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MEMORANDUM

TO: Water Resources Commission

FROM: Ivan Gall, Groundwater Manager

SUBJECT: Agenda Item D**,** August 2, 2012
Water Resources Commission Meeting

Information Update on the Klamath Basin Groundwater Flow Modeling Report

I. Introduction

The U.S. Geological Survey (USGS) and the Oregon Water Resources Department (OWRD) have released a report on groundwater simulation and management models in the Upper Klamath Basin. The report, *Groundwater Simulation and Management Models for the Upper Klamath Basin, Oregon and California*, can be viewed on the web at http://pubs.usgs.gov/sir/2012/5062/and is available free of charge from the USGS. This is an informational report, no Commission action is required.

II. Background

In 1998 the USGS and OWRD signed a cooperative agreement to study groundwater in the Upper Klamath Basin. Hydrologists from the California Department of Water Resources participated in data collection. The study was jointly funded by the U.S. Bureau of Reclamation and OWRD. The first report, *Ground-Water Hydrology of the Upper Klamath Basin, Oregon and California*, was completed in 2007. The 2007 report characterizes the hydrology and geology of the basin, setting the framework for the construction of the groundwater flow model. The flow model provides the Department with a predictive groundwater simulation tool to evaluate different groundwater use scenarios in the basin.

The 2012 report also documents a groundwater management model that is coupled to the groundwater flow model. The goal of the management model is to assess the effect of sustained groundwater pumping on the complex and interconnected groundwater and surface water system of the upper Klamath Basin. This will facilitate identifying future groundwater development strategies that minimize impacts to groundwater and surface water resources. Both the flow model and management model are now complete and available for use in OWRD management decisions. Below is the summary abstract from the report.

III. Abstract

The following is based on the abstract from the 2012 USGS Report. The upper Klamath Basin encompasses about 8,000 square miles, including lands in Oregon and northern California. Much of the basin once held broad shallow lakes and extensive wetlands. Most of these shallow lake areas have been drained or otherwise modified and are now cultivated. Major parts of the basin are now managed as wildlife refuges, primarily for migratory waterfowl. The permeable volcanic bedrock of the upper Klamath Basin hosts a substantial regional groundwater system that provides much of the flow to major streams and lakes that, in turn, provide water for wildlife habitat and are the principal source of irrigation water for the basin's agricultural economy.

Over the past decade federal management of surface water for endangered species has resulted in increased groundwater pumping, particularly for irrigation. The potential effects of increased groundwater pumping on groundwater levels and discharge to springs and streams have caused concern among groundwater users, wildlife and Tribal interests, and State and Federal resource managers. To provide information on these potential impacts and to aid in the development of a groundwater management strategy, the USGS, and OWRD developed a groundwater model that can simulate the response of the hydrologic system to groundwater pumping.

The groundwater model was developed using USGS developed software called MODFLOW. It is calibrated using data from 1989 through 2004 base period. All major streams and most major tributaries for which a substantial part of the flow comes from groundwater discharge are included in the model. Groundwater discharge to agricultural drains, evapotranspiration from aquifers in areas of shallow groundwater, and groundwater flow to and from adjacent basins also are simulated in key areas.

Historical data indicate that the groundwater system in the upper Klamath Basin fluctuates in response to decadal climate cycles, with groundwater levels and spring flows rising and declining in response to wet and dry periods. Data also show that groundwater levels fluctuate seasonally and interannually in response to groundwater pumping. The most prominent response is to the marked increase in groundwater pumping starting in 2001.

Example model simulations show that the timing and location of the effects of groundwater pumping vary markedly depending on the pumping location. Pumping from wells close (within a few miles) to groundwater discharge features, such as springs, drains, and certain streams, can affect those features within weeks or months of the onset of pumping, and the impacts can be fully manifested in several years. Simulations indicate that seasonal variations in pumping rates are buffered by the groundwater system, and peak impacts are closer to mean annual pumping rates than to instantaneous rates. Thus, pumping effects are, essentially spread out over the entire year. When pumping locations are distant (more than several miles) from discharge features, the effects take many years or decades to fully express themselves with much of the pumped water coming from groundwater storage over a broad geographic area. When the effects

are spread out over a broad area, the impacts to individual features are much smaller. Simulations show that the discharge features most affected by pumping in the area of the Bureau of Reclamation's Klamath Irrigation Project are agricultural drains, and impacts to other surface-water features are small in comparison.

An optimization model was also developed to identify the optimal strategy to meet water user needs. The coupled groundwater simulation-optimization models were formulated to help identify strategies to meet water demand in the upper Klamath Basin. The models maximize groundwater pumping while simultaneously keeping the detrimental impacts of pumping on groundwater levels and groundwater discharge within prescribed limits.

IV. Conclusion

A simulation-optimization model for the upper Klamath Basin has been completed that provides an improved understanding of how the groundwater and surface-water system responds to sustained groundwater pumping within the Bureau of Reclamation's Klamath Project. The optimization model results demonstrate that a certain amount of supplemental groundwater pumping can occur without exceeding defined limits on drawdown and stream capture. The results of the different applications of the model demonstrate the importance of identifying constraint limits in order to better define the amount and distribution of groundwater withdrawal that is sustainable.

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