and material excavated would be used to backfill the pipe trench.

Mitigation and Residual Impact:

Mitigation for potentially significant erosion and siltation impacts are addressed under Water Resources (Section 4.16). Residual impacts would be less than significant.

4.9 HAZARDOUS MATERIALS/RISK OF UPSET

Will the proposal result in:	Potentially Significant	Less than Significant with Mitigation	Less than Significant	No Impact	Reviewed Under Previous Document
a. In the known history of this property, have there been any past uses, storage or discharge of hazardous materials (e.g., fuel or oil stored in underground tanks, pesticides, solvents or other chemicals)?				X	
b. The use, storage or distribution of hazardous or toxic materials?			X		
c. A risk of an explosion or the release of hazardous substances (e.g., oil, gas, biocides, bacteria, pesticides, chemicals or radiation) in the event of an accident or upset conditions?				X	
d. Possible interference with an emergency response plan or an emergency evacuation plan?				X	
e. The creation of a potential public health hazard?			X		
f. Public safety hazards (e.g., due to development near chemical or industrial activity, producing oil wells, toxic disposal sites, etc.)?				X	
g. Exposure to hazards from oil or gas pipelines or oil well facilities?				X	
h. The contamination of a public water supply?				X	

Setting:

The project area is rural/agricultural with only a few scattered residences. The only commercial land use in the area is the Rancho Maria Golf Course. No industrial land uses are located in immediate area. Due to the long history of agriculture in the project area, some accumulation of historic pesticides may have occurred.

Based on review of the GeoTracker (State Water Resources Control Board) and ENVIROSTOR (California Department of Toxic Substances Control) data bases, one site was identified along the pipeline alignment. The site consists of a leaking underground storage tank at the Rancho Maria Golf Course. The tank leaked gasoline and resulted in soil contamination in 1991, and was cleaned up and the case closed in December 1992.

Impact Discussion:

a. Pipeline installation would occur within the roadway right-of-way and would avoid agricultural soils and potential historic pesticide contamination. Known soil contamination at the Rancho Maria Golf Course has been resolved, and excavation associated with pipeline installation is not expected to encounter hazardous materials.

b. Excluding fuels used by construction equipment and vehicles, the project does not involve the use, storage or distribution of hazardous or toxic materials. Equipment and vehicles associated with the project would be fueled from a maintenance vehicle located away from drainages and residences. No storage of fuel is proposed at or near the project site.

c. No risk of explosion is expected as a result of project-related activities.

d. The proposed project would not interfere with any emergency response plan. Traffic control would be provided on Black Road and Highway 1 during pipeline installation, and would ensure emergency vehicles can safely transit the work area.

e. The proposed project involves distribution and use of recycled water at a public golf course per Section 60304 of Title 22 of the California Code of Regulations. The recycled water would not be used for potable uses, and signage would be provided at the golf course to inform the public of the use of recycled water and to avoid direct contact.

f. The proposed project does not include any new development near hazardous materials.

g. The project area does not include any oil or gas pipelines or well facilities.

h. The proposed project does not include any activities that would affect public water supplies.

Mitigation and Residual Impact:

No mitigation is required. No cumulatively considerable or residual impacts are anticipated.

4.10 HISTORIC RESOURCES

Will the proposal result in:	Potentially Significant	Less than Significant with Mitigation	Less than Significant	No Impact	Reviewed Under Previous Document
a. Adverse physical or aesthetic impacts on a structure or property at least 50 years old and/or of historic or cultural significance to the community, state or nation?				X	
b. Beneficial impacts to an historic resource by providing rehabilitation, protection in a conservation/open easement, etc.?				X	

Setting:

Overview. The written historic period for the Santa Maria Valley can be divided into three main periods: the Spanish Legacy (1769-1821), the Mexican Period (1821-1848), and the American Period (1848-present). Land grants first appeared in the project region after the end of the Mexican War in 1821. The project site is located within the historic boundaries of the Rancho Punta de La Laguna, which encompassed 26,646 acres and was granted to Luis Arellanes and Emilio Miguel Ortega in 1844 (Cowan, 1977).

Starting in 1848, the Californio (Mexican resident) economy and prevalence in the area gradually declined due to the Treaty of Guadalupe Hidalgo and the Lands Act of 1851, which required verification of all Spanish-Mexican claims by the U.S. government. During the early American Period, cattle ranching and agricultural production continued to be the primary economic focus in the project region.

At the turn of the century, oil exploration and production became another important economic component in the Santa Maria Valley and resulted in growth of Santa Maria and the founding of Orcutt. Agriculture and oil remained the basis for the region's economy throughout the first half of the Twentieth Century.

In the late fifties with the building of Camp Cooke (Vandenberg Air Force Base), many people moved to the area bringing a new boom to the economy. Many subdivision projects were undertaken in Santa Maria and Orcutt in the 1950s and 1960s to meet housing needs for the base population. The Rancho Maria Golf Course was constructed in the 1960s. Today, the estimated population of the area is about 161,227, which includes the Santa Maria Valley, the city of Guadalupe, and the unincorporated township of Orcutt. Vandenberg Air Force Base, agriculture and oil production continue to be the three primary components of the Santa Maria Valley's economy.

Record Search. The record search conducted at the Central Coast Information Center identified three historic sites in the project area:

- **CA-SBa-1169H** is a historic trash deposit consisting of animal bone, shell, glass bottles, domestic and tableware glass, show leather, with some metal and ceramics. The site was recorded by Greenwood and McIntyre in 1980. CA-SBA-1169H is located over 300 feet west of the project APE and would not be impacted by project implementation.

- **CA-SBa-2744H** is an existing residence near the corner of State Highway 1 and Black Road. The small, rectangular, wood frame, hipped roof structure was built around 1900 in Santa Maria. The structure was moved to its current location sometime prior to 1942 (Toren, 1995). CA-SBa-2744H is adjacent to but outside of the project APE, and would not be affected by project construction.
- **42-400910** consists of the Black Road Bridge (51C-0031), which was constructed in 1943. In 2003, Applied Earthworks conducted an archaeological survey and a bridge evaluation for the Black Road Bridge (51C-0031) Replacement Project. In accordance with 36 CFR 800.4(d) (1), Applied Earthworks concluded that Bridge 51C-0031 lacked any significant qualities that would make it eligible for the National Register. Caltrans also lists Black Road Bridge as not eligible for listing on the National Register.

Impact Discussion:

a. All excavation and other project-related work would occur within or immediately adjacent to roadway right-of-ways or within the Rancho Maria Golf Course. No structures or properties would be affected.

b. The project does not offer any opportunities for rehabilitation or protection of historic resources.

Mitigation and Residual Impact:

No mitigation is required. No cumulatively considerable or residual impacts are anticipated.

4.11 LAND USE

Will the proposal result in:	Potentially Significant	Less than Significant with Mitigation	Less than Significant	No Impact	Reviewed Under Previous Document
a. Structures and/or land use incompatible with existing land use?				X	
b. Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?				X	
c. The induction of substantial growth or concentration of population?				X	
d. The extension of sewer trunk lines or access roads with capacity to serve new development beyond this proposed project?				X	

Will the proposal result in:	Potentially Significant	Less than Significant with Mitigation	Less than Significant	No Impact	Reviewed Under Previous Document
e. Loss of existing affordable dwellings through demolition, conversion or removal?				X	
f. Displacement of substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?				X	
g. Displacement of substantial numbers of people, necessitating the construction of replacement housing elsewhere?				X	
h. The loss of a substantial amount of open space?				X	
i. An economic or social effect that would result in a physical change? (i.e. Closure of a freeway ramp results in isolation of an area, businesses located in the vicinity close, neighborhood degenerates, and buildings deteriorate. Or, if construction of new freeway divides an existing community, the construction would be the physical change, but the economic/social effect on the community would be the basis for determining that the physical change would be significant.)				X	
j. Conflicts with adopted airport safety zones?				X	

Setting:

The pipeline alignment lies within the public right-of-way along Black Road and Highway 1. Portions of the pipeline within the Rancho Maria Golf Course would be located on APN 113-250-014 (129.6 acres), which has a land use designation and zoning designation of Recreation (REC). Areas along the Black Road portion of the alignment are primarily grazing lands, with row crops along Highway 1. However, the area east of Black Road has a land use and zoning designation of Residential Ranchette (RR-20, 1 unit per 20 acres), and could be developed in the future.

Impact Discussion:

a. The proposed project does not involve any new above-ground structures or change in current land use, and is entirely compatible with surrounding land uses.

b. The proposed project is consistent with all applicable plans and policies (see Tables 5 and 6).

c. The proposed project involves modifying the method of disposal of treated wastewater and would not increase the capacity of the District's wastewater treatment plant, or include any other action that may induce population growth.

d. The proposed project does not include the extension of sewer lines or roadways.

e. The proposed project would not displace any dwellings.

f. See e.

g. See e.

h. No loss of open space would occur as a result of the proposed project.

i. No physical change in the local community would occur as a result of the proposed project.

j. The proposed pipeline alignment is located within 1.3 miles of the nearest clear zone and within 0.5 miles of the nearest approach zone for the Santa Maria Airport. The project would not be located within or conflict with airport safety zones.

Mitigation and Residual Impact:

No mitigation is required. No cumulatively considerable or residual impacts are anticipated.

4.12 NOISE

Will the proposal result in:	Potentially Significant	Less than Significant with Mitigation	Less than Significant	No Impact	Reviewed Under Previous Document
a. Long-term exposure of people to noise levels exceeding County thresholds (e.g. locating noise sensitive uses next to an airport)?				X	
b. Short-term exposure of people to noise levels exceeding County thresholds?		X			
c. Project-generated substantial increase in the ambient noise levels for adjoining areas (either day or night)?		X			

Setting:

Noise sensitive receptors in the immediate vicinity of the pipeline alignment are limited to one residence along Highway 1, approximately 850 feet north of the pipeline alignment. A noise measurement taken along Highway 1 at the Rancho Maria Golf Course on December 20, 2006 yielded 62.5 dBA Leq (Rincon Consultants, 2007a).

Impact Discussion:

a. The proposed project involves installation and operation of a buried recycled water pipeline, no long-term noise would be generated.

b. Noise modeling using the Federal Highway Administration Roadway Construction Noise Model indicates project-related noise levels at the nearest residence would be 56.3 dBA Leq during pipeline installation activities, which is less than ambient conditions along Highway 1. The County has not developed any short-term noise thresholds. However, construction activities within 1,600 feet of residences is considered to generally result in a potentially significant impact (County of Santa Barbara, 2008).

c. See b. above.

Mitigation and Residual Impact:

NOISE-1 To minimize potentially significant noise impacts to adjacent residences, the following measure shall be implemented:

- Pipeline installation activities involving heavy equipment or heavy-duty truck traffic within 1,600 feet of residences shall be limited to 7 am to 4 pm, with no work on weekends, unless weekend work is required to minimize traffic congestion.

Plan Requirements/Timing: This condition shall be included in the project specifications. **MONITORING**: The District-appointed inspector shall ensure the measure is fully implemented.

Full implementation of the above mitigation measure would reduce project-specific and cumulative noise impacts to a level of less than significant.

4.13 PUBLIC FACILITIES

Will the proposal result in:	Potentially Significant	Less than Significant with Mitigation	Less than Significant	No Impact	Reviewed Under Previous Document
a. A need for new or altered police protection and/or health care services?				X	
b. Student generation exceeding school capacity?				X	
c. Significant amounts of solid waste or breach any national, state, or local standards or thresholds relating to solid waste disposal and generation (including recycling facilities and existing landfill capacity)?				X	
d. A need for new or altered sewer system facilities (sewer lines, lift-stations, etc.)?				X	
e. The construction of new storm drainage or water quality control facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?				X	

Impact Discussion:

a. The proposed project does not include any facilities that would require police protection or health care services.

b. The project does not include any residential land uses, and would not generate demand for school capacity.

c. The proposed project would not generate solid waste. Materials removed from the streambed would be used at construction sites or used for roadway maintenance purposes at other locations.

d. The proposed project does not include any residential development, and would not generate demand for sewage collection or related facilities.

e. The proposed project would not require the construction of any storm drain or water quality control facilities.

Mitigation and Residual Impact:

No mitigation is required. No cumulatively considerable or residual impacts are anticipated.

4.14 RECREATION

Will the proposal result in:	Potentially Significant	Less than Significant with Mitigation	Less than Significant	No Impact	Reviewed Under Previous Document
a. Conflict with established recreational uses of the area?				X	
b. Conflict with biking, equestrian and hiking trails?				X	
c. Substantial impact on the quality or quantity of existing recreational opportunities (e.g., overuse of an area with constraints on numbers of people, vehicles, animals, etc. which might safely use the area)?				X	

Setting:

Recreational facilities in the immediate area are limited to the Rancho Maria Golf Course. Highway 1 in the project area is considered a Class 3 bikeway in the Orcutt Community Plan.

Impact Discussion:

a. Pipeline installation within the golf course would be planned to avoid peak golfing season and would not conflict with safe operation of the Rancho Maria Golf Course. No loss of use of this recreational facility is anticipated.

b. The project is not located in the vicinity of any trails; bikeways are addressed under Transportation (section 4.15).

c. The project does not include residential land uses; therefore, it would not generate demand for recreational facilities or result in associated overuse.

Mitigation and Residual Impact:

No mitigation is required. No cumulatively considerable or residual impacts are anticipated.

4.15 TRANSPORTATION/CIRCULATION:

Will the proposal result in:	Potentially Significant	Less than Significant with Mitigation	Less than Significant	No Impact	Reviewed Under Previous Document
a. Generation of substantial additional vehicular movement (daily, peak-hour, etc.) in relation to existing traffic load and capacity of the street system?			X		
b. A need for private or public road maintenance, or need for new road(s)?			X		
c. Effects on existing parking facilities, or demand for new parking?				X	
d. Substantial impact upon existing transit systems (e.g. bus service) or alteration of present patterns of circulation or movement of people and/or goods?				X	
e. Alteration to waterborne, rail or air traffic?				X	
f. Increase in traffic hazards to motor vehicles, bicyclists or pedestrians (including short-term construction and long-term operational)?				X	
g. Inadequate sight distance?				X	
h. Inadequate ingress/egress?				X	
i. Inadequate general road capacity?				X	
j. Inadequate emergency access?				X	
k. Impacts to the Congestion Management Plan system?				X	

Setting:

The pipeline alignment is located along Black Road and Highway 1. Traffic volumes are estimated at about 1,100 average daily trips on Black Road and 2,400 average daily trips on Highway 1 (Rincon Consultants, 2007a). The Black Road/Highway 1 intersection currently operates at Level of Service B during p.m. peak hour (Rincon Consultants, 2007a). Highway 1 in the project area is considered a Class 3 bikeway in the Orcutt Community Plan.

Impact Discussion:

a. Employee and material transportation associated with pipeline installation would generate a maximum of 20 round trips per day (10 heavy-duty truck, 10 light-duty vehicles). This level of vehicular movement would not substantially increase volume to capacity ratios at affected intersections.

b. Pipeline installation would include pavement replacement in roadways affected by trenching, and would be scheduled (if feasible) to avoid recent pavement overlays. The proposed project would not generate a significant need for roadway maintenance or a new road.

c. Parking facilities to do occur in the project area. The project would not generate parking demand.

d. The proposed project would not create a demand for transit or interfere with the existing transit system or circulation of people and goods.

e. The proposed project would not affect waterborne or rail traffic, and is not located in either clear zones or approach zones of any airport.

f. The proposed project involves use of heavy equipment within and/or immediately adjacent to Black Road and Highway 1. However, traffic controls (including signage and flagmen) would be used to minimize any traffic hazards to motorists or bicyclists.

g. The proposed project would not affect sight distance.

h. The proposed project would not affect ingress/egress to and from Black Road and Highway 1. Access to all land uses would be maintained during the construction period.

i. The proposed project would not affect roadway capacity.

j. Emergency access to residences served by Black Road and Highway 1 would not change. Traffic control would be used to maintain access during the construction period.

k. Roadways and intersection in the Orcutt area operate at acceptable levels of service and are not subject to Congestion Management Plan requirements.

Mitigation and Residual Impact:

No mitigation is required. No cumulatively considerable or residual impacts are anticipated.

4.16 WATER RESOURCES/FLOODING:

Will the proposal result in:	Potentially Significant	Less than Significant with Mitigation	Less than Significant	No Impact	Reviewed Under Previous Document
a. Changes in currents, or the course or direction of water movements, in either marine or fresh waters?			X		
b. Changes in percolation rates, drainage patterns or the rate and amount of surface water runoff?			X		
c. Change in the amount of surface water in any water body?			X		
d. Discharge into surface waters or alteration of surface water quality, including but not limited to temperature, dissolved oxygen, turbidity, or thermal water pollution?		X			
e. Alterations to the course or flow of flood waters, or need for private or public flood control projects?				X	

Will the proposal result in:	Potentially Significant	Less than Significant with Mitigation	Less than Significant	No Impact	Reviewed Under Previous Document
f. Exposure of people or property to water related hazards such as flooding (placement of project in 100 year flood plain), accelerated runoff or tsunamis?				X	
g. Alteration of the direction or rate of flow of groundwater?				X	
h. Change in the quantity of groundwaters, either through direct additions or withdrawals, or through interception of an aquifer by cuts or excavations or recharge interference?				X	
i. Overdraft or overcommitment of any groundwater basin? Or, a significant increase in the existing overdraft or overcommitment of any groundwater basin?				X	
j. The substantial degradation of groundwater quality including saltwater intrusion?				X	
k. Substantial reduction in the amount of water otherwise available for public water supplies?				X	

Setting:

Surface Waters. The proposed project involves pipeline installation across Orcutt Creek. The Orcutt Creek watershed encompasses approximately 18.5 square miles. A stream gauge is located immediately upstream of the Black Road bridge, and recorded an average annual stream flow ranging from 0.090 to 13.8 cubic feet per second (cfs) over the period of 1983 to 2007. The highest peak storm flow recorded at this location is 2,100 cfs on March 5, 2001.

Floodplain. The pipeline alignment lies within the 100-year floodplain at Orcutt Creek. Based on the National Flood Insurance Program Flood Insurance Rate Map (06083C0188F) and topography presented in the project design drawings, the 100-year floodplain width is 220 feet at the proposed pipeline crossing.

Groundwater. The proposed pipeline alignments lie within the Santa Maria River Valley Groundwater Basin, which comprises 288 square miles in Santa Barbara and San Luis Obispo counties. Groundwater levels declined from historically high to historically low levels from the 1920's to the late 1960's. Since then, groundwater levels have fluctuated over alternating 5 to 15 year periods. From 2002 through 2008, groundwater levels in both shallow and deep zones have gradually declined (Luhdorff and Scalmanini, 2009). Water quality concerns in the Basin are elevated total dissolved solids and nitrate concentrations.

Water Quality Regulation. The Regional Water Quality Control Board (RWQCB) has developed a Water Quality Control Plan for the Central Coast Region (Basin Plan) (1994) to protect the water quality of surface and groundwaters of the region. The Basin Plan designates beneficial uses, sets narrative and numerical objectives to protect beneficial uses and describes implementation programs. Beneficial uses are processes, habitats, organisms or features that require water and are considered worthy of protection. Orcutt Creek has been designated as impaired under Section 303(d) of the Clean Water Act due to elevated levels of ammonia, boron, chlopyrifos, DDT, dieldrin, fecal coliform and nitrate.

Impact Discussion:

a. The project may involve temporary diversion of surface flow in Orcutt Creek during pipeline installation. An earthen berm, sandbags or similar structure would be used to temporarily impound surface water upstream of the pipeline crossing. Surface water would flow around the work area in a pipe and discharge to the streambed downstream of the pipeline crossing. Work would not be conducted during high flow periods. The pipeline would be buried below the expected scour depth, the streambed would be restored and the flow diversion would be removed following pipeline installation. Therefore, no significant impacts to water movement are anticipated.

b. No long-term changes in creek or storm drain locations, dimensions or hydraulic characteristics would occur. Therefore, no change in percolation rates or surface runoff would occur. As discussed in a. above, temporary stream diversion may be required and would affect drainage patterns for a few weeks.

c. No change in the amount of surface water present in any water body would occur as a result of the project.

d. As discussed in a. above, stream diversion may involve diverting surface flow into a pipe and discharging it to the streambed downstream of the work area. However, water quality degradation may occur as a result of surface flow diversion and storm run-off from construction areas.

e. As discussed under a., stream diversion (if required) would be implemented during non-storm periods. Therefore, no changes in the course or flow of flood waters would occur, and no new flood control facilities would be required.

f. The proposed project would not result in land development or otherwise increase the exposure of persons or property to water-related hazards.

g. The proposed project would not affect groundwater flow as groundwater recharge from Orcutt Creek and surrounding farmlands would not be affected.

h. The project does not involve extraction of groundwater, excavation of aquifers or interference with recharge.

i. Currently, the Rancho Maria Golf Course uses about 600 acre-feet per year of groundwater for irrigation of turfgrass and other landscaping. The project involves providing recycled water for irrigation, which would substantially reduce groundwater consumption by the golf course. Impacts to the Santa Maria Groundwater Basin would be beneficial.

j. Data collected from coastal monitoring wells indicate seawater intrusion has not occurred in the Santa Maria Groundwater Basin (Santa Barbara County Public Works, 2006). The amount of the recycled water/groundwater mixture that would be applied at the Rancho Maria Golf Course would be limited to the water needs of the landscaping, with occasional leaching of salts from the root zone. Substantial recharge of the aquifer by recycled water is not anticipated. In any case, the use of recycled water for landscape irrigation is equivalent to spray disposal, which is the current use of treated wastewater from the District's Wastewater Treatment Plant. Overall, the project would not affect groundwater quality including saltwater intrusion.

k. The project would not require water and would not affect public water supplies.

