Salinas Valley Deep Aquifers Study

MONTGOMERY & ASSOCIATES
Water Resource Consultants

Final Presentation

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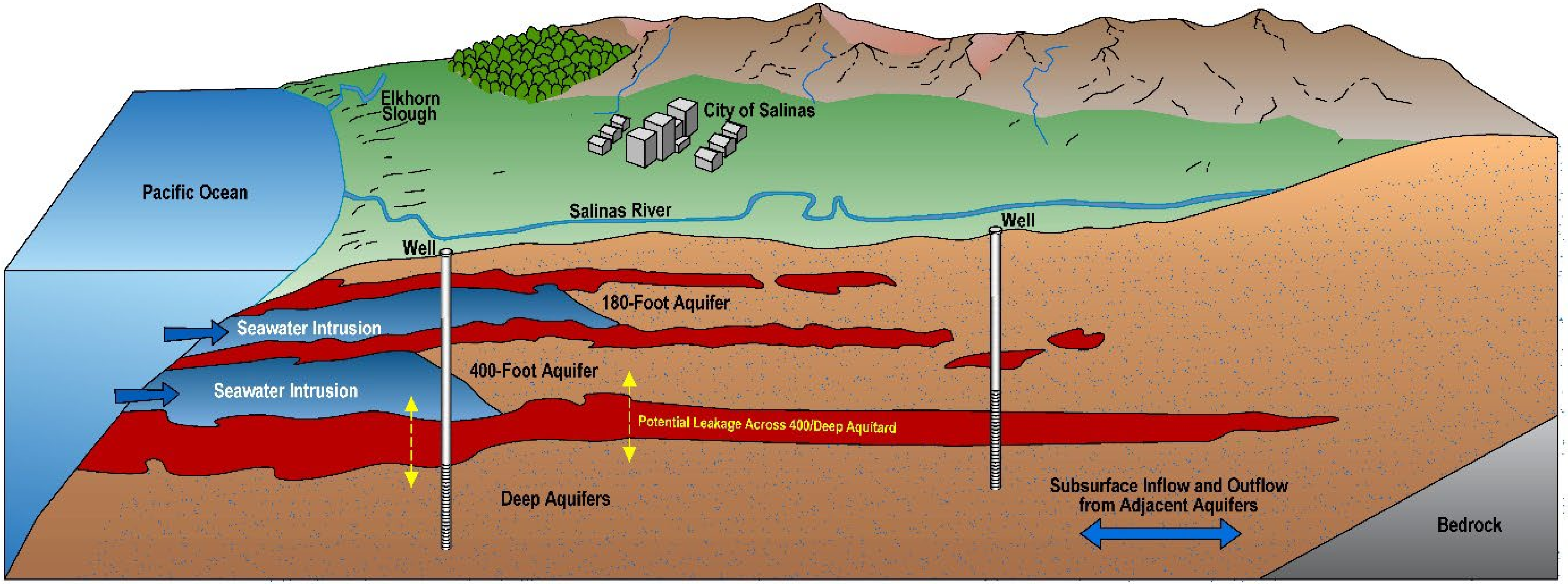
Deep Aquifers within the Salinas Valley

- Key municipal and agricultural source of water
- Particularly important in seawater intruded areas



Summary of Study Contributions

Developed definition, extent, and HCM of the Deep Aquifers

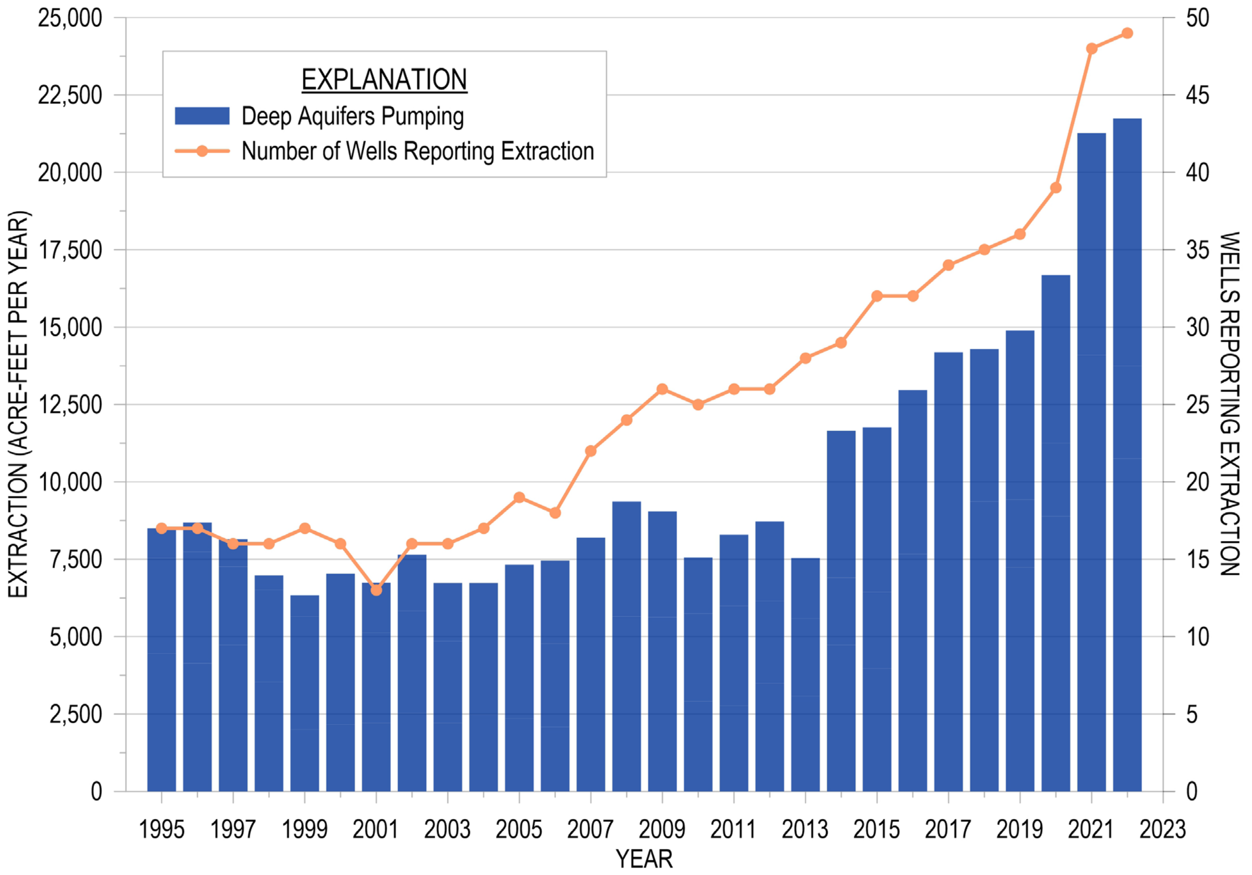
Developed a water budget for the Deep Aquifers

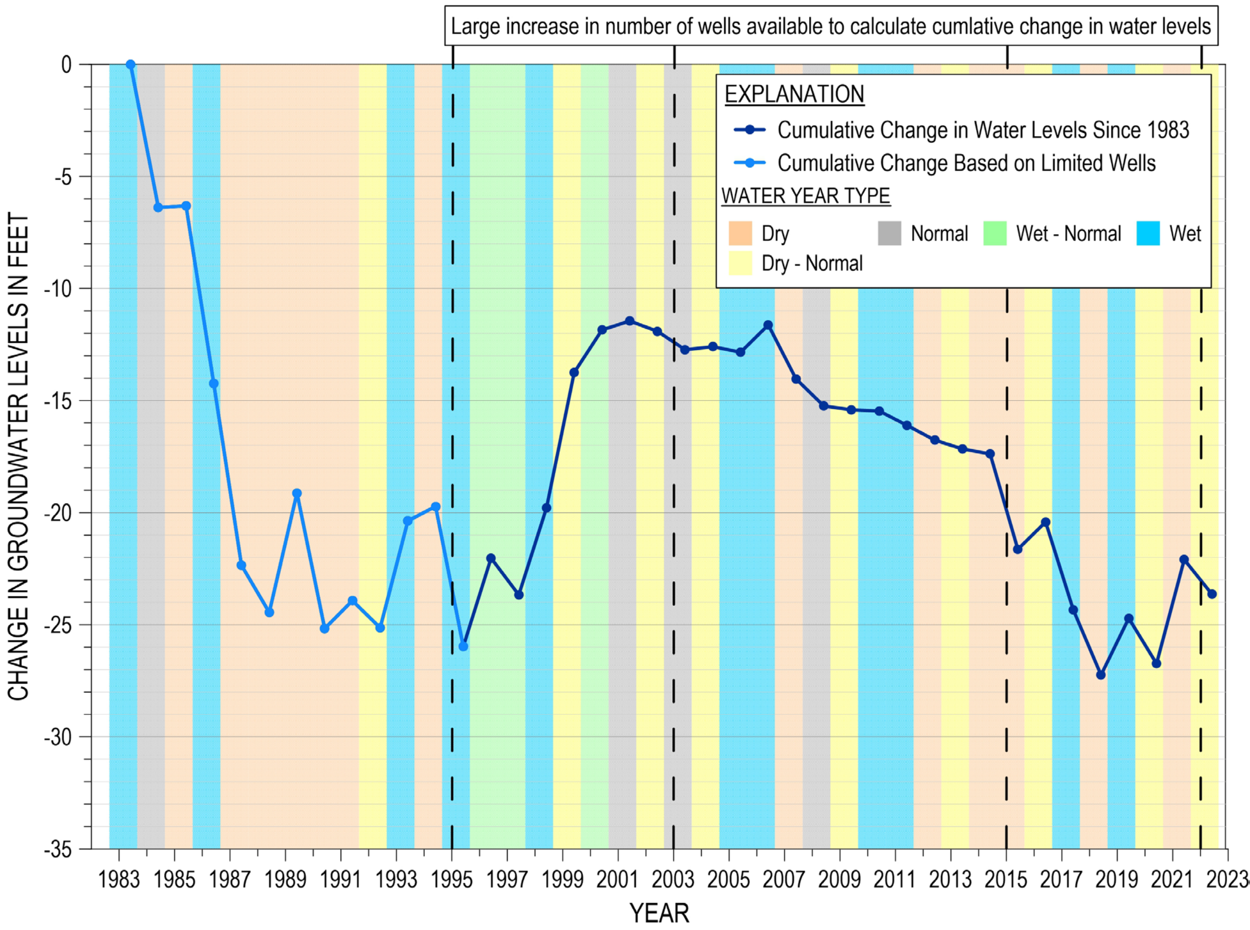
Made monitoring recommendations

Provided guidance for management based on the Study's findings

Scope and Approach

Need for Study to Better Understand the Deep Aquifers for Management





Groundwater Elevations have Declined as Wells and Extraction Increased

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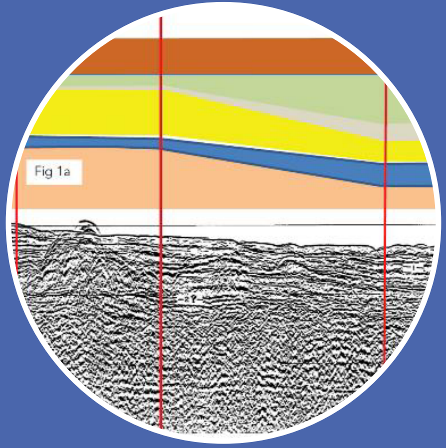
Study Focused on Key Questions for Management

- How should the Deep Aquifers be defined?
- What is the lateral extent?
- Does it receive inflows?
- What is the water budget?
- How should monitoring be focused?
- What principles should guide management?

Collected Key Data to Define Extent and Properties



Geophysics
maps important geologic features

RAMBOLL

Aquifer testing
provides data on groundwater movement and storage

Groundwater chemistry
assesses variation across extent and relationship with overlying aquifer

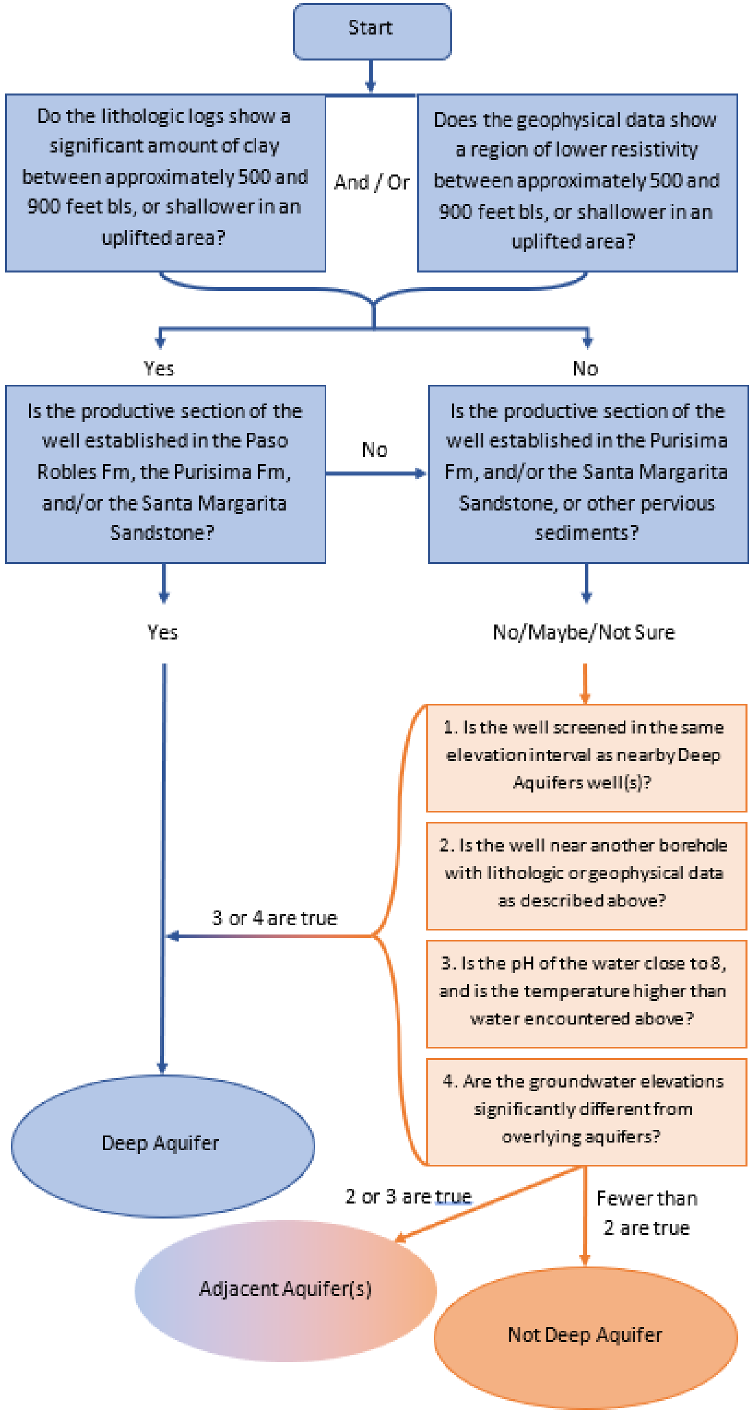
Isotope Analysis
indicates age of water and relationship with overlying aquifer

Findings

Study Developed Scientifically Robust Definition of the Deep Aquifers

Water-bearing sediments present below the 400-Foot Aquifer, or its stratigraphic equivalent.

