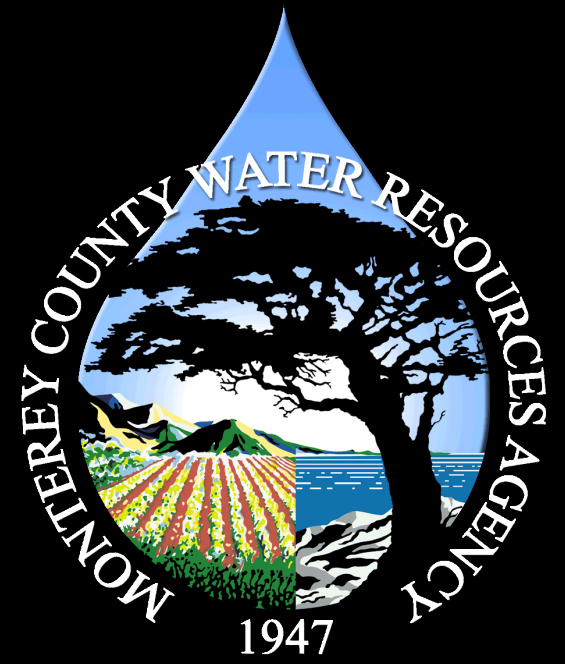
MONTEREY COUNTY WATER RESOURCES AGENCY
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TODAY'S ACTION

Recommend the Board of Directors Receive a Report on Dam Breach Inundation Maps for Nacimiento and San Antonio Dams

Financial Impact

- There is no financial impact in receiving this report.

Prior BOD Action

- On September 18, 2017 the Board of Directors approved Amendment No. 4 to the Agreement with AECOM Technical Services, Inc. to complete inundation maps for dam and spillway breach scenarios required by Calif. Dept. of Water Resources, Division of Safety of Dams (DSOD)
- On June 18, 2018 the Board of Directors approved Amendment No. 5 to the Agreement with AECOM Technical Services, Inc. to complete DSOD required revision to one set of inundation maps
- Total cost: $76,010

  paid from Hydroelectric Fund 130

Discussion

- 2017 State law (Calif. Water Code Sections 6160 and 6161) requires Emergency Action Plans (EAP) preparation and updated mapping of areas of inundation downstream of "high" and "extremely high" hazard classification dams for failure of the dam embankment, and separately for failure of critical appurtenant structures, at full reservoir with no inflow.
- Under 2017 State law, Nacimiento and San Antonio Dams are now classified as "extremely high" hazard dams (from "high" hazard). Both dams require EAP's and inundation mapping.
- The Salinas River Diversion Facility dam is classified as a "low" hazard dam (unchanged) – with no EAP or inundation mapping requirements.

Discussion

Effective July 1, 2017

Criteria for DSOD's Downstream Hazard Potential Classification

Downstream Hazard Potential Classification	Loss of Human Life	Economic, Environmental, and Lifeline Losses
Low*	None expected	Low and principally limited to dam owner's property
Significant*	None expected	Yes
High*	Probable (One or more expected)	Yes (but not necessary for this classification)
Extremely High	Considerable	Yes – major impacts to critical infrastructure or property

*Reference FEMA P-946, July 2013, Federal Guidelines for Inundation Mapping of Flood Risks Associated with Dam Incidents and Failures

http://www.water.ca.gov/damsafety/docs/Hazard_Classification.pdf

Discussion (cont.)

Prior to 2017 State law:

- Federal Energy Regulatory Commission (FERC) regulations required an EAP for catastrophic failure at Nacimiento Dam, with dam embankment failure inundation mapping. MCWRA maintained annual EAP updates with distribution to emergency responders in Monterey and San Luis Obispo Counties.
- MCWRA relied primarily upon the Nacimiento Dam EAP for emergency notifications for San Antonio Dam failure scenarios, and the Nacimiento Dam inundation mapping was viewed as a conservative approximation of downstream inundation for a San Antonio Dam failure scenario because of similarities in:
  - ❑ Dam size
  - ❑ Dam construction
  - ❑ Reservoir storage volume
  - ❑ Dam location / downstream population, infrastructure and channel characteristics

Discussion (cont.)

Per 2017 State law:

- DSOD reviews and approves all inundation maps
- All inundation maps for Nacimiento Dam and San Antonio Dam are approved by DSOD (Dec 2018)
- California Office of Emergency Services (Cal-OES) reviews and approves dam Emergency Action Plans (EAPs)
- The most recent EAP for Nacimiento Dam is presently under review by Cal-OES.
- A new EAP for San Antonio Dam has been reviewed by Cal-OES and revisions are required. Staff is preparing revisions for re-submittal to Cal-OES for approval.
- The Federal Energy Regulatory Commission (FERC) also reviews and approves the EAP and inundation maps for Nacimiento Dam.

Discussion (cont.)

DSOD requires downstream inundation mapping of two failure scenarios at each dam:

- Failure of **Nacimiento Dam** embankment structure with full reservoir (at top of spillway - 800 feet, no inflow to reservoir)
- Failure of the **Nacimiento Dam** concrete spillway structure to Elev. 750 feet with full reservoir (at top of spillway - 800 feet, no inflow to reservoir, dam intact)
- Failure of **San Antonio Dam** embankment structure with full reservoir (at top of spillway - 780 feet, no inflow to reservoir)
- Failure of **San Antonio Dam** concrete spillway structure to Elev. 771.5 feet with full reservoir (at top of spillway - 780 feet, no inflow to reservoir, dam intact)

Discussion (cont.)

Dam Breach Estimated Flow and Arrival Times

	San Antonio Dam Breach at Full Reservoir (water at spillway crest 780 ft)			Nacimiento Dam Breach at Full Reservoir (water at spillway crest 800 ft)		
	Estimated Peak Flow (cfs)	Estimated Flood Arrival Time (HOURS)	Estimated Peak Arrival Time (HOURS)	Estimated Peak Flow (cfs)	Estimated Flood Arrival Time (HOURS)	Estimated Peak Arrival Time (HOURS)
Camp Roberts	---	1.5	< 2	3,312,017	1	1.5
Bradley	830,000	2	3	2,581,650	1.5	2
San Miguel	n/a	n/a	n/a	---	1.5	2
San Ardo	790,000	3	4	2,275,146	2.5	3
San Lucas	660,000	5.5	7	1,935,096	4	4.5
King City	510,000	8	10	1,697,237	5	5.5
Greenfield	420,000	11	12.5	1,267,444	6.5	7
Soledad	370,000	14	16	1,187,513	8.5	9
Gonzales	330,000	17	18.5	1,128,507	10.5	11
Chualar	---	19	20	903,687	12.5	13
Hwy 68 Salinas/Spreckels	230,000	24	25	745,870	18.5	22
Hwy 1 Castroville	150,000	28	29.5	< 700,000	19	22.2
Moss Landing	---	29	30	< 700,000	22.5	22.5

