



— BUREAU OF —
RECLAMATION

Real-Time CVP Delta Operations and Fisheries Assessments

Adam Witt, PhD, PE | Stantec

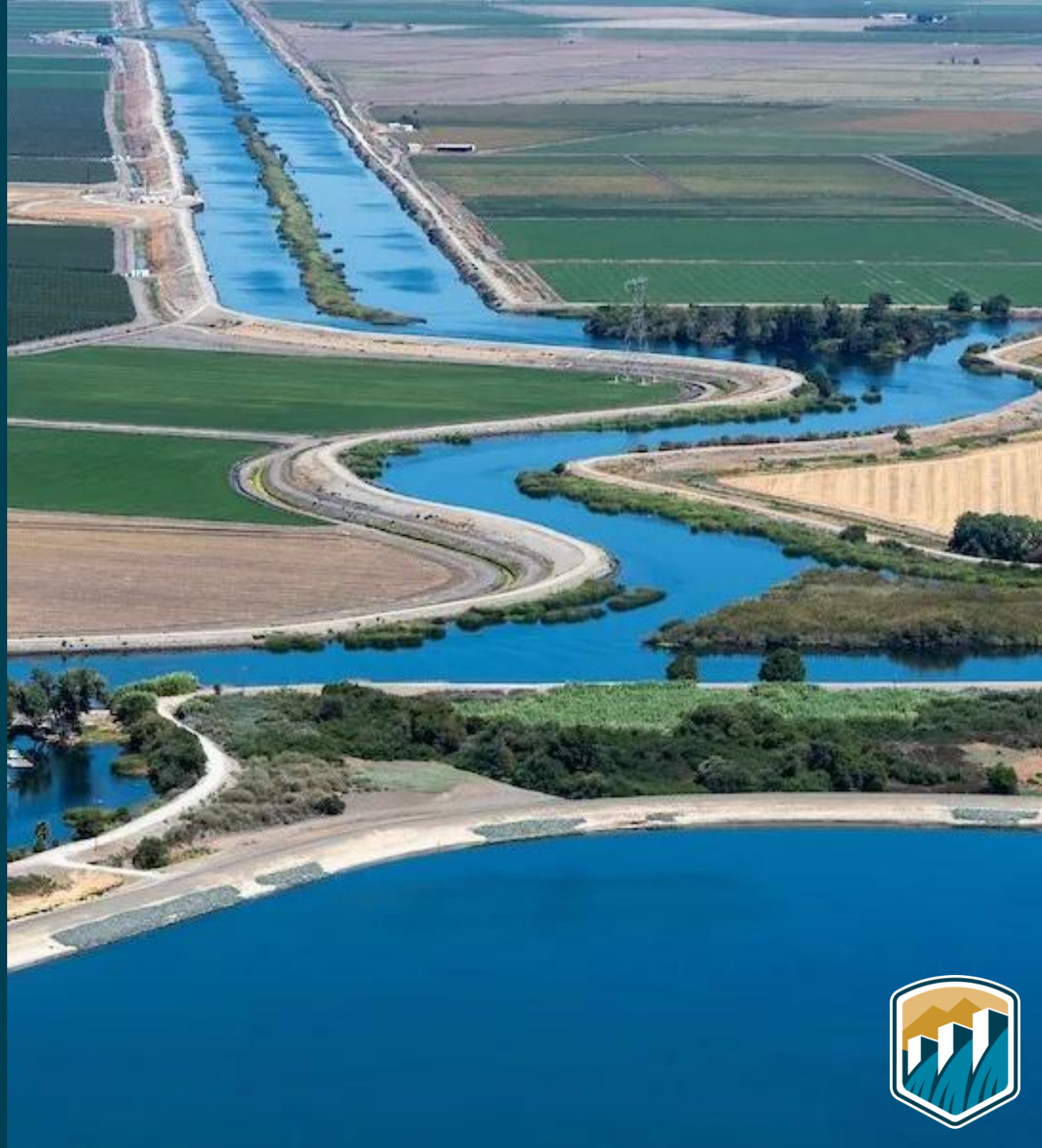
Levi Brekke, PhD, PE | Stantec

CWEMF 2026 Session 1. Reclamation Model Development (Part 1)

Monday April 20, 2026

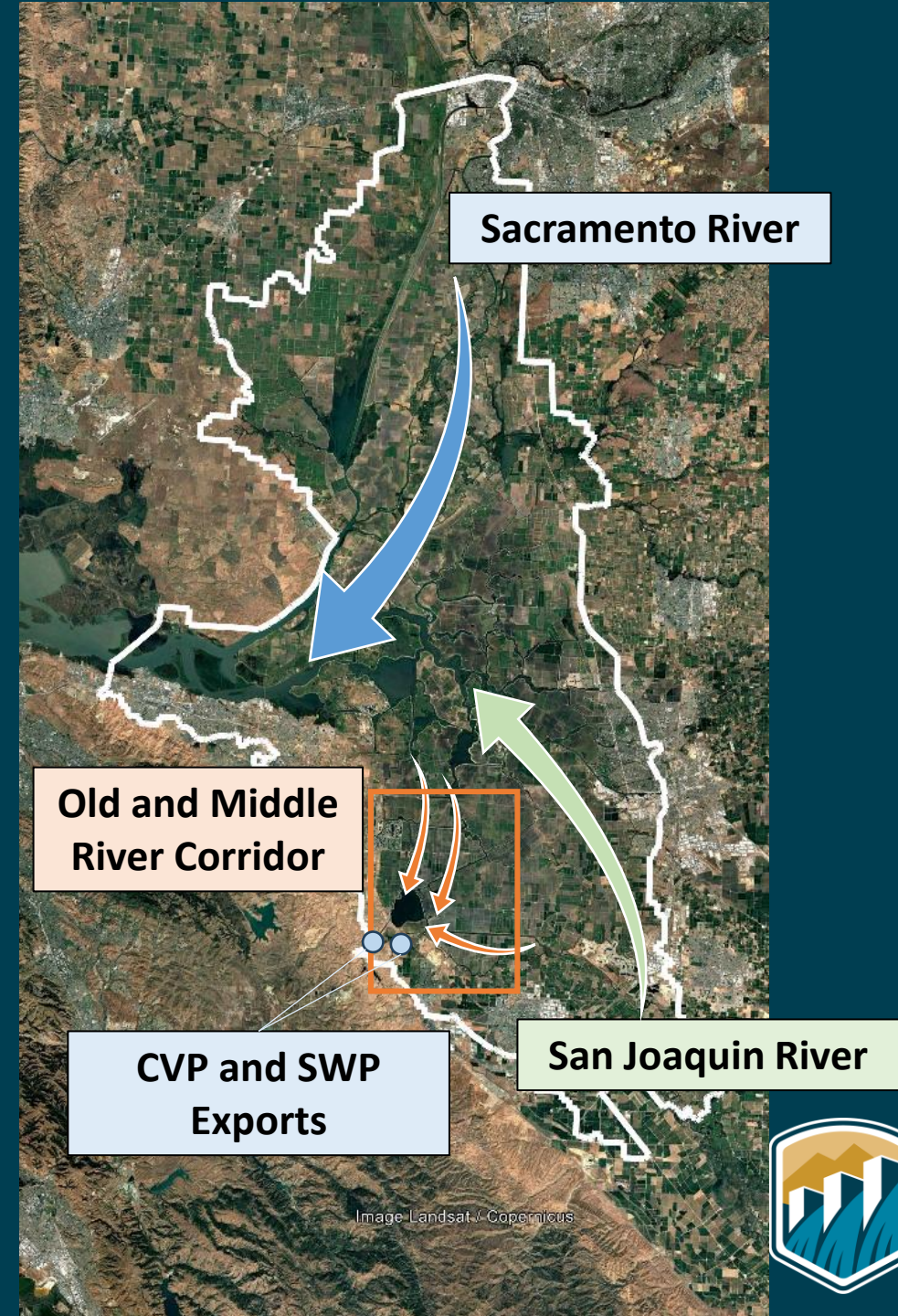
Agenda

- OMR Flow Management Background
- Weekly Real Time Assessment Framework
- Results Review
- Future Automation Opportunities



OMR Flow Management

- Export pumps from the Delta can cause reverse flow in the Old and Middle River (OMR) corridor
- Reverse flows and direct pumping impacts can cause fish mortality
- Reclamation and DWR manage OMR flows to meet water delivery obligations while minimizing negative effects on protected fish species



OMR Flow Management

Historic OMR Management Approach

Monitor salvage, physical, and chemical variables:

- Take of endangered species at the pump stations
- Flow levels
- Turbidity levels

