MEMORANDUM

To: Salinas Valley Basin Groundwater Sustainability Agency – Board Members

CC: Piret Harmon and Emily Gardner, SVBGSA
Nancy Isakson, Salinas Valley Water Coalition
Eric Robinson, Kronick Moskovitz Tiedemann & Girard

From: Dwight L. Smith, PG, CHg, Principal Hydrogeologist

Date: January 5, 2026

Subject: **Superposition Modeling – Summary Points**

What is the Superposition Testing Method Accomplishing?

- Turning off or on an attribute in the regional flow model to see how other aspects of the hydrologic system respond.

In our case, turn off pumping by subbasin and observing the simulated responses in water levels, subsurface flows between subbasins, magnitudes of seawater intrusion, and flows in the Salinas River.

This method of evaluation is used commonly in modeling to analyze specific effects of historical projects or management actions, and for impact analyses for proposed projects. Local examples:

- Hydrologic Effects of Historical Operation of the Reservoirs (HBA)
- Hydrologic Effects of the Proposed Interlake Tunnel (EIS)
- Hydrologic Changes associated with Proposed Reservoir Operational Change (HCP)

This method is also commonly used in modeling to gain a general understanding of how hydrologically connected certain attributes are to each other within the model, in this instance, impacts of pumping in one subbasin on the other subbasins in the valley.

- During model calibration to identify key calibration parameters
- For reporting of sensitivities to calibrated parameters

Appropriate Use of Superposition Testing Results

- *Improve the general understanding of hydrological degrees of connection* (strong or weak) associated with historical (and future) groundwater pumping in each subbasin over the entire Salinas Valley hydrologic system, and/or individual subbasins.
- Potentially provide some insights into proposed management actions by a subbasin that might involve curtailment of pumping (demand management), and its impact/effect on other subbasins.

<u>Not be used or confused with:</u>

- Review of project-specific proposed management actions.

- A precise simulation. In this case, the modeling completed is a fictious / hypothetical exercise of full on or off pumping by subbasin to examine the extremes in hydrologic connection responses, but without consideration of how historical water management actions or land use actions may have changed if pumping was theoretically not present in a subbasin (historical reservoir releases and land uses are held constant during the modeling).
- An interpretation of "available water" impacts. The reality is that groundwater pumping evolved in all subbasins concurrently based on suitability of lands for agriculture and access to water.

Key Observations of Superposition Testing Results

- Historical pumping in the Upper Valley and Forebay Subbasins has had little effect on historical magnitudes of seawater intrusion into the 180/400 Subbasin (380 and 420 AFA average annual change, or 4.4% and 4.9% of the historical baseline conditions). Reference **UES Table 2, Figure 2,** and **M&A Table 1** (values rounded to 400 AFA).
- Historical pumping in the Upper Valley has had little effects on groundwater outflows into the 180/400 and Eastside Subbasins (3 AFA and 26 AFA to 180/400 and Eastside, respectively). Reference **UES Table 2, Figure 2,** and **M&A Table 1** (values rounded to zero).
- Historical pumping in the Forebay Subbasin has had moderate effects on groundwater outflows into the 180/400 and Eastside Subbasins (1910 AFA and 2020 AFA to 180/400 and Eastside, respectively). Reference **UES Table 2, Figure 3,** and **M&A Table 1** (values rounded to 1900 and 2000 AFA).
- Historical pumping in the 180/400 and Eastside Subbasins has induced greater subsurface flows out of the Forebay and into these down-gradient subbasins, of about 2600 AFA. Reference **UES Table 2, Figures 4 and 5,** and **M&A Table 1.**
- Groundwater level elevation changes observed throughout the Salinas Valley as a result of Upper Valley and Forebay Pumping have been historically mild, as contrasted with the locally caused drawdown averaging about 1-5 ft. Reference **M&A Figures in Attachment 2**.
- Historical Eastside Subbasin pumping has a significant effect on groundwater flow to the 180/400 Subbasin – natural flow gradient was about 22,000 AFA to the 180/400, which has been reversed to approximately 27,000 AFA from the 180/400 (*represents a 49,000 AFA subsurface flow reversal*). Reference **UES Figure 1** and **M&A Table 1** (baseline values for 180/400 to Eastside).
- Historical pumping from the Upper Valley and Forebay Subbasins has caused historical reduction in flows in the Salinas River (36,000 and 39,000 AFA, respectively) of about a 14.6% and 15.9% of the total flow simulated at the Spreckels gage. Reference **UES Table 5** and **M&A Table 2** (values 33,200 and 38,200 AFA for pumping off, and -40,100 and 43,700 AFA for pumping on). The river is the primary recharge source to the aquifer in the Upper Valley and Forebay Subbasins, and retention of a portion of the river sourced water is in keeping with conservation practices for uses of Salinas River flows and reservoir management of flows under permitted water rights for the reservoirs.
- Salinas River flow reductions as a result of historical pumping in the Upper Valley and Forebay Subbasins <u>should not be confused with or implied as a reduction in "water availability",</u> as stated in aquilogic, Inc. December 2, 2025 memorandum (Section 1a, 1b). "Water availability" is a complex term and infers permitted access to water without harming the environment or causing overdraft, and placement of water to a defined beneficial use. In the case of hypothetical beneficial uses in the

180/400 or Eastside Subbasins, surface “water availability” would also be highly dependent on reservoir management actions, which have historically occurred to accommodate timing and magnitude of delivery to a down-stream permitted diversion point, such as the Salinas River Diversion Facility (SRDF), for the purpose of stopping/halting seawater intrusion.

- The historical flow reduction in the Salinas River flow caused by pumping from the Upper Valley and Forebay Subbasins is more appropriately and technically viewed as “salvaged” surface water that has been placed to a reasonable beneficial use consistent with water right permits for the reservors, the surface water of which would otherwise have historically flowed out to the ocean.

<u>Conclusion:</u>

Bottom line, pumping in the Upper Valley and Forebay Subbasins has little to no effect on helping to stop seawater intrusion, or improving groundwater levels in the critically over-drafted 180/400 Subbasin.

References

Aquilogic, Inc., December 2, 2025, Comments on Montgomery & Associates draft Memorandum, “Results of Computer Modeling Agreement for SVWC and SBWA,” dated August 22, 2025, Project No.: 018-09, 6 pages plus table and figures.

UES, October 18, 2025, Technical Review Comments on Montgomery & Associates’ Superposition Modeling Technical Memorandum dated August 22, 2025, 8 pages plus figures.

GSA 2025 Superposition Modeling – Summary

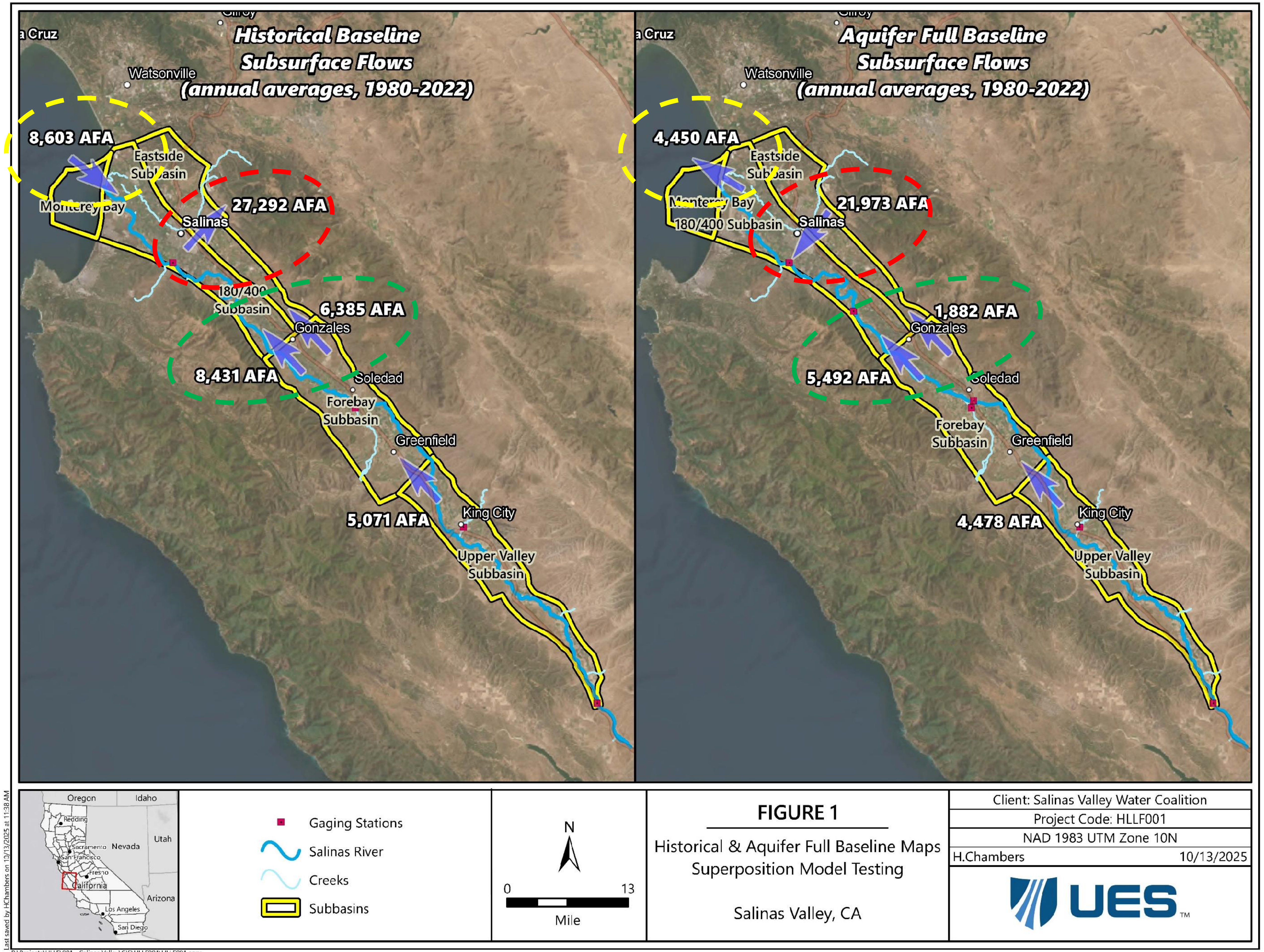
What is the Superposition Testing Method Accomplishing?

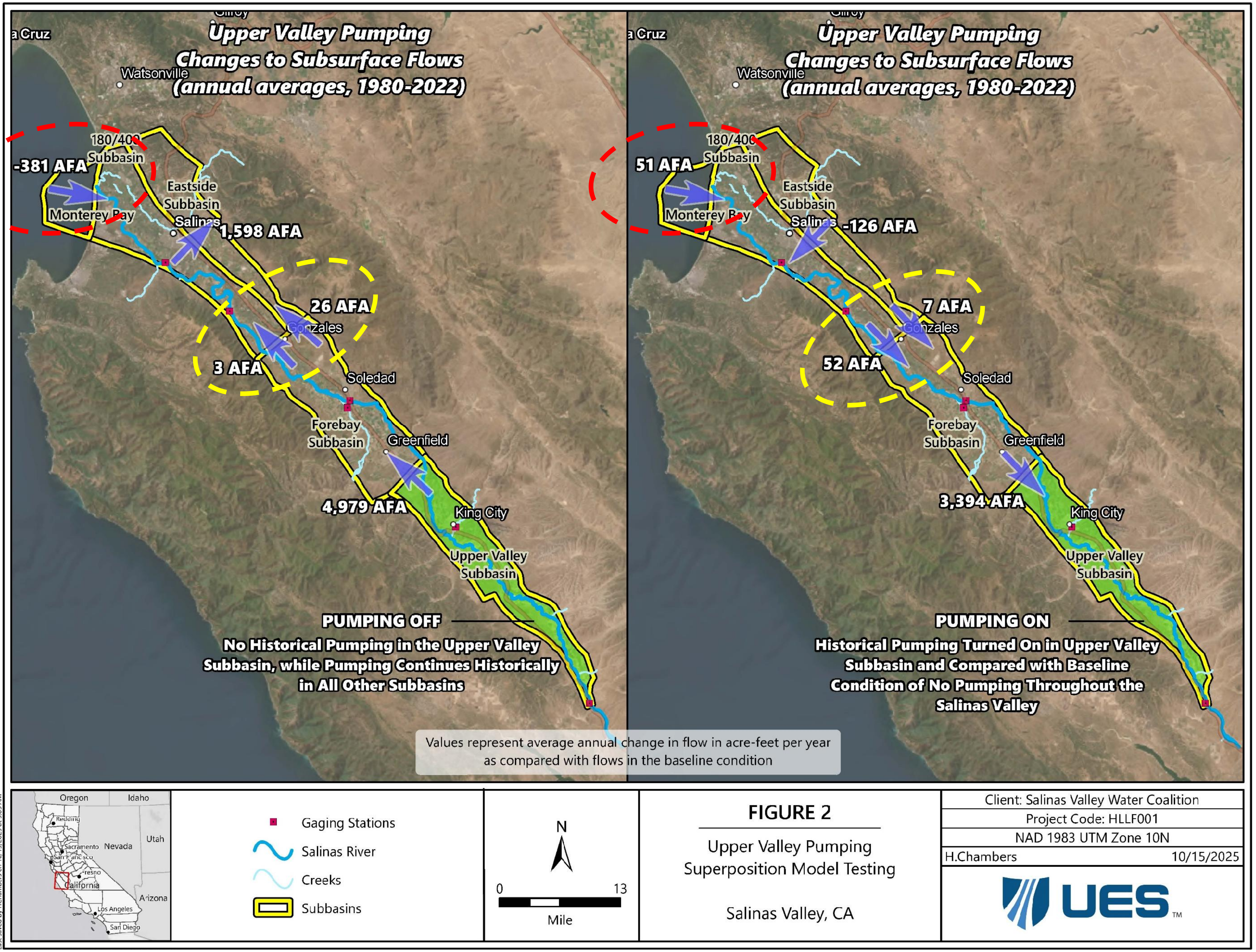
Turning off or on an attribute in the regional flow model to see how other aspects of the hydrologic system respond.

Appropriate Use of Superposition Testing Results

Improve the general understanding of hydrological degrees of connection (strong or weak) associated with historical (and future) groundwater pumping in each subbasin over the entire Salinas Valley hydrologic system, and/or individual subbasins.

Potentially provide some insights into proposed management actions by a subbasin that might involve curtailment of pumping (demand management), and its impact/effect on other subbasins.


