



# **Annual Surveillance Report January 2023 to December 2023 for Sand Canyon Dam DSOD Dam No. 1029-002**

Irvine, California

Submitted to:  
Irvine Ranch Water District  
Dams & Storage  
15600 Sand Canyon Avenue  
Irvine, CA 92618



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July 3, 2024  
GEI Project No. 1901888

Consulting July 3, 2024  
Engineers and GEI Project No. 1901888  
Scientists

Ms. Danielle Drake,  
Assistant Engineer – Dams & Storage  
Irvine Ranch Water District  
15600 Sand Canyon Avenue  
Irvine, CA 92618

**Re: Sand Canyon Dam, DSOD Dam No. 1029-002,  
Annual Surveillance Report from January 2023 to December 2023**

Dear Ms. Drake:

GEI Consultants, Inc. (GEI) is pleased to submit this Annual Surveillance Report for Sand Canyon Dam covering January 2023 to December 2023. This report is part of the scope of work described under our Professional Service Agreement between Irvine Ranch Water District (District) and GEI Consultants Inc. (GEI) dated February 11, 2019.

We appreciate this opportunity to provide the District with our services. Please contact Emerson Revolorio at [erevolorio@geiconsultants.com](mailto:erevolorio@geiconsultants.com) or Rich Sanchez at [rsanchez@geiconsultants.com](mailto:rsanchez@geiconsultants.com) with any questions.

Sincerely,

**GEI CONSULTANTS, INC.**



Richard Sanchez, P.E.  
Principal Engineer



Emerson Revolorio, P.E.  
Project Engineer

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Reservoir Dam Valve Exercising Table

CNC Survey Report

Valves Exhibit for Emergency Release

## Acronyms and Abbreviations

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AC	asphalt concrete
AF	acre-feet
CML&C	cement-mortar-lined and coated
CMP	Corrugated Metal Pipe
District	Irvine Ranch Water District
DSOD	State of California, Department of Water Resources, Division of Safety of Dams
El, EL, Elev	elevation
ft	feet
GEI	GEI Consultants, Inc.
gpm	gallons per minute
gal/min	gallons per minute
H:V	Horizontal to Vertical
ID	identification
in.	inches
liter/min	liters per min
MW	monitoring well
NAVD 88	North American Vertical Datum of 1988
NGVD 29	National Geodetic Vertical Datum of 1929
No.	number
NOAA	National Oceanic and Atmospheric Administration
P.E.	Professional Engineer
P or Piez	Piezometer
RCP	reinforced concrete pipe
Res.	Reservoir
VW, VWP, VB	Vibrating Wire Piezometer
W.S.	water surface
YR	year

# 1.0 Introduction and Background

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## 1.1 General

This report presents the results of the dam safety monitoring and surveillance for Sand Canyon Dam conducted by the Irvine Ranch Water District (District) and GEI Consultants, Inc. (GEI) covering the period between January 2023 through December 2023. It includes a review of previous surveillance reports, a compilation of the field measurements, maintenance reports, observations, and conclusions related to the general condition and safety of the dam. In addition, recommendations are provided for continued operation, surveillance, and monitoring of the dam. This report is submitted as part of the jurisdictional requirements of the State of California, Department of Water Resources, Division of Safety of Dams (DSOD).

Piezometer water levels, reservoir water surface elevations, and seepage flow rates covered in Table 2 are from 2007 to 2023 with representative plots in Figures 4 through 14. Tables 3 through 6 provide annual and cumulative horizontal and vertical movement based on survey data collected at Sand Canyon Dam. Annual (short term) and cumulative (long term) representations of the data help to identify any adverse trends or significant deviations in the data. Survey data tables and figures are presented to show the results of horizontal and vertical movement surveys from 1995 through 2023. Survey data tables also include limited data for years between 1968 and 1995. No surveys were conducted in calendar years 2017 and 2021. A survey was performed in December 2023 and included in this report.

The vertical datum indicated on the as-built plans and project documents for Sand Canyon Dam is National Geodetic Vertical Datum of 1929 (NGVD 29). The reservoir water surface elevation, piezometer instrumentation data and vertical survey data are currently based on NGVD 29.

## 1.2 Dam and Reservoir

Sand Canyon Dam is a 59-foot-high compacted embankment dam located on Sand Canyon Wash in Irvine, California. The dam was completed in 1943. The District took over operation of the Sand Canyon Dam and Reservoir in 1967 from The Irvine Company.

The dam crest is at Elevation 202 ft (NGVD 29). There is a one-foot-high concrete parapet wall (Top of Wall at Elevation 203 ft) along the upstream edge of the crest of the dam (Figures 1 and 2). The watershed drainage area is 6.8 square miles, and the spillway crest is at Elevation 193.5 ft, providing 8.5 ft of freeboard. The reservoir area is 51 acres and the reservoir capacity at the spillway crest elevation is 960 acre-feet upon original construction. The maximum capacity has been reduced from 960 acre-feet to 740 acre-feet due to sedimentation in the reservoir (Draft Data Summary Report, Sand Canyon Dam, HDR

2021). The dam is 861 ft long with a 10-foot-wide crest. The crest is paved with Asphalt Concrete (AC).

The upstream face of the dam is lined with 3-inch-thick AC extending approximately 19 ft down from the crest of the dam and has a slope of 2.5H:1V. The downstream face of the dam is covered with grass and has a slope of 2H:1V.

The dam is a zoned embankment with an upstream shell zone consisting of "selected impervious" material, a central core zone of "random" material, and a downstream shell zone of "unselected pervious" material. During construction of the dam, test results indicated that the embankment is homogeneous and consists, for the most part, of medium dense sandy clay and clayey sand (DSOD, 1984). The dam was founded on alluvium across the original broad stream channel, and on sandstone of the Santiago Formation at the abutments. A cutoff trench was constructed under portions of the upstream and central zones of embankment material (see Figure 2). The trench typically penetrates 2 to 4 ft into the sandstone bedrock but does not extend across the full width of the broad alluvial channel.

### **1.3 Spillway**

The spillway is located about 250 ft to the East from the right end of the dam. There is a rock knob that separates the dam and the spillway. The spillway consists of an approach section, an ungated concrete ogee weir, and a rectangular channel. The channel has 18-foot-high reinforced concrete retaining walls on both sides. The bottom of the channel is mostly unlined and consists of sandstone bedrock with filled-in areas of dental concrete. The channel conveys the water to an energy dissipation reinforced concrete structure that outlets to Sand Canyon Wash. The spillway crest is at Elevation 193.5 ft, which provides 8.5 ft of freeboard.

### **1.4 Outlet Works**

The outlet works consist of a 36-inch-diameter corrugated metal pipe (CMP) controlled by four upstream and three downstream gates. The upstream controls consist of three 24-inch-diameter inlet slide gates at Elevations 169.9, 177.1, and 185.0 ft, and one 20-inch-diameter main gate located near the upstream toe. The inlet gates are manually operated from the hand wheel controls located at the upstream edge of the crest of the dam.

The 36-inch CMP connects to a 20-inch steel outlet pipe under the dam, 260 ft in length and transitions to a 24-inch-diameter distribution line near the downstream toe of the dam. The 24-inch-diameter distribution line splits into a 24-inch-diameter and 20-inch-diameter emergency outlet pipe, and a 12-inch-diameter main outlet pipe. At approximately 330 ft downstream of the toe of the dam, there are 3 emergency valves that control flow into Sand Canyon Wash (Figure 1). IRWD updated their non-potable system details during the review period and provided updated layouts and valve sizes. The updated details are provided in the

appendix and have been incorporated in Figure 1. Based on the updated details, the emergency valve sizes are 24-inch-diameter (Valve 7 and 19) and 20-inch-diameter (Valve 20). Water is released through a 24-inch-diameter outfall located in the creek. During this year's field evaluation, we discovered a new vault box near the emergency valves.

The District provided a Reservoir Dam Valve Exercising summary table which states that the valves were exercised during the DSOD inspection dated 4/18/2023 and 4/19/2023. During our annual inspection, the District stated that the stem of gate valve #2 (Figure 1) was damaged during the exercise. The valve exercise table is provided in the Appendix of this report.

## **1.5 Subdrains**

There was no internal drainage system installed within the embankment during the construction of the dam. However, two seepage subdrains referred to as the Left Subdrain and Right Subdrain, were installed at the downstream toe near the left groin (Figure 1). The Left Subdrain consists of a 6-inch pipe with two 4-inch branches, while the Right Subdrain is a 6-inch pipe extending approximately 100 ft parallel to the toe (DSOD, 1984). The two subdrains discharge into a Drain Junction Vault located at the downstream toe of the dam near the left abutment. The flow from the two subdrains is measured at a small Drain Junction Vault by the District staff monthly.

## 2.0 Instrumentation Measurements

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### 2.1 General

Instrumentation at Sand Canyon Dam includes 18 piezometers, two seepage subdrains, and six survey monuments. District staff measure the water levels in the reservoir, levels in the piezometers, and measure the seepage flow rates monthly and immediately following significant seismic events. The survey monuments are surveyed annually by a licensed surveyor under contract with the District. Precipitation is measured on-site.

Figure 1 is a Site and Instrumentation Plan showing the layout of the dam and appurtenances, as well as the locations of the piezometers, seepage collection subdrains, and survey monuments. The left and right designations are as viewed looking downstream.

Throughout this report, instrumentation measurements and readings remained within historical limits and followed historical trends will be classified as normal. Historical limit is classified as the range between maximum and minimum water levels within the past ten years.

Based on the ten-year historical data from January 2013 through December 2023, the reservoir water surface elevation varied from a minimum Elevation of 163.6 ft to a maximum Elevation of 194.1 ft. During the 2023 review period, the reservoir water surface elevation varied from a minimum Elevation of 189.2 ft to a maximum Elevation of 194.0 ft, see Table 2. During the review period, the reservoir spilled and water flowed through the spillway intermittently from January to April/May. The exact start and end date of spilling was not provided by the District. The reservoir water surface elevations during the 2023 review period remained within historical limits and considered normal.

Starting in December 2022, there was a significant increase in rainfall compared to previous years. The largest rainfall occurred between January and March 2023 with readings ranging from 4.0 to 7.2 inches per month. A large rainfall event also occurred in August 2023, which recorded 1.8 inches of rain during the month. Based on historical data, August is typically a dry month with little to no rain. The significant increase in rainfall attributed to the reservoir spilling between January and May. Rainfall data is included in Table 2 and Figures 4 through 15.

### 2.2 Piezometers

Originally, the dam had 18 open-well piezometers. An open-well piezometer is a small-diameter well, used mainly to measure the pressure or depth of groundwater. It is typically installed as a casing in a vertical borehole and has a discrete perforated zone near its bottom to enable monitoring of changes in groundwater levels within that zone. More than one piezometer can be



installed within a single, larger-diameter outer well casing. These groups of piezometers are often referred to as multi-stage or nested piezometers. Piezometers 1 through 8 remain as open-well piezometers with an A and B designations for nested piezometers (1A & 1B, 2A & 2B, and 8A & 8B). Both A & B are placed in the same hole but at different elevations.

In 2015, the District converted Piezometers 9 through 13 to vibrating wire piezometers (VWP). All the VWPs were recording erroneous digital readings from February 2019 until December 2020 (Table 2). The erroneous readings are marked in red as shown in Table 2. The District reported they were having problems with the digital data logger. The District was able to fix the data logger unit with the help of the manufacturer (Geokon) and started providing readings in 2021. The readings appear to be given as depths and in units of feet and follow the historical trends seen before the data logger malfunction. VWPs contain a high tensile steel wire attached at one end to a diaphragm. The frequency of vibration in the wire induces an alternating electrical current in a coil. The magnitude of the current is detected, and the reading is then converted to a pressure. The pressure fluctuates with changes in water levels in the immediate vicinity of the piezometer tip. The VWPs at the dam are designated with a V to identify them as such and with an A or B for nested piezometers (VBW9A & 9B and VBW/10A & 10B). Again, both A and B are placed in the same hole.

The location of each piezometer is shown on Figure 1. Thirteen of the 18 piezometers are located either at or near the maximum section of the dam. Three of the remaining five piezometers are in the right portion of the dam and two are in the left portion.

Table 2 lists the reservoir water surface elevations and piezometer water levels from January 2007. Figures 4 through 8 are 2-year graphical plots (January 2022 through December 2023) of the piezometer data and reservoir water levels. Figures 9 through 13 are historical 10-year graphical plots (since 2013) of the piezometer data and reservoir water levels.

The following is a discussion of the piezometers including the water level measurements during the 2023 review period as well as comparisons with historical trends. As noted above the vibrating wire piezometers were producing erroneous digital readings from February 2019 to December 2020. The District provided readings for the vibrating wire piezometers for the 2023 review period, and they follow historical trend.

Table 1 provides the maximum and minimum water levels recorded during the current review period, as well as the historical range for each piezometer. Readings with isolated spikes or drops were not considered reliable and were not included in the maximum and minimum water level range.

**Table 1. Piezometers – Maximum and Minimum Water Level Ranges**

Piezometer	Tip Elevation (ft)	2012-2022 10-Year Range (ft)	2023 Range (ft)	Comment
P-1A	159.3	159.3 - 160.5	159.6 - 159.7	Piezometer water levels have been reported near the bottom of well elevation. It was verified as dry by IRWD staff during 2023 inspection.
P-1B	132.9	140.4 - 148.0	144.5 - 147.8	
P-2A	153.9	165.1 - 174.5	168.0 - 174.5	Reading on 6/28/2023 was at the historical max.
P-2B	123.8	137.3 - 143.2	141.9 - 143.4	Reading on 1/11/2023 was 8.6 ft above the historical max. This was an isolated reading and the piezometer water level returned back to within historic range values. Reading on 3/29/2023 was 0.2 ft above the historical max.
P-3	155.8	159.8 - 182.0	177.6 - 180.9	
P-4	129.1	136.2 - 142.6	141.6 - 150.7	Readings from 1/11/2023 to 3/29/2023 were at or near the top of well elevation, 8.1 ft above the historical max.
P-5	129.6	139.8 - 146.5	142.1 - 145.1	
P-6	127.7	140.1 - 146.8	143.7 - 147.0	Reading on 3/29/2023 was 0.2 ft above the historical max.
P-7	152.7	154.7 - 166.5	165.0 - 166.7	Reading on 9/26/2023 was 0.2 ft above the historical max.
P-8A	164.3	164.3 - 173.6	168.8 - 173.8	Reading on 3/29/2023 was 0.2 ft above the historical max.
P-8B	144.5	152.5 - 164.3	161.6 - 164.5	Reading on 3/28/2023 was 0.2 ft above the historical max.
VBW9A	160.4	160.1 - 163.6	160.9 - 167.0	Reading on 3/29/2023 was 3.4 ft above the historical max.
VBW9B	151.7	151.7 - 157.2	155.4 - 159.1	Reading on 3/29/2023 was 1.9 ft above the historical max.
VBW/10A	148.0	157.6 - 163.2	159.8 - 164.3	Reading on 3/29/2023 was 1.1 ft above the historical max.
VBW/10B	136.1	136.1 - 143.2	139.0 - 140.5	
VBW/11	155.4	155.4 - 156.7	155.9 - 156.9	Reading on 2/28/2023 was 0.2 ft above the historical max.
VBW/12	151.5	151.0 - 156.7	152.0 - 154.6	
VBW/13	150.6	150.1 - 153.6	151.7 - 155.5	Reading on 3/29/2023 was 1.9 ft above the historical max.

Piezometers P-1A, P-1B, and P-6 are located near the right end of the dam along a similar cross section of the dam. Piezometers P-1A and P-1B are located on the crest of the dam, while Piezometer P-6 is near its toe. The tip of Piezometer P-1A (Elevation 159.3 ft) is located within the embankment, while Piezometers P-1B and P-6 have tips within the foundation alluvium (Elevations 132.9 ft and 127.7 ft, respectively). Piezometer P-1A remained dry during 2023 (Figure 4) and has historically shown slight to no response to the reservoir water level changes (Figure 9). Piezometers P-1B and P-6 tracked the reservoir level indicating groundwater levels within the alluvium foundation are responsive to reservoir water levels changes. The District stated to GEI that it has been having issues with obtaining readings from piezometer P-1B due to debris build up within the standpipe. The District is planning to clean out the piezometer.

Piezometers P-2A and P-2B are located on the crest of the dam, Piezometer P-5 is located near the toe of the dam, while Piezometers VBW/10A and VBW/10B are located at the

downstream face of the dam. All five piezometers are near the maximum section of the dam. The tips of Piezometer P-2A, P-2B, P-5, VBW/10A, and VBW/10B are at Elevations 153.9 ft, 123.8 ft, 129.6 ft, 148 ft, and 136.1 ft, respectively. Piezometers P-2A installed within the dam embankment, generally tracked the reservoir levels during 2023 (Figure 5). The District stated to GEI that a stone was encountered within piezometer P-2A on 7/7/2023. Based on correspondence with the District, the stone has not been removed yet. The water level observed in VBW/10A appears to follow the historical trend and reacting to the change in reservoir level due to the increase in rainfall. The water levels observed in piezometers P-2A and VBW/10A remained within historical levels with the exceptions identified in Table 1 (Figures 5 and 10).

Piezometers P-2B, P-5, and VBW/10B are installed within the foundation alluvium. Piezometer P-2B tracked the reservoir levels slightly during the 2023 review period, see Figure 5. The exceptions on 1/11/2023, where the readings in P-2B rose approximately 8.6 ft, respectively beyond the historical max but generally remained at normal levels throughout the review period. The unusual rise in readings are most likely due to an obstruction in the well since readings are near elevation 150 ft and because these sporadic spikes were seen during the 2022 review period. Piezometer VBW/10B and P-5 had slight fluctuations during the review period. The water levels observed in VBW/10B, P-2B, and P-5 piezometers remained within historical levels (Figure 10) during the 2023 review period, with the exceptions stated above and in Table 1.

Piezometers P-4, P-8A, P-8B, VBW9A, VBW9B and VBW/11 are located along another plane near the maximum cross section of the dam. Piezometers P-8A & P-8B are located on the crest of the dam, Piezometer P-4 is located near the toe of the dam, and Piezometers VBW9A & VBW9B are located along the downstream face of the dam along with Piezometer VBW/11. Graphs of the water levels during the two-year period from January 2022 through December 2023 are shown on Figure 6, and graphs for the historical period from January 2013 through December 2023 are shown on Figure 11. Piezometers P-8A, VBW9A, and VBW/11 are installed within the dam embankment. Piezometers P-8A continues to respond to reservoir water surface fluctuations. For the 2023 review period, VBW9A had a slight response to reservoir water surface fluctuations. VBW9A also had a slight increase on 3/27/2023, in see Figure 6. The water level observed in the piezometers during the 2023 review period was consistent with historical levels (Figure 11). Piezometers P-4 and P-8B are installed in foundation bedrock, and VBW9B was installed in foundation alluvium. Piezometers P-8B and P-4 generally responded to reservoir water surface fluctuations. The water level within piezometer P-4 increased and was near the top of the piezometer casing elevation. The water level increase occurred during the large rain events in the beginning of the year and began trending downwards as the reservoir level decreased. During the review period, VBW9B and VBW/11 had minor fluctuations. The water levels observed in these piezometers during this 2023 review period were consistent with historical levels (Figures 6 and 11).

Piezometers P-3 and P-7 are located in the left portion of the dam. Piezometer P-3 is located on the crest of the dam, while Piezometer P-7 is on the downstream face near the left groin. Graphs of the water levels during the two-year period from January 2022 through December 2023 are shown on Figure 7, and those for the historical period from January 2013 through December 2023 are shown on Figure 12. The tips of these piezometers are set below the base of the embankment, and possibly into bedrock. During the 2023 review period and historically, both piezometers tracked the reservoir levels closely. The water levels observed in these piezometers during this 2023 review period were consistent with historical levels (Figures 7 and 12).

Vibrating wire piezometers VBW/12 and VBW/13 are located in the maximum section area of the dam at the downstream toe area. Graphs of the water levels during the two-year period from January 2022 through December 2023 are shown on Figure 8, and those for the historical period from January 2013 through December 2023 are shown on Figure 13. The tip elevation of these two piezometers is within the dam embankment. During the 2023 review period, both piezometers had slight responses to reservoir water surface fluctuations, see Figure 13.

Based on GEI's review, the piezometers responded to the increase in reservoir water surface level based on the year's increase rainfall. Though many piezometers had slight increases, the water levels remained normal and consistent with historical levels.

## **2.3 Seepage Flows**

There are no internal drains that were installed during construction of the dam but because of seepage appearing at the downstream toe soon after filling, the Left Subdrain was installed near the downstream toe at the left groin. In 1976, the Right Subdrain was added.

Figure 14 represents the seepage flow rates from the Left and Right Subdrains versus the reservoir water surface elevations for the two-year period from January 2022 through December 2023. Figure 15 covers the historical period from January 2013 through December 2023. Tabulated data for the seepage flow rates is presented in Table 2.

The range of minimum and maximum flow rate for the Left Subdrain based on trends from the ten-year historical data from January 2013 through December 2023 was between 0 and 4.23 gallons per minute (gpm).

During 2023, the Right Subdrain remained dry, while the Left Subdrain flow rate tracked the reservoir levels and ranged from 1.97 gpm to a maximum flow rate of 4.04 gpm. Historically, the left subdrain seepage tracks the reservoir level (Figure 15).

Based on GEI's review of the seepage data, the flow rates continue to be consistent with historical flow rates and there are no indications of unusual conditions or trends. The flows should continue to be observed for clarity to check for the presence of any suspended solids that might indicate a potential piping condition.

## 2.4 Movement Surveys

There are six survey monuments (S-1 through S-6) located on the crest of Sand Canyon Dam spanning from the left abutment to the right abutment (Figure 1). Survey Monuments S-1 through S-5 were initially read on September 15, 1969, while S- 6 was initially read on October 20, 1987. Starting in 1995 the monuments are normally surveyed annually by a licensed surveyor under contract with the District.

Table 3 presents the horizontal movement of the survey monuments compared to the baseline measurements, while Table 4 presents the cumulative horizontal displacement of the survey monuments since 1975. Table 5 presents the survey monument elevations from 1968 through 2023, while Table 6 presents the cumulative vertical movement of the survey monuments since 1969. Figures 16 and 17 are graphical presentations of the cumulative horizontal displacement and cumulative vertical movement of the survey monuments since 1995, respectively.

No survey was performed in 2017 and 2021. A survey was performed on 12/6/2023 and is provided in the Appendix of this report. The data for 2023 has been reviewed and found within historic limits and trends. The cumulative horizontal (+0.1 inch) and vertical (+0.1 inch) movements show relatively minor changes (Tables 3 thru 6) during the review period and most likely related to temperature and reservoir level changes. Based on GEI's review of the historical data, the horizontal and vertical movements are judged to be minimal with no unusual movements.

## 3.0 Field Evaluations

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### 3.1 Field Evaluation of July 10, 2023

A field evaluation and inspection were performed by Emerson Revolorio and Kody Vandervort of GEI, and Cristina Rodriguez, Steve Habiger, and Ryan Tran of the District on July 10, 2023. The reservoir level was reported to be at Elevation 191.7 ft and 1.8 ft below the spillway crest. Weather conditions were sunny with temperature in the mid-70s. Photos taken by GEI are included in the Appendix of this report.

#### 3.1.1 Dam

The crest of the dam was walked, and the asphalt concrete surface was observed to be in good condition with no signs of movement and significant cracking, see Photo 1. Minor temperature related AC cracking was observed near the left abutment, see Photo 1. The exposed upstream AC-lined slope face above the reservoir water level had some long-standing transverse and longitudinal shrinkage-expansion cracking with vegetation growing within the cracks, see Photo 2. The dam crest and upstream face looked similar to what was observed during the December 2022 inspection.

The downstream toe area, downstream embankment slope, and both groin areas were inspected. GEI inspected the previously reported desiccation cracks near piezometer P-7. The cracks appeared similar to the conditions seen in the December 2022 inspection and are not considered a dam safety issue, see Photo 3. The downstream slope of the dam had recently been mowed, see Photo 4. GEI noticed an existing bulge in the downstream slope near the right abutment, see Photo 5. IRWD reported that the bulge has existed for years. GEI did not observe any signs of instability or seepage in the bulge. GEI observed minor signs of rodent activity along the downstream slope of the dam near the left abutment, see Photo 6. During the inspection, GEI discovered little to no poison in the rodent control feeder boxes throughout the dam. IRWD reported that they are limited to the amount of poison they can add to the environment. Currently, IRWD is utilizing carbon monoxide as an effective treatment for ground squirrel control. IRWD still has black feeder control stations for rats and mice near the dam caretaker houses and other IRWD facilities. No signs of live seepage were seen on the downstream slope face. During the inspection, it was observed that an automatic data acquisition system pilot program was installed at select piezometers throughout the dam to determine the future of instrumentation monitoring at Sand Canyon, see Photo 7.

During the inspection, IRWD staff took readings at piezometers P-2A, P-2B, and P-4 and GEI determined that the readings followed historical trends. The District indicated that there was an odor and possible debris inside P-2A. GEI observed that the top of standpipe for P-2A is flush



with the ground which can allow surface runoff water to enter the piezometer when it rains, see Photo 8.

Overall, the condition of the dam remains largely unchanged from the conditions observed during the December 2022 inspection. Overall, the dam was well maintained with no signs of instability or distress.

### **3.1.2 Spillway**

The District reported the reservoir spilled this year and stopped spilling in late April or May. The reservoir was not spilling during the inspection, but reservoir water levels were near the ogee weir crest, see Photo 9. GEI was not able to access the spillway by climbing the weir due to the high-water level. GEI accessed the spillway by climbing down a chute wall. Vegetation and debris have accumulated along the spillway channel due to the recent spilling, see Photo 9 and 10. Minor brush/tule growth was observed at the end of the stilling basin, see Photo 11. The District is aware this vegetation growth has to be monitored continuously and cut as required. The District recently installed a crack gauge at the previously reported right spillway concrete wall vertical joint offset, see Photo 12 and 13. GEI measured the vertical offset and confirmed that there has not been any movement since the last inspection in December 2022. The x-direction crack gauge measurement was +2 mm (upstream), see Photo 12. The z-direction crack gauge measurement was -2 mm (into the wall), see Photo 13. GEI recommends using the above crack gauge measurements as a base reference for comparison for future measurements. GEI also measured the undermining at the previously reported concrete repair work in the spillway channel floor on the right side of the spillway, see Photo 14. Based on observations, the undermining progressed by a couple of inches since the last inspection. The maximum dimensions of the undermining were approximately 10-inches in height, 14-inches deep, and 88-inches long. The undermining will continue to progress when the spillway flows. The expansion joint material between the spillway panels continues to deteriorate, see Photo 12. The vegetation directly above the spillway channel walls was still present and continues to grow, see Photos 9 and 10.

The exposed concrete wall surfaces, ogee section, rock/concrete in-fill channel bottom, and stilling basin were inspected, and no signs of instability or concrete defects were seen.

### **3.1.3 Outlet Works**

The four upstream outlet gates and three downstream blowoff/control valves were not exercised during this inspection. The District reported they were all exercised on 4/18/2023 and 4/19/2023 during the DSOD inspection. The District also reported that the gate valve #2 stem was damaged when it was exercised during the DSOD inspection, see Photo 15 and 16. The overgrown vegetation in Sand Canyon creek near the 24-inch outfall had been recently cleared, see Photo 17. GEI was not able to locate the 24-inch outfall due to the high-water level in the creek. The

District plans to locate the outfall once the water level in the creek lowers. Access to emergency valve 7 is currently obstructed with large diameter angular rocks and vegetation, see Photo 18. The rocks and vegetation make it difficult to access and operate the valve during an emergency. The District recently installed a water meter inside a concrete vault box at the outfall to measure the flow of water from the emergency outlet valves, see Photo 19. GEI observed pooled water inside the new water meter vault box. Since the December 2022 inspection, the District updated their non-potable system details.

Based on the District's report, and observations of the control equipment; the outlet works for the dam appeared fully operational except for the gate 2 outlet valve. Figure 1 shows the locations of the inlet gate structure which consist of three upstream 24-inch outlet gates (Nos. 1, 2, and 3), and one 20-inch diameter main lower outlet slide gate. Downstream of the dam adjacent to the Sand Canyon Creek, there are two 24-inch-diameter emergency valves (Valve 7 and 19), and a 20-inch-diameter emergency valve (Valve 20) for lowering the reservoir level in an emergency. The outfall is located within the creek area.

#### **3.1.4 Seepage**

Seepage flow rates continue to be monitored and measured monthly by District staff. A small seepage flow, estimated as 2 to 3 gpm, was observed in the Left Subdrain. The Right Subdrain was dry during this inspection. The observed seepage conditions were within past levels and based on past records and observations. Seepage water did not appear to have turbidity and appeared to be clear, see Photo 20. The District plans to install a new vault box for the two seepage drains.

## 4.0 Conclusions and Recommendations

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### 4.1 Conclusions

- 1) Based on the review of available instrumentation data and the field inspection, the dam does not appear to have signs of structural deficiencies, seepage, and instability.
- 2) Starting in December 2022, there was a significant increase in rainfall compared to previous years. The largest rainfall occurred between January and March with readings ranging from 4.0 to 7.2 inches per month. A large rainfall event also occurred in August 2023, which recorded 1.8 inches of rain during the month. Based on historical data, August is typically a dry month with little to no rain. The significant increase in rainfall attributed to the reservoir intermittently spilling between January and May.
- 3) Based on GEI's review, the piezometers responded to the increase in reservoir water surface level based on the year's increase rainfall. Though many piezometers had slight increases, the water levels remained normal and consistent with historical levels.
- 4) The District has been having issues obtaining readings from Piezometer P-1B due to debris build up within the standpipe.
- 5) There is a stone stuck inside piezometer P-2A. The top of standpipe for piezometer P-2A is flush with the adjacent ground which can allow surface runoff water to enter the piezometer when it rains.
- 6) There is possible sedimentation or obstruction in piezometer P-2B.
- 7) The water level within piezometer P-4 increased and was near the top of the piezometer casing elevation. The water level increase occurred during the large rain events in the beginning of the year and began trending downwards as the reservoir level decreased.
- 8) Seepage flow rates during this review period are within historical values and trends.
- 9) Horizontal and vertical movement are within historical values and trends.
- 10) The downstream face grass cover has been mowed since the December 2022 inspection.
- 11) GEI saw minor rodent activity along the downstream slope of the dam near the left abutment. IRWD is continuing with rodent control measures. IRWD is currently utilizing carbon monoxide as an effective treatment for ground squirrel control. IRWD still has black feeder control stations for rats and mice near the dam caretaker houses and other IRWD facilities.
- 12) The long-standing transverse and longitudinal shrinkage-expansion cracking along the upstream face of the AC liner appeared similar to what was observed during the December 2022 inspection.

- 13) An automatic data acquisition system pilot program was installed at select piezometers around the dam.
- 14) The AC pavement on the dam crest has minor temperature expansion cracking.
- 15) Outlet works gate valve #2 stem was damaged when it was exercised during the April DSOD inspection.
- 16) Outlet valves were not exercised during the inspection. Per the District, the outlet valves were last exercised on 4/18/2023 and 4/19/2023 during the DSOD inspection. Based on visual observations of exposed control equipment and District's comments, the outlet facilities remain fully functional except for outlet works gate valve #2.
- 17) IRWD has updated their non-potable system details.
- 18) The area surrounding the 24-inch blowoff outfall has been cleared of overgrown vegetation. The 24-inch outfall was not located due to the high-water level in the creek.
- 19) IRWD had recently installed a water meter and concrete vault box near the outfall. Water has entered and pooled within the vault box.
- 20) Access to the emergency valves is currently obstructed with large diameter angular rocks and vegetation. The rocks and vegetation make it difficult to access and operate the valves during an emergency.
- 21) During the review period, the reservoir spilled and water flowed through the spillway intermittently from January to April/May.
- 22) Vegetation and debris have accumulated along the spillway channel due to the recent spilling.
- 23) Brush/tule growth was sprouting at the end of the spillway stilling basin.
- 24) A crack gauge was recently installed at the right spillway concrete wall vertical joint offset. GEI measured the offset and confirmed that there has not been any movement since the December 2022 inspection.
- 25) The expansion joint material between the spillway panels is deteriorating.
- 26) GEI measured the undermining of previous localized concrete repair areas in the spillway channel floor on the right side of the spillway. The undermining appears to have increased by a couple of inches since the December 2022 inspection.
- 27) GEI observed vegetation directly above the spillway channel walls.
- 28) GEI inspected the desiccation cracks near P-7. The cracks appeared similar to the conditions seen in the December 2022 inspection.

## 4.2 Recommendations

- 1) The District should continue collaborating with pest management companies to determine most effective treatment options in controlling rodent activity. In addition, the District should continue collapsing, backfilling, and compacting rodent holes with surrounding material as an ongoing maintenance item throughout the dam.
- 2) The District needs to clean out piezometer P-1B and P-2B.
- 3) The District needs to clean out piezometer P-2A and extend the top of standpipe to prevent water from entering the piezometer. The top of standpipe should be resurveyed.
- 4) The District needs to prevent any water surface runoff from entering the casing in piezometer P-4. The District should continue to monitor the piezometer, and nearby area for any wet spots.
- 5) Repair AC at localized crack areas on the upstream slope and crest of the dam. These cracks should be repaired with a Sika AC repair product. Vegetation and brush at the upstream slope need to be removed.
- 6) The outlet controls should continue to be fully exercised annually.
- 7) The outlet works gate valve #2 stem needs to be repaired and fully exercised to confirm it is still operable.
- 8) The District to provide condition of the 24-inch blowoff outfall once the water level in the creek lowers.
- 9) GEI recommends clearing the rocks and vegetation restricting access to the emergency valves.
- 10) The District needs to continue monitoring brush/tule growth at the spillway stilling basin and cut when appropriate to avoid any damage to spillway concrete or impacts to spillway operability.
- 11) The District needs to remove vegetation and debris that accumulate in the spillway channel after spilling.
- 12) The right spillway concrete wall vertical joint offset has not changed from the previous inspections. The recently installed crack gauges at the offset need to be measured annually for further movement and evaluation. GEI recommends using the measured values as a base reference for comparison for future measurements.
- 13) The expansion joint material between the spillway wall panels needs to be repaired with a flexible joint sealant.

- 14) The District needs to inspect the undermining at the previous localized concrete repair areas in the spillway channel when the spillway is dry. The District should plan to repair the area before the next wet season.
- 15) GEI recommends clearing the vegetation directly above the spillway channel walls.
- 16) GEI recommends continuously monitoring the desiccation cracks near piezometer P-7.
- 17) Continued careful monitoring by the District staff of the condition of the dam, appurtenances and instrumentation is essential. Staff needs to be inspecting for signs of distress or movement, increased seepage, or any other unusual conditions including instrumentation readings during their periodic inspections. Any unusual observations should be reported immediately to the Dam Safety Engineer.
- 18) GEI recommends continuing following IRWD's Dam Safety Program Guidelines after a 4.0 earthquake.



### Sand Canyon Dam Action Item Summary

Item	Location	Maintenance	Measures
Rodent activity	Throughout dam	Active rodent holes and lack of poison in rodent control feeder boxes	The District should continue collaborating with pest management companies to determine most effective treatment options in controlling rodent activity. In addition, the District should continue collapsing, backfilling, and compacting rodent holes with surrounding material as an ongoing maintenance item throughout the dam.
Piezometer P-1B	Dam crest	Possible obstruction in piezometer	Clean out piezometer.
Piezometer P-2B	Dam crest	Possible obstruction in piezometer	Clean out piezometer.
Piezometer P-2A	Dam crest	Possible obstruction in piezometer and standpipe	Clean out piezometer. Extend the top of standpipe to prevent water from entering. Resurvey top of piezometer.
Piezometer P-4	Dam crest	Increase piezometer water level readings	Prevent water surface runoff from entering piezometer. Continue monitoring piezometer, and nearby area for wet spots.
AC pavement	Dam crest	Shrinkage-expansion temperature cracking	Repair AC pavement by filling in cracks and creating a smooth surface with a Sika AC repair product.
AC Liner	Upstream face	Shrinkage-expansion temperature cracking and vegetation growth in cracks	Repair areas with large cracks by filling in and creating a smooth surface with a Sika AC repair product. Remove vegetation.
AC Liner	Upstream face near water line	Overgrown brush within the reservoir near the water line	Remove brush.
Gate valve #2 stem	Upstream face	Buckled outlet works stem	Repair stem and fully exercise to confirm if it is still operable.
Emergency 24-inch blowoff outfall	Downstream of dam in Sand Canyon Creek	Unable to locate	Report condition of outfall when water level in creek lowers.
Downstream emergency outfall valves	Downstream of dam	Vegetation and angular rocks obstructing area	Clear area of rocks and vegetation to provide access to the emergency outfall valves.
Stilling basin	Spillway stilling basin	Brush/tule growth	Cut and maintain.
Spillway channel wall	Right spillway concrete wall vertical joint	Vertical wall joint with approximately a 1-inch offset between concrete wall sections	Continue to monitor and measure crack gauges annually. Report to Dam Safety Engineer if the wall continues to deflect.
Spillway channel wall	Right spillway concrete wall vertical joint	Expansion joint material between spillway wall panels is deteriorating	Repair with flexible joint sealant.
Spillway channel walls	Spillway	Overgrown vegetation above spillway channel walls	Remove vegetation directly above the spillway channel walls.
Spillway channel	Spillway	Vegetation and debris throughout channel, undermining of previous localized concrete repairs	Remove vegetation and debris that accumulated in the channel after spilling. The District needs to inspect the undermining at the previous localized concrete repair areas in the spillway channel when the spillway is dry. The District should plan to repair the area before the next wet season.

