



# Analysis of Near-Term Groundwater Capture Areas for Production Wells Located Near the Whittaker-Bermite Property (Santa Clarita, California)

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## Introduction

In cooperation with state regulatory agencies and investigators working for Whittaker-Bermite, the Castaic Lake Water Agency (CLWA) and the retail water purveyors in the Santa Clarita Valley (hereafter referred to collectively as the Purveyors) have developed a plan to restore municipal groundwater supply that has been impacted by perchlorate. The plan will include the resumption of groundwater pumping at two of the contaminated production wells (SCWC-Saugus1 and SCWC-Saugus2) that were shut down in 1997 because perchlorate was detected in both wells. In addition to resuming the production of water for municipal water supply, the pumping plan is also a groundwater containment plan that is designed to hydraulically control local groundwater flow patterns in a manner that protects other Saugus production wells located downgradient, to the west and northwest, where perchlorate has not been detected in groundwater. The SCWC-Saugus1 and SCWC-Saugus2 production wells are completed in the Saugus Formation aquifer system that underlies the Santa Clarita Valley in Los Angeles County, California. Figure 1 is a map of the study area, showing the locations of these and other nearby wells (tables and figures are located at the end of this technical memorandum).

The Saugus wells contaminated by perchlorate had produced a combined average of 4,186 acre-feet per year over the five years preceding the detection of perchlorate. Restoration of that amount of water supply is currently planned to be achieved by reactivating the SCWC-Saugus1 and SCWC-Saugus2 wells, with treatment for removal of perchlorate, and by constructing replacement wells in other parts of the Saugus Formation not impacted by perchlorate. Full restoration of impacted water supply, including the containment plan, is currently scheduled for implementation by 2006. The containment plan will consist of (1) pumping groundwater on a nearly continual basis from the SCWC-Saugus1 and SCWC-Saugus2 production wells; (2) treating the pumped water using ion exchange resins followed by chlorine and ammonia disinfection; and (3) pumping the treated water to CLWA's Rio Vista Intake Pump Station for subsequent distribution for municipal water supply.

The Purveyors have requested that CH2M HILL conduct an analysis to evaluate the possibility that uncontaminated Saugus production wells will be impacted by perchlorate migration while they are used for regular water supply during this interim period (prior to

the 2006 implementation of the containment plan). This issue has been evaluated using the regional groundwater flow model for the Santa Clarita Valley (hereafter referred to as the Regional Model), and is described in this technical memorandum. The Regional Model was used to forecast the locations and extents of the hydraulic capture zones that would result from the interim operation of production wells that lie north and west of the Whittaker-Bermite property and withdraw water from the Saugus Formation and Alluvial Aquifer. The Regional Model's construction and calibration are described in *Regional Groundwater Flow Model for the Santa Clarita Valley: Model Development and Calibration* (CH2M HILL, 2004a). An analysis of the long-term containment plan for the contaminated Saugus Formation production wells is described in the final report, *Analysis of Perchlorate Containment in Groundwater Near the Whittaker-Bermite Property, Santa Clarita, California* (CH2M HILL, 2004b).

The remainder of this technical memorandum describes the methods used to forecast groundwater capture by production wells during the interim period, followed by the findings from the analysis.

## Methodology

Figure 1 shows the location of each production well that lies in the vicinity of the Whittaker-Bermite property. The figure identifies the production wells that are completed in the surficial Alluvial Aquifer and production wells that are completed in the deeper Saugus Formation. The figure also identifies which wells have been contaminated by perchlorate. As shown on the figure, the contaminated Saugus production wells are SCWC-Saugus1, SCWC-Saugus2, NCWD-11, and VWC-157, and Alluvial Aquifer production well SCWC-Stadium. Figure 1 also shows measured perchlorate concentrations at each production well and the highest perchlorate concentrations that have been measured at monitoring wells and other exploratory borings that have been drilled on and near the Whittaker-Bermite property in recent years.

