

4.5 GROUNDWATER

TABLE OF CONTENTS

4.5	GROUNDWATER	4.5-1
	Impacts Evaluated in Other Sections	4.5-1
	Setting	4.5-1
	Concepts of Groundwater Hydrology	4.5-1
	Regional Groundwater	4.5-2
	Hydrogeologic Units	4.5-4
	Groundwater Areas	4.5-6
	Groundwater Quality Data	4.5-8
	Recycled Water Quality	4.5-9
	Regulatory Framework	4.5-9
	Groundwater Characteristics at Alternative Sites	4.5-11
	Goals, Objectives, and Policies.....	4.5-12
	Evaluation Criteria with Significance Thresholds	4.5-13
	Methodology	4.5-14
	Impacts and Recommended Mitigation Measures	4.5-15
	Cumulative Impacts	4.5-23
	Summary of Significant Impacts and Mitigation Measures	4.5-26
	Preparers and References	4.5-27
	Preparers	4.5-27
	Reviewers.....	4.5-27
	References.....	4.5-27

LIST OF TABLES

Table 4.5-1	Groundwater Characteristics at Alternative Sites	4.5-6
Table 4.5-2	Goals, Objectives, and Policies – Groundwater	4.5-12
Table 4.5-3	Evaluation Criteria with Significance Thresholds – Groundwater.....	4.5-13
Table 4.5-4	Groundwater Impacts	4.5-15
Table 4.5-5	Relation of Proposed Ponds to Nearby Municipal Wells.....	4.5-18
Table 4.5-6	Percentage of Cumulative Contribution from Recycled Water at Municipal Wells	4.5-19
Table 4.5-7	Summary of Significant Impacts and Mitigation Measures – Groundwater.....	4.5-26

LIST OF FIGURES

Figure 4.5-1, Santa Rosa Valley Groundwater Basin and the Santa Rosa Plain Subbasin. 4.5-3
Figure 4.5-2 Location of Municipal Wells in the Vicinity of Alpha, Brown, and Kelly Farms
..... 4.5-17

4.5 GROUNDWATER

This section discusses groundwater quality, the potential for groundwater elevations in nearby wells to increase or decrease, the potential for seepage from storage ponds into groundwater, and the potential for Seasonal Storage Project (SSP) facilities to affect groundwater recharge rates.

IMPACTS EVALUATED IN OTHER SECTIONS

The following items are related to the Groundwater Section, but are evaluated in other sections of the document:

- Impacts to surface waters are evaluated in Section 4.6, Surface Water Quality.
- Groundwater quality in relation to drinking water standards are evaluated in Section 4.7, Public Health and Safety.

SETTING

Concepts of Groundwater Hydrology

The following section provides a summary of the basic concepts of groundwater hydrology. The material has been summarized from the *Evaluation of Groundwater Resources: Sonoma County* (Ford et al. 1975) and focuses on processes relevant to the Project impact evaluation.

Water is present in two zones beneath the ground surface. The upper zone is the zone of aeration (or vadose zone) where pore spaces in the geologic material are partly filled with air and partly filled with water. Wells do not produce groundwater from the vadose zone because the molecules of water adhere tightly to the various geologic materials. Water stored in this zone of aeration is called soil moisture or vadose water. Soil moisture is drawn into the rootlets of growing plants. As the plants use the water, it is transpired as vapor to the atmosphere. Under some conditions, water can flow laterally in the vadose zone in a process known as interflow (Fetter 1994). Isolated zones of saturated soil can occur in the zone of aeration. These zones of perched groundwater can occur above low permeability layers and are separated from the main groundwater body by an underlying unsaturated zone.

The lower zone is the zone of saturation where all of the interconnected pore spaces in the geologic material are filled with groundwater, and only dissolved gaseous air is present. Groundwater in the saturated zone is either confined or unconfined. An aquifer containing unconfined groundwater is one that is not overlain by a confining bed of relatively low permeability geologic material. The upper surface of an unconfined body of groundwater is called the water table. It is represented by the level of water in a well penetrating the saturated zone. In an unconfined aquifer the water table is assumed to be connected to the atmosphere through the overlying soil pores.

A confined aquifer is overlain by relatively impermeable material and is isolated from overlying aquifers. Groundwater contained in confined aquifers is under pressure, and the level to which the water will rise in a non-pumping well is the potentiometric surface of the groundwater. The potentiometric surface is an imaginary surface that represents the upward pressure exerted by the confined groundwater on the materials overlying it.

Water recharges an aquifer through precipitation, stream flow, irrigation, or other sources by entering the ground and moving downward through the zone of aeration and into the zone of saturation. Groundwater under pressure moves toward areas of lower pressure, such as pumping depressions. In cases where the pressure relief area is along a stream channel, springs form and provide stream flow even during periods of low precipitation.

The general groundwater movement pattern of a basin can be interpreted from groundwater contour maps¹ which show lines of equal elevation of the groundwater surface. Groundwater movement is perpendicular to the contour lines and from the higher elevation contours to the lower. The relative spacing between the contour lines indicates the hydraulic gradient of the groundwater, which is an index of the resistance encountered as the water moves through the aquifer.

Regional Groundwater

Sonoma County has been divided into three groundwater resource regions. These regions are referred to as: (1) primary groundwater basins; (2) contiguous and detached groundwater areas outside boundaries of groundwater basins; and (3) non-water-bearing areas. Groundwater basins are areas that are underlain by water-bearing materials and have potential for groundwater development, such as groundwater extraction. Groundwater is usually available in predictable quantities nearly everywhere within the limits of the groundwater basin. Within the SSP study area there is one groundwater basin: the Santa Rosa Valley (Ford et al. 1975). The SSP alternative sites, Kelly Farm, Brown Farm, and Alpha Farm, are located within the Santa Rosa Plain, a sub-basin of the Santa Rosa Valley groundwater basin. The geographic location of the Santa Rosa Valley Groundwater Basin and the Santa Rosa Plain Subbasin are shown in Figure 4.5-1.

The second important groundwater region in Sonoma County is composed of the contiguous and detached groundwater areas, which are generally located in the upland areas of Sonoma County outside the boundaries of groundwater basins. These areas are underlain by a variety of geologic materials, which range in their water-yielding capabilities from high yield in the case of the Merced formation to low yield in the case of the Petaluma formation.

¹ Groundwater contour maps should not be confused with topographic maps, which show ground surface topography by mapping lines of equal elevation. Although groundwater in an unconfined aquifer may mimic topography, groundwater basins and flow directions are controlled by the groundwater gradient.