- **Aquitard**
- Depth
- Geologic Formation



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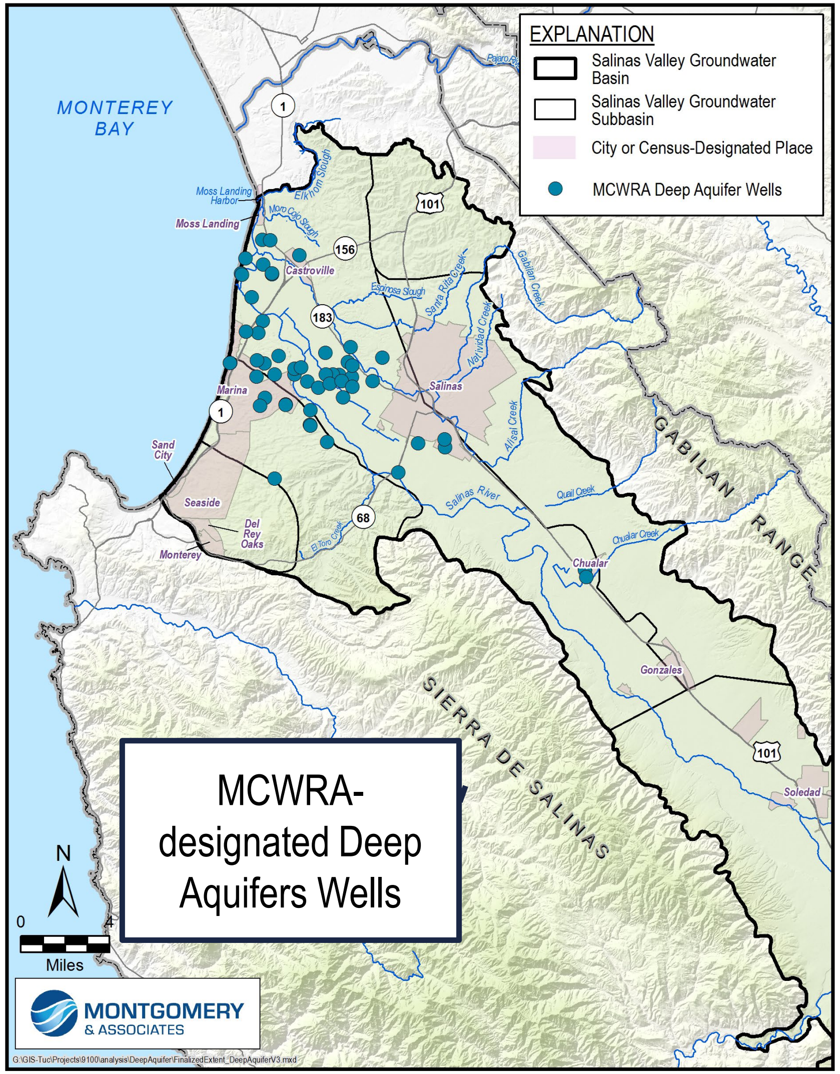
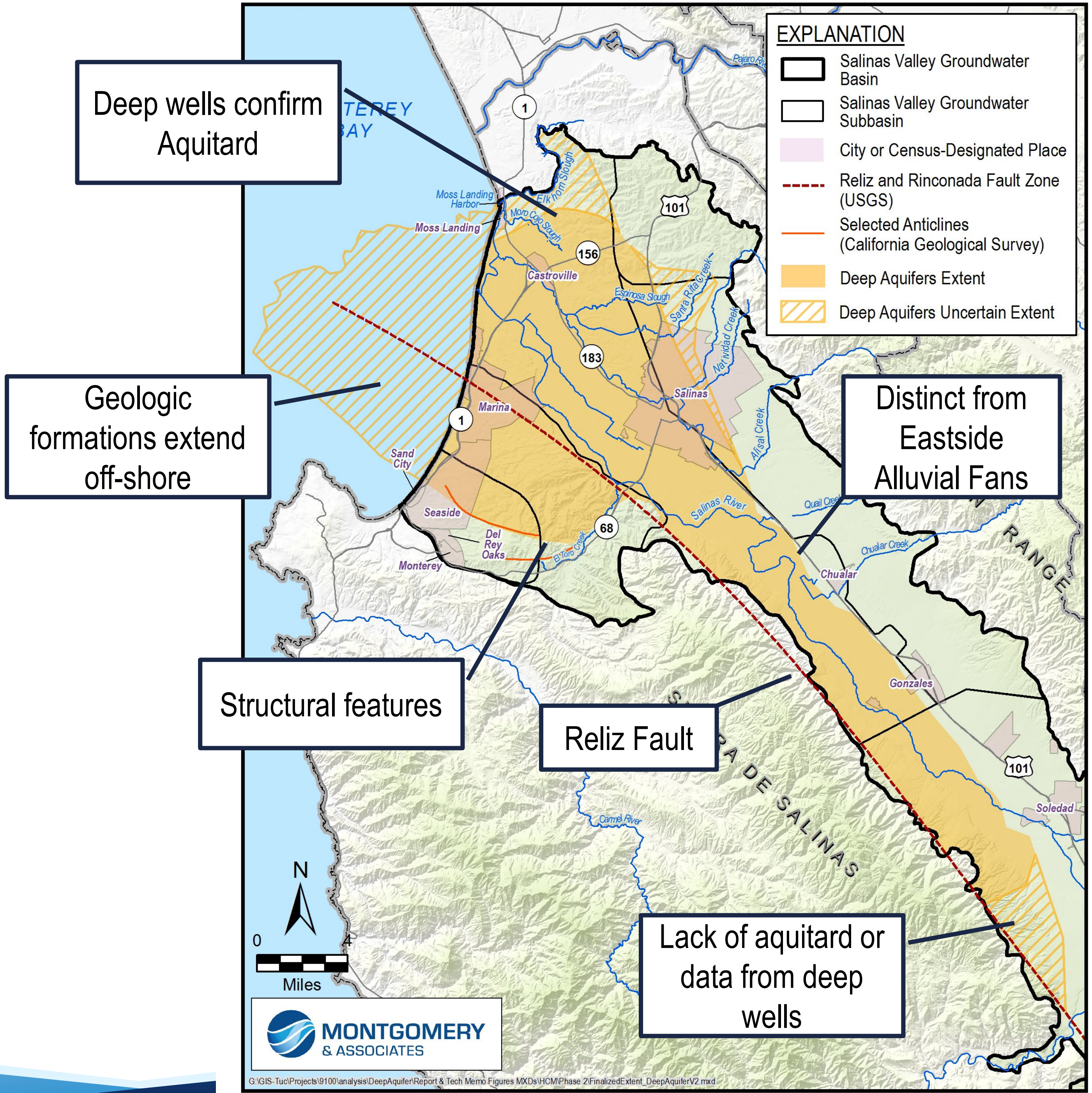
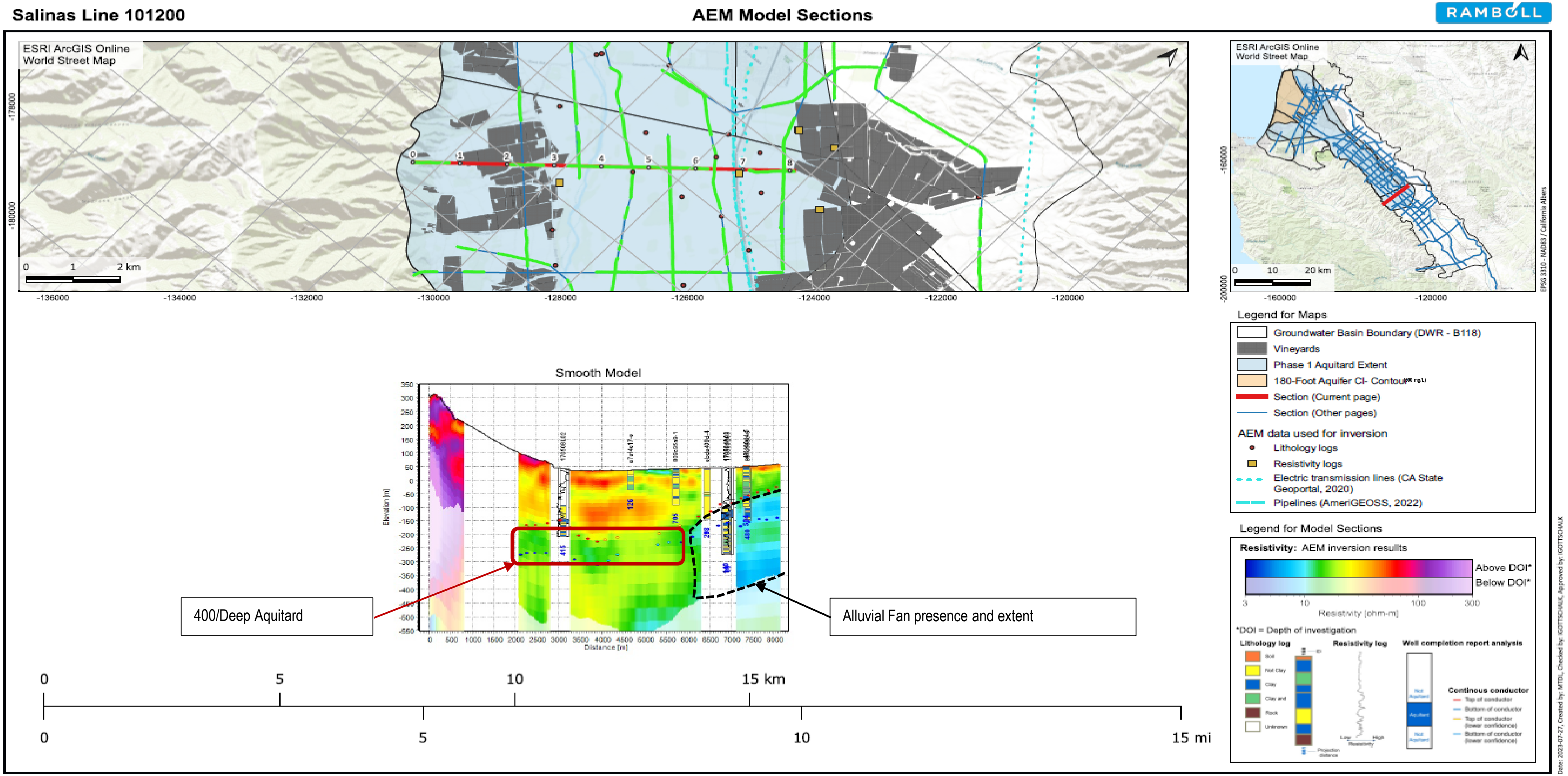
Study Delineated Geographic Extent

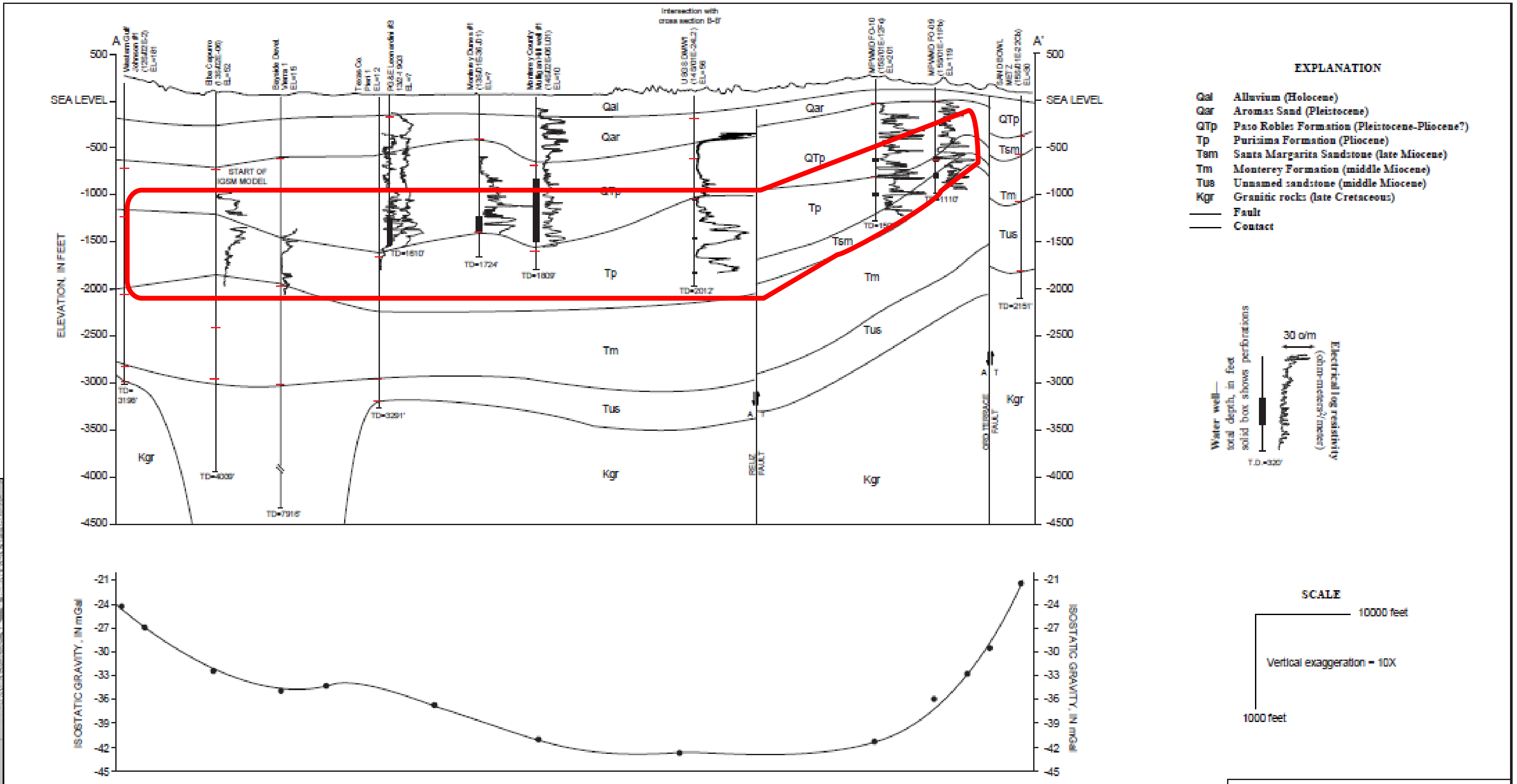


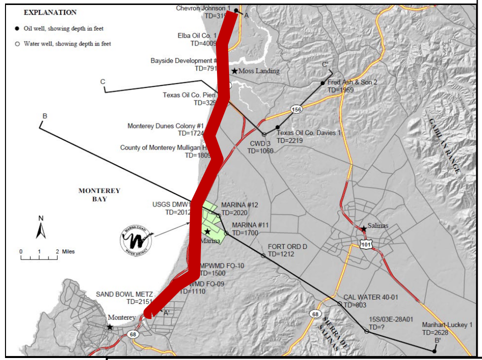


Study Used AEM to Map Aquitard



Study found Deep Aquifers Extend into Seaside Subbasin





Cross Section A-A' from Feeney and Rosenberg, 2003, Adapted to Exemplify the Deep Aquifers' Geology and Generalized Zone where the Deep Aquifers are Encountered (as shown with red outline)

