# SECOND UPDATE

# HYDROLOGY AND WATER QUALITY ANALYSIS REPORT

# FOR THE AMENDMENTS TO THE

# CEMEX ELIOT QUARRY SMP-23 RECLAMATION PLAN

# ALAMEDA COUNTY, CALIFORNIA

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## Executive Summary

The proposed Reclamation Plan Amendment at the CEMEX Eliot Quarry facility in Pleasanton, California has been evaluated from the perspective of the criteria in Appendix G of the California Environmental Quality Act (CEQA) and the requirements of Section 3706 of the Surface Mining and Reclamation Act (SMARA), for potential impacts on hydrology and water quality. The Reclamation Plan is being amended to reflect changes in the areas and depths to be mined at the Eliot facility compared to those that were addressed in the existing 1987 SMP-23 Reclamation Plan. The reclaimed mining pits will be smaller than those assumed in 1987 but will generally extend to a greater depth. Existing groundwater and surface water conditions are identified to provide the baseline for comparison of the effects of the proposed amendments to the Reclamation Plan. The project will generally result in reduced water demand and enhanced recharge of groundwater. The proposed Reclamation Plan Amendment requires additional permits (e.g. modifications to Waste Discharge Requirements, Streambed Alteration Agreement) and incorporates measures to avoid or minimize impacts related to erosion. The evaluation of individual CEQA and SMARA hydrology and water quality criteria indicates that there will be no significant impacts because of the measures that are incorporated as part of the project in anticipation of various permitting requirements, primarily related to the Arroyo del Valle and future operation of the Chain of Lakes by Zone 7.

## 1.0 Introduction

This second update to this technical report provides an analysis of hydrology and water quality conditions for the proposed amendments to the Reclamation Plan related to Lake A, Lake B, and Lake J at the CEMEX Eliot Quarry in Pleasanton, California. The existing Reclamation Plan, also known as SMP-23, was approved in 1987. This report has been prepared to provide the appropriate technical data and evaluations to support the CEQA review of the proposed amendments to the 1987 SMP-23 Reclamation Plan. In addition, this report addresses the reclamation performance standards identified in Section 3706 of the SMARA regulations found in Title 14 of the California Code of Regulations. This document is an update to the original June 8, 2013 report and the subsequent August 11, 2014 update. The updates were prepared to address comments received from Alameda County and the Zone 7 Water Agency (Zone 7) on the prior version and to incorporate additional data and analyses that have been prepared since the previous version of this report was submitted.

## 2.0 Background

The CEMEX Eliot Quarry site is located in unincorporated Alameda County, California between the cities of Livermore and Pleasanton (Figure 1). The site is located south of Stanley Boulevard and north of the Arroyo del Valle. Use of the project site is governed by underlying Quarry Permit No. 1 (Q-1) and Quarry Permit No. 76 (Q-76); the 1981 Alameda County Specific Plan for the Livermore-Amador Valley Quarry Area Reclamation (Specific Plan); the Alameda County General Plan; the East County Area Plan (ECAP); Alameda County Surface Mining Ordinance (ACSMO); and the 1987 Alameda County Surface Mining Permit and Reclamation Plan No. 23 (SMP-23). SMP-23 is the reclamation plan for the site, not a conditional use permit for mining, as mining at the site is vested under the Q-1 and Q-76 permits.

The current active mining areas are referred to as Lake A, Lake B, and Lake J. Lake A is located east of Isabel Avenue (State Route 84). Surface elevations around the perimeter of Lake A range from approximately 445 feet above mean sea level (ft msl) on the northeast side of the pit to approximately 415 ft msl on the southwest side of the pit. The current mining depths range from approximately 390 ft msl to 360 ft msl in Lake A.

Lake B is located west of Isabel Avenue. Surface elevations around the perimeter of Lake B range from approximately 410 ft msl on the east side of the pit to approximately 380 ft msl on the west side of the pit. The current mining depths range from approximately 325 ft msl to 270 ft msl in Lake B (Spinardi and Associates, 2013 and 2014).

Mining in Lake J, within the aggregate processing plant area, began in 2014. The current surface elevation of the plant site area around Lake J is approximately 380 ft msl. As of November 2016, the mining depth in Lake J ranges from approximately 320 ft msl to 300 ft msl.

The predominant land use in the general vicinity of the project site is aggregate mining. Mining of sand and gravel in the Livermore-Amador Valley in the vicinity of the project site began prior to 1900. The Specific Plan was adopted by the County in 1981. As part of the Specific Plan, quarry operators in the Livermore-Amador Valley are required to excavate basins for future use by Zone 7 of the Alameda County Flood Control and Water Conservation District, now referred to as the Zone 7 Water Agency (Zone 7) for groundwater storage, conveyance and recharge facilities. The quarry basins to be used for groundwater storage, conveyance, and recharge facilities are commonly known as the "Chain of Lakes" (Figure 1). Zone 7's responsibilities include management of the Livermore-Amador Valley groundwater basin and the Chain of Lakes. The Specific Plan requires the mining operators to dedicate to Zone 7 certain excavated basins within the Specific Plan area. At the completion of mining, Lake A and Lake B will become part of the Chain of Lakes. Lake J will be retained by CEMEX and will not be a part of the Chain of Lakes.

CEMEX is proposing to amend the SMP-23 Reclamation Plan for the project site to reflect:

- Additional resource extraction at Lake A, along with minor perimeter grading for reclamation purposes, which will enhance the ability of Lake A to meet the Specific Plan objectives for diversion of water from the Arroyo del Valle to the Chain of Lakes;
- Mining to a maximum surface area of 223 acres in Lake B, and from an interim mining depth of 250 ft msl down to 150 ft msl; and
- Mining of the plant site area (Lake J) over an area of approximately 50 acres to a depth of 250 ft bgs or an elevation of 130 ft bgs.

Mining at the site is vested, as discussed above, but the adjustments to the mining will affect reclamation of the Eliot site. The primary changes to the SMP-23 Reclamation Plan that are being proposed will have limited effects on project water demand and the assessment of available water supply (EMKO Environmental, Inc., 2016a). The proposed changes that have the potential to affect water demand include:

- An overall reduction in the size of Lake A from a water surface area of approximately 208 acres to 100 acres. The 1987 SMP-23 Reclamation Plan included excavation and elimination of Arroyo del Valle. The reduction in the surface area of Lake A under the proposed project is primarily due to maintaining the Arroyo del Valle channel in its existing location.

- An overall reduction in the water surface area of Lake B from approximately 243 acres, as identified in the 1987 SMP-23 Reclamation Plan to a water surface area of 211 acres[1] under Option 1 of the proposed project. Options 2 and 3 of the proposed project result in an even larger reduction of the water surface area of Lake B. Under Option 2 or Option 3, the water surface area would be 197 acres or 166 acres, respectively.
- A final water surface area at the elevation of the static groundwater table in Lake J (at 330 ft msl) of approximately 38 acres. The 1987 SMP-23 Reclamation Plan did not define an area for the Lake J water surface. However, the 1981 Specific Plan anticipated an area of 90 acres for Lake J.

The reclamation actions that will be implemented as part of the proposed project will not be completed until the mid-2050s, or approximately 35 to 40 years from the time this report was prepared.

The end use for Lake A is as a mechanism to store and convey water from the Arroyo del Valle to Lake C (controlled by Calmat Co. dba Vulcan Materials Company) and the rest of the Chain of Lakes, in accordance with the Specific Plan. The end use for Lake B is a water storage and groundwater recharge basin as part of the Chain of Lakes, in accordance with the Specific Plan. The end use for Lake J is open space and as a lake and water supply to support agricultural uses on surrounding land. Reclamation must ultimately be conducted in accordance with the Specific Plan. The potential environmental impacts of the Specific Plan and Chain of Lakes were analyzed in the Specific Plan Environmental Impact Report (EIR) conducted in accordance with CEQA and certified by the County in 1981.

## 3.0 Hydrogeology

The information presented in this section has been summarized primarily from the *Hydrostratigraphic Investigations of the Aquifer Recharge Potential for Lakes C and D of the Chain of Lakes, Livermore, California* (Alameda County Flood Control and Water Conservation District Zone 7, 2011), the *Groundwater Management Plan for Livermore-Amador Valley Groundwater Basin* (Prepared for Zone 7 Water Agency by Jones and Stokes, 2005), Zone 7 annual monitoring reports (Zone 7, 2011, 2012, 2013, 014a, 2015, 2016), and groundwater and surface water data provided by Zone 7 staff.

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[1] While the total disturbance area for Lake B at the ground surface will be up to 223 acres, the groundwater table is approximately 30 feet below the ground surface. Due to the 2:1 side slopes in Lake B, and the depth to the groundwater table, the area of the water surface in Lake B will be 211 acres once mining is completed and the water in the pit equilibrates with the groundwater.at the elevation of the groundwater table.

Additional interpretation is also provided based on studies conducted by DWR (1966, 1974, 2003) and the U.S. Geological Survey (1989a), studies conducted for adjacent quarry permits (SMP-16) (Brown & Caldwell, 2004), and borehole data obtained by CEMEX in 2013.

The discussion below is focused on the following hydrogeologic conditions:

- Hydrostratigraphy;
- Aquifer properties;
- Water level trends; and
- Water quality.

Each of these hydrogeologic conditions is described in detail below. Dewatering of the existing mining pits is not a reclamation activity and, therefore, is not addressed in this report. However, to address questions raised by the County regarding how the proposed amendments to the Reclamation Plan may affect dewatering and water management during the vested mining operations, an evaluation of these conditions is presented in a separate document (EMKO, 2016d).

## *3.1 Hydrostratigraphy*

This section describes the hydrostratigraphy in the vicinity of the Eliot facility. Hydrostratigraphy is a term that refers to the layering of the underlying geologic sediments (e.g. alternating layers of gravels and clays) and how that layering may affect the occurrence and movement of groundwater.

The Eliot facility is located within the Livermore-Amador Valley, an east-west trending inland alluvial basin located in northeastern Alameda County (Figure 1). An alluvial basin is a valley that has been filled with sediments deposited predominantly by streams and rivers. The basin is surrounded primarily by north-south trending faults and hills of the Diablo Range. The Livermore-Amador Valley encompasses approximately 42,000 acres, is about 14 miles long (east to west), and varies from three miles to six miles wide (north to south). The Livermore Valley Groundwater Basin is located in the central part of the Livermore-Amador Valley. The Main Basin is a part of the Livermore Valley Groundwater Basin that contains the highest-yielding aquifers and the best groundwater quality. Lake A and Lake B are located within the southeast corner of the Main Basin.

The Livermore-Amador Valley is partially filled with alluvial fan, stream, and lake deposits, collectively referred to as alluvium. The alluvium in the valley consists of unconsolidated gravel, sand, silt, and clay. Alluvial fans occur where streams and rivers from hilly or mountainous areas enter a valley and deposit very coarse sediment, primarily sand and gravel. The silt and clay were deposited in floodplain areas or lakes that developed at different times across the basin. The alluvium is relatively young from a geologic perspective, being deposited during the Pleistocene and Holocene geologic epochs (younger than 1.6 million years old). In the west-central area of the basin, the alluvium is up to 800 feet thick, but thins along the margins of the valley.

The southeastern and central parts of the Main Basin area contain the coarsest alluvial fan deposits. These alluvial fan deposits were formed by the ancestral and present Arroyo del Valle and Arroyo Mocho. The coarse alluvial fan deposits are economically important aggregate deposits, which has resulted in the widespread aggregate mining in the Main Basin area. The coarse alluvial fan deposits also comprise some of the most significant groundwater recharge areas in the Livermore-Amador Valley.

Numerous studies of the hydrogeology of the Livermore-Amador Valley Groundwater Basin have been conducted, only a limited number of which are cited above and in Section 7. In general, groundwater within the alluvium has been classified as being part of two main aquifer zones. The two aquifer zones are separated by a silty clay layer up to 50 feet thick that prevents or limits the vertical migration of groundwater between the two zones. This silty clay layer is referred to as an aquitard. The aquitard layer may not be present everywhere, may contain zones of coarser-grained material, or may become very thin in some locations. In areas where these variations occur, the aquitard is referred to as "leaky" because it may allow groundwater to be transmitted between the two aquifers.

As stated in *Hydrostratigraphic Investigations of the Aquifer Recharge Potential for Lakes C and D of the Chain of Lakes, Livermore, California* (Zone 7, 2011, page 5), the two aquifer zones are designated as the:

> "Upper Aquifer Zone – The upper aquifer zone consists of alluvial materials, including primarily sandy gravel and sandy clayey gravels. These gravels are usually encountered underneath the surficial clays typically 5 to 70 feet below ground surface [bgs] in the west and exposed at the surface in the east. The base of the upper aquifer zone is at about 80 to 150 ft bgs. Groundwater in this zone is generally unconfined; however when water levels are high, portions of the Upper Aquifer Zone in the western portion of the Main Basin can become confined."

and:

> "Lower Aquifer Zone – All sediments encountered below the clay aquitard in the center portion of the basin have been known collectively as the Lower Aquifer Zone. The aquifer materials consist of semi-confined to confined, coarse-grained, water-bearing units interbedded with relatively low permeability, fine-grained units. It is believed that the Lower Aquifer Zone derives most of its water from the Upper Aquifer Zone through the leaky aquitard(s) when groundwater heads in the upper zone are greater than those in the lower zone."

Recent investigations conducted on behalf of Zone 7 have been used to refine the interpretation of subsurface conditions based on specific stratigraphic depositional sequences, or the specific layering of the sediments that occur from changes in the conditions at the time the aggregate material was deposited. The 2011 Zone 7 study cited above describes four main stratigraphic sequences. From shallowest to deepest, these sequences are referred to as the Cyan Unit, the Gray Unit, the Purple Unit, and the Red Unit. The Cyan Unit corresponds with the Upper Aquifer Zone, as described above. The Gray Unit, Purple Unit, and Red Unit correspond collectively to the Lower Aquifer Zone.

Figure 2 shows the locations of several cross sections prepared by Zone 7 (2011) in the Chain of Lakes area of the Main Basin. The cross sections are shown on Figures 3 and 4. The cross sections show the relationships between the various aquifer zones and units. They also show the projected future depths of several of the mining pits that will become part of the Chain of Lakes, including Lake B and Lakes C and D being mined by Vulcan Materials Company immediately north of Lake B. Lakes C and D are part of Alameda County Surface Mining Permit and Reclamation Plan No. 16 (SMP-16). These cross sections show that in the vicinity of Lakes C and D and the Eliot facility, the aquitard layer between the upper and lower aquifer zones (i.e. between the Gray Unit and the Cyan Unit) is not present. As discussed further below, aquifer tests conducted by Zone 7 in 2011 show that the shallower aquifer units (Cyan and Gray) are in hydraulic communication with the deeper aquifer units (Purple and Red).

The aquifer materials present in the southeastern part of the Amador sub-basin were deposited by ancestral streams that flowed in the same areas from which Arroyo del Valle and Arroyo Mocho currently originate within the Livermore highlands to the south (DWR, 1966). While lakes formed intermittently in the central and western parts of the basin, the area south of Stanley Boulevard, in the current area of Lakes B, C, and D of the Chain of Lakes, was part of a large alluvial fan system emanating from the hills to the south (Alameda County Planning Department, 1979). Deposition of fine clays and silts in the lakes that formed away from the alluvial fan created the aquitard units between the main aquifers. The alternating deposition of coarse-grained aquifer materials and fine-grained aquitards materials outside of the alluvial fan resulted in the depositional sequences that were identified in the recent investigations conducted on behalf of Zone 7 (2011).

The ancestral stream channels for Arroyo del Valle and Arroyo Mocho were identified by DWR (1966). Figures 5 and 6 are copies of a part of Plates 7 and 6, respectively, from the DWR (1966) study of the geology of the Livermore Valley. Figure 5 shows the gross thickness of aquifer materials in the depth interval between 100 ft bgs and 200 ft bgs in the Amador sub-basin. The ancestral axes of the major stream depositional channels are also shown on Figure 5. In the area south of Stanley Boulevard and west of Isabel Avenue, the ancestral channel of Arroyo del Valle deposited as much as 90 feet of coarse-grained aquifer material within the 100-foot interval between 100 ft bgs to 200 ft bgs. The ancestral Arroyo del Valle channel depicted on Figure 5 is located along the northern and northeastern sides of Lake B. In contrast, north of Stanley Boulevard, the aquifer material comprises only 40 percent to 60 percent of the total sediment present in the interval between 100 ft bgs and 200 ft bgs. The information presented by DWR (1966), as shown on Figure 5, suggests that the aquitards are much thicker and more consistent in the area north of Stanley Boulevard than they are in the area of Lake B. Figure 5 also indicates that the Quaternary Alluvium is not present in this depth interval east of Isabel Avenue and south of Alden Lane, in the area of Lake A.

Figure 6 shows the gross thickness of aquifer materials in the depth interval between the ground surface and 100 ft bgs in the Amador sub-basin. The ancestral axes of the major stream depositional channels are also shown on Figure 6. The approximate outline of the Eliot facility and the location of several boreholes are also indicated on Figure 6. Deposition associated with the ancestral Arroyo del Valle channel within the depth interval down to 100 ft bgs extends east of Vallecitos Road. In the western part of Lake A, the eastern part of Lake B, and along the north side of Lake B, the coarse-grained aquifer deposits comprise over 90 percent of the material deposited by the ancestral Arroyo del Valle. It is also important to note that, while the ancestral stream channel follows the current stream channel in the Lake A area, it turns to the north in the Lake B area and then parallels the current location of Stanley Boulevard.

