OVERVIEW OF THE ESTRELLA SUBAREA OF THE PASO ROBLES GROUNDWATER BASIN

This overview of the Paso Robles Groundwater Basin (Basin) and the Estrella Subarea are provided to establish the groundwater setting and identify groundwater issues that may be used to develop groundwater management goals, objectives, and actions as part of the Paso Robles Groundwater Basin Management Plan. The following information was summarized from existing reports and available information for the Basin and the Estrella Subarea.

Paso Robles Groundwater Basin

The basin-wide information includes the general groundwater setting of the Paso Robles Groundwater Basin and recent hydrologic conditions.

Groundwater Setting of the Paso Robles Groundwater Basin

The Paso Robles Groundwater Basin covers about 505,000 acres in southern Monterey County and northern San Luis Obispo County. The Paso Robles Groundwater Basin is subdivided into eight subareas. The groundwater system in the Paso Robles Groundwater Basin consists of the Paso Robles Formation and the shallow alluvial aquifers associated with creeks and rivers.

The shallow alluvial aquifers are present along the Salinas River, Estrella River, Huerhuero Creek, and other tributary creeks. Groundwater stored in the alluvial aquifer system accounts for about two percent of the total groundwater storage in the entire Basin. While the amount of total storage may be small, the alluvial aquifers are a significant source of recharge to the Paso Robles Formation, particularly along the western end of the Basin where the Salinas River is located. The coarse-grained deposits of the shallow alluvium act as an unconfined aquifer.

In areas where the alluvial aquifers are not present, the Paso Robles Formation is exposed at the ground surface. The Paso Robles Formation consists of less permeable, interbedded deposits with highly variable thicknesses and permeability, but is the primary aquifer for most agricultural and municipal users. Groundwater stored in the Paso Robles Formation generally occurs under semi-confined to confined conditions. The two primary sources of recharge to the Paso Robles Formation include the infiltration of precipitation and the percolation of stream flow into the shallow alluvial aquifers that infiltrates the Paso Robles Formation.

The alluvium and Paso Robles Formation rest on older consolidated sediments. Faults have created a conduit to allow water trapped in these older sediments to come to the surface as geothermal water.

There are currently about 150 wells located within the limits of the Paso Robles Groundwater Basin that are monitored by the San Luis Obispo County Department of Public Works and the Monterey County Water Resources Agency (Figure 1). These wells are used to track the changes in groundwater level trends through time at a specific location (presented in well hydrographs), or across an area for a specific date (presented as water level maps).

