May 4, 2023
INFORMATION BRIEF

USGS, IDWR complete new Treasure Valley Groundwater Flow Model
5-year study creates dynamic 3-D Model to show how water flows in SW Idaho

Project Summary

The U.S. Geological Survey (USGS), in partnership with the Idaho Department of Water Resources (IDWR) and the Idaho Water Resource Board (Board), recently completed a new Treasure Valley Groundwater Flow Model, depicting how groundwater flows in aquifers in the Treasure Valley.

The model was completed and published in January 2023. The model and associated computer files are available for the public to use on the USGS web site. A final report is currently under scientific peer review.

The following background information is a big-picture summary about the Treasure Valley Groundwater Flow Model for policy makers, water users, scientists and the general public.

Treasure Valley Groundwater Flow Model requested by the Idaho Legislature in 2016

In 2016, SPF Water Engineering estimated that the population of the Treasure Valley will increase from 624,500 people in 2015 to approximately 1.6 million by 2065, resulting in a corresponding increase in domestic, commercial, municipal, and industrial water demand (DCMI). The Treasure Valley DCMI Water Demand Study found that there could be an increased demand of 158,000 acre-feet of water for DCMI uses by 2065 to serve the larger population base.
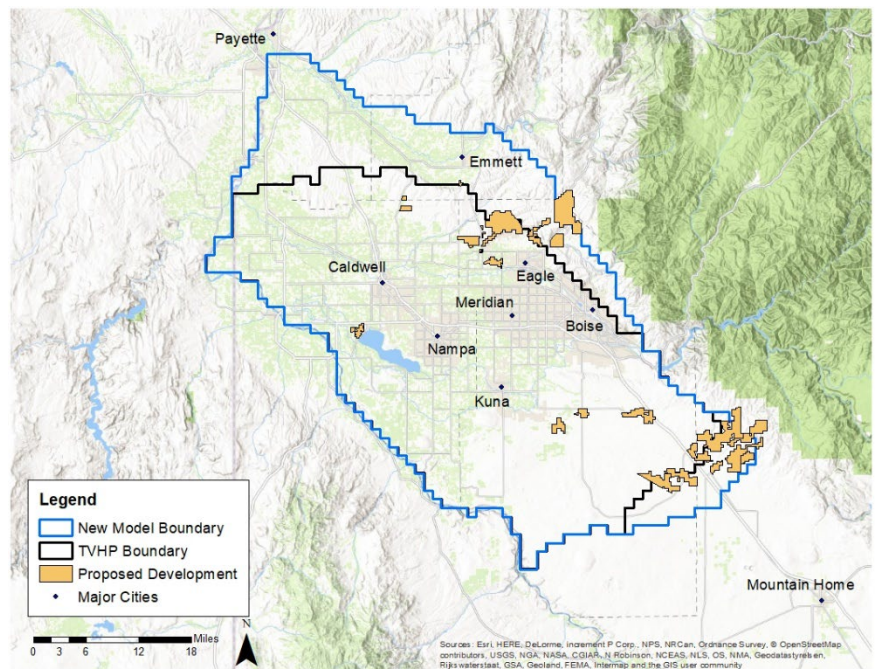
To address this anticipated demand for water, the Idaho Senate passed Concurrent Resolution 137 in 2016, which includes a request to "develop a groundwater model, with all necessary measurement networks" for the Treasure Valley. The Idaho Water Resource Board authorized $2.5 million to begin the study in 2016 in collaboration with USGS, IDWR and Treasure Valley stakeholder groups.

The Treasure Valley Groundwater Flow Model is the result of five years of scientific research. The study was informed and enhanced by extensive collaboration with multiple stakeholder groups via the Treasure Valley Flow Model Technical Advisory Committee.

The Treasure Valley Groundwater Flow Model is the fourth recent groundwater flow model that IDWR and the Board have developed in partnership with the U.S. Geological Survey and stakeholder groups. Previous collaborations included developing flow models for the Eastern Snake Plain Aquifer (ESPA), Big Wood River Basin and Spokane-Rathdrum Prairie Aquifer. The models are being actively used to better understand how changes in precipitation, water use, and water flows can affect the aquifers with relative precision. The Eastern Snake Plain Aquifer Model (ESPAM) Version 2.2, for example, has been used to calculate impacts of aquifer management activities to aquifer storage volume and discharge from the ESPA over time.

How will the Treasure Valley Groundwater Flow Model be used?

IDWR, the Idaho Water Resource Board, and other state, federal and local government agencies will use the model for future water-supply planning and management. The model uses new data about surface and groundwater consumption in the Treasure Valley and changes in land use (i.e. conversion of farmland to subdivisions).