In April 2013, CEMEX drilled and logged 22 boreholes at the Eliot Facility. The boreholes were drilled using a Becker Hammer drill rig. The borehole locations are shown on Figure 7. Five boreholes were drilled along the west and south sides Lake A, 14 boreholes were drilled around the perimeter of and within Lake B, and three boreholes were drilled in the existing plant area (Lake J). At Lake A the boreholes were drilled to depths of 110 feet below ground surface (ft bgs) to 200 ft bgs, corresponding to elevations of approximately 320 ft msl down to 220 ft msl. At Lake B the boreholes were drilled to depths of 200 ft bgs to 220 ft bgs within the pit and 280 ft bgs to 300 ft bgs around the perimeter, corresponding to elevations of approximately 136 ft msl down to 96 ft msl, except for the two shallow holes within the pit, which were drilled to 50 ft bgs and only reached an elevation of approximately 250 ft msl. In the plant area the boreholes were drilled to depths of 280 ft bgs to 290 ft bgs, corresponding to elevations of approximately 100 ft msl and 90 ft msl, respectively. Detailed borehole logs are provided in Appendix A of the Kane GeoTech, Inc. May 2013 report.

Figures 8, 9, and 10 present Cross Sections A-A', B-B', and C-C', respectively, for the Eliot Facility. The cross section locations are shown on each figure.

Cross Section A-A' (Figure 8) extends from the processing plant area at the Eliot Facility, near Stanley Boulevard, toward the southeast through Lake B and along the south side of Lake A to Vallecitos Road. In the Lake A area, the sand and gravel deposits that constitute the Quaternary Alluvium are approximately 100 feet thick, as indicated in boreholes BH2013-18 through BH2013-21. The alluvium is underlain by deposits that consist of gray and blue clays, partially-cemented gravels, and tuffs (volcanic ash). The deposits that are present beneath the alluvium are consistent with the description of the Lower Livermore Formation as defined by Barlock (U.S. Geological Survey, 1989a). The relatively thin Quaternary Alluvium in the Lake A area was also identified by DWR (1966), as indicated on Figures 5 and 6, which do not show the presence of alluvial deposits from ancestral Arroyo del Valle east of Isabel Avenue in the depth interval from 100 ft bgs to 200 ft bgs, but do show the occurrence of these deposits and the course of the ancestral streambed in the depth interval from the ground surface down to 100 ft bgs.

In the area of Isabel Avenue, between boreholes BH2013-17 and BH2013-1, the thickness of the sand and gravel deposits of the Quaternary Alluvium become much thicker due to the presence of a major erosional unconformity. As indicated on Figure 8, the thickness of the alluvium is at least 300 feet in the area of Lake B. However, the total thickness is unknown because none of the boreholes drilled in the Lake B area encountered the base of the alluvium.

The depth ranges and interpreted lateral extent of clay and silt deposits within the Quaternary Alluvium that were encountered in the boreholes are shown on each of the cross sections (Figures 8, 9 and 10). These clay and silt deposits typically form the aquitard units in the main part of the Amador sub-basin. As shown on Figure 8, the clay and silt deposits under Lake B are primarily thin and discontinuous. The approximate depth range of the various aquifer and aquitard units identified by Zone 7 (2011) are indicated along the left side of Cross Section A-A’ on Figure 8. It is readily apparent that there are not any continuous aquitard units present across the entire area of Cross Section A-A’ and that the various aquifer units are in hydraulic communication with each other (meaning that the sand and gravel deposits are interconnected and not separated by low-permeability fine-grained material).

Cross Section B-B’ (Figure 9) extends from near the southeast corner of the Main Silt Pond on the Eliot Facility toward the south-southeast along the northeast side of Lake B and eventually crosses Lake B near the east end of the pit, approximately 1,200 feet to 1,500 feet west of Isabel Avenue. The bottom of borehole BH2013-1 encounters the unconformity between the Quaternary Alluvium and the Lower Livermore Formation discussed above and shown on Figure 8. The Lower Livermore Formation was not encountered in BH2013-8 on the south side of Lake B, which was drilled to a depth that is 35 feet deeper than BH2013-1. The Lower Livermore Formation was also not encountered in boreholes BH2013-2 and BH2013-3 to the north-northwest of BH2013-1. Thus, BH2013-1 is interpreted to have encountered a ridge or “nose” on the surface of the unconformity that projects under Isabel Avenue in the location of that borehole. Field reconnaissance conducted by personnel from CEMEX and Kane GeoTech in May 2014 confirmed that the Lower Livermore Formation is not present in the east wall of Lake B (personal communication, Joseph Renner, Kane GeoTech, May 8, 2014).

The four boreholes drilled for CEMEX in 2013 that are shown on Figure 9 consist predominantly of sand and gravel. Clay or silt layers were not identified in BH2013-8. Clay or silt layers were also not identified in BH2013-2 below an elevation of 360 ft msl. In boreholes BH2013-1 and BH2013-3, relatively thin fine-grained layers were logged at approximately 165 ft msl and 175 ft msl, respectively, but these layers were not encountered in the nearest adjacent boreholes.

The north end of Cross Section B-B’ (Figure 9) occurs at the borehole for the 13P well cluster drilled for Zone 7 in 2010. The 2013 boreholes drilled for CEMEX extended to a maximum depth of approximately 300 feet, or an elevation of 100 ft msl. However, the 13P borehole was drilled to a maximum depth of 618 feet, or an elevation of -239 ft msl, substantially deeper than the proposed maximum depth of mining in Lake B. As shown on Figure 9, and the borehole log included in Appendix A, silts or clays were not encountered in the 13P borehole between approximately 325 ft msl and approximately 95 ft msl. A silty sand and gravel unit was encountered from approximately 95 ft msl to approximately 55 ft msl. This silty sand and gravel unit may function as an aquitard, or be laterally equivalent to a finer-grained aquitard layer toward the center of the sub-basin. However, fine-grained units that could potentially function as aquitards were not identified on the log for the 13P borehole from 325 ft msl to 95 ft msl, which is more than 50 feet below the proposed maximum mining depth for Lake B.

The borehole logs shown on Cross Section B-B' (Figure 9) indicate a substantial lack of fine-grained units above an elevation of 100 ft msl. Thus, there is no indication of the occurrence of any laterally continuous aquitard layers along the east and northeast side of Lake B within the proposed mining depth. This finding is consistent with the interpretation presented by DWR (1966), as shown on Figures 5 and 6. Cross Section B-B' roughly follows the path of the ancestral Arroyo del Valle channel and represents the area where the thickest and most continuous deposits of coarse-grained material exist within the Amador sub-basin. The information presented on Figure 9 clearly demonstrates that there are no confining layers in the area represented by Cross Section B-B' and that the Upper and Lower Aquifer Zones, as well as each of the depositional sequences from the Cyan Aquifer down to at least the Purple Aquifer are in direct hydraulic communication along the east and northeast sides of Lake B.

Cross Section C-C' (Figure 10) extends along the Arroyo del Valle channel and south side of Lake B eastward to the west end of Lake A. On the east side of this cross section, the major erosional unconformity between the Quaternary Alluvium and the Lower Livermore Gravels is present, as previously described in the discussion of Cross Section A-A', above. On the west side of Isabel Avenue, at borehole BH2013-8, the ancestral Arroyo del Valle channel is present, as indicated by the complete lack of observed fine-grained silt or clay deposits. Farther to the west, thicker and more continuous silt and clay aquitard layers are present. The most continuous aquitard layer occurs within the general range of 295 ft msl down to 240 ft msl. This aquitard layer is laterally equivalent to the aquitards separating the Upper and Lower Aquifer Zones and has also been referred to as the Cyan-Gray Aquitard (Zone 7, 2011). A shallower fine-grained zone, up to 40 feet thick, is also present within the Upper Aquifer Zone (also referred to as the Cyan Aquifer) to the south of the current Arroyo del Valle channel. In the interval between 250 ft msl and 150 ft msl, however, only thin, discontinuous fine-grained deposits are observed and there are not any laterally consistent aquitard zones present. The presence of the thicker and more continuous aquitard zones at the west end of Cross Section C-C' is consistent with the interpretations of DWR (1966). As shown on Figures 5 and 6, the percentage of coarse deposits present in the depth ranges between 100 ft bgs to 200 ft bgs and between ground surface and 100 ft bgs, respectively, increasess rapidly toward the southwest, across the axis of the ancestral Arroyo del Valle channel.

The lack of continuous aquitard layers and the hydraulic communication between the different aquifer zones and depositional sequences in the area of Lake B has also been recognized by the Alameda County Planning Department (1979) in the Specific Plan EIR. The Specific Plan EIR identifies the area between Stanley Boulevard and Arroyo del Valle as the "forebay area" and states that it is the primary recharge area for the aquifers in the Amador sub-basin. Section 3.a(3)(b) on page 15 of the Specific Plan EIR states that the area south of Stanley Boulevard, roughly coincident to the area of the Eliot Facility and parts of Lakes C and D, is the "major forebay for the confined aquifers in the northern portion of the Santa Rita (Amador) subbasin. Groundwater recharged in the forebay moves north and west toward areas of depletion, becoming confined under pressure beneath the progressively thickening aquicludes." DWR also states (1974, pages 67-68) that "[m]any of the aquifers merge near the course of Arroyo Valle, where the combined aquifers are present as a deposit of sandy gravel up to 300 feet in thickness." The description of the forebay area as the primary recharge area for the aquifers in the Amador sub-basin by the Alameda County Planning Department (1979) and DWR (1974) is consistent with the lack of aquitard layers under much of the Lake B area, as shown on Cross Sections A-A' through C-C' (Figures 8 through 10).

Additional documentation from other studies that concluded that the aquitard between the Upper and Lower Aquifer Zones is either discontinuous or not present in the area of the Eliot Facility include:

1. The California Department of Water Resources (DWR) states in *Livermore and Sunol Valleys, Evaluation of Ground Water Resources, Appendix A: Geology* (DWR Bulletin No. 118-2, Appendix A, August 1966):
    a. "…the aquicludes in the alluvium become gradually more permeable, thinner, and more difficult to distinguish on well logs toward the southeast" (page 48).
    b. "The second aquiclude becomes indistinguishable in well logs as a recognizable layer somewhat further south [of Stanley Boulevard]" (pages 48-49).
    c. "The portion of the subbasin south of [Stanley Boulevard] is the major forebay for the confined aquifers in the north portions of the…subbasin" (page 49).
2. Brown and Caldwell on behalf of Vulcan (SMP-16) at Lakes C and D in the *Final Report, Pleasanton Quarry Hydrogeologic Data Evaluation for Calmat Co. dba Vulcan Materials Company, Western Division* (Brown and Caldwell, August 2004) states that:
    a. "Increasingly thin and discontinuous clay is thus common in the forebay (recharge area) of basins" (page 7-1).

b. “Water levels in the area of…SMP-23…appear to be consistent with the presence of a window between wells screened above and below [the aquitards]” (page 7-1).

3. Zone 7 states in the *Hydrostratigraphic Investigation of the Aquifer Recharge Potential for Lakes C and D of the Chain of Lakes, Livermore, California* (Zone 7 Water Agency, May 2011):
   a. “…lacustrine [aquitard] deposits at the top of the…Units appear to thin, and, in at least one case, are non-existent…to the south and east” (page 25).
   b. “The fine-grained overbank deposits within the…Units also appear to thin and/or have been completely eroded to the south and east” (page 25).
   c. “The boundary between the [Upper and Lower Aquifers] does not provide much of a hydrostratigraphic flow boundary” (page 27).
   d. “The boundary between the…Units appears to be less of a hydrostratigraphic flow boundary in the study area than it is to the north” (page 28).
   e. “The aquitards…that act as vertical flow boundaries appear to thin or are completely eroded to the south and east…” (page 28).
   f. “It is believed that the Lower Aquifer Zone derives most of its water from the Upper Aquifer Zone through the leaky aquitard(s) when groundwater heads in the upper zone are greater than those in the lower zone” (page 5).

As discussed further below, the hydrostratigraphy of the Lake B area provides important insights and information for estimating dewatering rates during mining and recharge potential after mining is completed.

## *3.2 Aquifer Properties*

The aquifer properties addressed in the discussion below are the transmissivity and the storativity of the aquifer units. The transmissivity is a measurement of the ability of the aquifer to transmit water and is correlated to the permeability of the geologic material and the thickness of the aquifer. The storativity is a measurement of how much water the aquifer will provide when pumped, expressed as a fraction of the total volume of the geologic material and void space that comprises the aquifer.

As part of the *Hydrostratigraphic Investigations of the Aquifer Recharge Potential for Lakes C and D of the Chain of Lakes, Livermore, California* (Zone 7, 2011), Zone 7 installed new monitoring wells and conducted an aquifer pumping test with grant funds from the California Department of Water Resources. The maximum, minimum, and average aquifer parameters identified by the interpretation of the pumping test results are summarized in Table 1. During the aquifer pumping test, drawdown was observed in the shallower aquifer units (Cyan and Gray) as a result of pumping in deeper units (Purple and Red). The apparent hydraulic connection between the shallower aquifer units and the deeper aquifer units is consistent with the occurrence of thin or discontinuous aquitard units in the area of Lake B. This observation is also consistent with the discussion of the aquitard units presented in Section 3.1, above.

Table 1. Aquifer Properties.

| PARAMETER | UNITS | MAXIMUM | MINIMUM | AVERAGE | BEST FIT |
|---|---|---|---|---|---|
| Transmissivity (T) | Feet squared per day ($ft^2/d$) | 6900 | 2400 | 4600 | 4350 |
| Storativity | Unit-less | 0.001 | 0.00012 | 0.0007 | 0.0007 |

Dewatering rates in 2012 and 2013 were reported by CEMEX to be approximately 3,400 gpm. As discussed further in Section 3.3, the average groundwater elevation around the perimeter of the pit was 360 ft msl, whereas the elevation of the water in the west end of Lake B was about 280 ft msl, as measured by Zone 7 in 2012 and 2013. Thus, the maximum drawdown from dewatering was about 80 feet. In addition, the depth to groundwater as measured in the April 2013 boreholes suggests that at a distance of approximately 3,600 feet from the deepest part of the pit, the groundwater elevation was about 320 ft msl, equivalent to a drawdown of 40 feet.

To provide a more accurate representation of aquifer properties for the Lake B area, analytical simulations were conducted to simulate existing drawdown conditions in Lake B (EMKO, 2012). The analytical model used is based on the Theis equation and was run in an Excel spreadsheet using approximations for the Well Function (Wu). The model was run for the average, maximum, and minimum transmissivity values shown in the table above. The results from these initial runs were then used to identify the best-fit transmissivity and storativity values for the observed conditions described in the paragraph above. As indicated in Table 1, the best-fit transmissivity value is 4,350 $ft^2/d$.

A sensitivity analysis was also conducted for the range of storativity values (EMKO, 2012). The sensitivity analysis simulations were conducted using the best-fit transmissivity, comparing predicted drawdowns at 330 feet and 3,600 feet from the center of pumping for various pumping durations. The difference in the predicted drawdowns for the maximum storativity value of 0.001 and the average value of 0.0007 vary by only four to eight percent. The difference in the predicted drawdowns for the minimum storativity value of 0.00012 and the average value of 0.0007, however, vary by 18 to 38 percent. The sensitivity analysis for storativity indicates that the average value provides an appropriately conservative (i.e. does not over-estimate drawdown) and stable value for this parameter.

## *3.3 Water Level Trends*

Water level data were requested and received from Zone 7 in May 2013 for 17 wells in the vicinity of Lake A and Lake B. More recent water level data have been obtained from Zone 7 annual monitoring reports (Zone 7, 2014a, 2015, 2016). Figure 11 is a hydrograph of the water levels measured in these 17 wells. The well designations are listed in the legend of Figure 11. The well locations are shown on Figure 12, which is a copy of Figure 3.2-1 of the 2011 Annual Report from Zone 7, which is available on the Zone 7 website (http://www.zone7water.com/). The wells are designated based on the township, range, section, and 16$^{th}$-section designation in accordance with California Department of Water Resources standards. For example, well 3S-2E_30D02, as listed in the legend for Figure 11, is located in Township 3 South, Range 2 East, in the northwest corner of Section 30 (Mount Diablo Base and Meridian). For brevity, this well is referred to as well 30D2 in this report.

Water level records for two wells (13P1 and 20M1) are available since 1948, and from an additional well (23J1) since 1958. The water level data show that in most wells, the water levels have tended to fluctuate based on rainfall patterns. For example, significant dry periods in the late 1980s-early 1990s, in the early 2000s, and for the last four to five years are reflected in lower water levels at many locations. There are, however, exceptions to this pattern. Water levels in wells 29F4 and 30D2 show very little fluctuation over time. These two wells are both completed in the upper aquifer and located east of Isabel Avenue adjacent to the Arroyo del Valle.

To provide a closer focus on more recent water level trends, Figure 13 shows the water level data for the same 17 wells since 1999. This figure provides an even clearer depiction of the wells with relatively stable water levels and those with more cyclical water levels. The wells with water levels above 350 ft msl tend to exhibit more stable and less cyclical water levels over time. These wells include 23J1, 25C3, 20M1, 29F4, 30D2, and 30G1, which are all located south of the Arroyo del Valle or east of Lake A. The data indicate that these six wells are in locations that are not affected by dewatering and pumping activities within the main groundwater basin. These characteristics may be attributed to wells located in recharge areas or some distance upgradient of groundwater extraction areas.

The water levels for the other 11 wells shown on Figures 11 and 13 typically have a dual cyclical pattern. As discussed above, long-term cycles are related to climatic changes such as wet periods and drought periods. Annual cycles are due to recharge during the wet season and extraction during the dry season. Peak water levels generally occur between March and May each year, and minimum water levels generally occur in August or September. The long term climatic cycles can result in water-level changes of up to 100 feet. The annual cycles typically range in magnitude from about 15 feet to 40 feet.

