

Groundwater Response to Tides, Seawater Intrusion and Sea-Level Rise in Santa Clara County, California



Why did we do this study?

There has been a lot of recent interest in how groundwater near the San Francisco Bay might rise and emerge at the land surface due to future sea-level rise. Valley Water's 2025 report, titled Groundwater Response to Tides, Seawater Intrusion, and Sea-Level Rise in Santa Clara County, California¹, studies potential groundwater rise and emergence from climate change in detail and also describes current and future seawater intrusion. This report is intended to be a reference for cities, organizations, and stakeholders and to support climate adaptation planning efforts.

What caused historical seawater intrusion?

From the early 1900s to 1970s, groundwater overdraft caused permanent land subsidence in northern Santa Clara County. By lowering the land surface over broad areas, subsidence damaged infrastructure, increased the risk of flooding, and caused seawater intrusion. At its maximum extent, seawater intrusion affected about 57 square miles of shallow groundwater near the bay. By the 1970s, Valley Water investments and water management stopped groundwater overdraft, subsidence, and seawater intrusion from advancing further inland.

Is the groundwater supply impacted?

Although seawater intrusion persists in the shallow aquifer, there is no seawater intrusion in the deeper, principal aquifer that serves as the primary groundwater supply for municipal, domestic, and industrial use. The aquifers are not connected to the San Francisco Bay and are protected by bay mud and thick clay layers called aquitards (Figure 1).

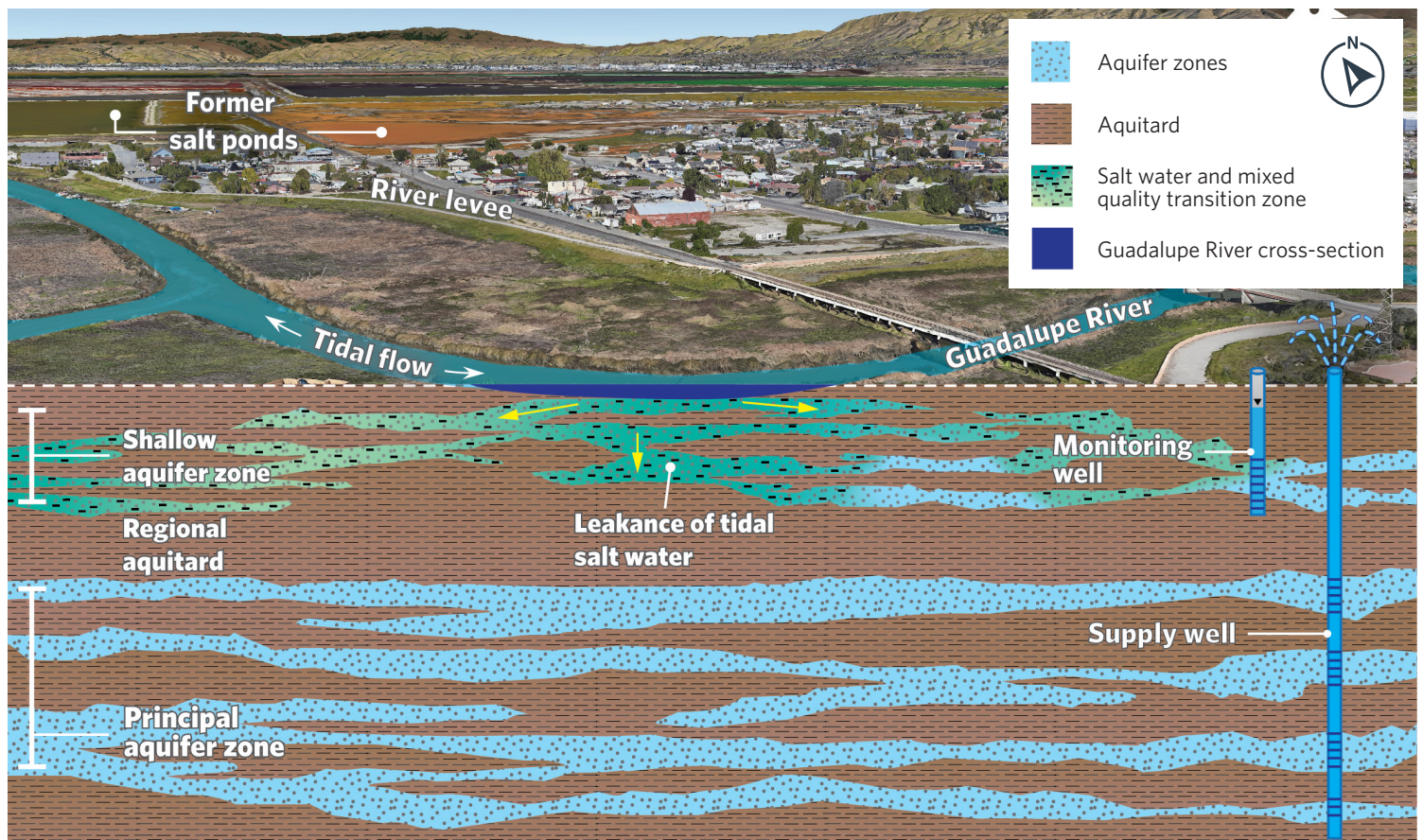
What causes seawater intrusion today?

Leakance of saltwater beneath tidal streams (Figure 1) is the primary mechanism affecting the extent of seawater intrusion. Today, seawater intrusion affects about 44 square miles of the shallow aquifer. Construction activities, like pilings that pierce the protective bay mud and clay layers, may contribute to localized seawater intrusion in the shallow aquifer.



Valley Water staff evaluating a seawater intrusion monitoring well near south San Francisco Bay.

