

An aerial photograph of an irrigation canal system. The canal flows from the top center towards the bottom center, where it passes through a dam with several spillways. The canal is bordered by earthen levees. To the left, there are green fields and a smaller canal. To the right, there are large green agricultural fields. The background shows a vast, flat landscape under a clear blue sky.

Western Madera County and Merced County

**LAND SUBSIDENCE
SOLUTIONS**

**Chris White
Central California Irrigation District**

**Chase Hurley
San Luis Canal Company**

**In Association with Washington Avenue Growers, Red Top
Area Growers, Merced and Madera Counties**

DRAFT

RECLAMATION

Managing Water in the West

Reclamation Subsidence NGS Stations

July 2012 to December 2012

Subsidence rates calculated by comparing December 2012 survey values at GPS Stations with July 2012 survey values.

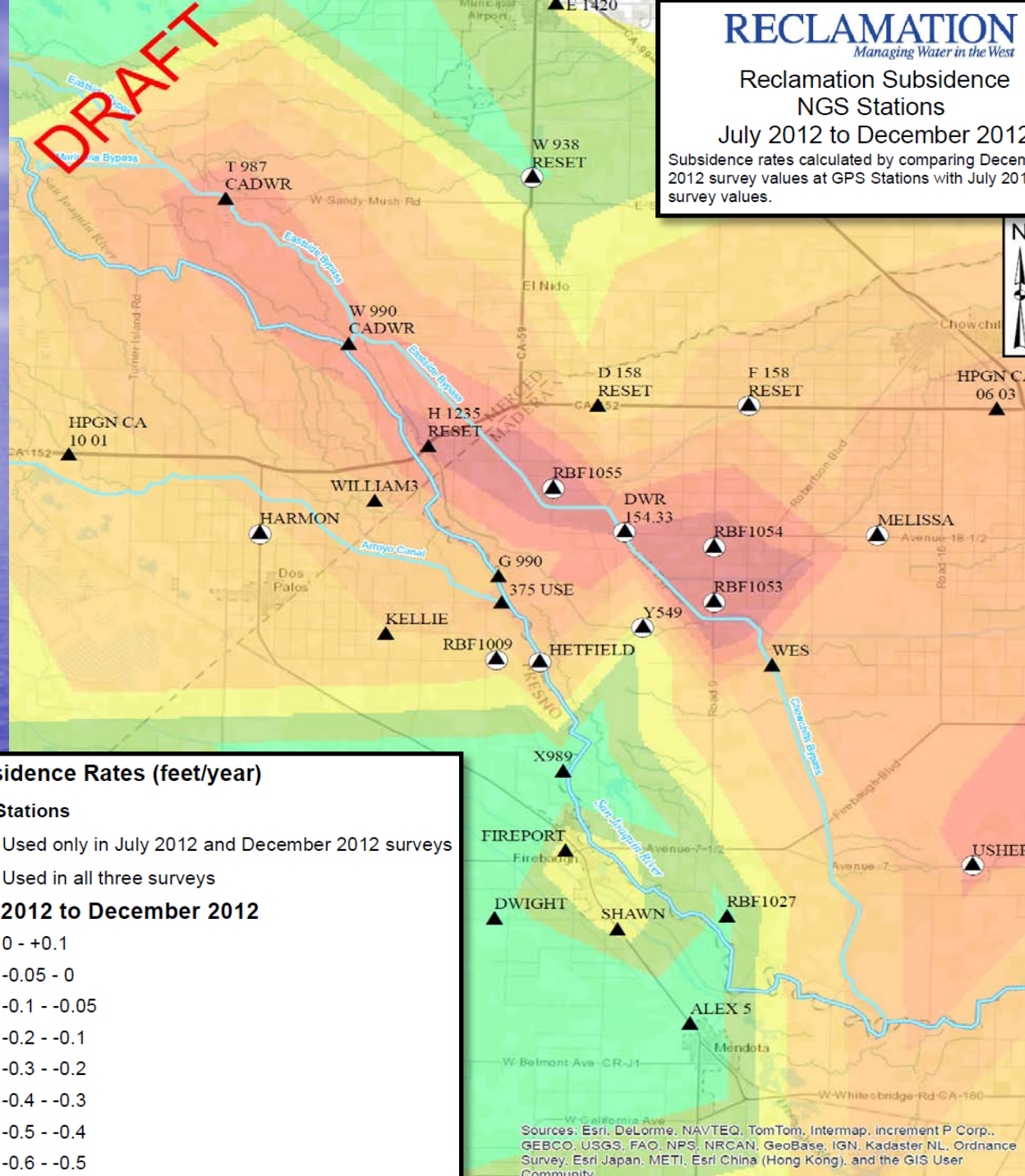
Subsidence Rates (feet/year)

GPS Stations

- ▲ Used only in July 2012 and December 2012 surveys
- ▲ Used in all three surveys