There are two well clusters included in the data evaluated for this study. Well cluster 13P5 through 13P8 is located just north of Lake B, between the SMP-23 main silt pond and future Lake D. Well cluster 19D7 through 19D10 is located along Isabel Avenue east of future Lake C. In each cluster, the screened interval is deeper with the higher number designation (i.e. 13P5 is the shallowest well and 13P8 is the deepest). At both clusters, the screened intervals correlate to the Cyan, Grey, Purple, and Red aquifer zones, respectively, as indicated on Figure 3. At both well cluster locations, the water levels show a downward vertical gradient, except between the Gray and the Purple units. Thus, the groundwater elevation in the Cyan unit is typically at a higher elevation than that in the Gray unit, and the water level in the Gray unit is typically higher than that in the Red unit, while the water level in the Purple unit is typically between that measured in the Cyan and Gray units.

Recent evaluations presented by Zone 7 (March 2014, Appendix D) provide anticipated conditions for the Chain of Lakes after mining and reclamation are completed. Zone 7 estimates that the maximum water surface elevations in Lake A and Lake B will be 410 ft msl and 370 ft msl, respectively. Zone 7 also estimates that the historical low water surface elevations in the vicinity of Lake A and Lake B are 325 ft msl and 265 ft msl, respectively. According to Zone 7 staff, the historical low elevations are for the Lower Aquifer (email from Colleen Winey to Andrew Kopania, May 27, 2014). Figure 14 is a hydrograph provided by Zone 7 staff (ibid) of wells in the Lower Aquifer in the vicinity of Lake A and Lake B used for the evaluation of historical low groundwater elevations. The well locations are shown on Figure 12. The data indicate that groundwater levels in the Lower Aquifer may vary by 80 feet or more between wet and dry climatic periods in the vicinity of the Eliot facility.

Figure 15 is a hydrograph provided by Zone 7 staff (ibid) of wells in the Upper Aquifer in the vicinity of Lake A and Lake B used for the evaluation of historical low groundwater elevations. The well locations are shown on Figure 12. The data indicate that groundwater levels in the Upper Aquifer may vary by 60 feet or more between wet and dry climatic periods in the some wells, but at other locations in the shallow aquifer near the Eliot facility, the long-term fluctuations have been less than 20 feet. Well 23J1 is located to the south of Lake B and has the longest historic record for the wells in the Upper Aquifer near Eliot (see Figure 11). The average groundwater elevation in Well 23J1 is approximately 353 ft msl while the historic low elevation has been about 323 ft msl, in 1992 and in 2015.

The data on Figures 14 and 15 indicate that water levels have been declining in both the Upper and Lower Aquifers for the past eight years, most likely due to persistent drought conditions. As of late 2015, groundwater levels in many of the wells are approaching their historic low levels, including at 23J1, 25C3, 30G1, and at the 13P well cluster.

The data on Figure 15 shows that at current mining depths in Lake B (which are shallower than the currently-allowed mining to an elevation of 250 ft msl under the Interim Corrective Action), the pit would not become dry due to seepage from the Upper Aquifer. Thus, if no additional mining were to occur at Lake B, groundwater would always be present in the lake. The groundwater seepage from the Upper Aquifer into Lake B would provide recharge to the Lower Aquifer, which has lower groundwater elevations.

Zone 7 also measures the water surface elevation in various ponds and mine pits in the Chain of Lakes area. Figure 16 shows the water surface elevations measured in these ponds in 2011, prior to the beginning of the current drought. Comparison with water levels in the same ponds at Lake A, adjacent to Lake B, and at Shadow Cliffs in the fall of 2015 (Zone 7, 2016, Figure 5-9) indicates that the water levels have changed by less than two feet over this time period. For example, Ponds P41 and P28 are the eastern and western mine pits, respectively, at Lake A. The 2011 and 2015 measurements, respectively, in these ponds is approximately 409 ft msl versus 410 ft msl in P41 and 401 ft msl versus 403 ft msl in P28. Ponds K18 and P12 are located along the channel of the Arroyo del Valle south of Shadow Cliffs, west of Lake B. The water surface elevation in these two ponds has remained relatively stable at approximately 350 ft msl for many decades. Based on a comparison of the water levels in the ponds discussed in this paragraph with the water levels in adjacent or nearby wells south of Arroyo del Valle, the water surface in the ponds described above appears to coincide with that of the groundwater in the shallow aquifer (Cyan zone).

Based on groundwater contours prepared by Zone 7 (2012, 2013, 2014a, 2015, 2016) and the observed elevation of seepage along the east and south sides of the existing mine pit, the elevation of the groundwater surface at the existing perimeter of Lake B appears to remain relatively constant at approximately 360 ft msl. Groundwater flow into the pit occurs primarily along the south side, and to a lesser extent along the east side. The north and west sides of the current Lake B pit are adjacent to former silt ponds and seepage into the pit is not observed in these areas.

Pond P42 is the sump at the western end of Lake B, which represents the depth from which the groundwater is pumped for dewatering of the mine pit. The water level in the pit has ranged from about 278 ft msl to 290 ft msl in prior years. In October 2015, however, the water level had dropped below 270 ft msl (Zone 7, 2016).

The water level trends appear to show an appreciable difference in the water level behavior in wells and ponds along and south of Arroyo del Valle when compared to that in wells and ponds north of Arroyo del Valle. The water levels in the wells and ponds along and south of Arroyo del Valle have remained relatively stable through the current drought and, in some cases, for many decades. In contrast, the water levels in the wells and ponds north of Arroyo del Valle fluctuate cyclically in response to annual pumping and to drought and wet climatic cycles. Several of these wells are approaching historic low groundwater levels during the current drought period. There is very little groundwater pumping south of Arroyo del Valle, so it is likely that recharge from the arroyo is sufficient to maintain the water levels in wells to the south and the ponds along the channel. In contrast, lack of recharge during drought periods combined with groundwater pumping and mine dewatering to the north of Arroyo del Valle appears to cause the cyclical water level trends at the monitoring locations north of the arroyo.

## *3.4 Water Quality*

As described above, after mining is completed, Lake A and Lake B will be reclaimed as basins for groundwater storage, conveyance and recharge as part of the Chain of Lakes. Under the Specific Plan, water will be diverted from Arroyo del Valle into Lake A and then conveyed through the Chain of Lakes to recharge groundwater. Lake J will be retained by CEMEX and will be reclaimed as open space and as a lake. The perimeter of Lake J will be graded to prevent runoff from adjacent lands or roadways from entering the lake. Thus, the only source of water entering Lake J after it is reclaimed will be precipitation falling directly onto the lake surface. The discussion presented here is provided to support the evaluation of any effects of the recharge of surface water from the Arroyo del Valle into Lake A and Lake B, as presented below. Additional discussion and evaluation of water quality data is presented in a separate technical memorandum (EMKO, 2016d).

Water quality data were obtained from Zone 7 for wells and surface water locations in the vicinity of Lake A and Lake B. Figures 12 and 16 show the locations of wells and surface water samples, respectively. Note that not all locations shown on these figures were evaluated for this report. The water quality data are provided in Tables 2 and 3 for groundwater and surface water, respectively.

Zone 7 (2011) reports that there are not any distinct water quality characteristics that uniquely distinguish an individual well or aquifer unit within the basin. The groundwater is primarily a calcium-bicarbonate water type. For groundwater, TDS levels range fairly uniformly from about 300 milligrams per liter (mg/L) to about 550 mg/L. The pH ranges from 6.8 to 8.0, with all but two values being between 7.2 and 7.7 (see Table 2). The predominant anion (negatively charged ion) is bicarbonate. Calcium is the predominant cation (positively charged ion). Evaluation of past water quality data indicates that water quality parameters have been consistent over time and that there have not been any significant trends in these parameters over the last 40 to 50 years (EMKO, 2016d).

Surface water quality data are presented in Table 3, based on samples collected by Zone 7 (2013). Surface water samples were collected from the east and west parts of Lake A, the pond at the bottom of Lake B, the ponds along Arroyo del Valle at the Topcon site, Island Pond, and Lake Boris. The ponds at the Topcon Site, Island Pond, and Lake Boris are historical aggregate mining pits along Arroyo del Valle. Island Pond and Lake Boris are located south of Shadow Cliffs Lake. The surface water data suggest that the general water chemistry is slightly different at Lake A compared to downstream locations. At Lake A, the water chemistry is similar to that for groundwater in nearby wells, with TDS levels in the range of 450 mg/L to 490 mg/L, and with magnesium, sodium, and chloride present at higher proportions than at other locations. At the locations downstream from Lake A, the TDS is less than 340 mg/L, the predominant cation alternates between calcium and sodium, and the predominant anion is bicarbonate. The pH at all surface water locations ranges from 8.4 to 8.9. The general water chemistry at P42 within Lake B is comparable to the water chemistry of the surface water locations along Arroyo del Valle, especially that at Island Pond. Field observations indicate that most of the water that seeps into Lake B enters along the south side of the mining excavation, adjacent to Arroyo del Valle.

**TABLE 2**

Groundwater Quality Data

| | Well | 13P1 | 13P05 | 13P06 | 13P07 | 13P08 | 23J01 | 25C03 | 19D07 | 19D08 | 19D09 | 19D10 | 20M01 | 29F04 | 30D02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Parameter | Units | 4/17/2012 | 4/17/2012 | 4/17/2012 | 4/17/2012 | 4/17/2012 | 2/8/2012 | 2/8/2012 | 4/16/2012 | 4/16/2012 | 4/16/2012 | 4/16/2012 | 2/8/2012 | 4/16/2012 | 5/30/2012 |
| Calcium | mg/L | 56 | 50 | 86 | 49 | 61 | 53 | 56 | 75 | 88 | 44 | 61 | 73 | 64 | 44 |
| Magnesium | mg/L | 18 | 22 | 22 | 12 | 17 | 30 | 23 | 51 | 56 | 15 | 30 | 33 | 26 | 22 |
| Sodium | mg/L | 48 | 49 | 34 | 50 | 52 | 58 | 69 | 30 | 32 | 27 | 44 | 68 | 38 | 37 |
| Potassium | mg/L | 1.8 | 1.7 | 2.0 | 2.0 | 2.1 | 1.0 | 1.3 | 2.1 | 2.3 | 1.4 | 1.8 | 1.7 | 1.9 | 1.9 |
| Bicarbonate (as CaCO3) | mg/L | 188 | 182 | 267 | 246 | 229 | 166 | 254 | 281 | 304 | 133 | 208 | 326 | 285 | 202 |
| Sulfate | mg/L | 45 | 45 | 42 | 40 | 43 | 13 | 31 | 22 | 25 | 10 | 32 | 53 | 56 | 43 |
| Chloride | mg/L | 80 | 83 | 69 | 16 | 56 | 144 | 96 | 135 | 152 | 48 | 97 | 89 | 42 | 54 |
| TDS | mg/L | 357 | 359 | 415 | 316 | 376 | 447 | 446 | 501 | 553 | 294 | 449 | 511 | 391 | 326 |
| SpecificConductivity | umho/cm | 623 | 621 | 704 | 506 | 628 | 813 | 763 | 902 | 988 | 467 | 735 | 881 | 657 | 566 |
| pH | std units | 7.4 | 7.4 | 7.3 | 7.7 | 7.3 | 8.0 | 6.8 | 7.2 | 7.3 | 7.4 | 7.3 | 7.6 | 7.6 | 7.7 |

**TABLE 3**

Surface Water Quality Data

| Sample No. | | P41 | P28 | P42 | P10 | P12 | K18 |
|---|---|---|---|---|---|---|---|
| Location | | Lake A East | Lake A West | Lake B | Topcon | Island Pond | Lake Boris |
| Parameter | Units | 5/29/2012 | 5/29/2012 | 5/29/2012 | 5/29/2012 | 5/29/2012 | 5/29/2012 |
| Calcium | mg/L | 52 | 35 | 47 | 25 | 40 | 36 |
| Magnesium | mg/L | 36 | 42 | 23 | 26 | 18 | 17 |
| Sodium | mg/L | 62 | 83 | 41 | 53 | 41 | 49 |
| Potassium | mg/L | 2.5 | 2.4 | 1.4 | 2.4 | 2.0 | 2.1 |
| Bicarbonate (as CaCO3) | mg/L | 236 | 216 | 202 | 173 | 164 | 138 |
| Sulfate | mg/L | 39 | 52 | 41 | 21 | 45 | 45 |
| Chloride | mg/L | 130 | 153 | 66 | 72 | 71 | 70 |
| TDS | mg/L | 457 | 487 | 339 | 310 | 313 | 308 |
| SpecificConductivity | umho/cm | 851 | 883 | 617 | 558 | 568 | 539 |
| pH | std units | 8.6 | 8.6 | 8.4 | 8.7 | 8.4 | 8.9 |

## 4.0 Surface Water Hydrology

Detailed engineering evaluations of the hydrology of Arroyo del Valle and of the ability to divert flows from the arroyo into Lake A have been conducted by Brown and Caldwell (February 2014; March 2014). These evaluations were prepared to address specific comments from Alameda County related to the application to amend the Reclamation Plan for SMP-23 related to:

- Hydraulic impacts: Conduct technical analyses (e.g., hydraulic modeling) to demonstrate that the restored channel will remain stable, and that neither the channel modifications nor the diversion structure will increase flood risk to neighboring properties and infrastructure.
- Design feasibility: Present a complete design concept (e.g., schematic plans) and demonstrate that the elements of the reclamation plan designed to address diversion and conveyance into the Chain of Lakes can be feasibly constructed in compliance with known regulatory requirements.

Alameda County has also requested that the potential for scour under the Isabel Avenue bridge be addressed. Evaluation of the hydraulic impacts, diversion structure design, and bridge scour are summarized below.

### *4.1 Hydraulic Impacts*

To evaluate the hydraulic impacts, Brown and Caldwell conducted the following tasks:

- Development of a baseline hydraulic model representing the existing conditions of the Arroyo del Valle channel and floodplain;
- Modification of the baseline hydraulic model to represent the proposed (reclaimed) conditions along the affected reaches of Arroyo del Valle;
- Evaluation of channel stability impacts by comparing long-term sediment transport capacities for baseline and proposed (reclaimed) conditions; and
- Evaluation of flooding impacts by comparing 100-year water surface profiles and potentially inundated areas for baseline and proposed (reclaimed) conditions.

A new HEC-RAS hydraulic model of the Arroyo del Valle channel and floodplain was developed because existing models either did not cover a sufficient area of the floodplain or did not include accurate flow data. The model that was developed extends from approximately 3,000 feet upstream of Vallecitos Road to approximately 1,000 feet downstream of Bernal Avenue, a distance of 5.4 miles. The model was used to evaluate potential channel stability and flooding impacts related to the proposed reclaimed conditions at the Eliot Facility, including the realignment and restoration of the Arroyo del Valle corridor along Lake B and addition of an in-channel diversion structure near Vallecitos Road. Brown and Caldwell (February 2014) made the following findings based on the modeling results:

- Average annual sediment loads within the restored reach will be roughly equivalent to the annual sediment loads in upstream reaches, and those loads are similar to the estimated loads for the baseline condition. In other words, the restored corridor will maintain sediment continuity, and therefore it is not likely to experience channel instabilities due to substantial aggradation or degradation.
- Calculated water surface elevations for baseline conditions are higher than the ground elevations separating the channel from Lakes A and B in at least two locations, indicating that floodwaters could potentially enter into the lakes during a 100-year flood event.
- Water surface elevations along the restored corridor are on average approximately 1.6 feet higher than under baseline conditions; however, the proposed geometry for the restored corridor has sufficient depth to contain the 100-year, as well as the 500-year, flood flows.
- The 100-year water surface elevation increase at the upstream end of the restored corridor is approximately 1.6 feet; however, this increase diminishes rapidly upstream and will not result in additional inundated areas if the modified corridor is tied into high ground.
- Water surface increases along the restored corridor are due to a combination of a narrower floodplain width and a higher Manning's roughness coefficient due to the anticipated vegetation that will be included in the channel restoration.
- An in-channel diversion with an obstruction as high as 10 feet at the upstream end of Lake A would increase water surface elevations in the vicinity immediately upstream of the diversion; however, those increases diminish rapidly and are negligible beyond Vallecitos Road.
- An in-channel diversion with an obstruction as high as 10 feet at the upstream end of Lake A could also increase the area inundated by a 100-year flood event unless adjacent grades are raised. In particular, the 100-year flood could potentially inundate a small portion of Vineyard Avenue, and comes close to impacting a nearby residential structure.

The specific areas and berm heights needed to address the potential for inundation during a 100-yer flood under current (baseline) conditions are identified in the hydraulic modeling report (Brown and Caldwell, February 2014) and are incorporated into the amended Reclamation Plan sheets prepared by Spinardi & Associates (2016).

## 4.2 Diversion Structure Design

To evaluate the diversion of up to 500 cubic feet per second (cfs) of water from Arroyo del Valle into Lake A in accordance with the Specific Plan, Brown and Caldwell (March 2014) conducted the following tasks:

- Investigated design requirements and performance criteria for diversion and conveyance facilities, including pertinent design criteria requested by Zone 7;
- Investigated options for key project components (e.g., fish exclusion, hydraulic grade controls, and fish passage), performed an initial screening of options, and developed several conceptual design alternatives;
- Evaluated each alternative with respect to key design criteria and identified a preferred alternative; and
- Developed conceptual design sketches and prepared a preliminary construction cost estimate for the preferred alternative.

