Observations Along the Napa River
after the
M6.0 "South Napa Earthquake"
Sunday, August 24, 2014, 3:20:44 A.M. PDT
American Canyon, Napa County, California

DWR/USGS Delta Seismic Workshop
Thursday, September 10, 2015
Menlo Park, CA

[1]Don Hoirup and [2]Chris Hitchcock

1) Senior Engineering Geologist, Specialist, California Department of Water Resources
2) Principal Engineering Geologist, InfraTerra

Special thanks to:

Louis Terrazas, Boat pilot, U.S.F&WS, Wildlife Refuge Specialist, San Pablo Bay NWR

Don Brubaker, Refuge Manager, U.S.F&WS, San Pablo Bay NWR

Karen Thorne, Research Ecologist, USGS Western Eco. Research Center, S.F. Bay Estuary

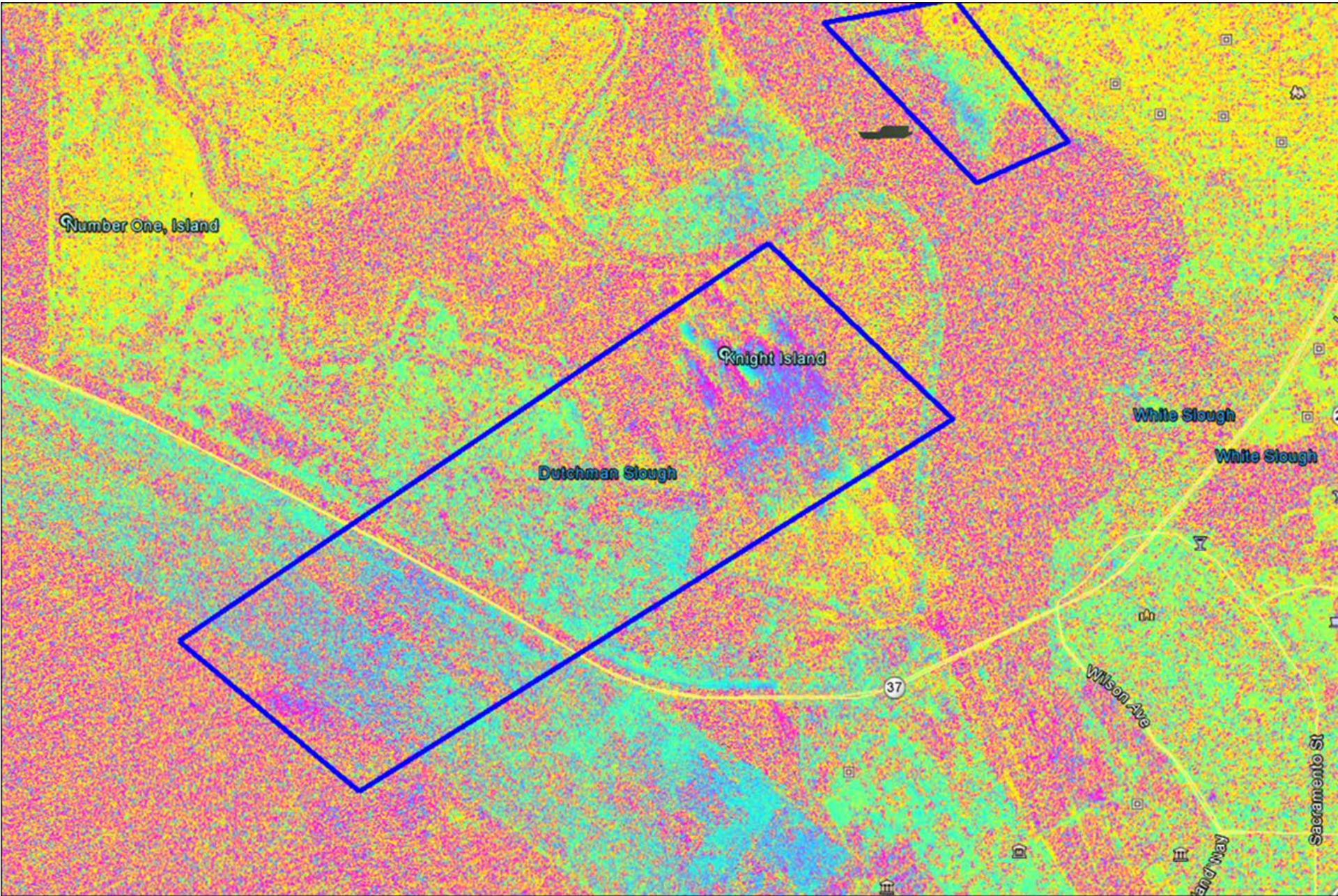
Susan E. W. De La Cruz, Wildlife Biologist, USGS