Historical Baseline
Subsurface Flows
(annual averages, 1980-2022)
Watsonville
8,603 AFA
Eastside Subbasin
Monterey Bay
27,292 AFA
Salinas
180/400 Subbasin
6,385 AFA
Gonzales
8,431 AFA
Soledad
Forebay Subbasin
Greenfield
5,071 AFA
King City
Upper Valley Subbasin
Aquifer Full Baseline
Subsurface Flows
(annual averages, 1980-2022)
Watsonville
4,450 AFA
Eastside Subbasin
Monterey Bay
180/400 Subbasin
21,973 AFA
Salinas
1,882 AFA
Gonzales
5,492 AFA
Soledad
Forebay Subbasin
Greenfield
4,478 AFA
King City
Upper Valley Subbasin
Oregon
Idaho
Nevada
Utah
California
Arizona
Gaging Stations
Salinas River
Creeks
Subbasins
N
0
13
Mile
FIGURE 1
Historical & Aquifer Full Baseline Maps
Superposition Model Testing
Salinas Valley, CA
Client: Salinas Valley Water Coalition
Project Code: HLLF001
NAD 1983 UTM Zone 10N
H.Chambers
10/13/2025



Upper Valley Pumping
Changes to Subsurface Flows
(annual averages, 1980-2022)
-381 AFA
180/400 Subbasin
Eastside Subbasin
Monterey Bay
Watsonville
Salinas
1,598 AFA
26 AFA
Gonzales
3 AFA
Soledad
Forebay Subbasin
Greenfield
4,979 AFA
King City
Upper Valley Subbasin
PUMPING OFF
No Historical Pumping in the Upper Valley Subbasin, while Pumping Continues Historically in All Other Subbasins
51 AFA
-126 AFA
7 AFA
52 AFA
3,394 AFA
PUMPING ON
Historical Pumping Turned On in Upper Valley Subbasin and Compared with Baseline Condition of No Pumping Throughout the Salinas Valley
Values represent average annual change in flow in acre-feet per year as compared with flows in the baseline condition
Oregon
Idaho
Nevada
Utah
California
Arizona
Sacramento
Los Angeles
San Diego
Gaging Stations
Salinas River
Creeks
Subbasins
N
0
13
Mile
FIGURE 2
Upper Valley Pumping Superposition Model Testing
Salinas Valley, CA
Client: Salinas Valley Water Coalition
Project Code: HLLF001
NAD 1983 UTM Zone 10N
H.Chambers
10/15/2025
UES
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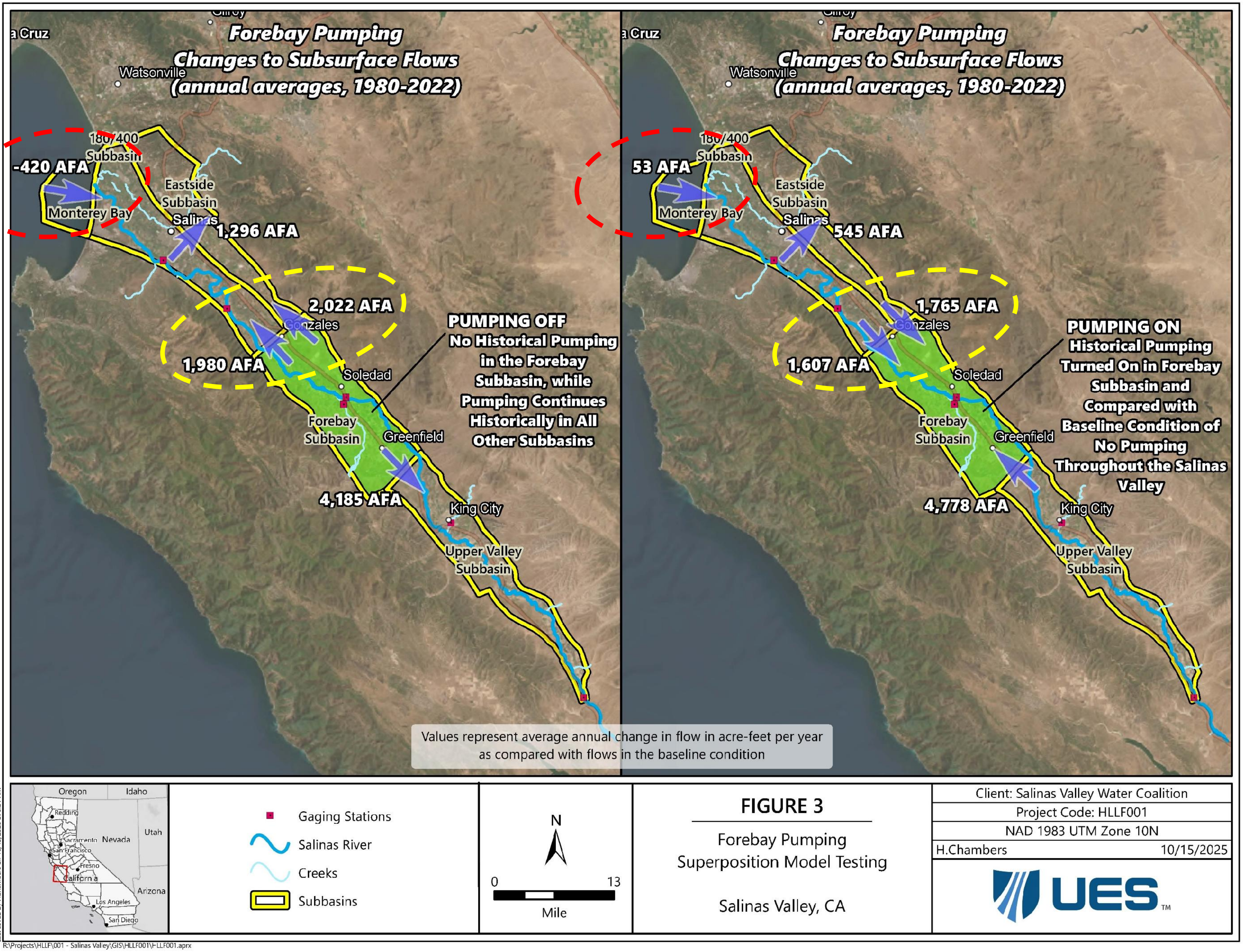

FIGURE 3

Forebay Pumping
Superposition Model Testing

Salinas Valley, CA

Client: Salinas Valley Water Coalition	
Project Code: HLLF001	
NAD 1983 UTM Zone 10N	
H.Chambers	10/15/2025

UES

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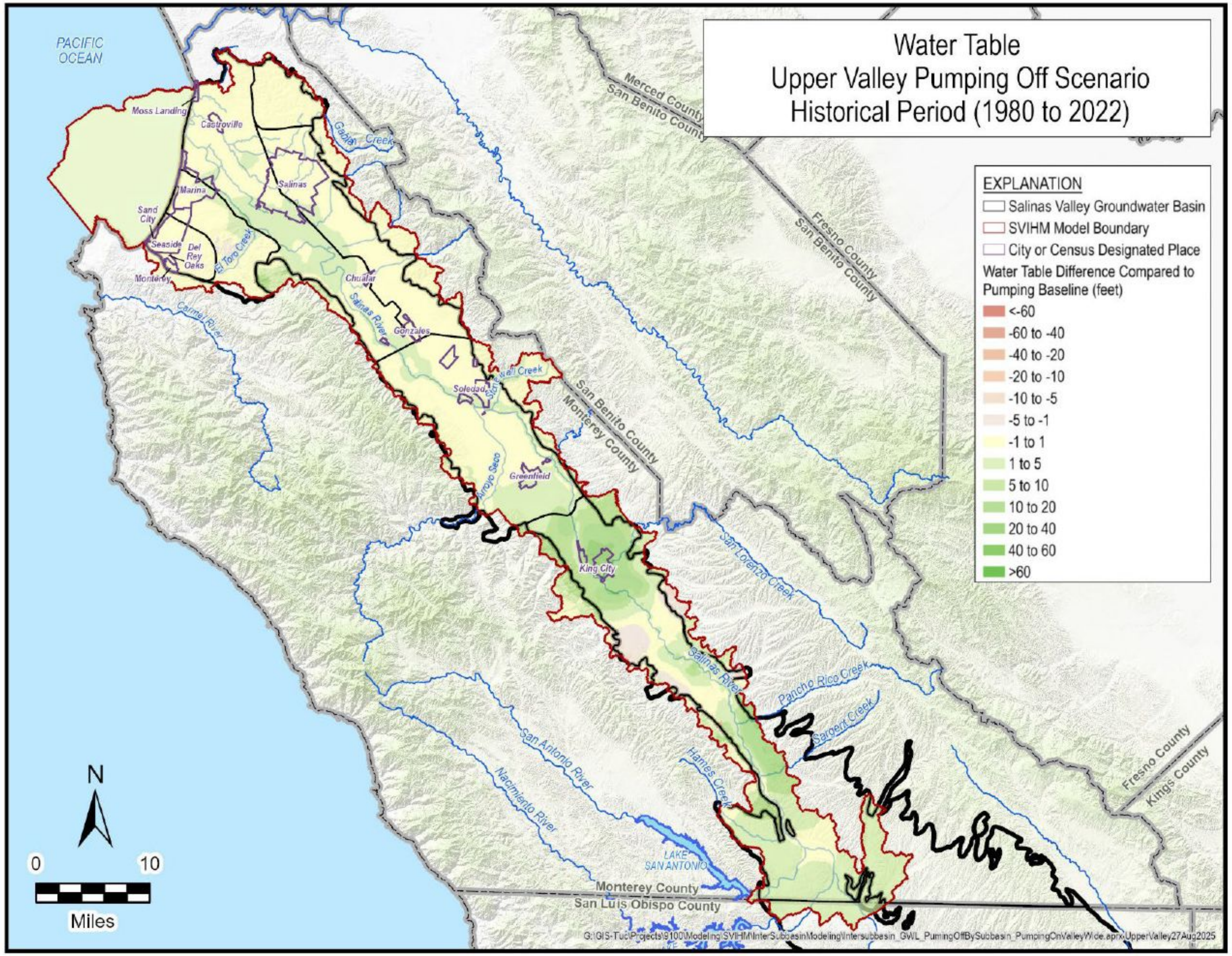


Figure 2-1. Upper Valley Pumping Off Scenario Compared to Pumping Baseline - Average Groundwater Level Difference for 1980-2022

From M&A Memorandum

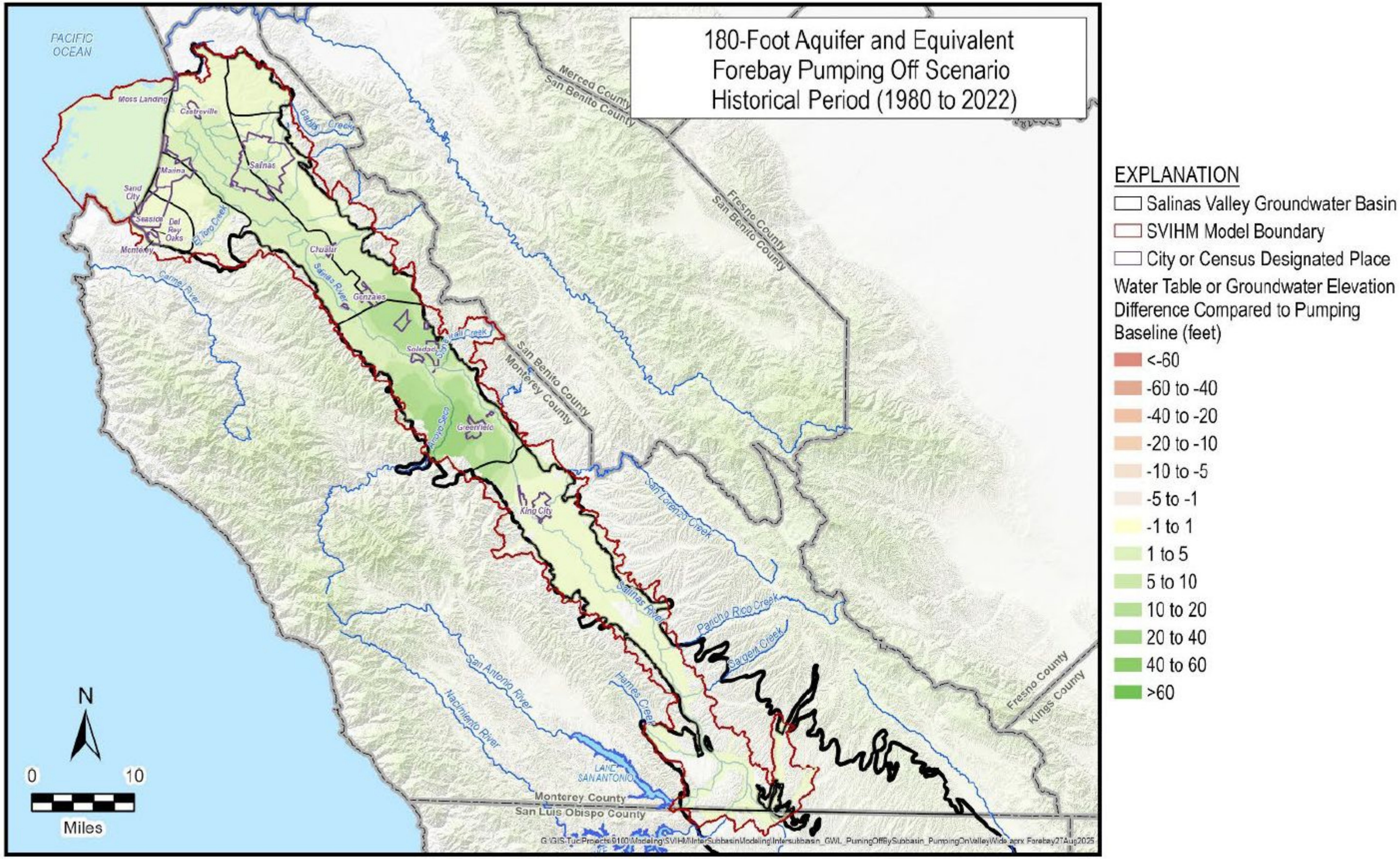


Figure from M&A Memorandum - Figure 2.2

Table 2. Summary of Surface Water Flows

Baseline Pumping Status	Simulation	Chualar Gage Annual Flow (AF/yr)	Chualar Gage Change in Annual Flow (AF/yr)
Pumping On	Simulated Flow with all Historical Pumping	244,400.00	-
	Simulated Flow with Upper Valley Pumping Off[1]	277,600.00	33,200.00
	Simulated Flow with Forebay Pumping Off[1]	282,600.00	38,200.00
	Simulated Flow with 180/400 Pumping Off[1]	254,000.00	9,600.00
	Simulated Flow with Eastside Pumping Off[1]	248,800.00	4,400.00
Pumping Off	Simulated Flow with all Historical Pumping	376,800.00	-
	Simulated Flow with Upper Valley Pumping On[2]	336,700.00	-40,100
	Simulated Flow with Forebay Pumping On[2]	333,000.00	-43,700
	Simulated Flow with 180/400 Pumping On[2]	366,800.00	-10,000
	Simulated Flow with Eastside Pumping On[2]	370,700.00	-6,000

Notes:

[1] Pumping in all other subbasins

[2] No pumping in other subbasins

Table from M&A Memorandum

GSA 2025 Superposition Modeling – Summary

Key Conclusions

- Pumping in the Upper Valley and Forebay Subbasins has little to no effect on seawater intrusion, and minor effects on groundwater levels in the 180/400 and Eastside Subbasins

- There has been a substantial reversal of flows to the 180/400 Subbasin because of pumping in the Eastside Subbasin

- The most dominant effect of pumping in the Upper Valley and Forebay Subbasins is reduction in Salinas River flows by ~15% entering the 180/400 Subbasin, and under conservation principles, this represents salvage of freshwater resources that otherwise would have discharged to the ocean.

MEMORANDUM

To:	Abby Ostovar and Derrik Williams, Montgomery & Associates
CC:	Nancy Isakson, Salinas Valley Water Coalition Eric Robinson, Kronick Moskovitz Tiedemann & Girard Piret Harmon and Emily Gardner, SVBGSA Bob Abrams, Aquilogic
From:	Dwight L. Smith, PG, CHg, Principal Hydrogeologist
Date:	October 18, 2025
Subject:	**Technical Review Comments on Montgomery & Associates' Superposition Modeling Technical Memorandum dated August 22, 2025**

1.0 INTRODUCTION

Montgomery & Associates (M&A) has conducted superposition modeling to examine subbasin water balance interactions in accordance with a written funding agreement executed by the Salinas Valley Water Coalition (SVWC), the Salinas Basin Water Alliance (SBWA), and the Salinas Valley Basin Groundwater Sustainability Agency (SVBGSA). The Work Plan attached to the funding agreement was developed in 2023, but superposition modeling was not conducted until after the U.S. Geological Survey published the Salinas Valley Integrated Hydrologic Model (SVIHM) in April of 2025. While an update to the 2025 published SVIHM is currently being worked on by the SVBGSA, the associated improvements expected to be forthcoming in the SVIHM v2 are not expected to significantly change the superposition modeling results produced by using the SVIHM v1 (2025).

In the context of hydrologic modeling, superposition testing is a method of examination used to evaluate the impact of one hydrologic parameter, or variable, on other attributes within a complex and interconnected hydrologic system. In numerical flow modeling, superposition testing is used during model calibration to examine the sensitivity of parameter values to achieving calibration and to direct calibration to the most meaningful parameters. Superposition testing is also used on calibrated models to examine effects of project-specific actions amongst cumulative actions, and to examine hydrologic effects of differing assumed input parameters, such as variables associated with climate change or varying conceptual flow models. In this case, superposition modeling was requested by SVWC and SBWA to aid in the understanding of pumping influences on a subbasin scale on primary attributes of Salinas Valley hydrology, including groundwater elevations, subsurface groundwater flows between the subbasins, flows in the Salinas River, and the magnitude of seawater intrusion along the coast. As implemented, large changes to pumping were input into the model, and the model-predicted hydrologic effects throughout the Salinas Valley's subbasins were then examined. Although this testing is fictitious in the sense that the pumping changes do not reflect proposed management actions, it is insightful for understanding the magnitude of presence or absence of hydrologic connections throughout the valley. Simply put, the superposition modeling reveals whether pumping in one subbasin affects groundwater conditions in other subbasins and, if so, how strongly.