Key components of the diversion include the type and height of grade control structure (i.e. diversion dam) needed and providing for fish screening and bypass in accordance with California Department of Fish and Wildlife (DFW) criteria. Based on the detailed engineering analysis conducted, Brown & Caldwell (March 2014) identified an infiltration bed as the best alternative to divert up to 500 cfs and meet the Zone 7 and DFW design criteria. The infiltration bed will be located near the southeast corner of Lake A. It will consist of a 100-foot by 200-foot by four-foot deep gravel infiltration bed adjacent to the stream channel. A rock-covered concrete diversion structure with fish bypass will provide the necessary head to inundate the gravel infiltration bed. Forty 100-foot long perforated horizontal drain pipes will be buried near the base of the gravel bed. The horizontal drain pipes join along a manifold pipe that is connected to a flow control gate. When the flow control gate is opened, water from the arroyo will infiltrate through the gravel, be collected in the drain pipes through the manifold and pass through the flow control gate. The connection to Lake A is completed with a 10-foot wide by 12-foot deep concrete-lined channel followed by a rip-rap chute extending into the lake.

## 4.3 Bridge Scour

Under the current SMP-23 Reclamation Plan, mining in Lake A and Lake B included the entire floodplain and channel for Arroyo del Valle from the east end of Lake A to the west end of Lake B. Arroyo del Valle would enter Lake A through a concrete spillway immediately west of Vallecitos Road, then pass from Lake A to Lake B through another spillway beneath Isabel Avenue, and eventually return to its existing channel at the west end of Lake B by flowing over a 750-foot wide (north to south) concrete and rip-rap buttress that would act as a weir structure.

The engineering plans for the 1987 SMP-23 Reclamation Plan (prepared by Bissel and Karn, Inc.) indicate that the spillway under Isabel Avenue would be located in the same position in which Arroyo del Valle currently flows under Isabel Avenue. The existing Isabel Avenue bridge over Arroyo del Valle would remain in place. No changes in bridge height or channel width were proposed. The spillway would consist of a rip-rap lined channel approaching Isabel Avenue from the east. Beginning halfway under the existing bridge and extending into Lake B, the bottom of the spillway would be concrete-lined, with rip-rap lined sides.

The proposed amendments to the Reclamation Plan for SMP-23 eliminate mining in the channel of Arroyo del Valle at Lake A and the eastern part of Lake B and will maintain the channel in its current location and configuration under Isabel Avenue. Therefore, the spillway from Lake A to Lake B is unnecessary and will not be built.
According to the Project Description in the Caltrans 2008 Initial Study with Negative Declaration/Environmental Assessment with Finding of No Significant Impact (IS-ND/EA-FONSI) for the State Route (SR) 84 Expressway Widening Project, the bridge over Arroyo del Valle would be widened by 53 feet to the east and a narrower pedestrian/bicycle trail bridge would be built to the east of the highway bridge. In 2009, WRECO prepared a Bridge Design Hydraulic Study Report for Caltrans. Consistent with the findings of the February 2014 Technical Memorandum No. 1 Hydraulic Modeling of Arroyo del Valle, prepared by Brown & Caldwell for CEMEX, the 2009 WRECO report concluded that hydraulic conditions within Arroyo del Valle would remain stable upstream and downstream of the bridge. Thus, the bridge widening project would not affect flood elevations or hydraulic conditions in Arroyo del Valle upstream or downstream of the bridge.

Although the hydraulic conditions within Arroyo del Valle would remain stable upstream and downstream of the bridge, the scour analysis conducted by WRECO (2009) determined that during a 100-year flood, significant scour could occur at the piers and abutments of the widened highway bridge and the new trail bridge. Scour at the highway bridge would range from about 7.5 feet to over 14.5 feet. Scour at the trail bridge would be about 25 feet. According to WRECO (2009), this scour would occur primarily in the part of the channel area under the widened highway bridge and the new trail bridge. The abutments and piers for the new bridge areas are located upstream of the area where the concrete-lined segment of the spillway would have been constructed under SMP-23.

According to WRECO, extensive coordination occurred between Caltrans and its design team regarding recommended countermeasures to prevent scour at the bridge abutments and piers. Caltrans concluded that the rock slope protection (RSP) mitigation measures identified in the 2008 IS-ND/EA-FONSI would not provide sufficient protection from scour. Therefore, WRECO recommended that the piers of the widened section of the highway bridge and the new trail bridge, as well as the abutments for the new trail bridge, be supported on piles. The piles are to extend as deep as the estimated maximum depth of scour at each pier or abutment location. In addition, the RSP along the embankments of Arroyo del Valle at SR 84 will also be upgraded as part of the mitigation measures for the SR 84 widening project. According to WRECO, RSP is the most common type of bridge scour countermeasure due to its general availability, ease of installation, and relatively low cost.

Based on the above discussion, the current channel under the Isabel Avenue/SR 84 bridge is stable. Potential scour during a 100-year flood event at the Isabel Avenue/SR 84 bridge over Arroyo del Valle is primarily due to the SR 84 widening project, including the extension of the highway bridge to the east and construction of a new trail bridge upstream of the current bridge location. These changes to the bridge widths and locations are unrelated to the proposed changes in the SMP-23 Reclamation Plan. Caltrans has identified and will implement mitigation measures to address the potential for bridge scour during major flooding events. Therefore, no further action related to bridge scour is necessary as part of the Reclamation Plan Amendment for SMP-23.

## 5.0 Project Water Demand

As described in Section 2.0, the proposed project is an amendment of the reclaimed conditions at the Eliot facility. As a result, the project water demand is the consumptive water use of the proposed reclaimed conditions, which will not be fully implemented until 35 to 40 years from now. This section provides a comparison between the current water demand of the mining activity at the Eliot facility, the water demand that would have occurred under reclaimed conditions for the 1987 SMP-23 Reclamation Plan, and the anticipated water demand from the proposed amendments to the SMP-23 Reclamation Plan.

At the Eliot facility there is not always a clear distinction between some reclamation actions and mining-related activities. For example, realignment of Arroyo del Valle will be conducted under Option 1 of the current application before mining in Lake B can extend farther to the south. While realignment of the arroyo changes the reclaimed configuration of Lake B, it is not being conducted to reclaim the Lake B mining disturbance. Thus, water use for the realignment (primarily construction-related dust control and water added to fill material to reach compaction specs) will be a mining-related water use. The realigned path of the arroyo is also included in the Specific Plan (see Plates 2, 3, and 5).

In other situations, mining and reclamation will either be done concurrently (e.g. the perimeter grading activities at Lake A are likely to occur simultaneously with any additional mining at Lake A) or will be a minor extension of mining (e.g. as Lake J fills, there will be some minor grading and hydroseeding for reclamation). The water use for these reclamation activities is a continuation of the construction/dust control water use during mining.

Furthermore, reclamation construction water use is a temporary, short term usage (i.e. it will only occur for a year or two). CEMEX will always have excess water available for dust control and other reclamation actions as long as dewatering is occurring (EMKO, 2016d). Since short-term water uses for construction are easily accommodated by the existing dewatering of the mining pits, the primary consideration of water use for CEQA analysis is ongoing permanent consumptive water demand that can't be easily altered or curtailed if water availability becomes an issue during extended drought periods or other water emergencies. As discussed in the Water Supply Assessment (EMKO, 2016a), the only long-term water demand that cannot be curtailed is evaporation from the pits once mining is completed.

Current water uses at the Eliot facility include water that is used to process the aggregate and remains in the product that is shipped from the site, dust control, water provided to East Bay Regional Park District (EBRPD) to help maintain the water level in Shadow Cliffs Lake, water used to manufacture concrete, and potable water use. Water is also lost to evaporation from the freshwater ponds and main silt pond. The existing water demand for the Eliot facility includes approximately 65 AF/yr for operational uses and 680 AF/yr of evaporation, or a total of approximately 745 AF/yr (EMKO, 2016a).

Under the 1987 SMP-23 Reclamation Plan, the surface area of Lake A, Lake B, and Lake J after mining is completed would have been 208 acres, 243 acres, and 90 acres, respectively (EMKO 2016b). The resulting evaporative loss that would have occurred from Lake A, Lake B, and Lake J after mining was completed under the 1987 SMP-23 Reclamation Plan would have been 764 AF/yr, 893 AF/yr, and 331 AF/yr (EMKO, 2016a). Thus, the total evaporative loss from the reclaimed mining pits would have been approximately 1,990 AF/yr under the 1987 SMP-23 Reclamation Plan.

Under the proposed project, the surface area of Lake A, Lake B, and Lake J after mining is completed will be reduced to 100 acres, 211 acres, and 38 acres, respectively (EMKO 2016b). The resulting evaporative loss that will occur from Lake A, Lake B, and Lake J after mining is completed under the proposed project will be reduced to 368 AF/yr, 775 AF/yr, and 140 AF/yr, respectively (EMKO, 2016a). Thus, the total evaporative loss from the reclaimed mining pits under the proposed amendments to the SMP-23 Reclamation Plan will be approximately 1,280 AF/yr, which is a reduction of more than 35 percent from that which would have occurred under the existing plan.

## 6.0 Impact Assessment

As discussed above, the purpose of this report is to provide an analysis of hydrology and water quality conditions for the proposed amendments to the existing SMP-23 Reclamation Plan, and an assessment of potential impacts, both adverse or beneficial, based on CEQA and SMARA criteria. The applicable basis for evaluating any potential effects on hydrology and water quality resulting from the project are the CEQA Appendix G thresholds of significance for hydrology and water quality and related conditions in Sections 3706(b) and 3706(d) of SMARA.

According to Appendix G of the CEQA Guidelines, the thresholds of significance for hydrology and water quality address whether a project, or modification to an existing project, will:

a. Violate any water quality standards or waste discharge requirements or otherwise substantially degrade surface or groundwater water quality;
b. Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted);
c. Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site;
d. Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site;
e. Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems, cause flooding on- and off-site, or provide substantial additional sources of polluted runoff;

f. Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map;
g. Place within a 100-year flood hazard area structures which would impede or redirect flood flows;
h. Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam; or
i. Result in inundation by seiche, tsunami, or mudflow.

SMARA 3706(b) states that the quality of water, recharge potential, and storage capacity of ground water aquifers which are the source of water for domestic, agricultural, or other uses dependent on the water, shall not be diminished, except as allowed in the approved reclamation plan.

SMARA 3706(d) states that surface runoff and drainage from surface mining activities shall be controlled by berms, silt fences, sediment ponds, revegetation, hay bales, or other erosion control measures, to ensure that surrounding land and water resources are protected from erosion, gullying, sedimentation and contamination. Erosion control methods shall be designed to handle runoff from not less than the 20-year/one-hour intensity storm event.

In addition to the conditions and criteria discussed above, the existing mining within Lake B has created a set of baseline conditions that include:

- On-going dewatering with use of the pumped groundwater for aggregate processing, ready-mix concrete, dust control, and discharge to Shadow Cliffs;
- Excavation at elevations below the base of the channel for Arroyo del Valle, such that continued mining will not change the amount of percolation from the stream into the pit; and
- Slope angles on the side of the pit will not change under the proposed amendments to the Reclamation Plan so there will be no change in the potential for erosion, runoff or sedimentation around the perimeter of the basin above the final reclaimed water surface in Lake B.

It should also be noted that the County has previously approved mining to depths as low as 150 ft msl in Lakes C and D at SMP-16, immediately north of Lake B, as well as approved mining to the depth of the aggregate deposit at Lake J.

Each CEQA hydrology and water-quality criterion and SMARA requirement, as listed above, is discussed below relative to the effects of the project.

**a:** *Will the project violate any water quality standards or waste discharge requirements or otherwise substantially degrade surface or groundwater water quality*?

The Lake A, Lake B, and Lake J quarry pits have already been excavated significantly below the ground surface of the surrounding land. The perimeter surface area is graded away from the top of slope and safety berms are present, which prevent storm water from flowing into the pits.

The Eliot facility operates under Waste Discharge Requirements Order No. R2-2003-0046 (NPDES No. CA0028789) and General Permit No. R2-2002-0063 (NPDES No. CAG982001) for discharge of aggregate wash water and groundwater to Shadow Cliffs and the Arroyo del Valle (collectively referred to as the WDRs). Once mining is completed, there will no longer be any discharges of aggregate wash water or groundwater from dewatering. Thus, the WDRs will no longer be necessary or applicable after mining is completed and the site is reclaimed in accordance with the proposed amendments to the reclamation plan. For ongoing mining operations, the WDRs require monitoring of discharges for compliance with specific water quality standards, as presented in Table 4. Comparison of the standards in Table 4 with the water-quality data from Lake B and surrounding surface water and groundwater samples (see Tables 2 and 3) indicates that the future discharge of water pumped from Lake B or Lake J for dewatering purposes will meet the water quality standards specified in the WDRs. If, however, water may be discharged to an offsite location other than Shadow Cliffs or the Arroyo del Valle, then it will be necessary for CEMEX to submit a Notice of Intent (NOI) to RWQCB to modify the point of discharge in the WDRs. This will be a requirement for the mining operations and does not apply to conditions that will exist as part of the proposed project once mining is completed.

Once mining is completed, several actions will be appropriate to protect water quality. The areas around Lake B and Lake J will need to be graded to prevent runoff from agricultural areas, roads, and developed areas from entering the lakes. Runoff from these areas could contain contaminants that might affect groundwater quality. Therefore, preventing runoff from entering reclaimed Lake B and Lake J will protect groundwater quality.

Reclamation will also need to be conducted in accordance with a stormwater pollution prevention plan (SWPPP) for the reclamation construction activities. CEMEX will need to file a Notice of Intent to comply with the stormwater regulations with the State Water Resources Control Board and the Regional Water Quality Control Board. If all stormwater is to be retained onsite, a Notice of Non-Applicability (NONA) can be filed in lieu of a SWPPP. The NONA will need to identify the measures that will be taken to ensure that all stormwater is retained on the project site, including appropriate hydrologic calculations identifying runoff quantities and necessary retention capacities. If stormwater may leave the site, then the SWPPP will need to identify best management practices (BMPs) to protect water quality and achieve the applicable water quality standards, and provide a monitoring program to confirm that the standards are being met.

**TABLE 4**

Water Quality Standards and Effluent Limitations

| Parameter | Units | Daily Maximum | 30-Day Arithmetic Mean | 7-Day Arithmetic Mean | 90-Day Arithmetic Mean |
|---|---|---|---|---|---|
| TDS | mg/L | 500 | | | 360 |
| Chlorides | mg/L | 250 | | | 60 |
| Total Suspended Solids | mg/L | | 30 | 45 | |
| Turbidity | NTU | 40 | | | |
| Total Settleable Solids | mL/hr | 0.2 | 0.1 | | |
| Chlorine Residual | mg/L | 0.0 | | | |
| pH | std units | 6.5-8.5 | | | |
| Acute Toxicity (96-hr) | | 70% survival | | | |

Notes:

1. TDS and Chlorides limits are applicable only to discharges to Alameda Creek watershed above Niles. Exceedance of the dissolved solids or chloride limits will not constitute a violation of this Order if the discharger demonstrates that the source water is also high in dissolved solids or chloride concentration and the exceedance is not caused by its facility operation.
2. Chlorine residual limit is applicable only to sand washing facilities that use municipal water supply as wash water.
3. Exceedance of pH limit will not constitute a violation of the WDRs if the discharger demonstrates that the source water is also high in pH and the high pH in its discharge effluent is not caused by the facility's operation.

CEMEX's compliance with the applicable stormwater requirements at the time of reclamation, subject to applicable monitoring and reporting requirements and regulatory oversight, will ensure that the proposed amendments to the SMP-23 Reclamation Plan will not adversely affect water quality or violate water quality standards. Accordingly, the potential impact on water quality standards and the potential to violate waste discharge requirements is less than significant. The WDRs are implemented in accordance with the Porter Cologne Water Quality Control Act and the Water Code, in compliance with the Federal Clean Water Act, which conforms to SMARA Section 3706(a). Likewise, the quality of groundwater in the aquifers will not be diminished, in accordance with SMARA Section 3706(b).

**b:** *Will the project substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)?*

The only long-term water demand related to reclamation of the project site that cannot be curtailed during a drought or other water emergency is evaporation from the pits once mining is completed. The evaporation that would occur from Lake A, Lake B, and Lake J once mining is completed under the existing SMP-23 Reclamation Plan would be 1,990 AF/yr. This volume is the baseline for CEQA evaluation of the evaporative loss from end uses under the existing 1987 SMP-23 Reclamation Plan. Under the proposed project, the surface area of the three reclaimed mining pits will be reduced. The resulting evaporative loss that will occur from Lake A, Lake B, and Lake J after mining is completed under the proposed project will be approximately 1,280 AF/yr, which is a reduction of more than 35 percent from that which would have occurred under the existing plan. Therefore, the proposed project will reduce the evaporative loss of groundwater.

Lake A and Lake B are part of the Chain of Lakes, as described in the Specific Plan. As such, the reclamation objectives for Lake A and Lake B include allowing Zone 7 to enhance water storage and groundwater recharge and improve the reliability and sustainability of groundwater supplies. Changes to the reclaimed condition of Lake B will enhance the recharge of groundwater in the lower aquifer (EMKO, 2016c).

The reduction in evaporative loss from the reclaimed mining pits and the enhanced recharge from Lake B will increase groundwater supplies, as opposed to depleting them. In addition, the proposed project does not include any changes to the condition of the ground surface that could interfere with groundwater recharge (i.e. construction of impermeable surfaces such as pavement or buildings). Therefore, there will be no CEQA-related impacts under this criterion for the proposed project. In addition, the recharge potential and storage capacity of ground water aquifers will not be diminished, in accordance with SMARA Section 3706(b).