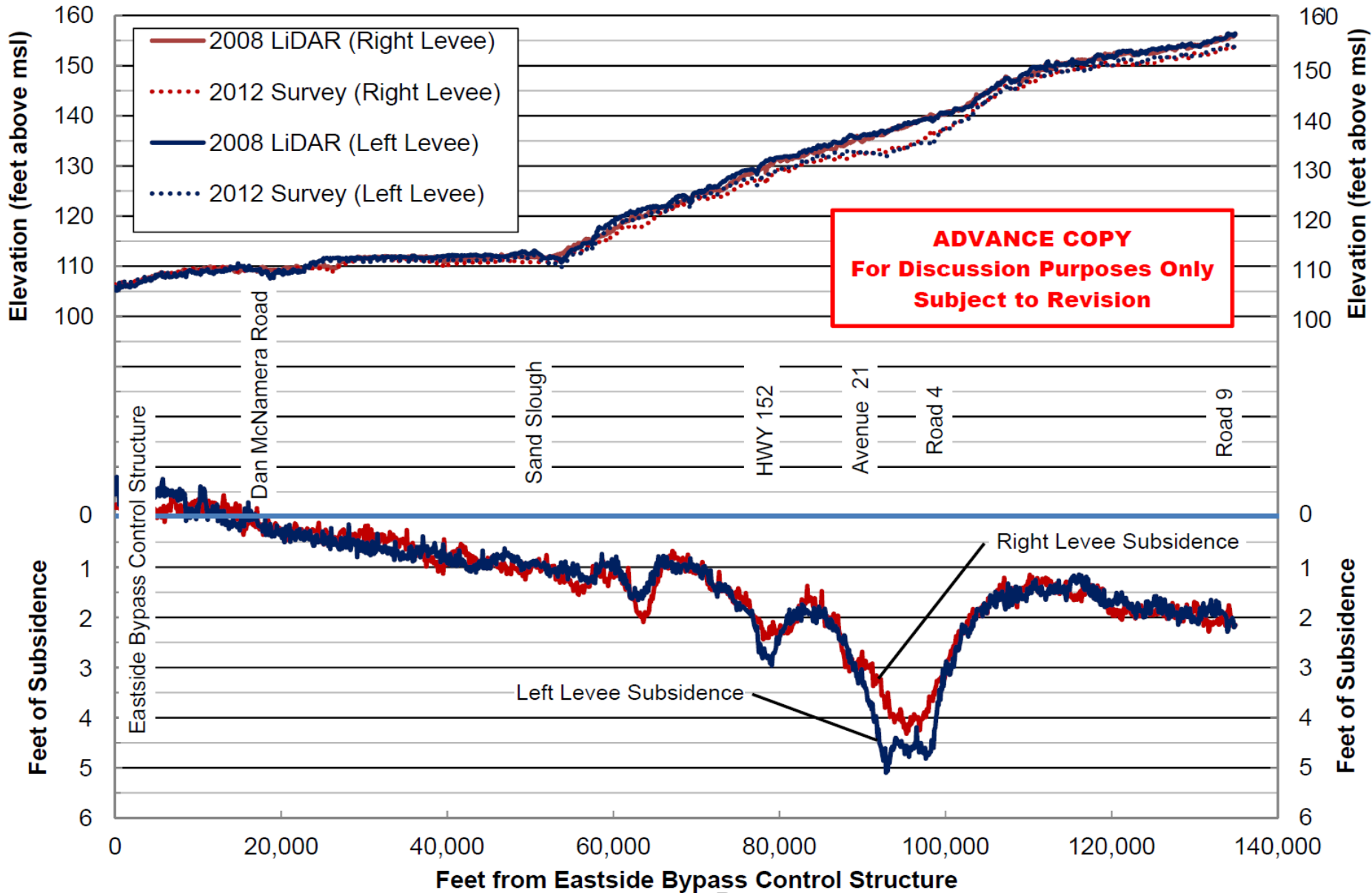
July 2012 to December 2012

Light Green	0 - +0.1
Light Green	-0.05 - 0
Yellow	-0.1 - -0.05
Light Orange	-0.2 - -0.1
Orange	-0.3 - -0.2
Dark Orange	-0.4 - -0.3
Red-Orange	-0.5 - -0.4
Red	-0.6 - -0.5



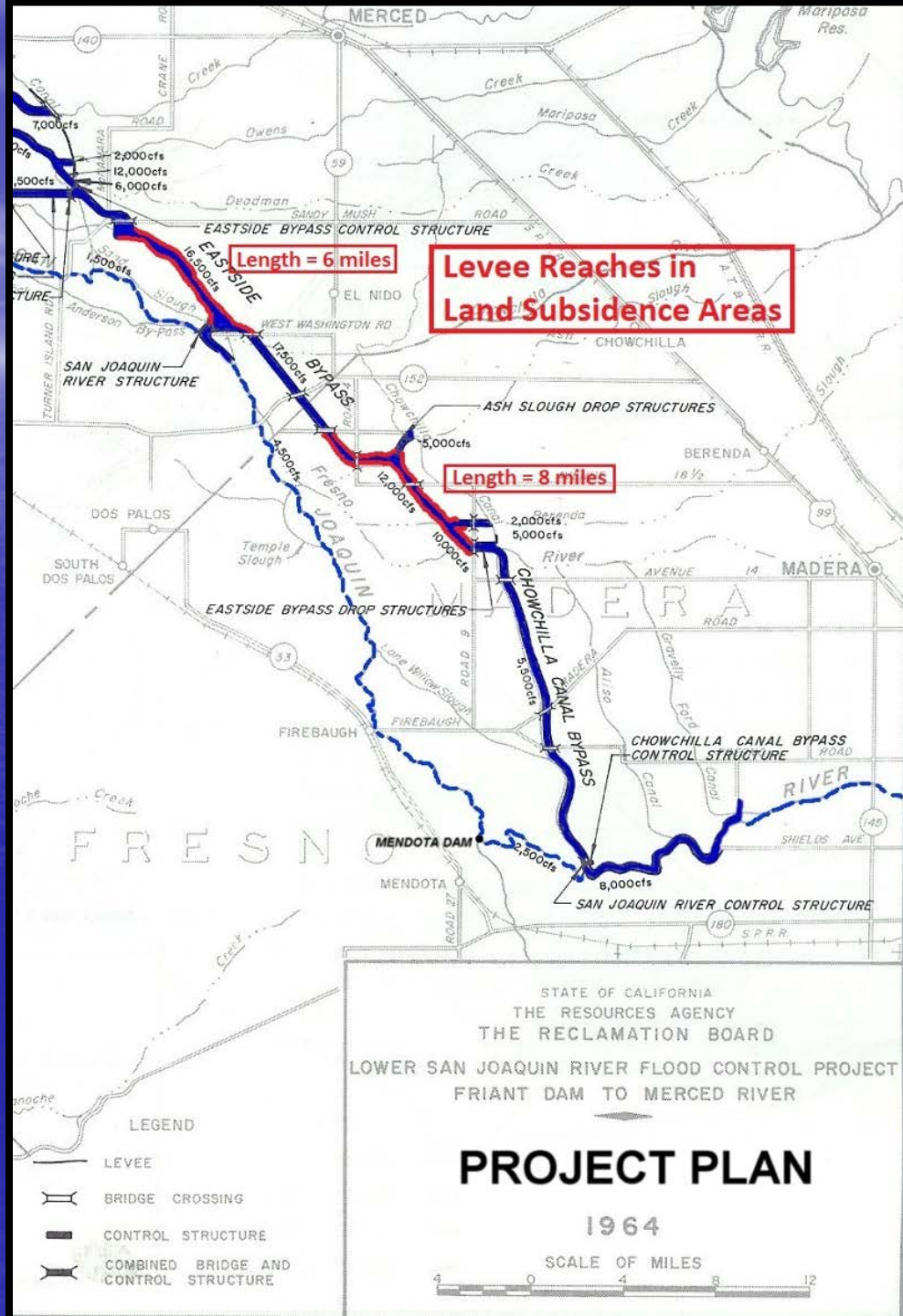
Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), and the GIS User Community

2008 to 2012 Subsidence Along the Eastside Bypass



San Joaquin River Exchange Contractors
Merced and Madera County Subsidence Study

Merced County
 (approx. 6 miles)
 &
 Madera County
 (approx. 8 miles)



**Eastside Bypass
@ Avenue 18 1/2, Madera County**

Photo Date: July 2003

Levee Unit #5



**Eastside Bypass
@ Avenue 18 1/2, Madera County**

Photo Date: January 2013

Levee Unit #5



Eastside Bypass

2006



El Nido G. S.

Levee Unit #6

Levee Unit #5



Approximate location of maximum subsidence in the United States identified by research efforts of Dr. Joseph F. Poland (pictured). Signs on pole show approximate altitude of land surface in 1925, 1955, and 1977. (28 feet in 50 years, .56 feet/year)

The site is in the San Joaquin Valley southwest of Mendota, California.