Mitigation Measures and Residual Impacts:

WR-1 The project would require coverage under the General Permit for Storm Water Discharges Associated with Construction Activity (Water Quality Order 99-08-DWQ) or the General Permit for Storm Water Discharges Associated with Construction Activity from Small Linear Underground/Overhead Projects (Water Quality Order 2003-0007-DWQ). As required by the conditions of the General Permit, a Storm Water Quality Pollution Prevention Plan (SWPPP) would be prepared, which would include best management practices to be implemented and a monitoring program. The following Best Management Practices shall be incorporated into the SWPPP to minimize potential water quality impacts. These impacts would be mitigated to a less than significant level with the implementation of these measures.

- All ground disturbance shall be limited to the dry season or periods when rainfall is not predicted, to minimize erosion and sediment transport to surface waters;
- Disturbed areas shall be stabilized or re-vegetated prior to the start of the rainy season;
- Straw wattles (or equivalent measures) shall be used to trap suspended sediment downstream of the pipeline crossing at Orcutt Creek during creation and removal of the diversion berm;
- Groundwater discharged to surface waters (if any) shall be allowed to settle to reduce suspended sediment, prior to such discharge;
- Impacts to vegetation within and adjacent to creeks and storm drains shall be minimized. The work area shall be flagged to identify its limits. Vegetation shall not be removed or intentionally damaged beyond these limits.
- Construction materials and soil piles shall be placed in designated areas where they could not enter creeks or storm drains due to spillage or erosion.
- Waste and debris generated during construction shall be stored in designated waste collection areas and containers away from watercourses, and shall be disposed of regularly.

- All fueling of heavy equipment shall occur in a designated area removed from Orcutt Creek and other drainages, such that any spillage would not enter surface waters. The designated area shall include a drain pan or drop cloth and absorbent materials to clean up spills.
- Vehicles and equipment shall be maintained properly to prevent leakage of hydrocarbons and coolant, and shall be examined for leaks on a daily basis. All maintenance shall occur in a designated offsite area. The designated area shall include a drain pan or drop cloth and absorbent materials to clean up spills.
- Any accidental spill of hydrocarbons or coolant that may occur on the construction site shall be cleaned immediately. Absorbent materials shall be maintained on the construction site for this purpose. The Regional Board shall be notified immediately in the event of an accidental spill to ensure proper clean up and disposal of waste.

Plan Requirements/Timing: These measures shall be included in the project specifications and SWPPP. **MONITORING**: The District-appointed inspector shall ensure the measures are fully implemented.

Mitigation measures are provided above would reduce construction-related water quality impacts to a level of less than significant.

5.0 INFORMATION SOURCES

5.1 COUNTY DEPARTMENTS CONSULTED

Public Works Department

5.2 COMPREHENSIVE PLAN (CHECK THOSE SOURCES USED):

X	Seismic Safety/Safety Element	X	Conservation Element
X	Open Space Element	X	Noise Element
	Coastal Plan and Maps	X	Circulation Element
	ERME		Agricultural Element

5.3 OTHER SOURCES (CHECK THOSE SOURCES USED):

X	Field work		Ag Preserve maps
	Calculations		Flood Control maps
X	Project plans	X	Other technical references
	Traffic studies		(reports, survey, etc.)
	Records		Planning files, maps, reports
	Grading plans	X	Zoning maps
	Elevation, architectural renderings	X	Soils maps/reports
	Published geological map/reports		Plant maps
X	Topographical maps	X	Archaeological maps and reports
X	Important Farmland Maps	X	FEMA Floodplain maps

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6.0 PROJECT SPECIFIC (SHORT- AND LONG-TERM) AND CUMULATIVE IMPACT SUMMARY

6.1 SIGNIFICANT UNAVOIDABLE IMPACTS

None identified.

6.2 SIGNIFICANT BUT MITIGABLE IMPACTS

Biological Resources. The proposed project may result in:

- Temporary loss of approximately 0.10 acres of arroyo willow riparian forest/County-defined wetlands associated with a trenched pipeline crossing of Orcutt Creek;
- Adverse impacts to vernal pool fairy shrimp and western spadefoot toad potentially residing within seasonal pools near the pipeline alignment;
- Potential adverse impacts to California tiger salamander upland retreats along the pipeline alignment;
- Adverse impacts to California red-legged frog and southwestern pond turtle within Orcutt Creek and its tributaries associated with pipeline installation;

Cultural Resources. The proposed project may result in:

- Potential disturbance of unknown buried cultural resources in an archeologically sensitive area.

Geologic Processes. The proposed project may result in:

- Temporary erosion and siltation associated with a trenched pipeline crossing of Orcutt Creek.

Noise. The proposed project may result in:

- Exposure of adjacent residences to temporary noise generated by heavy equipment and heavy-duty trucks.

Water Resources/Flooding. The proposed project may result in:

- Temporary degradation of surface water quality associated with a trenched crossing of Orcutt Creek.

6.3 CUMULATIVE IMPACTS

Cumulative impacts are defined as two or more individual effects which, when considered together are considerable, or which compound or increase other environmental impacts. Under Section 15064 of the State CEQA Guidelines, the lead agency (Laguna County Sanitation District) must identify cumulative impacts, determine their significance and determine if the effects of the project are cumulatively considerable.

This assessment is focused on potential impacts of the project that may be less than significant on a project-specific basis, but potentially significant when viewed in combination with other projects in the region. Section 3.2 lists 16 other projects under review or recently approved within the Orcutt area.

6.3.1 Air Quality

Other land development projects (see Section 3.2.1) would generate both short-term construction emissions and long-term vehicle emissions, while infrastructure projects would generate only construction emissions. The proposed project would not contribute to cumulative long-term vehicle emissions, but may contribute to cumulative construction emissions, should construction of these projects occur at the same time as the proposed project. However, construction emissions of both the proposed project and other projects would be mitigated by standard measures required by the Santa Barbara County APCD. Implementation of these measures is considered to prevent significant project-specific and cumulative air quality impacts from construction. Therefore, cumulative air quality impacts from construction would not be cumulatively considerable.

6.3.2 Water Resources

Projects listed above would require potable water service and may affect groundwater supplies. The proposed project would not require a water supply and would not contribute to this impact. Cumulative development would increase pollutant concentrations in storm run-off and may adversely affect surface water quality. During the construction period, the proposed project may contribute to cumulative surface water quality impacts. However, mitigation measures are provided to avoid and minimize impacts to surface water quality.

Similar to the proposed project, some of the cumulative projects are located near drainages and inadvertent spills of fuel or lubricants could occur and percolate into groundwater supplies. The proposed project would contribute to this cumulative impact; however, mitigation measures are provided to avoid and minimize impacts to groundwater quality. The project's contribution to groundwater impacts would not be considerable.

6.3.3 Biological Resources

The Santa Maria Pacific pipeline and Black Road bridge replacement projects may adversely affect California red-legged frog, and the proposed project would incrementally contribute to cumulative impacts. The Santa Maria Pacific pipeline and SB Clark LLC projects may adversely affect California tiger salamander, and the proposed project would incrementally contribute to cumulative impacts. The Santa Maria Pacific pipeline, Black Road bridge replacement, SB Clark LLC and Rice Ranch projects may adversely affect southwestern pond turtle, and the proposed project would incrementally contribute to cumulative impacts. These projects may also result in the loss of sensitive riparian habitat and wetlands, and the proposed project would incrementally contribute to cumulative impacts. However, project-specific impacts would be temporary and mitigation measures have been provided to offset project impacts to riparian vegetation, wetlands and special-status wildlife species. The project's contribution to cumulative biological impacts would not be considerable.

6.3.4 Cultural Resources

Cumulative projects listed above are primarily located in previously developed areas and are unlikely to adversely affect intact archeological resources. However, similar to the proposed project, isolated resources may be discovered during construction-related ground disturbance. The proposed project would contribute to this cumulative impact; however, mitigation measures are provided to avoid and minimize potential impacts to archeological resources. The project's contribution to cumulative cultural resources impacts would not be considerable.

6.3.5 Noise

Other land development projects (see Section 3.2.1) would generate both short-term construction noise and long-term traffic noise, while infrastructure projects would generate only construction noise. The proposed project would not contribute to cumulative traffic noise, but may contribute to cumulative construction noise. However, the proposed project is not located in close proximity to other projects and/or would not be implemented at the same time, and would not have a considerable contribution to cumulative impacts at noise sensitive receptors affected by these projects.

7.0 MANDATORY FINDINGS OF SIGNIFICANCE

	Potentially Significant	Less than Significant with Mitigation	Less than Significant	No Impact	Reviewed Under Previous Document
1. Does the project have the potential to substantially degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?		X			
2. Does the project have the potential to achieve short-term to the disadvantage of long-term environmental goals?				X	
3. Does the project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects and the effects of probable future projects.)			X		
4. Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?		X			
5. Is there disagreement supported by facts, reasonable assumptions predicated upon facts and/or expert opinion supported by facts over the significance of an effect which would warrant investigation in an EIR?				X	

8.0 PROJECT ALTERNATIVES

No significant, adverse unmitigable impacts were identified; therefore, no project alternatives were considered.

9.0 INITIAL REVIEW OF PROJECT CONSISTENCY WITH APPLICABLE SUBDIVISION, ZONING AND COMPREHENSIVE PLAN REQUIREMENTS

An analysis of the consistency of the proposed project with applicable policies is provided in Table 5 for the Comprehensive Plan and Table 6 for the Orcutt Community Plan. The proposed project, with mitigation, is expected to be consistent with all existing land use and development policies.

Table 5. Policy Consistency Analysis – Comprehensive Plan

Applicable Policy Number	Issue	Consistency
Land Use: Streams & Creeks 1	All permitted construction and grading within stream corridors shall be carried out in such a manner as to minimize impacts from increased run-off, sedimentation, biochemical degradation or thermal pollution	A trenched pipeline crossing of Orcutt Creek (if required) may result in an increase in sedimentation. Mitigation measures have been provided to minimize discharge of sediment and reduce erosion during pipeline installation.
Land Use: Flood Hazard 1	All development, including construction, excavation and grading, except flood control projects shall be prohibited in the floodway.	Pipeline installation would occur within the floodway; however, the pipeline would be buried under the streambed and would not adversely affect flood flows

Table 6 Policy Consistency Analysis – Orcutt Community Plan

Applicable Policy Number	Issue	Consistency
WW-O-4	District to use all feasible methods of water conservation and reclamation	The project would provide recycled water as a replacement for groundwater, which would promote water conservation and reclamation
WW-O-5	Future trunk and service lines to be sited and constructed consistent with Community Plan policies	The proposed recycled water pipeline alignment is consistent with the Orcutt Community Plan policies
BIO-O-1	Important natural resources in Orcutt shall be protected consistent with the Open Space Plan	The proposed recycled pipeline alignment follows roadways to avoid biological resources to the extent feasible and is consistent with the Open Space Plan
BIO-O-2	Natural stream channels and riparian vegetation shall be maintained in an undisturbed state	The pipeline crossing at Orcutt Creek would be fully buried, and the stream channel and riparian vegetation restored (if a trenched crossing is utilized)
BIO-O-5	New facilities in Orcutt shall be sited to avoid significant natural resources	The proposed recycled pipeline alignment follows roadways to avoid natural resources to the extent feasible
HA-O-1	Archeological and historic resources in the Orcutt Planning Area shall be protected and preserved	An archeological survey was conducted along the pipeline alignment and no cultural resources were found
NSE-O-2	Construction noise in Orcutt shall be minimized during non-standard work hours	Pipeline installation would be primarily conducted during standard work hours

10.0 RECOMMENDATION BY LEAD AGENCY STAFF

On the basis of the Initial Study, staff:

_____ Finds that the proposed project WILL NOT have a significant effect on the environment and, therefore, recommends that a Negative Declaration (ND) be prepared.

__X__ Finds that although the proposed project could have a significant effect on the environment, there will not be a significant effect in this case because the mitigation measures incorporated into the REVISED PROJECT DESCRIPTION would successfully mitigate the potentially significant impacts. Staff recommends the preparation of a Mitigated Negative Declaration (MND). The MND finding is based on the assumption that mitigation measures will be acceptable to the applicant; if not acceptable a revised Initial Study finding for the preparation of an EIR may result.

_____ Finds that the proposed project MAY have a significant effect on the environment, and recommends that an EIR be prepared.

____ Finds that from existing documents (previous EIRs, etc.) that a subsequent document (containing updated and site-specific information, etc.) pursuant to CEQA Sections 15162/15163/15164 should be prepared.

Potentially significant unavoidable adverse impact areas: None

_____ With Public Hearing ___X___ Without Public Hearing

PREVIOUS DOCUMENT: None

PROJECT EVALUATOR: Matt Ingamells, Padre Associates **DATE:** January 4, 2010

11.0 DETERMINATION BY ENVIRONMENTAL HEARING OFFICER

✓ I agree with staff conclusions. Preparation of the appropriate document may proceed.

____ I DO NOT agree with staff conclusions. The following actions will be taken:

____ I require consultation and further information prior to making my determination.

SIGNATURE: [signature] INITIAL STUDY DATE: 12-31-09

SIGNATURE: [signature] MND DATE: 1-11-10

SIGNATURE: [signature] REVISION DATE: 2-18-10

SIGNATURE: [signature] FINAL MND DATE: 2-18-10

Attachment A

Laguna County Sanitation District
Draft Mitigated Negative Declaration

For the

Recycled Water Distribution Main (Phase 2) Project

09NGD-00000-00021
State Clearing House # 2010011018
Public Comment Period 1-11-2010 to 2-12-2010

Response to Comments
February 18, 2010

Public/Agency Comments Received

City of Santa Maria (1.26.2010)
California Department of Fish and Game (2.11.2010)
U.S. Fish & Wildlife Service (2.12.2010)
Santa Barbara County Air Pollution Control District (2.12.2010)

Santa Maria
All-America City

CITY OF SANTA MARIA
COMMUNITY DEVELOPMENT
DEPARTMENT

110 S. PINE STREET #101 (ON HERITAGE WALK) • SANTA MARIA, CALIFORNIA 93458-5082 • 805-925-0951 • TDD 925-4354

January 26, 2010

Mr. Martin Wilder, District Manager
Laguna County Sanitation District
620 W. Foster Road
Santa Maria, CA 93455

Re: Response to 09-NGD-00021, Laguna Recycled Water Distribution Main (Phase 2)

Dear Marty:

Thank you for providing the City with a copy of the Mitigated Negative Declaration for Phase 2 of your distribution program. I have read the entire MND and have provided comments below which will clarify some issues thus resulting in a more accurate document.

1. Project Description: It is clear from the ND's analysis that the primary impact will be in the pipeline construction. You have identified a route that minimizes impacts to the greatest extent feasible. With that said, there seem to be some unanswered questions about the project.

a) There is no mention of the total output of the plant and how much water is being directed to the golf course.
b) Has the golf course requested a minimum or maximum amount of water?
c) How will this change between the wet and dry seasons?
d) The report states that water will be transmitted through the pipeline to one of two ponds located on the golf course property. However, there is no mention of check valves to shut down the pipeline if the pond is full, particularly during the wet season.
e) Does the wastewater receive chlorine as part of the treatment process? If so, what would be the effect on the landscaping that receives the water?

2. Energy: The ND concludes that since wastewater is pumped to the off-site spray disposal areas that "there would not be a substantial increase in pumping requirements or related energy consumption." A quick review of the topography of the area of the treatment plan and the golf course shows that the course is approximately fifty (50) feet higher in elevation and two miles from the source. That appears to be considerably higher than the off-site disposal fields which would then result in increased energy costs. The report should provide at minimum a calculation of the pumping costs.

3. Archaeology: The report details the known archaeological sites in the vicinity with survey number, locations and finds. In the past, this has been contrary to Planning and Development's policy which ensures to the best of its ability, the confidentiality of the site. I would recommend that the detailed sites be removed from the document as well as any electronic versions that might be posted on the web at this time.

Given the sensitivity of the know sites in the vicinity of the project, we would recommend that P&D's two standard conditions (monitoring and discovery) be added as required mitigation.

4. Cumulative Projects: The report refers to the Santa Maria Pacific (SMP) pipeline project in a couple places. Is it possible that Phase I is the SMP project? Given the significance of this project and the amount of water that is required under full steaming production, and in order to describe the "whole of an action" under CEQA Section 15378(a), we believe that more information should be included on that specific project. At a minimum the report should include, the amount of water allocated to SMP, and what protocol will be followed to determine how much water will be allocated to each project. If there are other receiver sites, existing or proposed, they should be listed along with the volume that is allocated to the specific use.

5. Other Pending Projects: The list of pending projects includes the Orcutt Plaza (Key 25). That site is no longer within the County's jurisdiction and therefore the project identified for the site should not be listed as pending or approved as it is unknown what type of development will be submitted to the City by the property owner.

This concludes our comments on your draft MND. Should you have any questions, please do not hesitate to call me at 925-0951 x240.

Sincerely,

Larry

LAWRENCE W. APPEL, Director
Community Development Department

S:\Community Development\Admin\Larry's Folder\2010 Corresponsence\Wilder-LagunaSan012610.doc

This Response to Comments addresses issues raised in each of the three comment letters. For purposes of organization, comments have been numbered in the right margin of the comment letter, which corresponds to the response numbering below. Copies of the comment letters are attached. Changes to the text of the Initial Study associated with these comments are noted by underlining (new text) and strike-out (deleted text).

Commenter: City of Santa Maria

Date: January 26, 2010

Responses:

1. The District's wastewater treatment plant produces approximately 2.1 million gallons per day of recycled water. The Rancho Maria Golf Course has not requested a specific allotment of recycled water, but has stipulated that recycled water not be used on greens and tees due to the sensitivity of these areas to salinity. The Golf Course would be provided with as much recycled water as needed (when available), typically they use 350,000 gallons per month in the wet season, and 700,000 gallons per month during the remainder of the year. A control system will be installed to maintain desired water levels in the irrigation reservoirs. Chlorine residuals would be low (about 0.2 mg/l) and would not affect landscaping or turfgrass. Note that ultraviolet exposure is used to disinfect the wastewater at the treatment plant, chlorine is added to keep the distribution pipelines free of growth.

2. Currently, most of the recycled water produced by the wastewater treatment plant is sprayed on pasture land, which is up to 80 feet higher in elevation than the treatment plant. Project implementation would result in pumping recycled water to the Rancho Maria Golf Course instead of pasture land, with no substantial increase in energy consumption by the District. Based on preliminary estimates by the project engineer, energy consumption associated with irrigation water pumping at the Golf Course would decrease, primarily due to the reduction in use of the existing well pump. Overall, the project would not result in a substantial increase in energy demand, such that energy impacts are considered less than significant.

3. The description of archeological sites in the Initial Study is very general to prevent collecting by the public, but serve to illustrate the sensitivity of the project area. The Initial Study is consistent with County and State policies, as it does not provide maps or specific locations of archeological sites. The draft MND provides mitigation measures (see page 39), including construction worker training, monitoring and measures to be implemented if archeological resources or human remains are discovered.

4. The proposed project is labeled "Phase 2" because it is the second recycled water distribution project proposed by the Laguna County Sanitation District. The first project (Phase 1) currently serves the Santa Maria Airport property and consumes about 25 percent of the available recycled water. The proposed project would consume about 25 percent, and the Santa Maria Pacific project (Phase 3) would consume about 5 to 10 percent of the recycled water. The Phase 2 project, as proposed, is the whole of the action, with independent utility and no dependence on past or future phases. The proposed project would provide (when available) sufficient recycled water to meet the irrigation needs of the Rancho Maria Golf Course (less greens and tees), or about 150 million gallons per year.