**c.** *Will the project substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site?*

A segment of Arroyo del Valle adjacent to the western part of Lake B will be rerouted to allow expansion of the mining in Lake B to the south. The new segment of the creek bed, however, will be designed in a manner that enhances the overall flows and wildlife values of the streambed. The stream course will be designed with a variable channel profile to carry minimum dry-season design flows, typical wet season dam releases, and the maximum dam release of 7,000 cfs. The hydraulic modeling conducted for this project (Brown & Caldwell, February 2014) demonstrates that the stream channel will be stable and will not result in additional aggradation or degradation of the stream bed. The channel profile is designed specifically to prevent erosion and siltation to allow the development of appropriate aquatic habitat, such that there will be no impact under this criterion and in accordance with SMARA Section 3706(e). The rerouting of the stream channel shall be conducted in accordance with a Streambed Alteration Agreement to be issued by the Department of Fish and Wildlife in accordance with applicable state and federal regulations (SMARA Section 3706(f)).

The rerouted stream channel will be designed to convey the maximum potential release of 7,000 cfs from Del Valle Reservoir. Since 1912, the peak daily discharge on the Arroyo del Valle upstream of the project site has been 5,930 cfs. Peak daily flows over 5,000 cfs have only been recorded twice. Thus, the design stream capacity of 7,000 cfs is greater than the flow that would occur from a 20-year, one-hour storm event, and meets the requirements of SMARA Section 3706(d).

While scour may occur along the piers and abutments of the Isabel Avenue bridge during a 100-year flood, this is not due to the proposed project or any other actions to be conducted by CEMEX. The primary cause of the bridge scour is the widening of the highway bridge and construction of a new trail bridge on the upstream side of the current bridge. This is not a project-related impact.

The proposed changes to the reclaimed conditions for Lake A, Lake B, and Lake J relate to the overall size and dimensions of the final reclaimed pits. The steepness of the sideslopes and the perimeter grading will not change from those in the existing reclamation plan. Thus, there is no change from baseline conditions related to erosion or siltation of the reclaimed mining areas.

**d.** *Will the project substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site?*

The proposed project will not increase runoff from the project site. In addition, after implementation of the proposed project, Zone 7 will have the ability to divert up to 500 cfs of the flow from Arroyo del Valle into Lake A once the Chain of Lakes is completed. Therefore, the project will decrease the potential for flooding both onsite and offsite.

As discussed under criterion **c**, above, realignment of a segment of the Arroyo del Valle will be conducted in a manner that will maintain the capacity of the stream to convey the maximum potential release from Del Valle Reservoir without causing flooding of adjacent parcels.

**e.** *Will the project create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems, cause flooding on- and off-site, or provide substantial additional sources of polluted runoff?*

As discussed under above criteria **c, d,** and **a,** respectively, the project will not create or contribute runoff water which would exceed the capacity of any drainage systems, cause flooding onsite or offsite, or degrade water quality (including through erosion and discharge of turbid or sediment-laden water). Therefore, there is no impact under this criterion.

**f.** *Will the project place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?*

The project does not include the construction of any housing. Therefore, there is no impact under this criterion.

**g.** *Will the project place within a 100-year flood hazard area structures which would impede or redirect flood flows?*

The project does not involve the construction of any structures that would impede flood flows, with the exception of the grade control structure (diversion dam) for the 500-cfs diversion structure to be constructed near the southeast corner of

Lake A. However, the water level within Arroyo del Valle only needs to be raised one foot to achieve the 500-cfs diversion capacity. As part of the Reclamation Plan Amendment, the berms along the south side of Lake A will be raised to prevent inundation of the lake by the 100-year flood. The diversion structure will not cause flood elevations to increase to a level that would overtop the banks of the stream and would not cause inundation of structures or other land, including Sycamore Grove Park located east of Vallecitos Road. Furthermore, the Lake A diversion structure could potentially be used to redirect flood flows into Lake A under certain conditions, which could have beneficial effects in attenuating flood flows and enhancing water storage for groundwater recharge. This would occur as part of the operation of the Chain of Lakes by Zone 7, however, and not by CEMEX as part of this project. Therefore, there are no impacts under this criterion.

**h.** *Will the project expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam?*

The project does not include any components that would expose people or structures to flooding beyond the flood risks that currently exist along Arroyo del Valle, including any potential for failure of the dam at Del Valle Reservoir. The project includes the construction or enhancement of the levees along Arroyo del Valle, especially within the area of the streambed that will be rerouted. These levees, however, will be designed to retain the maximum potential release of 7,000 cfs from Del Valle Reservoir and thus will meet or exceed the capacity of the existing streambed and levees.

As discussed under Criterion g, above, the project will include the construction of a 500-cfs diversion structure to allow Zone 7 to divert water from Arroyo del Valle into the Chain of Lakes in accordance with the Specific Plan. The proposed amendments to the Reclamation Plan also include a 400-foot long, six-inch deep notch in the top of the berm at the southwest corner of Lake A. The notch is designed to allow up to 500 cfs of the water diverted from Arroyo del Valle to immediately return to the arroyo in case there is a malfunction in either the diversion structure or in the Lake A to Lake C pipeline that would allow water to enter Lake A but not be routed to the rest of the Chain of Lakes. The notch includes appropriate rock armoring at the top and a 3:1 slope to the arroyo, which are designed to prevent flow velocities that could potentially erode the berm around Lake A.

Due to the construction of levees along Arroyo del Valle that will be capable of containing the maximum potential dam release, and the notch in the berm near the southwest corner of Lake A, there are no impacts under this criterion.

**i.** *Will the project result in inundation by seiche, tsunami, or mudflow?*

Seiches are standing waves resulting from oscillations in enclosed bodies of water, typically generated by seismic shaking associated with an earthquake. During mining in Lake B and Lake J, any water ponded within the mine pit will be present at a depth far below the top of the pit, preventing any oscillating water from inundating areas outside of the pit. The potential for seiches to form in the fresh water ponds and the main silt pond are the same as they are under current, baseline conditions. Therefore, the potential for inundation by a seiche during continued mining at the site is no different than it is under baseline conditions, resulting in no impact under CEQA.

The potential impact related to seiches once mining is completed and Lake A and Lake B are operated as part of the Chain of Lakes by Zone 7 was addressed in the CEQA analysis of the Specific Plan. Filling and operation of the Chain of Lakes is not a part of this project. However, the final design for Lake A, Lake B, and Lake J include the freeboard levels requested by Zone 7 (i.e. 10 feet) to prevent a seiche from overtopping the surrounding berms and inundating adjacent properties.

The project site is approximately 19 miles from San Francisco Bay and 38 miles from the Pacific Ocean. Therefore, there is no potential for a tsunami generated in the Pacific Ocean to adversely affect the project site.

The site is not located downstream of any potential mudflow sources. Therefore, the Project would have no impact with respect to risk from mudflows.

Based on the above discussion, the project will not result in any increased potential for inundation by seiche, tsunami, or mudflow, resulting in no impact under CEQA.

## 7.0 Conclusions

Reclamation of the CEMEX Eliot Quarry will be conducted in accordance with the Specific Plan and will assist with the creation of the Chain of Lakes, which will improve management of the groundwater resources in the Livermore-Amador Valley. The most recent evaluation by Zone 7 of the use and function of the Chain of Lakes assumes that the changes proposed in the proposed amendments to the SMP-23 Reclamation Plan will be approved (Zone 7, 2014b) and will support the objectives of the Specific Plan. Cross sections prepared by Zone 7 (see Figures 3 and 4) and for this report (Figures 8, 9, and 10) show that mining to the proposed depths at Lakes B and J are appropriate to maximize effective recharge into the Lower Aquifer. In addition, the 2011 Zone 7 aquifer test results show that Lake B will be an effective recharge basin once mining is completed. Lake J is identified as an optional lake in the Specific Plan, although Lake J will not be part of the Chain of Lakes and ownership will be retained by CEMEX.

Based on the information presented in this hydrology and water quality analysis, the proposed Amendments to the SMP-23 Reclamation Plan will not have any adverse effects on groundwater and surface water resources. To the contrary, the proposed project is consistent with the Specific Plan, will enhance conditions along Arroyo del Valle, and will be beneficial for operation of the Chain of Lakes and management of groundwater by Zone 7, consistent with the most recent evaluation of lake use (Zone 7, 2014b).

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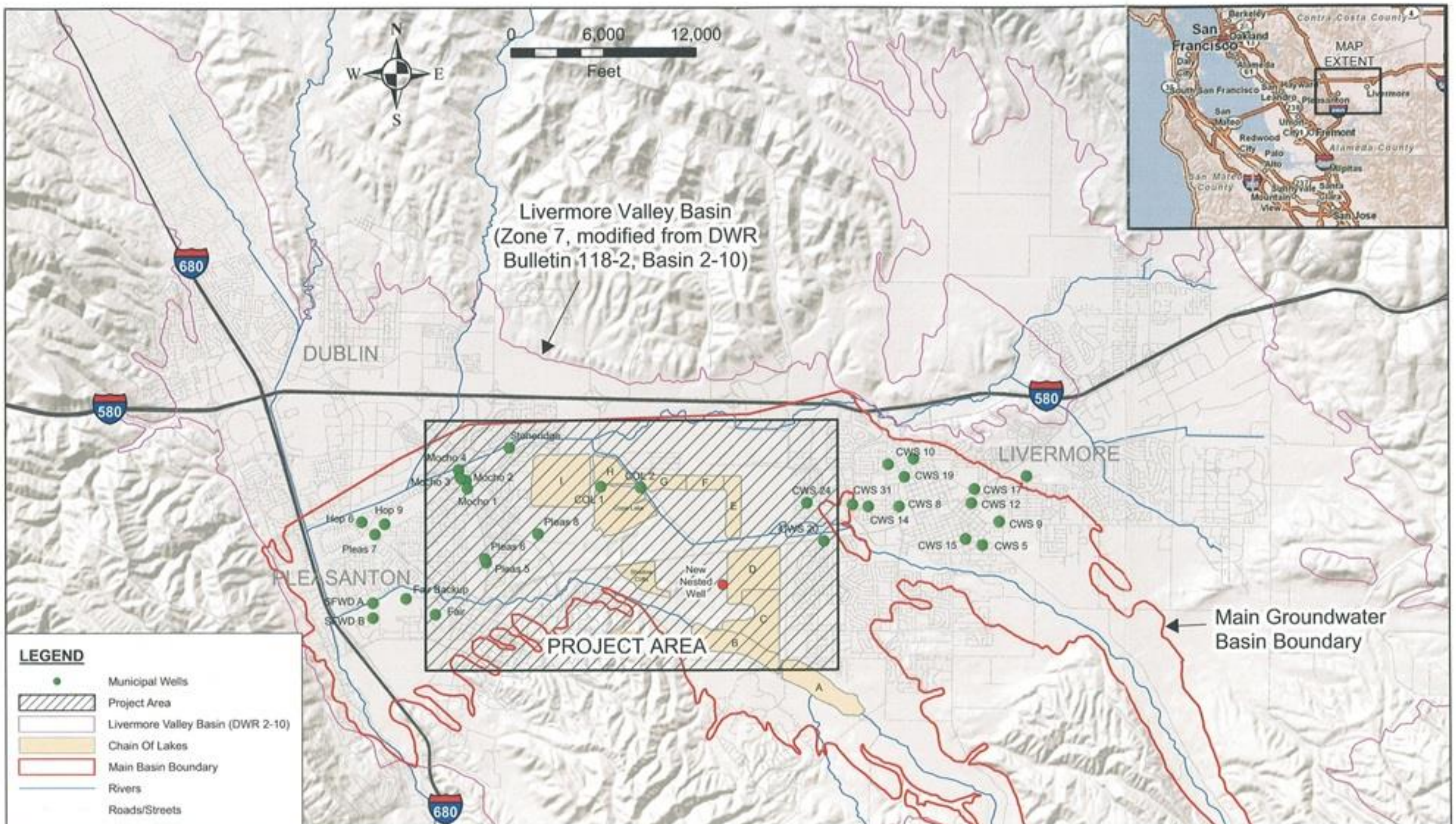


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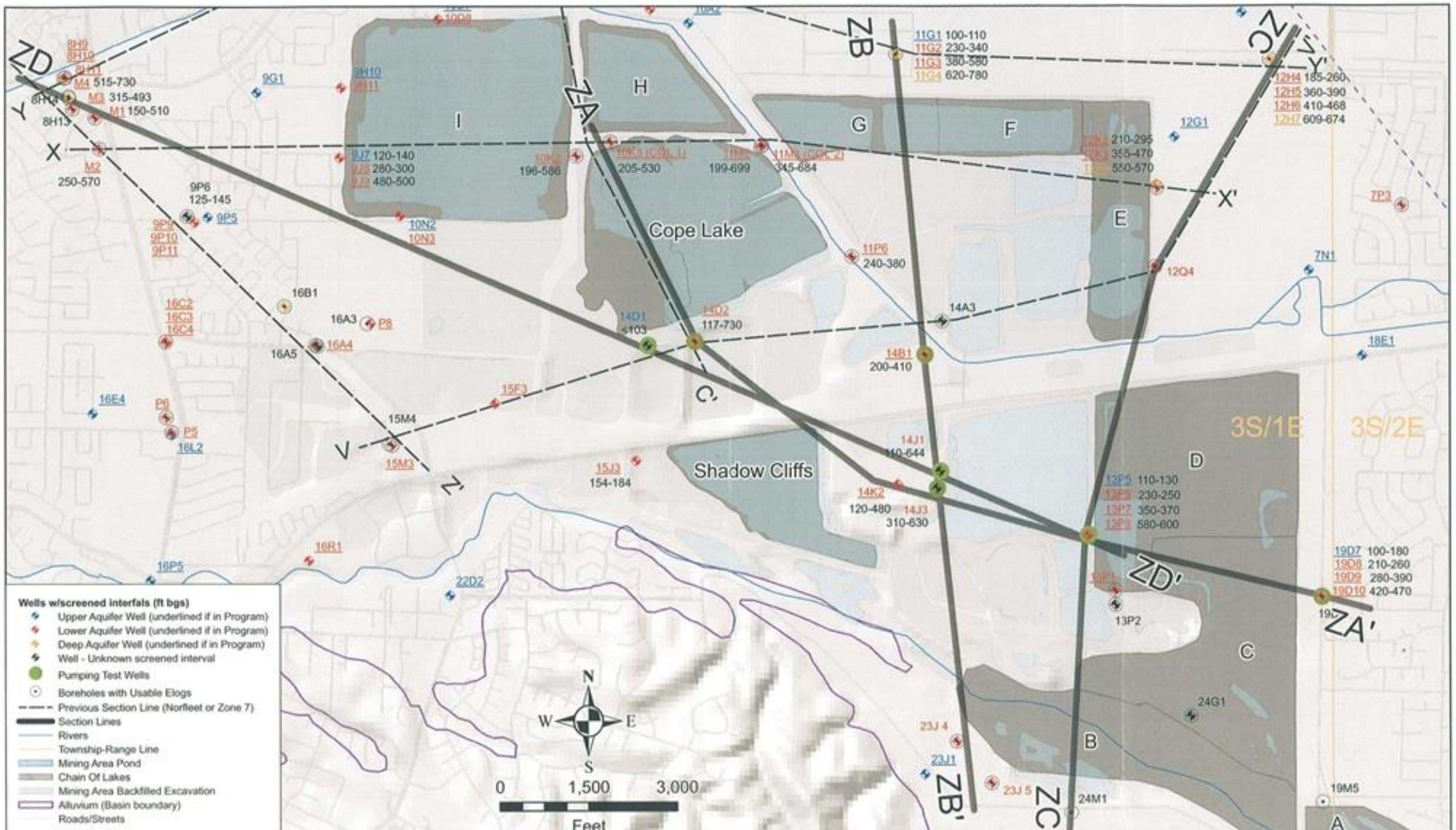
|---|---|---|---|
| ZONE 7 WATER AGENCY<br>100 North Canyons Parkway<br>Livermore, CA | DRAWN: TR / MG | SCALE: 1 in = 6,000 ft | **FIGURE 1.**<br>Livermore Valley Groundwater Basin and the Chain of Lakes Project Area.<br>(Source: Zone 7, 2011) |
| | REVIEWED: TR | DATE: Apr 14, 2011 | |
| | FILE: E:\PROJECTS\LGAGrantGWStudy2010\Report\Figures\Fig2-1-BasinProjectArea.mxd | | |

