

# **Alamitos Barrier Project**

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## **Member Agencies:**

Orange County Water District  
Water Replenishment District of Southern California  
Long Beach Water Department  
Golden State Water Company  
Los Angeles County Flood Control District

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## **Submitted by:**

Paul Boice, Secretary  
Joint Management Committee

**Annual report on the control of seawater intrusion  
2022 - 2023**

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## **INTRODUCTION**

The Alamitos Barrier Project (ABP) was designed and constructed to protect the groundwater supplies of the Central/Orange County Basin of the Coastal Plain from the intrusion of seawater through the Alamitos Gap area. The project facilities are located near the Los Angeles-Orange County border about two miles inland from the terminus of the San Gabriel River. The original facilities included injection wells to form a freshwater pressure ridge and extraction wells to form a saltwater trough. The freshwater pressure ridge has proven to be historically effective, whereas the saltwater trough has not. As a result, the extraction wells are currently not in operation. A map showing the supply pipeline, injection wells, extraction wells, and observation wells is shown on page A-12.

Los Angeles County Public Works (Public Works) operates and maintains the ABP and its associated facilities under the direction and approval of the Joint Management Committee (JMC), acting on behalf of the Los Angeles County Flood Control District (LACFCD) and the Orange County Water District (OCWD).

This report summarizes design and construction issues, operation and maintenance activities, hydrogeologic effects, chloride concentrations, and project costs for Fiscal Year (FY) 2022-23 (i.e., July 1, 2022, through June 30, 2023).

## SUMMARY

During FY 2022-23, a total of 6,475 acre-feet (AF) of water was injected into the ABP (an average rate of 8.9 cubic feet per second (cfs)). Of that total, OCWD purchased 2,414 AF (37.3 percent) and the Water Replenishment District of Southern California (WRD) purchased 4,061 AF (62.7 percent). This total injected amount was 713 AF less than FY 2021-22 and was 276 AF higher than the average injection of 6,199 AF for the previous five fiscal years. The ABP experienced one full shutdown, which occurred between April 25, 2023, to May 03, 2023, and five partial shutdowns. These shutdowns are detailed in the Injection Operation section of this report, and in Table 2.

The total costs associated with the ABP in FY 2022-23 are summarized below:

- Total Cost in FY 2022-23: \$12,870,745.
  - Injection Water costs: \$8,562,547 (OCWD: \$3,187,986; WRD: \$5,374,561)
  - Total Operations and Maintenance Costs (not including liability insurance): \$4,231,847.
    - Injection-related costs: \$2,841,292 (OCWD: \$1,059,802; LACFCD: \$1,781,490).
      - Equivalent cost per AF of water injected: \$438.94.
    - Special Project related costs: \$1,389,643 (OCWD: \$25,119; LACFCD: \$1,364,524).
    - Extraction-related costs: \$912 (LACFCD only)
  - Liability Insurance cost: \$76,352 (OCWD: \$38,176; LACFCD \$38,176)

During this reporting period, the ABP generally had groundwater elevations near or above protective elevations throughout all aquifer zones, except some portions of the A and I Zones due to injection wells that are screened across 4 zones. Compared to the last reporting period, groundwater elevations generally increased slightly, with the exception of the portion near the Unit 15 project site, where localized decreases were observed due to injection wells being taken offline.

West of the San Gabriel River, chloride concentrations had a slight decrease for the C, B, and I Zone. The R and A Zones had an increase. East of the San Gabriel River, chloride concentrations increased slightly in the C, A, and I Zones. Chloride concentrations in the B-Zone had an increase of over 300 mg/L. These increases were most likely due to the partial shutdown needed for the construction of the ABP Unit 15. Detailed analyses of the reporting period's groundwater elevations and chloride concentrations are provided in the "Hydrogeologic Effects" and "Chlorides" sections of the report.

It is imperative that the ABP operate consistently and continuously to prevent seawater intrusion. The JMC will continue to ensure that the ABP is operated and maintained efficiently, economically, and continuously protects the region's groundwater supplies. The newly installed injection wells associated with the ABP Unit 15 Project have significantly aided in the protection of the region's groundwater resources by raising groundwater elevations.

## **PROJECTS AND STUDIES**

Capital improvement projects and studies over this reporting period are briefly summarized below. The general location of each project is identified on the map in Appendix A-12.

**Table 1. Capital Improvement Projects and Contracts**

<b>Project Title</b>	<b>Description</b>	<b>Board Award Date</b>	<b>Contractor</b>	<b>Final Contract Amount</b>	<b>Field Acceptance</b>
ABP Unit 15 Replacement Wells	Construction of 5 new injection wells and 2 nested observation wells	11/16/2021	Environmental Construction, Inc.	\$7,714,771	September 2023
Seawater Barrier Condition Assessment	Assessment of portions of the ABP supply line, appurtenances, and wells	N/A	CH2M Hill (now Jacobs)	\$1,347,150	Final Report distributed: July 2023

Note: For a full history of improvement projects and contracts on record, please contact Public Works.

### **ABP Unit 15 Replacement Wells (Total Estimated Cost: \$9,542,979)**

Constructed five new injection wells and two new observation wells to replace and supplement existing ABP facilities located within the Cities of Long Beach and Seal Beach. Five injection wells were constructed to replace four existing injection wells and to provide increased protection against seawater intrusion. The two new observation wells were constructed to provide Public Works with additional groundwater elevation and chloride concentration data to enable more efficient operation of the ABP. In October 2019, LACFCD was awarded grant project funding up to \$4,191,693 from the State Water Resources Control Board, Proposition 1 Groundwater Grant to construct these wells. The total estimated cost of the project is \$9,542,979. Project construction began in May 2022 and was completed September 2023. In September 2021, LACFCD and LADWP entered into a 5-year License Agreement for the newly constructed injection and observation wells located on the Haynes Generating Station, which is owned by the City of Los Angeles Department of Water and Power (LADWP). LACFCD and LADWP will continue working towards a 30-year license agreement to encompass all ABP facilities located within the Haynes Generating Station.

The ABP Unit 15 Project included the following:

- Destruction of injection wells 33W (C,B,A,I), 34F(A), 34H(A), and 34H(I).
- Construction of new injection wells 33W2(C,B), 33W2(A,I) 34F2(A), 34H2(I), and 34H2(A).
- Construction of new internodal observation wells 34FG (A,I) and 34G2H2 (C,B,A,I)

### Seawater Barriers Condition Assessment

This project involved the assessment of all three of LACFCD's Seawater Barriers (Alamitos Barrier Project, Dominguez Gap Project, and West Coast Basin Barrier Project). The project was managed by Public Works and funded by both the LACFCD and OCWD. This project encompassed the evaluation of 5,764 feet of the ABP supply pipeline, 12 underground vaults, and 11 injection wells. The scope of work was developed during FY 2019-20. CH2M Hill (now Jacobs Engineering Group) was selected from a list of Public Works As-Needed Engineering Consultants in February 2021 and a Notice to Proceed was issued in March 2021. Field work started in May 2021 and was completed in December 2021. The final report was finalized and distributed in July 2023 and a summary of the findings can be found below:

- Injection wells 33N, 33S, 33U, 33U3, 33Y, 34G, 34S (C/B), 34S (I), and 34V (A) were found to be in good to moderate condition overall.
- Injection wells 34Z and 35G were found to be in poor condition.
- The 5,764 feet of the ABP supply line that was tested was found to have:
  - 2,213 feet in good condition (38%)
  - 2,797 feet in moderate condition (49%)
  - 754 feet in poor condition (13%)

## **INJECTION OPERATIONS**

The total amount of water injected into the ABP during FY 2022-23 was 6,475 AF. Of this total, approximately 66.7 percent (4,318 AF) was recycled water and 33.3 percent (2,158 AF) was imported water. The maximum monthly injection during this reporting period was 657 AF (26.0 percent imported, and 74.0 percent recycled) which occurred in October 2022. The minimum monthly injection of 396 AF (20.2 percent imported, and 79.8 percent recycled) occurred in April 2023, and is directly related to the full ABP shutdown that occurred in this month. The full shutdown was necessary so that Metropolitan Water District (MWD) could inspect their LB-07 Valve. Public Works took advantage of this opportunity and coordinated the replacement of a seized isolation valve at injection well 33W, and performed other miscellaneous repairs at injection wells and the pressure reducing station. The ABP also had a subsequent 3-week partial shutdown in May 2023, which was necessary to modify the wellheads at injection well 34S so it could be redeveloped via surging and airlifting, rather than the traditional method of disassembling and swabbing. In addition, there were four other partial shutdowns which were required to allow for chloride sampling or due to construction activities on the ABP Unit 15 Project. Overall, there was a total of six shutdowns on the ABP, whereas only one of those events was a full shutdown. All ABP injection well shutdowns that occurred during FY 2022-23 are summarized in *Table 2 – Summary of ABP Shutdowns*.

**Table 2. Summary of ABP Shutdowns**

Shutdown	Startup	Duration (days)	Impacted Portion of ABP	Reason
08/11/2022	08/18/2022	7	34N – 34Q (6 wells)	Observation Well 34LS Modification & WRD Q3 Sampling Event
9/22/2022	5/23/2023	250	34E -34J (8 wells)	To assist in drilling wells for the Unit 15 Project
9/23/2022	9/28/2022	5	34N – 34Z2 (16 wells)	Chloride Sampling Event for observation wells that are typically artesian & WRD Q2 Sampling Event
11/01/2022	11/04/2022	3	34L, 34N(C/B), 34Q(C/B), 34S(C/B) (4 wells)	WRD Q4 Sampling Event
4/25/2023	5/03/2023	7	Entire Barrier	MWD Inspection of their LB-07A Valve, Isolation valve replacement at 33W2 construction site, Injection well 34S wellhead modification.
04/25/2023	5/23/2023	28	34E – 35H2 (37 wells)	Continuation of injection well 34S wellhead modification

**Notes:**

\* Routine and/or minor shutdowns of individual wells are not listed here but are included in Figure 5.

Since completion of the Leo J. Vander Lans Advanced Water Treatment Facility (LVL AWTF) expansion in 2014, the LVL AWTF has operated intermittently between 2.5 and 6 million gallons per day (MGD). Further details regarding LVL AWTF operations can be found in the *Recycled Water Operations* section of this report.

The injection volumes and costs for FY 2021-22 and FY 2022-23 are shown in Table 3. The representative unit costs included in Table 3 for imported and reclaimed water were calculated by WRD. Table 3 shows that the volume of water injected into the ABP during FY 2022-23 decreased by 9.9 percent (713 AF) from the previous year. The decrease in injection was a direct result of ongoing projects that occurred during the reporting period that required injection wells to be taken offline, per Table 2 of this report.

**TABLE 3. INJECTION OPERATIONS**

Imported Water Injections			Recycled Water Injections			Total Injections		
FY21-22	FY22-23	Percent Change From Previous Year	FY21-22	FY22-23	Percent Change From Previous Year	FY21-22	FY22-23	Percent Change From Previous Year

VOLUME OF WATER INJECTED IN ACRE-FEET

OCWD <sup>1</sup>	1,228.1	794.3	-35.3%	1,475.8	1,619.6	9.7%	2,703.9	2,413.9	-10.7%
WRD <sup>2</sup>	1,935.8	1,363.2	-29.6%	2,548.1	2,698.0	5.9%	4,483.9	4,061.2	-9.4%
TOTAL	3,163.9	2,157.5	-31.8%	4,023.9	4,317.6	7.3%	7,187.8	6,475.1	-9.9%

AVERAGE INJECTION RATE IN CFS

OCWD <sup>1</sup>	1.70	1.10	-35.3%	2.04	2.24	9.7%	3.74	3.34	-10.7%
WRD <sup>2</sup>	2.67	1.88	-29.6%	3.52	3.73	5.9%	6.19	5.61	-9.4%
TOTAL	4.37	2.98	-31.8%	5.56	5.96	7.3%	9.93	8.94	-9.9%

COST OF WATER PURCHASED

OCWD <sup>1</sup>	\$1,566,785	\$1,049,515	-33.0%	\$1,898,513	\$2,138,471	12.6%	\$3,465,298	\$3,187,986	-8.0%
WRD <sup>2</sup>	\$2,475,603	\$1,805,804	-27.1%	\$3,289,605	\$3,568,757	8.5%	\$5,765,209	\$5,374,561	-6.8%
TOTAL	\$4,042,388	\$2,855,318	-29.4%	\$5,188,119	\$5,707,228	10.0%	\$9,230,507	\$8,562,547	-7.2%

UNIT COST OF WATER PER ACRE-FOOT<sup>3</sup>

JULY - DEC	\$1,203.79	\$1,258.83	4.6%	\$1,203.79	\$1,258.83	4.6%			
JAN - JUN	\$1,237.25	\$1,312.51	6.1%	\$1,237.25	\$1,312.51	6.1%			

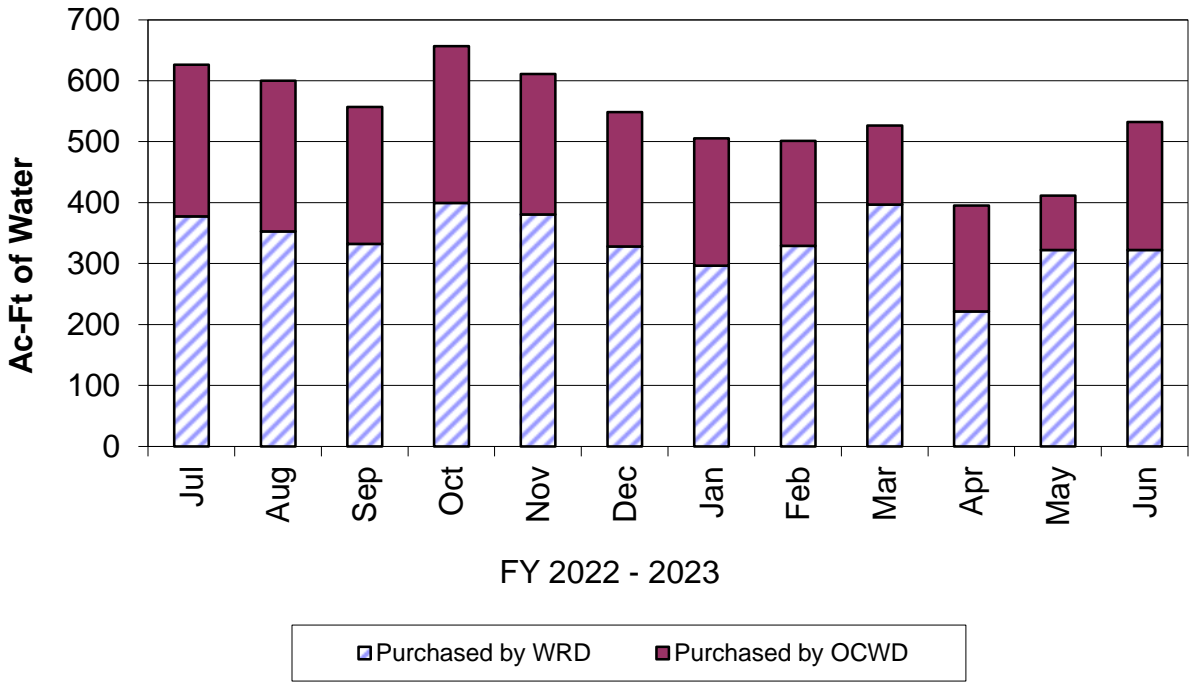
<sup>1</sup> Orange County Water District (OCWD)

<sup>2</sup> Water Replenishment District of Southern California (WRD)

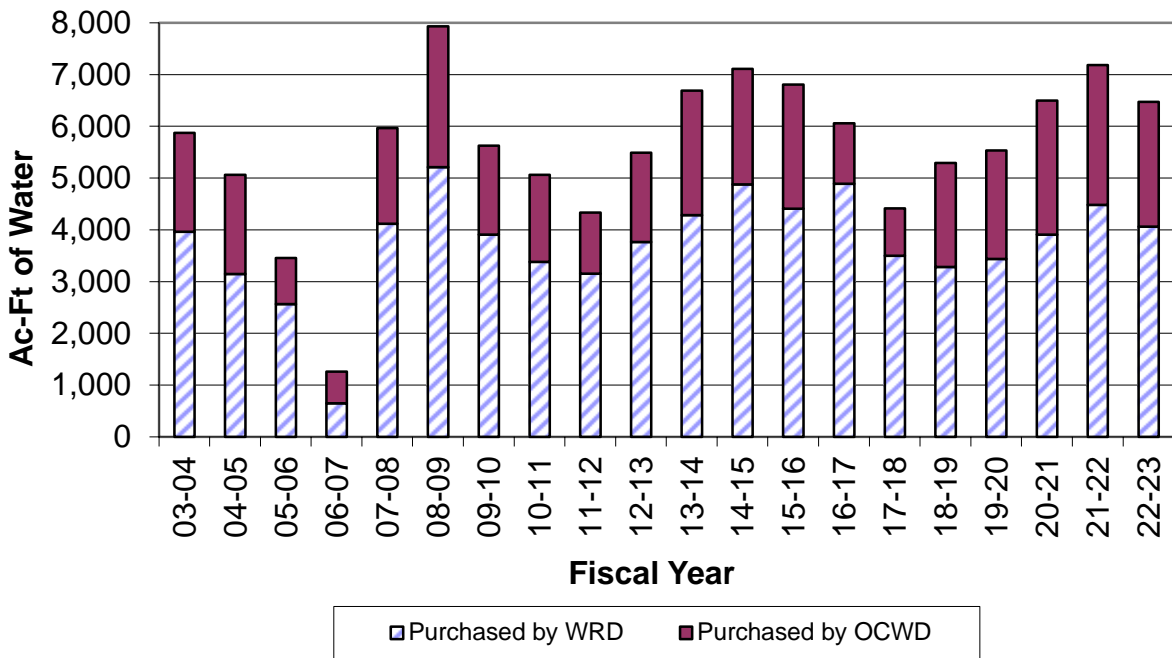
<sup>3</sup> The Unit Cost of **Imported Water** Per Acre-Foot is the sum of the Metropolitan Water District's wholesale rate at LB-07A (managed by Long Beach Water Department), the \$5 Administrative Surcharge, Readiness-To-Serve (RTS) costs, and Capacity costs (using total volume plus penalties). This amount is greater than what is shown on monthly invoices because Capacity costs are not typically known or accounted for at the time of those invoices. Based on the agreement between the OCWD and the WRD, the representative Unit Cost of **Recycled Water** Per Acre-Foot is equal to that of the imported water and is shown in the calculations by the WRD.



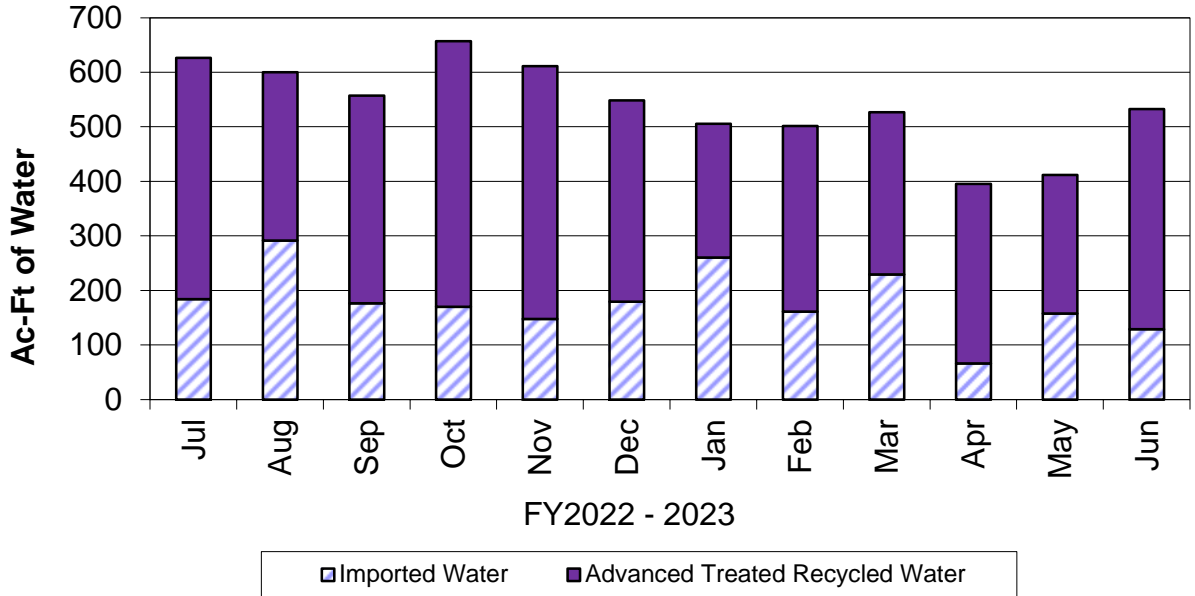
**FIGURE 1 - MONTHLY AMOUNT OF WATER INJECTED**



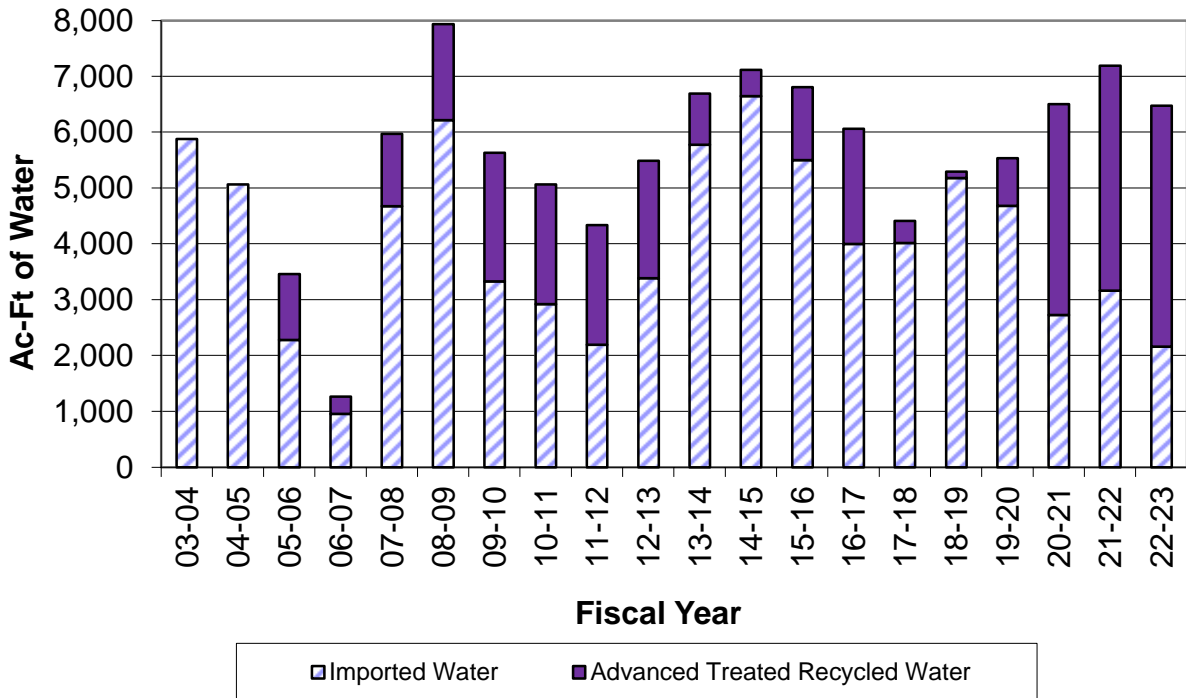
**FIGURE 2 - ANNUAL AMOUNT OF WATER INJECTED**



**FIGURE 3 - MONTHLY AMOUNT OF IMPORTED AND RECYCLED WATER INJECTED WATER**



**FIGURE 4 - ANNUAL AMOUNT OF IMPORTED AND RECYCLED WATER INJECTED WATER**



## **RECYCLED WATER OPERATIONS**

The LVL AWTF was constructed in 2005 to provide up to 3 million gallons per day (MGD) of advanced treated recycled water to inject at the ABP. The LVL AWTF treatment train consists of Micro-Filtration (MF), Reverse Osmosis (RO), and Ultra-Violet light (UV) disinfection. An expansion project completed in 2014 increased the plant capacity to 8 MGD by adding a recovery MF system and a third stage RO system. The Long Beach Water Reclamation Plant (LBWRP) owned by the Los Angeles County Sanitation Districts (LACSAN) provides recycled water to Long Beach Water Department (LBWD), who in turn provides recycled water to the LVL for advanced treatment.

The LVL AWTF was authorized to deliver up to 3 MGD for injection at the ABP under Regional Water Quality Control Board (RWQCB) Order No. R4-2005-0061 with the condition that the 10-year running average of recycled water contribution does not exceed 50 percent. In conjunction with completion of the plant expansion project, the LVL AWTF was authorized under RWQCB Order No. R4-2014-0111 to inject up to 8 MGD of advanced treated recycled water with no limitation on the percent recycled water contribution running average.

During the reporting period, the LVL AWTF provided a total of 4,317.6 AF of advanced treated recycled water to the ABP at rates between 2.5 MGD to 5.5 MGD. The volume of advanced treated recycled water was 7.3 percent more than FY 2021-22. The average percentage water supplied by the LVL AWTF in the three previous reporting periods was 59 percent.

WRD continues to make significant improvements at the LVL AWTF and the supply of advanced treated recycled water has greatly increased over the past three years. However, fifty-one (51) plant shutdowns occurred during the reporting period where most of the shutdowns were of short duration (9 were due to Southern California Edison Power outages and 5 were planned controlled shutdowns). LACPW, WRD, and LVL AWTF Operation Staff continue to have regular discussions regarding facility operation and how

to maximize recycled water delivery while preventing undue stress on the ABP infrastructure, which has been in operation since the mid 1960's.

**MAINTENANCE**

Typical well maintenance at the ABP includes injection well redevelopments and observation well cleanouts. The purpose of injection well redevelopments is to remove accumulated sediments and microbiological build-up within the well casings to restore each well's ability to operate at its maximum injection capacity. Each of the 60 injection well casings are routinely redeveloped once every two years. During FY 2022-23, Public Works completed redevelopment activities at 27 well casings:

**Table 4. Injection Well Redevelopment Program**

33V (A,I)	33X (C,B,A,I)	33Z (C,B,A,I)	33Z2 (A)	33Z2 (I)	34D (C,B,A,I)
34K (C/B)	34N (C/B)	34N (A)	34N (I)	34Q (C/B)	34Q (A)
34Q (I)	34T (C/B)	34T (A)	34T (I)	34X (B)	34X (A)
34X (I)	34Z2 (A)	34Z2 (I)	34Z (I)	35E (I)	35H1 (A)
35H1 (I)	35H2 (A)	35F(I)			

Observation well cleanouts are performed on an as-needed basis to clean out accumulated sediments and microbiological build-up within the well casings. Public Works staff performing observation well cleanouts typically rotate between the ABP, Dominguez Gap Barrier Project, and West Coast Basin Barrier Project. During FY 2022-23, Public Works completed cleanout activities at 12 well casings:

**Table 5. Observation Well Clean-out Program**

33NQ (A,I)	33T 13 (C)	33T 13 (B)	33T 13 (A)	33U 11 (C)	33U 11 (B)
33U 11 (A)	33X 20 (A)	33X 20 (I)	34D' 6 (C)	34D' 6 (A)	34D' 6 (I)

Figure 5 (Page 15), depicts the operating status of each injection and extraction well during FY 2022-23. The ABP was in operation throughout the entire reporting period except for shutdowns that occurred in September 2022 and April 2023. The partial shutdown in September 2022 consisted of the shutdown of 7 injection wells to assist in

nearby drilling operations associated with the ABP Unit 15 Project. The full shutdown during the last week of April 2023 allowed MWD to inspect their south coast feeder valve (LB-07A). In addition, Public Works took advantage of this opportunity and coordinated the following repairs: the replacement of a seized isolation valve at injection well 33W; modified the wellhead at injection well 34S; and performed miscellaneous repairs at the pressure reducing station.

#### Wells West of the San Gabriel River

Injection well 33W was operating at a reduced rate due to intermittent surface leakage after being struck by an automobile in 2003, and a subsequent sink hole later developed in 2007. In November 2022 this well was destroyed and replaced with injection well 33W2 as part of the ABP Unit 15 Project. Injection well 33W2 was put into operation in June 2023.

Injection well 33S1, also located west of the San Gabriel River, continues to operate at a reduced flow rate due to potential surface leakage.

#### Wells East of the San Gabriel River

In August 2022 injection well 34F (A) was destroyed and replaced with well 34F2 (A). Injection well 34F2 (A) as part of the ABP Unit 15 Project was put into operation in June 2023.

Injection well 34G(A) has historically experienced surface leakage issues. The area around the well was grouted in 2000 and 2004 to prevent surface leakage, which seemed to resolve the issue until 2016. In July 2016, a packer was installed due to reoccurring surface leakage. The goal of the packer was to direct the water below the poor casing welds, which were suspected of being the cause of the surface leakage. The well was turned off in 2019 due to reoccurring surface leakage. However, injection was resumed in December 2021 at a reduced rate and no signs of surface leakage have since been reported.

Injection wells 34H (A) and 34H (I) had holes in their casings and were not repairable. Excessive fill prevented these wells from operating effectively. In August 2022, injection wells 34H (A) and 34H (I) were destroyed and replaced with 34H2 (A) and 34H2 (I) during the ABP Unit 15 Project. Injection wells 34H2(A) and 34H2(I) were put in operation in June 2023.

In order to perform redevelopment activities at injection wells 34S and 34V, Public Works staff must typically turn off approximately 23 nearby injection wells in an effort to reduce ground water levels. In May 2023, Public Works staff modified the three wellheads at injection well 34S (C/B, A, I) to that of a “self-juttering” well to allow airlift redevelopment without the need to disassemble the wellhead. Testing is scheduled to be performed in Fall 2023. If successful, similar modifications will be made to the three well heads at injection well 34V (C/B, A, I).

Injection well 35G (A) was constructed in 1991 and injected into the A and I Zone until 2013, when a redevelopment swab became lodged at a depth of 100-feet, in the blank section between the A and I Zone perforations. As a result, the well was still operational, but could only inject into the A Zone. On February 25, 2020, this well was turned off due to the vault filling up with water. The Seawater Barriers Condition Assessment revealed that this well is plugged with sediment which is covering most of the perforations. This well is currently inoperable.



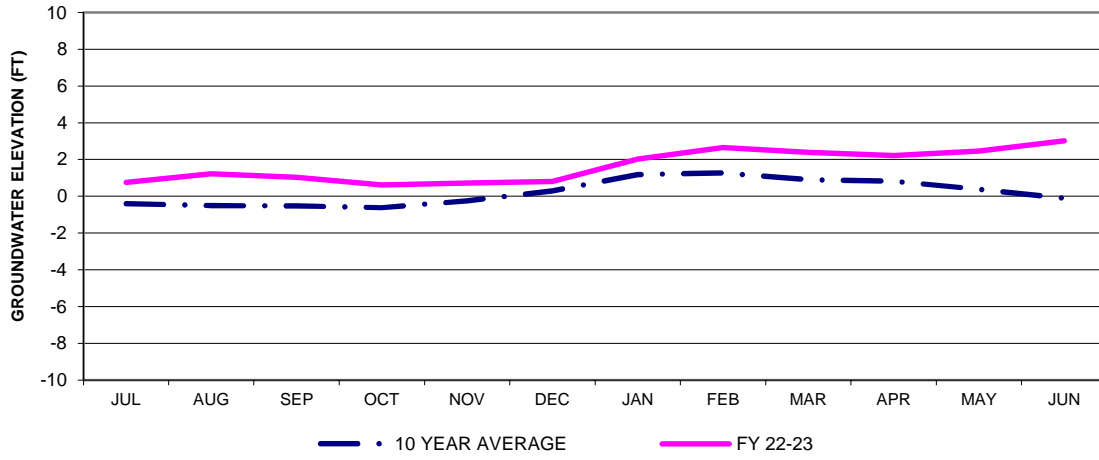
## **HYDROGEOLOGIC EFFECTS**

Figures 6 through 10 (pp. 17-21) show the average monthly groundwater elevation during FY 2022-23 relative to the average groundwater elevation of the 10 preceding years (FY 2012-13 to FY 2021-22) in the vicinity of the ABP alignment in the R, C, B, A, and I Zones, respectively. Two graphs were created for each aquifer to account for changes in groundwater elevation trends along two portions of the ABP alignment: wells west of the San Gabriel River and wells east of the San Gabriel River. It is important to note that the 10-year average does not represent a groundwater elevation goal, nor does it specifically reflect the performance of the ABP, but is simply included for comparison purposes. The graph includes all available semi-monthly, monthly, semi-annual, and annual data for wells within the ABP alignment and landward for approximately 2,000 feet from the ABP. As a result, semi-monthly values are “weighted” more heavily than the annuals in the calculation of the monthly average. Also, the months of September 2022 and March 2023 consistently have lower values than preceding and succeeding months due to the fact that semi-annual and annual water levels are measured during these months.