The completed superposition modeling work is consistent with the Work Plan, and the documentation provided by M&A is thorough. The modeling meets the expectations of requested work by SVWC, but I do have a few suggestions that relate to the need for a clear and concise summary of the results. As agreed by the SVBGSA, interpretation of the results may be left to the reader, but the results are to be presented to the SVBGSA's Board of Directors, so clearly summarizing the purpose of superposition testing and the key results is important. These comments focus on the need for a clearer summary of the results, so they can be readily understood.

2.0 M&A MEMORANDUM REVIEW RECOMMENDATIONS

2.1 DEFINE SUPERPOSITION MODELING FOR THE AUDIENCE

The M&A technical memorandum is thorough but needs an introduction describing superposition modeling. Something like the description provided above should be added to M&A's final technical memorandum.

2.2 SUMMARY OF RESULTS NEEDED

The final M&A memorandum should include a "Summary" section presenting highlights of the superposition test results, not just "Summary Notes" stating caveats and limitations. The Summary should present a clear and concise overview of superposition testing results that an interested layperson can easily understand.

2.2.1 Subsurface Flow Observations

A primary interest for SVWC is the subsurface flow relationships between the Upper Valley, Forebay, Eastside and 180/400 Subbasins. While documentation of subsurface flow changes is complete, the tables within the M&A memorandum are complex and results are unnecessarily difficult to decipher. The new Summary section should include tables such as those presented below (**Tables 1-4**) and figures such as **Figures 1-5** presented below. Those tables and figures present the primary superposition test results in a format this is more easily understood by the SVBGSA's Board of Directors and interested lay people. Some description of the information in the tables and text should help guide the reader. For example:

Figure 1 illustrates the model simulated subsurface flows between the Upper Valley, Forebay, Eastside and 180/400 subbasins for the two baseline conditions from which superposition testing is compared. The left pane shows the simulated average annual subsurface flows between subbasins that has historically occurred. The right pane shows the simulated subsurface flows between subbasins for a baseline condition where no pumping has occurred in any subbasins. All values are in units of acre-feet per year (AFA) as averaged over the modeled years of 1980-2022. Under the historical baseline, an average of 5,071 AFA flows from the Upper Valley to the Forebay Subbasin; 8,431 AFA flow from the Forebay to the 180/400 Subbasin, and 6385 AFA flows from the Forebay to the Eastside Subbasin; 27,292 AFA flows from the 180/400 to the Eastside Subbasin; and 8603 AFA flows from the bay into the 180/400 Subbasin as seawater intrusion.

The **Figure 2** left pane illustrates how much the subsurface flows are simulated to change if there had been no pumping from the Upper Valley Subbasin over the entire historical period. There is a simulated increase in subsurface flow from the Upper Valley to the Forebay Subbasin of 4,979 AFA; a simulated increase in subsurface flow from the Forebay to the 180/400 and Eastside Subbasins of 3 and 26 AFA, respectively; a simulated increase in subsurface flow from the 180/400 to the Eastside Subbasin of 1,598 AFA; and a reduction in seawater intrusion to the 180/400 Subbasin of 381 AFA. The changes under the "full aquifer" baseline where the starting point is no pumping anywhere in the valley, then pumping is turned on in the Upper Valley produces comparable results, but the direction of subsurface flows comparison are presented changes (note direction of arrows in the figures).

Results of the superposition testing may be made for changes to pumping in the Forebay, Eastside, and 180/400 Subbasins using Figures 3-5. Values for subsurface flows in the baseline conditions, and then the changes observed by testing pumping in each subbasin are summarized in the **Tables 1-4**. **Table 1** summarizes the superposition results from the scenario in which pumping in each subbasin is successively turned off, while pumping in all the other subbasins remains on for the hydrologic testing period 1980-2022. The first row shows the baseline amounts of annual groundwater flow between subbasins and seawater intrusion with actual historic pumping turned on in all subbasins. The second row shows the impact on inter-subbasin flows if actual historic Upper Valley pumping were turned off. For example, turning off Upper Valley pumping would reduce seawater intrusion into the 180/400 Subbasin to 8,221 AFA (down 382 AFA). Meanwhile, the bottom row shows that turning off 180/400 Subbasin pumping would reduce seawater intrusion into the 180/400 Subbasin to 456 AFA (down 8,147 AFA). Those and all the other net changes in inter-subbasin flows and seawater intrusion are summarized below in **Table 2**.

Table 3 summarizes the superposition results from the scenario in which pumping in each subbasin is successively turned on, while pumping in all the other subbasins remains off for the hydrologic testing period 1980-2022. The first row shows the baseline amounts of annual groundwater flow between subbasins and 4,450 AFA of groundwater discharge to the ocean with actual historic pumping turned off in all subbasins. The second row shows the impact on inter-subbasin flows and ocean discharge if actual historic Upper Valley pumping were turned on. For example, turning on Upper Valley pumping would reduce ocean discharge from the 180/400 Subbasin to 4,339 AFA (down 51 AFA). Meanwhile, the bottom row shows that turning on 180/400 Subbasin pumping would reduce ocean discharge from the 180/400 Subbasin to 3 AFA (down 4,447 AFA) while turning on Eastside Subbasin pumping would reduce ocean discharge from the 180/400 Subbasin to 3,515 AFA (down 935 AFA). Those and all the other net changes in inter-subbasin flows and ocean discharge are summarized below in **Table 4**.

Table 1 – Summary of Subbasin Subsurface Flows – Historical Baseline Superposition Modeling

(Average Values 1980-2022 in AFA)

Model Scenario	Upper Valley to Forebay	Forebay to Eastside	Forebay to 180/400	180/400 to Eastside	Seawater Intrusion to 180/400
Historical Conditions	5,071	6,385	8,431	27,292	8,603
No Upper Valley Pumping[a]	10,050	6,412	8,434	28,890	8,221
No Forebay Pumping[a]	887	8,407	10,339	28,588	8,183
No Eastside Pumping[a]	5,013	3,751	6,815	10,566	6,555
No 180/400 Pumping[a]	5,005	5,251	5,766	52,324	456

Notes:
a Historical pumping continues in all other subbasins.

Table 2 – Summary of Subbasin Subsurface Flow Changes from Baseline – Historical Baseline Superposition Modeling

(Average Values 1980-2022 in AFA)

Model Scenario	Upper Valley to Forebay[b]	Forebay to Eastside[b]	Forebay to 180/400[b]	180/400 to Eastside[b]	Seawater Intrusion to 180/400
No Upper Valley Pumping[a]	4,979	26	3	29	-381[c]
No Forebay Pumping[a]	-4,185	2,022	1,908	3,930	-420[c]
No Eastside Pumping[a]	-58	-3,635	-1,616	-5,251	-2,047[c]
No 180/400 Pumping[a]	-67	-1,134	-2,665	-3,799	-8,147[c]

Notes:
a Historical pumping continues in all other subbasins.
b Positive value = increase over historical baseline flow; Negative value = decrease over historical baseline flow.
c Negative value = less seawater intrusion.

Table 3 – Summary of Subbasin Flows – Full Aquifer Baseline Superposition Modeling

(Average Values 1980-2022 in AFA)

Model Scenario	Upper Valley to Forebay	Forebay to Eastside	Forebay to 180/400	Eastside to 180/400	Seawater Intrusion to 180/400
Full Aquifer Conditions (No Historical Pumping)	4,478	1,822	5,492	21,973	-4,450[b]
Upper Valley Pumping On[a]	1,084	1,815	5,440	22,100	-4,339 [b]
Forebay Pumping On[a]	9,256	57	3,884	21,429	-4,397 [b]
Eastside Pumping On[a]	4482	4266	6632	-16,941	-3,515 [b]
180/400 Pumping On[a]	4,484	2,547	6,841	36,700	-3 [b]

Notes:
a No pumping in all other subbasins.
b Negative value for seawater intrusion = subsurface outflow to the ocean

Table 4 – Summary of Subbasin Flow Changes from Baseline – Full Aquifer Baseline Superposition Modeling

(Average Values 1980-2022 in AFA)

Model Scenario	Upper Valley to Forebay[b]	Forebay to Eastside[b]	Forebay to 180/400[b]	Eastside to 180/400[b]	Seawater Intrusion to 180/400
Upper Valley Pumping On[a]	-3,394	-7	-52	127	51 [c]
Forebay Pumping On[a]	4,778	-1,765	-1,608	-544	53 [c]
Eastside Pumping On[a]	4	2,444	1,140	-38,914	935 [c]
180/400 Pumping On[a]	6	725	1,349	14,727	4,447 [c]

Notes:
a No pumping in all other subbasins.
b Positive value = increase over historical baseline flow, Negative value = decrease over historical baseline flow.
c Positive value = less outflow to the ocean.

2.2.2 Salinas River Flow Observations

Simulated flow changes in the Salinas River should also be summarized in the new Summary text. Average annual discharge at key gages in units of acre-feet per year (AFA) would suffice. M&A Tables 7 and 14 are relatively easy to understand and probably do not need to be repeated in the Summary, but general average annual magnitudes of change in flow in the superposition testing should be simply and clearly described, and a complementary summary figures are suggested, such as the **Figures 6-10**. **Figure 6** shows the simulated baseline flows at three key gages on the Salinas River, in units of AFA, averaged over the 1980-2022 simulation period. **Figures 7-10** then show the simulated changes in flows resulting from subbasin pumping turned off while other pumping continues (historical baseline – left side pane) and pumping turned on by subbasin at historical rates for the "aquifer full" baseline condition (right side pane). **Tables 5 and 6** summarizes the simulated Salinas River flow changes, for both the historical baseline testing and the "full aquifer" baseline testing for the most down-stream gage Spreckels.

For example, Salinas River average annual flow at the Spreckels gage for historical pumping baseline is simulated at 246,536 AFA (left pane, **Figure 6**). When all historical pumping in the Upper Valley Subbasin is turn off for the simulation period, there is an increase in average annual flow at the Spreckels gage of 35,904 AFA (left pane, **Figure 7**), or an approximate flow increase of 14.6% (**Table 5**). For the "full aquifer" baseline conditions, historical pumping turned on in the Upper Valley Subbasin is simulated to decrease the average annual flow at the Spreckels gage from 423,519 AFA to 378,498 AFA, or a reduction in flow of 45,020 AFA or 10.6% of the total annual flow at Spreckels (refer to **Figure 7** right pane, and **Table 6**).

Table 5 – Summary of Salinas River Simulated Annual Flows and Changes at the Spreckels Gage for Historical Baseline Superposition Modeling

(Average Values 1980-2022)

Model Scenario	Annual Flow (AFA)	Change in Annual Flow (AFA)	Percentage Change in Flow
Simulated Flow with All Historical Pumping	246,536	--	--
Simulated Flow with Upper Valley Pumping Off	282,461	+35,904	14.6%
Simulated Flow with Forebay Pumping Off	285,866	+39,310	15.9%
Simulated Flow with Eastside Pumping Off	254,677	+8,121	3.3%
Simulated Flow with 180/400 Pumping Off	266,920	+20,364	8.3%

Table 6 – Summary of Salinas River Simulated Annual Flows and Changes at the Spreckels Gage for the "Full Aquifer" Baseline Superposition Modeling

(Average Values 1980-2022)

Model Scenario	Annual Flow (AFA)	Change in Annual Flow (AFA)	Percentage Change in Flow
Simulated Flow with No Historical Pumping ("Full Aquifer" Condition)	423,519	--	--
Simulated Flow with Upper Valley Pumping On	378,498	-45,020	14.6%
Simulated Flow with Forebay Pumping On	376,506	-47,013	15.9%
Simulated Flow with Eastside Pumping On	409,221	-14,298	3.3%
Simulated Flow with 180/400 Pumping On	397,481	-26,038	8.3%

2.2.3 Regional Groundwater Level Changes

Regional water level elevation changes are relatively easy to visualize in color-flood maps in the M&A memorandum. Some complimentary Summary text and tables are needed to describe the magnitude and geographic distribution of average responses by subbasin. **Tables 7 and 8** are examples of this type of summary table, where maximum water level changes by subbasin (1980-2022, average change) are presented.

Table 7 shows water levels resulting from successively turning pumping off in each subbasin. For example, the first row shows turning Upper Valley Subbasin pumping off would increase Upper Valley water levels by 20-40 feet while increasing water levels elsewhere by 1-5 feet. The bottom row shows turning 180/400 Subbasin pumping off would increase water levels in the Forebay Subbasin by 5-10 feet, in the Eastside Subbasin by 40-60 feet, and in the 180/400 Subbasin by more than 60 feet.

Table 8 shows water levels resulting from successively turning pumping on in each subbasin. For example, the first row shows turning Upper Valley Subbasin pumping on would reduce Upper Valley water levels by 20-40 feet while reducing Forebay Subbasin water levels elsewhere by 1-5 feet, and water levels every else by less than 1 foot The bottom row shows turning the 180/400 Subbasin pumping on would reduce water levels in the Forebay Subbasin by 1-5 feet, in the Eastside Subbasin by 40-60 feet, and in the 180/400 Subbasin by more than 60 feet.

Table 7 – Summary of Maximum Water Level Changes – Historical Baseline Superposition Modeling

(Average Values 1980-2022 in Feet)

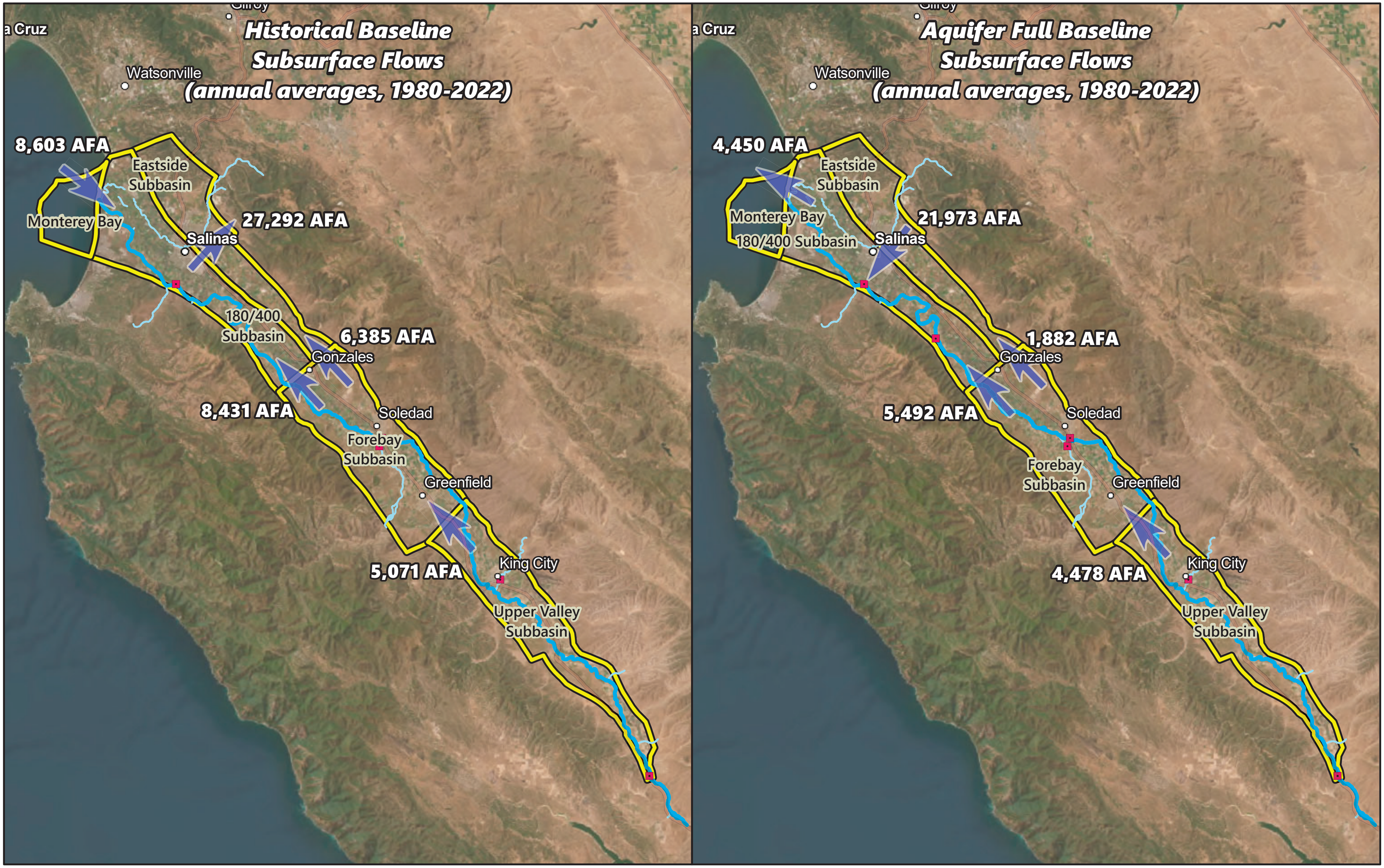
Model Scenario	Upper Valley	Forebay	Eastside	180/400
Upper Valley Pumping Off	20-40	1-5	1-5	1-5
Forebay Pumping Off	1-5	20-40	10-20	5-10
Eastside Pumping Off	<1	5-10	>60	20-40
180/400 Pumping Off	<1	5-10	40-60	>60

Table 8 – Summary of Maximum Water Level Changes – Full Aquifer Baseline Superposition Modeling

(Average Values 1980-2022 in Feet)

Model Scenario	Upper Valley	Forebay	Eastside	180/400
Upper Valley Pumping On	20-40	1-5	<1	<1
Forebay Pumping On	<1	20-40	10-20	1-5
Eastside Pumping On	<1	5-10	>60	20-40
180/400 Pumping On	<1	1-5	40-60	>60

Note: **Tables 7 and 8** above might present more accurately if average water level change over the subbasin is used in addition to maximum values presented from color flood figures (subbasin averages are not presented in the M&A memorandum, so not used in these example tables).