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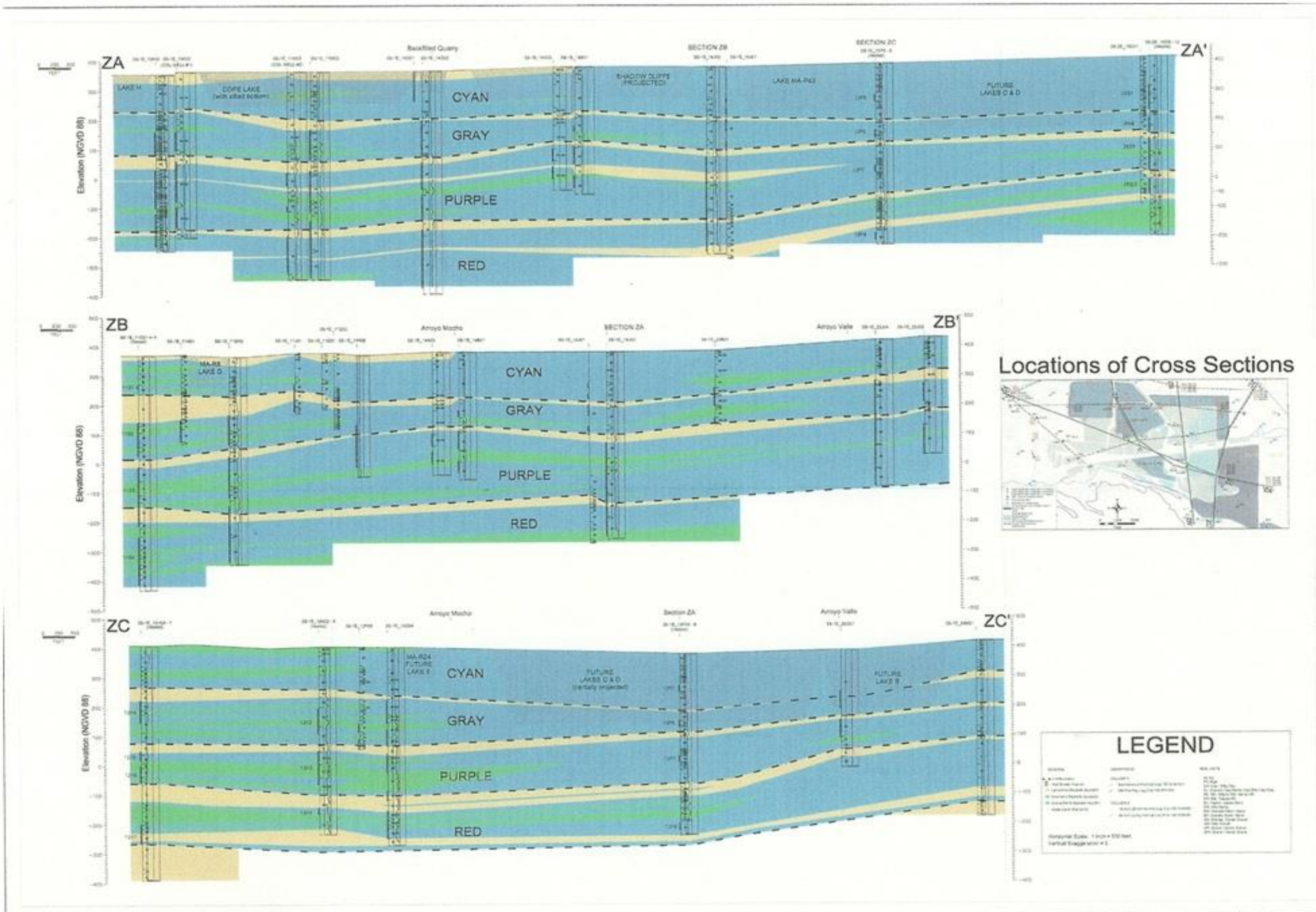
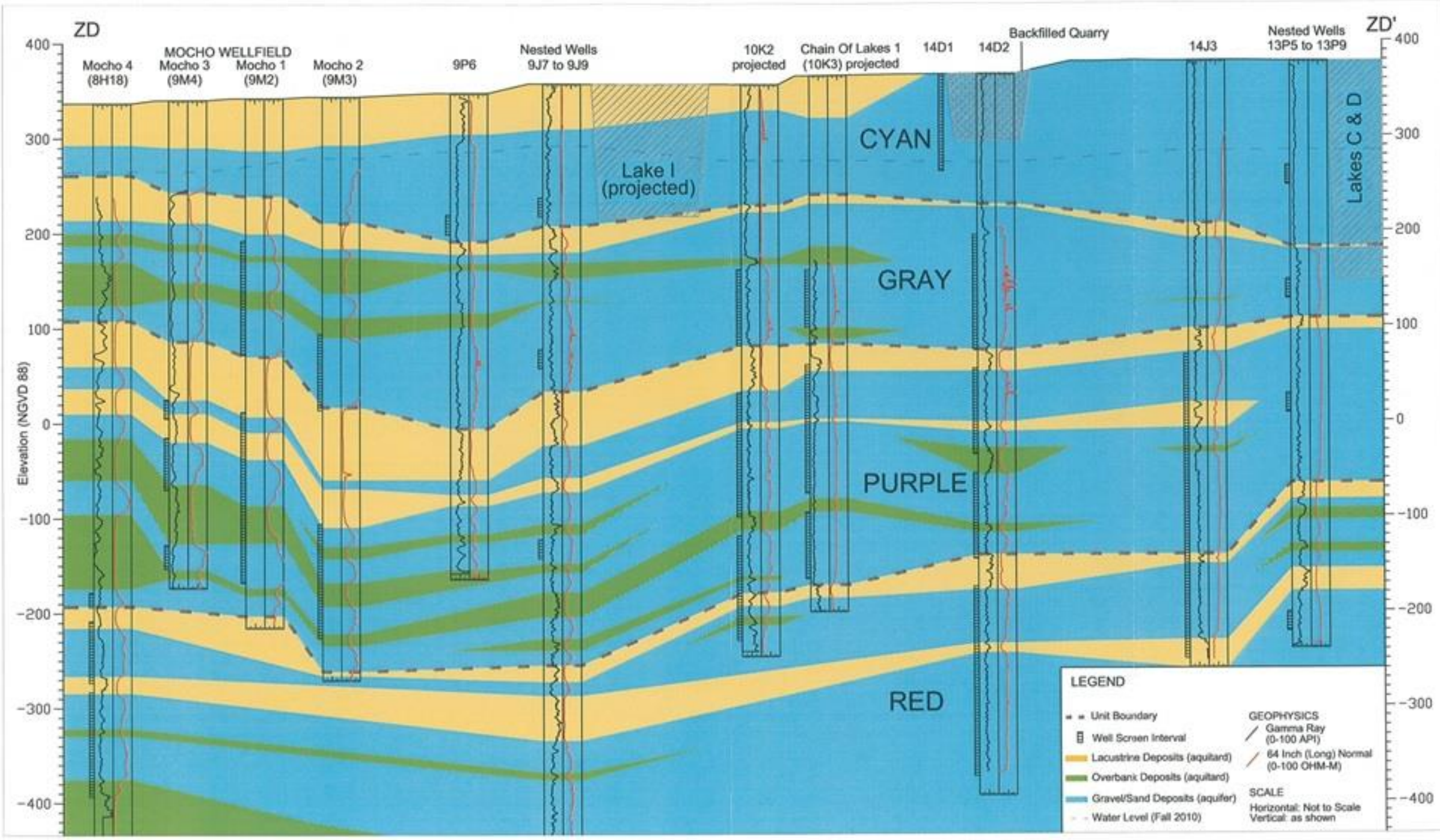
|---|---|---|---|
| ZONE 7 WATER AGENCY<br>100 North Canyons Parkway<br>Livermore, CA | DRAWN: TR | SCALE: 1 in = 1,500 ft | **Figure 2.**<br>Locations of Wells and Stratigraphic Cross Sections<br>(Source: Zone 7, 2011) |
| | REVIEWED: TR, MK | DATE: Apr 11, 2011 | |
| | FILE: E:\PROJECTS\LGAGrantGWStudy2010\DWRGrantProjectMap.mxd | | |




Cross Sections ZA to ZC

**Figure 3.**

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|---|---|---|---|
| **ZONE 7 WATER AGENCY**<br>100 NORTH CANYONS PKWY<br>LIVERMORE, CA 94551 | DWN: TR<br>DES.: TR<br>CHK: MK<br>APPD: MK | SCALE: Horizontal: none; Vertical: 1"=100'<br>DATE: May 20, 2011<br>FILE: E:\GISProg\Zone7\GeoSections\MainSections\Section-ZD.dwg | **Figure 4.**<br>CROSS SECTION ZD<br>Hydrostratigraphic Investigation for Lakes C and D |

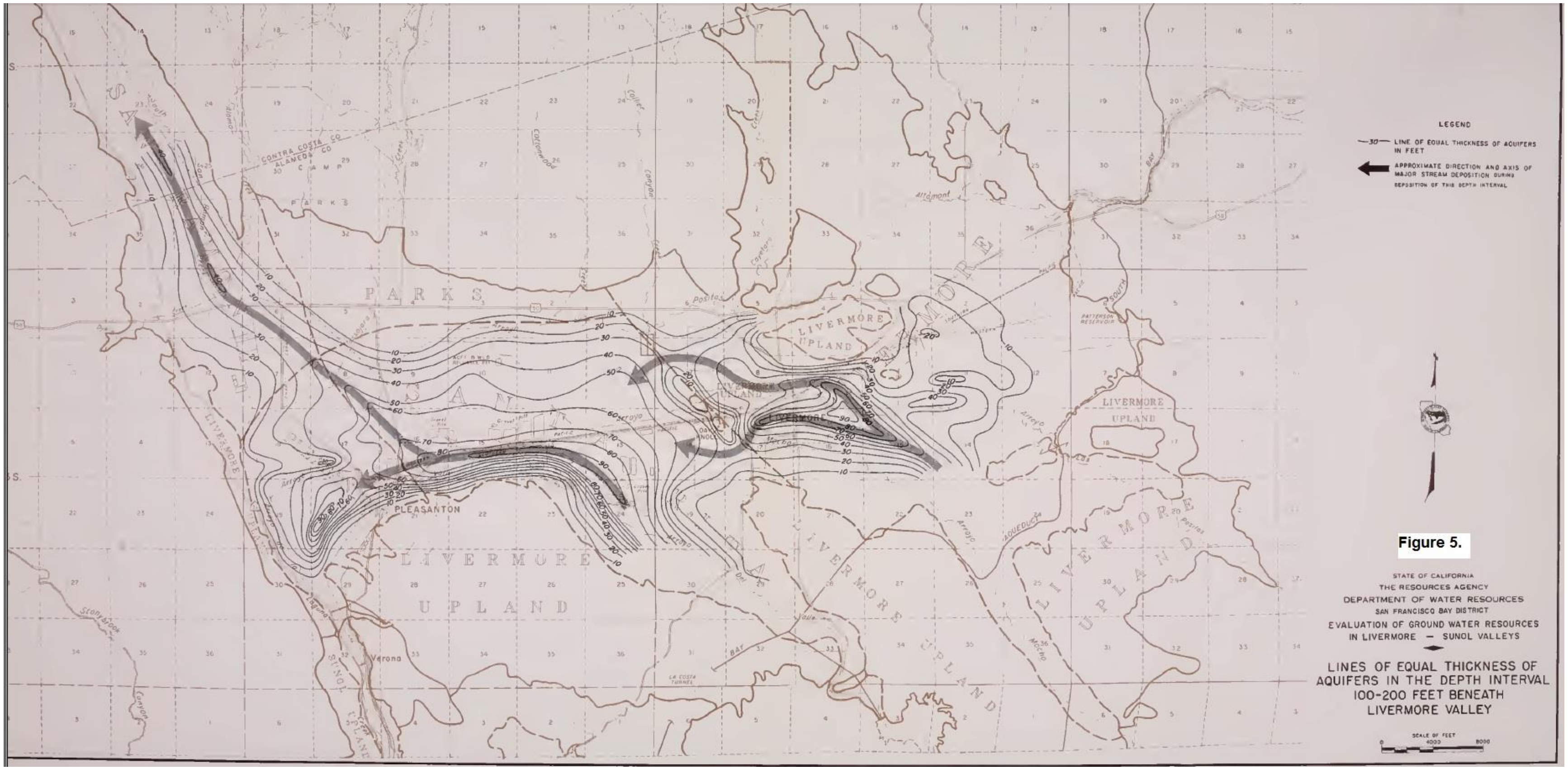

LEGEND
—30— LINE OF EQUAL THICKNESS OF AQUIFERS IN FEET
APPROXIMATE DIRECTION AND AXIS OF MAJOR STREAM DEPOSITION DURING DEPOSITION OF THIS DEPTH INTERVAL
PLEASANTON
LIVERMORE
LIVERMORE UPLAND
PARKS
Altamont
Verona
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SAN FRANCISCO BAY DISTRICT
EVALUATION OF GROUND WATER RESOURCES
IN LIVERMORE — SUNOL VALLEYS
LINES OF EQUAL THICKNESS OF AQUIFERS IN THE DEPTH INTERVAL 100-200 FEET BENEATH LIVERMORE VALLEY
SCALE OF FEET
0
4000
8000

Figure 5.

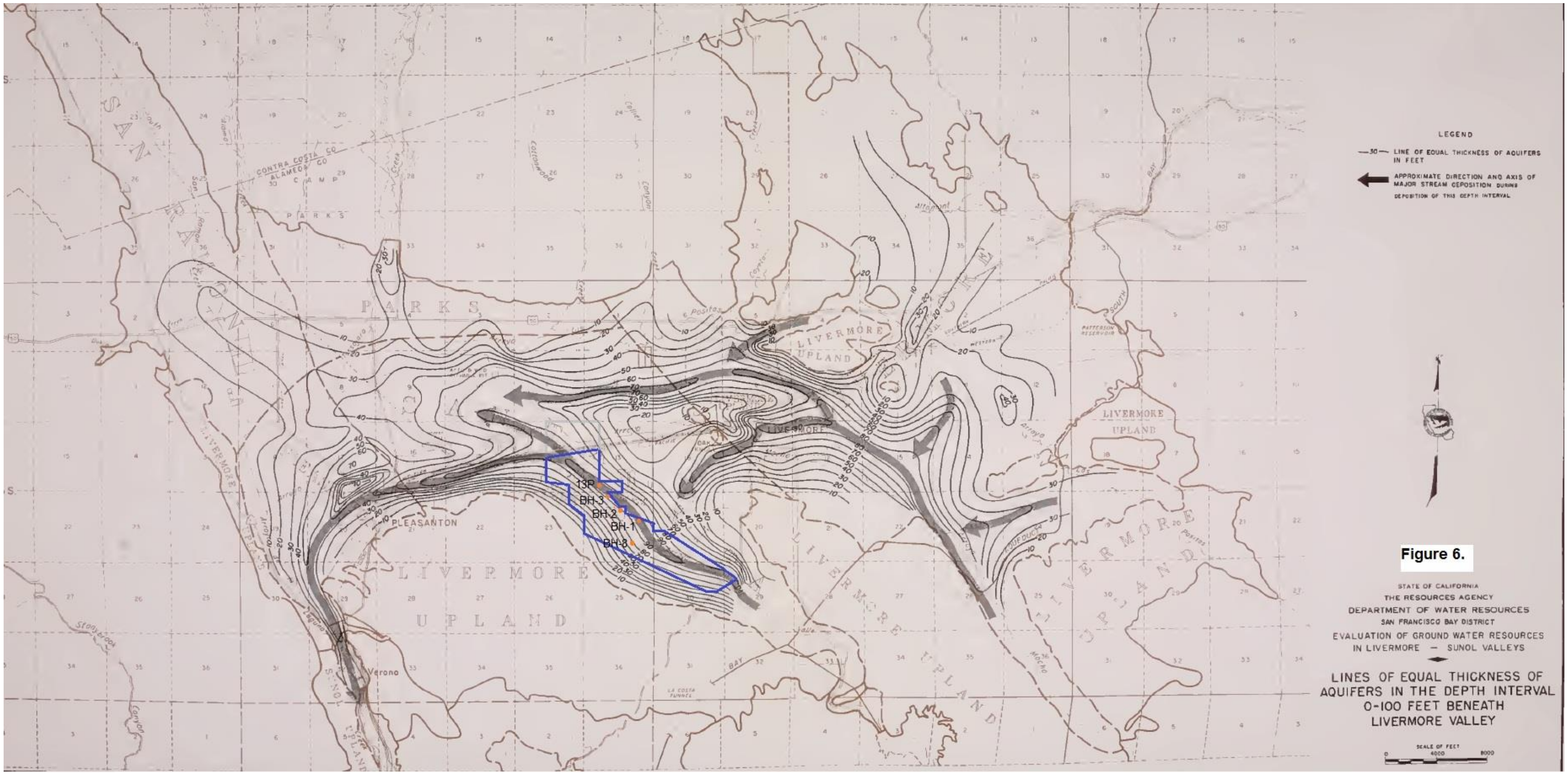

LEGEND
—30— LINE OF EQUAL THICKNESS OF AQUIFERS IN FEET
APPROXIMATE DIRECTION AND AXIS OF MAJOR STREAM DEPOSITION DURING DEPOSITION OF THIS DEPTH INTERVAL
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SAN FRANCISCO BAY DISTRICT
EVALUATION OF GROUND WATER RESOURCES IN LIVERMORE — SUNOL VALLEYS
LINES OF EQUAL THICKNESS OF AQUIFERS IN THE DEPTH INTERVAL 0-100 FEET BENEATH LIVERMORE VALLEY
SCALE OF FEET
0 4000 8000
LIVERMORE UPLAND
PLEASANTON
PARKS
CAMP PARKS
CONTRA COSTA CO
ALAMEDA CO
LIVERMORE
Verona
13P
BH-3
BH-2
BH-1
BH-8

Figure 6.

