suspended sediment samples were collected on the December 02, 2012 during the highest peak flow runoff event of the water year by Zone 7 and SFEI.

- On January 26, 2013, the Lawrence Livermore National Laboratory flushed their pipelines with approximately 100,000 gallons of water over the course of the day (daily average of 0.15 cfs). The majority of this water flowed to the Arroyo Las Positas. On August 03, 2013, 200,000 gallons of water was again flushed over the course of the day (daily average of 0.31 cfs). The ALPL stream gage did not record noticeable changes in the Arroyo Las Positas flow due to these pipeline flushes.

#### 2.2.2.4 Arroyo De La Laguna

The following are items of special note for the Arroyo De La Laguna in the 2013 Water Year (October 2012 through September 2013):

- Water flowed continuously down Arroyo De La Laguna throughout the 2013 Water Year (October 2012 through September 2013). The peak flow recorded at the Arroyo De La Laguna at Verona (ADLLV) stream gage during the 2013 Water Year was 5,070 cfs on December 02, 2012 at 10:45. Upstream of ADLLV, ADVP peaked at 236 cfs at 09:30 and AMP peaked at 770 cfs. This indicates that the majority of the peak flow recorded at ADLLV came from unmonitored Alamo Canal.

- A total of 31,776 AF of water flowed out of the valley past ADLLV during the 2013 Water Year (October 2012 through September 2013), 60% of average (where the average is 53,150 AF for Water Years 1970 through 2012). The water year annual mean flow was 43.9 cfs, the median was 21.0 cfs, and the minimum instantaneous flow was 3.1 cfs.

## 2.3 Chain of Lakes Monitoring

### 2.3.1 Program Description

The Chain of Lakes/Mining Area Monitoring Program includes water level measurements and water quality sampling in many of the mining area ponds or quarry lakes. The program also maps and documents current mining activities, locations of discharge lines, circulation and conveyance of water between pits, and the locations of flow barriers created by clay-lined or backfilled pits.

*Figure 2.3-A* below identifies the previous owners, current owners, and current mining operators associated with each lake/pond prefix and pond number as shown on *Figure 2.3-1*.

*Figure 2.3-A: Mining Pond Operators and Owners*

| Pond Prefix* | Previous Owner(s) | Pond Number | Current Owner | Current Operator (if other than Owner) | Other Name |
|---|---|---|---|---|---|
| K | Kaiser Sand & Gravel; Hanson Aggregates | K1-8,19,32,33 | Various | backfilled/developed | |
| | | K9-14,24 | Lionstone/Legacy | backfilled | |
| | | K15 | EBRP | | Shadow Cliffs Lake |
| | | K18 | EBRP | | |
| | | K28 | PGC | Hanson Aggregates | Lake H |
| | | K30 | Zone 7 | | Cope Lake |
| | | K37 | Zone 7 | | Lake I |
| R | Rhodes & Jamieson | R3-4, 12 | Vulcan | | |
| | | R5 | PGC | Vulcan | Lake G |
| | | R8,10,11,13,21,23,24,27,28 | PGC | Vulcan | |
| | | R22 | PGC | Vulcan | Lake F |
| | | R25 | PGC | Vulcan | Lake E |
| C | Cal Rock | C1,2,6 | PGC | Vulcan | Lake C |
| | | C3,4 | PGC | Vulcan | |
| | | C5 | Cemex | | |
| | | C7-9 | PGC | Vulcan | Lake D |
| P | Pacific Coast Aggregates; RMC/Lonestar | P1-11,13,21,27,34,40,43-45 | Cemex | | |
| | | P12 | EBRP | | Island Pond |
| | | P28, 41 | Cemex | | Lake A |
| | | P39,42 | Cemex | | Lake B |

* Prefix for pond names (e.g., K37)
PGC Pleasanton Gravel Company
EBRP East Bay Regional Parks District

Water surface elevations are measured semi-annually in the ponds. The semi-annual measurements are collected at the same time as the semi-annual groundwater measurements.