Table 1 shows the pumping rates for normal years at each active Saugus Formation production well not contaminated by perchlorate. Table 2 shows the same information for each active production well in the Alluvial Aquifer. Important notes regarding the pumping distribution during this interim period are as follows:

1. All pumping rates were derived from records of instantaneous and annual pumping in recent years.
2. In a few of the Alluvial wells, the pumping rates were increased for the purposes of this analysis to include Alluvial pumping that has ceased at the one contaminated Alluvial well (SCWC-Stadium).
3. There is no pumping at the four contaminated Saugus production wells, or at the one contaminated Alluvial well.
4. The combined pumping rate is 1,100 acre-feet per year (AF/yr) from wells VWC-201 and VWC-205, which are the closest wells to contaminated wells SCWC-Saugus1 and SCWC-Saugus2.

5. The combined pumping rate is 2,630 AF/yr from wells NCWD-12 and NCWD-13, which are the closest wells to contaminated well NWCD-11.
6. The Alluvial Aquifer production wells that are closest to the contaminated Saugus production wells are six wells owned by the Valencia Water Company (VWC). These six wells (VWC-N, -N7, -N8, -S6, -S7, and -S8) are located along the Santa Clara River at the mouth of the South Fork Santa Clara River. These wells pump 5,880 AF/yr under the operational plan that will be in effect during the interim period. Well VWC-Q2, which lies just to the east, pumps 1,046 AF/yr.
7. Two VWC-owned Alluvial Aquifer wells that are due north of the Whittaker-Bermite property (VWC-T2 and VWC-T4) pump a combined 978 AF/yr. These wells lie along the north side of Soledad Canyon, on the opposite side of the Santa Clara River from the Whittaker-Bermite facility.
8. Two VWC-owned Alluvial Aquifer wells (VWC-U4 and VWC-U6) that lie south of the river and east (upgradient) of the Whittaker-Bermite site pump a combined 1,869 AF/yr.
9. The normal-year pumping rates listed in Tables 1 and 2 were simulated with the model. Dry-year pumping was not simulated because (a) the remainder of 2004 has an average water supply, and (b) if 2005 were to be a dry year, water demands during such a year can be met from a combination of non-impacted local groundwater, water imported from the State Water Project, and alternate firming supplies available to CLWA, most notably some of the nearly 51,000 AF that CLWA can recover from its banked water in the Semitropic Groundwater Banking Program.

The pumping rates listed in Tables 1 and 2 were used to generate new groundwater elevations and groundwater flow fields in each of the seven model layers, using the steady-state version of the Regional Model. Groundwater capture zones<sup>1</sup> were then delineated for a 2-year period, which is conservative in light of the approximately 1.5-year period that is currently scheduled for returning the SCWC-Saugus1 and SCWC-Saugus2 production wells to service. For the groundwater capture zone delineation process, an effective porosity of 0.05 was assumed, which is at or slightly below the low end of the range of effective porosity values that are typical for the deposits that comprise the aquifer matrix in the Saugus Formation. The longer time and the lower effective porosity were used together for modeling purposes to minimize the possibility of underestimating the extents of the 2-year groundwater capture zone for each well.

## Results for Saugus Production Wells

Figure 2 shows the forecasted 2-year groundwater capture zones for the four actively pumping Saugus Formation production wells that lie closest to the Whittaker-Bermite property. The figure shows the following:

1. Wells VWC-201 and VWC-205 would draw water from very localized areas around these wells, and would not draw water from locations where perchlorate has been detected in the Saugus Formation. Specifically:

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<sup>1</sup> A groundwater capture zone is defined in this technical memorandum as the geographic area within which a well obtains a specified volume of groundwater during a specific time period.