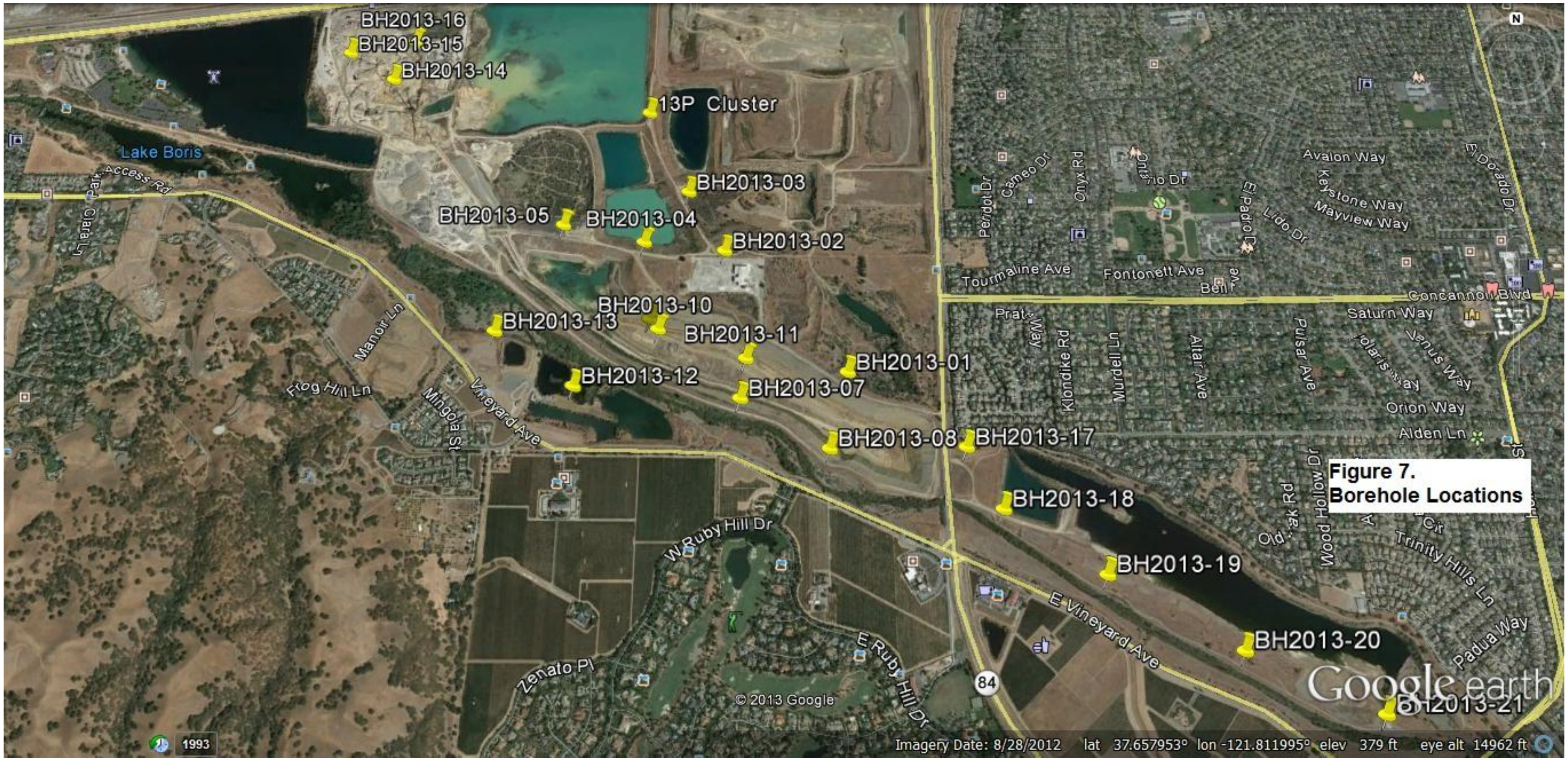
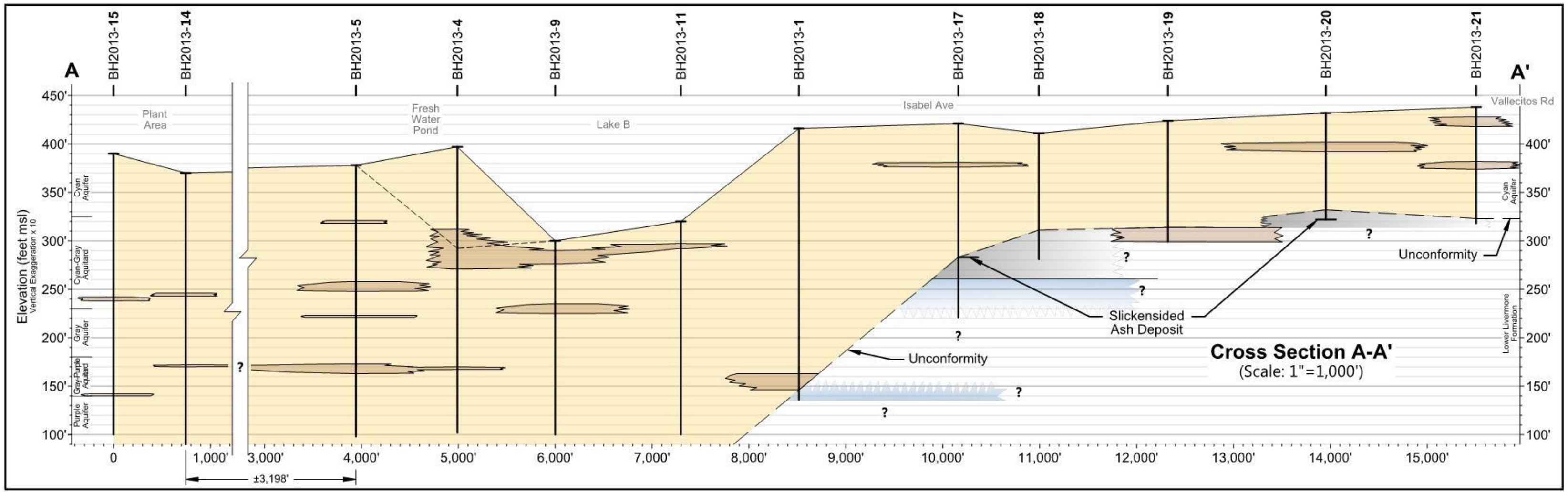
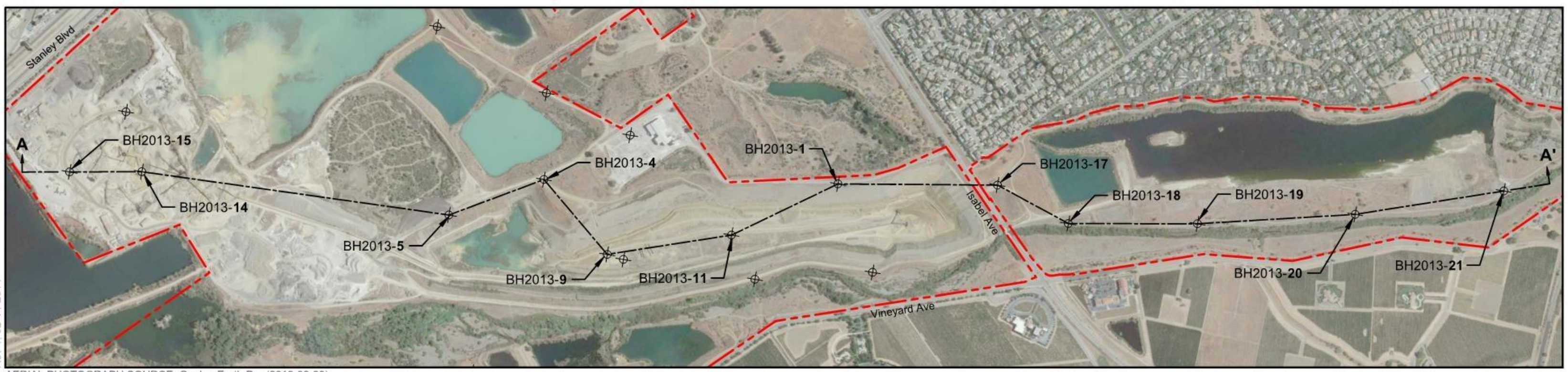



**Figure 7.**
**Borehole Locations**




AERIAL PHOTOGRAPH SOURCE: Goolge Earth Pro (2012-08-28)

0 1,000'
NORTH
Scale: 1" = 1,000'

**EMKO Environmental, Inc.**

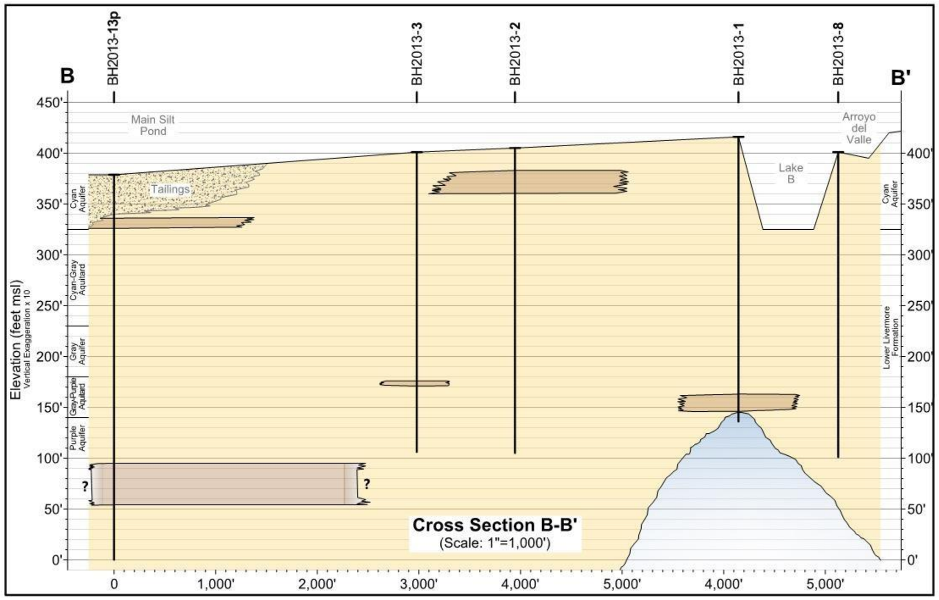
**LEGEND**

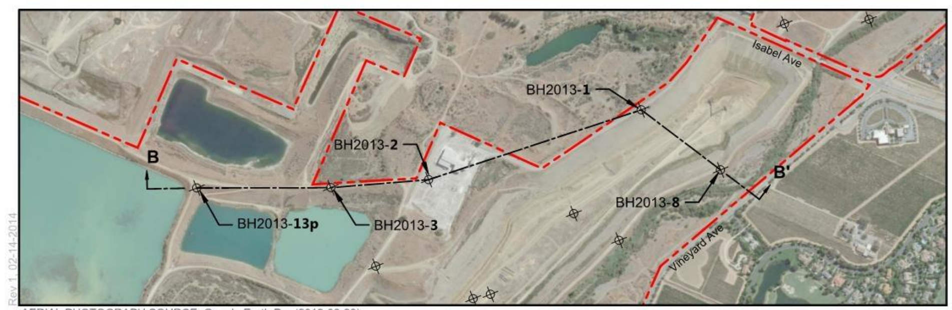
| | |
|---|---|
| Site Boundary | Bore Hole Location |
| Sand and Gravel | Gray Clay |
| Brown Clay and Silt | Blue Clay |

**Geologic Cross Section A-A'**

**CEMEX - Eliot Quarry, Alameda County**

**Figure 8.**




AERIAL PHOTOGRAPH SOURCE: Google Earth Pro (2012-08-28)

**LEGEND**

| | |
|---|---|
| Site Boundary | Bore Hole Location |
| Sand and Gravel | Gray Clay |
| Brown Clay and Silt | Blue Clay |

0 NORTH 1,000'

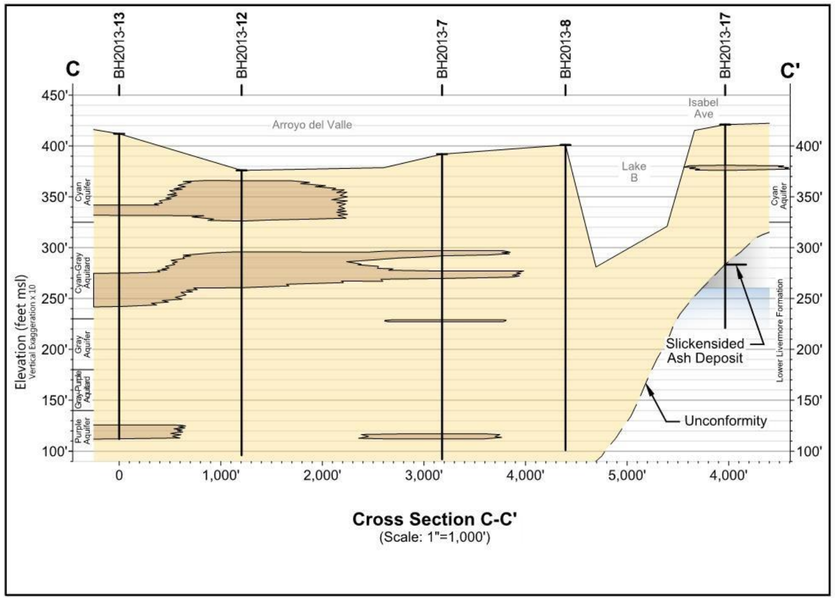
Scale: 1" = 1,000'

EMKO Environmental, Inc.

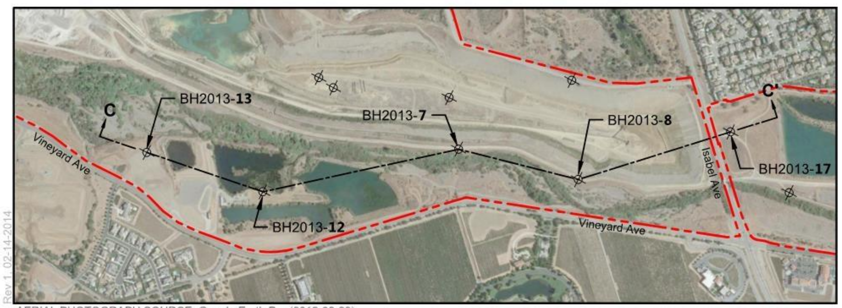
**Geologic Cross Section B-B'**

**CEMEX - Eliot Quarry, Alameda County**

**Figure 9.**




**Cross Section C-C'**
(Scale: 1"=1,000')




AERIAL PHOTOGRAPH SOURCE: Google Earth Pro (2012-08-28)

**LEGEND**

| | |
|---|---|
| Site Boundary | Bore Hole Location |
| Sand and Gravel | Gray Clay |
| Brown Clay and Silt | Blue Clay |

0 1,000'
NORTH
Scale: 1" = 1,000'

*EMKO Environmental, Inc.*

**Geologic Cross Section C-C'**
**CEMEX - Eliot Quarry, Alameda County**
**Figure 10.**

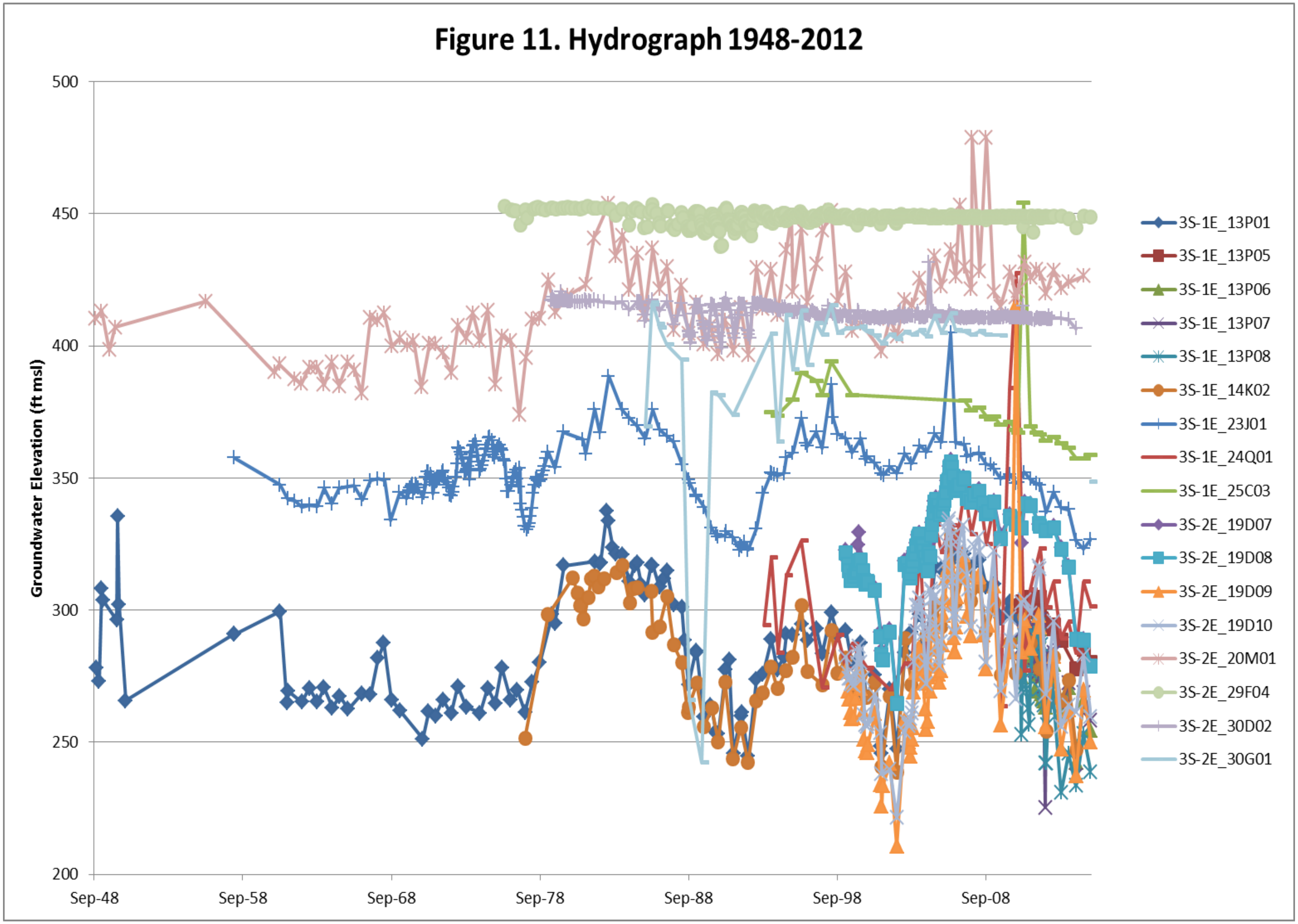
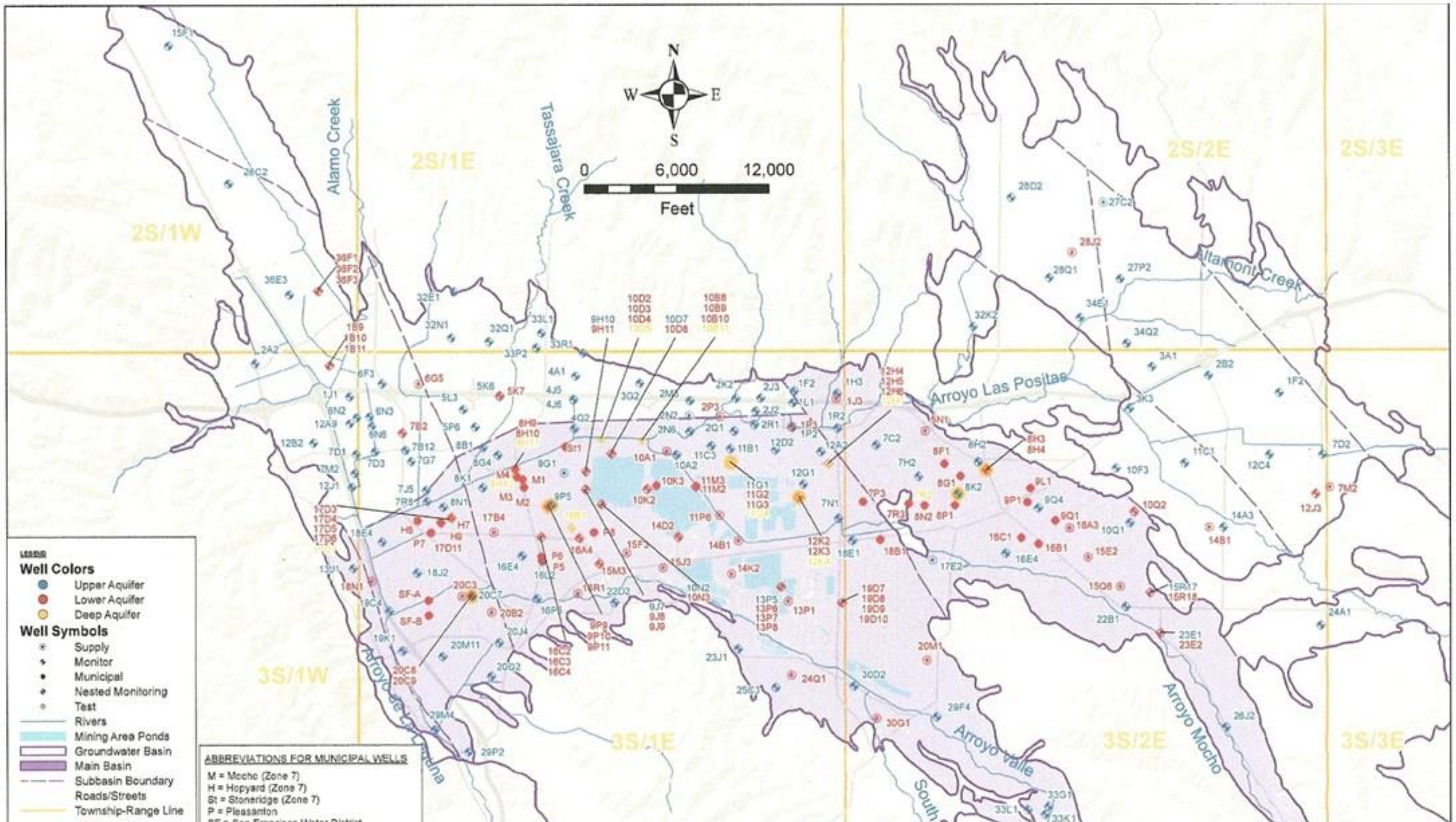