Gaging Stations

Salinas River

Creeks

Subbasins

N

0 13

Mile

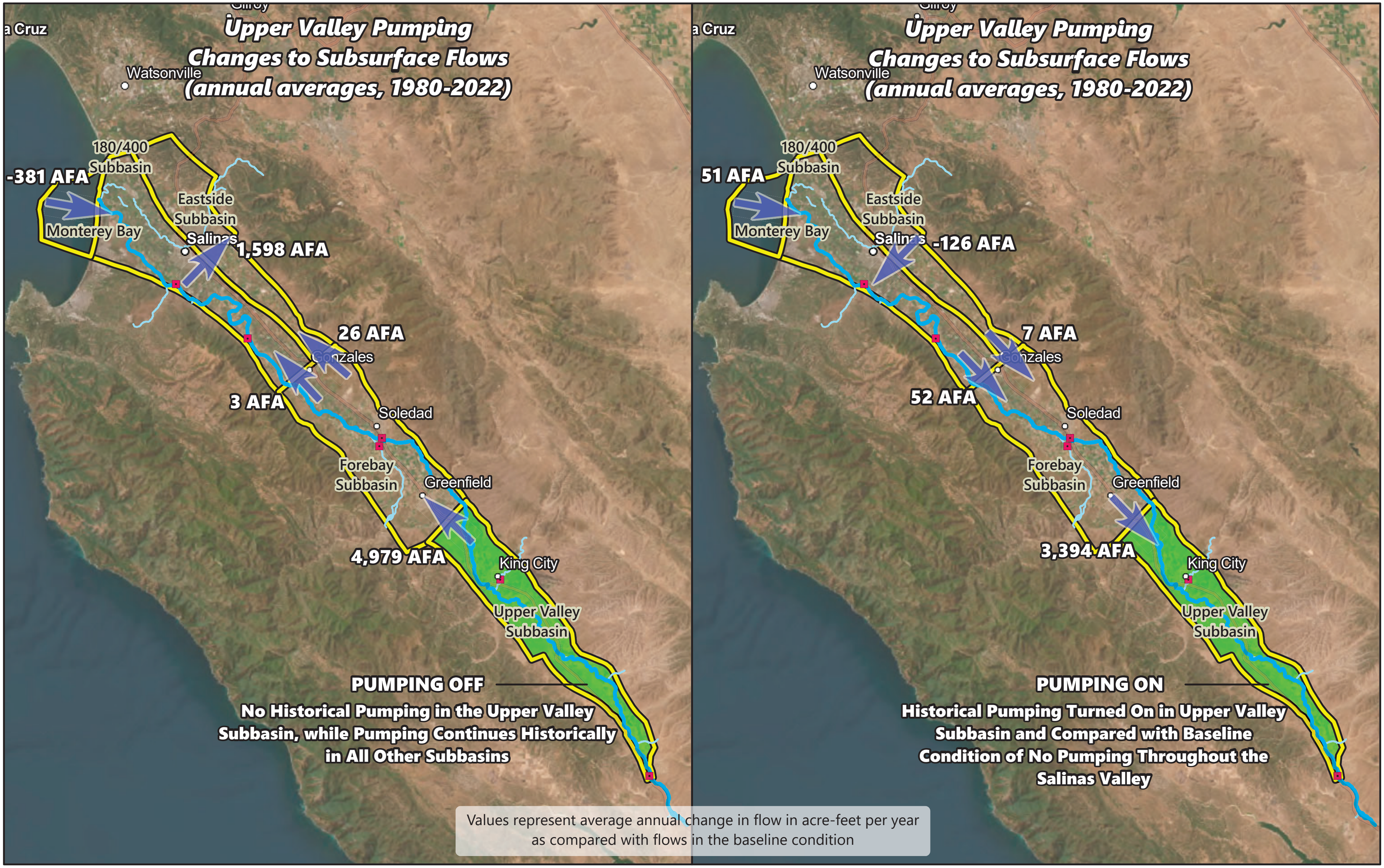
FIGURE 1

Historical & Aquifer Full Baseline Maps
Superposition Model Testing

Salinas Valley, CA

Client: Salinas Valley Water Coalition	
Project Code: HLLF001	
NAD 1983 UTM Zone 10N	
H.Chambers	10/13/2025

UES



- Gaging Stations
- Salinas River
- Creeks
- Subbasins

N

0 — 13 Mile

FIGURE 2

Upper Valley Pumping
Superposition Model Testing

Salinas Valley, CA

Client: Salinas Valley Water Coalition	
Project Code: HLLF001	
NAD 1983 UTM Zone 10N	
H.Chambers	10/15/2025

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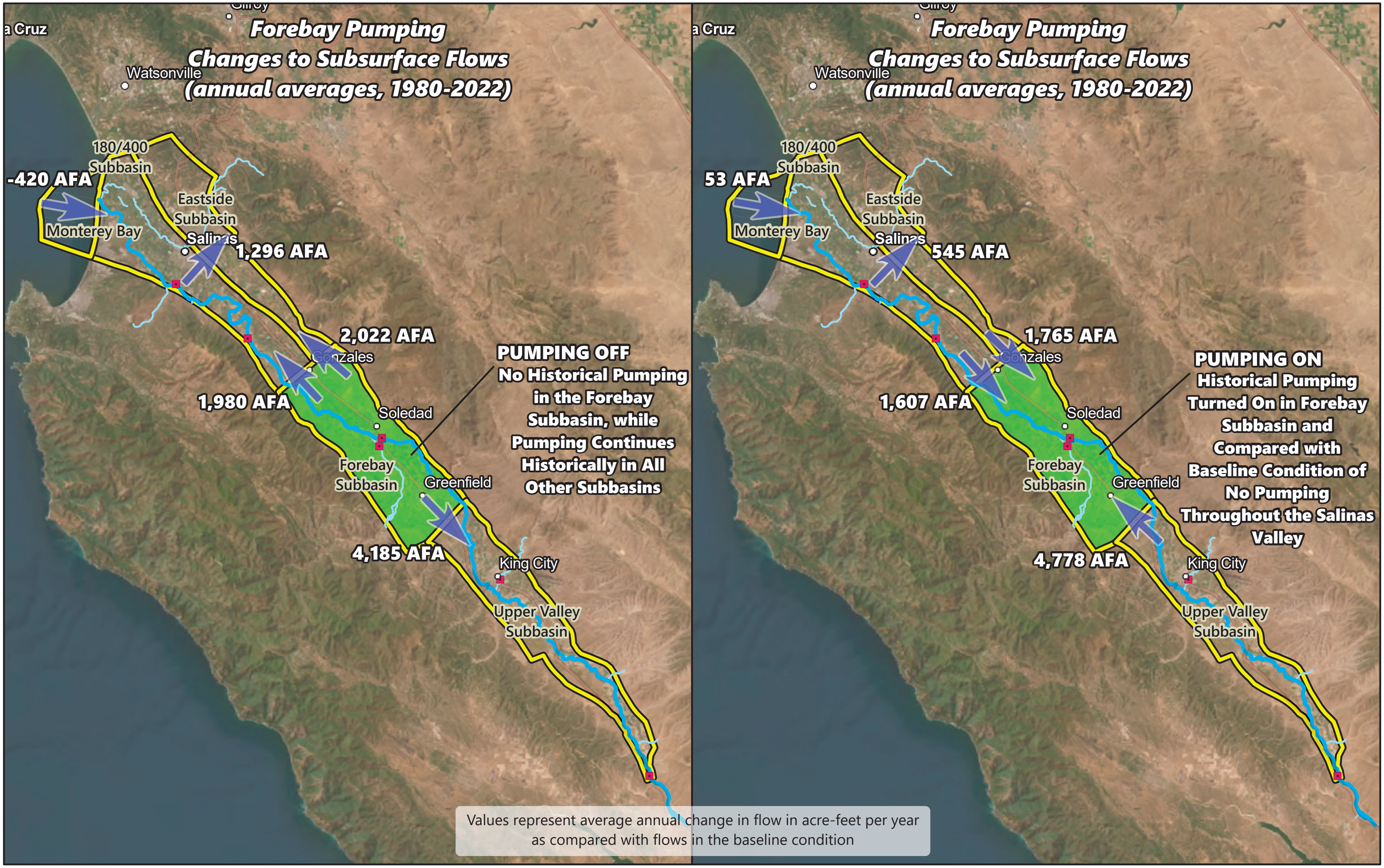


Gaging Stations
Salinas River
Creeks
Subbasins

N
0 13
Mile

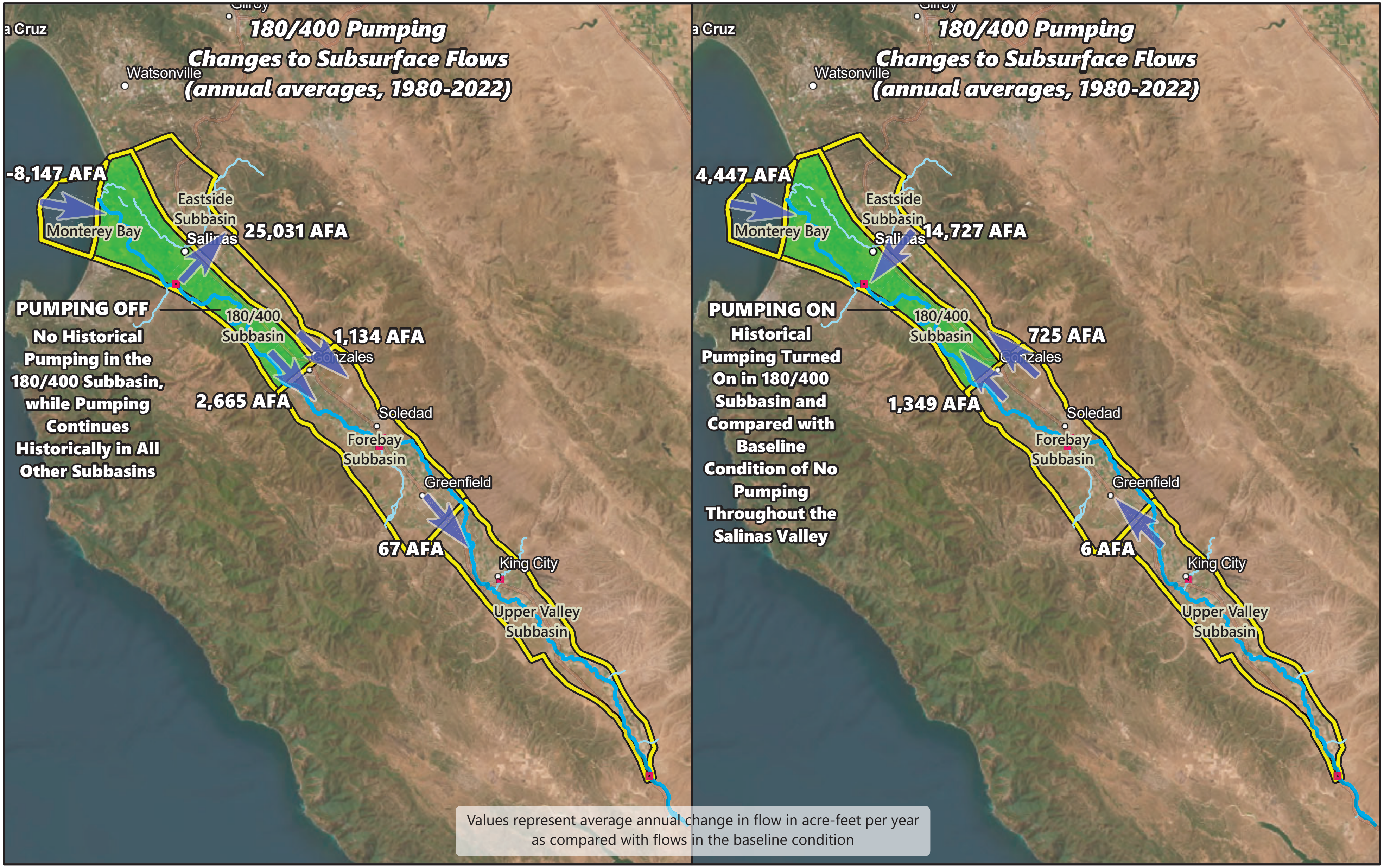
FIGURE 3

Forebay Pumping
Superposition Model Testing

Salinas Valley, CA

Client: Salinas Valley Water Coalition
Project Code: HLLF001
NAD 1983 UTM Zone 10N
H.Chambers 10/15/2025

UES™



- Gaging Stations
- Salinas River
- Creeks
- Subbasins

N

0 13
Mile

FIGURE 4

180/400 Pumping
Superposition Model Testing

Salinas Valley, CA

Client: Salinas Valley Water Coalition
Project Code: HLLF001
NAD 1983 UTM Zone 10N
H.Chambers 10/15/2025

