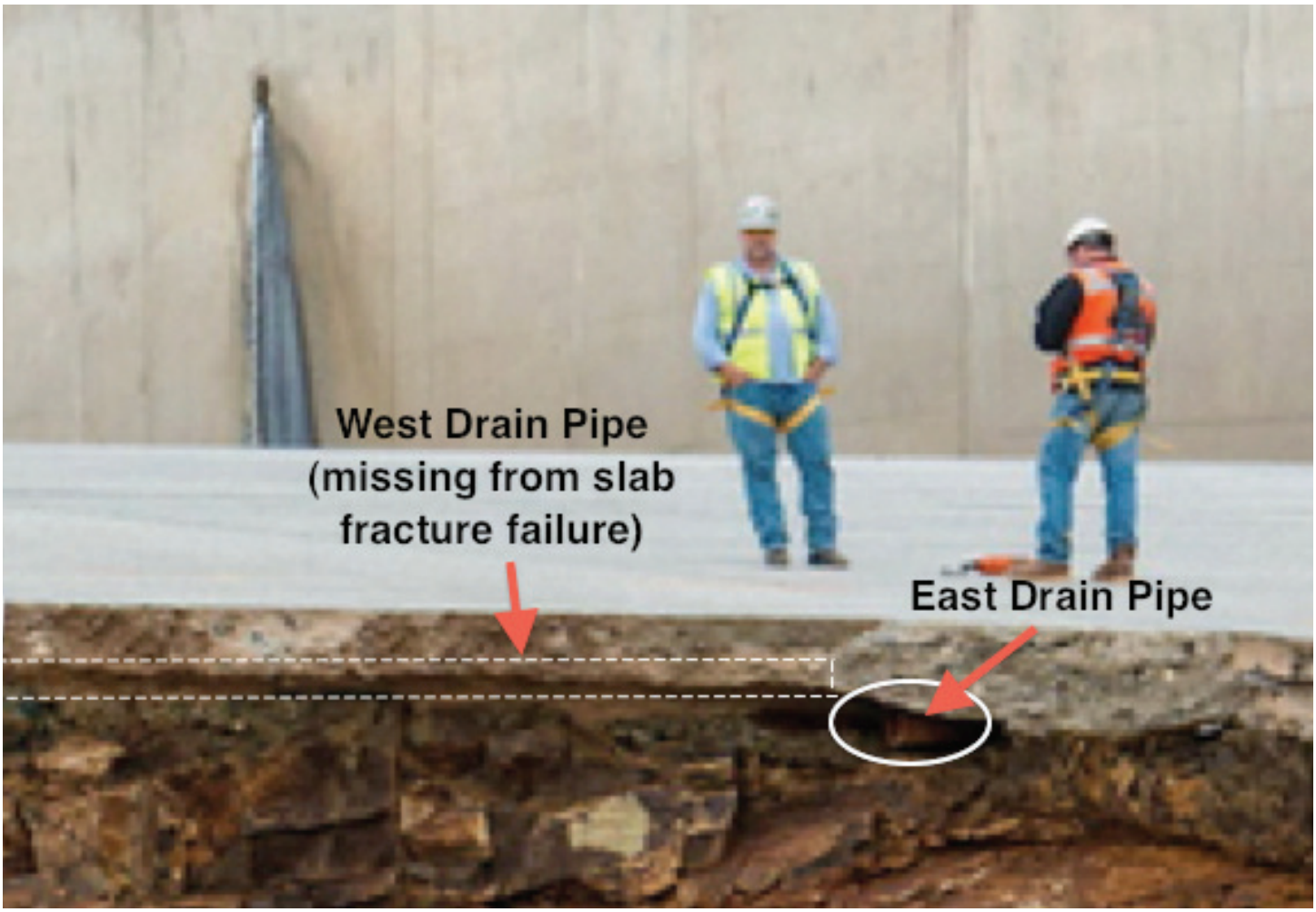
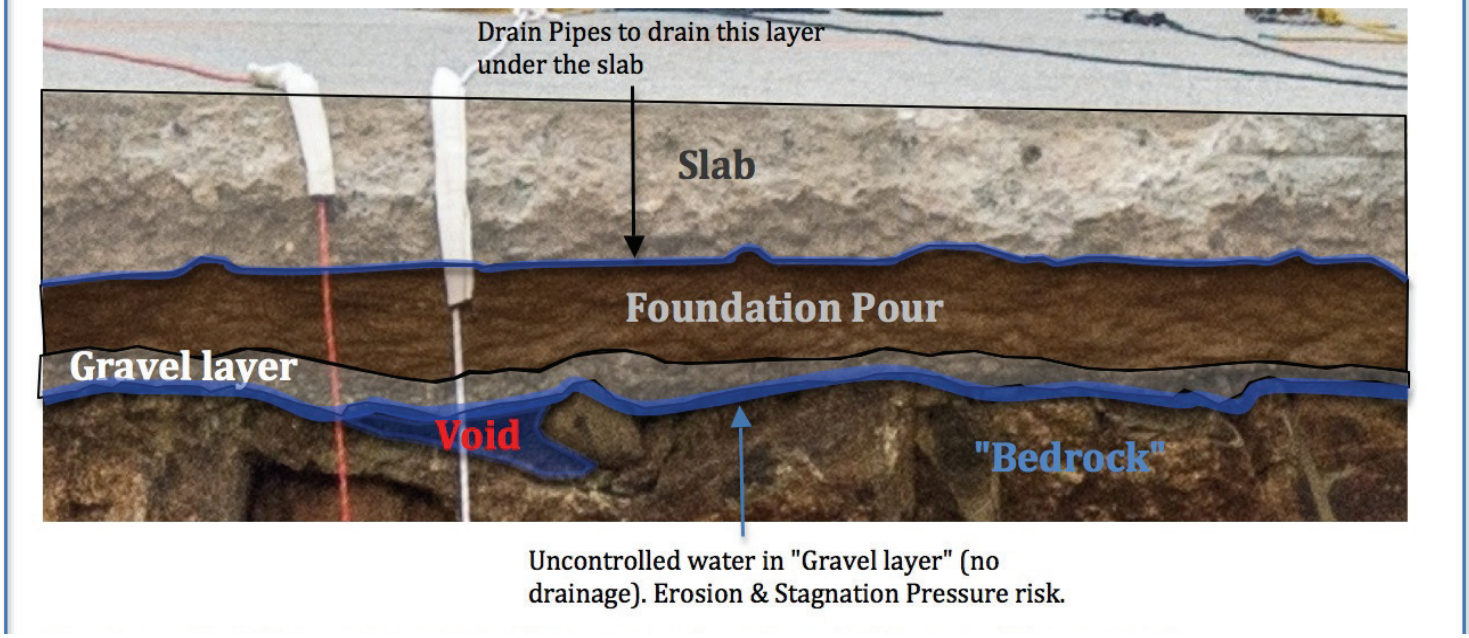

West Drain Pipe
(missing from slab
fracture failure)
East Drain Pipe


West Drain Pipe outline created by Pipe
+ Polyethelene Plastic + emplacement
gravel
Gravel retained from
penetrating concrete
Waterflow seams and
Voids deeper Under
Drain Pipe

Source (27)

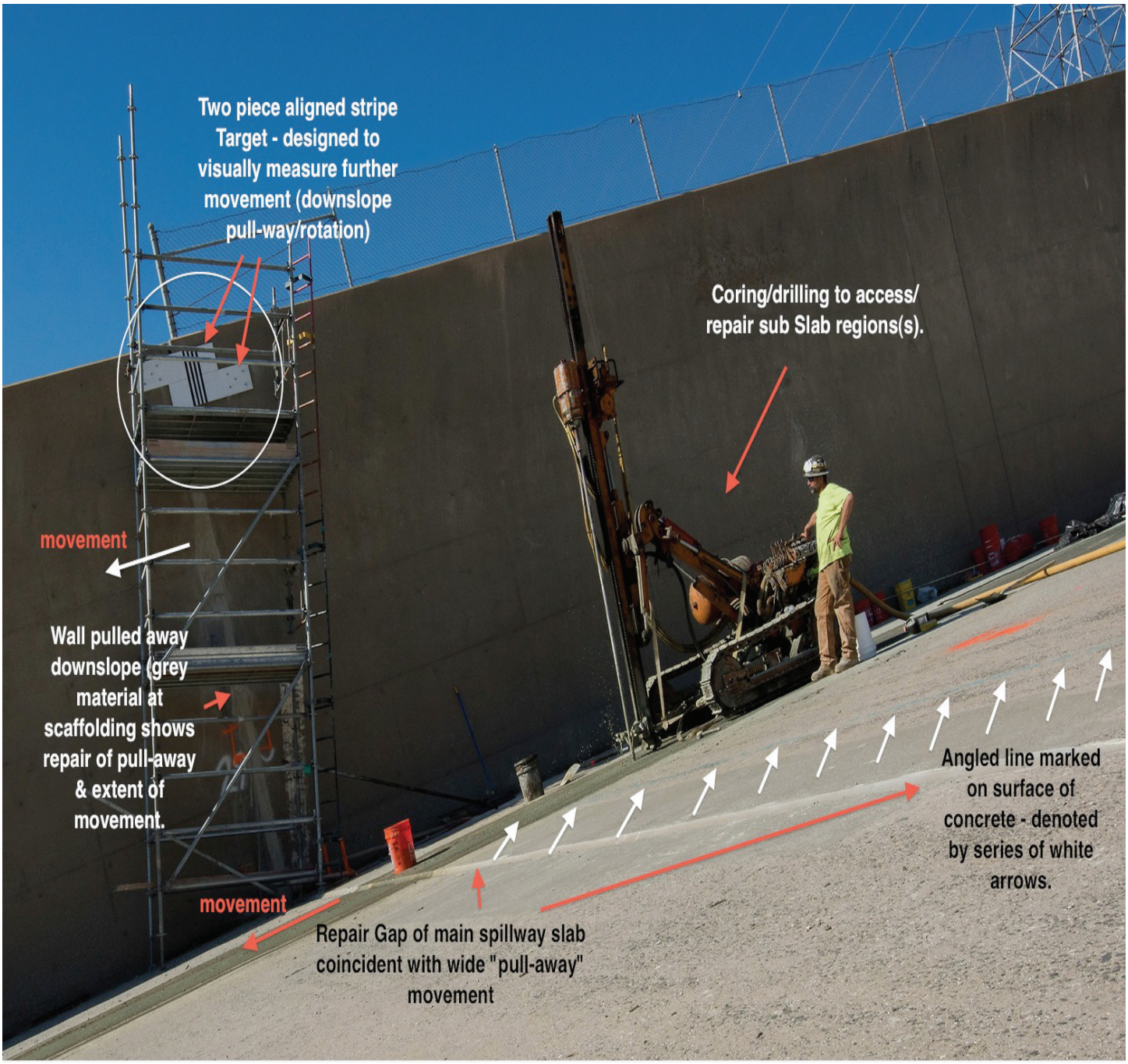

Voids deeper under Drain Pipe (possible source of water induced weathering of rock - leading to large pockets of weakened base rock)


Drain Pipes to drain this layer under the slab
Slab
Foundation Pour
Gravel layer
Void
"Bedrock"
Uncontrolled water in "Gravel layer" (no drainage). Erosion & Stagnation Pressure risk.