When thresholds are exceeded, OMR flows are made less negative by reducing export pumping

New OMR Management Approach Being Explored

Guide export decisions through weekly forecast of Delta conditions:

- Quantify geographic zone of influence (ZOI) of Delta exports
- Estimate proportion of fish populations influenced by pumping
- Quantify impacts to fish in ZOI
- Evaluate population level consequences of operations

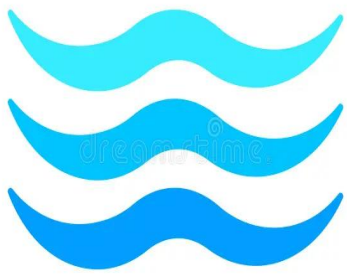


Weekly Analysis Framework

4 OMR Scenario
Forecasts



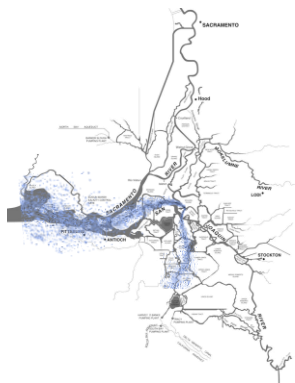
DSM2 HYDRO



Delta
Hydrodynamics



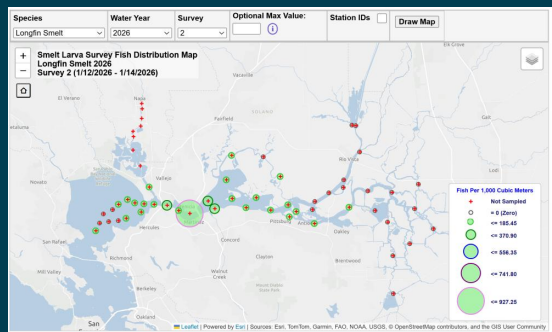
PTM/ECO-PTM



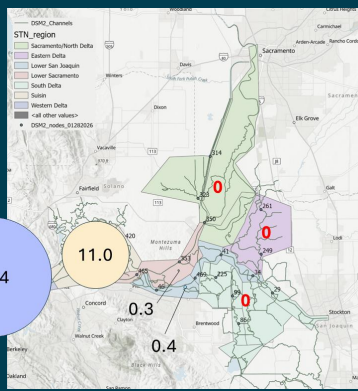
Particle
Tracking



Smelt Larval
Survey (SLS) Data



Delta Larval LFS
Abundance Model
Design-based approach from
6-Agency Redesign design team

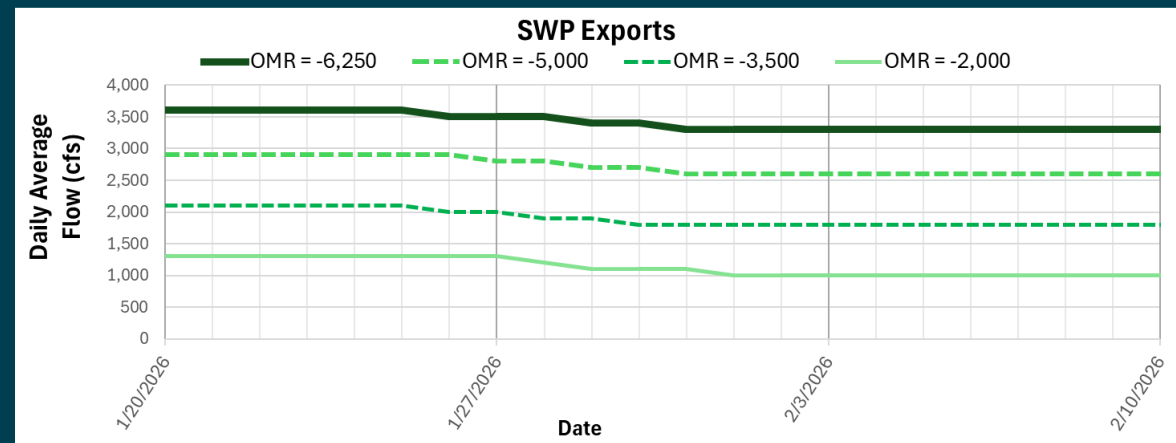
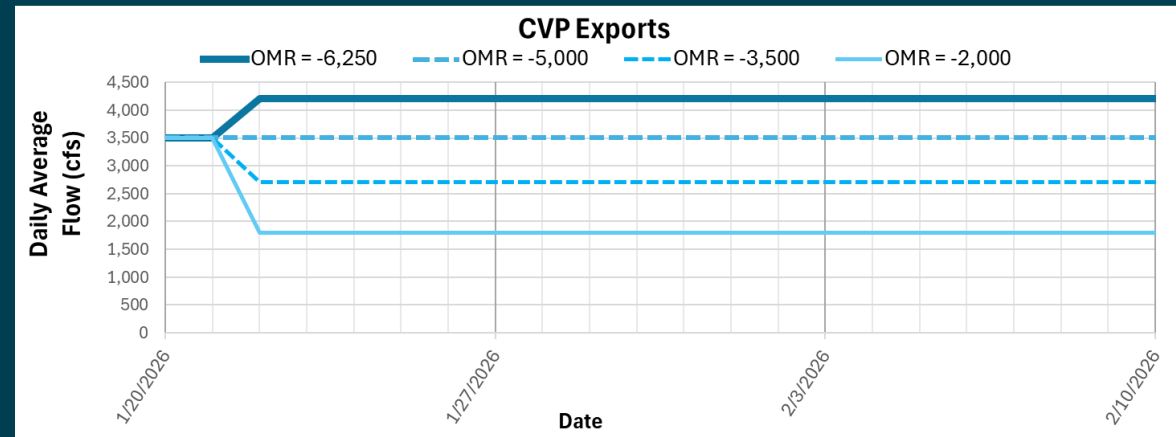
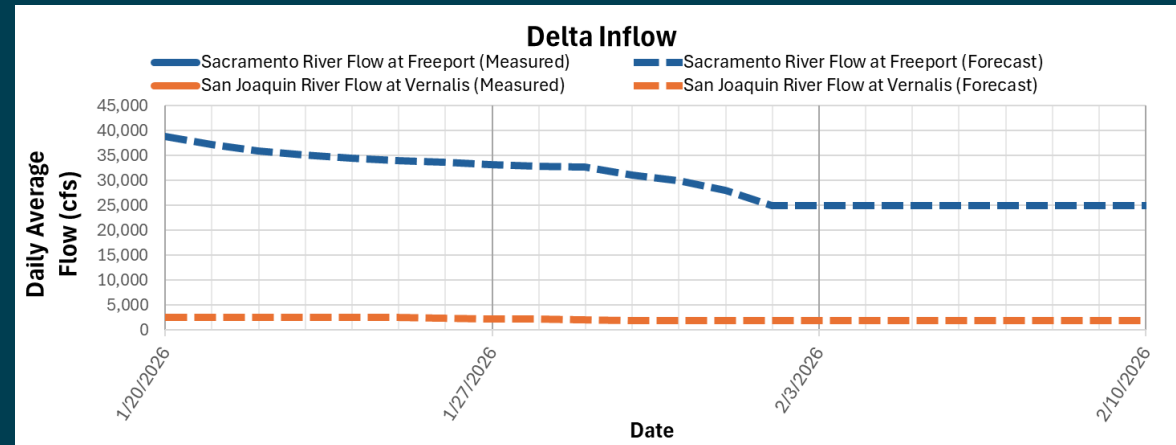


Weekly Estimate of Larval LFS
Population Entrained by OMRI Scenario



Weekly Scenarios

- Major Delta inflows (Sacramento and San Joaquin River) acquired from the NOAA California Nevada River Forecast Center 5-day deterministic forecast
- Other Delta inflows approximated based on prior week trends and major inflow forecast
- Inflow datasets extended out 3 weeks based on judgement
- Delta exports adjusted to achieve desired OMRI scenario using Hutton (2008) equation

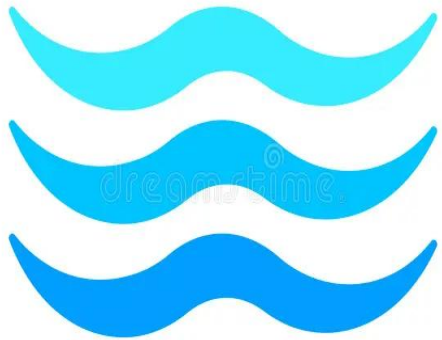


Weekly Analysis Framework | Zone of Influence (ZOI)

3-Week Forecast Period x
4 OMRI Scenarios:

-2,000, -3,500, -5,000, -6,250

DSM2 HYDRO



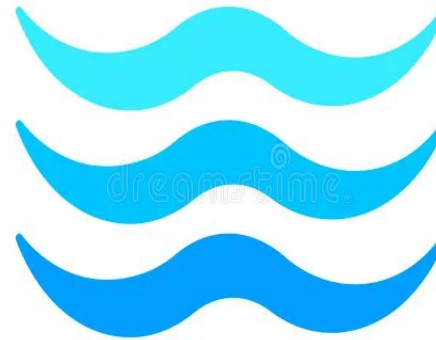
Delta Hydrodynamics



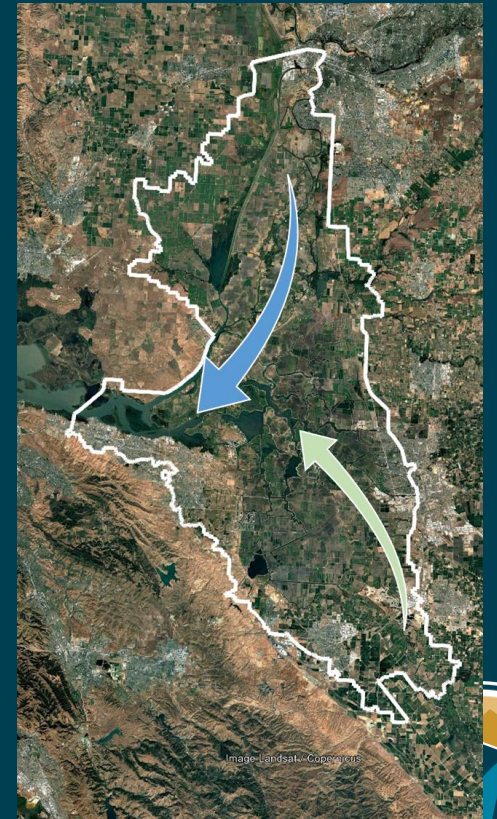
3-Week Forecast Period x
4 OMRI Scenarios:

-2,000, -3,500, -5,000, -6,250

DSM2 HYDRO
(no pumping)

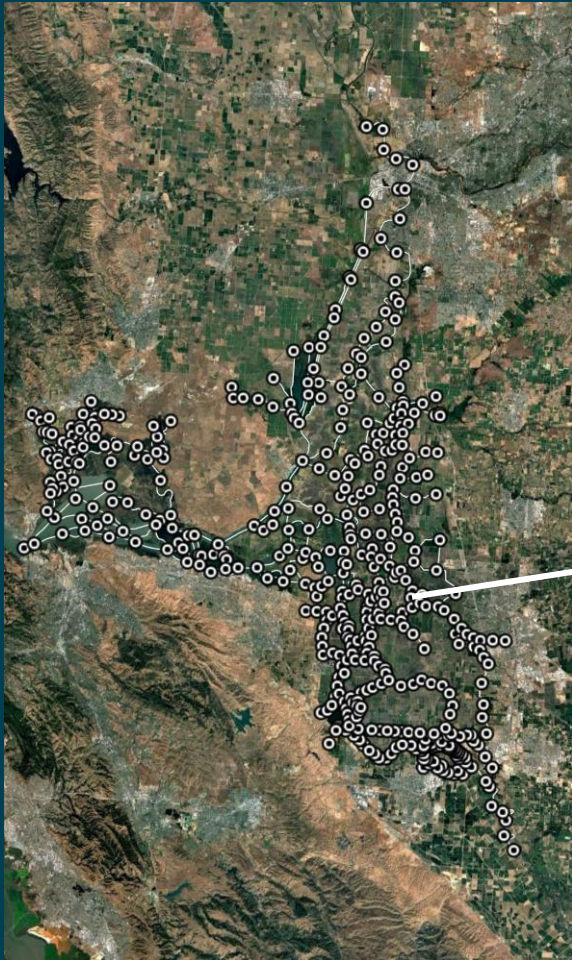


Delta Hydrodynamics

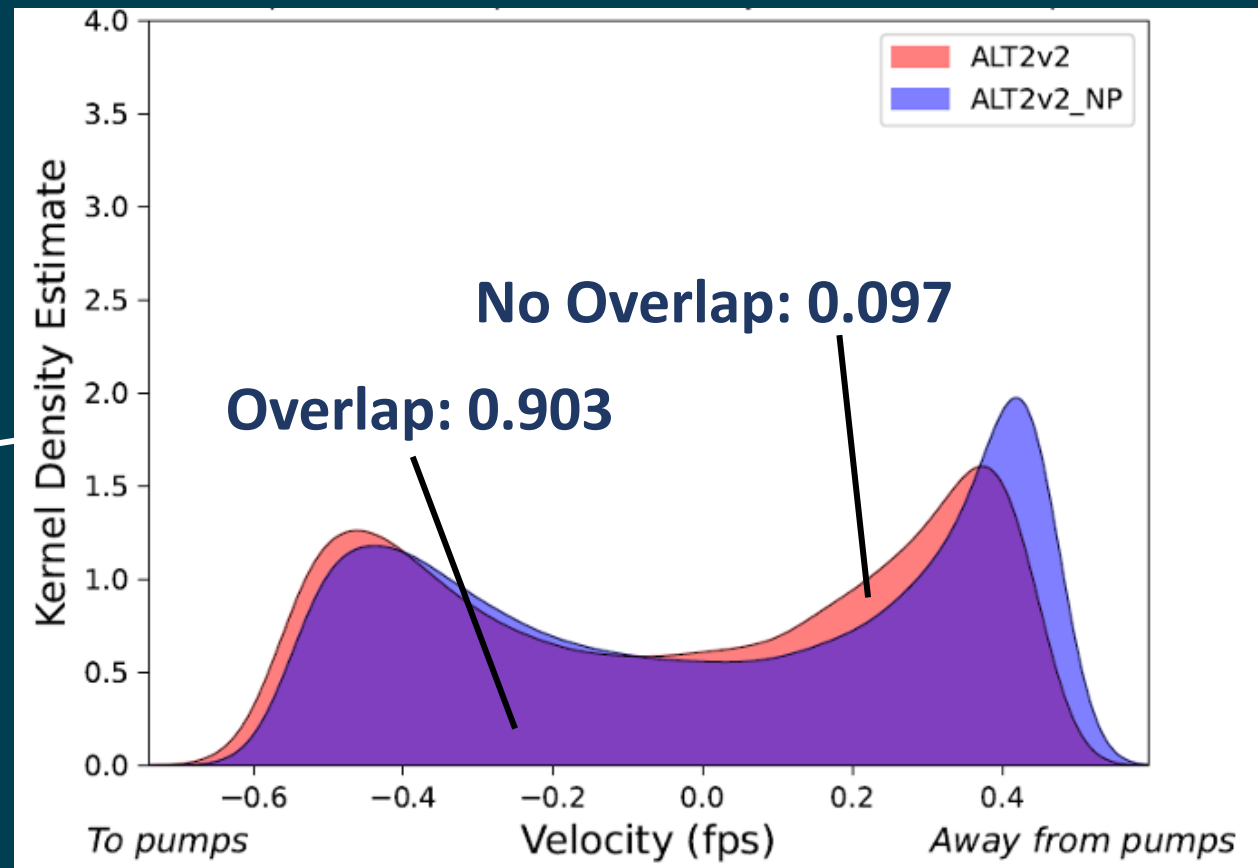


Weekly Analysis Framework | ZOI

At each DSM2 Node...