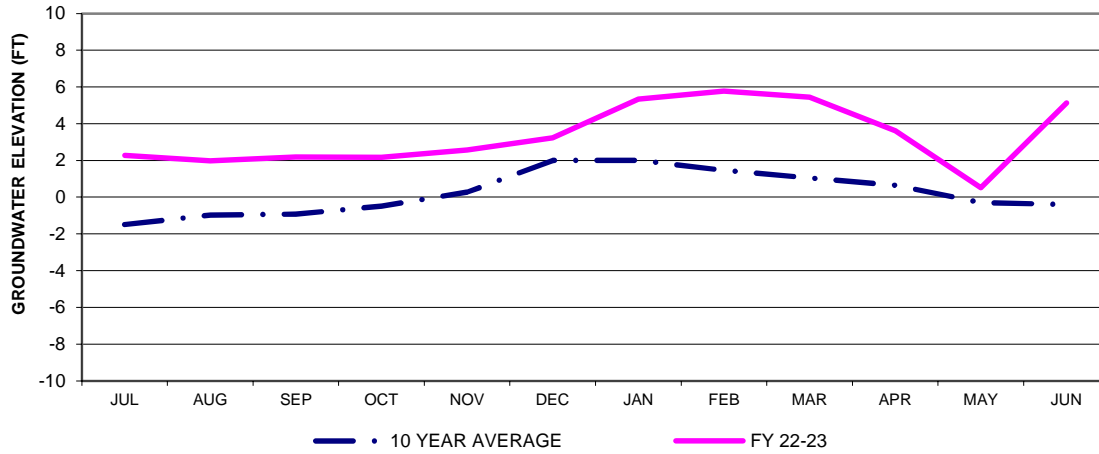
As shown in the graphs, groundwater elevations along the entire ABP were generally above the 10-year average. Groundwater levels during the month of September 2022 were lower for two reasons. First, the ABP was partially shutdown to support the Seawater Barriers chloride sampling event. Second, the injection wells near the Unit 15 Project site were taken offline to assist drilling operations. In May 2023, low groundwater levels were due to a full barrier shutdown, followed by partial shutdown of the north-south alignment (i.e., only half of the ABP was brought online). These shutdowns allowed MWD to inspect their LB-07A valve and for Public Works to perform various repairs and maintenance work, as mentioned in the above *Maintenance* Section. Groundwater elevations west of the San Gabriel River were generally at or slightly above the 10-year average, except in the months of September 2022 and May 2023, where lower elevations occurred due to full and partial shutdowns. Groundwater elevations east of the San Gabriel River were generally well above the 10-year average for the fiscal year.



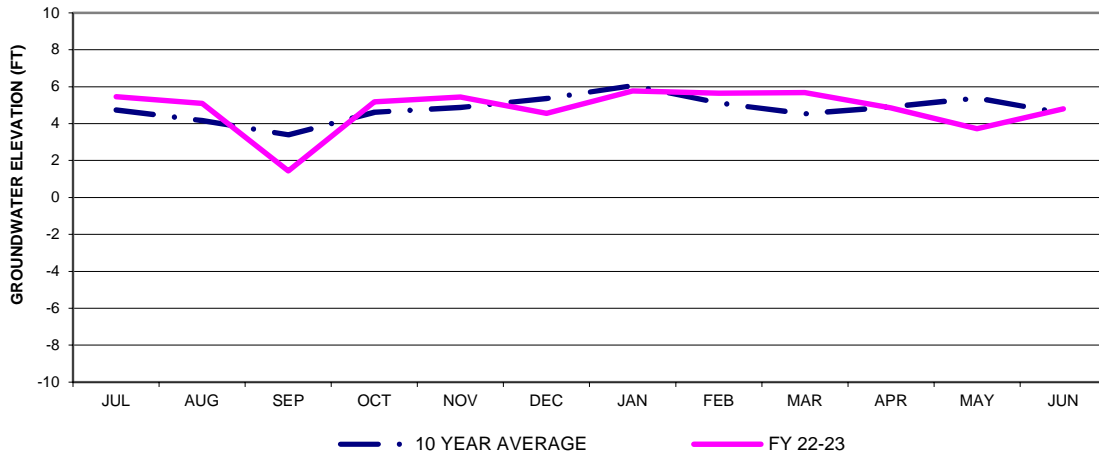
**FIGURE 6a RECENT ZONE WEST OF THE SAN GABRIEL RIVER**



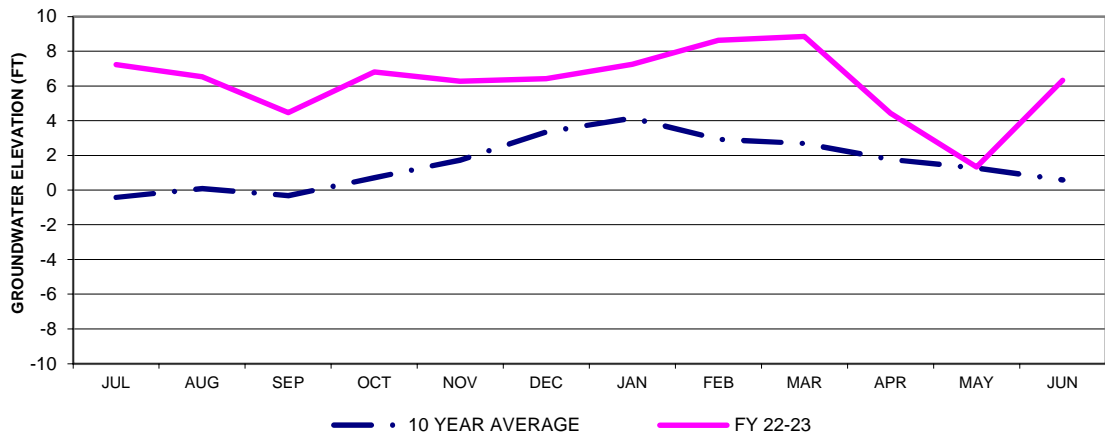
**FIGURE 6b RECENT ZONE EAST OF THE SAN GABRIEL RIVER**



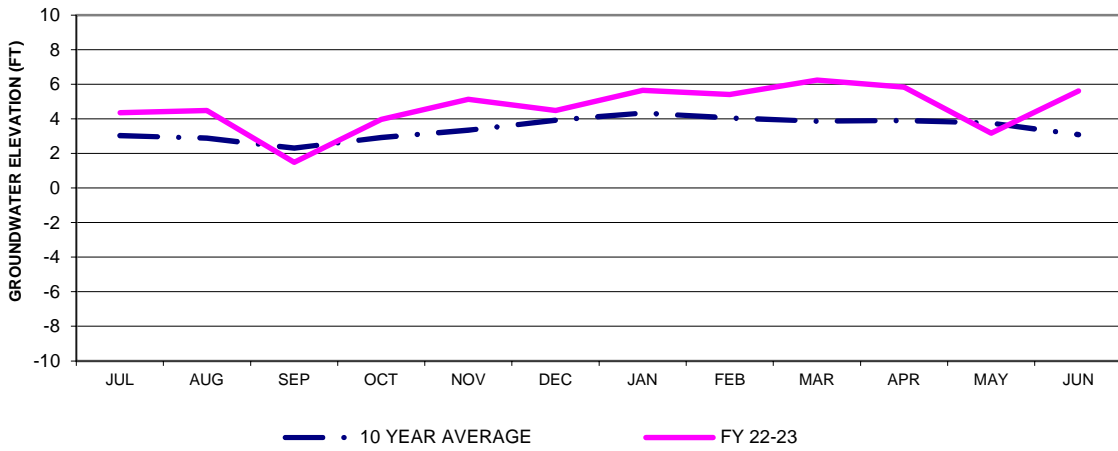
**FIGURE 7a C-ZONE WEST OF THE SAN GABRIEL RIVER**



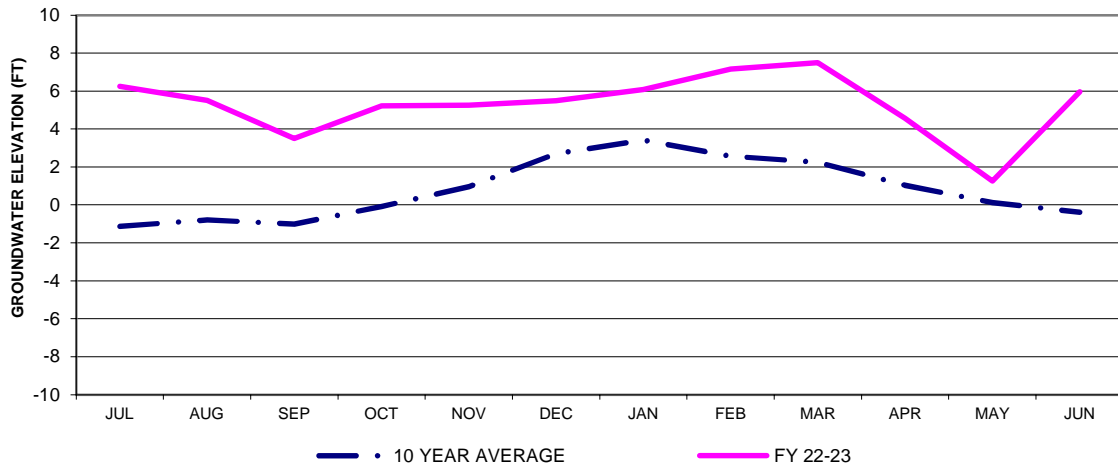
**FIGURE 7b C-ZONE EAST OF THE SAN GABRIEL RIVER**



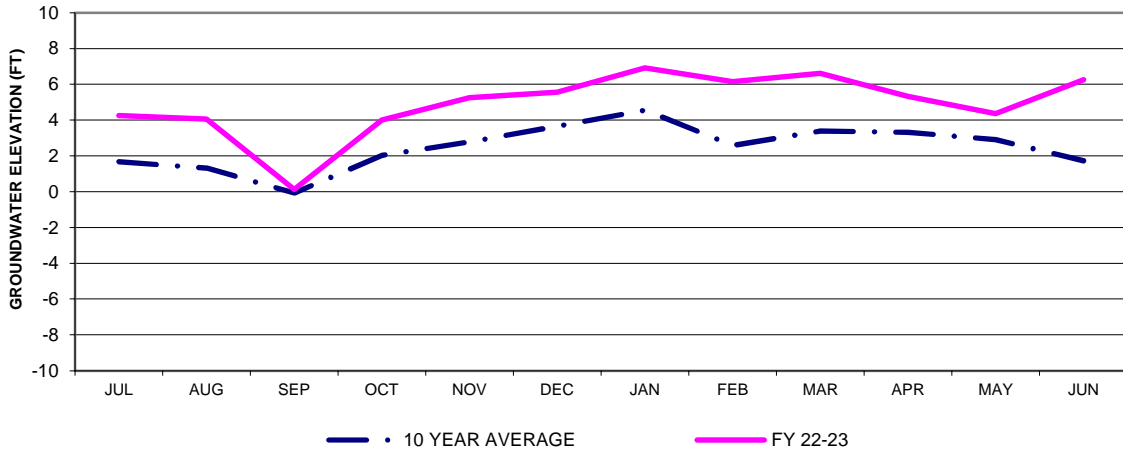
**FIGURE 8a B-ZONE WEST OF THE SAN GABRIEL RIVER**



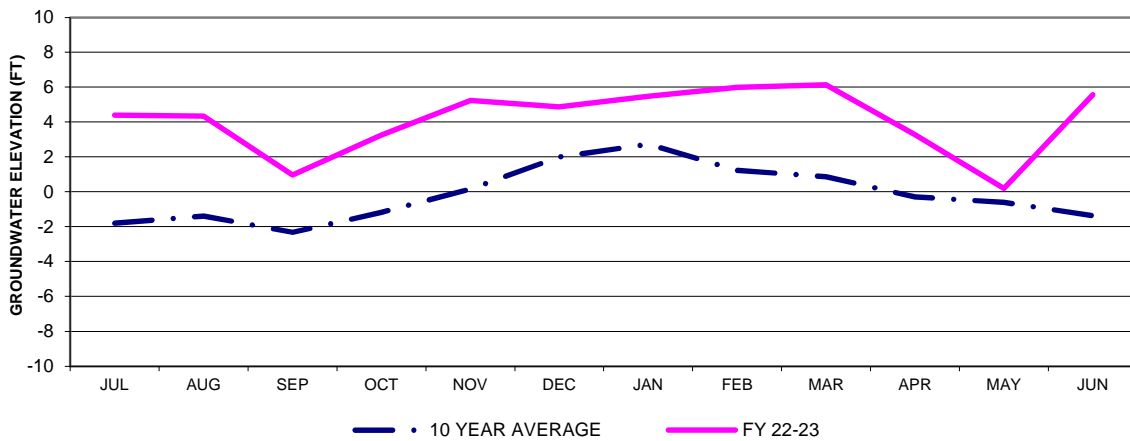
**FIGURE 8b B-ZONE EAST OF THE SAN GABRIEL RIVER**



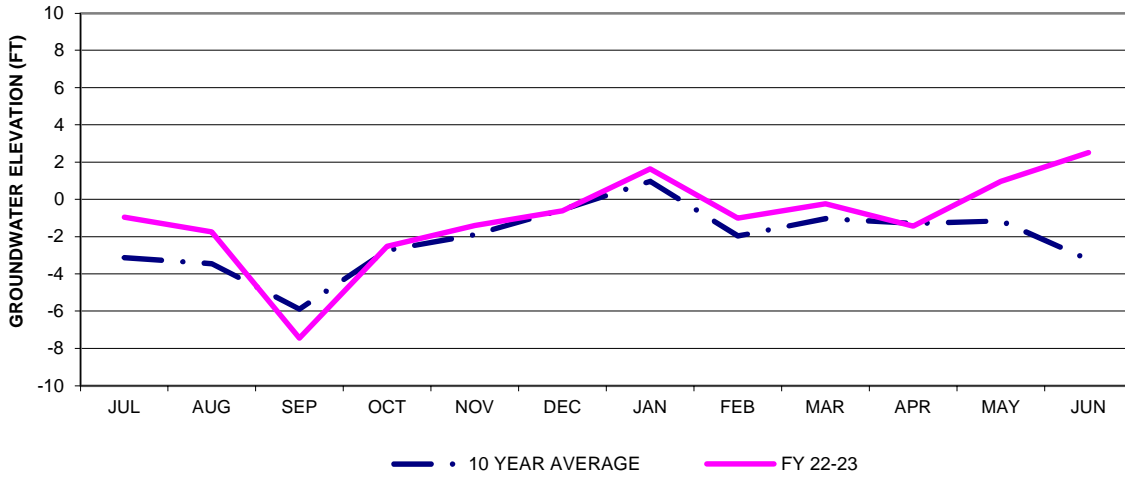
**FIGURE 9a A-ZONE WEST OF THE SAN GABRIEL RIVER**



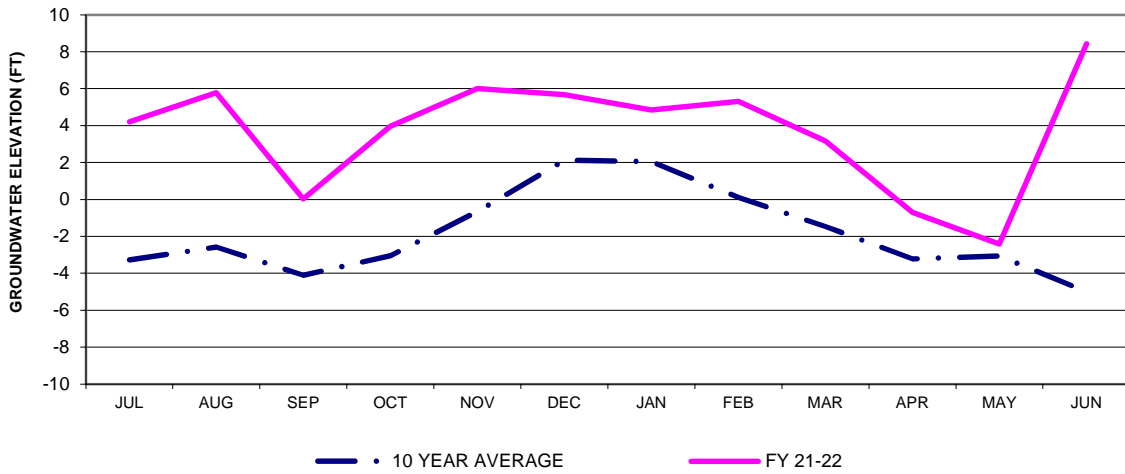
**FIGURE 9b A-ZONE EAST OF THE SAN GABRIEL RIVER**



**FIGURE 10a I-ZONE WEST OF THE SAN GABRIEL RIVER**



**FIGURE 10b I-ZONE EAST OF THE SAN GABRIEL RIVER**



Groundwater elevation contours for the R, C, B, A, and I Zones have been prepared from data collected in Spring 2023 and are included in Appendix A-1.1, 2.1, 3.1, 4.1, and 5.1. In general, the contours show that the groundwater levels were the highest near the ABP alignment, and typically decrease moving landward. The general shapes of each contour are similar to the previous year and some similar groundwater mounds are seen around certain injection wells. Groundwater levels near injection wells that are screened across all four zones (i.e., 33X, 33Y, and 33Z), tend to over inject into aquifers C and B, while under injecting into aquifers A and I. This can be observed near observation wells 33XY and 33YZ where there are higher groundwater elevations in the C and B Zones, but lower groundwater levels in the A and I Zones.

Contours of **changes** in groundwater elevations for the R, C, B, A, and I Zones between Spring 2022 and Spring 2023 are shown in A-1.2, 2.2, 3.2, 4.2, and 5.2. The data set is based on available data from Spring 2022, which was then subtracted from the corresponding and available data from Spring 2023 (shown in A-1.3, 2.3, 3.3, 4.3, and 5.3). These contours clearly identify increases and decreases in groundwater elevations from one reporting period to the next. Below is a brief summary and discussion of each aquifer zone relative to the ABP Alignment:

- R Zone:
  - Groundwater elevations along the ABP alignment west of the San Gabriel River were observed to be between 0.5 to 4.3 feet above sea level. Groundwater elevations East of the San Gabriel River ranged from 4.0 to 7.2 feet.
  - Compared to last year, groundwater elevations along the western alignment had changes in elevations by no more than a foot, with the exception of 33WX, which had an increase of 2.9 feet. East of the San Gabriel River had changes between -0.8 and 6.9 feet.

- C Zone:
  - Groundwater elevations along the ABP alignment west of the San Gabriel River were between 2.0 and 13.7 feet above sea level, with the highest elevations at observation wells 33XY and 33YZ. East of the San Gabriel River groundwater elevations along the ABP alignment were observed to be consistently above 8.0 feet, with the highest at observation well 34LS at 11.5 feet. Groundwater levels at internodal wells along the ABP alignment for this zone were above the protective elevation, by an average of 6.7 feet.
  - Compared to last year, groundwater elevations west of the San Gabriel River generally increased between 0.5 foot to 3.7 feet, except 33YZ, which decreased by 0.5 foot. East of the San Gabriel River, observation well 34DG decreased by 1.2 feet. From 34HJ2 to 34T0.1, groundwater levels increased by an average of 6.7 feet.
  
- B Zone:
  - Groundwater elevations along the ABP alignment west of the San Gabriel River were generally between 3.0 and 14.5 feet above sea level with the highest groundwater elevation of 14.4 feet at 33YZ. East of the San Gabriel River, groundwater ranged from 1.0 to 9.8 feet. Groundwater elevations at internodal wells were found to be at least 2.5 feet above the protective elevation.
  - Compared to last year, groundwater levels west of the San Gabriel River generally increased by 1.0 foot, with the largest increase at 33XY, which was 3.5 feet. East of the San Gabriel River, groundwater levels decreased by more than 2.0 feet at observation wells 34DG and 34F5. However, groundwater levels increased by more than 1.5 feet at observation wells 34HJ2, 34LS, 34T0.1, and 35J1, with the largest increase at 34LS of 9.8 feet.

- A Zone:
  - Groundwater elevations along the ABP alignment west of the San Gabriel River were observed to be 8.8 to 13.3 feet between observation wells 33GJ and 33YZ. Groundwater levels along the ABP alignment east of the San Gabriel River were between 2.2 and 9.9 feet. Generally, groundwater elevations were more than 1.4 feet above the protective elevation, with the exception of 35H11, 35H12, and 35J1, which typically have elevations below the protective elevation.
  - Compared to last year, groundwater elevations generally increased 1.3 to 5.5 feet west of the San Gabriel River. East of the San Gabriel River Along the ABP alignment, groundwater elevations generally increased between 1.2 to 4.5 feet. The only decrease in this stretch was observed at 34Y0.1, which was -0.5 feet.
  
- I Zone:
  - West of the San Gabriel River, groundwater elevations along the ABP alignment were observed to be 3.7 to 13.2 feet above sea level. Groundwater elevations along the ABP alignment east of the San Gabriel River were -0.6 to 10.3 feet above sea level. Groundwater levels at internodal wells were above protective elevations except between observation wells 33WX and 34LS, which had elevations 0.4 to 11.9 feet below the protective elevation.
  - Compared to last year, groundwater elevations generally remained unchanged between observation wells 33GJ to 33XY. Ground water elevations between observation wells between 33YZ to 34S0.1 decreased between 0.5 and 10 feet. Ground water elevations south of 34S0.1 increased by more than of 3.0 feet.



Graphs showing the average, maximum and minimum groundwater elevations at each internodal observation well throughout FY 2022-23 are included in Appendix A-13 through A-16. As shown in the graphs for the C and B Zones, the average groundwater elevations were above protective elevation at all wells along the ABP. For the A and I Zones, the average groundwater elevations were below the protective elevation for some of the wells along the ABP for this reporting period. This is most likely due to operational changes related to the ABP Unit 15 Project.

## **CHLORIDES**

Figures 11a through 15b (pp. 27-31) show the last 10-years of chloride concentrations in each individual aquifer zone. The graphs plot the average of every maximum value measured at each observation well during each sampling event within the target area throughout FY 2022-23. The data includes all available information from the annual and semi-annual chloride sampling events for wells within the ABP alignment and landward for approximately 2,000 feet from the barrier. As a result, the semi-annual values are “weighted” more heavily than the annuals in the calculation of the annual average. Two sets of graphs were created for each aquifer to account for changes in chloride concentration trends in the areas to the west and east of the San Gabriel River, respectively. In each figure, the average of the maximum chloride concentrations per well per event over the last 10 fiscal years (including FY 22-23) is shown with respect to the freshwater condition (250 mg/L).

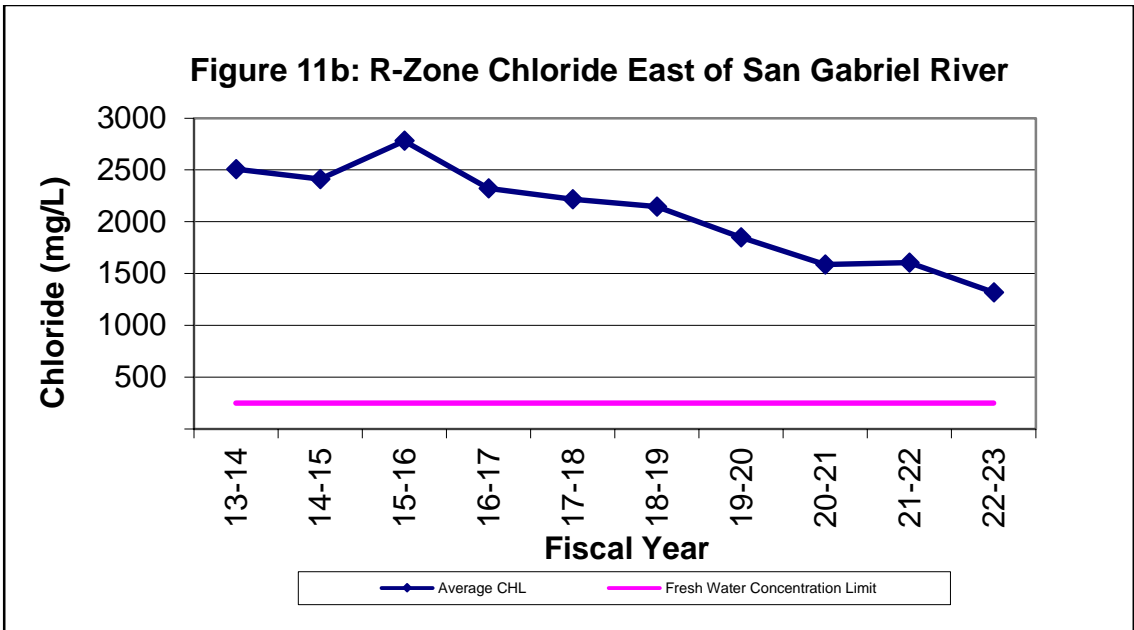
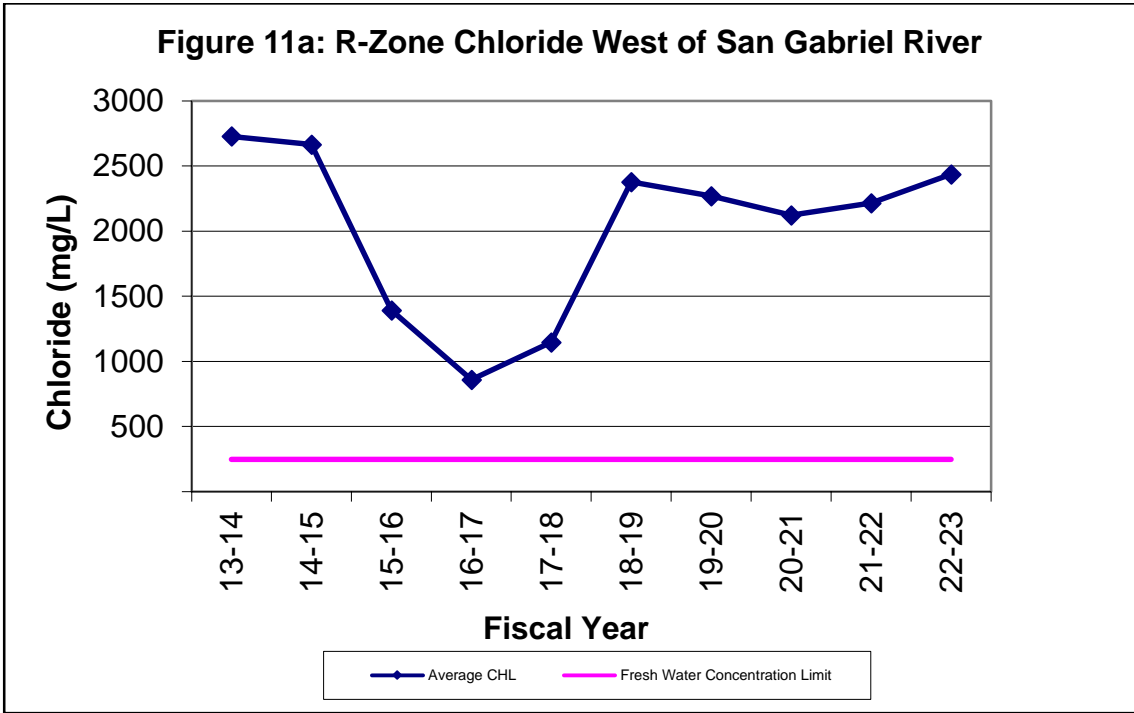


Figure 12a: C-Zone Chloride West of San Gabriel River

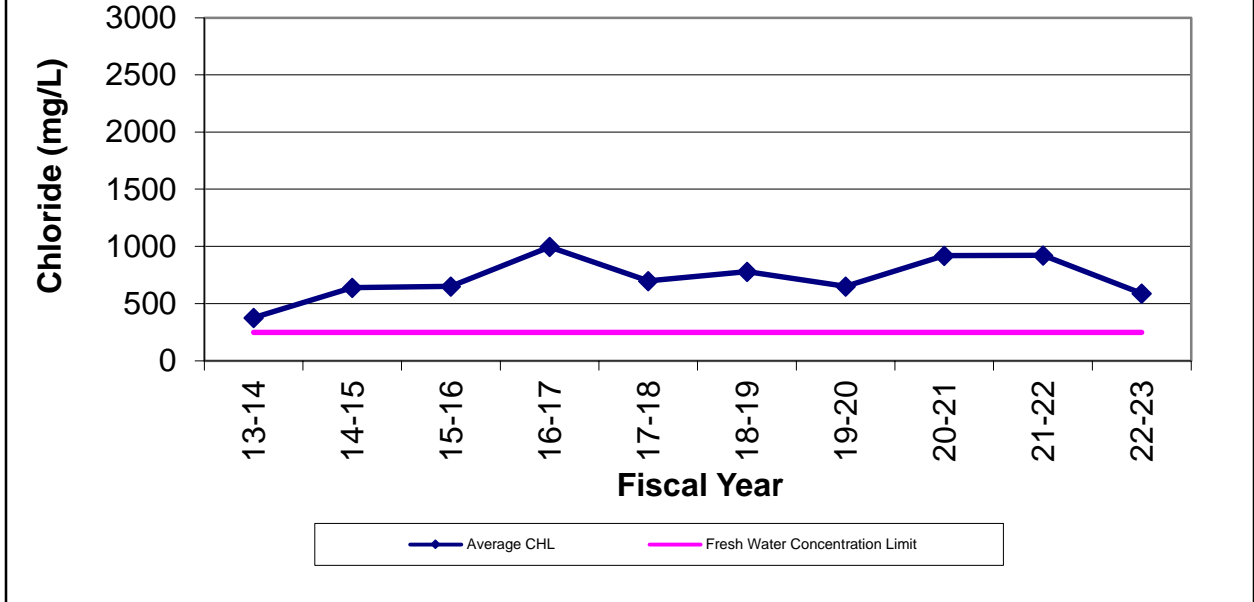
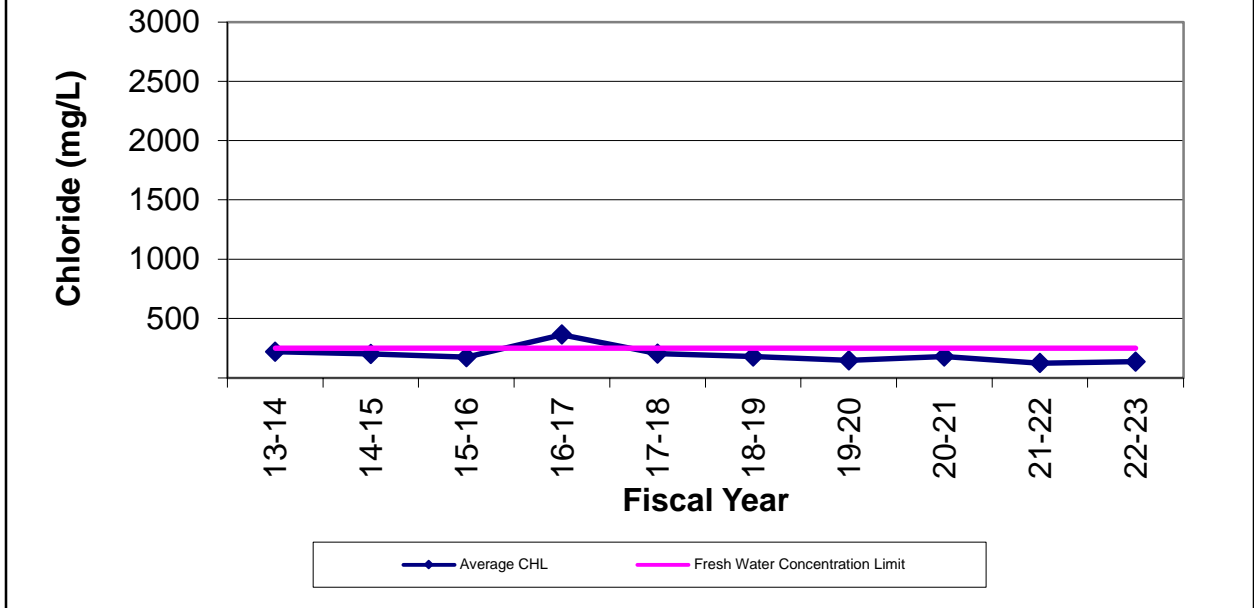
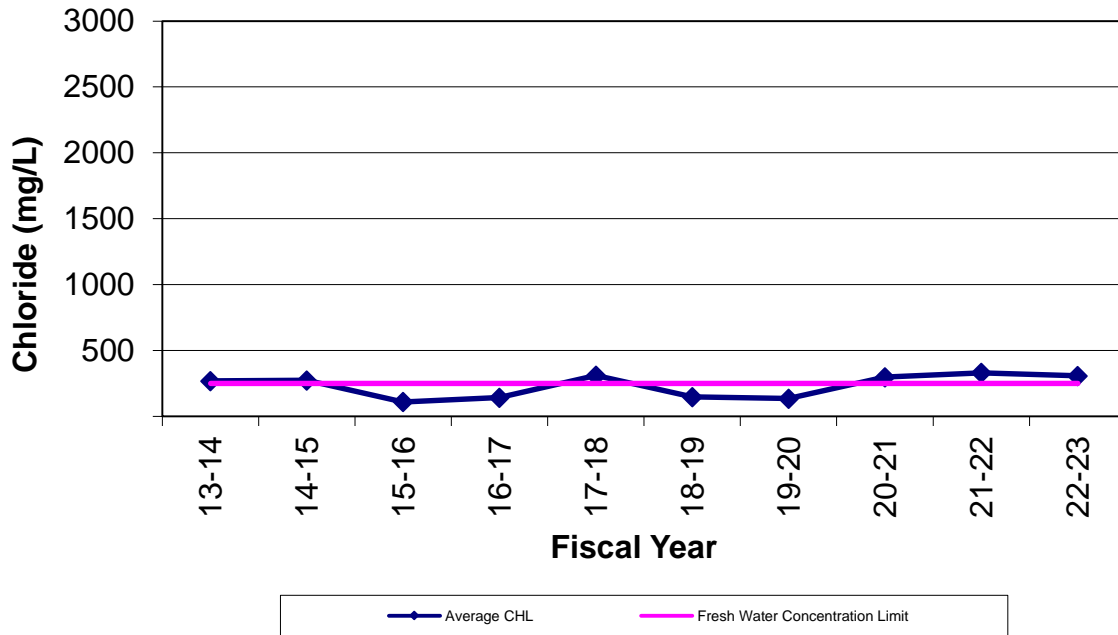