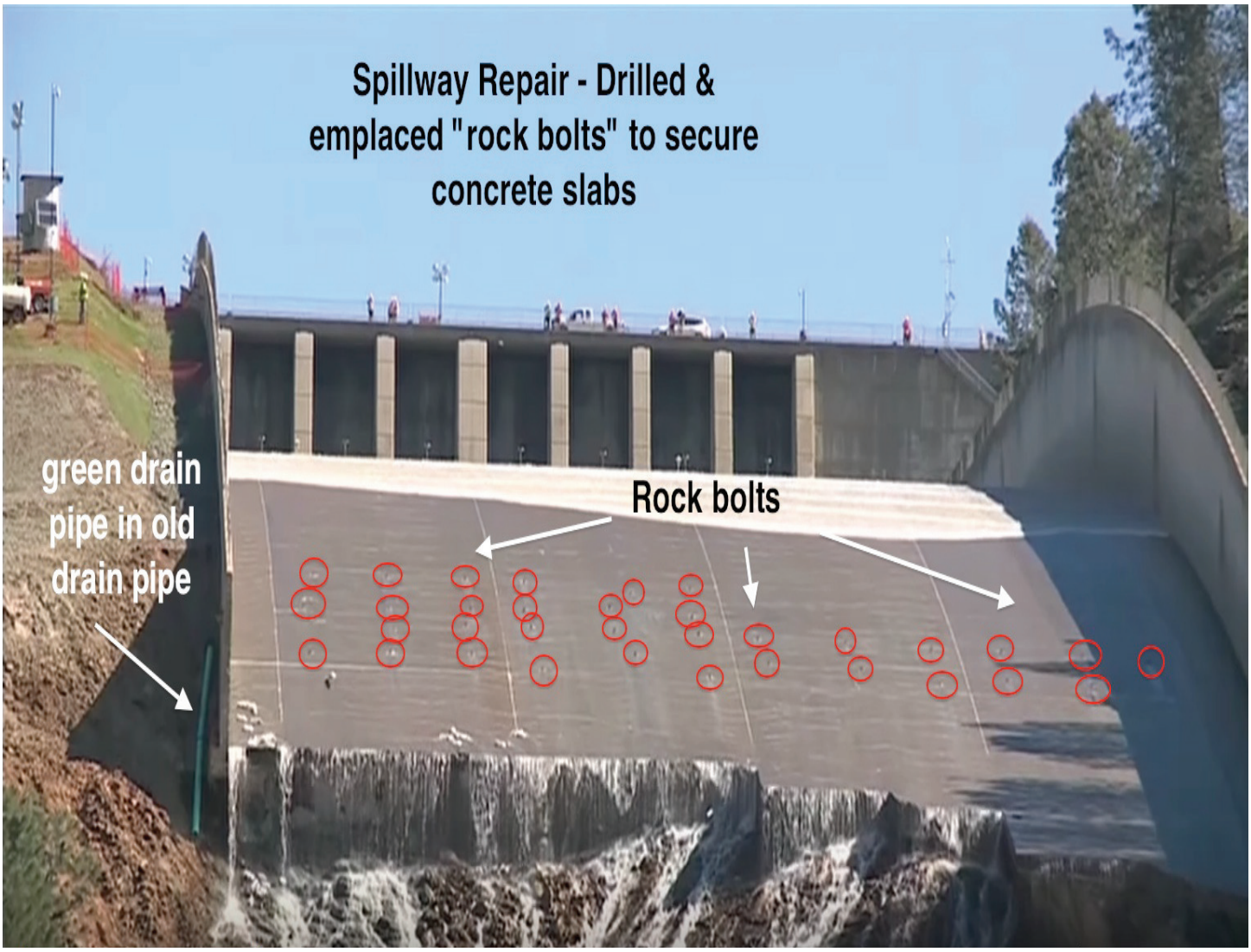
Source (27)


"pulling away" gap in wall and spillway slab.
gap narrowing further down spillway indicates a "rotation"
Erosion of foundation base of wall from broken drain at 5th fence post behind spillway wall.
Rotation indicators of section of main spillway (gaps, broken drain erosion on wall foundation, and spillway backcutting).

Source (27)


Two piece aligned stripe Target - designed to visually measure further movement (downslope pull-way/rotation)
Coring/drilling to access/ repair sub Slab regions(s).
movement
Wall pulled away downslope (grey material at scaffolding shows repair of pull-away & extent of movement.
Angled line marked on surface of concrete - denoted by series of white arrows.
movement
Repair Gap of main spillway slab coincident with wide "pull-away" movement

Source (27)


Spillway Repair - Drilled & emplaced "rock bolts" to secure concrete slabs
green drain pipe in old drain pipe
Rock bolts

Source (27)


No longitudinal reinforcement steel connecting spillway slabs to prevent separation

Source (19)

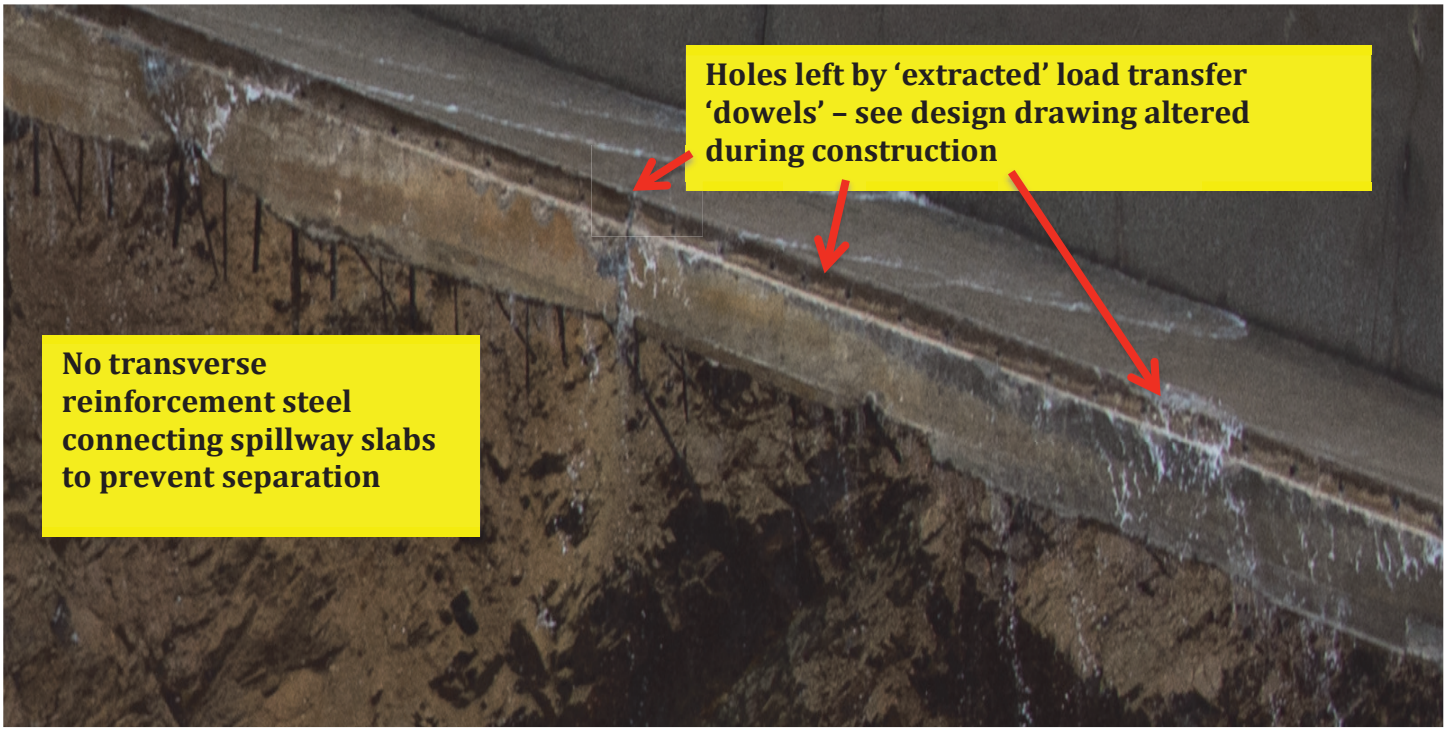

No longitudinal reinforcement steel connecting spillway slabs

Source (19)