5. Orcutt Plaza (Key Site 25) has been removed from the list of pending or approved projects, since a specific development proposal has not been submitted to the City.

From: Martin Potter [MPOTTER@dfg.ca.gov]
Sent: Thursday, February 11, 2010 9:36 AM
To: Martin Wilder; Matt Ingamells
Cc: Betty Courtney; Natasha Lohmus; Sean Carlson; Andrea Adams
Subject: Recycled Water Distribution Main (Phase 2) SCH 201011018

Mr. Wilder,

This is to follow up on our phone conversation on 2/9/10. The Laguna County Sanitation District proposes to provide recycled wastewater to the Rancho Maria Golf Course via an approximately 2-mile long underground pipeline. The recycled water would be delivered to an existing irrigation pond on the golf course and minor improvements would be made to the existing golf course irrigation system. The project has potential for impacts to listed species California red-legged frog and California tiger salamander, and other special status species associated with aquatic habitats.

The Department will be notified under Sec. 1602 of the Fish and Game Code for the project's impacts to biological resources where the pipeline will cross Orcutt Creek and a tributary. Impacts would be minimized with the mitigation measures listed in the Draft Mitigated Negative Declaration prepared for the project. If a Lake and Streambed Alteration Agreement is required, additional mitigation measures may be required, along with modifications to the project. One modification to the project discussed was to avoid trenching across Orcutt Cr. by attaching the pipeline to the existing bridge along Black Rd. You explained this option was considered but rejected because the bridge is slated for replacement.

You informed me also that consultation with the U.S. Fish and Wildlife Service is under way for this project and a CTS protection and relocation program will be developed should this species be discovered during surveys. You should be aware the Fish and Game Commission issued a Notice of Candidacy and declared the California Tiger Salamander (CTS) a candidate species as defined by Section 2068 of the Fish and Game code, on February 10, 2009. This means that during it's candidacy, which ends February 22, 2010, CTS impacted by this project are afforded all protections under Sec. 2081 of the Fish and Game Code. If the Commission votes to list CTS, consultation must include the Department, and a California Endangered Species Act permit will be required to authorize incidental take of CTS.

Thank you for your candor and your time in this matter.

Sincerely,

Martin Potter

Martin Potter
Environmental Scientist
California Department of Fish and Game
South Coast Region
P.O. Box 1797
Ojai, CA 93024
Phone/Fax (805) 640-3677
email mpotter@dfg.ca.gov

Pursuant to the Governor's Executive Orders S-16-08 and S-13-09, I will not be available on the first, second, and third Fridays of the month.

Commenter: California Department of Fish and Game

Date: February 11, 2010 (e-mail)

Responses:

The e-mail does not provide comments on the adequacy of the Initial Study and MND, but describes the requirements of future permitting activities with the Department and the U.S. Fish and Wildlife Service regarding waters of the State, California red-legged frog and California tiger salamander. Therefore, no response is provided.

The proposed project provides an opportunity for the District and Rancho Maria golf course to address the likely impacts of the ongoing use of the golf course activities on listed species while meeting the objectives of the proposed project. For example, the use of fertilizers, pesticides, and other typical golf course management chemicals at the project site is likely to have adverse effects on amphibians occurring at the site, and the intensive use of rodent control identified in the MND (page 31) is also of cause for concern. We would like to work with the District and the golf course to minimize these ongoing impacts to listed species. The Service previously coordinated with the U.S. Army Corps of Engineers (Corps) and a project proponent for the same area with regard to potential impacts of development to listed species at the project site. We encourage the District to employ a similar level coordination with the Service and the Corps to ensure compliance with the Act for the subject project as well as the ongoing operation of the golf course. 5.

Measures BIO-3 and BIO-4 in the MND are identified as measures that are intended prevent take of California red-legged frogs and California tiger salamanders. The proposed relocation of California tiger salamanders and California red-legged frogs is considered by the Service to constitute take; therefore, an incidental take permit would be required for these activities. 6.
Measure BIO-4 is also characterized in the MND as a listing of measures to prevent take of the federally threatened vernal pool fairy shrimp (*Branchinecta lynchi*); however, all of the measures in BIO-4 address California tiger salamanders only. 7.
All of the pipeline alignment along Dutard and Black Roads and the northeastern half of the golf course property are within designated critical habitat unit 2 for the federally endangered La Graciosa thistle (*Cirsium loncholepis*) (74 Federal Register 56978). Minimization measures for the proposed project should include consideration of potential impacts to La Graciosa thistle and its designated critical habitat. 8.

It is not clear from the MND whether the project would involve a Federal agency whereupon exemptions to the prohibitions against take could be granted through consultation under section 7 of the Act. We encourage the District to clarify as soon as possible the extent of the Corps' jurisdiction over the proposed project. If there is not Federal nexus, there are several options for proceeding with projects that may result in take of listed species. After analyzing the potential effects that the project may have on listed species, and reducing those effects by revising the project description or implementing protection measures such that all take can be avoided, the project proponent may request our concurrence that the project is not likely to result in take. If the project cannot be designed such that all likelihood of take is avoided, the District should complete a habitat conservation plan (HCP) and apply for an incidental take permit pursuant to section 10(a)(1)(B) of the Act. Such a permit would provide the District with an authorization for take of listed species covered by the HCP. The decision to obtain a permit lies with the applicant; however, should the District elect not to obtain an incidental take permit and unauthorized take of listed species occurs, the responsible individual or entity could be liable under the enforcement provisions of the Act. 9.

We appreciate the opportunity to provide comments on the draft Mitigated Negative Declaration for the proposed recycled water distribution pipeline and Rancho Maria golf course irrigation system development and to present our concerns regarding the project's potential effects on the

Martin Wilder

California tiger salamander, California red-legge
We are available to meet with you to discuss this
Act. If you have any questions, please contact A
extension 318.

8. A botanical survey was conducted along the pipeline alignment on May 28, 2009 and La Graciosa thistle was not observed. This species was also not observed during botanical surveys conducted near the golf course for the Rancho Maria Estates Specific Plan EIR (see page 4.4-12 of the EIR). Project-related impacts within the designated critical habitat area would occur along the roadway shoulder and landscaped areas, such that no loss of suitable habitat for La Graciosa thistle would occur.

9. The District has applied to the Corps of Engineers for Section 404 permit to authorize pipeline installation within waters of the U.S., and plans to work closely with the Service to implement all reasonable and prudent measures to avoid take of CTS and CRLF.

Santa Barbara County
Air Pollution Control District

February 12, 2010 REC'D 2/19/10

Martin Wilder, District Manager
Laguna County Sanitation District
620 Foster Road
Santa Maria, California 93455

Re: APCD Comments on Draft MND for Recycled Water Distribution Main (Phase 2), 09NGD-00000-00021

Dear Mr. Wilder:

The Air Pollution Control District (APCD) has reviewed the Draft Mitigated Negative Declaration (MND) for the above-referenced project. The Laguna County Sanitation District as lead agency proposes to install a pipeline and associated facilities to supply recycled water to the Rancho Maria Golf Course. The project involves the installation of approximately 10,500 feet of buried 12-inch diameter polyvinyl chloride (PVC) pipe between an existing "T" fitting from the Phase 1 project at the Dutard Road/Black Road intersection and the Rancho Maria Golf Course. The existing well pump continues to feed the existing storage tank, and a new 150,000-gallon storage reservoir will be constructed adjacent to the 18th green. A new pump station would pressurize the new irrigation main line, which would be installed throughout the golf course to provide well water to each tee and green. Based on our telephone conversation on February 11, 2010, the project does not involve modifications to the existing wastewater treatment facility, and the new pump station will consist of electrical pump(s), with no internal combustion (IC) engines.

The proposed project is located in the unincorporated northern Santa Barbara County, within the Santa Maria Valley, southwest of the City of Santa Maria.

APCD staff offers the following comments regarding the Draft MND:

1. **Section 4.3, Air Quality Checklist, Page 19**: Although the air quality discussion section includes an evaluation of greenhouse gas emissions and climate change impacts, the checklist for air quality impacts does not include this potential air quality impact.

2. **Section 4.3, Air Quality, Impact Discussion Item a, Page 20**: The first paragraph of this section introduces an air quality significance threshold for long-term air emissions of 25 pounds per day of ozone precursors (reactive organic compounds, or ROC, and oxides of nitrogen, or NO_X). The text in this section should be updated to reflect all of the CEQA significance thresholds that are included in Santa Barbara County's Environmental Thresholds Manual (for example, 55 pounds per day for NO_X and ROC, and 80 pounds per day for PM_{10} from all project sources, mobile and stationary).

If you have any questions regarding these comments, please feel free to contact me at 961-8838 (email mmp@sbcapcd.org).

Sincerely,

Molly Pearson

Molly Pearson
Air Quality Specialist
Technology and Environmental Assessment Division

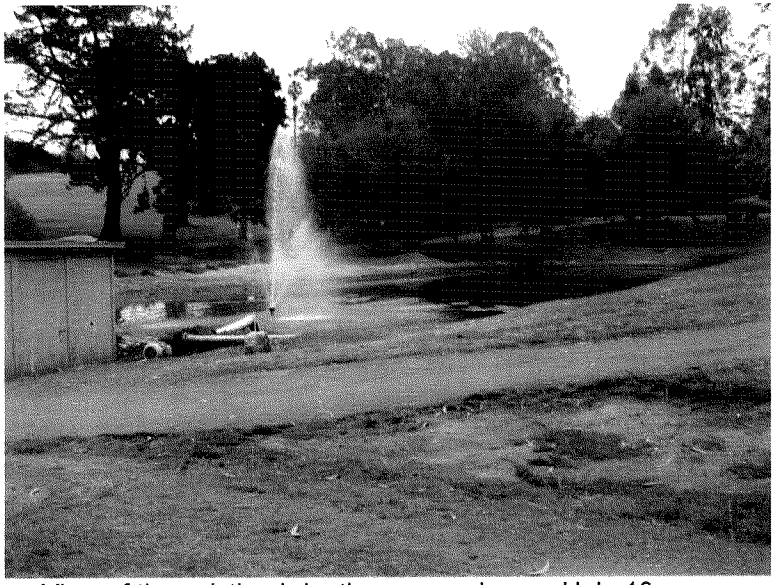
cc: Project File
TEA Chron File

Commenter: Santa Barbara County Air Pollution Control District

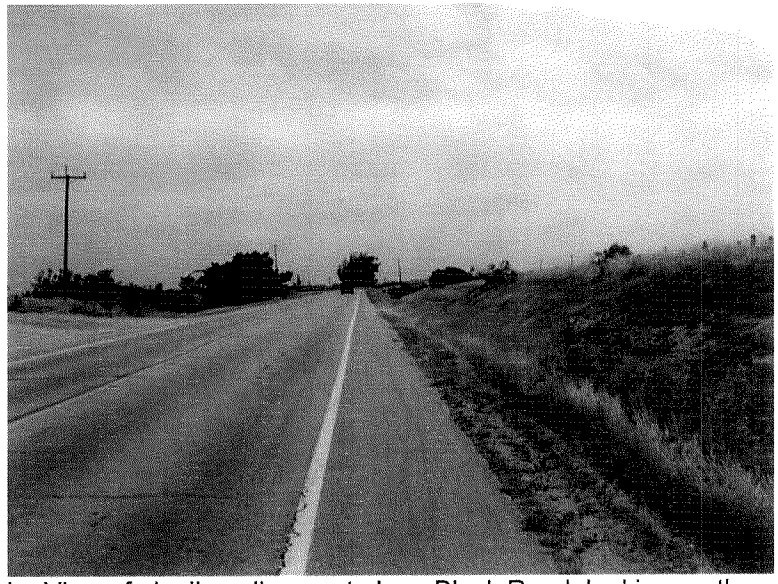
Date: February 12, 2010

Responses:

1. The County's Initial Study checklist appears to have been recently updated to include greenhouse gases. The Initial Study has been revised to include the greenhouse gases portion of the checklist. However, this issue was addressed in the text of the Initial Study and no change in impact significant is proposed.
2. The referenced air quality significance thresholds (55 pounds per day NOx and ROC, 80 pounds per day PM10) are not listed in the County's Environmental Thresholds and Guidelines Manual. In any case, these thresholds are not relevant to construction emissions, which are the only project-related emissions that would occur.



a. View of the existing irrigation reservoir near Hole 10



b. View of pipeline alignment along Black Road, looking north

c. View of pipeline alignment along Black Road, near Orcutt Creek

d. View of pipeline alignment along Highway 1, looking east

SITE PHOTOGRAPHS
FIGURE 5

Final
Rancho Maria Golf Course
Soil Test Results and Plant Survey - February 2010

PREPARED FOR: Martin Wilder/LCSD

PREPARED BY: Kathy Rose/CH2M HILL
Russell Huddleston/CH2MHILL

COPIES: Mary Vorissis/CH2MHILL

REVIEWED BY: Jim Jordahl/CH2M HILL

DATE: May 3, 2010

Introduction

This technical memorandum presents first quarter (Q1) soil test results and tree/shrub survey results for the Rancho Maria Golf Course (RMGC) fairways that were identified in the Sampling and Analysis Plan (CH2M HILL 2010a). Q1 soil test results in conjunction with results obtained during second, third, and fourth quarter soil sampling, will be utilized in golf course management decisions. Recommended adaptive management measures for fairway irrigation and fertilization will be presented in a separate technical memorandum.

Methodology

The first quarter samples were collected on February 8, 2010, by CH2M HILL staff, for baseline soil characterization. Subsequent quarterly sampling will be conducted by others. Soil sampling was conducted at the locations shown on Figure 1, which represent one of three conditions:

- Irrigation water may result in runoff due to presence fairly steep slopes and low permeability soils, and application of a leaching fraction may be difficult (Holes 7 and 13);
- Water may run on from adjacent areas, delivering additional salinity and nutrients (Holes 4 and 16);
- Irrigation water should be transmitted readily through the soil profile, due to good drainage and rapid permeability, as described in the soil survey (this location is meant to serve as a reference where irrigation management should be relatively straightforward; Hole 1).

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Fairway soil samples were collected at two different depths in February 2010:

- 0 to 12 inches
- 12 to 24 inches

For future sampling events, it is recommended that sample depth increments conform to those identified in the Sampling and Analysis Plan (CH2M HILL 2010a). To be representative of overall fairway conditions, three individual samples were collected at each depth, and composited into one representative sample. Samples were analyzed at the following laboratory:

A&L Western Agricultural Laboratories
1311 Woodland Avenue, Suite #1
Modesto, CA 95351
Telephone: (209) 529-4080
Fax: (209) 529-4736

On the Soil Sample Information Sheet, the following tests were requested:

- **S10C**: Organic Matter, Estimated Nitrogen Release, Phosphorus (Weak Bray and Sodium Bicarbonate-P), Extractable Cations (Potassium. Magnesium, Calcium, Sodium), Hydrogen, Sulfate-S, pH, Cation Exchange Capacity and percent cation saturation (computed), Nitrate-Nitrogen, Zinc, Manganese, Iron, Copper and Boron. Using a saturated soil extract: Saturation Percentage, Soluble Salts, Sodium, Calcium, Magnesium, Chloride, Boron, Carbonate, Bicarbonate, pH, SAR and ESP
- Kjeldahl-Nitrogen (the analytical laboratory discouraged the analysis of Kjeldahl-N in the future as results are difficult to interpret)

Q1 Soil Test Results

Results of the February 2010 sampling are provided graphically in Attachment 1, and lab data sheets are located in Attachment 2. Data from subsequent sampling events should be compiled and presented similarly.

Constituent levels in soils were rated by the laboratory as ranging from very low (VL) to very high (VH). The rating summary is provided in Table 2 (and Appendix 2), and general guidelines for interpreting soil test results were provided in the Sampling and Analysis Plan (CH2M HILL, 2010a). Additionally, Attachment 2 (Lab Data Sheets) includes fertilizer and soil amendment recommendations from the laboratory agronomist, based on soil test results. (Note that management decisions should be made based on recommendations for the surface soils only, although laboratory recommendations were made for all samples).

Based on the soil test results in February 2010, the following preliminary observations are made:

- Many nutrient constituents (e.g., nitrogen), are present at low levels in fairway soils and turfgrass may respond favorably to irrigation with recycled water that contains these nutrient elements. Some constituents (e.g., potassium, manganese) may need

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TABLE 2
Constituent Levels in Fairway Soils at RMGC in February 2010[1]

Constituent	Hole Number									
	Reference		Receives Run-on				Contributes Run-off			
	1		4		16		7		13	
Depth (inches)	*0-12*	*12-24*	*0-12*	*12-24*	*0-12*	*12-24*	*0-12*	*12-24*	*0-12*	*12-24*
Organic Matter	L	L	L	L	L	L	L	L	L	L
Electrical conductivity (dS/m)	0.4	0.4	0.6	1.1	1.8	1.9	2.4	3.7	2.3	2.1
SAR (unitless)	1.6	2.5	2.7	4.1	4.8	4.8	7.3	9.4	3.8	5.6
pH (units)	7.4	7.7	7.9	8.1	7.6	7.5	7.8	7.2	7.9	7.8
Phosphorus	M	L	M	L	H	H	M	M	M	M
Potassium	M		L	M	H	L	L	L	L	L
Magnesium	VH		VH	L	VH	VH	H	VH	VH	VH
Calcium	M		M	VH	L	L	M	L	M	L
Sodium	L		H	M	H	VH	H	VH	H	VH
Nitrate-N	L	L	L	H	L	L	L	L	L	VL
Sulfate-S	L	L	H	L	VH	VH	VH	VH	VH	VH
Zinc	M	L	L	VH	VL	VL	L	VL	VL	VL
Manganese	VL	VL	VL	VL	M	M	VL	VL	L	VL
Iron	L	L	H	M	M	VH	M	M	M	M
Copper	L	M	L	M	L	L	M	L	L	L
Boron	H	M	H	L	M	L	H	M	H	M

Note: Laboratory results did not include ratings for some constituents at the 12-24 inch depth for Hole 1.

[1]Conditions represent period of time when well water was used for irrigation; however no irrigation likely occurs during winter months when soils were sampled (February 2010)

to be supplied through supplemental fertilization if not present at adequate levels in recycled water.

- Some constituents, such as sodium, are present at high or very high levels in fairway soils and may increase further with irrigation using recycled water. Management of irrigation and application of soil amendments may need to be tailored to limit adverse soil and turfgrass effects related to these constituents. Specifically, Hole 7 had high sodium levels at the 0 to 12 inch depth while soil calcium concentrations were rated as medium; this fairway may benefit from applications of gypsum to ensure that good infiltration rate is maintained. Recommendations for management of sodium hazard are provided in CH2MHILL (2010b).

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- Salinity is above the tolerance threshold level for sensitive plants on some fairways, such as on Holes 7 and 13 where soils have low permeability, slopes are relatively steep, and run-off is likely. These soils may need careful management to ensure an adequate leaching fraction is applied to flush excess salts from the plant root zone. Salinity was low on Fairway 1 (reference site), which had coarser textured soils and greater permeability.

Results will be reviewed after sampling has been completed for 2010, and it appears likely that irrigation and fertilizer management will need to be modified in order to avoid potential adverse turfgrass effects and to maximize the inherent benefits of using recycled water.

Baseline Fairway Tree and Shrub Survey

Limited tree surveys were performed along sections of four fairways at the Rancho Maria Golf Course on February 8, 2010. These survey areas were located in the same vicinity as the surface soil sample collection areas as shown on Figure 1. The primary objectives of the tree survey were to identity the tree species along the fairways, note the general size and condition of the trees, and assess the potential for adverse affects resulting from the use of recycled water (primarily overspray from sprinkler irrigation). In selected areas all tree species were identified and mapped using a Trimble® Geo-XT Global Positioning System (Figure 1).

Tree Condition was visually assessed and assigned a value of Good, Moderate or Poor based on the following definitions:

- **Good:** Minimal evidence of stress; only minor leaf loss and/or discoloration; no major broken limbs or structural defects; overall canopy appears healthy and normal.
- **Moderate:** Clear evidence of some degree of stress; moderate leaf loss and/or discoloration; deformed leaves; evidence of parasites (e.g. leaf galls); some broken, cut limbs or dead limbs resulting in an uneven canopy structure; generally health appearance of overall canopy, but less robust and even structured.
- **Poor:** Widespread evidence of stress; extensive leaf loss and/or discoloration, many deformed leaves; multiple broken or dead branches resulting in sickly looking, often uneven canopy.