Short Term Subsidence Solutions



Reduce deep well (sub-Corcoran) pumping

Existing wells:

- Convert pumping from primarily deep wells to primarily shallow wells on Triangle T – at least 3,000 acre feet
- Substitute 2 deep wells on Vlot Property for 2 shallow wells on Triangle T – 2,000 acre feet

Fallow late year forage crops and purchase feed from an outside source:

- 160 to 300 acres – 1,000 acre feet
- Secure and distribute supplemental water supply from an outside source – 3,000 acre feet

Total 2013 reduction in deep well pumping – 6,000 to 9,000 acre feet

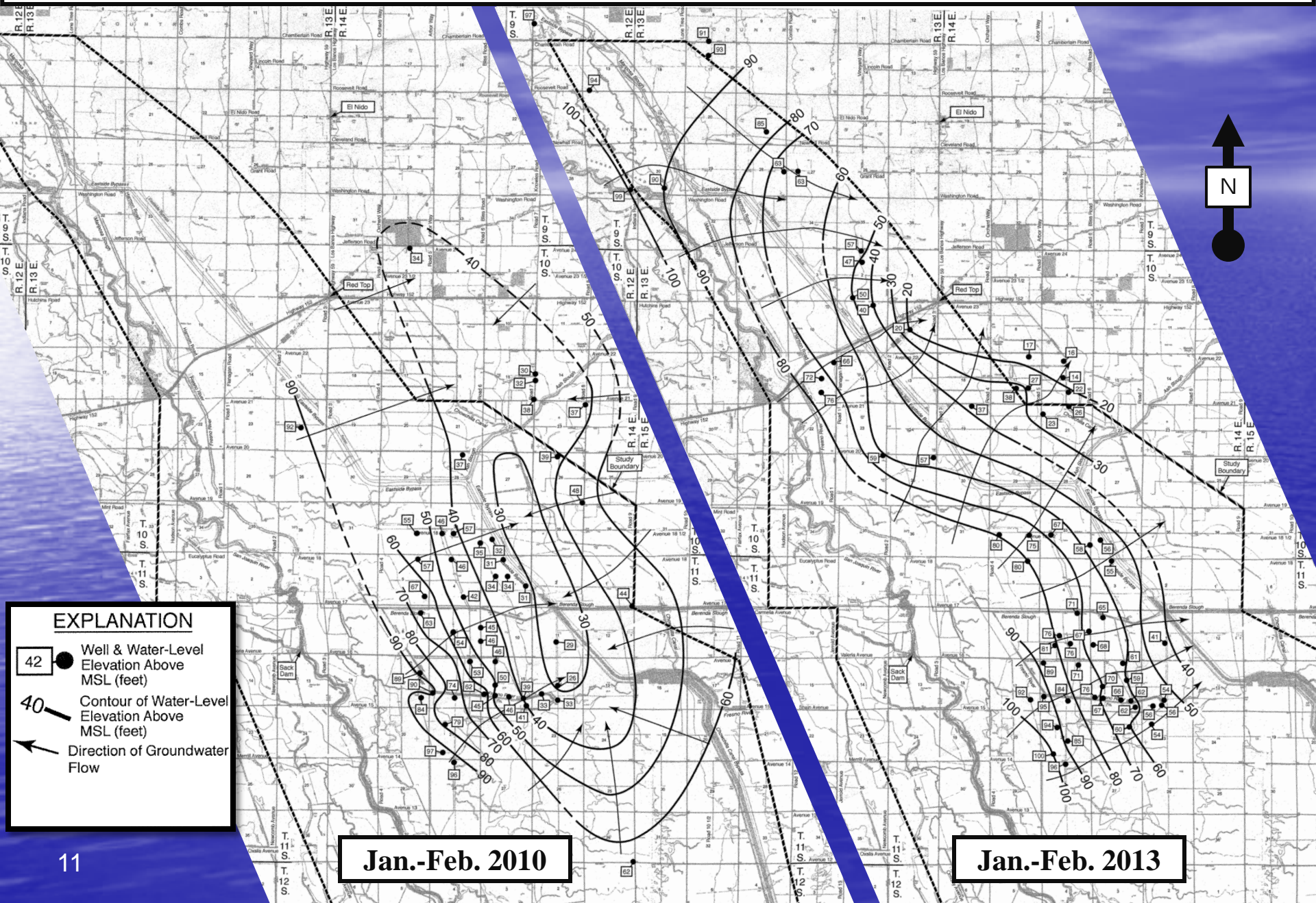
(Due to management practices)

Reduction in deep well pumping due to crop changes.

(Temporary until crop matures)