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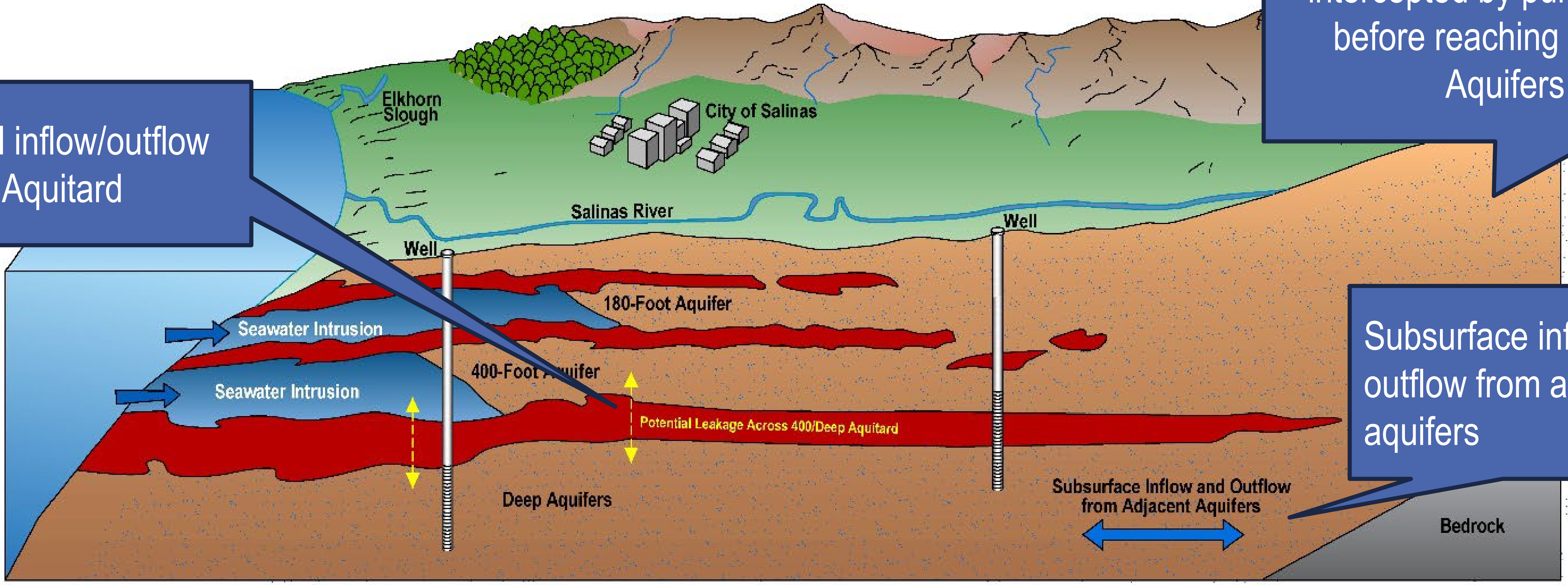
Deep Aquifers do not directly receive natural, surficial recharge

- Observed data shows no evidence of modern recharge (post-1953)

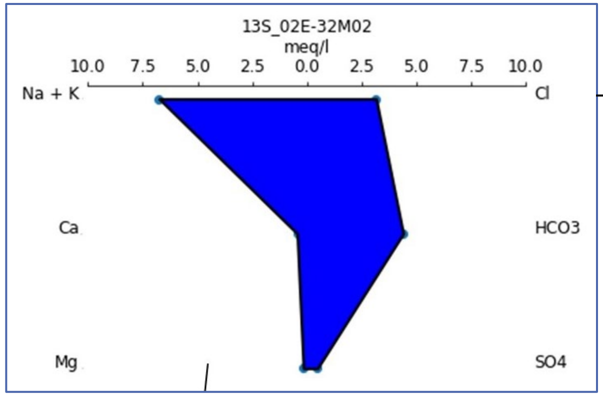


Vertical inflow/outflow across Aquitard

Outcrops are either far or intercepted by pumping before reaching Deep Aquifers wells

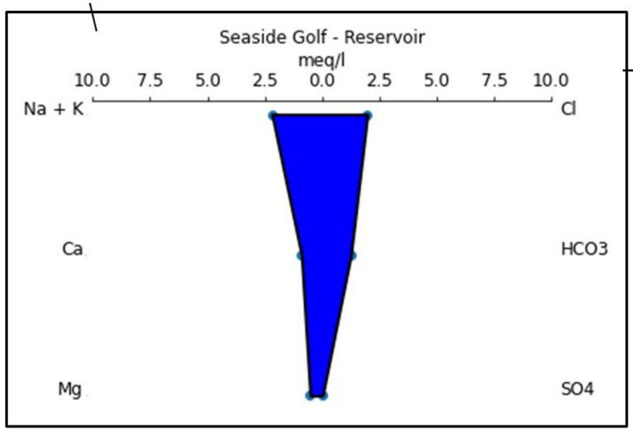
Subsurface inflow and outflow from adjacent aquifers

Study Identified 3 Regions of the Deep Aquifers



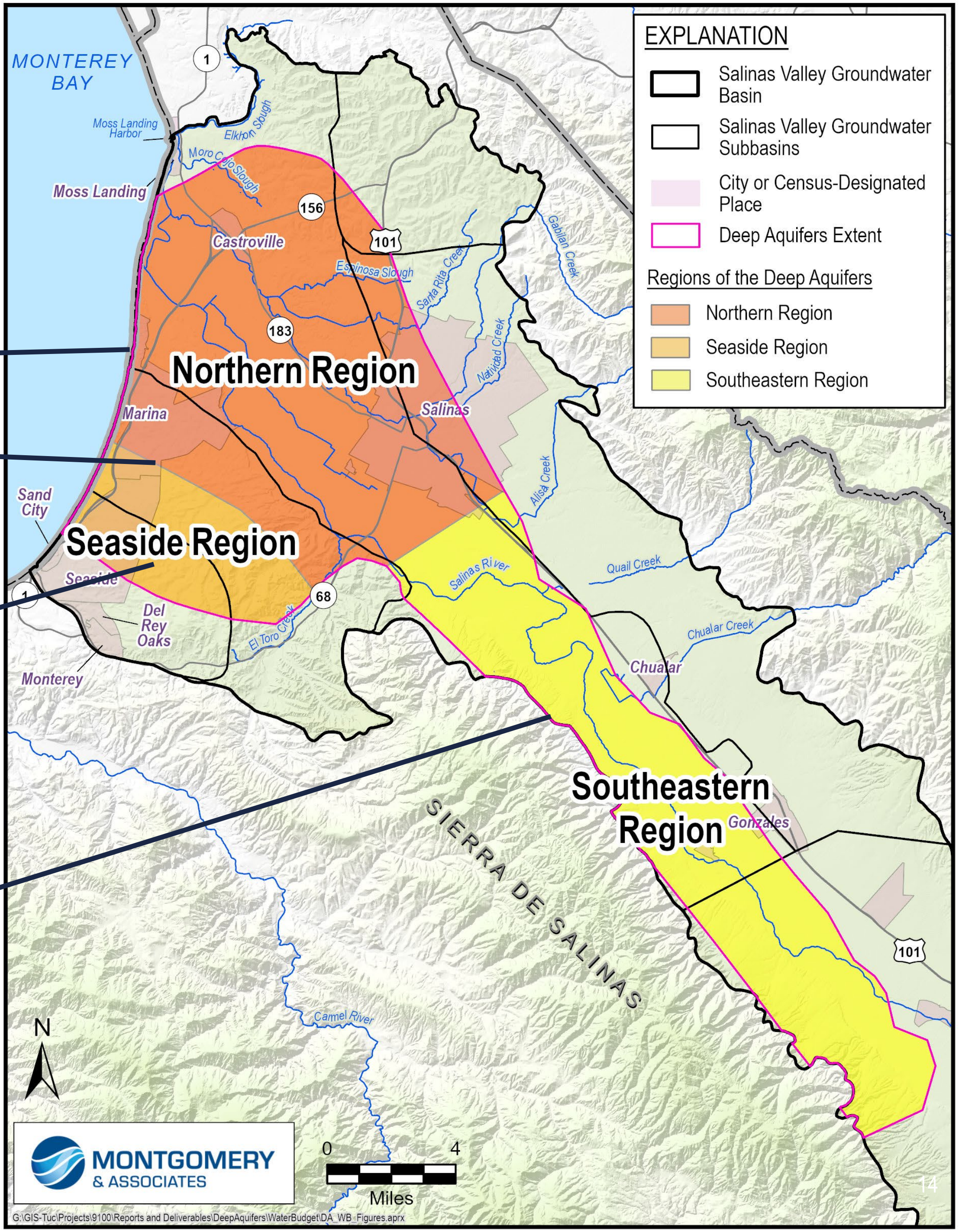
Paso Robles Formation and Purisima Formation

Groundwater Level Divide



Santa Margarita Sandstone and Paso Robles Formation

Lack of true Deep Aquifers wells



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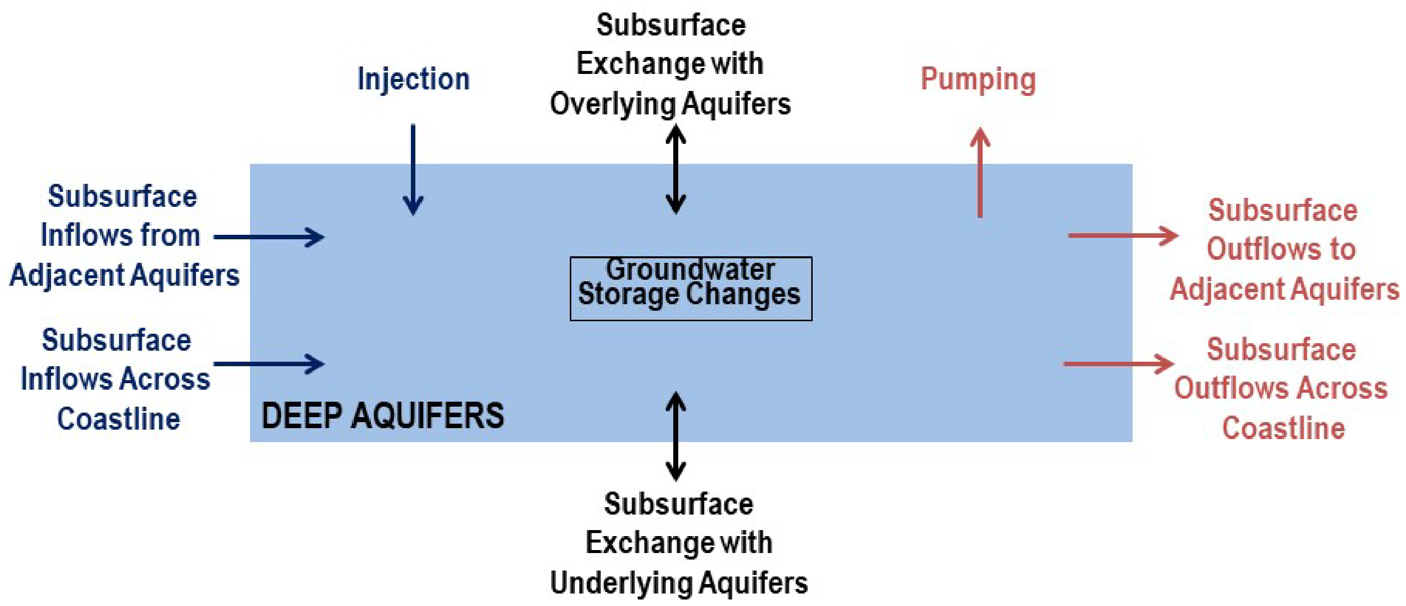
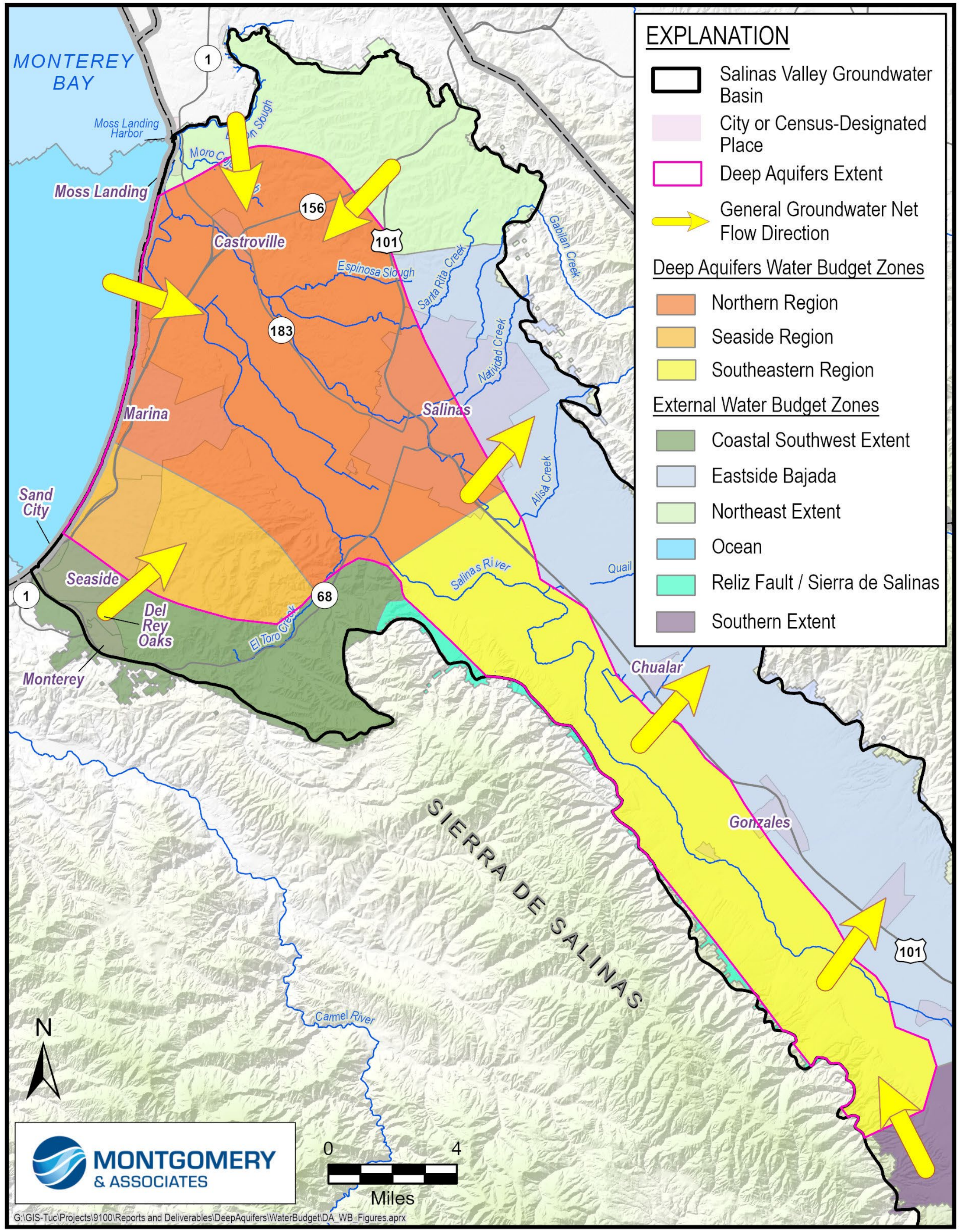
Study Modeled Deep Aquifers Subsurface Inflows and Outflows