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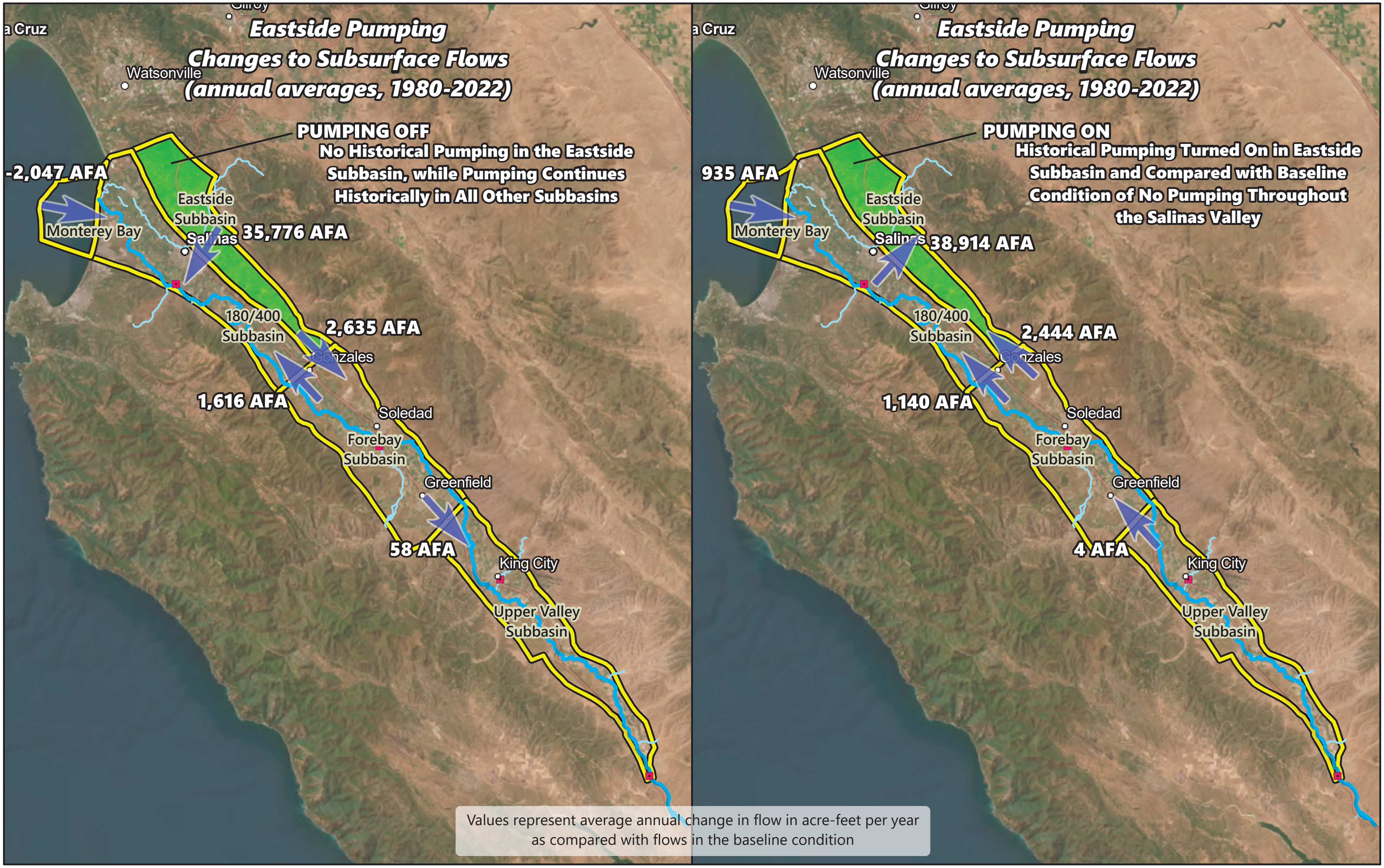

- Gaging Stations
- Salinas River
- Creeks
- Subbasins

N

0 13

Mile

FIGURE 5

Eastside Pumping
Superposition Model Testing

Salinas Valley, CA

Client: Salinas Valley Water Coalition	
Project Code: HLLF001	
NAD 1983 UTM Zone 10N	
H.Chambers	10/15/2025

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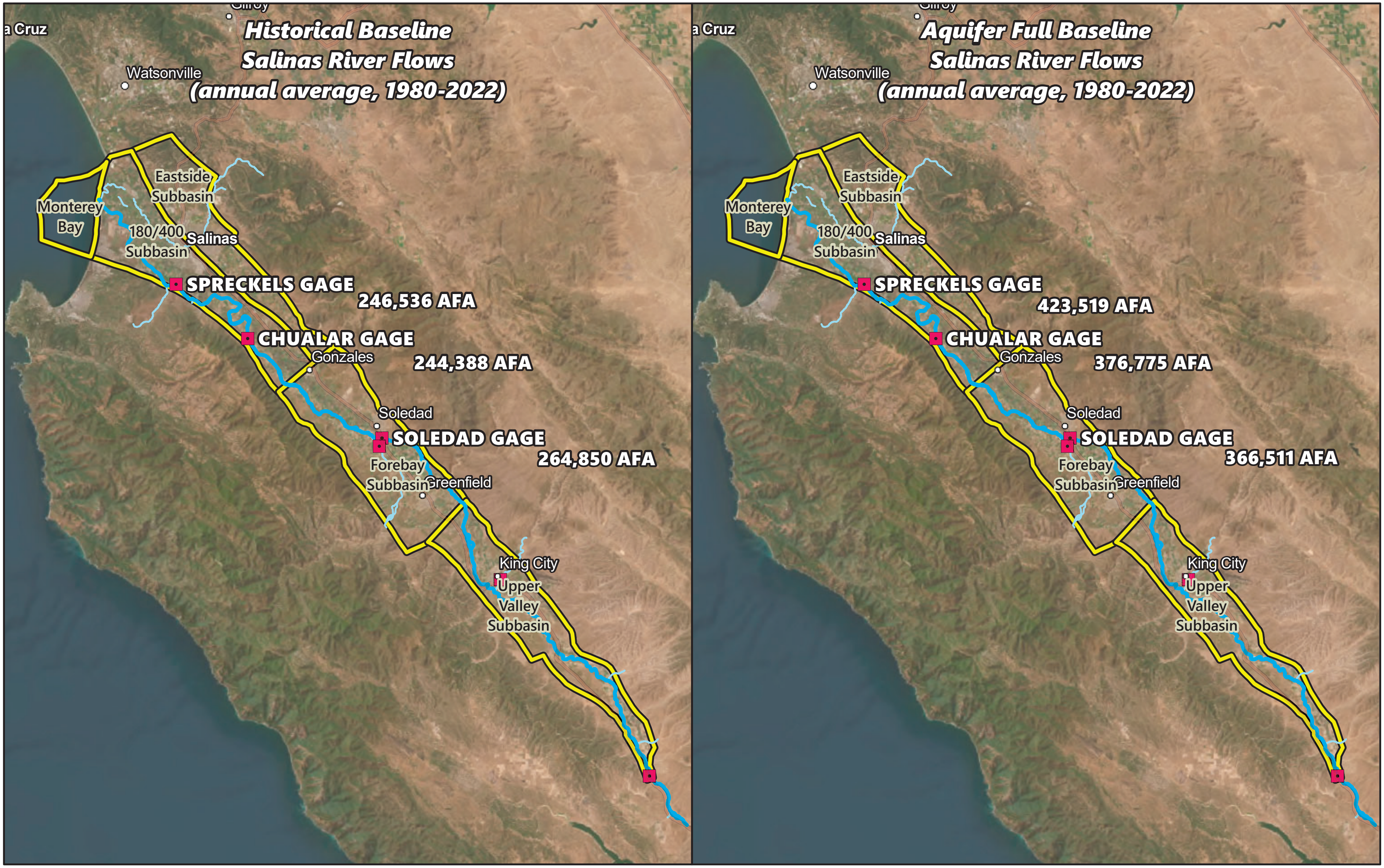

Gaging Stations
Salinas River
Creeks
Subbasins

N
0 13
Mile

FIGURE 6

Historical & Aquifer Full Baseline Maps
Superposition Model Testing

Salinas Valley, CA

Client: Salinas Valley Water Coalition
Project Code: HLLF001
NAD 1983 UTM Zone 10N
H.Chambers 10/17/2025

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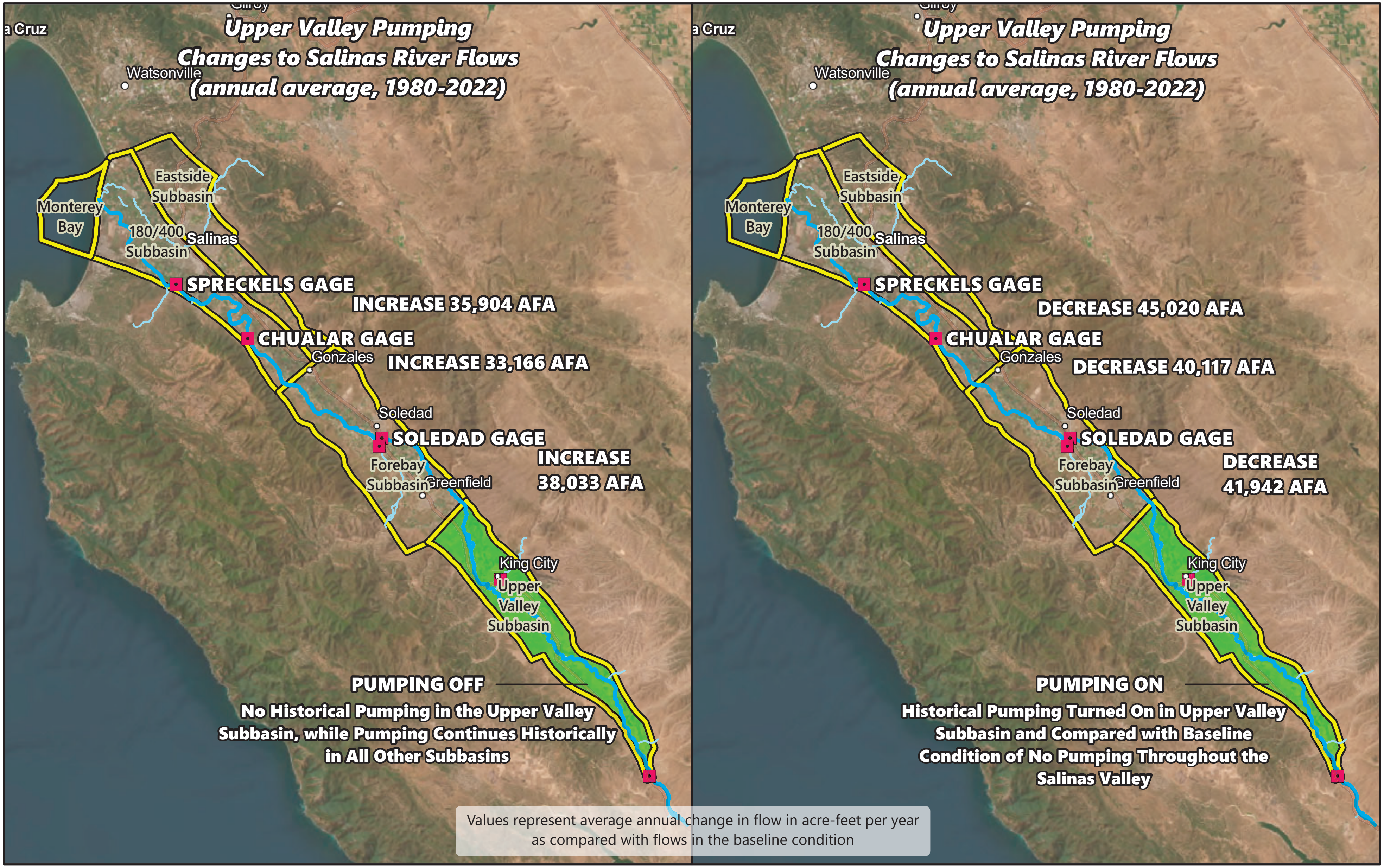

Gaging Stations
Salinas River
Creeks
Subbasins

N
0 13
Mile

FIGURE 7

Upper Valley - Gages
Superposition Model Testing

Salinas Valley, CA

Client: Salinas Valley Water Coalition
Project Code: HLLF001
NAD 1983 UTM Zone 10N
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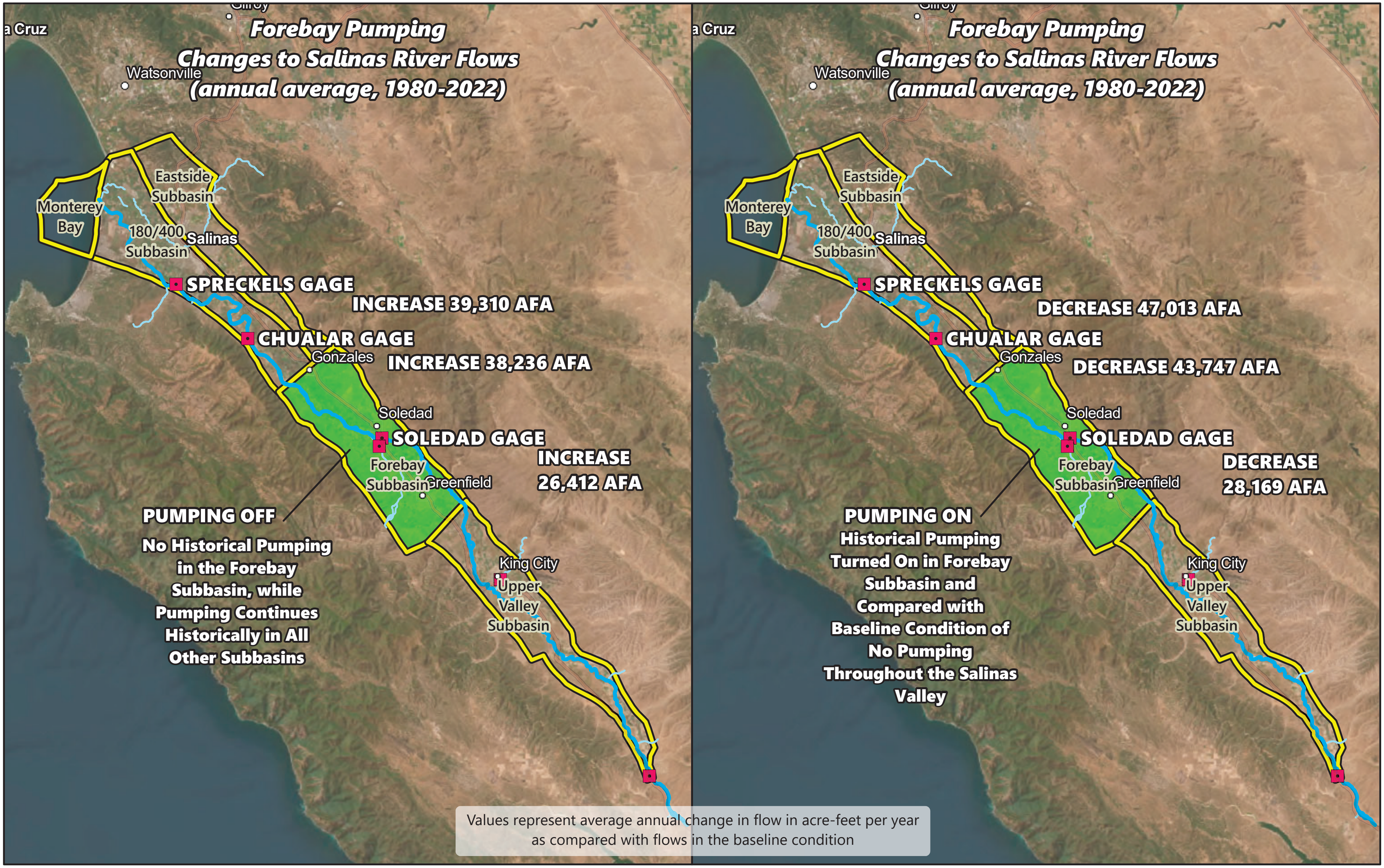