Water quality is determined annually by sampling and analysis. Zone 7's laboratory performs a general mineral analysis that is consistent with the analyses performed for the groundwater monitoring program.

All mining water that is discharged to a non-quarry property (i.e. to an arroyo, Shadow Cliffs, or Cope Lake) is metered. The volume of water that leaves the Valley through discharges to the streams is computed by prorating the flows after accounting for any re-percolation back into the groundwater basin.

This program also includes the tracking of pond evaporative areas, total monthly evaporative losses for the ponds, and an estimate of groundwater lost due to the export of moist gravels. Mining area evaporation accounts for a large portion of the "Demand" component for the annual hydrologic inventory (HI) calculation, second only to "Municipal Pumping."

### 2.3.2 2013 Water Year Results

Mining activities continued for Vulcan Materials (formerly Calmat) and Cemex (formerly RMC and Lonestar). Vulcan Materials continued their mining in R24 (future Lake E). Cemex continued mining in P42 (Lake B). A summary of mining pit conditions including their areal extent and water elevations are shown on *Figure 2.3-1*.

For the 2013 Water Year (October 2012 through September 2013), Vulcan Materials discharged 7,055 AF into the Arroyo Mocho, of which an estimated 2,259 AF re-percolated back into the groundwater basin and 4,796 AF was lost as basin outflow. In December 2103 Vulcan Materials, in collaboration with Zone 7, completed an extension to their existing discharge pipeline. This extension allows the discharge water to be captured in Cope Lake. Zone 7 has installed (May 2014) a pipeline which will then transfer the water from Cope Lake into Lake I for subsequent recharge back into the aquifers. This project will eliminate a portion of the water normally lost due to Mining Area discharges being made to the Arroyo Mocho (recently 2,000 AF to 5,000 AF annually).

Cemex did not discharge into the Arroyo Valle during the 2013 Water Year (October 2012 through September 2013). The groundwater pumped from their active excavation was discharged to onsite ponds and used as a gravel wash water source. Consequently, some of this water evaporated or left the Valley as gravel moisture, and some percolated through the ponds' bottoms and sides and back into the aquifer.

In addition to the 4,796 AF of mining discharge water that exited the Valley in the arroyos, an estimated 2,895 AF of water evaporated from the mining ponds, and 700 AF left as gravel moisture during the 2013 Water Year (October 2012 through September 2013).

Zone 7 resumed its cooperative off-site recharge program with East Bay Regional Parks District (EBRPD) and diverted approximately 540 AF to Shadow Cliff's lake from October 2012 to September 2013. As a result, water levels in Shadow Cliffs were maintained at about 333 ft in elevation through most of the year.

Water elevations were measured in most of the pits in the mining area that contained water (i.e., the lakes or ponds) during the 2013 Water Year (October 2012 through September 2013), and the results are shown on *Figure 2.3-2*. The water elevations from the pits that are in direct communication with the upper aquifer are included in the Groundwater Monitoring Program's dataset used for the upper aquifer groundwater elevation contour maps (*Figure 2.4-8* and *Figure 2.4-9*).

Water quality was also monitored in certain mining ponds (*Figure 2.3-3*). Salt concentrations, measured as TDS, in the mining area ponds ranged from about 340 mg/L in the ponds along the Arroyo Valle to over 1,400 mg/L in Cope Lake [K30]. The high TDS in Cope Lake is due to evaporation which concentrates the salts in this pond that is effectively clay-lined from the former use as a sedimentation pond. The TDS, nitrate and boron concentrations measured in the mining area ponds that are in direct communication with the upper aquifer are included in the Groundwater Monitoring Program's dataset used to create the upper aquifer concentration maps (*Figure 2.4-14* to *Figure 2.4-16*).