Figure 12b: C-Zone Chloride East of San Gabriel River



**Figure 13a: B-Zone Chloride West of San Gabriel River**



**Figure 13b: B-Zone Chloride East of San Gabriel River**

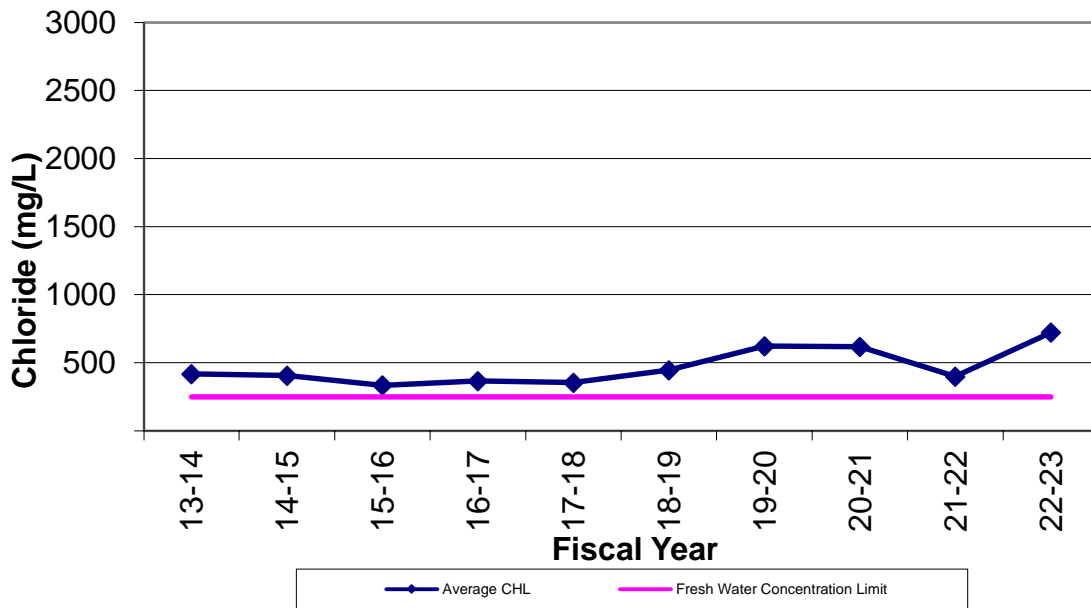


Figure 14a: A-Zone Chloride West of San Gabriel River

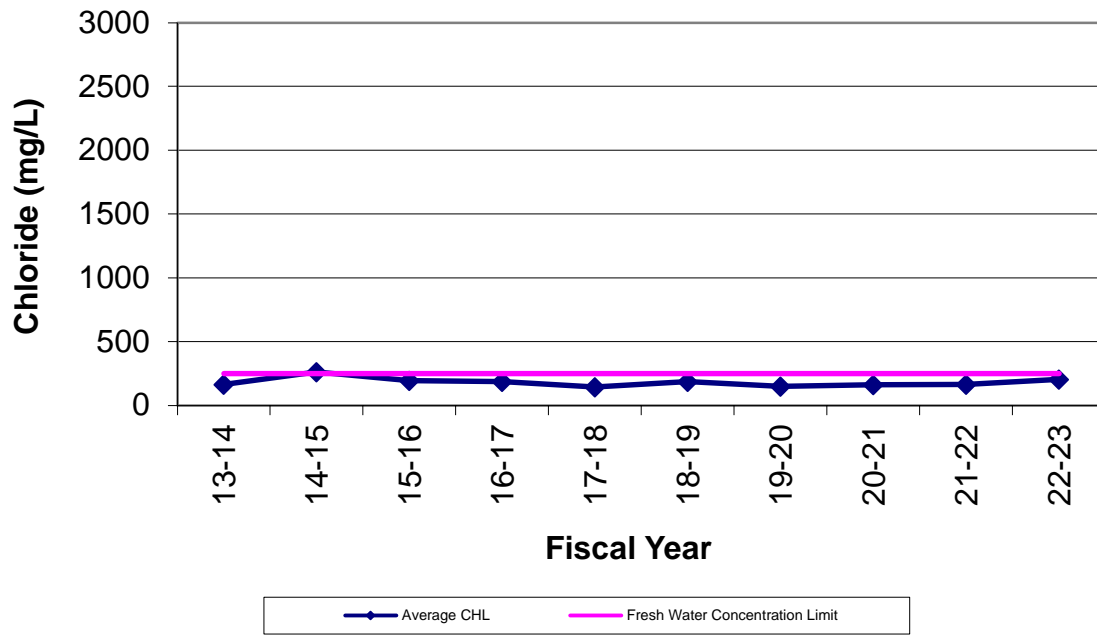
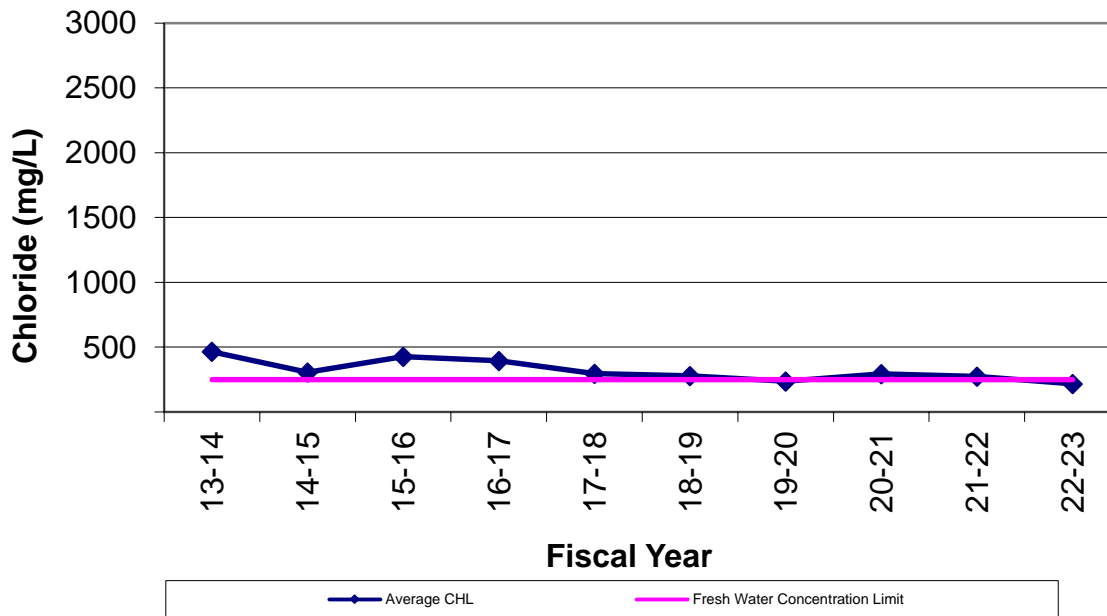
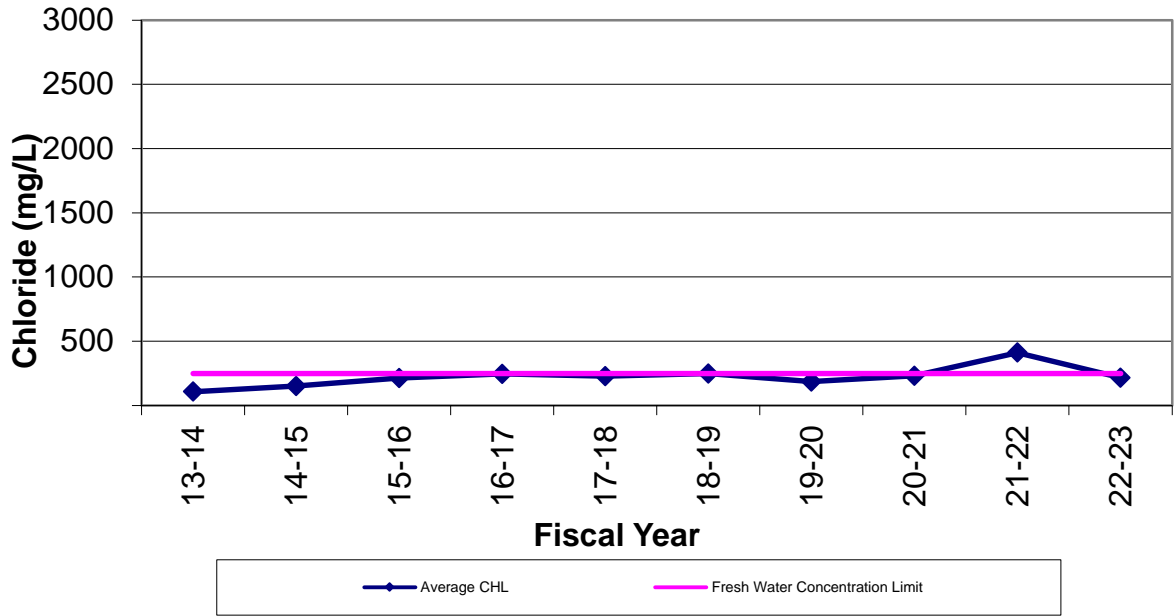


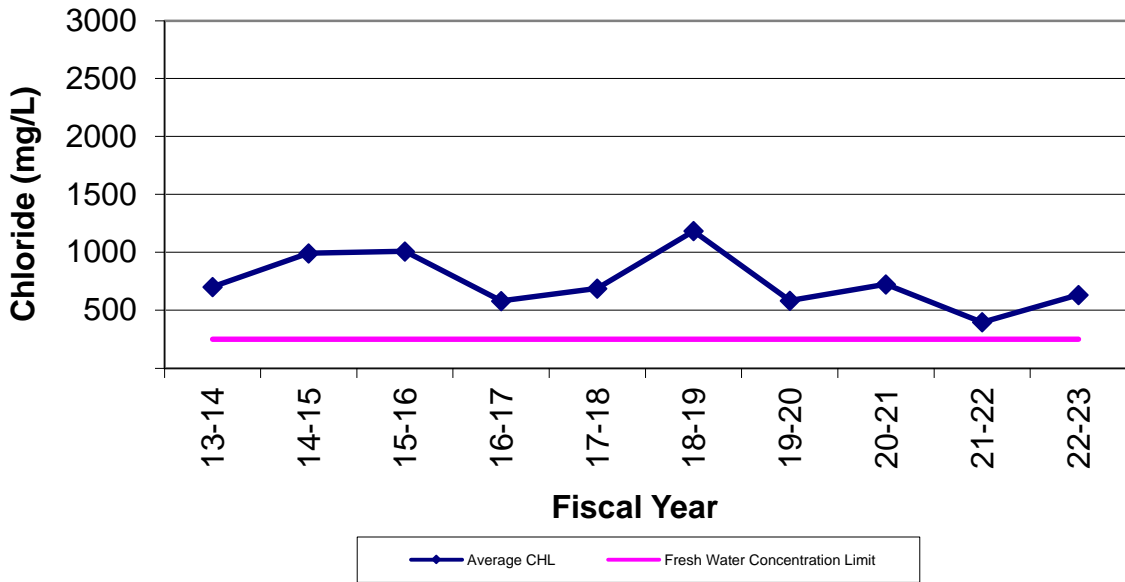
Figure 14b: A-Zone Chloride East of San Gabriel River



**Figure 15a: I-Zone Chloride West of San Gabriel River**



**Figure 15b: I-Zone Chloride East of San Gabriel River**



West of the San Gabriel River, the average maximum chloride concentrations in FY2022-23 increased slightly in R and A Zones. The B, C, and I Zones all showed a decrease in chlorides by a collective average of 258 mg/L. The increase in chlorides was very minimal, with the largest increase of 225 mg/L in the R Zone.

East of the San Gabriel River, the average maximum chloride concentrations in FY2022-23 increased slightly in the C, B, and I Zones. The largest increase in chlorides was exhibited in the B Zone in the amount of 325 mg/L. Chlorides decreased in the R and A Zone by an average of 171 mg/L.

Chloride concentration contour maps for the R, C, B, A, and I Zones were prepared from data collected in Spring 2023 and are included in Appendix A-6.1, A-7.1, A-8.1, A-9.1, and A-10.1, respectively. The I Zone chloride concentration map (A-10.1) was further analyzed and interpreted by OCWD Hydrogeologists as it pertains to chlorides east of the San Gabriel River. The chloride contour maps are based on the maximum chloride concentration (mg/L) measured at each observation well. Chloride data was gathered from observation wells located within the immediate vicinity of the ABP and does not represent basin-wide conditions for the groundwater basin protected by the ABP. Wells with chloride concentrations of 250 mg/L or less were considered fresh. The chloride measurements used in this report were taken during the semi-annual sampling event between March and April 2023, and the annual event in February and March 2023.

Contours of **changes** in chloride concentration for the R, C, B, A, and I Zones between Spring 2022 and Spring 2023 are shown in Appendices A-6.2, A-7.2, A-8.2, A-9.2, and A-10.2. The data set is based on available data for Spring 2022, which was then subtracted from the corresponding data for Spring 2023 (shown in A-1.3, 2.3, 3.3, 4.3, and 5.3). These contours very clearly identify areas where chloride concentrations increased and decreased between these two reporting periods.



The chloride concentration contours for FY 2022-23 are similar in shape and pattern to those of the previous year. The current contours and the corresponding chloride concentration cross-section (A-11) for this reporting period indicate that intrusion of seawater across the barrier continued to be controlled west of the San Gabriel River. East of the San Gabriel River, several areas recorded elevated chloride concentrations indicating seawater intrusion.

- R Zone:

- Chloride concentrations remained elevated landward and seaward of the ABP.
- West of the San Gabriel River, the average chloride concentrations overall, increased by 223 mg/L. In the vicinity of observation well 33Z'1, chlorides increased by 860 mg/L. Chlorides east of the San Gabriel River decreased by an average of 285, with a significant decrease at observation well 34S0.1 of over 1,000 mg/L.

- C Zone:

- Chloride concentrations along the ABP alignment remained below 100 mg/L, averaging 69 mg/L. The highest concentration was at 34T0.1, at 96 mg/L. West of the San Gabriel River, persistent chlorides remain north of the ABP alignment near observation wells 33T4, 33T13, 33S18, and 33U11.
- Compared to the last reporting period, the ABP alignment had decreases in chloride concentrations, averaging 22 mg/L. Observation well 33T13 was observed to have a decrease in chloride concentrations of more than 1,000 mg/L and an increase of over 1,000 mg/L was measured at well 33T4. In addition, a significant change in chloride concentrations was measured at observation well 34V3 where chlorides increased by 480 mg/L.

- B Zone:
  - Much of the ABP alignment remained below 250 mg/L, with chloride concentrations averaging 75 mg/L. On the other hand, observation wells 34V3 and 34U8, both had chloride concentrations of over 1,000 mg/L.
  - Compared to the last reporting period, much the alignment's chloride concentrations was observed to be unchanged. However, an increase of 97mg/L was measured at 33JL. Significant changes in chloride concentrations were observed at observation wells 34V3 of 3,750 mg/L and a decrease at 34U8 of 400 mg/L.
  
- A Zone:
  - West of the San Gabriel River, chloride concentrations along the ABP alignment were below 250 mg/L, except for 33Z'1, which had a chloride concentration of 640 mg/L. East of the San Gabriel River, chloride concentrations along the ABP alignment remained below 250 mg/L, with the exception of 34DG, 35H11, and 35H12 which had concentrations of 760 mg/L, 560 mg/L, and 760 mg/L, respectively.
  - Chloride concentrations remained generally unchanged from the last reporting period for most of the ABP alignment. However, chloride concentrations at observation well 32Z'5 increased by 1,900 mg/L and decreased by 1,950 mg/L at observation well 35E0.1.
  
- I Zone:
  - Chloride concentrations remained below 250 mg/L along the ABP alignment from observation well 33GJ to 34HJ with the exception of observation well 33XY, which had a chloride concentration of 1,000 mg/L. Observation wells south of 34HJ were observed to have high chlorides. Internodal observation wells 34JL, 34S0.1, 34Y0.1, and 35E0.1 had chloride concentrations of 10,000 mg/L, 950 mg/L, 1,100 mg/L, 730 mg/L, and 2,000 mg/L respectively.

- West of the San Gabriel River, chloride concentrations remained unchanged. However, a significant decrease in chlorides of 4,000 mg/L was observed seaward of the ABP at observation well 33V'8. Chloride concentrations at 33X20 have been in decline over the previous two reporting periods. Chloride concentrations along the ABP alignment east of the San Gabriel River generally increased with the largest increase occurring at observation well 34JL in the amount of 9,911 mg/L. The only decrease was at observation well 34T0.1 in the amount of 1,750 mg/L.

There continues to be high chloride concentrations in the R, C, and I Zones north of the ABP alignment west of the San Gabriel River. Three possible reasons include the remaining seawater from previous intrusions, migration of seawater inland by the Los Cerritos Channel, and suspected intrusion around the west end of the ABP. Elevated chloride concentrations in this area will be monitored using the observation wells that were constructed by Public Works in the 2012-13 reporting period. East of the San Gabriel River, high chlorides remain near observation wells 34U8 and 34V3 in the B Zone and may be the residual chlorides that have remained since the completion of OCWD's Unit 14 Project. The addition of OCWD's Unit 14 Project, which helped fill in gaps east of the San Gabriel River, and the Public Works Unit 15 project, which replaced deficient injection wells, will aid in raising groundwater elevations to protective elevations to prevent seawater intrusion.

## **BARRIER PROJECT COSTS**

This section of the report is divided into four parts: Water Costs, Services and Supplies Costs (operation and maintenance), Fixed Assets Costs (capital outlay), and Budget. Under the terms of the 1964 Cooperative Agreement between LACFCD and OCWD, fixed assets are typically divided into facilities paid for by the LACFCD, facilities paid for by the OCWD, and joint facilities paid for by both agencies, depending on their location. Under the same agreement, water costs are divided between the LACFCD (whose portion is paid by the WRD per a separate agreement) and the OCWD. The total cost of the ABP in FY 2022-23 was \$12,870,745 which can be broken down as follows: water costs of \$8,562,547, Operation and Maintenance costs of \$4,231,846 and joint liability insurance cost of \$76,352.

## WATER COSTS

During FY 2022-23, 6,475 AF of water was injected at an estimated total cost of \$8,562,547, as shown in Table 6. The monthly unit water cost (dollars per AF) from July 2022 to June 2023 varied periodically as shown above in Table 3. The monthly quantity of water injected and total water costs paid by each agency are shown below in Table 6.

**TABLE 6. QUANTITY OF WATER INJECTED AND COSTS**

MONTH	VOLUME BY WRD (AF)	VOLUME BY OCWD (AF)	TOTAL VOLUME (AF)
Jul-22	377.7	249.0	626.7
Aug-22	353.0	247.4	600.4
Sep-22	332.3	225.1	557.4
Oct-22	399.5	257.3	656.8
Nov-22	380.7	230.5	611.2
Dec-22	328.5	220.2	548.7
Jan-23	296.7	209.1	505.8
Feb-23	329.3	172.1	501.4
Mar-23	396.9	129.7	526.6
Apr-23	221.8	173.8	395.6
May-23	322.4	89.6	412.0
Jun-23	322.4	210.1	532.5
<b>TOTAL INJECTED</b>	<b>4,061.2</b>	<b>2,413.9</b>	<b>6,475.1</b>
<b>TOTAL COST (\$)</b> [From Tbl. 3]	<b>\$5,374,561</b>	<b>\$3,187,986</b>	<b>\$8,562,547</b>

## OPERATIONS AND MAINTENANCE COSTS

A total of \$4,231,846 was spent on Operations and Maintenance during FY 2022-23 (not including liability insurance). Pursuant to the 1964 Cooperative Agreement, the OCWD pays a percentage of the applicable services and supplies costs for injection operations proportional to the percentage of the total amount of injection water paid for by the OCWD. The distribution of FY 2022-23 services and supplies costs is summarized in Table 7.

**TABLE 7. DISTRIBUTION OF SERVICES AND SUPPLIES COSTS FOR INJECTION AND EXTRACTION ACTIVITIES**

ITEM	LACFCD	OCWD	TOTAL
Service & Supplies of Injection Facilities (including Observation Wells)	\$1,781,490	\$1,059,802	\$2,841,292
Service & Supplies of Extraction Facilities	\$912	\$0	\$912
Special Projects	\$1,364,524	\$25,119	\$1,389,643
<b>SUBTOTAL</b>	<b>\$3,146,925</b>	<b>\$1,084,921</b>	<b>\$4,231,846</b>
Liability Insurance	\$38,176	\$38,176	\$76,352
<b>TOTAL</b>	<b>\$3,185,101</b>	<b>\$1,123,097</b>	<b>\$4,308,198</b>

The values in Table 7 come from the ABP FY 2022-23 Costs (see A-17) as follows:

<sup>1</sup> The sum of Items 1, 2, 3, 7, 8, 9, 10, 11, 12, and 13. OCWD is responsible for 37.3% of all costs for these items per the agreement. OCWD is only responsible for 37.3% of costs associated with Item 14, Seawater Barrier Condition Assessment.

<sup>2</sup> The sum of Items 4, 5, and 6; OCWD is not responsible for any portion of the cost for these items.

<sup>3</sup> The sum of Item 14. OCWD is responsible for 37.3% of costs associated with the ABP portion of Seawater Barrier Condition Assessment. LACFCD responsible for 100% of costs associated with Alamitos Barrier Project Unit 15 Well Replacement Project.

The yearly cost of the services and supplies (including special programs but excluding water and extraction costs) for the last 10 years of ABP operations are shown in Table 8.

**TABLE 8. COSTS OF SERVICES AND SUPPLIES FOR INJECTION**

<b>Fiscal Year</b>	<b>Volume of Water Injected (AF)</b>	<b>Total Cost</b>	<b>Cost Per AF Injected</b>
2013-14 <sup>1</sup>	6,692.3	\$3,605,859	\$538.81
2014-15	7,113.1	\$1,678,123	\$235.92
2015-16	6,807.7	\$2,237,637	\$328.69
2016-17	6,060.0	\$1,650,686	\$272.39
2017-18	4,414.1	\$2,138,420	\$484.45
2018-19	5,295.2	\$2,293,529	\$433.13
2019-20	5,536.9	\$2,465,320	\$445.25
2020-21	6,500.9	\$2,649,077	\$407.49
2021-22	7,187.8	\$2,403,462	\$334.38
2022-23	6,475.1	\$2,841,292	\$438.80

<sup>1</sup> The costs reported in Table 8 prior to the FY 2014-15 period are higher because these years included costs for multiple repairs and/or capital improvement projects.

The costs of the services and supplies for extraction operations for the last 10 years, including electrical costs, are shown in Table 9.

**TABLE 9. COSTS OF SERVICES AND SUPPLIES FOR EXTRACTION**

<b>Fiscal Year</b>	<b>Volume of Water Extracted (AF)</b>	<b>Total Cost</b>	<b>Cost Per AF Extracted</b>
2013-14	0.0	\$6,768	N/A
2014-15	0.0	\$13,714	N/A
2015-16	0.0	\$6,961	N/A
2016-17	0.0	\$1,510	N/A
2017-18	0.0	\$1,538	N/A
2018-19	0.0	\$1,556	N/A
2019-20	0.0	\$1,512	N/A
2020-21	0.0	\$1,132	N/A
2021-22	0.0	\$2,847	N/A
2022-23	0.0	\$912	N/A

**FIXED ASSETS**

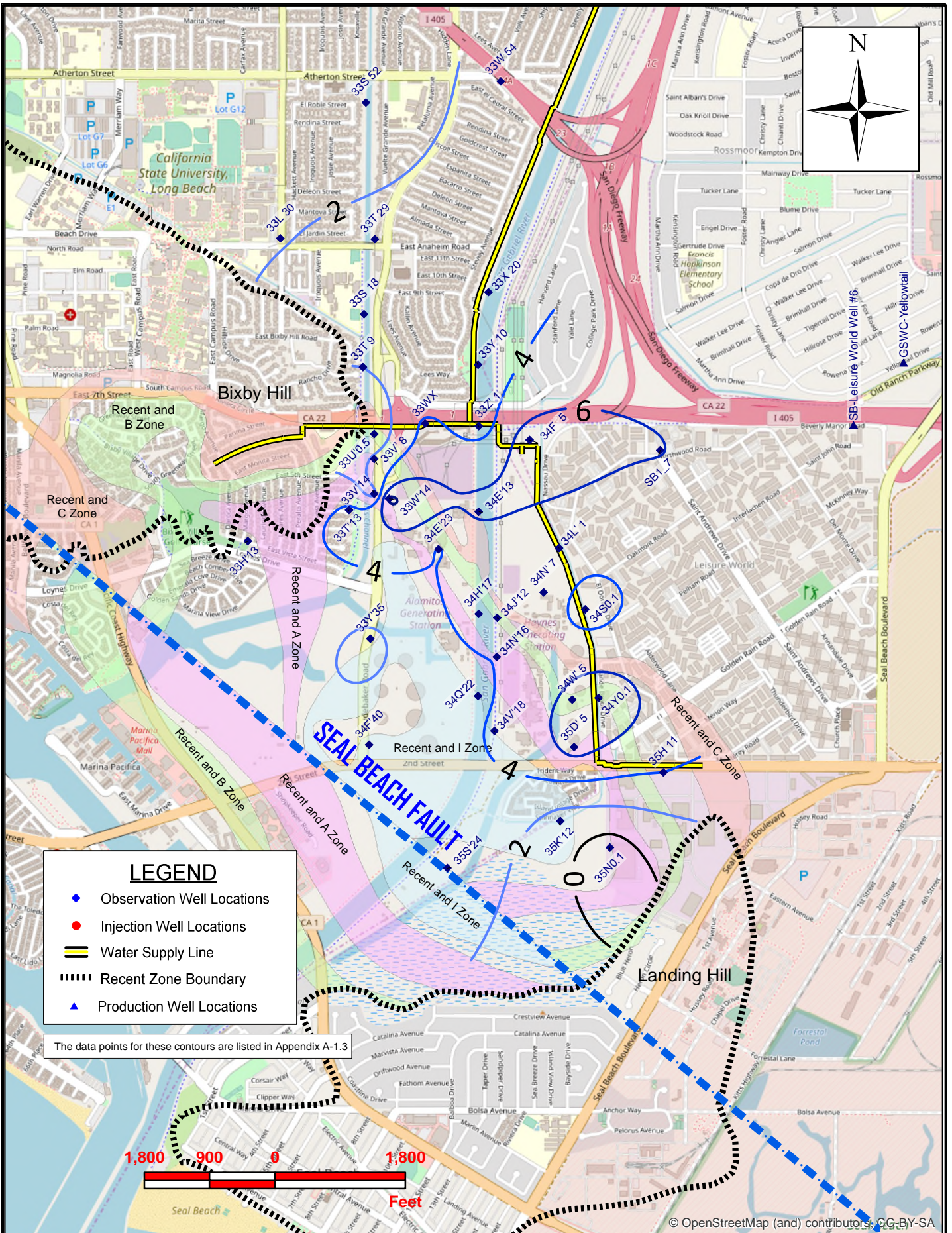
During Fiscal Year 2022-23, five injection wells and two observation wells were constructed under the ABP Unit 15 Project. Four injection wells were destroyed.

**BUDGET**

The FY 2024-25 budget for the cost of ABP Supplies and Services is \$3,085,000. A breakdown of this amount, along with past expenditures per category, is shown in Appendix A-18.