Anne Morkill, Refuge Manager, U.S.F&WS, San Francisco Bay NWR Complex

Meg Marriott, Biologist, U.S.F&W Service

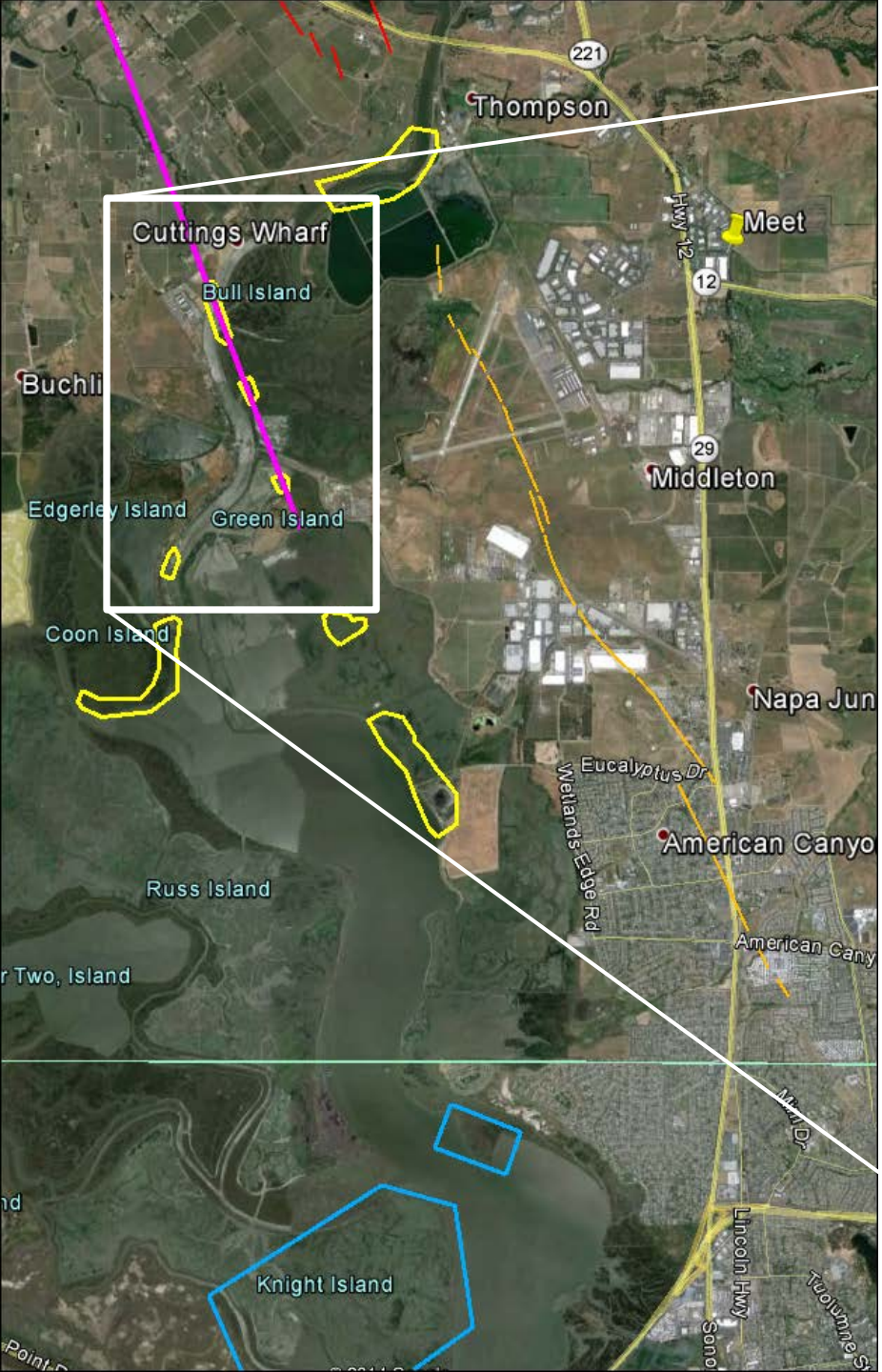
James Griffin, U.S.F&W Service

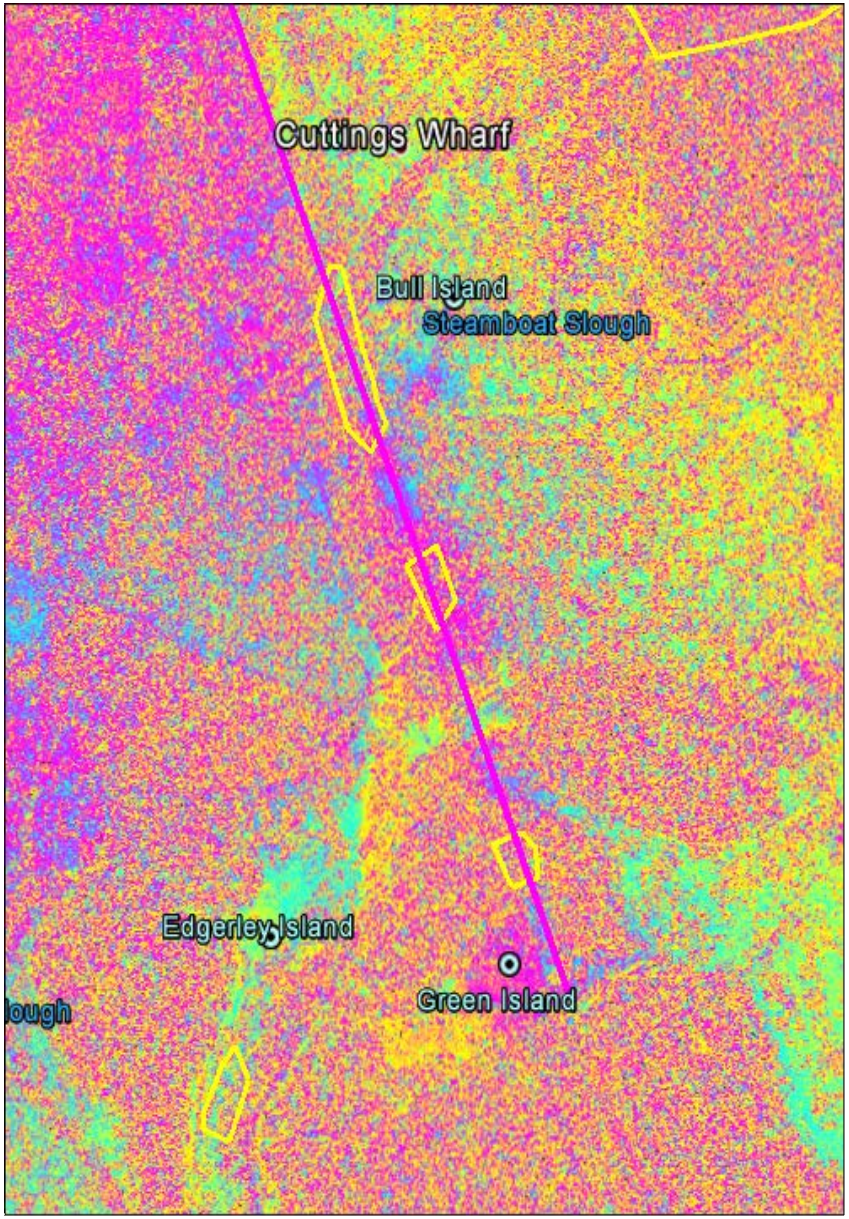
Motivation for River Inspection



Number One. Island