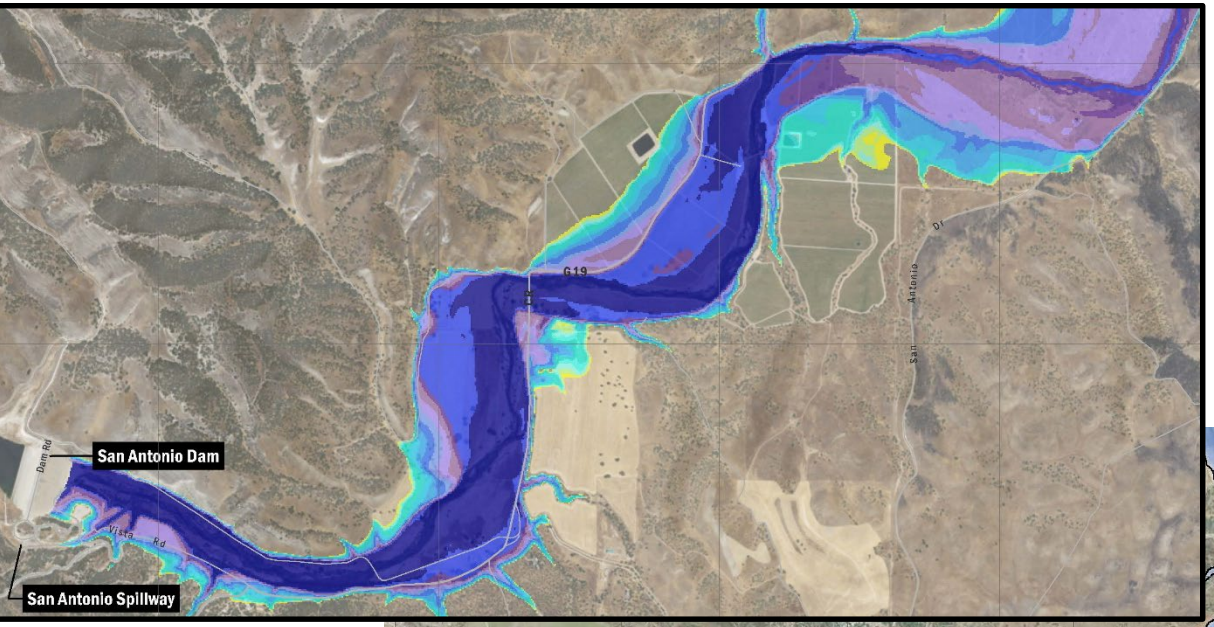
--- not specifically presented in report

Point of Reference:

Jan 30, 2019 Mississippi River Flow at Vicksburg MS = 1,210,000 cfs (USGS)

Embankment Breach at Full Reservoir (water at spillway crest)

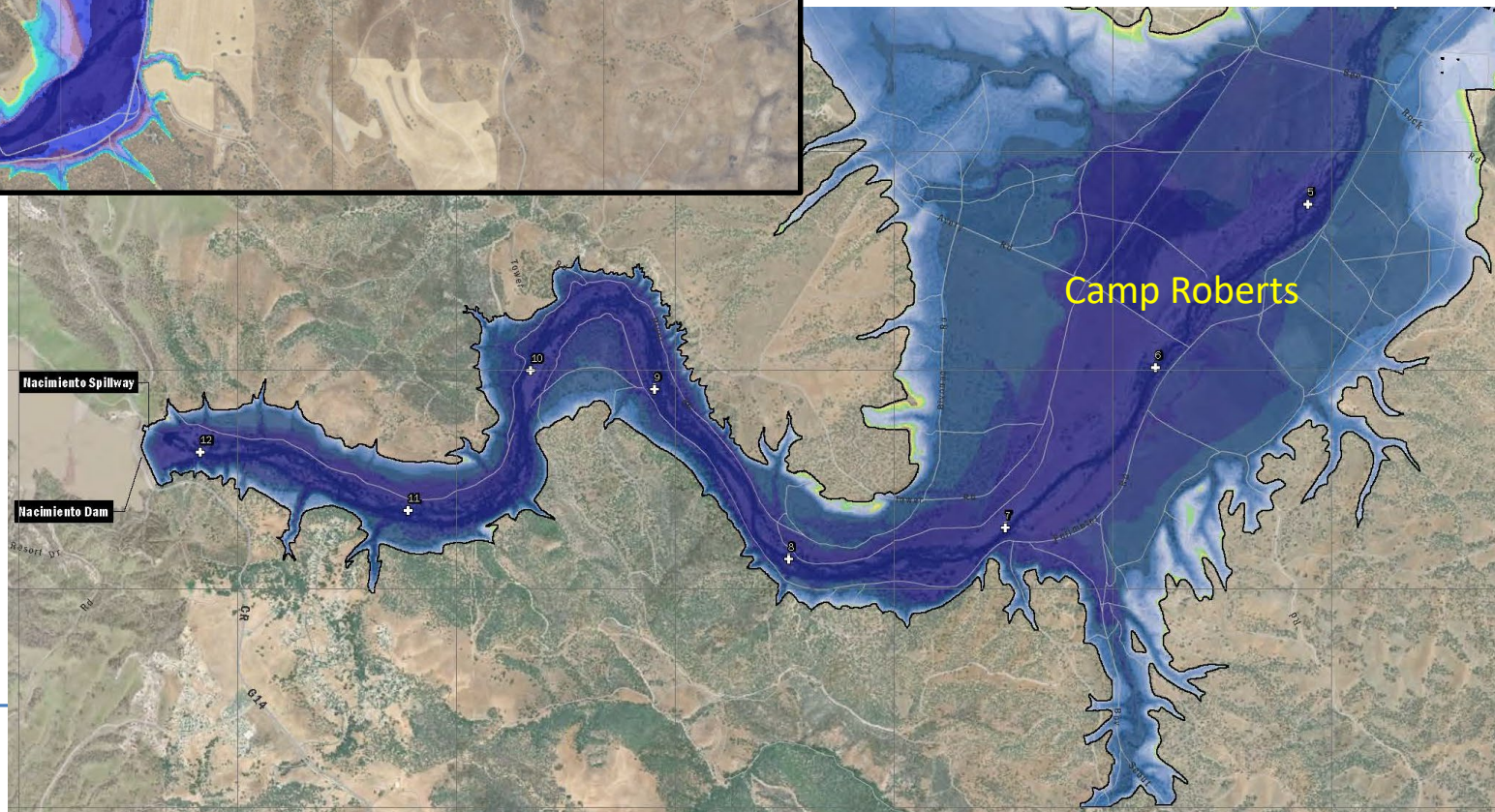
San Antonio **IMMEDIATELY BELOW DAMS** Nacimiento



Maximum Flood Depth (ft)

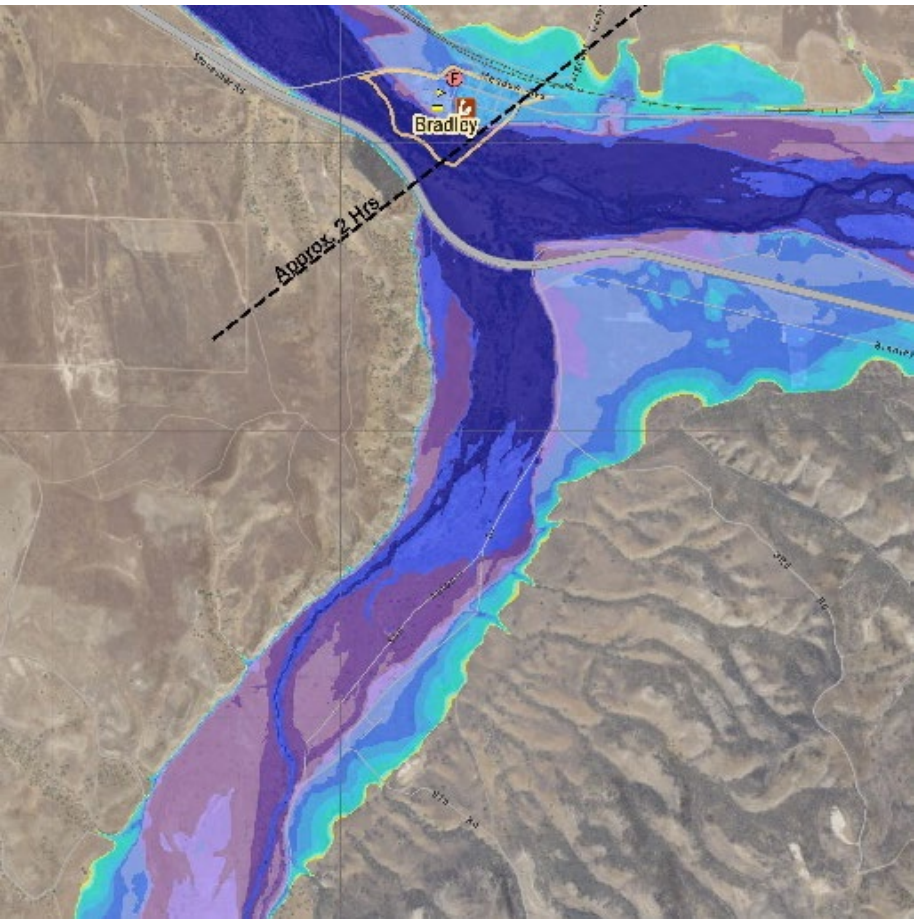
0 - 1	5 - 10	30 - 35
1 - 2	10 - 15	35 - 40
2 - 3	15 - 20	40 - 45
3 - 4	20 - 25	45 - 50
4 - 5	25 - 30	>50