## 5.0 Limitations

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This report presents observations made, conclusions drawn, and opinions formed from (1) a visual inspection of the Sand Canyon Dam and its appurtenant structures, and (2) a review of instrumentation data, including piezometer levels and seepage, collected by the District and reported since 1975. The purpose of the inspection and review is to assess the safety of the structure for continuing operation. Reuse of this report for any other purposes, in part or in whole, is at the sole risk of the user.

In the context intended above, the term "safety" is interpreted to be restricted specifically to major structural and control features of the project in regard to their adequacy against possible catastrophic failure due to natural or operational events. No consideration is given herein to those public safety aspects related to voluntary occupancy or use of project features in such manner as to result in personal mishaps.

The undersigned who performed the inspection and reviewed the instrumentation data and prepared this report, desire that it be clearly understood that the conclusions regarding the condition and safety of the dam and related facilities are not guaranteed but do represent our best judgment. Inevitably, such judgment must be recognized to be affected to an uncertain degree by the practical limitations that affect all dam evaluations, relative principally to approximate knowledge of the existing properties of the structures and their foundations, the potential for storm or seismic damage, and the uncertainties that are known to exist in estimating margins of safety.

The conclusions and professional opinions presented herein were developed by GEI Consultants, Inc. for the Irvine Ranch Water District in accordance with generally accepted engineering principles and practices. We make no other warranty, either expressed or implied.

## 6.0 References

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California Department of Water Resources, Division of Safety of Dams (DSOD), 1984, Sand Canyon Dam, 1029-2, Safety Review Report; safety Review Report; by DSOD; date April 1984.

California Department of Water Resources, DSOD, 2020, Inspection of Dam and Reservoir in Certified Status report; October 19, 2020.

HDR. 2021, Draft Data Summary Report, Sand Canyon Dam, July 2021

## Tables

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**TABLE 2**  
**SAND CANYON DAM**  
**PIEZOMETER AND SUBDRAIN MEASUREMENTS**  
**JANUARY 2007 THROUGH DECEMBER 2023**

Monitoring Well --->			1A		1B		2A		2B	
Top of Well Elevation --->			201.9		201.8		201.9		202	
Bottom of Well Elevation --->			159.3		132.9		153.9		123.8	
Depth of Well --->			42.6		68.9		48		78.2	
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Reading	Elev.	Reading	Elev.
	Elevation	Rainfall								
1/31/2007	176.80		41.6	160.3	59.1	142.7	35.2	166.7	62.7	139.3
2/28/2007	177.60		42.5	159.4	59.2	142.6	35.5	166.4	62.6	139.4
3/29/2007	177.10		42.3	159.6	59.2	142.6	35.6	166.3	62.6	139.4
4/27/2007	176.60		42.3	159.6	59.3	142.5	35.3	166.6	62.8	139.2
5/24/2007	176.80		42.3	159.6	59.7	142.1	35.9	166.0	63.1	138.9
6/27/2007	179.90		42.5	159.4	59.6	142.2	35.3	166.6	63.4	138.6
7/27/2007	177.80		42.4	159.5	60.0	141.8	35.8	166.1	64.0	138.0
8/28/2007	177.20		42.4	159.5	60.1	141.7	35.5	166.4	64.1	137.9
9/26/2007	177.00		42.5	159.4	59.7	142.1	35.7	166.2	63.8	138.2
10/30/2007	175.50		42.5	159.4	59.6	142.2	36.0	165.9	63.9	138.1
11/27/2007	175.90		42.5	159.4	59.9	141.9	36.3	165.6	63.9	138.1
12/27/2007	178.20		42.6	159.3	59.5	142.3	36.4	165.5	63.0	139.0
1/30/2008	184.40		42.4	159.5	57.7	144.1	35.8	166.1	61.0	141.1
2/26/2008	186.10		42.4	159.5	57.0	144.8	34.9	167.0	60.7	141.3
3/26/2008	188.00		42.6	159.3	56.6	145.2	33.8	168.1	60.8	141.2
4/25/2008	191.00		42.4	159.5	56.5	145.3	32.7	169.2	61.0	141.0
5/28/2008	190.93		41.4	160.6	55.9	145.9	31.3	170.6	60.3	141.7
6/25/2008	189.50		42.3	159.6	56.1	145.7	30.7	171.2	60.5	141.5
7/29/2008	185.10		41.4	160.5	56.6	145.2	30.9	171.0	61.0	141.0
7/30/2008	185.10	0.00	41.5	160.4	56.5	145.3	30.7	171.2	60.9	141.1
8/27/2008	178.00	0.00	41.7	160.2	57.6	144.2	32.1	169.8	61.7	140.3
9/25/2008	176.80	0.00	42.5	159.4	58.4	143.4	33.1	168.8	62.4	139.6
10/28/2008	175.20	0.00	44.4	157.5	58.8	143.0	34.3	167.6	62.9	139.1
11/25/2008	175.80	1.82	42.4	159.5	58.9	142.9	35.2	166.7	63.0	139.0
12/30/2008	181.70	2.91	42.6	159.3	57.7	144.1	35.2	166.7	61.4	140.6
1/29/2009	182.20	0.39	42.4	159.5	57.5	144.3	34.8	167.1	61.3	140.7
2/25/2009	185.70	3.10	42.0	159.9	57.0	144.8	34.1	167.8	59.9	142.1

Notes:

1. Readings in red are classified as erroneous
2. Elevation calculations between 2/27/2019 and 12/29/2020 were not included due to issues with data logger.
3. Piezometer data based on NGVD 29 datum.

**TABLE 2**  
**SAND CANYON DAM**  
**PIEZOMETER AND SUBDRAIN MEASUREMENTS**  
**JANUARY 2007 THROUGH DECEMBER 2023**

Monitoring Well --->			1A		1B		2A		2B	
Top of Well Elevation --->			201.9		201.8		201.9		202	
Bottom of Well Elevation --->			159.3		132.9		153.9		123.8	
Depth of Well --->			42.6		68.9		48		78.2	
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Reading	Elev.	Reading	Elev.
	Elevation	Rainfall								
3/26/2009	188.40	0.10	42.4	159.5	56.9	144.9	33.2	168.7	61.0	141.0
4/28/2009	189.30	0.00	42.4	159.5	56.7	145.1	32.0	169.9	61.3	140.7
5/18/2009	188.50	0.00	41.3	160.6	56.6	145.2	31.4	170.5	61.0	141.0
5/27/2009	188.10	0.00	42.2	159.7	56.7	145.1	31.2	170.7	61.0	141.0
6/30/2009	188.60	0.10	42.4	159.5	56.7	145.1	31.2	170.7	61.3	140.7
7/30/2009	184.80	0.00	42.3	159.6	56.9	144.9	30.9	171.0	61.3	140.7
8/26/2009	176.60	0.00	41.5	160.4	57.8	144.0	31.6	170.3	61.8	140.2
9/30/2009	174.50	0.00	42.2	159.7	59.0	142.8	33.3	168.6	62.8	139.2
10/28/2009	175.30	0.29	42.6	159.3	59.2	142.6	34.2	167.7	63.0	139.0
12/1/2009	176.40	0.00	42.0	159.9	59.4	142.4	35.2	166.7	63.3	138.7
12/28/2009	178.80	2.75	42.5	159.5	58.6	143.3	35.5	166.5	62.2	139.8
1/26/2010	191.30	4.15	42.4	159.5	57.3	144.5	34.9	167.0	60.6	141.4
2/24/2010	193.60	2.29	42.4	159.5	55.4	146.4	32.5	169.4	59.8	142.2
3/29/2010	193.50	1.18	42.2	159.7	55.4	146.4	29.9	172.0	60.0	142.0
4/4/2010	193.50		41.5	160.4	55.5	146.3	25.5	176.4	60.0	142.0
4/27/2010	193.90	1.66	42.3	159.6	55.4	146.4	29.2	172.7	59.9	142.1
5/27/2010	192.90	0.03	41.4	160.5	55.4	146.4	28.7	173.2	59.9	142.1
6/29/2010	191.60	0.00	41.4	160.5	55.4	146.4	28.7	173.2	59.7	142.3
7/28/2010	187.50	0.00	42.3	159.6	55.9	145.9	29.1	172.8	60.4	141.6
8/31/2010	179.20	0.00	41.5	160.4	57.3	144.5	30.8	171.1	61.4	140.6
9/29/2010	175.60	0.00	41.2	160.7	58.5	143.3	31.7	170.2	62.0	140.0
10/26/2010	178.20	2.93	41.4	160.5	58.6	143.2	33.0	168.9	61.9	140.1
11/30/2010	178.80	1.14	42.6	159.3	58.8	143.0	34.4	167.5	62.4	139.6
12/30/2010	193.90	9.95	42.4	159.5	55.4	146.4	33.8	168.1	59.5	142.5
1/27/2011	194.00	0.86	41.5	160.4	55.4	146.4	30.4	171.5	60.0	142.0
2/23/2011	193.80	1.02	42.4	159.5	55.5	146.4	28.9	173.0	59.7	142.3
3/29/2011	193.90	2.38	41.3	160.6	54.9	146.9	28.1	173.8	59.5	142.5
4/27/2011	193.60	0.56	42.3	159.6	55.3	146.5	27.6	174.3	59.8	142.2

Notes:

1. Readings in red are classified as erroneous
2. Elevation calculations between 2/27/2019 and 12/29/2020 were not included due to issues with data logger.
3. Piezometer data based on NGVD 29 datum.



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Bottom of Well Elevation --->			159.3		132.9		153.9		123.8	
Depth of Well --->			42.6		68.9		48		78.2	
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Reading	Elev.	Reading	Elev.
	Elevation	Rainfall								
5/25/2011	193.10	0.51	41.4	160.5	55.2	146.6	27.9	174.0	59.8	142.2
6/28/2011	192.00	0.00	42.3	159.6	55.3	146.5	28.2	173.7	59.7	142.3
7/27/2011	186.75	0.00	41.5	160.5	55.8	146.0	28.9	173.1	60.0	142.0
8/25/2011	176.30	0.00	42.4	159.5	57.2	144.6	30.3	171.6	61.0	141.0
9/28/2011	176.00	0.06	42.4	159.5	58.6	143.3	32.5	169.5	62.1	139.9
10/25/2011	176.50	0.89	42.2	159.7	59.1	142.7	33.5	168.4	62.3	139.7
11/22/2011	177.20	1.31	42.4	159.5	58.9	143.0	34.4	167.5	62.2	139.8
12/22/2011	176.70	0.20	41.6	160.3	59.0	142.8	34.5	167.4	62.5	139.5
1/25/2012	178.60	0.84	41.4	160.5	58.6	143.2	35.0	166.9	61.9	140.1
2/28/2012	179.20	0.68	41.5	160.4	58.6	143.2	35.5	166.4	61.1	140.9
3/27/2012	180.60	1.73	41.5	160.4	58.4	143.5	35.1	166.8	61.6	140.4
6/27/2012	180.70	0.00	42.5	159.4	58.6	143.2	33.8	168.1	61.9	140.1
7/26/2012	179.20	0.10	42.3	159.6	58.7	143.1	34.3	167.6	62.1	139.9
8/8/2012	178.50	0.10	42.2	159.7	58.9	142.9	34.3	167.6	62.7	139.3
8/28/2012	177.10	0.00	42.4	159.5	59.3	142.5	34.6	167.3	62.9	139.1
8/29/2012	177.10	0.00	42.0	159.9	59.1	142.7	34.3	167.6	62.7	139.3
9/25/2012	175.30	0.00	42.3	159.6	59.8	142.0	35.0	166.9	63.5	138.5
10/30/2012	176.00	0.19	42.3	159.6	60.0	141.8	35.6	166.3	63.8	138.2
11/27/2012	175.80	0.69	42.4	159.5	59.7	142.1	35.8	166.2	63.4	138.6
12/12/2012	176.10	1.40	42.5	159.4	59.7	142.1	35.7	166.2	62.9	139.1
1/22/2013	177.20	1.20	42.4	159.5	58.8	143.0	36.0	165.9	62.1	139.9
2/27/2013	178.20	0.31	42.3	159.6	58.4	143.4	35.8	166.1	61.8	140.2
3/28/2013	178.20	0.71	42.4	159.5	58.4	143.4	35.8	166.1	61.7	140.3
4/25/2013	177.30	0.03	42.5	159.4	58.4	143.4	35.9	166.0	62.4	139.7
5/22/2013	177.60	0.00	42.5	159.4	59.0	142.8	35.9	166.0	62.3	139.7
6/25/2013	177.50	0.00	42.3	159.6	59.2	142.7	36.0	165.9	62.5	139.5
7/23/2013	175.70	0.00	42.5	159.4	59.6	142.2	36.0	165.9	63.1	138.9
8/21/2013	174.50	0.00	42.5	159.4	59.9	141.9	36.2	165.7	63.7	138.3

Notes:

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**TABLE 2**  
**SAND CANYON DAM**  
**PIEZOMETER AND SUBDRAIN MEASUREMENTS**  
**JANUARY 2007 THROUGH DECEMBER 2023**

Monitoring Well --->			1A		1B		2A		2B	
Top of Well Elevation --->			201.9		201.8		201.9		202	
Bottom of Well Elevation --->			159.3		132.9		153.9		123.8	
Depth of Well --->			42.6		68.9		48		78.2	
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Reading	Elev.	Reading	Elev.
	Elevation	Rainfall								
9/25/2013	175.70	0.00	42.6	159.3	60.2	141.6	36.3	165.6	63.8	138.2
10/29/2013	176.00	0.00	42.6	159.3	59.9	141.9	36.5	165.4	63.6	138.4
11/27/2013	176.50	0.44	42.3	159.6	59.5	142.3	36.4	165.5	63.3	138.7
12/19/2013	176.80	0.53	42.5	159.4	59.5	142.3	36.4	165.5	63.1	138.9
1/28/2014	176.80	0.00	42.5	159.4	59.1	142.7	36.5	165.4	62.7	139.3
2/25/2014	176.70	0.72	42.3	159.6	59.0	142.8	36.6	165.3	62.5	139.5
3/25/2014	178.50		42.5	159.4	58.5	143.3	36.5	165.4	62.0	140.0
3/29/2014	178.40	1.44	42.5	159.4	58.6	143.2	36.6	165.3	62.0	140.0
4/25/2014	177.40	0.74	42.4	159.5	58.8	143.0	36.3	165.6	62.2	139.8
5/28/2014	176.40	0.00	42.5	159.4	59.4	142.4	36.3	165.6	62.9	139.1
6/25/2014	176.10	0.00	42.5	159.4	60.0	141.8	36.5	165.4	63.6	138.4
7/30/2014	177.30	0.00	42.5	159.4	60.1	141.7	36.4	165.5	63.7	138.4
8/26/2014	176.10	0.03	42.5	159.4	60.2	141.6	36.3	165.6	63.8	138.2
9/23/2014	175.90	0.00	42.3	159.6	60.3	141.5	36.5	165.4	64.2	137.9
10/30/2014	176.30	0.00	42.2	159.7	60.1	141.7	36.6	165.3	64.0	138.0
11/21/2014	176.20	0.25	42.2	159.7	59.9	141.9	36.7	165.2	63.9	138.1
12/30/2014	178.90	3.37	42.3	159.6	58.8	143.0	36.7	165.2	62.5	139.5
1/27/2015	179.60	0.89	42.3	159.6	58.3	143.5	36.2	165.7	62.2	139.9
2/27/2015	180.00	0.46	42.3	159.6	58.3	143.5	35.8	166.1	62.0	140.0
3/26/2015	179.60	0.45	42.3	159.6	58.2	143.6	35.7	166.2	62.1	139.9
4/29/2015	178.20	0.24	42.2	159.7	58.7	143.1	35.5	166.4	62.7	139.3
5/27/2015	179.00	1.04	42.2	159.7	58.6	143.2	35.8	166.1	62.6	139.4
6/25/2015	179.60	0.00	42.2	159.7	58.5	143.3	35.6	166.3	62.3	139.7
7/29/2015	178.10	0.00	42.3	159.6	58.9	142.9	35.5	166.4	63.1	138.9
8/26/2015	176.20	0.00	42.2	159.7	59.2	142.6	35.4	166.5	63.3	138.7
9/22/2015	178.20	1.64	42.2	159.7	58.9	142.9	35.8	166.1	62.8	139.2
10/27/2015	176.90	0.10	42.3	159.6	59.0	142.8	35.8	166.1	63.0	139.0
11/24/2015	176.30	0.17	42.2	159.7	59.2	142.6	36.0	165.9	63.1	138.9

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**PIEZOMETER AND SUBDRAIN MEASUREMENTS**  
**JANUARY 2007 THROUGH DECEMBER 2023**

Monitoring Well --->			1A		1B		2A		2B	
Top of Well Elevation --->			201.9		201.8		201.9		202	
Bottom of Well Elevation --->			159.3		132.9		153.9		123.8	
Depth of Well --->			42.6		68.9		48		78.2	
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Reading	Elev.	Reading	Elev.
	Elevation	Rainfall								
12/22/2015	177.60	0.72	42.3	159.7	58.9	143.0	36.1	165.8	62.9	139.1
1/27/2016	180.10	2.86	42.6	159.3	58.2	143.6	36.5	165.4	61.9	140.1
2/25/2016	181.60	0.20	42.2	159.7	57.8	144.0	35.6	166.3	61.8	140.2
3/24/2016	184.80		42.3	159.6	57.7	144.1	34.1	167.8	61.3	140.7
3/31/2016	184.50	1.51	42.2	159.7	57.7	144.1	35.0	166.9	61.8	140.2
4/28/2016	183.60	0.04	42.2	159.7	57.8	144.0	34.3	167.7	62.1	139.9
5/25/2016	182.50	0.13	42.2	159.7	58.0	143.8	34.2	167.7	62.2	139.8
6/28/2016	180.70	0.00	42.9	159.0	59.2	142.6	33.3	168.6	63.3	138.7
7/27/2016	178.40	0.00	42.4	159.5	59.1	142.7	34.2	167.7	63.1	138.9
8/24/2016	176.40	0.00	42.3	159.6	59.6	142.3	34.8	167.1	63.5	138.5
9/27/2016	175.80	0.00	42.3	159.6	60.0	141.8	35.3	166.6	63.9	138.1
10/26/2016	178.60	0.64	42.3	159.6	59.8	142.0	35.6	166.3	63.7	138.3
11/22/2016	178.30	1.11	42.4	159.5	59.7	142.1	35.5	166.4	63.5	138.5
12/28/2016	184.80	4.01	42.3	159.6	59.0	142.8	35.6	166.3	62.6	139.4
1/25/2017	193.30	6.33	42.4	159.5	56.1	145.7	34.6	167.3	59.0	143.0
2/28/2017	193.90	3.27	42.3	159.6	54.5	147.3	31.2	170.7	58.8	143.2
3/29/2017	193.70	0.08	42.4	159.5	54.7	147.1	29.6	172.3	59.2	142.8
4/27/2017	192.90	0.04	42.2	159.7	54.7	147.1	28.8	173.1	59.5	142.5
5/23/2017	187.90	0.33	42.2	159.7	55.2	146.6	29.1	172.8	59.5	142.5
6/21/2017	182.50	0.00	42.2	159.7	56.1	145.7	29.9	172.0	60.1	141.9
7/26/2017	163.60	0.00	42.2	159.7	58.2	143.6	32.0	169.9	61.6	140.4
8/30/2017	163.60	0.00	42.2	159.7	59.7	142.1	34.1	167.8	62.9	139.1
9/28/2017	163.60	0.00	42.3	159.6	60.8	141.0	35.5	166.4	63.7	138.3
10/26/2017	171.80	0.00	42.1	159.8	61.4	140.4	36.2	165.7	64.2	137.8
11/29/2017	177.20	0.08	42.2	159.7	60.7	141.1	36.8	165.1	64.4	137.6
12/27/2017	176.70	0.00	42.3	159.6	60.9	140.9	36.4	165.5	64.5	137.5
1/24/2018	178.10	1.67	42.3	159.6	60.3	141.5	36.0	165.9	63.9	138.1
2/21/2018	177.80	0.27	42.2	159.7	60.2	141.6	35.9	166.0	63.9	138.1

Notes:

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**JANUARY 2007 THROUGH DECEMBER 2023**

Monitoring Well --->			1A		1B		2A		2B	
Top of Well Elevation --->			201.9		201.8		201.9		202	
Bottom of Well Elevation --->			159.3		132.9		153.9		123.8	
Depth of Well --->			42.6		68.9		48		78.2	
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Reading	Elev.	Reading	Elev.
	Elevation	Rainfall								
3/28/2018	183.50	1.23	42.3	159.6	59.7	142.1	35.6	166.3	63.5	138.5
4/27/2018	184.30	0.05	42.2	159.7	59.5	142.3	35.0	166.9	63.5	138.5
5/30/2018	183.10	0.13	42.2	159.7	59.1	142.7	34.0	167.9	63.4	138.6
6/28/2018	181.70	0.00	42.4	159.5	59.3	142.5	33.8	168.1	63.6	138.4
7/26/2018	180.00	0.00	42.4	159.5	59.8	142.0	34.2	167.7	63.6	138.4
8/28/2018	177.30	0.00	42.3	159.6	60.2	141.6	34.3	167.6	64.2	137.8
9/27/2018	178.10	0.00	42.3	159.6	60.3	141.5	64.4	137.5	64.7	137.3
10/24/2018	178.00	0.66	42.4	159.5	60.3	141.5	64.4	137.5	64.3	137.7
11/29/2018	177.50	1.60	42.3	159.6	60.3	141.5	35.0	166.9	64.3	137.7
12/20/2018	181.40	2.39	42.2	159.7	59.1	142.7	35.0	166.9	62.9	139.1
1/30/2019	189.40	4.56	42.2	159.7	57.4	144.4	34.6	167.3	61.2	140.8
2/27/2019	194.10	7.48	42.3	159.6	54.8	147.0	30.9	171.0	59.4	142.6
3/27/2019	194.00	1.27	42.4	159.5	54.9	146.9	29.1	172.8	59.4	142.6
4/24/2019	193.60	0.07	42.30	159.6	55.00	146.8	28.20	173.7	59.55	142.5
5/30/2019	191.40	0.73	42.20	159.7	55.30	146.5	28.00	173.9	59.80	142.2
6/26/2019	190.80	0.02	42.40	159.5	55.40	146.4	28.10	173.8	59.80	142.2
7/5/2015	190.40	0.00	42.30	159.6	55.40	146.4	28.00	173.9	60.00	142.0
7/30/2019	188.95	0.00	42.30	159.6	55.70	146.1	28.30	173.6	60.30	141.7
8/27/2019	187.40	0.00	42.10	159.8	60.50	141.3	28.10	173.8	60.70	141.3
9/26/2019	186.20	0.00	42.30	159.6	60.40	141.4	28.00	173.9	59.90	142.1
10/22/2019	185.20	0.00	42.20	159.7	56.50	145.3	29.80	172.1	61.20	140.8
11/26/2019	183.50	2.66	42.20	159.7	56.90	144.9	30.80	171.1	61.30	140.7
12/18/2019	186.80	4.44	42.40	159.5	56.40	145.4	31.10	170.8	60.40	141.6
1/28/2020	192.00	0.24	42.20	159.7	55.00	146.8	28.30	173.6	59.50	142.5
2/25/2020	192.10	0.49	42.25	159.7	54.90	146.9	28.20	173.7	59.40	142.6
3/24/2020	194.00	3.89	42.20	159.7	54.80	147.0	28.00	173.9	59.10	142.9
4/29/2020	193.50	4.59	42.20	159.7	53.80	148.0	27.40	174.5	59.20	142.8
5/27/2020	193.10	0.03	42.20	159.7	54.00	147.8	27.40	174.5	59.50	142.5
6/24/2020	190.00	0.00	41.90	160.0	54.10	147.7	27.70	174.2	59.70	142.3

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**JANUARY 2007 THROUGH DECEMBER 2023**

Monitoring Well --->			1A		1B		2A		2B	
Top of Well Elevation --->			201.9		201.8		201.9		202	
Bottom of Well Elevation --->			159.3		132.9		153.9		123.8	
Depth of Well --->			42.6		68.9		48		78.2	
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Reading	Elev.	Reading	Elev.
	Elevation	Rainfall								
7/29/2020	188.90	0.00	42.20	159.7	54.50	147.3	28.50	173.4	59.60	142.4
8/27/2020	185.90	0.00	42.10	159.8	55.10	146.7	29.10	172.8	59.80	142.2
9/29/2020	183.10	0.00	42.30	159.6	55.70	146.1	30.25	171.7	60.00	142.0
10/29/2020	180.30	0.00	42.10	159.8	56.60	145.2	31.40	170.5	60.80	141.2
11/24/2020	179.00	0.65	42.20	159.7	57.40	144.4	32.10	169.8	61.20	140.8
12/29/2020	179.00	1.03	42.20	159.7	57.80	144.0	33.10	168.8	61.20	140.8
1/26/2021	180.50	2.39	42.20	159.7	57.60	144.2	33.50	168.4	60.90	141.1
2/25/2021	182.10	0.03	42.30	159.6	57.40	144.4	33.30	168.6	60.90	141.1
3/23/2021	182.90	1.15	41.40	160.5	57.30	144.5	33.50	168.4	61.30	140.7
4/27/2021	182.00	0.04	42.30	159.6	57.60	144.2	33.20	168.7	61.30	140.7
5/26/2021	181.00	0.11	42.20	159.7	57.80	144.0	33.40	168.5	61.60	140.4
6/30/2021	179.00	0.00	42.30	159.6	58.10	143.7	33.50	168.4	61.90	140.1
7/27/2021	177.10	0.08	42.30	159.6	58.50	143.3	34.00	167.9	62.30	139.7
8/24/2021	175.40	0.00	42.20	159.7	58.90	142.9	34.30	167.6	52.40	149.6
9/28/2021	175.20	0.06	42.20	159.7	59.10	142.7	35.00	166.9	52.80	149.2
10/27/2021	177.20	0.80	42.30	159.6	59.20	142.6	35.40	166.5	63.00	139.0
11/23/2021	177.80	0.00	42.30	159.6	59.10	142.7	35.20	166.7	63.10	138.9
12/21/2021	180.50	5.86	42.20	159.7	58.60	143.2	35.20	166.7	62.10	139.9
1/25/2022	187.00	0.08	42.20	159.7	54.20	147.6	29.30	172.6	59.70	142.3
2/22/2022	186.60	0.18	42.30	159.6	57.30	144.5	33.30	168.6	60.90	141.1
3/28/2022	186.60	1.38	42.30	159.6	56.70	145.1	30.90	171.0	60.10	141.9
4/26/2022	186.60	0.01	42.20	159.7	57.20	144.6	32.00	169.9	61.10	140.9
5/25/2022	185.30	0.05	42.30	159.6	57.70	144.1	31.90	170.0	61.30	140.7
6/28/2022	182.70	0.00	42.30	159.6	58.00	143.8	32.20	169.7	61.70	140.3
7/26/2022	179.70	0.00	42.30	159.6	58.50	143.3	32.60	169.3	62.30	139.7
8/30/2022	178.30	0.13	42.20	159.7	59.10	142.7	33.30	168.6	62.70	139.3
9/29/2022	175.80	0.24	42.20	159.7	59.40	142.4	34.10	167.8	52.70	149.3
10/26/2022	175.30	0.26	42.20	159.7	59.40	142.4	34.70	167.2	63.00	139.0
11/22/2022	179.40	1.46	42.30	159.6	59.10	142.7	35.10	166.8	62.60	139.4

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**JANUARY 2007 THROUGH DECEMBER 2023**

Monitoring Well --->			1A		1B		2A		2B	
Top of Well Elevation --->			201.9		201.8		201.9		202	
Bottom of Well Elevation --->			159.3		132.9		153.9		123.8	
Depth of Well --->			42.6		68.9		48		78.2	
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Reading	Elev.	Reading	Elev.
	Elevation	Rainfall								
12/29/2022	185.70	2.21	42.30	159.6	58.00	143.8	34.20	167.7	51.40	150.6
1/11/2023	191.70	3.90	42.20	159.70	57.30	144.50	33.90	168.00	50.20	151.80
1/25/2023	194.00	7.17	42.20	159.70	55.90	145.90	32.70	169.20	59.80	142.20
2/28/2023	194.00	3.98	42.30	159.60	55.30	146.50	29.70	172.20	58.90	143.10
3/29/2023	194.00	5.92	42.20	159.70	54.00	147.80	28.20	173.70	58.60	143.40
4/25/2023	194.00	0.19	42.20	159.70	55.10	146.70	27.70	174.20	59.60	142.40
5/24/2023	193.40	0.89	42.20	159.70	55.00	146.80	27.84	174.07	59.64	142.36
6/28/2023	192.70	0.07	42.30	159.60	55.30	146.50	27.40	174.50	59.80	142.20
7/26/2023	191.60	0.00	42.20	159.70	55.00	146.80	27.50	174.40	59.70	142.30
8/29/2023	190.50	1.84	42.18	159.72	54.90	146.90	27.60	174.30	59.60	142.40
9/26/2023	189.80	0.00	42.25	159.65	54.90	146.90	27.65	174.25	59.35	142.65
10/25/2023	189.70	0.19	42.20	159.70	54.90	146.90	27.70	174.20	60.10	141.90
11/30/2023	189.20	0.65	42.20	159.70	54.90	146.90	27.70	174.20	60.00	142.00
12/27/2023	190.00	1.15	42.20	159.70	54.90	146.90	27.80	174.10	59.90	142.10

Notes:

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**TABLE 2**  
**SAND CANYON DAM**  
**PIEZOMETER AND SUBDRAIN MEASUREMENTS**  
**JANUARY 2007 THROUGH DECEMBER 2023**

Monitoring Well --->			3		4		5		6	
Top of Well Elevation --->			201.2		150.7		151.5		167.4	
Bottom of Well Elevation --->			155.8		129.1		129.6		127.7	
Depth of Well --->			45.4		21.6		21.9		39.7	
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Reading	Elev.	Reading	Elev.
	Elevation	Rainfall								
1/31/2007	176.80		31.9	169.3	9.4	141.3	9.2	142.3	25.6	141.8
2/28/2007	177.60		31.7	169.5	9.6	141.1	9.3	142.2	25.4	142.0
3/29/2007	177.10		31.9	169.3	10.4	140.3	9.6	141.9	25.6	141.8
4/27/2007	176.60		32.1	169.1	10.5	140.2	9.5	142.0	25.7	141.7
5/24/2007	176.80		32.7	168.5	10.7	140.0	9.8	141.7	26.0	141.4
6/27/2007	179.90		30.0	171.2	11.0	139.7	9.6	141.9	26.0	141.4
7/27/2007	177.80		30.8	170.4	11.5	139.2	9.8	141.7	26.4	141.0
8/28/2007	177.20		31.5	169.7	11.8	138.9	10.2	141.3	26.4	141.0
9/26/2007	177.00		30.5	170.7	11.9	138.8	10.2	141.3	26.1	141.3
10/30/2007	175.50		31.9	169.3	12.3	138.4	10.3	141.2	26.0	141.4
11/27/2007	175.90		31.8	169.4	12.6	138.1	10.3	141.2	25.5	141.9
12/27/2007	178.20		30.3	170.9	12.6	138.1	10.6	140.9	25.4	142.0
1/30/2008	184.40		27.2	174	10.8	139.9	10.3	141.2	24.2	143.2
2/26/2008	186.10		25.6	175.6	9.7	141.0	9.2	142.3	23.6	143.8
3/26/2008	188.00		24.4	176.8	10.0	140.7	9.0	142.5	23.4	144.0
4/25/2008	191.00		22.2	179.0	10.2	140.5	8.9	142.6	23.1	144.3
5/28/2008	190.93		21.9	179.3	10.2	140.6	8.9	142.6	22.6	144.8
6/25/2008	189.50		22.2	179.0	10.2	140.5	8.9	142.6	22.8	144.6
7/29/2008	185.10		24.5	176.7	10.3	140.4	9.0	142.5	23.1	144.3
7/30/2008	185.10	0.00	24.4	176.8	10.3	140.4	8.9	142.6	23.0	144.4
8/27/2008	178.00	0.00	29.3	171.9	10.5	140.2	9.2	142.3	24.0	143.4
9/25/2008	176.80	0.00	30.3	170.9	10.7	140.0	8.9	142.6	24.6	142.8
10/28/2008	175.20	0.00	36.6	164.6	11.0	139.7	9.1	142.4	25.2	142.2
11/25/2008	175.80	1.82	31.5	169.7	11.3	139.4	9.2	142.3	25.3	142.1
12/30/2008	181.70	2.91	27.5	173.7	10.9	139.8	9.2	142.3	24.1	143.3
1/29/2009	182.20	0.39	27.1	174.1	10.9	139.8	9.1	142.4	24.0	143.4
2/25/2009	185.70	3.10	25.1	176.1	10.8	139.9	9.1	142.4	23.5	143.9

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**JANUARY 2007 THROUGH DECEMBER 2023**

Monitoring Well --->			3		4		5		6	
Top of Well Elevation --->			201.2		150.7		151.5		167.4	
Bottom of Well Elevation --->			155.8		129.1		129.6		127.7	
Depth of Well --->			45.4		21.6		21.9		39.7	
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Reading	Elev.	Reading	Elev.
	Elevation	Rainfall								
3/26/2009	188.40	0.10	23.3	177.9	10.8	139.9	9.2	142.3	23.4	144.0
4/28/2009	189.30	0.00	22.4	178.8	10.9	139.8	9.1	142.4	23.1	144.3
5/18/2009	188.50	0.00	22.8	178.4	10.9	139.8	9.2	142.3	23.2	144.2
5/27/2009	188.10	0.00	23.0	178.2	10.9	139.8	9.2	142.3	23.2	144.2
6/30/2009	188.60	0.10	22.8	178.4	11.0	139.7	9.0	142.5	23.7	143.7
7/30/2009	184.80	0.00	24.7	176.5	11.0	139.7	9.1	142.4	23.4	144.0
8/26/2009	176.60	0.00	29.2	172.0	11.1	139.6	9.1	142.4	24.2	143.2
9/30/2009	174.50	0.00	32.1	169.1	11.3	139.4	9.2	142.3	25.3	142.1
10/28/2009	175.30	0.29	31.8	169.4	11.5	139.2	8.3	143.2	25.6	141.8
12/1/2009	176.40	0.00	31.5	169.7	11.9	138.8	9.5	142.0	25.7	141.7
12/28/2009	178.80	2.75	29.9	171.3	11.3	139.4	9.5	142.0	24.9	142.5
1/26/2010	191.30	4.15	22.8	178.4	9.9	140.8	9.2	142.3	23.8	143.6
2/24/2010	193.60	2.29	20.3	180.9	9.8	140.9	7.9	143.6	22.0	145.4
3/29/2010	193.50	1.18	19.7	181.5	8.5	142.2	8.2	143.3	22.0	145.4
4/4/2010	193.50		19.8	181.4	8.7	142.0	8.2	143.3	22.1	145.3
4/27/2010	193.90	1.66	19.5	181.7	8.9	141.8	7.8	143.7	22.0	145.4
5/27/2010	192.90	0.03	19.9	181.3	9.2	141.5	7.8	143.7	22.0	145.4
6/29/2010	191.60	0.00	20.6	180.6	9.5	141.2	7.7	143.8	22.0	145.4
7/28/2010	187.50	0.00	22.6	178.6	9.8	140.9	7.8	143.7	22.4	145.0
8/31/2010	179.20	0.00	27.9	173.3	10.2	140.5	8.0	143.5	23.6	143.8
9/29/2010	175.60	0.00	31.2	170.0	10.6	140.1	8.1	143.4	24.9	142.5
10/26/2010	178.20	2.93	30.5	170.7	10.8	139.9	9.7	141.8	24.9	142.5
11/30/2010	178.80	1.14	30.2	171.0	11.6	139.1	8.3	143.2	25.0	142.4
12/30/2010	193.90	9.95	20.4	180.8	8.6	142.1	5.9	145.6	22.0	145.4
1/27/2011	194.00	0.86	20.0	181.2	9.3	141.4	6.2	145.4	22.0	145.4
2/23/2011	193.80	1.02	20.0	181.3	9.5	141.2	5.9	145.6	22.0	145.4
3/29/2011	193.90	2.38	19.6	181.6	8.9	141.8	6.7	144.8	21.7	145.7
4/27/2011	193.60	0.56	19.7	181.5	9.0	141.7	7.0	144.5	22.0	145.4