Knight Island
Dutchman Slough
White Slough
White Slough
Lewis Brown Dr
29
37
Wilson Ave
Sacramento St
Redwoo

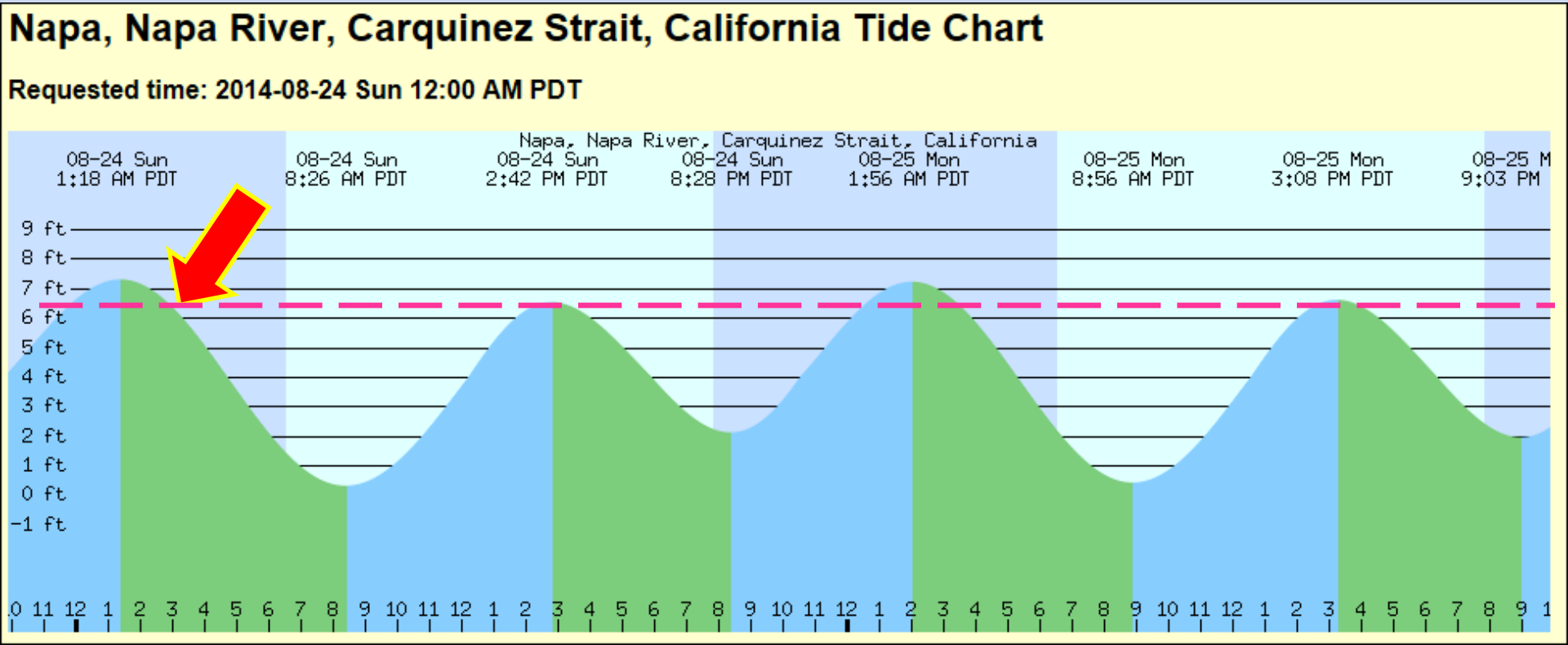
American Canyon
Russ Island
Number Two, Island
Tubbs Island
Number One, Island
Knight Island
Vallejo
Mare Island
San Pablo Bay
© 2014 Google