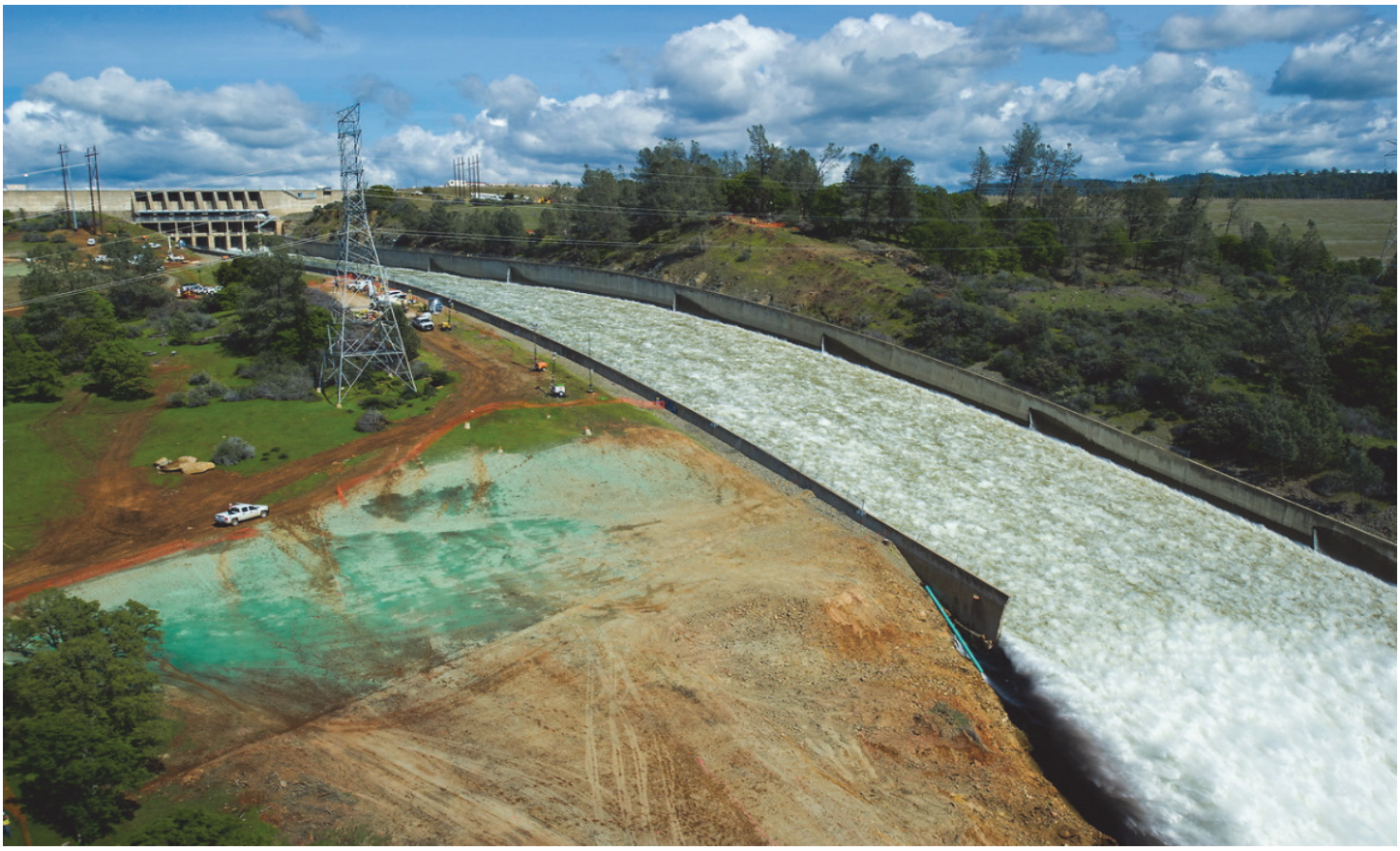

No transverse reinforcement steel connecting spillway slabs to prevent separation

Source (19)

Source (19)



Source (19)

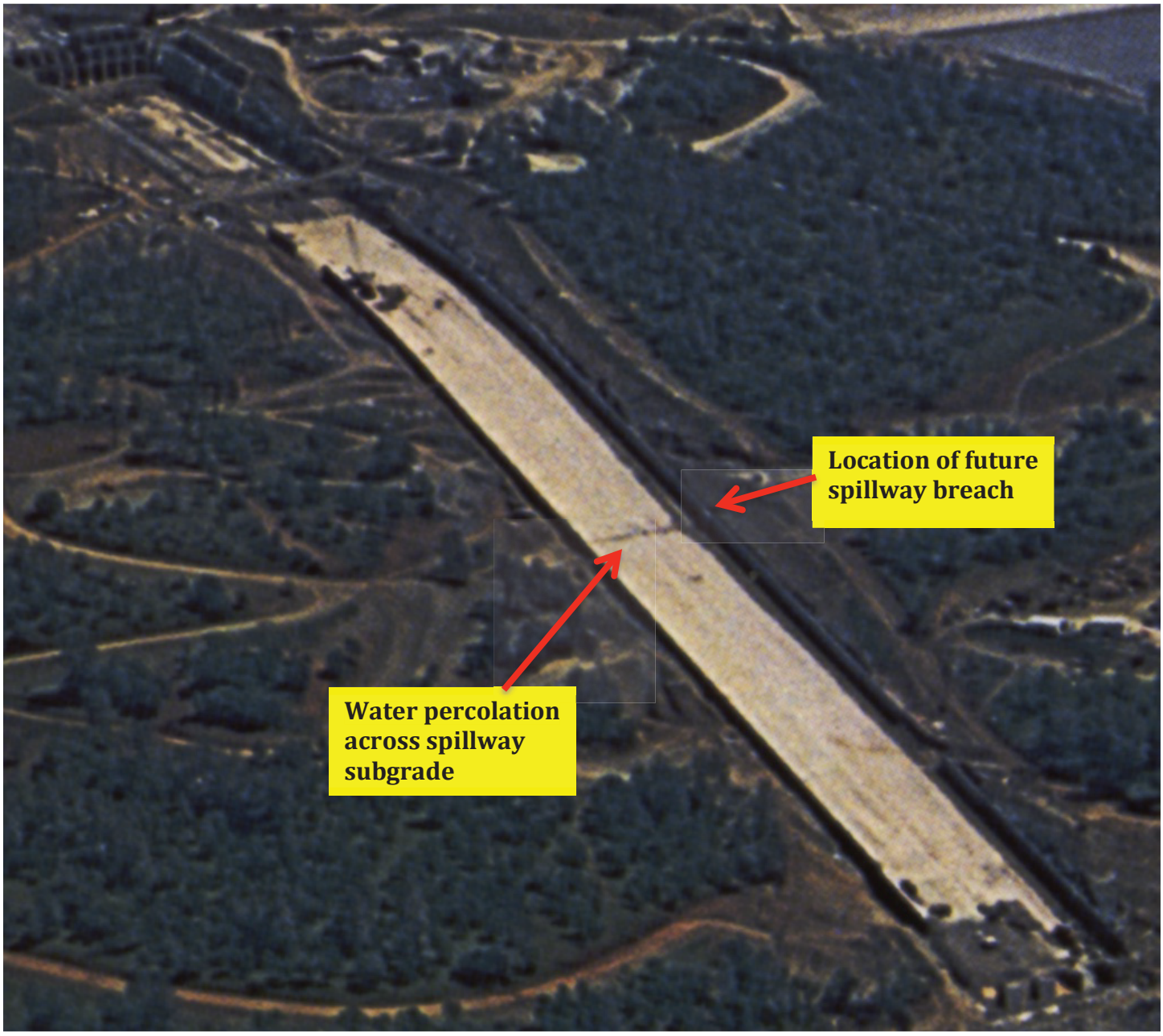


Source (19)

Pre-Failure Images

1967 – Spillway being constructed – walls being cast – chute subgrade placed

Source (22)


Location of future spillway breach
Water percolation across spillway subgrade

Source (22)

August 4, 1969

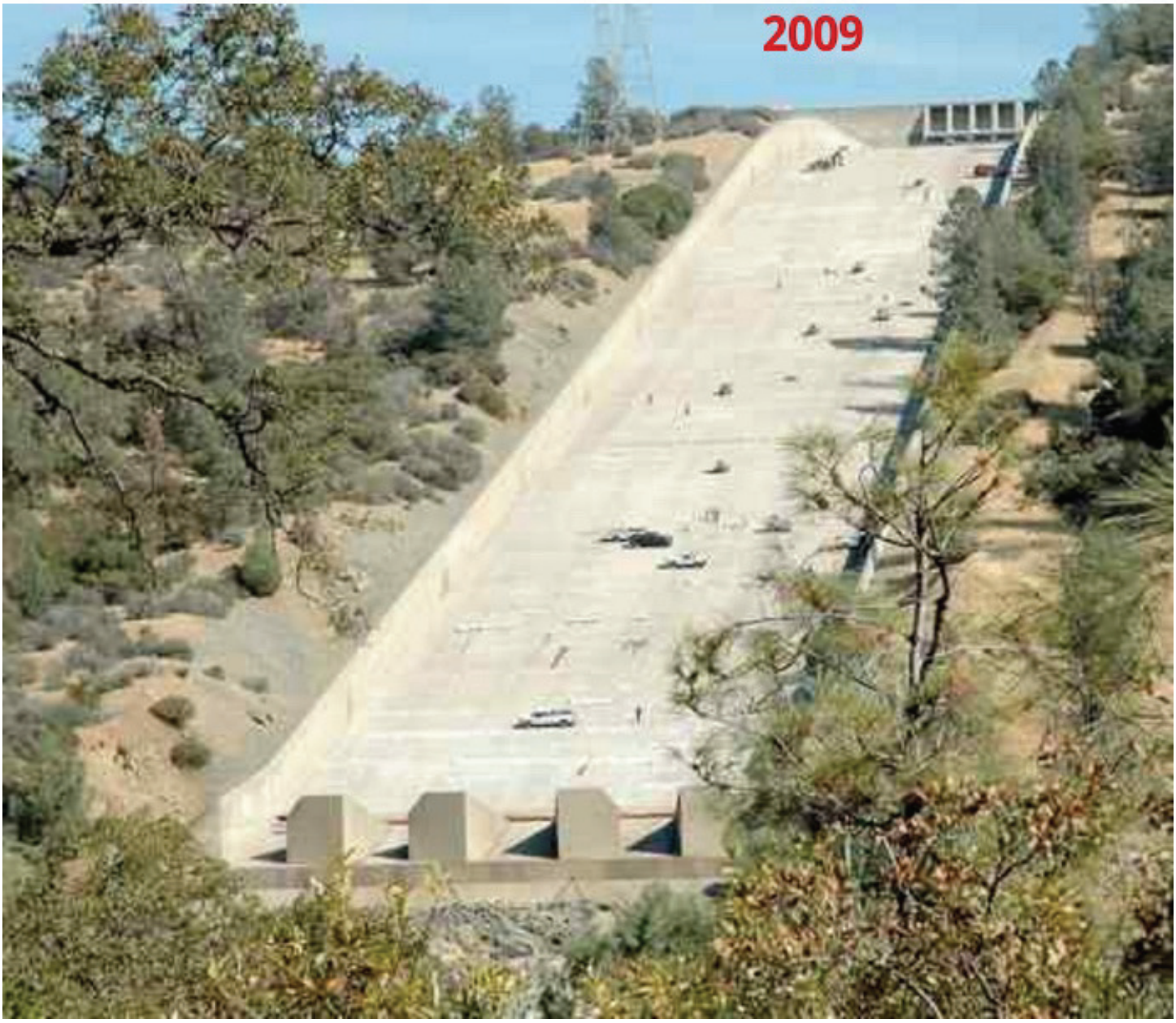
Source (22)