Groundwater flows toward areas of lowest groundwater levels





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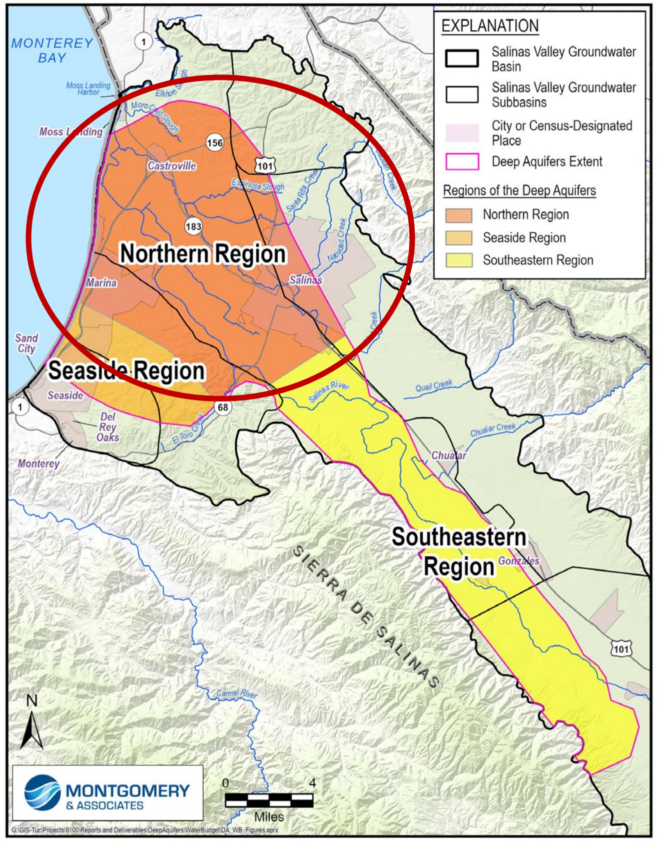
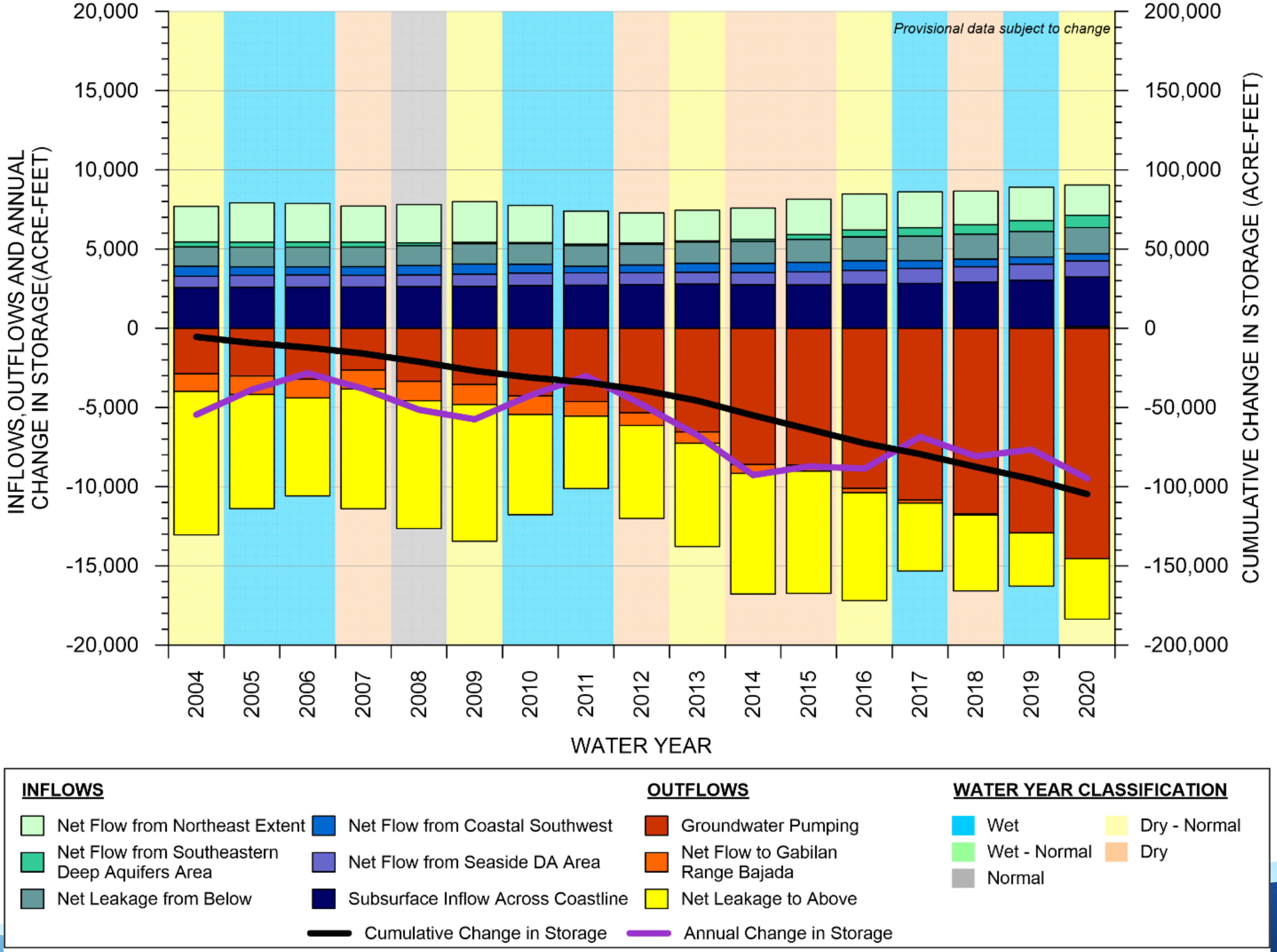
Northern Region

2018-2020





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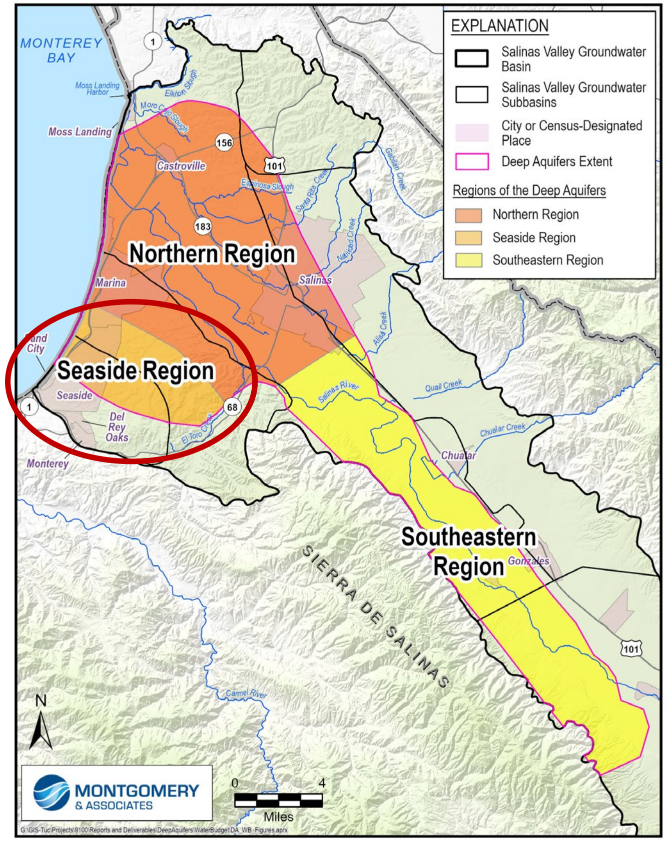
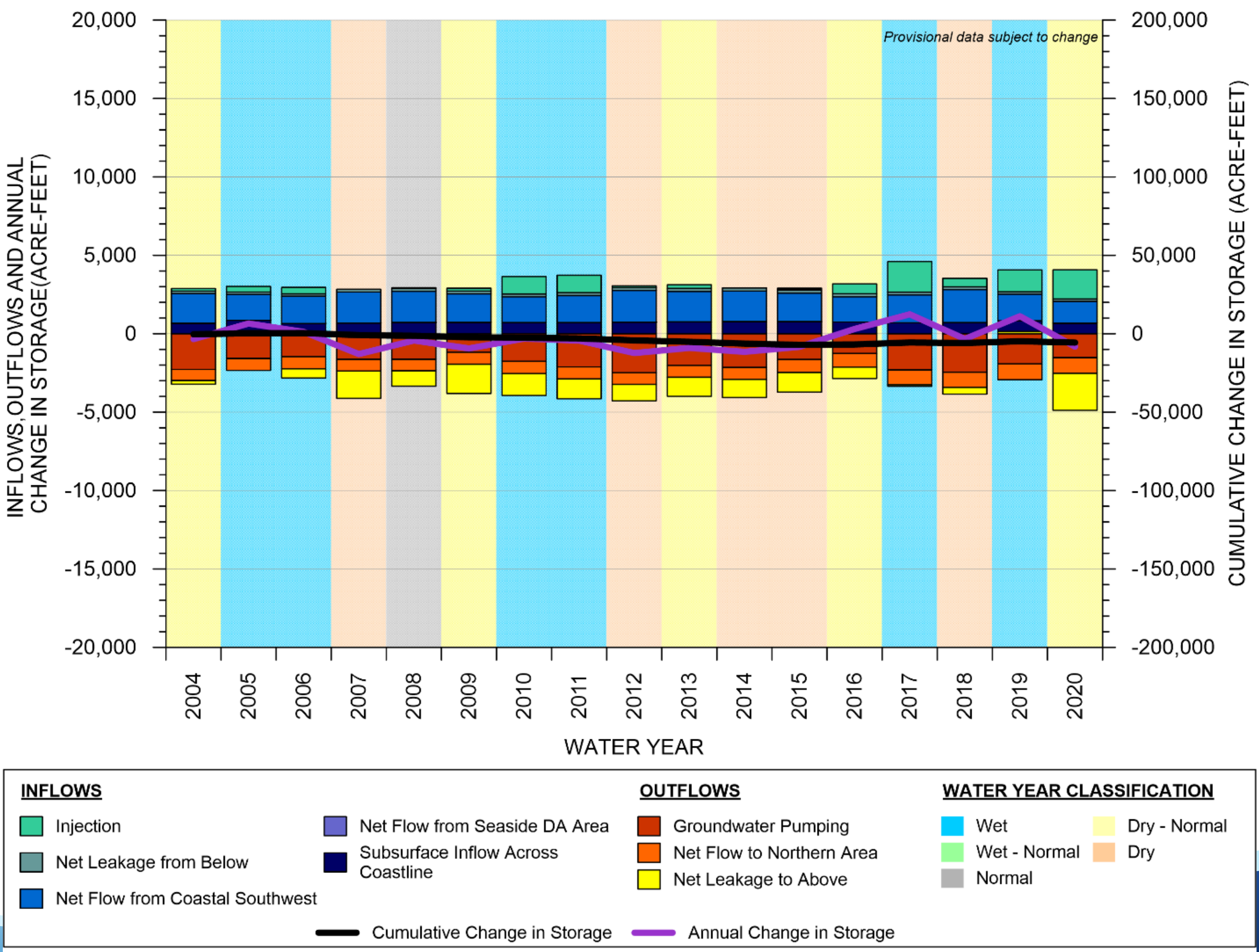
Seaside Region

2018-2020





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Simulated Recent Water Budget Shows Decrease in Storage in Deep Aquifers

Water Budget Component (2018-2020 in AF/yr) *Positive = Net Inflow, Negative = Net Outflow*	**Seaside Region**	**Northern Region**	***Southeastern Region***	***Full Deep Aquifers Extent***
Pumping	-2,000	-13,100	*-2,500*	*-17,600*
Injection	1,300			
Decrease in Storage	0	-8,400	*-1,200*	*-9,600*
Subsurface Flow from Adjacent/Overlying Aquifers	1,700	3,100	*300*	*5,100*
Flow from Other Deep Aquifers Regions	-1,000	1,700	*-700*	*1,700*

**Need to change sign of Decrease in Storage to balance water budget*

High Model Uncertainty

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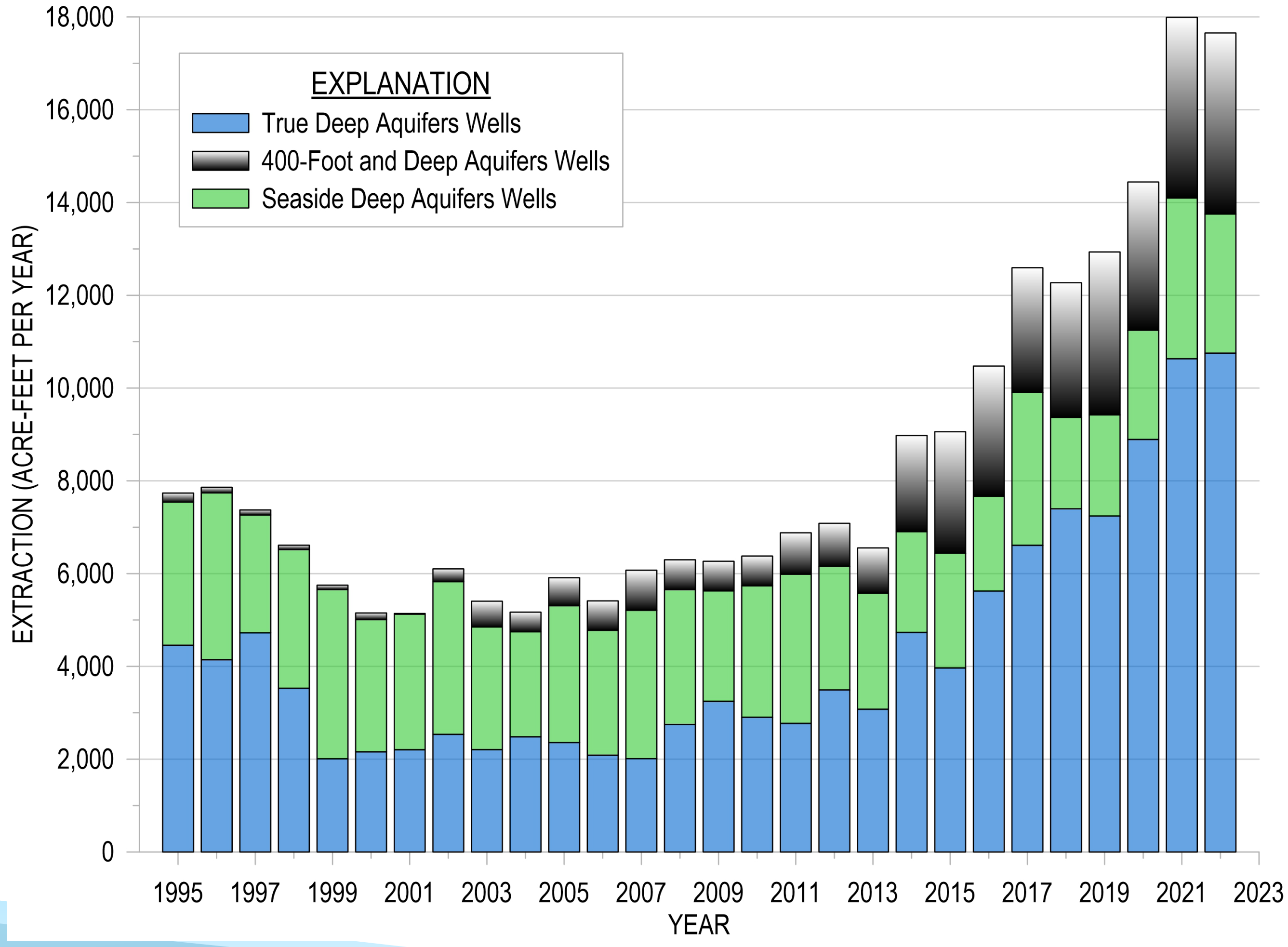
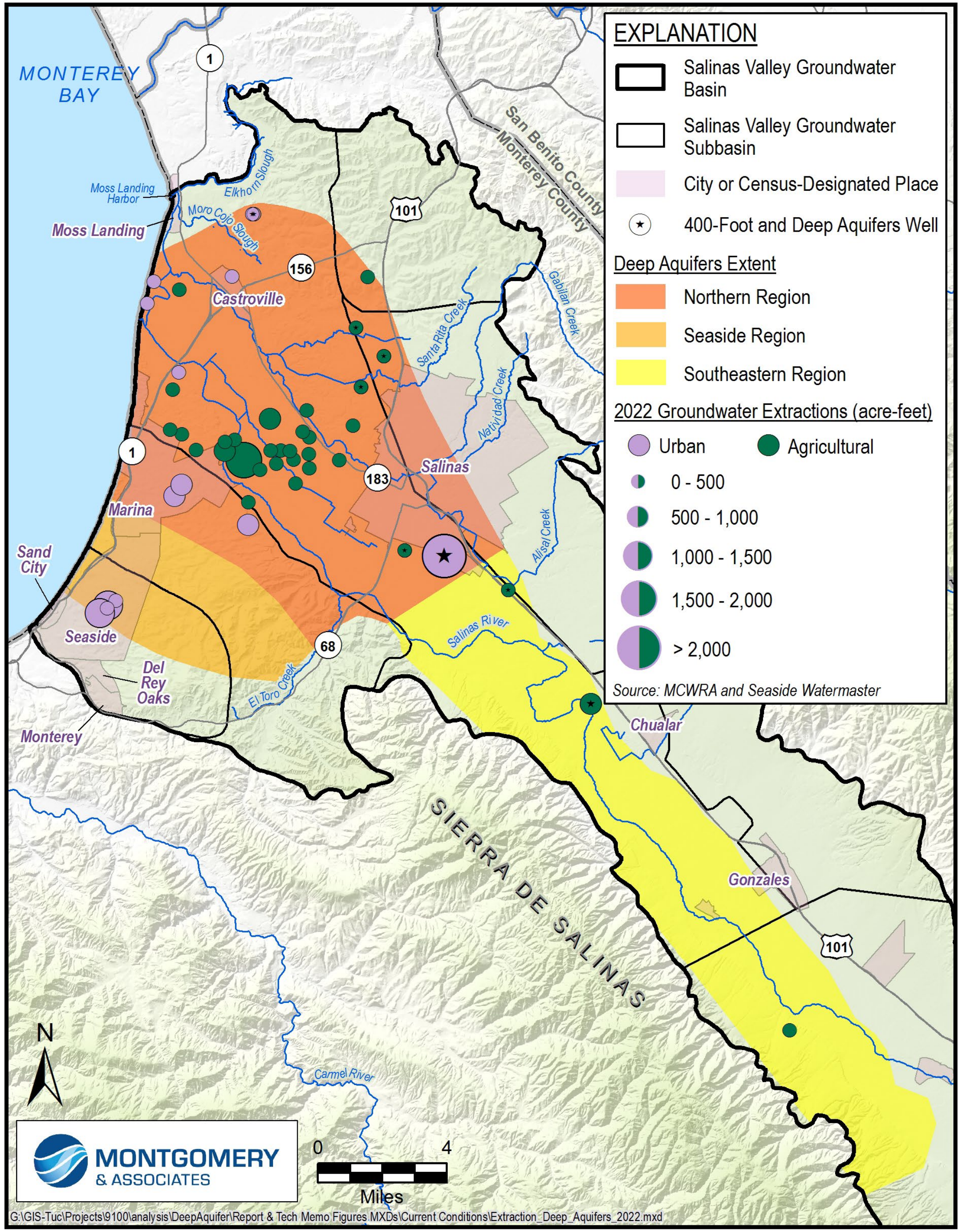
Extraction from the Deep Aquifers