Thompson
221
Cuttings Wharf
Bull Island
Meet
Hwy 12
12
Buchli
29
Middleton
Edgerley Island
Green Island
Coon Island
Napa Jun
Eucalyptus Dr
Wetlands Edge Rd
American Canyo
Russ Island
American Cany
r Two, Island
Knight Island
Lincoln Hwy
Tuolumne St


Cuttings Wharf
Bull Island
Steamboat Slough
Edgerley Island
Green Island

Background

- **Earthquake (EQ)** = Sunday, August 24, 2014, 3:20 A.M.
- **Tide during EQ** = About +6.5 feet (MSL) and ebbing from a high tide of +7.3 feet (MSL) at 1:18 A.M. ('spring' tide, syzygy during new moon phase)



Background

- **River boat inspection** = Wednesday, September 10th, 2014, ~9:30 A.M. until ~2:30 P.M. Boat launched at Brinkman's Marina, Vallejo (*courtesy of U.S. F&WS, 21-foot Boston Whaler)*

- **Tide range during boat inspection** = About +0.3 feet (MSL) at 9:30 A.M. (launch) to about +7.0 feet (MSL) at about 2:30 P.M (return).
  - *Note: Tide was +7.7 feet (MSL) at 3:03 A.M. and again at 4:12 P.M. that same day.*

- **Furthest upstream inspection location** = Just past Highway 29-Napa River Bridge at 11:00 A.M. About 30 miles roundtrip including inspections of feeder sloughs.

Background

- **Time lapse (EQ to inspection)** = ~18 days
- **Cycles of tides** = ~36 periods of ‘high’ and ‘very-high’ tides
- **Highest high-tide** = A +8.0 foot (MSL) on Monday, September 8th, about 1.5 feet higher than time of EQ

