

STATE OF CALIFORNIA
 CALIFORNIA NATURAL RESOURCES AGENCY
 DEPARTMENT OF WATER RESOURCES
 DIVISION OF SAFETY OF DAMS

INSPECTION OF DAM AND RESERVOIR IN CERTIFIED STATUS

Name of Dam Phoenix Lake Dam No. 33-3 County Marin
 Type of Dam ERTH Type of Spillway Concrete weir and chute
 Water is 0.1 feet above the spillway crest and 15.1 feet below the dam crest.
 Weather Conditions Clear and mild
 Contacts Made Lucy Croy and Conner Pollard during the inspection
 Reason for Inspection Periodic Evaluation

Important Observations, Recommendations or Actions Taken

The spillway entrance is occupied with dormant tule and cattails which require removal. I directed Ms. Croy to have the tule and cattails removed as soon as possible.

A crack within the spillway is presently being monitored using electronic extensometers, but the data generated appears to be unreliable. I recommended the owner place inexpensive crack movement indicators across the crack so that the crack can be monitored while they are working to sort out their instrumentation issues. See page below the spillway crack indicates a fair amount of leakage through the crack. I would estimate that several gpm or more is leaking through the spillway crack.

The dam appears to be performing satisfactorily, and no additional instrumentation is believed necessary at this time, but careful and consistent monitoring of the spillway crack is imperative, and any indication of potentially adverse displacements must be reported to DSOD immediately. I recommended that the owner thoroughly evaluate the spillway for static and seismic stability, and to make whatever repairs or improvements are necessary to maintain the spillway in a safe condition for operation.

As discussed within the 25 April 2013 inspection report, several deep erosion gullies occupy the lower portions of both downstream groins, and repairs are required to fill the gullies to minimize or prevent future damage to the embankment. I directed Ms. Croy to develop and implement a plan to address the erosion as soon as is practical.

Tire ruts within the embankment crest require filling with suitable, well compacted, fill.

Conclusions

From the known information and visual inspection, the dam, reservoir, and the appurtenances are judged safe for continued use.

Observations and Comments

<u>Dam</u>	<p>The visible portion of the upstream face, crest, downstream face, and abutments are in generally satisfactory condition, with no indication of deep seated distress or instability. Several deep erosion gullies occupy the lower portions of both downstream groins, and repairs are required to fill the gullies to minimize or prevent future damage to the embankment. I directed Ms. Croy to develop and implement a plan to address the erosion as soon as is practical. Tire ruts within the embankment crest also require filling with suitable, well compacted, fill.</p> <p>Vegetation control is generally satisfactory, but emerging bushes along the upstream face and scattered across the downstream face should be removed later in the season. Tule and cattails along the waterline must also be cleared, and overhanging trees and bushes should be trimmed along the right downstream groin.</p>
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Photos taken? Yes No
 cc for Owner/Book

Inspected by J. Lowe
 Date of Inspection 14 February 2018
 Date of Report 16 February 2018

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Date of Inspection 14 February 2018