# APPENDIX



**LEGEND**

- ◆ Observation Well Locations
- Injection Well Locations
- Water Supply Line
- - - - Recent Zone Boundary
- ▲ Production Well Locations

The data points for these contours are listed in Appendix A-1.3

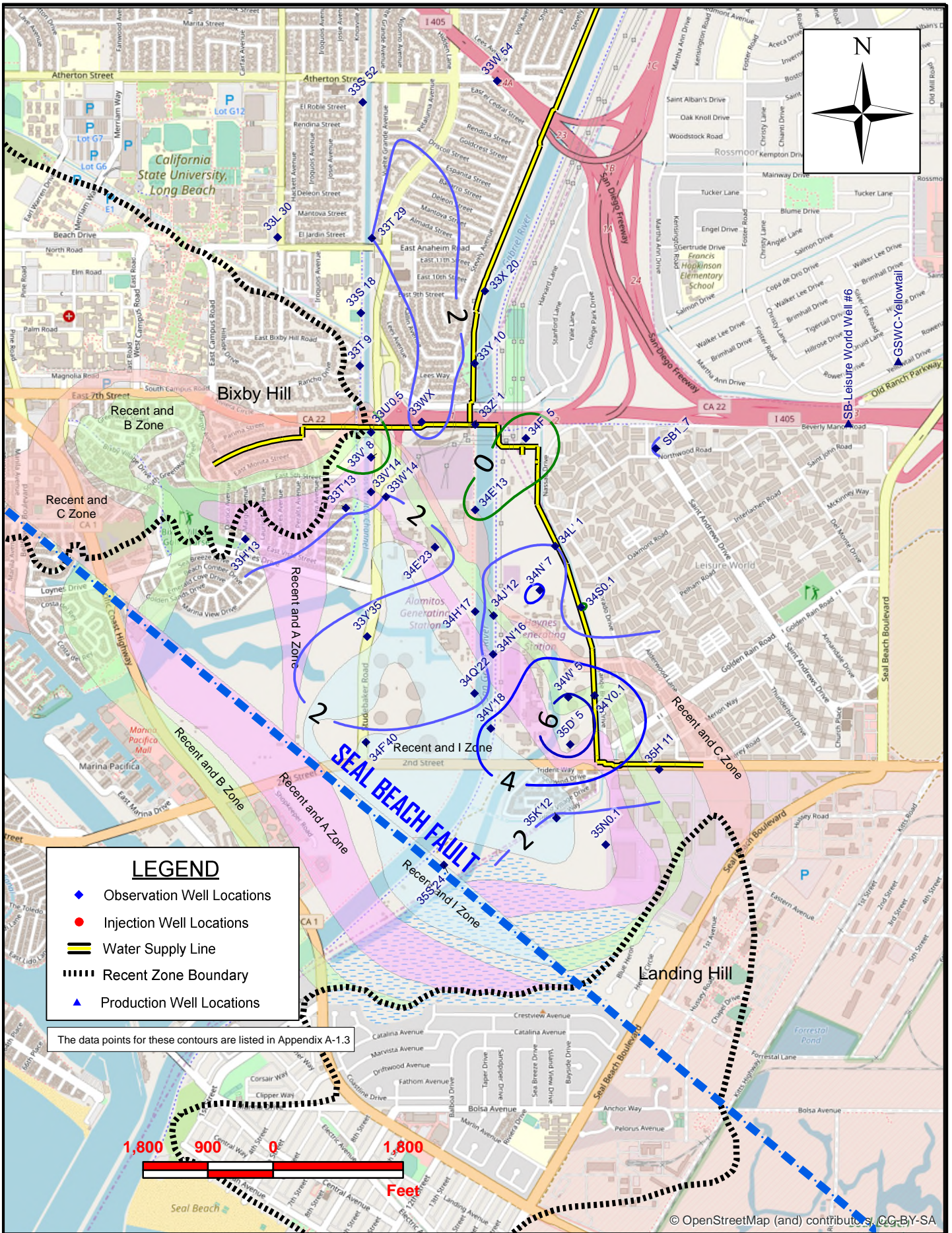


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Alamitos Barrier Project  
R Zone Groundwater Elevation (ft) Contours, Spring 2023





**LEGEND**

- ◆ Observation Well Locations
- Injection Well Locations
- Water Supply Line
- - - - Recent Zone Boundary
- ▲ Production Well Locations

The data points for these contours are listed in Appendix A-1.3



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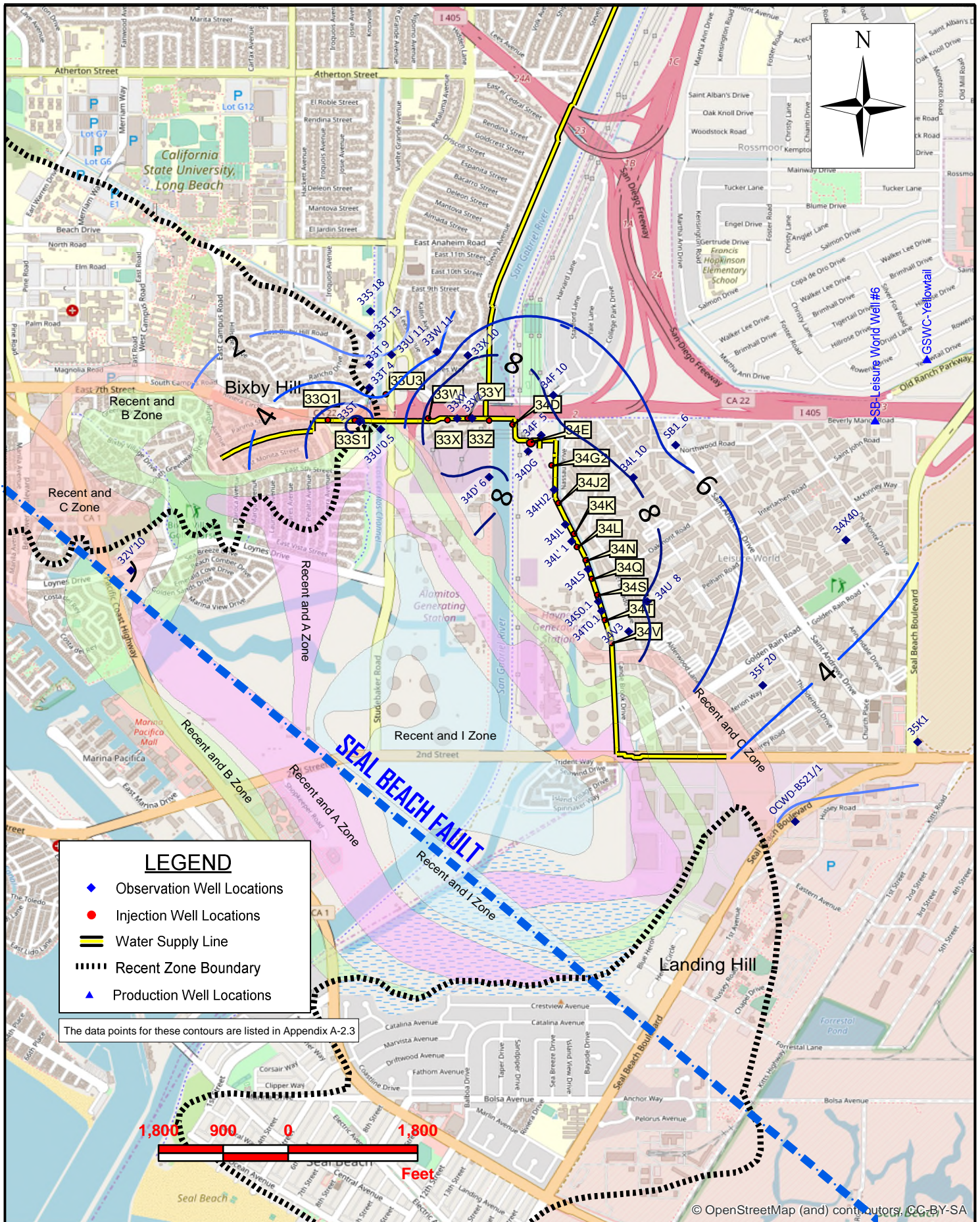
**Alamitos Barrier Project**  
**R Zone Change in Elevation (ft), Spring 2022 to Spring 2023**

**ALAMITOS BARRIER PROJECT**  
**R-Zone**  
**Groundwater Elevation Data for Contours and Tables**

POINT	PROJ	FCD	AQUIFER	DATE	FY 22-23 ELEV	P.E. <sup>1</sup>	Δ <sup>2</sup>	FY 21-22 ELEV2	CHANGE IN ELEV
1	33H'13	493YY	RA	20230228	3.6			1.7	1.9
2	33L 30	491G	R	20230301	1.9			0.3	1.6
3	33S 18	492AH	R	20230309	3.6			1.8	1.8
4	33S 52	491J	R	20230309	1.0			-1.0	2.0
5	33T 9	492CV	R	20230306	2.0			0.8	1.2
6	33T 29	491D	R	20230309	2.5			0.5	2.0
7	33T'13	492AU	R	20230228	4.5			2.6	1.9
8	33U'0.5	492CB	R	20230306	0.5			1.7	-1.2
9	33V' 8	492BY	RA	20230302	2.3			3.4	-1.1
10	33V'14	492HH	R	20230307	1.4			0.2	1.2
11	33W 54	501C	R	20230302	2.5			0.6	1.9
12	33W'14	492AT	R	20230328	8.5			6.4	2.1
13	33WX	502AZ	R	20230316	4.3			1.4	2.9
14	33X 20	502L	R	20230315	3.0			1.1	1.9
15	33Y 10	502BA	R	20230302	2.9			1.0	1.9
16	33Y'35	493AB	R	20230228	1.6			-0.2	1.8
17	33Z' 1	502AU	R	20230306	3.0			2.1	0.9
18	34E'13	503AU	R	20230306	6.2			6.8	-0.6
19	34E'23	503X	R	20230328	3.9			1.1	2.8
20	34F 5	502BT	R	20230320	7.1			7.9	-0.8
21	34F'40	483J	R	20230302	2.5			0.4	2.1
22	34H'17	503Y	R	20230302	5.1			4.5	0.6
23	34J'12	503U	R	20230404	5.6			2.1	3.5
24	34L' 1	503P	R	20230306	4.7			2.7	2.0
25	34N' 7	503AE	R	20230313	5.5			1.1	4.4
26	34N'16	503W	R	20230307	4.1			1.5	2.6
27	34Q'22	503T	R	20230302	3.5			2.8	0.7
28	34S0.1	503BT	R	20230628	3.0			3.2	-0.2
29	34V'18	503V	R	20230404	4.3			-0.5	4.8
30	34W' 5	503AH	R	20230228	6.4			0.2	6.2
31	34Y0.1	503CK	R	20230628	7.2			1.6	5.6
32	35D' 5	503AL	R	20230228	6.7			-0.2	6.9
33	35H 11	514F	R	20230313	4.0			1.1	2.9
34	35K'12	504R	R	20230313	1.2			-0.5	1.7
35	35N0.1	504M	R	20230301	-0.9			-1.1	0.2
36	35S'24	504K	R	20230307	3.9			1.3	2.6
37	SB1_7		R	20230310	6.1			4.0	2.1
AVG=					3.8			AVG=	1.7

<sup>1</sup> P.E. represents the protective elevations calculated for internodal wells.  
<sup>2</sup> Δ (+/-) represents how much groundwater level is above/below respective P.E.  
 = A max. or min. elevation during that period.



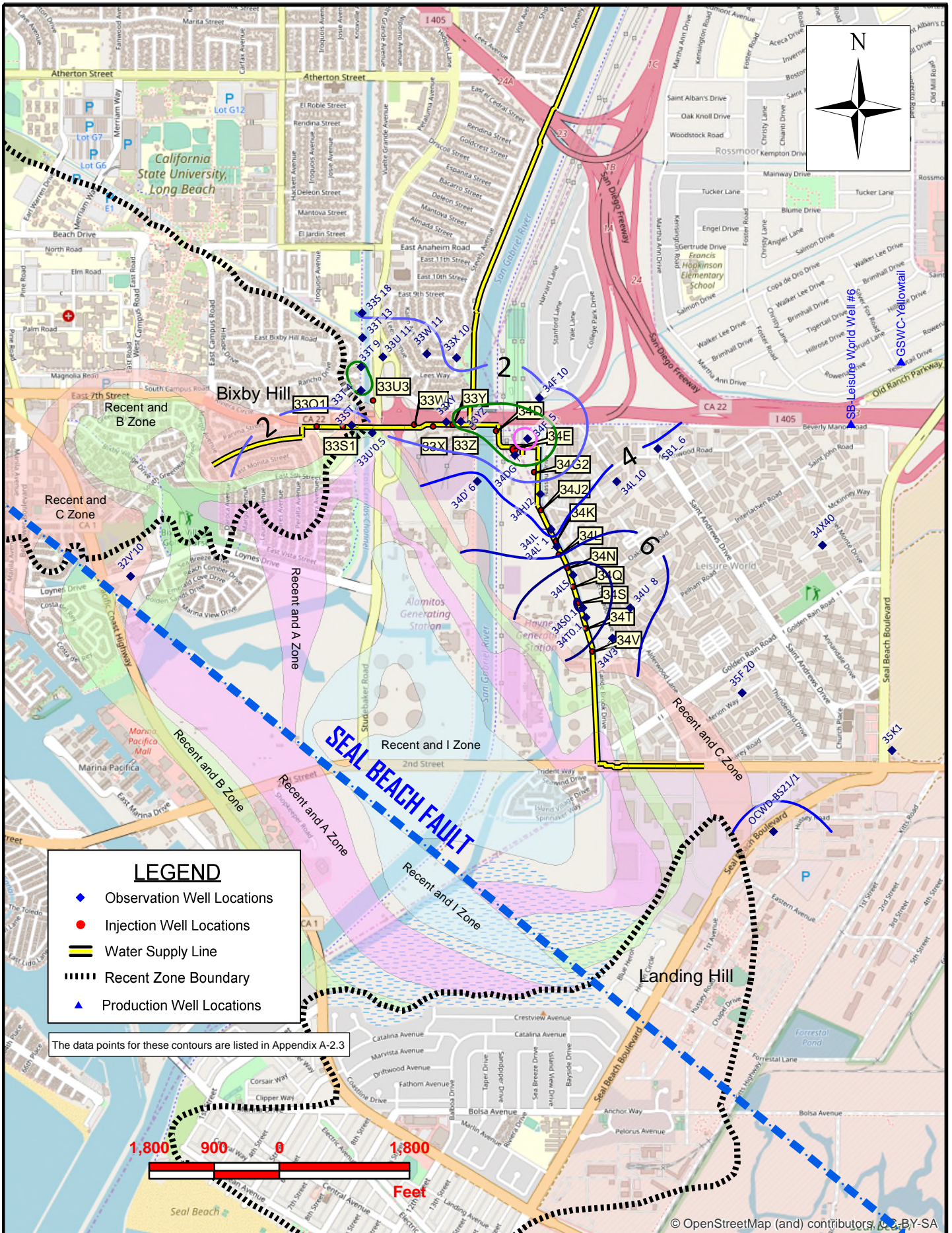


Alamitos Barrier Project  
C Zone Groundwater Elevation (ft) Contours, Spring 2023



C Zone GWIST





**LEGEND**

- ◆ Observation Well Locations
- Injection Well Locations
- ▬ Water Supply Line
- ⋯ Recent Zone Boundary
- ▲ Production Well Locations

The data points for these contours are listed in Appendix A-2.3



**Alamitos Barrier Project**  
**C Zone Change in Elevation (ft), Spring 2022 to Spring 2023**

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**ALAMITOS BARRIER PROJECT**  
**C-Zone**  
**Groundwater Elevation Data for Contours and Tables**

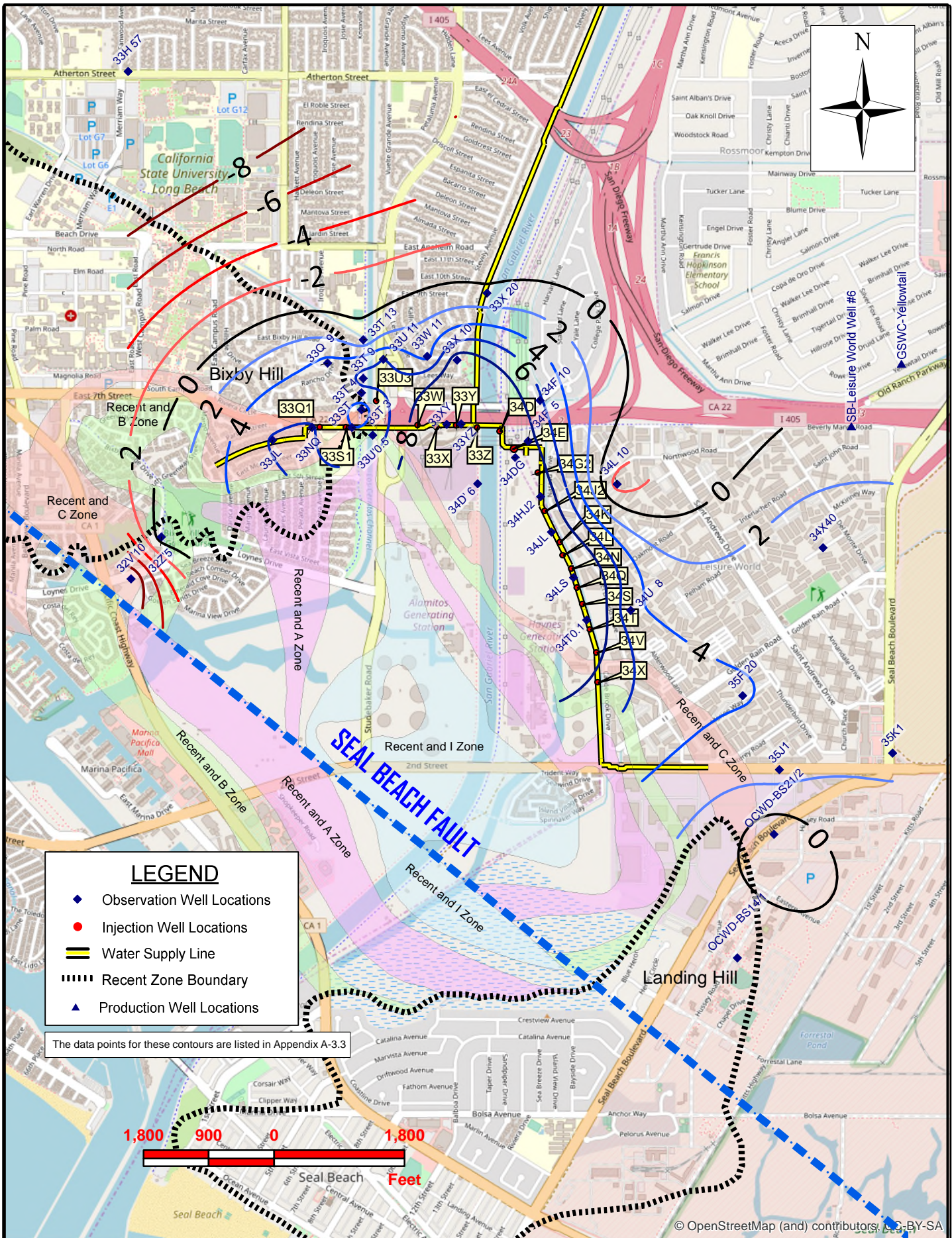
POINT	PROJ	FCD	AQUIFER	DATE	FY 22-23 ELEV	P.E. <sup>1</sup>	$\Delta^2$	FY 21-22 ELEV	CHANGE IN ELEV
1	32V'10	483H	C	20230227	-0.1			-0.4	0.3
2	33S 18	492AG	C	20230309	1.6			-0.6	2.2
3	33ST	492BK	CB	20230315	9.1	0.9	8.2	5.5	3.7
4	33T 13	492AC	C	20230316	0.0			-1.0	1.0
5	33T 4	492CT	C	20230314	2.7			3.1	-0.4
6	33T 9	492CU	C	20230315	2.9			3.2	-0.3
7	33U 11	492AL	C	20230403	2.2			0.5	1.7
8	33U'0.5	492CA	C	20230207	3.9			1.8	2.1
9	33W 11	502R	C	20230316	3.7			2.8	0.9
10	33X 10	502BB	C	20230307	7.6			4.7	2.9
11	33XY	502BL	C	20230306	13.1	5.4	7.7	12.7	0.4
12	33YZ	502AB	C	20230306	13.7	5.4	8.3	14.2	-0.5
13	34D' 6	502BF	C	20230306	6.8			1.6	5.2
14	34DG	502X	C	20230306	9.5	5.4	4.1	10.8	-1.2
15	34F 5	502BU	C	20230406	8.5			11.6	-3.1
16	34F 10	502AP	C	20230323	7.6			5.9	1.7
17	34HJ2	502CH	C	20230306	9.8	4.1	5.7	6.5	3.3
18	34JL	503AR	C	20230329	9.9	4.2	5.7	6.2	3.7
19	34L' 1	503N	C	20230329	10.8	4.8	6.0	6.4	4.4
20	34L 10	502AK	C	20230308	7.9			3.0	4.9
21	34LS	503BF	C	20230306	11.5	4.5	7.0	1.5	10.0
22	34S0.1	503BU	C	20230306	10.8	3.7	7.1	0.8	10.0
23	34T0.1	503AB	C	20230306	10.7	3.6	7.1	0.9	9.8
24	34U 8	513D	C	20230308	7.7			1.2	6.5
25	34V3	503CB	C	20230308	9.1			2.5	6.6
26	34X40	513R	C	20230323	4.9			0.1	4.8
27	35F 20	513L	C	20230313	4.7			-0.4	5.1
28	35K1	523D	C	20230330	2.4			-2.5	4.9
29	SB1_6		C	20230309	5.5			1.4	4.1
30	OCWD-BS21/1		C	20230302	1.6			-2.0	3.6
AVG=					6.7	AVG=		3.4	

<sup>1</sup> P.E. represents the protective elevations calculated for internodal wells.

<sup>2</sup>  $\Delta$  (+/-) represents how much groundwater level is above/below respective P.E.

= A max. or min. elevation during that period.





Alamitos Barrier Project  
 B Zone Groundwater Elevation (ft) Contours, Spring 2023







**ALAMITOS BARRIER PROJECT**  
**B-Zone**  
**Groundwater Elevation Data for Contours and Tables**

POINT	PROJ	FCD	AQUIFER	DATE	FY 22-23 ELEV	P.E. <sup>1</sup>	Δ <sup>2</sup>	FY 21-22 ELEV	CHANGE IN ELEV
1	32V'10	483G	B	20230227	-9.9			-11.6	1.7
2	32Z'5	482W	BA	20230301	0.9			-0.5	1.4
3	33H 57	481	B	20230307	-14.4			-17.9	3.5
4	33JL	492BQ	B	20230523	6.2	0.8	5.4	3.3	2.9
5	33NQ	492BN	B	20230523	6.1	0.7	5.4	4.4	1.7
6	33Q 9	492CM	B	20230508	4.6			2.9	1.7
7	33ST	492BK	CB	20230510	4.0	0.9	3.1	3.5	0.5
8	33T 13	492AB	B	20230316	3.2			2.2	1.0
9	33T 3	492CL	B	20230508	5.1			4.2	0.9
10	33T 4	492CS	B	20230508	6.8			7.3	-0.5
11	33T 9	492YY	B	20230315	0.7			-0.2	0.9
12	33U 11	492AK	B	20230403	6.1			6.7	-0.6
13	33U'0.5	492BZ	B	20230405	4.8			3.9	0.9
14	33W 11	502S	B	20230316	3.5			3.4	0.1
15	33X 10	502BC	B	20230406	9.3			7.2	2.1
16	33X 20	502K	B	20230405	0.5			-3.2	3.7
17	33XY	502BM	B	20230207	11.8	6.3	5.5	9.8	2.1
18	33YZ	502AC	B	20230306	14.4	7.1	7.3	10.9	3.5
19	34D' 6	502BG	B	20230405	10.6			10.6	0.0
20	34DG	502Y	B	20230523	11.3	6.6	4.7	13.3	-2.1
21	34F 5	502BS	B	20230427	8.8			11.6	-2.8
22	34F 10	502AQ	B	20230323	6.2			5.2	1.0
23	34HJ2	502CJ	B	20230329	9.8	5.9	3.9	8.2	1.6
24	34JL	503AQ	B	20230207	9.9	5.3	4.6	9.9	0.0
25	34L 10	502AL	B	20230501	-2.8			3.7	-6.5
26	34LS	503BE	B	20230425	12.4	5.4	7.0	2.5	9.8
27	34T0.1	503AC	B	20230329	10.7	6.1	4.6	5.2	5.5
28	34U 8	513E	B	20230323	4.5			-0.3	4.8
29	34X40	513Q	B	20230323	3.9			-0.7	4.6
30	35F 20	513K	B	20230406	4.1			-1.0	5.1
31	35J1	514M	B	20230306	2.9	5.8	-2.9	-2.4	5.3
32	35K1	523A	B	20230330	2.6			-3.2	5.8
33	OCWD-BS14/1		B	20230421	1.2			-3.1	4.3
34	OCWD-BS21/2		B	20230504	-1.4			-2.7	1.3

AVG= 4.7

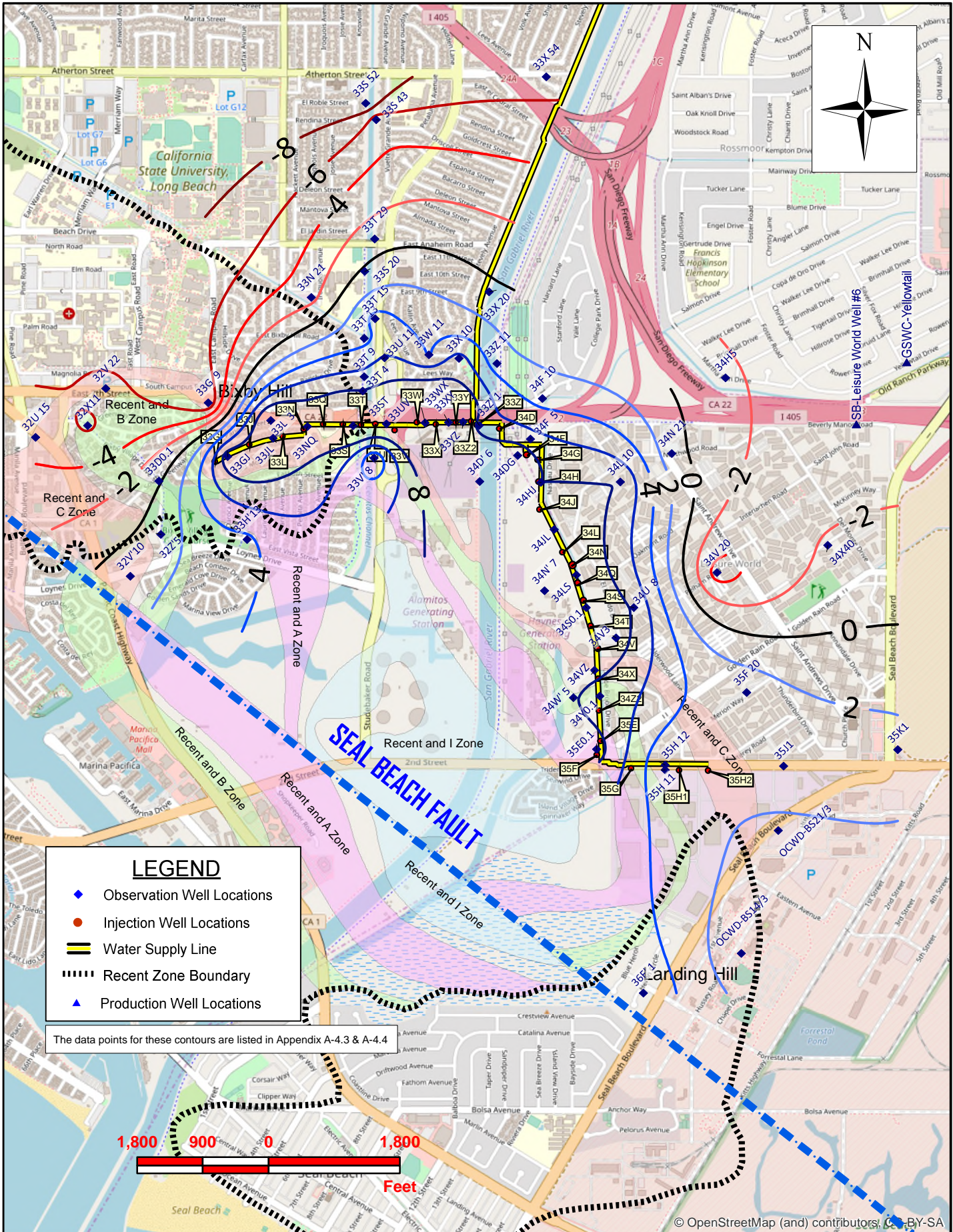
AVG= 2.9

<sup>1</sup> P.E. represents the protective elevations calculated for internodal wells.

<sup>2</sup> Δ (+/-) represents how much groundwater level is above/below respective P.E.

= A max. or min. elevation during that period.

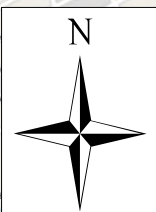
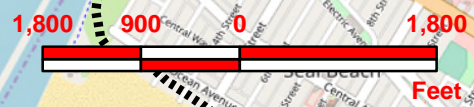




**LEGEND**

- ◆ Observation Well Locations
- Injection Well Locations
- Water Supply Line
- ▬ Recent Zone Boundary
- ▲ Production Well Locations

The data points for these contours are listed in Appendix A-4.3 & A-4.4

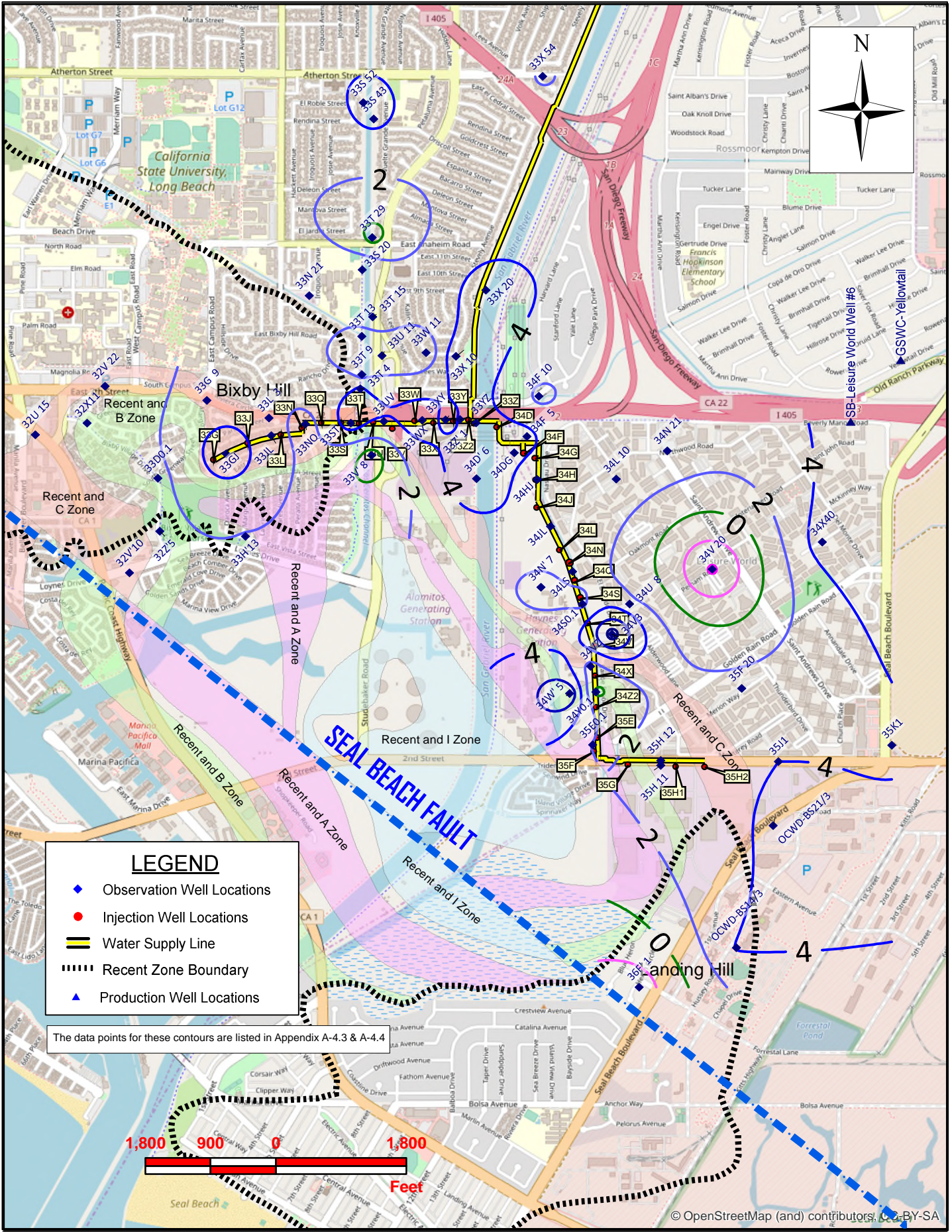


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Alamitos Barrier Project  
A Zone Groundwater Elevation (ft) Contours, Spring 2023





**LEGEND**

- ◆ Observation Well Locations
- Injection Well Locations
- Water Supply Line
- Recent Zone Boundary
- ▲ Production Well Locations

The data points for these contours are listed in Appendix A-4.3 & A-4.4



A zone GW.SJT

**ALAMITOS BARRIER PROJECT**  
**A-Zone**  
Groundwater Elevation Data for Contours and Tables (Page 1 of 2)

POINT	PROJ	FCD	AQUIFER	DATE	FY 22-23 ELEV	P.E. <sup>1</sup>	Δ <sup>2</sup>	FY 21-22 ELEV	CHANGE IN ELEV
1	32U 15	482M	A	20230227	-4.5			-5.0	0.5
2	32V 22	482P	A	20230228	-5.2			-5.5	0.3
3	32V'10	483F	A	20230227	1.2			-0.2	1.4
4	32X11	482S	A	20230309	-6.3			-6.8	0.5
5	32Z'5	482W	AB	20230301	0.9			-0.5	1.4
6	33D0.1	482U	AI	20230306	-0.2			-1.6	1.4
7	33G 9	482F	A	20230301	-7.8			-10.7	2.9
8	33GJ	482X	A	20230329	9.2	1.4	7.8	3.8	5.4
9	33H'13	493YY	R,A	20230228	3.6			1.7	1.9
10	33JL	492BW	AI	20230321	9.2	3.1	6.1	6.4	2.8
11	33L 3	492	A	20230302	11.3			8.6	2.7
12	33N 21	492BU	A	20230313	-2.6			-6.0	3.4
13	33NQ	492BP	AI	20230315	8.8	3.6	5.2	7.5	1.3
14	33S 20	492BR	A	20230309	0.3			-3.7	4.0
15	33S 43	491E	A	20230309	-5.0			-9.4	4.4
16	33S 52	491H	A	20230309	-9.8			-14.0	4.2
17	33ST	492BL	A	20230329	11.8	2.8	9.0	6.7	5.1
18	33T 13	492ZZ	A	20230316	3.3			2.6	0.7
19	33T 15	492SS	A	20230309	4.7			0.8	3.9
20	33T 29	491C	A	20230309	-0.8			-0.1	-0.7
21	33T 4	492CR	A	20230315	8.1			3.7	4.4
22	33T 9	492TT	A	20230315	6.6			5.3	1.3
23	33U 11	492AJ	A	20230403	6.2			5.3	0.9
24	33UV	492BH	A	20230329	10.3	4.0	6.3	6.5	3.8
25	33V' 8	492BY	RA	20230302	2.3			3.4	-1.1
26	33W 11	502T	A	20230316	3.9			3.7	0.3
27	33WX	502AF	A	20230306	13.0	7.6	5.4	7.5	5.5
28	33X 10	502BD	A	20230307	6.7			1.2	5.5
29	33X 20	502J	A	20230306	0.5			-4.3	4.8
30	33X 54	501	AI	20230307	-6.7			-8.6	1.9
31	33XY	502BN	A	20230329	11.8	8.0	3.8	8.5	3.4
32	33YZ	502AD	A	20230329	13.3	8.7	4.6	9.1	4.1
33	33Z' 1	502G	A	20230321	6.7			2.4	4.3
34	33Z 11	502V	A	20230404	3.0				n/a
35	34D' 6	502BH	A	20230306	11.0			5.6	5.4
36	34DG	502Z	A	20230306	9.5	8.5	1.0	4.9	4.5
37	34F 5	502BR	A	20230307	6.8			2.2	4.6
38	34F 10	502AR	A	20230323	3.3			1.8	1.5
39	34H5	512E	A	20230403	-1.6				n/a
40	34HJ	502BX	A	20230320	8.0	8.6	-0.6	5.5	2.5
41	34JL	503AP	A	20230329	9.9	7.8	2.1	5.9	4.0

<sup>1</sup> P.E. represents the protective elevations calculated for internodal wells.