Background

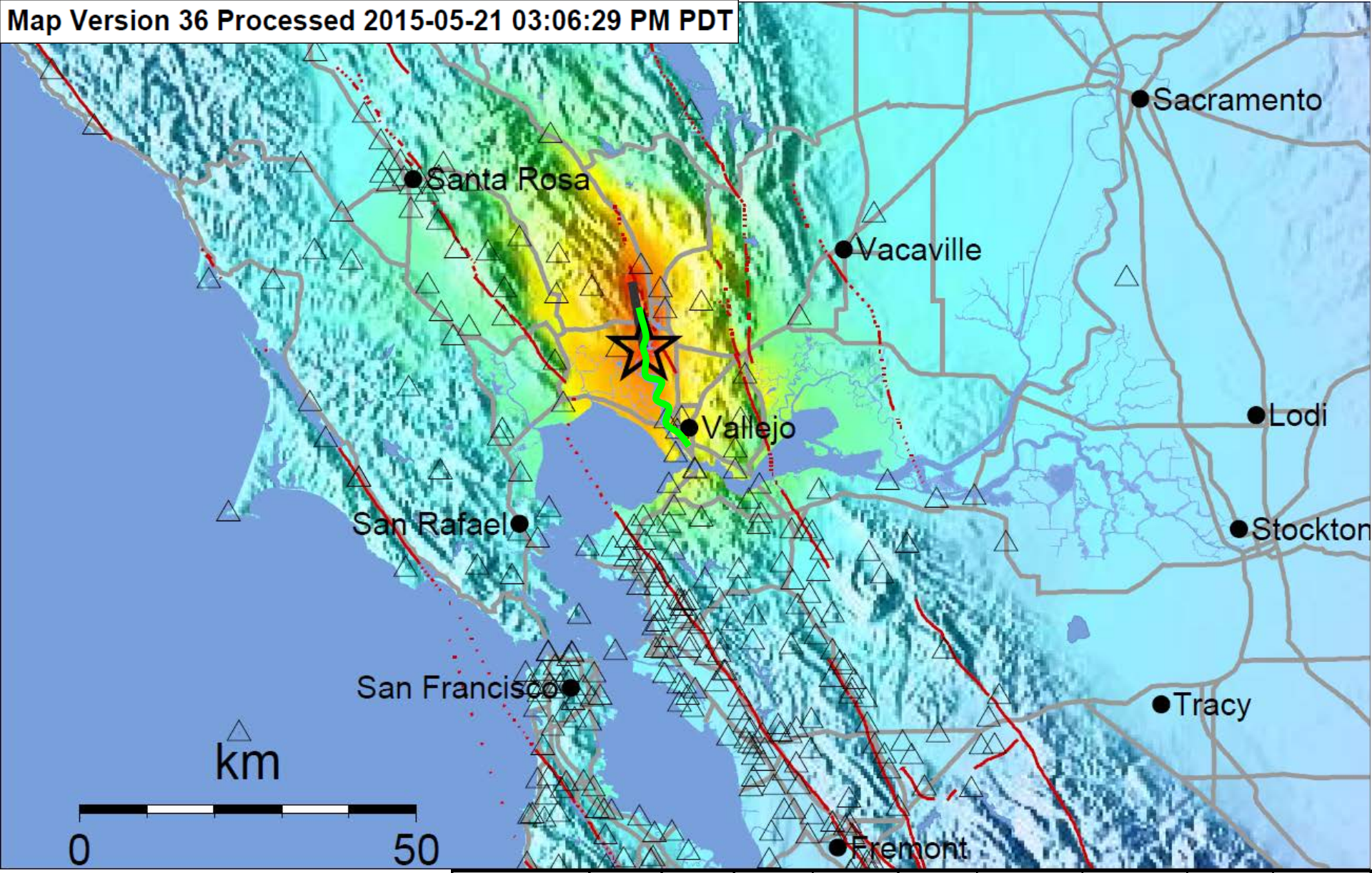
- **Resulting tidal effect** = Evidence of some EQ related features possibly lost or disturbed by erosion-
  - river bank slumps, slides, spreads, etc…
  - liquefaction ejecta
  - secondary effects
    - seiche water sediment deposit (marks and lines)
    - marine debris deposit lines (flotsam, jetsam)
    - fissure filling
    - biologic…
- **Consequences of delay…..**

Photo by Dan Ponti, USGS, ~August 24th, day or day after the EQ.

Lost information…

Location: Buhman Ave, west-side, 3-miles due west of downtown Napa. Red arrows are reference point.

Photo by Don Hoirup, DWR, 19 days after the EQ on September 11, 2014.