15,000 + acre feet

Water Level Elevations and Direction of Groundwater Flow in the Upper Aquifer



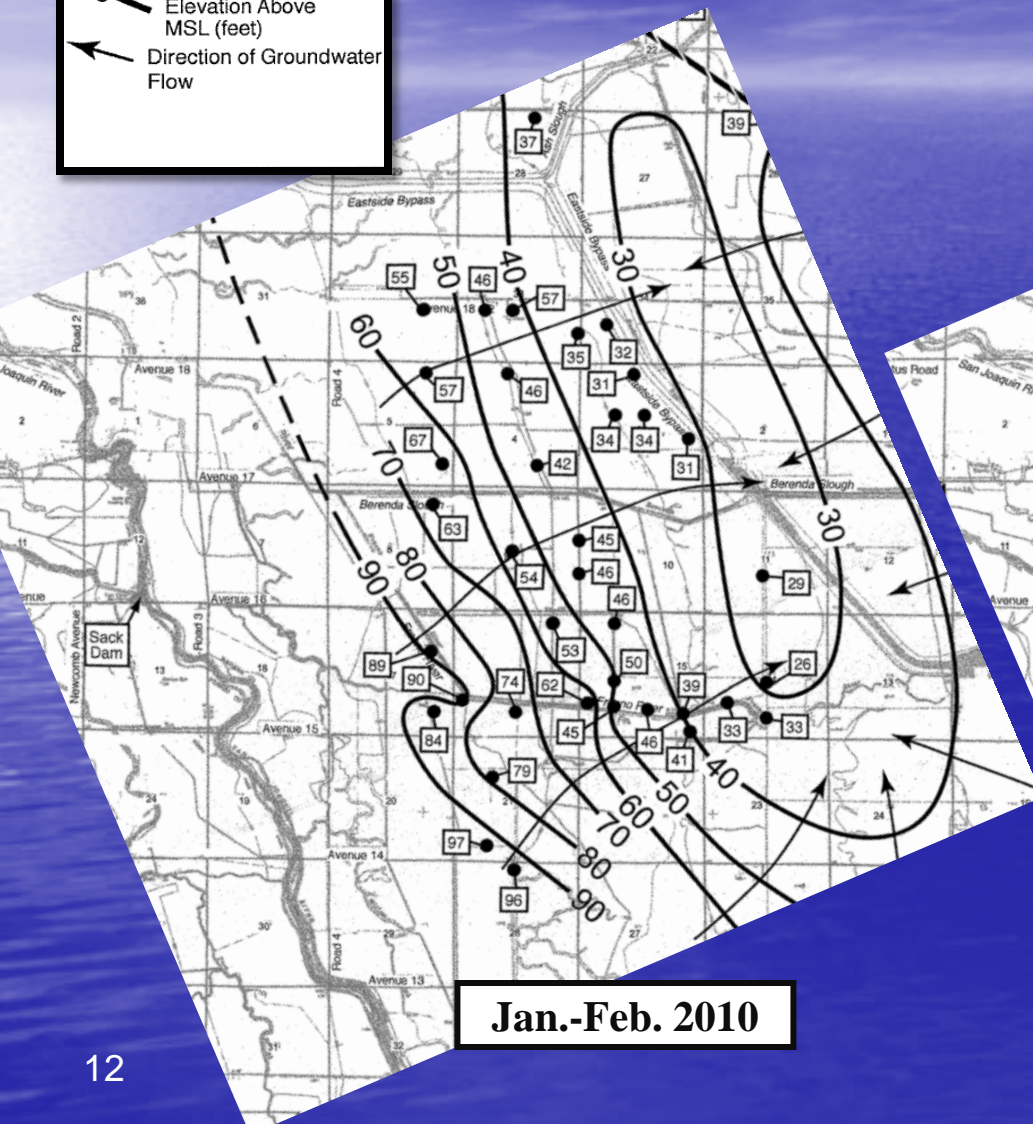
Jan.-Feb. 2010

Jan.-Feb. 2013

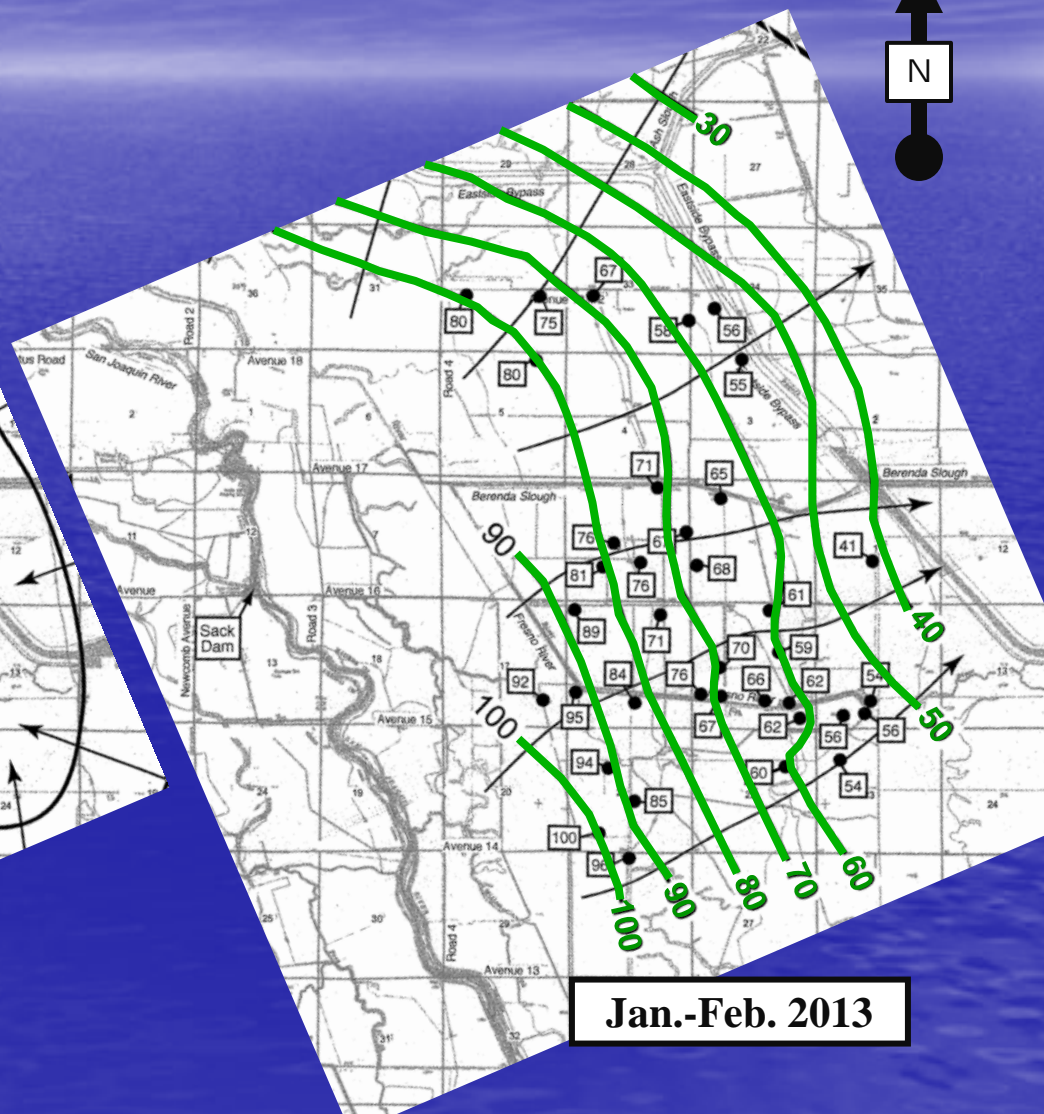
Water Level Elevations and Direction of Groundwater Flow in the Upper Aquifer Sack Dam to Eastside Bypass Comparison

EXPLANATION

- 42 ● Well & Water-Level Elevation Above MSL (feet)
- 40 — Contour of Water-Level Elevation Above MSL (feet)
- ↖ Direction of Groundwater Flow