...for each week, calculate proportional overlap of velocity distribution

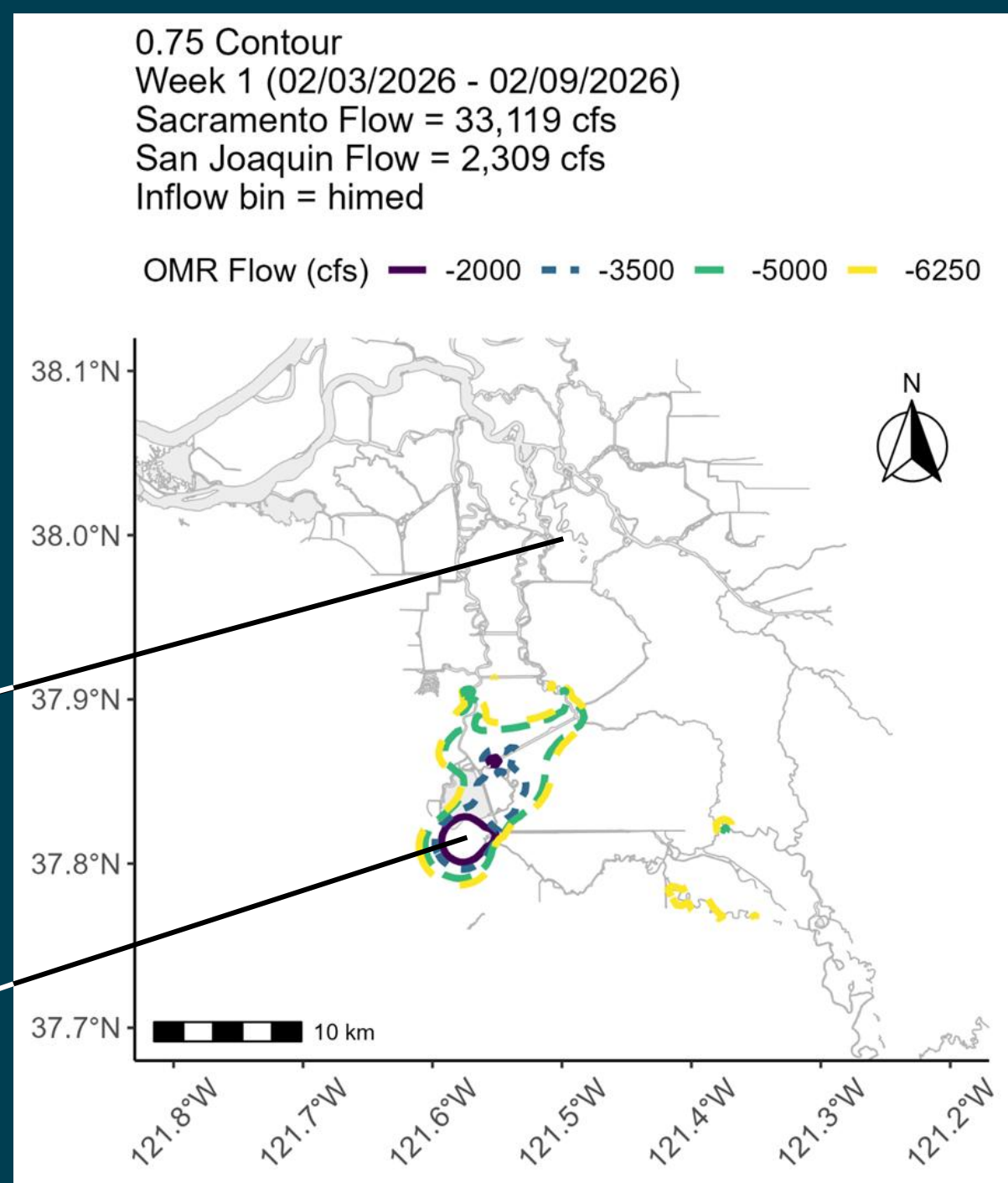


Weekly Analysis Framework | ZOI

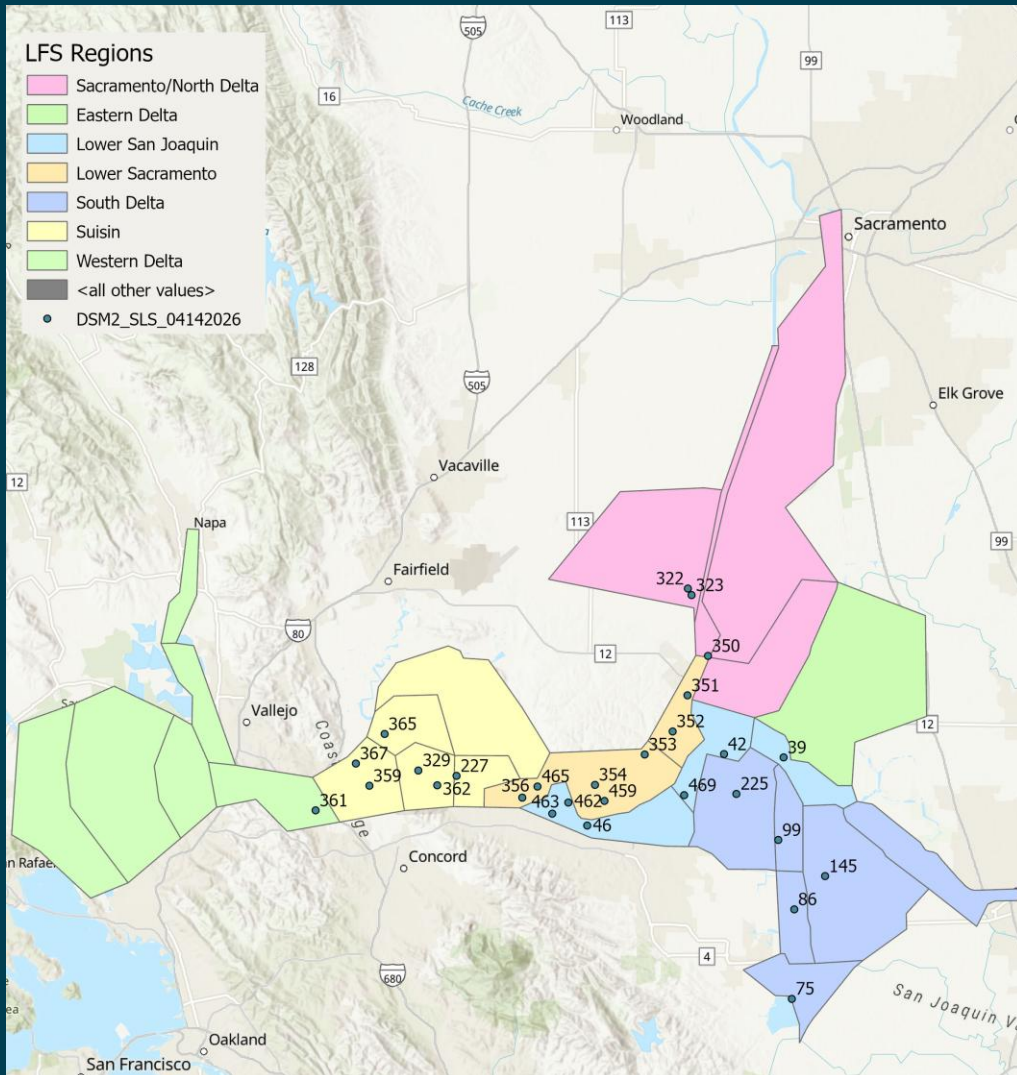
For each week, create contour maps based on velocity overlap for each OMR scenario

The space outside each contour represents the area experiencing 0.75 or more proportional overlap of velocity probability density curves (25% or less hydrologic alteration).

The space inside each contour represents the area experiencing less than 0.75 proportional overlap of velocity probability density curves (25% or more hydrologic alteration).



Particle Tracking Model



- Inject particles separately at 28 nodes
- 1,000 particles injected at each node over 24-hour period
- Surface oriented particles (PP) used to emulate longfin smelt larva
- Track particle flux into CVP and SWP export facilities
- Report cumulative flux of particles at the end of each week