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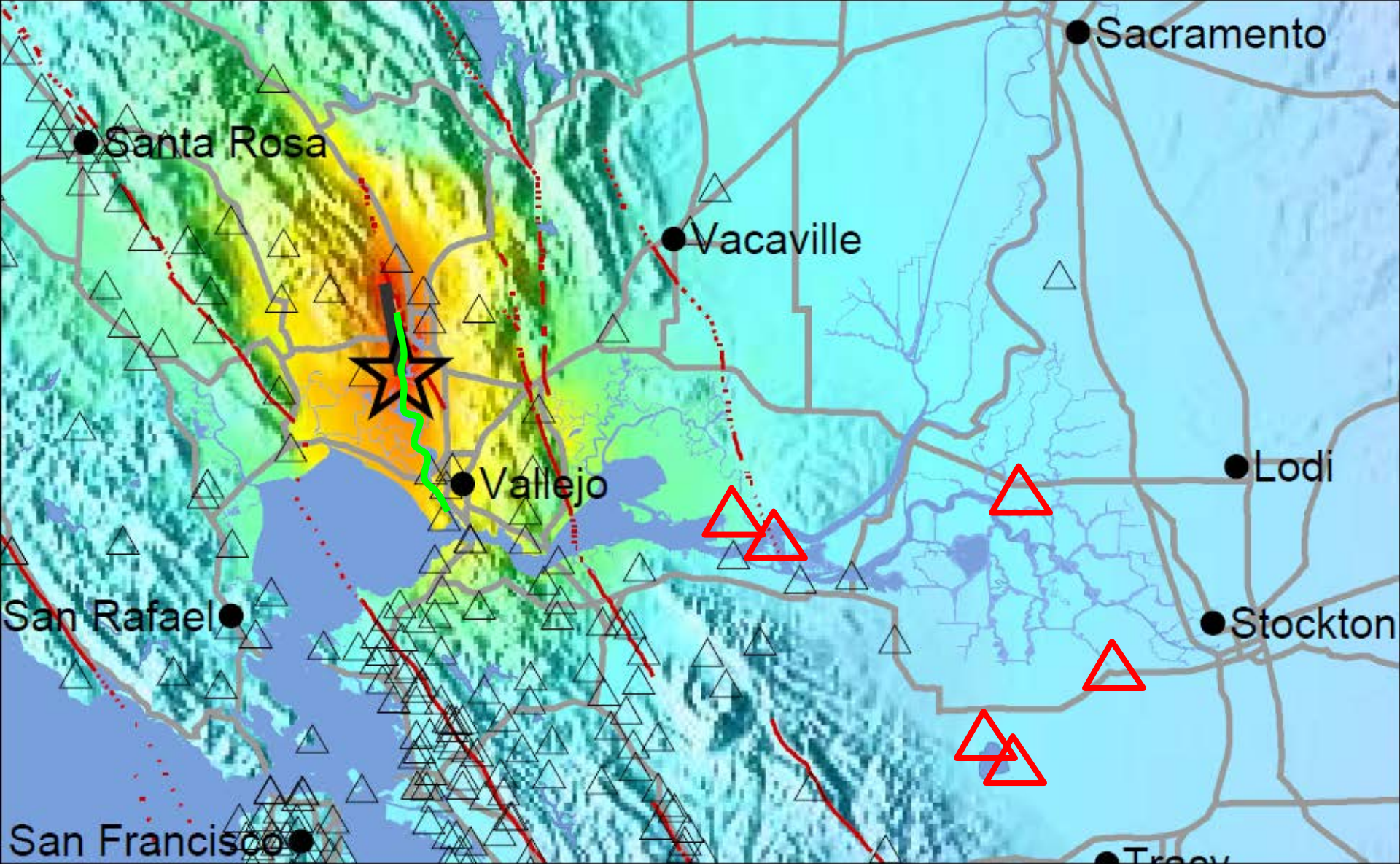
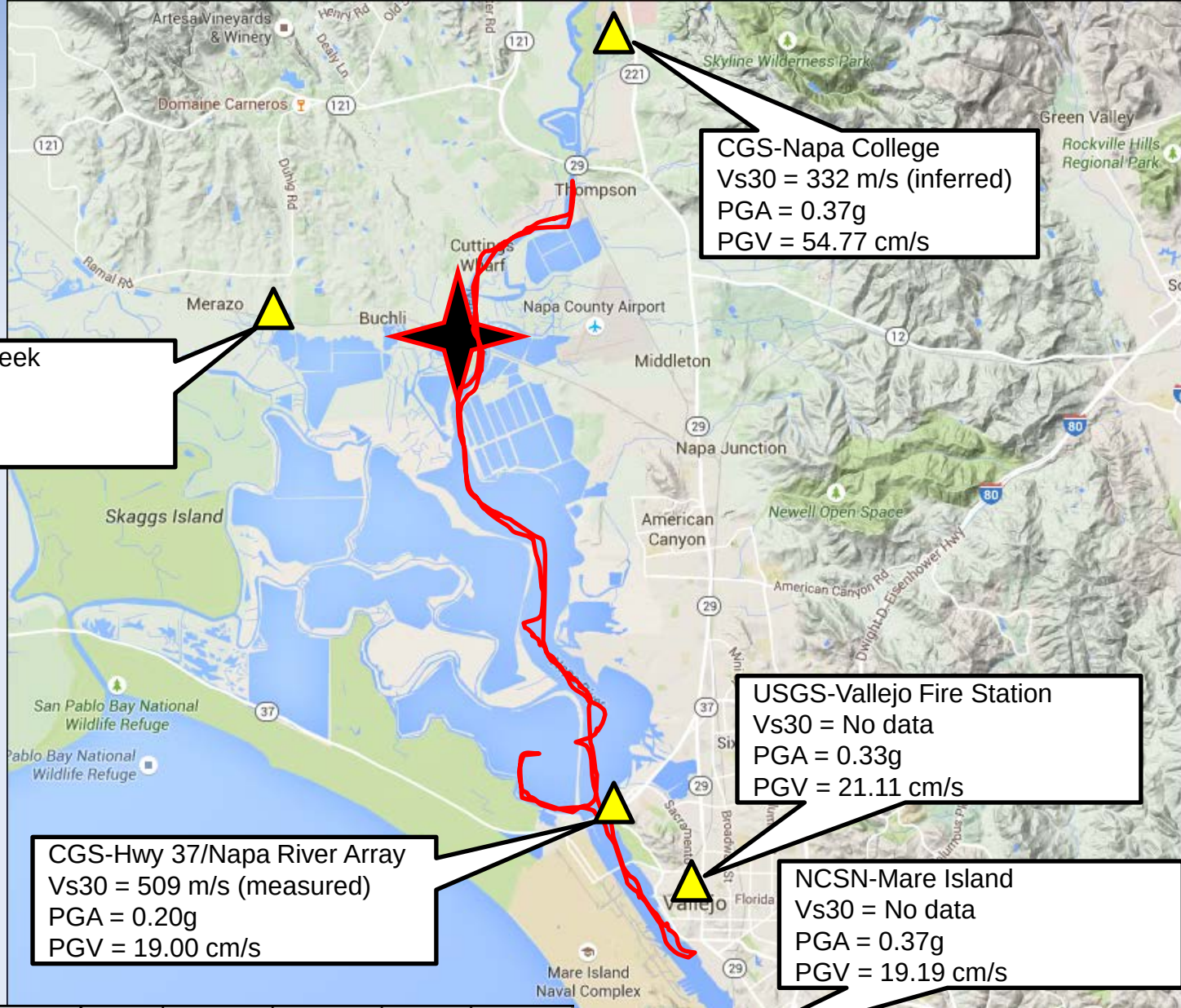
PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Mod./Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	*<0.1*	*0.5*	*2.4*	*6.7*	*13*	24	44	83	>156
PEAK VEL.(cm/s)	<0.07	0.4	1.9	5.8	*11*	*22*	*43*	*83*	*>160*
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+