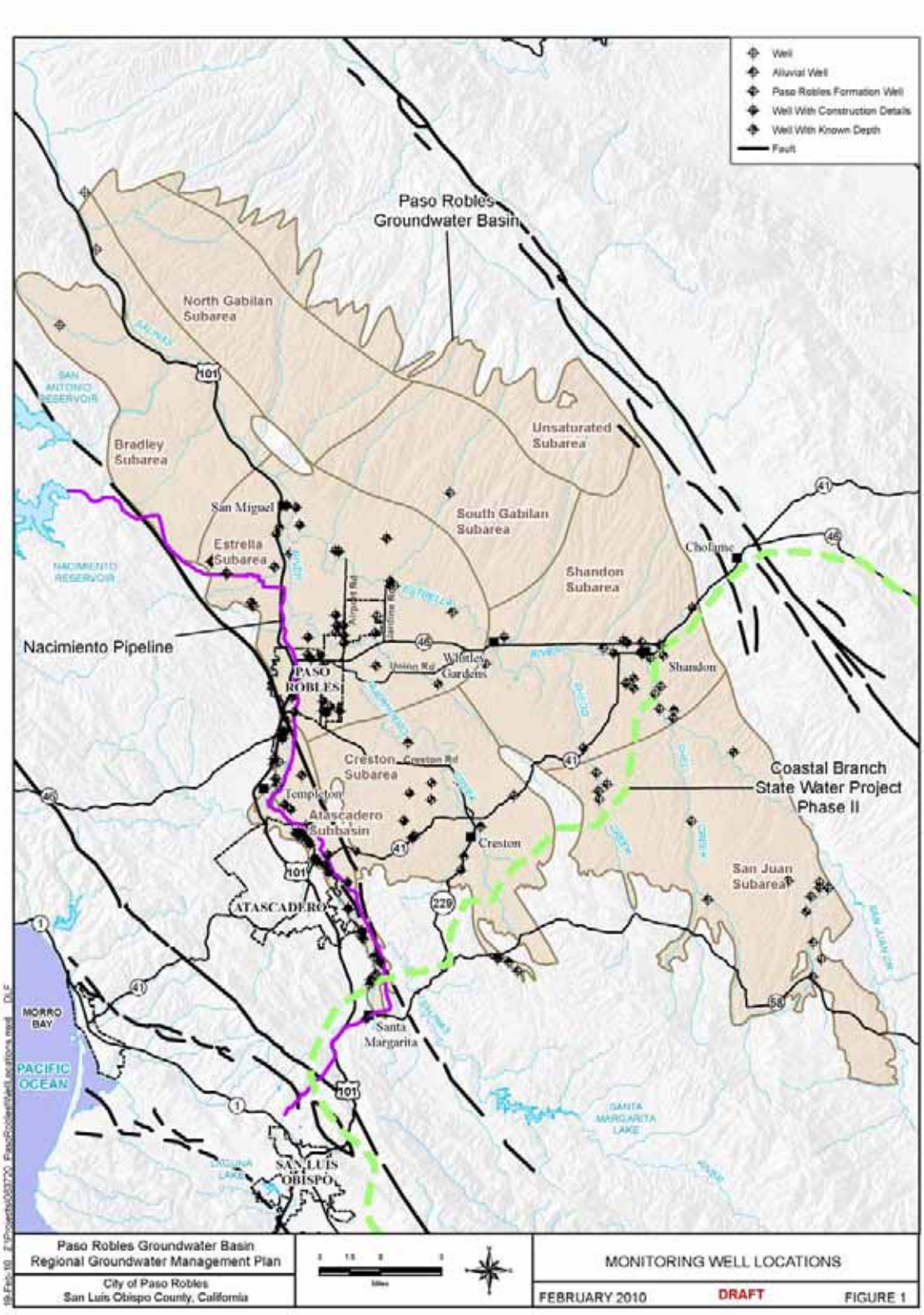

Figure 1. Location of Groundwater Monitoring Wells in the Paso Robles Groundwater Basin

Recent Hydrologic Conditions

This section summarizes the recent hydrologic conditions for the areas tributary to the Paso Robles Groundwater Basin. The annual precipitation is measured at seven rainfall gauge stations located throughout the Basin to record the geographic variation in rainfall. The Atascadero MWC Station No. 34 is one of the gauges with a long, continuous period of record. The long-term average annual precipitation at this gauge is 17.6 inches per year for the 1916 to 2009 period.

During the 1998 to 2009 period, the Atascadero MWC Station No. 34 averaged 16.7 inches per year. Based on this comparison, the average annual precipitation for the 1998 to 2009 period is somewhat drier than the long-term average.

While the 12-year average for the 1998 to 2009 period may not differ greatly from the long-term average, there is considerable annual variation in precipitation. During the 1998 to 2009 period, the annual precipitation at the Atascadero MWC Station No. 34 ranged from a minimum of 7.6 inches in 2007 to a maximum of 34.6 inches in 2005. Additionally, the last three years (2007 to 2009) received below average rainfall.

Estrella Subarea

The following information for the Estrella Subarea includes the recent land and water conditions and local groundwater conditions.