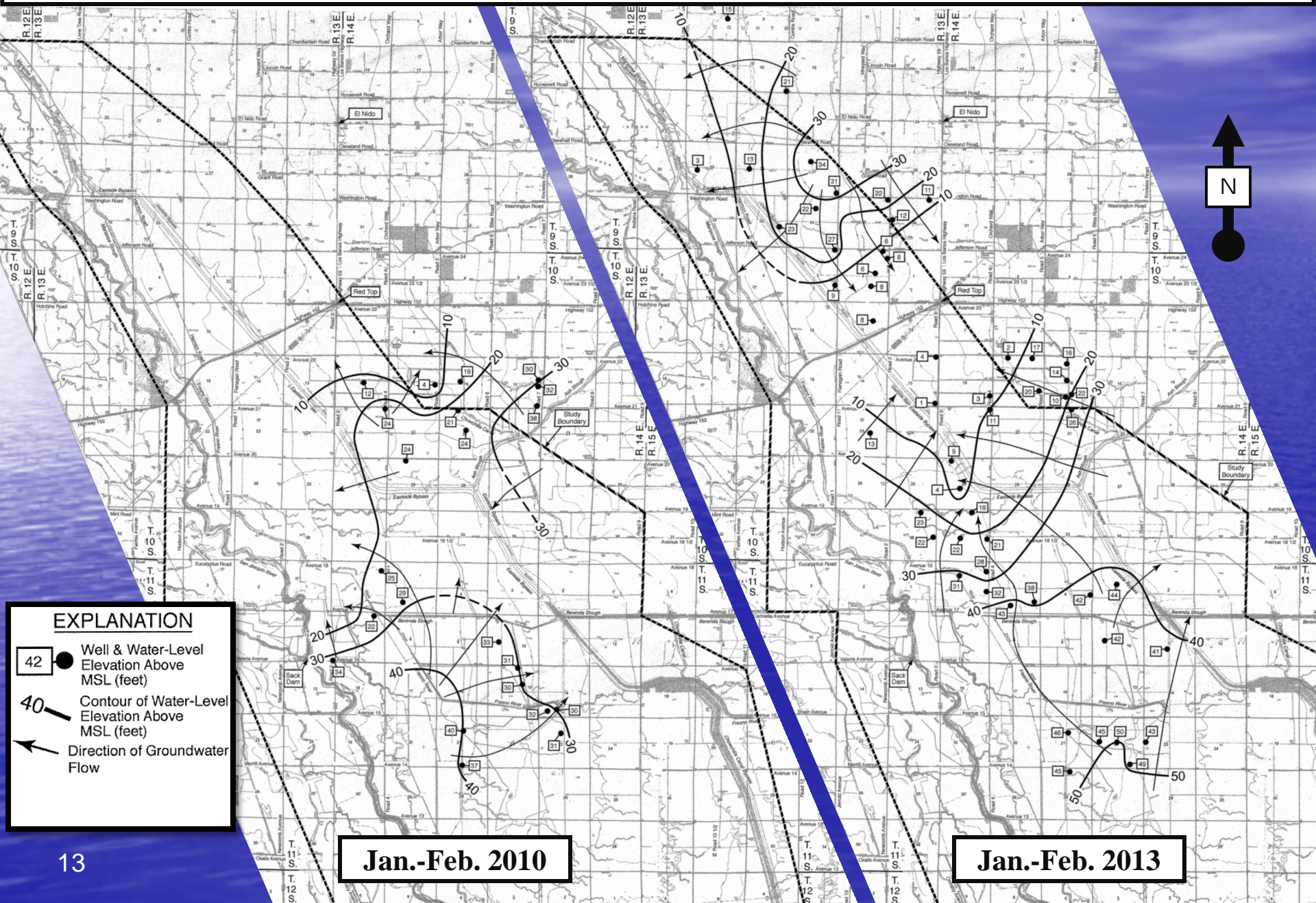


Jan.-Feb. 2010



Jan.-Feb. 2013

Water Level Elevations and Direction of Groundwater Flow in the Lower Aquifer



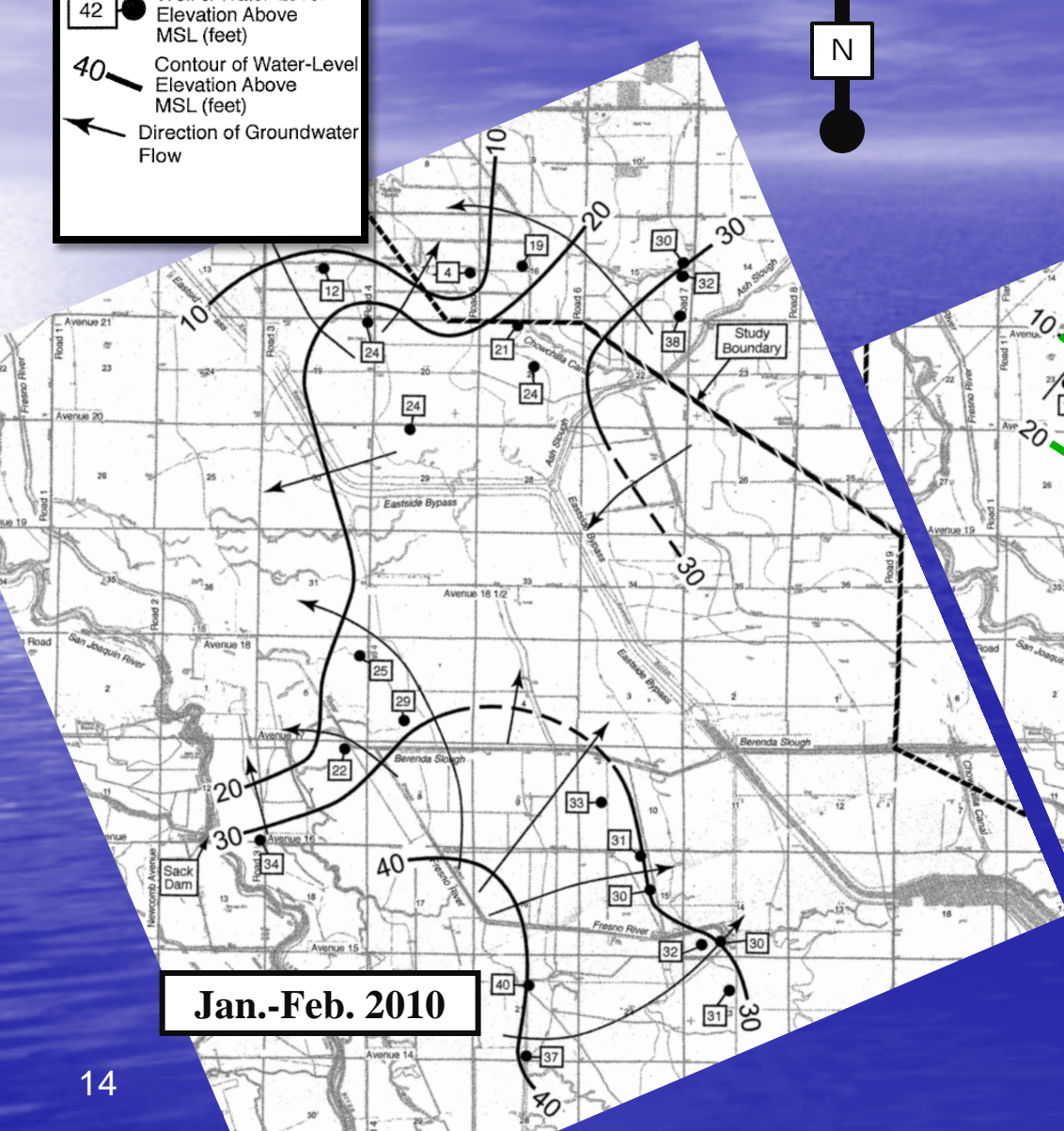
Jan.-Feb. 2010

Jan.-Feb. 2013

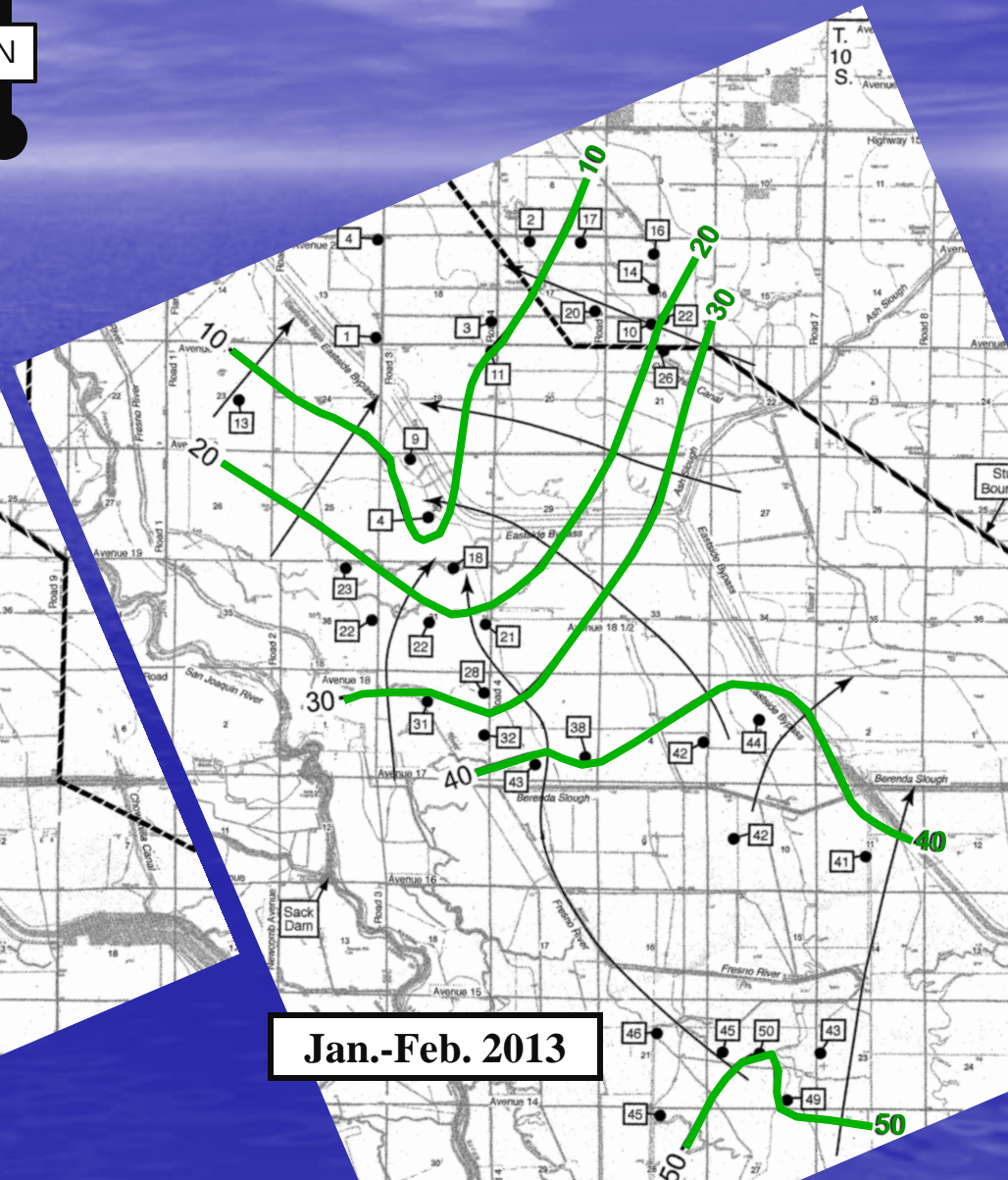
Water Level Elevations and Direction of Groundwater Flow in the Lower Aquifer Sack Dam to Eastside Bypass Comparison

EXPLANATION

- 42 ● Well & Water-Level Elevation Above MSL (feet)
- 40 — Contour of Water-Level Elevation Above MSL (feet)
- ↖ Direction of Groundwater Flow