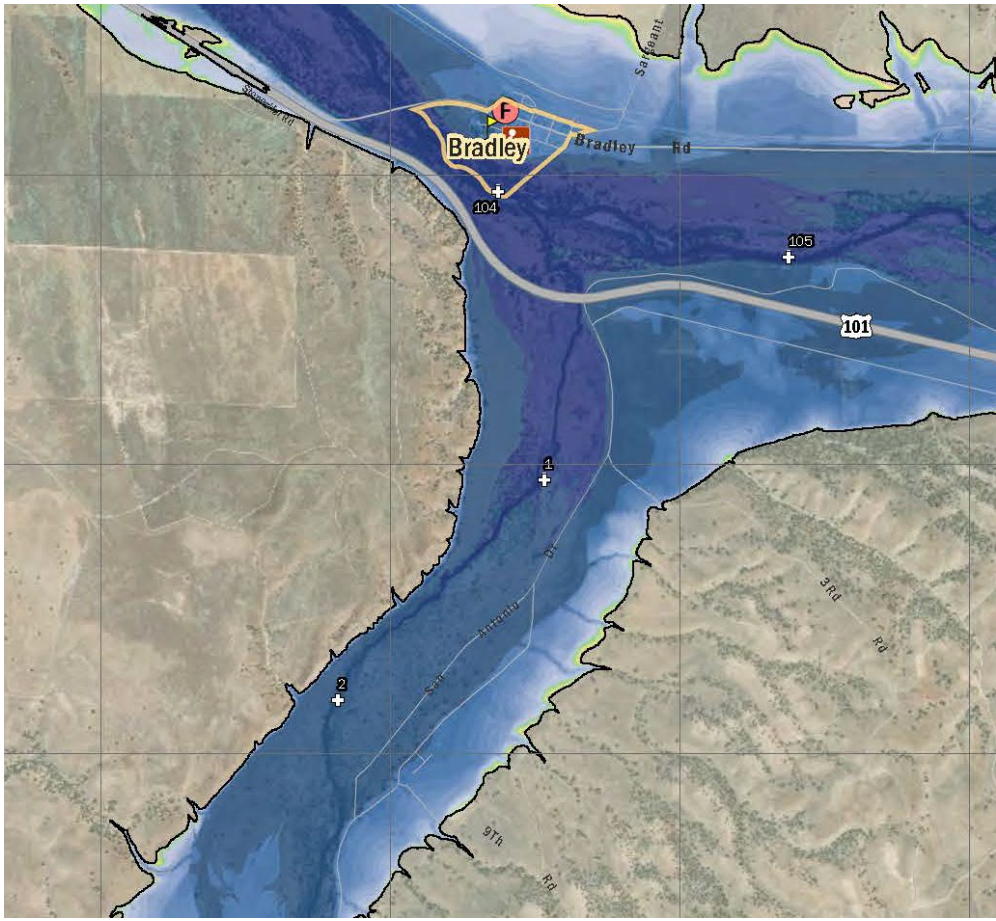
Note: Map shows areas of flooding greater than one foot. Shallow flooding less than one foot deep may occur between areas that are shown as disconnected.



Embankment Breach at Full Reservoir (water at spillway crest)

San Antonio **BRADLEY** Nacimiento





Maximum Flood Depth (ft)

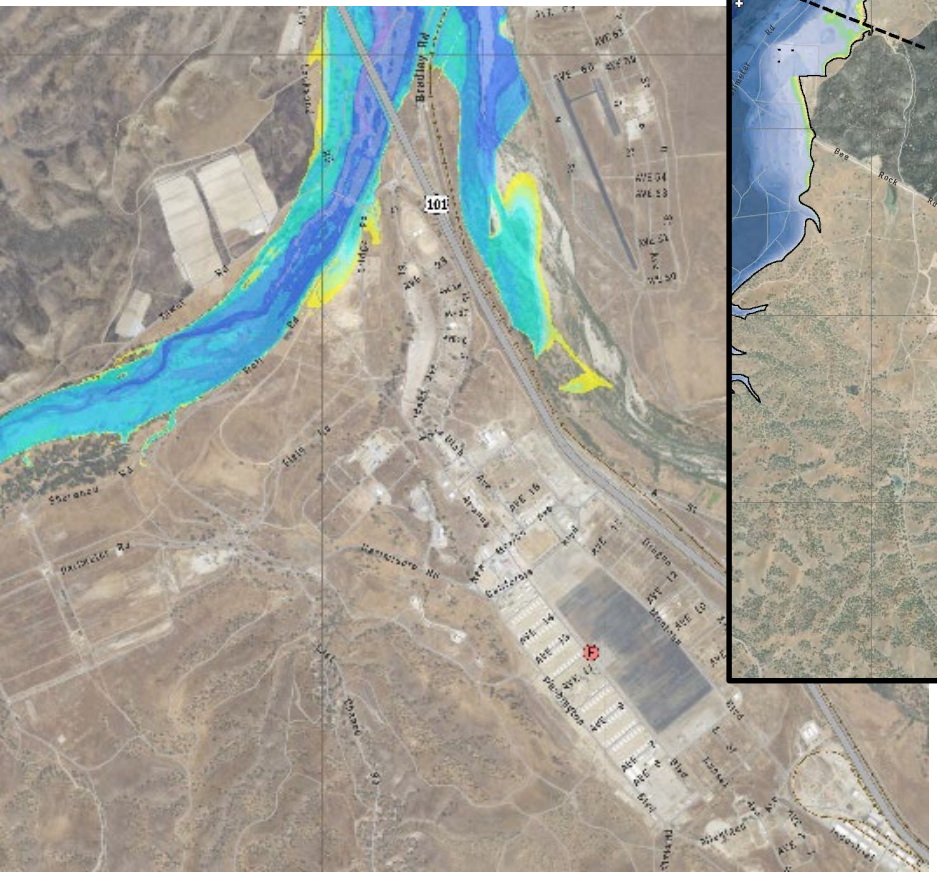
0 - 1	5 - 10	30 - 35
1 - 2	10 - 15	35 - 40
2 - 3	15 - 20	40 - 45
3 - 4	20 - 25	45 - 50
4 - 5	25 - 30	>50