Land and Water Use

The Estrella Subarea is located in the western portion of the Paso Robles Groundwater Basin and has an area of approximately 82,500 acres, which makes up about 16 percent of the area of the Basin. This subarea includes the City of Paso Robles (City) and the San Miguel Communities Services District. The Salinas River flows north roughly paralleling Highway 101. Huerhuero Creek enters the subarea from the Creston Subarea and flows into the Salinas River near the City of Paso Robles. The Estrella River flows from the Shandon Subarea and enters the Salinas River north of the City.

The water use in 2006 totaled about 34,000 acre-feet representing about 38 percent of the water use in the Basin. The water users in the Estrella Subarea and their uses are shown in Table 1. In 2006, the entire demand was met with groundwater. There is a diverse group of water users in this subarea. About two-thirds of the pumping in this subarea is for agricultural uses. Rural and municipal users account for about one-third of the groundwater pumping.

Beginning in 2010, up to 4,000 acre-feet of surface water from the Nacimiento Pipeline will be available to the City of Paso Robles to offset the municipal groundwater pumping. The City will not be able to directly use this supply until a water treatment plant is constructed, which is anticipated to come on-line in 2012.

Table 1. Total Estimated Pumping in 2006 in the Estrella Subarea (AF)

Agriculture	Municipal	Small Community	Small Commercial	Rural	**2006 Total**
23,111	3,930	156	1,603	5,277	**34,078**
(68%)	(11%)	<1%)	(5%)	(15%)	**(100%)**

(Todd, 2009)

Local Groundwater Conditions

In the Estrella Subarea, the groundwater system consists of the Paso Robles Formation and the shallow alluvial aquifers.

Most production wells extract water from the Paso Robles Formation. Well total depths in the Estrella Subarea range from 300 to 900 feet and average between 500 to 600 feet. Groundwater wells production ranges from less than 100 to 1,000 gallons per minute. The alluvial aquifer associated with the Salinas River acts a primary source of recharge to the Paso Robles Formation. Wells tapping the alluvial aquifer tend to be less than 100 feet thick.

Groundwater Flow

Groundwater flows from areas with higher elevations to lower elevations. Figure 2 shows the groundwater elevations and general flow directions for Spring 2009. Groundwater generally flows to the west, towards the Estrella Subarea, and then north paralleling the Salinas River to the Basin outlet into the Salinas Valley Groundwater Basin. There is a groundwater low (pumping depression) in the Estrella Subarea beneath the City of Paso Robles.

There are currently 50 wells located within Estrella Subarea that are included in the groundwater monitoring network. Based on the groundwater level data collected in the Estrella Subarea, there has been a general decline in groundwater levels observed and recorded at selected wells located throughout the subarea since the 1960s. The rate of decline changes through time in response to changing hydrologic conditions and changes in the amount of local groundwater pumping.