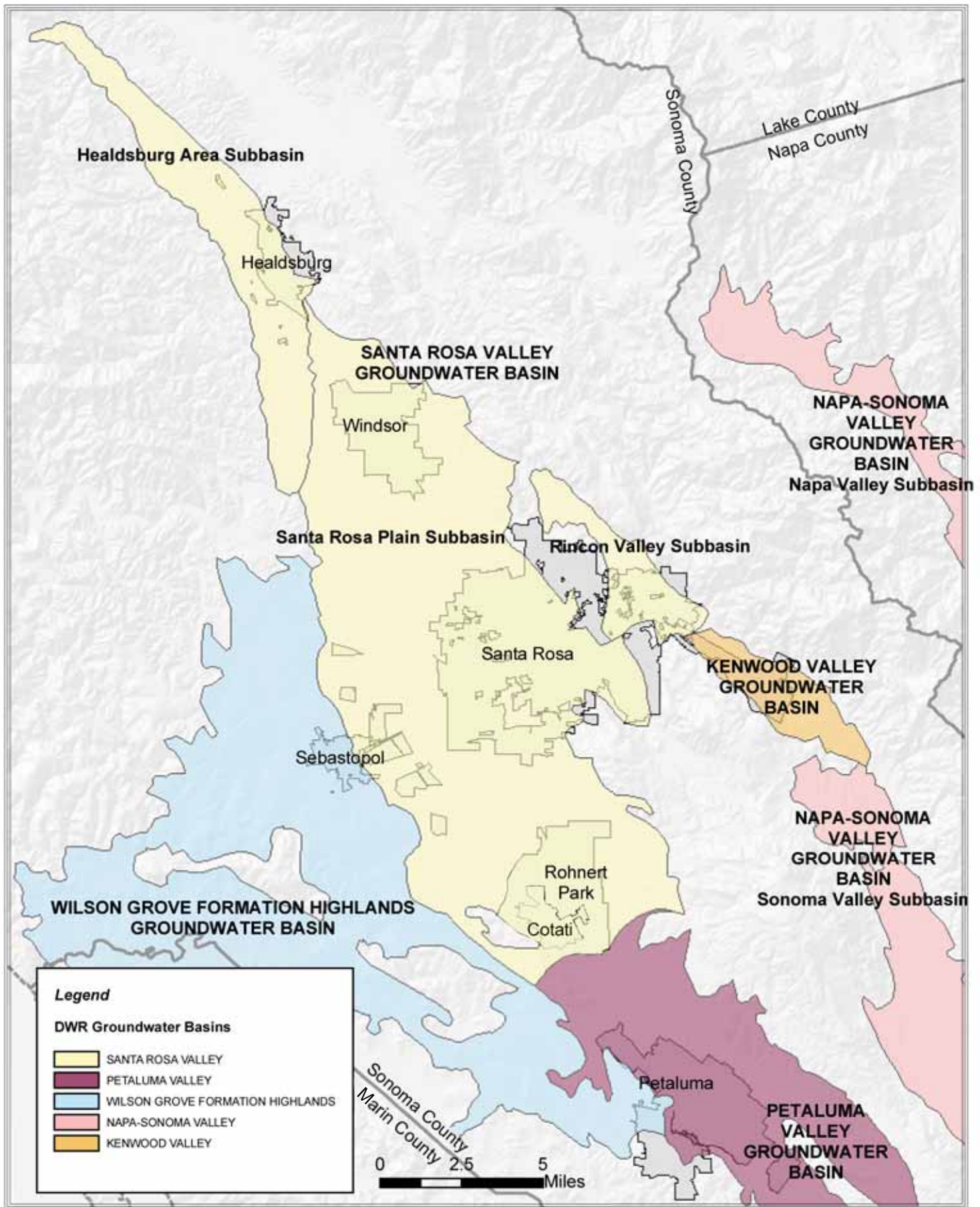


Figure 4.5-1
Groundwater Basins and Subbasins
Santa Rosa and Vicinity

The following discussion of groundwater as it relates to the evaluation of SSP Alternatives, primarily pertains to the Santa Rosa Valley (including the Santa Rosa Plain subbasin) and areas of non-water-bearing rock that are generally upland areas that surround the major groundwater basins. The discussion of the hydrogeology of these areas is based on various reports by California Department of Water Resources (Herbst et al. 1982), Cardwell (1958, 1965), Hauge and Mitchell (1983), Ford et al. (1975), and Fox (1983), which include the most current compilations of regional groundwater information. Groundwater recharge in the SSP study area generally occurs in upland areas adjacent to groundwater basins. The primary sources of recharge are precipitation and stream seepage. Recharge occurs wherever permeable materials are near the surface and connect with the principal groundwater body, and surface slopes are gentle enough to limit the amount of precipitation that becomes surface runoff.

Groundwater discharge occurs mostly along the major trunk streams. In these areas, groundwater discharges as underflow to the streams or adjacent low-lying areas such as the Laguna de Santa Rosa (Laguna). This water then flows as surface water toward the Russian River. Groundwater is also lost through evapotranspiration in the extensive marsh areas of the Laguna. Water extracted from wells also contributes to removal of groundwater from the basins.

In areas that have unconfined groundwater, the water table surface will generally follow the topography such that groundwater elevations are highest at topographic high areas and low in the lower topographic areas. In areas of confined groundwater, the level to which groundwater will rise in a well under hydrostatic pressure may or may not mirror the local topography.

Hydrogeologic Units

Groundwater within the SSP study area occurs in a complex system of highly variable geologic units. These units are commonly divided into non-water-yielding, variable water-yielding, and water-yielding groups. The units are listed in the sequence in which they occur from lowest (oldest) to highest (youngest).

Franciscan Complex (Jurassic-Cretaceous): Basement rocks consist of the Franciscan Complex, which is the oldest geologic unit within the study area. Rocks of the Franciscan Complex are generally non-water yielding because they are well consolidated and dense. However, zones of secondary porosity caused by joints, fractures, or shear zones may locally provide low yields of water. Fracture zones and shear zones also contribute to the groundwater discharge through baseflow. In the Santa Rosa Valley, the Franciscan Complex is relatively deep and generally not used as a groundwater resource. In the western uplands where the Franciscan occurs at or near the surface, small amounts of water may be obtained from water yielding zones. Well yields in the Franciscan Complex are generally low. Springs from fractures in the Franciscan Complex feed the tributaries of the Russian River. Ford et al. (1975) have attributed a very low specific yield of less than 3 percent to these rocks.

Petaluma formation (late Miocene [Fox, 1983]): The Petaluma formation overlies Franciscan bedrock in a major portion of the Petaluma and Santa Rosa valleys and is overlain by and locally interfingers with the Merced formation. The Petaluma formation occurs along the eastern margin of the Santa Rosa/Petaluma trough (Cardwell 1958, Fox 1983).

Groundwater occurs in the sandstone and conglomerate lenses that are interspersed in the predominant claystone of the Petaluma formation. This formation can yield moderate amounts of water adequate for domestic needs, though because of the predominance of claystone, well yields are generally low (Cardwell 1958). Specific yields for this unit are low, from 3 to 7 percent (California State Department of Water Resources 1987).

Merced formation (Late Miocene to Pliocene [Fox 1983]): The Merced formation (also referred to as the Wilson Grove formation) is one of the principal water-producing formations in Sonoma County. Groundwater in the Merced formation is typically unconfined, but semi-confined or confined conditions can occur locally wherever laterally continuous clay beds occur. Because of its uniform high porosity and moderate permeability, this unit yields good quantities of water (Cardwell 1958). The Merced formation has high specific yields of 10 to 20 percent in the Santa Rosa Plain (California State Department of Water Resources 1987).

Sonoma Volcanics (late Miocene to Pliocene [Fox 1983]): The Sonoma Volcanics are a thick sequence of volcanic material consisting of lava flows, tuffs, and intrusive rocks (Ford et al. 1975). In the Santa Rosa Valley, the volcanics interfingers with the Petaluma and Merced formations. The Sonoma Volcanics border the eastern edge of the Santa Rosa Plain and extend under the plain a short distance. Productivity of water wells within this unit is highly variable, ranging from dry wells to wells with yields that are adequate for domestic purposes. Some of the better producing wells may yield 10 to 50 gallons per minute (gpm) with drawdowns of 10 to 120 feet (Ford et al. 1975). Specific yields range from 0 to 15 percent (Herbst et al. 1982). Water yields from rocks in this formation are highly variable and extremely unpredictable.