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The diameter (at breast height), canopy width and tree height were all visually estimated to provide a general idea of size and shape of the tree.

A total of 144 trees were included in the survey. A total of 16 different species were identified, but three species: lemon scented eucalyptus (*Eucalyptus citriodora*), Italian stone pine (*Pinus pinea*) and Monterey pine (*Pinus radiata*) accounted for 64 percent of the trees along the fairways. Most of the trees (85 percent) appeared to be in good (52 percent) to moderate (33 percent) condition. Only 15 percent of the trees included in the survey were considered to be in poor condition. Table 3 provides a summary of the trees observed in the survey, Appendix 3 provides more thorough baseline data for species and their relative tolerance to salinity (for species where data are available). The following sections describe the observations at each of the fairway locations included in the survey.

TABLE 3
Summary of February 2010 Fairway Tree/Shrub Species and Performance
Complete survey results are located in Attachment 3

Hole Number	Tree/Shrub Species	Total Number of Individuals	Number of Individuals (Percent)		
			Good	Moderate	Poor
1	Monterey pine	8	4 (50)	2 (25)	2 (25)
	Monterey cypress	2	1 (50)	1 (50)	
	Leyland Cypress	1	1 (100)		
	Italian stone pine	2	1 (50)	1 (50)	
	Red ironbark	2		1 (50)	1 (50)
	Torrey pine	1		1 (100)	
	Palm	1	1 (100)		
	Coast live oak	3	3 (100)		
1	**TOTAL**	**20**	**11 (55)**	**6 (30)**	**3 (15)**
4	Italian stone pine	11	5 (45)	4 (36)	2 (18)
	Monterey pine	3	2 (67)		1 (33)
	Lemon eucalyptus	3	1 (33)	2 (67)	
	Coast live oak	1	1 (100)		
	Leyland cypress	1	1 (100)		
4	**TOTAL**	**19**	**10 (53)**	**6 (32)**	**3 (16)**
16	Leyland cypress	3	3 (100)		
	Lemon eucalyptus	4			4 (100)

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TABLE 3
Summary of February 2010 Fairway Tree/Shrub Species and Performance
Complete survey results are located in Attachment 3

Hole Number	Tree/Shrub Species	Total Number of Individuals	Number of Individuals (Percent)		
			Good	Moderate	Poor
	Monterey cypress	4	2 (50)	2 (50)	
	Coast redwood	7		4 (57)	3 (43)
	Monterey pine	2	1 (50)	1 (50)	
	Italian stone pine	3	2 (67)	1 (33)	
	Myoporum	1		1 (100)	
16	**TOTAL**	**24**	**8 (33)**	**9 (38)**	**7 (29)**
7	Ash	5	2 (40)	2 (40)	1 (20)
	Peppermint eucalyptus	5	2 (40)	3 (60)	
	Monterey pine	7	3 (43)	3 (43)	1 (14)
	Palm	1	1 (100)		
	Italian stone pine	7	2 (29)	3 (43)	2 (29)
	Sycamore	1		N/A	
	Lemon eucalyptus	17	6 (35)	10 (59)	1 (6)
	Monterey cypress	1	1 (100)		
	Torrey pine	2	2 (100)		
7	**TOTAL**	**46**	**19 (41)**	**21 (46)**	**5 (11)**
13	Red ironbark	1	1 (100)		
	Leyland cypress	2	2 (100)		
	Peppermint eucalyptus	2	2 (100)		
	Monterey pine	6	5 (83)		1 (17)
	Italian stone pine	7	7 (100)		
	Ash	2	1 (50)	1 (50)	
	Lemon eucalyptus	10	4 (40)	4 (40)	2 (20)
	Willow	2	1 (50)	1 (50)	
	Coast live oak	1	1 (100)		

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TABLE 3
Summary of February 2010 Fairway Tree/Shrub Species and Performance
Complete survey results are located in Attachment 3

Hole Number	Tree/Shrub Species	Total Number of Individuals	Number of Individuals (Percent)		
			Good	Moderate	Poor
	Myoporum	1			1 (100)
	Torrey pine	1	1 (100)		
	Palm	1	1 (100)		
13	**TOTAL**	**36**	**26 (72)**	**6 (17)**	**4 (11)**

Hole 1

Several large mature trees are present along the fairway along Hole 1 where they tend to occur in widely spaced clusters. Large Monterey pines are the most common trees in this area along with some large low, generally large rounded coast live oak (*Quercus agrifolia*) and Monterey cypress (*Cupressus macrocarpa*) trees. Only two rediron bark eucalyptus (*Eucalyptus sideroxylon*) were noted in this area. Two of the Monterey pines in this area were in poor condition as evidenced by extensive needle loss and discoloration, one of the trees appears to be nearly dead. One of the rediron bark eucalyptus trees also had a number of dead branches and was considered to be in poor condition. No small trees were noted in this area, however, the coast live oak and Monterey cypress trees have relatively low, rounded canopies that may receive some irrigation water overspray.

Hole 4

The fairway in this area has large Italian stone pine with scattered large lemon scented eucalyptus and Monterey pine. One of the Italian stone pines in this area was nearly dead with minimal live, green foliage remaining; another Italian stone pine had extensively cut branches. Based on conversations with the golf course staff this damage may be the result of a pine beetle. One lemon scented eucalyptus was also considered in poor condition due to several dead branches. One relatively small Leyland cypress (x *Cupressocyparis leylandii*) is present in this area that is likely to receive irrigation water overspray. Leyland cypress are reported to be moderately tolerant of salinity in both soil and overspray (U.S. Forest Service Fact Sheet 1994). Small Leyland cypress trees, therefore, may not be affected by salinity in sprinkler overspray, but regular monitoring should be conducted to confirm this.

Hole 7

Lemon scented eucalyptus is the most common tree in this area followed by an even mix of Italian stone and Monterey Pines. Most of these are large trees in moderate to good condition. Around 10 percent of the trees in this area were considered to be in poor condition, largely due to numerous broken, dead or cut branches. A few small trees including two Torrey pines (*Pinus torreyana*), a Monterey cypress and a lemon scented eucalyptus are present along the fairway. These smaller trees are most likely to receive irrigation overspray. Salinity tolerance thresholds for Torrey pine Monterey cypress were not found in the literature; lemon scented eucalyptus are reported to have low tolerance to

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soil salinity (threshold <4 dS/m; Food and Agriculture Organization [FAO] Website 2010), but no information was found on tolerance to salt in aerosol. Since there is uncertainty associated with tolerance to salinity in irrigation overspray for these species, small trees should be regularly monitored.

Hole 13

Landscape trees in this area are generally similar to those found around Hole 7, with lemon scented eucalyptus the most common species, followed by a nearly even mixture of Italian stone pine and Monterey pine. The southwest part of the fairway in this area abuts what appears to be native woodland and chaparral habitat consisting of area of coast live oak and willow (*Salix* spp.) trees intermixed with patches of coyote brush (*Baccharis pilularis*) scrub. Four trees in this area (just over 10 percent) were considered to be in poor condition. Extensive leaf deformation resulting from a leaf parasite was noted on two of the lemon scented eucalyptus, leaf curl was also noted the one Myoporum (*Myoporum laetum*) that was noted in this area. One Monterey pine was considered to be in poor condition as a result of numerous dead branches. A pale whitish film was noted on the lower leaves of the coast live oak tree along the western edge of the fairway, but the tree was otherwise considered in good condition.

Hole 16

This was the only area included in the tree survey with Coast Redwoods (*Sequoia sempervirens*), which are the most common tree in the western part of the fairway for Hole 16. Other trees in this area include lemon scented eucalyptus and Italian stone pine. Relative to other areas of the golf course included in the tree survey many of the trees in this area were in poor condition (30 percent). Most of the eucalyptus had a number of dead limbs and extensive leaf loss and several of the redwoods had discolored leaves and generally poor vigor. It is possible that trees in this area are stressed as a result of poor drainage resulting in extensive soil saturation. Three newly planted Leyland cypress trees are located along the edges of the fairway in this area. These young trees as well as the redwoods and cypress are generally short and the lower foliage may receive irrigation water overspray.

Conclusions

Q1 soil test results reveal differences in chemical and physical properties among fairway soil types at the RMGC. In particular, soil salinity (EC_e) is greatest in soils that are on slopes and have relatively low permeability and fine textures; this is in contrast to fairway soils on Hole 1, which have low salinity, sandy soils and rapid permeability. On certain fairways, such as Hole 7, it appears likely that periodic flushing may be required to remove excess salts from the turfgrass root zone. Additionally, Q1 soil testing revealed that soils generally had poor nutrient status during February; however, nitrogen levels tend to have high temporal variability, and concentrations will likely increase during the spring when microbial activity is higher, and RMGC typically applies a slow release fertilizer in spring as well. Additional soil testing during 2010 will show seasonal variation that would influence management decisions.

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Most trees lining golf course fairways are in good condition. However, no coast redwood individuals are in good condition, and this species is known to be sensitive or moderately sensitive to salinity (see Attachment 3 for salinity thresholds for most of the observed tree species). While the cause of its relatively poor performance is not known, this tree species will need to be monitored closely following transition to a recycled water source, since performance may be further reduced if tree foliage intercepts overspray or soil salinity levels exceed tolerance thresholds. On the other hand, salt-tolerant species such as coast live oak appear to perform well at the RMGC, and these species should continue to perform well when fairways are irrigated with recycled water.

References

CH2MHILL. 2010a. Rancho Maria Golf Course Soil Sampling and Analysis Plan

CH2MHILL. 2010b. Rancho Maria Golf Course Adaptive Management Plan

FAO Website, http://ecocrop.fao.org/ecocrop/srv/en/dataSheet?id=5842; accessed May 2, 2010

U.S. Forest Service. 1994. x Cupressocyparis leylandii 'Naylor's Blue' Leyland Cypress. Fact Sheet ST-673.

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Attachment 1

Q1 Soil Test Graphical Results – February 2010

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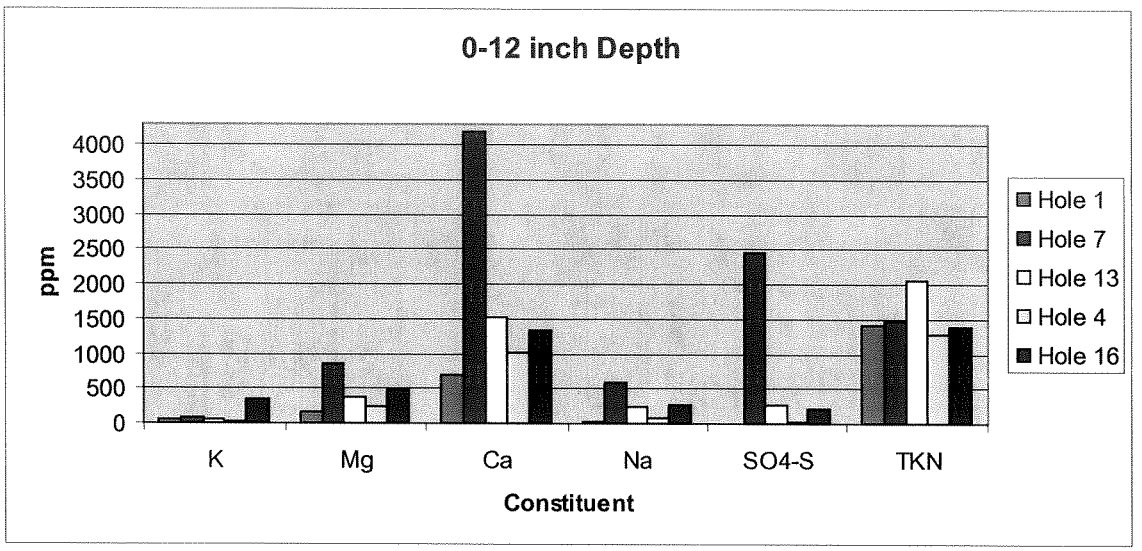

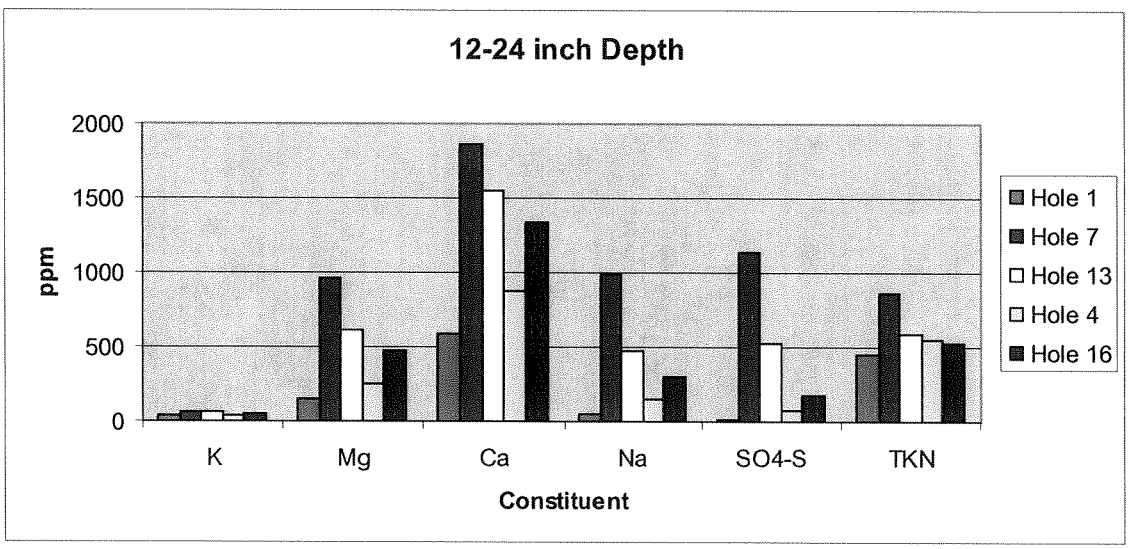

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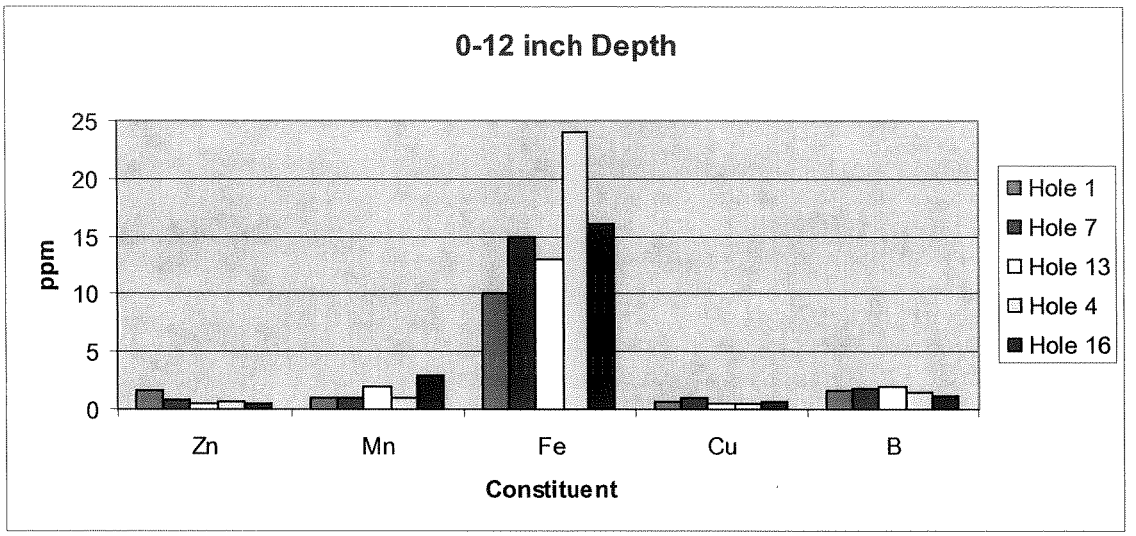

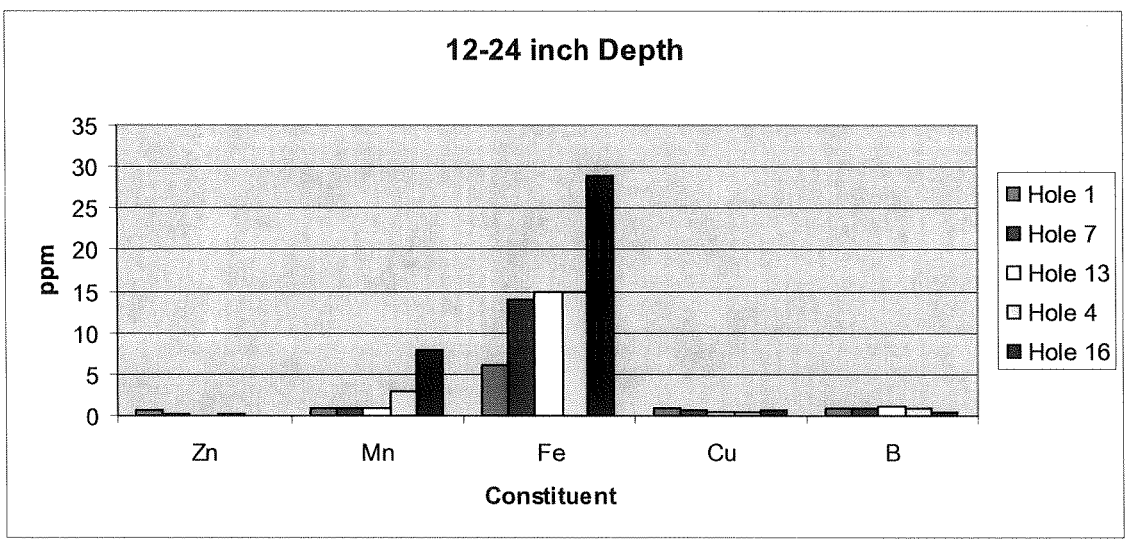

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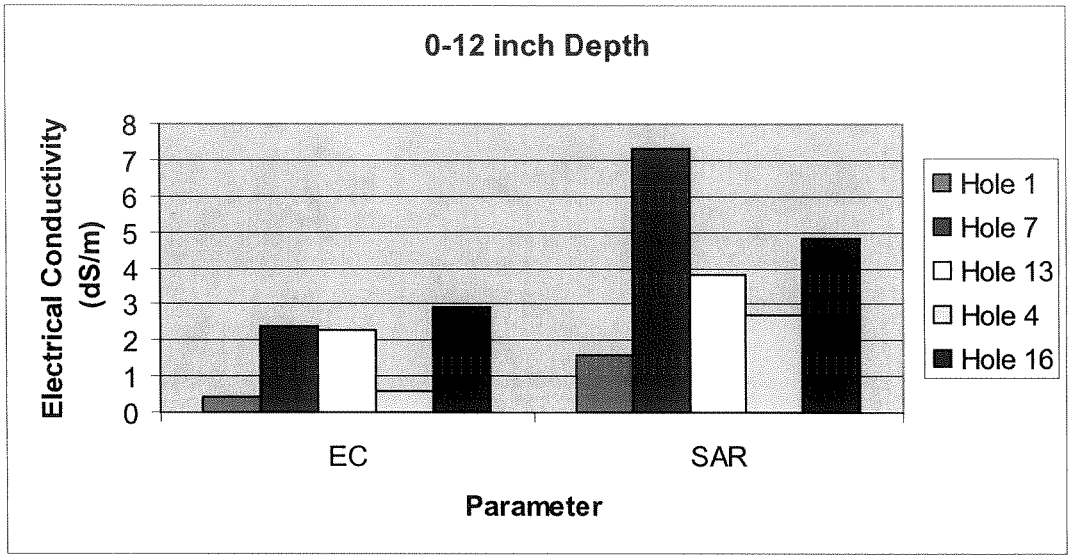