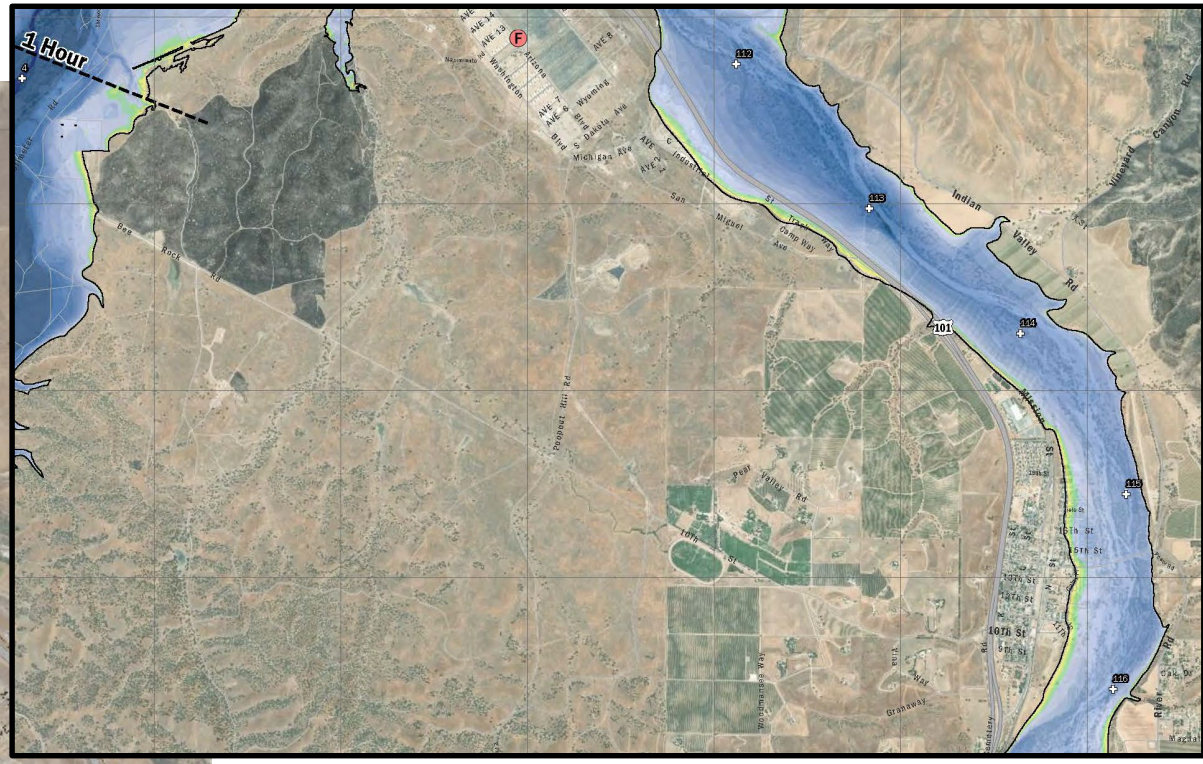
Note: Map shows areas of flooding greater than one foot. Shallow flooding less than one foot deep may occur between areas that are shown as disconnected.

Embankment Breach at Full Reservoir (water at spillway crest)

San Antonio **"BACKWATER"** Nacimiento

Camp Roberts





San Miguel

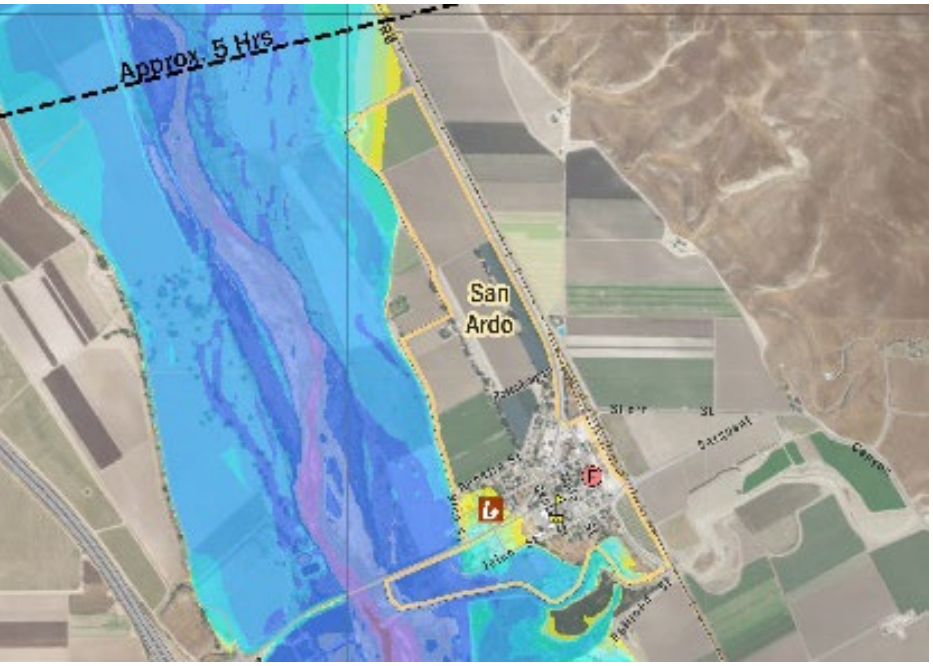
Maximum Flood Depth (ft)

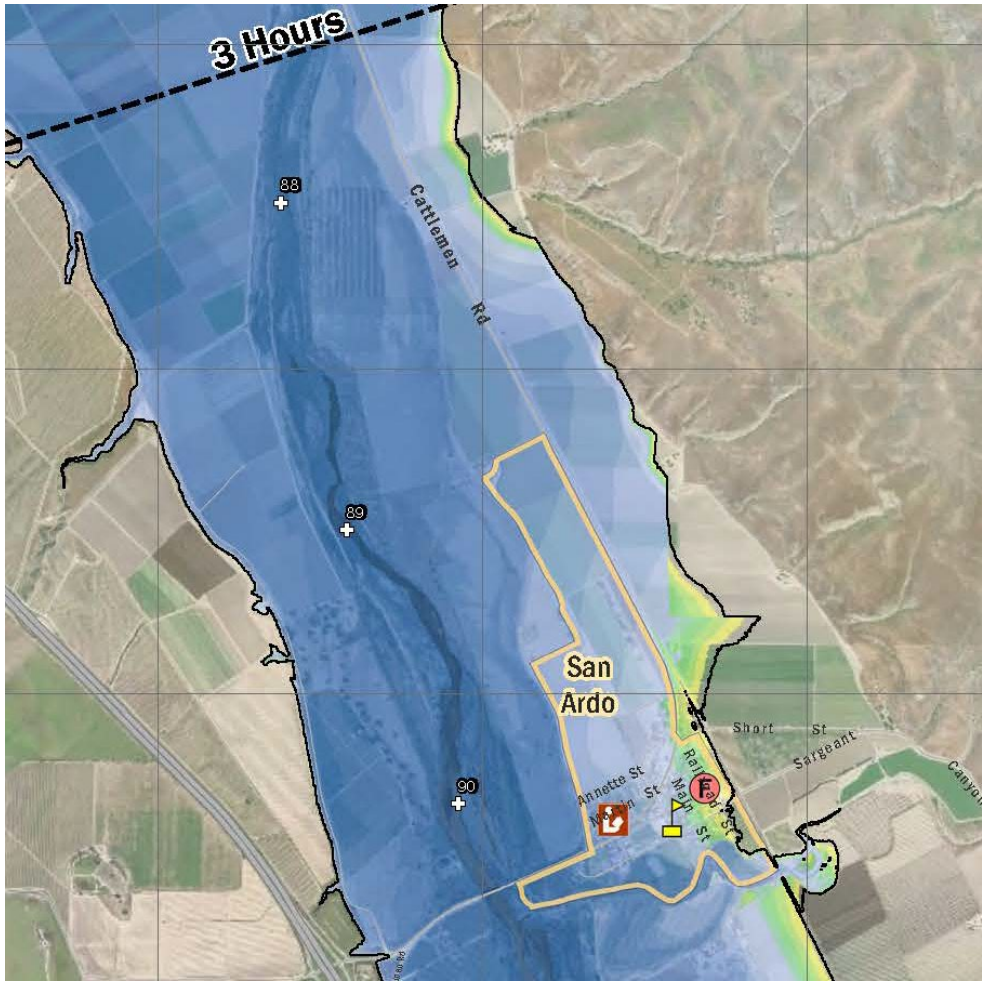
- 0 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- 5 - 10
- 10 - 15
- 15 - 20
- 20 - 25
- 25 - 30
- 30 - 35
- 35 - 40
- 40 - 45
- 45 - 50
- >50

Note: Map shows areas of flooding greater than one foot. Shallow flooding less than one foot deep may occur between areas that are shown as disconnected.