Notes:

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Monitoring Well --->			3		4		5		6	
Top of Well Elevation --->			201.2		150.7		151.5		167.4	
Bottom of Well Elevation --->			155.8		129.1		129.6		127.7	
Depth of Well --->			45.4		21.6		21.9		39.7	
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Reading	Elev.	Reading	Elev.
	Elevation	Rainfall								
5/25/2011	193.10	0.51	20.2	181.0	9.2	141.5	7.0	144.5	21.9	145.5
6/28/2011	192.00	0.00	20.7	180.5	9.3	141.4	7.2	144.3	22.0	145.4
7/27/2011	186.75	0.00	23.5	177.8	9.4	141.4	7.1	144.4	22.4	145.0
8/25/2011	176.30	0.00	29.7	171.5	9.7	141.0	7.2	144.3	23.6	143.8
9/28/2011	176.00	0.06	24.7	176.5	10.5	140.3	7.6	143.9	24.9	142.5
10/25/2011	176.50	0.89	31.7	169.5	11.0	139.7	8.1	143.4	25.2	142.2
11/22/2011	177.20	1.31	31.7	169.6	11.1	139.7	8.2	143.4	25.2	142.2
12/22/2011	176.70	0.20	31.7	169.5	11.5	139.2	8.2	143.3	25.4	142.0
1/25/2012	178.60	0.84	30.8	170.4	11.7	139.0	8.3	143.2	25.0	142.4
2/28/2012	179.20	0.68	30.5	170.7	11.7	139.0	8.5	143.0	25.0	142.4
3/27/2012	180.60	1.73	29.7	171.5	11.5	139.2	8.4	143.1	24.8	142.7
6/27/2012	180.70	0.00	28.0	173.2	10.3	140.4	8.8	142.7	24.9	142.5
7/26/2012	179.20	0.10	29.8	171.5	10.9	139.8	8.8	142.7	25.1	142.3
8/8/2012	178.50	0.10	30.1	171.1	10.8	139.9	8.6	142.9	25.3	142.1
8/28/2012	177.10	0.00	31.0	170.2	11.2	139.5	8.7	142.8	25.6	141.8
8/29/2012	177.10	0.00	30.8	170.4	11.0	139.7	8.5	143.0	25.5	141.9
9/25/2012	175.30	0.00	32.2	169.0	11.6	139.1	8.8	142.7	26.1	141.3
10/30/2012	176.00	0.19	32.0	169.2	12.1	138.6	8.9	142.6	26.3	141.1
11/27/2012	175.80	0.69	32.2	169.0	12.4	138.3	9.4	142.1	26.0	141.4
12/12/2012	176.10	1.40	31.9	169.3	12.5	138.2	9.5	142.0	25.8	141.6
1/22/2013	177.20	1.20	31.3	169.9	12.5	138.2	9.6	141.9	25.1	142.3
2/27/2013	178.20	0.31	30.7	170.5	12.2	138.5	9.3	142.2	24.7	142.7
3/28/2013	178.20	0.71	31.0	170.2	12.1	138.6	9.5	142.0	24.7	142.7
4/25/2013	177.30	0.03	31.6	169.6	12.2	138.6	9.6	141.9	25.1	142.3
5/22/2013	177.60	0.00	31.4	169.8	12.1	138.6	9.6	141.9	25.3	142.1
6/25/2013	177.50	0.00	31.4	169.9	12.2	138.6	9.6	141.9	25.5	142.0
7/23/2013	175.70	0.00	32.4	168.8	12.3	138.4	9.7	141.8	25.9	141.5
8/21/2013	174.50	0.00	32.8	168.4	12.5	138.2	9.7	141.8	26.3	141.1

Notes:

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**PIEZOMETER AND SUBDRAIN MEASUREMENTS**  
**JANUARY 2007 THROUGH DECEMBER 2023**

Monitoring Well --->			3		4		5		6	
Top of Well Elevation --->			201.2		150.7		151.5		167.4	
Bottom of Well Elevation --->			155.8		129.1		129.6		127.7	
Depth of Well --->			45.4		21.6		21.9		39.7	
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Reading	Elev.	Reading	Elev.
	Elevation	Rainfall								
9/25/2013	175.70	0.00	32.4	168.8	12.9	137.8	10.2	141.3	26.5	140.9
10/29/2013	176.00	0.00	32.2	169.0	13.0	137.7	10.2	141.3	26.3	141.2
11/27/2013	176.50	0.44	31.8	169.4	12.9	137.8	10.0	141.5	25.9	141.5
12/19/2013	176.80	0.53	31.7	169.5	13.1	137.6	10.2	141.3	25.8	141.6
1/28/2014	176.80	0.00	32.0	169.2	13.0	137.7	10.3	141.2	25.5	141.9
2/25/2014	176.70	0.72	32.2	169.0	12.8	137.9	10.3	141.2	25.4	142.1
3/25/2014	178.50		30.9	170.3	8.1	142.6	10.2	141.3	24.9	142.5
3/29/2014	178.40	1.44	31.1	170.1	8.2	142.5	10.3	141.2	24.9	142.5
4/25/2014	177.40	0.74	31.5	169.7	8.9	141.8	10.2	141.3	25.0	142.4
5/28/2014	176.40	0.00	32.4	168.8	9.7	141.0	10.3	141.3	25.7	141.7
6/25/2014	176.10	0.00	32.2	169.0	10.3	140.4	10.2	141.3	26.3	141.1
7/30/2014	177.30	0.00	31.6	169.6	10.7	140.1	10.2	141.3	26.4	141.0
8/26/2014	176.10	0.03	32.1	169.1	11.0	139.7	10.2	141.3	26.4	141.0
9/23/2014	175.90	0.00	32.0	169.2	11.4	139.3	10.3	141.2	26.7	140.8
10/30/2014	176.30	0.00	32.1	169.1	11.9	138.8	10.5	141.0	26.5	140.9
11/21/2014	176.20	0.25	31.8	169.4	12.1	138.6	10.5	141.0	26.2	141.2
12/30/2014	178.90	3.37	30.3	170.9	11.9	138.8	10.5	141.0	25.2	142.2
1/27/2015	179.60	0.89	29.9	171.3	11.9	138.8	10.5	141.1	24.8	142.6
2/27/2015	180.00	0.46	29.7	171.5	11.9	138.8	10.5	141.0	24.6	142.8
3/26/2015	179.60	0.45	30.0	171.2	11.9	138.8	10.4	141.1	24.5	142.9
4/29/2015	178.20	0.24	30.8	170.4	11.9	138.8	10.6	140.9	24.9	142.5
5/27/2015	179.00	1.04	30.8	170.4	12.0	138.7	10.4	141.1	24.9	142.5
6/25/2015	179.60	0.00	29.8	171.4	12.0	138.7	10.3	141.2	25.0	142.4
7/29/2015	178.10	0.00	30.8	170.4	12.3	138.4	10.4	141.1	25.3	142.1
8/26/2015	176.20	0.00	31.9	169.3	12.3	138.4	10.4	141.1	25.6	141.8
9/22/2015	178.20	1.64	31.0	170.2	9.3	141.4	10.5	141.0	25.3	142.1
10/27/2015	176.90	0.10	31.4	169.8	9.9	140.8	10.5	141.0	25.3	142.1
11/24/2015	176.30	0.17	32.5	168.7	10.4	140.3	10.6	140.9	25.7	141.7

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Monitoring Well --->			3		4		5		6	
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Bottom of Well Elevation --->			155.8		129.1		129.6		127.7	
Depth of Well --->			45.4		21.6		21.9		39.7	
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Reading	Elev.	Reading	Elev.
	Elevation	Rainfall								
12/22/2015	177.60	0.72	31.2	170.0	10.7	140.0	10.5	141.0	25.2	142.2
1/27/2016	180.10	2.86	30.2	171.0	10.2	140.5	10.5	141.0	24.5	142.9
2/25/2016	181.60	0.20	29.2	172.0	10.6	140.1	9.9	141.6	24.2	143.2
3/24/2016	184.80		27.6	173.6	10.1	140.6	9.8	141.7	24.0	143.4
3/31/2016	184.50	1.51	27.6	173.6	10.2	140.5	9.8	141.7	24.1	143.3
4/28/2016	183.60	0.04	27.8	173.4	10.4	140.3	9.8	141.7	24.3	143.1
5/25/2016	182.50	0.13	28.4	172.8	10.6	140.1	9.8	141.7	24.4	143.0
6/28/2016	180.70	0.00	29.3	171.9	11.0	139.7	9.9	141.6	24.9	142.5
7/27/2016	178.40	0.00	30.7	170.5	11.1	139.6	9.9	141.6	25.5	141.9
8/24/2016	176.40	0.00	32.1	169.2	11.4	139.3	10.0	141.5	25.6	141.8
9/27/2016	175.80	0.00	32.7	168.5	11.8	138.9	10.1	141.4	26.4	141.0
10/26/2016	178.60	0.64	31.0	170.2	11.2	139.5	10.2	141.3	25.4	142.0
11/22/2016	178.30	1.11	31.2	170.0	12.2	138.5	10.3	141.3	26.1	141.3
12/28/2016	184.80	4.01	29.3	172.0	12.3	138.4	10.3	141.2	25.5	142.0
1/25/2017	193.30	6.33	22.5	178.7	11.0	139.7	7.1	144.4	22.6	144.8
2/28/2017	193.90	3.27	21.4	179.8	9.3	141.4	6.7	144.8	21.1	146.3
3/29/2017	193.70	0.08	21.2	180.0	9.1	141.6	7.2	144.3	21.4	146.0
4/27/2017	192.90	0.04	21.5	179.7	9.0	141.7	7.2	144.3	21.4	146.0
5/23/2017	187.90	0.33	23.8	177.4	9.1	141.6	7.3	144.2	21.9	145.5
6/21/2017	182.50	0.00	27.0	174.2	9.3	141.4	7.3	144.2	22.6	144.8
7/26/2017	163.60	0.00	34.6	166.6	9.7	141.0	8.3	143.3	24.4	143.0
8/30/2017	163.60	0.00	37.8	163.4	10.5	140.2	7.2	144.3	25.9	141.5
9/28/2017	163.60	0.00	40.2	161.0	11.4	139.3	10.5	141.0	26.9	140.5
10/26/2017	171.80	0.00	41.4	159.8	11.7	139.0	10.6	140.9	27.3	140.1
11/29/2017	177.20	0.08	33.1	168.1	12.3	138.4	10.9	140.6	27.1	140.3
12/27/2017	176.70	0.00	32.6	168.6	12.7	138.0	11.1	140.4	27.1	140.3
1/24/2018	178.10	1.67	31.8	169.4	13.0	137.7	11.1	140.4	27.1	140.3
2/21/2018	177.80	0.27	31.8	169.4	13.2	137.5	11.1	140.4	26.6	140.8

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Top of Well Elevation --->			201.2		150.7		151.5		167.4	
Bottom of Well Elevation --->			155.8		129.1		129.6		127.7	
Depth of Well --->			45.4		21.6		21.9		39.7	
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Reading	Elev.	Reading	Elev.
	Elevation	Rainfall								
3/28/2018	183.50	1.23	28.8	172.4	13.3	137.4	11.2	140.3	26.1	141.3
4/27/2018	184.30	0.05	27.9	173.3	13.4	137.3	11.3	140.2	25.9	141.5
5/30/2018	183.10	0.13	28.2	173.0	13.5	137.2	11.7	139.8	25.7	141.7
6/28/2018	181.70	0.00	29.2	172.0	13.4	137.3	11.2	140.3	25.7	141.7
7/26/2018	180.00	0.00	30.4	170.8	13.4	137.3	11.2	140.3	24.7	142.7
8/28/2018	177.30	0.00	31.8	169.4	13.7	137.0	11.2	140.3	26.6	140.8
9/27/2018	178.10	0.00	32.0	169.2	13.8	136.9	11.3	140.2	26.7	140.7
10/24/2018	178.00	0.66	31.7	169.5	14.0	136.7	11.3	140.2	26.6	140.8
11/29/2018	177.50	1.60	31.8	169.4	14.5	136.2	11.4	140.1	26.6	140.8
12/20/2018	181.40	2.39	29.3	171.9	13.7	137.0	11.4	140.1	25.5	141.9
1/30/2019	189.40	4.56	24.4	176.8	11.4	139.3	9.3	142.2	24.0	143.4
2/27/2019	194.10	7.48	21.5	179.7	10.3	140.4	7.0	144.5	21.4	146.0
3/27/2019	194.00	1.27	21.2	180.0	9.9	140.8	7.4	144.1	21.5	145.9
4/24/2019	193.60	0.07	21.05	180.2	9.80	140.9	7.50	144.0	21.70	145.7
5/30/2019	191.40	0.73	22.20	179.0	9.70	141.0	5.00	146.5	21.90	145.5
6/26/2019	190.80	0.02	22.30	178.9	9.70	141.0	7.60	143.9	22.00	145.4
7/5/2015	190.40	0.00	22.60	178.6	9.70	141.0	7.60	143.9	22.10	145.3
7/30/2019	188.95	0.00	22.90	178.3	9.90	140.8	7.60	143.9	22.40	145.0
8/27/2019	187.40	0.00	24.10	177.1	10.50	140.2	8.10	143.4	22.70	144.7
9/26/2019	186.20	0.00	23.80	177.4	10.10	140.6	7.30	144.2	21.90	145.5
10/22/2019	185.20	0.00	25.50	175.7	10.80	139.9	8.00	143.5	23.50	143.9
11/26/2019	183.50	2.66	26.20	175.0	10.80	139.9	8.15	143.4	23.50	143.9
12/18/2019	186.80	4.44	24.50	176.7	10.70	140.0	8.20	143.3	22.85	144.6
1/28/2020	192.00	0.24	20.10	181.1	9.90	140.8	7.70	143.8	21.70	145.7
2/25/2020	192.10	0.49	21.00	180.2	9.20	141.5	7.60	143.9	21.60	145.8
3/24/2020	194.00	3.89	20.70	180.5	9.80	140.9	7.40	144.1	21.20	146.2
4/29/2020	193.50	4.59	19.25	182.0	8.15	142.6	6.75	144.8	20.60	146.8
5/27/2020	193.10	0.03	19.80	181.4	8.50	142.2	7.00	144.5	20.70	146.7
6/24/2020	190.00	0.00	20.70	180.5	8.70	142.0	7.30	144.2	20.60	146.8

Notes:

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3. Piezometer data based on NGVD 29 datum.

**TABLE 2**  
**SAND CANYON DAM**  
**PIEZOMETER AND SUBDRAIN MEASUREMENTS**  
**JANUARY 2007 THROUGH DECEMBER 2023**

Monitoring Well --->			3		4		5		6	
Top of Well Elevation --->			201.2		150.7		151.5		167.4	
Bottom of Well Elevation --->			155.8		129.1		129.6		127.7	
Depth of Well --->			45.4		21.6		21.9		39.7	
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Reading	Elev.	Reading	Elev.
	Elevation	Rainfall								
7/29/2020	188.90	0.00	22.30	178.9	9.10	141.6	7.20	144.3	21.30	146.1
8/27/2020	185.90	0.00	24.00	177.2	9.10	141.6	7.20	144.3	21.60	145.8
9/29/2020	183.10	0.00	26.10	175.1	9.35	141.4	7.30	144.2	22.25	145.2
10/29/2020	180.30	0.00	27.80	173.4	9.60	141.1	7.40	144.1	23.00	144.4
11/24/2020	179.00	0.65	27.00	174.2	9.80	140.9	7.60	143.9	23.70	143.7
12/29/2020	179.00	1.03	29.10	172.1	10.10	140.6	7.90	143.6	24.10	143.3
1/26/2021	180.50	2.39	28.60	172.6	10.30	140.4	8.00	143.5	24.00	143.4
2/25/2021	182.10	0.03	27.50	173.7	10.40	140.3	8.90	142.6	23.70	143.7
3/23/2021	182.90	1.15	27.20	174.0	10.50	140.2	8.10	143.4	23.60	143.8
4/27/2021	182.00	0.04	27.70	173.5	10.70	140.0	8.20	143.3	24.00	143.4
5/26/2021	181.00	0.11	28.20	173.0	10.80	139.9	8.30	143.2	24.10	143.3
6/30/2021	179.00	0.00	29.40	171.8	11.00	139.7	8.40	143.1	24.40	143.0
7/27/2021	177.10	0.08	30.50	170.7	11.20	139.5	8.70	142.8	24.80	142.6
8/24/2021	175.40	0.00	31.80	169.4	11.40	139.3	8.90	142.6	25.20	142.2
9/28/2021	175.20	0.06	32.40	168.8	11.70	139.0	9.50	142.0	25.30	142.1
10/27/2021	177.20	0.80	31.40	169.8	12.00	138.7	9.60	141.9	25.50	141.9
11/23/2021	177.80	0.00	30.40	170.8	12.20	138.5	9.60	141.9	25.40	142.0
12/21/2021	180.50	5.86	29.20	172.0	12.30	138.4	9.70	141.8	24.90	142.5
1/25/2022	187.00	0.08	22.50	178.7	9.70	141.0	7.20	144.3	21.60	145.8
2/22/2022	186.60	0.18	25.60	175.6	11.40	139.3	9.30	142.2	23.60	143.8
3/28/2022	186.60	1.38	23.90	177.3	10.70	140.0	8.20	143.3	22.40	145.0
4/26/2022	186.60	0.01	25.70	175.5	11.20	139.5	9.10	142.4	23.70	143.7
5/25/2022	185.30	0.05	26.20	175.0	11.10	139.6	9.10	142.4	23.90	143.5
6/28/2022	182.70	0.00	27.40	173.8	11.30	139.4	9.20	142.3	24.30	143.1
7/26/2022	179.70	0.00	29.20	172.0	11.40	139.3	9.30	142.2	24.80	142.6
8/30/2022	178.30	0.13	30.70	170.5	11.70	139.0	9.50	142.0	25.40	142.0
9/29/2022	175.80	0.24	31.60	169.6	12.10	138.6	9.70	141.8	25.70	141.7
10/26/2022	175.30	0.26	32.30	168.9	12.20	138.5	9.70	141.8	25.70	141.7
11/22/2022	179.40	1.46	30.20	171.0	12.30	138.4	9.90	141.6	25.40	142.0

Notes:

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**TABLE 2**  
**SAND CANYON DAM**  
**PIEZOMETER AND SUBDRAIN MEASUREMENTS**  
**JANUARY 2007 THROUGH DECEMBER 2023**

Monitoring Well --->			3		4		5		6	
Top of Well Elevation --->			201.2		150.7		151.5		167.4	
Bottom of Well Elevation --->			155.8		129.1		129.6		127.7	
Depth of Well --->			45.4		21.6		21.9		39.7	
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Reading	Elev.	Reading	Elev.
	Elevation	Rainfall								
12/29/2022	185.70	2.21	26.00	175.2	12.00	138.7	9.90	141.6	24.30	143.1
1/11/2023	191.70	3.90	23.60	177.60	9.10	141.60	9.40	142.10	23.70	143.70
1/25/2023	194.00	7.17	21.40	179.80	0.04	150.66	7.80	143.70	22.40	145.00
2/28/2023	194.00	3.98	21.10	180.10	0.00	150.70	7.00	144.50	21.80	145.60
3/29/2023	194.00	5.92	20.30	180.90	0.00	150.70	6.40	145.10	20.40	147.00
4/25/2023	194.00	0.19	21.20	180.00	0.90	149.80	7.50	144.00	21.60	145.80
5/24/2023	193.40	0.89	20.87	180.33	1.61	149.09	7.70	143.80	21.77	145.63
6/28/2023	192.70	0.07	21.40	179.80	2.40	148.30	7.70	143.80	21.90	145.50
7/26/2023	191.60	0.00	21.60	179.60	3.00	147.70	7.80	143.70	22.00	145.40
8/29/2023	190.50	1.84	22.20	179.00	3.64	147.06	7.76	143.74	21.94	145.46
9/26/2023	189.80	0.00	22.60	178.60	4.10	146.60	7.60	143.90	21.80	145.60
10/25/2023	189.70	0.19	23.20	178.00	4.60	146.10	7.70	143.80	22.10	145.30
11/30/2023	189.20	0.65	23.40	177.80	5.10	145.60	7.80	143.70	21.90	145.50
12/27/2023	190.00	1.15	23.40	177.80	5.60	145.10	7.80	143.70	21.90	145.50

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**TABLE 2**  
**SAND CANYON DAM**  
**PIEZOMETER AND SUBDRAIN MEASUREMENTS**  
**JANUARY 2007 THROUGH DECEMBER 2023**

Monitoring Well --->			7		8A		8B		VBW9A	
Top of Well Elevation --->			169.2		202.3		202.2		184	
Bottom of Well Elevation --->			152.7		164.3		144.5		160.4	
Depth of Well --->			16.5		38		57.7		23.6	
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Reading	Elev.	Reading	Elev.
	Elevation	Rainfall								
1/31/2007	176.80		8.4	160.8	35.8	166.5	46.9	155.3	22.5	161.5
2/28/2007	177.60		8.1	161.1	36.3	166.0	47.0	155.2	23.1	160.9
3/29/2007	177.10		8.3	160.9	36.3	166.0	47.2	155.0	23.3	160.7
4/27/2007	176.60		8.7	160.5	36.2	166.1	47.0	155.2	23.2	160.8
5/24/2007	176.80		9.4	159.8	36.6	165.7	47.3	154.9	23.4	160.6
6/27/2007	179.90		8.2	161.0	36.0	166.3	46.1	156.1	23.2	160.8
7/27/2007	177.80		7.8	161.4	35.9	166.4	46.5	155.7	23.1	160.9
8/28/2007	177.20		8.6	160.6	36.0	166.3	46.7	155.5	23.0	161.0
9/26/2007	177.00		7.5	161.7	36.0	166.3	46.5	155.7	23.1	160.9
10/30/2007	175.50		8.0	161.2	36.3	166.0	47.2	155.0	23.3	160.7
11/27/2007	175.90		7.9	161.3	36.6	165.7	47.2	155.0	23.5	160.5
12/27/2007	178.20		7.4	161.8	36.4	165.9	46.6	155.6	23.4	160.6
1/30/2008	184.40		6.7	162.5	35.6	166.8	45.0	157.3	23.3	160.7
2/26/2008	186.10		5.8	163.4	34.5	167.8	44.1	158.1	22.7	161.3
3/26/2008	188.00		5.4	163.8	33.5	168.8	43.7	158.5	22.3	161.7
4/25/2008	191.00		4.5	164.7	32.2	170.1	42.6	159.6	21.7	162.3
5/28/2008	190.93		4.5	164.7	31.4	170.9	42.3	159.9	21.2	162.8
6/25/2008	189.50		5.0	164.2	31.9	170.4	42.6	159.6	20.8	163.2
7/29/2008	185.10		6.9	162.3	32.0	170.3	43.3	158.9	20.9	163.1
7/30/2008	185.10	0.00	4.9	164.3	31.9	170.4	43.3	158.9	20.8	163.2
8/27/2008	178.00	0.00	6.3	162.9	33.6	168.7	45.6	156.6	21.4	162.6
9/25/2008	176.80	0.00	6.9	162.3	34.8	167.5	46.0	156.2	22.1	161.9
10/28/2008	175.20	0.00	7.4	161.8	35.6	166.7	46.8	155.4	22.5	161.5
11/25/2008	175.80	1.82	7.7	161.5	36.1	166.2	47.0	155.2	22.8	161.2
12/30/2008	181.70	2.91	6.5	162.7	35.6	166.7	45.1	157.1	22.8	161.2
1/29/2009	182.20	0.39	6.0	163.2	34.9	167.4	44.7	157.5	22.7	161.3
2/25/2009	185.70	3.10	5.8	163.4	34.6	167.7	43.9	158.3	22.4	161.6

Notes:

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**TABLE 2**  
**SAND CANYON DAM**  
**PIEZOMETER AND SUBDRAIN MEASUREMENTS**  
**JANUARY 2007 THROUGH DECEMBER 2023**

Monitoring Well --->			7		8A		8B		VBW9A	
Top of Well Elevation --->			169.2		202.3		202.2		184	
Bottom of Well Elevation --->			152.7		164.3		144.5		160.4	
Depth of Well --->			16.5		38		57.7		23.6	
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Reading	Elev.	Reading	Elev.
	Elevation	Rainfall								
3/26/2009	188.40	0.10	5.0	164.2	33.0	169.3	43.1	159.1	21.9	162.1
4/28/2009	189.30	0.00	3.7	165.5	31.9	170.4	42.7	159.5	21.4	162.6
5/18/2009	188.50	0.00	4.5	164.7	31.9	170.4	42.7	159.5	21.0	163.0
5/27/2009	188.10	0.00	4.6	164.6	31.9	170.4	42.9	159.3	21.0	163.0
6/30/2009	188.60	0.10	4.3	164.9	31.7	170.6	42.6	159.6	21.0	163.0
7/30/2009	184.80	0.00	4.5	164.7	32.0	170.3	43.2	159.0	20.9	163.1
8/26/2009	176.60	0.00	5.8	163.4	33.3	169.0	45.1	157.1	21.4	162.6
9/30/2009	174.50	0.00	7.7	161.5	35.1	167.2	46.6	155.6	22.2	161.8
10/28/2009	175.30	0.29	7.8	161.4	35.6	166.7	46.7	155.5	22.5	161.5
12/1/2009	176.40	0.00	7.7	161.5	36.1	166.2	46.9	155.3	22.8	161.2
12/28/2009	178.80	2.75	6.8	162.4	36.0	166.3	46.0	156.2	23.0	161.1
1/26/2010	191.30	4.15	5.5	163.7	35.4	166.9	43.2	159.0	22.9	161.1
2/24/2010	193.60	2.29	3.2	166.0	31.8	170.5	41.5	160.7	21.6	162.4
3/29/2010	193.50	1.18	3.4	165.8	31.3	171.0	41.2	161.0	20.2	163.8
4/4/2010	193.50		3.6	165.6	30.2	172.1	41.1	161.1	20.3	163.7
4/27/2010	193.90	1.66	3.4	165.8	29.8	172.5	41.0	161.2	19.5	164.5
5/27/2010	192.90	0.03	3.4	165.8	29.8	172.5	41.0	161.2	19.4	164.6
6/29/2010	191.60	0.00	3.1	166.1	29.9	172.4	41.2	161.0	19.4	164.6
7/28/2010	187.50	0.00	3.3	165.9	30.6	171.7	42.6	159.6	19.8	164.2
8/31/2010	179.20	0.00	4.6	164.6	32.6	169.7	44.4	157.8	21.0	163.0
9/29/2010	175.60	0.00	6.3	162.9	34.2	168.1	45.8	156.4	21.5	162.5
10/26/2010	178.20	2.93	6.8	162.4	35.2	167.1	45.8	156.4	22.3	161.7
11/30/2010	178.80	1.14	6.4	162.8	35.7	166.6	45.8	156.4	22.8	161.2
12/30/2010	193.90	9.95	4.1	165.1	33.8	168.5	41.3	160.9	19.6	164.4
1/27/2011	194.00	0.86	2.9	166.3	30.3	172.0	41.0	161.2	19.2	164.8
2/23/2011	193.80	1.02	2.8	166.4	29.5	172.9	40.7	161.5	18.7	165.4
3/29/2011	193.90	2.38	2.7	166.5	28.8	173.5	40.4	161.8	16.3	167.7
4/27/2011	193.60	0.56	2.8	166.5	29.0	173.3	40.5	161.7	18.2	165.9

Notes:

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**PIEZOMETER AND SUBDRAIN MEASUREMENTS**  
**JANUARY 2007 THROUGH DECEMBER 2023**

Monitoring Well --->			7		8A		8B		VBW9A	
Top of Well Elevation --->			169.2		202.3		202.2		184	
Bottom of Well Elevation --->			152.7		164.3		144.5		160.4	
Depth of Well --->			16.5		38		57.7		23.6	
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Reading	Elev.	Reading	Elev.
	Elevation	Rainfall								
5/25/2011	193.10	0.51	2.5	166.7	29.4	172.9	40.6	161.6	18.8	165.2
6/28/2011	192.00	0.00	2.5	166.7	29.6	172.7	40.9	161.3	19.2	164.8
7/27/2011	186.75	0.00	2.9	166.3	30.7	171.6	42.1	160.1	19.7	164.3
8/25/2011	176.30	0.00	4.7	164.5	32.7	169.6	44.8	157.4	20.9	163.1
9/28/2011	176.00	0.06	6.6	162.6	34.9	167.4	46.0	156.2	22.1	161.9
10/25/2011	176.50	0.89	6.7	162.5	35.8	166.5	46.1	156.1	22.5	161.5
11/22/2011	177.20	1.31	6.7	162.6	36.0	166.4	46.2	156.0	22.8	161.2
12/22/2011	176.70	0.20	6.3	162.9	35.9	166.4	45.9	156.3	22.9	161.1
1/25/2012	178.60	0.84	6.5	162.7	35.7	166.6	45.5	156.7	22.8	161.2
2/28/2012	179.20	0.68	6.4	162.8	35.9	166.4	45.6	156.6	22.8	161.2
3/27/2012	180.60	1.73	6.3	162.9	35.6	166.7	45.0	157.2	23.0	161.1
6/27/2012	180.70	0.00	5.9	163.3	34.4	167.9	44.6	157.6	22.4	161.6
7/26/2012	179.20	0.10	6.3	162.9	35.0	167.3	45.1	157.1	22.5	161.5
8/8/2012	178.50	0.10	6.2	163.0	34.8	167.5	45.2	157.0	22.4	161.6
8/28/2012	177.10	0.00	6.5	162.7	35.3	167.0	45.6	156.6	22.6	161.4
8/29/2012	177.10	0.00	6.4	162.8	35.0	167.3	45.5	156.7	22.3	161.7
9/25/2012	175.30	0.00	7.0	162.2	35.7	166.6	46.3	155.9	22.8	161.2
10/30/2012	176.00	0.19	7.0	162.2	36.3	166.0	46.4	155.8	23.2	160.8
11/27/2012	175.80	0.69	7.0	162.2	36.4	165.9	46.5	155.7	23.3	160.7
12/12/2012	176.10	1.40	6.9	162.3	36.3	166.0	46.3	155.9	23.1	160.9
1/22/2013	177.20	1.20	6.4	162.8	36.4	165.9	45.8	156.4	23.3	160.7
2/27/2013	178.20	0.31	6.1	163.1	36.0	166.3	45.4	156.8	23.1	160.9
3/28/2013	178.20	0.71	6.4	162.8	36.0	166.3	45.5	156.7	23.3	160.7
4/25/2013	177.30	0.03	6.6	162.6	36.1	166.2	45.8	156.4	23.3	160.8
5/22/2013	177.60	0.00	6.6	162.6	36.1	166.2	45.7	156.5	23.2	160.8
6/25/2013	177.50	0.00	6.5	162.7	36.2	166.1	45.7	156.5	23.3	160.7
7/23/2013	175.70	0.00	6.8	162.4	36.3	166.0	46.3	156.0	23.3	160.7
8/21/2013	174.50	0.00	7.0	162.2	38.0	164.3	46.5	155.7	23.3	160.7

Notes:

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**TABLE 2**  
**SAND CANYON DAM**  
**PIEZOMETER AND SUBDRAIN MEASUREMENTS**  
**JANUARY 2007 THROUGH DECEMBER 2023**

Monitoring Well --->			7		8A		8B		VBW9A	
Top of Well Elevation --->			169.2		202.3		202.2		184	
Bottom of Well Elevation --->			152.7		164.3		144.5		160.4	
Depth of Well --->			16.5		38		57.7		23.6	
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Reading	Elev.	Reading	Elev.
	Elevation	Rainfall								
9/25/2013	175.70	0.00	6.8	162.4	36.2	166.1	46.3	155.9	23.4	160.6
10/29/2013	176.00	0.00	6.5	162.7	36.6	165.7	46.2	156.0	23.5	160.6
11/27/2013	176.50	0.44	6.1	163.1	36.4	165.9	45.9	156.3	23.3	160.7
12/19/2013	176.80	0.53	6.2	163.0	36.3	166.0	45.8	156.4	23.2	160.8
1/28/2014	176.80	0.00	6.2	163.0	36.5	165.8	45.9	156.3	23.5	160.5
2/25/2014	176.70	0.72	6.3	163.0	36.5	165.8	45.9	156.3	23.5	160.5
3/25/2014	178.50		6.0	163.3	36.2	166.1	45.4	156.9	23.4	160.6
3/29/2014	178.40	1.44	5.9	163.3	36.4	165.9	45.5	156.7	23.5	160.5
4/25/2014	177.40	0.74	6.1	163.1	36.1	166.2	45.5	156.7	23.3	160.7
5/28/2014	176.40	0.00	6.6	162.6	36.3	166.0	46.0	156.2	23.3	160.7
6/25/2014	176.10	0.00	6.4	162.8	36.4	165.9	44.9	157.3	23.3	160.7
7/30/2014	177.30	0.00	6.2	163.0	36.3	166.0	45.6	156.7	23.2	160.9
8/26/2014	176.10	0.03	6.1	163.1	36.2	166.1	45.6	156.6	23.6	160.4
9/23/2014	175.90	0.00	6.0	163.2	36.4	166.0	45.7	156.5	23.3	160.8
10/30/2014	176.30	0.00	5.9	163.3	36.3	166.0	45.8	156.4	23.3	160.7
11/21/2014	176.20	0.25	5.8	163.4	36.3	166.0	45.5	156.7	23.2	160.8
12/30/2014	178.90	3.37	5.3	163.9	36.0	166.3	44.9	157.3	23.1	160.9
1/27/2015	179.60	0.89	5.2	164.0	35.8	166.5	44.6	157.6	23.2	160.9
2/27/2015	180.00	0.46	5.2	164.0	35.2	167.1	44.3	157.9	22.8	161.2
3/26/2015	179.60	0.45	5.3	163.9	35.3	167.0	44.4	157.8	22.8	161.2
4/29/2015	178.20	0.24	5.6	163.6	35.3	167.0	44.8	157.4	22.6	161.4
5/27/2015	179.00	1.04	5.8	163.4	35.7	166.6	45.0	157.2	22.9	161.1
6/25/2015	179.60	0.00	5.2	164.0	35.2	167.1	44.5	157.7	23.0	161.0
7/29/2015	178.10	0.00	5.4	163.8	35.3	167.0	44.8	157.4	22.6	161.4
8/26/2015	176.20	0.00	5.6	163.6	35.6	166.7	45.2	157.0	22.7	161.3
9/22/2015	178.20	1.64	5.6	163.6	35.8	166.5	44.9	157.3	22.9	161.1
10/27/2015	176.90	0.10	5.4	163.8	35.8	166.5	45.0	157.2	22.5	161.5
11/24/2015	176.30	0.17	5.6	163.6	35.8	166.5	45.3	156.9	23.2	160.8

Notes:

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**TABLE 2**  
**SAND CANYON DAM**  
**PIEZOMETER AND SUBDRAIN MEASUREMENTS**  
**JANUARY 2007 THROUGH DECEMBER 2023**