Glen Ellen Formation (Pliocene to Pleistocene): The Glen Ellen formation consists of alluvial fan, continental, and floodplain deposits that are highly variable in their water yielding capability due to the heterogeneity of the formation. Specific yields range from 3 to 7 percent. Domestic well yields can vary from 1 to 140 gpm (Hauge and Mitchell 1983).

Alluvial Fan Deposits (Pliocene to Recent): The alluvial fan deposits, which include the Glen Ellen formation, are composed of a heterogeneous mixture of unconsolidated gravel, sand, silt, and silty clay. Due to their overall coarseness, these deposits are estimated to have moderate to high specific yields of 8 to 17 percent (Herbst et al. 1982). Water yields in this formation are highly variable.

Terrace Deposits (Pleistocene): Terrace deposits consist of unconsolidated deposits of sand and gravel that reflect alluvial fan, floodplain, and stream deposits until the stream further eroded its channel leaving the terraces exposed. Water yields from these deposits are moderate ranging from 8 to 15 percent except where perched on top of knolls where they become drained (Hauge and Mitchell 1983).

Basin Deposits (Pleistocene to Recent): Basin deposits consist of organic-rich, clay, and silty clay deposited in freshwater marsh and lakes. These deposits occur in low-lying areas of the Santa Rosa Plain including the central portion of the southern plain, adjacent to the Laguna and the lower reaches of tributary stream valleys (Herbst et al. 1982). The fine-grained basin deposits have low permeability and do not yield significant quantities of groundwater. They restrict infiltration and downward percolation of water and form a confining layer where they overlie coarse-grained, water-yielding deposits. These deposits have been assigned low specific yields of 3 to 7 percent (Herbst et al. 1982).

Alluvium (Pleistocene to Recent). A variety of unconsolidated alluvial deposits occurs as discontinuous interbeds of gravel, sand, silt, and clay. These undifferentiated alluvial deposits represent a mixture of coarse-grained stream channel and natural levee deposits, and fine-grained floodplain deposits. The specific yield is variable, depending on the amount of clay and the thickness of the deposits. Most deposits are less than 100 feet thick with variable specific yields, ranging from 3 to 15 percent (Herbst et al. 1982).

Groundwater Areas

The SSP Alternatives are located in various groundwater areas including designated groundwater basins, contiguous and detached groundwater areas, and non-water-bearing areas that are not within defined groundwater basins. Table 4.5-1 provides a summary of groundwater conditions that occur in the groundwater areas where SSP Alternatives are located.

TABLE 4.5-1
Groundwater Characteristics at Alternative Sites

Site	Groundwater Area	Hydro-geologic Unit/ Formation	Shallowest Depth to Groundwater	Approx. Flow Direction	Number of Wells Sampled/Nitrate Concentrations (mg/L)
KF1	Santa Rosa Valley Groundwater Basin (Santa Rosa Plain Subbasin)	Alluvium	14	W	4/ (0-7 mg/L)
KF2	Santa Rosa Valley Groundwater Basin (Santa Rosa Plain Subbasin)	Alluvium	9	SW	3/ (0-31 mg/L)
BF1	Santa Rosa Valley Groundwater Basin (Santa Rosa Plain Subbasin)	Alluvium	10	W	3/ (0-1 mg/L)
BF2	Santa Rosa Valley Groundwater Basin (Santa Rosa Plain Subbasin)	Alluvium	19	W	2/ (0-1 mg/L)
AF	Santa Rosa Valley Groundwater Basin (Santa Rosa Plain Subbasin)	Alluvium	3	SW	10/ (0-5 mg/L)

Santa Rosa Valley

The Santa Rosa Valley Groundwater Basin lies in a northwest trending structural depression between the Mendocino Range on the west and the Mayacmas and Sonoma mountains on the east. The cities of Rohnert Park, Cotati, Sebastopol, Santa Rosa, and Windsor and Sonoma State University obtain water from the Santa Rosa Valley Groundwater Basin.

Santa Rosa Plain

The Santa Rosa Plain is the largest subbasin of the Santa Rosa Valley Groundwater Basin and is characterized by low relief with an average ground surface elevation of approximately 145 feet above mean sea level (California State Department of Water Resources 1987).

The Santa Rosa Plain is composed of geologic units with variable water-yielding properties. The water table is typically shallow. In the 1950s groundwater levels were generally 5 to 20 feet below the ground surface (Cardwell 1958). Comparison of groundwater contours from 1960 to 1975 indicates that groundwater levels in some areas of the Santa Rosa Plain have dropped while other areas have risen or remained the same (Herbst et al. 1982). Groundwater levels have risen in the vicinity of Santa Rosa where groundwater use has decreased over this time period. In the southern portion of the Santa Rosa Plain, groundwater use has increased causing a decline in water levels in that area. Because these variations tend to offset each other, the groundwater basin as a whole is viewed as being in balance (Herbst et al. 1982). Most of the groundwater in this subbasin appears to be in unconfined aquifers although there is evidence that some deeper portions are under semi-confined to confined conditions (California State Department of Water Resources 1987).

Groundwater in the Plain generally moves toward the Laguna, which is adjacent to and parallel with the western margin of the basin (Cardwell 1958). Therefore, the predominant flow direction is toward the southwest. The primary source of recharge for groundwater in the Santa Rosa Plain is from infiltration of rainfall and seepage from streams (Cardwell 1958). Recharge is dependent on topography, surface soil conditions, and vegetation.

Groundwater of the Santa Rosa Plain is used for irrigation, domestic, industrial, and municipal water supply. Many wells that serve rural agricultural residential uses are shallow and extract a relatively minor amount of water from the aquifer. These wells are widely distributed in the Santa Rosa Plain.

Industrial and municipal wells tend to be clustered in and around urban areas and extend to depths ranging from 450 to greater than 1,000 feet. In general, high groundwater levels in the Santa Rosa Plain indicate that the major portion of the aquifer is at or near its storage capacity.

Groundwater quality in the Santa Rosa Plain is generally good to excellent, but tends to be hard with high calcium and magnesium concentrations (City of Santa Rosa and U.S. Bureau of Reclamation 1990). The secondary drinking water standard (i.e., maximum contaminant level or “MCL”) for iron is frequently exceeded. Chemical characteristics are variable, depending on geologic factors, adjacent land uses, well extraction, and infiltration.

Excellent quality water is usually obtained from alluvium and alluvial fan deposits. The Merced formation generally produces high quality water, although high iron, manganese, sodium, and total dissolved solids have been reported in wells tapping the lower portion of the Merced formation.

Many shallow domestic wells and older shallow wells (particularly in the eastern portion of the Santa Rosa Plain) lack adequate sanitary seals. These older wells may serve as a direct conduit for agricultural runoff to enter the shallow groundwater and degrade its quality.