Jan.-Feb. 2010

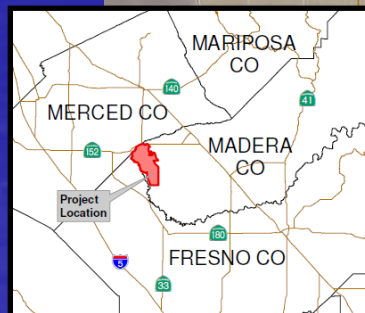
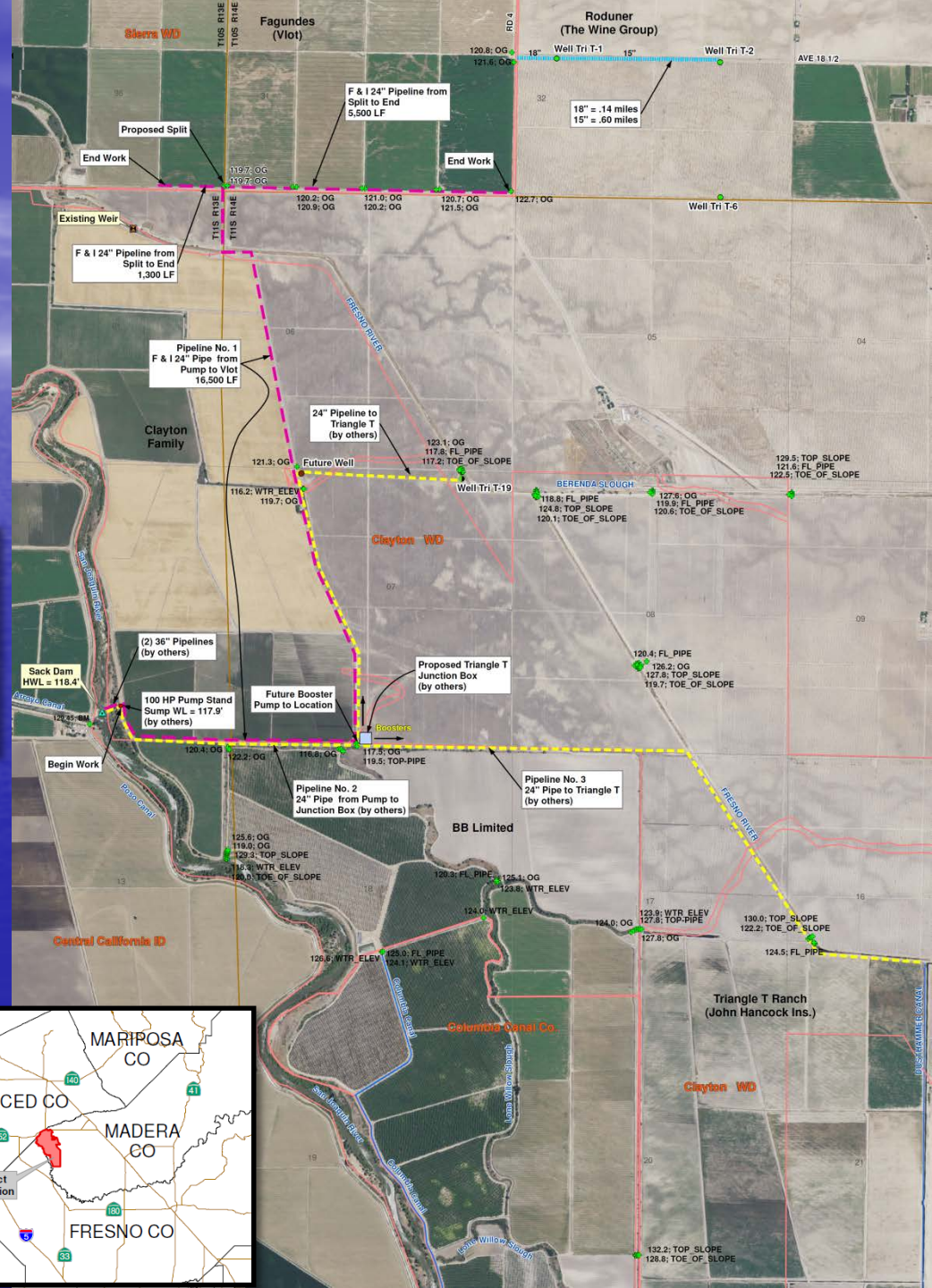


Jan.-Feb. 2013

Alignments for Clayton WD and Sierra WD Irrigation Conveyance

- Existing Well - Upper Aquifer
- Existing Well - Composite of Upper & Lower Aquifers
- ▬ Proposed Pipeline for Vlot (by others)
- ▬ Proposed Clayton WD/Triangle T Pipeline - 24" (by others)
- ▬ Furnish & Install 24" PVC Pipeline to Vlot/Fagundes (Pipe lengths are approximate)
- Survey Points
- ▭ Township & Range
- ▭ District Boundaries