# 2.4 Groundwater Monitoring

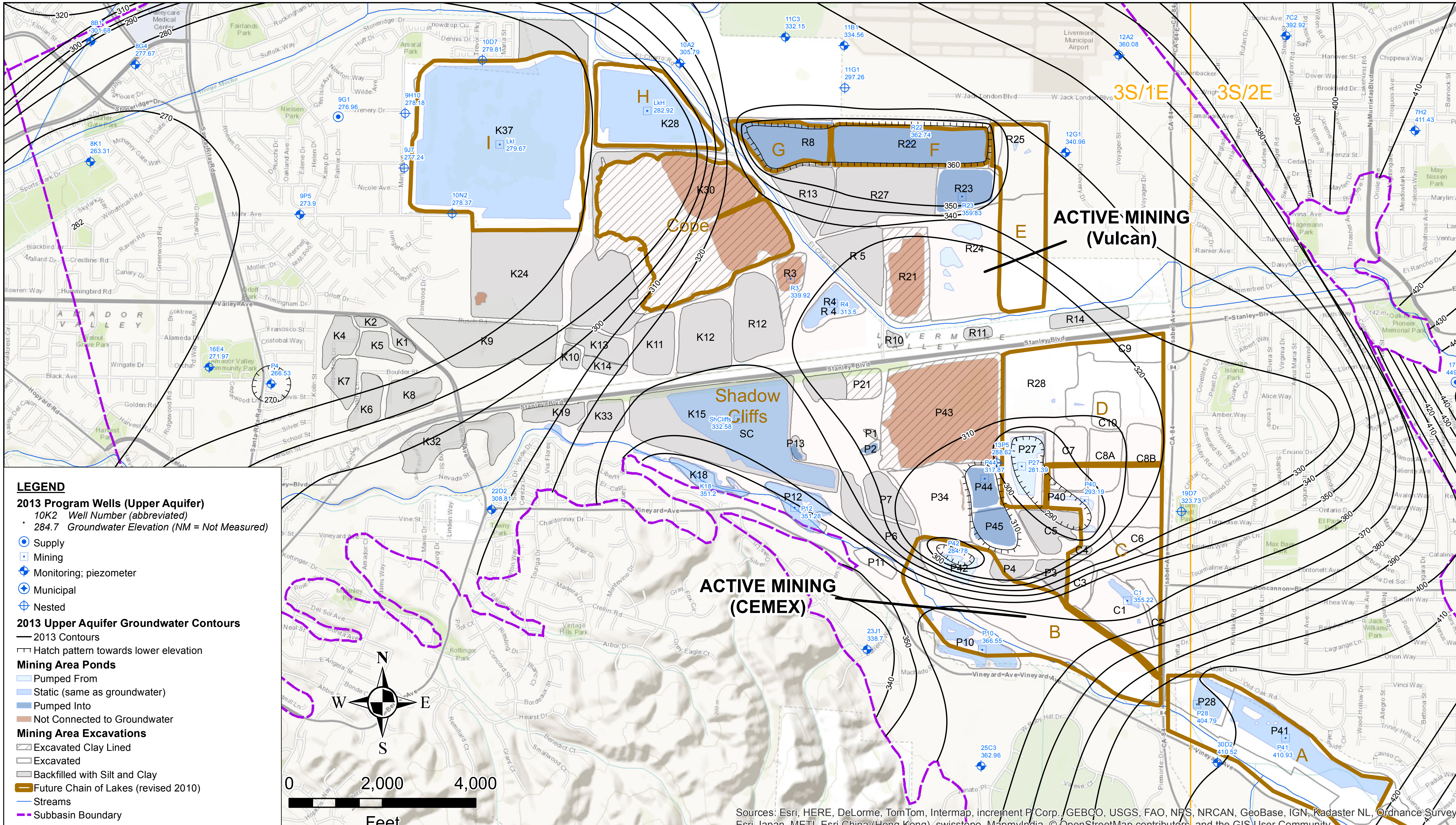
This section describes Zone 7's Groundwater Monitoring Program. The Groundwater Monitoring Program is the groundwater data collection portion of the overall Groundwater Management Program and includes the measurement of groundwater levels in monitoring and production wells, and the collection and analyses of groundwater samples. These hydrologic data are needed to assess groundwater supplies (i.e., quantity, quality, and trends) and define management needs to achieve sustainability. The program focuses on the Main Basin, where groundwater is pumped for municipal uses. Other Zone 7 programs utilize the data collected in this program, and the results are used in water resources management planning and decision making. The results of the groundwater elevation and quality portions of the program are presented in Sections 2.4.2 and 2.4.3, respectively. Groundwater storage is presented in Chapter 3, Section 3.1. These data are used in Zone 7's management of water supply and water quality including management tools such as the groundwater model, Salt Management Plan (SMP), and Nutrient Management Plan (NMP) which are described in Chapter 3, Section 3.3.