Groundwater Quality Data

Groundwater quality data have been compiled from the California State Department of Water Resources for some wells within the SSP study area. Water quality data collected from monitoring wells in Sonoma County were also reported as part of the Santa Rosa Subregional Long-Term Wastewater Project (Parsons Engineering Science 1996). The available groundwater quality data establish the general groundwater quality and allow comparison of existing groundwater quality to recycled water quality. Groundwater in the study area is generally characterized by relatively low concentrations of total dissolved solids (100 to 600 mg/L), chloride (1 to 200 mg/L), sulfate (0 to 150 mg/L), and nitrate (0 to 10 mg/L, as N). However, a few locations have nitrate levels of up to 34 mg/L (as N). In 2007, additional nitrate data were collected at new and existing wells at and near the Kelly Farm, Brown Farm, and Alpha Farm sites to assist the groundwater evaluation and to help establish baseline water quality at these sites. Background nitrate concentrations in groundwater near the proposed Brown Farm and Alpha Farm ponds are generally less than about 5 mg/L (as N). Nitrate concentrations in groundwater near the proposed Kelly Farm ponds vary between zero and about 30 mg/L (as N), which is above the MCL standard of 10 mg/L. The high background nitrate concentrations may be due to past agricultural practices.

Dissolved concentrations of iron and manganese exceed the secondary MCL in numerous wells in the Santa Rosa Plain. High levels of iron and manganese appear concentrated along the eastern portion of the basin in the vicinity of the Rodgers Creek and Healdsburg faults.

Groundwater quality, and notably nitrate concentration, varies substantially from one season to the next and from location to location. Groundwater quality may also vary substantially among hydrogeologic units. Therefore, the depth of a well and the screened interval (the portion of the well casing that is perforated and contributes water to the well) will influence the data that characterize groundwater quality. Groundwater, particularly in the shallow zone, may be influenced by septic systems and/or agricultural uses of the land. For example, the few locations where nitrate levels in groundwater exceed the MCL are likely related to

shallow wells affected by septic system effluent and/or farming activities in these. Agricultural use in Sonoma County tends to be most intense in low-lying, valley floor areas.

Recycled Water Quality

The quality of recycled water from the Subregional System is described in *TM 4, Groundwater Evaluation* provided in Volume 5 of this EIR and summarized in Section 4.6, Surface Water Quality. Information on the concentrations of inorganic and organic chemical constituents and pathogens can be found in Section 4.7, Public Health, and Safety.

Of particular note for evaluating groundwater impacts on drinking water supplies are recycled water constituents that exceed drinking water MCLs. Recycled water, which is used to fill the existing and proposed storage ponds, had an average nitrate concentration of about 11 mg/L (as N) from 2005 through 2006 as measured at the Laguna Plant. Recycled water in the existing Brown Farm Pond, however, was observed to have a time-weighted average nitrate concentration of 5.6 mg/L (as N) during the discharge seasons from 2000 through 2002. Other ponds also have nitrate concentrations lower than the MCL and lower than those of the recycled water sampled at the Laguna Plant. The observed decline in nitrate concentration in the ponds is assumed to be the result of denitrification and algal uptake occurring in the ponds.

Maximum concentrations of n-Nitrosodimethylamine (NDMA) and n-Nitrosodi-n-propylamine (NDPA) in recycled water have been recorded at 0.012 and 0.013 micrograms per liter ($\mu\text{g/L}$), respectively, exceeding the California Department of Public Health (CDPH) notification level of 0.01 $\mu\text{g/L}$ for both NDMA and NDPA². Existing ponds, however, have been sampled twice for both NDMA and NDPA, and both concentrations were found to be below the reporting limit of 0.002 $\mu\text{g/L}$, indicating that both chemicals are attenuated in the pond environment.

Regulatory Framework

California Department of Public Health Guidelines for Recycled Water

Criteria for recycled water quality are established in Title 22 of the California State Code of Regulations (Title 22, California State Code of Regulations, §60301 et. seq.). Title 22 specifies treatment requirements and establishes water quality standards for recycled water (Water Recycling Criteria). These regulations are summarized in Section 4.7, Public Health and Safety. The CDPH is the agency responsible for development and implementation of the regulations for use of recycled water.

A recent letter from the CDPH (July 2007) (see Appendix D) regarding the Discharge Compliance Project indicates that it is acceptable for a potable water well to draw a fractional amount of groundwater that is from a stream containing treated and

² *TM 4, Groundwater Evaluation Attachment 1* (in Volume 5 of this EIR) analyzes nitrate, NDMA and NDPA potential effects based on concentrations in recycled water sampled at the Laguna Plant and finds no significant effects on groundwater quality at drinking water wells. Such analysis is conservative in that it does not account for lower concentrations of the three chemicals in stored recycled water samples.

disinfected wastewater discharges under certain conditions, and that the protection provided by the standard provisions of the Clean Water Act and Safe Drinking Water Act assure a safe drinking water under these conditions. CDPH recommends that not more than 5 percent of drinking water from a well be derived from wastewater sources.

Groundwater Non-degradation Policy

In 1968, the State Water Resources Control Board adopted Resolution 68-16, "Statement of Policy with Respect to Maintaining High Quality of Waters in California State," establishing a non-degradation policy for the protection of water quality. Under this policy, whenever the existing quality of water exceeds the quality necessary to maintain present and potential beneficial uses of the water, existing water quality must be maintained. This policy pertains to both surface waters and the groundwater of the State.

The Water Quality Control Plan (Basin Plan) for the North Coast Region [North Coast Regional Water Quality Control Board (NCRWQCB), 1994] establishes water quality objectives that are considered to be necessary to protect present and probable future beneficial water uses. The SSP would require waste discharge requirements (WDRs) approved by the NCRWQCB. The NCRWQCB would consider potential groundwater impacts of the SSP in the context of the adopted Basin Plan and would require that best practicable treatment or discharge control be included in approved WDRs.

Some degradation of water quality may be considered acceptable if it can be demonstrated that the Project would be "consistent with maximum benefit to the people of the State, will not unreasonably affect present and anticipated beneficial uses of such water and will not result in water quality less than that prescribed in the policies" (Resolution No. 68-16). The California State Water Code specifically allows increases of salinity associated with water reclamation projects: "A regional board may not deny issuance of water reclamation requirements to a project which violates only a salinity standard in the basin plan" (Division 7, Chapter 7, Section 13523.5 of the California State Water Code). Therefore, it is possible for WDRs to be approved that could result in some increase in chemical concentrations in groundwater above background levels. However, in no case may increases in chemical concentrations cause adverse impacts to groundwater resources. Nitrate levels in excess of the MCL for drinking water (10 mg/L) would be considered an adverse effect. Waters in which salinity, as measured by total dissolved solids, exceed 3,000 mg/L are considered unsuitable for water supply (State Water Resources Control Board Resolution No. 88-63, "Sources of Drinking Water"). For the SSP, it is anticipated that by coordinating the overall IRWP closely with the NCRWQCB, the existing WDRs could be modified to recognize any new seasonal storage sites and new WDR applications would not be needed.

Groundwater Characteristics at Alternative Sites

Kelly Farm 1 (KF1) and Kelly Farm 2 (KF2)

The KF1 and KF2 sites are located 1,300 feet from each other and are situated within similar lithology. Heterogeneous alluvium and floodplain deposits comprise the surface soils near KF1 and KF2. Near-surface soils are typically fine-grained with thin sand and gravel lenses that are assumed to be discontinuous. The alluvial deposits east of the Laguna are up to 400 feet thick, increasing in thickness toward the south. Regional groundwater flow is in a westerly direction across the Santa Rosa Plain. Available data indicate depth to water in shallow wells ranges from several feet to 40 feet below ground surface. Water levels in the Kelly Farm area declined between approximately 1998 and 2005 but have remained stable since 2005. Seasonal fluctuation of groundwater levels is approximately 6 feet. Significant vertical hydraulic gradients exist near Kelly Farm indicating groundwater flow is predominantly vertical in shallow soils.

