MONTGOMERY & ASSOCIATES
Water Resource Consultants

Groundwater experts since 1984

TECHNICAL MEMORANDUM

DATE: March 30, 2021 **PROJECT #:** 9100.2206

TO: SWIG TAC

CC: SVBGSA Staff

FROM: Derrik Williams, Staffan Schorr

PROJECT: Seawater Intrusion Model Development

SUBJECT: Seawater Intrusion Model Capabilities

INTRODUCTION

The Seawater Intrusion Working Group Technical Advisory Committee (SWIG TAC) is tasked with conducting a refined assessment of seawater intrusion, and assessing how projects and management actions will affect seawater intrusion. To help accomplish this, the Salinas Valley Basin GSA (SVBGSA) and the Marina Coast Water District GSA (MCWD GSA) are developing a seawater intrusion model of the Monterey Subbasin. This model could serve as the basis for regional seawater intrusion modeling throughout the Salinas Valley. This memo outlines the purpose of the seawater intrusion model, extent of funded model development, model uses and limitations, and further data needed.

MODEL DEVELOPMENT

A model that can predict how seawater intrusion will change in response to projects and management actions is needed for assessing seawater intrusion control strategies. To simulate seawater intrusion, the model must have the ability to account for the differing densities of fresh water, seawater, and brackish water. The two groundwater models being used for assessing Groundwater Sustainability Plan projects: the Salinas Valley Operational Model (SVOM) and the Monterey Subbasin Model, currently do not have the ability to model variable density flows.

To model seawater intrusion, the SVBGSA is funded to begin initial development of a variable density numerical model of the Monterey Subbasin, based on the MCWD's Monterey Subbasin Model and information in the SVOM. This model will eventually be extended to cover all sweater intruded portions of both the Monterey Subbasin and 180/400-Foot Aquifer Subbasin. The variable density model will be based on the common MODFLOW modeling platform. The seawater intrusion model will have the advantages of more accurately simulating variable density impacts on groundwater flow, and estimating the salinity of water in aquifers.

CURRENT MODEL FUNDING

SVBGSA has secured funding for the initial development of the Monterey Subbasin seawater intrusion model through a Department of Water Resources Round 3 SGMA Planning Grant. The grant includes funds for MCWD to develop a groundwater model for the Monterey Subbasin, and for SVBGSA to develop an initial seawater intrusion model for the Monterey Subbasin. SVBGSA's grant tasks include:

1. Initial development of a seawater intrusion model to assess the impacts of projects and management actions on the rate and extent of seawater intrusion, and
2. Coordinating model efforts with MCWD GSA and other adjacent stakeholders affected by seawater intrusion.

The grant only covers initial model development for the Monterey Subbasin; however, the seawater intrusion model is being developed in a manner that could be extended to cover the rest of the seawater-intruded area of the Salinas Valley.

MODEL PURPOSES, USES AND LIMITATIONS

All groundwater models are simplifications of the hydrogeologic system. The simplifications result in limitations on model accuracy. Furthermore, all models are only as accurate as the underlying data. The large amounts of information derived from models can sometimes provide a false impression of providing new data. The information provided by models is more accurately described as a refined interpretation of existing data that can be used for predictive purposes.

Model Uses

The seawater intrusion model can generally be used for the following activities:

- Predict the future location of the 500 mg/L chloride front if no groundwater management actions are taken. The model will also be able to estimate future chloride concentrations

between the 500 mg/L chloride front and the ocean **to the degree that the model can be calibrated to existing salinity levels behind the existing front**.

- Estimate the amount of seawater flowing across the coastline more accurately than the SVIHM or SVOM or the Monterey Subbasin Model.
- Assess and predict the impacts or benefits of various projects in the model area on controlling or reversing seawater intrusion. The model will be able to predict the location of the 500 mg/L chloride front. The model will also be able to estimate future chloride concentrations between the chloride front and the ocean **to the degree that the model can be calibrated to existing salinity behind the existing front**.
- Provide rough estimates of the impact or benefits of various projects that are not in the model area on controlling or reversing seawater intrusion. The impact of projects that are not in the model area must be assessed by first running the SVOM, then transferring information from the SVOM to the seawater intrusion model's inland boundaries.
- Quantify the value of collecting additional groundwater elevation or groundwater quality data. The benefits of improving or expanding the seawater intrusion monitoring network can be quantified with the model, allowing for a more focused and rational use of funds for well installations or monitoring programs.

Model Limitations

Most model limitations result from limitations of the data used to develop and calibrate the model. These include:

- There is limited aquifer parameter testing data. The aquifer parameters dictate the rate and volume of seawater intrusion.
- With limited or no groundwater quality data on the seaward side of the seawater intrusion front, the model's estimate of chloride concentrations between the 500 mg/L line and the coast is highly uncertain.
- Because of the uncertainty of the chloride concentrations behind the 500 mg/L line, salinity estimates of any water pumped for desalination will be highly uncertain.
- The current and historical extent of seawater intrusion will be based on limited groundwater quality data and single-point-in-time AEM data. Gaps in the historical groundwater quality data will result in uncertainty in the historical extent of seawater intrusion.
- The historical groundwater quality data are not necessarily associated with specific aquifers or specific depth zones. This will lead to significant uncertainty in the depth of

seawater intrusion. This may become particularly important where the 180-Foot aquifer is split into an upper and lower aquifer in the Monterey subbasin.

- The locations of abandoned wells where seawater may have flowed vertically from one aquifer to another are unknown.

ADDITIONAL DATA FOR MODEL IMPROVEMENT

Based on the limitations identified above, the following additional data would lead to a more refined and reliable seawater intrusion model.

- More extensive chloride data showing the distribution of chlorides from the coast to concentrations of approximately 100 mg/L.
- Quantitative, aquifer specific groundwater quality data showing the depth distribution of seawater intrusion
- Concurrent groundwater level and groundwater quality collected throughout the entire seawater intrusion area. This will allow ground-truthing of model predictions and accurately assess intrusion of seawater and mitigation efforts.
- Aquifer test data that provide aquifer storage and hydraulic conductivity information. The aquifer parameters dictate the rate and volume of seawater intrusion. Additional aquifer parameter testing can be conducted on the seawater intrusion monitoring wells using constant discharge tests.