## 2.4.1 Program Description

There were a total of 236 wells in the Zone 7 groundwater monitoring program during the 2013 Water Year (October 2012 through September 2013) (shown on *Figure 2.4-1*). Each well in the program was monitored and/or sampled to fulfill one or more specific objectives. *Figure 2.4-2* lists all of the wells in the program, the objective(s) of monitoring each well, and the frequency of monitoring or sampling for each objective. The objectives are summarized below. Well construction details for each of the wells in the program are shown in *Figure 2.4-3*.

**Zone 7's Water Level Monitoring –** groundwater level measurements are made twice per year during seasonal extremes (i.e., spring highs and fall lows) for storage tracking. Water level measurements are also measured monthly in some wells to monitor subsidence potential, adjust recharge and pumping operations, and identify seasonal peaks when semi-annual water level measurements should be scheduled.

**Zone 7's Water Quality Sampling –** water quality sampling of groundwater is performed annually, with samples collected from each of the wells in the program. Sampling is performed in some wells more frequently if required for an additional program described below. Also, some of the wells in the program are sampled and tested by an outside entity with the results supplied to Zone 7. The samples are analyzed for general water quality parameters and select metals.




ZONE 7 WATER AGENCY
100 North Canyons Parkway
Livermore, CA

| | |
|---|---|
| DRAWN: TR/CW | SCALE: 1 in = 2,000 ft |
| REVIEWED: | DATE: Jul 21, 2014 |

File: E:\MONITOR\MA\2013WY\Fig2.3-1-MiningArea13.mxd

**Figure 2.3-1**
**Map of Gravel Mining Pits with Groundwater Elevation Contours (October 2013)**
**Livermore Valley Groundwater Basin**