Embankment Breach at Full Reservoir (water at spillway crest)

San Antonio **SAN ARDO** Nacimiento





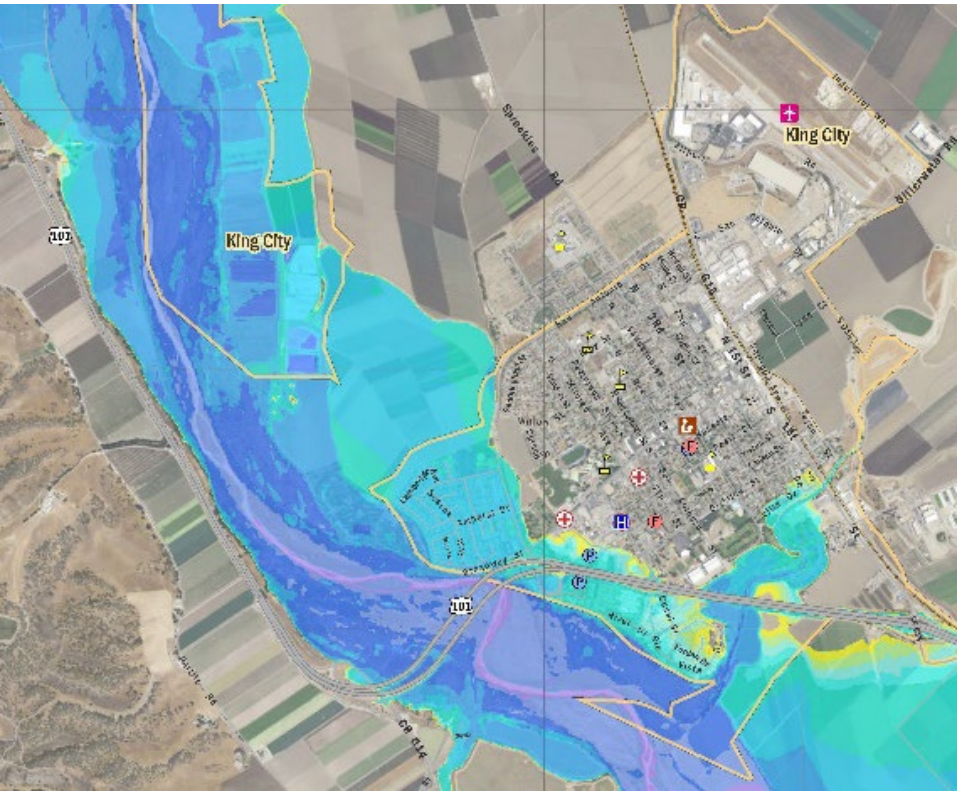
Maximum Flood Depth (ft)

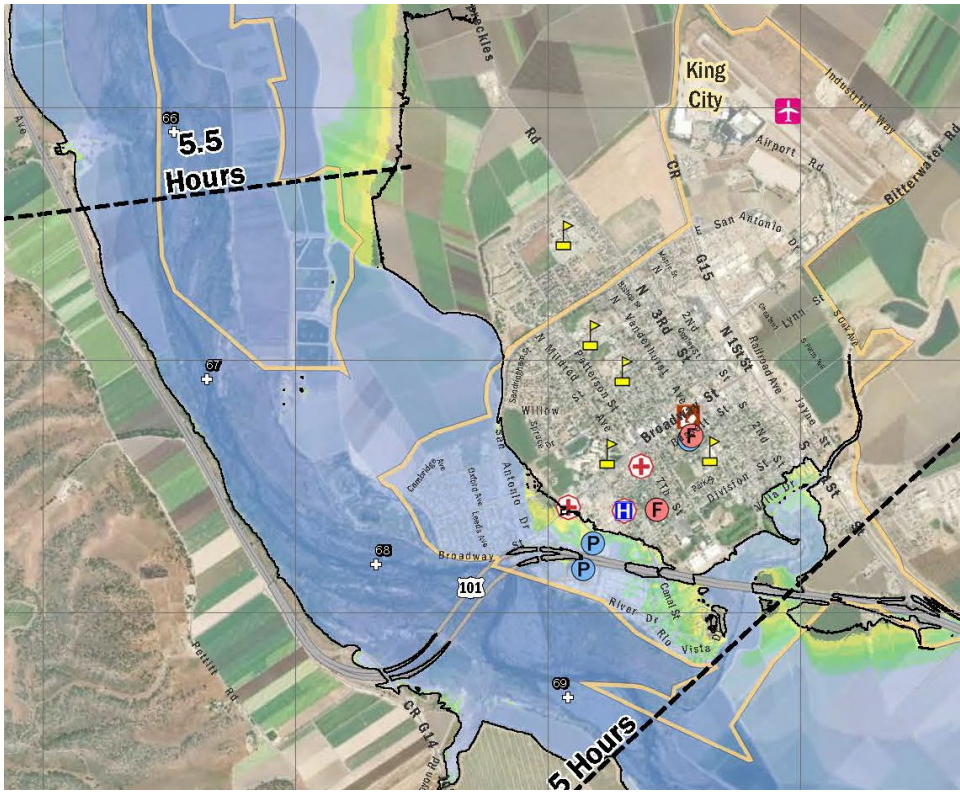
0 - 1	5 - 10	30 - 35
1 - 2	10 - 15	35 - 40
2 - 3	15 - 20	40 - 45
3 - 4	20 - 25	45 - 50
4 - 5	25 - 30	>50

Note: Map shows areas of flooding greater than one foot. Shallow flooding less than one foot deep may occur between areas that are shown as disconnected.