- a. During the next two years, well VWC-201 will potentially draw Saugus groundwater from areas located as far as 450 feet east of this well, but is unlikely to draw water from areas any farther to the east during this period.
  - b. During the next two years, well VWC-205 will potentially draw Saugus groundwater from areas lying as far as 650 feet to the east and northeast of this well.
2. Wells NCWD-12 and NCWD-13, which are owned by the Newhall County Water District (NCWD), would also draw water from relatively localized areas during the modeled 2-year period, although the areal extent of these groundwater capture zones is larger than for the two Valencia Water Company wells because the simulated pumping is higher at the two NCWD wells (2,630 AF/yr) than at the two Valencia Water Company wells (1,100 AF/yr). The areal extent of these 2-year groundwater capture zones is approximately 1,500 feet for Well 12 and 1,300 feet for Well 13. Additionally, the outer portion of the 2-year groundwater capture zone for NCWD-13 includes the location of contaminated well NCWD-11. A reduction in the pumping rate at NCWD-13 would decrease the areal extent of its groundwater capture zone so that it does not include the location of NCWD-11. A decrease in the NCWD-13 pumping rate could be accomplished by shifting some or all of its pumping to another NCWD well and/or by increasing NCWD's importation of State Water Project water.

The groundwater capture zones shown on Figure 2 for each uncontaminated well might be larger than the areas that actually contribute water to these wells during the interim period that precedes implementation of the long-term containment plan. This is because (1) the analysis period (two years) is longer than is likely to be required to implement the long-term containment plan, and (2) the assumed effective porosity (0.05) is relatively low for the types of sediment that comprise the Saugus Formation, which therefore makes the areal extent of each simulated groundwater capture zone larger for each Saugus production well than might arise in the field.

## Results for Alluvial Production Wells

Figure 3 shows the forecasted 2-year groundwater capture zones for the Alluvial Aquifer production wells in the vicinity of the Whittaker-Bermite property. The figure uses separate colors to distinguish the groundwater capture zones for each well. The analysis suggests the following:

1. VWC's Pardee wellfield (wells VWC-N, -N7, and -N8) could be impacted by perchlorate during the interim period, because the groundwater capture zones for these wells lie close to the contaminated well SCWC-Stadium and are closer to the Whittaker-Bermite property than the groundwater capture zones of the other Alluvial Aquifer production wells.
2. The other Alluvial Aquifer production wells will likely obtain water from areas upgradient of the Whittaker-Bermite property or from areas that lie north of the groundwater capture zones for the Pardee wells. Consequently, these wells are less likely to be impacted by perchlorate during the interim period.

3. The VWC-owned Alluvial Aquifer production wells shown in Figure 3 obtain their water from the portion of the Alluvial Aquifer that lies along the Santa Clara River in and near Soledad Canyon. These wells do not obtain water from areas to the south that include the alluvial valley occupied by the South Fork Santa Clara River. The groundwater capture zones for these wells also do not include the area at, and immediately south of, Bouquet Junction where observation wells with historical perchlorate detections are located (observation wells EM01, EM02, EM03, AL04A, AL04B, AL04\_R1, AL04\_R2, AL04\_R3, and AL04\_R4).

## References

CH2M HILL. 2004a. *Regional Groundwater Flow Model for the Santa Clarita Valley: Model Development and Calibration*. Prepared for the Upper Basin Water Purveyors (Castaic Lake Water Agency, Santa Clarita Water Division of CLWA, Newhall County Water District, and Valencia Water Company). April.

CH2M HILL. 2004b. *Final: Analysis of Perchlorate Containment in Groundwater Near the Whittaker-Bermite Property, Santa Clarita, California*. Prepared for the Upper Basin Water Purveyors (Castaic Lake Water Agency, Santa Clarita Water Division of CLWA, Newhall County Water District, and Valencia Water Company). December.

**TABLE 1**

Active Municipal Groundwater Source Capacity for Saugus Formation Wells

*Technical Memorandum: Analysis of Near-Term Groundwater Capture Areas for Production Wells Located Near the Whittaker-Bermite Property, Santa Clarita, California*

<b>Wells</b>	<b>Pump Capacity (gpm)</b>	<b>Maximum Annual Capacity (AF)</b>	<b>Normal-year Production<sup>a</sup> (AF)</b>
<b>Newhall County Water District</b>			
7	300	480	N/A <sup>b</sup>
10	600	960	N/A <sup>b</sup>
12	2,300	3,700	1,315
13	2,500	4,030	1,315
NCWD Subtotal	5,700	9,170	2,630
<b>Valencia Water Company</b>			
159	500	800	50
160	2,000	3,220	1,000
201	2,400	3,870	100
205	2,700	4,350	1,000
206	2,500	4,030	1,175
VWC Subtotal	10,100	16,270	3,325
<b>Total Active Capacity</b>	<b>15,800</b>	<b>25,440<sup>c</sup></b>	<b>5,955<sup>c</sup></b>