# FIGURE 2.3-2
# SEMIANNUAL WATER LEVELS IN MINING AREA PONDS
# 2013 WATER YEAR (Oct 2012 to Sep 2013)

| Pit Number | Chain of Lakes Name | Frequency | | Contact with Aquifer | Original Ground Elev | Deepest Mined Depth | | Mining Use | Pond Elevation (ft MSL, NAVD88) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Levels | Quality | | | Elev | Depth | 2013 | Spring 13 | Fall 13 | Difference |
| **CALROCK/RHODES & JAMIESON/VULCAN/PLEASANTON GRAVEL COMPANY/CALMAT** | | | | | | | | | | | |
| C 1 | C | SA | A | C | 410 | 360 | 50 | Unused | 357.71 | 355.22 | 2.49 |
| C 2 | C | | | N | 410 | 360 | 50 | Clay Storage | | | |
| C 3 | | | | N | 410 | 360 | 50 | Clay Storage | | | |
| C 4 | | | | N | 400 | 390 | 10 | Clay Storage | | | |
| C 5 | | | | N | 400 | 290 | 110 | Clay Storage | | | |
| C 6 | C | | | N | 400 | 385 | 15 | Unused | | | |
| C 7 | D | | | N | 400 | 330 | 70 | Clay Storage | | | |
| C 8A | D | | | C | 410 | 330 | 80 | Unused | | | |
| C 8B | D | | | C | 410 | 340 | 70 | Unused | | | |
| C 9 | D | | | N | 410 | 310 | 100 | Unused | | | |
| R 3 | | SA | A | CP | 370 | 240 | 130 | Water & Clay | 337.67 | 339.92 | -2.25 |
| R 4 | | SA | A | CP | 380 | 240 | 140 | Water Storage | 313.45 | 313.5 | -0.05 |
| R 5 | | | | N | 380 | 240 | 140 | Clay Storage | | | |
| R 8 | G | SA | A | CP | 365 | 260 | 105 | Same as R22 | | | |
| R10 | | | | N | 380 | 370 | 10 | Clay Storage | | | |
| R11 | | | | N | 390 | 370 | 20 | Clay Storage | | | |
| R12 | | | | N | 370 | 240 | 130 | Clay Storage | | | |
| R13 | | | | N | 370 | 270 | 100 | Clay & Debris | | | |
| R21 | | | | N | 380 | 280 | 100 | Water & Clay | | | |
| R22 | F | SA | A | CP | 380 | 290 | 90 | Water Storage | 361.09 | 362.74 | -1.65 |
| R23 | | SA | A | CP | 380 | 270 | 110 | Water & Clay | 359.26 | 359.83 | -0.57 |
| R24 | E | SA | A | C | 390 | 200 | 190 | Active Mining | | | |
| R25 | E | | | - | 395 | 300 | 95 | Inactive Mining | 188.78 | 167.79 | 20.99 |
| R27 | | | | N | 380 | 300 | 80 | Water Storage | | | |
| R28 | D | SA | A | CP | 400 | 320 | 80 | Active Mining | | | |
| **KAISER GRAVELS/HANSON AGGREGATES** | | | | | | | | | | | |
| K 1 | | | | N | 350 | 325 | 25 | Backfilled with clay | | | |
| K 2 | | | | N | 350 | 325 | 25 | Backfilled with clay | | | |
| K 4 | | | | N | 350 | 315 | 35 | Backfilled with clay | | | |
| K 5 | | | | N | 350 | 315 | 35 | Backfilled with clay | | | |
| K 6 | | | | N | 350 | 325 | 25 | Backfilled with clay | | | |
| K 7 | | | | N | 350 | 320 | 30 | Backfilled with clay | | | |
| K 8 | | | | N | 350 | 320 | 30 | Backfilled with clay | | | |