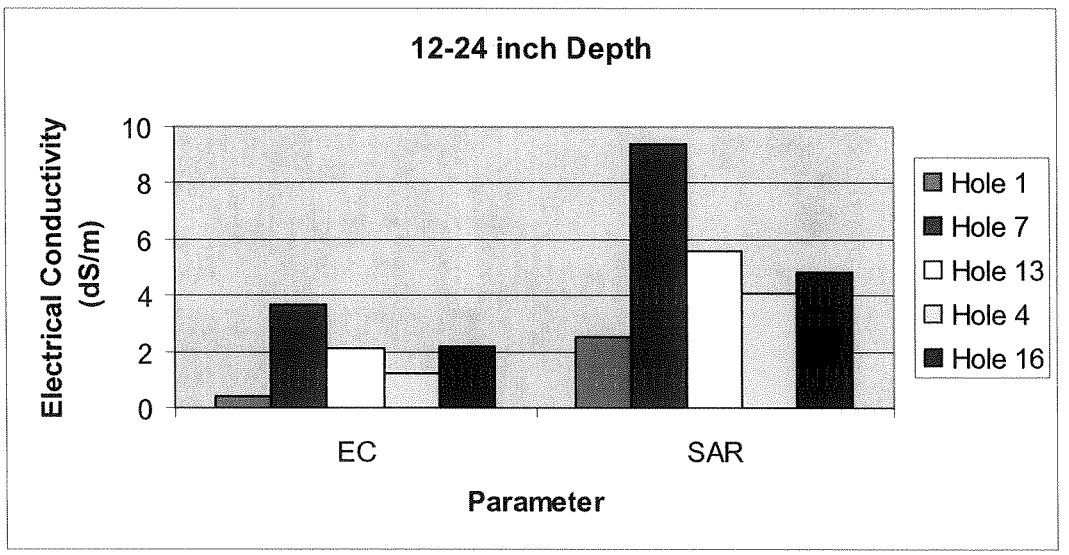

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Attachment 2

Laboratory Data Sheets – Q1 Soil Testing, February 2010

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ATTACHMENT 2-A. SAMPLE IDENTIFICATION REFERENCE

Sample ID	Hole Number	Sample Depth (inches)
GC-1	1	0-12
GC-2	1	12-24
GC-3	4	0-12
GC-4	4	12-24
GC-5	7	0-12
GC-6	7	12-24
GC-7	13	0-12
GC-8	13	12-24
GC-9	16	0-12
GC-10	16	12-24
GC-11	16	24-36

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A & L WESTERN AGRICULTURAL LABORATORIES

1311 WOODLAND AVE #1 • MODESTO, CALIFORNIA 95351 • (209) 529-4080 • FAX (209) 529-4736

REPORT NUMBER: 10-048-016 **CLIENT:** 9999-D

SUBMITTED BY: KATHY ROSE-CH2M HILL

SEND TO: CO OF SANTA BARBARA P W DEPT
620 WEST FOSTER ROAD
SANTA MARIA, CA 93455-

GROWER: LAGUNA CO SANITAION DI

DATE OF REPORT: 02/25/10

SOIL FERTILITY GUIDELINES

RATE: /1000 sq

Sample ID	Lab Number	Crop	SOIL AMENDMENTS				Nitrogen N	Phosphate P_2O_5	Potash K_2O	Magnesium Mg	Sulfur SO_4-S	Zinc Zn	Manganese Mn	Iron Fe	Copper Cu	Boron B
			Dolomite	Lime	Gypsum	Elemental Sulfur										
GC-1	57417	TURF					3.4	2.0	5.5		0.6		*	*		
GC-2	57418	TURF				20	3.7	2.5	6.0			*	*	*		
GC-3	57419	TURF				25	3.4	2.0	6.0			*	*			
GC-4	57420	TURF			40	30	3.5	2.0	6.0			*		*	*	
GC-5	57421	TURF				25	3.4	2.5	5.0			*	*	*		

COMMENTS

SODIUM: If a concern, broadcast amendment and incorporate if possible. Follow with frequent/heavy watering (but check water quality first) to aid in the amending; preferably before fertilizing. MUCH OF the "exchangeable" sodium may be "soluble" where high levels of soluble salts exist. This fraction can be leached out (with good quality water) WITHOUT the addition of amendments. SOLUBLE SALTS: Levels above 3.0 mmhos/cm (dS/m) need to be reduced before further fertilizing, if aiming for 100% growth potential. Even levels above 1.5 mmhos/cm may affect seedling emergence. LOW cation exchange capacity (CEC) of less than 5 meq/100g indicates that close attention needs to be paid to water and nutrient requirements. Try to maintain reasonable organic matter levels. MAINTENANCE: Split the above amount over the year at a time according to local conditions and requirements. Choose a source that best fits this combination.

NOTES:

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Mike Buttress, CPAg
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1311 WOODLAND AVE #1 • MODESTO, CALIFORNIA 95351 • (209) 529-4080 • FAX (209) 529-4736

REPORT NUMBER: 10-048-016 CLIENT: 9999-D

SUBMITTED BY: KATHY ROSE-CH2M HILL

SEND TO: CO OF SANTA BARBARA P W DEPT
620 WEST FOSTER ROAD
SANTA MARIA, CA 93455-

GROWER: LAGUNA CO SANITAION DI

DATE OF REPORT: 02/25/10

SOIL FERTILITY GUIDELINES

RATE: /1000 sq

Sample ID	Lab Number	Crop	SOIL AMENDMENTS				Nitrogen N	Phosphate P_2O_5	Potash K_2O	Magnesium Mg	Sulfur SO_4-S	Zinc Zn	Manganese Mn	Iron Fe	Copper Cu	Boron B
			Dolomite	Lime	Gypsum	Elemental Sulfur										
GC-6	57422	TURF			250		3.5	2.0	5.0			*	*	*		
GC-7	57423	TURF			60	25	3.4	2.5	4.5			*	*	*		
GC-8	57424	TURF			120	25	3.5	2.5	4.5			*	*	*		
GC-9	57425	TURF			70	20	3.4	2.0				*		*		
GC-10	57426	TURF			80	15	3.7	1.0	5.0			*				

COMMENTS

NITROGEN: The above requirements may need to be adjusted according to local conditions. Follow label instructions as controlled-release fertilizers may be applied less frequently.
POTASH: Optimum wear tolerance may be achieved by applying up to 8 lb potash/1000 sq ft per year. The above guidelines may need to be modified if tissue analyses indicate so.
ORGANIC MATTER levels maintained above 2.0 percent will provide an improved soil structure and a more sustained release of nutrients. Follow supplier's instructions where levels are low.
* ACIDIFICATION of high pH soils could improve soil environment. Compare different sources of acidifying materials, but be aware that sulfate-sulfur (as shown on report) has NO acidifying power.
ESTABLISHED TURF: Limit sulfur applications to 5 lb/1,000 sq ft every 5-6 weeks during the active growing season until the desired soil pH is reached. Larger amounts at a time may burn.

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REPORT NUMBER: 10-048-017 **CLIENT:** 9999-D

SUBMITTED BY: KATHY ROSE-CH2M HILL

SEND TO: CO OF SANTA BARBARA P W DEPT
620 WEST FOSTER ROD
SANTA MARIA, CA 93455-

GROWER: LAGUNA CO SANITATION D

DATE OF REPORT: 02/25/10

SOIL FERTILITY GUIDELINES

RATE: /1000 sq

Sample ID	Lab Number	Crop	SOIL AMENDMENTS				Nitrogen N	Phosphate P_2O_5	Potash K_2O	Magnesium Mg	Sulfur SO_4-S	Zinc Zn	Manganese Mn	Iron Fe	Copper Cu	Boron B
			Dolomite	Lime	Gypsum	Elemental Sulfur										
GC-11	57427	TURF			110		3.7	2.0	5.5							

COMMENTS

FULL GUIDELINES CANNOT BE GIVEN as a complete analysis was not run. Consider the "S3C" or graphical S3CG test if problems exist. For now, recommended nitrogen may not need to be exceeded.
SAMPLE SIZE: Please note that providing insufficient soil may lead to problems in the lab. We prefer to have about a pint of soil per sample to run most tests adequately. Thank you.
SODIUM: If a concern, broadcast amendment and incorporate if possible. Follow with frequent/heavy watering (but check water quality first) to aid in the amending; preferably before fertilizing.
NITROGEN: The above requirements may need to be adjusted according to local conditions. Follow label instructions as controlled-release fertilizers may be applied less frequently.
ORGANIC MATTER levels maintained above 2.0 percent will provide an improved soil structure and a more sustained release of nutrients. Follow supplier's instructions where levels are low.

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REPORT NUMBER: 10-048-016

CLIENT NO: 9999-D

SEND TO: CO OF SANTA BARBARA P W DEPT
620 WEST FOSTER ROAD
SANTA MARIA, CA 93455-

SUBMITTED BY: KATHY ROSE-CH2M HILL

GROWER: LAGUNA CO SANITAION DIST

DATE OF REPORT: 02/25/10

SOIL ANALYSIS REPORT

SAMPLE ID	LAB NUMBER	Organic Matter		Phosphorus		Potassium	Magnesium	Calcium	Sodium	pH		Hydrogen	Cation Exchange Capacity	PERCENT CATION SATURATION (COMPUTED)				
		* % Rating	** ENR lbs/A	P1 (Weak Bray) **** * ppm	$NaHCO_3$-P (Olsen Method) **** * ppm	K ***** * ppm	Mg *** * ppm	Ca *** * ppm	Na *** * ppm	Soil pH	Buffer Index	H meq/100g	C.E.C. meq/100g	K %	Mg %	Ca %	H %	Na %
GC-1	57417	1.4L	57	12L	9M	49M	166VH	704M	32L	7.4		0.0	5.1	2.4	26.6	68.3	0.0	2.7
GC-2	57418	0.4L	38	13 *	6L	37	152	584	45	7.7		0.0	4.5	2.1	28.1	65.4	0.0	4.4
GC-3	57419	1.5L	60	4 *	10M	40L	250VH	1021M	91H	7.9		0.0	7.6	1.3	26.9	66.6	0.0	5.2
GC-4	57420	0.6L	42	6 *	10M	36L	247VH	874M	149H	8.1		0.0	7.1	1.3	28.5	61.2	0.0	9.1
GC-5	57421	2.1L	72	5 *	8M	82L	859H	4180M	599H	7.8		0.0	30.7	0.7	23.0	67.9	0.0	8.5

* Weak Bray unreliable at M or H excess lime or pH > 7.5

SAMPLE NUMBER	Nitrogen NO_3-N ppm	Sulfur SO_4-S ppm	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Excess Lime Rating	Soluble Salts mmhos/cm	Chloride Cl ppm		PARTICLE SIZE ANALYSIS			
												SAND %	SILT %	CLAY %	SOIL TEXTURE
GC-1	6L	6L	1.6M	1VL	10L	0.6L	1.6H	L	0.4L						
GC-2	5L	9L	0.6L	1VL	6L	0.9M	0.8M	L	0.4L						
GC-3	6L	27H	0.6L	1VL	24H	0.5L	1.4H	L	0.6L						
GC-4	6L	70VH	0.2VL	3M	15M	0.4L	0.8M	L	1.1M						
GC-5	6L	2468VH	0.8L	1VL	15M	1.0M	1.8H	L	2.4H						

* CODE TO RATING: VERY LOW (VL), LOW (L), MEDIUM (M), HIGH (H), AND VERY HIGH (VH).
** ENR - ESTIMATED NITROGEN RELEASE
*** MULTIPLY THE RESULTS IN ppm BY 2 TO CONVERT TO LBS. PER ACRE OF THE ELEMENTAL FORM
**** MULTIPLY THE RESULTS IN ppm BY 4.6 TO CONVERT TO LBS. PER ACRE P_2O_5
***** MULTIPLY THE RESULTS IN ppm BY 2.4 TO CONVERT TO LBS. PER ACRE K_2O
MOST SOILS WEIGH TWO (2) MILLION POUNDS (DRY WEIGHT) FOR AN ACRE OF SOIL 6-2/3 INCHES DEEP

This report applies only to the sample(s) tested. Samples are retained a maximum of thirty days after testing.

Mike Buttress, CPAg
A & L WESTERN LABORATORIES, INC.

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1311 WOODLAND AVE #1 • MODESTO, CALIFORNIA 95351 • (209) 529-4080 • FAX (209) 529-4736

REPORT NUMBER: 10-048-016

CLIENT NO: 9999-D

SEND TO: CO OF SANTA BARBARA P W DEPT
620 WEST FOSTER ROAD
SANTA MARIA, CA 93455-

SUBMITTED BY: KATHY ROSE-CH2M HILL

GROWER: LAGUNA CO SANITAION DIST

DATE OF REPORT: 02/25/10

SOIL ANALYSIS REPORT

SAMPLE ID	LAB NUMBER	Organic Matter		Phosphorus		Potassium	Magnesium	Calcium	Sodium	pH		Hydrogen	Cation Exchange Capacity	PERCENT CATION SATURATION (COMPUTED)				
		* % Rating	** ENR lbs/A	P1 (Weak Bray) **** * ppm	$NaHCO_3$-P (Olsen Method) **** * ppm	K ***** * ppm	Mg *** * ppm	Ca *** * ppm	Na *** * ppm	Soil pH	Buffer Index	H meq/100g	C.E.C. meq/100g	K %	Mg %	Ca %	H %	Na %
GC-6	57422	1.0L	50	10L	9M	67L	962VH	1859L	988VH	7.2		0.0	21.7	0.8	36.5	42.8	0.0	19.9
GC-7	57423	1.4L	59	9 *	8M	64L	375VH	1512M	237H	7.9		0.0	11.8	1.4	26.1	63.8	0.0	8.7
GC-8	57424	0.5L	40	13 *	8M	65L	614VH	1548L	478VH	7.8		0.0	15.0	1.1	33.6	51.4	0.0	13.8
GC-9	57425	1.8L	65	45 *	19H	345H	480VH	1340L	268H	7.6		0.0	12.7	7.0	31.1	52.7	0.0	9.2
GC-10	57426	0.7L	45	52VH	24VH	56L	481VH	1333L	300VH	7.5		0.0	12.1	1.2	32.8	55.2	0.0	10.8

* Weak Bray unreliable at M or H excess lime or pH > 7.5

SAMPLE NUMBER	Nitrogen NO_3-N ppm	Sulfur SO_4-S ppm	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Excess Lime Rating	Soluble Salts mmhos/cm	Chloride Cl ppm		PARTICLE SIZE ANALYSIS			
												SAND %	SILT %	CLAY %	SOIL TEXTURE
GC-6	5L	1140VH	0.2VL	1VL	14M	0.6L	0.8M	L	3.7H						
GC-7	7L	274VH	0.5VL	2L	12M	0.5L	1.9H	L	2.3H						
GC-8	6L	530VH	0.1VL	1VL	15M	0.5L	1.1M	L	2.1H						
GC-9	5L	205VH	0.5VL	3M	16M	0.7L	1.2M	L	1.8M						
GC-10	4VL	181VH	0.1VL	8M	29VH	0.7L	0.5L	L	1.9M						

* CODE TO RATING: VERY LOW (VL), LOW (L), MEDIUM (M), HIGH (H), AND VERY HIGH (VH).

** ENR - ESTIMATED NITROGEN RELEASE

*** MULTIPLY THE RESULTS IN ppm BY 2 TO CONVERT TO LBS. PER ACRE OF THE ELEMENTAL FORM

**** MULTIPLY THE RESULTS IN ppm BY 4.6 TO CONVERT TO LBS. PER ACRE P_2O_5

***** MULTIPLY THE RESULTS IN ppm BY 2.4 TO CONVERT TO LBS. PER ACRE K_2O

MOST SOILS WEIGH TWO (2) MILLION POUNDS (DRY WEIGHT) FOR AN ACRE OF SOIL 6-2/3 INCHES DEEP

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Mike Buttress, CPAg
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REPORT NUMBER: 10-048-016

CLIENT: 99999

SUBMITTED BY: KATHY ROSE-CH2M HILL

SEND TO: CO OF SANTA BARBARA P W DEPT
620 WEST FOSTER ROAD
SANTA MARIA, CA 93455-

GROWER: LAGUNA CO SANITAION DIST

DATE OF REPORT: 02/23/10

SOIL SALINITY ANALYSIS REPORT

Sample ID	Lab Number	SAR	ESP	Na meq/L	Ca meq/L	Mg meq/L	pH	CO_3 meq/L	HCO_3 meq/L	E.C. dS/m	Cl meq/L	B ppm	Saturation %
GC-1	57417	1.6	1.1	2.0	2.0	1.3	7.4	0.0	2.1	0.4	0.8	0.3	48.3
GC-2	57418	2.5	2.4	3.1	1.6	1.5	7.7	0.0	2.0	0.4	0.6	0.1	26.0
GC-3	57419	2.7	2.6	5.4	5.0	3.3	7.9	0.0	2.9	0.6	3.0	0.2	38.6
GC-4	57420	4.1	4.6	9.2	5.6	4.5	8.1	0.0	2.1	1.1	2.3	0.2	33.7
GC-5	57421	7.3	8.6	38.3	28.9	26.7	7.8	0.0	3.1	2.4	8.2	0.2	48.9
GC-6	57422	9.4	11.2	46.3	23.2	25.4	7.2	0.0	3.5	3.7	12.5	0.1	42.1
GC-7	57423	3.8	4.2	14.9	17.2	13.4	7.9	0.0	2.9	2.3	6.5	0.2	46.2

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REPORT NUMBER: 10-048-016 CLIENT: 99999

SUBMITTED BY: KATHY ROSE-CH2M HILL

SEND TO: CO OF SANTA BARBARA P W DEPT
620 WEST FOSTER ROAD
SANTA MARIA, CA 93455-

GROWER: LAGUNA CO SANITAION DIST

DATE OF REPORT: 02/23/10

SOIL SALINITY ANALYSIS REPORT

Sample ID	Lab Number	SAR	ESP	Na meq/L	Ca meq/L	Mg meq/L	pH	CO_3 meq/L	HCO_3 meq/L	E.C. dS/m	Cl meq/L	B ppm	Saturation %
GC-8	57424	5.6	6.6	25.7	23.2	18.8	7.8	0.0	2.5	2.1	7.5	0.1	35.2
GC-9	57425	4.8	5.5	19.3	16.7	15.8	7.6	0.0	2.9	1.8	5.5	0.2	47.7
GC-10	57426	4.8	5.5	19.1	16.7	14.7	7.5	0.0	2.2	1.9	6.7	0.1	33.9

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REPORT NUMBER: 10-048-017

CLIENT NO: 9999-D

SEND TO: CO OF SANTA BARBARA P W DEPT
620 WEST FOSTER ROD
SANTA MARIA, CA 93455-

SUBMITTED BY: KATHY ROSE-CH2M HILL

GROWER: LAGUNA CO SANITATION DIST

DATE OF REPORT: 02/25/10

SOIL ANALYSIS REPORT

SAMPLE ID	LAB NUMBER	Organic Matter		Phosphorus		Potassium	Magnesium	Calcium	Sodium	pH		Hydrogen	Cation Exchange Capacity	PERCENT CATION SATURATION (COMPUTED)				
		* % Rating	** ENR lbs/A	P1 (Weak Bray) **** * ppm	$NaHCO_3$-P (Olsen Method) **** * ppm	K ***** * ppm	Mg *** * ppm	Ca *** * ppm	Na *** * ppm	Soil pH	Buffer Index	H meq/100g	C.E.C. meq/100g	K %	Mg %	Ca %	H %	Na %
GC-11	57427	0.6L	43	36H	17H	42L	631VH	1386L	437VH	7.2		0.0	14.1	0.8	36.8	49.0	0.0	13.5

SAMPLE NUMBER	Nitrogen NO_3-N ppm	Sulfur SO_4-S ppm	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Excess Lime Rating	Soluble Salts mmhos/cm	Chloride Cl ppm		PARTICLE SIZE ANALYSIS			
												SAND %	SILT %	CLAY %	SOIL TEXTURE
GC-11	4VL	193VH						L	1.5M						

* CODE TO RATING: VERY LOW (VL), LOW (L), MEDIUM (M), HIGH (H), AND VERY HIGH (VH).

** ENR - ESTIMATED NITROGEN RELEASE

*** MULTIPLY THE RESULTS IN ppm BY 2 TO CONVERT TO LBS. PER ACRE OF THE ELEMENTAL FORM

**** MULTIPLY THE RESULTS IN ppm BY 4.6 TO CONVERT TO LBS. PER ACRE P_2O_5

***** MULTIPLY THE RESULTS IN ppm BY 2.4 TO CONVERT TO LBS. PER ACRE K_2O

MOST SOILS WEIGH TWO (2) MILLION POUNDS (DRY WEIGHT) FOR AN ACRE OF SOIL 6-2/3 INCHES DEEP

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Mike Buttress, CPAg
A & L WESTERN LABORATORIES, INC.