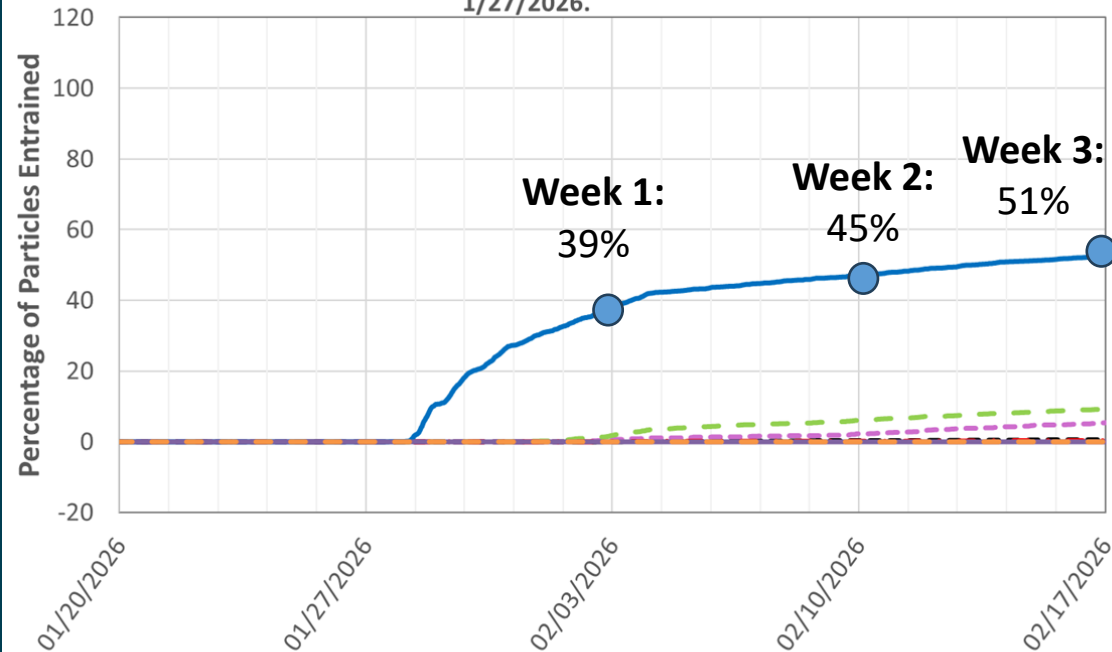


Particle Tracking Model | Cumulative CVP/SWP Entrainment

OMR = -6,250 cfs

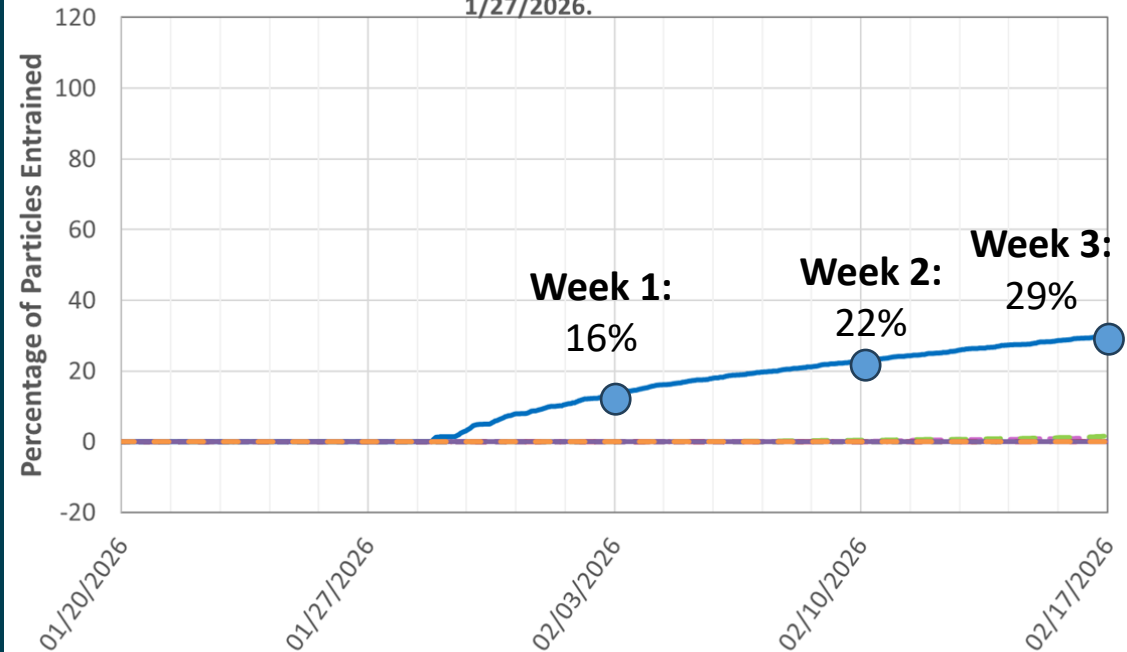
OMR = -2,000 cfs

Average PTM Results by Injection Region for Position Oriented Particles Entrained at CVP and SWP. OMR Scenario = -6,250. Particles Injected 1/27/2026.



--- Sacramento/North Delta (average 314, 323, 350) - - - Eastern Delta (average 249, 261)
- - - Lower San Joaquin (average 34, 41, 46, 469) - - - Lower Sacramento (average 353, 465)
- - - South Delta (average 29, 86, 99, 225) - - - Suisun Marsh (average 329, 420)
- - - West Delta (359)

Average PTM Results by Injection Region for Position Oriented Particles Entrained at CVP and SWP. OMR Scenario = -2,000. Particles Injected 1/27/2026.

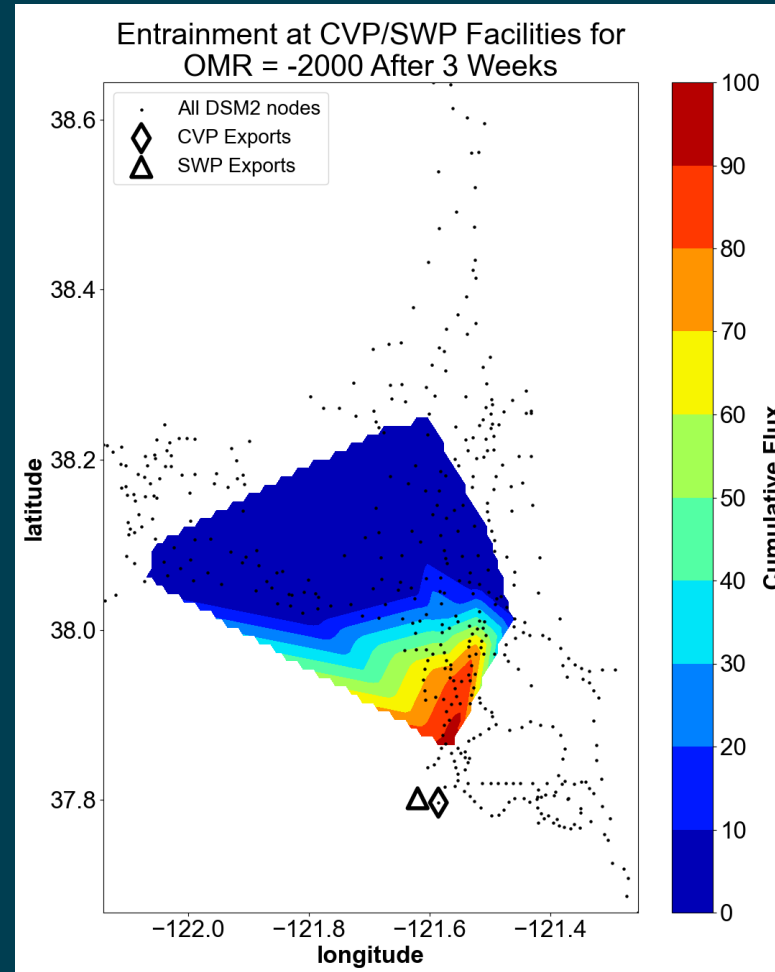
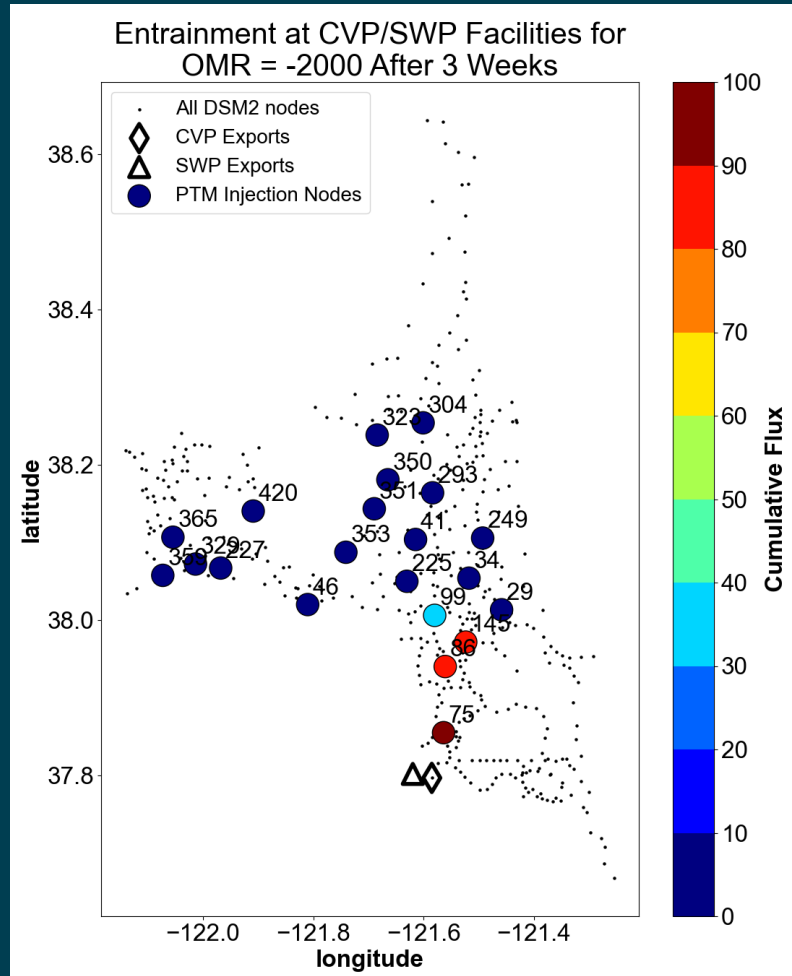