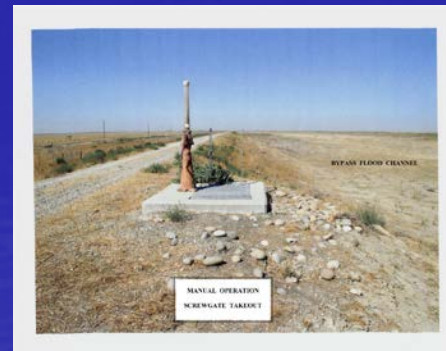
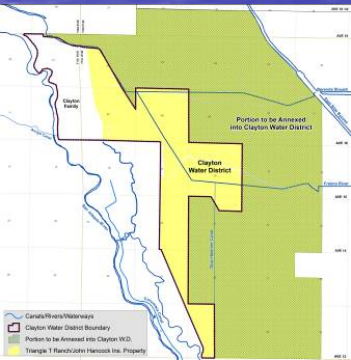
Aerial - National Agricultural Imagery Program (NAIP), June 2012



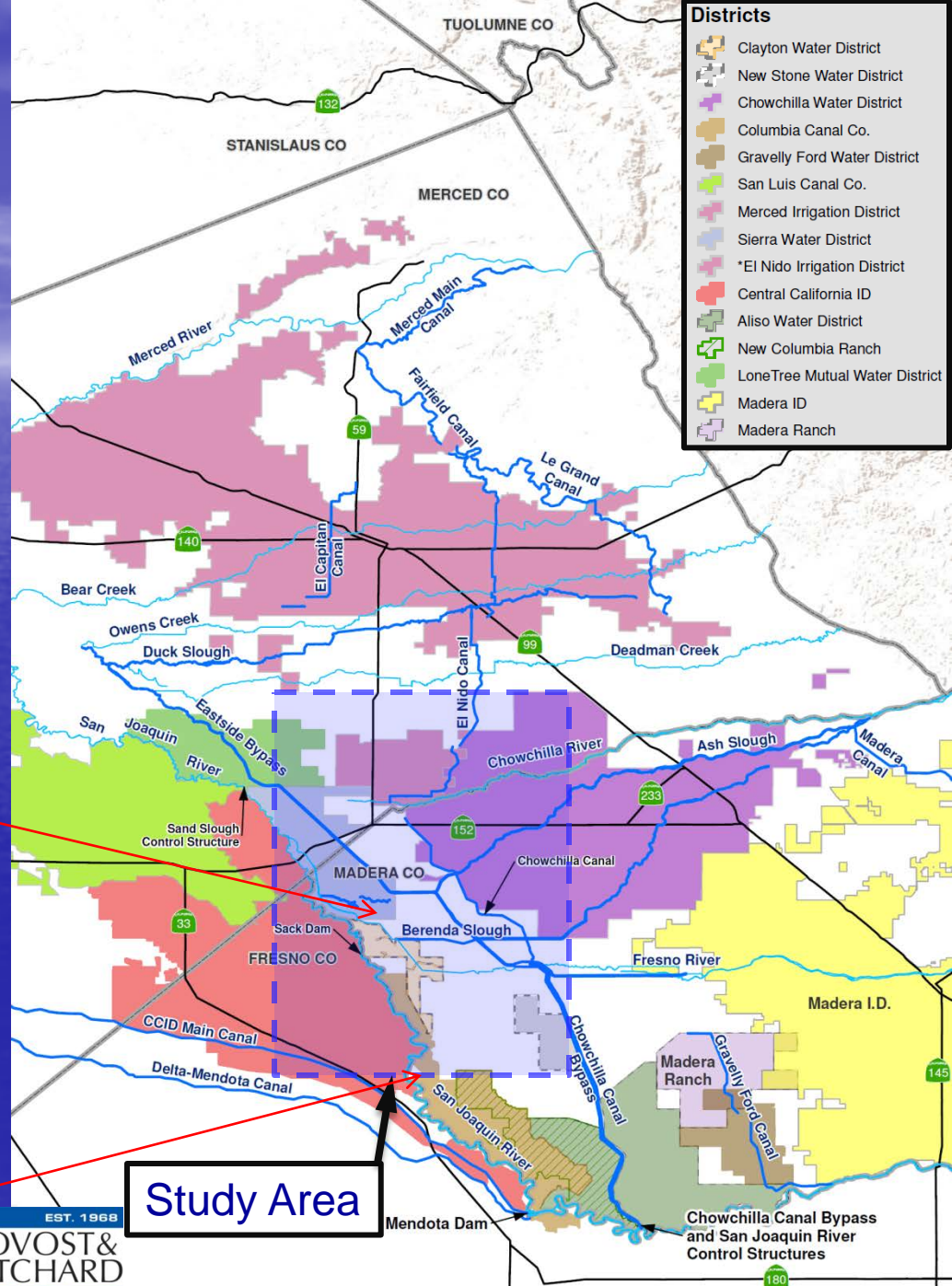
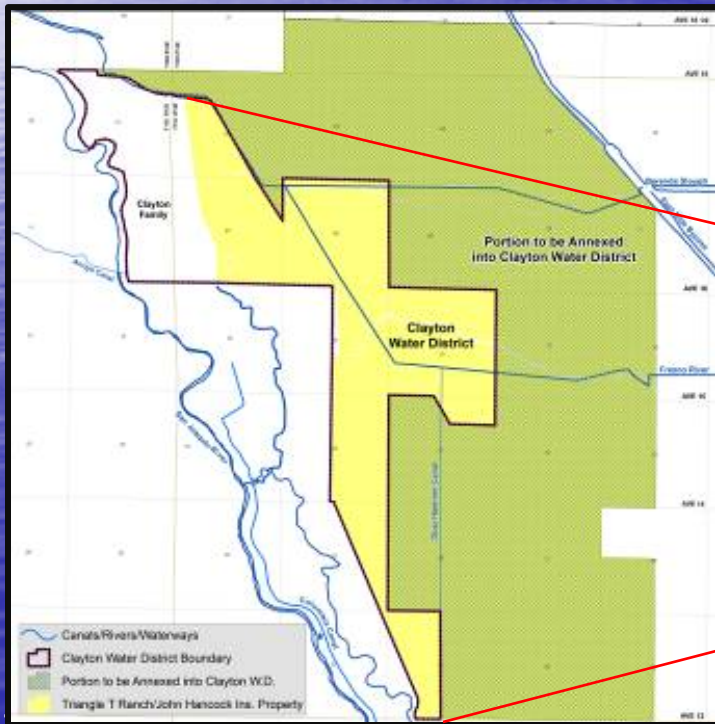
Western Madera County Subsidence Study

Long Term Solutions

- Continue grower-driven process to revive existing districts, form a new district, and/or annex into Madera Irrigation District.
- Develop Recharge Ponds and Turnouts from the Bypass (existing and proposed).
- The target schedule is to submit applications for permits this fall.
- Replace deep wells with shallow aquifer wells.
- Construct internal conveyance infrastructure improvements.