<sup>a</sup>Based on recent actual annual pumping, as simulated in the perchlorate containment analysis report (CH2M HILL, 2004b), except contaminated production wells SCWC-Saugus1, SCWC-Saugus2, and NCWD-11 do not currently operate

<sup>b</sup>Emergency supply only

<sup>c</sup>Currently active wells only; additional capacity to meet dry-year operating plan would be met by restoration of contaminated wells and new well construction

Notes:

gpm = gallons per minute

AF = acre-feet

**TABLE 2**

Active Municipal Groundwater Source Capacity for Alluvial Aquifer Wells

*Technical Memorandum: Analysis of Near-Term Groundwater Capture Areas for Production Wells Located Near the Whittaker-Bermite Property, Santa Clarita, California*

<b>Wells</b>	<b>Pump Capacity (gpm)</b>	<b>Maximum Annual Capacity (AF)</b>	<b>Normal-year Production<sup>a</sup> (AF)</b>
<b>Newhall County Water District</b>			
Castaic1	600	960	385
Castaic2	425	680	166
Castaic4	270	430	100
Pinetree1	300	480	164
Pinetree3	550	880	545
Pinetree4	500	800	300
NCWD Subtotal	2,645	4,230	1,660
<b>Santa Clarita Water Division of CLWA</b>			
Clark	600	960	782
Guida	1,000	1,610	1,320
Honby	950	1,530	740
Lost Canyon 2	850	1,370	741
Lost Canyon 2A	825	1,330	1,034
Mitchell 5B	700	1,120	557
N. Oaks Central	1,000	1,610	873
N. Oaks East	950	1,530	1,311
N. Oaks West	1,400	2,250	954
Sand Canyon	750	1,200	930
Sierra	1,500	2,410	846
SCWD Subtotal	10,525	16,920	10,088
<b>Valencia Water Company</b>			
Well D	1,050	1,690	690
Well N	1,250	2,010	659
Well N7	2,500	4,030	1,232
Well N8	2,500	4,030	1,232
Well Q2	1,200	1,930	1,046
Well S6	2,000	3,220	919
Well S7	2,000	3,220	919
Well S8	2,000	3,220	919
Well T2	800	1,290	489
Well T4	700	1,120	489
Well U4	1,000	1,610	876



**TABLE 2**

Active Municipal Groundwater Source Capacity for Alluvial Aquifer Wells

*Technical Memorandum: Analysis of Near-Term Groundwater Capture Areas for Production Wells Located Near the Whittaker-Bermite Property, Santa Clarita, California*

<b>Wells</b>	<b>Pump Capacity (gpm)</b>	<b>Maximum Annual Capacity (AF)</b>	<b>Normal-year Production<sup>a</sup> (AF)</b>
Well U6	1,250	2,010	993
Well W9	800	1,290	600
Well W10	1,500	2,410	865
Well W11	1,000	1,610	350
VWC Subtotal	21,550	34,690	12,278
<b>Wayside Honor Rancho</b>			
Well 10	500	800	300
Well 15	1,600	2,580	950
Well 17	600	960	350
WHR Subtotal	2,700	4,340	1,600
<b>Total Purveyors</b>	<b>34,720</b>	<b>55,840</b>	<b>24,026</b>
<b>Total Purveyors and Wayside Honor Rancho</b>	<b>37,420</b>	<b>60,180</b>	<b>25,626</b>

<sup>a</sup>Based on recent actual annual pumping, as simulated in the perchlorate containment analysis report (CH2M HILL, 2004b), but with SCWC-Stadium well pumping (800 AF/yr) assigned to selected wells owned by the Valencia Water Company and the Santa Clarita Water Division of CLWA.