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1311 Woodland Avenue, Suite 1 • Modesto, California 95351 • (209) 529-4080

Report No: 10-048-016 **Account No:** 9999

Send to: CO OF SANTA BARBARA P W DEPT
620 WEST FOSTER ROD
SANTA MARIA, CA 93455

Grower: LAGUNA CO SANITATION DIST **Submitted by:** KATHY ROSE-CH2M HILL

Date Received: 02/17/2010
Date Reported: 02/25/2010

SOIL ANALYSIS REPORT

Analyte:		**TKN**
Detection Limit:		**40 mg/kg**
Method Code:		**NAPT S-8.10**
Lab Number:	**Sample ID:**	**mg/kg (ppm)**
57417	GC-1	1406
57418	GC-2	448
57419	GC-3	1274
57420	GC-4	548
57421	GC-5	1469
57422	GC-6	857
57423	GC-7	2056
57424	GC-8	590
57425	GC-9	1380
57426	GC-10	529

A & L Western Agricultural Laboratories

Mike Buttress, CPAg
Agronomist

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Report No: 10-048-017

Account No: 9999

Send to: CO OF SANTA BARBARA P W DEPT
620 WEST FOSTER ROD
SANTA MARIA, CA 93455

Grower: LAGUNA CO SANITATION DIST

Submitted by: KATHY ROSE-CH2M HILL

Date Received: 02/17/2010
Date Reported: 02/25/2010

SOIL ANALYSIS REPORT

Analyte:		**TKN**
Detection Limit:		**40 mg/kg**
Method Code:		**NAPT S-8.10**
Lab Number:	**Sample ID:**	**mg/kg (ppm)**
57427	GC-11	555

A & L Western Agricultural Laboratories

Mike Buttress, CPAg
Agronomist

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Attachment 3

Baseline Tree and Shrub Survey

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APPENDIX 3
RMGC Baseline Tree and Shrub Survey – February 2010

Tree Species	Hole	Salt Tolerance[1]		Condition	Diameter	Canopy	Height
		Spray	*Soil*				
Ash (*Fraxinus* sp.)	7	M	M	Moderate	25	30	30
Ash (*Fraxinus* sp.)	7	M	M	Poor	18	15	30
Peppermint Eucalyptus (*Eucalyptus Nicholii*)	7			Moderate	24	30	30
Ash (Fraxinus sp.)	7	M	M	Moderate	24	30	30
Ash (Fraxinus sp.)	7	M	M	Good	36	50	50
Monterey Pine (*Pinus radiata*)	7			Poor	36	50	35
Sycamore (*Platanus racemosa*)	7			N/A	18	25	25
Monterey Pine (*Pinus radiata*)	7			Moderate	6	10	10
Italian Stone Pine (*Pinus pinea*)	7		T	Good	30	30	30
Monterey Pine (*Pinus radiata*)	7			Good	35	35	35
Italian Stone Pine (*Pinus pinea*)	7		T	Poor	36	30	30
Palm (*Washingtonia filifera*)	7			Good	28	65	
Monterey Pine (*Pinus radiata*)	7			Good	50	100	100
Peppermint Eucalyptus (*Eucalyptus Nicholii*)	7			Good	30	65	60
Italian Stone Pine (*Pinus pinea*)	7		T	Moderate	50	60	50
Lemon scented eucalyptus (*Eucalyptus citriodora*)[3]	7		S	Moderate	30	30	50
Peppermint Eucalyptus (*Eucalyptus Nicholii*)	7			Good	12	35	30
Italian Stone Pine (*Pinus pinea*)	7		T	Good	30	50	35
Monterey Cypress (*Cupressus macrocarpa*)	7			Good	6	8	10
Italian Stone Pine (*Pinus pinea*)	7		T	Poor	18	20	20
Lemon scented eucalyptus (*Eucalyptus citriodora*)	7		S	Poor	20	20	50
Lemon scented eucalyptus (*Eucalyptus citriodora*)	7		S	Good	40	65	60
Torrey Pine (*Pinus torreyana*)	7			Good	5	8	25
Lemon scented eucalyptus (*Eucalyptus citriodora*)	7		S	Moderate	50	50	45
Torrey Pine (*Pinus torreyana*)	7			Good	3	10	5
Lemon scented eucalyptus	7		S	Moderate	35	45	45

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APPENDIX 3
RMGC Baseline Tree and Shrub Survey – February 2010

Tree Species	Hole	Salt Tolerance[1]		Condition	Diameter	Canopy	Height
		Spray	*Soil*				
(*Eucalyptus citriodora*)							
Lemon scented eucalyptus (*Eucalyptus citriodora*)	7		S	Good	10	20	25
Lemon scented eucalyptus (*Eucalyptus citriodora*)	7		S	Good	28	50	50
Italian Stone Pine (*Pinus pinea*)	7		T	Moderate	30	35	30
Lemon scented eucalyptus (*Eucalyptus citriodora*)	7		S	Moderate	24	25	30
Italian Stone Pine (*Pinus pinea*)	7		T	Moderate	30	25	30
Lemon scented eucalyptus (*Eucalyptus citriodora*)	7		S	Moderate	24	50	50
Lemon scented eucalyptus (*Eucalyptus citriodora*)	7		S	Moderate	24	35	50
Lemon scented eucalyptus (*Eucalyptus citriodora*)	7		S	Moderate	30	25	40
Peppermint Eucalyptus (*Eucalyptus Nicholii*)	7			Moderate	50	35	50
Peppermint Eucalyptus (*Eucalyptus Nicholii*)	7			Moderate	30	25	50
Lemon scented eucalyptus (*Eucalyptus citriodora*)	7		S	Moderate	4	5	12
Lemon scented eucalyptus (*Eucalyptus citriodora*)	7		S	Moderate	15	15	25
Lemon scented eucalyptus (*Eucalyptus citriodora*)	7		S	Moderate	18	25	45
Monterey Pine (*Pinus radiata*)	7			Good	30	45	50
Monterey Pine (*Pinus radiata*)	7			Moderate	28	20	30
Monterey Pine (*Pinus radiata*)	7			Moderate	36	40	50
Lemon scented eucalyptus (*Eucalyptus citriodora*)	7		S	Good	10	30	25
Lemon scented eucalyptus (*Eucalyptus citriodora*)	7		S	Good	15	25	30
Lemon scented eucalyptus (*Eucalyptus citriodora*)	7		S	Good	10	15	30
Ash (*Fraxinus* sp.)	7	M	M	Good	50	50	50
Red Ironbark (*Eucalyptus sideroxylon*)	13			Good	20	25	25

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APPENDIX 3
RMGC Baseline Tree and Shrub Survey – February 2010

Tree Species	Hole	Salt Tolerance[1]		Condition	Diameter	Canopy	Height
		Spray	*Soil*				
Leyland Cypress [2] (x *Cupressocyparis leylandii*)	13	M	M	Good	4	5	10
Peppermint Eucalyptus (*Eucalyptus Nicholii*)	13			Good	20	25	30
Monterey Pine (*Pinus radiata*)	13			Good	30	25	35
Lemon scented eucalyptus (*Eucalyptus citriodora*)	13		S	Good	50	50	50
Monterey Pine (*Pinus radiata*)	13			Good	36	35	40
Italian Stone Pine (*Pinus pinea*)	13		T	Good	25	30	1
Italian Stone Pine (*Pinus pinea*)	13		T	Good	30	30	30
Ash (*Fraxinus* sp.)	13	M	M	Moderate	36	30	40
Ash (*Fraxinus* sp.)	13	M	M	Good	36	30	35
Lemon scented eucalyptus (*Eucalyptus citriodora*)	13		S	Moderate	20	25	35
Willow (*Salix* sp.)	13			Moderate	8	15	25
Myoporum (*Myoporum laetum*)	13		T	Poor	5	10	15
Coast Live oak (*Quercus agrifolia*)	13	HT	T	Good			
Peppermint Eucalyptus (*Eucalyptus Nicholii*)	13			Good	36	35	50
Willow (*Salix* sp.)	13			Good	10	25	25
Lemon scented eucalyptus (*Eucalyptus citriodora*)	13		S	Good	24	25	25
Leyland Cypress (x *Cupressocyparis leylandii*)	13	M	M	Good	3	5	12
Monterey Pine (*Pinus radiata*)	13			Poor	24	20	30
Italian Stone Pine (*Pinus pinea*)	13		T	Good	30	30	40
Italian Stone Pine (*Pinus pinea*)	13		T	Good	36	30	40
Lemon scented eucalyptus (*Eucalyptus citriodora*)	13		S	Poor	12	25	35
Lemon scented eucalyptus (*Eucalyptus citriodora*)	13		S	Poor	10	20	25
Lemon scented eucalyptus (*Eucalyptus citriodora*)	13		S	Moderate	12	30	45
Lemon scented eucalyptus (*Eucalyptus citriodora*)	13		S	Moderate	10	25	30

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APPENDIX 3
RMGC Baseline Tree and Shrub Survey – February 2010

Tree Species	Hole	Salt Tolerance[1]		Condition	Diameter	Canopy	Height
		Spray	*Soil*				
Italian Stone Pine (*Pinus pinea*)	13		T	Good	36	40	60
Italian Stone Pine (*Pinus pinea*)	13		T	Good	30	45	60
Lemon scented eucalyptus (*Eucalyptus citriodora*)	13		S	Moderate	10	25	30
Italian Stone Pine (*Pinus pinea*)	13		T	Good	40	30	50
Monterey Pine (*Pinus radiata*)	13			Good	36	25	40
Lemon scented eucalyptus (*Eucalyptus citriodora*)	13		S	Good	20	25	30
Monterey Pine (*Pinus radiata*)	13			Good	36	50	50
Lemon scented eucalyptus (*Eucalyptus citriodora*)	13		S	Good	45	50	60
Torrey Pine (*Pinus torreyana*)	13			Good	36	30	50
Palm (*Washingtonia filifera*)	13			Good	20	60	
Monterey Pine (*Pinus radiata*)	13			Good	40	50	60
Leyland Cypress (x *Cupressocyparis leylandii*)	16	M	M	Good	1	5	7
Leyland Cypress (x *Cupressocyparis leylandii*)	16	M	M	Good	2	5	7
Lemon scented eucalyptus (*Eucalyptus citriodora*)	16		S	Poor	4	5	15
Lemon scented eucalyptus (*Eucalyptus citriodora*)	16		S	Poor	8	8	18
Lemon scented eucalyptus (*Eucalyptus citriodora*)	16		S	Poor	5	5	18
Monterey Cypress (*Cupressus macrocarpa*)	16			Moderate	20	20	30
Monterey Pine (*Pinus radiata*)	16			Good	7	10	15
Coast Redwood (*Sequoia sempervirens*)	16	S or M	S or M	Moderate	16	12	20
Monterey Cypress (*Cupressus macrocarpa*)	16			Moderate	16	20	25
Leyland Cypress (x *Cupressocyparis leylandii*)	16	M	M	Good	1	4	5
Coast Redwood (*Sequoia sempervirens*)	16	S or M	S or M	Poor	10	10	25
Coast Redwood (*Sequoia sempervirens*)	16	S or M	S or M	Poor	12	12	30

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APPENDIX 3
RMGC Baseline Tree and Shrub Survey – February 2010

Tree Species	Hole	Salt Tolerance[1]		Condition	Diameter	Canopy	Height
		Spray	*Soil*				
Italian Stone Pine (*Pinus pinea*)	16		T	Good	30	25	40
Monterey Pine (*Pinus radiata*)	16			Moderate	30	25	35
Italian Stone Pine (*Pinus pinea*)	16		T	Moderate	24	20	35
Italian Stone Pine (*Pinus pinea*)	16		T	Good	26	30	45
Coast Redwood (*Sequoia sempervirens*)	16	S or M	S or M	Moderate	12	15	25
Lemon scented eucalyptus (*Eucalyptus citriodora*)	16		S	Poor	12	10	25
Coast Redwood (*Sequoia sempervirens*)	16	S or M	S or M	Moderate	14	15	25
Monterey Cypress (*Cupressus macrocarpa*)	16			Good	20	25	25
Coast Redwood (*Sequoia sempervirens*)	16	S or M	S or M	Moderate	6	8	12
Coast Redwood (*Sequoia sempervirens*)	16	S or M	S or M	Poor	6	10	18
Monterey Cypress (*Cupressus macrocarpa*)	16			Good	8	15	15
Myoporum (*Myoporum laetum*)	16		T	Moderate	8	15	15
Monterey Pine (*Pinus radiata*)	1			Poor	50	30	50
Monterey Cypress (*Cupressus macrocarpa*)	1			Moderate	10	15	20
Monterey Pine (*Pinus radiata*)	1			Poor	50	25	50
Leyland Cypress (x *Cupressocyparis leylandii*)	1	M	M	Good	7	12	15
Italian Stone Pine (*Pinus pinea*)	1		T	Moderate	30	25	40
Red Ironbark (*Eucalyptus* sideroxylon)	1			Moderate	36	25	50
Red Ironbark (*Eucalyptus* sideroxylon)	1			Poor	50	25	50
Torrey Pine (*Pinus torreyana*)	1			Moderate	40	30	50
Palm (*Washingtonia filifera*)	1			Good	18	60	
Monterey Pine (*Pinus radiata*)	1			Moderate	60	40	60
Monterey Pine (*Pinus radiata*)	1			Moderate	20	20	30
Monterey Cypress (*Cupressus macrocarpa*)	1			Good	30	25	30

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APPENDIX 3
RMGC Baseline Tree and Shrub Survey – February 2010

Tree Species	Hole	Salt Tolerance[1]		Condition	Diameter	Canopy	Height
		Spray	*Soil*				
Monterey Pine (*Pinus radiata*)	1			Good	24	25	40
Monterey Pine (*Pinus radiata*)	1			Good	75	50	100
Coast Live oak (*Quercus agrifolia*)	1	HT	T	Good	30		
Monterey Pine (*Pinus radiata*)	1			Good	50	45	100
Monterey Pine (*Pinus radiata*)	1			Good	45	50	100
Italian Stone Pine (*Pinus pinea*)	1		T	Good	36	40	75
Coast Live oak (*Quercus agrifolia*)	1	HT	T	Good	50		
Coast Live oak (*Quercus agrifolia*)	1	HT	T	Good	30		
Italian Stone Pine (*Pinus pinea*)	4		T	Good	36	30	40
Monterey Pine (*Pinus radiata*)	4			Poor	10	10	25
Italian Stone Pine (*Pinus pinea*)	4		T	Good	20	25	35
Italian Stone Pine (*Pinus pinea*)	4		T	Moderate	10	20	30
Lemon scented eucalyptus (*Eucalyptus citriodora*)	4			Moderate	20	50	30
Monterey Pine (*Pinus radiata*)	4			Good	30	25	40
Lemon scented eucalyptus (*Eucalyptus citriodora*)	4		S	Moderate	20	25	45
Lemon scented eucalyptus (*Eucalyptus citriodora*)	4		S	Good	40	35	80
Coast Live oak (*Quercus agrifolia*)	4	HT	T	Good	50		
Leyland Cypress (x *Cupressocyparis leylandii*)	4	M	M	Good	6	10	20
Italian Stone Pine (*Pinus pinea*)	4		T	Good	24	50	30
Italian Stone Pine (*Pinus pinea*)	4		T	Poor	20	15	25
Italian Stone Pine (*Pinus pinea*)	4		T	Poor	24	25	30
Italian Stone Pine (*Pinus pinea*)	4		T	Moderate	30	25	30
Italian Stone Pine (*Pinus pinea*)	4		T	Moderate	24	15	25
Italian Stone Pine (*Pinus pinea*)	4		T	Good	40	40	80
Italian Stone Pine (*Pinus pinea*)	4		T	Moderate	30	20	30
Italian Stone Pine (*Pinus pinea*)	4		T	Good	45	25	65

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APPENDIX 3
RMGC Baseline Tree and Shrub Survey – February 2010

Tree Species	Hole	Salt Tolerance[1]		Condition	Diameter	Canopy	Height
		Spray	*Soil*				
Monterey Pine (*Pinus radiata*)	4			Good	36	30	60

[1] Tolerance values from Wu and Dodge (2005), except where noted. Tolerance to salt spray was defined by the observations of salt stress symptoms on leaves of plants receiving the following ranges of specific ion concentrations in irrigation water: (H) no salt stress symptoms at 600 mg/L Na and 900 mg/L Cl; (T) no salt stress symptoms at 200 mg/L Na and 400 mg/L Cl; (M) salt stress symptoms observed in 10% or less of leaves at 200 mg/L Na and 400 mg/L Cl; (S) salt stress symptoms observed in 20% or more of leaves at 200 mg/L Na and 400 mg/L Soil salinity threshold values for tree species where no quantitative EC threshold was found in the literature were estimated as follows: T (tolerant) EC_e =6; M (moderately tolerant) EC_e = 4; S (low tolerance) EC_e = 2.

[2] From USGS, 1994.

[3] From FAO Website: http://ecocrop.fao.org/ecocrop/srv/en/dataSheet?id=5842; accessed May 2, 2010.

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Figure 1

Soil Sampling and Tree/Shrub Locations

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LEGEND

GPS RESULTS

- Soil Sample
- Live Oak
- Conifer
- Hardwood
- Palm

SOIL RATINGS (µm per second)

- <= 4.0413 (Very Slow)
- > 4.0413 and <= 8.325 (Slow)
- > 8.325 and <= 28 (Moderate)
- > 28 and <= 61.3949 (Fast)
- > 61.3949 and <= 92 (Very Fast)
- Not Rated or Not Available

Notes:
Soil types source: Natural Resources Conservation Service

BmC—Betteravia loamy sand, 2 to 9 percent slopes
BnB2—Betteravia loamy sand, dark variant, 0 to 5 percent slopes, eroded
BoD2—Botella loam, 2 to 15 percent slopes, eroded
BtC—Botella clay loam, 2 to 9 percent slopes
ChF—Chamise shaly loam, 15 to 45 percent slopes
ChG2—Chamise shaly loam, 30 to 75 percent slopes, eroded
CtA—Corralitos sand, 0 to 2 percent slopes
CtD—Corralitos sand, 2 to 15 percent slopes
CuC—Corralitos loamy sand, 2 to 9 percent slopes
CuD—Corralitos loamy sand, 9 to 15 percent slopes
EdC2—Elder sandy loam, 2 to 9 percent slopes, eroded
GuE—Gullied land
PnC—Pleasanton sandy loam, 2 to 9 percent slopes
Rs—Riverwash
RuG—Rough broken land
TnC—Tierra sandy loam, 2 to 9 percent slopes
TnD2—Tierra sandy loam, 9 to 15 percent slopes, eroded
TnE2—Tierra sandy loam, 15 to 30 percent slopes, eroded
TrE3—Tierra loam, 5 to 30 percent slopes, severely eroded

N

0 300 600
Feet

Figure 1
Rancho Maria Golf Course
Soil Sampling Locations and Landscape Tree/Shrub Identification
Rancho Maria Golf Course

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Final

Rancho Maria Golf Course
Soil Sampling and Analysis Plan

PREPARED FOR:	Martin Wilder/LCSD
PREPARED BY:	Kathy Rose/CH2MHILL
COPIES:	Mary Vorissis/CH2MHILL
REVIEWED BY:	Jim Jordahl/CH2MHILL
DATE:	May 3, 2010

This Sampling and Analysis Plan provides a sampling strategy for collecting baseline soils data during 2010 and additional data for several years following conversion to a recycled water irrigation source. In separate technical memoranda, first quarter test results will be presented and interpreted, and recommended measures to adaptively manage irrigation with recycled water will be presented.

Soil Sampling and Analysis Plan

Quarterly soil sampling and analysis are planned for 2010 in order to determine baseline soil characteristics on fairways that may be affected by golf course irrigation using Laguna County Sanitation District (LCSD) recycled water. When fairways are irrigated with recycled water (anticipated in 2011), soil testing will be an important component of golf course turfgrass management. Soil testing is expected to be performed for at least the first two years of irrigation with recycled water. The sections that follow provide information pertaining to:

- Where baseline fairway soil samples will be collected
- When soil samples will be collected
- Methods for sampling soils
- Instructions for processing samples
- Discussion of how results will be used in irrigation management

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TABLE 1
Soil Characteristics and Potential Challenges on RMGC Fairways Sampled in February 2010

Hole Number	Soil Characteristics	Management Challenge
1	Betteravia loamy sand, 2 to 9 percent slopes (BnB2); Saturated hydraulic conductivity = 8.7 inches per hour; Drainage class = Well drained; 24 to 36 inches to restrictive horizon	Relatively coarse texture, rapid permeability, low nutrient status
4	Tierra loam (TrE3), 5 to 30 percent slopes, severely eroded; Saturated hydraulic conductivity = 0.18 inch per hour; Drainage class = Moderately well drained; 6 to 10 inches to abrupt textural change	Receives run-off from other holes and off-site areas; slowly permeable soils
7, 13	Tierra loam, 5 to 30 percent slopes, severely eroded (TrE3); Saturated hydraulic conductivity = 0.18 inch per hour; Drainage class = Moderately well drained; 6 to 10 inches to abrupt textural change	Slowly permeable soils, high runoff potential (hydrologic class D)
16	Botella clay loam 2 to 9 percent slopes (BtC); Saturated hydraulic conductivity = 0.38 inch per hour; Drainage class: well drained; more than 80 inches to restrictive feature	Receives run-off from other holes and off-site areas; slowly permeable soils

Methodology

Equipment and Supplies

Soil sampling equipment must be capable of penetrating compacted, fine-textured soils. Samples should be obtained using a hand auger with an approximately 2-inch bucket suitable for collection of clayey soils, such as those shown in Figures 2A and 2B (http://www.ams-samplers.com/category.cfm?CNum=6; accessed 03/30/2010). For fairways with sandier soils (Hole 1), a regular soil auger may be necessary to keep soil material from falling out of the bucket (Figure 2C).