Subsidence Area District Vicinity



Study Area

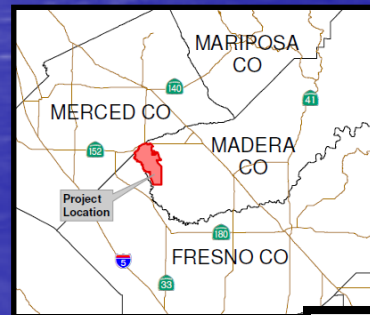
EST. 1968
PROVOST & PRITCHARD
 CONSULTING GROUP
 An Employee Owned Company

Sources: USGS, ESRI, TANA, A...

Western Madera County Subsidence Area Base-map with Recharge Ponds and Conveyance Facilities

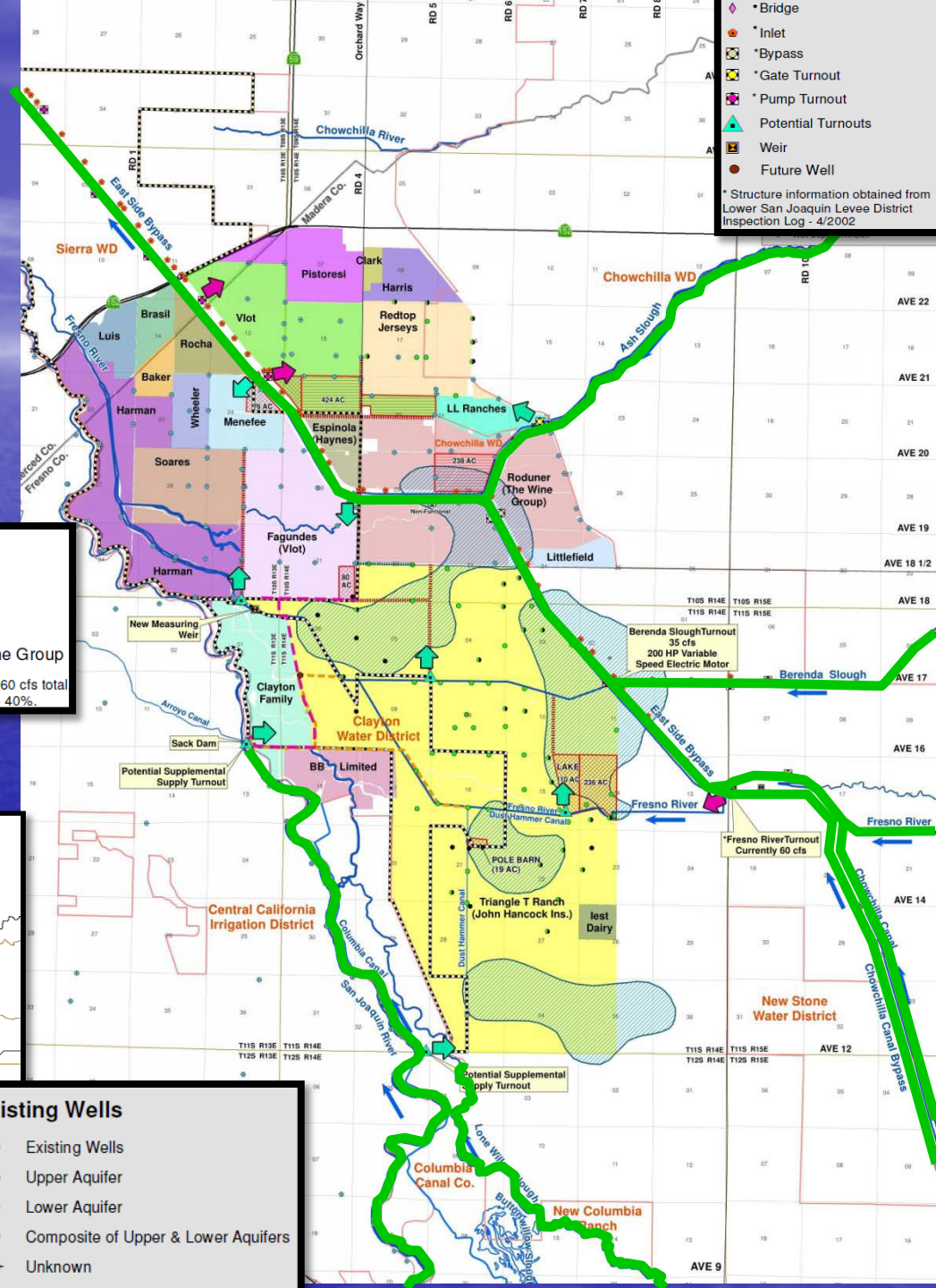
- District Boundaries
- Proposed Recharge Ponds
- Possible Pond Extension
- Proposed Recharge Areas
- Flow Direction
- Future Pipeline
- Proposed Pipeline for Vlot
- Proposed Clayton WD/Triangle T Pipeline - 24"
- Future Sierra WD Pipeline - 24"/Vlot and The Wine Group

* Design capacity is 100 cfs but currently at 60 cfs total
Triangle Ranch - 60%, Harman & Menefee - 40%.



- ### Existing Wells
- Existing Wells
 - Upper Aquifer
 - Lower Aquifer
 - Composite of Upper & Lower Aquifers
 - Unknown

- Bridge
 - Inlet
 - Bypass
 - Gate Turnout
 - Pump Turnout
 - Potential Turnouts
 - Weir
 - Future Well
- * Structure information obtained from Lower San Joaquin Levee District Inspection Log - 4/2002



Western Madera County Subsidence Solution Cost Summary

Description	Quantity	Cost	Capital Cost	Total Annual Cost
On-Site Facilities				
Recharge Ponds & Turnouts	720 Acres	\$3,000	\$2,161,000	\$141,000
Shallow Water Supply Replacement Wells	30 Wells	\$120,000	\$3,600,000	\$235,000
Surface Water Distribution System	25,640 Acres	\$156	\$4,000,000	\$261,000
Subtotal:			\$9,761,000	\$637,000
Supplemental Supply Acquisition (1/2 acre-foot/acre)				
Supplemental Water Supply Acquisition**	10,000 ac-ft/year	\$300		\$3,000,000
Total Program Cost:			\$9,761,000	\$3,637,000
*Capital cost amortized @ 20 years, 3% interest.				
** Assumes Bureau of Reclamation to contribute \$9 million under their current cooperative agreement to facilitate start up operation of the Madera County Water Supply Enhancement Project (Madera Water Bank) with capability of delivering 10,000 acre-feet/year to the site.				

Participation in the Madera Water Bank provides guaranteed new supplemental supply that does not compete with existing scarce water supplies south of the Delta.

Subsidence Study

Ongoing Coordination Efforts

- Coordinate with landowners.
- Coordinate solutions with County Boards of Supervisors.
- Coordinate with adjacent water and irrigation districts.
- Work with DWR on determining flood carrying capacity of Bypass and SJR.
- Work with reservoir operators on coordinated releases to minimize flood risk.
- Coordinate efforts with the SJR Restoration Program.
- Continue subsidence monitoring network.

Western Madera County

- Project Question
 - Will the County support the organization of the landowners in the project area into an Irrigation District for the purposes of solving the Red Top subsidence problem?
- Well Construction Question
 - Will the County allow combination (above and below Corcoran Clay) wells?
- Project Participation Question
 - Given the public safety concern with subsidence impacts on the flood control system and to other adjacent facilities, what will be the County's participation in the project now and in the future?

Contact Information

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Top Area Growers, Merced and Madera Counties**