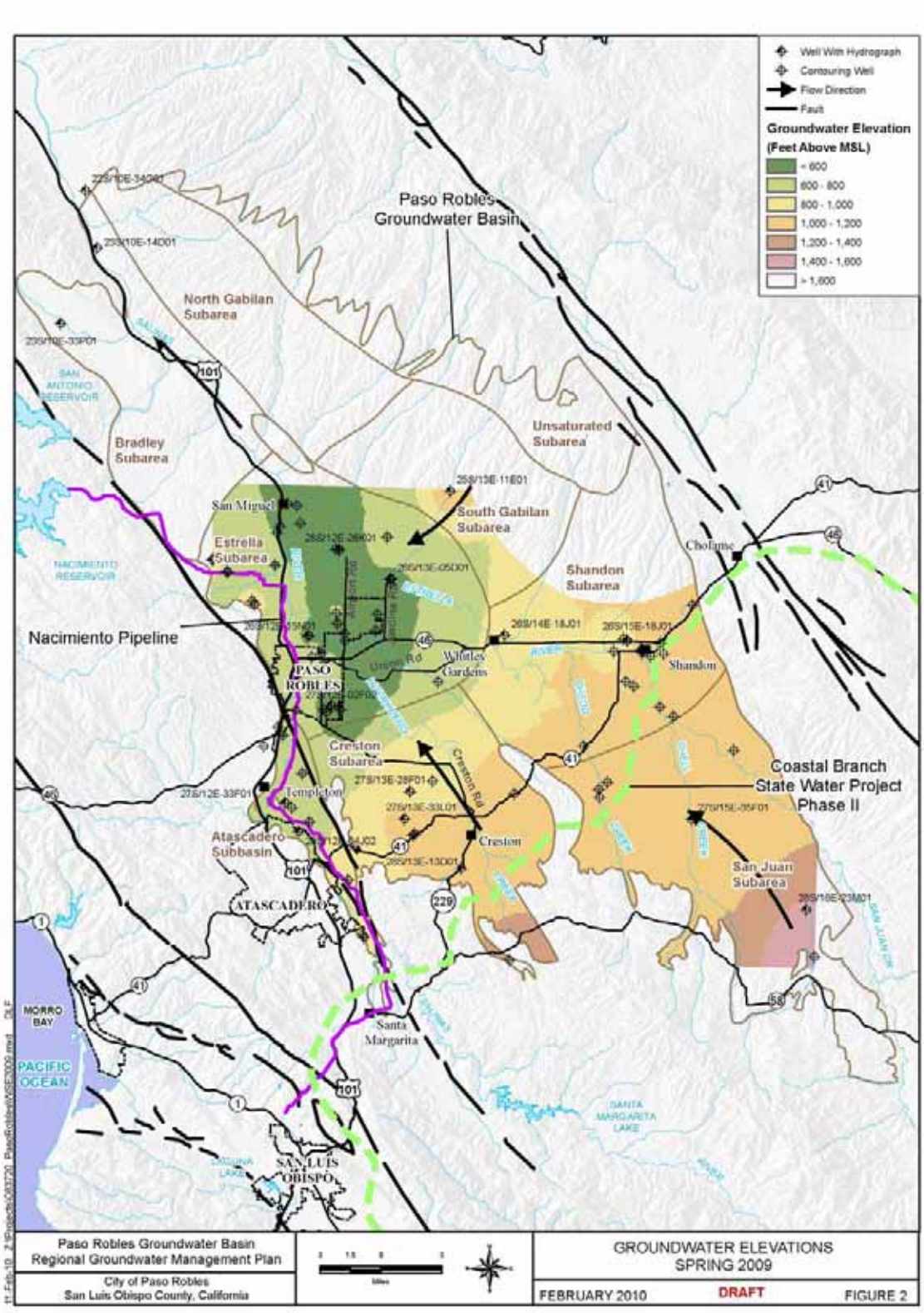

Figure 2. Spring 2009 Groundwater Levels in Paso Robles Groundwater Basin

Groundwater Levels

Several wells have been identified in the Estrella Subarea to demonstrate how groundwater levels have changed through time (well hydrographs) at discrete locations in the subarea. These wells were selected to represent a range of the conditions in the subarea through an extended period of record. Figures 3 through 6 show the groundwater level trends in key wells in the Estrella Subarea. The locations of these wells are shown on Figure 2. A brief discussion is provided for each well.

Well 25S/12E-26K01 – This well is located north of Airport Road near the Estrella River as shown on Figure 7, and is on the north edge of the pumping depression with the subarea. Over the 50-year period of record, groundwater levels in this well declined almost 80 feet, with about half of this decline between 1997 and 2009, as shown on Figure 3. During this 12-year period, the rate of decline has averaged about three feet per year. The seasonal variation (difference between spring and fall observations) in groundwater levels is about 10 to 20 feet during this period.