Brown Farm 1 (BF1) and Brown Farm 2 (BF2)

The BF1 and BF2 sites are located 500 feet from each other and are situated within similar lithology. The lithologic description for Brown Farm is the same as the Kelly Farm area. Regional groundwater flow is in a westerly direction across the Santa Rosa Plain. Available data indicate depth to water in shallow wells ranges from several feet to 40 feet below ground surface. Historic water level data in the Brown Farm area is sparse, so long-term trends are not known. However, observed groundwater levels were 79 feet mean sea level at recently installed wells near Brown Farm in January 2007. Significant vertical hydraulic gradients also exist near Brown Farm indicating groundwater flow is predominantly vertical in shallow soils.

Alpha Farm (AF)

The AF site is located within similar lithology as Kelly Farm and Brown Farm. Thus, the lithologic description for Alpha Farm is the same as the Kelly Farm area. Seasonal fluctuation of groundwater levels is approximately 8 feet near Alpha Farm, and long-term trends show groundwater levels to be stable in the area. Vertical hydraulic gradients, although not as great as those observed at Brown Farm and Kelly Farm, are still substantial and result in groundwater moving primarily downward in shallow soils.

GOALS, OBJECTIVES, AND POLICIES

Table 4.5-2 identifies goals, objectives, and policies that provide guidance for development in relation to groundwater in the study area. The table also indicates which criteria in this section are responsive to each set of policies.

TABLE 4.5-2
Goals, Objectives, and Policies – Groundwater

Adopted Plan Document	Document Section	Document Numeric Reference	Policy	Relevant Evaluation Criteria¹
Santa Rosa General Plan	Open Space and Conservation	Policy OSC-F-5	Maintain high levels of water quality for human consumption and for other life systems in the region by regularly monitoring water quality.	1, 2, 3, 4
		Policy NS-D-1	Ensure floodplain protection by retaining existing open areas and creating new open areas needed to recharge aquifers.	

Source: Santa Rosa 2002

Note: 1. Evaluation criteria are identified in Table 4.5-3

EVALUATION CRITERIA WITH SIGNIFICANCE THRESHOLDS

According to Appendix G of the California Environmental Quality Act (CEQA) Guidelines, a project will normally have a significant effect on the environment if it would alter the direction or rate of flow of groundwater; change the quantity of groundwater, either through direct addition or withdrawals or through interception of an aquifer by cuts or excavation; or adversely affect groundwater quality. Groundwater impacts were evaluated for significance based on the criteria listed in Table 4.5-3. The groundwater concepts presented there are discussed further in methodology.

TABLE 4.5-3
Evaluation Criteria with Significance Thresholds – Groundwater

Evaluation Criteria	As Measured by	Significance Thresholds	Sources of Criteria
1. Will the SSP degrade groundwater quality at existing or future drinking water wells, resulting in a public health hazard or otherwise degrading groundwater quality?	Cumulative recycled water contributions to groundwater drinking sources	5 percent cumulative recycled water contributions, over short durations (monthly averages at groundwater source) for pathogenic microorganism control; 10 percent cumulative recycled water contributions, as an average over long periods of time (yearly averages at groundwater source), for chemical contaminant control).	CDPH (2007) (see <i>Appendix D</i>)
2. Will the SSP cause groundwater mounding or increase groundwater levels that cause surface water discharge?	Increase in groundwater levels	Groundwater that is raised to within 6 feet of the surface	CEQA Guidelines Appendix G, Checklist Item VIII (d) ¹
3. Will the SSP lower groundwater levels at existing wells?	Wells be subject to lower groundwater levels	Greater than 0 wells	CEQA Guidelines Appendix G, Checklist Item VIII (b) ²
4. Will the SSP lower groundwater levels in areas that could have been developed for future water supply?	Number of parcels that would be subject to lower groundwater levels	Greater than 0 parcels	CEQA Guidelines Appendix G, Checklist Item VIII (b) ²

Notes:

1. CEQA checklist item VIII (d) asks if the Project would substantially alter the existing drainage pattern of the site or substantially increase the rate or amount of surface runoff in a manner that would result in flooding on or off site. This section specifically considers the effects of groundwater mounding on flooding. Elevated water tables can interfere with the operation of leachfields or can result in surface runoff and flooding. Additional aspects of flooding are addressed in Section 4.4, Surface Water Hydrology.

2. CEQA checklist item VIII (b) asks if the Project would substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or lowering of the local groundwater table (i.e., the production rate of pre-existing nearby wells would drop to a level that would not support existing land uses for which permits have been granted). The reduction of groundwater levels can cause existing wells to cease providing water for their intended uses or eliminate potential future water supply.

METHODOLOGY

The Program EIR impact analysis is based on a review of relevant groundwater literature and technical reports prepared for impact evaluation and engineering design for the SSP. Analyses were based upon data and information in *TM 4, Groundwater Evaluation* provided in Volume 5 of this EIR. The groundwater evaluation presents water quality data and results of groundwater sampling and numerical modeling.

Relative to groundwater quality, the groundwater modeling was designed to analyze the contribution of the Project to drinking water wells, as described in the recent letter from the CDPH in Appendix D. CDPH recommends that not more than 5 percent of drinking water from a well be derived from wastewater sources. Because CDPH has provided this guidance, the analysis of groundwater quality impacts on drinking water wells has focused on the cumulative percentage of water reaching nearby wells from wastewater sources. This analysis has the benefit of considering all of the constituents in recycled water as a whole, rather than on a constituent by constituent basis. It takes into account reduction in constituent concentrations that would occur as groundwater moves through the soil, as well as other contributions to groundwater quality.

IMPACTS AND RECOMMENDED MITIGATION MEASURES

TABLE 4.5-4
Groundwater Impacts

Evaluation Criteria	Significance Threshold	Impact	Type of Impact ¹	Level of Significance ²
5.1. Will the SSP degrade groundwater quality at existing or future drinking water wells, resulting in a public health hazard or otherwise degrading groundwater quality?	5 percent cumulative recycled water contribution			
<i>Storage component</i> <i>Pump Station component</i>		3 percent or less None	O&M/P O&M/P	○ ==
5.2. Will the SSP cause groundwater mounding or increase groundwater levels that cause surface water discharge?	Groundwater raised to within 6 feet of the surface			
KF1 and KF2 <i>Storage component</i> <i>Pump Station component</i>		None None	O&M/P O&M/P	== ==
BF1, BF2, and AF <i>Storage component</i> <i>Pump Station component</i>		Groundwater levels could rise to within 6 feet of the land surface. None	O&M/P O&M/P	⊙ ==
5.3. Will the SSP lower groundwater levels at existing wells?	Greater than 0 wells			
KF1 and KF2 <i>Storage component</i> <i>Pump Station component</i>		Potential to lower groundwater levels Dewatering during construction	O&M/P O&M/P	⊙ ○
BF1, BF2, and AF <i>Storage component</i> <i>Pump Station component</i>		None Dewatering during construction	O&M/P O&M/P	== ○

**TABLE 4.5-4
Groundwater Impacts**

Evaluation Criteria	Significance Threshold	Impact	Type of Impact ¹	Level of Significance ²
5.4. Will the SSP lower groundwater levels in areas that could have been developed for future water supply?	Greater than 0 parcels			
KF1 and KF2 <i>Storage component</i>		Potential to lower groundwater levels	O&M/P	⊙
<i>Pump Station component</i>		Dewatering during construction	O&M/P	○
BF1, BF2, and AF <i>Storage component</i>		None	O&M/P	==
<i>Pump Station Component</i>		Dewatering during construction	O&M/P	○

Notes: 1. Type of Impact:
C: Construction
O&M: Operation and Maintenance
P: Permanent

2. Level of Significance:
● Significant impact before and after mitigation
⊙ Significant impact before mitigation; less than significant impact after mitigation
○ Less than significant impact; no mitigation proposed
== No impact

Impact: 5.1. Will the SSP degrade groundwater quality at existing or future drinking water wells, resulting in a public health hazard or otherwise degrading groundwater quality??