<sup>2</sup> Δ (+/-) represents how much groundwater level is above/below respective P.E.

= A max. or min. elevation during that period.



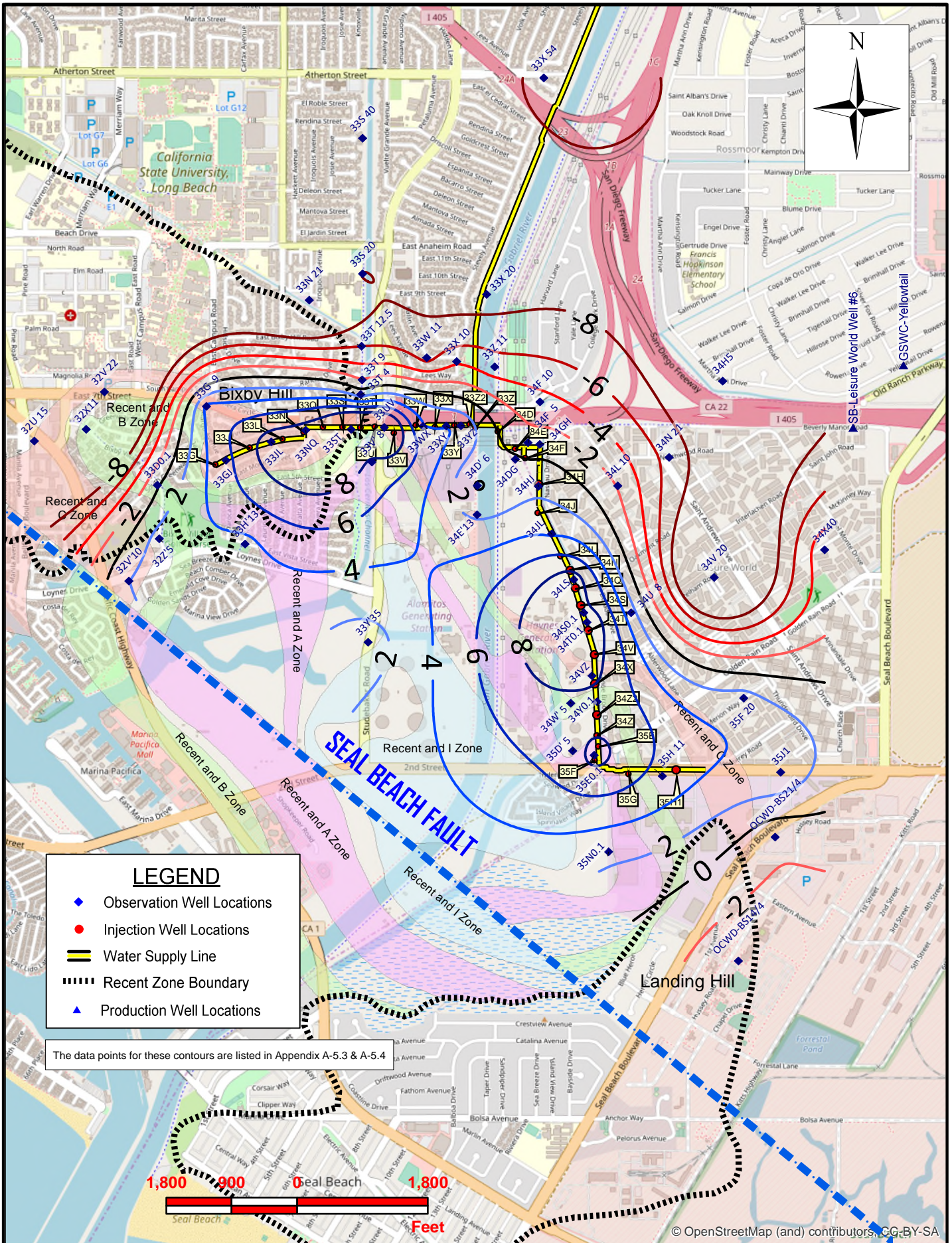
ALAMITOS BARRIER PROJECT  
A-Zone  
Groundwater Elevation Data for Contours and Tables (Page 2 of 2)

POINT	PROJ	FCD	AQUIFER	DATE	FY 22-23 ELEV	P.E. <sup>1</sup>	Δ <sup>2</sup>	FY 21-22 ELEV2	CHANGE IN ELEV
41	34L 10	502AM	A	20230308	7.9			4.6	3.3
42	34LS	503BD	A	20230329	9.1	7.7	1.4	6.4	2.7
43	34N 21	512B	A	20230314	0.8			-2.6	3.4
44	34N' 7	503AF	A	20230314	9.1			8.0	1.1
45	34S0.1	503BV	A	20230306	9.6	6.7	2.9	8.0	1.6
46	34U 8	513F	A	20230308	7.7			5.2	2.5
47	34V 20	513B	A	20230501	-4.9			-0.5	-4.4
48	34V3	503CD	A	20230308	9.1			-0.1	9.2
49	34W' 5	503AJ	A	20230228	8.1			0.3	7.8
50	34X40	513P	A	20230323	-1.7			-6.7	5.0
51	34VZ	503BH	A	20230306	8.5	4.4	4.1	7.4	1.2
52	34Y0.1	503CL	A	20230306	7.2	2.8	4.4	7.7	-0.5
53	35E0.1	503BK	A	20230306	8.8	2.4	6.4	6.9	1.9
54	35F 20	513J	A	20230308	3.3			0.6	2.7
55	35H 11	514G	A	20230306	2.5	3.8	-1.3	-0.2	2.7
56	35H 12	514D	A	20230329	2.2	3.8	-1.6	-1.2	3.4
57	35J1	514L	A	20230329	2.9	6.2	-3.3	-1.1	4.0
58	35K1	523B	A	20230330	2.7			-1.1	3.8
59	36F' 1	505D	A	20230403	5.5			8.6	-3.1
60	OCWD-BS14/3		A	20230302	0.5			-3.6	4.1
61	OCWD-BS21/3		A	20230302	1.6		1.6	-2.6	4.3
AVG=					4.1			AVG=	1.5

<sup>1</sup> P.E. represents the protective elevations calculated for internodal wells.

<sup>2</sup> Δ (+/-) represents how much groundwater level is above/below respective P.E.

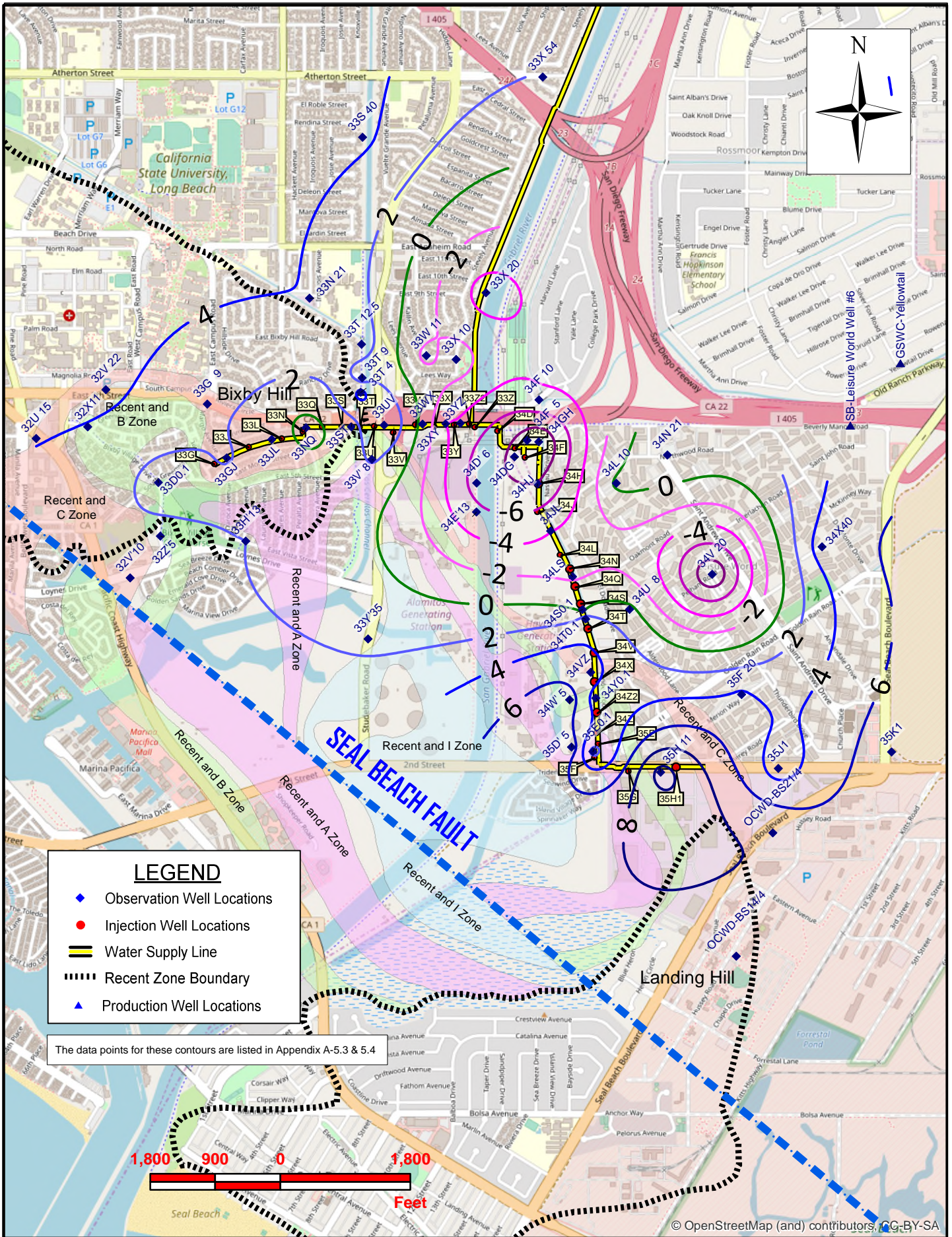
= A max. or min. elevation during that period.



Alamitos Barrier Project  
I Zone Groundwater Elevation (ft) Contours, Spring 2023



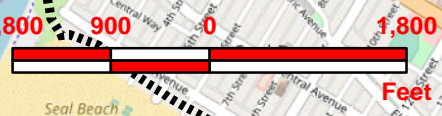




**LEGEND**

- ◆ Observation Well Locations
- Injection Well Locations
- Water Supply Line
- - - - Recent Zone Boundary
- ▲ Production Well Locations

The data points for these contours are listed in Appendix A-5.3 & 5.4



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**Alamitos Barrier Project**  
 I Zone Change in Elevation (ft), Spring 2022 to Spring 2023



ALAMITOS BARRIER PROJECT  
I-Zone  
Groundwater Elevation Data for Contours and Tables (Page 1 of 2)

POINT	PROJ	FCD	AQUIFER	DATE	FY 22-23 ELEV	P.E. <sup>1</sup>	$\Delta^2$	FY 21-22 ELEV	CHANGE IN ELEV
1	32U 15	482L	I	20230227	-16.6			-20.7	4.1
2	32V 22	482N	I	20230228	-19.8			-24.4	4.6
3	32V'10	483E	I	20230227	2.0			0.0	2.0
4	32X11	482R	I	20230309	-18.9			-22.8	3.9
5	32Z'5	482V	I	20230301	2.8			0.4	2.4
6	33D0.1	482U	AI	20230306	-0.2			-1.6	1.4
7	33G 9	482G	I	20230301	4.4			2.2	2.2
8	33GJ	482Y	I	20230329	5.4	2.6	2.8	3.3	2.1
9	33H'13	493XX	I	20230228	3.4			1.4	2.0
10	33JL	492BW	AI	20230329	9.0	3.1	5.9	7.4	1.6
11	33N 21	492BV	I	20230313	-15.4			-19.3	3.9
12	33NQ	492BP	AI	20230315	8.8	3.6	5.2	9.8	-1.0
13	33S 20	492BS	I	20230309	-7.8				N/A
14	33S 40	491F	I	20230313	-18.0			-22.4	4.4
15	33ST	492BM	I	20230306	13.2	4.2	9.0	12.2	1.0
16	33T 4	492CQ	I	20230315	1.2			-3.4	4.6
17	33T 9	492XX	I	20230315	-1.9			-2.9	1.0
18	33T 12.5	492BT	I	20230313	-6.0			-9.1	3.1
19	33UV	492BJ	I	20230306	12.3	6.1	6.2	8.4	4.0
20	33V' 8	492BX	I	20230302	7.2			5.0	2.2
21	33W 11	502U	I	20230316	-6.7			-4.1	-2.6
22	33WX	502AG	I	20230306	4.1	10.4	-6.3	4.6	-0.5
23	33X 10	502BE	I	20230307	-4.2			-3.5	-0.7
24	33X 20	502H	I	20230321	-8.9			-3.9	-5.0
25	33X 54	501	AI	20230307	-6.7			-8.6	1.9
26	33XY	502BP	I	20230306	4.0	11.0	-7.1	8.0	-4.0
27	33Y'35	493ZZ	I	20230228	1.0			-0.5	1.5
28	33YZ	502AE	I	20230306	3.7	11.1	-7.4	7.9	-4.2
29	33Z 11	502W	I	20230404	-5.1				N/A
30	34D' 6	502BI	I	20230307	-0.3			6.5	-6.8
31	34DG	502AA	I	20230306	0.4	11.1	-10.7	8.8	-8.4
32	34E'13	503AT	I	20230306	1.7			7.2	-5.5
33	34F 5	502BQ	I	20230307	-1.8			7.1	-8.9
34	34F 10	502AS	I	20230323	-3.2			1.3	-4.5
35	34GH	502BV	I	20230306	-0.6	11.3	-11.9	9.5	-10.1
36	34H5	512D	I	20230403	-11.7				N/A
37	34HJ	502BW	I	20230306	1.6	11.0	-9.4	9.6	-8.0

<sup>1</sup> P.E. represents the protective elevations calculated for internodal wells.

<sup>2</sup>  $\Delta$  (+/-) represents how much groundwater level is above/below respective P.E.

= A max. or min. elevation during that period.

ALAMITOS BARRIER PROJECT  
I-Zone  
Groundwater Elevation Data for Contours and Tables (Page 2 of 2)

POINT	PROJ	FCD	AQUIFER	DATE	FY 21-22 ELEV	P.E. <sup>1</sup>	Δ <sup>2</sup>	FY 20-21 ELEV	CHANGE IN ELEV
38	34JL	503AN	I	20230306	3.8	10.5	-8.9	7.9	-4.0
39	34L 10	502AN	I	20230308	-2.1			-2.5	0.4
40	34LS	503BC	I	20230306	9.1	9.5	-0.4	11.3	-2.2
41	34N 21	512C	I	20230314	-6.6			-8.4	1.8
42	34S0.1	503BW	I	20230306	8.5	8.1	0.4	9.0	-0.5
43	34T0.1	503AD	I	20230329	10.3	8.4	1.9	7.3	3.0
44	34U 8	513G	I	20230323	2.8			2.3	0.5
45	34V 20	513C	I	20230501	-16.3			-6.4	-9.9
46	34VZ	503BG	I	20230306	8.5	5.9	2.6	3.7	4.8
47	34W' 5	503AK	I	20230228	7.5			0.6	6.9
48	34X40	513N	I	20230323	-2.4			-7.5	5.1
49	34Y0.1	503CM	I	20230306	7.2	4.8	2.4	4.1	3.1
50	35D' 5	503AM	I	20230228	6.9			-0.3	7.2
51	35E0.1	503BJ	I	20230306	8.8	3.0	5.8	7.5	1.3
52	35F 20	513H	I	20230322	2.8			-1.5	4.3
53	35H 11	514H	I	20230316	5.3	5.5	-2.7	-5.5	10.8
54	35J1	513M	I	20230306	3.6	4.8	0.5	0.6	3.0
55	35K1	523C	I	20230330	-4.1			-11.5	7.4
56	35N0.1	504N	I	20230301	2.5				N/A
	OCWD-BS14/4		I	20230302	-3.4			-10.0	6.6
	OCWD-BS21/4		I	20230302	-1.6			-9.4	7.8

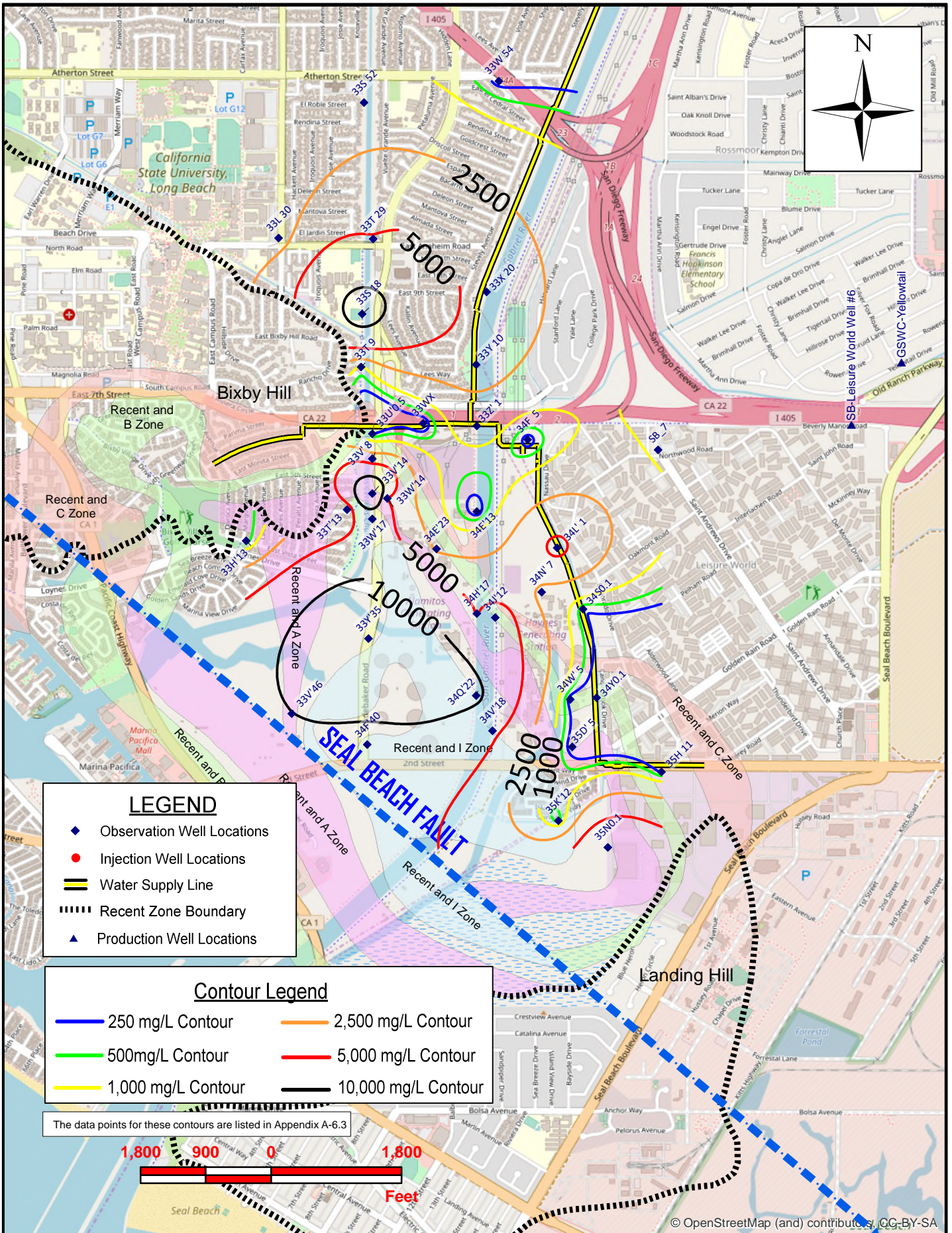
AVG= -0.3

AVG= -0.7

<sup>1</sup> P.E. represents the protective elevations calculated for intertidal wells.

<sup>2</sup> Δ (+/-) represents how much groundwater level is above/below respective P.E.

= A max. or min. elevation during that period.



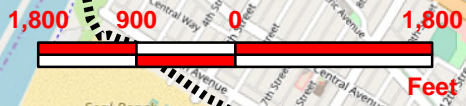
**LEGEND**

- ◆ Observation Well Locations
- Injection Well Locations
- Water Supply Line
- - - Recent Zone Boundary
- ▲ Production Well Locations

**Contour Legend**

- 250 mg/L Contour
- 500mg/L Contour
- 1,000 mg/L Contour
- 2,500 mg/L Contour
- 5,000 mg/L Contour
- 10,000 mg/L Contour

The data points for these contours are listed in Appendix A-6.3

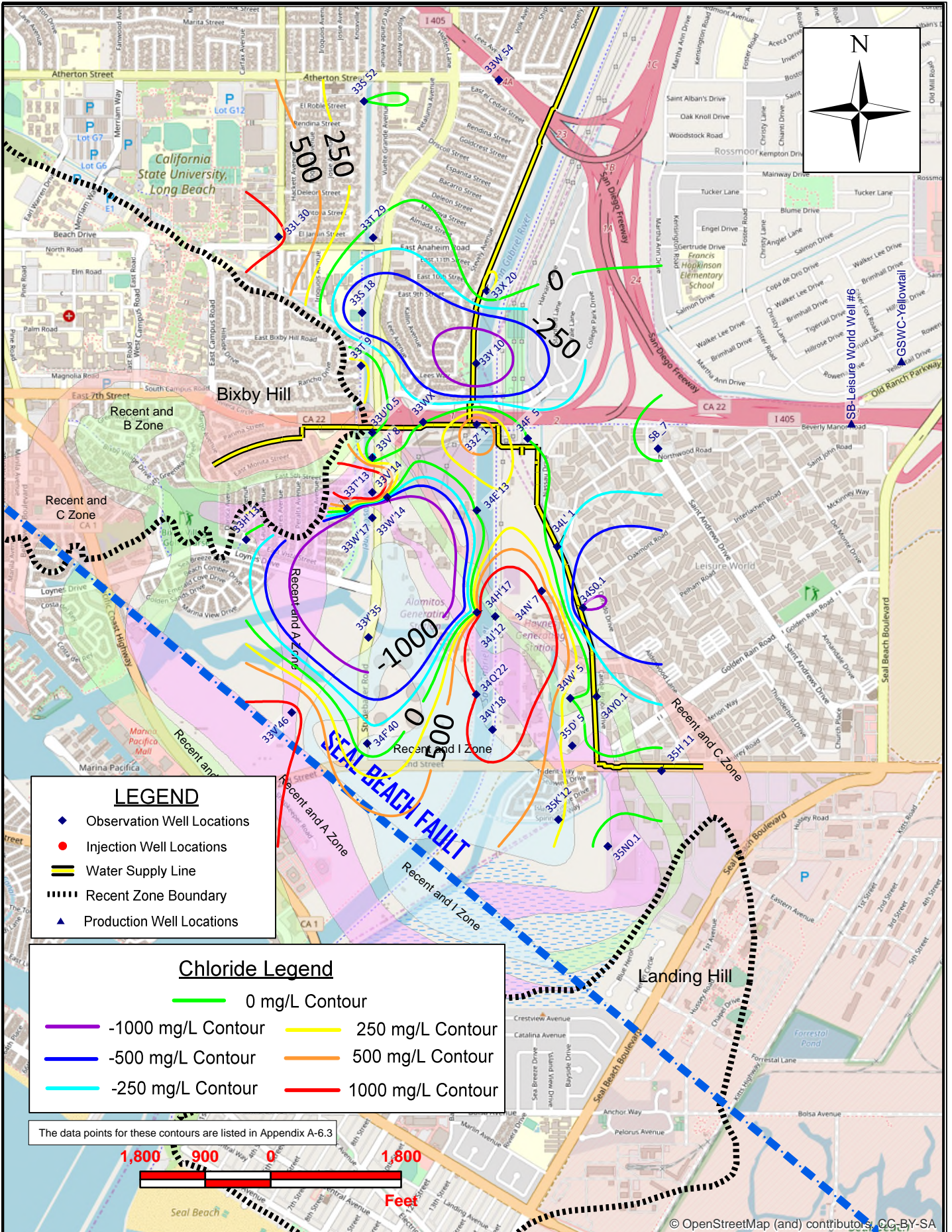


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Alamitos Barrier Project  
R Zone Chloride Concentration (mg/L) Contours, Spring 2023



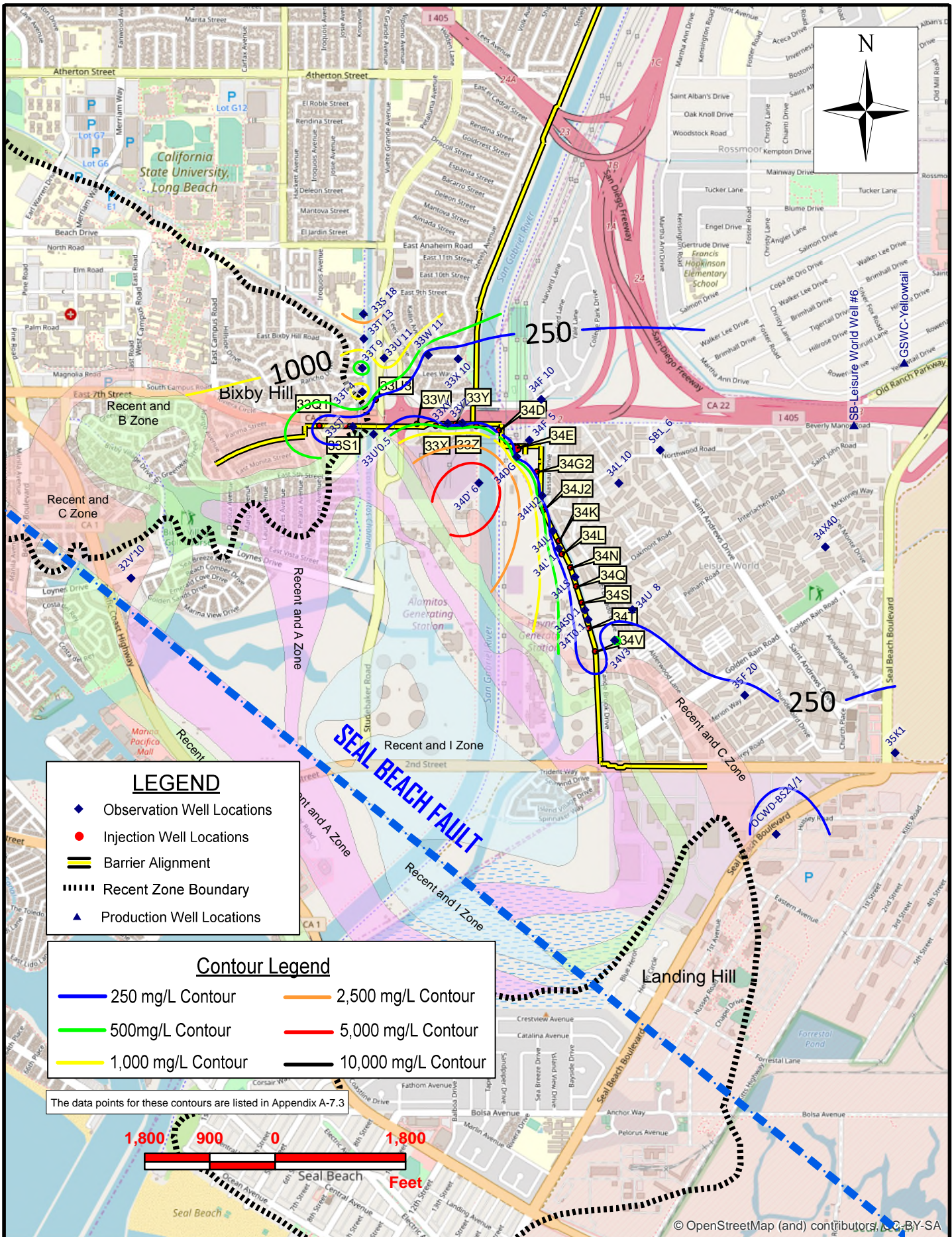


**ALAMITOS BARRIER PROJECT**  
**R-ZONE CHLORIDE CONCENTRATIONS**  
Chloride Data Used for Contours and Cross-Section

No.	PROJ	FCD	AQUIFER	DATE	Sampling Depths and Chloride Data					For Contours	MAX CHLORIDE FY21-22	Change in Chloride (FY22-23 - FY21-22)	
					ELEV 1 (ft)	CHL 1 (mg/L)	ELEV 2 (ft)	CHL 2 (mg/L)	ELEV 3 (ft)	CHL 3 (mg/L)			MAX CHL. 22-23
1	33H13	493YY	R,A	20230228	-18	260	-38	270	67	270	270	330	-60
2	33L 30	491G	R	20230301	-50	1,700					1,700	600	1,100
3	33S 18	492AH	R	20230309	-67	13,000					13,000	14,000	-1,000
4	33S 52	491J	R	20230309	-54	1,800					1,800	1,800	0
5	33T 9	492CV	R	20230314	-21	680					680	290	390
6	33T13	492AU	R	20230228	-41	2,700	-51	2,800			2,800	2,500	300
7	33T 29	491D	R	20230309	-56	5,200					5,200	5,300	-100
<b>8</b>	<b>33U0.5</b>	<b>492CB</b>	<b>R</b>	<b>20230314</b>	<b>-15</b>	<b>210</b>					<b>210</b>	<b>170</b>	<b>40</b>
9	33V 8	492BY	RA	20230302	-24	3,400	-48	3,100			3,400	3,700	-300
10	33V14	492JJ	R	20230302	-67	19,000					19,000	16,000	3,000
11	33V46	493UU	R	20230501	-61	9,930					9,930	8,700	1,230
12	33W14	492AT	R	20230328	-46	3,800	-66	5,000			5,000	5,400	-400
13	33W17	493PP	R	20230313	-41	7,400	-51	1,400			7,400	13,000	-5,600
14	33W 54	501C	R	20230302	-33	120	-53	140			140	120	20
<b>15</b>	<b>33WX</b>	<b>502AZ</b>	<b>R</b>	<b>20230316</b>	<b>-45</b>	<b>7</b>					<b>7</b>	<b>14</b>	<b>-7</b>
16	33X 20	502L	R	20230315	-68	3,900					3,900	3,600	300
17	33Y 10	502BA	R	20230302	-58	780	-83	3,700			3,700	5,800	-2,100
18	33Y35	493AB	R	20230228	-36	20,000					20,000	22,000	-2,000
<b>19</b>	<b>33Z' 1</b>	<b>502AU</b>	<b>R</b>	<b>20230321</b>	<b>-46</b>	<b>1,400</b>	<b>-56</b>	<b>1,800</b>			<b>1,800</b>	<b>940</b>	<b>860</b>
20	34E13	503AU	R	20230307	-19	62	-52	63			63	5	58
21	34F 5	502BT	R	20230320	-136	76	-146	65	-156	63	76	83	-7
22	34F40	483J	R	20230302	-40	7,200					7,200	7,400	-200
23	34H17	503Y	R	20230302	-46	4,900					4,900	4,900	0
24	34J12	503U	R	20230404	-28	6,600	-36	6,800			6,800	910	5,890
<b>25</b>	<b>34L' 1</b>	<b>503P</b>	<b>R</b>	<b>20230313</b>	<b>-57</b>	<b>5,900</b>					<b>5,900</b>	<b>6,100</b>	<b>-200</b>
26	34N' 7	503AE	R	20230313	-51	1,300	-61	1,400	80	2,000	2,000	1,300	700
27	34Q22	503T	R	20230302	-42	8,300	-57	11,000			11,000	10,000	1,000
<b>28</b>	<b>34S0.1</b>	<b>503BT</b>	<b>R</b>	<b>20230425</b>	<b>-59</b>	<b>220</b>	<b>-69</b>	<b>270</b>			<b>270</b>	<b>1,300</b>	<b>-1,030</b>
29	34V18	503V	R	20230404	-48	5,600					5,600	4,100	1,500
30	34W' 5	503AH	R	20230228	-51	72					72	68	4
<b>31</b>	<b>34Y0.1</b>	<b>503CK</b>	<b>R</b>	<b>20230427</b>	<b>-60</b>	<b>150</b>	<b>-70</b>	<b>150</b>			<b>150</b>	<b>150</b>	<b>0</b>
32	35D' 5	503AL	R	20230228	-57	68					68	8	60
<b>33</b>	<b>35H 11</b>	<b>514F</b>	<b>R</b>	<b>20230313</b>	<b>-42</b>	<b>120</b>	<b>-65</b>	<b>170</b>			<b>170</b>	<b>29</b>	<b>141</b>
34	35K12	504R	R	20230313	-44	290	-54	170			290	5	285
35	35N0.1	504M	R	20230301	-38	9,600	-62	9,500			9,600	9,700	-100
36	SB_7		R	20230412		860					860	770	90