Legend:
- Gaging Stations
- Salinas River
- Creeks
- Subbasins

N

0 — 13 Mile

FIGURE 8

Forebay - Gages
Superposition Model Testing

Salinas Valley, CA

Client: Salinas Valley Water Coalition	
Project Code: HLLF001	
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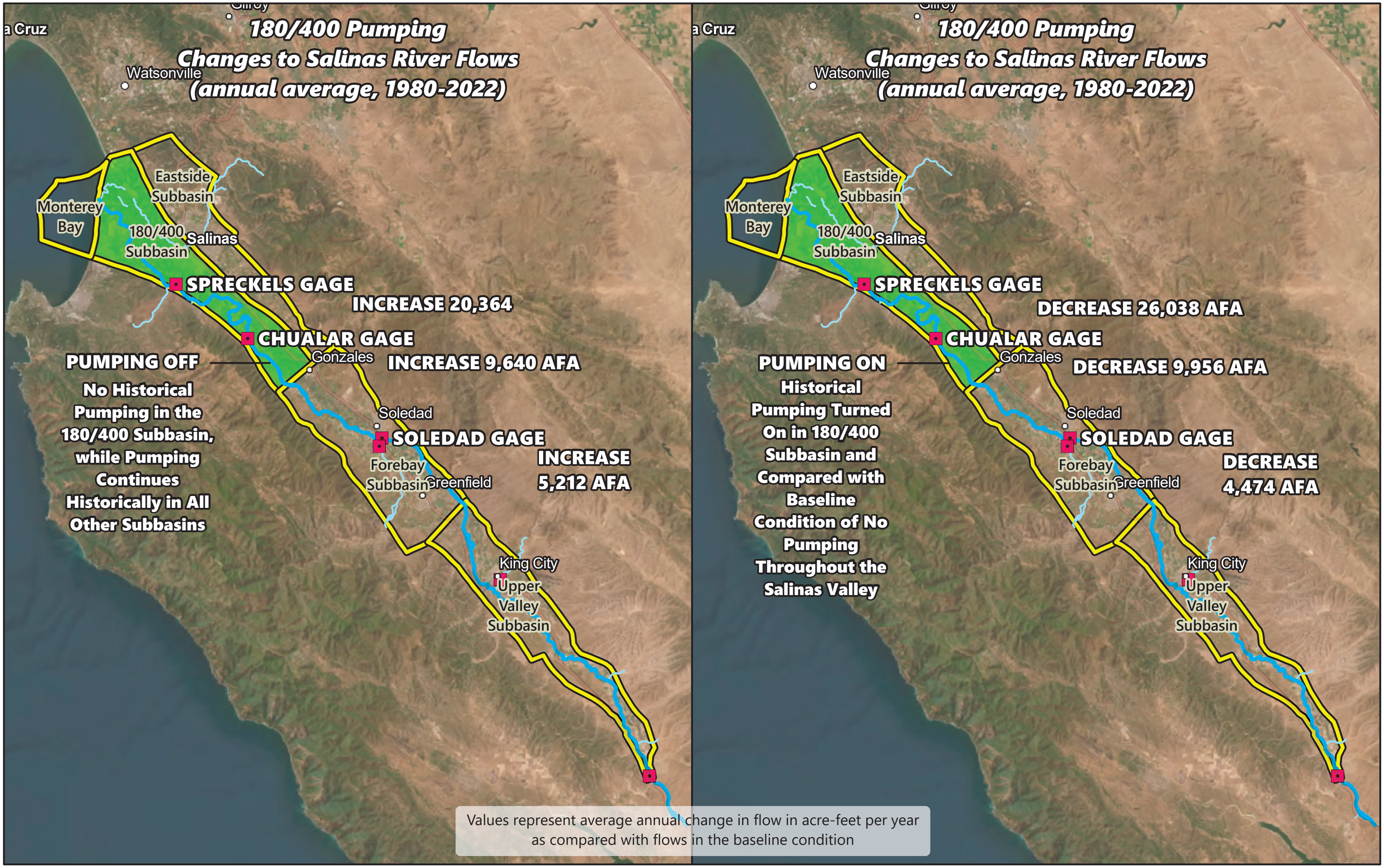

Gaging Stations
Salinas River
Creeks
Subbasins

N
0 13
Mile

FIGURE 9

180/400 - Gages
Superposition Model Testing

Salinas Valley, CA

Client: Salinas Valley Water Coalition
Project Code: HLLF001
NAD 1983 UTM Zone 10N
H.Chambers 10/17/2025

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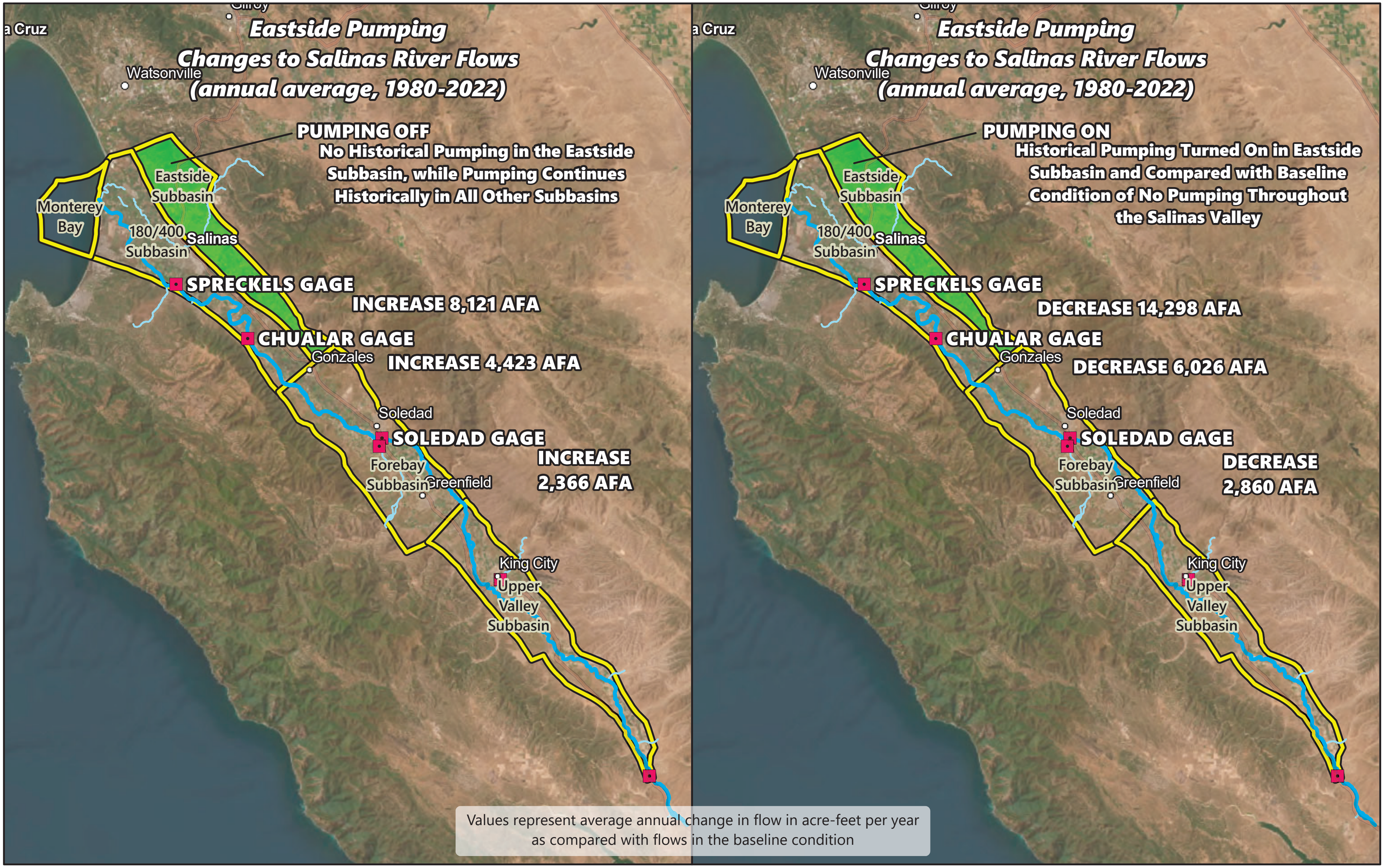

Gaging Stations
Salinas River
Creeks
Subbasins

N
0 13
Mile

FIGURE 10

Eastside - Gages
Superposition Model Testing

Salinas Valley, CA

Client: Salinas Valley Water Coalition	
Project Code: HLLF001	
NAD 1983 UTM Zone 10N	
H.Chambers	10/17/2025

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aquilogic, Inc.
environment ● water ● strategy

245 Fischer Avenue, Suite D-2
Costa Mesa, CA 92626
Tel. +1.714.770.8040
Web: www.aquilogic.com

MEMORANDUM

To:	Abby Ostovar and Derrik Williams, Montgomery & Associates
Cc:	Piret Harmon and Emily Gardner, Salinas Valley Basin Groundwater Sustainability Agency Christopher Bunn, Salinas Basin Water Alliance Stephanie Hastings, Brownstein Hyatt Faber Schrek, LLP Dwight Smith, UES
From:	Anthony Brown, Principal-In-Charge, aquilogic, Inc. Bob Abrams, PhD, PG, CHg, Senior Principal Hydrogeologist, aquilogic, Inc.
Date:	December 2, 2025
Subject:	**Comments on Montgomery & Associates draft Memorandum, "*Results of Computer Modeling Agreement for SVWC and SBWA*," dated August 22, 2025** **Project No.: 018-09**

Montgomery & Associates (M&A), on behalf of the Salinas Valley Basin Groundwater Sustainability Agency (SVBGSA), prepared a draft memorandum, "*Results of Computer Modeling Agreement for SVWC and SBWA*," dated August 22, 2025. The M&A draft memorandum summarizes results of a hydrologic modeling exercise (hereafter referred to as inter-subbasin impact modeling) designed to isolate and individually evaluate the impacts of pumping in the Upper Valley Aquifer Subbasin (UV), the Forebay Aquifer Subbasin (FB), the 180/400-Ft Aquifer Subbasin (180/400), and the East Side Aquifer Subbasin (ES), one subbasin at a time, on the water resources[1] of the other three subbasins.[2]

The inter-subbasin impact modeling was jointly requested by the Salinas Basin Water Alliance (SBWA) and the Salinas Valley Water Coalition (SVWC). SVBGSA agreed that the modeling would be beneficial and instructed M&A to proceed. The M&A draft memorandum presents a summary of the results of the inter-subbasin impact modeling, which was conducted by M&A. The purpose of this **aquilogic** memorandum is to provide comments on, and recommendations for revisions of, the M&A draft memorandum, so that any final iteration is more easily understood by readers who may lack a technical background, including stakeholders.[3]

---

[1] In this context, the term "water resources" has the same meaning as "water availability." Water availability in the Salinas Valley Groundwater Basin (SVGB) concerns both groundwater and stream flows in the Salinas River.

[2] The inter-subbasin impact modeling was conducted by M&A using the version of the Salinas Valley Hydrologic Model (SVIHM) released by the United States Geological Survey (USGS) in April 2025.

[3] **Aquilogic** will provide further independent comments on the model results to the SVBGSA Board of Directors, under separate cover.

As described in the M&A draft memorandum, the modeling was conducted by: (1) sequentially turning pumping on in one subbasin at a time using a "full basin" as a starting point (i.e., no pumping anywhere); and (2) sequentially turning pumping off in one subbasin at a time using the simulated historical condition as a starting point (i.e., pumping everywhere). Changes in groundwater flow and Salinas River flow between the subbasins, as well as changes in groundwater elevations in all four subbasins, were then evaluated and compared to the respective starting points.

The modeling described in the M&A memorandum is hypothetical in nature. The modeling was conducted in a "what if" (i.e., hypothesis testing) mode using the principle of superposition. As such, the modeling results were not expected to be precise. Instead, the results should be considered as "order-of-magnitude" accuracy (e.g., 10,000 to 15,000, instead of 13,051).[4]

CHRONOLOGY OF INTER-SUBBASIN IMPACT MODELING DEVELOPMENT

Aquilogic, Inc. (**aquilogic**), on behalf of SBWA, and McGinley & Associates (now UES), on behalf of SVWC (collectively, the stakeholder team), requested that SVBGSA conduct the inter-subbasin impact modeling in a memorandum, "*Assessment of Groundwater Flows between Subbasins of the Salinas Valley Groundwater Basin (SVGB),*" dated June 21, 2022, to Donna Myers, then General Manager of SVBGSA. The purpose of the June 21, 2022 memorandum was to, "*jointly submit a set of proposed simulation scenarios, developed by aquilogic and McGinley & Associates, to the SVBGSA to run and evaluate*." Importantly, the June 21, 2022 memorandum noted the integral role the Salinas River plays in SVGB water availability.

M&A responded to the stakeholder team's June 21, 2022 memorandum by preparing a letter to Ms. Myers, "*Cost Estimate for Salinas Basin Water Alliance and Salinas Valley Water Coalition Modeling Request*," dated August 24, 2022. Ms. Myers, SVBGSA, and M&A agreed that the inter-subbasin impact modeling would enhance the scientific understanding of SVGB hydrology. The June 21, 2022 letter was followed by a memorandum from M&A to the stakeholder team, "*Summary of Modeling Approach*," dated June 16, 2023.

Taken together, the three documents described above provided the "roadmap" for the modeling to be conducted by M&A, and the resulting August 22, 2025 M&A draft memorandum. All of these documents acknowledge that the hydrology of the Salinas Valley is highly integrated and essentially represents a single water resource composed of both groundwater and surface water (e.g., potential capture of Salinas River water by pumping and the need to evaluate changes in Salinas River flow resulting from such pumping are acknowledged). The hydrology of

[4] After completing the inter-subbasin impact modeling, M&A updated the version of SVIHM released in April 2025 by the USGS. **Aquilogic** expects that modeling results obtained from using the updated SVIHM would be consistent with the results discussed herein and in the M&A draft memorandum.

the SVGB dictates that groundwater pumping necessarily impacts Salinas River stream flows and these stream flows necessarily impact groundwater levels. Not surprisingly, the summary modeling results presented by M&A in their draft memorandum emphasize the strong connection between the groundwater system and the Salinas River.

The M&A draft memorandum provides summaries of simulated Salinas River flows and changes in flows at the Soledad, Chualar, and Spreckels stream gages. However, it should be noted that it would also be useful to include similar information at all other Salinas River stream gages, in a revised M&A memorandum.

RECOMMENDED REVISIONS TO THE M&A DRAFT MEMORANDUM

Aquilogic recommends the following revisions be made to the introductory text, figures, and tables of the M&A draft memorandum.

Introduction Section

M&A's summary memorandum is well written, clear, and easily understood by technical experts with knowledge of the SVBG and the inter-subbasin impact modeling. However, it may not be well understood by laypersons, including stakeholders. Accordingly, we recommend that the introductory discussion provide sufficient background and context to enable the reader to understand why the modeling was undertaken.

Figures

Changes in Groundwater Elevations, Figures 2 through 5 and Figures 9 through 12

The figures in the draft M&A memorandum are generally informative. However, Figures 2 through 5 and Figures 9 through 12 do not show the results of interest. These figures show the groundwater elevation changes in the subbasin for which pumping was turned on or off. They do not show the impact of pumping in one subbasin on water availability in adjacent and downgradient subbasins. M&A provided draft "replacement figures" at **aquilogic**'s request but did not update their draft memorandum.

Further, the color ramps used for Figures 2 through 5 and Figures 9 through 12 make it difficult to understand the modeling results, because the shades of green or red are nearly identical for several of the contour intervals. For example, these figures make clear that pumping in the UV and FB lowers groundwater levels in the 180/400. However, the magnitude of the impacts cannot easily be discerned. We suggest here that labeled contour lines be superimposed on the color shading.

The replacement figures are particularly difficult to decipher, due to the issues noted above with the color ramp, as well as the scale of maps. **Aquilogic** suggests that each figure should be split into three parts. These parts should zoom in on: (1) the 180/400 and ES; (2) the FB; and (3) the UV. The revised replacement figures should be included in a revised draft of the M&A August 25, 2025 draft memorandum.

Additional Figures

The tables in the M&A draft memorandum do a good job of summarizing the modeling results. However, most of the same information can and should be displayed on a few graphs, which would make it much easier to understand the results.

Aquilogic has independently reviewed the model results and summarized the results in the attached **aquilogic Figures 1** through **4**. It should be noted that changes in Salinas River stream flows from one subbasin to the others are approximated in **Figures 1** through **4** by the changes in stream flows at the Soledad stream gage (UV to FB) and Chualar stream gage (FB to 180/400) caused by pumping in the various subbasins.

Aquilogic Figure 1 shows the changes in Salinas River stream flows and groundwater flow between subbasins caused by pumping in the UV. **Aquilogic Figure 2** shows the changes in Salinas River stream flows and groundwater flow between the subbasins caused by pumping in the FB. **Aquilogic Figure 3** shows the changes in Salinas River stream flows and groundwater flow between the subbasins caused by pumping in the 180/400. **Aquilogic Figure 4** shows the changes in Salinas River stream flows and groundwater flow between the subbasins caused by pumping in the ES. All four figures also show the impact on seawater intrusion (SWI) caused by pumping in each subbasin.