Analysis: *Storage component - Less than Significant: KF1, KF2, BF1, BF2, and AF*

A potential source of groundwater quality degradation is seepage of recycled water from the storage ponds. The storage ponds would be lined with a compacted native clay liner with a permeability of approximately 10⁻⁷ centimeters per second, which would result in seepage ranging from 3 to 29 gpm; see Table 4.5-5 for maximum seepage rates estimated for each pond.

A groundwater model for areas near the five alternatives was constructed and is presented in *TM 4, Groundwater Evaluation*. The groundwater modeling was conducted to determine the direction of flow and time of travel of the seepage relative to nearby municipal and domestic wells.

Three Sonoma County Water Agency (SCWA) wells are located near the proposed ponds and five City of Sebastopol wells are located across the Laguna from the proposed ponds. The location of the municipal wells relative to the alternative storage sites is shown in Figure 4.5-2. The distance from each pond to the closest well is listed in Table 4.5-5. The model predicts that if recycled water seeps from the proposed ponds, it would travel downward

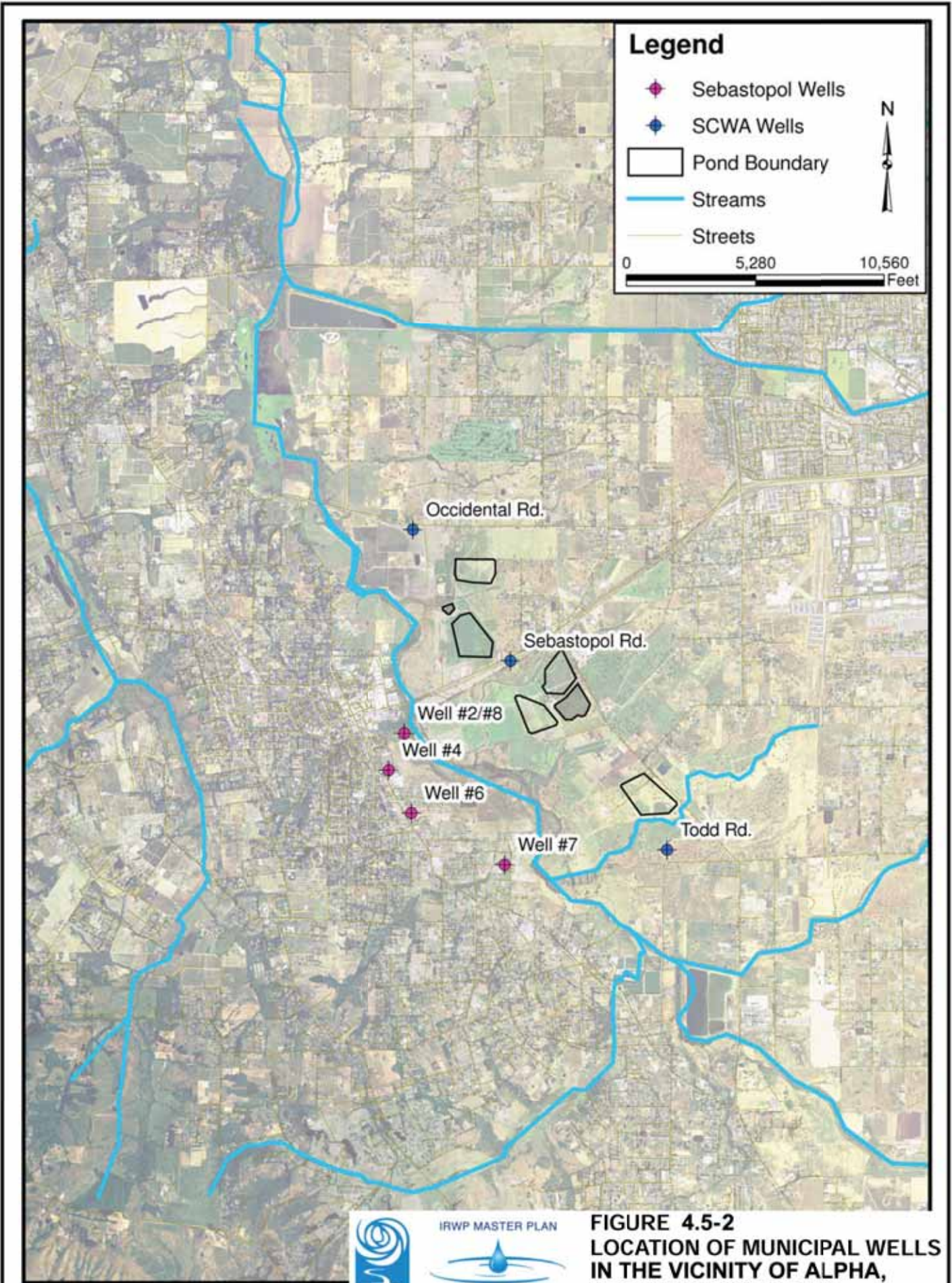


FIGURE 4.5-2
LOCATION OF MUNICIPAL WELLS
IN THE VICINITY OF ALPHA,
BROWN, KELLY FARMS
 WINZLER & KELLY **CH2MHILL**



and toward the municipal wells in the area. Water from the ponds would not ultimately discharge to the Laguna or other creeks.

TABLE 4.5-5
Relation of Proposed Ponds to Nearby Municipal Wells

Alternative	Max. Seepage (gpm)	Nearby Municipal Well/Horizontal Distance (ft)	Est. Travel Time to Well (yrs)	Closest Domestic Wells (ft)
KF1	4	SCWA Seb / 650	50	1 at 650
		SCWA Occ / 3,900	50	
KF2	3	SCWA Occ / 2,100	50	1 at 700
		SCWA Seb / 3,100	50	
BF1	18	SCWA Seb / 1,800	50	3 within 500
BF2	10	SCWA Seb / 1,800	50	1 at 1,000
AF	29	SCWA Todd / 1,500	50	1 at 800
		SCWA Seb / 6,500	500	
		Sebastopol #6 / 8,200	1,000	
		Sebastopol #7 / 5,300	1,000	

Note: Seb is SCWA Sebastopol Rd. well; Occ is SCWA Occidental Rd. well; Todd is SCWA Todd Rd. well. Sebastopol #6 and #7 are City of Sebastopol wells.

The groundwater model results indicate that travel time for the recycled water in the ponds to reach the wells would be on the order of 50 to 1,000 years or longer, as listed in Table 4.5-5, if municipal pumping continues at existing rates. The predominant gradient for all of the alternative pond sites is initially vertical so that seepage reaches the lower aquifer at approximately 500 to 900 feet below ground surface. Once reaching the lower aquifer, the direction of groundwater flow is primarily toward the nearest municipal well.

