County of Monterey

Board of Supervisors
Chambers
168 W. Alisal St., 1st Floor
Salinas, CA 93901

Board Report

File #: WRABMAC 21-016, **Version:** 1

Consider receiving a report on Mechanisms and Pathways of Seawater Intrusion
RECOMMENDATION:
It is recommended that the Monterey County Water Resources Agency Basin Management Advisory Committee:

Receive a report on Mechanisms and Pathways of Seawater Intrusion

SUMMARY:
The Monterey County Water Resources Agency (MCWRA) monitors the movement and extent of seawater intrusion in the Salinas Valley Groundwater Basin. The current understanding of seawater intrusion is shaped by available data on groundwater levels, groundwater quality, geochemistry, hydrogeology, and solute transport.

DISCUSSION:

Regional Seawater Intrusion
In the Salinas Valley Groundwater Basin, seawater intrusion has been documented in the 180-Foot and 400-Foot Aquifers. The geologic formations that comprise these aquifers are in direct hydraulic communication with the Pacific Ocean, a condition that provides a pathway for seawater intrusion (Attachment 1; Kennedy/Jenks, 2004). A secondary contributor to seawater intrusion in the 180-Foot and 400-Foot Aquifers is the persistent reversal of the seawater groundwater gradient (Attachment 1; Kennedy/Jenks, 2004). When combined, these two factors result in regional seawater intrusion wherein seawater infiltrates the 180-Foot and 400-Foot Aquifers through submarine outcrops, then moves inland where groundwater pumping has resulted in groundwater levels that are below sea level in both aquifers.

Inter-Aquifer Seawater Intrusion
A second pathway for seawater intrusion also exists in the 180-Foot, 400-Foot, and Deep Aquifers, termed inter-aquifer seawater intrusion. The results of this type of seawater intrusion were first documented by MCWRA in the *2015 Historical Seawater Intrusion Map for the Pressure 400-Foot Aquifer* (Attachment 2), with the appearance of three "islands" of seawater intrusion that were disconnected from the contiguous seawater intrusion front.

Inter-aquifer seawater intrusion occurs when groundwater that is impaired by seawater intrusion moves vertically between aquifers. This movement requires the presence of impaired groundwater; a mechanism for movement (e.g. a vertical hydraulic gradient wherein groundwater levels are deeper in the underlying aquifer); and a pathway for the impaired water. Pathways could be thin or discontinuous aquitards, wells with screens/perforations across multiple aquifer units, improperly constructed or abandoned wells, and/or wells in poor condition (Attachment 1; MCWRA, 2017).

The mechanism for movement is documented regularly by MCWRA through its groundwater level monitoring program. Multiple pathways for inter-aquifer seawater intrusion have been documented, including a 2004 report, *Hydrostratigraphic Analysis of the Northern Salinas Valley*, which illustrates areas in the 180/400 Foot Aquifer Subbasin where the aquitard between the 180-Foot and 400-Foot Aquifers is thin or missing (Attachment 1; Kennedy/Jenks, 2004). MCWRA has data on multiple instances of poorly constructed or damaged wells acting as pathways for leakage of impaired groundwater from the 180-Foot Aquifer into the 400-Foot Aquifer.

Persistent Effects

Once impaired groundwater has entered the aquifer, the processes by which its dissolved constituents (e.g. chloride) move through the aquifer materials is complex. The two primary processes relevant to transporting solutes are diffusion and advection. Diffusion refers to the movement of solutes from areas of higher concentration to areas of lower concentration, while advection is the process by which moving groundwater carries solutes with it (Attachment 1; Fetter, 2001). Both processes are relevant in the 180-Foot and 400-Foot Aquifers and contribute to persistent effects from seawater intrusion.

For example, if a leaking well serves as a pathway for vertical migration of seawater intruded-groundwater from the 180-Foot Aquifer to the 400-Foot Aquifer, a water quality sample at the leaking well site would show a relatively high concentration of chloride compared to nearby wells in the 400-Foot Aquifer. However, even if the leaking well is destroyed soon thereafter, the high-chloride groundwater will continue to move away from the well site into the surrounding groundwater through diffusion and advection. The result will be higher chloride levels at the surrounding wells due to transport of the chloride with the groundwater.

As described in the MCWRA report *Recommendations to Address the Expansion of Seawater Intrusion in the Salinas Valley Groundwater Basin: 2020 Update* ("2020 Update"), a lack of data points behind the seawater intrusion front impairs MCWRA's ability to understand the nature of the groundwater mass in areas that have long been impacted by seawater intruded. Chloride concentrations are continually increasing in the area behind the seawater intrusion front. Even if all groundwater pumping were to immediately cease in the coastal area, chloride (and other solutes) will continue to diffuse and advect from the impaired mass into the surrounding area until chemical equilibrium is reached. Insufficient data from the area complicates MCWRA's ability to manage the groundwater resources in the area, which is one reason that the 2020 Update included a recommendation to install monitoring wells in the coastal area.

OTHER AGENCY INVOLVEMENT:

None

FINANCING:

There is no financial impact in receiving this report.

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Attachments:

1. Reference Sheet
2. 2015 Historical Seawater Intrusion Map for the Pressure 400-Foot Aquifer