Stephen Hundt, USGS Hydrologist who built the Treasure Valley Groundwater Flow Model, says it will:

- Improve the understanding of groundwater and surface water interactions in the Treasure Valley aquifers.
- Facilitate conjunctive water management, i.e., understanding the impacts of surface water use on groundwater resources and vice versa.
- Create a tool for water resources planning.

Key benefits of the Model:

- The model updates the Treasure Valley-wide aquifer **Water Budget** using 30 years of water-consumption data from 1986 to 2015. The previous comprehensive water budget for the Treasure Valley was completed in the year 2000. Significant changes to the landscape and water use have occurred in the last 23 years. Population in the Treasure Valley has almost doubled over that period of time to approximately 750,000 today. The new model will reflect some of those changes.

Right: New Treasure Valley Water Budget developed with the Treasure Valley Groundwater Flow Model.
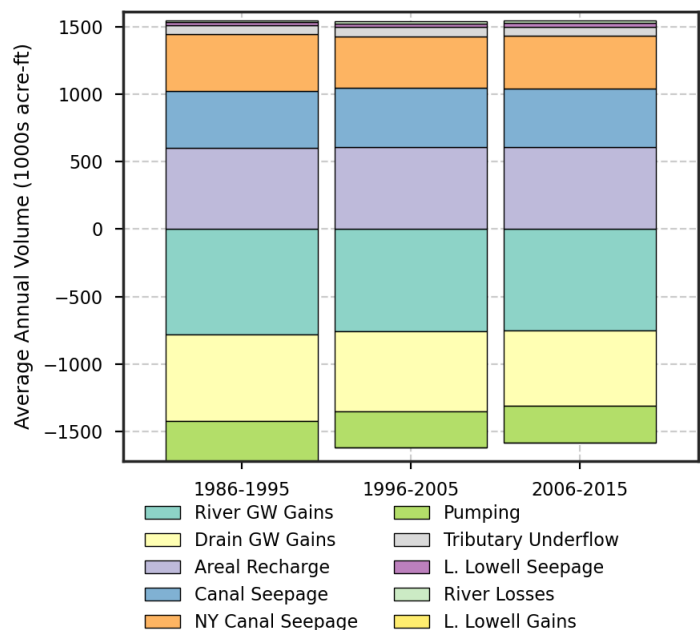
- **Evapotranspiration (ET) Data.** Monthly ET data based on LANDSAT satellite imagery will enhance the ability to track water consumption data on all types of land uses in the valley. ET data details spatial coverage of that consumption in 30-meter pixels across the entire Treasure Valley and improves the spatial and temporal estimates of how much water is delivered to meet demands.
- **Dynamic and valuable "Transient" model**, meaning it can predict the impact of proposed changes in water allocation or land use over time. Previous Treasure Valley groundwater flow models were static in nature and did not have the ability to evaluate the timing of impacts.
- **New aquifer discharge data for Irrigation Drains** in the western Treasure Valley. Part of the new water budget includes data from stream gages installed on agricultural drains that help constrain groundwater discharge. The previous Water Budget estimated that about 500,000 acre-feet annually of groundwater flows into the Boise River from irrigation drains. The new model estimates that more than 558,000 acre-feet of groundwater flows annually into the Boise River from irrigation drains (2006-2015), but drain discharge amounts are slowly declining.
- **New data regarding how aquifers are recharged in the Treasure Valley** including precipitation, the Boise River, canal seepage and other factors. The new model can calculate monthly estimates of seepage from the Boise River, New York Canal, and Lake Lowell into the shallow groundwater aquifer.
- **Expanded model boundary to include the lower Payette River Valley** from Emmett to the Snake River. The new model extended the northern model boundary to the Payette River Valley and the cities of Emmett, New Plymouth, and Fruitland at the recommendation of the Treasure Valley Comprehensive Aquifer Management Plan Advisory Committee. This area also is experiencing population growth and residential development.