Internodal Wells in **BOLD** and used for A-11 Barrier Cross Section

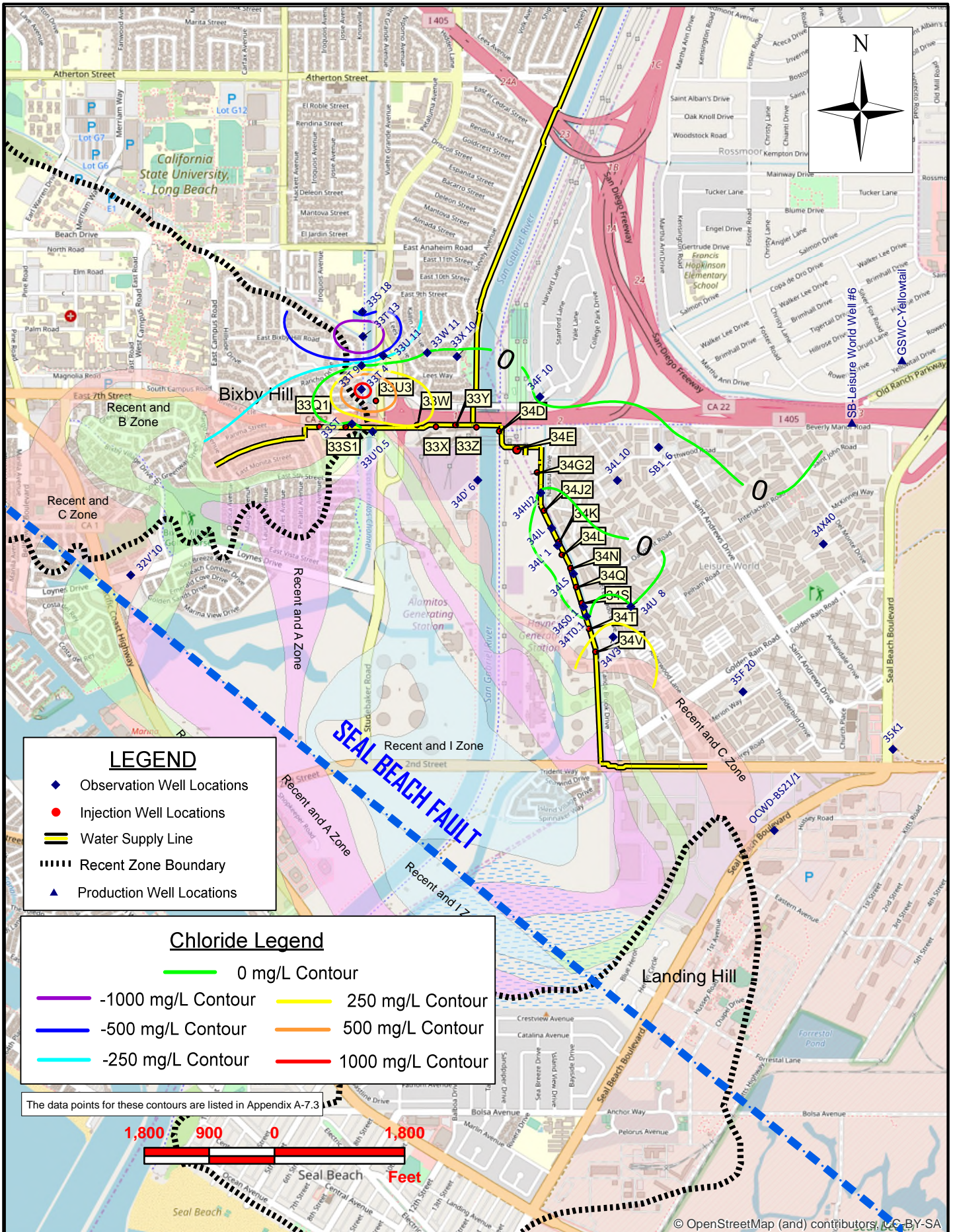




Alamitos Barrier Project  
C Zone Chloride Concentration (mg/L) Contours, Spring 2023







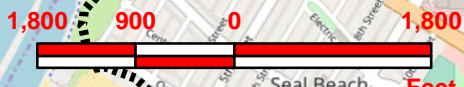
**LEGEND**

- ◆ Observation Well Locations
- Injection Well Locations
- Water Supply Line
- ▬▬▬ Recent Zone Boundary
- ▲ Production Well Locations

**Chloride Legend**

- 0 mg/L Contour
- -1000 mg/L Contour
- -500 mg/L Contour
- -250 mg/L Contour
- 250 mg/L Contour
- 500 mg/L Contour
- 1000 mg/L Contour

The data points for these contours are listed in Appendix A-7.3



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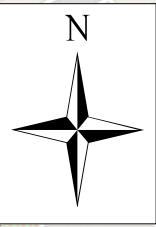
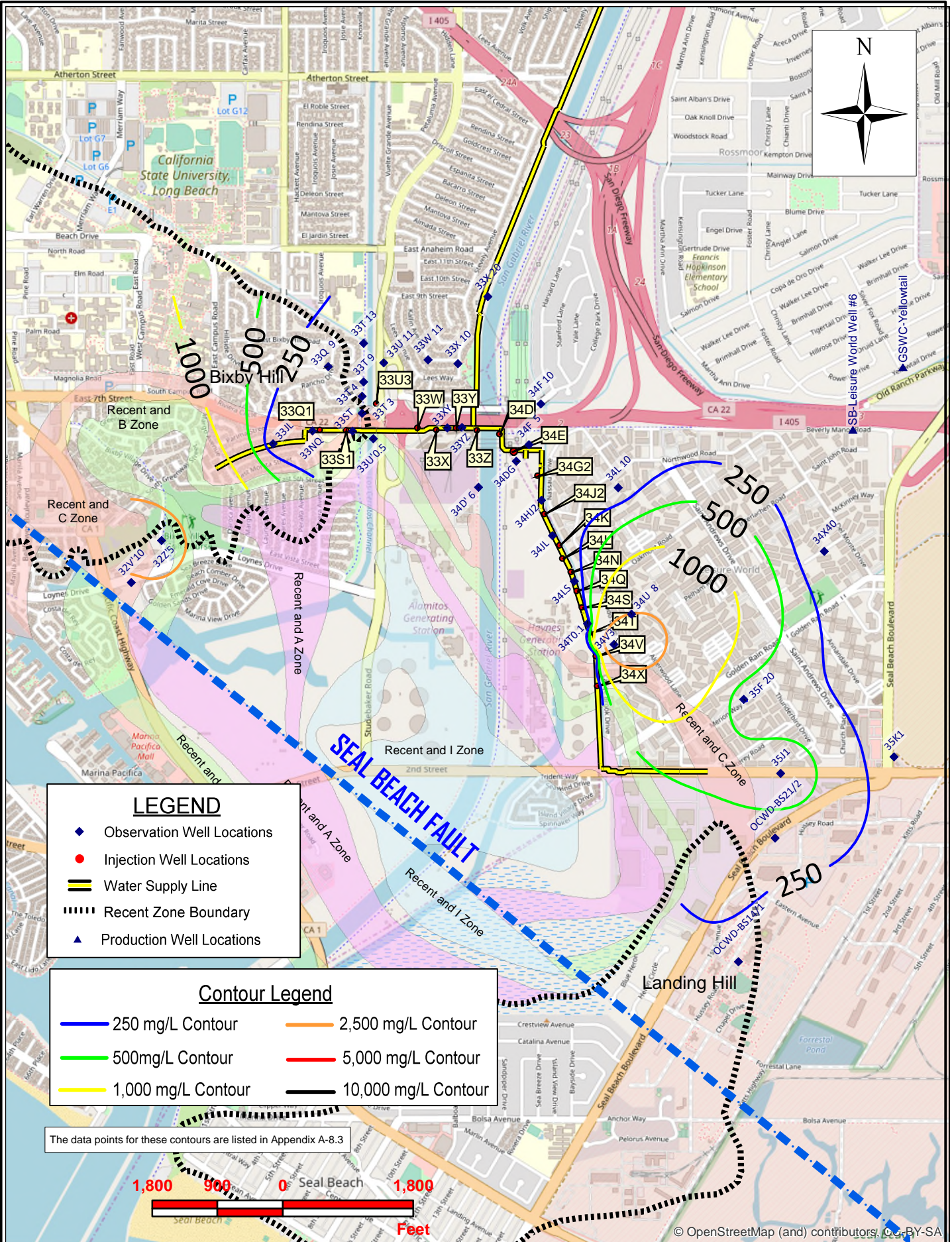
**ALAMITOS BARRIER PROJECT**  
**C-ZONE CHLORIDE CONCENTRATIONS**  
 Chloride Data Used for Contours and Cross-Section

No.	PROJ	FCD	AQUIFER	DATE	Sampling Depths and Chloride Data						For Contours	MAX CHLORIDE	Change in Chloride
					ELEV 1 (ft)	CHL 1 (mg/L)	ELEV 2 (ft)	CHL 2 (mg/L)	ELEV 3 (ft)	CHL 3 (mg/L)	MAX CHL. 22-23	FY21-22	(FY22-23 - FY21-22)
1	32V10	483H	C	20230227	-37	590					590	760	-170
2	33S 18	492AG	C	20230309	-225	3,100					3,100	3,300	-200
3	<b>33ST</b>	<b>492BK</b>	<b>CB</b>	<b>20230315</b>	<b>-25</b>	<b>21</b>					<b>21</b>	<b>86</b>	<b>-65</b>
4	33T 4	492CT	C	20230314	-56	1,500					1,500	180	1,320
5	33T 9	492CU	C	20230315	-129	85	-144	150			150	130	20
6	33T 13	492AC	C	20230316	-199	1,400					1,400	3,800	-2,400
7	<b>33U*0.5</b>	<b>492CA</b>	<b>C</b>	<b>20230314</b>	<b>-39</b>	<b>72</b>					<b>72</b>	<b>85</b>	<b>-13</b>
8	33U 11	492AL	C	20230403	-188	1,500					1,500	1,800	-300
9	33W 11	502R	C	20230316	-183	84	-216	87			87	74	13
10	33X 10	502BB	C	20230307	-190	81	-215	97			97	73	24
11	<b>33XY</b>	<b>502BL</b>	<b>C</b>	<b>20230501</b>	<b>-194</b>	<b>73</b>	<b>-210</b>	<b>72</b>			<b>73</b>		<b>n/a</b>
12	<b>33YZ</b>	<b>502AB</b>	<b>C</b>	<b>20230501</b>	<b>-195</b>	<b>73</b>	<b>-210</b>	<b>74</b>			<b>74</b>		<b>n/a</b>
13	34D 6	502BF	C	20230307	-125	8,600					8,600	8,400	200
14	<b>34DG</b>	<b>502X</b>	<b>C</b>	<b>20230320</b>	<b>-190</b>	<b>66</b>	<b>-205</b>	<b>66</b>			<b>66</b>		<b>n/a</b>
15	34F 5	502BU	C	20230427	-191	68	-201	69	-211	69	69		n/a
16	34F 10	502AP	C	20230323	-211	80					80	90	-10
17	<b>34HJ2</b>	<b>502CH</b>	<b>C</b>	<b>20230425</b>	<b>-148</b>	<b>68</b>	<b>-158</b>	<b>68</b>			<b>68</b>	<b>75</b>	<b>-7</b>
18	34JL	503AR	C	20230425	-160	70					70	110	-40
19	<b>34L* 1</b>	<b>503N</b>	<b>C</b>	<b>20230427</b>	<b>-162</b>	<b>65</b>					<b>65</b>	<b>76</b>	<b>-11</b>
20	34L 10	502AK	C	20230501	-166	96					96	10	86
21	<b>34LS</b>	<b>503BF</b>	<b>C</b>	<b>20230425</b>	<b>-133</b>	<b>74</b>	<b>-151</b>	<b>78</b>	<b>-163</b>	<b>72</b>	<b>78</b>	<b>80</b>	<b>-2</b>
22	<b>34S0.1</b>	<b>503BU</b>	<b>C</b>	<b>20230425</b>	<b>-129</b>	<b>73</b>	<b>-139</b>	<b>74</b>			<b>74</b>	<b>88</b>	<b>-14</b>
23	<b>34T0.1</b>	<b>503AB</b>	<b>C</b>	<b>20230427</b>	<b>-134</b>	<b>96</b>					<b>96</b>	<b>120</b>	<b>-24</b>
24	34U 8	513D	C	20230501	-150	88	-165	83			88	87	1
25	34V3	503CB	C	20230501	-168	560					560	79	481
26	34X40	513R	C	20230323	-85	55	-101	64			64	56	8
27	35F 20	513L	C	20230313	-70	270	-78	200	-85	180	270	260	10
28	<b>35K1</b>	<b>523D</b>	<b>C</b>	<b>20230330</b>	<b>-88</b>	<b>35</b>	<b>-98</b>	<b>330</b>			<b>330</b>	<b>160</b>	<b>170</b>
29	OCWD-BS21/1		C	20230403		219					219	209	10
30	SB1_6		C	20230412		98					98	90	8
31	33Q1						DP1				50	50	n/a
32	33U3						DP2				50	50	n/a
33	34D						DP3				50	50	n/a
34	34G2						DP4				50	50	n/a

DP = Dummy Point with an assumed chloride concentration of 50 mg/L placed at wells that were injecting into this zone during this reporting period.

Internodal Wells in **BOLD** and used for A-11 Barrier Cross Section





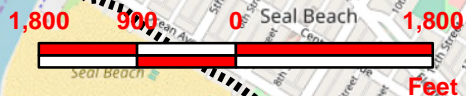
**LEGEND**

- ◆ Observation Well Locations
- Injection Well Locations
- Water Supply Line
- - - - Recent Zone Boundary
- ▲ Production Well Locations

**Contour Legend**

— 250 mg/L Contour	— 2,500 mg/L Contour
— 500mg/L Contour	— 5,000 mg/L Contour
— 1,000 mg/L Contour	— 10,000 mg/L Contour

The data points for these contours are listed in Appendix A-8.3



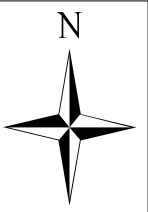
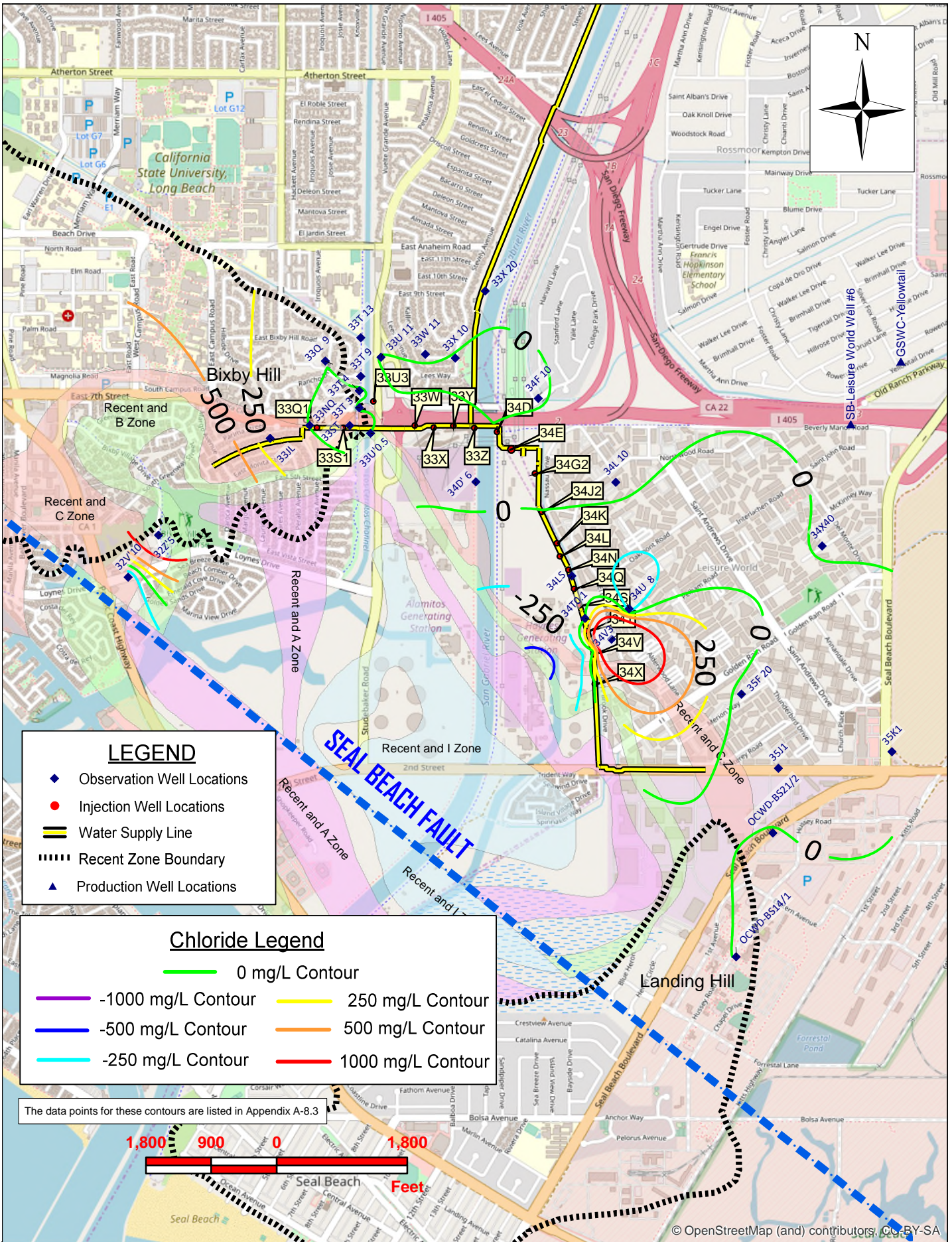
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**Alamitos Barrier Project**  
**B Zone Chloride Concentration (mg/L) Contours, Spring 2023**

B zone CL.srf





**LEGEND**

- ◆ Observation Well Locations
- Injection Well Locations
- Water Supply Line
- ▬▬▬ Recent Zone Boundary
- ▲ Production Well Locations

**Chloride Legend**

— 0 mg/L Contour	— 250 mg/L Contour
— -1000 mg/L Contour	— 500 mg/L Contour
— -500 mg/L Contour	— 1000 mg/L Contour
— -250 mg/L Contour	

The data points for these contours are listed in Appendix A-8.3



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Alamitos Barrier Project  
 B Zone Change in Chloride Concentration, Spring 2022 to Spring 2023

B zone CL.srf

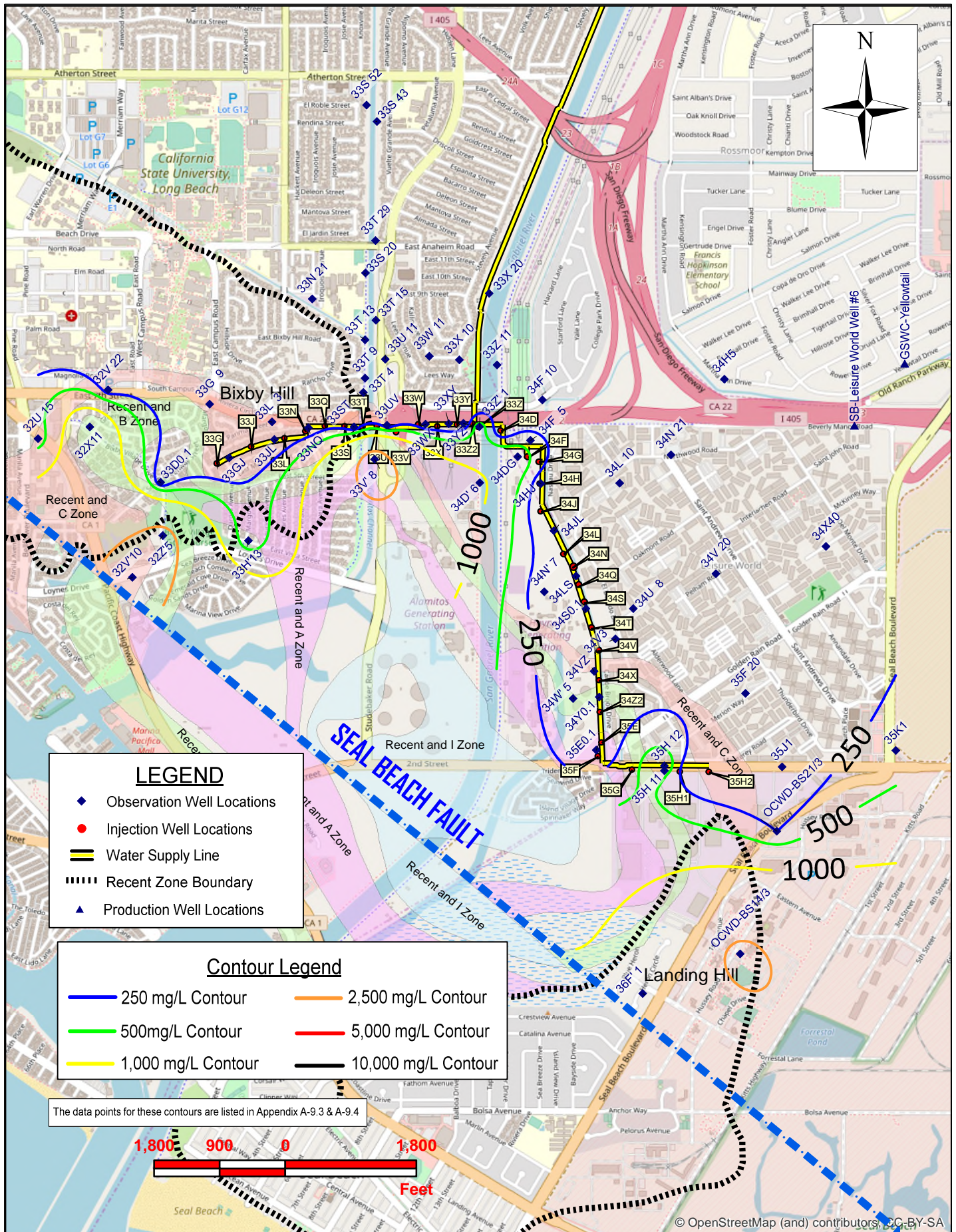
**ALAMITOS BARRIER PROJECT**  
**B-ZONE CHLORIDE CONCENTRATIONS**  
**Chloride Data Used for Contours and Cross-Section**

No.	PROJ	FCD	AQUIFER	DATE	Sampling Depths and Chloride Data						For Contours	MAX CHLORIDE FY21-22	Change in Chloride (FY22-23 - FY21-22)
					ELEV 1 (ft)	CHL 1 (mg/L)	ELEV 2 (ft)	CHL 2 (mg/L)	ELEV 3 (ft)	CHL 3 (mg/L)	MAX CHL. 22-23		
1	32V'10	483G	B	20230227	-72	2,400					2,400	2,900	-500
2	32Z'5	482W	BA	20230301	-20	680	-30	1,000	-40	3,000	3,000	1,100	1,900
<b>3</b>	<b>33JL</b>	<b>492BQ</b>	<b>B</b>	<b>20230321</b>	<b>3</b>	<b>71</b>	<b>-7</b>	<b>110</b>			<b>110</b>	<b>13</b>	<b>97</b>
4	33NQ	492BN	B	20230315	-3	76	-14	72			76	78	-2
5	33Q 9	492CM	B	20230301	-85	72	-95	74	-105	85	85	85	0
<b>6</b>	<b>33ST</b>	<b>492BK</b>	<b>CB</b>	<b>20230315</b>	<b>-25</b>	<b>21</b>					<b>21</b>	<b>86</b>	<b>-65</b>
7	33T 13	492AB	B	20230316	-254	140					140	52	88
8	33T 3	492CL	B	20230301	-40	85	-57	86	-75	84	86	79	7
9	33T 4	492CS	B	20230315	-91	65					65	73	-8
10	33T 9	492YY	B	20230315	-163	170					170	140	30
11	33U 11	492AK	B	20230403	-260	68					68	74	-6
12	33U'0.5	492BZ	B	20230314	-57	73					73	71	2
13	33W 11	502S	B	20230316	-241	93	-269	94			94	91	3
14	33X 10	502BC	B	20230307	-275	75					75	76	-1
15	33X 20	502K	B	20230321	-266	79					79	69	10
<b>16</b>	<b>33XY</b>	<b>502BM</b>	<b>B</b>	<b>20230501</b>	<b>-244</b>	<b>66</b>					<b>66</b>		<b>n/a</b>
<b>17</b>	<b>33YZ</b>	<b>502AC</b>	<b>B</b>	<b>20230501</b>	<b>-214</b>	<b>75</b>	<b>-263</b>	<b>71</b>			<b>75</b>		<b>n/a</b>
18	34D' 6	502BG	B	20230307	-180	73	-194	82			82	9	73
<b>19</b>	<b>34DG</b>	<b>502Y</b>	<b>B</b>	<b>20230320</b>	<b>-232</b>	<b>68</b>	<b>-257</b>	<b>76</b>			<b>76</b>		<b>n/a</b>
20	34F 5	502BS	B	20230427	-231	67	-260	72			72		n/a
21	34F 10	502AQ	B	20230323	-269	73					73	81	-8
22	34HJ2	502CJ	B	20230425	-203	71	-215	71	-228	69	71		n/a
<b>23</b>	<b>34JL</b>	<b>503AQ</b>	<b>B</b>	<b>20230425</b>	<b>-195</b>	<b>79</b>	<b>-211</b>	<b>80</b>			<b>80</b>		<b>n/a</b>
24	34L 10	502AL	B	20230501	-224	79	-249	93			93	11	82
<b>25</b>	<b>34LS</b>	<b>503BE</b>	<b>B</b>	<b>20230425</b>	<b>-188</b>	<b>57</b>					<b>57</b>	<b>75</b>	<b>-18</b>
<b>26</b>	<b>34T0.1</b>	<b>503AC</b>	<b>B</b>	<b>20230427</b>	<b>-174</b>	<b>51</b>	<b>-207</b>	<b>51</b>	<b>-239</b>	<b>51</b>	<b>51</b>	<b>70</b>	<b>-19</b>
27	34U 8	513E	B	20230323	-225	2,500					2,500	2,900	-400
28	34V3	503CC	B	20230501	-208	4,500					4,500	750	3,750
29	34X40	513Q	B	20230323	-137	24					24	14	10
30	35F 20	513K	B	20230322	-115	240					240	330	-90
<b>31</b>	<b>35J1</b>	<b>514M</b>	<b>B</b>	<b>20230413</b>	<b>-128</b>	<b>630</b>	<b>-143</b>	<b>770</b>	<b>-148</b>	<b>760</b>	<b>770</b>	<b>990</b>	<b>-220</b>
<b>32</b>	<b>35K1</b>	<b>523A</b>	<b>B</b>	<b>20230330</b>	<b>-127</b>	<b>110</b>	<b>-142</b>	<b>130</b>	<b>-157</b>	<b>130</b>	<b>130</b>	<b>130</b>	<b>0</b>
33	OCWD-BS14/1		B	20230403		244					244	239	5
34	OCWD-BS21/2		B	20230403		296					296	276	20
35	34D					DP1					50	50	n/a
36	34J2					DP2					50	50	n/a
37	34V					DP3					50	50	n/a
38	34X					DP4					50	50	n/a

DP = Dummy Point with an assumed chloride concentration of 50 mg/L placed at wells that were injecting into this zone during this reporting period.

Internodal Wells in **BOLD** and used for A-11 Barrier Cross Section



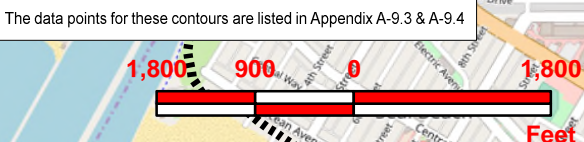


**LEGEND**

- ◆ Observation Well Locations
- Injection Well Locations
- Water Supply Line
- - - - Recent Zone Boundary
- ▲ Production Well Locations

**Contour Legend**

— 250 mg/L Contour	— 2,500 mg/L Contour
— 500mg/L Contour	— 5,000 mg/L Contour
— 1,000 mg/L Contour	— 10,000 mg/L Contour

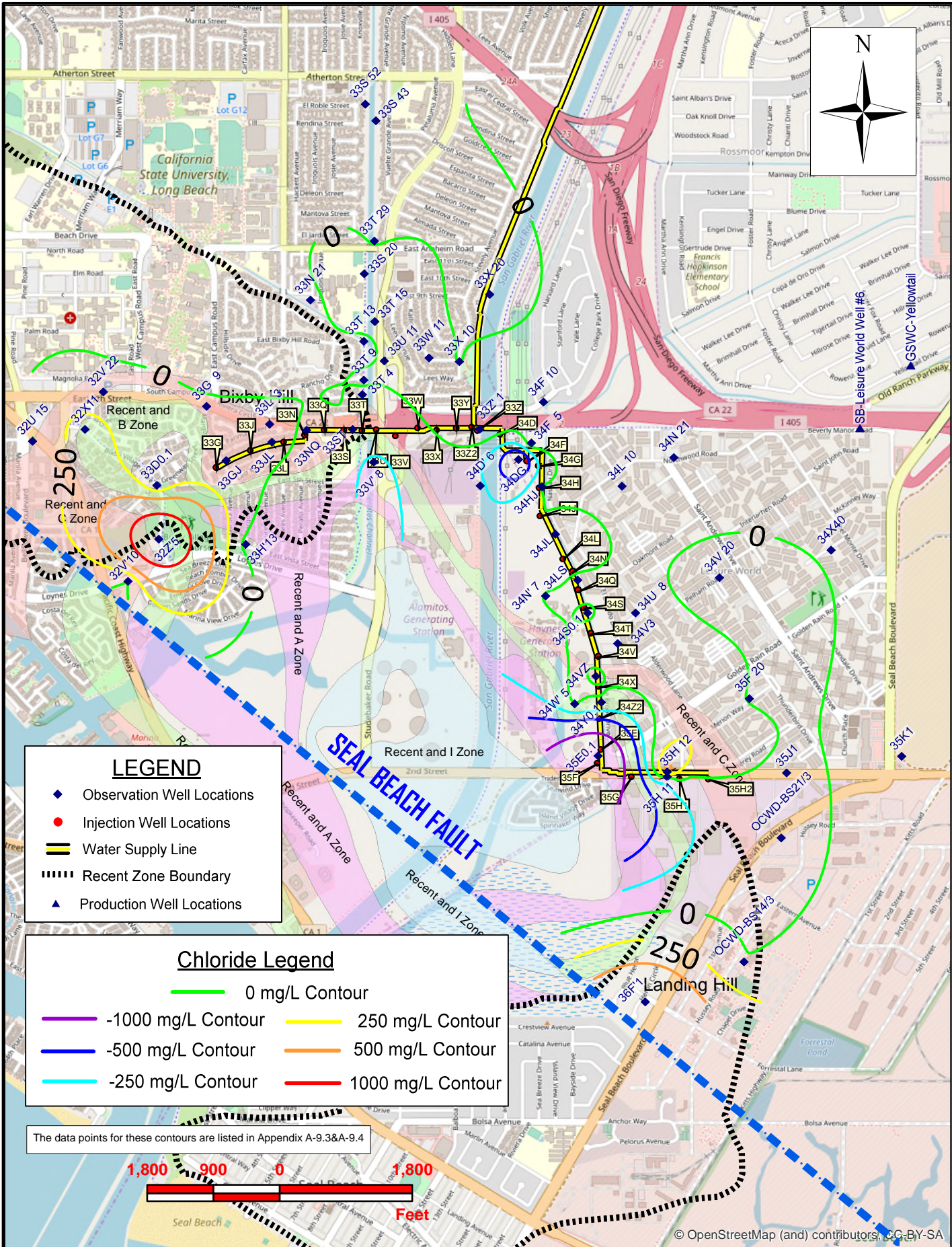


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**Alamitos Barrier Project**  
**A Zone Chloride Concentration (mg/L) Contours, Spring 2023**