Aquilogic's figures illustrate the modeling results, specifically:

1. Changes in Salinas River stream flows are significantly larger than changes in groundwater flow between the UV, FB, and 180/400:
    a. Pumping in the UV removes approximately 40,000 acre-feet per year (AFY) from the Salinas River (predominantly growing season reservoir releases), reducing water availability and groundwater replenishment in the FB and 180/400 (compared to 105,370 AFY total UV groundwater pumping[5])
        i. Therefore, approximately 38% of the pumping in the UV is derived directly from the Salinas River (i.e., growing season reservoir releases)

[5] Water Year 2024 Annual Report, Upper Valley Aquifer Subbasin, Table 3-2, p. 16). https://svbgsa.org/wp-content/uploads/2025/04/UpperValley_AnnualReport2024_Final-Cond.pdf, accessed October 27, 2025.

   b. Pumping in the FB removes approximately 40,000 AFY from the Salinas River (predominantly growing season reservoir releases), reducing water availability in the 180/400 (compared to 118,320 AFY total FB groundwater pumping[6])
      i. Therefore, approximately 35% of the pumping in the FB is derived directly from the Salinas River (i.e., growing season reservoir releases), potentially with contributions from the Arroyo Seco early in the growing season
2. Pumping in the UV and FB removes approximately 80,000 AFY from the Salinas River (i.e., stream depletion)
3. Pumping in the 180/400 reduces Salinas River flow from the FB to the 180/400 by approximately 10,000 AFY (compared to 103,980 AFY total 180/400 groundwater pumping[7])
   a. Therefore, approximately 10% of the pumping in the 180/400 is derived directly from Salinas River (i.e., growing season reservoir releases), potentially with contributions from the Arroyo Seco early in the growing season
4. Pumping in the ES removes approximately 35,000 AFY of groundwater from the 180/400 and less than 5,000 AFY from the FB (compared to approximately 81,540 AFY total ES groundwater pumping[8]
   a. Therefore, approximately 45% of the pumping in the ES is supplied by groundwater from the 180/400
5. Pumping in the 180/400 does causes minor impacts on water availability in the UV and FB (i.e., approximately 5,000 to 10,000 AFY)
6. Pumping in the ES does not cause significant impacts on water availability in the UV and FB (i.e., approximately 2,500 to 5,000 AFY)
7. Pumping in the UV and FB does not directly cause significant SWI in the 180/400, although it does reduce water availability in the 180/400
8. Pumping in the 180/400 and ES causes the majority of SWI in the 180/400 (5,000 to 8,000 AFY and 1,000 to 2,000 AFY, respectively)[9]

Additional Table

To better illustrate the model results – specifically, changes in Salinas River stream flows caused by pumping – we recommend including the attached **Table 1**. **Aquilogic**'s **Table 1** shows the relevance of the modeling requested by the stakeholder team by comparing the pumping-induced Salinas River depletion to water year (WY) 2024 total pumping.

[6] Water Year 2024 Annual Report, Forebay Aquifer Subbasin, Table 3-2, p. 16. https://svbgsa.org/wp-content/uploads/2025/04/Forebay_AnnualReport2024_Final-Cond.pdf, accessed October 27, 2025.
[7] Water Year 2024 Annual Report, 180/400-Ft Aquifer Subbasin, Table 3-1, p. 10. https://svbgsa.org/wp-content/uploads/2025/04/180400_AnnualReport2024_Final-Cond.pdf, accessed October 27, 2025.
[8] Water Year 2024 Annual Report, East Side Aquifer Subbasin, Table 3-1, p. 12. https://svbgsa.org/wp-content/uploads/2025/04/Eastside_AnnualReport2024_Final-Cond.pdf, accessed October 27, 2025.
[9] Presumably , pumping closer to the coast has a larger impact on SWI than pumping in distal portions of the 180/400

Conclusion

The inter-subbasin impact modeling results demonstrate that pumping in each of the upstream subbasins within the SVGB decreases water availability in downstream subbasins. The model results also demonstrate that water produced in upstream subbasins is mostly derived from growing season reservoir releases. This result is consistent with data provided by the Monterey County Water Resources Agency (MCWRA) Salinas River Discharge Measurements Series Results (River Series).[10] M&A's draft memorandum should be updated to more clearly reflect the model results.

[10] https://www.countyofmonterey.gov/government/government-links/water-resources-agency/documents/salinas-river-discharge-measurement-series, accessed October 27, 2025.

Table 1: Impacts of Pumping on Salinas River Flow

Salinas Basin Water Alliance

		Change in Salinas River Flow UV to FB (AFY)				Change in Salinas River Flow FB to 180/400 (AFY)			
	WY 2024 Annual Report Total Pumping (AFY)	Pumping Turned On Decrease	Pumping Turned Off Increase	Average	Approximate Percent of UV Pumping Derived from Salinas River	Pumping Turned On Decrease	Pumping Turned Off Increase	Average	Approximate Percent of FB Pumping Derived from Salinas River
UV	105,370	41,942	38,033	39,988	38%	40,117	33,166	36,642	--
FB	118,320	28,169	26,412	27,291	--	43,747	38,236	40,992	35%
180/400	103,980	4,474	5,212	4,843	--	9,956	9,640	9,798	--
ES	81,540	2,860	2,366	2,613	--	6,026	4,423	5,225	--

Notes:

AFY: Acre-feet per year

UV: Upper Valley Aquifer Subbasin

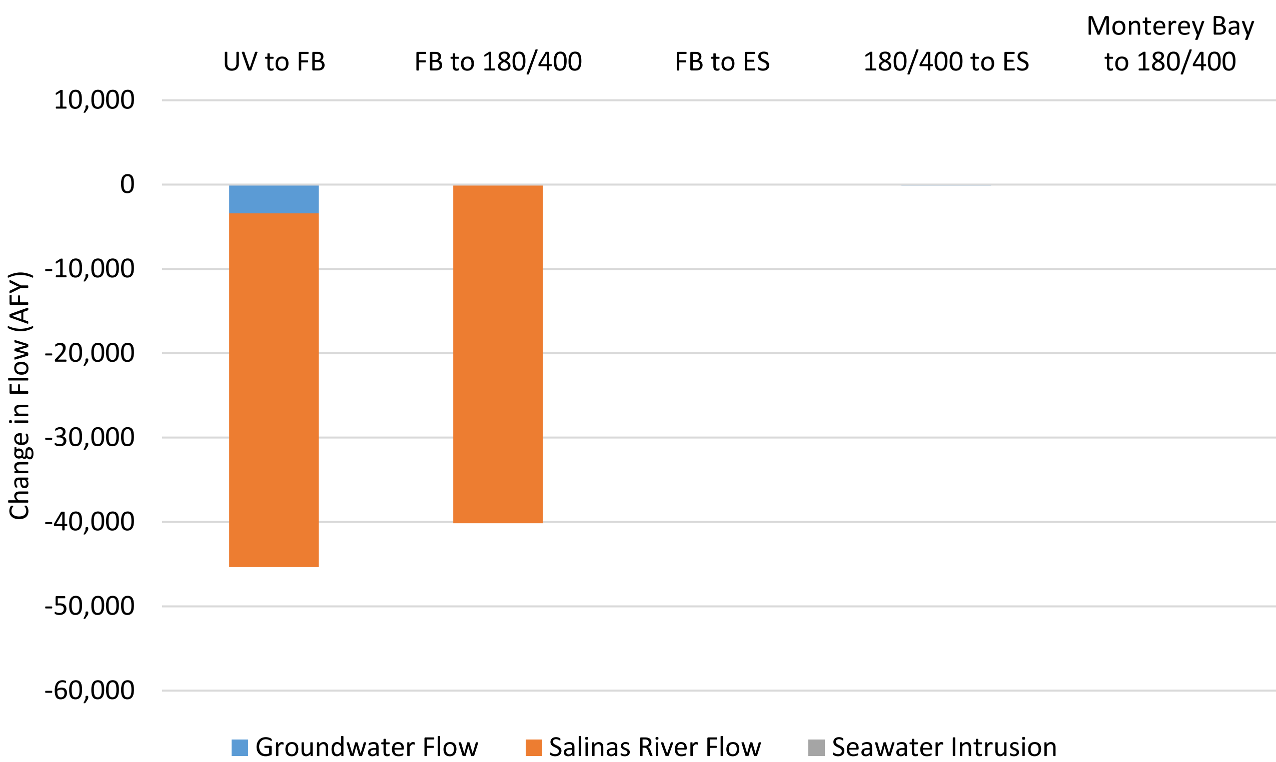
FB: Forebay Aquifer Subbasin

180/400: 180/400-Ft Aquifer Subbasin

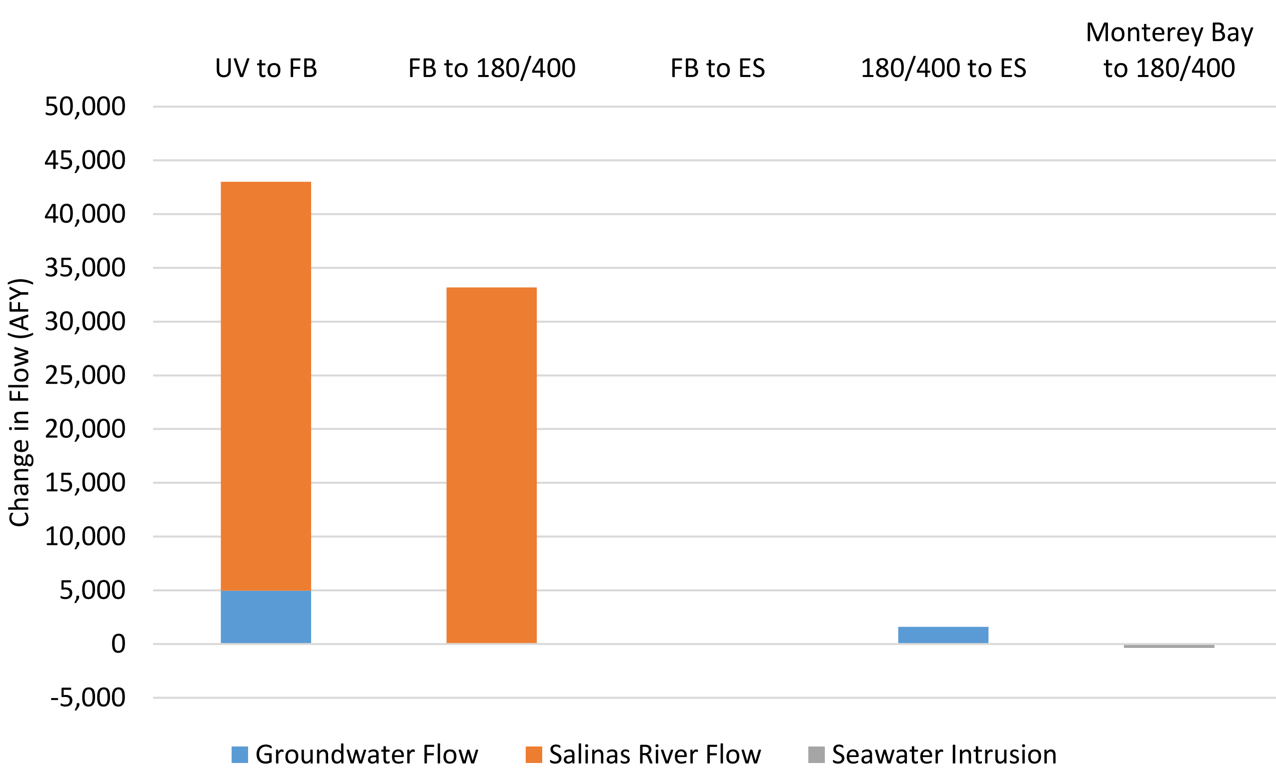
ES: East Side Aquifer Subbasin

--: Not applicable

Upper Valley Pumping Turned On



Upper Valley Pumping Turned Off



UV: Upper Valley Aquifer Subbasin
FB: Forebay Aquifer Subbasin
180/400: 180/400-Ft Aquifer Subbasin
ES: East Side Aquifer Subbasin
AFY: Acre-feet per year

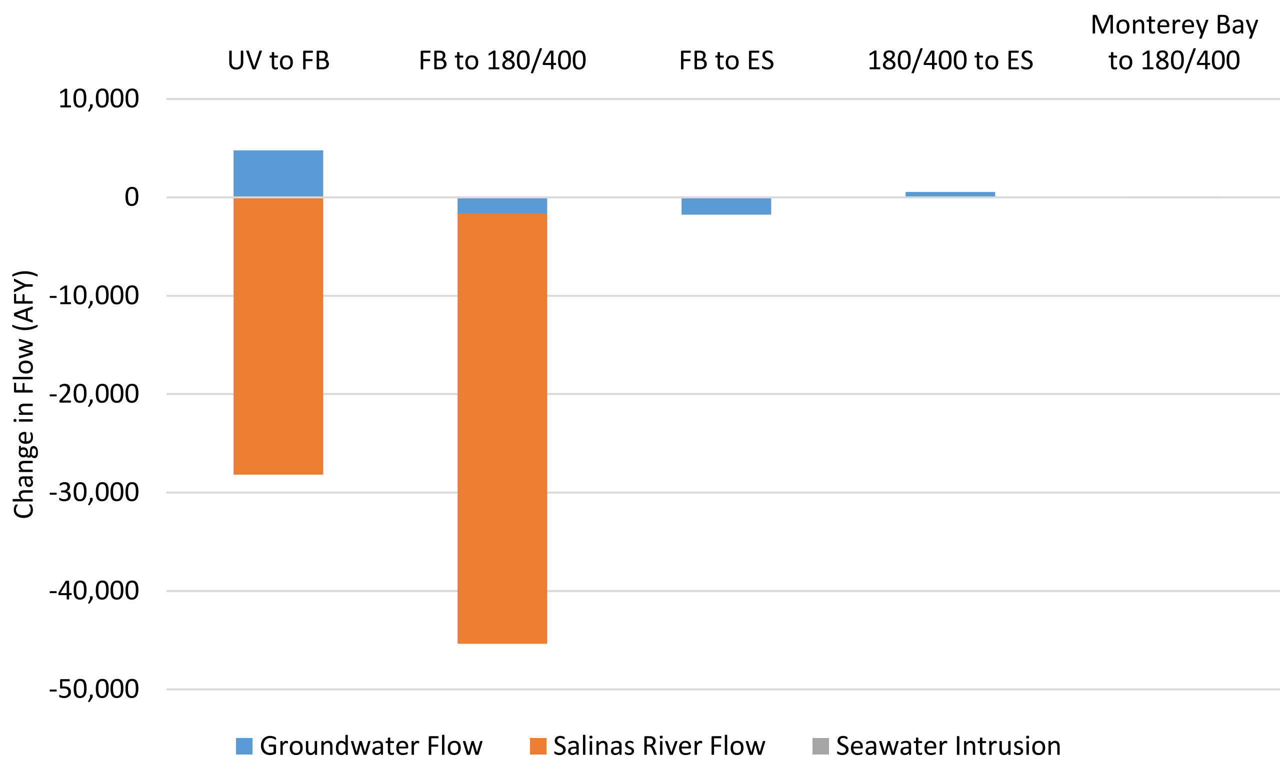
aquilogic, Inc.