Embankment Breach at Full Reservoir (water at spillway crest)

San Antonio **KING CITY** Nacimiento





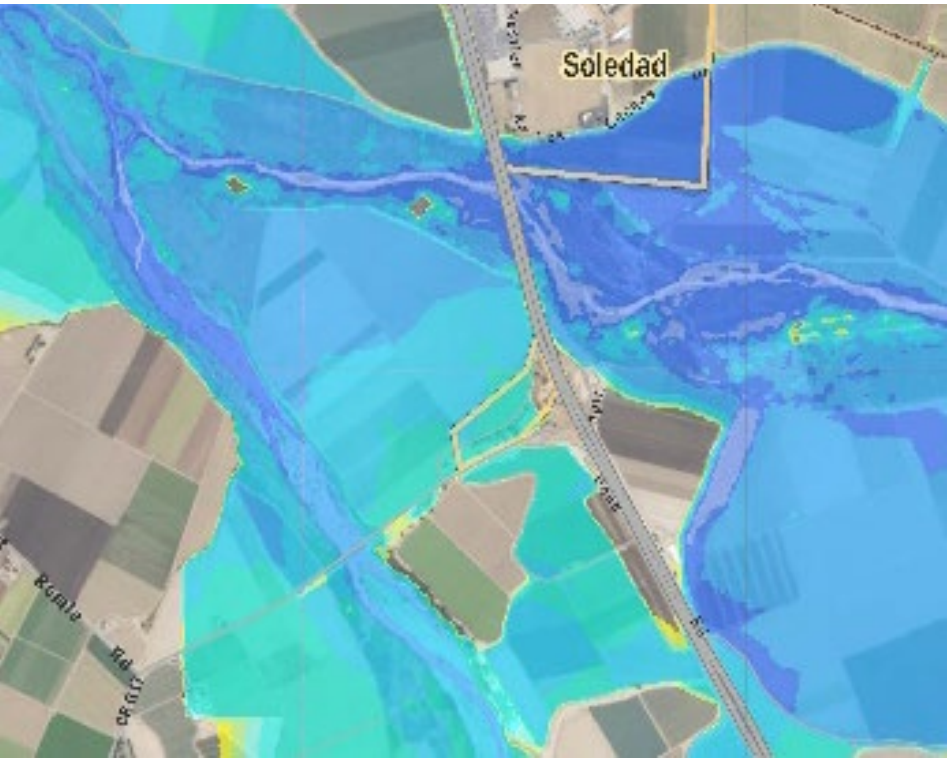
Maximum Flood Depth (ft)

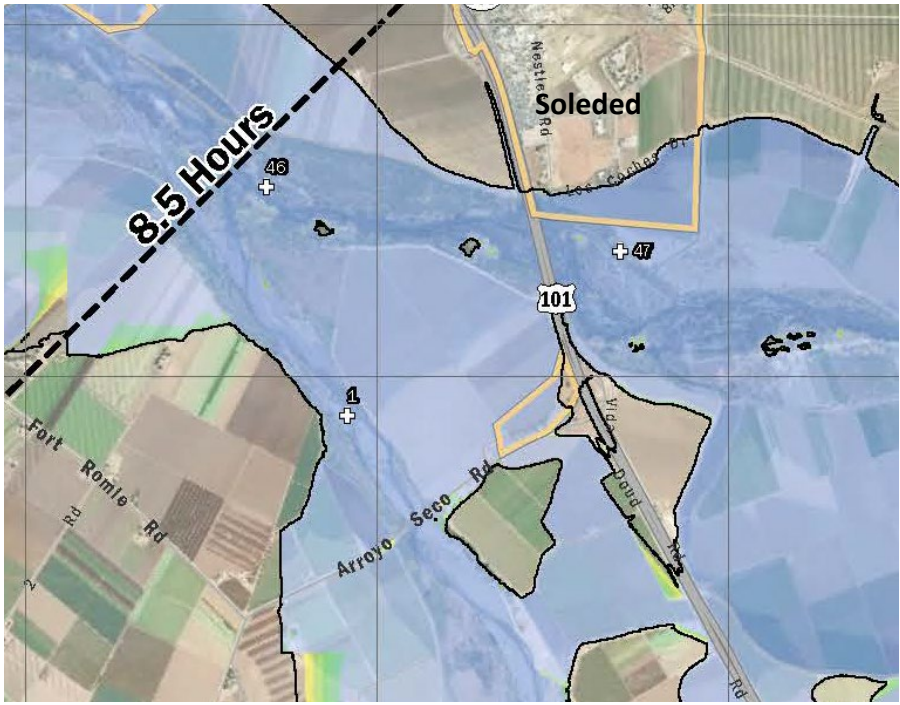
0 - 1	5 - 10	30 - 35
1 - 2	10 - 15	35 - 40
2 - 3	15 - 20	40 - 45
3 - 4	20 - 25	45 - 50
4 - 5	25 - 30	>50

Note: Map shows areas of flooding greater than one foot. Shallow flooding less than one foot deep may occur between areas that are shown as disconnected.

Embankment Breach at Full Reservoir (water at spillway crest)

San Antonio **SOLEDAD** Nacimiento





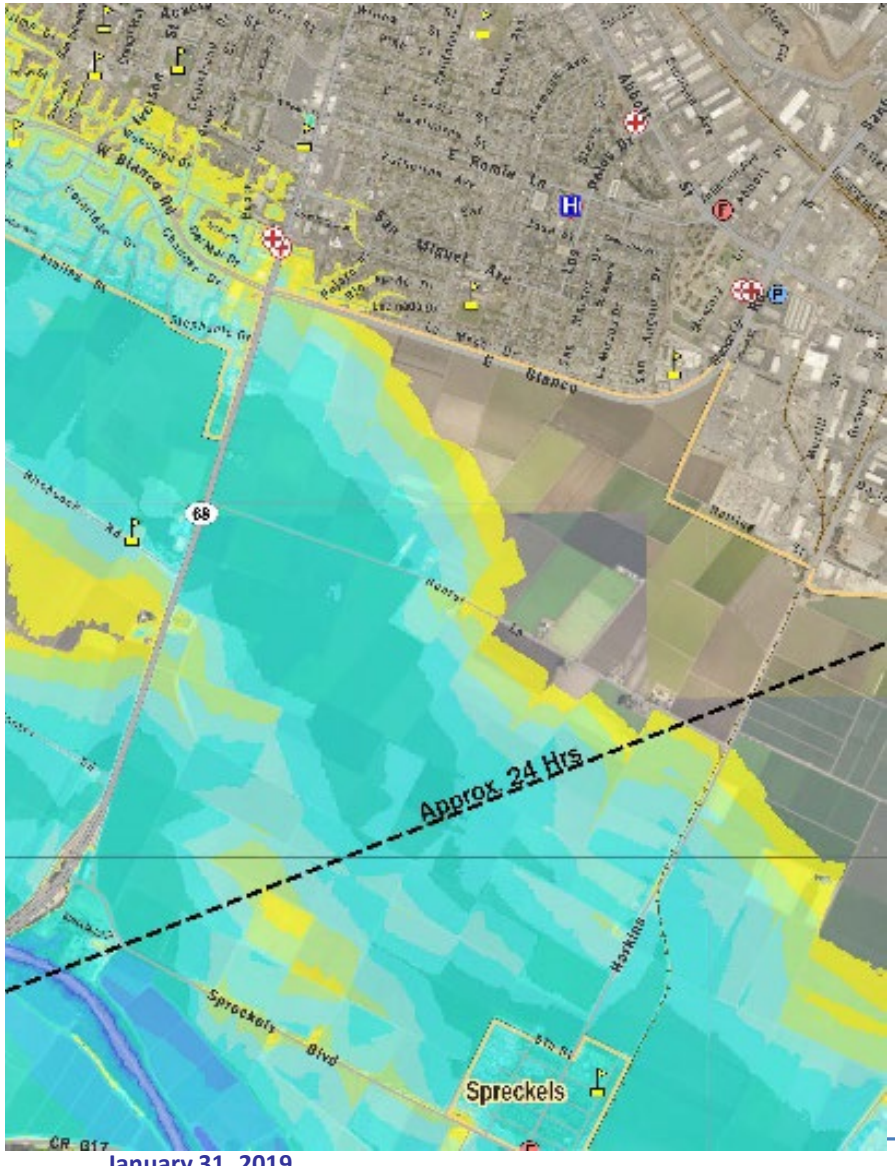
Maximum Flood Depth (ft)