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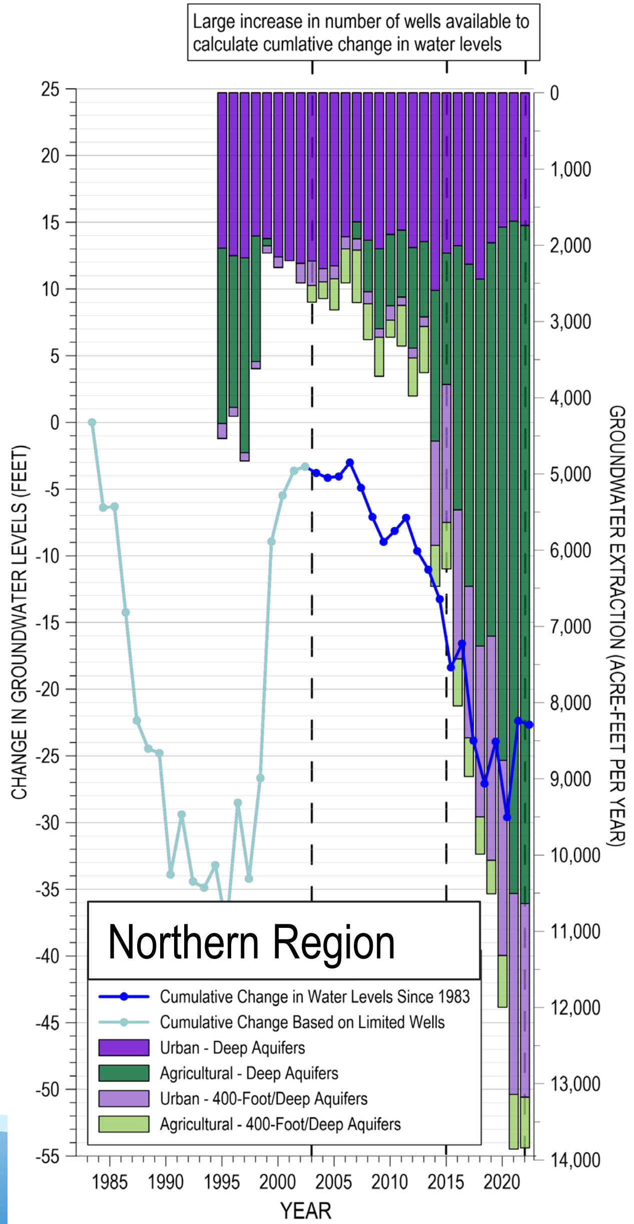
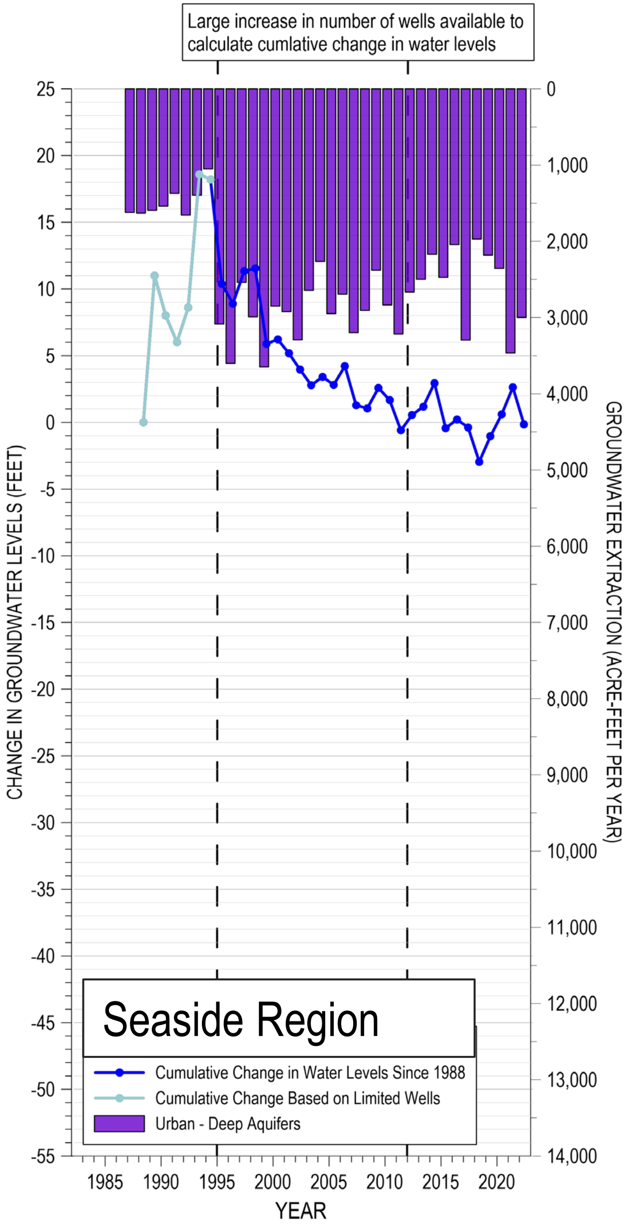
Pumping and Cumulative Change in Groundwater Elevations by Region

Extraction from Deep Aquifers is between 13,800 and 17,700 AF/yr

Groundwater elevations are declining





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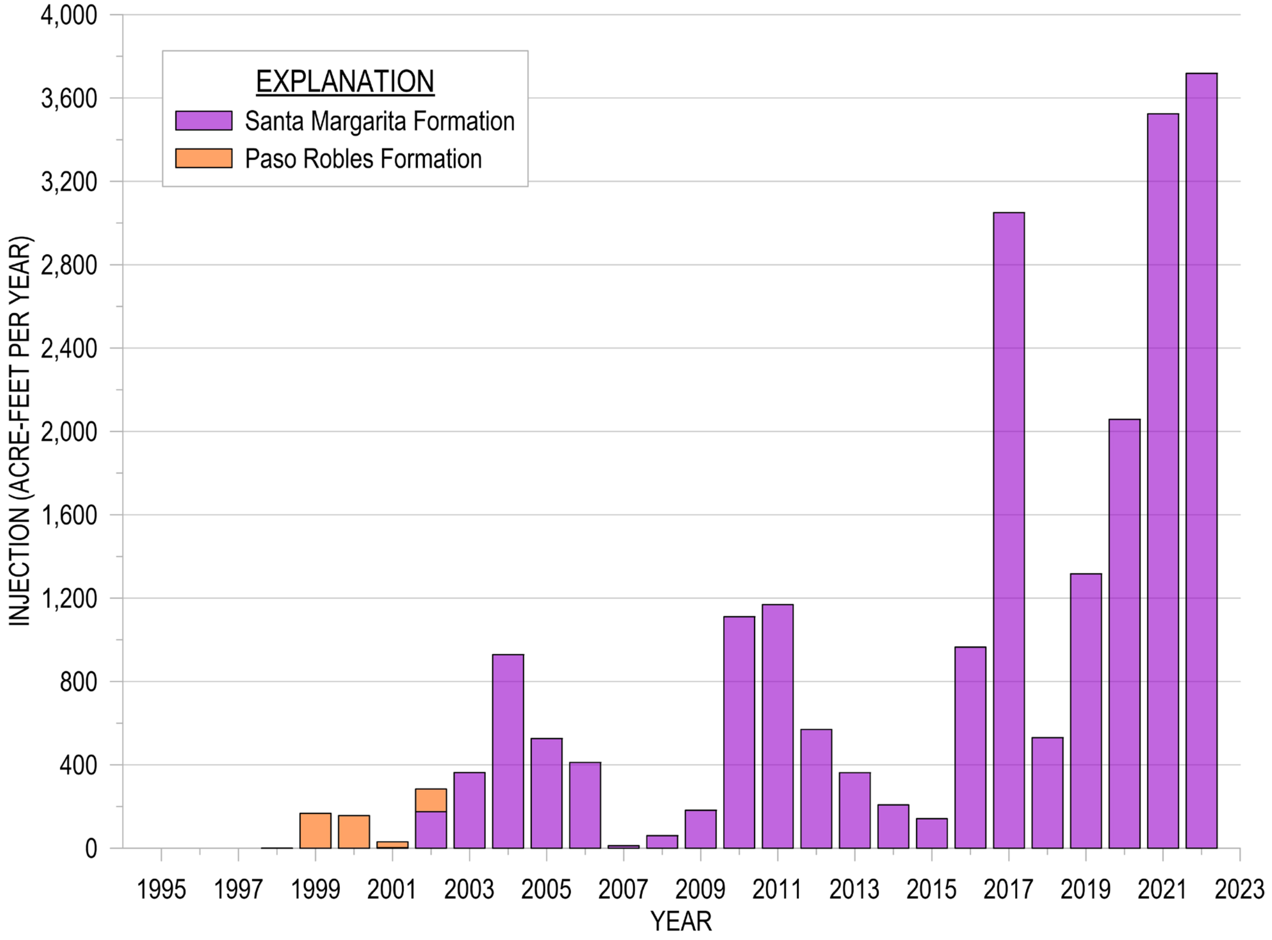
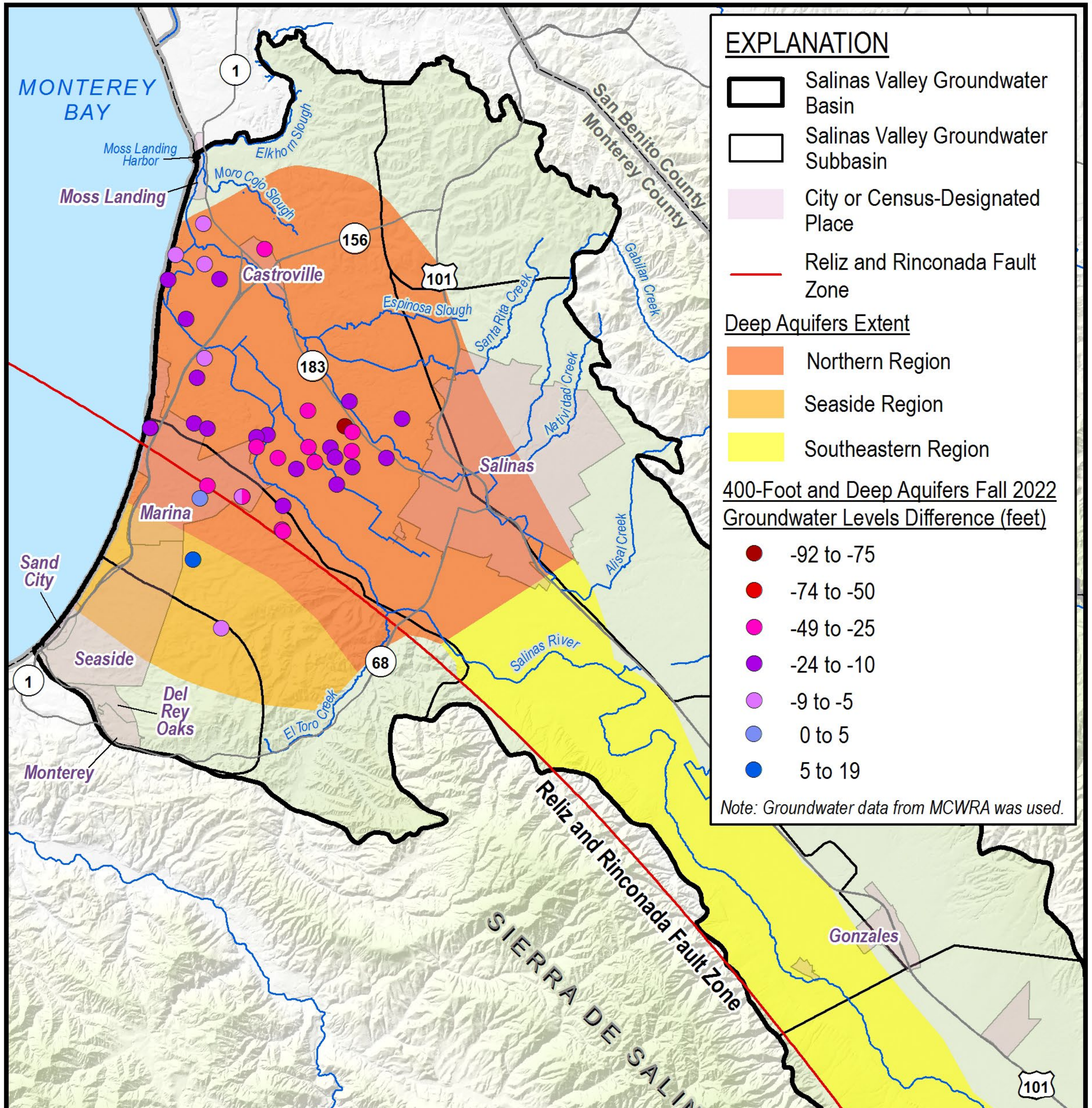
Injection into the Deep Aquifers – Seaside Region