November 9, 2007

Source (22)

Source (22)

October 7, 2009 – Repairs being made to spillway base slabs



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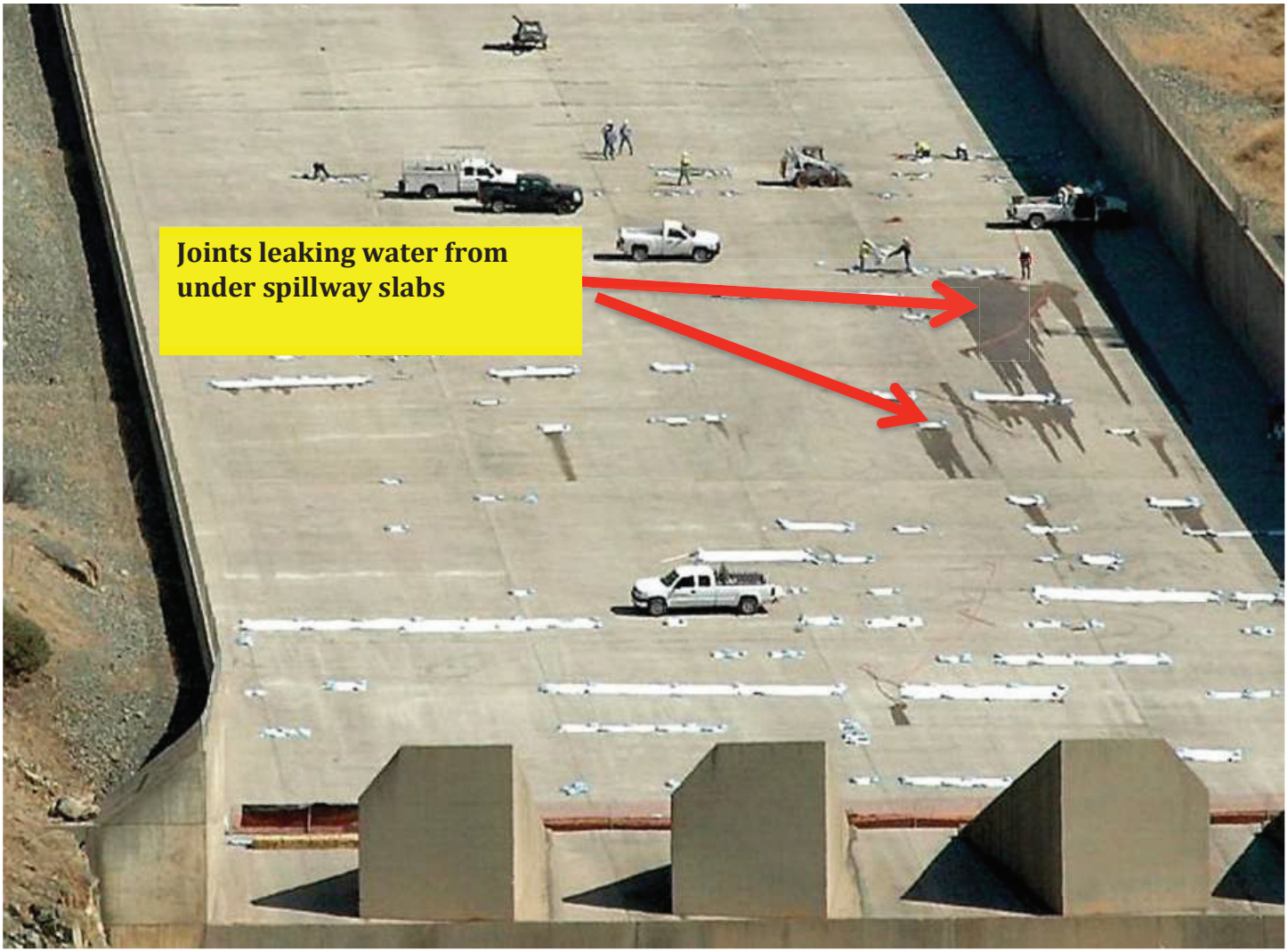


Source (22)

July 9 - 10, 2010

Source (22)

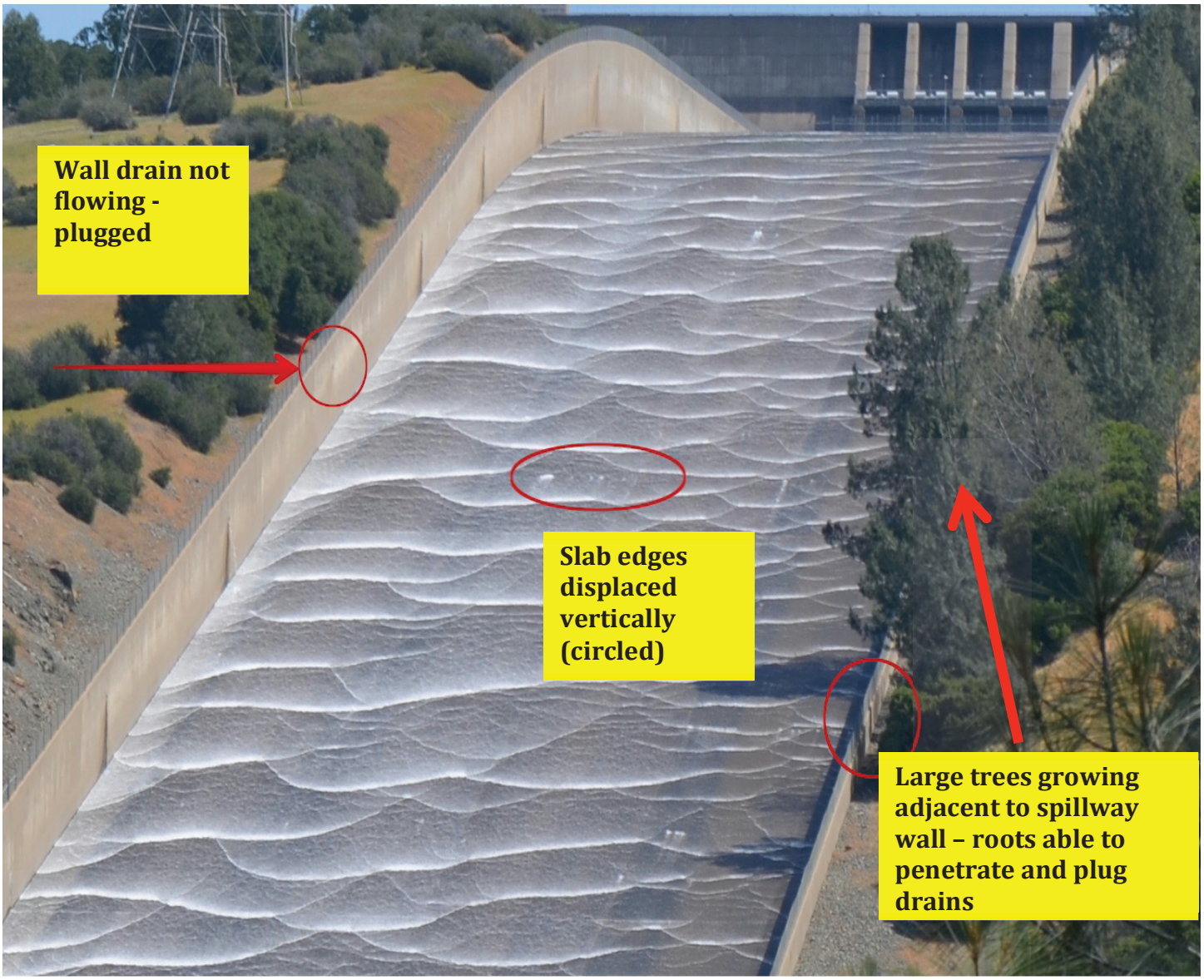

7/9/2010
2015
1998
Cracks in spillway chute slabs
Large trees growing adjacent to spillway wall – roots able to penetrate and plug drains
Google Earth
1998
Imagery Date: 7/9/2010 10 S 629099.39 m E 4377636.00 m N elev 540 ft eye alt 404 ft

Source (22)


7/9/2010
1998
2015
Cracks in spillway discharge slabs
Google Earth
1998
Imagery Date: 7/9/2010 10 S 628915.57 m E 4377441.75 m N elev 327 ft eye alt 404 ft

Source (22)