The groundwater model was developed to examine the percentage of water of wastewater origin that would reach each municipal well, including seepage from any combination of three SSP ponds that would achieve the 500 million gallon (MG) capacity goal. Under steady-state conditions, 0.1 to 3 percent of water extracted at municipal wells is estimated to be of wastewater origin. See Table 4.5-6 for the estimate of cumulative percentage for each municipal well. In a recent letter from CDPH (July 2007, *Appendix D of this EIR*), CDPH recommends that not more than 5 percent of the drinking water from a well be derived from wastewater sources over short durations and not more than 10 percent over long periods of time. The maximum estimated concentration of 3 percent for any well is within the CDPH recommendation.

**TABLE 4.5-6
Percentage of Cumulative Contribution from Recycled Water at Municipal Wells**

Municipal Well	Cumulative Contribution from Three SSP Ponds under Steady State Conditions
SCWA Sebastopol Rd Well	3 percent
SCWA Occidental Rd Well	0.1 percent
SCWA Todd Rd Well	3 percent
Sebastopol #6	0.1 percent
Sebastopol #7	0.1 percent
Future, anywhere in Santa Rosa Plain	3 percent

Note: SCWA wells water supply is mixed with supply from Russian River Ranney collectors.

In addition to evaluating the potential for pond seepage to travel toward existing wells, the groundwater model was used to evaluate impacts to potential future municipal wells. Results suggest that a hypothetical new municipal well at a similar depth and with similar pumping rates as existing municipal wells could be installed anywhere in the vicinity of the ponds and would have a contribution of less than 3 percent recycled water originating from any combination of SSP ponds with a capacity of 500 MG.

The significance threshold for impacts to groundwater quality is 5 percent cumulative recycled water contributions over short durations (monthly averages at groundwater source) for pathogenic microorganism control; or 10 percent cumulative recycled water contributions, as an average over long periods of time (yearly averages at groundwater source), for chemical contaminant control. The estimated cumulative recycled water contribution would be less than 5 percent over short durations and less than 10 percent over long periods of time. Therefore, the impact is less than significant.

Domestic wells or irrigation wells, which pump from the shallower aquifer, would not be affected by potential pond seepage because the hydraulic gradient near the storage pond sites is dominated by the deep municipal pumping from the SCWA wells. Gradients are predominantly vertical near each pond, thus groundwater does not flow laterally to nearby domestic wells. Refer to Table 4.5-5 which identifies the distance from each pond to the closest domestic wells.

In addition to the groundwater modeling analysis, a brief analysis of specific constituents in recycled water is provided. As indicated in the Setting Section, only one constituent in recycled water, nitrate, exceeds the drinking water MCL as it leaves the Laguna Plant; two constituents exceed the CDPH notification level: NDMA and NDPA. However, sampling of water in Brown Farm Pond shows a time-weighted average nitrate concentration of 5.6 mg/L (as N), which indicates that any seepage from the proposed ponds would not

exceed the MCL of 10 mg/L (as N). Existing ponds have been sampled twice for both NDMA and NDPA, and both concentrations were found to be below the reporting limit of 0.002 µg/L, and were therefore below the notification level of 0.01 µg/L. These sampling results indicate that storage of recycled water in ponds attenuates constituents such as nitrate and NDMA and NDPA below MCLs/notification levels.

Background nitrate concentrations in groundwater near the proposed Alpha Farm and Brown Farm ponds are generally less than about 5 mg/L (as N). Nitrate concentrations in groundwater near the proposed Kelly Farm ponds vary between zero and about 30 mg/L (as N), which is above the MCL standard of 10 mg/L (as N). The high background nitrate concentrations may be due to cattle or manure application to fields. These localized areas of high nitrate concentrations may depend on a natural flushing affect of clean groundwater to dilute the nitrate source that is impacting the well's water. If water seeping from the ponds (nitrate assumed to be 5.6 mg/L) replaces the natural recharge from precipitation (nitrate assumed to be 0 mg/L) over the pond footprint, then the dilution effect may be lessened, resulting in higher nitrate concentrations at some wells. The groundwater model was used to predict concentrations in drinking water wells if this dilution effect were to be lessened; increases in nitrate, NDMA, and NDPA would be slight and would remain substantially below the MCL and notification limit respectively in nearby wells.

The ponds would not result in a public health hazard or otherwise degrade groundwater quality, in that all water quality regulations are complied with and impacts to beneficial uses of groundwater such as municipal, domestic or agricultural irrigation wells are less than significant. Any incremental change in groundwater quality is considered less than significant, because it would not require additional treatment on the part of any well owners, according to the CDPH 2007 guidance letter which states that compliance with their recommended thresholds would not trigger the need for further investigation into the need for additional wastewater and/or drinking water treatment.

Pump Station component – No Impact: KF1, KF2, BF1, BF2, and AF

Construction and operation of the inboard or outboard pump stations would not degrade groundwater quality at existing or future wells.

Mitigation: No mitigation is needed.

Impact: 5.2. Will the SSP cause groundwater mounding or increase groundwater levels that cause surface water discharge?

Analysis: *Storage component - Significant: BF1, BF2, and AF*

The groundwater model predicts that if recycled water seeps from the proposed ponds, it would travel downward and toward the municipal wells in the area. Water from the ponds would not ultimately discharge to the Laguna., other creeks, or as any form of surface water.

The Storage component at the BF1 site is predicted to raise groundwater levels by about 8 feet at the center of the pond. Groundwater levels are expected to rise minimally beyond the Brown Farm property boundary. The groundwater level is predicted to increase by 2 feet within approximately 300 feet of the eastern property boundary. The 2-foot rise in groundwater levels beyond the eastern property boundary could place the water table within 6 feet of the land surface. This is largely due to the fact that groundwater is naturally shallow in this area and is typically near this depth.

The rise in groundwater resulting from construction of BF2 is predicted to be approximately 2 feet at the center of the proposed pond. Groundwater levels are expected to rise less than one foot beyond the Brown Farm property boundary. The one-foot rise in groundwater levels beyond the property boundary could place the water table within 6 feet of the land surface. This is largely due to the fact that groundwater is naturally shallow in this area and is typically near this depth.

The rise in groundwater resulting from construction of Alpha Farm is predicted to be approximately 4 feet at the center of the pond. Groundwater levels are expected to rise by less than 2 feet beyond the Alpha Farm property boundary, which could increase groundwater levels to within 6 feet of ground surface.

An increase in groundwater levels to within 6 feet of ground surface is a significant impact.

Storage component - No Impact: KF1 and KF2

The Storage component at the KF1 and KF2 sites would not result in increased groundwater levels. In contrast, groundwater levels are expected to decline because the seepage from the proposed pond is predicted to be less than the amount of recharge from precipitation that currently occurs in the pond areas.

Pump Station component – No Impact: KF1, KF2, BF1, BF2, and AF

Construction of the pump station would not result in increased groundwater levels; no impact would occur.

Mitigation: *Storage component: KF1 and KF2*

Pump Station component: KF1, KF2, BF1, BF2, and AF

No mitigation is needed.

Storage component - Significant: BF1, BF2, and AF

3.5.2 Septic System Replacement

After

Mitigation: *Storage component – Less than Significant: BF1, BF2, and AF*

Increases in groundwater levels to within 6 feet of ground surface could interfere with septic system leachfields. Under Mitigation Measure 3.5.2

Septic System Replacement, if monitoring indicates that the Project has adversely affected septic system operation or environmental health and safety, then septic systems would be replaced with a different type of system, such as a mound system, that can operate effectively in shallow groundwater conditions.