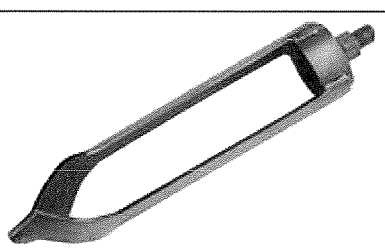

Figure 2A. AMS Open Face Auger

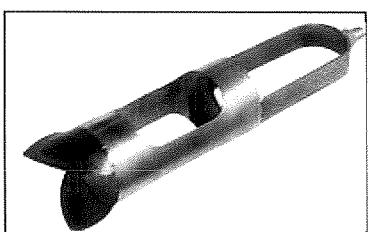

Figure 2B. AMS Mud Auger

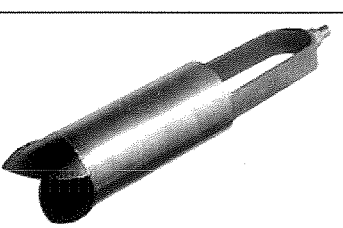

Figure 2C. Regular Soil Auger

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In February 2010, samples were obtained using an ¾-inch-diameter Oakfield soil probe. Samples were very difficult to obtain using this equipment, even though a recent rain event had occurred and soils were wet. Fine textures, presence of a clay pan, and/or compaction made it very difficult to penetrate the soil below a depth of about 4 inches (the depth to which soils are aerified), and even with hammering it was nearly impossible to collect samples to the 24-inch depth. Use of a hand auger should provide greater ease in sample collection from these soils.

Soil sample bags may be obtained from the analytical laboratory, and are free upon request. Sample bags should be requested ahead of time so that they are available when field work is conducted.

Sample Collection and Processing

Fairway soil samples should be collected at three different depths:

- 0 to 6 inches
- 6 to 12 inches
- 12 to 24 inches

Soil samples need to be representative of overall fairway conditions. To achieve this, five individual samples will be collected at each depth, and composited into one representative sample. Care should be taken to ensure that the five sampling locations are randomly selected in proximity to the sample locations shown on Figure 1, and that they are all within the same soil survey soil map units for those areas. All five samples should be of approximately equal size.

When augering through subsoils, it is possible that soil from shallower depths may slough into the augered hole and be captured in the auger bucket. This backfill material will be at the top portion of the bucket, while soils from the depth of interest will be in the "teeth" and immediately above. Care should be taken to exclude the backfilled material from the sample that is collected, by removing any obvious backfilled material prior to placement in the sample container. The auger should be cleaned between samples in order to prevent cross-contamination. Following sample collection, follow RMGC instructions for backfilling augered holes.

Total sample size submitted to the laboratory should be about 2 cups, which is the approximate capacity of soil sample bags supplied by A&L Western Agricultural Laboratories. If necessary, a large zip-lock bag may be used to collect subsamples if overall size will be greater than 2 cups. Later, samples should be mixed well and a 2-cup volume placed into the laboratory sample bags. This may prove difficult with soils that have a high clay content, because soils will be sticky and "clump" together. If sample compositing as described above is difficult, then it may be necessary to send the entire sample (in large Ziploc bag) to the analytical laboratory for processing.

Sample bags should be properly labeled with hole number, depth increment, and date. When samples are ready for shipping, a Soil Sample Information Sheet should be filled out and samples shipped for analysis within 24 hours of the time sampled (example Soil Sample Information Sheet is provided in Attachment 1). If samples cannot be shipped within 2 days, they should be kept refrigerated until shipping so that analytical results for pH and nitrate-

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nitrogen are not affected. Samples should be analyzed at the following laboratory to ensure consistency with previous analyses:

A&L Western Agricultural Laboratories
1311 Woodland Avenue, Suite #1
Modesto, CA 95351
Telephone: (209) 529-4080
Fax: (209) 529-4736

On the Soil Sample Information Sheet, the following tests should be requested (A&L Western Agricultural Laboratories Website 2010):

- **S10C**: Organic Matter, Estimated Nitrogen Release, Phosphorus (Weak Bray and Sodium Bicarbonate-P), Extractable Cations (Potassium. Magnesium, Calcium, Sodium), Hydrogen, Sulfate-S, pH, Cation Exchange Capacity and percent cation saturation (computed), Nitrate-Nitrogen, Zinc, Manganese, Iron, Copper and Boron. Using a saturated soil extract: Saturation Percentage, Soluble Salts, Sodium, Calcium, Magnesium, Chloride, Boron, Carbonate, Bicarbonate, pH, SAR and ESP (Current cost per sample = $60)

For one quarter, it is recommended that the analyses include soil texture and free calcium carbonate content, in addition to the soil tests above. These analyses should be conducted as part of the second or third quarter sampling, so that results can be used in making recommendations to be implemented potentially during the fall.

- Soil Texture (% sand, % silt, % clay) (Current cost per sample = $15.00)
- Alkaline Earth Carbonates (percent limestone) (Current cost per sample = $17.00)

Laboratory Results

The analytical laboratory's turnaround time is typically about two weeks. Results are delivered via email or fax, depending on what is requested on the Soil Sample Information Sheet (Attachment 1). If requested, the laboratory will also provide limited interpretation and recommendations for fertilizer and/or soil amendment applications. When received, data may be compiled into Excel spreadsheets and results may be graphed in order to observe differences among fairway soil properties (see CH2M HILL 2010b).

Interpretation of Results

Soil test results provide an index of the amount of plant nutrients or other constituents in the soil, and results can be correlated with the likelihood of a positive response from fertilizer applications and/or adverse response to salinity or specific ions. Where nutrient rating is "Low," turfgrass may respond favorably to fertilizer applications; a rating of "Medium" indicates that the nutrient range is suitable for turfgrass; and a rating of "High" indicates that fertilizer applications of that constituent would not likely produce improved performance (California Plant Health Association, 2002). While not specific for turfgrass, general guidelines for interpreting soil test results are provided in Attachment 2.

Over the course of the year, soil test results will reflect seasonal variations in constituent concentrations, the baseline nutrient status of the soil, and whether levels of certain

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constituents/parameters are at potentially harmful levels. For example, LCSD recycled water will have a higher salinity level than the current irrigation water source (i.e., groundwater); therefore, if baseline soil EC levels are high throughout the year, salinity levels would be expected to be even higher when recycled water is used for irrigation and additional leaching may be required to flush salts through the turfgrass root zone. Additionally, if background nitrate levels in the soil are low, turfgrass would be expected to demonstrate improved performance when irrigated with recycled water, which contains nitrate-nitrogen.

Conclusions

Quarterly soil sampling and analysis will provide baseline information to assist RMGC in transitioning to a recycled water source. Because fairway soils across the golf course show wide variation in texture, drainage and other chemical and physical properties, obtaining baseline data is important to the overall irrigation and nutrient management at the site. When irrigation with recycled water begins, continued soil monitoring will be an important part of an adaptive management plan.

References

A&L Western Laboratories website: http://www.al-labs-west.com/sections/anservices/soil/fees; accessed May 3, 2010.

AMS website: http://www.ams-samplers.com/category.cfm?CNum=6; accessed 03/30/2010.

Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online at http://websoilsurvey.nrcs.usda.gov/ accessed [07/10/2010].

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Attachment 1
Soil Sample Information Sheet

SOIL SAMPLE INFORMATION SHEET

A & L WESTERN AGRICULTURAL LABORATORIES, INC.

LAB USE ONLY

MODESTO OFFICE
1311 WOODLAND AVENUE, SUITE #1 • MODESTO, CA 95351 • (209) 529-4080 FAX (209) 529-4736

PORTLAND OFFICE
10220 S.W. NIMBUS AVE., BLDG K-9 • PORTLAND, OR 97223 • (503) 968-9225 FAX (503) 598-7702

N / W / E / S

CUSTOMER	GROWER	SUBMITTED BY
PHONE NO:	PHONE NO:	PHONE NO:

☐ Graphics Report ($1.00 per sample) ☐ Fax Report (____) _____ ☐ Email Report (email address required) _____

SAMPLE ID (5 CHARACTERS)	TEST PACKAGES									CHECK BOX IF RECOMMENDATIONS REQUIRED ☐ LBS PER ACRE ☐ LBS PER 1,000 SQ FT ☐					
	S1B	S1BN	S2	S2N	S3C	S10C	TEXTURE	NEMATODE	OTHER ANALYSES	CROP OR PLANT TYPE	PREVIOUS CROP OR PLANT TYPE	PLANTING DATES	SAMPLE DEPTH	AMENDMENTS APPLIED	METHOD OF IRRIGATION
_ _ _ _ _															
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EXPLANATION OF TESTS (SUBMIT ABOUT TWO CUPS OF SOIL PER SAMPLE)

S1B: BASIC SOIL ANALYSIS. Organic matter estimated nitrogen release, phosphorus (weak Bray and sodium bicarbonate-P), potassium, magnesium, calcium, sodium, sulfate-sulfur, soil pH, buffer pH, C.E.C. and percent cation saturation (computed).
S1BN: BASIC SOIL ANALYSIS plus nitrate-nitrogen.
S2: BASIC SOIL ANALYSIS plus soluble salts and excess lime.
S2N: BASIC SOIL ANALYSIS plus soluble salts, excess line, and nitrate-nitrogen.
S3C: COMPLETE ANALYSIS. BASIC SOIL ANALYSIS (plus soluble salts, excess lime, nitrate-nitrogen, Zn, Mn, Fe, Cu, and B).
S10C: COMPLETE ANALYSIS plus saturation percentage, SAR, ESP, carbonate, bicarbonate, chloride, and saturated paste boron.
NOTE: Strong Bray Phosphorus may be substituted for Sodium Bicarbonate Phosphorus in S1B package. Ask for package S1A

NO_3-N = Nitrate - N
SO_4-S = Sulfate - S
Zn = Zinc
Mn = Manganese
Fe = Iron
Cu = Copper
B = Boron
Mo = Molybdenum
Cl = Chloride

PRINT NAME OF SAMPLER _____

SIGNATURE OF SAMPLER _____

DATE SAMPLES SUBMITTED _____

Attachment 2
General Guidelines for Interpretation of Soil Test Results

A & L TECHNOTES

SOIL ANALYSIS

General Guidelines for Interpreting Soil Analysis Ratings

Comments: Note that the cations potassium, magnesium, calcium and sodium are rated according to what percentage of the total cation exchange capacity they take. A clay soil may have 4,000 ppm calcium whereas a sandy soil may have only 400 ppm and both may be rated as "medium" in terms of their percent cation saturation.

These ratings are not crop-specific. However, when soil fertility guidelines are requested, specific crop requirements and tolerances are taken into account.

Analyte	Description	Units	VLow	Low	Medium	High	VHigh
OM	Organic Matter	percent	0.3	2.2	3.7	5.2	15.0
pH	Soil pH	pH	5.0	6.0	7.5	8.5	10.0
P1	Weak Bray-phosphorus	ppm	8.0	17.0	26.0	39.0	90.0
HCO_3-P	$NaHCO_3$-phosphorus	ppm	3.0	7.0	13.0	22.0	50.0
K	Potassium	% Cation Sat.	0.6	2.0	5.0	10.0	15.0
Mg	Magnesium	% Cation Sat.	5.0	10.0	20.0	25.0	35.0
Ca	Calcium	% Cation Sat.	35.0	60.0	70.0	75.0	85.0
Na	Sodium	% Cation Sat.	1.0	3.0	5.0	10.0	30.0
NO_3-N	Nitrate-Nitrogen	ppm	4.0	12.0	25.0	40.0	65.0
S	Sulfate-Sulfur	ppm	3.0	10.0	25.0	35.0	60.0
Zn	Zinc	ppm	0.5	1.0	3.0	6.0	9.0
Mn	Manganese	ppm	1.0	2.0	12.0	30.0	40.0
Fe	Iron	ppm	5.0	10.0	16.0	25.0	35.0
Cu	Copper	ppm	0.3	0.8	1.2	2.5	5.0
B	Boron	ppm	0.3	0.5	1.2	2.0	5.0
Ex. Lime	Excess Lime	percent	1.0	2.0	3.0	4.0	7.0
SS (ECe)	Soluble Salts	mmhos/cm	0.3	0.7	2.0	4.0	6.0
Cl	Chloride	ppm	70.0	170.0	350.0	900.0	999.9
Mo	Molybdenum	ppm	0.05	0.1	0.2	0.4	1.0

Example: Organic matter = "Medium" between 2.3% and 3.7% (inclusive of numbers)

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The Soil Experts

Figure 1
Rancho Maria Golf Course Soil Sampling Locations

LEGEND

GPS RESULTS

- Soil Sample
- Live Oak
- Conifer
- Hardwood
- Palm

SOIL RATINGS (µm per second)

- <= 4.0413 (Very Slow)
- > 4.0413 and <= 8.325 (Slow)
- > 8.325 and <= 28 (Moderate)
- > 28 and <= 61.3949 (Fast)
- > 61.3949 and <= 92 (Very Fast)
- Not Rated or Not Available

Notes:
Soil types source: Natural Resources Conservation Service

BmC—Betteravia loamy sand, 2 to 9 percent slopes
BnB2—Betteravia loamy sand, dark variant, 0 to 5 percent slopes, eroded
BoD2—Botella loam, 2 to 15 percent slopes, eroded
BtC—Botella clay loam, 2 to 9 percent slopes
ChF—Chamise shaly loam, 15 to 45 percent slopes
ChG2—Chamise shaly loam, 30 to 75 percent slopes, eroded
CtA—Corralitos sand, 0 to 2 percent slopes
CtD—Corralitos sand, 2 to 15 percent slopes
CuC—Corralitos loamy sand, 2 to 9 percent slopes
CuD—Corralitos loamy sand, 9 to 15 percent slopes
EdC2—Elder sandy loam, 2 to 9 percent slopes, eroded
GuE—Gullied land
PnC—Pleasanton sandy loam, 2 to 9 percent slopes
Rs—Riverwash
RuG—Rough broken land
TnC—Tierra sandy loam, 2 to 9 percent slopes
TnD2—Tierra sandy loam, 9 to 15 percent slopes, eroded
TnE2—Tierra sandy loam, 15 to 30 percent slopes, eroded
TrE3—Tierra loam, 5 to 30 percent slopes, severely eroded

N

0 300 600
Feet

Figure 1
Rancho Maria Golf Course
Soil Sampling Locations and Landscape Tree/Shrub Identification
Rancho Maria Golf Course

Final
Rancho Maria Golf Course Adaptive Management Plan

PREPARED FOR:	Martin Wilder/LCSD
PREPARED BY:	Kathy Rose/CH2MHILL
COPIES:	Mary Vorissis/CH2MHILL
REVIEWED BY:	Jim Jordahl/CH2MHILL
DATE:	May 3, 2010

Introduction

Plans are being formulated to dual plumb the irrigation system at the Rancho Maria Golf Course (RMGC), such that greens and tees will be irrigated with the existing groundwater source, and fairways will be irrigated using 100 percent recycled water in the near future (Figure 1 shows layout of the golf course). This Adaptive Management Plan provides a discussion of potential issues that may arise over time when fairway turfgrass at the Rancho Maria Golf Course (RMGC) is irrigated with 100 percent recycled water. Recommendations are provided for adaptively managing irrigation, fertilization and application of soil amendments, based upon turfgrass observations and soil/plant testing. This technical memorandum incorporates relevant portions of reports prepared previously, which include:

- Laguna County Sanitation District, Recycled Water Agronomic Investigation: Final Report, dated March 2, 2009
- Response to Letter from Irrigation & Turfgrass Services, dated 1/12/2010 - February 4, 2010
- Draft Rancho Maria Golf Course Soil Sampling and Analysis Plan, dated March 30, 2010
- Draft Rancho Maria Golf Course Soil Test Results and Plant Survey, dated March 30, 2010

Management measures should be finalized as a collaborative effort between the Laguna County Sanitation District (LCSD) and the Rancho Maria Golf Course (RMGC), to ensure successful irrigation and fertility management of fairways following transition to a recycled water irrigation source.

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Existing Conditions

According to the golf course superintendent, the fairway irrigation system consists of a main line running down the middle of each fairway, with laterals extending to the edges. Quick coupler connections provide irrigation water from heads that spray water across the entire width of the fairway, and some of this water may come into contact with tree and shrub foliage. Soils at the golf course have textures that range from somewhat excessively drained sandy soils on several northern holes, to moderately well-drained loam soils underlying many of the southern holes. Fairways are currently fertilized twice per year: 2 tons of 25-5-5 slow release fertilizer are applied in March, and 2 tons of ammonium nitrate are applied in November. Assuming a total fairway area of 86 acres (i.e., 91 total irrigated acres minus 5 acres of greens and tees), then the current annual application rate is approximately 0.64 lbs N per 1000 ft^2 per year, which is far less than that required by cool season turfgrass in areas receiving a medium level of maintenance in this area (up to 6 lbs N per 1000 ft^2 according to Carrow et al. [2001]). Fungicide applications occur approximately every three weeks. No other soil amendments/fertilizers/pesticides are applied.

Adaptive Management

While turfgrass performance should benefit from the nutrients present in a recycled water irrigation source, attention will need to be paid to plant appearance and soil physical and chemical characteristics to ensure that no adverse effects to turfgrass and other landscape vegetation occur. In previous reports, the following potential problems related to irrigation with recycled water and of concern to RMGC were documented:

(1) Overspray on fairway trees and shrubs may cause foliar damage.

(2) Soil salinity may increase to levels that will damage turfgrass, trees and shrubs; additional irrigation water may need to be applied to flush salts from the root zone of plants.

(3) Clay pans or other impervious layers in some fairway soils may limit the amount of leaching that can be achieved; water may perch above restrictive features, accumulate salts, and promote disease.

(4) Elevated sodium levels in recycled water may cause problems with water infiltration into the soil.

(5) High levels of total nitrogen in recycled water may result in over-fertilization, leading to increased expenses related to mowing and application of growth regulators, and increased number of disease outbreaks. Ammonia-nitrogen may contribute to anaerobic conditions.

Therefore, the sections that follow focus on the following topics:

- Salinity management
- Soil drainage and infiltration management
- Specific ion toxicity

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- Nutrient management
- Disease management

Salinity Management

Soil Salinity.

High salt content in soil solution can make it difficult for sensitive plants to take up water and can damage plants on a cellular level. Based on limited data collected during 2010, it appears that salinity levels vary among fairway soils, and differences may be related to soil texture and landscape position. For example, loamy sand soils on Hole 1 had low salinity, while the finer textured soils on Holes 7 and 13 had higher salinity levels in February 2010 (CH2M HILL 2010b). Average soil salinity (0 to 12 inch depth) for the five fairways sampled was 1.5 dS/m in February 2010 (CH2M HILL 2010b), which is considered non-saline, but was 4.2 dS/m in December 2008 (0 to 12 inch depth), which is considered slightly saline (CH2M HILL 2009). Quarterly soil testing during 2010 should provide additional insight into temporal and spatial differences in soil salinity among fairways; however it appears that attention to salinity management may be necessary, especially on fairways with fine-textured soils, steep slopes and high runoff potential.

To prevent salt buildup from becoming excessive within the plant root zone, irrigation can be managed to apply more water than is required by the plant, in order to move a portion of the excess salts below the root zone. Leaching of salts to control salinity was discussed in CH2M HILL (2009) and is repeated here for clarity. In order to estimate leaching requirement, both electrical conductivity (EC) of the irrigation water and the EC tolerance threshold of the plant must be known. Leaching requirements can be calculated using the following equation (Ayers and Westcot, 1985):

$$LF = \frac{EC_w}{5(EC_e) - EC_w}$$

where LF = leaching fraction

EC_w = EC of irrigation water (dS/m)

EC_e = Plant threshold EC of soil saturation paste extract (dS/m)

Assuming a LCSD recycled water EC_w of 1.47 dS/m and threshold EC_e of 6.5 for perennial ryegrass (CH2M HILL 2009), a leaching fraction of approximately 5 percent would need to be applied in order to prevent salts from building up in fairway soil to levels that could be harmful to turfgrass. This means that the agronomic water requirement, plus an additional 5 percent of the agronomic requirement, would need to be applied (e.g., with every irrigation), although a portion of the leaching requirement will also be received from precipitation. A previous report suggested that RMGC currently applies a leaching fraction equal to or greater than this amount (CH2MHILL, 2009).