Current Vertical Gradient is Mostly Downwards

Difference in Fall 2022 Groundwater Levels Between the 400-Foot and Deep Aquifers



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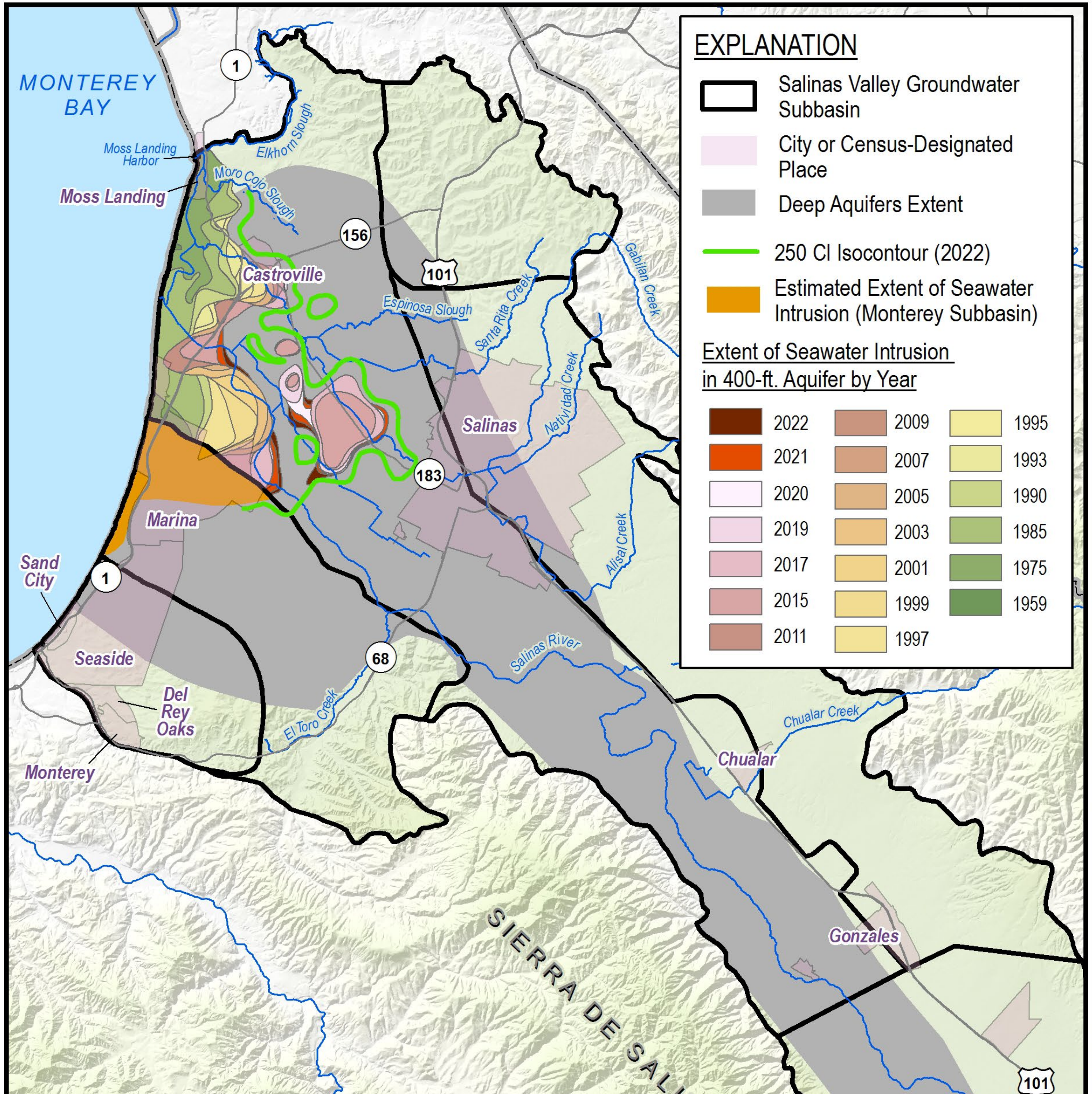
Seawater Intrusion in 400-Foot or Equivalent Aquifer

- Historical extent of 500 mg/L chloride isocontour
- 2022 250 mg/L chloride isocontour



Land Subsidence

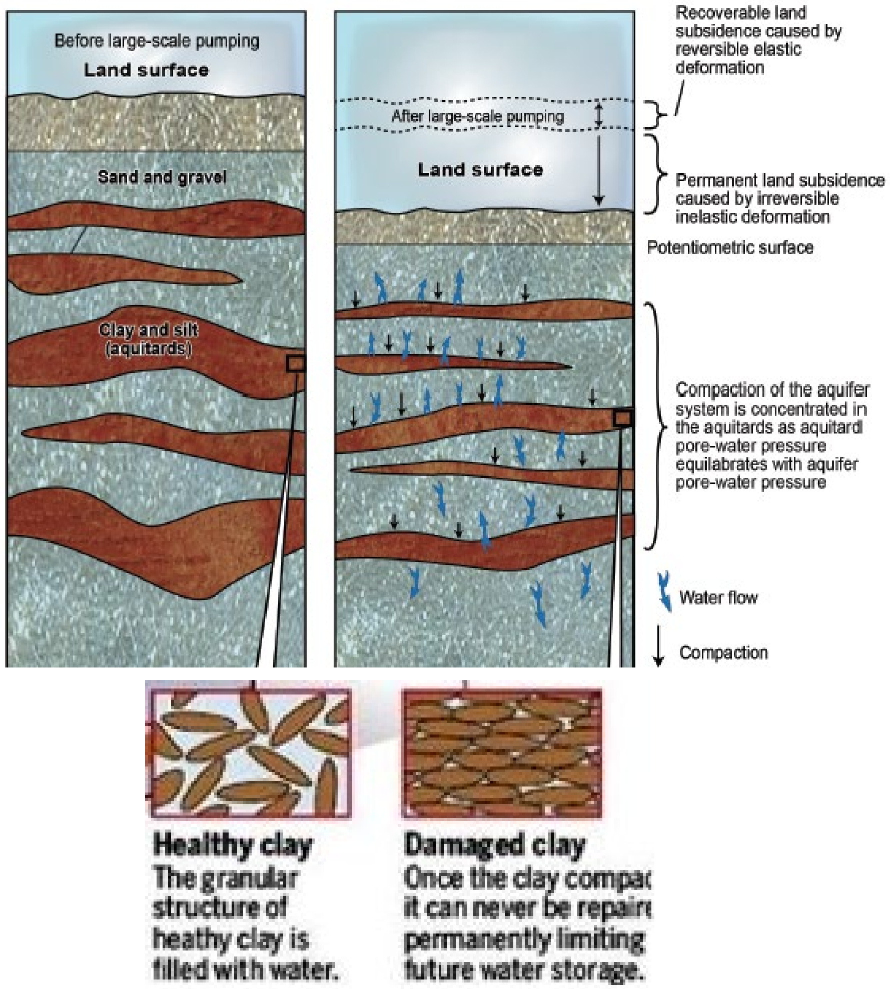


Figure 1. Schematic diagram of land subsidence due to groundwater withdrawal (modified from Galloway and others, 1999).

- Water extracted from the Deep Aquifers lowers pressures
- As clays are depressurized, they compact
- Compacted clays lead to collapsed ground
- Do not know whether/when subsidence will occur until it does

Example: San Joaquin Valley & Corcoran Clay

Summary of Current Conditions

Analysis of historical and current conditions does not change conceptual understanding

Current conditions confirm previous conclusions that the Deep Aquifers are in overdraft and not being recharged, and they're at risk of seawater intrusion

Continued overdraft put the Deep Aquifers at risk for irreversible damage

Data is sufficient for moving forward with management

Guidance for Management

Regulatory Context

Guidance for Management

Regulatory Context

Regulatory Context:	Agency Authority:
• Seaside Subbasin is Adjudicated • Other subbasins subject to the Sustainable Groundwater Management Act (SGMA) • Management must meet adjudication or SGMA regulatory goals	• Sufficient jurisdictional and legal authority exist to manage the Deep Aquifers (MCWRA, EHB, MCWD, SVBGSA, Seaside Watermaster, cities and County) • Agencies should work collaboratively to manage across the extent of the Deep Aquifers and adjacent aquifers

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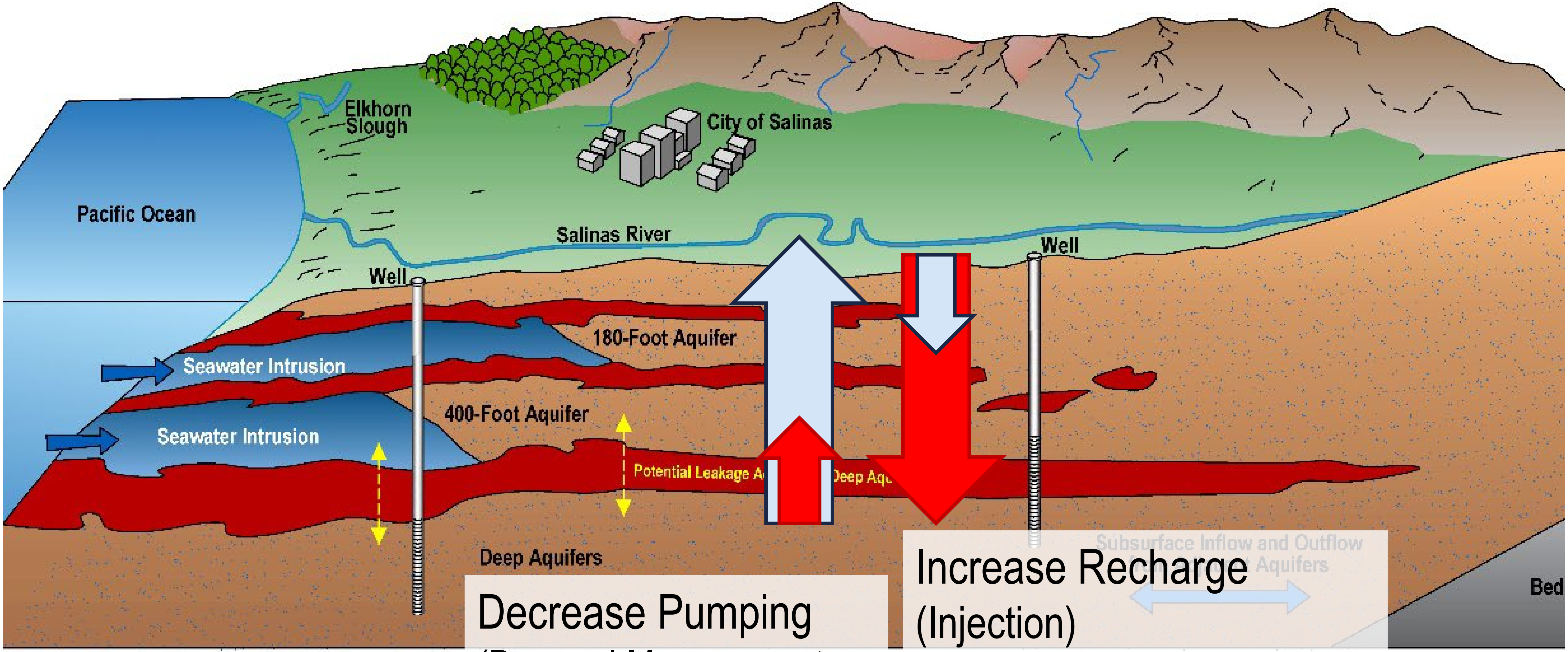
Types of Management Actions and Projects



Decrease Pumping
(Demand Management or Alternative Supply)

Increase Recharge
(Injection)

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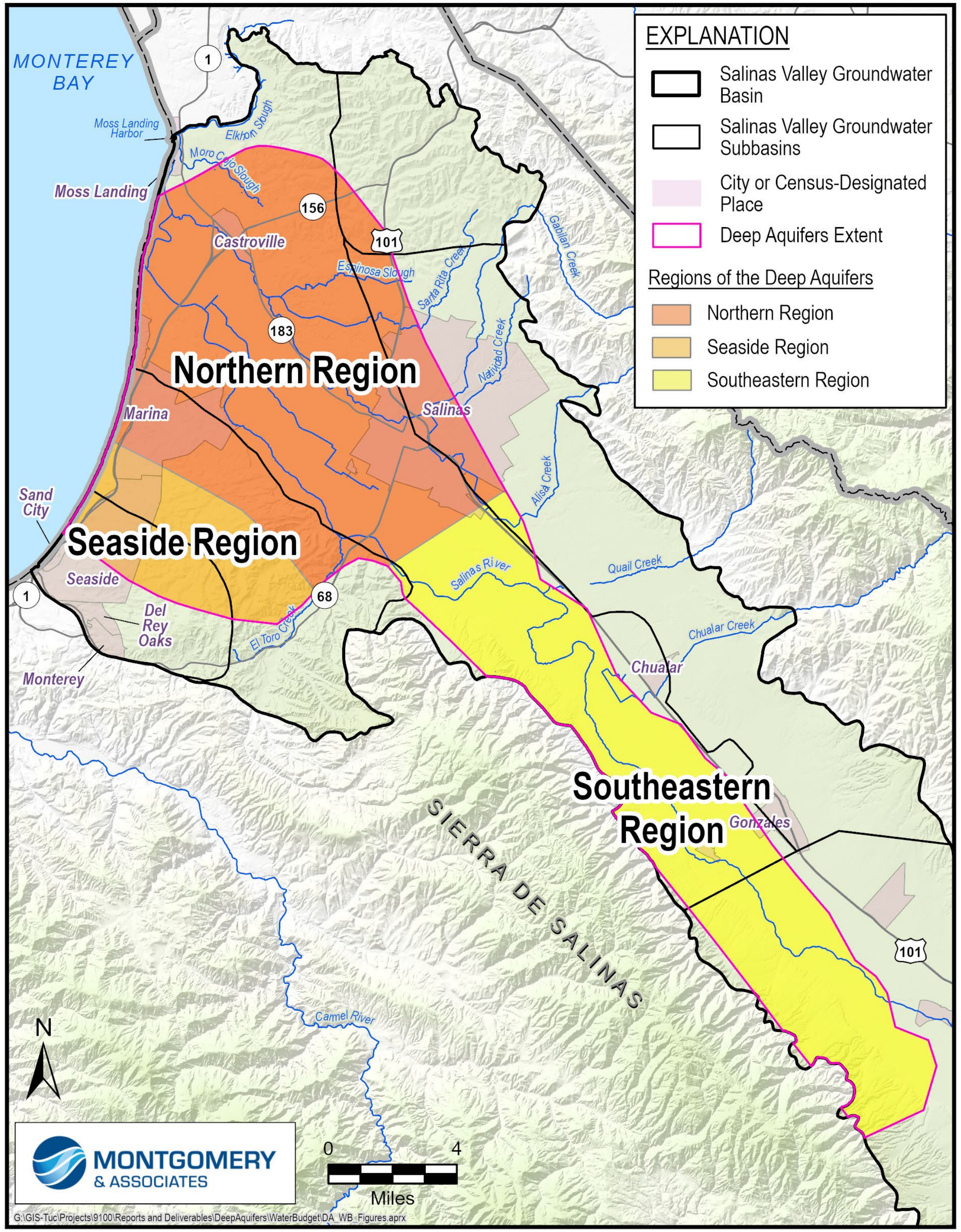
Location of Management