Monitoring Well --->			7		8A		8B		VBW9A	
Top of Well Elevation --->			169.2		202.3		202.2		184	
Bottom of Well Elevation --->			152.7		164.3		144.5		160.4	
Depth of Well --->			16.5		38		57.7		23.6	
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Reading	Elev.	Reading	Elev.
	Elevation	Rainfall								
12/22/2015	177.60	0.72	5.5	163.7	35.8	166.5	44.9	157.3	22.9	161.1
1/27/2016	180.10	2.86	5.3	163.9	36.0	166.3	44.7	157.5	23.5	160.5
2/25/2016	181.60	0.20	5.0	164.2	34.9	167.4	43.8	158.4	23.5	160.5
3/24/2016	184.80		4.8	164.4	34.5	167.8	43.3	158.9	23.4	160.6
3/31/2016	184.50	1.51	4.7	164.5	34.4	167.9	43.1	159.1	23.3	160.7
4/28/2016	183.60	0.04	4.8	164.4	33.8	168.5	43.2	159.0	23.2	160.8
5/25/2016	182.50	0.13	4.7	164.5	34.1	168.2	43.6	158.6	22.9	161.1
6/28/2016	180.70	0.00	4.8	164.4	34.3	168.0	43.9	158.3	23.1	160.9
7/27/2016	178.40	0.00	5.1	164.1	34.6	167.7	44.6	157.6	23.2	160.8
8/24/2016	176.40	0.00	5.7	163.5	35.3	167.0	45.1	157.1	23.4	160.6
9/27/2016	175.80	0.00	6.1	163.1	35.8	166.5	45.5	156.7	23.5	160.5
10/26/2016	178.60	0.64	5.3	163.9	35.8	166.5	44.8	157.4	23.6	160.4
11/22/2016	178.30	1.11	5.6	163.7	35.7	166.6	44.8	157.4		
12/28/2016	184.80	4.01	5.2	164.0	35.5	166.8	44.0	158.2	23.4	160.6
1/25/2017	193.30	6.33	3.9	165.3	33.9	168.4	41.1	161.1	22.3	161.7
2/28/2017	193.90	3.27	3.2	166.0	30.7	171.6	40.5	161.7	21.2	162.8
3/29/2017	193.70	0.08	3.0	166.2	30.0	172.3	40.3	161.9	20.5	163.5
4/27/2017	192.90	0.04	2.7	166.5	29.7	172.6	40.0	162.2	20.4	163.6
5/23/2017	187.90	0.33	3.0	166.2	30.5	171.8	41.2	161.0	23.4	160.6
6/21/2017	182.50	0.00	3.5	165.7	31.9	170.4	42.6	159.6	21.3	162.7
7/26/2017	163.60	0.00	5.8	163.4	34.5	167.8	46.7	155.5	22.8	161.3
8/30/2017	163.60	0.00	8.7	160.5	36.4	165.9	48.6	153.6	23.5	160.5
9/28/2017	163.60	0.00	12.6	156.6	37.5	164.8	49.7	152.5	23.6	160.4
10/26/2017	171.80	0.00	14.5	154.7	37.7	164.6	48.8	153.4	23.6	160.4
11/29/2017	177.20	0.08	9.7	159.5	37.2	165.1	46.3	155.9	23.6	160.4
12/27/2017	176.70	0.00	7.6	161.6	36.7	165.6	46.1	156.1	23.6	160.4
1/24/2018	178.10	1.67	7.7	161.5	36.3	166.0	45.4	156.8	23.6	160.4
2/21/2018	177.80	0.27	6.8	162.4	36.1	166.2	45.3	156.9	23.6	160.4

Notes:

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**TABLE 2**  
**SAND CANYON DAM**  
**PIEZOMETER AND SUBDRAIN MEASUREMENTS**  
**JANUARY 2007 THROUGH DECEMBER 2023**

Monitoring Well --->			7		8A		8B		VBW9A	
Top of Well Elevation --->			169.2		202.3		202.2		184	
Bottom of Well Elevation --->			152.7		164.3		144.5		160.4	
Depth of Well --->			16.5		38		57.7		23.6	
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Reading	Elev.	Reading	Elev.
	Elevation	Rainfall								
3/28/2018	183.50	1.23	5.9	163.3	35.6	166.7	44.0	158.2	23.3	160.7
4/27/2018	184.30	0.05	5.2	164.0	34.8	167.5	43.5	158.7	23.6	160.4
5/30/2018	183.10	0.13	5.3	163.9	34.2	168.1	43.6	158.6	23.3	160.8
6/28/2018	181.70	0.00	5.7	163.5	34.2	168.1	44.0	158.2	23.3	160.7
7/26/2018	180.00	0.00	6.0	163.2	34.5	167.8	44.4	157.8	23.9	160.1
8/28/2018	177.30	0.00	6.7	162.5	35.2	167.2	45.3	156.9	23.4	160.6
9/27/2018	178.10	0.00	7.0	162.2	35.5	166.8	45.5	156.7	23.6	160.4
10/24/2018	178.00	0.66	6.2	163.0	35.6	166.7	45.3	156.9	23.6	160.4
11/29/2018	177.50	1.60	6.9	162.3	35.5	166.8	45.5	156.7	23.6	160.4
12/20/2018	181.40	2.39	6.6	162.6	35.3	167.0	44.4	157.8	23.6	160.4
1/30/2019	189.40	4.56	5.0	164.2	33.6	168.7	41.8	160.4	23.4	160.6
2/27/2019	194.10	7.48	3.5	165.7	30.8	171.5	39.7	162.5	20.1	
3/27/2019	194.00	1.27	3.9	165.3	29.6	172.7	34.3	167.9	20.9	
4/24/2019	193.60	0.07	4.25	165.0	29.40	172.9	39.30	162.9	20.10	
5/30/2019	191.40	0.73	4.60	164.6	29.90	172.4	39.90	162.3	20.50	
6/26/2019	190.80	0.02	4.50	164.7	30.30	172.0	40.20	162.0	20.70	
7/5/2015	190.40	0.00	4.40	164.8	30.50	171.8	40.30	161.9	20.80	
7/30/2019	188.95	0.00	4.70	164.5	30.70	171.6	40.50	161.7	21.00	
8/27/2019	187.40	0.00	4.70	164.5	31.10	171.2	41.20	161.0	2.31	
9/26/2019	186.20	0.00	4.70	164.5	31.50	170.8	41.20	161.0	21.70	
10/22/2019	185.20	0.00	5.00	164.2	32.40	169.9	42.00	160.2	22.00	
11/26/2019	183.50	2.66	5.10	164.1	32.70	169.6	42.50	159.7	8804.00	
12/18/2019	186.80	4.44	4.80	164.4	32.60	169.7	41.65	160.6	8803.00	
1/28/2020	192.00	0.24	4.00	165.2	30.50	171.8	39.40	162.8	23.30	
2/25/2020	192.10	0.49	4.00	165.2	30.30	172.0	39.10	163.1	87.67	
3/24/2020	194.00	3.89	4.00	165.2	3.20		39.10	163.1	8760.00	
4/29/2020	193.50	4.59	3.30	165.9	28.70	173.6	37.90	164.3	8719.457	
5/27/2020	193.10	0.03	3.00	166.2	29.00	173.3	38.10	164.1	8736.785	
6/24/2020	190.00	0.00	2.80	166.4	29.70	172.6	38.40	163.8	8749.643	

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**TABLE 2**  
**SAND CANYON DAM**  
**PIEZOMETER AND SUBDRAIN MEASUREMENTS**  
**JANUARY 2007 THROUGH DECEMBER 2023**

Monitoring Well --->			7		8A		8B		VBW9A	
Top of Well Elevation --->			169.2		202.3		202.2		184	
Bottom of Well Elevation --->			152.7		164.3		144.5		160.4	
Depth of Well --->			16.5		38		57.7		23.6	
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Reading	Elev.	Reading	Elev.
	Elevation	Rainfall								
7/29/2020	188.90	0.00	2.90	166.3	30.30	172.0	39.40	162.8	8763.9	
8/27/2020	185.90	0.00	3.30	165.9	31.10	171.2	40.30	161.9	8779.345	
9/29/2020	183.10	0.00	4.20	165.0	32.40	169.9	41.55	160.7	8796.117	
10/29/2020	180.30	0.00	5.00	164.2	33.40	168.9	42.60	159.6	8808.922	
11/24/2020	179.00	0.65	5.70	163.5	34.00	168.3	43.30	158.9	8817.643	
12/29/2020	179.00	1.03	5.90	163.3	34.50	167.8	43.30	158.9	8824.287	
1/26/2021	180.50	2.39	4.80	164.4	34.70	167.6	43.00	159.2	23.3	160.7
2/25/2021	182.10	0.03	5.60	163.6	34.10	168.2	41.90	160.3	23.10	160.9
3/23/2021	182.90	1.15	5.40	163.8	33.80	168.5	41.40	160.8	23.20	160.8
4/27/2021	182.00	0.04	5.60	163.6	34.00	168.3	42.10	160.1	23.20	160.8
5/26/2021	181.00	0.11	5.70	163.5	34.20	168.1	42.40	159.8	23.60	160.4
6/30/2021	179.00	0.00	6.00	163.2	34.60	167.7	43.20	159.0	23.40	160.6
7/27/2021	177.10	0.08	6.50	162.7	35.00	167.3	43.90	158.3	23.50	160.5
8/24/2021	175.40	0.00	6.80	162.4	35.40	166.9	44.60	157.6	23.50	160.5
9/28/2021	175.20	0.06	6.90	162.3	35.90	166.4	45.10	157.1	23.60	160.4
10/27/2021	177.20	0.80	6.60	162.6	36.10	166.2	44.80	157.4	23.60	160.4
11/23/2021	177.80	0.00	6.20	163.0	35.70	166.6	44.20	158.0	23.60	160.4
12/21/2021	180.50	5.86	5.90	163.3	35.60	166.7	43.50	158.7	23.60	160.4
1/25/2022	187.00	0.08	3.20	166.0	39.90	162.4	39.60	162.6	23.60	160.4
2/22/2022	186.60	0.18	4.70	164.5	33.00	169.3	40.50	161.7	23.10	160.9
3/28/2022	186.60	1.38	4.60	164.6	32.30	170.0	41.50	160.7	22.80	161.2
4/26/2022	186.60	0.01	4.50	164.7	33.20	169.1	40.50	161.7	22.73	161.3
5/25/2022	185.30	0.05	4.60	164.6	32.60	169.7	41.00	161.2	22.70	161.3
6/28/2022	182.70	0.00	5.00	164.2	33.20	169.1	41.90	160.3	22.80	161.2
7/26/2022	179.70	0.00	5.40	163.8	33.90	168.4	43.00	159.2	23.00	161.0
8/30/2022	178.30	0.13	6.10	163.1	34.60	167.7	43.90	158.3	23.40	160.6
9/29/2022	175.80	0.24	6.40	162.8	35.30	167.0	44.70	157.5	23.70	160.3
10/26/2022	175.30	0.26	6.60	162.6	35.80	166.5	45.20	157.0	23.60	160.4
11/22/2022	179.40	1.46	6.00	163.2	35.90	166.4	44.30	157.9	23.60	160.4

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**SAND CANYON DAM**  
**PIEZOMETER AND SUBDRAIN MEASUREMENTS**  
**JANUARY 2007 THROUGH DECEMBER 2023**

Monitoring Well --->			7		8A		8B		VBW9A	
Top of Well Elevation --->			169.2		202.3		202.2		184	
Bottom of Well Elevation --->			152.7		164.3		144.5		160.4	
Depth of Well --->			16.5		38		57.7		23.6	
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Reading	Elev.	Reading	Elev.
	Elevation	Rainfall								
12/29/2022	185.70	2.21	45.00		34.00	168.3	41.90	160.3	23.60	160.4
1/11/2023	191.70	3.90	4.20	165.00	33.50	168.80	40.60	161.60	23.10	160.90
1/25/2023	194.00	7.17	3.40	165.80	31.90	170.40	38.80	163.40	22.50	161.50
2/28/2023	194.00	3.98	3.40	165.80	30.10	172.20	38.10	164.10	20.50	163.50
3/29/2023	194.00	5.92	3.20	166.00	28.50	173.80	37.70	164.50	17.00	167.00
4/25/2023	194.00	0.19	3.60	165.60	28.80	173.50	37.90	164.30	19.30	164.70
5/24/2023	193.40	0.89	3.79	165.41	28.83	173.48	38.55	163.65	19.80	164.20
6/28/2023	192.70	0.07	3.00	166.20	29.40	172.90	38.80	163.40	20.08	163.92
7/26/2023	191.60	0.00	2.80	166.40	29.70	172.60	38.80	163.40	20.45	163.55
8/29/2023	190.50	1.84	2.60	166.60	30.19	172.11	39.15	163.05	20.77	163.23
9/26/2023	189.80	0.00	2.50	166.70	30.55	171.75	39.60	162.60	20.90	163.10
10/25/2023	189.70	0.19	2.70	166.50	30.80	171.50	39.80	162.40	21.20	162.80
11/30/2023	189.20	0.65	3.00	166.20	30.80	171.50	39.80	162.40	21.40	162.60
12/27/2023	190.00	1.15	3.20	166.00	31.20	171.10	39.80	162.40	21.50	162.50

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**PIEZOMETER AND SUBDRAIN MEASUREMENTS**  
**JANUARY 2007 THROUGH DECEMBER 2023**

Monitoring Well --->			VBW9B		VBW/10A		VBW/10B		VBW/11	
Top of Well Elevation --->			184.2		183.4		183.7		165.6	
Bottom of Well Elevation --->			151.7		148.0		136.1		155.4	
Depth of Well --->			32.5		35.4		47.6		10.2	
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Reading	Elev.	Reading	Elev.
	Elevation	Rainfall								
1/31/2007	176.80		28.9	155.3	19.4	164.0	45.0	138.7	8.4	157.2
2/28/2007	177.60		28.5	155.7	19.3	164.1	45.2	138.5	9.2	156.4
3/29/2007	177.10		28.6	155.6	19.3	164.1	45.6	138.1	8.4	157.2
4/27/2007	176.60		28.5	155.7	19.3	164.1	45.4	138.3	9.3	156.3
5/24/2007	176.80		28.6	155.6	19.3	164.1	45.9	137.8	9.2	156.4
6/27/2007	179.90		28.4	155.8	19.2	164.2	45.4	138.3	8.2	157.4
7/27/2007	177.80		28.5	155.7	19.3	164.1	46.5	137.2	9.2	156.4
8/28/2007	177.20		28.3	155.9	19.4	164.0	46.4	137.3	8.0	157.6
9/26/2007	177.00		28.4	155.8	19.4	164.0	46.5	137.2	9.3	156.3
10/30/2007	175.50		28.7	155.5	19.4	164.0	46.6	137.1	9.3	156.3
11/27/2007	175.90		28.8	155.4	19.5	163.9	46.6	137.1	9.3	156.3
12/27/2007	178.20		28.9	155.3	19.5	163.9	45.5	138.2	9.5	156.1
1/30/2008	184.40		28.6	155.6	19.4	164.1	43.6	140.3	9.4	156.2
2/26/2008	186.10		28.2	156.0	19.4	164.0	43.2	140.6	9.3	156.3
3/26/2008	188.00		27.7	156.5	19.3	164.1	43.4	140.4	9.1	156.5
4/25/2008	191.00		27.1	157.1	19.5	163.9	42.8	141.0	8.9	156.7
5/28/2008	190.93		26.7	157.5	19.6	163.8	42.9	141.0	8.3	157.3
6/25/2008	189.50		26.5	157.7	19.8	163.6	42.8	141.0	8.3	157.3
7/29/2008	185.10		26.5	157.7	19.2	164.2	42.8	141.0	8.2	157.4
7/30/2008	185.10	0.00	26.5	157.7	19.3	164.1	42.7	141.1	7.8	157.8
8/27/2008	178.00	0.00	26.9	157.3	19.4	164.0	44.2	139.6	8.3	157.3
9/25/2008	176.80	0.00	27.6	156.6	19.3	164.1	45.0	138.8	8.1	157.5
10/28/2008	175.20	0.00	28.1	156.1	21.0	162.4	45.3	138.5	8.0	157.6
11/25/2008	175.80	1.82	28.4	155.8	21.4	162.0	45.4	138.4	9.0	156.6
12/30/2008	181.70	2.91	28.2	156.0	21.7	161.7	43.9	139.9	9.0	156.6
1/29/2009	182.20	0.39	28.2	156.0	21.5	161.9	43.9	139.9	9.1	156.5
2/25/2009	185.70	3.10	28.0	156.2	21.4	162.0	43.0	140.8	8.9	156.7

Notes:

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**SAND CANYON DAM**  
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**JANUARY 2007 THROUGH DECEMBER 2023**

Monitoring Well --->			VBW9B		VBW/10A		VBW/10B		VBW/11	
Top of Well Elevation --->			184.2		183.4		183.7		165.6	
Bottom of Well Elevation --->			151.7		148.0		136.1		155.4	
Depth of Well --->			32.5		35.4		47.6		10.2	
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Reading	Elev.	Reading	Elev.
	Elevation	Rainfall								
3/26/2009	188.40	0.10	27.5	156.7	20.9	162.5	43.6	140.2	8.8	156.8
4/28/2009	189.30	0.00	27.1	157.1	20.2	163.2	43.7	140.1	8.5	157.1
5/18/2009	188.50	0.00	26.8	157.4	19.6	163.8	43.4	140.4	8.4	157.2
5/27/2009	188.10	0.00	26.8	157.4	19.4	164.0	43.6	140.2	8.4	157.2
6/30/2009	188.60	0.10	26.7	157.5	19.2	164.2	43.7	140.1	8.4	157.2
7/30/2009	184.80	0.00	26.7	157.5	19.2	164.2	43.9	139.9	8.3	157.3
8/26/2009	176.60	0.00	27.0	157.2	19.5	163.9	44.1	139.7	8.3	157.3
9/30/2009	174.50	0.00	27.7	156.5	20.4	163.0	45.1	138.7	8.7	156.9
10/28/2009	175.30	0.29	28.0	156.2	20.8	162.6	44.4	139.4	8.9	156.7
12/1/2009	176.40	0.00	28.4	155.8	21.0	162.4	45.0	138.8	9.0	156.6
12/28/2009	178.80	2.75	28.5	155.8	21.8	161.6	44.5	139.3	9.2	156.5
1/26/2010	191.30	4.15	28.3	155.9	21.5	161.9	43.0	140.8	8.1	157.5
2/24/2010	193.60	2.29	27.2	157.0	20.5	162.9	42.4	141.4	8.3	157.3
3/29/2010	193.50	1.18	26.1	158.1	19.1	164.3	42.4	141.4	8.1	157.5
4/4/2010	193.50		26.0	158.2	18.7	164.7	42.6	141.2	8.2	157.4
4/27/2010	193.90	1.66	25.8	158.4	18.4	165.0	42.5	141.3	8.0	157.6
5/27/2010	192.90	0.03	25.7	158.5	18.2	165.2	42.4	141.4	7.8	157.8
6/29/2010	191.60	0.00	25.8	158.4	18.1	165.3	42.2	141.6	7.9	157.7
7/28/2010	187.50	0.00	26.1	158.1	18.3	165.1	42.9	140.9	8.0	157.6
8/31/2010	179.20	0.00	26.8	157.4	18.9	164.5	42.9	140.9	7.9	157.7
9/29/2010	175.60	0.00	27.2	157.0	19.3	164.1	44.0	139.8	8.0	157.6
10/26/2010	178.20	2.93	27.8	156.4	20.3	163.1	44.3	139.5	8.6	157.0
11/30/2010	178.80	1.14	28.4	155.8	21.3	162.1	44.6	139.2	8.9	156.7
12/30/2010	193.90	9.95	27.0	157.2	19.5	163.9	42.1	141.7	7.5	158.1
1/27/2011	194.00	0.86	26.0	158.2	18.8	164.6	42.7	141.2	7.8	157.8
2/23/2011	193.80	1.02	25.6	158.7	18.2	165.2	42.4	141.4	7.9	157.8
3/29/2011	193.90	2.38	24.6	159.6	16.8	166.6	41.9	141.9	7.6	158.0
4/27/2011	193.60	0.56	25.0	159.2	17.0	166.4	42.4	141.4	7.8	157.8

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**JANUARY 2007 THROUGH DECEMBER 2023**

Monitoring Well --->			VBW9B		VBW/10A		VBW/10B		VBW/11	
Top of Well Elevation --->			184.2		183.4		183.7		165.6	
Bottom of Well Elevation --->			151.7		148.0		136.1		155.4	
Depth of Well --->			32.5		35.4		47.6		10.2	
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Reading	Elev.	Reading	Elev.
	Elevation	Rainfall								
5/25/2011	193.10	0.51	25.5	158.7	17.6	165.8	42.3	141.5	7.9	157.7
6/28/2011	192.00	0.00	25.8	158.4	18.3	165.1	42.4	141.4	8.0	157.6
7/27/2011	186.75	0.00	26.1	158.1	18.4	165.1	42.6	141.2	8.2	157.4
8/25/2011	176.30	0.00	26.9	157.3	18.5	164.9	43.4	140.4	8.5	157.1
9/28/2011	176.00	0.06	27.7	156.5	20.0	163.5	44.5	139.3	8.7	156.9
10/25/2011	176.50	0.89	28.1	156.1	20.6	162.8	44.8	139.0	8.9	156.7
11/22/2011	177.20	1.31	28.4	155.8	21.2	162.2	44.7	139.1	9.0	156.6
12/22/2011	176.70	0.20	28.5	155.7	21.6	161.8	45.2	138.6	8.9	156.7
1/25/2012	178.60	0.84	28.3	155.9	21.4	162.0	44.2	139.6	9.2	156.4
2/28/2012	179.20	0.68	28.6	155.6	21.7	161.7	44.2	139.6	9.4	156.2
3/27/2012	180.60	1.73	28.4	155.8	21.8	161.7	43.8	140.0	9.2	156.4
6/27/2012	180.70	0.00	27.9	156.3	20.2	163.2	44.1	139.7	9.6	156.0
7/26/2012	179.20	0.10	28.2	156.0	21.5	161.9	44.4	139.4	9.2	156.4
8/8/2012	178.50	0.10	28.0	156.2	21.1	162.3	44.9	138.9	9.0	156.6
8/28/2012	177.10	0.00	28.2	156.0	21.3	162.1	45.3	138.5	9.1	156.5
8/29/2012	177.10	0.00	27.8	156.4	20.9	162.5	45.7	138.1	8.9	156.7
9/25/2012	175.30	0.00	28.3	155.9	21.4	162.0	46.2	137.6	9.1	156.5
10/30/2012	176.00	0.19	28.6	155.6	21.8	161.6	46.3	137.5	9.2	156.4
11/27/2012	175.80	0.69	28.8	155.4	22.1	161.3	46.1	137.7	9.3	156.3
12/12/2012	176.10	1.40	28.6	155.6	22.0	161.5	45.6	138.2	9.3	156.3
1/22/2013	177.20	1.20	28.8	155.4	22.3	161.1	44.6	139.2	9.2	156.4
2/27/2013	178.20	0.31	28.6	155.6	22.2	161.2	44.4	139.4	9.4	156.2
3/28/2013	178.20	0.71	28.7	155.5	22.3	161.1	44.1	139.7	9.5	156.1
4/25/2013	177.30	0.03	28.7	155.5	22.3	161.1	45.0	138.8	9.5	156.1
5/22/2013	177.60	0.00	28.5	155.7	22.3	161.1	44.9	138.9	9.5	156.1
6/25/2013	177.50	0.00	28.7	155.5	22.4	161.1	45.0	138.8	9.6	156.1
7/23/2013	175.70	0.00	28.7	155.5	22.3	161.1	45.7	138.1	9.5	156.2
8/21/2013	174.50	0.00	28.6	155.6	22.3	161.1	46.1	137.7	9.4	156.2

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**JANUARY 2007 THROUGH DECEMBER 2023**

Monitoring Well --->			VBW9B		VBW/10A		VBW/10B		VBW/11	
Top of Well Elevation --->			184.2		183.4		183.7		165.6	
Bottom of Well Elevation --->			151.7		148.0		136.1		155.4	
Depth of Well --->			32.5		35.4		47.6		10.2	
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Reading	Elev.	Reading	Elev.
	Elevation	Rainfall								
9/25/2013	175.70	0.00	28.7	155.5	22.0	161.4	46.4	137.4	9.4	156.2
10/29/2013	176.00	0.00	28.8	155.4	22.5	160.9	42.3	141.6	9.4	156.2
11/27/2013	176.50	0.44	28.6	155.6	22.5	160.9	46.2	137.6	9.3	156.3
12/19/2013	176.80	0.53	28.6	155.6	22.5	160.9	45.6	138.2	9.5	156.1
1/28/2014	176.80	0.00	28.9	155.3	22.9	160.5	45.4	138.4	9.6	156.0
2/25/2014	176.70	0.72	28.9	155.3	22.9	160.5	45.2	138.6	9.6	156.0
3/25/2014	178.50		28.8	155.5	22.9	160.6	44.6	139.2	9.6	156.0
3/29/2014	178.40	1.44	28.9	155.3	22.9	160.5	44.7	139.1	9.3	156.3
4/25/2014	177.40	0.74	28.7	155.5	22.7	160.7	44.8	139.0	9.5	156.1
5/28/2014	176.40	0.00	28.8	155.4	22.7	160.7	43.3	140.5	9.6	156.0
6/25/2014	176.10	0.00	28.8	155.4	22.7	160.7	46.3	137.5	8.9	156.7
7/30/2014	177.30	0.00	28.6	155.7	22.6	160.9	46.9	136.9	9.3	156.3
8/26/2014	176.10	0.03	32.5	151.7	22.5	160.9	42.5	141.3	9.5	156.1
9/23/2014	175.90	0.00	28.7	155.5	22.7	160.7	46.6	137.3	9.4	156.3
10/30/2014	176.30	0.00	28.7	155.5	22.7	160.7	46.6	137.2	9.3	156.3
11/21/2014	176.20	0.25	28.6	155.6	22.7	160.7	45.0	138.8	9.1	156.5
12/30/2014	178.90	3.37	28.5	155.7	22.8	160.6	45.1	138.7	9.4	156.2
1/27/2015	179.60	0.89	28.6	155.6	22.8	160.6	44.8	139.0	9.3	156.3
2/27/2015	180.00	0.46	28.2	156.0	22.4	161.0	44.3	139.5	9.1	156.5
3/26/2015	179.60	0.45	28.2	156.0	22.3	161.1	42.5	141.3	9.1	156.5
4/29/2015	178.20	0.24	28.1	156.1	22.1	161.3	42.4	141.4	9.0	156.6
5/27/2015	179.00	1.04	28.5	155.7	22.2	161.2	44.0	139.8	9.3	156.3
6/25/2015	179.60	0.00	28.3	155.9	22.1	161.3	46.9	136.9	9.0	156.6
7/29/2015	178.10	0.00	28.0	156.2	22.0	161.4	45.0	138.8	8.9	156.7
8/26/2015	176.20	0.00	28.0	156.2	21.2	162.2	40.6	143.2	8.9	156.7
9/22/2015	178.20	1.64	28.2	156.0	22.1	161.3	45.4	138.4	9.0	156.6
10/27/2015	176.90	0.10	28.3	155.9	22.2	161.2	45.8	138.0	9.2	156.4
11/24/2015	176.30	0.17	28.5	155.7	22.3	161.1	42.7	141.1	9.3	156.3

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**JANUARY 2007 THROUGH DECEMBER 2023**

Monitoring Well --->			VBW9B		VBW/10A		VBW/10B		VBW/11	
Top of Well Elevation --->			184.2		183.4		183.7		165.6	
Bottom of Well Elevation --->			151.7		148.0		136.1		155.4	
Depth of Well --->			32.5		35.4		47.6		10.2	
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Reading	Elev.	Reading	Elev.
	Elevation	Rainfall								
12/22/2015	177.60	0.72	28.7	155.5	22.7	160.7	45.7	138.1	9.3	156.3
1/27/2016	180.10	2.86	29.4	154.8	24.7	158.7	45.7	138.1	10.1	155.5
2/25/2016	181.60	0.20	29.3	154.9	24.6	158.9	46.5	137.3	10.1	155.5
3/24/2016	184.80		29.1	155.1	24.3	159.1	46.3	137.5	10.1	155.5
3/31/2016	184.50	1.51	29.1	155.1	24.3	159.1	46.5	137.3	10.1	155.5
4/28/2016	183.60	0.04	28.9	155.3	24.0	159.4	46.9	136.9	10.2	155.4
5/25/2016	182.50	0.13	28.8	155.4	23.7	159.7	46.8	137.0	9.8	155.8
6/28/2016	180.70	0.00	28.9	155.3	23.6	159.8	47.1	136.7	9.9	155.7
7/27/2016	178.40	0.00	29.0	155.2	23.6	159.8	47.5	136.3	9.9	155.7
8/24/2016	176.40	0.00	29.1	155.1	23.6	159.8	47.6	136.2	9.8	155.8
9/27/2016	175.80	0.00	29.4	154.8	23.9	159.5	47.6	136.2	10.0	155.6
10/26/2016	178.60	0.64	29.5	154.7	24.1	159.3	47.6	136.2	10.0	155.6
11/22/2016	178.30	1.11								
12/28/2016	184.80	4.01	29.3	154.9	24.2	159.2	45.5	138.4	10.1	155.5
1/25/2017	193.30	6.33	28.2	156.0	23.0	160.4	42.9	140.9	9.5	156.1
2/28/2017	193.90	3.27	27.4	156.8	21.3	162.1	43.1	140.7	9.0	156.6
3/29/2017	193.70	0.08	27.0	157.2	20.5	162.9	43.7	140.1	9.0	156.6
4/27/2017	192.90	0.04	27.0	157.2	20.6	162.8	43.9	139.9	9.2	156.4
5/23/2017	187.90	0.33	27.3	156.9	23.0	160.4	44.0	139.8	9.7	155.9
6/21/2017	182.50	0.00	27.7	156.5	21.1	162.3	44.8	139.0	9.3	156.3
7/26/2017	163.60	0.00	28.6	155.6	22.0	161.4	46.6	137.2	9.5	156.1
8/30/2017	163.60	0.00	29.4	154.8	23.1	160.3	47.6	136.2	9.8	155.8
9/28/2017	163.60	0.00	29.8	154.4	23.8	159.6	47.6	136.2	9.9	155.7
10/26/2017	171.80	0.00	29.9	154.3	24.3	159.1	47.6	136.2	37.3	128.3
11/29/2017	177.20	0.08	30.0	154.2	24.7	158.7	47.6	136.2	10.2	155.4
12/27/2017	176.70	0.00	29.8	154.4	24.7	158.7	47.6	136.2	10.2	155.4
1/24/2018	178.10	1.67	29.8	154.4	24.7	158.7	47.6	136.1	10.2	155.4
2/21/2018	177.80	0.27	29.8	154.4	24.7	158.7	47.6	136.1	10.2	155.4

Notes:

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Monitoring Well --->			VBW9B		VBW/10A		VBW/10B		VBW/11	
Top of Well Elevation --->			184.2		183.4		183.7		165.6	
Bottom of Well Elevation --->			151.7		148.0		136.1		155.4	
Depth of Well --->			32.5		35.4		47.6		10.2	
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Reading	Elev.	Reading	Elev.
	Elevation	Rainfall								
3/28/2018	183.50	1.23	29.7	154.5	24.6	158.8	47.6	136.1	10.2	155.4
4/27/2018	184.30	0.05	29.4	154.8	24.4	159.0	47.6	136.1	10.2	155.4
5/30/2018	183.10	0.13	29.2	155.0	24.4	159.0	47.6	136.1	10.2	155.4
6/28/2018	181.70	0.00	29.0	155.2	23.6	159.8	47.6	136.1	28.2	137.4
7/26/2018	180.00	0.00	29.1	155.1	23.5	159.9	47.6	136.1	10.0	155.6
8/28/2018	177.30	0.00	29.2	155.0	23.5	159.9	47.6	136.1	9.9	155.7
9/27/2018	178.10	0.00	29.4	154.8	23.7	159.7	47.6	136.1	10.0	155.6
10/24/2018	178.00	0.66	29.4	154.8	23.9	159.5	47.6	136.1	10.1	155.5
11/29/2018	177.50	1.60	29.6	154.6	24.2	159.2	47.6	136.1	10.2	155.4
12/20/2018	181.40	2.39	29.5	154.7	24.1	159.3	46.8	136.9	10.1	155.5
1/30/2019	189.40	4.56	28.9	155.3	25.8	157.6	45.6	138.1	9.9	155.7
2/27/2019	194.10	7.48	17.8		33.9		41.8		6.1	
3/27/2019	194.00	1.27	26		20.5		43.7		9.1	
4/24/2019	193.60	0.07	29.40		20.30		43.80		9.20	
5/30/2019	191.40	0.73	26.90		20.50		44.10		9.30	
6/26/2019	190.80	0.02	27.00		20.60		44.00		9.40	
7/5/2015	190.40	0.00	27.10		20.60		44.20		10.20	
7/30/2019	188.95	0.00	17.80		34.90		42.40		7.30	
8/27/2019	187.40	0.00	18.03		35.11		42.62		7.73	
9/26/2019	186.20	0.00	18.20		34.90		42.80		8.06	
10/22/2019	185.20	0.00	27.90		21.30		45.80		9.70	
11/26/2019	183.50	2.66	8743.00		8514.00		8702.00		8316.00	
12/18/2019	186.80	4.44	8741.00		8511.00		8665.00		8308.00	
1/28/2020	192.00	0.24	29.14		23.80		45.60		9.80	
2/25/2020	192.10	0.49	87.16		8488.50		8635.60		8296.30	
3/24/2020	194.00	3.89	8712.80		8481.00		8636.60		8300.80	
4/29/2020	193.50	4.59	8678.46		8455.261		8641.121		8286.36	
5/27/2020	193.10	0.03	8695.179		8468.494		8646.494		8295.486	
6/24/2020	190.00	0.00	8704.683		8475.23		8651.577		8304.142	

Notes:

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**TABLE 2**  
**SAND CANYON DAM**  
**PIEZOMETER AND SUBDRAIN MEASUREMENTS**  
**JANUARY 2007 THROUGH DECEMBER 2023**

Monitoring Well --->			VBW9B		VBW/10A		VBW/10B		VBW/11	
Top of Well Elevation --->			184.2		183.4		183.7		165.6	
Bottom of Well Elevation --->			151.7		148.0		136.1		155.4	
Depth of Well --->			32.5		35.4		47.6		10.2	
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Reading	Elev.	Reading	Elev.
	Elevation	Rainfall								
7/29/2020	188.90	0.00	8718.148		8484.906		8654.388		8309.247	
8/27/2020	185.90	0.00	8726.589		8495.277		8663.389		8316.309	
9/29/2020	183.10	0.00	8737.937		8507.042		8659.805		8314.927	
10/29/2020	180.30	0.00	8747.634		8518.862		8682.145		8317.247	
11/24/2020	179.00	0.65	8753.042		8531.034		8686.862		8318.992	
12/29/2020	179.00	1.03	8757.986		8545.635		8683.545		8319.8	
1/26/2021	180.50	2.39	29.10	155.1	23.20	160.2	45.50	138.20	10.10	155.50
2/25/2021	182.10	0.03	28.90	155.3	23.30	160.1	45.30	138.40	9.80	155.80
3/23/2021	182.90	1.15	28.90	155.3	23.30	160.1	45.40	138.30	10.00	155.60
4/27/2021	182.00	0.04	28.90	155.3	23.20	160.2	45.80	137.90	10.00	155.60
5/26/2021	181.00	0.11	28.90	155.3	23.28	160.1	46.58	137.12	9.90	155.70
6/30/2021	179.00	0.00	29.10	155.1	23.40	160.0	46.80	136.90	10.00	155.60
7/27/2021	177.10	0.08	29.20	155.0	23.50	159.9	46.80	136.90	9.90	155.70
8/24/2021	175.40	0.00	29.20	155.0	23.50	159.9	46.80	136.90	9.90	155.70
9/28/2021	175.20	0.06	29.50	154.7	23.80	159.6	47.40	136.30	10.08	155.52
10/27/2021	177.20	0.80	29.50	154.7	24.00	159.4	47.40	136.30	10.10	155.50
11/23/2021	177.80	0.00	29.60	154.6	24.30	159.1	47.60	136.10	10.20	155.40
12/21/2021	180.50	5.86	29.40	154.8	24.30	159.1	46.80	136.90	10.10	155.50
1/25/2022	187.00	0.08	28.80	155.4	23.60	159.8	45.40	138.30	10.10	155.50
2/22/2022	186.60	0.18	28.80	155.4	23.60	159.8	45.40	138.30	10.10	155.50
3/28/2022	186.60	1.38	28.50	155.7	22.70	160.7	45.70	138.00	10.20	155.40
4/26/2022	186.60	0.01	28.40	155.8	22.70	160.7	45.50	138.20	9.80	155.80
5/25/2022	185.30	0.05	28.40	155.8	22.50	160.9	46.10	137.60	9.80	155.80
6/28/2022	182.70	0.00	28.60	155.6	22.60	160.8	46.50	137.20	9.60	156.00
7/26/2022	179.70	0.00	28.80	155.4	22.70	160.7	46.80	136.90	9.60	156.00
8/30/2022	178.30	0.13	29.10	155.1	23.20	160.2	47.10	136.60	9.80	155.80
9/29/2022	175.80	0.24	29.30	154.9	23.60	159.8	47.50	136.20	9.90	155.70
10/26/2022	175.30	0.26	29.40	154.8	23.80	159.6	47.60	136.10	9.90	155.70
11/22/2022	179.40	1.46	29.50	154.7	24.09	159.3	46.95	136.75	10.03	155.57