Observations and Comments

	<p>Similar to recent past inspections rodent control remains satisfactory and few to no indications of rodent activity were observed.</p>
<u>Spillway</u>	<p>The spillway entrance is occupied with dormant tule and cattails which require removal; the control section and exit channel were open and clear. I directed Ms. Croy to have the tule and cattails removed as soon as possible.</p> <p>A crack within the spillway is presently being monitored using electronic extensometers, but the data generated appears to be unreliable. I recommended the owner place inexpensive crack movement indicators across the crack so that the crack can be monitored while they are working to sort out their instrumentation issues. The spillway was flowing approximately 0.1 feet deep across the entrance weir. Seepage below the spillway crack indicates a fair amount of leakage through the crack. I would estimate that several gpm or more is leaking through the spillway crack.</p> <p>The current design storm, prepared in 1984, is for a 35,000-year return period producing 2662 cfs (~1210 cfs / sq mi) from the 2.2 square mile drainage area. The spillway capacity is ~3970 cfs which is greater than the peak inflow. Total freeboard is 15.2 feet and the residual freeboard for the design storm is 3.4 feet. Freeboard is satisfactory.</p>
<u>Outlet</u>	<p>Plans show the normally unpressurized outlet to consist of a cast iron pipe with a concrete cap. While most of the cap is unreinforced, a short section of the cap near the upstream end of the outlet is reinforced. Upstream outlet control is provided by two vertically mounted hydraulically operated 20-inch sluice gates; a 30-inch diameter butterfly valve provides downstream control.</p> <p>Due to seasonal environmental concerns, none of the outlet controls were cycled during this inspection. All upstream and downstream outlet controls were partially cycled during the 7 April 2016 inspection, and all were found to be in satisfactory operating condition at that time. All outlet controls were fully cycled during the 5 March 2015 inspection.</p>
<u>Seepage</u>	<p>The downstream face, groins, and abutments were dry and free of any indication of seepage. Horsetails which are normally scattered across the upper half of the downstream face were absent.</p>
<u>Instr.</u>	<p>Instrumentation consists of the following:</p> <ul style="list-style-type: none">• Ten (10) operable piezometers designated 5-1, 5-2, 6-1, 6-2, 7, 7A, B-3, B-4, B-5, and B-6, installed to monitor the phreatic surface within the embankment. Piezometers are monitored monthly.• Three (3) crest survey monuments (M-3, M-4 and M-5) installed to monitor settlement and/or displacement of the crest. Monuments are monitored on a roughly five-year basis.• Two (2) crack meters installed to monitor vertical and horizontal displacement of a crack within the raised portion of the concrete spillway chute. <p>The complete piezometer history is somewhat complicated and is not covered in this report. A detailed review of the piezometer history is presented in the April 25, 2013 inspection report. Since the 2013 inspection four additional piezometers, designated B-3, B-4, B-5, and B-6, were installed in November of 2014.</p> <p>The latest instrumentation data was received from the owner on 21 June 2017.</p>

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Piezometer data covers the period between January 2007 and May 2017. Piezometer 6-1 has gone dry and is no longer measured. For the period reviewed, all of the remaining piezometers follow historic patterns, and no long-term indication of a change of the phreatic surface within the embankment is indicated.

Settlement data covers the period between January 1982 and July 2017. The measured maximum total settlement is 0.346 feet (4.2") for monument M-5 on November 12, 2015. Monuments M-3 and M-4 show maximum total settlements of 1" and 2", respectively. The latest readings show less total settlement than the November 2015 readings.

Alignment data covers the period between January 1982 and February 2017. There is nothing of note since the previous instrumentation report except for a small downstream displacement of survey monuments M-4 and M-5 of 0.2" and 0.3", respectively. The total reported downstream displacements M-4 and M-5 are 1.9" and 3.4", respectively.

Spillway crack data covers the period between December 2005 and June 2017. Crack monitors indicate horizontal displacements are cyclic, though following recent recalibration of the extensometers and data logger in late 2015, reported displacements have increased many fold and are now in the 25 mm to 35 mm range. The reported displacements are inconsistent with observations in the field, and I asked Ms. Croy to continue to evaluate the performance of both the spillway and the spillway crack monitoring instrumentation.