- Differentiate groundwater management by the 3 regions
- In Southeastern Region
  - Lack of true Deep Aquifers wells
  - Monitor first
  - Then manage if Deep Aquifers groundwater elevations are found to be declining
- Manage together with adjacent and overlying aquifers



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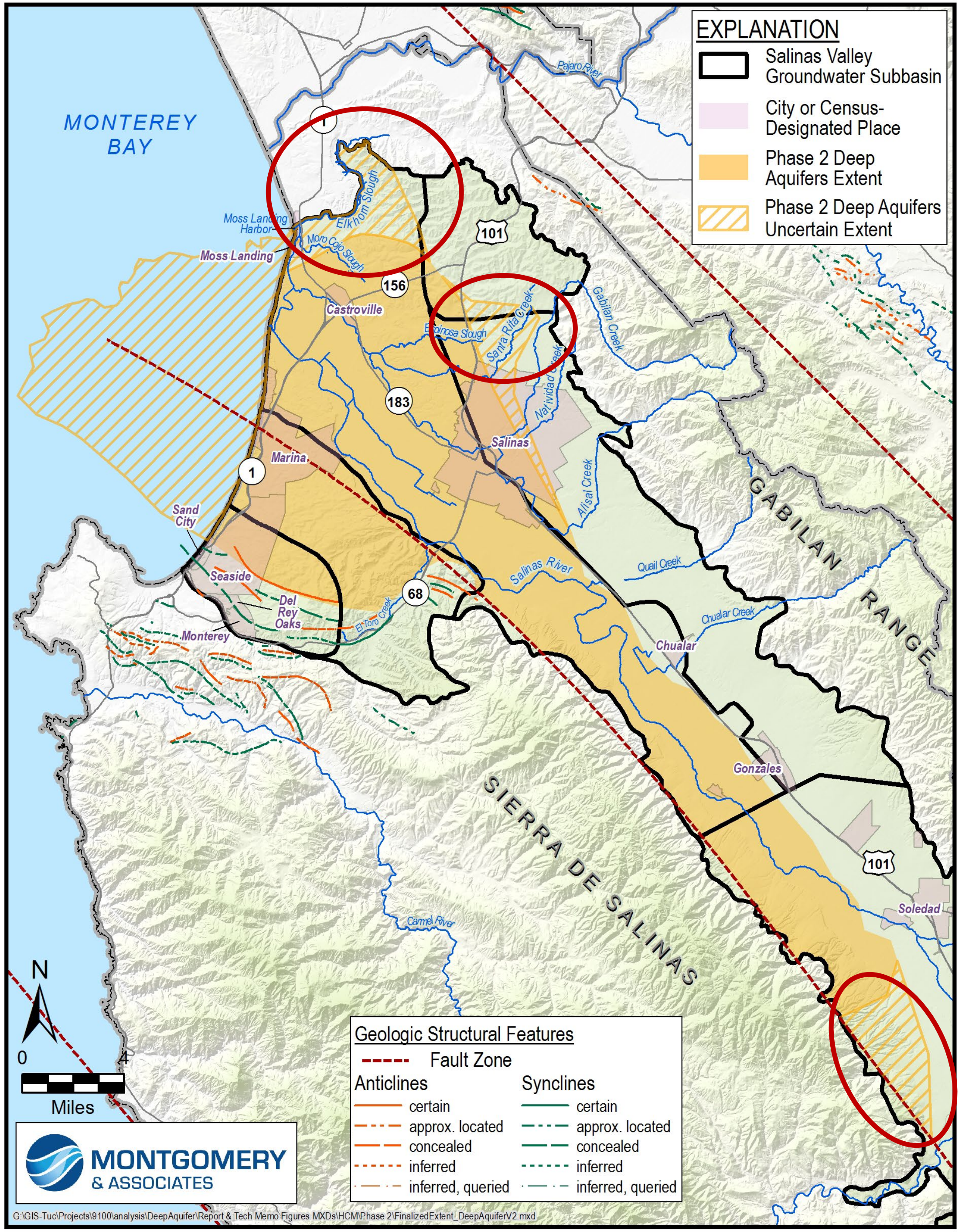
Areas of Uncertainty

- Take precautionary approach to new deep wells and increasing net extraction, unless shown not to be Deep Aquifers



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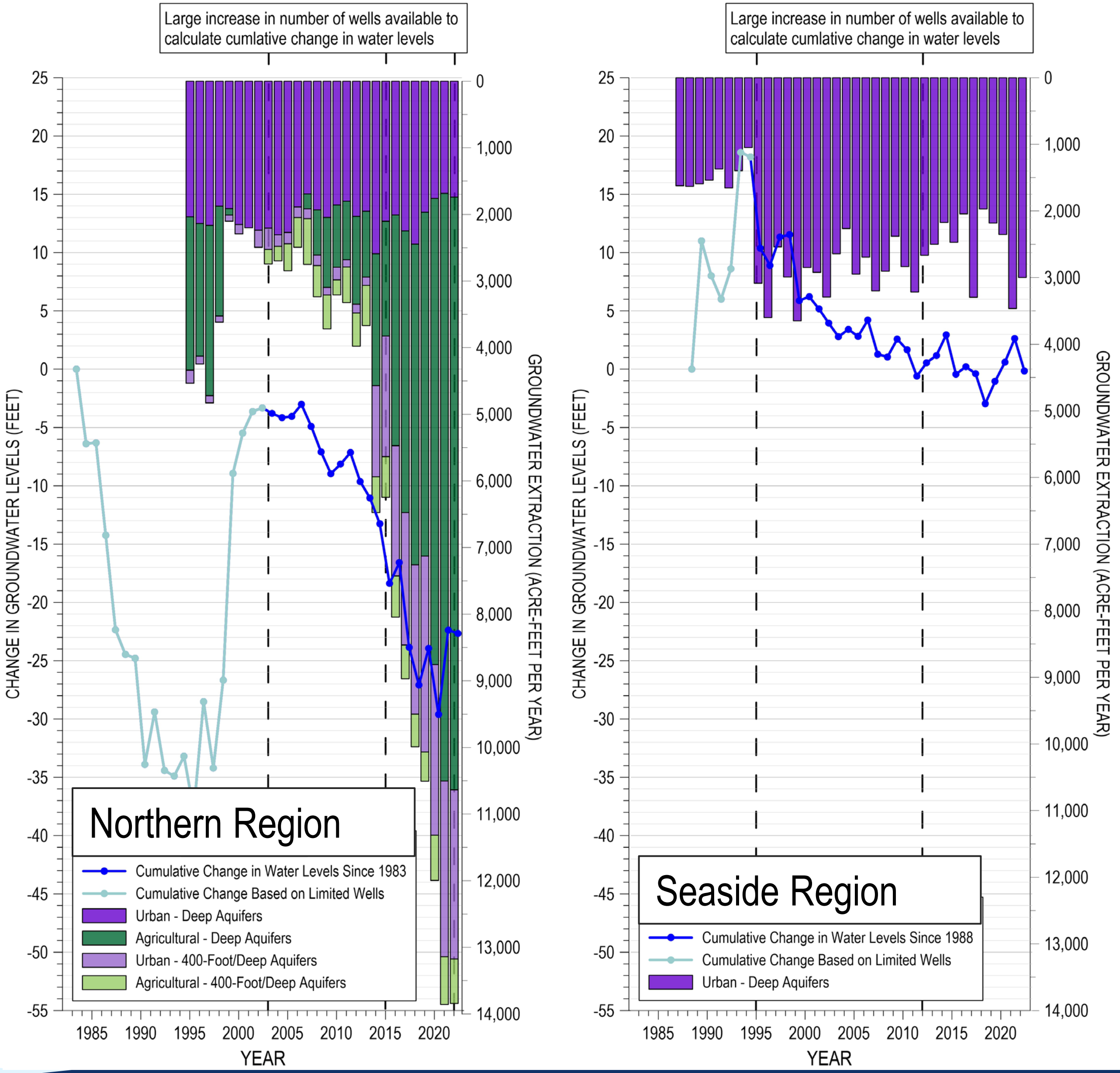
Current Net Extraction is Not Sustainable

- Prevent increases in net extraction from new wells
- Reduce net extraction



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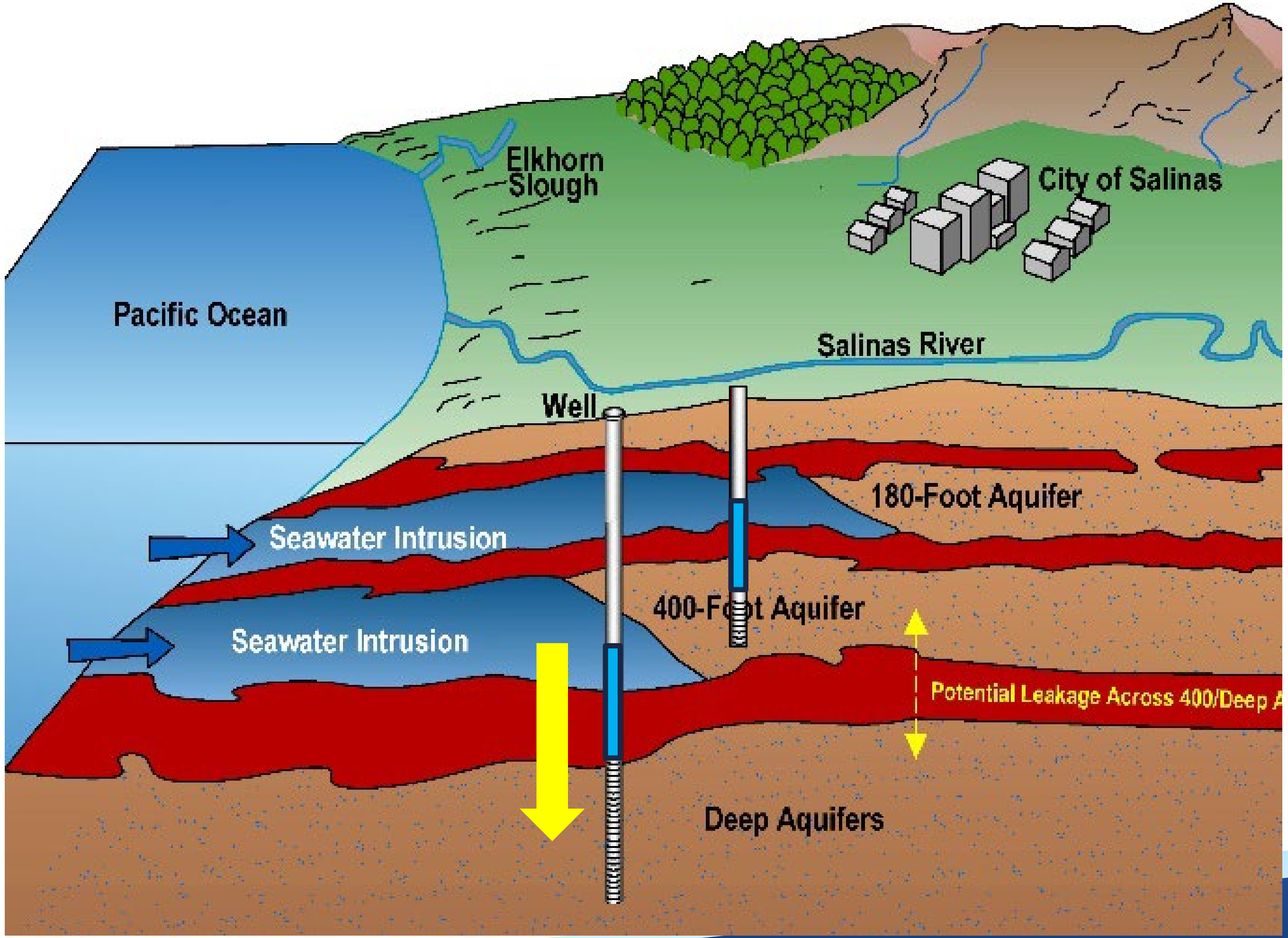
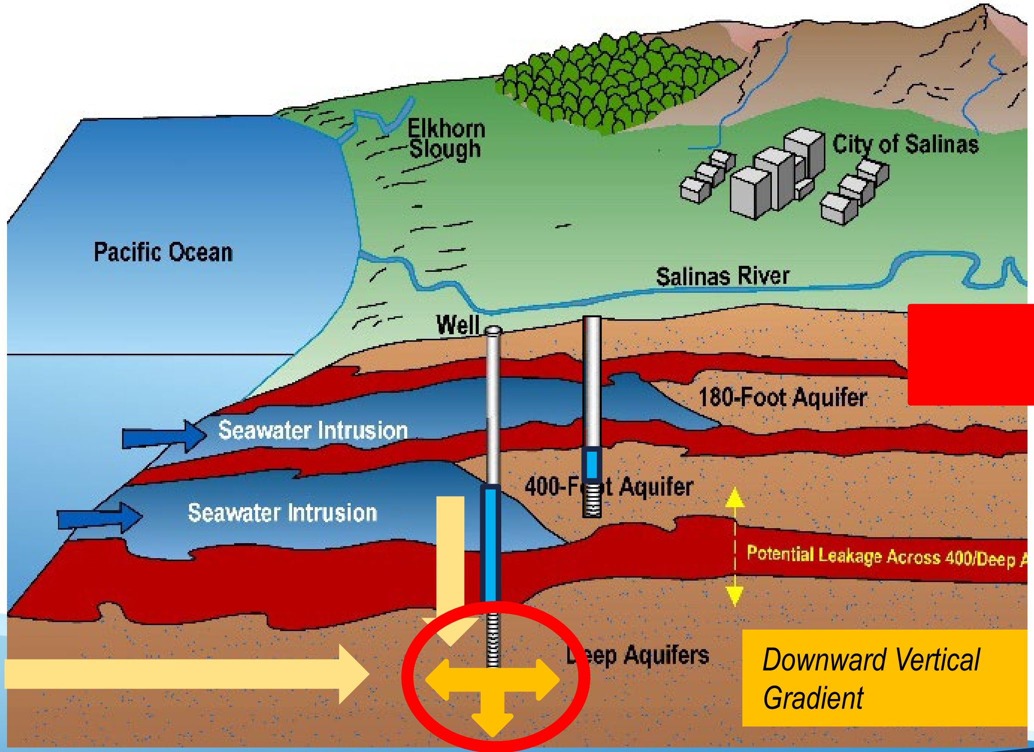
Hydrogeologic Principles to Guide Management to Prevent Subsidence