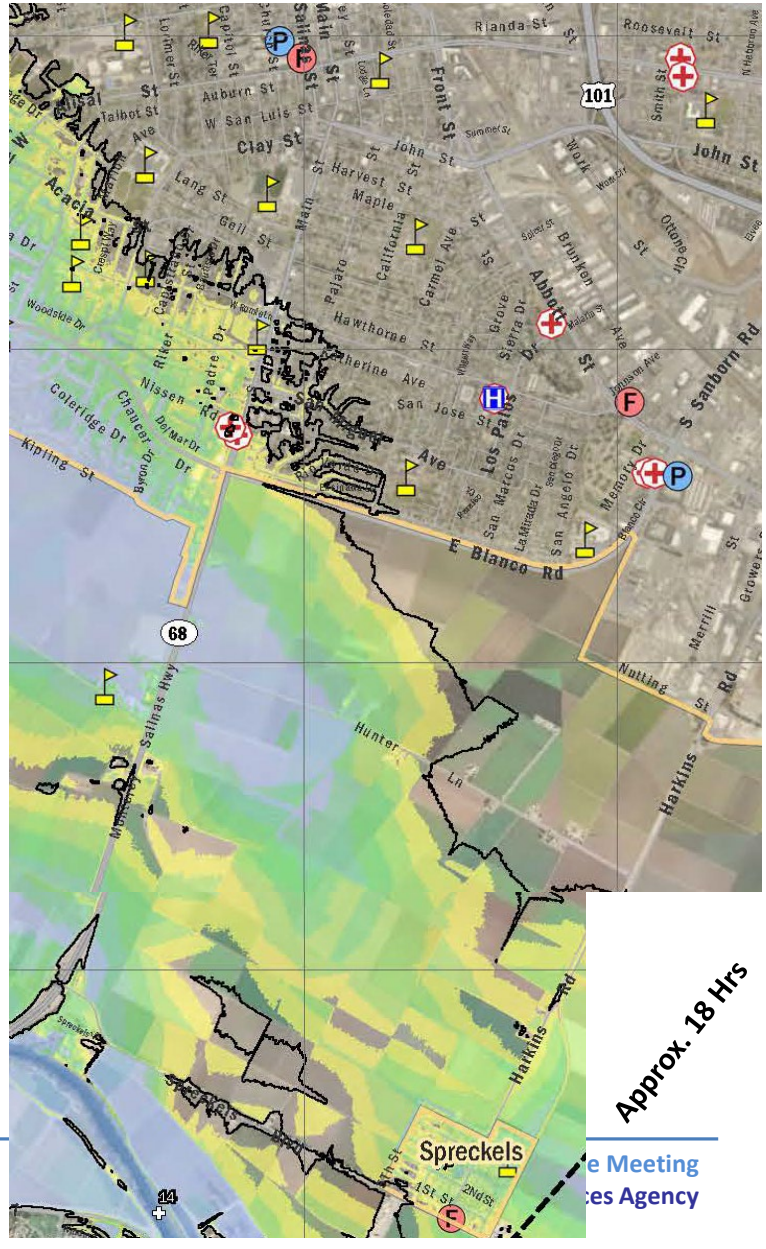
0 - 1	5 - 10	30 - 35
1 - 2	10 - 15	35 - 40
2 - 3	15 - 20	40 - 45
3 - 4	20 - 25	45 - 50
4 - 5	25 - 30	>50

Note: Map shows areas of flooding greater than one foot. Shallow flooding less than one foot deep may occur between areas that are shown as disconnected.

Embankment Breach at Full Reservoir (water at spillway crest)

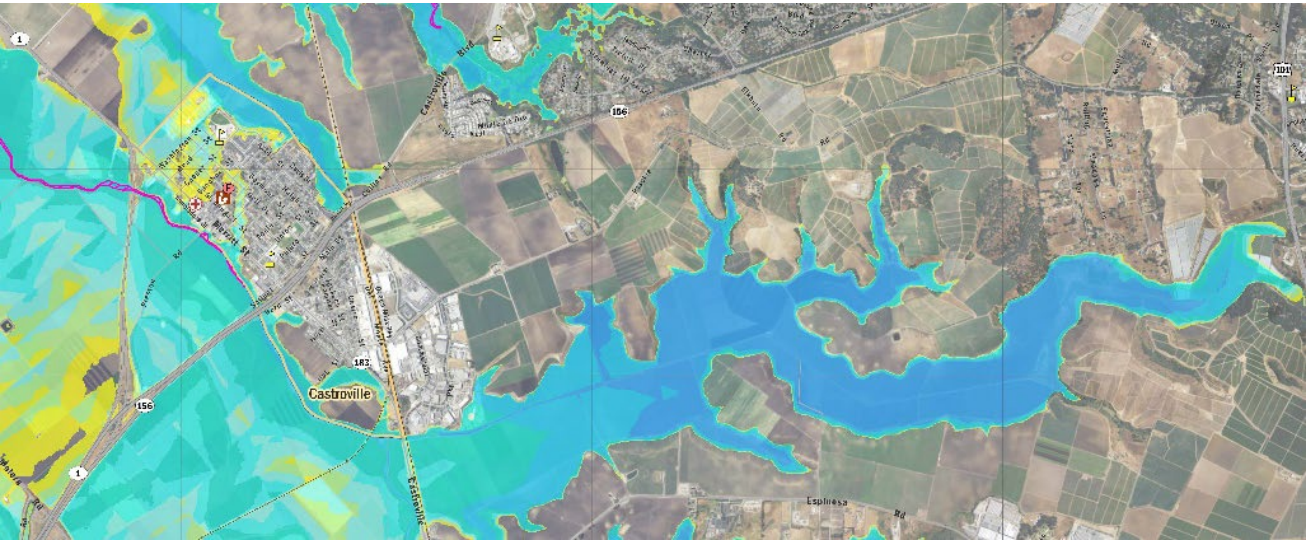
San Antonio **SPRECKELS - SALINAS** Nacimiento





Embankment Breach at Full Reservoir (water at spillway crest)

San Antonio **CASTROVILLE** Nacimiento



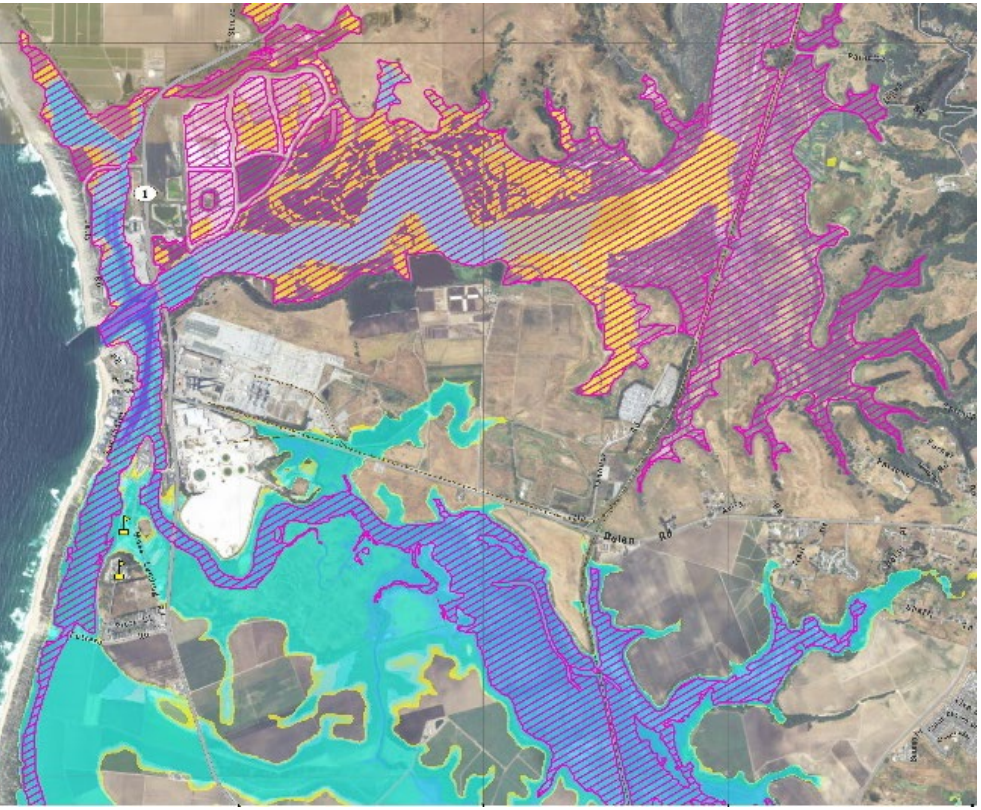
Maximum Flood Depth (ft)