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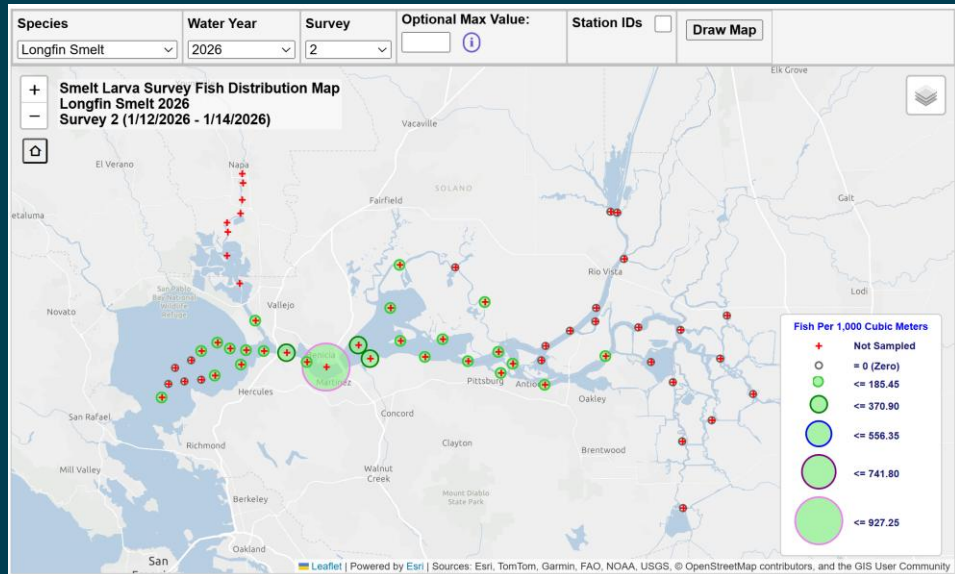
Particle Tracking Model | Entrainment Contours

- Develop contour maps of cumulative weekly entrainment



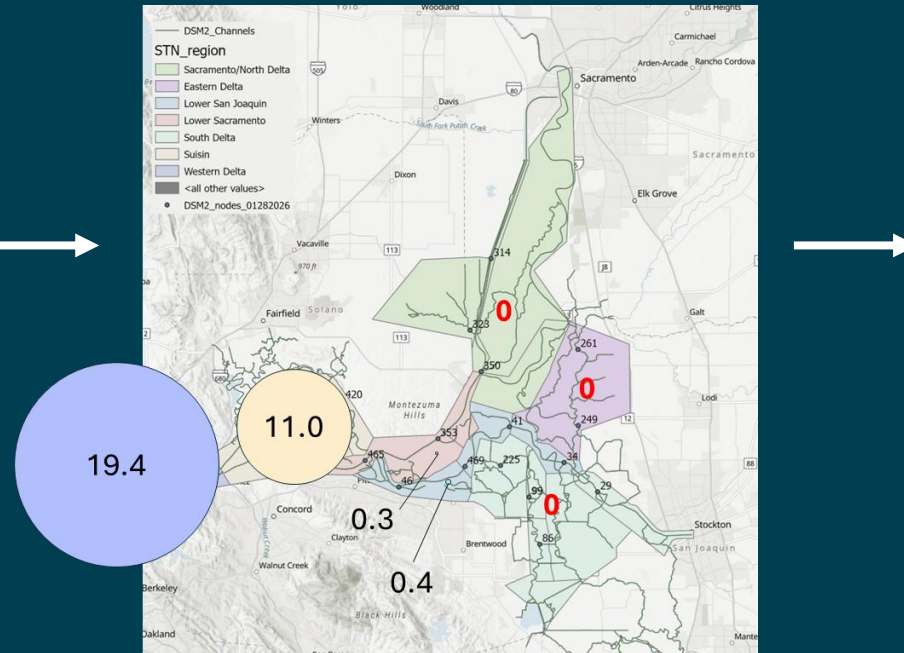
LFS Abundance Estimate

CDFW Bi-Weekly Smelt Larval Survey (SLS) Data



Subregional Delta Larval LFS Abundance Model

Design-based approach from
6-Agency Redesign design team



LFS Entrainment Analysis Results

LFS Entrainment Estimate using PTM with Surface Oriented Particles: Week 1 ending 02/02/2026

OMR (cfs)	Combined Exports (cfs)	Metric \ Region	West	Suisun	Sacramento/ North Delta	Lower San Joaquin	Lower Sacramento	South Delta	East	Total (#)	Total (%)
		DSM2 Injection Node	359	329, 420	314, 323, 350	34, 41, 46, 469	465, 353	29, 86, 99, 225	249, 261		
		LFS Larva Abundance	19,443,000	11,003,000	0	425,000	290,000	0	0	31,161,000	
-6,250	7,542	PTM Entrained (%)	0.0	0.0	0.0	0.9	0.0	34.3	0.1		
-5,000	6,254	PTM Entrained (%)	0.0	0.0	0.0	0.4	0.0	30.4	0.0		
-3,500	4,751	PTM Entrained (%)	0.0	0.0	0.0	<0.1	0.0	23.3	0.0		
-2,000	3,205	PTM Entrained (%)	0.0	0.0	0.0	0.0	0.0	11.6	0.0		
-6,250	7,542	Smelt Larva Entrained (#)	0.0	0.0	0.0	3,719	0.0	0.0	0.0	3,719	<0.1%
-5,000	6,254	Smelt Larva Entrained (#)	0.0	0.0	0.0	1,488	0.0	0.0	0.0	1,488	<0.1%
-3,500	4,751	Smelt Larva Entrained (#)	0.0	0.0	0.0	106	0.0	0.0	0.0	106	<0.1%
-2,000	3,205	Smelt Larva Entrained (#)	0.0	0.0	0.0	0	0.0	0.0	0.0	0	0.0

Notes:

Values between 0.0 and 0.1 are indicated with <0.1

For locations with multiple DSM2 nodes indicated, the PTM entrained (%) value reflects the average across all nodes

Example description for End of Week 1:

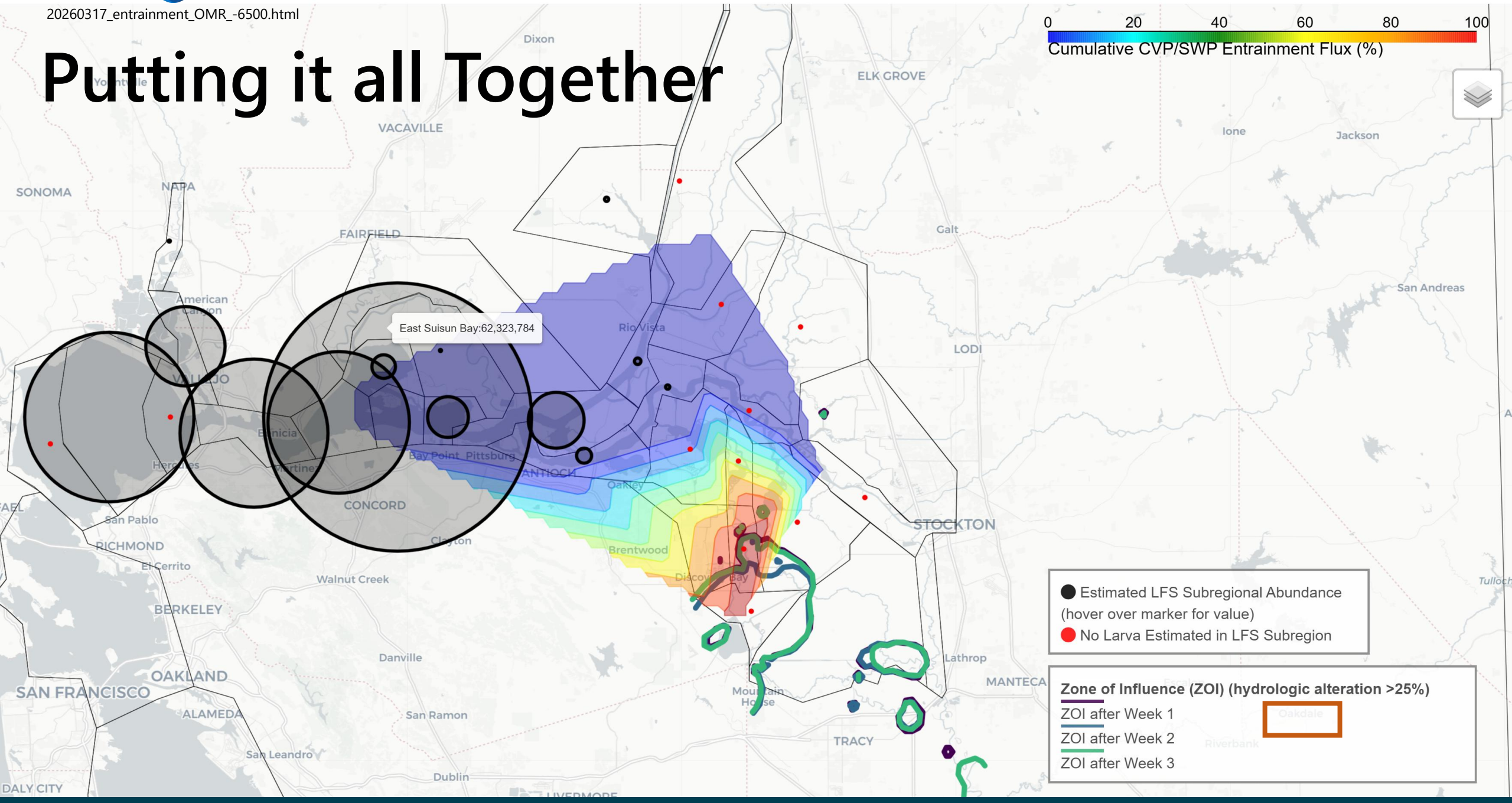
- Lower San Joaquin LFS Larva abundance estimate is 425,000
- After 1 week 0.9% of particles injected into the Lower San Joaquin region, averaged across DSM2 injection nodes 34, 41, 46, and 469 for OMR scenario -6,250, are entrained into the CVP and SWP facilities
- The number of LFS Larva Entrained from the Lower San Joaquin region after 1 week = $0.9\% \times 425,000 = 3,719$
- The delta-wide LFS Larva Entrained after 1 week = 3,719, or $3,719/31,161,000 = <0.1\%$ of LFS Larva in Delta





20260317_entrainment_OMR_-6500.html

Putting it all Together



Behind the Scenes

Weekly assessments completed: 17

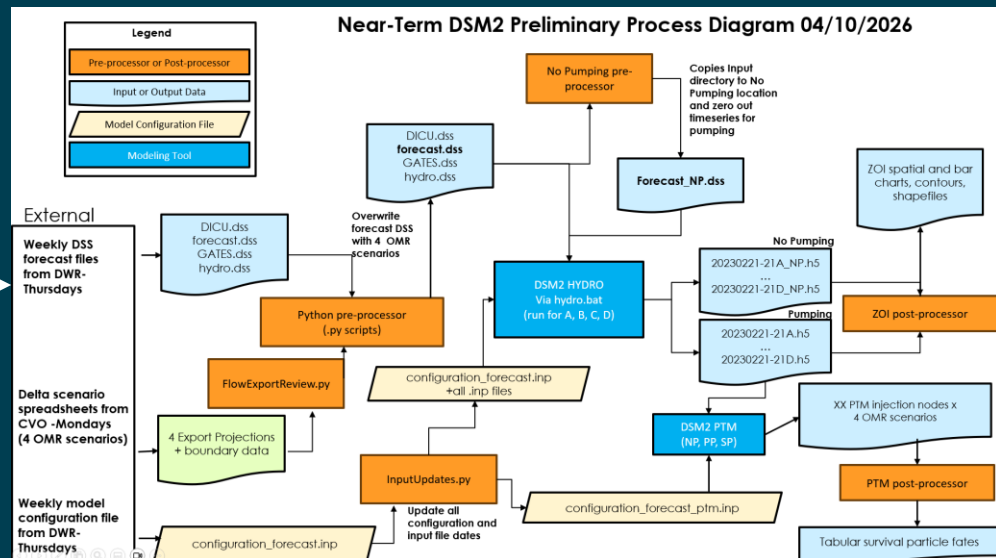
Workflow computation time: 2 hours x 1 person

Weekly DSM2 model runs: 8

Weekly PTM runs: 43 nodes x 4 scenarios = 172

Scripting tools: python + batch files, near full automation

Process diagram

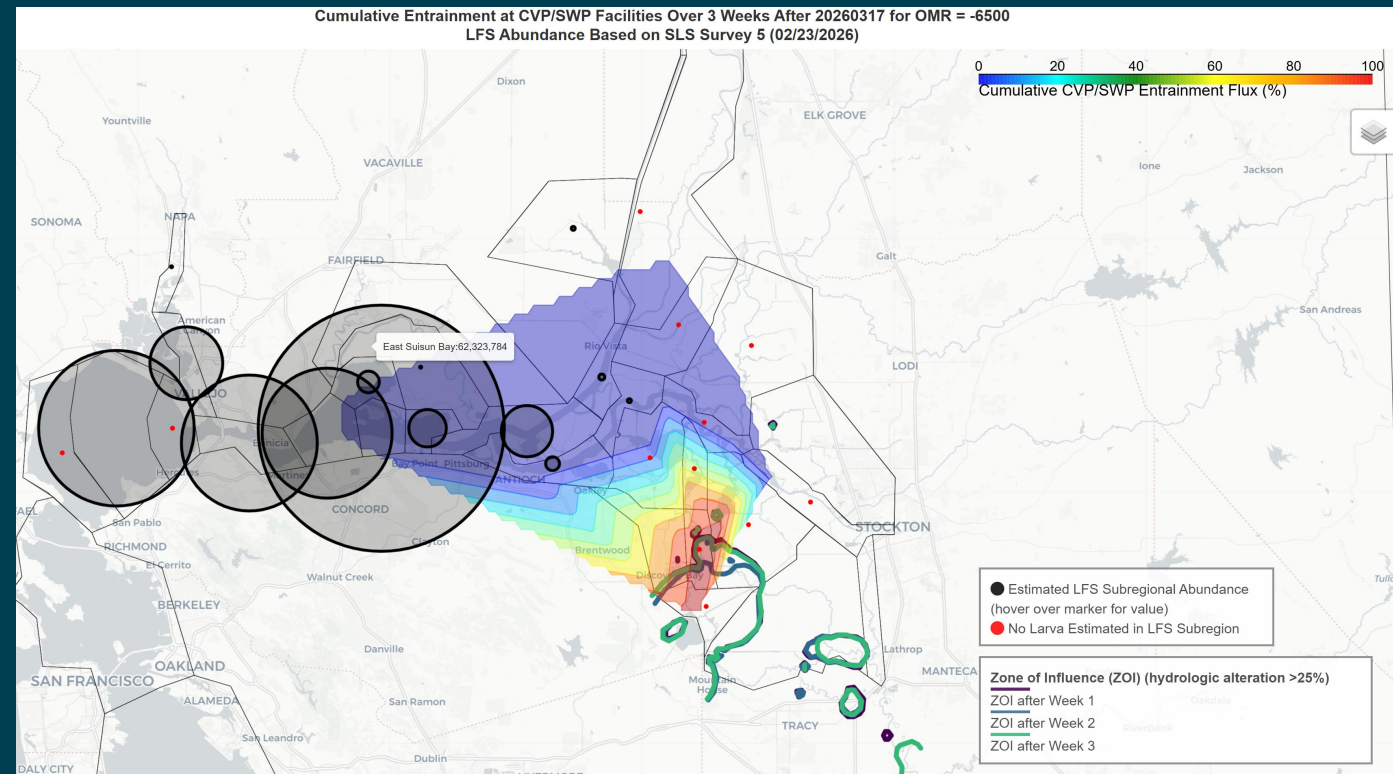


Bigger Picture

Guide export decisions through weekly forecast of Delta conditions:

- Quantify geographic zone of influence (ZOI) of Delta exports
- Estimate proportion of fish populations influenced by pumping
- Quantify impacts to fish in ZOI
- Evaluate population level consequences of operations

Use data, science, and automation to advance real-time Delta operations



Automating Real-Time Assessments

- Situation
 - Many assessments
 - Time-consuming work
- Interests
 - less time assessing
 - more time engaging
- Opportunities
 - More Scripted Workflows
 - Predictive AI
 - Generative AI