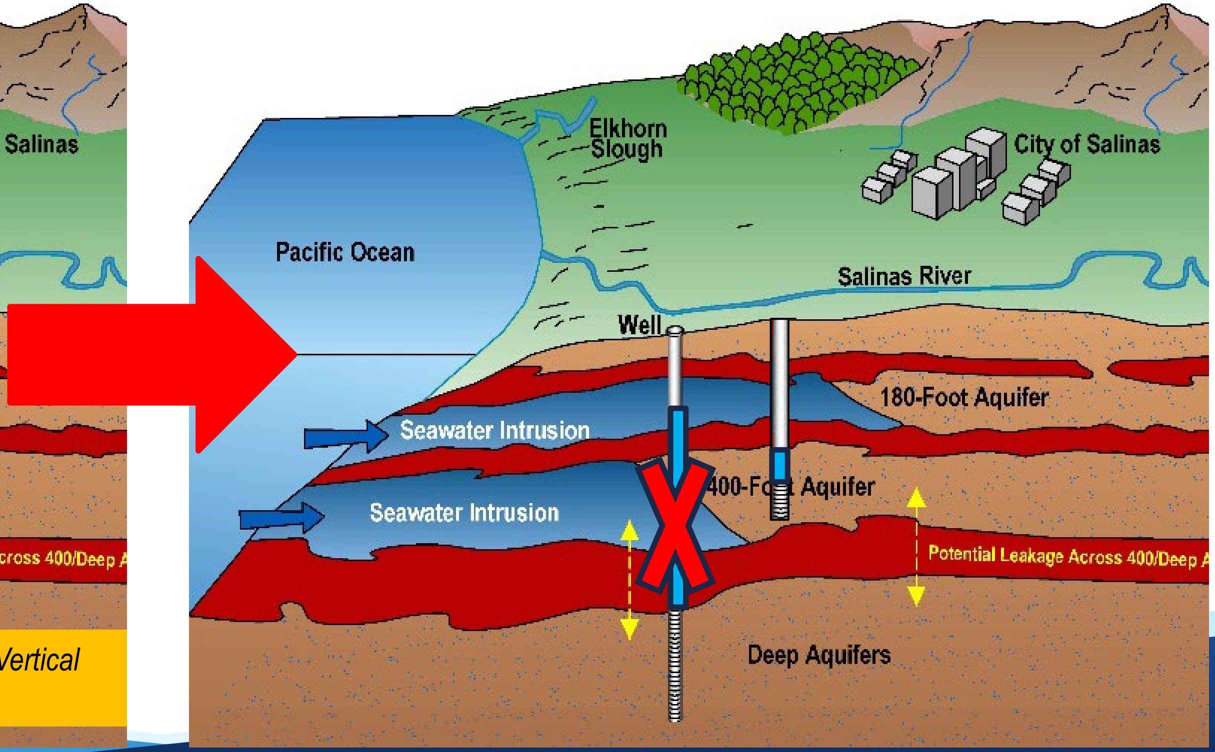
- Keep Deep Aquifers groundwater elevations above historical levels at a minimum



Hydrogeologic Principles to Guide Management to Prevent Seawater Intrusion

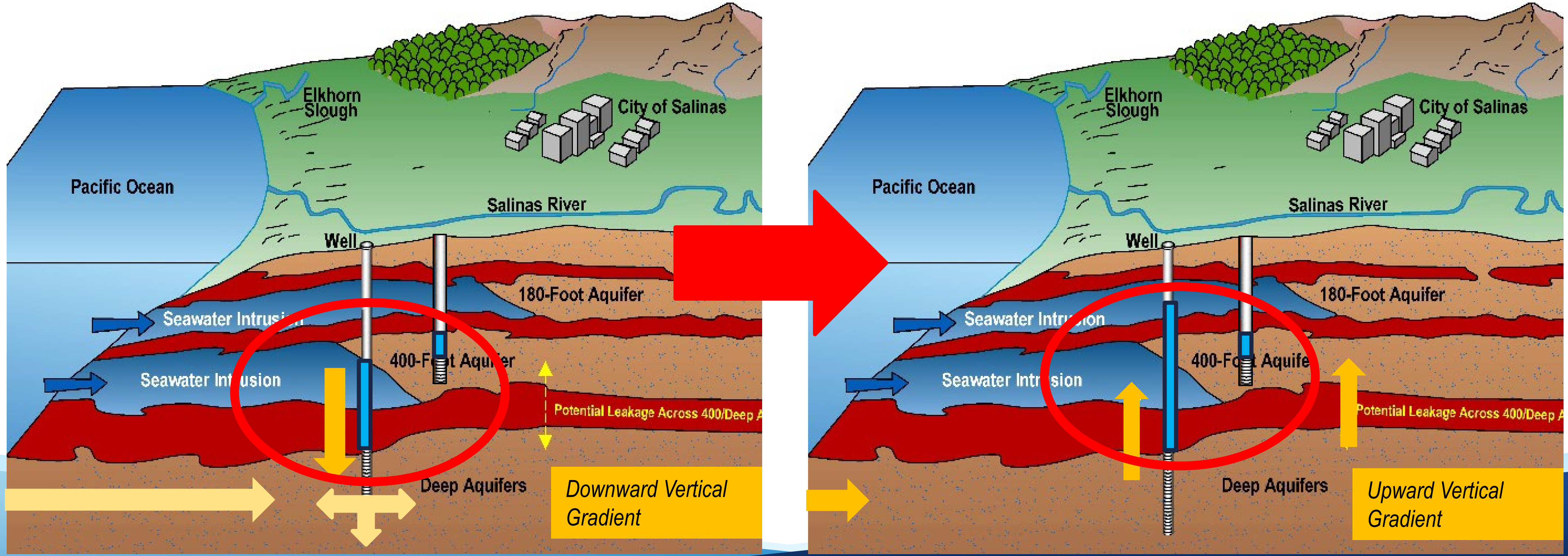
- If evidence of seawater intrusion leakage downward is detected, destroy wells that may facilitate leakage





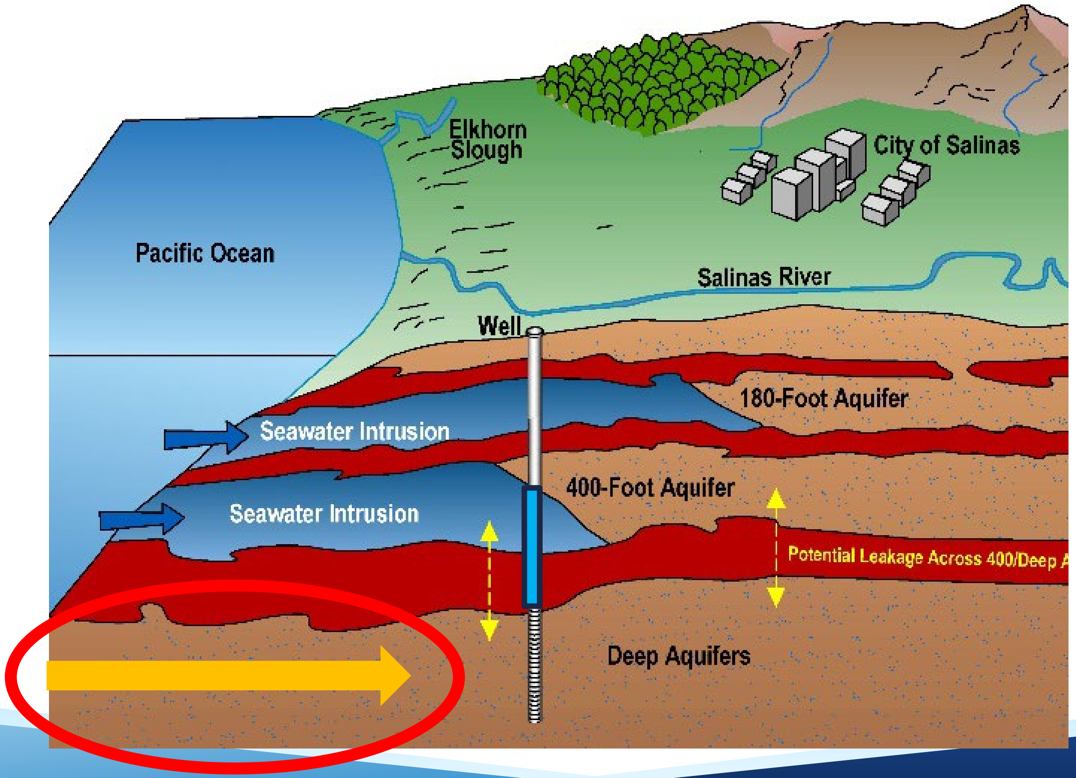
Hydrogeologic Principles to Guide Management to Prevent Seawater Intrusion

- To prevent downward migration: raise groundwater levels to above the overlying aquifer where intrusion is present



Hydrogeologic Principles to Guide Management to Prevent Seawater Intrusion

- Evaluate and select preferred option for controlling lateral seawater intrusion from ocean
- If intrusion is detected in the Deep Aquifers, stop extraction in vicinity of intrusion and implement preferred action

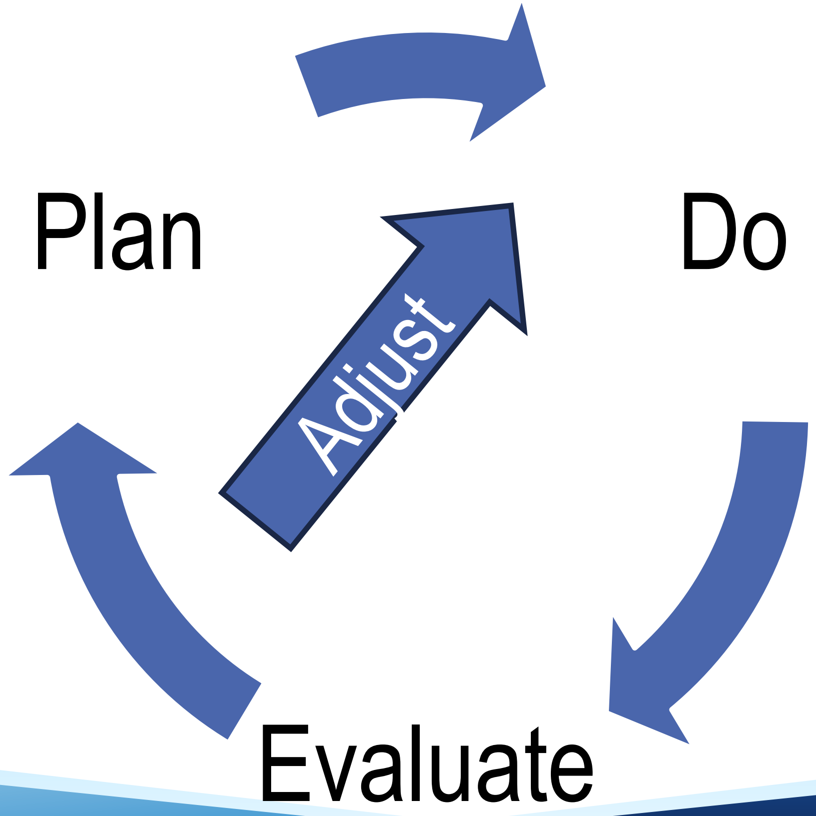


Process to Manage

- Use simulated sustainable/safe yield by Area to guide initial groundwater management
- Adjust management over time according to changes in observed groundwater elevations
- Include wells screened fully and partially in the Deep Aquifers
- Manage together with overlying and adjacent aquifers

Process to Manage

- Adaptively manage Deep Aquifers such that quantity of extraction and injection is reviewed and revised periodically based on groundwater elevations



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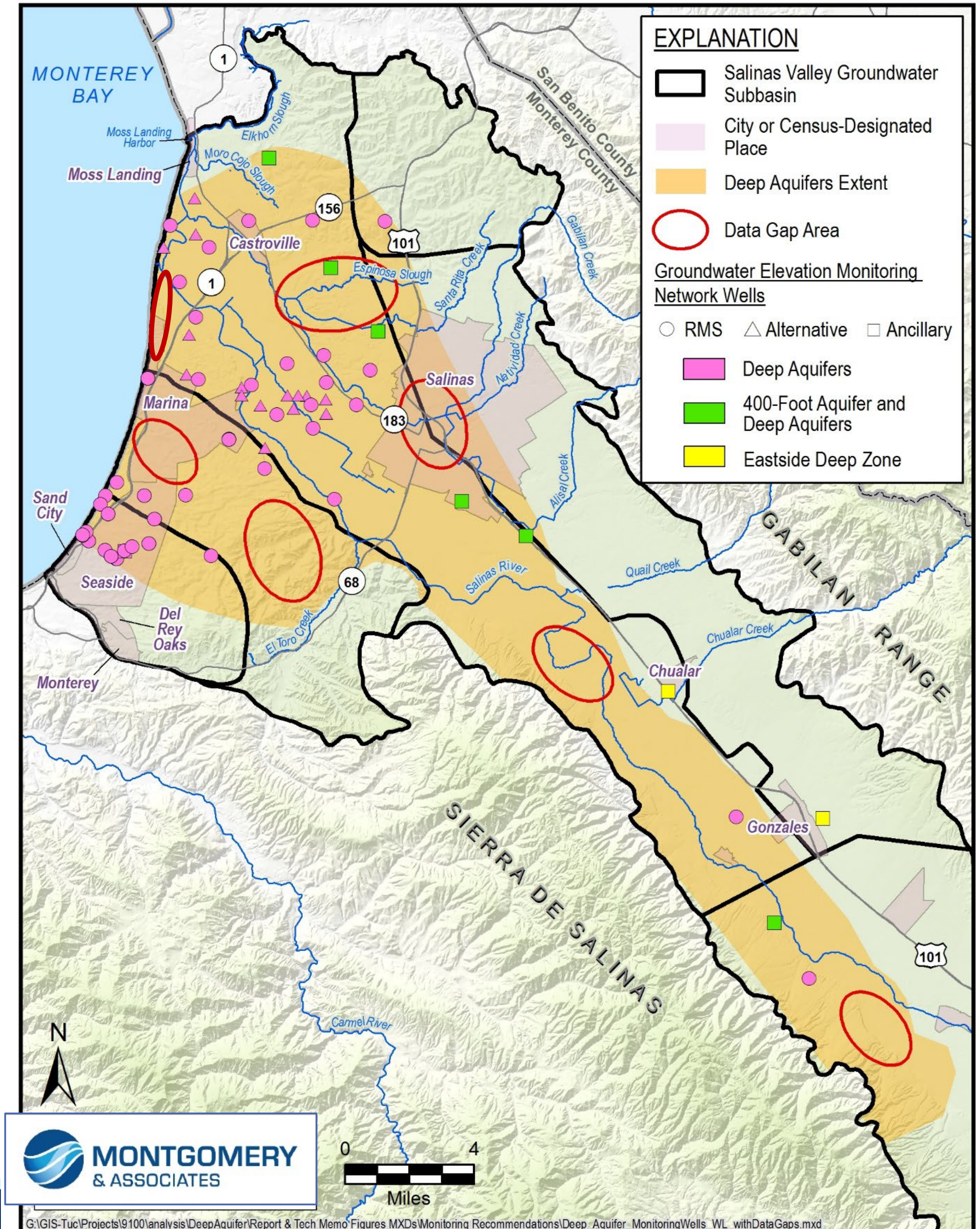
Monitoring Recommendations

Monitoring Recommendations

Extraction	Collect extraction data from all wells in Deep Aquifers.
Elevations	Monitor 82 wells, including 4 recently drilled wells, 5 existing production wells, and filling the 7 data gaps.
Quality	Sample an additional 16 wells to bring wells monitored to 66.

Groundwater Elevation Data Gaps

Coastal data gaps to also watch for seawater intrusion from Ocean



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Additional Monitoring and Assessment

Induction Logging

- Detect chloride increases in key wells

Isotope Sampling

- Further assess relationship with adjacent aquifers

Periodic Assessment

- Evaluate trends and changes every 5 years

SUMMARY OF STUDY CONTRIBUTIONS

- Developed definition, extent, and HCM of the Deep Aquifers
- Developed a water budget for the Deep Aquifers
- Made monitoring recommendations
- Provided guidance for management based on the Study's findings

Questions/Comments