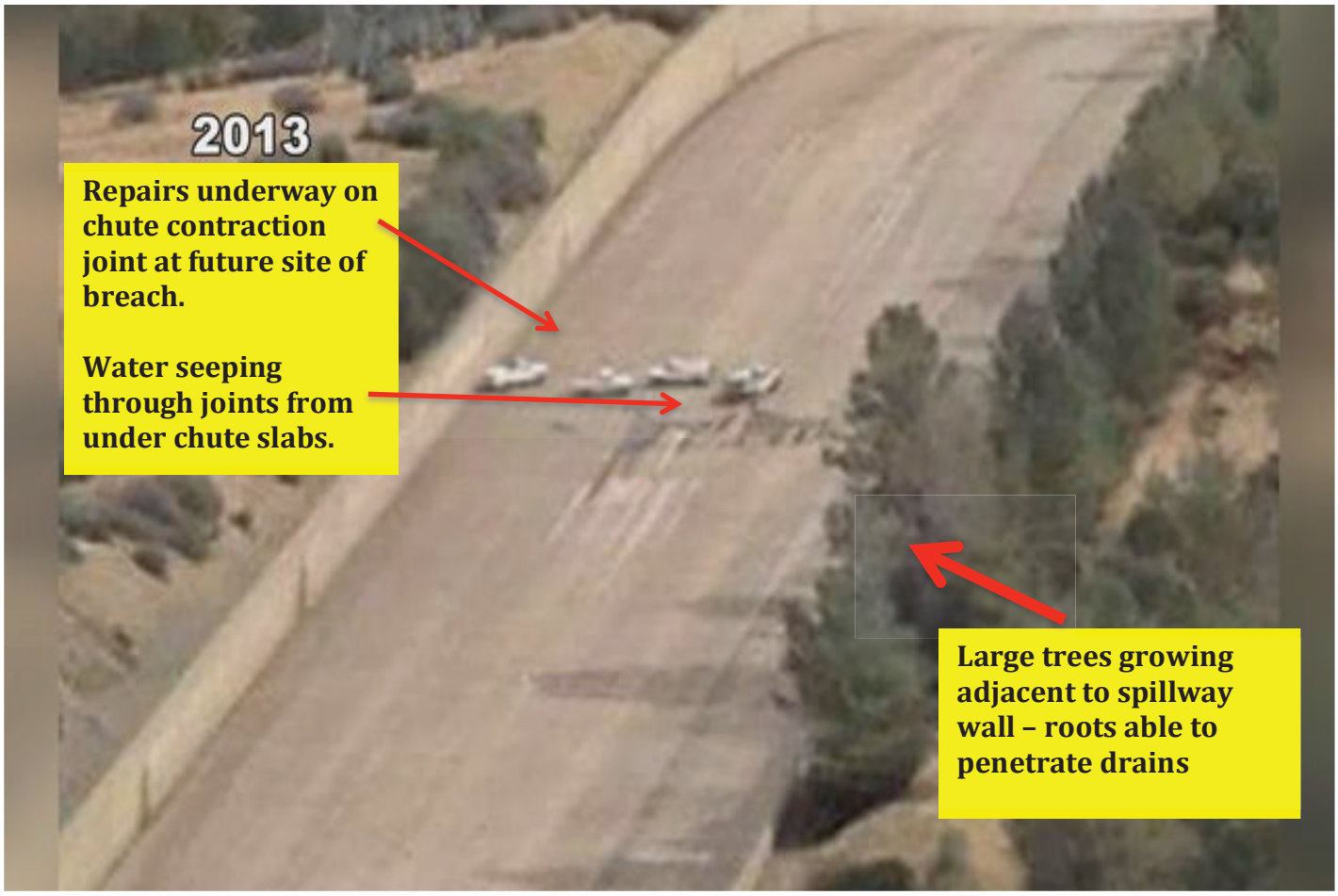
2012



Source (22)

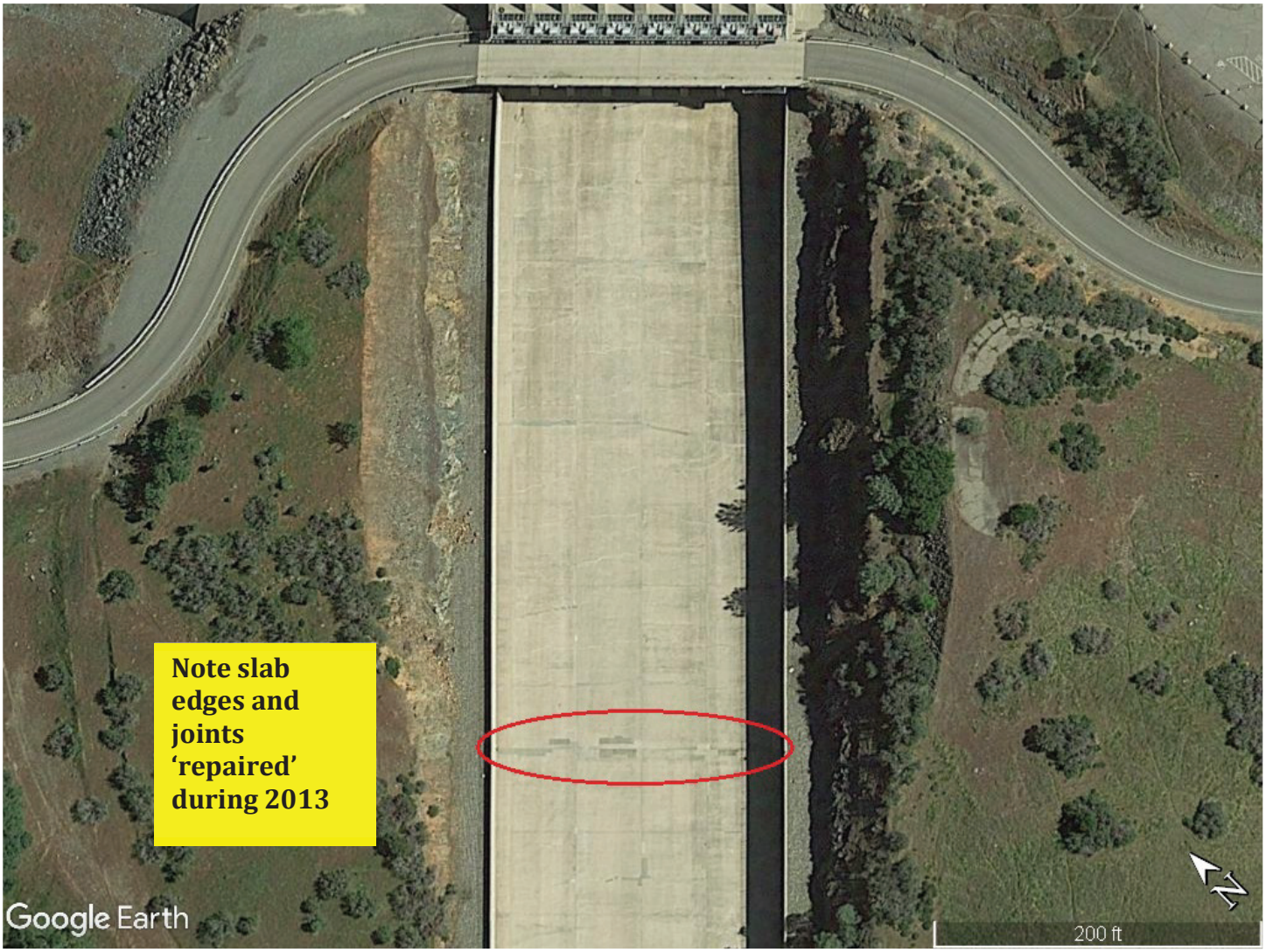
2013

Source (22)

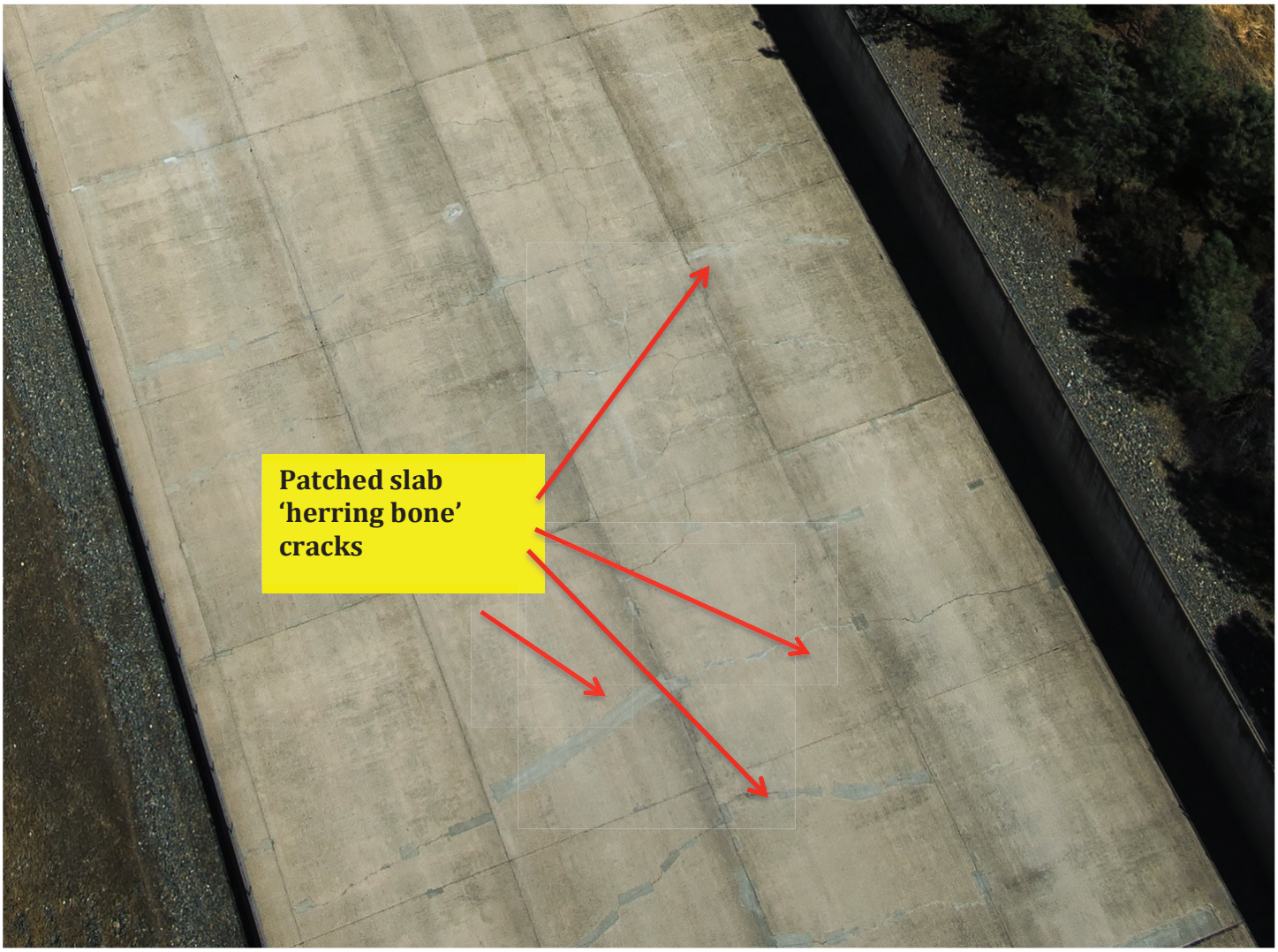

2013
Repairs underway on chute contraction joint at future site of breach.
Water seeping through joints from under chute slabs.
Large trees growing adjacent to spillway wall – roots able to penetrate drains