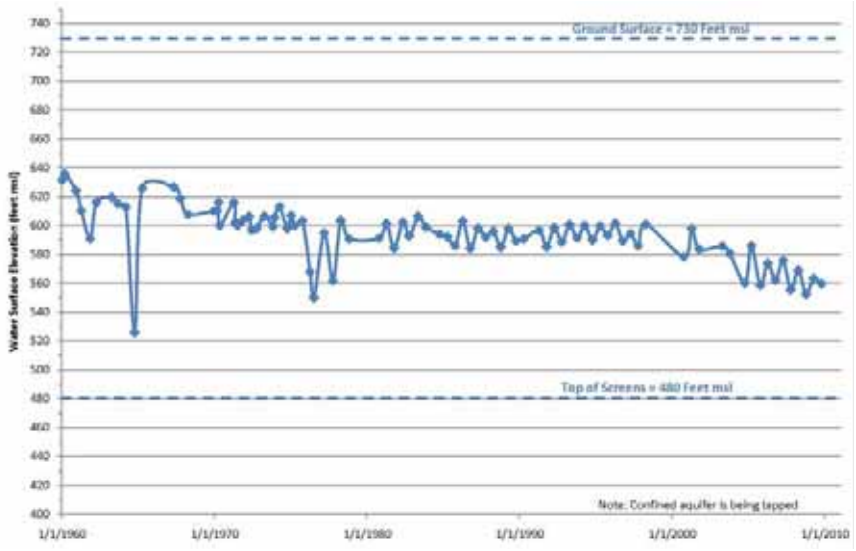

Figure 3. Hydrograph for Well 25S/12E-26K01

Well 26S/13E-5D01– This well is located north of Jardine Road near the Estrella River as shown on Figure 7 and is on the northeast edge of the expanding pumping depression with the subarea. Groundwater levels in this well declined almost 120 feet, with about 90 feet of this decline between 1997 and 2009 as shown on Figure 4. During this 12-year period, the rate of decline has averaged about 7.5 feet per year. The seasonal variation (difference between spring and fall observations) in groundwater levels is about 20 to 50 feet during this period.

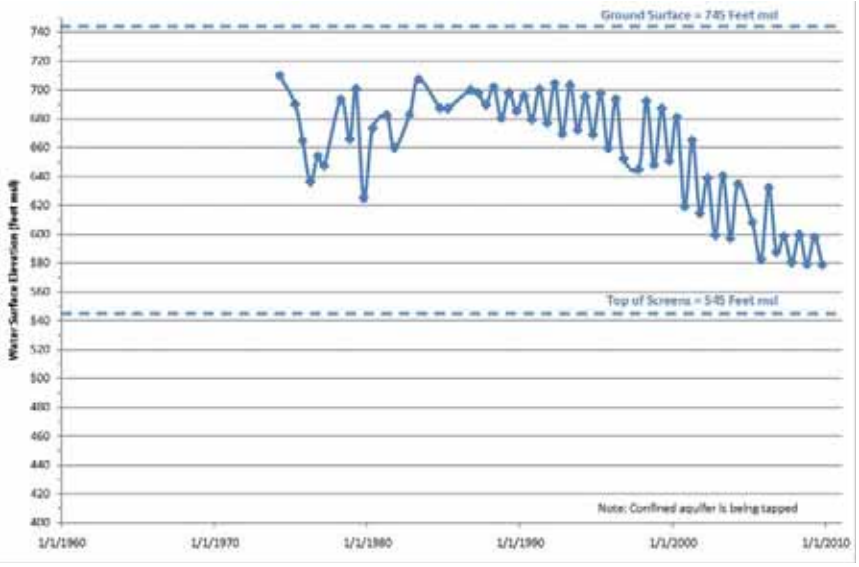

Figure 4. Hydrograph for Well 26S/13E-5D01

Well 27S/12E-2F02– This well is located in the southwest corner of the City of Paso Robles just northeast of Creston Road as shown on Figure 7, and is considered to be within the pumping depression. Over the 40-year period of record, spring groundwater levels in this well declined almost 110 feet as shown on Figure 5. During the 12-year period from 1997 to 2009, water levels dropped about 95 feet. This corresponds to an average rate of decline of about 8 feet per year. The fall groundwater level measurements taken in some years show seasonal drawdowns approaching 120 feet compared to the spring measurements, and in some cases these measurements dropped below the top of the well screens.