| K 9 | | | | N | 360 | 305 | 55 | Backfilled with clay | | | |
| K10 | | | | N | 370 | 355 | 15 | Backfilled with clay | | | |
| K11 | | | | N | 370 | 315 | 55 | Backfilled with clay | | | |
| K12 | | | | N | 370 | 275 | 95 | Backfilled with clay | | | |
| K13 | | | | N | 370 | 275 | 95 | Backfilled with clay | | | |
| K14 | | | | N | 370 | 275 | 95 | Backfilled with clay | | | |
| K15 | Sh.Cliff | SA | A | C | 360 | 265 | 95 | Water Storage | 332.99 | 332.58 | 0.41 |
| K18 | | SA | A | C | 360 | 330 | 30 | Unused | 350.89 | 351.2 | -0.31 |
| K19 | | | | | 350 | 335 | 15 | Backfilled with clay | | | |
| K24 | | | | N | 360 | 220 | 140 | Backfilled with clay | | | |
| K24A | Busch Pit | | | N | 360 | 220 | 140 | Drainage/Stormwater | | | |
| K28 | H | SA | A | C | 360 | 220 | 140 | Water Storage | 284.43 | 282.92 | 1.51 |
| K30 | Cope | SA | A | N | 370 | 240 | 130 | Water & Clay | | | |
| K32 | | | | N | 360 | 335 | 25 | Backfilled with clay | | | |
| K33 | | | | - | 360 | 335 | 25 | Unused | | | |
| K37 | I | SA | A | C | 360 | 220 | 140 | Water Storage | 284.42 | 279.67 | 4.75 |
| **PACIFIC AGGREGATE/RMC/LONESTAR/CEMEX** | | | | | | | | | | | |
| P 1 | | | | | 380 | 360 | 20 | Clay Storage | | | |
| P 2 | | | | CP | 380 | 360 | 20 | Water Storage | | | |
| P 3 | | | | | 400 | 360 | 40 | Clay Storage | | | |
| P 4 | | | | | 400 | 360 | 40 | Clay Storage | | | |
| P 6 | | | | | 380 | 280 | 100 | Clay & Debris | | | |
| P 7 | | | | | 380 | 280 | 100 | Clay & Debris | | | |
| P 9 | | | | | 400 | 380 | 20 | Clay Storage | | | |
| P10 | | SA | A | C | 400 | 340 | 60 | Unused | 367.14 | 366.55 | 0.59 |
| P11 | | SA | A | C | 380 | 340 | 40 | Unused | | | |
| P12 | | SA | A | C | 360 | 330 | 30 | Unused | 350.93 | 351.28 | -0.35 |
| P13 | | | | C | 380 | 300 | 80 | Water Storage | | | |
| P21 | | | | | 380 | 240 | 140 | Clay Storage | | | |
| P27 | | SA | A | C | 390 | 250 | 160 | Water Storage | 289.29 | 281.39 | 7.9 |
| P28 | A | SA | A | CP | 420 | 360 | 60 | Water Storage | 406.14 | 404.79 | 1.35 |
| P34 | | | | | 380 | 270 | 110 | Clay & Debris | | | |
| P39 | B | | | | 410 | 380 | 30 | Inactive Mining | | | |
| P40 | | SA | A | C | 390 | 260 | 130 | Water Storage | 299.42 | 293.19 | 6.23 |
| P41 | A | SA | A | CP | 410 | 370 | 40 | Water Storage | 413.18 | 410.93 | 2.25 |
| P42 | B | SA | A | CP | 380 | 310 | 70 | Active Mining | 282.29 | 284.78 | -2.49 |
| P43 | | | | N | 390 | 240 | 150 | Water & Clay | 345.76 | 343.29 | 2.47 |
| P44 | | SA | A | CP | 390 | 250 | 140 | Water Storage | 319.61 | 317.87 | 1.74 |
| P45 | | | | CP | 380 | 310 | 70 | Water Storage | | | |