Automating Real-Time Assessments: FY 2026 Pilot Activities

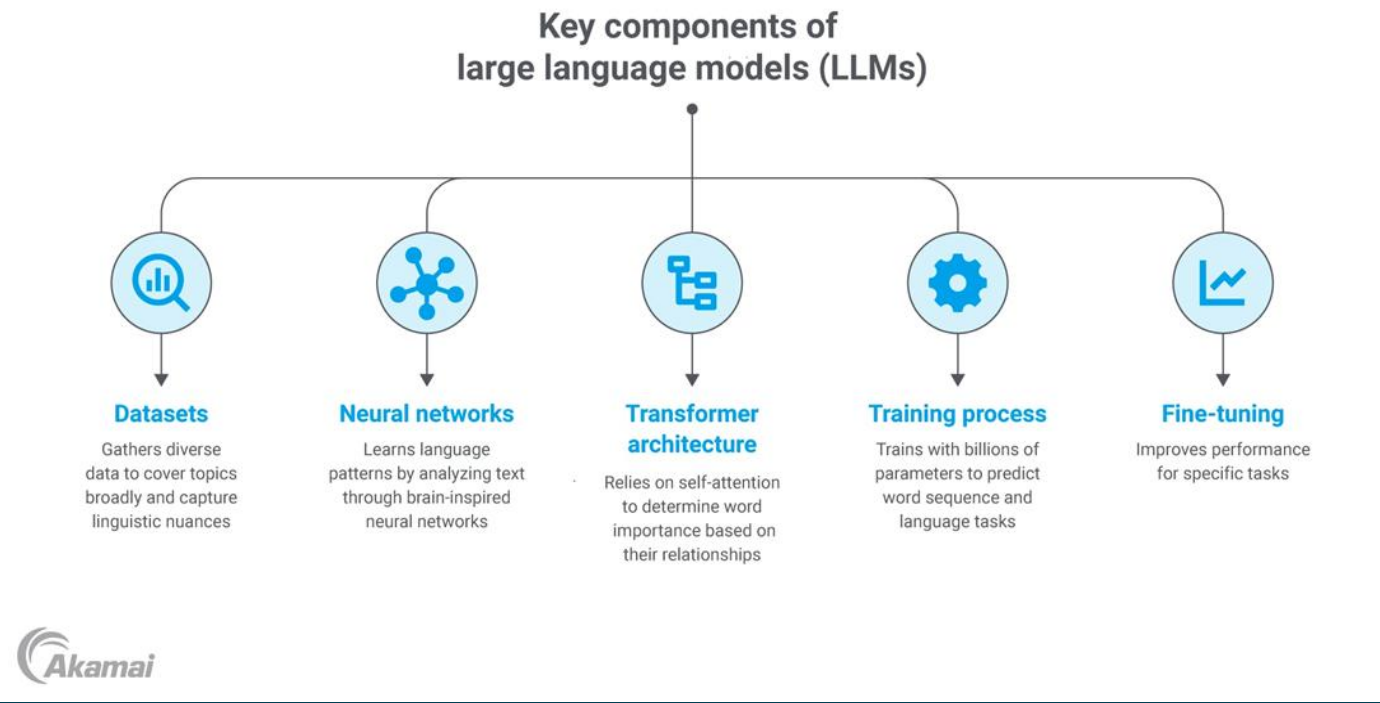
Goals and related BDO Assessment Areas	Automation: Script More Workflow Tasks and Segments	Automation: Add Predictive AI to speed Ops Scenario Dev.	Automation: Test Generative AI capabilities
1. Delta Hydrodynamics and Entrainment Assessment - Integrate into SacPAS	Yes		See Goal 2
2. Results Interpretation and Narratives Development: Test GenAI/LLM Applications			Yes (test cases likely taken from Goal 1 and/or Goal 3)
3. Sacramento River Assessment – Seasonal Flow Scheduling Decision-Support	Yes	Possibly (auto-identify upstream reservoir release schedule scenarios)	See Goal 2
4. <i>(tentative) Stanislaus River Assessment –Instability Flow Scheduling Decision-Support</i>	Yes	Possibly (auto-identify upstream reservoir release schedule scenarios)	See Goal 2



What is Generative AI? What are LLMs?

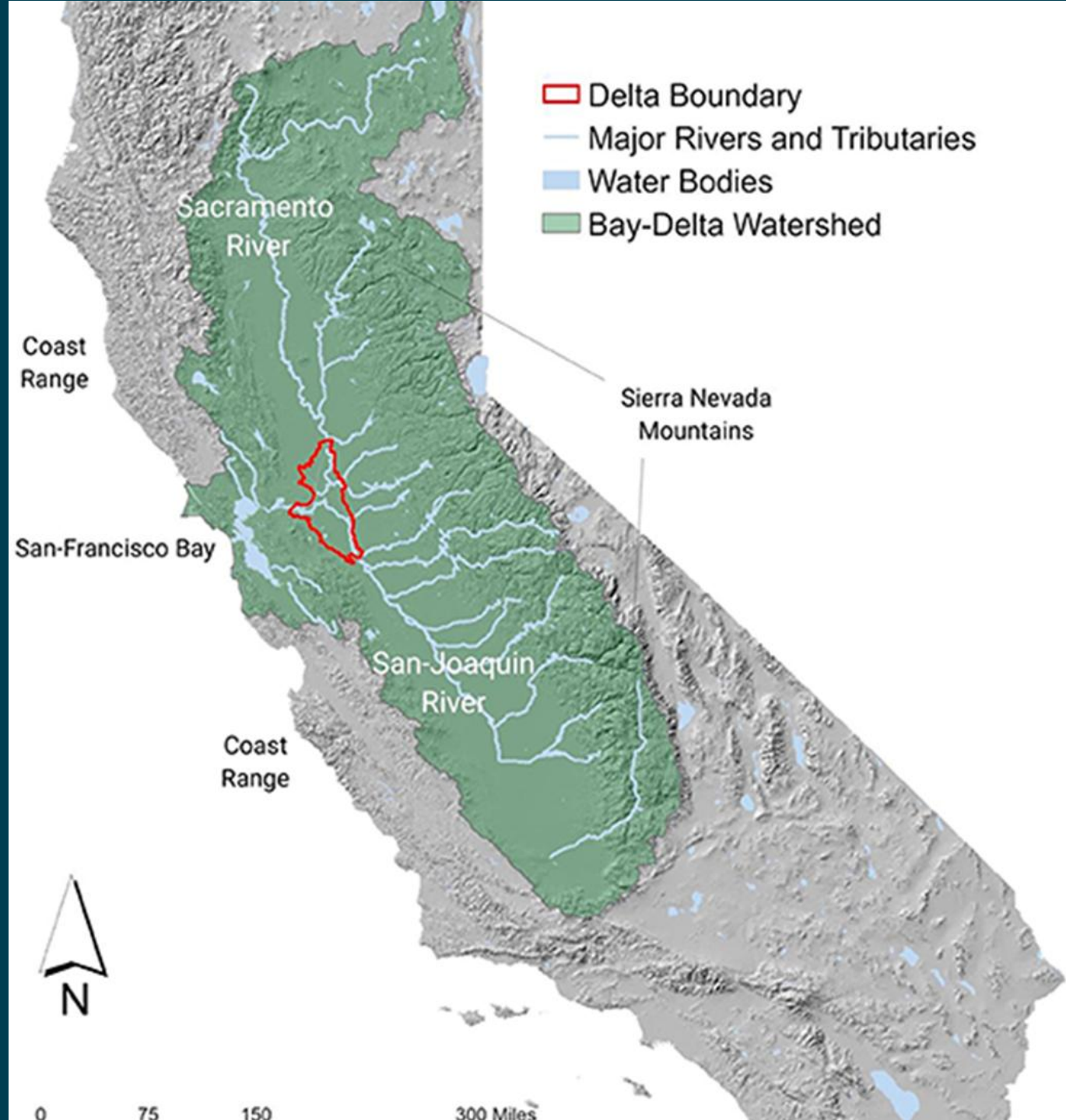


What are the key components of large language models (LLMs)?



Guiding Factors

- Approach
 - Sharpen GenAI Interests
 - Proof of Concept testing
- Principles
 - Start simple
 - learn together (about GenAI capabilities)
 - Comply w/ policies
 - Define success
 - Adapt approach after initial results



Application Flexibilities

- Which LLM(s)?
- What degree of LLM "creativity"?
- What modes of data do we have LLM(s) accept or produce?
- What level of external knowledge is brought to bear?

We'll address these during Workflow Orchestration (started Apr 2026): defining scheduling, executing, monitoring, and management workflow so that tasks and content generation happen reliability and reproducibly (*just underway*)



Thank you

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