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**TABLE 2**  
**SAND CANYON DAM**  
**PIEZOMETER AND SUBDRAIN MEASUREMENTS**  
**JANUARY 2007 THROUGH DECEMBER 2023**

Monitoring Well --->			VBW9B		VBW/10A		VBW/10B		VBW/11	
Top of Well Elevation --->			184.2		183.4		183.7		165.6	
Bottom of Well Elevation --->			151.7		148.0		136.1		155.4	
Depth of Well --->			32.5		35.4		47.6		10.2	
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Reading	Elev.	Reading	Elev.
	Elevation	Rainfall								
12/29/2022	185.70	2.21	29.30	154.9	24.10	159.3	45.80	137.90	9.90	155.70
1/11/2023	191.70	3.90	28.80	155.40	23.60	159.80	44.40	139.30	9.70	155.90
1/25/2023	194.00	7.17	28.10	156.10	22.80	160.60	44.00	139.70	8.80	156.80
2/28/2023	194.00	3.98	27.30	156.90	21.20	162.20	43.20	140.50	8.70	156.90
3/29/2023	194.00	5.92	25.10	159.10	19.10	164.30	43.40	140.30	8.70	156.90
4/25/2023	194.00	0.19	26.10	158.10	19.80	163.60	44.20	139.50	8.90	156.70
5/24/2023	193.40	0.89	26.50	157.70	19.90	163.50	44.30	139.40	8.90	156.70
6/28/2023	192.70	0.07	26.75	157.45	20.23	163.17	44.44	139.26	9.05	156.55
7/26/2023	191.60	0.00	27.10	157.10	20.60	162.80	44.20	139.50	9.00	156.60
8/29/2023	190.50	1.84	27.31	156.89	20.83	162.57	44.47	139.23	9.15	156.45
9/26/2023	189.80	0.00	27.40	156.80	21.00	162.40	43.90	139.80	8.90	156.70
10/25/2023	189.70	0.19	27.60	156.60	21.20	162.20	44.70	139.00	9.00	156.60
11/30/2023	189.20	0.65	27.70	156.50	21.30	162.10	44.60	139.10	9.10	156.50
12/27/2023	190.00	1.15	27.70	156.50	21.40	162.00	44.30	139.40	9.00	156.60

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**SAND CANYON DAM**  
**PIEZOMETER AND SUBDRAIN MEASUREMENTS**  
**JANUARY 2007 THROUGH DECEMBER 2023**

Monitoring Well --->			VBW/12		VBW/13		Seepage Flow Point	
Top of Well Elevation --->			160.5		160.1		Drain ID	
Bottom of Well Elevation --->			151.5		150.6			
Depth of Well --->			9		9.5			
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Seepage Flow Point (Gal / Min)	
	Elevation	Rainfall					Left Subdrain	Right Subdrain
1/31/2007	176.80		8.2	152.3	8.6	151.5	0.00	0.0
2/28/2007	177.60		8.4	152.1	5.7	154.4	0.00	0.0
3/29/2007	177.10		8.7	151.8	9.2	150.9	0.00	0.0
4/27/2007	176.60		8.8	151.7	8.9	151.2	0.00	0.0
5/24/2007	176.80		8.9	151.6	9.3	150.8	0.00	0.0
6/27/2007	179.90		8.7	151.8	9.1	151.0	0.00	0.0
7/27/2007	177.80		8.8	151.7	9.4	150.7	0.00	0.0
8/28/2007	177.20		8.9	151.6	9.2	150.9	0.00	0.0
9/26/2007	177.00		8.9	151.6	9.2	150.9	0.00	0.0
10/30/2007	175.50		8.9	151.6	9.2	150.9	0.00	0.0
11/27/2007	175.90		9.0	151.5	9.3	150.8	0.00	0.0
12/27/2007	178.20		9.0	151.5	9.4	150.7	0.00	0.0
1/30/2008	184.40		6.5	154.0	6.3	153.8	0.16	0.0
2/26/2008	186.10		7.6	152.9	7.7	152.4	0.36	0.0
3/26/2008	188.00		8.0	152.5	8.6	151.5	0.84	0.0
4/25/2008	191.00		8.9	151.6	9.0	151.1	1.59	0.0
5/28/2008	190.93		8.6	151.9	9.0	151.1	1.98	0.0
6/25/2008	189.50		8.3	152.2	8.7	151.4	1.59	0.0
7/29/2008	185.10		7.9	152.6	8.4	151.7	1.74	0.0
7/30/2008	185.10	0.00	7.6	152.9	8.6	151.5	2.06	0.0
8/27/2008	178.00	0.00	8.2	152.3	8.3	151.8	0.79	0.0
9/25/2008	176.80	0.00	8.2	152.3	8.1	152.0	0.29	0.0
10/28/2008	175.20	0.00	8.4	152.1	8.6	151.5	0.03	0.0
11/25/2008	175.80	1.82	8.6	151.9	8.7	151.4	0.04	0.0
12/30/2008	181.70	2.91	8.0	152.5	7.8	152.3	0.63	0.0
1/29/2009	182.20	0.39	8.6	151.9	8.5	151.6	0.68	0.0
2/25/2009	185.70	3.10	7.7	152.8	7.5	152.6	1.06	0.0

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**SAND CANYON DAM**  
**PIEZOMETER AND SUBDRAIN MEASUREMENTS**  
**JANUARY 2007 THROUGH DECEMBER 2023**

Monitoring Well --->			VBW/12		VBW/13		Seepage Flow Point	
Top of Well Elevation --->			160.5		160.1		Drain ID	
Bottom of Well Elevation --->			151.5		150.6			
Depth of Well --->			9		9.5			
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Seepage Flow Point (Gal / Min)	
	Elevation	Rainfall					Left Subdrain	Right Subdrain
3/26/2009	188.40	0.10	8.5	152.0	8.5	151.6	1.59	0.0
4/28/2009	189.30	0.00	8.6	151.9	8.9	151.2	2.26	0.0
5/18/2009	188.50	0.00	7.8	152.7	9.0	151.1	2.18	0.0
5/27/2009	188.10	0.00	8.7	151.8	9.1	151.0	1.98	0.0
6/30/2009	188.60	0.10	7.8	152.7	8.6	151.5	2.98	0.0
7/30/2009	184.80	0.00	8.1	152.4	8.4	151.7	2.26	0.0
8/26/2009	176.60	0.00	8.0	152.5	8.1	152.0	0.63	0.0
9/30/2009	174.50	0.00	7.9	152.6	8.4	151.7	0.01	0.0
10/28/2009	175.30	0.29	8.0	152.5	8.5	151.6	0.00	0.0
12/1/2009	176.40	0.00	8.0	152.5	8.7	151.4	0.00	0.0
12/28/2009	178.80	2.75	8.2	152.3	8.6	151.5	0.21	0.0
1/26/2010	191.30	4.15	5.6	154.9	4.9	155.2	1.06	0.0
2/24/2010	193.60	2.29	7.1	153.4	6.7	153.4	2.88	0.0
3/29/2010	193.50	1.18	7.3	153.2	6.8	153.3	1.82	0.0
4/4/2010	193.50		7.5	153.0	7.0	153.1	2.54	0.0
4/27/2010	193.90	1.66	7.3	153.2	6.8	153.3	0.75	0.0
5/27/2010	192.90	0.03	7.4	153.1	7.5	152.6	3.17	0.0
6/29/2010	191.60	0.00	7.7	152.8	8.6	151.5	2.38	0.0
7/28/2010	187.50	0.00	7.5	153.0	7.1	153.0	1.59	0.0
8/31/2010	179.20	0.00	7.4	153.1	7.7	152.4	0.98	0.0
9/29/2010	175.60	0.00	7.3	153.2	7.3	152.8	0.13	0.0
10/26/2010	178.20	2.93	7.5	153.0	7.6	152.5	0.20	0.0
11/30/2010	178.80	1.14	8.0	152.5	8.6	151.5	0.32	0.0
12/30/2010	193.90	9.95	4.6	155.9	3.7	156.4	2.51	0.0
1/27/2011	194.00	0.86	6.4	154.2	5.9	154.2	2.25	0.0
2/23/2011	193.80	1.02	6.5	154.0	6.1	154.0	1.46	0.0
3/29/2011	193.90	2.38	4.8	155.7	3.8	156.3	0.87	0.0
4/27/2011	193.60	0.56	6.0	154.6	5.2	154.9	0.79	0.0

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**JANUARY 2007 THROUGH DECEMBER 2023**

Monitoring Well --->			VBW/12		VBW/13		Seepage Flow Point	
Top of Well Elevation --->			160.5		160.1		Drain ID	
Bottom of Well Elevation --->			151.5		150.6			
Depth of Well --->			9		9.5			
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Seepage Flow Point (Gal / Min)	
	Elevation	Rainfall					Left Subdrain	Right Subdrain
5/25/2011	193.10	0.51	6.8	153.7	6.2	153.9	0.79	0.0
6/28/2011	192.00	0.00	7.8	152.7	7.3	152.8	1.59	0.0
7/27/2011	186.75	0.00	7.7	152.9	7.0	153.1	0.98	0.0
8/25/2011	176.30	0.00	7.7	152.8	7.8	152.3	0.69	0.0
9/28/2011	176.00	0.06	7.8	152.7	7.9	152.3	0.13	0.0
10/25/2011	176.50	0.89	7.9	152.6	8.3	151.8	0.26	0.0
11/22/2011	177.20	1.31	8.4	152.1	8.4	151.8	0.24	0.0
12/22/2011	176.70	0.20	8.7	151.8	8.5	151.6	0.30	0.0
1/25/2012	178.60	0.84	7.8	152.7	8.6	151.5	0.32	0.0
2/28/2012	179.20	0.68	8.0	152.5	8.6	151.5	0.40	0.0
3/27/2012	180.60	1.73	7.9	152.6	8.6	151.5	0.43	0.0
6/27/2012	180.70	0.00	8.9	151.6	9.4	150.7	0.13	0.0
7/26/2012	179.20	0.10	8.8	151.7	9.5	150.6	0.12	0.0
8/8/2012	178.50	0.10	8.9	151.6	8.6	151.5	0.32	0.0
8/28/2012	177.10	0.00	8.9	151.6	9.4	150.7	0.24	0.0
8/29/2012	177.10	0.00	9.2	151.3	8.6	151.5	0.18	0.0
9/25/2012	175.30	0.00	8.9	151.6	9.4	150.7	0.07	0.0
10/30/2012	176.00	0.19	8.9	151.6	9.3	150.8	0.12	0.0
11/27/2012	175.80	0.69	9.0	151.5	9.2	150.9	0.13	0.0
12/12/2012	176.10	1.40	9.0	151.6	9.0	151.1	0.13	0.0
1/22/2013	177.20	1.20	9.0	151.5	9.3	150.8	0.24	0.0
2/27/2013	178.20	0.31	8.9	151.6	9.2	150.9	0.14	0.0
3/28/2013	178.20	0.71	9.0	151.5	9.4	150.7	0.32	0.0
4/25/2013	177.30	0.03	9.0	151.5	9.4	150.7	0.34	0.0
5/22/2013	177.60	0.00	9.0	151.5	9.4	150.7	0.16	0.0
6/25/2013	177.50	0.00	8.9	151.6	9.2	150.9	0.23	0.0
7/23/2013	175.70	0.00	8.9	151.6	9.3	150.8	0.12	0.0
8/21/2013	174.50	0.00	9.0	151.5	9.5	150.6	0.10	0.0

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**JANUARY 2007 THROUGH DECEMBER 2023**

Monitoring Well --->			VBW/12		VBW/13		Seepage Flow Point	
Top of Well Elevation --->			160.5		160.1		Drain ID	
Bottom of Well Elevation --->			151.5		150.6			
Depth of Well --->			9		9.5			
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Seepage Flow Point (Gal / Min)	
	Elevation	Rainfall					Left Subdrain	Right Subdrain
9/25/2013	175.70	0.00	9.0	151.5	9.4	150.7	0.16	0.0
10/29/2013	176.00	0.00	9.0	151.5	9.4	150.7	0.22	0.0
11/27/2013	176.50	0.44	8.9	151.6	9.2	150.9	0.25	0.0
12/19/2013	176.80	0.53	9.0	151.5	9.4	150.7	0.40	0.0
1/28/2014	176.80	0.00	9.0	151.5	9.4	150.7	0.37	0.0
2/25/2014	176.70	0.72	9.0	151.5	9.4	150.7	0.22	0.0
3/25/2014	178.50		9.0	151.5	9.4	150.7	0.25	0.0
3/29/2014	178.40	1.44	9.0	151.5	9.4	150.7	0.47	0.0
4/25/2014	177.40	0.74	9.0	151.5	9.5	150.6	0.32	0.0
5/28/2014	176.40	0.00	9.0	151.5	9.3	150.8	0.04	0.0
6/25/2014	176.10	0.00	9.0	151.5	9.5	150.6	0.21	0.0
7/30/2014	177.30	0.00	9.0	151.5	9.4	150.7	0.28	0.0
8/26/2014	176.10	0.03	9.0	151.5	9.4	150.7	0.29	0.0
9/23/2014	175.90	0.00	8.9	151.7	9.2	150.9	0.26	0.0
10/30/2014	176.30	0.00	8.0	152.5	8.5	151.6	0.29	0.0
11/21/2014	176.20	0.25	8.9	151.6	9.2	150.9	0.32	0.0
12/30/2014	178.90	3.37	8.8	151.7	9.2	150.9	0.42	0.0
1/27/2015	179.60	0.89	8.9	151.6	9.1	151.0	0.40	0.0
2/27/2015	180.00	0.46	8.9	151.6	9.1	151.0	0.52	0.0
3/26/2015	179.60	0.45	9.0	151.5	8.9	151.2	0.61	0.0
4/29/2015	178.20	0.24	8.9	151.6	9.2	150.9	0.55	0.0
5/27/2015	179.00	1.04	8.9	151.6	9.3	150.8	0.48	0.0
6/25/2015	179.60	0.00	8.9	151.6	9.3	150.8	0.44	0.0
7/29/2015	178.10	0.00	8.9	151.6	9.3	150.8	0.55	0.0
8/26/2015	176.20	0.00	8.9	151.6	9.3	150.8	0.13	0.0
9/22/2015	178.20	1.64	8.9	151.6	9.3	150.8	0.61	0.0
10/27/2015	176.90	0.10	8.9	151.6	9.3	150.8	0.42	0.0
11/24/2015	176.30	0.17	9.0	151.5	9.3	150.8	0.40	0.0

Notes:

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3. Piezometer data based on NGVD 29 datum.

**TABLE 2**  
**SAND CANYON DAM**  
**PIEZOMETER AND SUBDRAIN MEASUREMENTS**  
**JANUARY 2007 THROUGH DECEMBER 2023**

Monitoring Well --->			VBW/12		VBW/13		Seepage Flow Point	
Top of Well Elevation --->			160.5		160.1		Drain ID	
Bottom of Well Elevation --->			151.5		150.6			
Depth of Well --->			9		9.5			
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Seepage Flow Point (Gal / Min)	
	Elevation	Rainfall					Left Subdrain	Right Subdrain
12/22/2015	177.60	0.72	9.0	151.5	8.4	151.7	0.41	0.0
1/27/2016	180.10	2.86	8.9	151.6	9.4	150.7	0.37	0.0
2/25/2016	181.60	0.20	9.0	151.5	9.5	150.6	0.57	0.0
3/24/2016	184.80		8.9	151.6	9.5	150.6	0.60	0.0
3/31/2016	184.50	1.51	8.9	151.6	9.5	150.6	2.03	0.0
4/28/2016	183.60	0.04	9.0	151.5	9.5	150.6	1.76	0.0
5/25/2016	182.50	0.13	9.0	151.5	9.5	150.6	1.61	0.0
6/28/2016	180.70	0.00	9.0	151.5	9.5	150.6	1.11	0.0
7/27/2016	178.40	0.00	9.0	151.5	9.5	150.6	1.02	0.0
8/24/2016	176.40	0.00	9.0	151.5	9.5	150.6	0.61	0.0
9/27/2016	175.80	0.00	9.0	151.5	9.5	150.6	0.40	0.0
10/26/2016	178.60	0.64	9.0	151.5	9.5	150.6	0.88	0.0
11/22/2016	178.30	1.11					0.92	0.0
12/28/2016	184.80	4.01	9.0	151.5	9.5	150.6	1.36	0.0
1/25/2017	193.30	6.33	4.7	155.8	7.7	152.4	2.01	0.0
2/28/2017	193.90	3.27	3.8	156.7	6.5	153.6	1.72	0.0
3/29/2017	193.70	0.08	4.9	155.6	7.7	152.4	1.66	0.0
4/27/2017	192.90	0.04	5.5	155.0	8.2	151.9	2.77	0.0
5/23/2017	187.90	0.33	9.0	151.5	9.0	151.1	3.29	0.0
6/21/2017	182.50	0.00	8.9	151.6	8.6	151.5	2.06	0.0
7/26/2017	163.60	0.00	8.8	151.7	8.5	151.6	0.26	0.0
8/30/2017	163.60	0.00	8.4	152.1	9.2	150.9	0.00	0.0
9/28/2017	163.60	0.00	9.0	151.5	9.5	150.6	0.00	0.0
10/26/2017	171.80	0.00	9.0	151.5	9.5	150.6	0.00	0.0
11/29/2017	177.20	0.08	9.0	151.5	9.5	150.6	0.00	0.0
12/27/2017	176.70	0.00	9.0	151.5	9.5	150.6	0.00	0.0
1/24/2018	178.10	1.67	9.0	151.5	9.5	150.6	0.02	0.0
2/21/2018	177.80	0.27	9.0	151.5	9.5	150.6	0.00	0.0

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**TABLE 2**  
**SAND CANYON DAM**  
**PIEZOMETER AND SUBDRAIN MEASUREMENTS**  
**JANUARY 2007 THROUGH DECEMBER 2023**

Monitoring Well --->			VBW/12		VBW/13		Seepage Flow Point	
Top of Well Elevation --->			160.5		160.1		Drain ID	
Bottom of Well Elevation --->			151.5		150.6			
Depth of Well --->			9		9.5			
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Seepage Flow Point (Gal / Min)	
	Elevation	Rainfall					Left Subdrain	Right Subdrain
3/28/2018	183.50	1.23	9.0	151.5	9.5	150.6	0.14	0.0
4/27/2018	184.30	0.05	9.0	151.5	9.5	150.6	0.29	0.0
5/30/2018	183.10	0.13	9.0	151.5	9.5	150.6	0.22	0.0
6/28/2018	181.70	0.00	9.0	151.5	9.5	150.6	0.15	0.0
7/26/2018	180.00	0.00	9.0	151.5	9.5	150.6	0.03	0.0
8/28/2018	177.30	0.00	9.0	151.5	9.5	150.6	0.00	0.0
9/27/2018	178.10	0.00	9.0	151.5	9.5	150.6	0.00	0.0
10/24/2018	178.00	0.66	9.0	151.5	9.5	150.6	0.00	0.0
11/29/2018	177.50	1.60	9.0	151.5	9.5	150.6	0.00	0.0
12/20/2018	181.40	2.39	9.0	151.5	9.5	150.6	0.08	0.0
1/30/2019	189.40	4.56	8.4	152.1	8.4	151.7	0.76	0.0
2/27/2019	194.10	7.48	6.5		5.8		1.82	0.0
3/27/2019	194.00	1.27	7.1		7		1.66	0.0
4/24/2019	193.60	0.07	7.60		7.60		1.66	0.0
5/30/2019	191.40	0.73	8.40		8.20		1.35	0.0
6/26/2019	190.80	0.02	7.90		7.90		1.53	0.0
7/5/2015	190.40	0.00	9.00		9.50		1.59	0.0
7/30/2019	188.95	0.00	9.00		9.50		1.37	0.0
8/27/2019	187.40	0.00	9.00		0.00		1.06	0.0
9/26/2019	186.20	0.00	9.00		9.50		1.03	0.0
10/22/2019	185.20	0.00	9.00		9.50		1.05	0.0
11/26/2019	183.50	2.66	8081.00		8358.00		1.13	0.0
12/18/2019	186.80	4.44	8070.00		8344.00		1.65	0.0
1/28/2020	192.00	0.24	8.39		8.40		2.06	0.0
2/25/2020	192.10	0.49	8052.60		8325.60		2.57	0.0
3/24/2020	194.00	3.89	8014.40		8288.70		2.44	0.0
4/29/2020	193.50	4.59	8005.488		8269.357		3.70	0.0
5/27/2020	193.10	0.03	8038.796		8312.104		4.12	0.0
6/24/2020	190.00	0.00	8073.167		8344.973		4.23	0.0

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**TABLE 2**  
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**PIEZOMETER AND SUBDRAIN MEASUREMENTS**  
**JANUARY 2007 THROUGH DECEMBER 2023**

Monitoring Well --->			VBW/12		VBW/13		Seepage Flow Point	
Top of Well Elevation --->			160.5		160.1		Drain ID	
Bottom of Well Elevation --->			151.5		150.6			
Depth of Well --->			9		9.5			
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Seepage Flow Point (Gal / Min)	
	Elevation	Rainfall					Left Subdrain	Right Subdrain
7/29/2020	188.90	0.00	8066.977		8341.389		3.54	0.0
8/27/2020	185.90	0.00	8080.359		8356.421		3.49	0.0
9/29/2020	183.10	0.00	8077.749		8356.66		2.43	0.0
10/29/2020	180.30	0.00	8084.328		8366.622		1.51	0.0
11/24/2020	179.00	0.65	8089.965		8379.636		1.05	0.0
12/29/2020	179.00	1.03	8086.061		8380.184		0.89	0.0
1/26/2021	180.50	2.39	9.00	151.50	9.50	150.60	0.98	0.00
2/25/2021	182.10	0.03	9.00	151.50	9.50	150.60	1.00	0.00
3/23/2021	182.90	1.15	9.00	151.50	9.50	150.60	1.36	0.00
4/27/2021	182.00	0.04	9.00	151.50	9.50	150.60	1.17	0.00
5/26/2021	181.00	0.11	9.00	151.50	9.50	150.60	0.87	0.00
6/30/2021	179.00	0.00	9.00	151.50	9.50	150.60	0.69	0.00
7/27/2021	177.10	0.08	9.00	151.50	9.50	150.60	0.43	0.00
8/24/2021	175.40	0.00	9.00	151.50	9.50	150.60	0.24	0.00
9/28/2021	175.20	0.06	8.79	151.71	9.50	150.60	0.19	0.00
10/27/2021	177.20	0.80	9.00	151.50	9.50	150.60	0.32	0.00
11/23/2021	177.80	0.00	9.00	151.50	9.50	150.60	0.51	0.00
12/21/2021	180.50	5.86	9.00	151.50	9.50	150.60	0.63	0.00
1/25/2022	187.00	0.08	9.00	151.50	9.50	150.60	1.59	0.00
2/22/2022	186.60	0.18	9.00	151.50	9.50	150.60	1.59	0.00
3/28/2022	186.60	1.38	9.00	151.50	9.50	150.60	1.33	0.00
4/26/2022	186.60	0.01	9.00	151.50	9.50	150.60	1.35	0.00
5/25/2022	185.30	0.05	9.20	151.30	9.90	150.20	1.30	0.00
6/28/2022	182.70	0.00	9.00	151.50	9.50	150.60	1.19	0.00
7/26/2022	179.70	0.00	9.00	151.50	9.50	150.60	0.76	0.00
8/30/2022	178.30	0.13	9.00	151.50	9.50	150.60	0.57	0.00
9/29/2022	175.80	0.24	9.50	151.00	10.00	150.10	0.32	0.00
10/26/2022	175.30	0.26	9.00	151.50	9.50	150.60	0.27	0.00
11/22/2022	179.40	1.46	9.00	151.50	9.50	150.60	0.49	0.00

Notes:

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3. Piezometer data based on NGVD 29 datum.

**TABLE 2**  
**SAND CANYON DAM**  
**PIEZOMETER AND SUBDRAIN MEASUREMENTS**  
**JANUARY 2007 THROUGH DECEMBER 2023**

Monitoring Well --->			VBW/12		VBW/13		Seepage Flow Point	
Top of Well Elevation --->			160.5		160.1		Drain ID	
Bottom of Well Elevation --->			151.5		150.6			
Depth of Well --->			9		9.5			
Date	Spillway 378'		Reading	Elev.	Reading	Elev.	Seepage Flow Point (Gal / Min)	
	Elevation	Rainfall					Left Subdrain	Right Subdrain
12/29/2022	185.70	2.21	8.90	151.60	9.80	150.30	1.37	0.00
1/11/2023	191.70	3.90	6.70	153.80	6.10	154.00	1.97	0.00
1/25/2023	194.00	7.17	7.20	153.30	7.30	152.80	2.12	0.00
2/28/2023	194.00	3.98	6.50	154.00	5.90	154.20	2.69	0.00
3/29/2023	194.00	5.92	5.90	154.60	4.60	155.50	3.17	0.04
4/25/2023	194.00	0.19	6.70	153.80	6.30	153.80	3.04	0.00
5/24/2023	193.40	0.89	7.00	153.50	6.80	153.30	2.64	0.00
6/28/2023	192.70	0.07	7.60	152.90	7.40	152.70	3.17	0.00
7/26/2023	191.60	0.00	8.10	152.40	7.90	152.20	3.59	0.00
8/29/2023	190.50	1.84	8.24	152.26	8.06	152.04	3.43	0.00
9/26/2023	189.80	0.00	8.50	152.00	8.30	151.80	4.04	0.00
10/25/2023	189.70	0.19	8.40	152.10	8.40	151.70	3.70	0.00
11/30/2023	189.20	0.65	8.40	152.10	8.40	151.70	2.43	0.00
12/27/2023	190.00	1.15	8.30	152.20	8.30	151.80	3.80	0.00

Notes:

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3. Piezometer data based on NGVD 29 datum.

**TABLE 3**  
**SAND CANYON DAM**  
**HORIZONTAL MOVEMENT OF SURVEY MONUMENTS**  
**1975 THROUGH 2023**

Monument ID		Reservoir Elevation (feet)	Temperature (°C)	S-1		S-2		S-3		S-4		S-6		S-5	
Approx . Station				8+00.234		6+00.212		4+00.125		2+00.191		0+61.430		0+00.079	
Year	Date			(feet)	(inches)	(feet)	(inches)	(feet)	(inches)	(feet)	(inches)	(feet)	(inches)	(feet)	(inches)
1968															
1969															
1975	9/15/1975			0.050	0.600	0.060	0.720	0.050	0.600	0.040	0.480			0.000	0.000
1976															
1977															
1978															
1979															
1980															
1981	12/15/1981			0.070	0.840	0.080	0.960	0.080	0.960	0.040	0.480			0.100	1.200
1982	6/15/1982			0.030	0.360	0.070	0.840	0.100	1.200	0.080	0.960			0.050	0.600
1983															
1984															
1985	10/20/1985			0.070	0.840	0.090	1.080	0.120	1.440	0.130	1.560			0.060	0.720
1986															
1987	10/20/1987			0.080	0.960	0.120	1.440	0.110	1.320	0.110	1.320	0.150	1.800	0.060	0.720
1988															
1989															
1990															
1991															
1992															
1993															
1994															
1995	5/8/1995			0.060	0.720	0.080	0.960	0.130	1.560	0.120	1.440	0.120	1.440	0.040	0.480
1996	5/1/1996			0.080	0.960	0.100	1.200	0.120	1.440	0.120	1.440	0.150	1.800	0.050	0.600
1997	5/28/1997			0.070	0.840	0.080	0.960	0.100	1.200	0.100	1.200	0.130	1.560	0.005	0.600
1998	5/11/1998			0.070	0.840	0.080	0.960	0.100	1.200	0.100	1.200	0.120	1.440	0.010	0.120

Note:  
1. Vertical data is referenced in NGVD 29 datum.

**TABLE 3**  
**SAND CANYON DAM**  
**HORIZONTAL MOVEMENT OF SURVEY MONUMENTS**  
**1975 THROUGH 2023**

Monument ID		Reservoir Elevation (feet)	Temperature (°C)	S-1		S-2		S-3		S-4		S-6		S-5	
Approx . Station				8+00.234		6+00.212		4+00.125		2+00.191		0+61.430		0+00.079	
Year	Date			(feet)	(inches)	(feet)	(inches)	(feet)	(inches)	(feet)	(inches)	(feet)	(inches)	(feet)	(inches)
1999	4/26/1999			0.070	0.840	0.090	1.080	0.100	1.200	0.095	1.140	0.115	1.380	0.015	0.180
2000	6/29/2000			0.075	0.900	0.090	1.080	0.105	1.260	0.095	1.140	0.120	1.440	0.015	0.180
2001	5/2/2001			0.075	0.900	0.090	1.080	0.100	1.200	0.095	1.140	0.110	1.320	0.020	0.240
2002	5/21/2002			0.070	0.840	0.090	1.080	0.120	1.440	0.100	1.200	0.105	1.260	0.020	0.240
2003	5/21/2003			0.075	0.900	0.095	1.140	0.115	1.380	0.100	1.200	0.110	1.320	0.015	0.180
2004	5/18/2004			0.070	0.840	0.100	1.200	0.120	1.440	0.100	1.200	0.115	0.138	0.020	0.240
2005	5/31/2005			0.070	0.840	0.100	1.200	0.105	1.260	0.100	1.200	0.115	1.380	0.020	0.240
2006	5/31/2006			0.070	0.840	0.095	1.140	0.110	1.320	0.100	1.200	0.115	1.380	0.010	0.120
2007	5/15/2007			0.080	0.960	0.085	1.020	0.105	1.260	0.090	1.080	0.105	1.260	0.020	0.240
2008	5/27/2008			0.080	0.960	0.085	1.020	0.105	1.260	0.100	1.200	0.120	1.440	0.020	0.240
2009	6/9/2009			0.065	0.780	0.085	1.020	0.095	1.140	0.100	1.200	0.120	1.440	0.020	0.240
2010	5/24/2010			0.060	0.720	0.080	0.960	0.110	1.320	0.090	1.080	0.105	1.260	0.020	0.240
2011	5/18/2011			0.065	0.780	0.080	0.960	0.110	1.320	0.110	1.320	0.120	1.440	0.020	0.240
2012	5/18/2012			0.065	0.780	0.085	1.020	0.110	1.320	0.105	1.260	0.120	1.440	0.020	0.240
2013	6/6/2013			0.065	0.780	0.105	1.260	0.100	1.200	0.100	1.200	0.115	1.380	0.015	0.180
2014	4/25/2014			0.095	1.140	0.100	1.200	0.130	1.560	0.100	1.200	0.120	1.440	0.015	0.180
2015	6/4/2015			0.080	0.960	0.080	0.960	0.115	1.380	0.105	1.260	0.115	1.380	0.020	0.240
2016	7/25/2016			0.080	0.960	0.085	1.020	0.115	1.380	0.110	1.320	0.125	1.500	0.015	0.180
2017	6/15/2017														
2018	5/31/2018			0.080	0.960	0.090	1.080	0.115	1.380	0.105	1.260	0.125	1.500	0.025	0.300
2019	6/13/2019			0.080	0.960	0.095	1.140	0.120	1.440	0.115	1.380	0.125	1.500	0.020	0.240
2020	10/16/2020			0.060	0.720	0.060	0.720	0.110	1.320	0.110	1.320	0.130	1.560	0.035	0.420
2021															
2022	4/26/2022			0.060	0.720	0.070	0.840	0.110	1.320	0.110	1.320	0.120	1.440	0.025	0.300
2022	10/27/2022	175.2	27.2	0.070	0.840	0.095	1.140	0.115	1.380	0.095	1.140	0.115	1.380	0.020	0.240
2023	12/6/2023	189.3	12.8	0.070	0.840	0.085	1.020	0.120	1.440	0.100	1.200	0.120	1.440	0.020	0.240

Note:

1. Vertical data is referenced in NGVD 29 datum.



**TABLE 4**  
**SAND CANYON DAM**  
**CUMULATIVE HORIZONTAL DISPLACEMENT OF SURVEY MONUMENTS**  
**1975 THROUGH 2023**

Monument ID		Reservoir Elevation (feet)	Temperature (°C)	S-1		S-2		S-3		S-4		S-6		S-5	
Approx . Station				8+00.234		6+00.212		4+00.125		2+00.191		0+61.430		0+00.079	
Year	Date			(feet)	(inches)	(feet)	(inches)	(feet)	(inches)	(feet)	(inches)	(feet)	(inches)	(feet)	(inches)
1968															
1969															
1975	9/15/1975			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000			0.000	0.000
1976															
1977															
1978															
1979															
1980															
1981	12/15/1981			0.020	0.240	0.020	0.240	0.030	0.360	0.000	0.000			0.100	1.200
1982	6/15/1982			-0.020	-0.240	0.010	0.120	0.050	0.600	0.040	0.480			0.050	0.600
1983															
1984															
1985	10/20/1985			0.020	0.240	0.030	0.360	0.070	0.840	0.090	1.080			0.006	0.720
1986															
1987	10/20/1987			0.030	0.360	0.060	0.720	0.060	0.720	0.070	0.840	0.000	0.000	0.060	0.720
1988															
1989															
1990															
1991															
1992															
1993															
1994															
1995	5/8/1995			0.010	0.120	0.020	0.240	0.080	0.960	0.080	0.960	-0.030	-0.360	0.040	0.480
1996	5/1/1996			0.030	0.360	0.040	0.480	0.070	0.840	0.080	0.960	0.000	0.000	0.050	0.600
1997	5/28/1997			0.020	0.240	0.020	0.240	0.050	0.600	0.060	0.720	-0.020	-0.240	0.050	0.600
1998	5/11/1998			0.020	0.240	0.020	0.240	0.050	0.600	0.060	0.720	-0.030	-0.360	0.010	0.120

Note:

1. Vertical data is referenced in NGVD 29 datum.

**TABLE 4**  
**SAND CANYON DAM**  
**CUMULATIVE HORIZONTAL DISPLACEMENT OF SURVEY MONUMENTS**  
**1975 THROUGH 2023**

Monument ID		Reservoir Elevation (feet)	Temperature (°C)	S-1		S-2		S-3		S-4		S-6		S-5	
Approx . Station				8+00.234		6+00.212		4+00.125		2+00.191		0+61.430		0+00.079	
Year	Date			(feet)	(inches)	(feet)	(inches)	(feet)	(inches)	(feet)	(inches)	(feet)	(inches)	(feet)	(inches)
1999	4/26/1999			0.020	0.240	0.030	0.360	0.050	0.600	0.055	0.660	-0.035	-0.420	0.015	0.180
2000	6/29/2000			0.025	0.300	0.030	0.360	0.055	0.660	0.055	0.660	-0.030	-0.360	0.015	0.180
2001	5/2/2001			0.025	0.300	0.030	0.360	0.050	0.600	0.055	0.660	-0.040	-0.480	0.020	0.240
2002	5/21/2002			0.020	0.240	0.030	0.360	0.070	0.840	0.060	0.720	-0.045	-0.540	0.020	0.240
2003	5/21/2003			0.025	0.300	0.035	0.420	0.065	0.780	0.060	0.720	-0.040	-0.480	0.015	0.180
2004	5/18/2004			0.020	0.240	0.040	0.480	0.070	0.840	0.060	0.720	-0.035	-0.420	0.020	0.240
2005	5/31/2005			0.020	0.240	0.040	0.480	0.055	0.660	0.060	0.720	-0.035	-0.420	0.020	0.240
2006	5/31/2006			0.020	0.240	0.035	0.420	0.060	0.720	0.060	0.720	-0.035	-0.420	0.010	0.120
2007	5/15/2007			0.030	0.360	0.025	0.300	0.055	0.660	0.050	0.600	-0.045	-0.540	0.020	0.240
2008	5/27/2008			0.030	0.360	0.025	0.300	0.055	0.660	0.060	0.720	-0.030	-0.360	0.020	0.240
2009	6/9/2009			0.015	0.180	0.025	0.300	0.045	0.540	0.060	0.720	-0.030	-0.360	0.020	0.240
2010	5/24/2010			0.010	0.120	0.020	0.240	0.060	0.720	0.050	0.600	-0.045	-0.540	0.020	0.240
2011	5/18/2011			0.015	0.180	0.020	0.240	0.060	0.720	0.070	0.840	-0.030	-0.360	0.020	0.240
2012	5/18/2012			0.015	0.180	0.025	0.300	0.060	0.720	0.065	0.780	-0.030	-0.360	0.020	0.240
2013	6/6/2013			0.015	0.180	0.015	0.180	0.055	0.660	0.060	0.720	-0.035	-0.420	0.015	0.180
2014	4/25/2014			0.045	0.540	0.040	0.480	0.080	0.960	0.060	0.720	-0.030	-0.360	0.015	0.180
2015	6/4/2015			0.030	0.360	0.020	0.240	0.065	0.780	0.065	0.780	-0.035	-0.420	0.020	0.240
2016	7/25/2016			0.030	0.360	0.025	0.300	0.065	0.780	0.070	0.840	-0.025	-0.300	0.015	0.180
2017	6/15/2017														
2018	5/31/2018			0.030	0.360	0.030	0.360	0.065	0.780	0.065	0.780	-0.025	-0.300	0.025	0.300
2019	6/13/2019			0.030	0.360	0.035	0.420	0.070	0.840	0.075	0.900	-0.025	-0.300	0.020	0.240
2020	10/16/2020			0.010	0.120	0.000	0.000	0.060	0.720	0.070	0.840	-0.020	-0.240	0.035	0.420
2021															
2022	4/26/2022			0.010	0.120	0.010	0.120	0.060	0.720	0.070	0.840	-0.030	-0.360	0.025	0.300
2022	10/27/2022	175.2	27.2	0.020	0.240	0.035	0.420	0.065	0.780	0.055	0.660	-0.035	-0.420	0.020	0.240
2023	12/6/2023	189.3	12.8	0.020	0.240	0.025	0.300	0.070	0.840	0.060	0.720	-0.030	-0.360	0.020	0.240