Impact: 5.3 and 5.4. Will the SSP lower groundwater levels at existing wells or in areas that could have been developed for future water supply?

Analysis: *Storage component - Significant: KF1 and KF2*

Modeling results indicate that the Storage component would lower groundwater levels near KF1 and KF2. This is because the seepage from the proposed ponds is predicted to be less than the amount of recharge from precipitation that currently occurs in the pond area. The maximum decline in groundwater level is predicted to be approximately 6 feet below current water levels at the center of the proposed ponds. The groundwater level is predicted to decline by about 2 feet in an area extending approximately 500 feet from the Kelly Farm property line to the east and north. This decrease is considered to be a significant impact.

Storage component – No Impact: BF1, BF2, and AF

The Storage component at BF1, BF2, and AF would not lower groundwater levels. Modeling results indicate that the Storage component would raise groundwater levels; no impact would occur to existing or future wells.

Pump Station component – Less than Significant: KF1, KF2, BF1, BF2, and AF

Construction of the pump station requires excavation to a depth of approximately 7 feet below the storage pond bottom. Excavation to this depth would likely encounter groundwater. Thus, local soil dewatering may be required during construction. Dewatering would be localized in the immediate vicinity of the pump station. Therefore, nearby wells would not be affected, and impacts would be less than significant.

Implementation of Mitigation 3.3.18, Minimize Temporary and Permanent Visual Impacts, to reduce land use and visual resources impacts from the inboard pump stations at the KF1, KF2, and BF1 sites could include constructing the pump station outboard at grade instead of inboard on the pond embankment. Construction of an outboard pump station would require excavation to a depth of approximately 20 below ground surface. Excavation to this depth would likely encounter groundwater. Thus, local soil dewatering may be required during construction. Similar to dewatering for an inboard pump station, dewatering would be localized in the immediate vicinity of the pump and would not affect nearby wells. Impacts would be less than significant.

Mitigation: *Storage component: BF1, BF2, and AF*

Pump Station component: KF1, KF2, BF1, BF2, and AF

No mitigation is needed.

Storage component: KF1 and KF2

3.3.9 Well Protection Program

After

Mitigation: *Storage component – Less than Significant: KF1 and KF2*

If water level monitoring indicates that wells may become unproductive as a result of nearby ponds, Mitigation Measure 3.3.9 provides several optional ways to reduce the impact of lowering groundwater levels at existing wells, including drilling a new well outside the zone of impact, deepening the well, or providing a new water supply. One of these approaches would be successful at reducing impacts to less than significant.

No Project

Impact: 5.1 through 5.4. Will the No Project alternative impact groundwater based upon evaluation criteria 1 through 4?

Analysis: *No Impact*

The No Project alternative would not result in new facilities or operations that could affect groundwater.

Mitigation: No mitigation is needed.

CUMULATIVE IMPACTS

Impact: 5.1C. Will the SSP plus cumulative projects degrade groundwater quality at existing or future drinking water wells, resulting in a public health hazard or otherwise degrading groundwater quality?

Analysis: *Less than Significant*

The groundwater model constructed for the Project analyzed the cumulative condition, including:

- Effects from existing recycled water storage ponds in the Santa Rosa Plain;
- The potential for additional future municipal wells in the Santa Rosa Plain; and
- The potential for additional future domestic wells in the Santa Rosa Plain.

No other existing or future source of recycled water of wastewater origin has been identified. The model predicts that building any three storage ponds plus existing ponds and cumulative projects would contribute less than 3 percent water of wastewater origin at any existing or future municipal well, and would

contribute no water of wastewater origin to domestic wells. The Project's contribution to cumulative impacts is considered less than significant.

Impact: 5.2C. Will the SSP and cumulative projects cause groundwater mounding or increase groundwater levels that cause surface water discharge?

Analysis: *Less than Significant*

The groundwater model also analyzed the cumulative condition relative to groundwater levels. The model predicts that building any three storage ponds plus existing ponds and cumulative projects would cause the groundwater level at the BF1 and AF sites to rise to rise such that the water table comes within 6 feet of the land surface. Under Mitigation Measure 3.5.2 septic systems in the impacted areas would be replaced with a different type of system, such as a mound system, that can operate effectively in shallow groundwater conditions. Therefore, the contribution of these ponds to increased groundwater levels has been completely mitigated. No cumulative projects or trends have been identified that would exacerbate rising groundwater levels.

The Storage component at the KF1 and KF2 sites would not raise groundwater levels, and no contribution to cumulative impacts would occur at these sites. The Storage component at the BF2 site may raise groundwater levels by less than 1 foot; however, no cumulative projects have been identified that would exacerbate this impact, and the pond's contribution to cumulative impacts is not considerable.

Mitigation: No additional mitigation is needed.

Impact: 5.3C and 5.4C. Will the SSP plus cumulative projects lower groundwater levels at existing wells or in areas that could have been developed for future water supply?

Analysis: *Less than Significant: KF1 and KF2*

No Impact: BF1, BF2, and AF

The groundwater model also analyzed the cumulative condition relative to groundwater levels. The model predicts that building any three storage ponds plus existing ponds and cumulative projects would cause the groundwater level near KF1 and KF2 to decline by about 2 feet. Under Mitigation Measure 3.3.9, Well Protection Program, existing or future wells would be re-screened, redrilled or replaced if water level monitoring indicates that wells may become unproductive as a result of nearby ponds. Therefore, the contribution of these ponds to increased groundwater levels would be completely mitigated. In the Santa Rosa Plain, some well owners report a reduction in groundwater elevation. Even with such trends, Mitigation Measure 3.3.9 would still be effective at completely mitigating impacts of the KF1 and KF2 ponds on groundwater levels.

The Storage component at the BF1, BF2, and AF sites would not lower groundwater levels, and therefore these ponds would not contribute to cumulative impacts at existing or future wells.

Groundwater dewatering may be necessary during construction of the pump stations. Construction dewatering is a temporary operation; groundwater levels would be expected to return to pre-construction levels once construction was complete. Dewatering would be localized in the immediate vicinity of the pump station and would not affect existing or future wells, and therefore would not contribute to lowered groundwater levels from other projects.

Mitigation: No additional mitigation is needed.

SUMMARY OF SIGNIFICANT IMPACTS AND MITIGATION MEASURES

TABLE 4.5-7

Summary of Significant Impacts and Mitigation Measures – Groundwater

Impact	Level of Significance	Mitigation Measure
KF1		
5.3 and 5.4. The Storage component could lower groundwater levels at existing wells.	⊙	3.3.9 Well Protection Program
KF2		
5.3 and 5.4. The Storage component could lower groundwater levels at existing wells.	⊙	3.3.9 Well Protection Program
BF1		
5.2. The Storage component could cause groundwater mounding or increase groundwater levels that cause surface water discharge.	⊙	3.5.2 Septic System Replacement
BF2		
5.2. The Storage component could cause groundwater mounding or increase groundwater levels that cause surface water discharge.	⊙	3.5.2 Septic System Replacement
AF		
5.2. The Storage component could cause groundwater mounding or increase groundwater levels that cause surface water discharge.	⊙	3.5.2 Septic System Replacement

Notes: Level of Significance:

- : Significant impact before and after mitigation
- ⊙: Significant impact before mitigation; less than significant impact after mitigation

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