Source (22)

September 5, 2014



Source (22)



Source (22)

Source (22)

April 14, 2015

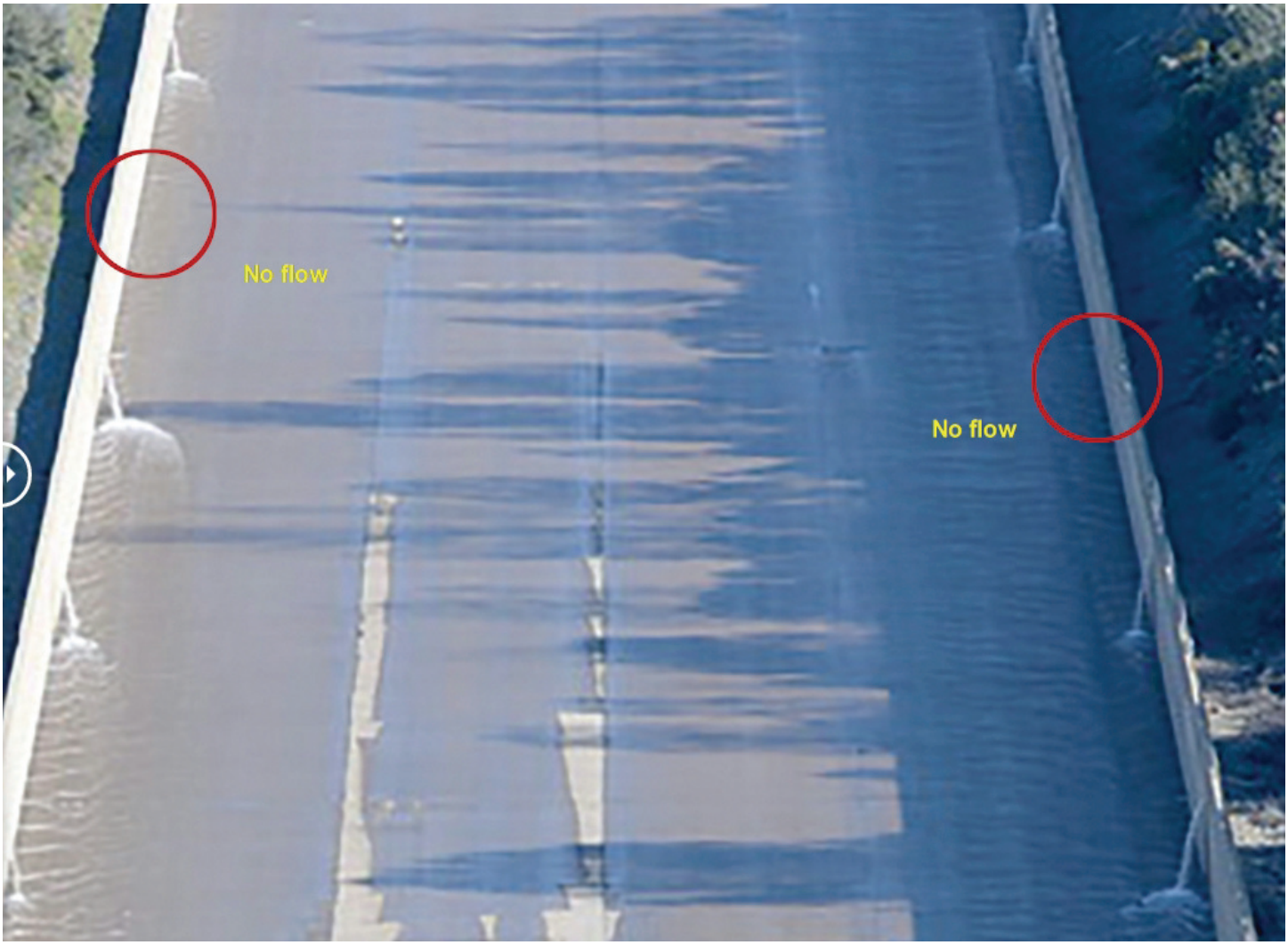
Source (22)

Source (22)

Source (22)

March 2016

January 27, 2017



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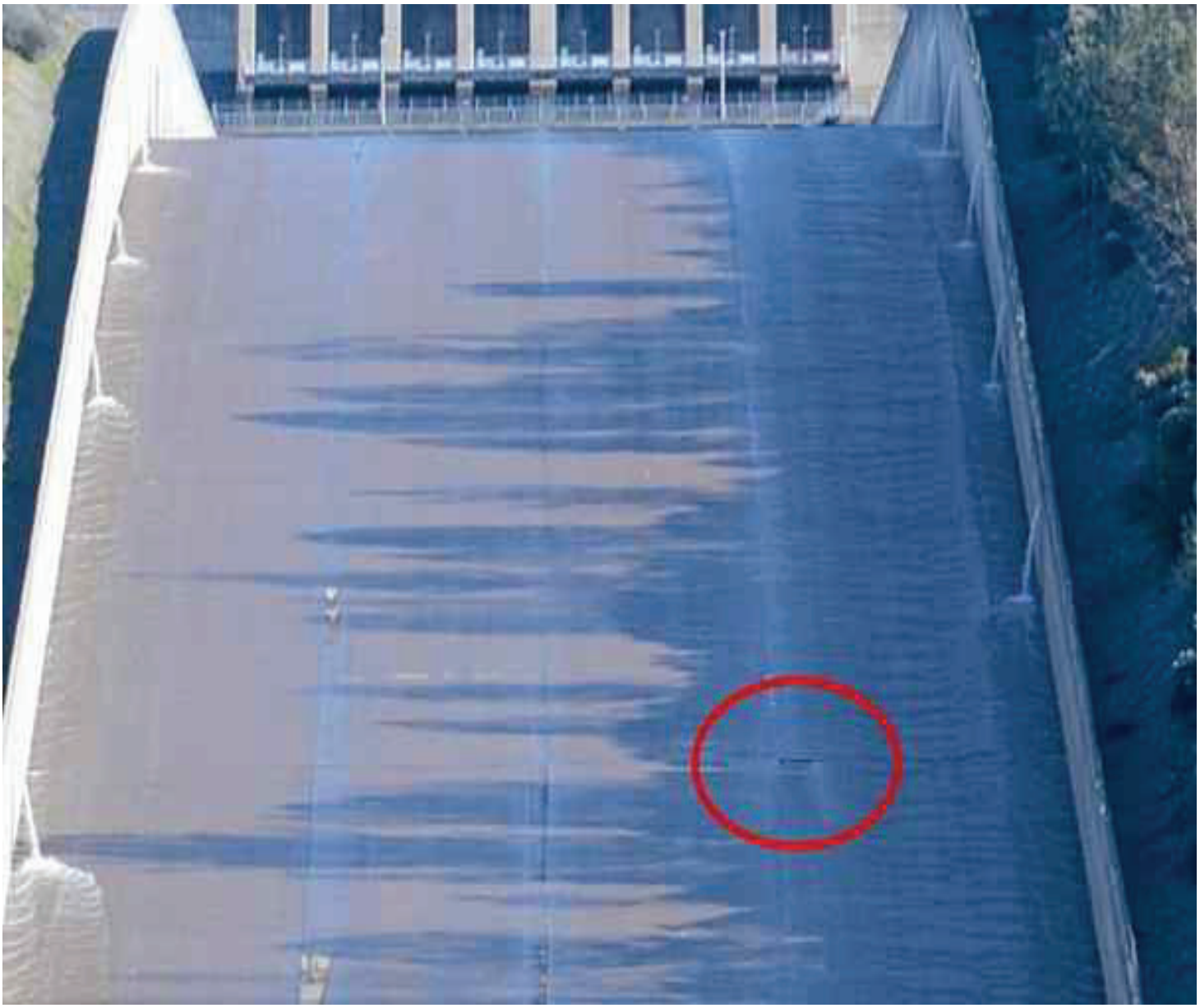


Source (22)

Previous inspection report photographs
(all from cited DWR inspection reports)

5/6/08 Inspection Report

11. The spillway at the flood control outlet remains in satisfactory condition.

12/14/09 Inspection Report

20. This view shows the flood control outlet chute as seen from the upper deck. The walls and chute appeared to be stable and in satisfactory condition. Minor repairs along the chute floor will be completed this year.