The current irrigation practice is to water fairways every other night in the dry season for approximately 30-45 minutes. Pond 10 supplies water for irrigation of the northern one-half of the fairways, and Pond 6 supplies water for irrigation of the southern one-half of the

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fairways, on alternate nights. Because it takes one day to fill each pond, irrigation on a nightly basis is not feasible and any required leaching fraction must be applied by irrigating for longer durations on alternate nights.

Salinity in recycled water has been shown to reduce turfgrass seed germination; however seedling establishment is usually enhanced with irrigation using recycled water containing nutrients. In high traffic areas, salt-tolerant grasses with high growth rates are preferred (Carrow and Duncan, 1998). While high growth rates typically result in the need for greater mowing frequencies, high traffic combined with salinity in irrigation water tend to reduce the growth rate. The following are recommended measures for managing soil salinity.

Salinity 1: If 2010 soil sampling indicates that baseline soil salinity levels are above turfgrass salinity thresholds (i.e., 6.5 dS/m for perennial ryegrass), irrigate with groundwater to flush salts from the turfgrass root zone before starting to irrigate with recycled water. EC can be spot-checked in the field using a hand-held measurement device or laboratory measurement of EC_e can be performed to verify salinity is below turfgrass tolerance thresholds.

Salinity 2: After irrigation with recycled water begins, conduct quarterly soil sampling in accordance with the Soil Sampling and Analysis Plan (CH2M HILL 2010a) to monitor whether soil salinity exceeds plant tolerance thresholds; increase the irrigation duration to apply a greater leaching fraction if soil salinity exceeds 6.5 dS/m, which is the salt tolerance threshold for perennial ryegrass.

Salinity 3: If irrigation water does not infiltrate soils but runs off fairways, then pulse irrigate in two sets separated by 1-2 hours between sets (e.g., 15-30 minutes per set). See following sections for recommendations for improving soil permeability.

Salinity 4: Increase the seeding rate when overseeding fairways, since seed germination rate may be reduced by high salinity in recycled water.

Salinity 5: If soil ECe cannot be managed at or below 6.5 dS/m using recycled water for leaching of salts (may occur on soils that are difficult to leach, such as Holes 7 and 13), then soils may need to be periodically flushed using groundwater or a blend of recycled water and groundwater.

Salinity 6: Consider overseeding fairways with salt-tolerant turfgrass species in areas where soil salinity cannot be managed easily. Some tolerant species kikuyugrass, alkaligrass, bermudagrass, fine leaf zoysiagrasses, seashore paspalum, tall fescue, and St. Augustinegrass (Pessarakli 2008).

Salinity in Overspray

Appendix 3 in CH2M HILL (2010b) provides limited information pertaining to salt sensitivity of fairway trees and shrubs to overspray. It appears that there is variable sensitivity to overspray among tree and shrub species with species sensitivity increasing as follows (more sensitive to the right): Coast live oak < ash < Coast redwood. Most fairway trees and shrubs are tall enough that foliage would not intercept irrigation spray; however, when new trees and shrubs are planted, foliage interception may occur. Harmful effects have been reported to begin to occur with sensitive plants when irrigation water

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concentrations are above 3 meq/L (70 mg/L) sodium and 3 meq/L (100 mg/L) chloride (Carrow and Duncan, 1998).

Santa Barbara Golf Club previously reported that where recycled water contacts foliage on some plants, the foliage dies (not the entire plant); Monterey pine is not affected, but ash trees are (CH2M HILL 2009). At RMGC, regular observations should be made to detect any foliar damage that occurs. If trees and shrubs are severely affected from overspray (i.e., foliage in contact with overspray dies), potential management options include:

Overspray 1: New and/or replacement trees should be selected from species that are known to be tolerant of salinity intercepted by foliage via sprinkler irrigation, such as Monterey pine and Coast live oak;

Overspray 2: Sprinkler heads should be replaced with lower trajectory heads such that the spray distance is reduced slightly preventing contact with foliage of perimeter trees and shrubs.

Soil Drainage and Infiltration Management

Restrictive Soil Layers

Mapped soil types on the RMGC show a wide variation in texture and drainage characteristics. Some fairways are on sandy soils with rapid percolation rates, while other fairways are on fine textured soils with a hardpan near the surface. Where abrupt textural changes or clay layers occur in or near the plant rooting depth, water can accumulate and as soils dry salts can move toward the soil surface through capillary pores. When soils are wet with poor aeration, disease outbreaks are more likely to occur. To mitigate these effects, the following management measures are recommended:

Drainage 1: Where the soil contains restrictive features such as a claypan in near surface soils, conduct deep tine aerification to ensure adequate drainage below the turfgrass root zone can be achieved. If irrigation pipelines are installed near the surface, however, deep aerification may cause damage. Currently, soils are aerified to a depth of 4 inches, which is approximately the rooting depth of turfgrass on fairways. Deeper (>4 inches) aeration would promote deeper percolation below the turfgrass rooting depth, and would promote downward leaching of salts in the root zone.

Drainage 2: To improve soil drainage where water percolates slowly or perches above a hard pan, install French drains or other features to ensure adequate soil drainage and aeration. Subsurface drainage has been installed on some fairways, such as Hole 15; similar drainage features may need to be installed on other fairways as well. Direct drainage water to surface water impoundments or open space areas between fairways; drainage water should not be discharged to offsite ephemeral streams.

Drainage 3: Continue to apply fungicides regularly to prevent or control turfgrass disease.

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Reduced Infiltration due to Elevated Sodium

A high proportion of sodium in soils relative to calcium and magnesium can result in destruction of soil structure and reduce water infiltration rates (Carrow and Duncan, 1998). Sodium adsorption ratio (SAR) is calculated from sodium, calcium and magnesium concentrations (millequivalents per liter [meq/L] or millimoles per liter [mmol/L]), in a soil saturation extract, as shown below.

$$SAR = \frac{[Na]}{\sqrt{\frac{([Ca]+[Mg])}{2}}}$$

Irrigation Water Evaluation - Symptoms of reduced permeability include water-logging, slow infiltration, crusting or compaction, poor aeration, weed invasion and disease infestation (Harivandi, 1991). The SAR in recycled water can be used along with EC values to evaluate whether irrigation problems may occur with recycled water irrigation. CH2M HILL (2009) estimated sodium hazard to be slight to moderate based on SAR and EC of LCSD recycled water, and Table 4 provides general guidelines for this evaluation. Furthermore, SAR of a saturated soil paste extract (SAR_e) can be used to estimate the degree of permeability problems that would be expected due to elevated levels of soil sodium: No problems are expected if $SAR_e < 2.1$; severe permeability problems are expected at $SAR_e > 12.0$; and permeability problems increase from SAR_e of 2.1 to 12.0 (Carrow et al., 2001).

Soil Evaluation - Soil SAR_e results for February 2010 are located in Appendix 3 of CH2M HILL (2010b). If SAR is to be reduced prior to beginning irrigation with recycled water, a total gypsum application rate can be estimated based on soil texture and exchangeable sodium percentage (ESP) using the guidelines in Table 5 (Carrow and Duncan, 1998). (Note that SAR_e approximates ESP reasonably well.) Gypsum application allows for replacement of sodium with calcium on cation exchange sites on soil particles, and subsequent leaching of salts reduces the soil SAR.

Measures to manage sodium hazard are presented below.

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TABLE 4
Guidelines for Interpretations of Water Quality for Irrigation
(from Ayers and Westcot, 1985)

Potential Irrigation Problem				Degree of Restriction on Use		
				None	Slight to Moderate	Severe
Infiltration (affects infiltration rate of water into the soil. Evaluate using ECw and SAR together)						
SAR	= 0 to 3	and EC_w	=	>0.7	0.7 to 0.2	<0.2
	= 3 to 6		=	>1.2	1.2 to 0.3	<0.3
	= 6 to 12		=	>1.9	1.9 to 0.5	<0.5
	= 12 to 20		=	>2.9	2.9 to 1.3	<1.3
	= 20 to 40		=	>5.0	5.0 to 2.9	<2.9
Specific Ion Toxicity (affects sensitive plants)						
Sodium: Surface Irrigation			SAR	<3	3 to 9	>9
Sodium: Sprinkler Irrigation			meq/L	<3	>3	
Chloride: Surface Irrigatgion			SAR	<4	4 to 10	>10
Chloride: Sprinkler Irrigation			meq/L	<3	>3	
Boron			mg/L	<0.7	0.7 to 3.0	>3.0

TABLE 5
Estimated gypsum requirements (tons per acre) per 12 inches of soil depth to reduce ESP to below 10% based on soil texture and initial ESP.
(from Carrow and Duncan, 1998)

Soil Texture	Clay Content	Initial Exchangeable Sodium Percentage				
	%	15	20	30	40	50
Sand, loamy sand	0 to 15	0.5 to 2	0.7 to 3	1 to 4	2 to 5	3 to 8
Loams	15 to 55	2 to 3	3 to 4	4 to 6	5 to 8	7 to 10
Clays	>55	3 to 4	4 to 6	6 to 8	8 to 11	10 to 14(+)

Note: 1 ton gypsum per acre equals 46 pounds per 1000 ft^2

Sodium 1: Gypsum can be applied as pellets or injected into irrigation lines. Small-sized pellets can be delivered as surface broadcast applications or worked into the soil. Carrow et al. (2001) indicates that the Yeager-Twose Turf Conditioner with a top-dresser attachment can apply gypsum to a depth of 7-8 inches on established turfgrass. Pellet surface

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applications may be more desirable than liquid injection since slow dissolution would likely result in a smaller increase in soil TDS than liquid injection.

Appendix 3 of CH2MHILL (2010b) includes laboratory recommendations for gypsum application rates; note that recommendations to be potentially implemented are those for surface soils, since the rooting depth of turfgrass is limited to the top 0 to 6 inches. Apply gypsum at the laboratory recommended rate based on 2010 soil test results for SAR_e and/or ESP prior to beginning irrigation with recycled water (Table 5 can be used as a guideline as well). Standard recommendation is 45 to 90 pounds per 1000 ft^2 per year; however, no more than 50 lbs per 1000 ft^2 should be applied in any one application to avoid foliar damage to plants (Carrow et al., 2001), and the recommended application rate should be split with the second application occurring about 6 months after the first application. Currently, the RMGC does not apply gypsum to turfgrass; however nitrogen fertilizer is applied in spring and fall, and gypsum applications could occur during this same time period.

Management of Specific Ion Toxicity

Elements that may potentially have toxic effects to plants include sodium, chloride and boron (Carrow and Duncan, 1998). Specific ion effects due to chloride toxicity are not usually a problem on turfgrass because of regular mowing. Because the chloride ion is negatively charged it is readily leached from the soil with irrigation water. While turfgrass is not usually affected by elevated chloride in soil, other plants may be affected at a chloride content in irrigation water of 70 mg/L due to build up in soil, and may be severely affected at concentrations in irrigation water that are above 355 mg/L (Carrow and Duncan, 1998). LCSD recycled water averaged about 195 mg/L chloride (2006 to 2008), and slight to moderate effects to shrubs and trees may occur due to elevated chloride levels in soil.

High sodium levels can cause cellular damage to root tissues and firing of leaf margins and tips. Excess sodium in soils can also induce nutrient deficiencies (Carrow and Duncan, 1998); however excess sodium is most likely to cause problems with soil structure and water infiltration (see discussion above). Ayers and Westcot (1985) indicate that sodium effects when sprinkler irrigating can occur at concentrations in irrigation water above 3 meq/L (70 mg/L), and with surface irrigation when SAR is greater than 3 (see Table 5). LCSD recycled water has an average sodium concentration of 171 mg/L (2006 to 2008 average), so some problems from elevated sodium may occur. Generally, salinity guidelines for plant sensitivities can also serve as a guide to sodium sensitivity, since sodium is usually a dominant component of salinity (Carrow et al., 2001). Measures to control excess salinity and/or SAR in the root zone should also prevent or reduce toxicity due to excess sodium.

Boron toxicity can occur at concentrations in irrigation water that are above 0.7 ppm (Ayers and Westcot, 1985; and see Table 5). Symptoms of boron toxicity in many trees and shrubs include "progressive necrosis of the leaf, beginning at the tip and/or margins as a chlorotic yellowing and finally spreading between the lateral veins toward the midrib. The leaf tip and margins soon show a burned or scorched appearance which later involves the entire leaf before it drops prematurely" (Homer D. Chapman Ed., 1966). LCSD recycled water averaged 0.39 mg/L boron during 2006-2008, consequently no boron toxicity is expected with irrigation using recycled water. To manage specific ion toxicity, the following measures are recommended:

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Toxicity 1: Turfgrass and landscape shrubs and trees should be regularly inspected for symptoms of toxicity. If symptoms occur, leaf samples should be collected and analyzed to determine the cause. Before sampling plant tissue, the analytical laboratory should be consulted to determine the type of plant tissue that should be collected (e.g., leaf petiole or entire leaf).

Toxicity 2: Inspection results should be compared with baseline plant surveys (for specific fairways) to evaluate whether symptoms could potentially be caused by preexisting conditions, such as pine bark beetle infestation (CH2M HILL 2010b). Damage due to specific ion toxicity should not be automatically assumed.

Toxicity 3: When necessary, fairway trees and shrubs should be replaced with species known to be tolerant of levels of sodium, chloride and other potentially toxic constituents present in recycled water.

Nutrient Management

First quarter 2010 soil tests revealed that soil nitrate-nitrogen status is low, and potassium and certain micronutrients (e.g., manganese) may be deficient (CH2MHILL 2010b). While soil testing is not necessarily an accurate representation of nitrogen status, since nitrogen levels are highly variable spatially and over time, it is likely that turfgrass does not receive nitrogen fertilization at an optimum rate based on current nutrient management practices. It would be reasonable to expect that nutrients in recycled water would lead to increased turfgrass growth and need for increased mowing frequency compared to current conditions. Fairways on sandy soils (e.g., Hole 1) would particularly benefit from nutrients in recycled water, since nitrate-N is readily leached through the root zone in sandy soils. Other benefits would include faster recovery following damage, greater turfgrass density, and better appearance. Furthermore, some turfgrass diseases are promoted by nitrogen deficiency (e.g., red thread), and consequently irrigation with recycled water may lead to better turfgrass health. Fertilizer recommendations include:

Fertilizer 1: Apply fertilizers containing macro- and micronutrients to maximize turfgrass performance, in accordance with laboratory recommendations. In particular, potassium amendments may improve disease resistance, and decrease traffic wear. Fertilizer additions should occur in spring.

Fertilizer 2: Soil pH above 7.0 may limit plant availability of certain micronutrients and phosphorus. When NH_3 forms of nitrogen in recycled water are transformed to nitrate in the soil, acidity would be produced that could lower soil pH and increase plant availability of certain nutrients. Regular soil sampling and analysis will include measurement of soil pH, and any laboratory recommendations for reducing soil pH (e.g., via sulphur application) should be followed prior to converting to a recycled water irrigation source. If substantial calcium carbonate is present in soil, acidification would release calcium, which would then replace sodium on soil exchange sites and with leaching would help reduce sodium hazard.

Fertilizer 3: Ensure all fairway soils are well aerated to ensure that ammonia forms of nitrogen that are present in recycled water can be quickly converted to nitrate.

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Fertilizer 4: Monitor monthly effluent water chemistry to determine if nutrient levels in recycled water are consistent. Discontinue applications of supplemental fertilizers containing nitrogen if recycled water consistently delivers this nutrient at the agronomic requirement.

Fertilizer 5: Consider applying cytokinins during the summer dry season. Cytokinins are plant hormones that have been shown to reduce adverse effects of salinity and specific ion toxicity (Carrow and Duncan, 1998).

Disease Management

Conditions that can promote disease include poor drainage, high compaction, thick thatch layers, long periods of leaf wetness, low mowing heights, excessive mechanical damage, and high nitrogen fertilization. Even without use of recycled water, *Rhizoctonia* blights can occur on turfgrass if these conditions are present. As mentioned previously, supplemental nitrogen fertilization will be reduced or eliminated because sufficient nitrogen to support turfgrass will likely be present in recycled water (i.e., up to 6 lbs N per 1000 ft^2 [Carrow et al., 2001]). However, irrigation during the summer months when brown patch can be problematic will provide nitrogen to fairways at a time during the year when fertilizer applications may not have occurred in the past, and this could potentially contribute to disease outbreaks if other conditions are favorable. The following management measures are recommended to manage disease outbreaks:

Disease 1: Over-irrigation should be avoided and surface drainage should be adequate to limit ponding of water on fairways.

Disease 2: Soils should be regularly aerified to facilitate downward drainage of water through soils.

Disease 3: According to the RMGC superintendent, fungicide applications are routinely applied every three weeks to greens; some application to fairways may also be required should *Rhizoctonia* or other fungal diseases develop.

Other Recommendations

Other operational management measures may need to be identified to ensure maximum turfgrass performance. These are identified below.

Other 1: Because algae may accumulate in recycled water impoundments, a filter should be placed where water enters the irrigation system in order to prevent clogging of sprinkler nozzles (Harivandi, 1991), and pond aeration should be considered (USGA, 2004).

Other 2: LCSD and RMGC need to agree on amount of water that will be required to be delivered to the golf course. Irrigation should not occur at rates above the agronomic requirement (including the leaching requirement); daily water deliveries should be tied to agronomic application rates.

Other 3: Note that Title 22 requirements prohibit recycled water spray from sprinkler irrigation from reaching eating areas or drinking fountains. Sprinkler systems may need to be modified if there is a risk of recycled water contacting these areas.

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Conclusions

Soil sampling over the course of 2010 should provide valuable information with which to finalize an appropriate management strategy for the RMGC. Soil testing during the first quarter of 2010 revealed substantial differences in soil chemical and physical properties among fairways. While a full year's data are necessary to document baseline conditions in the soil, it appears that converting to a recycled water source may provide nutritional benefits. However, modification of current irrigation management and amendment application practices may be necessary to ensure no adverse effects occur (e.g., with respect to sodium and salinity).

The sampling and analysis plan and adaptive management measures should be finalized based on consensus with LCSD and the RMGC. It will be important that golf course staff understand the benefits and increased oversight that will be necessary with conversion to a recycled water irrigation source. The input and agreement of all parties are essential to successful irrigation and fertilizer management in the future.

References

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Figure 1

RMGC Site Map

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LEGEND

GPS RESULTS

- Soil Sample
- Live Oak
- Conifer
- Hardwood
- Palm

SOIL RATINGS (µm per second)

- <= 4.0413 (Very Slow)
- > 4.0413 and <= 8.325 (Slow)
- > 8.325 and <= 28 (Moderate)
- > 28 and <= 61.3949 (Fast)
- > 61.3949 and <= 92 (Very Fast)
- Not Rated or Not Available

Notes:
Soil types source: Natural Resources Conservation Service

BmC—Betteravia loamy sand, 2 to 9 percent slopes
BnB2 Betteravia loamy sand, dark variant, 0 to 5 percent slopes, eroded
BoD2—Botella loam, 2 to 15 percent slopes, eroded
BtC Botella clay loam, 2 to 9 percent slopes
ChF—Chamise shaly loam, 15 to 45 percent slopes
ChG2—Chamise shaly loam, 30 to 75 percent slopes, eroded
CtA Corralitos sand, 0 to 2 percent slopes
CtD—Corralitos sand, 2 to 15 percent slopes
CuC—Corralitos loamy sand, 2 to 9 percent slopes
CuD Corralitos loamy sand, 9 to 15 percent slopes
EdC2—Elder sandy loam, 2 to 9 percent slopes, eroded
GuE—Gullied land
PnC Pleasanton sandy loam, 2 to 9 percent slopes
Rs Riverwash
RuG—Rough broken land
TnC—Tierra sandy loam, 2 to 9 percent slopes
TnD2—Tierra sandy loam, 9 to 15 percent slopes, eroded
TnE2—Tierra sandy loam, 15 to 30 percent slopes, eroded
TrE3 Tierra loam, 5 to 30 percent slopes, severely eroded

N

0 300 600
Feet

Figure 1
Rancho Maria Golf Course
Soil Sampling Locations and Landscape Tree/Shrub Identification
Rancho Maria Golf Course