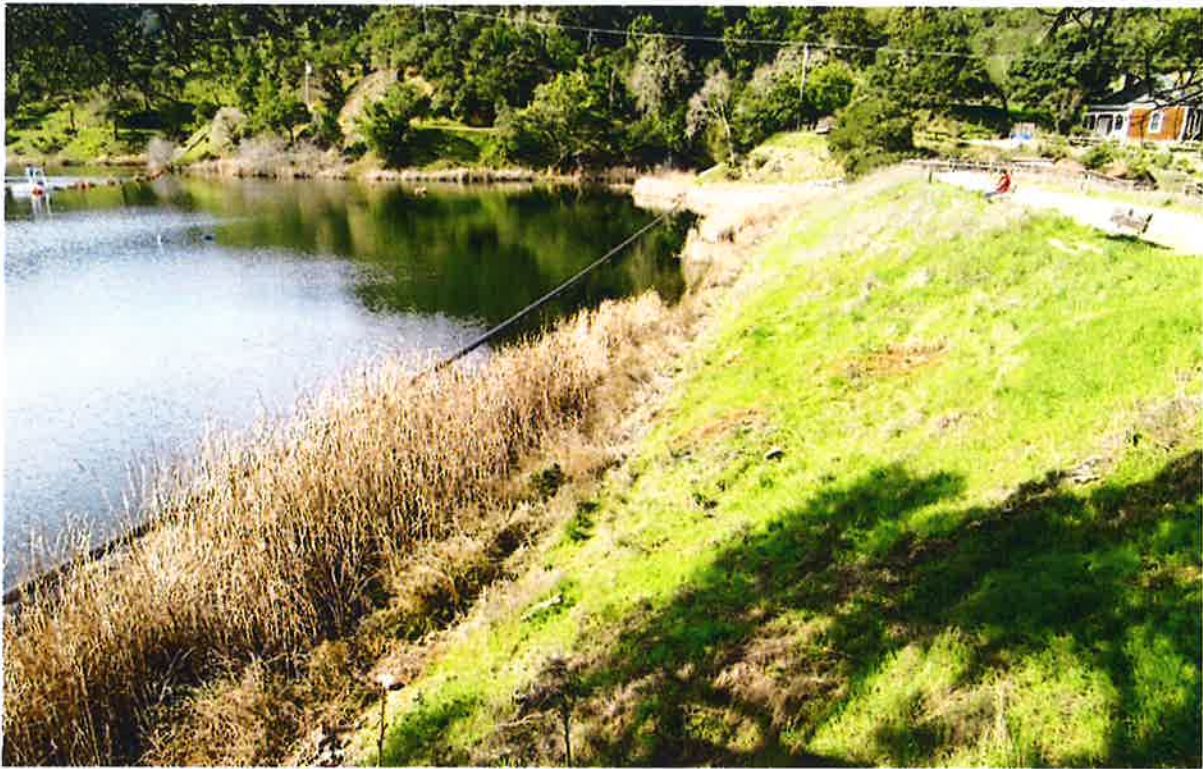
The owner's conclusions from their June 2017 submittal were that, "The Phoenix Lake piezometer readings are consistent with historic readings. ... The Phoenix Lake Dam spillway crack monitors indicate horizontal and vertical displacements. Crack meters and data loggers were removed in October 2015 and sent to the manufacture for calibration. Calibrated equipment and a new vertical crack meter were installed in early February 2016. ... Data since recalibration does not align with previous crack meter data and is currently under review of accuracy and calibration to determine if the spillway crack will need repairs. ... Phoenix Lake dam is trending toward stabilization: settlement of -0.35 ft (maximum) and alignment of -0.28 ft. (downstream direction; maximum)". Based on the data submitted I agree with the owner's conclusions. ***The dam appears to be performing satisfactorily, and no additional instrumentation is believed necessary at this time, but careful and consistent monitoring of the spillway crack is imperative, and any indication of potentially adverse displacements must be reported to DSOD immediately.***

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The upstream face looking towards the spillway entrance, above. Tule and cattails along the waterline must also be cleared. Vegetation control along the downstream face, below, is quite good.



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Looking across the downstream face towards the raised spillway section, above, with a closer look at the raised spillway below. The location of the crack within the spillway is indicated in both photographs.



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The spillway crack exposed behind the instrumentation box. I recommended the owner place inexpensive crack movement indicators across the crack so that the crack can be monitored while they are working to sort out their instrumentation issues.



The spillway entrance is occupied with dormant tules and cattails which require removal. I directed Ms. Croy to have the tules and cattails removed as soon as possible.