= DWR seismic monitoring station, not included in ShakeMap



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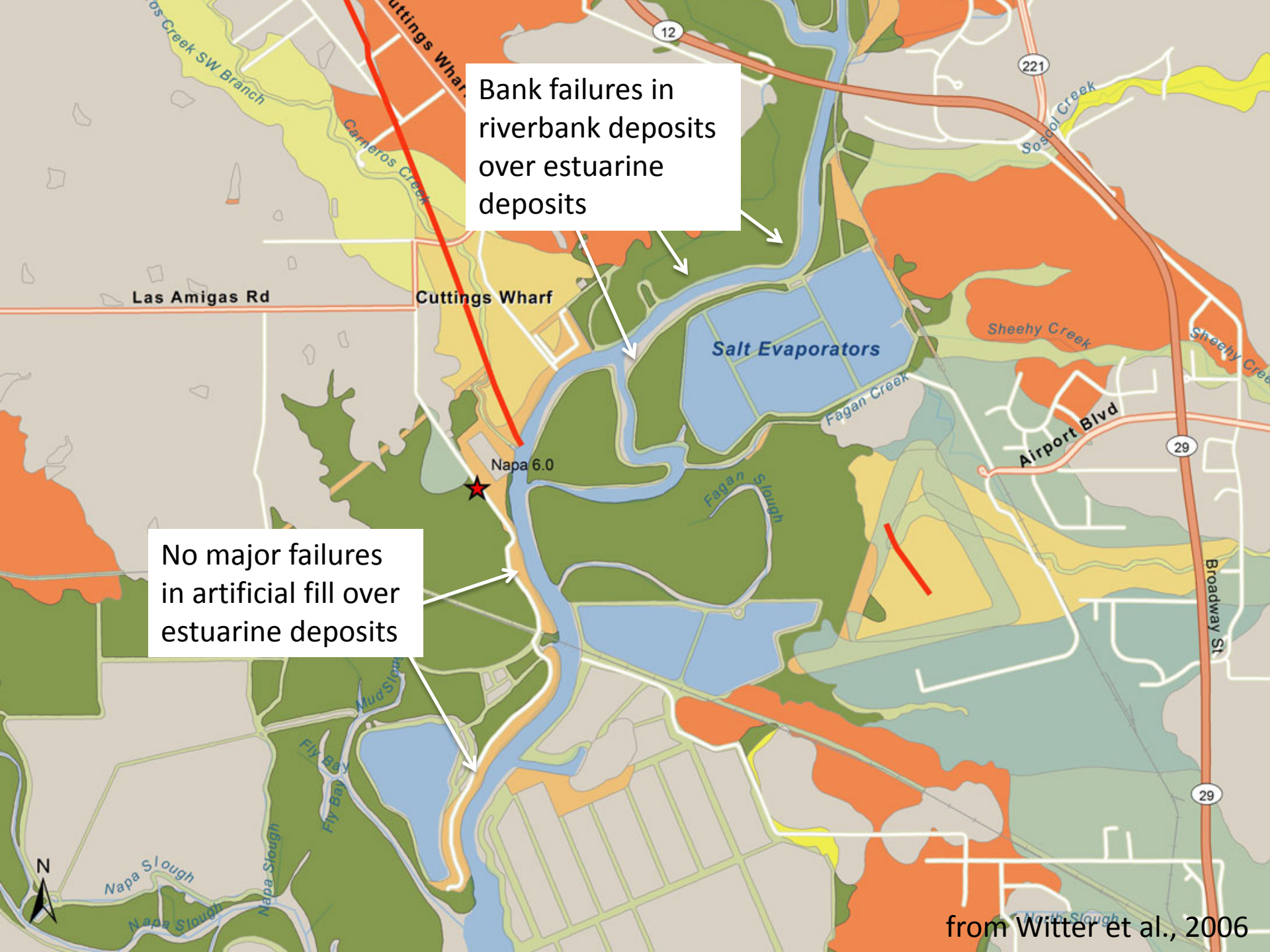
Surface Rupture