Note:

1. Vertical data is referenced in NGVD 29 datum.

**TABLE 5**  
**SAND CANYON DAM**  
**ELEVATIONS OF SURVEY MONUMENTS**  
**1968 THROUGH 2023**

Monument ID		Reservoir Elevation (feet)	Temperature (°C)	S-1	S-2	S-3	S-4	S-6	S-5
Approx . Station				8+00.234	6+00.212	4+00.125	2+00.191	0+61.430	0+00.079
Year	Date			(feet)	(feet)	(feet)	(feet)	(feet)	(feet)
1968				200.75	200.33	200.4	200.57		
1969				200.6	200.24	200.29	200.41		
1975	9/15/1975			200.727	200.956	200.534	200.430		200.570
1976									
1977									
1978									
1979									
1980									
1981	12/15/1981			200.750	201.970	200.540	200.630		200.570
1982	6/15/1982			200.800	201.010	200.570	200.660		200.610
1983									
1984									
1985	10/20/1985			200.740	200.960	200.540	200.600		200.550
1986									
1987	10/20/1987			200.790		200.550	200.630	200.760	200.550
1988									
1989									
1990									
1991									
1992									
1993									
1994									
1995	5/8/1995			200.840	201.060	200.610	200.680	200.830	200.660
1996	5/1/1996			200.840	201.060	200.610	200.690	200.840	200.670
1997	5/28/1997			200.850	201.070	200.610	200.700	200.810	200.680
1998	5/11/1998			200.850	201.060	200.600	200.680	200.780	200.660

Note:

1. Vertical data is referenced in NGVD 29 datum.

**TABLE 5**  
**SAND CANYON DAM**  
**ELEVATIONS OF SURVEY MONUMENTS**  
**1968 THROUGH 2023**

Monument ID		Reservoir Elevation (feet)	Temperature (°C)	S-1	S-2	S-3	S-4	S-6	S-5
Approx . Station				8+00.234	6+00.212	4+00.125	2+00.191	0+61.430	0+00.079
Year	Date			(feet)	(feet)	(feet)	(feet)	(feet)	(feet)
1999	4/26/1999			200.847	201.057	200.592	200.677	200.772	200.657
2000	6/29/2000			200.847	201.057	200.597	200.682	200.777	200.667
2001	5/2/2001			200.847	201.057	200.602	200.692	200.787	200.672
2002	5/21/2002			200.852	201.057	200.597	200.682	200.782	200.672
2003	5/21/2003			200.852	201.062	200.602	200.687	200.787	200.677
2004	5/18/2004			200.852	201.062	200.602	200.687	200.787	200.677
2005	5/31/2005			200.852	201.062	200.602	200.682	200.782	200.672
2006	5/31/2006			200.857	201.062	200.597	200.682	200.782	200.672
2007	5/15/2007			200.847	201.060	200.597	200.680	200.778	200.671
2008	5/27/2008			200.850	201.054	200.591	200.673	200.774	200.668
2009	6/9/2009			200.847	201.067	200.607	200.687	200.787	200.682
2010	5/24/2010			200.847	201.052	200.587	200.672	200.772	200.667
2011	5/18/2011			200.847	201.052	200.592	200.677	200.777	200.672
2012	5/18/2012			200.847	201.057	200.592	200.677	200.777	200.672
2013	6/6/2013			200.847	201.057	200.587	200.672	200.777	200.672
2014	4/25/2014			200.847	201.062	200.597	200.682	200.787	200.682
2015	6/4/2015			200.847	201.057	200.587	200.677	200.777	200.672
2016	7/25/2016			200.842	201.047	200.582	200.672	200.772	200.667
2017	6/15/2017								
2018	5/31/2018			200.842	201.057	200.592	200.682	200.787	200.682
2019	6/13/2019			200.852	201.052	200.582	200.667	200.767	200.662
2020	10/16/2020			200.843	201.052	200.574	200.660	200.764	200.658
2021									
2022	4/26/2022			200.845	201.054	200.581	200.668	200.771	200.667
2022	10/27/2022	175.2	27.2	200.842	201.057	200.581	200.669	200.767	200.665
2023	12/6/2023	189.3	12.8	200.845	201.048	200.578	200.665	200.769	200.663

Note:

1. Vertical data is referenced in NGVD 29 datum.

**TABLE 6**  
**SAND CANYON DAM**  
**CUMULATIVE VERTICAL MOVEMENT OF SURVEY MONUMENTS**  
**1969 THROUGH 2023**

Monument ID		Reservoir Elevation (feet)	Temperature (°C)	S-1		S-2		S-3		S-4		S-6		S-5	
Approx . Station				8+00.234		6+00.212		4+00.125		2+00.191		0+61.430		0+00.079	
Year	Date			(feet)	(inches)	(feet)	(inches)	(feet)	(inches)	(feet)	(inches)	(feet)	(inches)	(feet)	(inches)
1968															
1969				-0.15	-1.800	-0.09	-1.080	-0.11	-1.32	-0.16	-1.92				
1975	9/15/1975			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000			0.000	0.000
1976															
1977															
1978															
1979															
1980															
1981	12/15/1981			-0.023	-0.276	-1.014	-12.168	-0.006	-0.072	-0.200	-2.400			0.000	0.000
1982	6/15/1982			-0.073	-0.876	-0.054	-0.648	-0.036	-0.432	-0.230	-2.760			-0.040	-0.480
1983															
1984															
1985	10/20/1985			-0.013	-0.156	-0.004	-0.048	-0.006	-0.072	-0.170	-2.040			0.020	0.240
1986															
1987	10/20/1987			-0.063	-0.756		0.000	-0.016	-0.192	-0.200	-2.400	0.000	0.000	0.020	0.240
1988															
1989															
1990															
1991															
1992															
1993															
1994															
1995	5/8/1995			-0.113	-1.356	-0.104	-1.248	-0.076	-0.912	-0.250	-3.000	-0.070	-0.840	-0.090	-1.080
1996	5/1/1996			-0.113	-1.356	-0.104	-1.248	-0.076	-0.912	-0.260	-3.120	-0.080	-0.960	-0.100	-1.200
1997	5/28/1997			-0.123	-1.476	-0.114	-1.368	-0.076	-0.912	-0.270	-3.240	-0.050	-0.600	-0.110	-1.320
1998	5/11/1998			-0.123	-1.476	-0.104	-1.248	-0.066	-0.792	-0.250	-3.000	-0.020	-0.240	-0.090	-1.080

Note:  
1. Vertical data is referenced in NGVD 29 datum.

**TABLE 6**  
**SAND CANYON DAM**  
**CUMULATIVE VERTICAL MOVEMENT OF SURVEY MONUMENTS**  
**1969 THROUGH 2023**

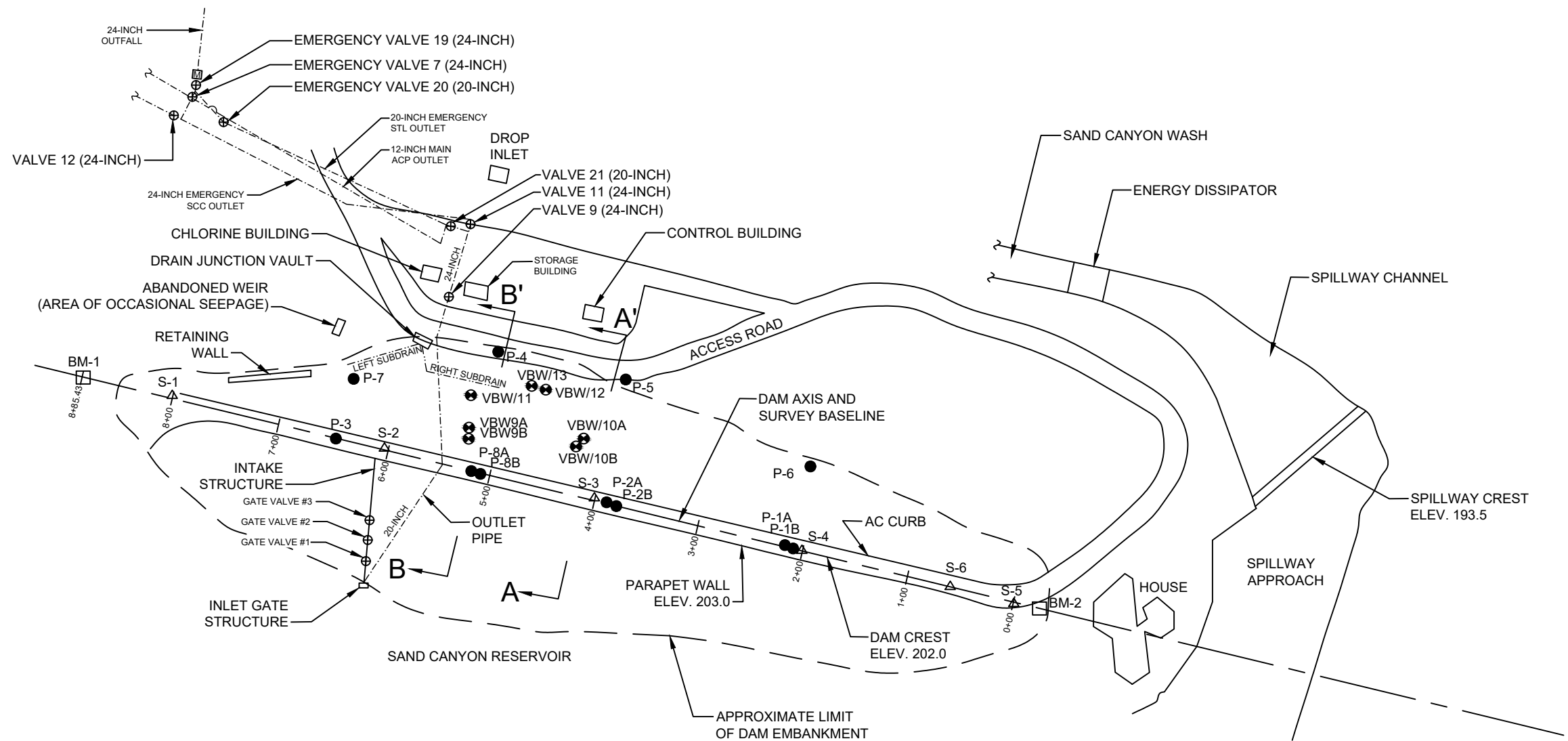
Monument ID		Reservoir Elevation (feet)	Temperature (°C)	S-1		S-2		S-3		S-4		S-6		S-5	
Approx . Station				8+00.234		6+00.212		4+00.125		2+00.191		0+61.430		0+00.079	
Year	Date			(feet)	(inches)	(feet)	(inches)	(feet)	(inches)	(feet)	(inches)	(feet)	(inches)	(feet)	(inches)
1999	4/26/1999			-0.120	-1.440	-0.101	-1.212	-0.058	-0.696	-0.247	-2.964	-0.012	-0.144	-0.087	-1.044
2000	6/29/2000			-0.120	-1.440	-0.101	-1.212	-0.063	-0.756	-0.252	-3.024	-0.017	-0.204	-0.097	-1.164
2001	5/2/2001			-0.120	-1.440	-0.101	-1.212	-0.068	-0.816	-0.262	-3.144	-0.027	-0.324	-0.102	-1.224
2002	5/21/2002			-0.125	-1.500	-0.101	-1.212	-0.063	-0.756	-0.252	-3.024	-0.022	-0.264	-0.102	-1.224
2003	5/21/2003			-0.125	-1.500	-0.106	-1.272	-0.068	-0.816	-0.257	-3.084	-0.027	-0.324	-0.107	-1.284
2004	5/18/2004			-0.125	-1.500	-0.106	-1.272	-0.068	-0.816	-0.257	-3.084	-0.027	-0.324	-0.107	-1.284
2005	5/31/2005			-0.125	-1.500	-0.106	-1.272	-0.068	-0.816	-0.252	-3.024	-0.022	-0.264	-0.102	-1.224
2006	5/31/2006			-0.130	-1.560	-0.106	-1.272	-0.063	-0.756	-0.252	-3.024	-0.022	-0.264	-0.102	-1.224
2007	5/15/2007			-0.120	-1.440	-0.104	-1.248	-0.063	-0.756	-0.250	-3.000	-0.018	-0.216	-0.101	-1.212
2008	5/27/2008			-0.123	-1.476	-0.098	-1.176	-0.057	-0.684	-0.243	-2.916	-0.014	-0.168	-0.098	-1.176
2009	6/9/2009			-0.120	-1.440	-0.111	-1.332	-0.073	-0.876	-0.257	-3.084	-0.027	-0.324	-0.112	-1.344
2010	5/24/2010			-0.120	-1.440	-0.096	-1.152	-0.053	-0.636	-0.242	-2.904	-0.012	-0.144	-0.097	-1.164
2011	5/18/2011			-0.120	-1.440	-0.096	-1.152	-0.058	-0.696	-0.247	-2.964	-0.017	-0.204	-0.102	-1.224
2012	5/18/2012			-0.120	-1.440	-0.101	-1.212	-0.058	-0.696	-0.247	-2.964	-0.017	-0.204	-0.102	-1.224
2013	6/6/2013			-0.120	-1.440	-0.101	-1.212	-0.053	-0.636	-0.242	-2.904	-0.017	-0.204	-0.102	-1.224
2014	4/25/2014			-0.120	-1.440	-0.106	-1.272	-0.063	-0.756	-0.252	-3.024	-0.027	-0.324	-0.112	-1.344
2015	6/4/2015			-0.120	-1.440	-0.101	-1.212	-0.053	-0.636	-0.247	-2.964	-0.017	-0.204	-0.102	-1.224
2016	7/25/2016			-0.115	-1.380	-0.091	-1.092	-0.048	-0.576	-0.242	-2.904	-0.012	-0.144	-0.097	-1.164
2017	6/15/2017														
2018	5/31/2018			-0.115	-1.380	-0.101	-1.212	-0.058	-0.696	-0.252	-3.024	-0.027	-0.324	-0.112	-1.344
2019	6/13/2019			-0.125	-1.500	-0.096	-1.152	-0.048	-0.576	-0.237	-2.844	-0.007	-0.084	-0.092	-1.104
2020	10/16/2020			-0.116	-1.392	-0.096	-1.152	-0.040	-0.480	-0.230	-2.760	-0.004	-0.048	-0.088	-1.056
2021															
2022	4/26/2022			-0.118	-1.416	-0.098	-1.176	-0.047	-0.564	-0.238	-2.856	-0.011	-0.132	-0.097	-1.164
2022	10/27/2022	175.2	27.2	-0.115	-1.38	-0.101	-1.212	-0.047	-0.564	-0.239	-2.868	-0.007	-0.084	-0.095	-1.140
2023	12/6/2023	189.3	12.8	-0.118	-1.416	-0.092	-1.104	-0.044	-0.528	-0.235	-2.82	-0.009	-0.108	-0.093	-1.116

Note:

1. Vertical data is referenced in NGVD 29 datum.

## Figures

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# LEGEND

- VBW/13 VIBRATING WIRE PIEZOMETER
- P-2A OPEN WELL PIEZOMETER
- △ S-3 SURVEY MONUMENT
- BM-1 BENCH MARK
- M METER

- A A' LINE OF SECTION
- OUTLET PIPE
- - - - SEEPAGE SUBDRAIN
- 0+00 STATION NUMBER

## NOTES:

- (1) SECTION A-A' IS SHOWN ON FIGURE 2
- (2) SECTION B-B' IS SHOWN ON FIGURE 3
- (3) ELEVATIONS ARE IN FEET RELATIVE TO NGVD29 DATUM
- (4) LOCATIONS OF OUTLET PIPES AND VALVES ARE ESTIMATED
- (5) ONLY DSOD JURISDICTIONAL VALVES ARE SHOWN

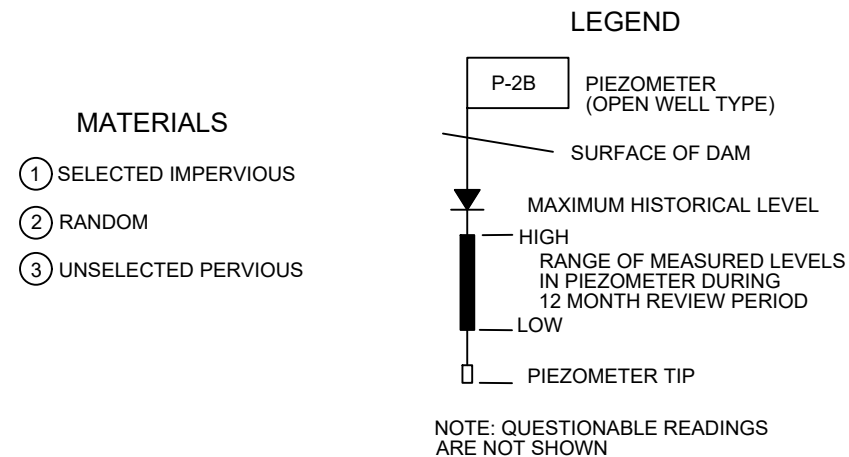
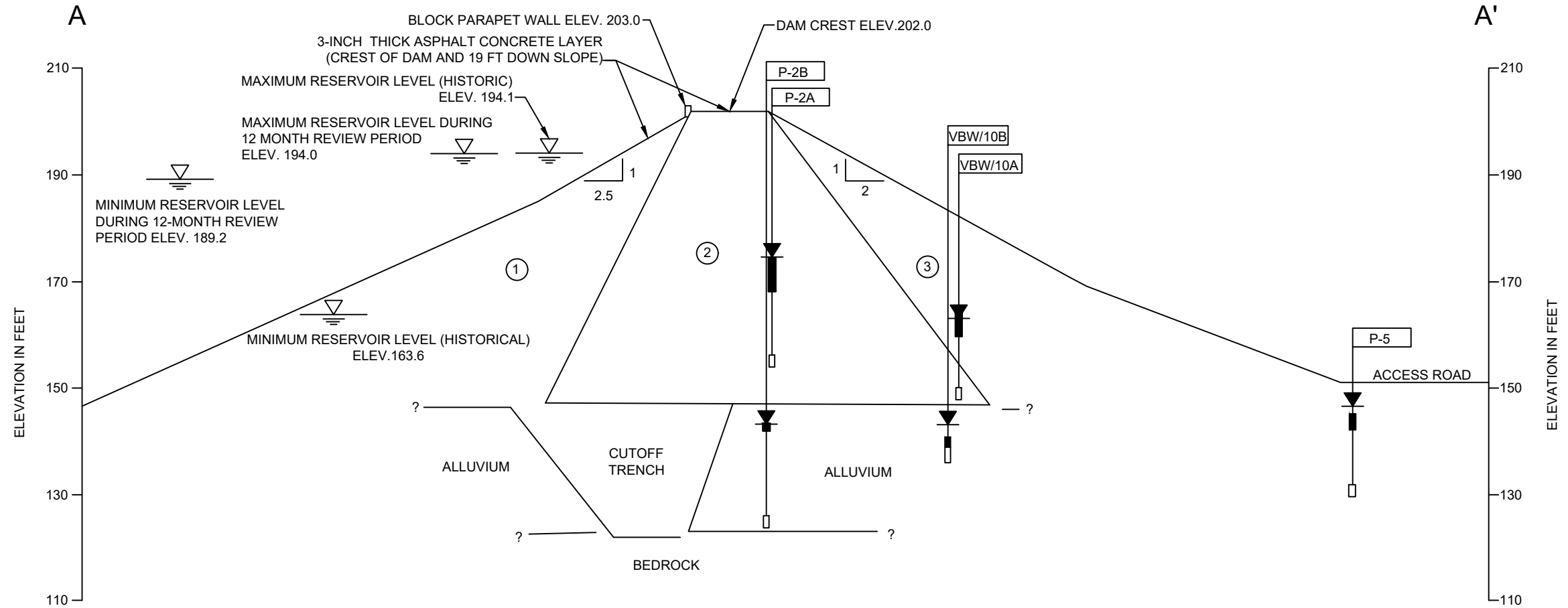
NOT TO SCALE

Annual Surveillance Report from Jan. 2023 to Dec. 2023	
Sand Canyon Dam	
Irvine, CA	
Irvine Ranch Water District	
Irvine, CA	

<div> <div>GEI</div> <div>Consultants</div> </div>	SITE AND INSTRUMENTATION PLAN	
	Project 1901888	July 2024

Fig. 1





NOTES:

(1) SEE FIGURE 1 FOR LOCATION OF SECTION

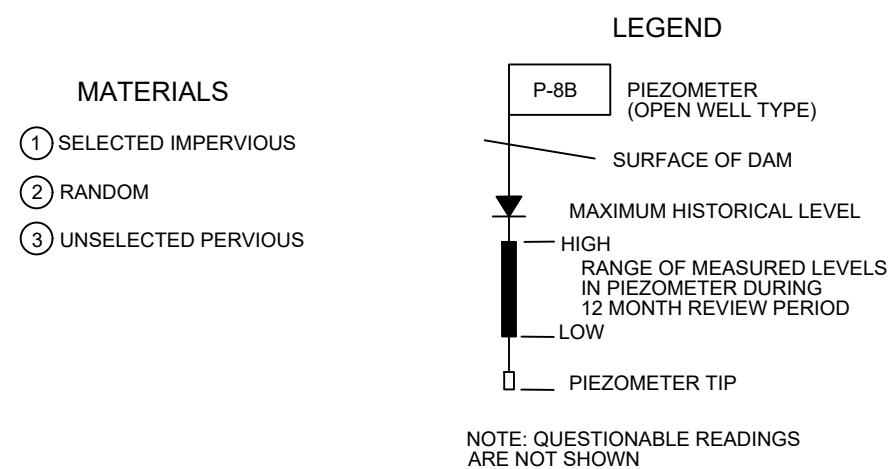
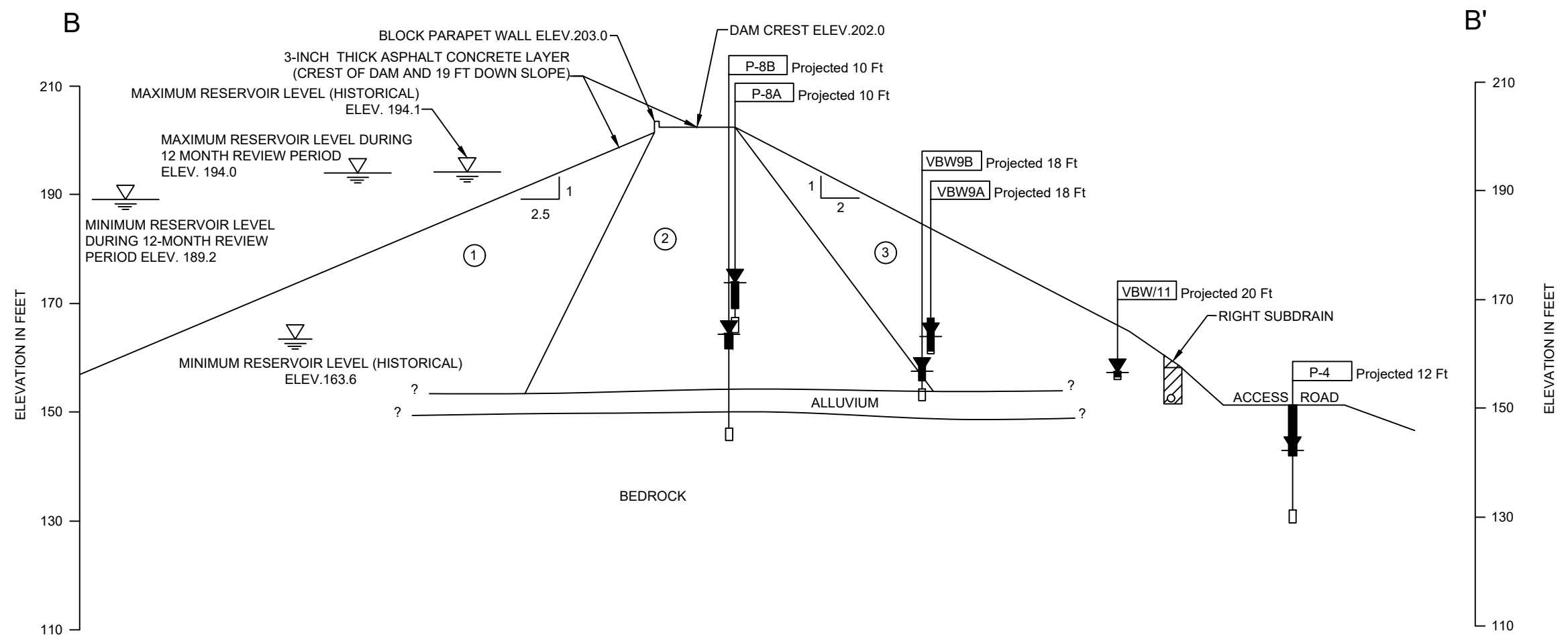
(2) ELEVATIONS ARE IN FEET RELATIVE TO NGVD29

NOT TO SCALE

Annual Surveillance Report from Jan. 2023 to Dec. 2023	
Sand Canyon Dam	
Irvine, CA	
Irvine Ranch Water District	
Irvine, CA	

<b>GEI</b> Consultants	
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SECTION A-A'	
July 2024	Fig. 2




**NOTES:**

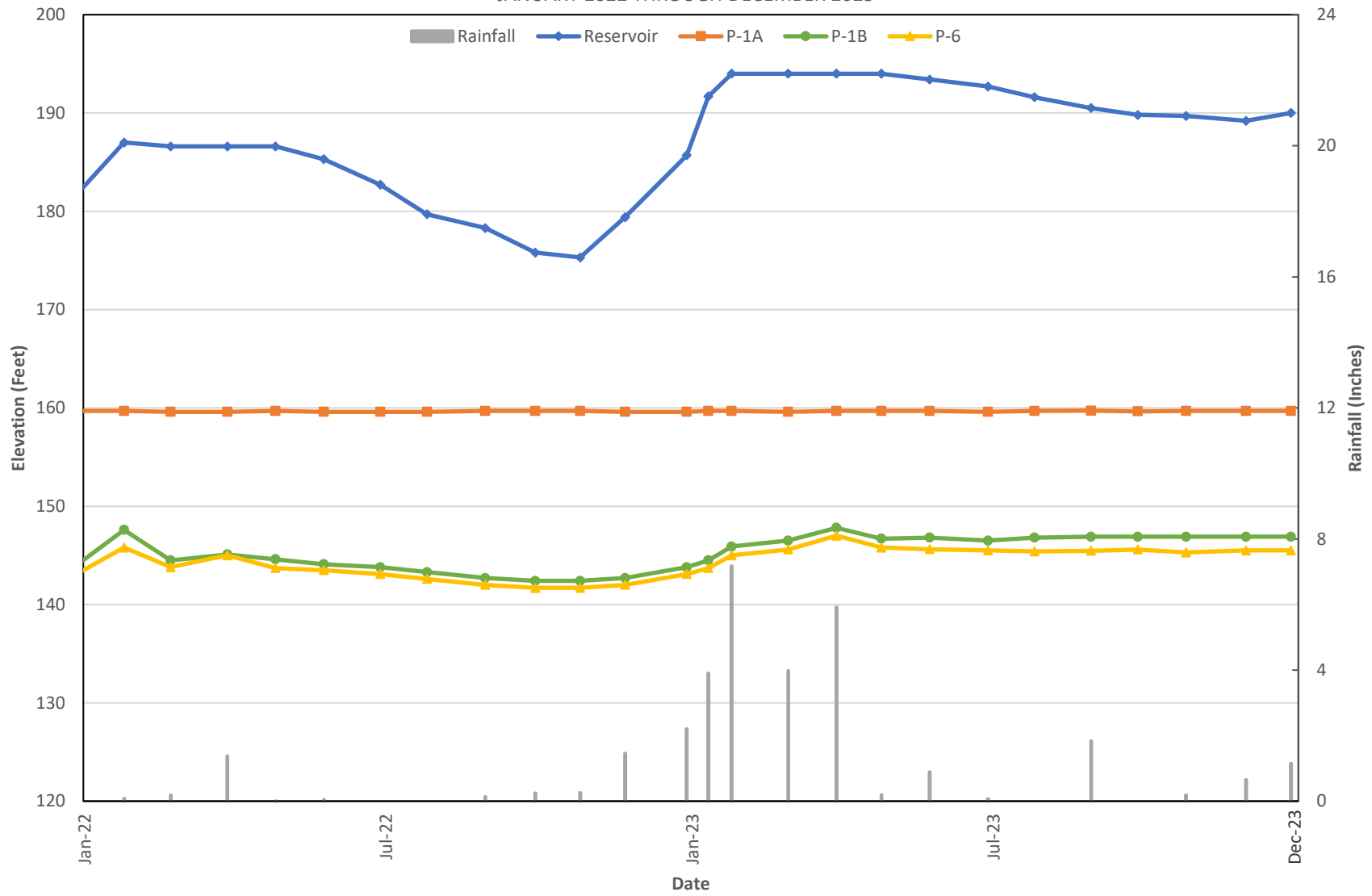
(1) SEE FIGURE 1 FOR LOCATION OF SECTION

(2) ELEVATIONS ARE IN FEET RELATIVE TO NGVD29

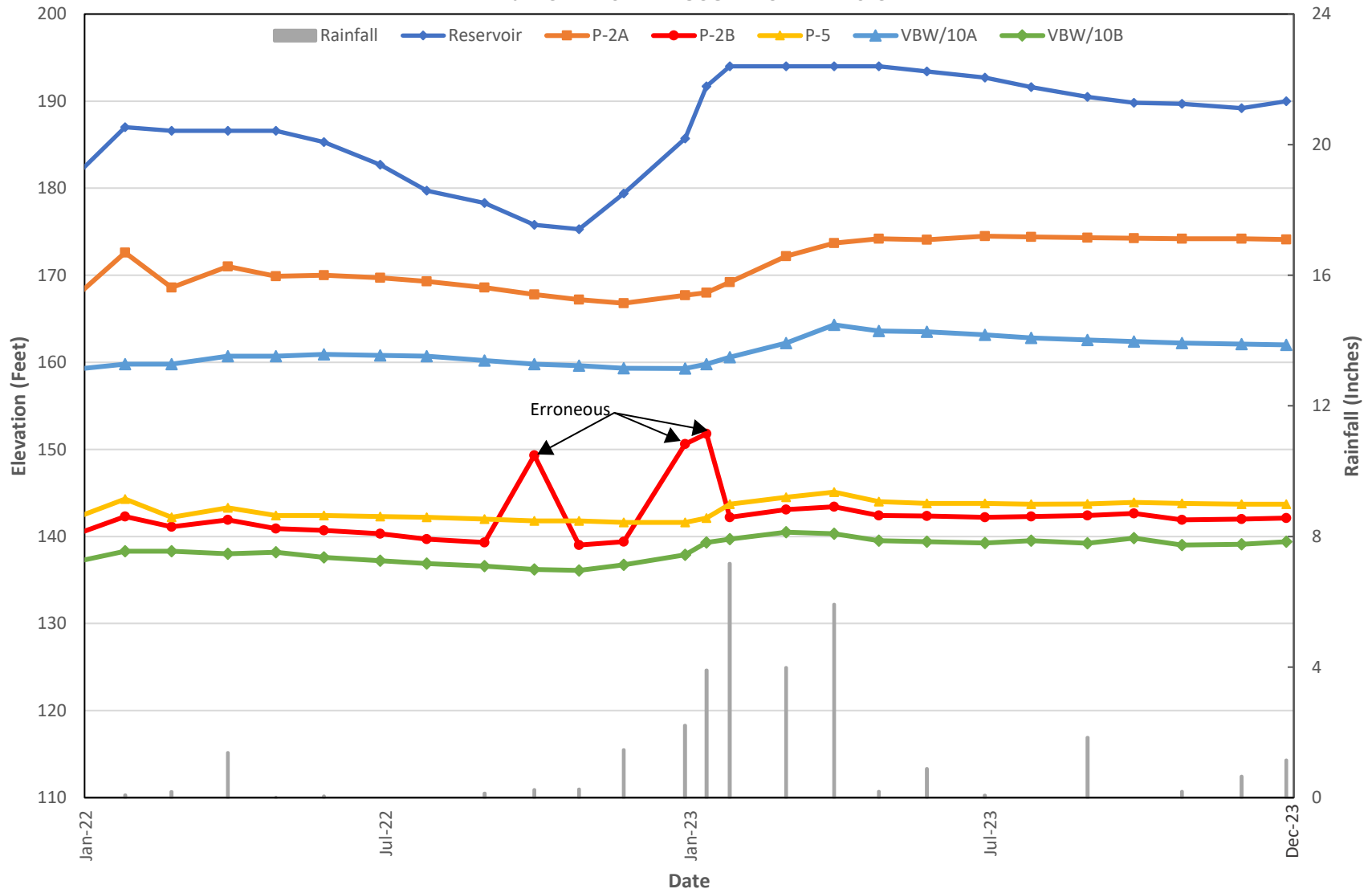
NOT TO SCALE

Annual Surveillance Report from Jan. 2023 to Dec. 2023 Sand Canyon Dam Irvine, CA		SECTION B-B'
Irvine Ranch Water District Irvine, CA	Project 1901888	July 2024 <span style="float: right;">Fig. 3</span>