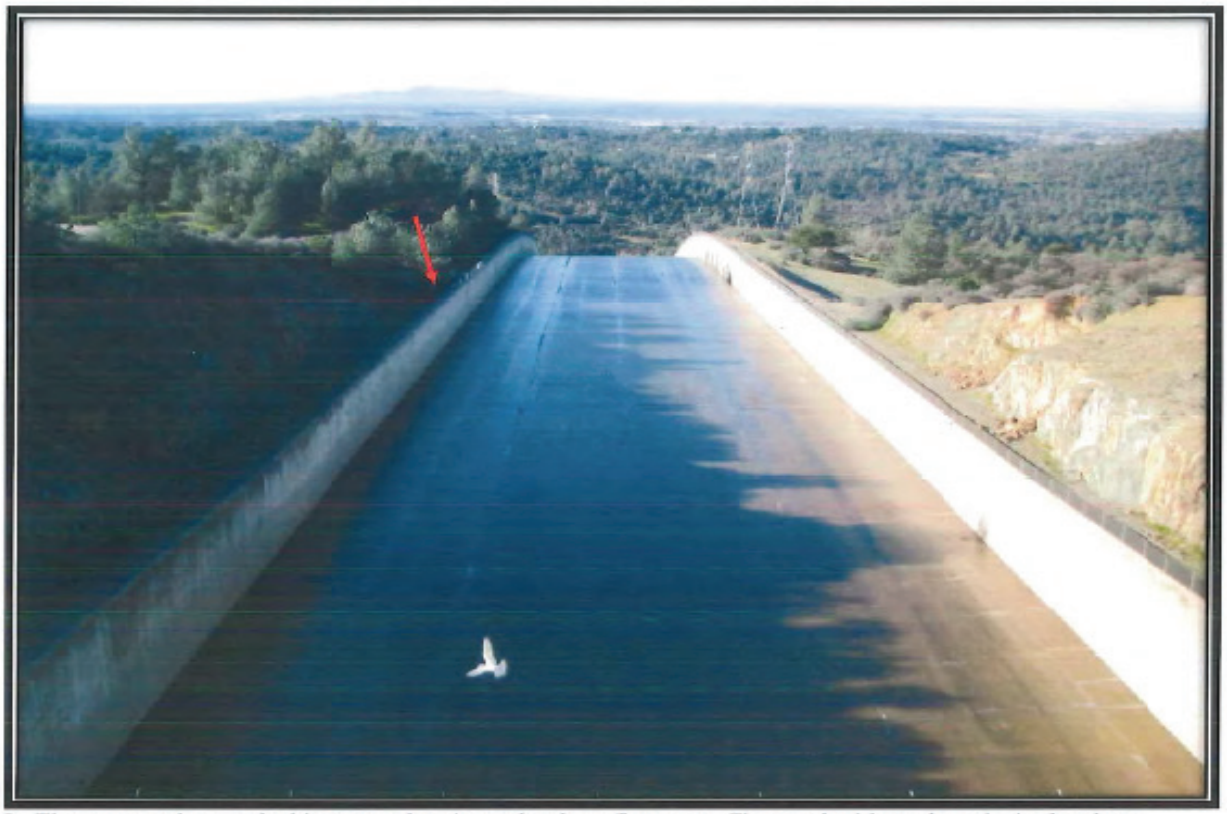
21. The lower flood control outlet chute is shown. Not the markings for the upcoming chute repairs.

6/25/10 Inspection Report

12. The concrete along the spillway chute has been repaired. The repaired herringbone crack pattern is said to reflect the underlying drain system.

Oroville Dam, No. 1-48

2/8/11 Inspection Report



9. The gates seals were leaking enough to keep the chute floor wet. The repaired lateral cracks in the chute floor are visible as light streaks. The brush at the arrow should be removed to prevent root invasion of the wall drain. No signs of instability were noted along the chute walls or floor. The drain holes at the end of the chute were flowing.

2/16/11 Inspection Report

11. The flood control outlet flow pattern was normal. The walls were well aligned and stable appearing. The drains at the vertical curve along the chute were flowing as expected. The brush growing in the backfill gravel adjacent to the left wall should be removed as previously requested. See arrow at left.

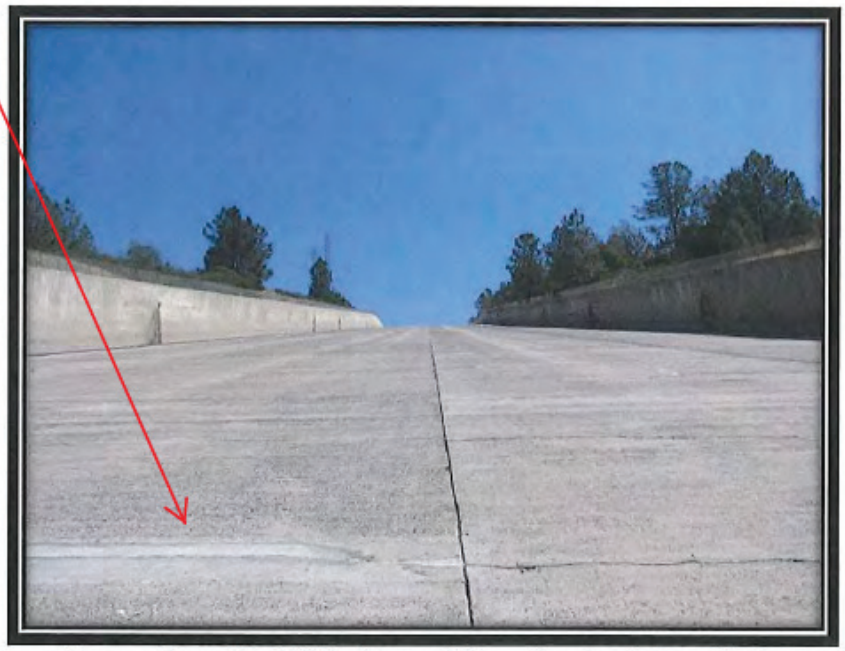
2/5/13 Inspection Report

14. The flood control outlet gate seal leakage and drain flow are visible. The trees and brush shown within the ovals should be removed by November 1, 2013.

Oroville Dam, No. 1-48

9/8/14 inspection report

12. The FCO channel appeared to be in satisfactory condition. The walls were well aligned and the patches along the chute floor remain intact.

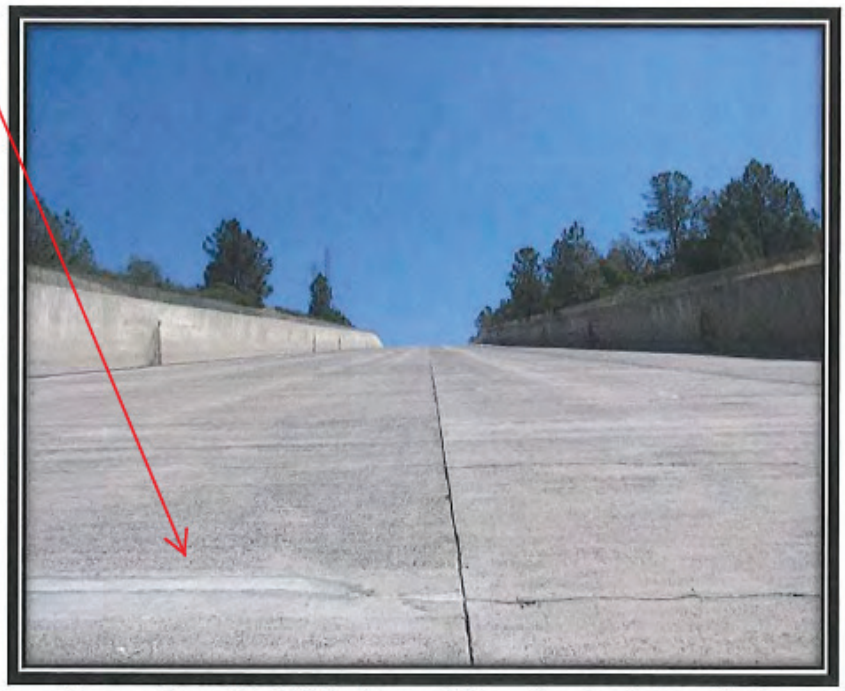


13. This view is looking upstream along the FCO channel from the dentates. Dark, vertical stains along the walls indicate the location of the drain outfalls.

2/3/15 inspection report

9. This view looking upstream along the FCO discharge chute shows one tree (arrow) that needs to be removed following a significant effort to remove brush along the outside of the wall.

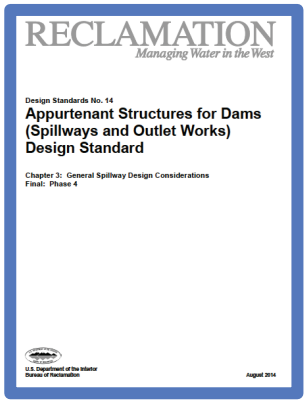
12. The FCO channel appeared to be in satisfactory condition. The walls were well aligned and the patches along the chute floor remain intact.