A = Annual; SA = Semiannual

C = in contact with GW; CP = GW contact but subject to pumping; N = no contact with GW

# FIGURE 2.3-3
# WATER QUALITY RESULTS FOR MINING AREA WATER SAMPLES
# 2013 WATER YEAR (Oct 2012 to Sep 2013)

| | | TEMP. | EC | | Mineral Constituents (mg/L) | | | | | | | | | | Select Metals (mg/L) | | | | TDS | Hard |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SITE ID | DATE | $^oC$ | umhos/cm | pH | Ca | Mg | Na | K | HCO3 | SO4 | Cl | NO3 | SiO2 | B | As | Fe | Mn | mg/L | mg/L |
| MA-C01 | 3-Oct-13 | 21.6 | 1563 | 8.3 | 131 | 34 | 179 | 3.5 | 412 | 88 | 259 | <0.44 | <1.1 | 1.00 | 0.0067 | <0.1 | <0.01 | 905 | 468 |
| MA-K15 | 3-Oct-13 | 21.4 | 729 | 8.8 | 30 | 33 | 76 | 3.9 | 207 | 46 | 107 | <0.44 | 10.1 | 0.50 | 0.0048 | <0.1 | <0.01 | 420 | 212 |
| MA-K28 | 3-Oct-13 | 21.9 | 870 | 8.6 | 35 | 53 | 80 | 2.3 | 277 | 53 | 105 | <0.44 | 18.8 | 0.72 | 0.0053 | <0.1 | 0.012 | 494 | 306 |
| MA-K30_NE | 3-Oct-13 | 22.1 | 2543 | 9.2 | 17 | 140 | 375 | 3.8 | 354 | 198 | 517 | <0.44 | 2.4 | 3.57 | 0.025 | 0.35 | 0.012 | 1480 | 619 |
| MA-K30_SE | 3-Oct-13 | 20.9 | 1310 | 9.8 | 28 | 69 | 167 | 1.3 | 168 | 97 | 243 | <0.44 | 3.0 | 1.35 | 0.0088 | <0.1 | <0.01 | 790 | 357 |
| MA-K37 | 3-Oct-13 | 23.6 | 1025 | 8.9 | 23 | 66 | 110 | 2.7 | 291 | 73 | 168 | <0.44 | 6.0 | 1.12 | 0.0046 | <0.1 | <0.01 | 614 | 331 |
| MA-P10 | 3-Oct-13 | 21.7 | 649 | 8.4 | 29 | 31 | 62 | 3.5 | 243 | 17 | 81 | <0.44 | <1.1 | 0.38 | 0.0026 | <0.1 | <0.01 | 349 | 201 |
| MA-P12 | 3-Oct-13 | 19.4 | 624 | 8.8 | 38 | 18 | 63 | 2.8 | 147 | 23 | 109 | <0.44 | 14.6 | 0.23 | 0.0016 | <0.1 | <0.01 | 349 | 169 |
| MA-P27 | 3-Oct-13 | 21.8 | 656 | 8.6 | 34 | 32 | 65 | 1.8 | 160 | 56 | 110 | <0.44 | 8.6 | 0.51 | 0.0036 | 0.11 | <0.01 | 392 | 214 |
| MA-P28 | 3-Oct-13 | 21.8 | 943 | 8.6 | 55 | 32 | 100 | 3.1 | 234 | 49 | 174 | <0.44 | 5.8 | 0.47 | 0.0045 | <0.1 | <0.01 | 543 | 268 |
| MA-P40 | 3-Oct-13 | 0.0 | 9255 | 8.3 | 131 | 447 | 1860 | 11 | 1255 | 885 | 2220 | <0.44 | 4.5 | 12.6 | 0.068 | 2.1 | 0.89 | 6199 | 2165 |
| MA-P41 | 3-Oct-13 | 22.7 | 901 | 8.9 | 29 | 48 | 94 | 3.0 | 220 | 43 | 171 | <0.44 | 6.6 | 0.42 | 0.0038 | <0.1 | <0.01 | 519 | 270 |
| MA-P42 | 3-Oct-13 | 21.4 | 668 | 8.3 | 30 | 37 | 55 | 1.9 | 212 | 45 | 83 | <0.44 | 16.3 | 0.37 | 0.0017 | <0.1 | <0.01 | 377 | 226 |
| MA-P43 | 3-Oct-13 | 21.7 | 618 | 8.4 | 38 | 19 | 61 | 2.5 | 118 | 56 | 105 | <0.44 | 7.5 | 0.43 | <0.001 | 0.14 | <0.01 | 350 | 174 |
| MA-P44 | 3-Oct-13 | 22.1 | 616 | 8.5 | 34 | 23 | 60 | 2.3 | 123 | 52 | 99 | <0.44 | 7.9 | 0.42 | <0.001 | <0.1 | <0.01 | 342 | 178 |
| MA-R03 | 3-Oct-13 | 17.9 | 682 | 8.3 | 40 | 41 | 39 | 3.1 | 231 | 44 | 79 | <0.44 | 16.7 | 0.31 | 0.0014 | <0.1 | <0.01 | 381 | 271 |
| MA-R04 | 3-Oct-13 | 20.8 | 682 | 8.5 | 40 | 44 | 38 | 2.4 | 232 | 43 | 77 | <0.44 | 17.3 | 0.30 | 0.0016 | <0.1 | <0.01 | 383 | 283 |
| MA-R22 | 3-Oct-13 | 20.4 | 666 | 8.6 | 45 | 41 | 37 | 2.2 | 221 | 45 | 76 | 1.68 | 17.1 | 0.31 | 0.0017 | <0.1 | <0.01 | 382 | 282 |
| MA-R23 | 3-Oct-13 | 20.5 | 674 | 8.6 | 42 | 43 | 38 | 2.3 | 230 | 45 | 76 | 0.62 | 18.2 | 0.31 | 0.0015 | <0.1 | <0.01 | 387 | 285 |
| MA-R25 | 3-Oct-13 | 18.0 | 702 | 8.1 | 53 | 41 | 33 | 1.8 | 262 | 42 | 68 | 10.41 | 23.5 | 0.30 | <0.001 | <0.1 | <0.01 | 405 | 301 |