Figure 11. Hydrograph 1948-2012
Groundwater Elevation (ft msl)
500
450
400
350
300
250
200
Sep-48
Sep-58
Sep-68
Sep-78
Sep-88
Sep-98
Sep-08
3S-1E_13P01
3S-1E_13P05
3S-1E_13P06
3S-1E_13P07
3S-1E_13P08
3S-1E_14K02
3S-1E_23J01
3S-1E_24Q01
3S-1E_25C03
3S-2E_19D07
3S-2E_19D08
3S-2E_19D09
3S-2E_19D10
3S-2E_20M01
3S-2E_29F04
3S-2E_30D02
3S-2E_30G01




ZONE 7 WATER AGENCY
100 North Canyons Parkway
Livermore, CA

| DRAWN: TR/MG | SCALE: 1 in = 6,000 ft |
| --- | --- |
| REVIEWED: CW | DATE: May 25, 2012 |
| FILE: E:\MONITOR\GM\2011WY\AnnualReport\Fig3.2-01-AllWells2011.mxd | |

**Figure 12. Well Location Map**

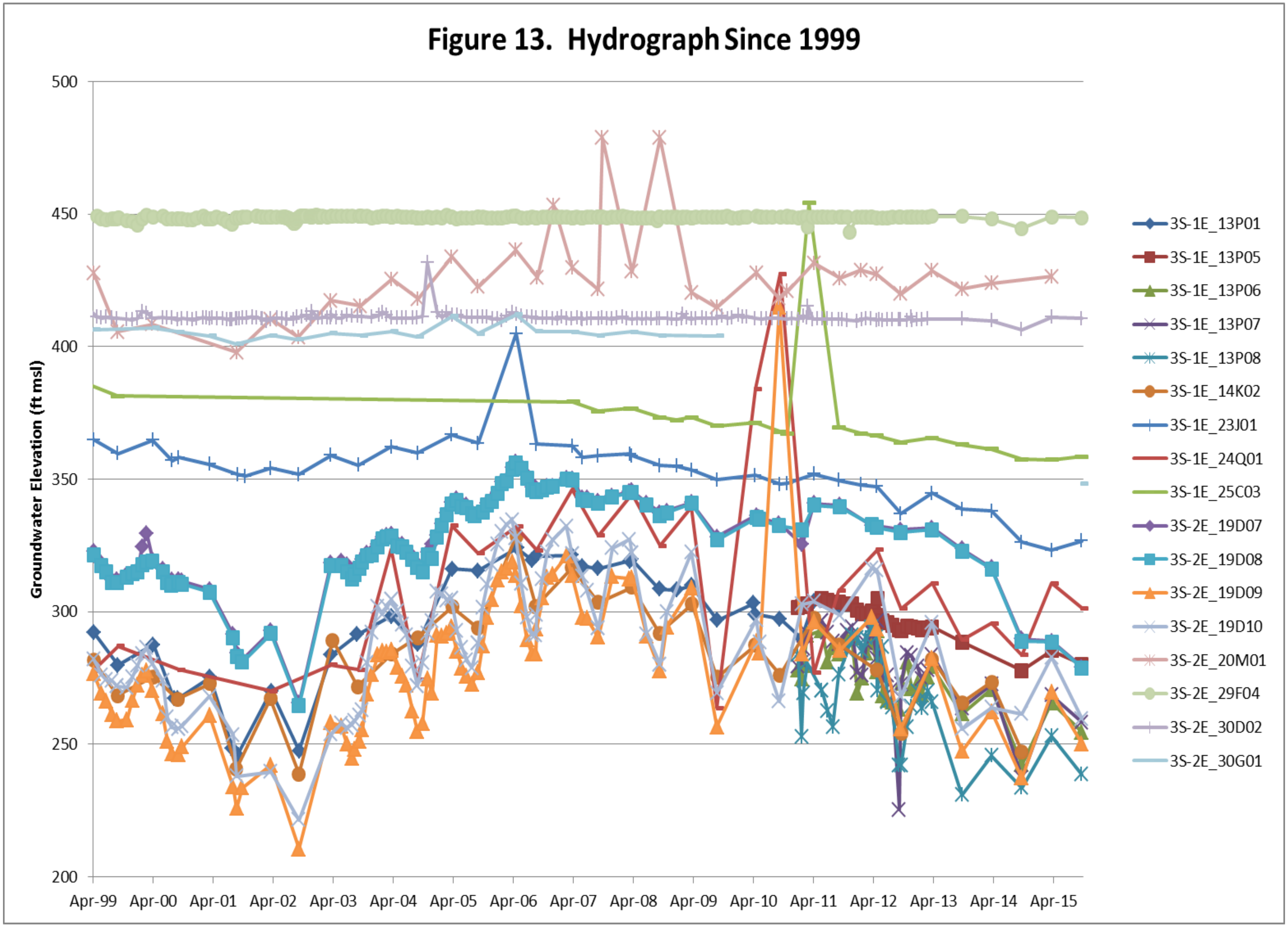


Figure 13. Hydrograph Since 1999
Groundwater Elevation (ft msl)
500
450
400
350
300
250
200
Apr-99
Apr-00
Apr-01
Apr-02
Apr-03
Apr-04
Apr-05
Apr-06
Apr-07
Apr-08
Apr-09
Apr-10
Apr-11
Apr-12
Apr-13
Apr-14
Apr-15
3S-1E_13P01
3S-1E_13P05
3S-1E_13P06
3S-1E_13P07
3S-1E_13P08
3S-1E_14K02
3S-1E_23J01
3S-1E_24Q01
3S-1E_25C03
3S-2E_19D07
3S-2E_19D08
3S-2E_19D09
3S-2E_19D10
3S-2E_20M01
3S-2E_29F04
3S-2E_30D02
3S-2E_30G01

**Figure 14.**

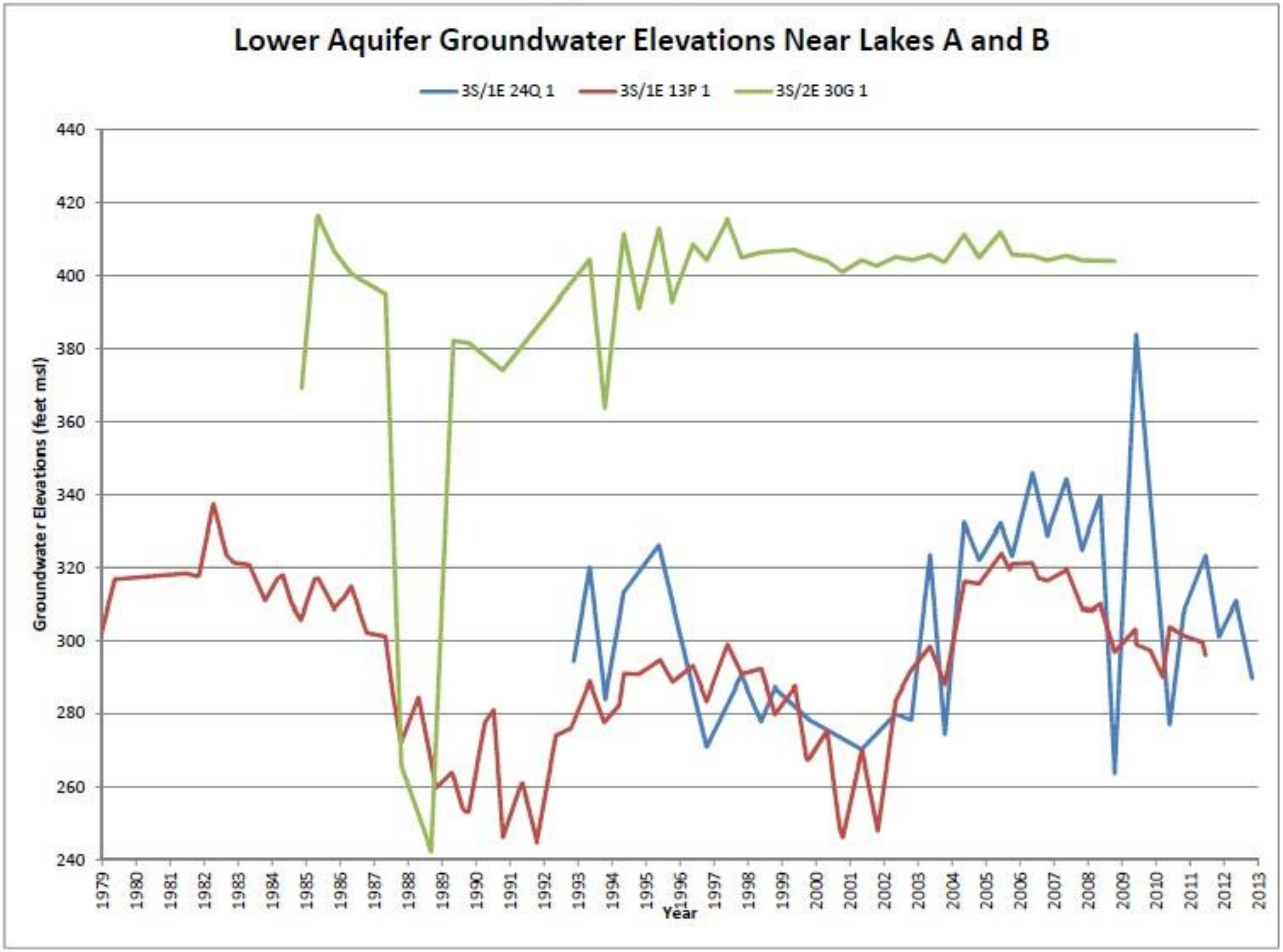
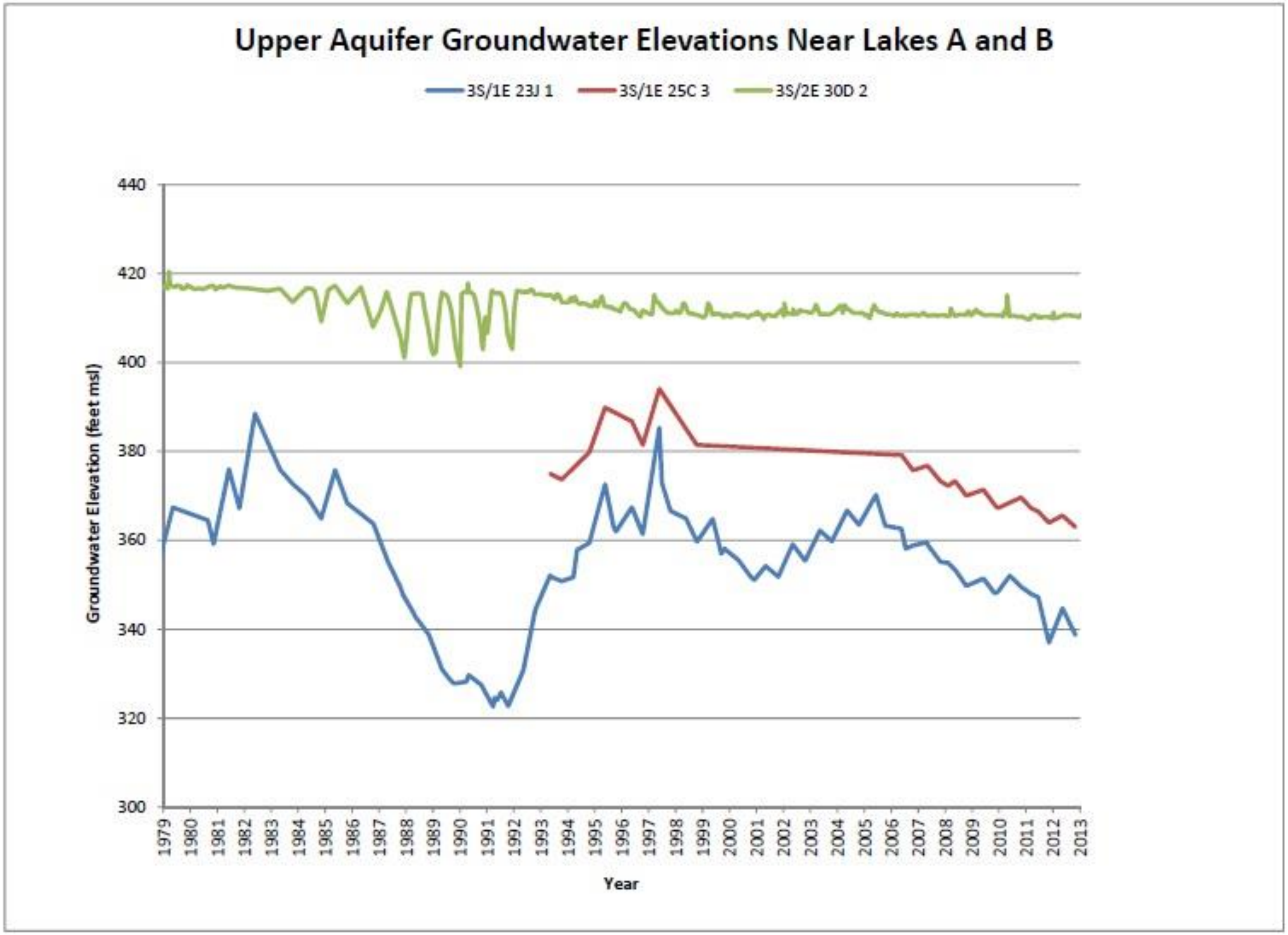

Lower Aquifer Groundwater Elevations Near Lakes A and B
3S/1E 24Q 1
3S/1E 13P 1
3S/2E 30G 1
Groundwate r Elevations (feet msl)
440
420
400
380
360
340
320
300
280
260
240
1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013
Year

**Figure 15.**


Upper Aquifer Groundwater Elevations Near Lakes A and B
3S/1E 23J 1
3S/1E 25C 3
3S/2E 30D 2
Groundwater Elevation (feet msl)
440
420
400
380
360
340
320
300
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
Year


ZONE 7 WATER AGENCY
100 North Canyons Parkway
Livermore, CA

| DRAWN: TR | SCALE: 1 in = 2,000 ft |
|---|---|
| REVIEWED: CW/MK | DATE: May 28, 2012 |
| FILE: E:\MONITOR\MA\2011WY\Fig3.5-1-MiningArea2011.mxd | |

Figure 16. Pond Water Elevations and Surface Water Sampling Locations


Figure 17. Surface Water Flow - Eliot Plant Site