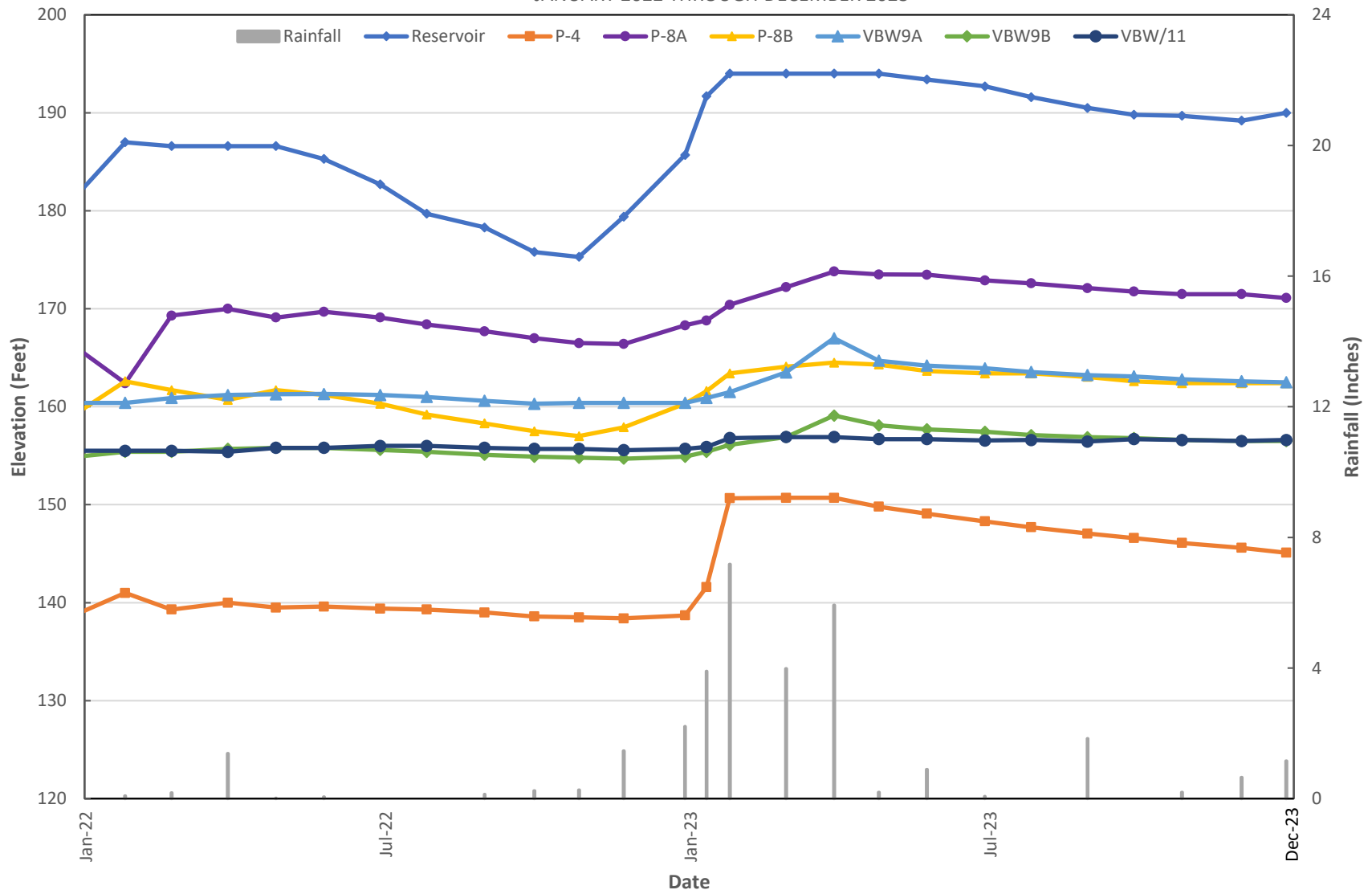
**Figure 4**  
**SAND CANYON DAM**  
**2-YR OPEN WELL PIEZOMETER AND RESERVOIR WATER SURFACE ELEVATIONS**  
**OPEN WELL PIEZOMETERS P-1A, P-1B, AND P-6**  
**JANUARY 2022 THROUGH DECEMBER 2023**



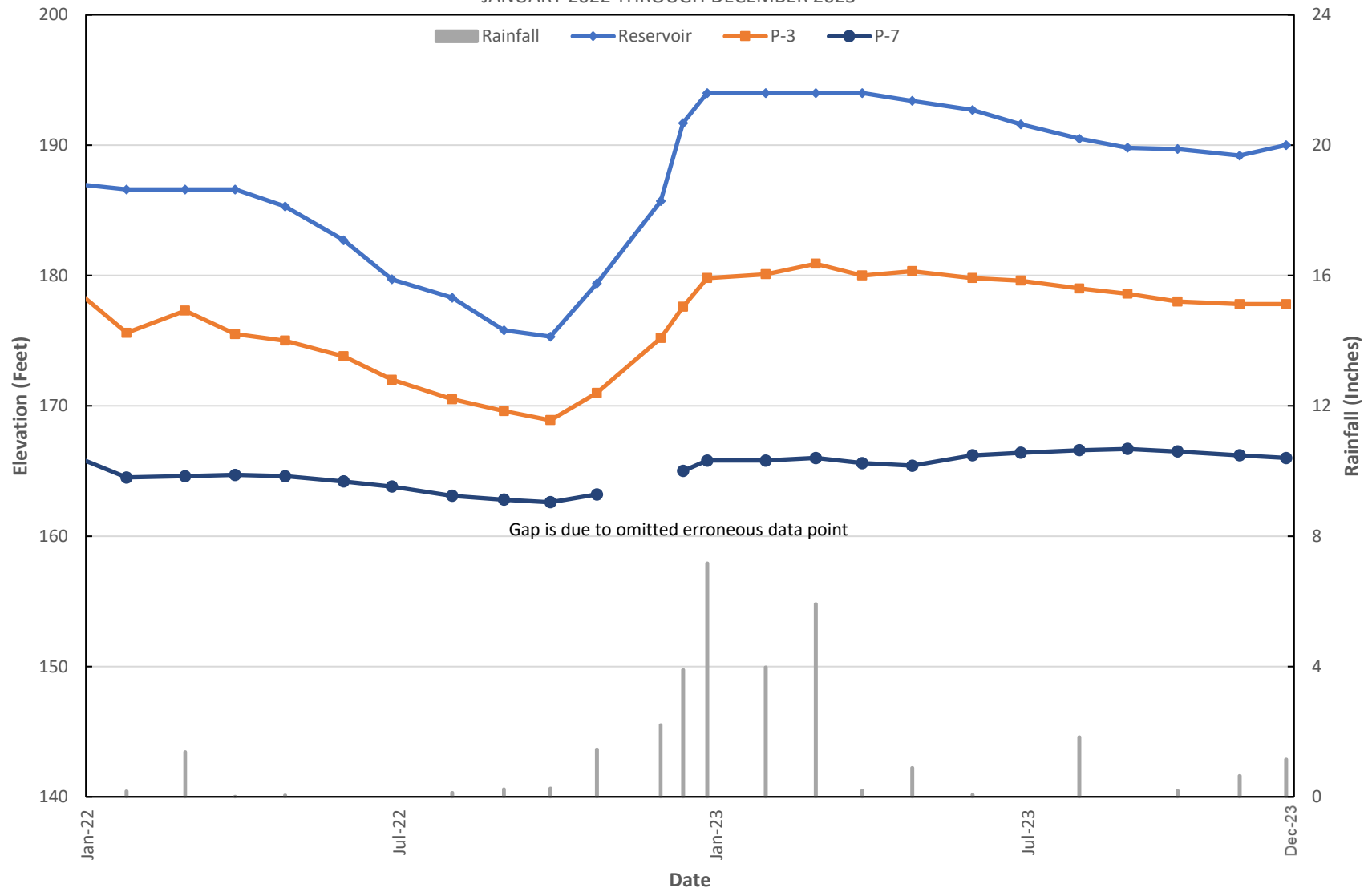
**Figure 5**  
SAND CANYON DAM  
2-YR PIEZOMETER AND RESERVOIR WATER SURFACE ELEVATIONS  
PIEZOMETERS P-2A, P-2B, P-5, VBW/10A, AND VBW/10B  
JANUARY 2022 THROUGH DECEMBER 2023



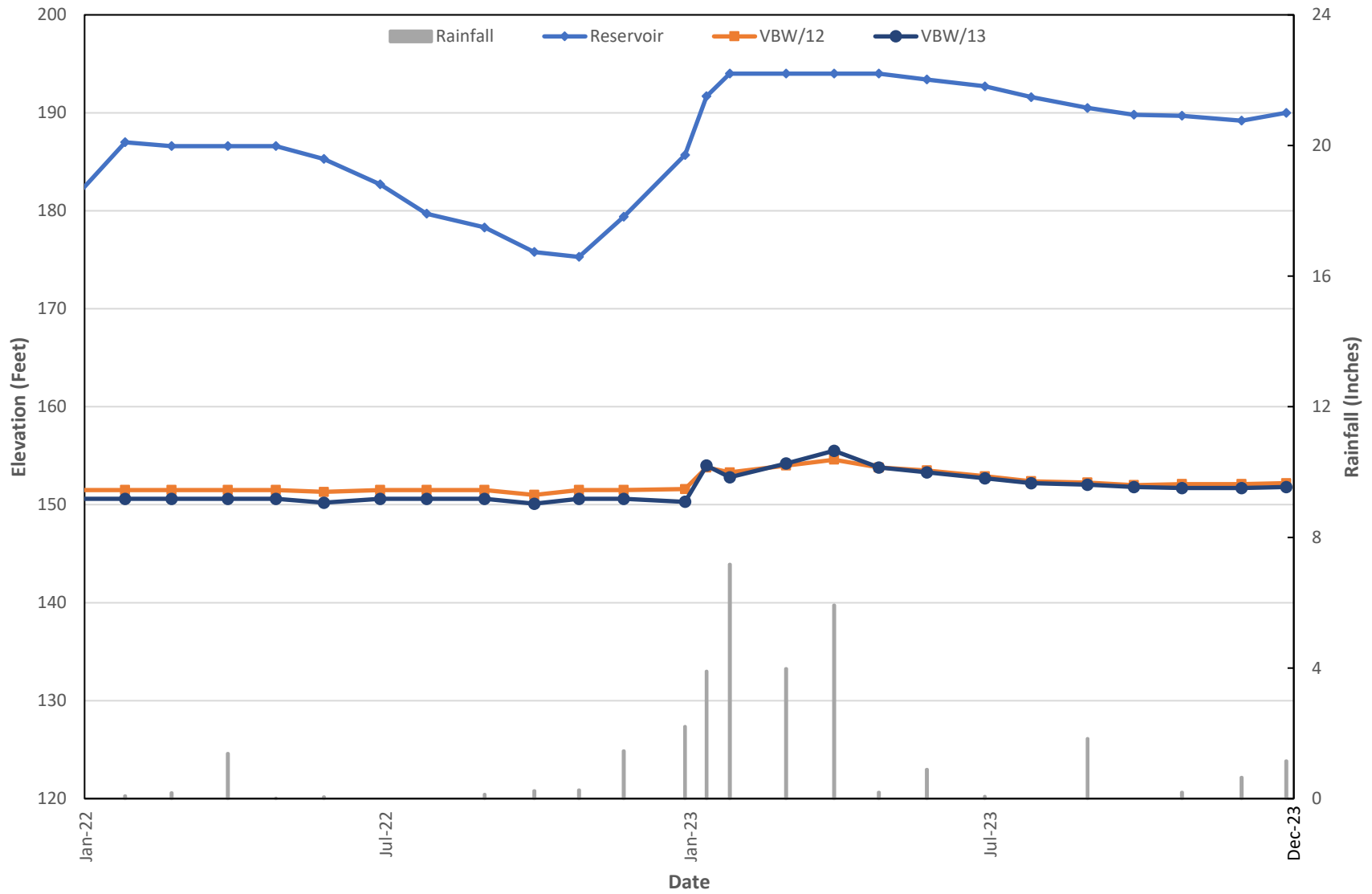
**Figure 6**  
**SAND CANYON DAM**  
**2-YR PIEZOMETER AND RESERVOIR WATER SURFACE ELEVATIONS**  
**PIEZOMETERS P-4, P-8A, P-8B, VBW9A, VBW9B, AND VBW/11**  
**JANUARY 2022 THROUGH DECEMBER 2023**



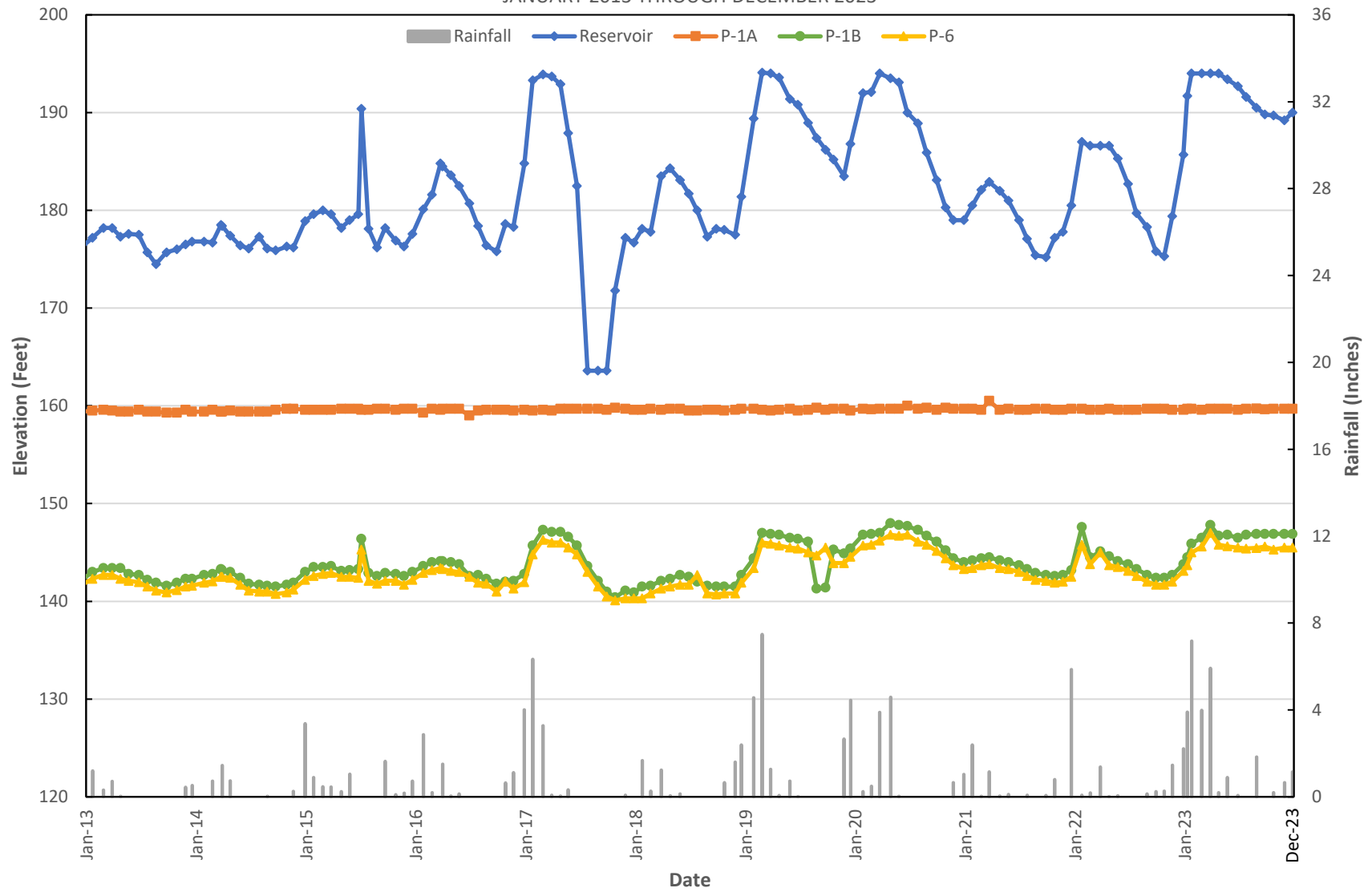
**Figure 7**  
SAND CANYON DAM  
2-YR OPEN WELL PIEZOMETER AND RESERVOIR WATER SURFACE ELEVATIONS  
OPEN WELL PIEZOMETERS P-3, AND P-7  
JANUARY 2022 THROUGH DECEMBER 2023



**Figure 8**  
**SAND CANYON DAM**  
**2-YR VIBRATING WIRE PIEZOMETER AND RESERVOIR WATER SURFACE ELEVATIONS**  
**VIBRATING WIRE PIEZOMETERS VBW/12, AND VBW/13**  
**JANUARY 2022 THROUGH DECEMBER 2023**

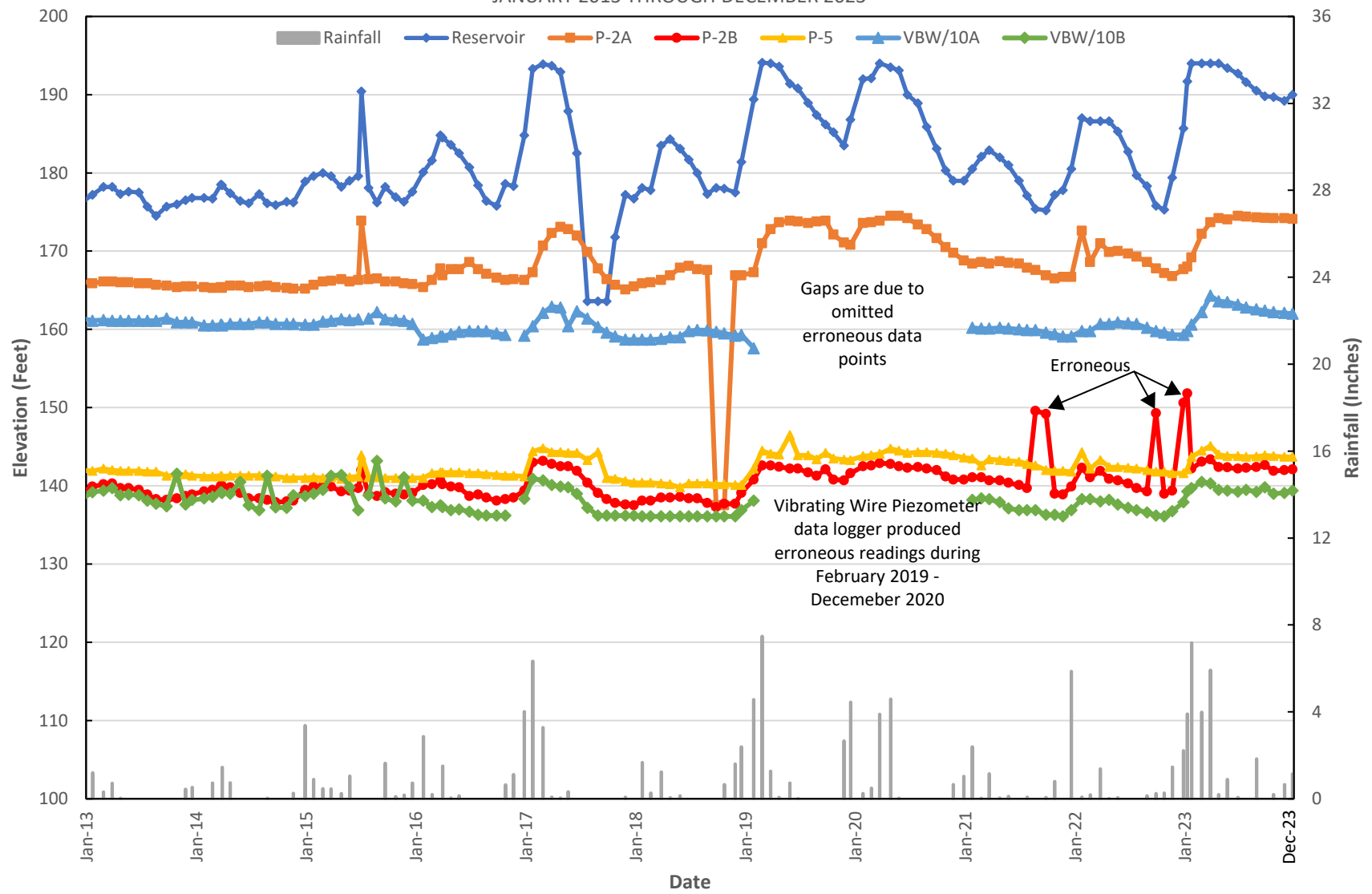


**Figure 9**  
**SAND CANYON DAM**  
**HISTORICAL OPEN WELL PIEZOMETER AND RESERVOIR WATER SURFACE ELEVATIONS**  
**OPEN WELL PIEZOMETERS P-1A, P-1B, AND P-6**  
**JANUARY 2013 THROUGH DECEMBER 2023**

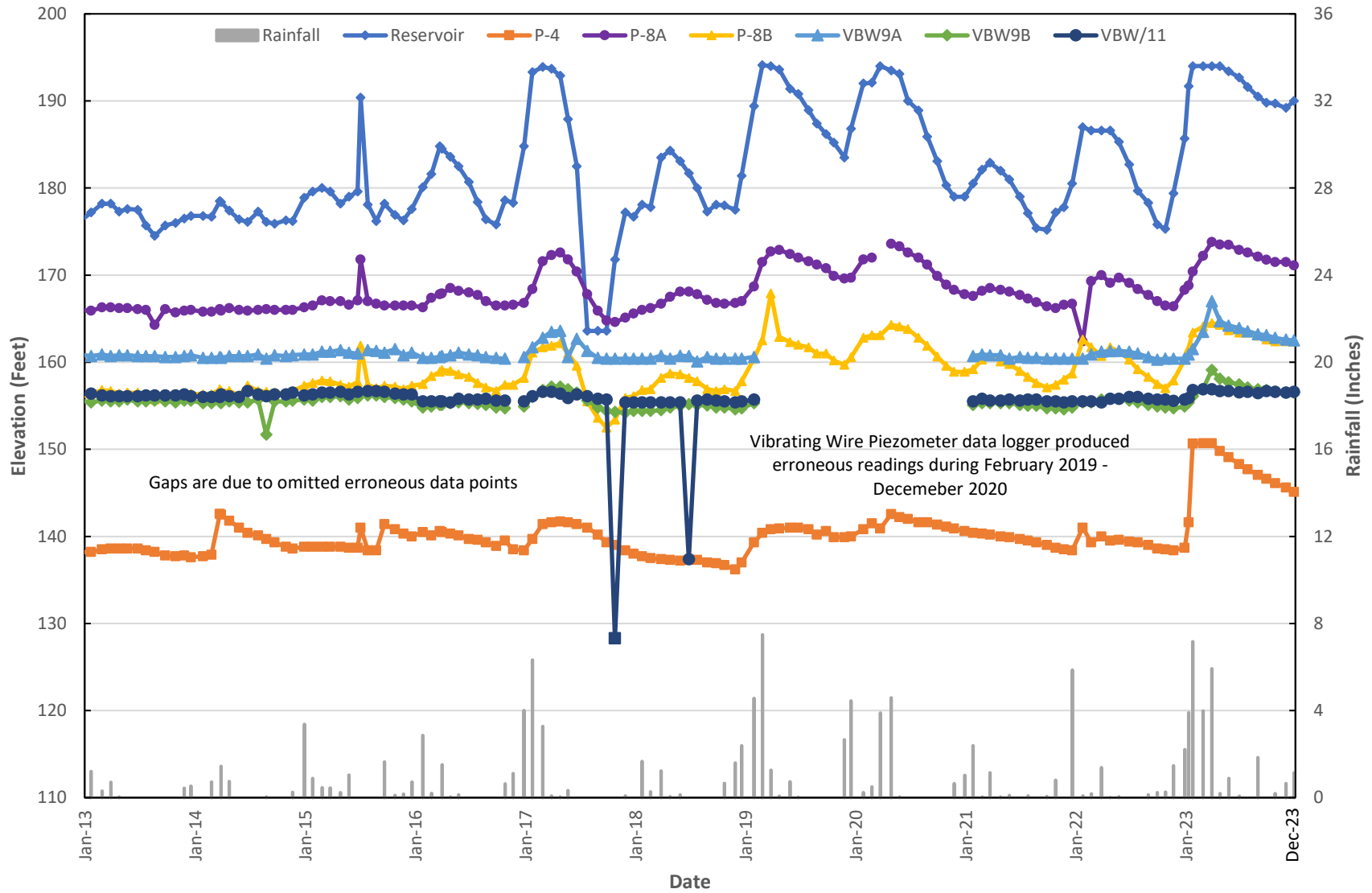




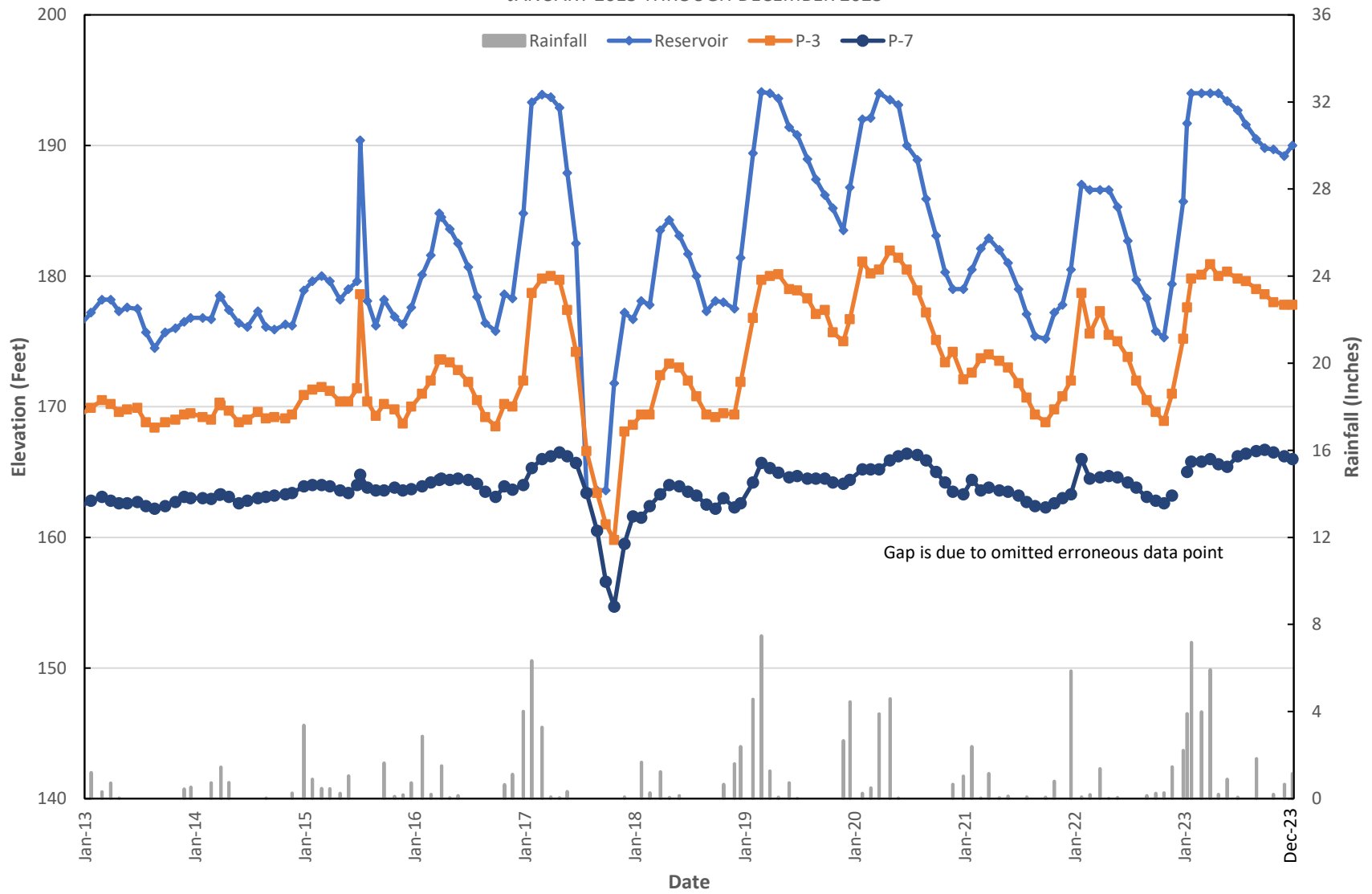
**Figure 10**  
**SAND CANYON DAM**  
**HISTORICAL PIEZOMETER AND RESERVOIR WATER SURFACE ELEVATIONS**  
**PIEZOMETERS P-2A, P-2B, P-5, VBW/10A, AND VBW/10B**  
**JANUARY 2013 THROUGH DECEMBER 2023**



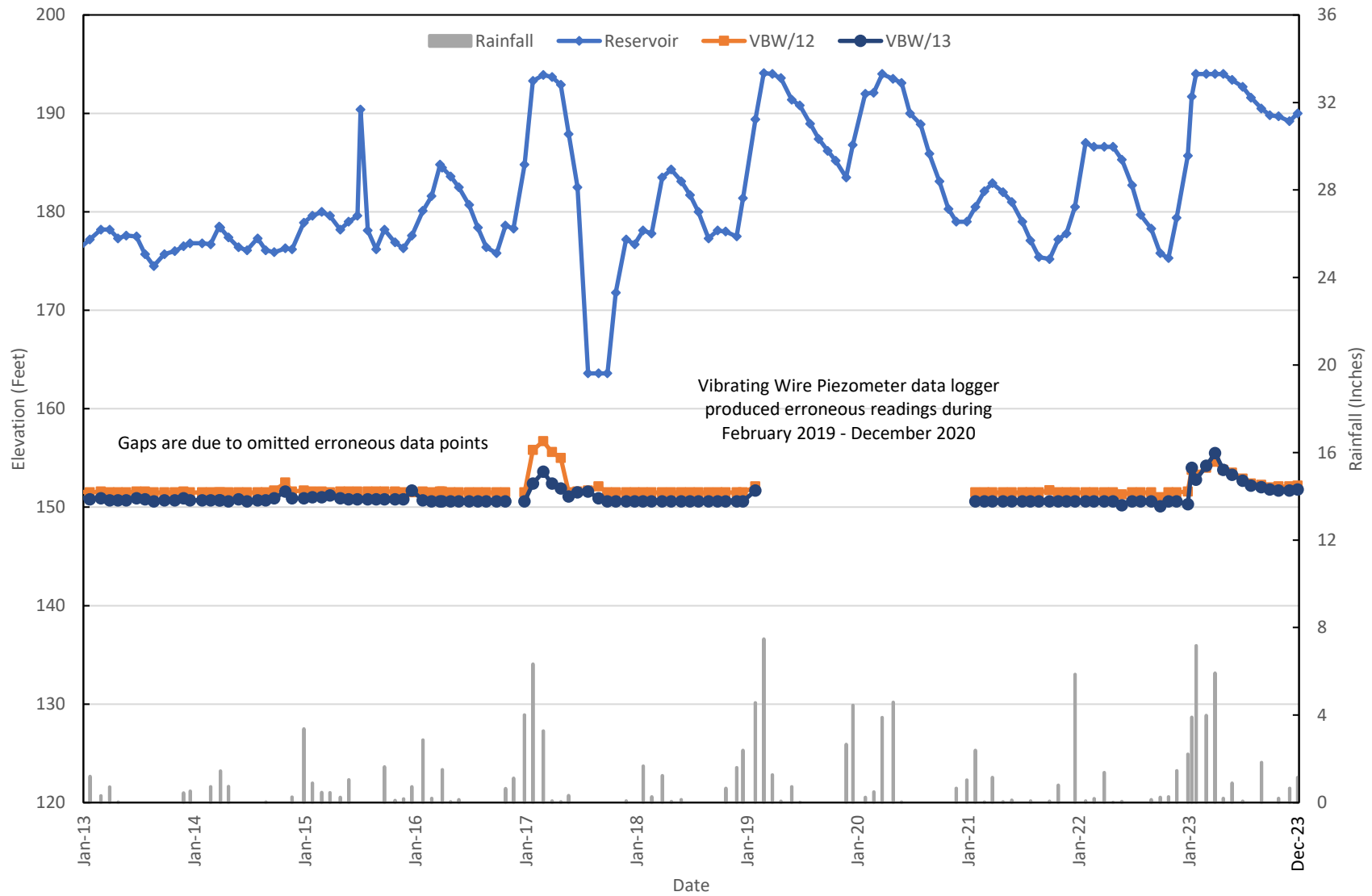
**Figure 11**  
**SAND CANYON DAM**  
**HISTORICAL PIEZOMETER AND RESERVOIR WATER SURFACE ELEVATIONS**  
**PIEZOMETERS P-4, P-8A, P-8B, VBW9A, VBW9B, AND VBW/11**  
**JANUARY 2013 THROUGH DECEMBER 2023**



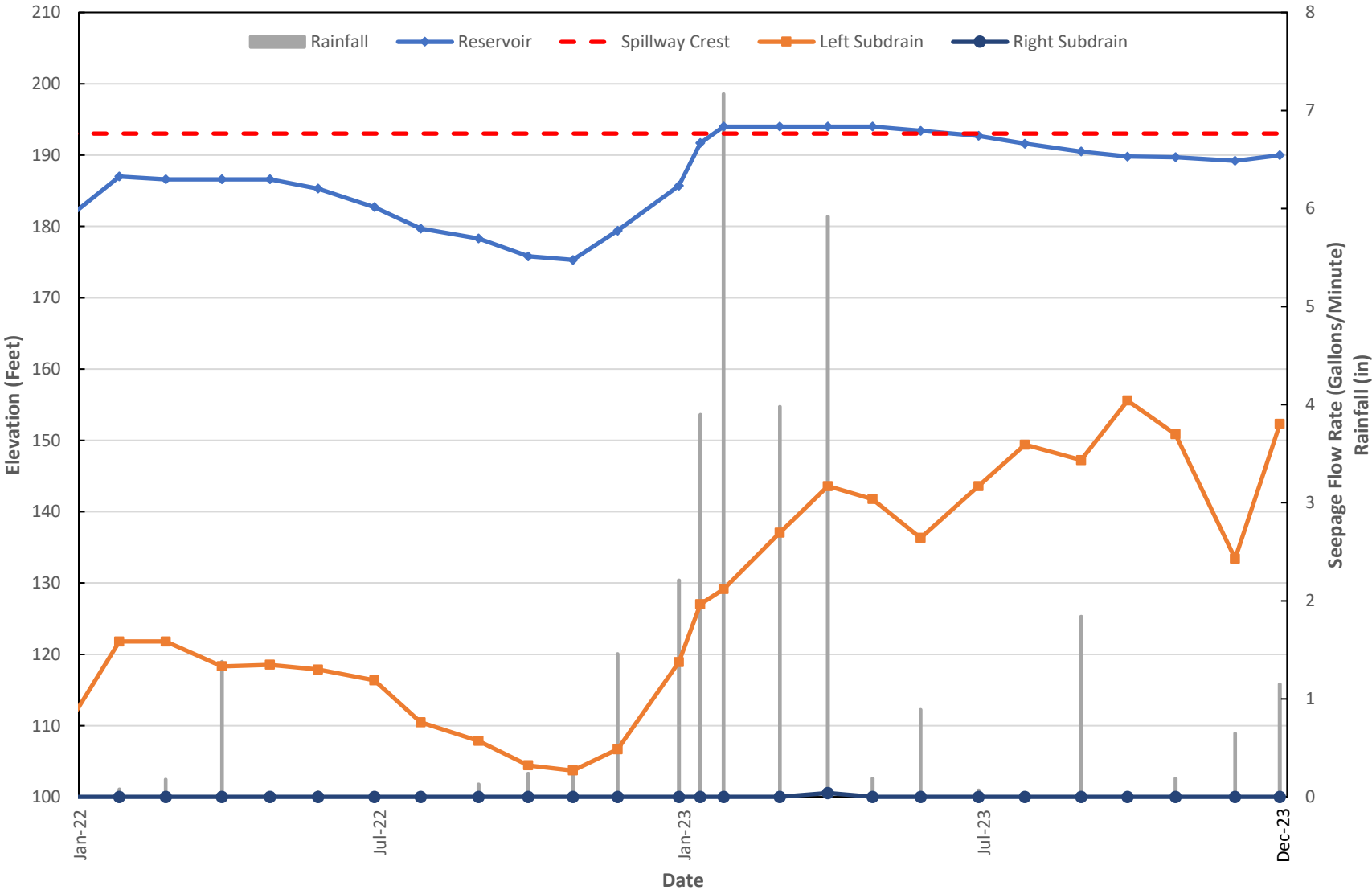
**Figure 12**  
**SAND CANYON DAM**  
**HISTORICAL OPEN WELL PIEZOMETER AND RESERVOIR WATER SURFACE ELEVATIONS**  
**OPEN WELL PIEZOMETERS P-3, AND P-7**  
**JANUARY 2013 THROUGH DECEMBER 2023**