Figure 5. Hydrograph for Well 27S/12E-2F02

Well 26S/12E-15N01– This well is located north of the City of Paso Robles; about one-half mile west of the Estrella River as shown on Figure 7, and is considered to be on the western edge of the pumping depression. Prior to 1980, seasonal groundwater levels fluctuated by as much as 60 feet as shown on Figure 6. Between 1980 and 2000, groundwater levels were stable near the highest levels and had much smaller seasonal fluctuations.

During the period from 1997 to 2009, water levels dropped by about 80 feet. This corresponds to an average rate of decline of about 6.5 feet per year. The seasonal variation (difference between spring and fall observations) in groundwater levels is about 20 to 50 feet during this period. These measurements suggest that groundwater elevations have dropped below the top of the well screens.

Figure 6. Hydrograph for Well 26S/12E-15N01

Change in Groundwater Storage

Overall, groundwater levels have been steadily declining in the Estrella Subarea for many years due to groundwater pumping. A slow decline in groundwater levels occurred between 1960 and 1980. Between 1980 and 2000, groundwater levels stabilized. Since 2000, groundwater levels have fallen in response to increased groundwater pumping. The pumping depression that was identified previously appears to have expanded since 2000 in response to increased groundwater pumping and below normal hydrologic conditions.

Between 1997 and 2009 groundwater levels within the Estrella Subarea have declined significantly as shown on Figure 7. In much of the subarea between the City of Paso Robles and Whitley Gardens and toward the Creston Subarea groundwater levels have declined by as much as 70 feet. Groundwater levels in the San Miguel area have generally declined between 10 and 20 feet during this period. In the area northeast of the City of Paso Robles, near Jardine Road, groundwater levels have declined by more than 50 feet. In some cases, groundwater levels have dropped below the existing rural domestic wells, causing those wells to go dry and require deepening to restore production.

Because of the lack of data east of Jardine Road and south of Union Road, the extent of the area with groundwater level decline greater than 70 feet may appear larger than actually exists. Additional observations wells are needed to provide more complete mapping of the groundwater levels in the area.