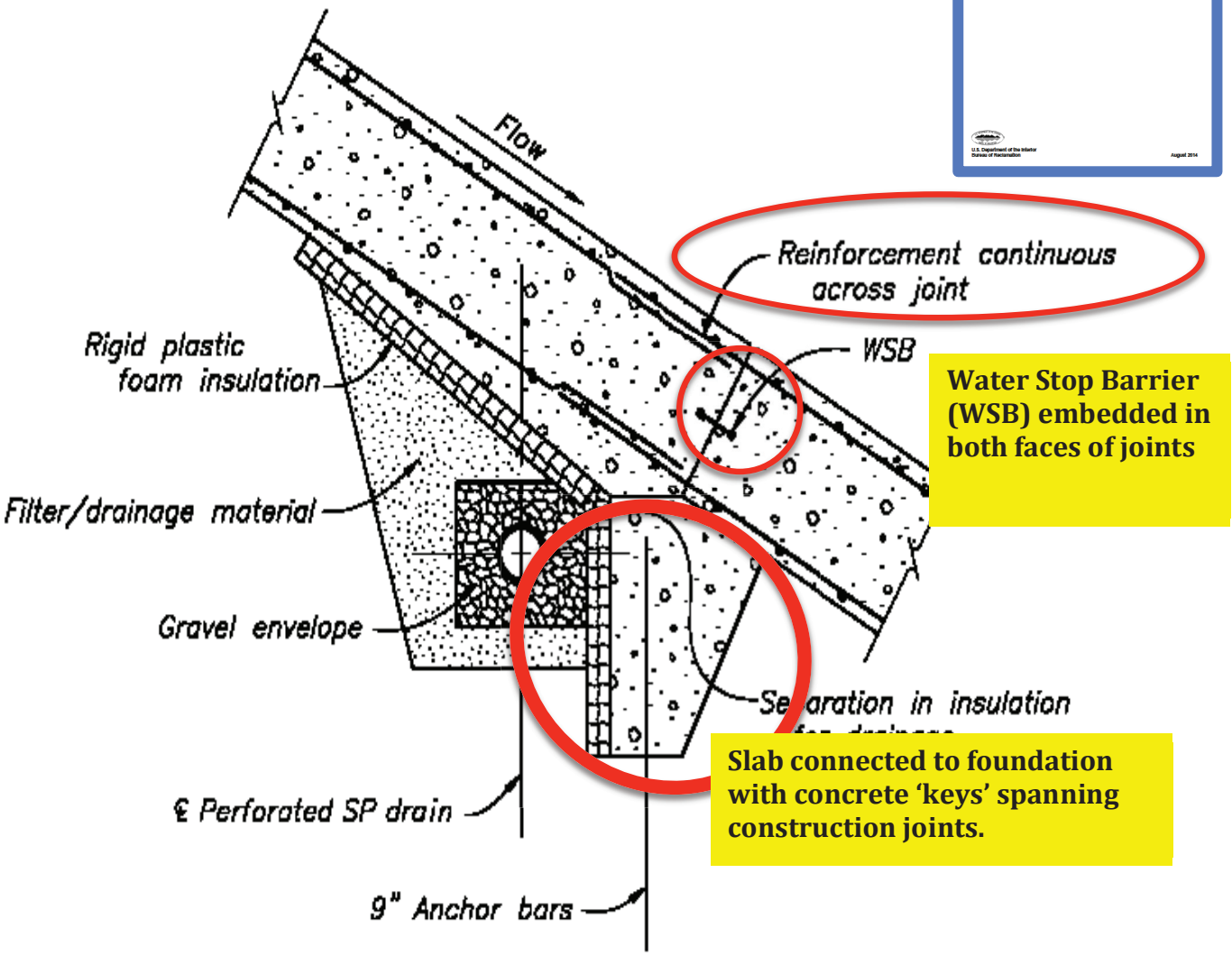


13. This view is looking upstream along the FCO channel from the dentates. Dark, vertical stains along the walls indicate the location of the drain outfalls.

9. This view looking upstream along the FCO discharge chute shows one tree (arrow) that needs to be removed following a significant effort to remove brush along the outside of the wall.

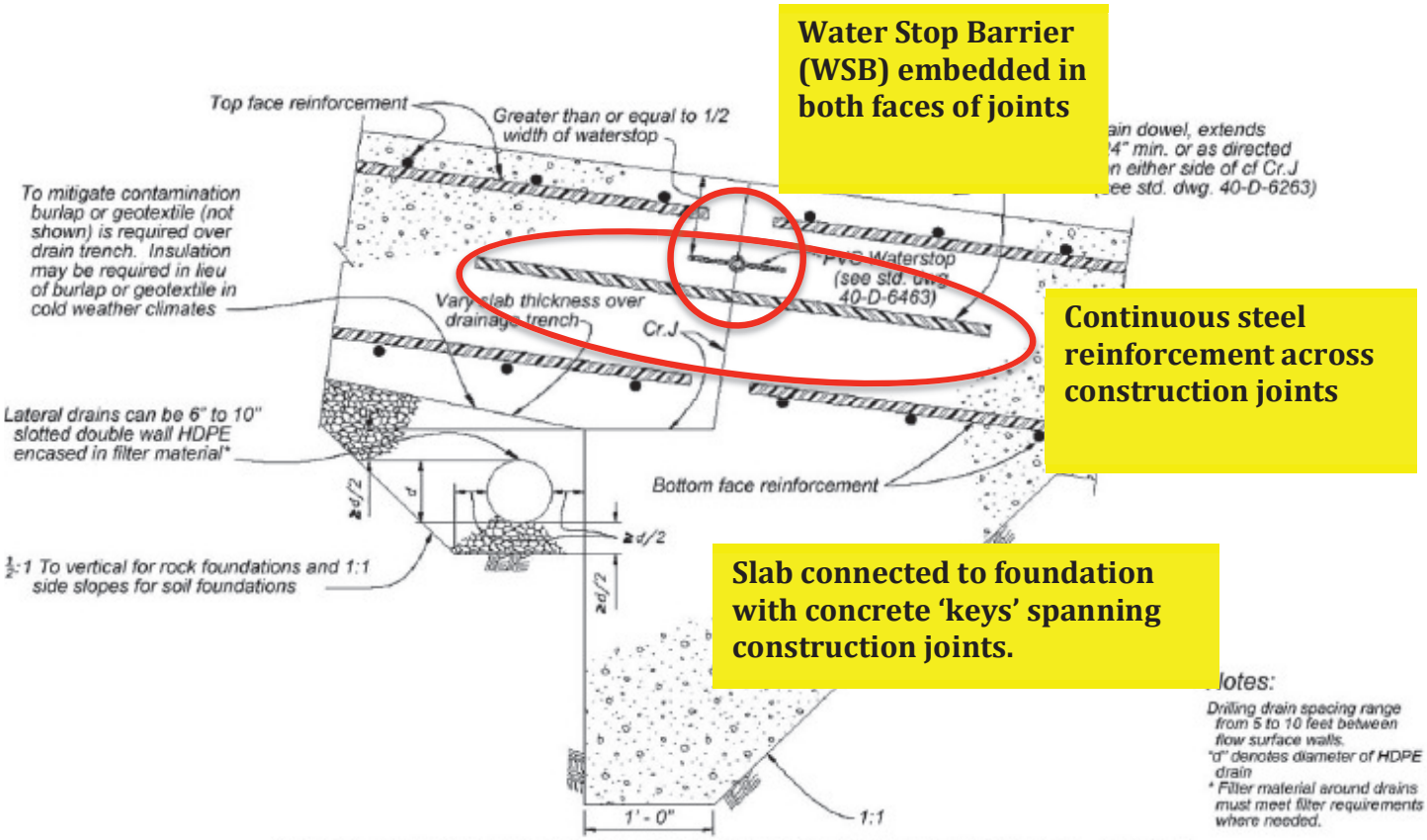
2014 Bureau of Reclamation spillway design cross sections (Source 24)



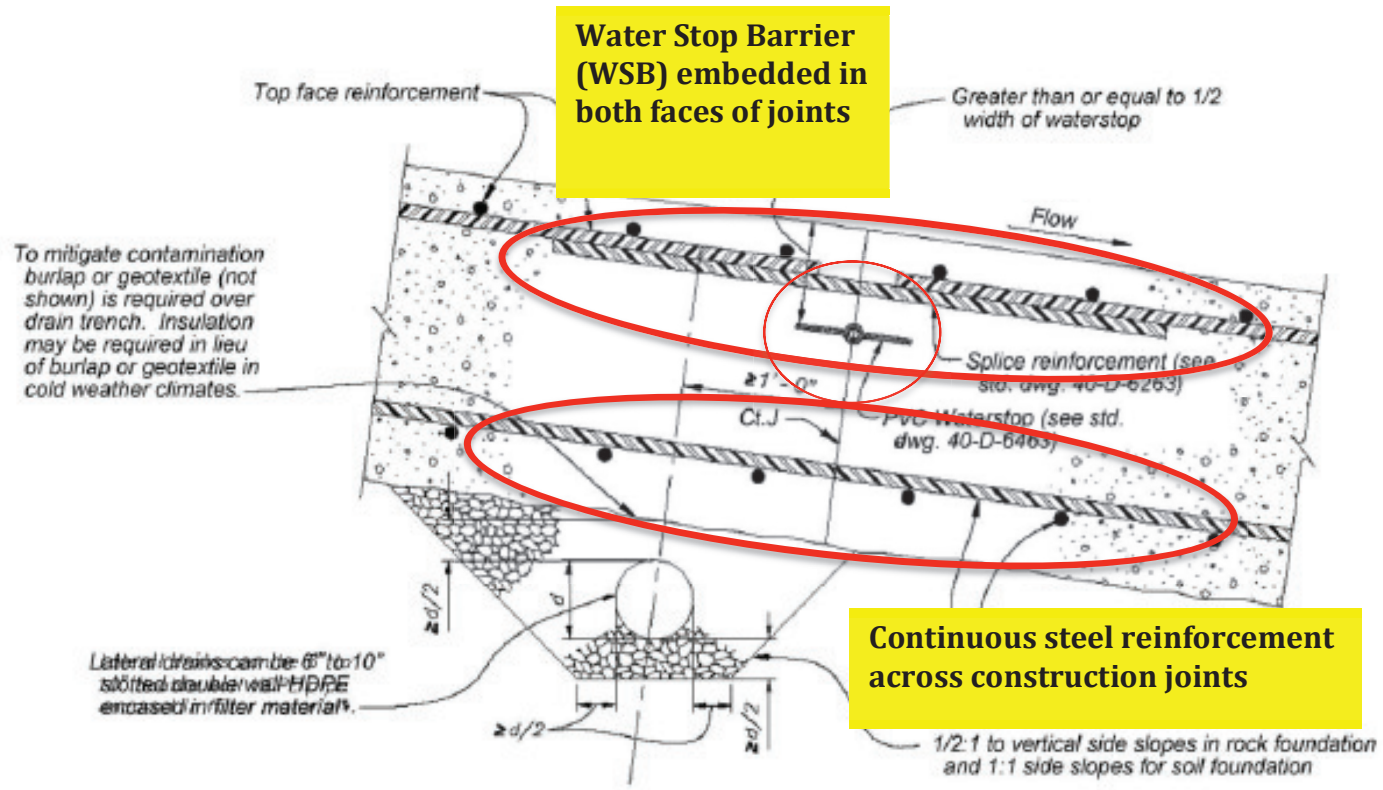


Water Stop Barrier (WSB) embedded in both faces of joints

Slab connected to foundation with concrete 'keys' spanning construction joints.



CASE 2B: ROCK OR SOIL FOUNDATION WITH FOUNDATION KEY – STEEP SLOPE – APPLICABLE FEATURE IS CONVEYANCE FEATURE (CHUTES)



CASE 1B: ROCK OR SOIL FOUNDATION WITHOUT FOUNDATION KEY – FLAT TO GRADUAL SLOPES – APPLICABLE FEATURE IS TERMINAL STRUCTURE (STILLING BASIN)