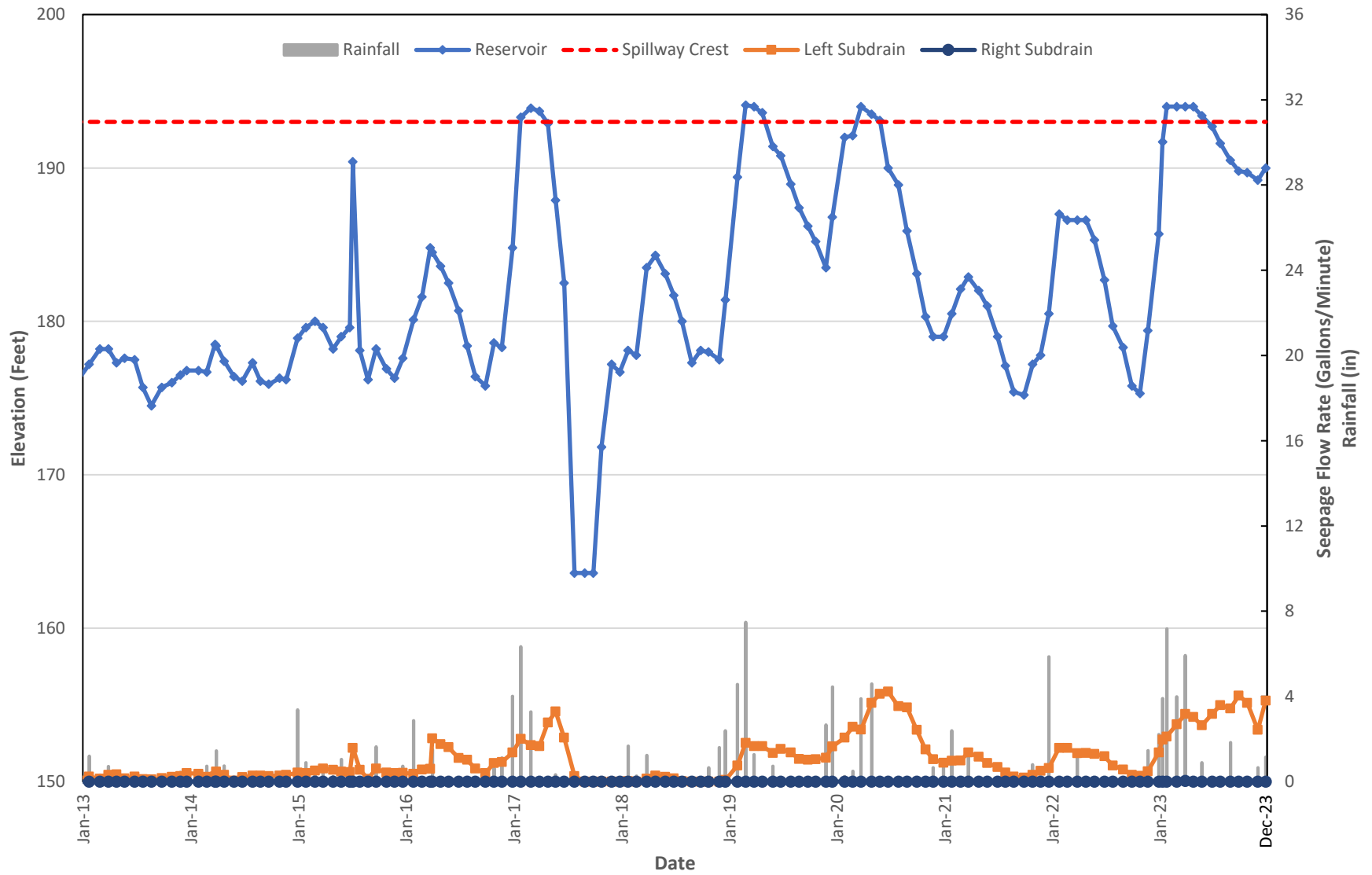
**Figure 13**  
**SAND CANYON DAM**  
**HISTORICAL VIBRATING WIRE PIEZOMETER AND RESERVOIR WATER SURFACE ELEVATIONS**  
**VIBRATING WIRE PIEZOMETERS VBW/12, AND VBW/13**  
**JANUARY 2013 THROUGH DECEMBER 2023**



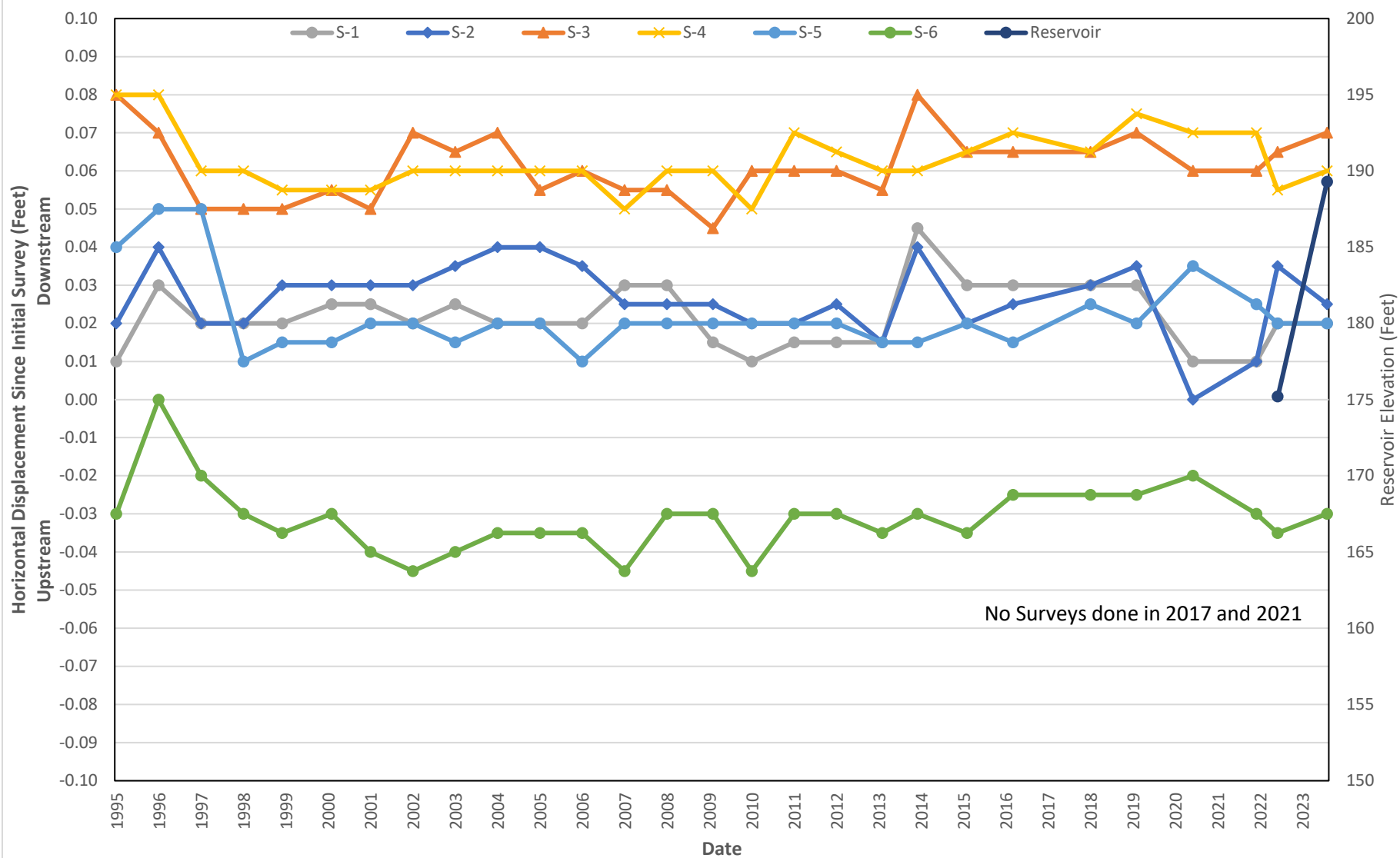
**Figure 14**  
SAND CANYON DAM  
2-YR SEEPAGE, RESERVOIR WATER SURFACE ELEVATIONS AND RAINFALL  
JANUARY 2022 THROUGH DECEMBER 2023



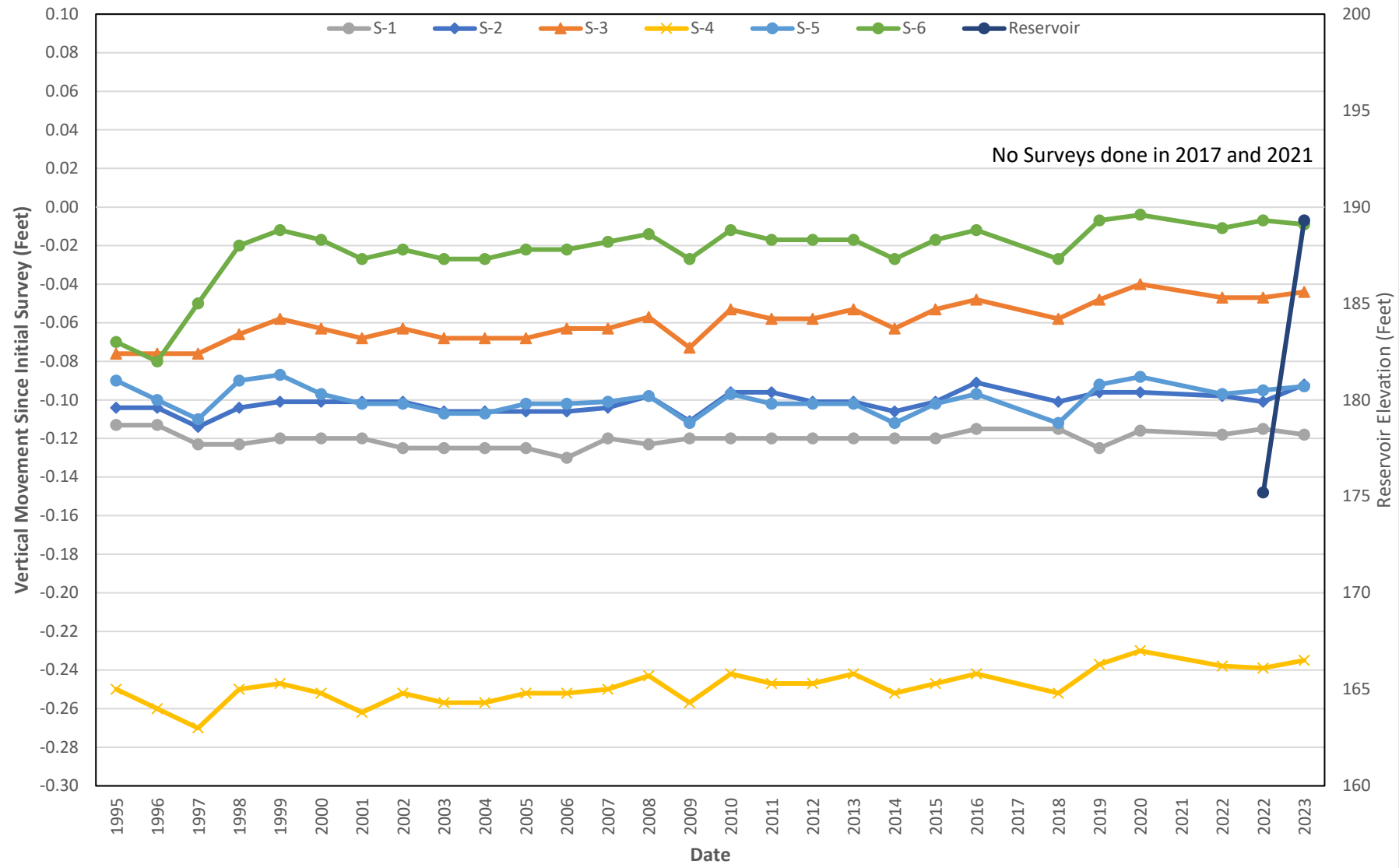
**Figure 15**  
**SAND CANYON DAM**  
**HISTORICAL SEEPAGE FLOW RATES AND RESERVOIR WATER SURFACE ELEVATIONS**  
**JANUARY 2013 THROUGH DECEMBER 2023**



**Figure 16**  
**SAND CANYON DAM**  
**HISTORICAL CUMULATIVE HORIZONTAL DISPLACEMENT**  
**SURVEY MONUMENTS S-1, S-2, S-3, S-4, S-5, S-6**  
**JANUARY 1995 THROUGH December 2023**



**Figure 17**  
SAND CANYON DAM  
HISTORICAL CUMULATIVE VERTICAL MOVEMENT  
SURVEY MONUMENTS S-1, S-2, S-3, S-4, S-5, S-6  
JANUARY 1995 THROUGH December 2023





## **Appendix**

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**Inspection Photographs of Sand Canyon Dam – July 10, 2023**

**Reservoir Dam Valve Exercising Table**

**CNC Survey Report**

**Valves Exhibit for Emergency Release**

**Inspection Photographs of Sand Canyon Dam**

**July 10, 2023**



**Photo 1)** AC paved crest looking towards the right abutment, including 1-foot-high curb wall.



**Photo 2)** AC-lined upstream face looking towards right abutment. Note cracks and brush along the face.



**Photo 3)** Previously reported desiccation cracking near piezometer P-7.



**Photo 4)** Downstream face looking towards the right abutment from dam toe.





**Photo 5)** Existing bulge on the downstream slope near right abutment.



**Photo 6)** Minor rodent activity on the downstream slope near the left abutment.





**Photo 7)** Recently installed wireless node at piezometer P-7 on the downstream slope near the left abutment.



**Photo 8)** Piezometers P-2A and P-2B. Note P-2A top of standpipe is flush with adjacent ground.





**Photo 9)** Spillway control ogee section and approach. Note debris and water level.

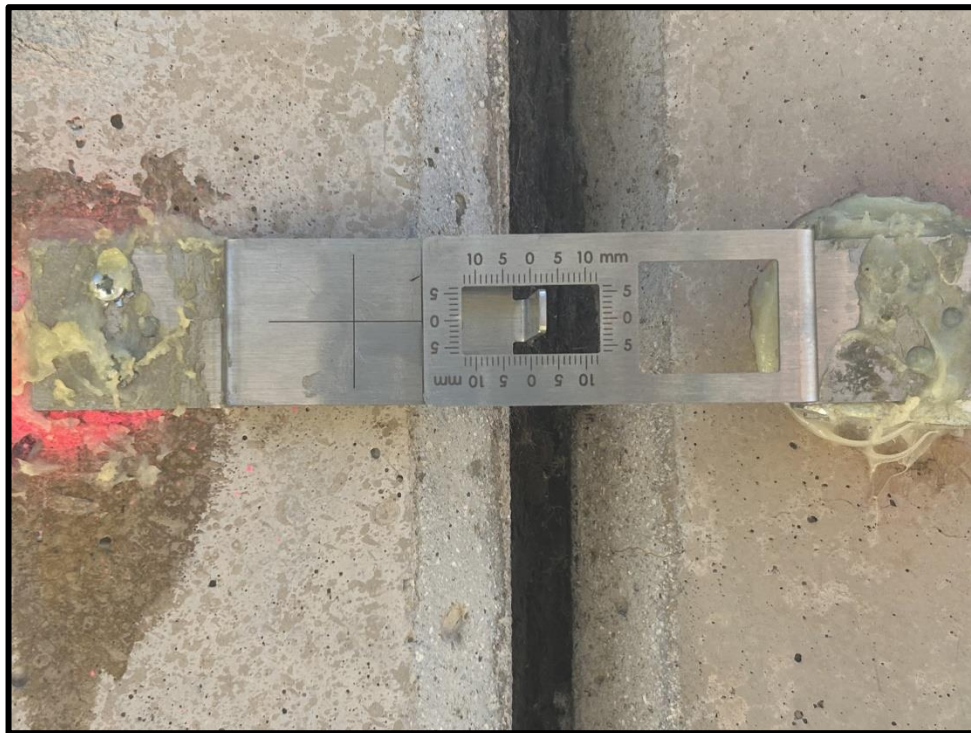


**Photo 10)** Spillway channel looking downstream. Note vegetation and debris.





**Photo 11)** Close up view of spillway stilling basin. Note brush/tule growth downstream.



**Photo 12)** Recently installed crack meter at the right spillway concrete wall vertical joint offset (+2 mm x-direction).





**Photo 13)** Recently installed crack meter at the right spillway concrete wall vertical joint offset. (-2 mm z-direction).



**Photo 14)** Close up view of undermining of recent concrete repair in the spillway channel floor.

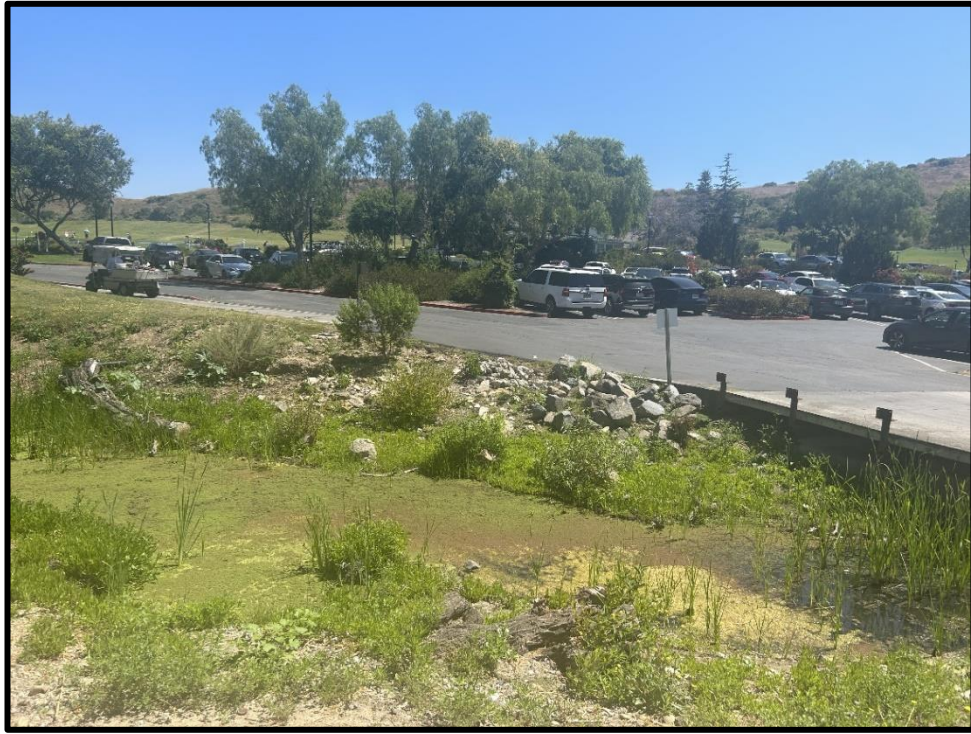


**Photo 15)** Outlet valve controls and stems. Note damaged gate valve #2 stem.



**Photo 16)** Close up view of the buckled gate valve #2 stem.





**Photo 17)** Sand Canyon creek. Note cleared vegetation.



**Photo 18)** Close up of large diameter angular rocks and vegetation limiting access to the 24-inch emergency outfall valve.



**Photo 19)** Recently installed water meter inside concrete vault box at the outfall. Note pooled water.



**Photo 20)** Seepage at left subdrain.

## **Reservoir Dam Valve Exercising Table**

# Reservoir Dam Valve Exercising

## Sand Canyon Dam

Date	Top # of turns	Middle # of turns	Bottom # of turns	Main # of turns	24" Blow off valve #2	24" Blow off valve #1	16" Blow off valve #3	Blow off creek flow/volume
5/6/2013	58	21	48	102		Not Turned		
4/22/2014	58	21	48	102		Not Turned		
4/20/2015 DSOD	58	21	48	102/50%		Not Turned		
5/26/2016 DSOD	58	21	48	30%		Not Turned		
7/20/2016	58	21	48	30%	Installed 2016	Exercised 100%	Replaced 2016	
4/5/2017 DSOD	58	21	48	30%	Exercised 100%	Exercised 100%	Exercised 100%	
Reservoir was drained and emty from 7/24/2017 to 10/19/2017 for outlet stucture and main valve repairs.								
5/2/2018 DSOD	58	21	48	102	Exercised 100%	Exercised 100%	Exercised 100%	
3/28/2019 DSOD	58	21	48	102	Exercised 100%	Exercised 100%	Exercised 100%	
1/14/2020 DSOD	58	21	48	102	Exercised 100%	Exercised 100%	Exercised 100%	
4/27/2021	58	21	48	102	Exercised 100%	Exercised 100%	Exercised 100%	
4/14/2022	58	21	48	102	Exercised 100%	Exercised 100%	Exercised 100%	
10/18/2022					Exercised 100%	Exercised 100%		
04/18-19/23 DSOD	58	21	N/A*	102	Exercised 100%	Exercised 100%	Exercised 100%	*Valve broken

## **CNC Survey Report**

Prepared by:



26 Executive Park | Ste 270  
Irvine | CA | 92614  
P | 949.863.0588  
www.cnc-eng.com

JOB NAME IRWD  
SAND CANYON RESERVOIR  
JOB NO. 22-006 SRN \_\_\_\_\_  
CREW A. MORENO  
R. STEWART  
DATE 12-6-2023 SHEET 1 OF 2

## RESERVOIR MONITORING LAND SURVEYING NOTES

NAME	STA.	OFFSET	HOLD FOR LINE.
BM1	8+85.338		BM1-BRASS DISC W/PUNCH MARK IN WELL MONUMENT AT WEST SIDE OF VAULT.

S-1	8+00.214	0.070'
-----	----------	--------

S-2	6+00.185	0.085'
-----	----------	--------

S-3	4+00.100	0.120'
-----	----------	--------

S-4	2+00.172	0.100'
-----	----------	--------

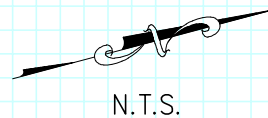
S-6	0+61.411	0.120'
-----	----------	--------

S-5	0+00.060	0.020'
-----	----------	--------

BM2	-0+15.380	
HOLD STATION		

HOLD FOR LINE.

BM1-BRASS DISC W/PUNCH MARK IN WELL MONUMENT AT WEST SIDE OF VAULT.



### NOTES:

- S-1 THRU S-6 ARE "+" ON BRASS DISC IN WELL MONUMENT.



INSTRUMENT SETUP

WEATHER CONDITIONS:

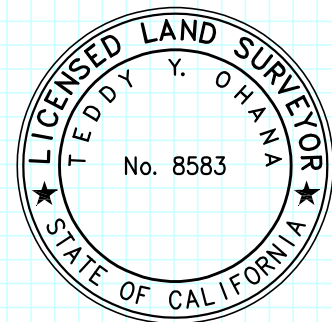
TEMP - 55°

CLEAR SKIES

HUMIDITY - 42%

BAROMETRIC PRESSURE (INHG) - 30.35

RESERVOIR WATER LEVEL ELEVATION - 189.3±



*Teddy Ohana*  
TEDDY Y. OHANA PLS 8583

BM2-BRASS DISC W/PUNCH MARK IN WELL MONUMENT AT EDGE OF CONC. WALK

HOLD FOR LINE



Prepared by:



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Irvine | CA | 92614  
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www.cnc-eng.com

Sheet 2 of 2  
SURVEY LEVELING NOTES

**PROJECT:** IRWD / Sand Canyon Reservoir – Level Report

STATION	B.S.	HI	F.S.	ADJ ELEVATION	SURVEY LEVELING NOTES
BM1				204.167	Brass CAP w/punch in well
	3.863	208.030			
S-1			7.185	200.845	"S" points are "+ "on Brass Disc in Well Monument
	6.552	207.397			
S-2			6.349	201.048	
	6.817	207.865			
S-3			7.286	200.578	
	7.221	207.800			
S-4			7.134	200.665	
	6.995	207.661			
S-6			6.890	200.769	
	6.918	207.689			
S-5			7.024	200.663	
	6.505	207.170			
BM2			5.474	201.694	Brass Disc w/punch in well Monument
	5.900	207.595			
E			4.386	203.208	"E" points are Nail and Square Washer on Top of Wall
	4.423	207.632			
E-1			4.408	203.222	
	4.573	207.797			
E-2			4.532	203.262	
	4.730	207.995			
E-3			4.600	203.392	
	4.042	207.437			
E-4			3.913	203.521	
	4.592	208.116			
BM1			3.946	204.167	Brass Disc w/punch in well Monument

**Valves Exhibit for Emergency Release**





**LEGEND**

Emergency Outlet

Main Outlet

Main Inlet

Emergency Valve,  
Normally Closed

Valve Normally Open

Valve Normally Closed

#\*

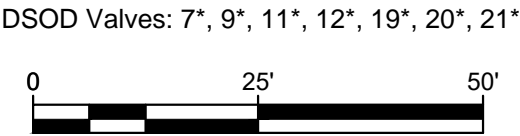
DSOD Valve

**NOTES**

①

20" STL LINE PREVIOUSLY  
ABANDONED. REVIVED BY  
CONSTRUCTION SERVICES  
AND CONNECTED TO 30"  
EMERGENCY DUMP IN  
APPROX. 2008  
(REF. BILL WESSON, 2023)

NO.	DATE	REVISIONS	APPROVED
2	4/11/2024	VALVE SIZES REVISED, METER BOX ADDED	DD



BILL WESSON	WATER OPERATIONS SUPERVISOR	DATE
DANIELLE DRAKE	ASSISTANT ENGINEER	DATE
JACOB MOEDER	IRWD ENGINEERING MANAGER	DATE

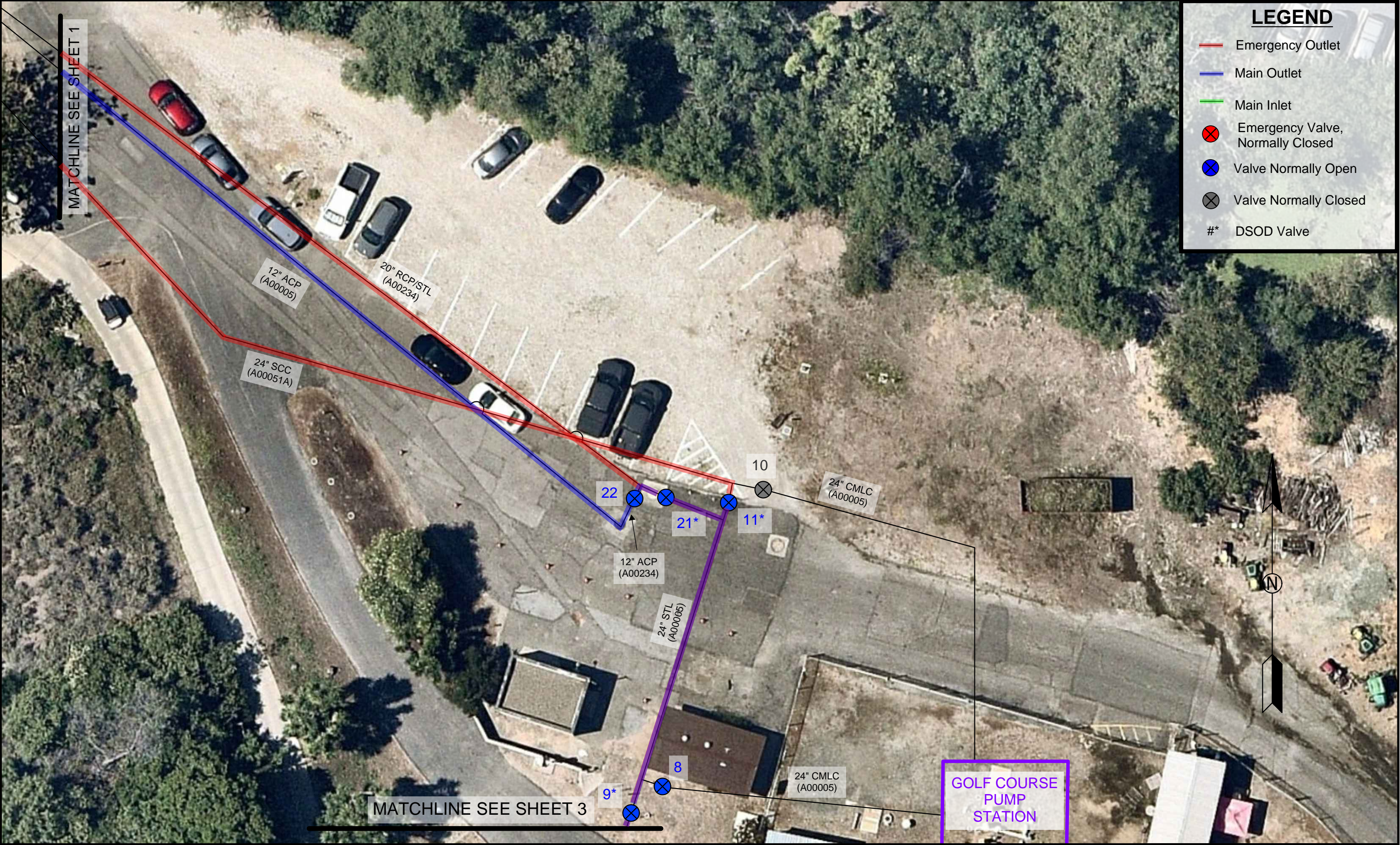


DEVELOPED BY ENGINEERING INTERNS:  
TINH NGUYEN  
RYAN TRAN

SAND CANYON DAM  
PIPELINE SCHEMATIC

SHEET  
01  
01 of 05  
SHEETS









NO.	DATE	REVISIONS	APPROVED



BILL WESSON	WATER OPERATIONS SUPERVISOR	DATE
DANIELLE DRAKE	ASSISTANT ENGINEER	DATE
JACOB MOEDER	IRWD ENGINEERING MANAGER	DATE



DEVELOPED BY ENGINEERING INTERNS:  
TINH NGUYEN  
RYAN TRAN

SAND CANYON DAM  
PIPELINE SCHEMATIC

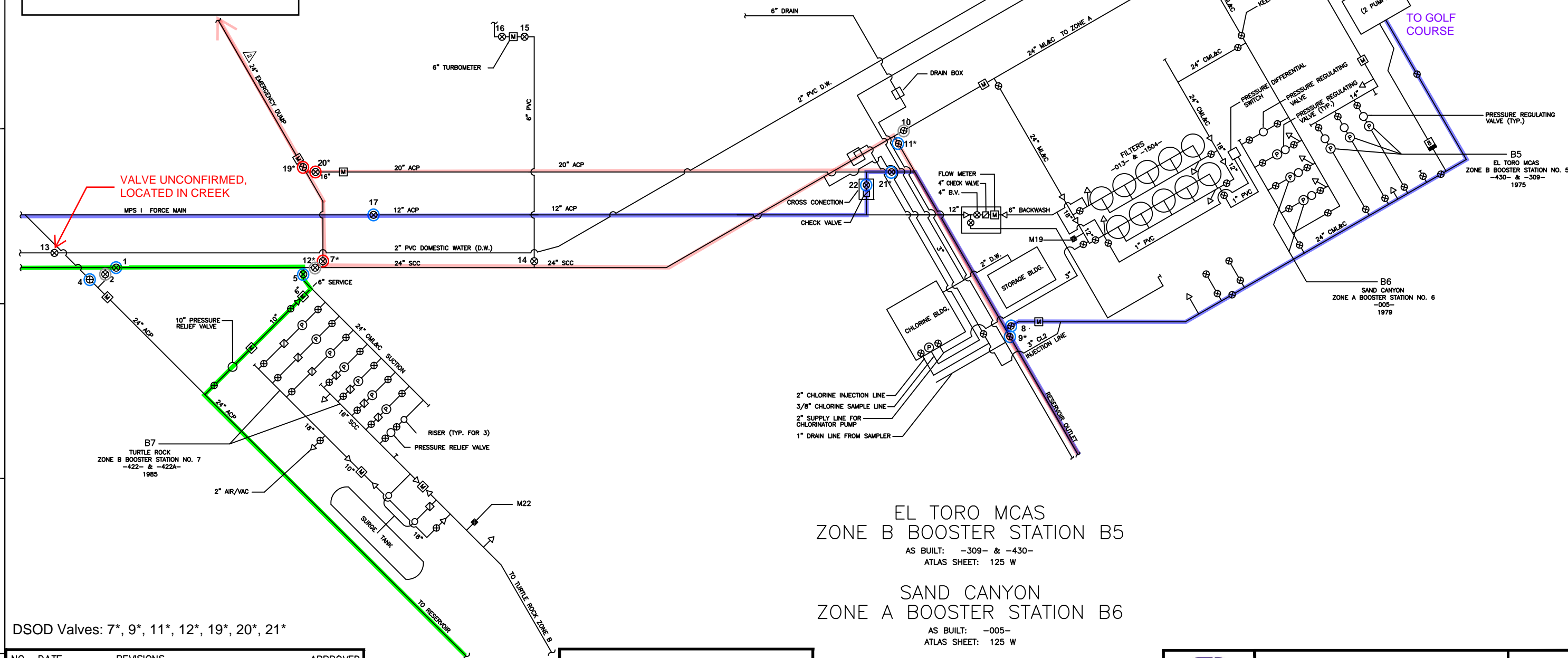


**LEGEND**

- Main Outlet
- Main Inlet
- Emergency Outlet
- Valve Normally Open
- Valve Normally Closed
- Valve Normally Closed, Emergency Valve to open

5  
4  
3  
2  
1

5  
4  
3  
2  
1



DSOD Valves: 7\*, 9\*, 11\*, 12\*, 19\*, 20\*, 21\*


NO.	DATE	REVISIONS	APPROVED
1	8/11/2023	VALVES REVISED & FLOW ROUTES HIGHLIGHTED	DD
2	4/11/2024	VALVE SIZES REVISED	DD

BILL WESSON	WATER OPERATIONS SUPERVISOR	DATE
DANIELLE DRAKE	ASSISTANT ENGINEER	DATE
JACOB MOEDER	IRWD ENGINEERING MANAGER	DATE

EL TORO MCAS  
ZONE B BOOSTER STATION B5  
AS BUILT: -309- & -430-  
ATLAS SHEET: 125 W

SAND CANYON  
ZONE A BOOSTER STATION B6  
AS BUILT: -005-  
ATLAS SHEET: 125 W

TURTLE ROCK  
ZONE B BOOSTER STATION B7  
AS BUILT: -422- & -422A-  
ATLAS SHEET: 125 W



SAND CANYON DAM  
PIPELINE SCHEMATIC

SHEET  
04  
04 of 05  
SHEETS

AUGUST 2023

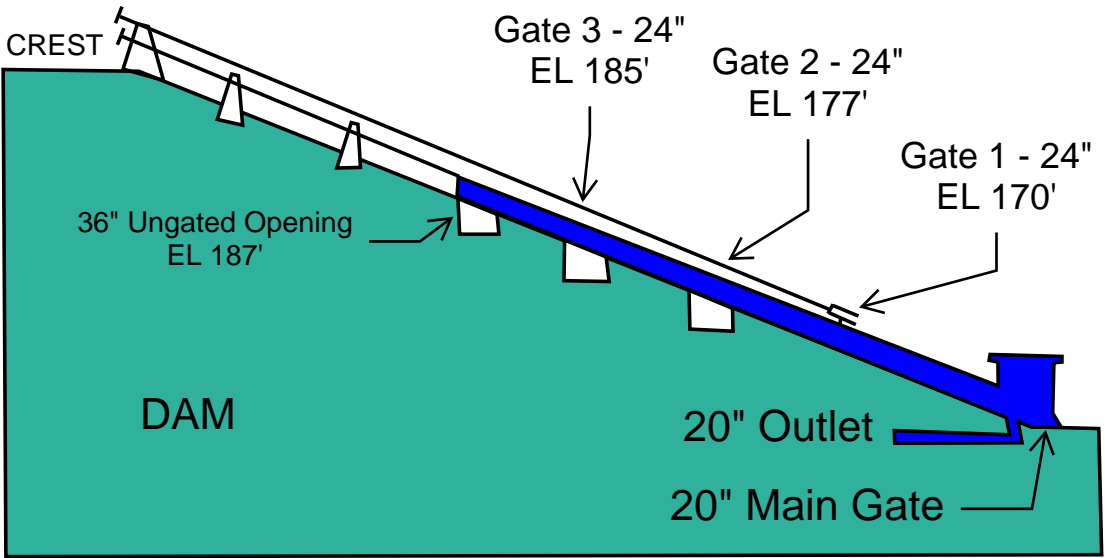


Sand Canyon Dam Valve Summary

Valve Number	Size	Turns	Normally:	Emergency Valve
1	24"		Open	
2	24"		Closed	
4	24"		Open	
5	24"		Open	
7*	24"	41	Closed	Yes
8	24"		Open	
9*	24"	38	Open	
10	24"	45	Closed	
11*	24"	42	Open	
12*	24"		Closed	
17	12"	37	Open	
19*	24"	57	Closed	Yes
20*	20"	32	Closed	Yes
21*	20"		Open	
22	12"		Open	

Sand Canyon Dam Gate Valve Summary

Valve	Turns	Size	Elevation
Main	102	20"	-
Gate 1	48	24"	170'
Gate 2	21	24"	177'
Gate 3	58	24"	185'



1 SAND CANYON DAM SECTION OF MULTILEVEL OUTLET



NO.	DATE	REVISIONS	APPROVED
2	4/11/2024	VALVE SIZES REVISED	DD

DSOD Valves: 7\*, 9\*, 11\*, 12\*, 19\*, 20\*, 21\*

BILL WESSON	WATER OPERATIONS SUPERVISOR	DATE
DANIELLE DRAKE	ASSISTANT ENGINEER	DATE
JACOB MOEDER	IRWD ENGINEERING MANAGER	DATE



DEVELOPED BY ENGINEERING INTERNS:  
TINH NGUYEN  
RYAN TRAN

SAND CANYON DAM  
PIPELINE SCHEMATIC

SHEET  
05  
05 of 05  
SHEETS

AUGUST 2023