Figure 1. Seawater leakance beneath a tidal stream near the San Francisco Bay.



¹ The report is available at: valleywater.org/your-water/groundwater/groundwater-studies

What causes groundwater rise and emergence?

Localized clay layers, proximity to tidal streams, seasonal and annual rainfall variability, king tides, and sea-level rise can contribute to groundwater rise. Groundwater rise is a concern because it can lead to temporary or permanent groundwater emergence (flooding) above land surface. Groundwater emergence is more likely in localized areas closer to the San Francisco Bay where the land surface is below sea level.

Is groundwater emergence a concern locally?

Currently, groundwater emergence is not a widespread concern in Santa Clara County because it is temporary and localized in undeveloped lands, wildlife preserves, and parks near the bay. Not all areas near the bay have, or are likely to have, groundwater emergence. Groundwater levels observed during the exceptionally wet 2023 winter confirm the projected groundwater emergence map (Figure 2) tends to overestimate locations of existing shallow and emergent groundwater.

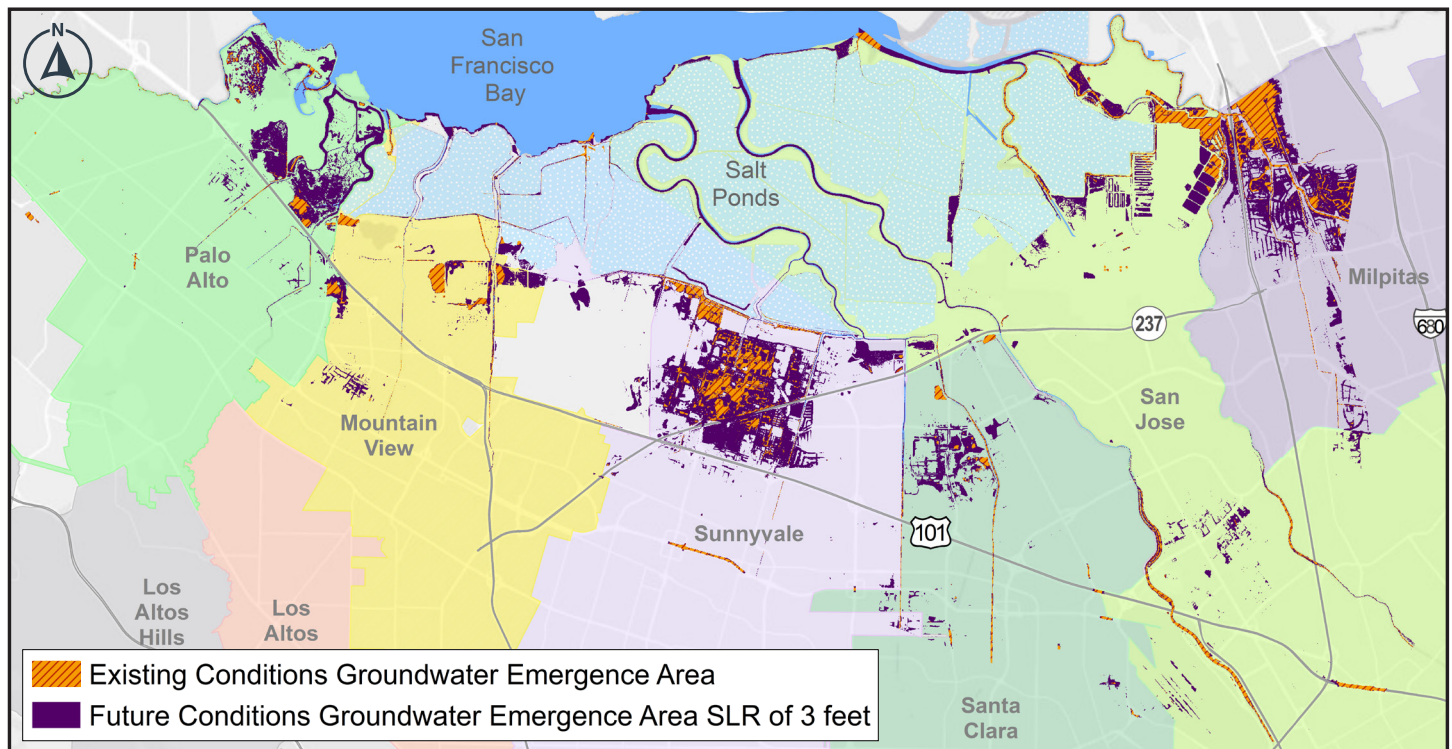
How will sea-level rise affect local groundwater?

With future sea-level rise, groundwater rise and emergence could become more permanent or expand in some areas. During the 2024 king tides, groundwater emergence occurred in some very localized areas. However, field verification of areas with projected groundwater emergence (Figure 2) found most areas either had a direct connection to tidal surface water or showed no emergence. Because communities are beginning to use these types of maps, this report discusses the uncertainties, limitations, and appropriate use of these maps to make best-informed planning and policy decisions.

What are the next steps?

Valley Water will continue to monitor conditions near the bay and remain engaged with local partners and stakeholders as they consider groundwater rise and emergence under future climate change and sea-level rise in the San Francisco Bay. Valley Water will continue to provide local groundwater management and expertise to support these important efforts.

Figure 2. Estimated existing and future groundwater emergence with 3 feet of sea-level rise (SLR).



Note: This map conservatively assumes a 1:1 response between sea-level and groundwater level rise, likely overestimating shallow and emergent groundwater.

CONTACT US

For more information, contact Jason Gurdak at 408-630-2971 or visit our website at valleywater.org and use our Access Valley Water customer request and information system to find out the latest information or to submit questions directly to a Valley Water staff person.



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