**ALAMITOS BARRIER PROJECT**  
**A-ZONE CHLORIDE CONCENTRATIONS**  
Chloride Data Used for Contours and Cross-Section

No.	PROJ	FCD	AQUIFER	DATE	Sampling Depths and Chloride Data						For Contours MAX CHL. 22-23	MAX CHLORIDE FY21-22	Change in Chloride (FY22-23 - FY21-22)
					ELEV 1 (ft)	CHL 1 (mg/L)	ELEV 2 (ft)	CHL 2 (mg/L)	ELEV 3 (ft)	CHL 3 (mg/L)			
1	32U 15	482M	A	20230227	-17	290					290	300	-10
2	32V 22	482P	A	20230228	-11	130					130	79	51
3	32V'10	483F	A	20230227	-90	2,800	-105	2,800			2,800	2,800	0
4	32X11	482S	A	20230309	-9	580	-24	1,800			1,800	1,400	400
5	32Z'5	482W	AB	20230301	-20	680	-30	1,000	-40	3,000	3,000	1,100	1,900
6	33D0.1	482U	AI	20230309	-24	86	-49	78	-74	76	86	10	76
7	33G 9	482F	A	20230301	-3	100	-23	100			100	92	8
8	33GJ	482X	A	20230309	-35	61					61	7	54
9	33H'13	493YY	R,A	20230228	-18	260	-38	270	-58	270	270	330	-60
10	33JL	492BW	AI	20230321	-41	67	-79	66	-116	66	67	8	59
11	33L 3	492	A	20230302	-60	76					76	64	12
12	33N 21	492BU	A	20230313	-305	130	-330	140	-346	150	150	170	-20
13	33NQ	492BP	AI	20230315	-48	68	-92	74	-136	71	74	87	-13
14	33S 20	492BR	A	20230309	-317	140	-336	200	-355	210	210	110	100
15	33S 43	491E	A	20230309	-333	120	-344	120			120	120	0
16	33S 52	491H	A	20230309	-284	190	-289				190	200	-10
17	33ST	492BL	A	20230315	-65	68	-86	68	-100	69	69	78	-9
18	33T 13	492ZZ	A	20230316	-128	85					85	98	-13
19	33T 15	492SS	A	20230309	-334	160					160	130	30
20	33T 29	491C	A	20230309	-350	100					100	110	-10
21	33T 4	492CR	A	20230315	-146	64	-166	73	-186	61	73	82	-9
22	33T 9	492TT	A	20230315	-262	86					86	81	5
23	33U 11	492AJ	A	20230403	-348	81					81	77	4
24	33UV	492BH	A	20230403	-106	85	-131	93	-155	90	93		n/a
25	33V' 8	492BY	RA	20230302	-24	3,400	-48	3,100			3,400	3,700	-300
26	33W 11	502T	A	20230316	-321	68	-349	73	-376	110	110	79	31
27	33WX	502AF	A	20230328	-258	69	-281	88	-297	88	88		n/a
28	33X 10	502BD	A	20230307	-320	76	-340	70	-356	71	76	79	-3
29	33X 20	502J	A	20230321	-353	89					89	120	-31
30	33XY	502BN	A	20230501	-278	67	-296	66	-311	67	67		n/a
31	33YZ	502AD	A	20230501	-296	55	-327	55			55		n/a
32	33Z' 1	502G	A	20230321	-320	640					640	420	220
33	33Z 11	502V	A	20230404	-321	69	-346	68			69		n/a
34	34D' 6	502BH	A	20230307	-270	220	-303	1,100	-335	790	1,100	1,300	-200
35	34DG	502Z	A	20230320	-292	330	-324	760			760	1,700	-940
36	34F 5	502BR	A	20230320	-297	82	-322	360	-347	330	360	210	150
37	34F 10	502AR	A	20230323	-311	73	-326	75			75	79	-4
38	34H5	512E	A	20230403	-298	93	-313	93	-328	95	95		n/a
39	34HJ	502BX	A	20230320	-310	82	-321	78	-331	78	82	70	12
40	34JL	503AP	A	20230425	-262	69	-288	71	-308	71	71	270	-199
41	34L 10	502AM	A	20230501	-310	79	-330	80	360	80	80	10	71
42	34LS	503BD	A	20230425	-238	100	-283	79			100	76	24
43	34N 21	512B	A	20230314	-328	120	-354	170			170	15	155
44	34N' 7	503AF	A	20230314	-106	93	-144	83	-176	89	93	84	9
45	34S0.1	503BV	A	20230425	-239	64	-249	64	-256	68	68	83	-15
46	34U 8	513F	A	20230501	-280	87	-310	130			130	100	30
47	34V3	503CD	A	20230501	-263	77					170	78	92
48	34V 20	513B	A	20230501	-234	170	-265	170	-292	170	77	150	-73

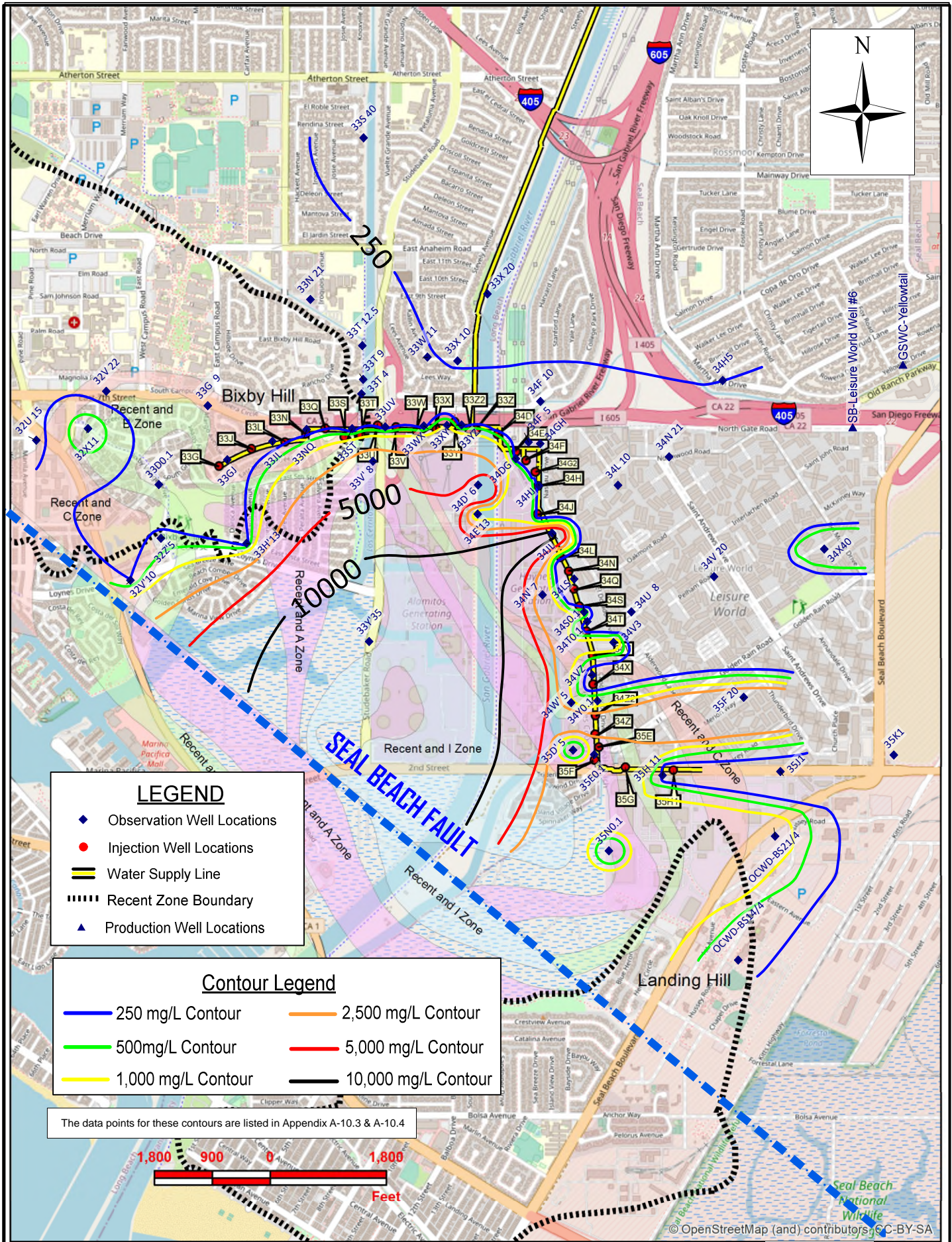
**ALAMITOS BARRIER PROJECT**  
**A-ZONE CHLORIDE CONCENTRATIONS**  
**Chloride Data Used for Contours and Cross-Section**

No.	PROJ	FCD	AQUIFER	DATE	Sampling Depths and Chloride Data					For Contours	MAX CHLORIDE	Change in Chloride	
					ELEV 1 (ft)	CHL 1 (mg/L)	ELEV 2 (ft)	CHL 2 (mg/L)	ELEV 3 (ft)	CHL 3 (mg/L)	MAX CHL. 22-23	FY21-22	(FY22-23 - FY21-22)
49	<b>34VZ</b>	<b>503BH</b>	<b>A</b>	<b>20230427</b>	<b>-146</b>	<b>52</b>	<b>-156</b>	<b>53</b>			<b>53</b>	<b>85</b>	<b>-32</b>
50	34W 5	503AJ	A	20230228	-81	70	-101	110	-119	88	110	96	14
51	34X40	513P	A	20230323	-202	36	-232	150			150	140	10
52	<b>34Y0.1</b>	<b>503CL</b>	<b>A</b>	<b>20230427</b>	<b>-107</b>	<b>120</b>					<b>120</b>	<b>150</b>	<b>-30</b>
53	35E0.1	503BK	A	20230427	-74	49					49	2,000	-1,951
54	35F 20	513J	A	20230322	-129	93	-158	190			190	200	-10
55	35H 11	514G	A	20230316	-123	470	-146	570			570	700	-130
56	35H 12	514D	A	20230413	-137	760					760	120	640
57	35J1	514L	A	20230413	-193	80	-208	78	-228	86	86	110	-24
58	35K1	523B	A	20230330	-197	15	-212	360	-227	120	360	300	60
59	36F 1	505D	A	20230403	-99	1,100					1,100	140	960
60	OCWD-BS14/3		A	20230403		2,790					2,790	2,780	10
61	OCWD-BS21/3		A	20230403		248					248	294	-46
62	34D					DP1					50	50	n/a
63	34J					DP2					50	50	n/a
64	35H1					DP3					50	50	n/a

DP = Dummy Point with an assumed chloride concentration of 50 mg/L placed at wells that were injecting into this zone during this reporting period.

Internodal Wells in **BOLD** and used for A-11 Barrier Cross Section





**LEGEND**

- ◆ Observation Well Locations
- Injection Well Locations
- Water Supply Line
- ▬▬▬ Recent Zone Boundary
- ▲ Production Well Locations

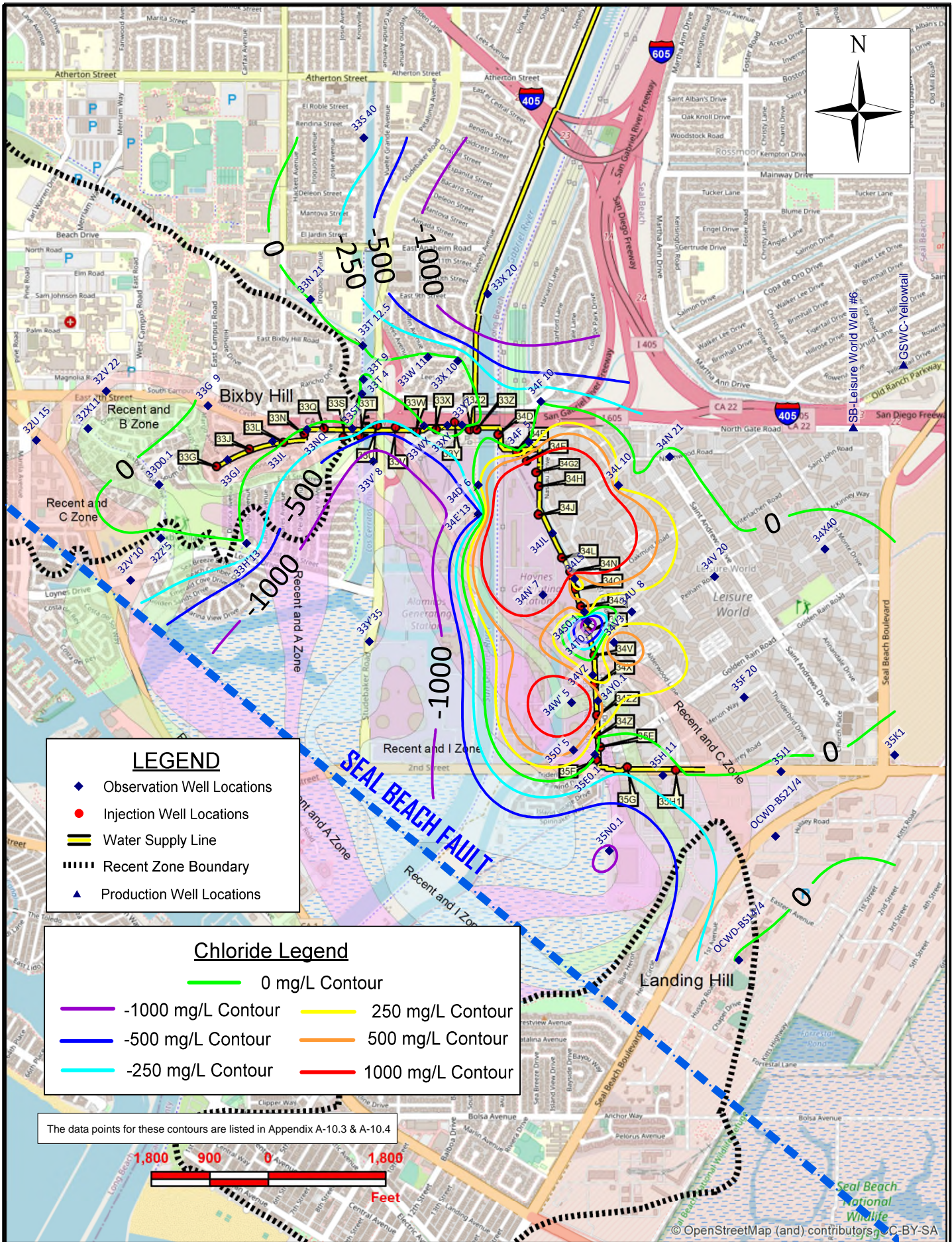
**Contour Legend**

— 250 mg/L Contour	— 2,500 mg/L Contour
— 500mg/L Contour	— 5,000 mg/L Contour
— 1,000 mg/L Contour	— 10,000 mg/L Contour

The data points for these contours are listed in Appendix A-10.3 & A-10.4









**ALAMITOS BARRIER PROJECT**  
**I-ZONE CHLORIDE CONCENTRATIONS**  
 Chloride Data Used for Contours and Cross-Section

No.	PROJ	FCD	AQUIFER	DATE	Sampling Depths and Chloride Data						For Contours	MAX CHLORIDE	Change in Chloride
					ELEV 1 (ft)	CHL 1 (mg/L)	ELEV 2 (ft)	CHL 2 (mg/L)	ELEV 3 (ft)	CHL 3 (mg/L)	MAX CHL. 22-23	FY21-22	(FY22-23 - FY21-22)
1	32U 15	482L	I	20230227	-74	160					160	160	0
2	32V 22	482N	I	20230228	-51	51					51	270	-219
3	32V10	483E	I	20230227	-140	230	-152	230	-165	260	260	340	-80
4	32X11	482R	I	20230309	-51	750	-61	750			750	870	-120
5	32Z'5	482V	I	20230301	-68	240	-83	370	-98	360	370	400	-30
6	33D0.1	482U	AI	20230309	-24	86	-49	78	-74	76	86	10	76
7	33G 9	482G	I	20230301	-34	67	-68	77	-78	95	95	81	14
8	33GJ	482Y	I	20230309	-75	56	-95	60			60	7	53
9	33H'13	493XX	I	20230228	-89	140					140	150	-10
10	33JL	492BW	AI	20230321	-41	67	-79	66	-116	66	67	8	59
11	33N 21	492BV	I	20230313	-457	65	-468	65			65	66	-1
12	33NQ	492BP	AI	20230315	-48	68	-92	74	-136	71	74	87	-13
13	33S 40	491F	I	20230313	-470	440					440	510	-70
14	33ST	492BM	I	20230427	-130	61	-148	66	-163	68	68	89	-21
15	33T 4	492CQ	I	20230315	-277	68	-292	70			70	78	-8
16	33T 9	492XX	I	20230315	-364	70					70	81	-11
17	33T 12.5	492BT	I	20230313	-423	91	-438	91	-443		91	90	1
18	33UV	492BJ	I	20230427	-209	76	-228	74	-246	77	77		n/a
19	33V 8	492BX	I	20230302	-109	4,000	-130	4,000			4,000	5,400	-1,400
20	33W 11	502U	I	20230316	-423	130	-446	160	-468	200	200	140	60
21	33WX	502AG	I	20230328	-374	89	-391	90	-405	90	90	95	-5
22	33X 10	502BE	I	20230307	-420	380	-440	150	-460	130	380	290	90
23	33X 20	502H	I	20230321	-442	390					390	2,800	-2,410
24	33XY	502BP	I	20230328	-403	610	-417	1,000	-431	1,000	1,000	810	190
25	33Y'35	493ZZ	I	20230228	-67	21,000					21,000	24,000	-3,000
26	33YZ	502AE	I	20230328	-402	77	-433	75			77	72	5
27	34D 6	502BI	I	20230307	-400	6,000	-410	8,200	-418		8,200	8,000	200
28	34DG	502AA	I	20230320	-402	71	-432	70			71		n/a
29	34E'13	503AT	I	20230307	-289	940	-308	850			940	1,600	-660
30	34F 5	502BQ	I	20230320	-411	56	-426	56	-441	57	57	67	-10
31	34F 10	502AS	I	20230323	-416	71	-442	75			75	75	0
32	34GH	502BV	I	20230320	-411	81	-427	81	-437	82	82		n/a
33	34H5	512D	I	20230403	-408	250	-423	240	-443	230	250		n/a
34	34HJ	502BW	I	20230320	-407	71	-417	75	-427	77	77		n/a
35	34JL	503AN	I	20230425	-382	260	-403	10,000			10,000	89	9,911
36	34L 10	502AN	I	20230314	-404	110	-426	110			110	7	103
37	34LS	503BC	I	20230425	-338	100	-368	100			100	70	30
38	34N 21	512C	I	20230314	-423	94	-448	91			94	7	87
39	34N 7	503AG	I	20230427	-221	92	-254	1,600	-274	1,900	1,900	250	1,650
40	34S0.1	503BW	I	20230425	-306	430	-310	950			950	130	820

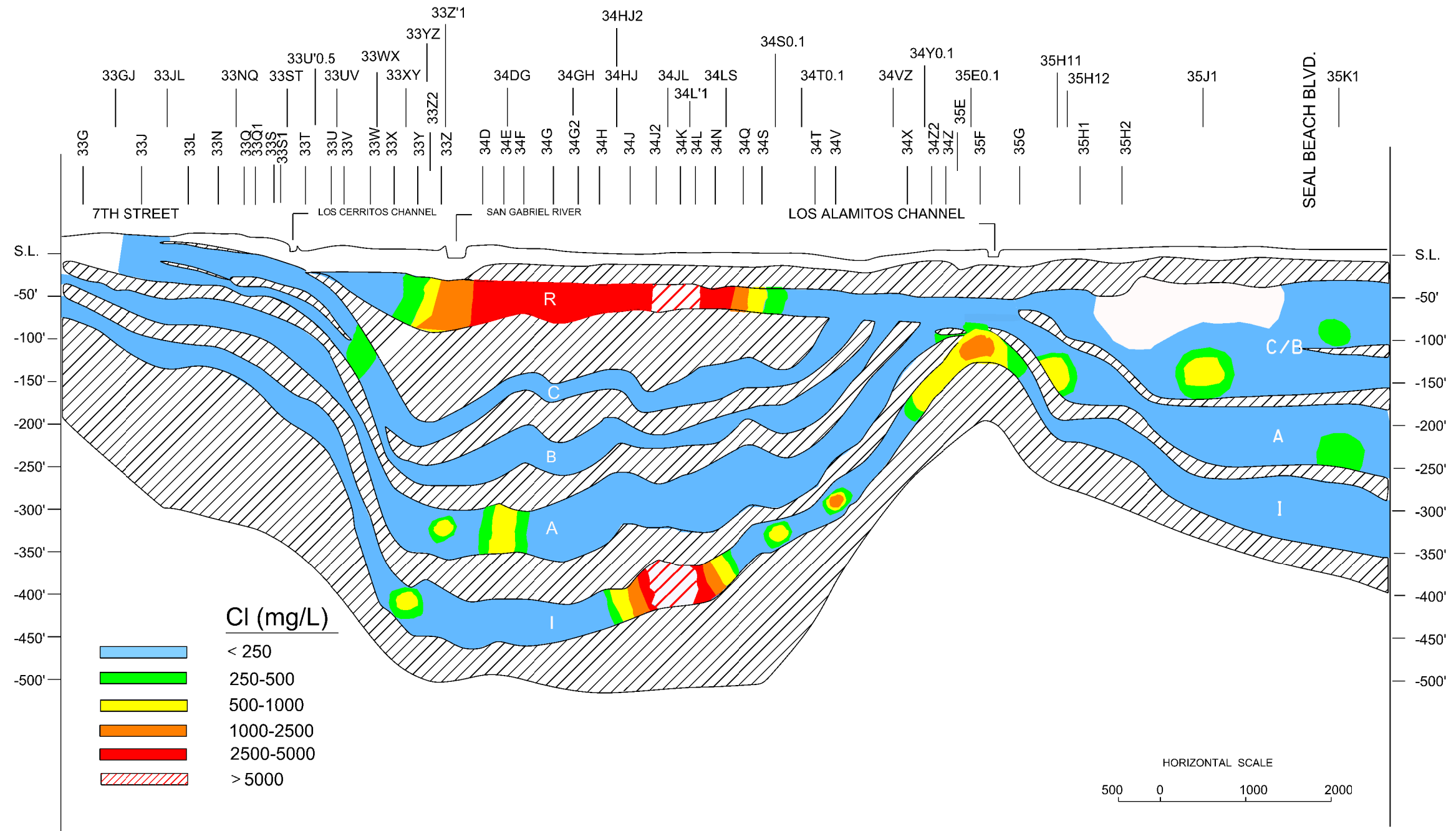
**ALAMITOS BARRIER PROJECT**  
**I-ZONE CHLORIDE CONCENTRATIONS**  
 Chloride Data Used for Contours and Cross-Section

No.	PROJ	FCD	AQUIFER	DATE	Sampling Depths and Chloride Data						For Contours	MAX CHLORIDE	Change in Chloride
					ELEV 1 (ft)	CHL 1 (mg/L)	ELEV 2 (ft)	CHL 2 (mg/L)	ELEV 3 (ft)	CHL 3 (mg/L)	MAX CHL. 22-23	FY21-22	(FY22-23 - FY21-22)
41	<b>34T0.1</b>	<b>503AD</b>	I	<b>20230427</b>	<b>-289</b>	<b>75</b>	<b>-312</b>	<b>66</b>	<b>-334</b>	<b>150</b>	<b>150</b>	<b>1,900</b>	<b>-1,750</b>
42	34U 8	513G	I	20230323	-360	110	-375	100			110	86	24
43	34V 20	513C	I	20230501	-386	91					91	89	2
44	34V3	503CE	I	20230501	-328	1,100					1,100	110	990
45	<b>34VZ</b>	<b>503BG</b>	I	<b>20230427</b>	<b>-214</b>	<b>63</b>	<b>-224</b>	<b>70</b>			<b>70</b>	<b>80</b>	<b>-10</b>
46	34W' 5	503AK	I	20230228	-156	2,700					2,700	330	2,370
47	34X40	513N	I	20230323	-331	940	-346	990			990	850	140
48	<b>34Y0.1</b>	<b>503CM</b>	I	<b>20230427</b>	<b>-175</b>	<b>70</b>	<b>-185</b>	<b>730</b>			<b>730</b>	<b>160</b>	<b>570</b>
49	35D 5	503AM	I	20230228	-89	560					560	52	508
50	<b>35E0.1</b>	<b>503BJ</b>	I	<b>20230427</b>	<b>-114</b>	<b>2,000</b>					<b>2,000</b>	<b>2,000</b>	<b>0</b>
51	35F 20	513H	I	20230322	-235	1,600	-245	3,100	-255	3,200	3,200	3,000	200
52	<b>35H 11</b>	<b>514H</b>	I	<b>20230316</b>	<b>-203</b>	<b>120</b>					<b>120</b>	<b>210</b>	<b>-90</b>
53	<b>35J1</b>	<b>513M</b>	I	<b>20230413</b>	<b>-261</b>	<b>110</b>	<b>-271</b>	<b>120</b>	<b>-281</b>	<b>110</b>	<b>120</b>	<b>160</b>	<b>-40</b>
54	35K1	523C	I	20230330	-363	52	-373	54			54	89	-35
55	35N0.1	504N	I	20230301	-71	330					330	1,400	-1,070
56	OCWD-BS14/4		I	20230403		445					445	417	28
57	OCWD-BS21/4		I	20230403		1,200					1,200	1,240	-40
62	34D						DP1				50	50	n/a
63	34E						DP2				50	50	n/a
64	34Z						DP3				50	50	n/a
65	35H1						DP4				50	50	n/a

DP = Dummy Point with an assumed chloride concentration of 50 mg/L placed at wells that were injecting into this zone during this reporting period.

Internodal Wells in **BOLD** and used for A-11 Barrier Cross Section

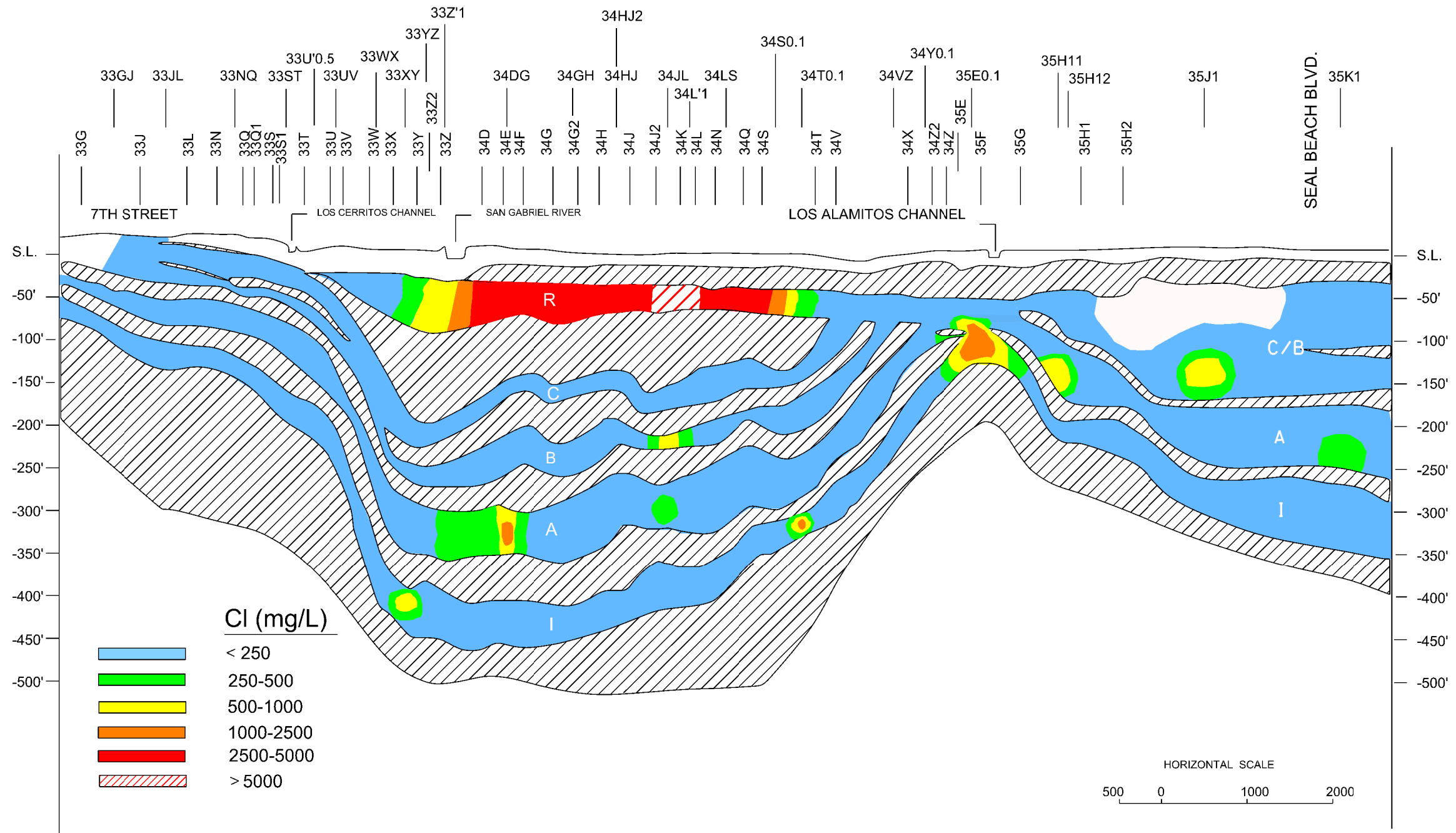
# ALAMITOS BARRIER PROJECT CHLORIDE CROSS-SECTION SPRING 2023



A-11.1

Note: The data points used to create this cross section are listed in the Appendix; A-6.3, 7.3, 8.3, 9.3, 9.4, 10.3, & 10.4

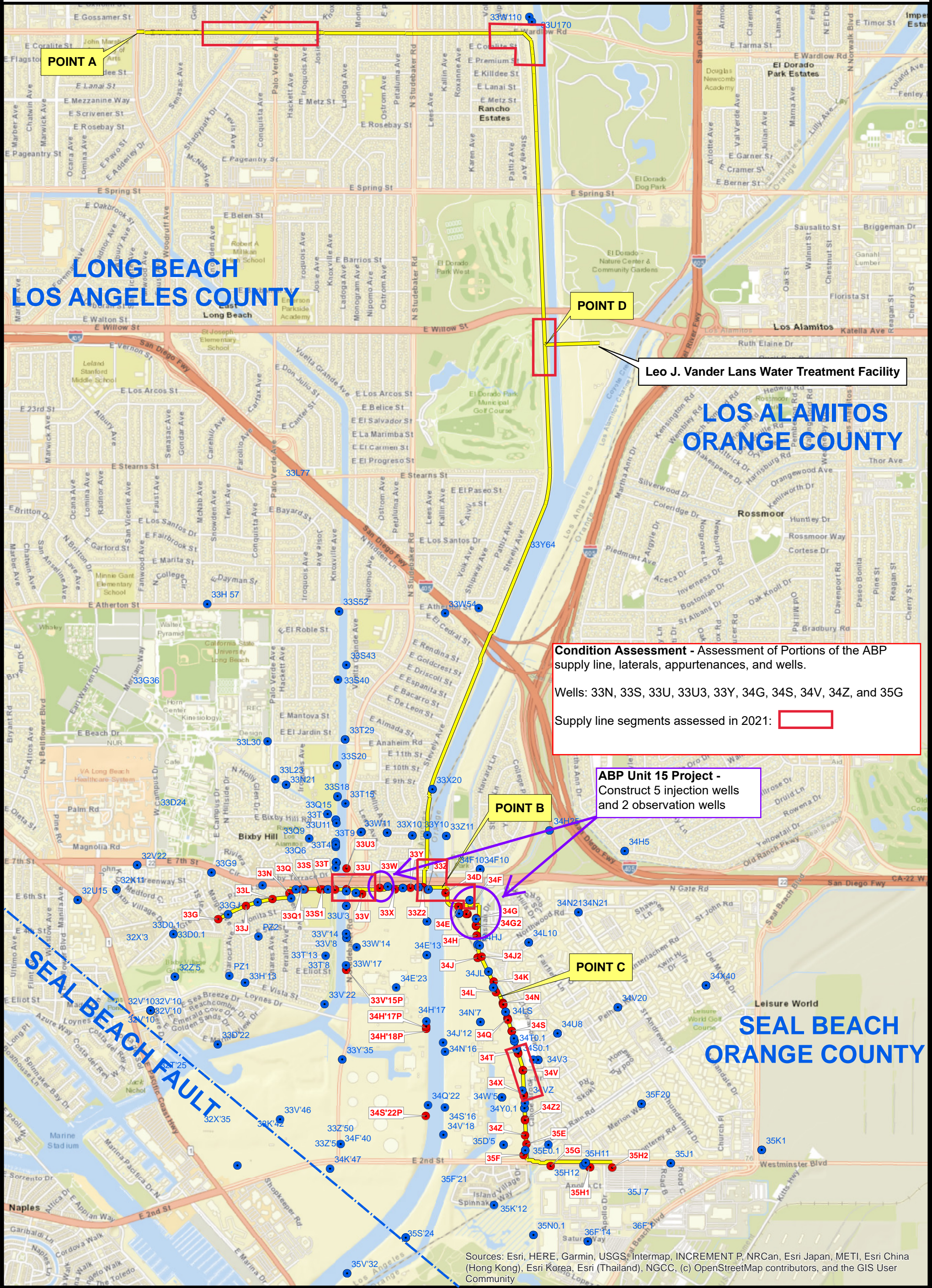
# ALAMITOS BARRIER PROJECT CHLORIDE CROSS-SECTION SPRING 2022



A-11.2

Note: The data points used to create this cross section are listed in the Appendix; A-6.3, 7.3, 8.3, 9.3, 9.4, 10.3, & 10.4