Salinas Basin Water Alliance

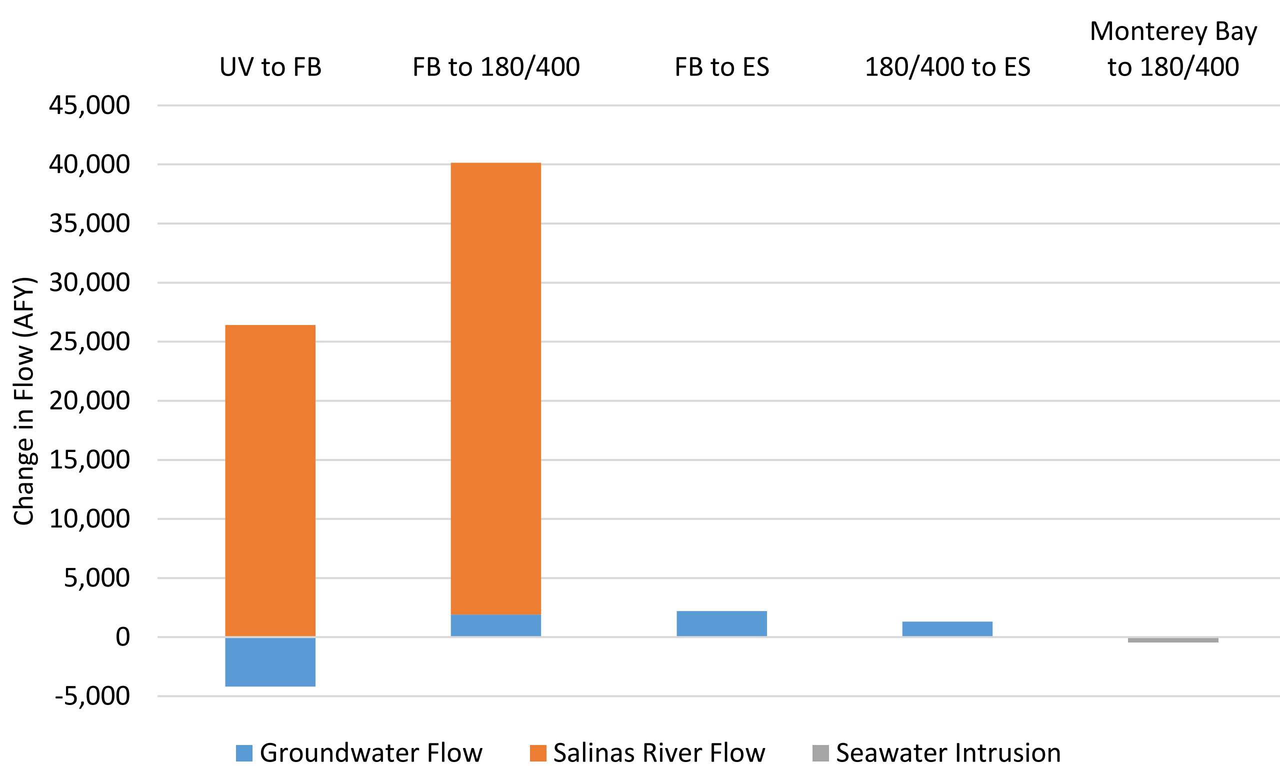
Upper Valley Aquifer Subbasin Pumping Impacts on Other Subbasins

Date:10/29/2025	Project #: 018-09	**Figure 1**

Forebay Pumping Turned On



Forebay Pumping Turned Off



UV: Upper Valley Aquifer Subbasin
FB: Forebay Aquifer Subbasin
180/400: 180/400-Ft Aquifer Subbasin
ES: East Side Aquifer Subbasin
AFY: Acre-feet per year

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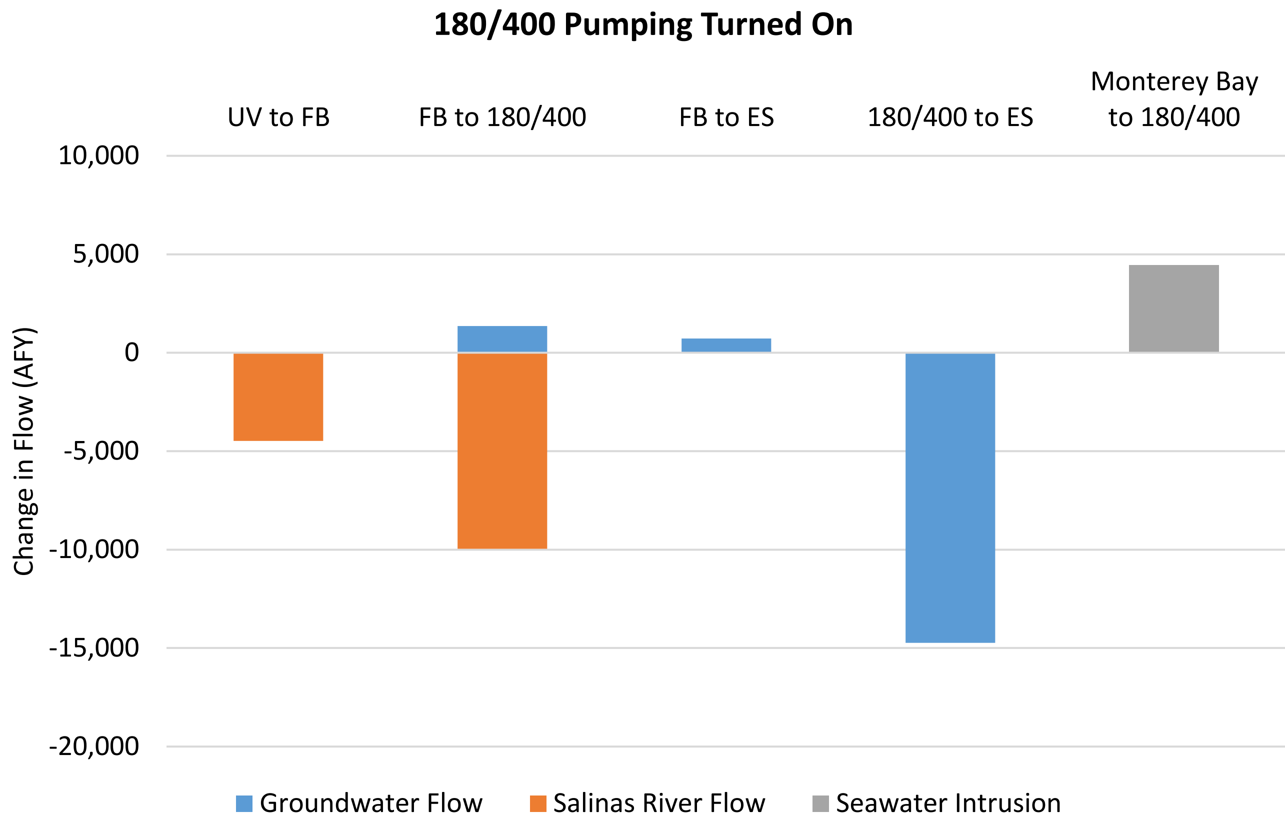
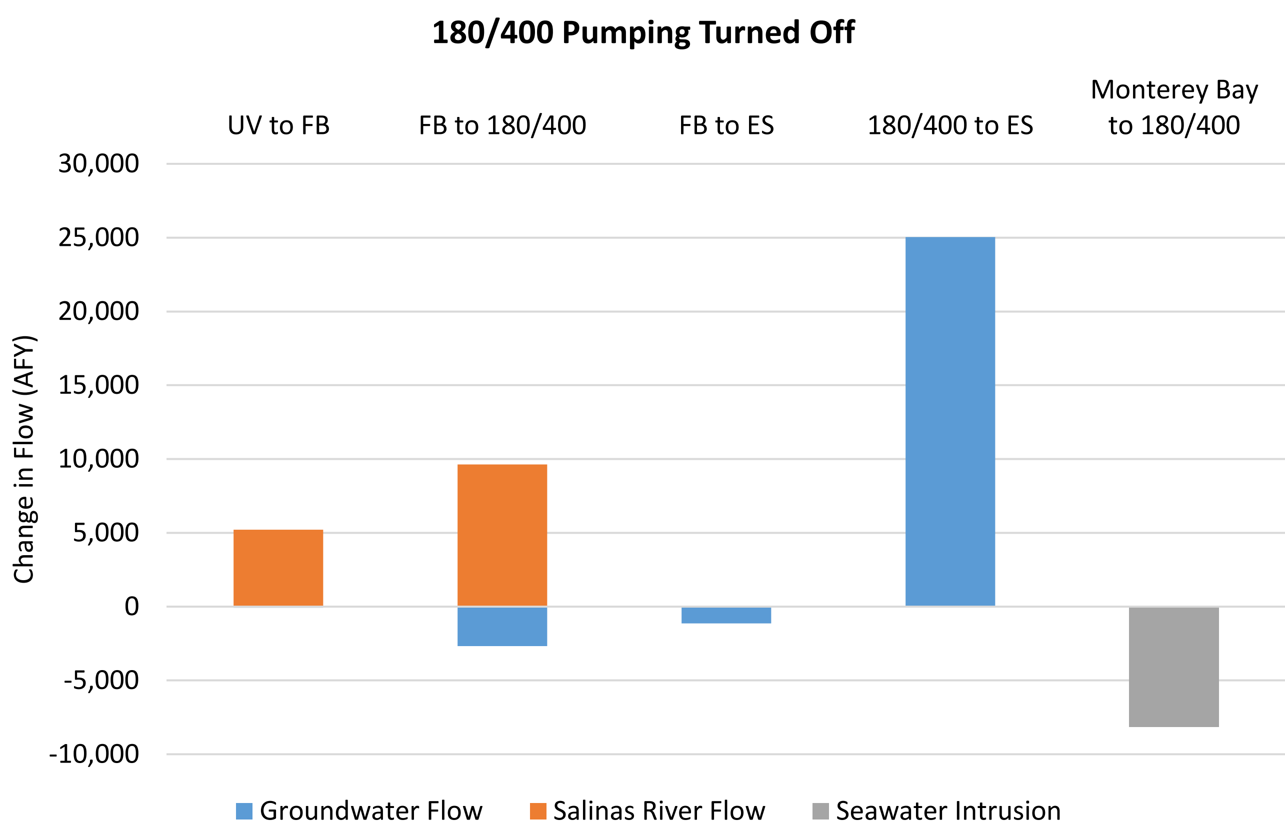
Forebay Aquifer Subbasin Pumping Impacts on Other Subbasins

Date:10/29/2025	Project #: 018-09	**Figure 2**





UV: Upper Valley Aquifer Subbasin
FB: Forebay Aquifer Subbasin
180/400: 180/400-Ft Aquifer Subbasin
ES: East Side Aquifer Subbasin
AFY: Acre-feet per year

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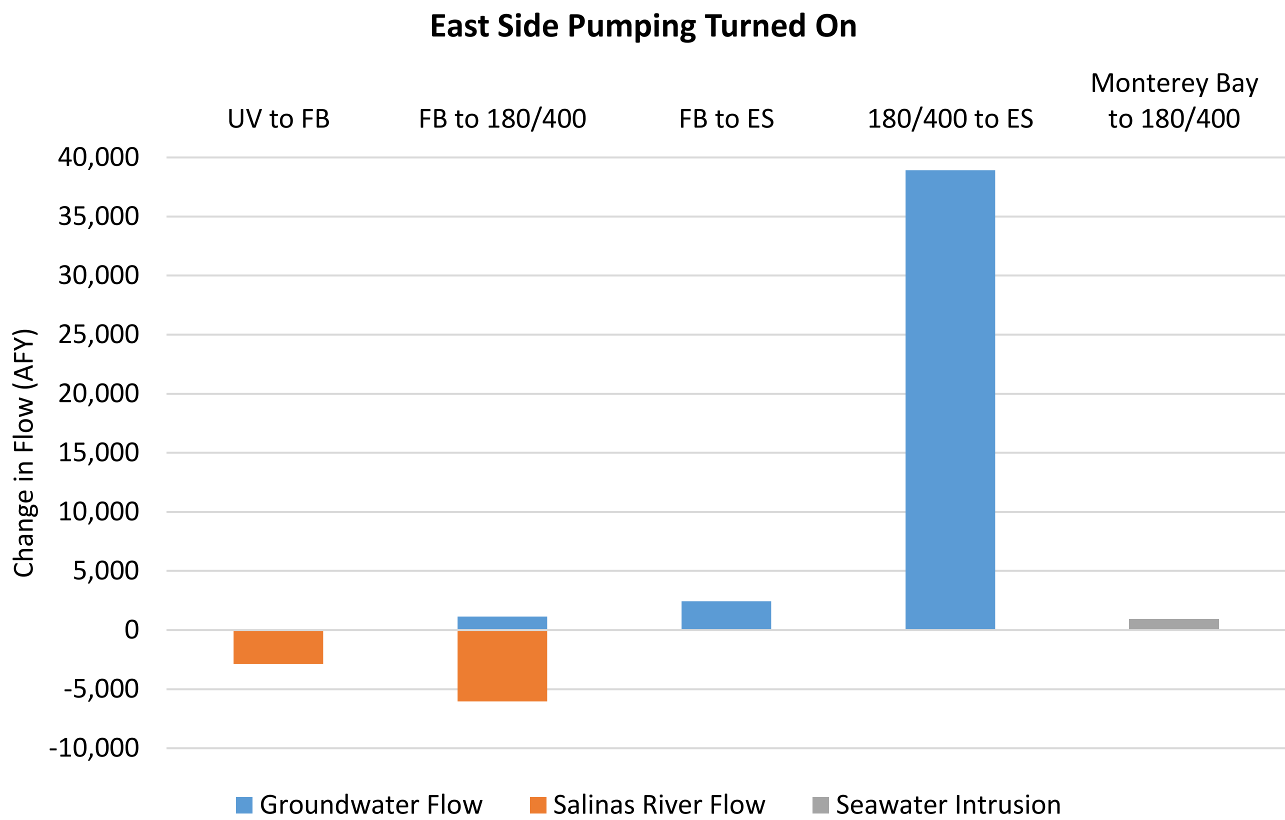
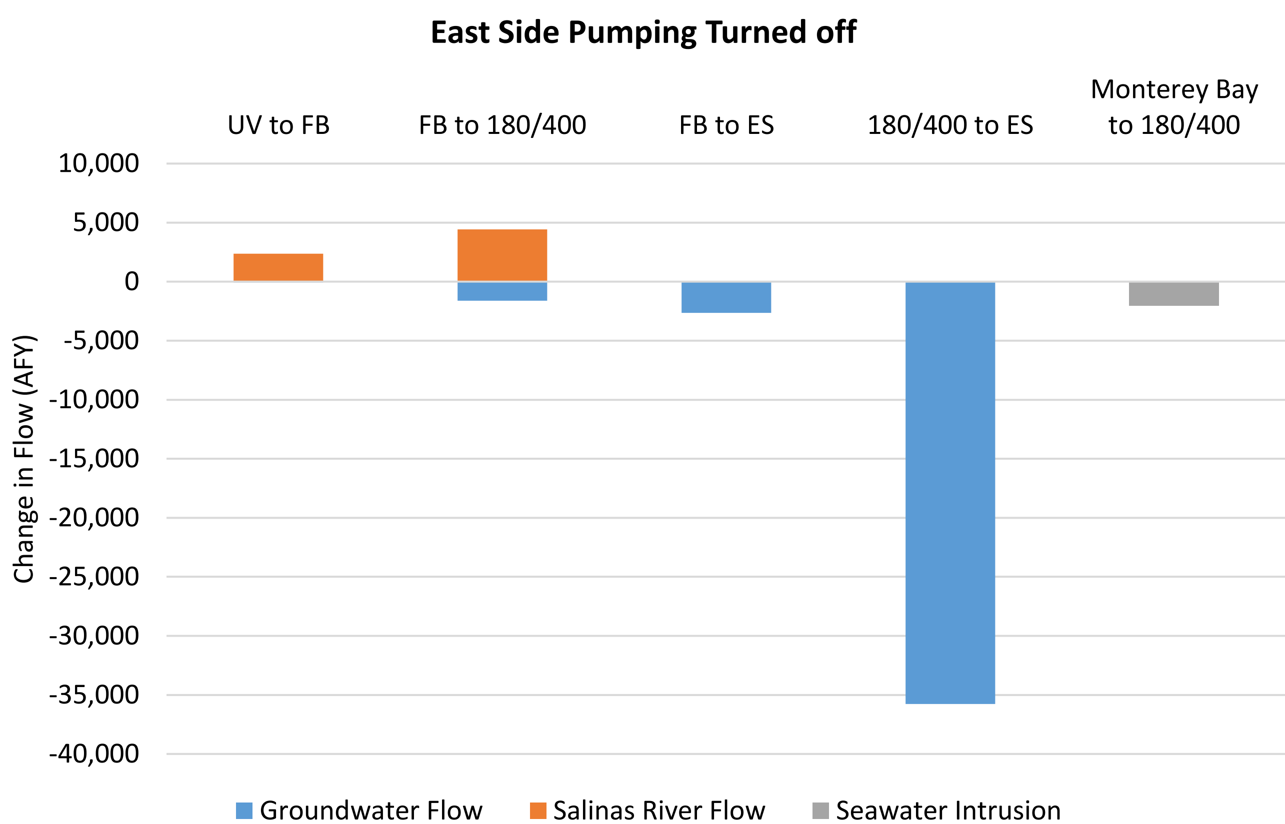
180/400-Ft Aquifer Subbasin Pumping Impacts on Other Subbasins

Date:10/29/2025	Project #: 018-09	**Figure 3**





UV: Upper Valley Aquifer Subbasin
FB: Forebay Aquifer Subbasin
180/400: 180/400-Ft Aquifer Subbasin
ES: East Side Aquifer Subbasin
AFY: Acre-feet per year

aquilogic, Inc.

Salinas Basin Water Alliance

East Side Aquifer Subbasin Pumping Impacts on Other Subbasins

Date:10/29/2025 | Project #: 018-09 | **Figure 3**