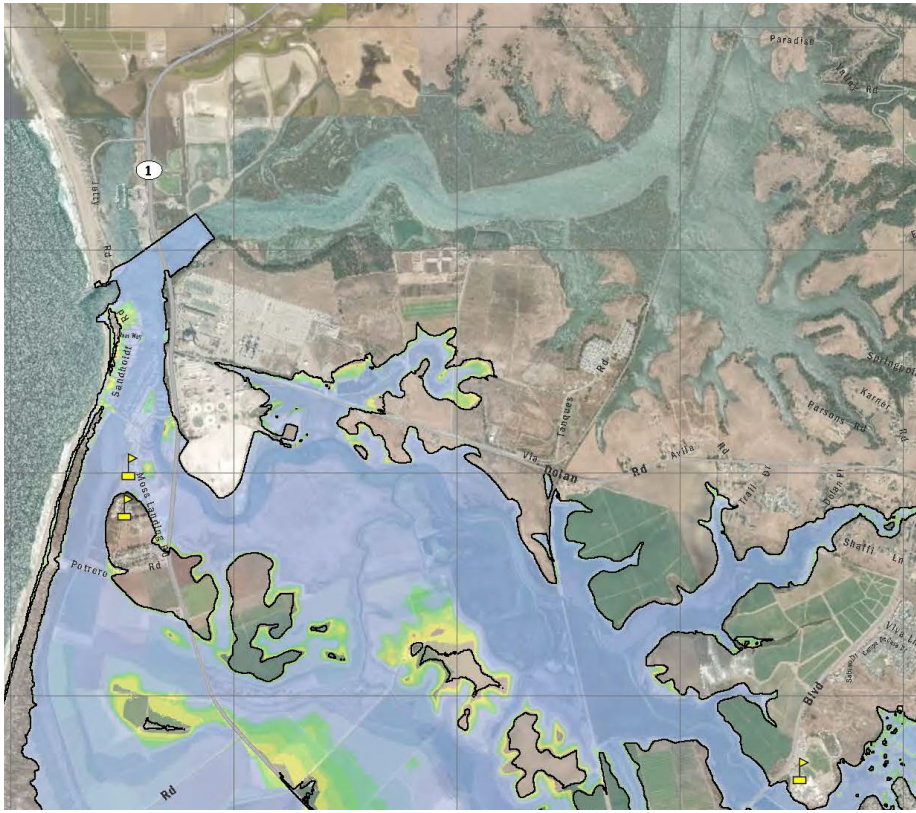
0 - 1	5 - 10	30 - 35
1 - 2	10 - 15	35 - 40
2 - 3	15 - 20	40 - 45
3 - 4	20 - 25	45 - 50
4 - 5	25 - 30	>50

Note: Map shows areas of flooding greater than one foot. Shallow flooding less than one foot deep may occur between areas that are shown as disconnected.

Embankment Breach at Full Reservoir (water at spillway crest)

San Antonio **MOSS LANDING** Nacimiento





Maximum Flood Depth (ft)		
0 - 1	5 - 10	30 - 35
1 - 2	10 - 15	35 - 40
2 - 3	15 - 20	40 - 45
3 - 4	20 - 25	45 - 50
4 - 5	25 - 30	>50

Note: Map shows areas of flooding greater than one foot. Shallow flooding less than one foot deep may occur between areas that are shown as disconnected.

Additional Inundation Maps

Critical Appurtenant Structure Failure:

- Failure of **San Antonio Dam** spillway structure (8.5’ x 140’ breach; full reservoir; no inflow; dam remains intact)
- Failure of **Nacimiento Dam** spillway structure (50’ x 157’ breach; full reservoir; no inflow; dam remains intact)

	San Antonio Spillway Failure Full Reservoir; 8.5' x 140' Spillway Breach; Dam Intact			Nacimiento Spillway Failure Full Reservoir; 50' x 157' Spillway Breach; Dam Intact		
	Estimated Peak Flow (cfs)	Estimated Flood Arrival Time (HOURS)	Estimated Peak Arrival Time (HOURS)	Estimated Peak Flow (cfs)	Estimated Flood Arrival Time (HOURS)	Estimated Peak Arrival Time (HOURS)
Camp Roberts	9,000	1.5	---	---	---	---
Bradley	---	4	---	134,000	3.5	6
San Miguel	n/a	n/a	n/a	n/a	n/a	n/a
San Ardo	---	14	---	127,000	8	10
San Lucas	---	25	---	113,000	11.5	15
King City	---	37	---	100,000	17	20
Greenfield	---	---	---	90,000	22	25
Soledad	---	73	---	80,000	24	30
Gonzales	---	96	---	73,000	34	36
Chualar	---	108	---	---	---	---
Hwy 68 Salinas/Spreckels	---	120	---	51,000	45	50
Hwy 1 Castroville	5,500	130	---	46,000	48	60
Moss Landing	with high tide	---	---	---	---	---

Map indicates some flooding

--- not specifically presented in report

Summary

- Extremely High potential for downstream loss of life and damage exist if Nacimiento Dam or San Antonio Dam breaches catastrophically with full or less-than-full reservoir

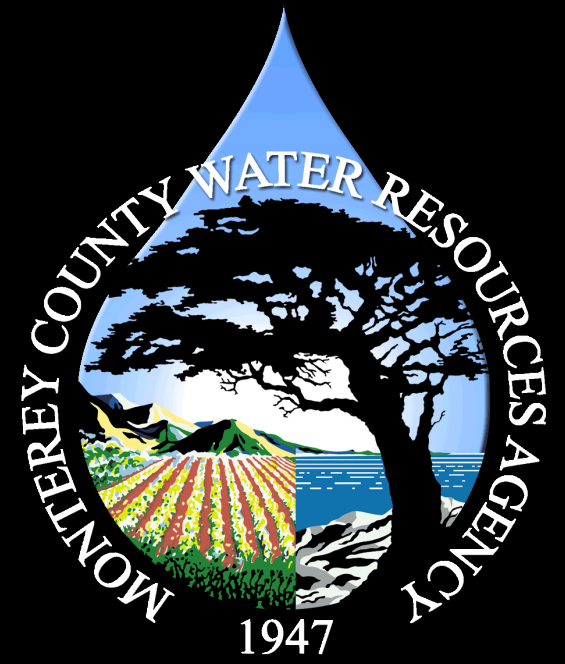
- Emergency Action Plans for both dams are being updated and will be reviewed and approved by California Office of Emergency Services (and FERC – Nacimiento)

- Inundation maps for embankment failure and spillway failure are approved by DSOD for both dams

- Inundation maps will be posted on the MCWRA website

TODAY'S ACTION

Recommend the Board of Directors Receive a Report on Dam Breach Inundation Maps for Nacimiento and San Antonio Dams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