**POINT A**

**POINT D**

**Leo J. Vander Lans Water Treatment Facility**

**LONG BEACH  
LOS ANGELES COUNTY**

**LOS ALAMITOS  
ORANGE COUNTY**

**SEAL BEACH  
ORANGE COUNTY**

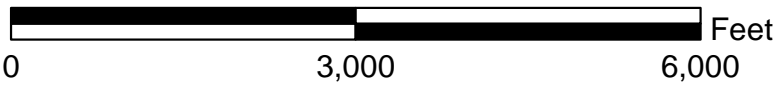
**Condition Assessment - Assessment of Portions of the ABP supply line, laterals, appurtenances, and wells.**  
Wells: 33N, 33S, 33U, 33U3, 33Y, 34G, 34S, 34V, 34Z, and 35G  
Supply line segments assessed in 2021:

**ABP Unit 15 Project - Construct 5 injection wells and 2 observation wells**

**POINT B**

**POINT C**

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

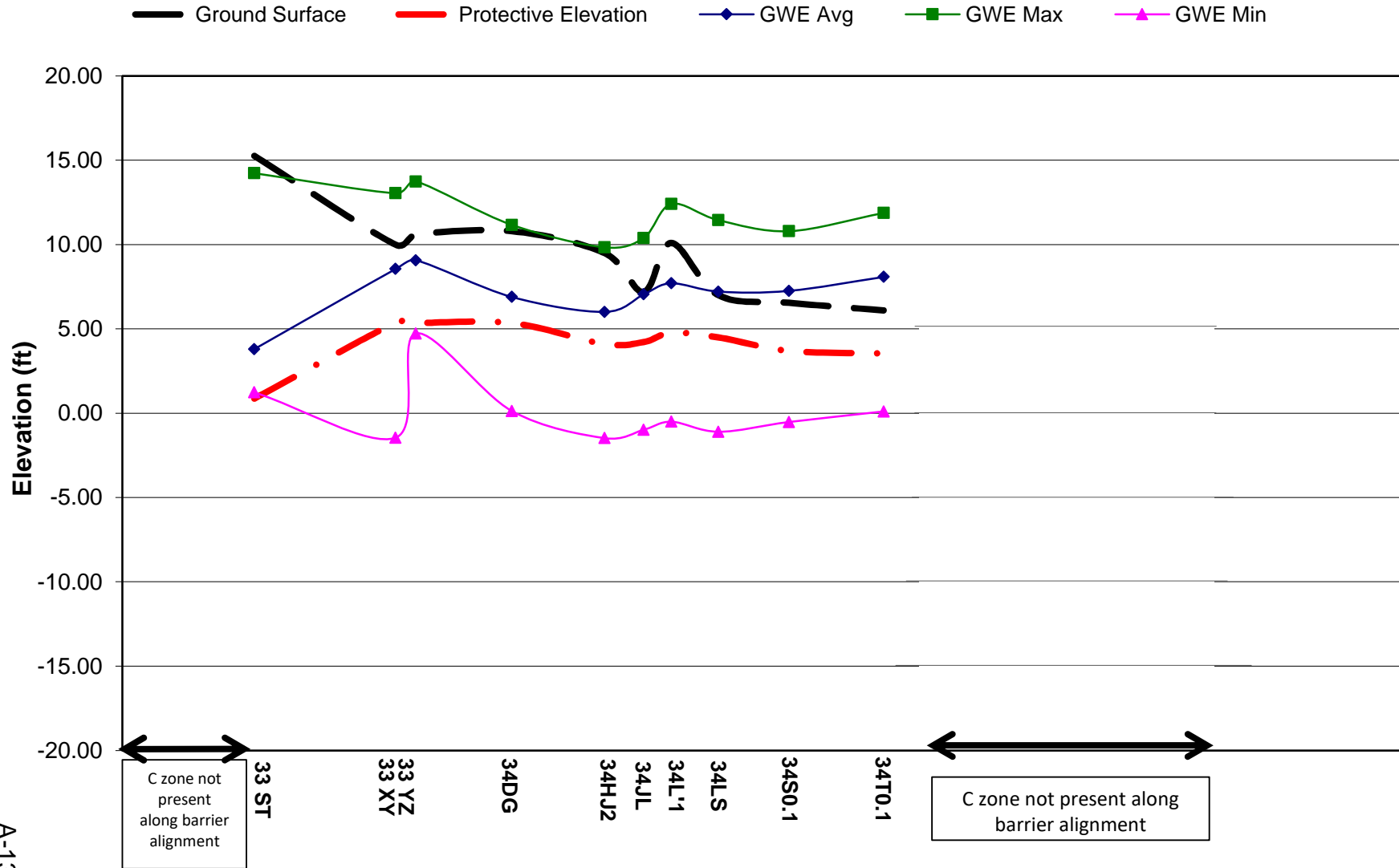


**Legend**

- Alamos\_Observation\_Wells
- Alamos\_Injection\_Wells
- Alamos Water Supply Line



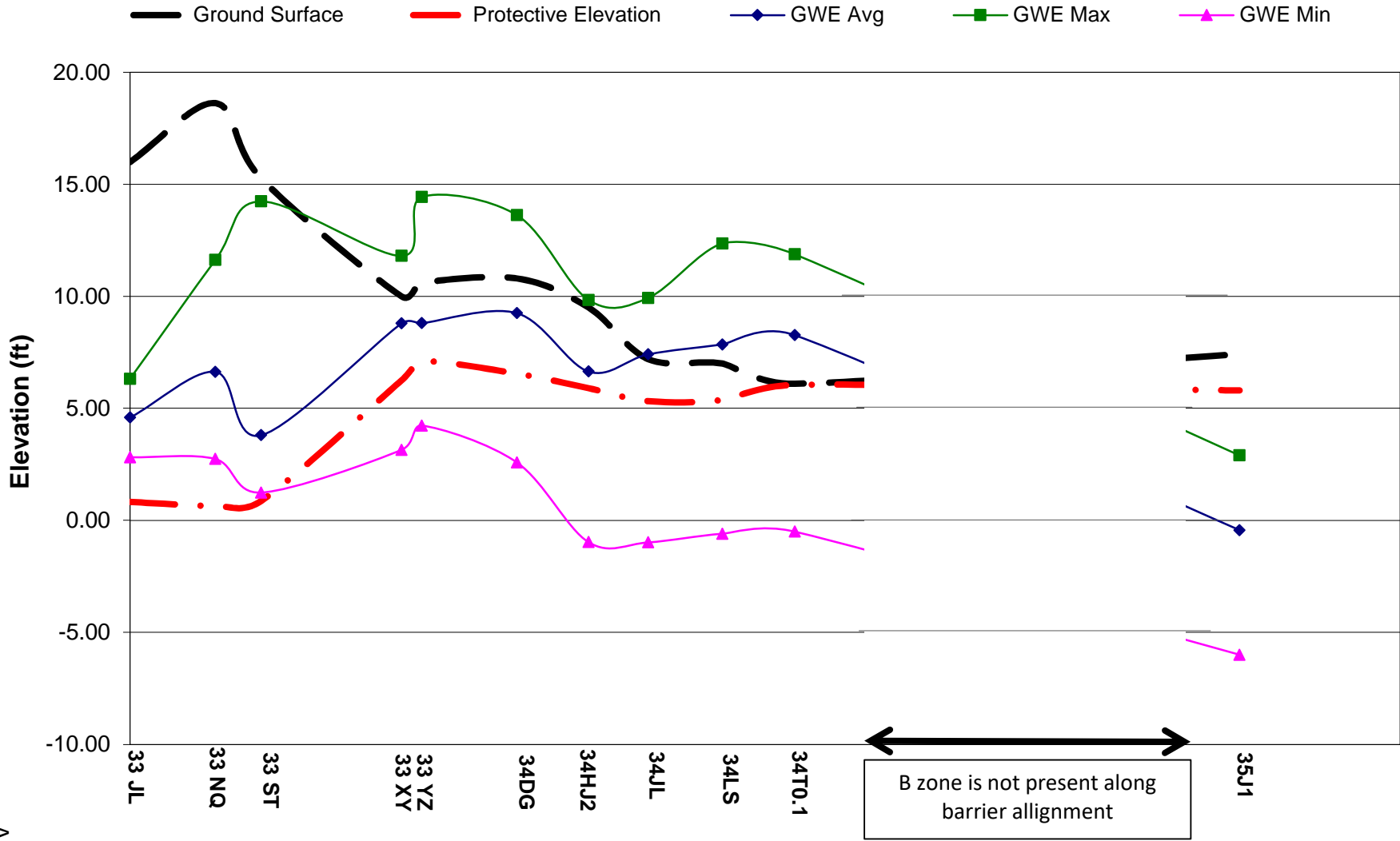
## C Zone - Groundwater Elevation (GWE) Along the ABP FY22-23



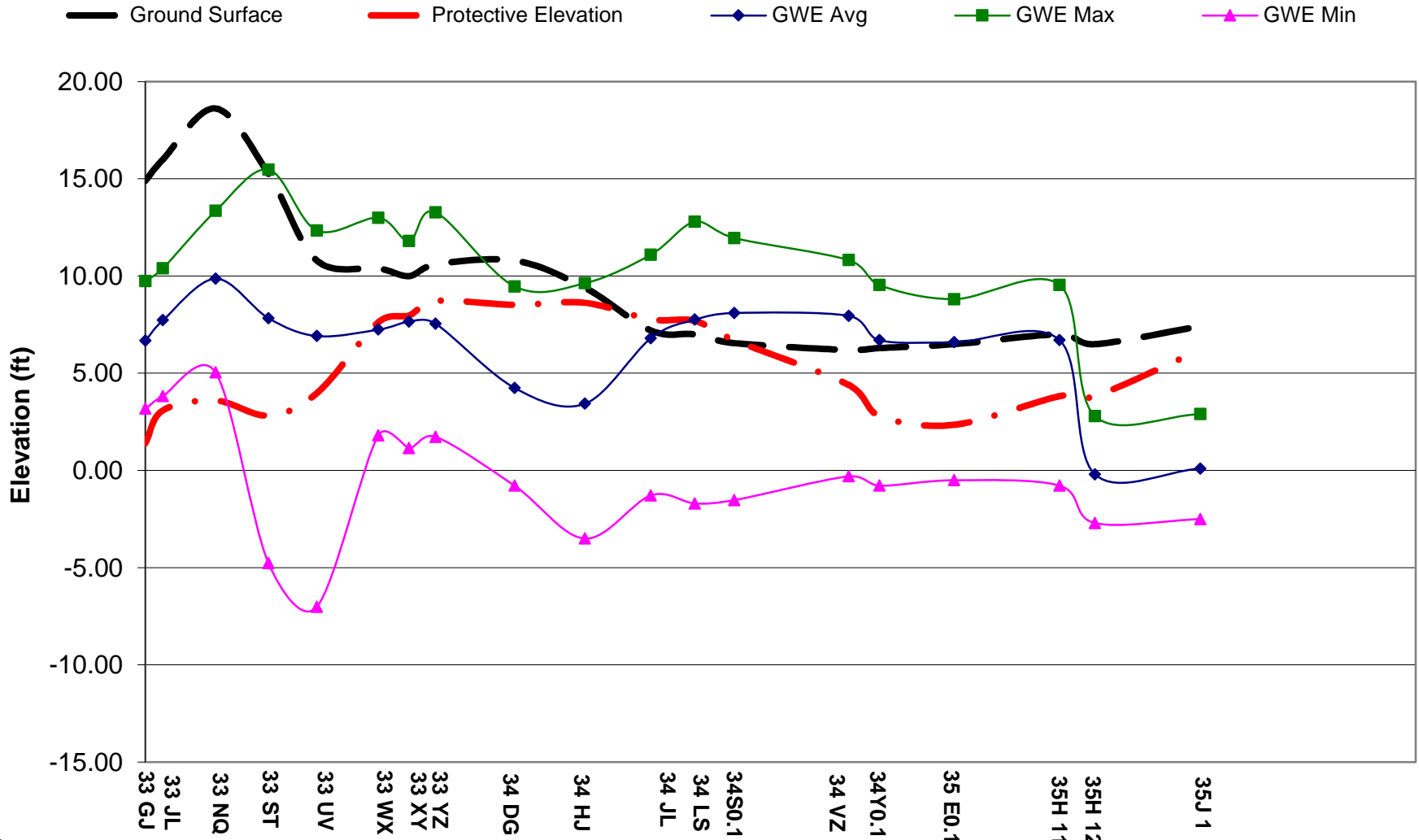
A-13



## B Zone - Groundwater Elevation (GWE) Along the ABP FY22-23

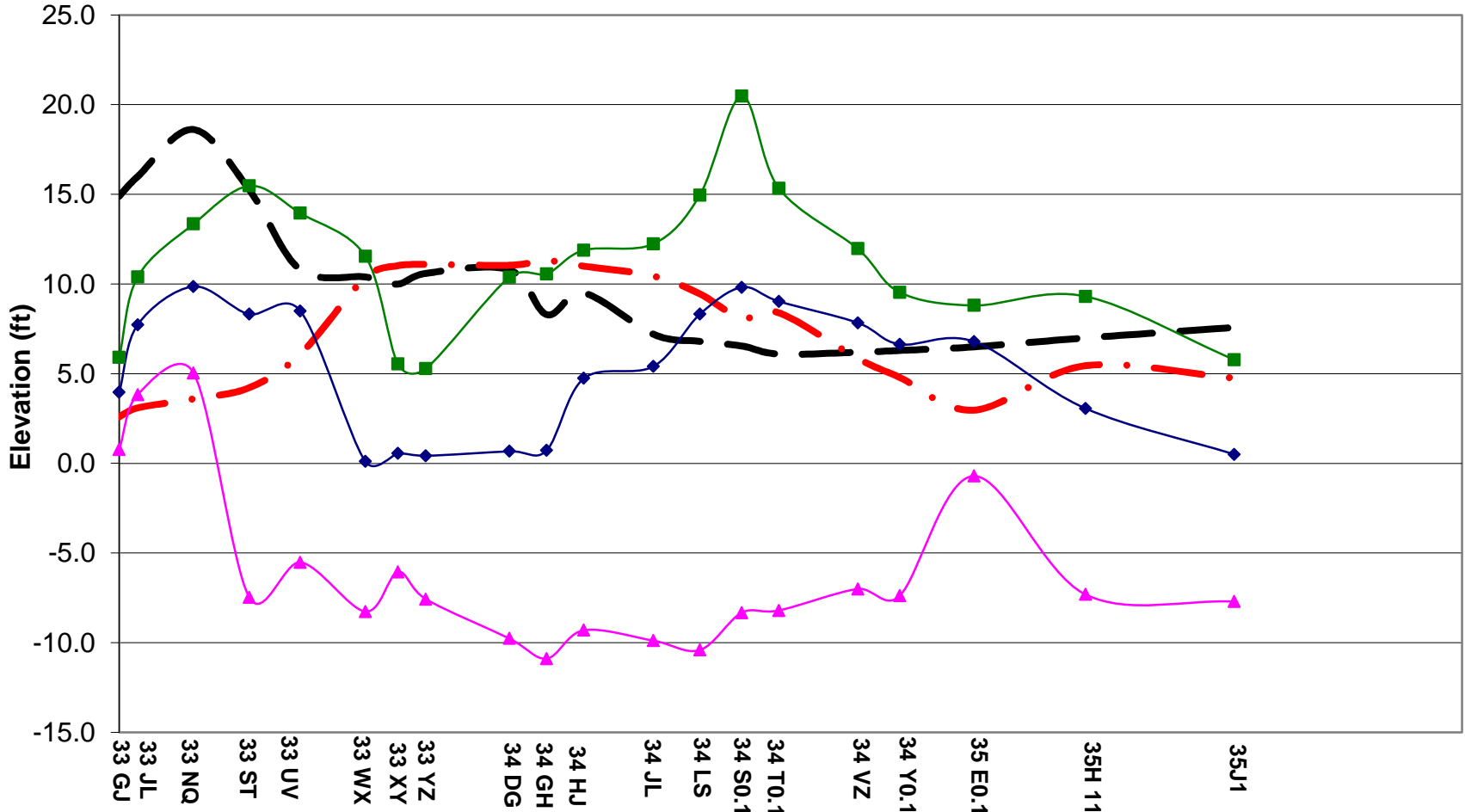


## A Zone - Groundwater Elevation (GWE) Along the ABP FY22-23



# I Zone - Groundwater Elevation (GWE) Along the ABP FY22-23

—◆ Ground Surface   
 —◆ Protective Elevation   
 —◆ GWE Avg   
 —■ GWE Max   
 —▲ GWE Min



**ABP EXPENDITURES  
FY 2022-23**

ITEM NO.	DESCRIPTION	JOB NO.	DESCRIPTION	SERVICES AND SUPPLIES	FY 2022-23 BUDGET	% BUDGET FY 22-23	OCWD SHARE	OCWD BUDGET FY 22-23	% OCWD BUDGET FY 22-23	LADPW SHARE	LADPW BUDGET FY 22-23	% LADPW BUDGET FY 22-23
1.	Analysis and direction of injection operations	H0321550 H0321551	BARRIER PROJECT OPERATION-GR ABP ANALY&DIR OF INJECTION O	129,779.52 58,006.70	250,000	75.14	70,944.26	100,000	70.04	117,741.96	150,000	78.54
			Subtotal #1	187,786.22								
2.	Maintenance and repair of injection wells	F5064011 F6004011 F599001F H0321911 HP0151000 F5009760F	INJECT. WELLS-MAINTAIN(ALAMITO) MAINT INJECTION WELLS - ABP MAINT ENDR - BARRIER PROJ Alamitos Barrier Proj-Telemetry Maint. DBSP Automated System (LEED maintenance contract/ABP) Sectorial Barriers Administrative Support DRILL EQPT-MAINT&TEST - Eaton Yard	40,057.37 159,736.25 17,941.20 31,948.21 79,981.57 166,457.85	207,732	110.14	184,829.91	180,000	102.74	310,692.64	270,000	115.14
			Subtotal #2	495,522.55	450,000							
3.	Operation of injection	F6004000	RECHARGE OVER U/S - ABP	64,234.12	75,000	85.64	23,959.33	30,000	79.94	40,274.79	45,000	89.54
			Subtotal #3	64,234.12								
4.	Analysis and direction of extraction operations (No cost to OCWD)	H0321555	ABP ANALY&DIR OF EXTRACT OPE	0.00	0.0	0.0%	0.00	0.0	0.0	0.00	0.0	0.0
			Subtotal #4	0.00								
5.	Maintenance, and repair of extraction wells (No cost to OCWD)			0.00	10,000	0.0%	0.00	0.0	0.0	0.00	10,000	0.0%
			Subtotal #5	0.00								
6.	Operation of extraction wells (No cost to OCWD)	F6000090	NON-LABOR EXP BARRIER (ALMT)	911.76	5,000	18.24	0.00	0.0	0.0	911.76	5,000	18.24
			Subtotal #6	911.76								
7.	Maintenance and repair of distribution system	F6004012 F6004014F F6009118 H0321016 H0321569 F6004010 F6001907	MAINT PRS - ABP ABP Locate & Mark Barrier Proj. U/grd. Lines Disassemble/Reassemble of Wells ABP Seawater Barriers Administrative Support ALAMITOS BARRIER PROJECT MAINT AIR/VAC-BLOWOFF U/S - ABP INSPECT CRANE PRES REDUCE - ABP	129,779.34 30,860.73 11,040.65 51,688.70 209,219.20 0.00 887.29	400,000	108.44	161,686.45	160,000	101.14	271,789.28	240,000	113.24
			Subtotal #7	433,475.73	400,000							
8.	Maintenance of observation wells	F5064044	OBSERV. WELLS-CLEANOUT(ALAMITO)	96,691.20	200,000	48.34	36,065.82	80,000	45.14	60,425.38	120,000	50.34
			Subtotal #8	96,691.20								
9.	Collection of groundwater data	H0321552	ABP COLL OF GR WTR DATA FOR OCW Permit No. F22-0113 Seal Beach Permit No. DPW04649 Seal Beach Permit No. DPW04779	177,599.46 547.00 718.00 736.00	200,000	89.84	66,990.97	80,000	83.74	112,609.49	120,000	93.84
			Subtotal #9	179,600.46	200,000							
10.	Yard Maintenance	F6001904 F6001920 F6003123 F7004207 F7001907 F6003124	CONDUCT QUARTERLY INSPECTION CONDUCT QUARTERLY INSPECTION BUILDING MAINTENANCE NONRESI Facility Maintenance Alamitos Yd P107 QUARTERLY INSPECTION OF 2 BUILDING MAINTENANCE - NONRESI (FY 21-22)	243.83 305.18 25,640.38 20,958.00 525.44 -16,772.86	50,000	61.84	11,525.70	20,000	57.64	19,374.29	30,000	64.64
			Subtotal #10	30,899.99	50,000							
11.	Well redevelopment	F4047073 F4047167 F4047169 F4047171 F4047172 F4047173 F4047174 F4047175 F4047176 F4047179 F4047180 F4047181 F4047182 F4047183 F4047184 F4047187 F4047188 F4047189 F4047193 F4047194 F4047195 F4047196 F4047210 F4047211 F4047226 F4047231 F4047243 F4047256 H0321554 H0321565 F5064022 F4047109	Redevelop injection well 34D - ABP Redevelop injection well 34Z2 (C/B) - ABP (Started-FY22) Redevelop injection well 34K (C/B) - ABP Redevelop injection well 34N (C/B) - ABP Redevelop injection well 34N (A) - ABP Redevelop injection well 34N (I) - ABP Redevelop injection well 34Q (C/B) - ABP Redevelop injection well 34Q (A) - ABP Redevelop injection well 34Q (I) - ABP Redevelop injection well 34T (C/B Zone) - ABP Redevelop injection well 34T (A Zone) - ABP Redevelop injection well 34T (I Zone) - ABP Redevelop injection well 34K (B Zone) - ABP Redevelop injection well 34X (A Zone) - ABP Redevelop injection well 34X (I Zone) - ABP Redevelop injection well 34Z2 (A) - ABP Redevelop injection well 34Z2 (I) - ABP Redevelop injection well 35E (I) - ABP Redevelop injection well 34Z (I) - ABP Redevelop injection well 35P (I) - ABP Redevelop injection well 33V - ABP Redevelop injection well 33X - ABPP Redevelop injection well 33Z - ABP Redevelop injection well 33F - ABP Redevelop injection well 35H2 - ABP (Started-FY23-24) Redevelop injection well 35H1 - ABP Redevelop injection well 35H1 zone - ABP Redevelop injection well 33E2 - ABP ABP WELL REDEVELOPMENT PROGRAM ABP NPDES MONI & REPORT INJ WR Redevelop injections wells - ABP Baker Tank Rental (In-house tanks repair)	123,306.40 241.80 22,701.43 3,168.44 2,270.33 6,747.11 3,875.27 3,878.74 4,033.54 3,422.53 4,833.71 5,078.23 3,909.51 3,581.86 6,533.68 3,699.52 9,053.37 11,913.93 66,084.92 29,339.92 56,854.20 76,602.65 117,240.52 45,483.82 58,411.27 45,450.30 23,860.03 61,282.66 192,117.71 47,750.34 131,872.67 69,600.80 1935.00 496.00	1,000,000	125.04	466,150.17	400,000	116.54	783,582.18	600,000	130.64
			Subtotal #11	1,249,723.25	1,000,000							
12.	Processing of data and preparation of reports	H0321553	ABP DATA PRO & PRE OF REPORT	46,450.25	70,000	66.44	17,325.94	28,000	61.94	29,124.31	42,000	69.34
			Subtotal #12	46,450.25								
13.	Reclaim Water Program	H0321556 F6060749	ABP RECLAIMED WATER SUPPLY ABP RECYCLED WATER REPAIR & MAINTENANCE	19,106.35 46,792.19	30,000	189.74	21,223.16	12,000	176.94	35,675.38	18,000	198.24
			Subtotal #13	56,898.54	30,000							
14.	Projects & Studies (Reimbursable amounts include labor expenses, plus approved contract expenses that are not addressed under a separate agreement).	HP01521000 EPO2620001	Seawater Barrier Condition Assessment Alamitos Barrier Project Unit 15 Replacement Injection	67,343.35 1,322,299.54	65,000	213.94	25,119.07	26,000	96.64	1,364,523.82	39,000	3498.84
			Subtotal #14	1,389,642.89	65,000							
15.	ABP Liability Insurance Premiums paid separately by OCWD	N/A	ABP General Liability Coverage	76,352.00	80,000	95.44	38,176.00	40,000	95.44	38,176.00	40,000	95.44
			Subtotal #15	76,352.00	80,000							
			<b>TOTAL</b>	<b>4,308,190.06</b>	<b>2,885,000.00</b>	<b>149.34</b>	<b>1,123,096.76</b>	<b>1,156,000.00</b>	<b>97.24</b>	<b>3,185,101.29</b>	<b>1,729,000.00</b>	<b>184.24</b>

1 OCWD share represents 37.34% of the total costs in all Items except for 4, 5, and 6. The percentage is based on amount of overall barrier injection water provided to the Orange County portion of the ABP during this fiscal year.  
2 Per Agreement No. 8458 between the LACFD and the OCWD, all costs included in Items 4, 5, and 6 are not reimbursable with respect to OCWD.  
3 OCWD will not be responsible for Item 14, Alamitos Barrier Project Unit 15 Replacement Injection project.  
4 Per Agreement No. 8458 between the LACFD and the OCWD, the cost of liability insurance (item 15) shall be split equally among the Parties.  
5 OCWD FY22-23 Budget totals \$1,116,000 (\$558,000).

TOTAL OPERATION AND MAINTENANCE COST (not including insurance premium)	\$	4,231,846.06
ORANGE COUNTY'S SHARE OF THE OPERATION AND MAINTENANCE COST (not including insurance premium)	\$	1,084,920.76
Less: Los Angeles County's Share of the FY22-23 Liability Insurance	\$	38,176.00
Less: Permit fees paid by OCWD	\$	7,432.00
Less: Advance Deposit Paid by OCWD*	\$	558,000.00
Balance Due for SMB Condition Assessment (FY20-21 to FY21-22)	\$	135,746.65
<b>BALANCE DUE FROM ORANGE COUNTY WATER DISTRICT</b>	<b>\$</b>	<b>617,059.41</b>



## ABP FY 2024-25 Operation and Maintenance Budget

JMC No.	Fiscal Year	LACFCD		OCWD		WRD		TOTAL	
		Budget	Actual	Budget	Actual	Budget	Actual	Budget	Actual
1.		Analysis and direction of injection operation (\$)							
	2020-21	90,000	141,961	60,000	86,529			150,000	228,490
	2021-22	120,000	112,263	80,000	67,704			200,000	179,967
	2022-23	150,000	117,780	100,000	70,006			250,000	187,786
	2023-24	150,000		100,000				250,000	
	2024-25	150,000		100,000				250,000	
2.		Maintenance and repair of injection wells (\$)							
	2020-21	270,000	220,155	180,000	134,190			450,000	354,345
	2021-22	330,000	237,257	220,000	143,085			550,000	380,342
	2022-23	270,000	310,793	180,000	184,729			450,000	495,523
	2023-24	300,000		200,000				500,000	
	2024-25	315,000		210,000				525,000	
3.		Operations of Injection Well Facilities (\$)							
	2020-21	42,000	44,685	28,000	27,237			70,000	71,922
	2021-22	42,000	35,461	28,000	21,386			70,000	56,847
	2022-23	45,000	40,288	30,000	23,946			75,000	64,234
	2023-24	45,000		30,000				75,000	
	2024-25	45,000		30,000				75,000	
4.		Analysis and direction of extraction operation (\$)							
	2020-21	0	0	0	0			0	0
	2021-22	0	0	0	0			0	0
	2022-23	0	0	0	0			0	0
	2023-24	0	0	0	0			0	0
	2024-25	0	0	0	0			0	0
5.		Redevelopment, maintenance, and repair of extraction wells (\$)							
	2020-21	10,000	0	0	0			10,000	0
	2021-22	10,000	0	0	0			10,000	0
	2022-23	10,000	0	0	0			10,000	0
	2023-24	5,000	0	0	0			5,000	0
	2024-25	5,000	0	0	0			5,000	0
6.		Operations of Extraction Wells (\$)							
	2020-21	5,000	1,132	0	0			5,000	1,132
	2021-22	5,000	2,847	0	0			5,000	2,847
	2022-23	5,000	912	0	0			5,000	912
	2023-24	0	0	0	0			0	0
	2024-25	0	0	0	0			0	0
7.		Maintenance and repair of ABP supply line and associated vaults (\$)							
	2020-21	222,000	256,376	148,000	156,268			370,000	412,644
	2021-22	225,000	237,783	150,000	143,402			375,000	381,185
	2022-23	240,000	271,877	160,000	161,599			400,000	433,476
	2023-24	270,000		180,000				450,000	
	2024-25	285,000		190,000				475,000	
8.		Maintenance of Observation Wells (\$)							
	2020-21	30,000	148,635	20,000	90,598			50,000	239,233
	2021-22	90,000	62,030	60,000	37,409			150,000	99,438
	2022-23	120,000	60,645	80,000	36,046			200,000	96,691
	2023-24	120,000		80,000				200,000	
	2024-25	120,000		80,000				200,000	
9.		Collection of groundwater data (\$)							
	2020-21	120,000	79,846	80,000	48,669			200,000	128,515
	2021-22	120,000	79,412	80,000	47,892			200,000	127,304
	2022-23	120,000	112,646	80,000	66,955			200,000	179,600
	2023-24	108,000		72,000				180,000	
	2024-25	108,000		72,000				180,000	
10.		Yard Maintenance (\$)							
	2020-21	65,000	25,997	10,000	17,238			75,000	43,235
	2021-22	65,000	33,509	10,000	20,208			75,000	53,717
	2022-23	30,000	45,073	20,000	26,790			50,000	71,863
	2023-24	55,000		20,000				75,000	
	2024-25	57,500		22,500				80,000	
11.		Injection Well Redevelopment (\$)							
	2020-21	600,000	694,466	400,000	423,297			1,000,000	1,117,763
	2021-22	600,000	669,845	400,000	403,969			1,000,000	1,073,814
	2022-23	600,000	783,835	400,000	465,897			1,000,000	1,248,732
	2023-24	600,000		400,000				1,000,000	
	2024-25	720,000		480,000				1,200,000	
12.		Processing of data and preparation of reports (\$)							
	2020-21	48,000	21,630	32,000	13,184			80,000	34,813
	2021-22	42,000	20,986	28,000	12,656			70,000	33,643
	2022-23	42,000	29,134	28,000	17,317			70,000	46,450
	2023-24	36,000		24,000				60,000	
	2024-25	36,000		24,000				60,000	
13.		Oversight of Reclaim Water Program (\$)							
	2020-21	30,000	11,846	20,000	7,221			50,000	19,067
	2021-22	18,000	10,733	12,000	6,473			30,000	17,205
	2022-23	18,000	6,339	12,000	3,768			30,000	10,106
	2023-24	18,000		12,000				30,000	
	2024-25	18,000		12,000				30,000	
14.		Projects and Studies (\$)							
	2020-21	12,000	749,986	8,000	19,722			20,000	769,708
	2021-22	55,000	563,636	8,000	35,542			63,000	598,178
	2022-23	39,000	1,364,537	26,000	25,105			65,000	1,389,643
	2023-24	39,000		26,000				65,000	
	2024-25	0		0				0	
15.		ABP Liability Insurance (\$)							
	2020-21	35,000	33,375	35,000	33,375			70,000	66,750
	2021-22	40,000	38,117	40,000	38,117			80,000	76,234
	2022-23	40,000	38,176	40,000	38,176			80,000	76,352
	2023-24	42,500		42,500				85,000	
	2024-25	42,500		42,500				85,000	
16.		Total ABP Expenditure (\$)							
	2020-21	1,579,000	2,430,090	1,021,000	1,057,527			2,600,000	3,487,617
	2021-22	1,762,000	2,103,890	1,116,000	977,841			2,878,000	3,081,722
	2022-23	1,729,000	3,182,035	1,156,000	1,120,334			2,885,000	4,302,370
	2023-24	1,788,500		1,186,500				2,975,000	
	2024-25	1,907,000		1,283,000				3,170,000	
TOTALS		Total ABP Operations and Maintenance (\$) [Item 16-Item 15]							
	2020-21	1,544,000	2,396,715	986,000	1,024,152			2,530,000	3,420,867
	2021-22	1,722,000	2,065,763	1,076,000	939,724			2,798,000	3,005,488
	2022-23	1,689,000	3,143,859	1,116,000	1,082,158			2,805,000	4,226,018
	2023-24	1,746,000		1,144,000				2,890,000	
	2024-25	1,864,500		1,220,500				3,085,000	
		Volume of Water (ac-ft)							
	2020-21			3,000	2,592	4,500	3,909	7,500	6,501
	2021-22			2,800	2,704	4,200	4,484	7,000	7,188
	2022-23			3,000	2,414	4,500	4,061	7,500	6,475
	2023-24			3,200		4,800		8,000	
	2024-25			3,200		4,800		8,000	