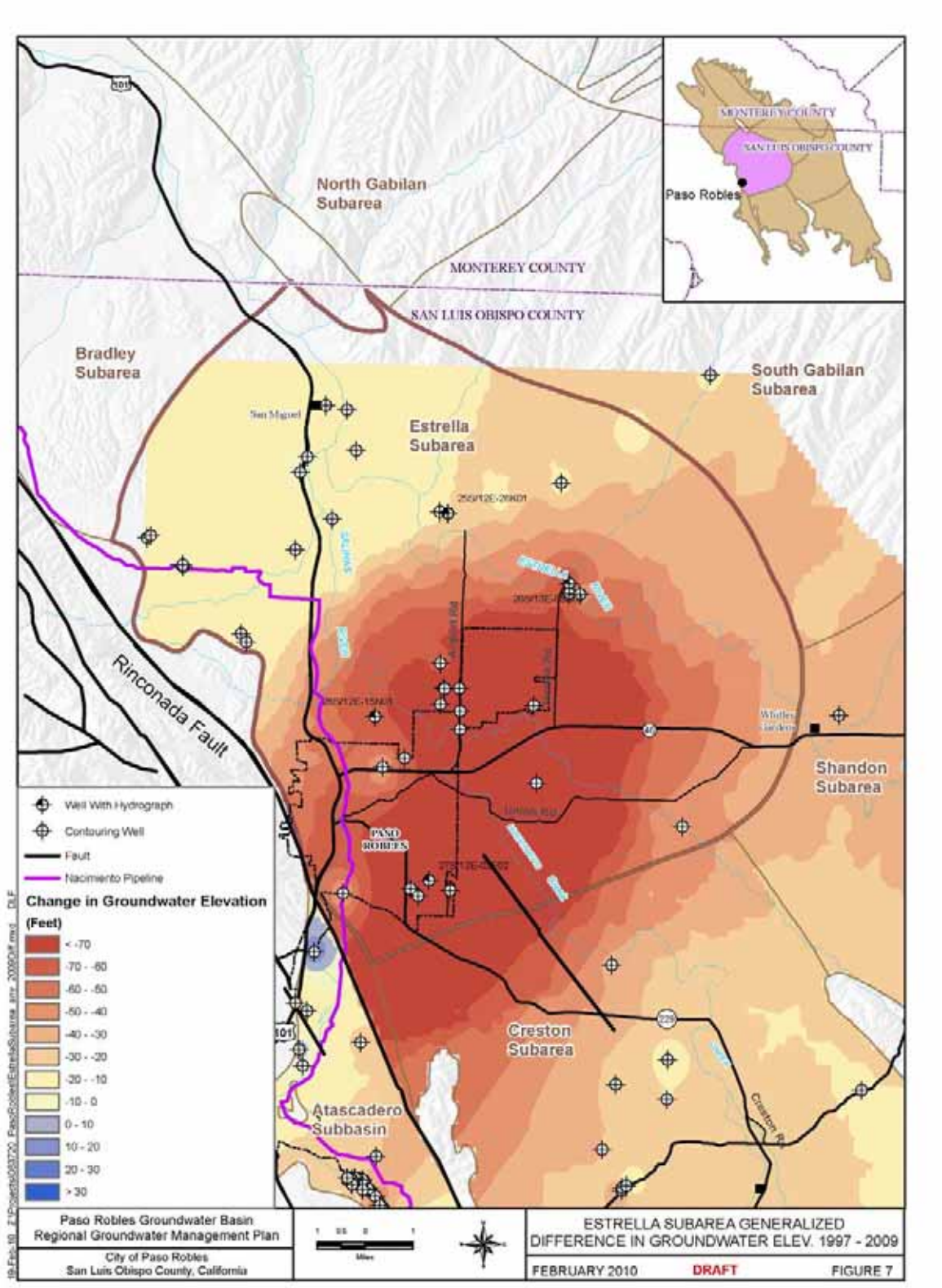

Figure 7. Change in Groundwater Levels in the Estrella Subarea for the 1997 to 2009 Period

Groundwater Quality Information

Groundwater quality in the subarea is generally good to moderate for municipal use. Total dissolved solids (TDS), a measurement of the salts in the water, is typically used to assess water quality. For municipal purposes, the TDS should be less than 500 mg/l, but can be usable up to 1,000 mg/l. TDS concentrations in local municipal supply wells, as reported in the 2007-2008 Consumer Confidence Reports, ranged from 370 to 740 mg/l (averaging 518 mg/l) for the City of Paso Robles, and ranged from 450 to 740 mg/l (averaging 580 mg/l) for San Miguel Community Services District(CSD).

Groundwater quality in the subarea is generally suitable for irrigation with slight to moderate restriction for trees and vines due to potential sodium and chloride ion toxicity (Fugro and Cleath, 2002).

Two locations have been identified as contamination sites within the Paso Robles Basin. The first is Sherwood Well #6 located on Niblick Avenue just east of Creston Road. Concentrations of PCE (perchloroethylene) have gone down at this site between 2002 and 2010. The second site is located at 1730, 1740, and 1750 Commerce Avenue. During a two-year period, between 2006 and 2008, contaminant concentrations have remained stable.

The influence of geothermal water on basin groundwater quality is generally restricted, based on structure and water levels, to basin sediments west of Paso Robles. Sodium concentrations across most of the Estrella Subarea do not appear to increase with depth, and no significant influence on water quality from geothermal waters in basin sediments is found east of Paso Robles.

References

Fugro and Cleath, 2002. *Paso Robles Groundwater Basin Study,* August 2002

Fugro, 2010. *Paso Robles Groundwater Basin Balance Review and Update.* February 2010

Todd, 2009. *Evaluation of Paso Robles Groundwater Basin Pumping, Water Year 2006.* May 2009