Riverbank Failures

- **Localized** - River bank slumps and spreads
  - Upstream of earthquake
  - Localized within river overbank deposits over estuarine deposits
  - No major failures within emplaced fill



from Witter et al., 2006

Far-field Failures

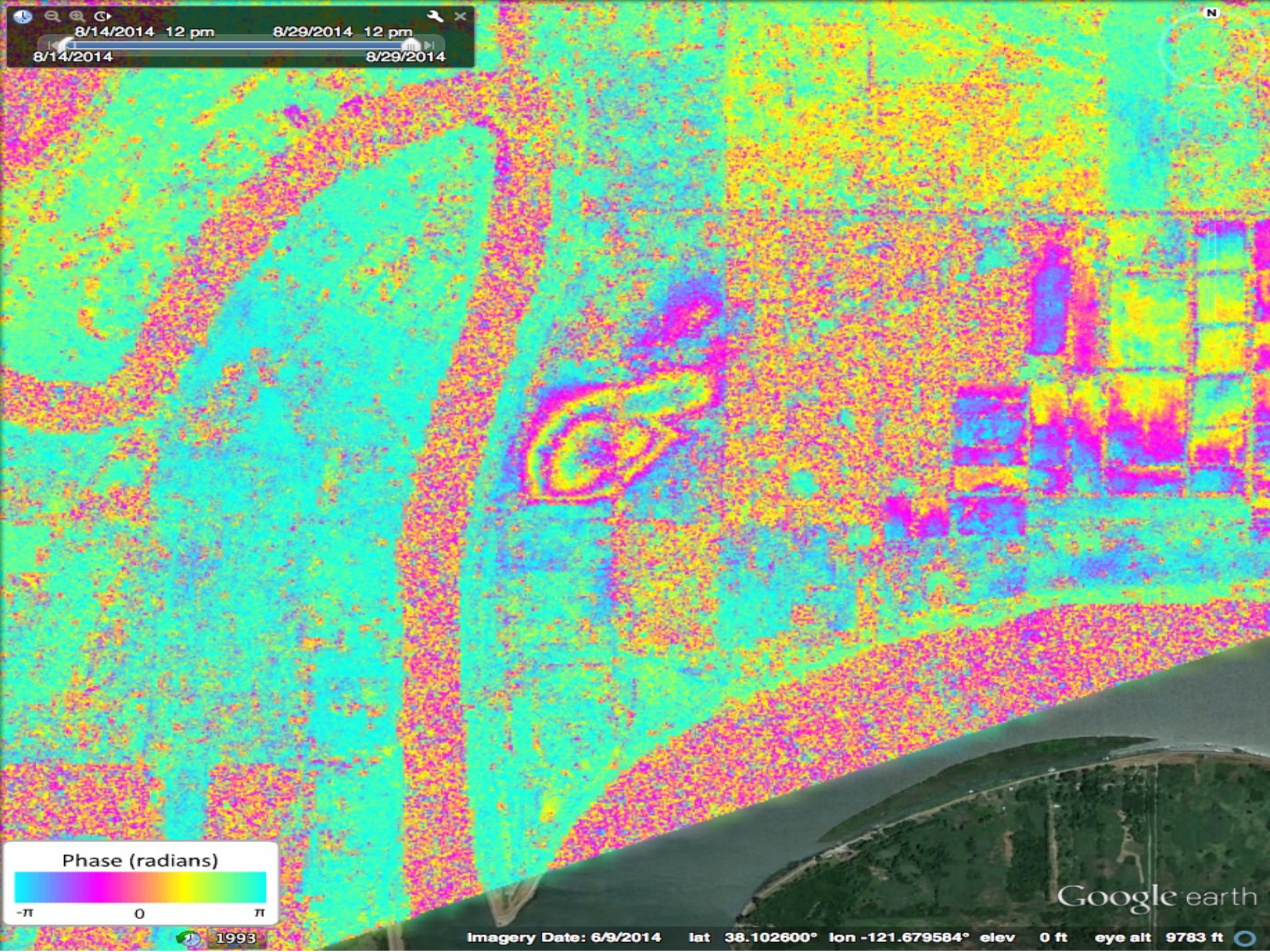
- **Localized EQ-related features**
  - Spreads and block failures
    - Fine-grained material
    - Modified by tidal action
- **Failure along pre-existing planes**

Cuttings Wharf
Napa 6.0
American Canyon
Localized failures
Chabot Terrace
Vallejo
Harry Floyd Terrace
San Pablo Bay
N
0.44
0.56
0.6
0.64
0.68
0.72
0.76
0.84
0.9
0.88
0.8
0.52
0.32
0.4
0.2
0.16
0.12
0.48
0.24
0.28
0.36
0.08
29
221
12
121
37

Google Earth Imagery (May 2014)

Google Earth Imagery (April 2015)

160
Delta Vista Berthing Area
Threemile Slough
Twitchell Island
Twitchell Island
Twitchell Island Ferry Rd
Sherman Island East Levee Rd
Bradford Island Levee Rd
Madre Dr
© 2015 Google
Google earth


8/14/2014 12 pm
8/29/2014 12 pm
8/14/2014
8/29/2014
Phase (radians)
-π
0
π
Google earth
1993
Imagery Date: 6/9/2014 lat 38.102600° lon -121.679584° elev 0 ft eye alt 9783 ft

Thank you

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