The model gives us a greater understanding about the complexities in the Treasure Valley aquifer system. In general terms, the Treasure Valley aquifer system has been broadly described as having two parts:

- A shallow water-table aquifer (0-100 feet deep), which serves many private domestic and stock water wells.
- A complex, deep underlying aquifer, (300-800 feet deep), which is the source of major drinking water supplies for Veolia, the municipal water

supplier for the City of Boise, City of Meridian, and other communities.
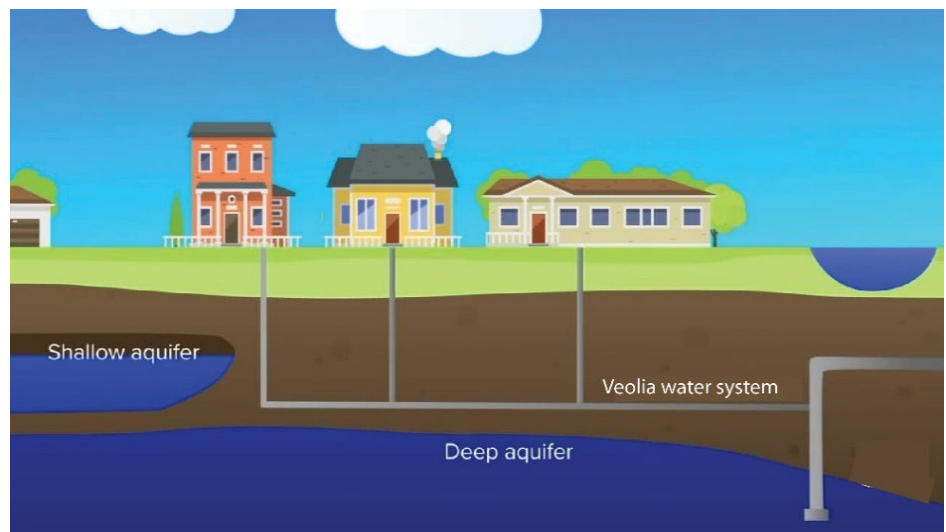
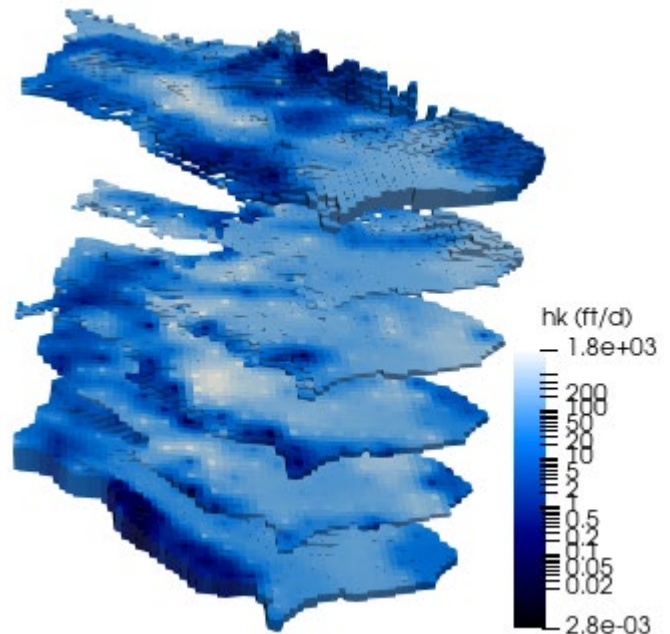**Limitations of the Treasure Valley Groundwater Flow Model**

- Model authors note that the geology underlying the Treasure Valley is extremely complex and heavily stratified by multiple layers of silt, sand and rock - a mixed bag of geologic features below the earth's surface. Defining distinct aquifers and hydrogeologic units is thus challenging; however, differences in the aquifer(s) at depth were captured as best as possible through vertical gradients in water levels. The model is best suited for evaluating broad-scale regional impacts.

- The model is technical in nature. It's built in MODFLOW, sophisticated computer software, and requires an experienced operator to run and analyze output. MODFLOW is free public domain software developed by USGS, and it is the de facto standard for groundwater flow modeling.
- Predictive uncertainty for the model has not yet been determined. Predictive strengths and weaknesses are not yet known/quantified.

How it works

The model is a 3-dimensional numerical groundwater flow model that represents the aquifer as a six-layered grid with square mile cells. In MODFLOW, the model shows the flow of water through the model domain of each cell in the 3-D Model.

Right: Graphical depiction of six aquifer layers in the Treasure Valley. The cells are shaded to represent the hydraulic conductivity of each. Hydraulic conductivity is a measure of the ability of the aquifer to conduct water. The scale shows water flow in feet per day. (IDWR illustration)

Technical Advisory Committee

A broad spectrum of people participated in the development of the Treasure Valley Groundwater Flow Model, representing many different state and federal agencies and interested groups, including USGS, IDWR, University of Idaho, Boise State University, Idaho Geological Survey, Southeast Boise Groundwater Management Area, City of Boise, City of Meridian, City of Nampa, Idaho DEQ, Trout Unlimited, and the Boise Project Board of Control.

For more information about the Treasure Valley Groundwater Flow Model, go to: https://idwr.idaho.gov/water-data/projects/treasure-valley/