

DESCRIPTIVE INFORMATION

PROPOSED TUMALO RESERVOIR MANAGED AQUIFER RECHARGE PROJECT

UPPER DESCHUTES BASIN, OREGON

May 23, 2017

PURPOSE

This written testimony describes the proposed managed aquifer recharge project including its purpose, basic technical aspects and how it is to be implemented.

TESTIMONY AUTHOR

This testimony was prepared by David J. Newton, registered in Oregon as a civil engineer, engineering geologist and certified water right examiner. David earned a Bachelor of Science degree in geological engineering at the University of Arizona. He is a native of Redmond, Oregon and has 40 years of professional experience in the upper Deschutes Basin focused on water supply planning and development for municipalities, resorts and agricultural interests.

David managed completion of five water resource planning studies in the upper Basin funded by a U.S. Bureau of Reclamation Water 2025 Challenge Grant in 2004-2006. This work is part of regional water resource management planning currently underway in the upper Basin and provided information on: 1) present and future water demands; 2) present and future water supply sources; 3) impacts of urbanization on agriculture and irrigation districts; 4) future ground water demand; and 5) reservoir management. David co-authored the report "*Long-Range Water Resources Management in Central Oregon: Balancing Supply and Demand in the Deschutes,*" May 2006.

PROJECT DESCRIPTION

Project Purpose

The Avion Water Company (Avion) and the Deschutes Valley Water District (DVWD) are planning to implement a managed aquifer recharge project. The intent of the project is to provide mitigation for new ground water permits necessary for their future supply.

Avion is a private water supplier serving approximately 12,000 connections in the City of Bend and in unincorporated areas of Crook and Deschutes County. The DVWD is a public water supplier serving approximately 14,000 customers in unincorporated areas of Jefferson County and the Cities of Culver, Madras and Metolius. Both Avion and the DVWD depend on ground water for their water supply.

The Avion and DVWD must provide for long-term water supply to meet future demand. Surface waters are fully appropriated (other than for winter storage) and ground water sources are necessary for future supply. New ground water permits are subject to the mitigation rules adopted by the Oregon Water Resources Commission in September 2002 (OAR 690-505-0600).

These rules require mitigation to offset impacts of ground water pumping on surface waters for protection of Scenic Waterway flows and other existing senior water rights on surface waters. The basis for mitigation requirements is hydraulic connectivity between ground water and surface water and potential for measurable decrease in stream flows due to ground water pumping formally confirmed in a joint study of the upper Deschutes Basin hydrology by the U.S. Geological Survey and the OWRD.

Currently, mitigation is accomplished by transferring surface water rights off irrigated land back into the stream. This water is protected as an instream flow under a new water right. Adding water to stream flow is intended to offset reduction of stream flow by the proposed ground water pumping. Other options for mitigation are scarce.

Public and private water suppliers, including the applicants and municipalities, have no certainty in when they can achieve the required mitigation for new ground water permits and respond to population growth and increasing water demand. The proposed aquifer recharge project provides an option.

The OWRD implemented aquifer recharge in irrigation district canals during the fall and winter seasons of 1998-2000 to generate some initial mitigation credits. The volume of recharge was 5,500 acre-feet in 1998 and 5,000 acre-feet in 1999/2000. Aquifer recharge is explicitly referenced in the mitigation rules as a mitigation alternative. On this basis, Avion and the DVWD plan to develop and implement the aquifer recharge project to meet their mitigation obligations for new ground water supplies.

Avion and the DVWD submitted an application for an aquifer recharge permit to the Oregon Water Resources Department (OWRD) on December 5, 2000. When issued, the permit would allow Avion and the DVWD to appropriate up to 25,000 acre-feet per year, or 200 cubic feet per second (cfs) for aquifer recharge.

Aquifer Recharge Site

Water for aquifer recharge will be diverted from the Deschutes River at Bend and conveyed about 8 miles through the Tumalo Irrigation District's Bend Feed and Tumalo Feed Canals to Tumalo Reservoir. The aquifer site location is shown on Figure 1 and 2. The water will be delivered to a recharge site in the reservoir area where it will infiltrate into the ground, ultimately entering and recharging the aquifer system.

The reservoir area was selected for the project since it is known to leak substantial amounts of water. The Tumalo Irrigation District (TID) estimates losses of approximately 6,000 acre-feet during its annual use of the reservoir. The TID also reports that a constant inflow rate of 25 cfs is required to offset seepage losses and maintain a pool in the reservoir. The reservoir with summer storage is shown on Figure 3.

The original Tumalo Project included a 70-foot high dam completed in 1914 at a site located about 2 miles north of the reservoir currently used by the TID. At a water depth of about 35 feet during the initial filling, a sinkhole opened on the reservoir bottom and all water was lost. Flow rates into the sinkhole were reported to be more than 200 cfs. The project was subsequently abandoned.

Other Potential Emerging Benefits of the Project

Although the primary purpose of the aquifer recharge project is to provide mitigation for future ground water permits, other potential benefits of the recharge project are emerging. Canal piping is underway in the upper Basin to conserve water and augment supplies for instream flows and to improve reliability of irrigation district water supply. Approximately 60,000 acre-feet of canal seepage losses have been eliminated, reducing artificial recharge to the aquifer system. Ground water pumping in the upper Basin has substantially increased. Climatic conditions have been relatively dry for several years. The combined effect of canal piping, ground water pumping and relatively dry climate conditions is resulting in declining ground water elevations in the area of Redmond and Bend. Declines up to 12 to 14 feet are recorded for the Redmond area.

Declines in ground water elevations bring concerns about impacts on discharge of springs into the Crooked, Deschutes and Metolius Rivers. The proposed aquifer recharge project is currently the only project in the range of upper Basin options for water supply management that may provide some potential benefit in this regard. The estimated trajectory of recharge water in the ground water system is illustrated by the ground water flow direction arrows on Figure 4. This shows that recharge water would move generally from the recharge site to the area of Redmond and the area of heavy spring discharge into the Crooked, Deschutes and Metolius Rivers.

High winter flows in the Deschutes River at Tumalo result in flooding. The proposed aquifer recharge project would divert significant amounts of river flow for recharge purposes upstream of Tumalo. These diversions would reduce river flows at Tumalo and help alleviate flood risk.

OPERATION PLAN

Goal

The operational plan is intended to guide diversions from the Deschutes River to be consistent with all conditions of a water permit issued by the OWRD and in a manner that will not infringe on any senior water rights or provisions of the Pelton Settlement Agreement. The operation plan allows passage of high flows necessary for down-stream channel maintenance and will allow for gradual effecting of diversion rates to prevent fish stranding. Finally, the operation plan accounts for how the diversions and recharge will be conducted in a manner acceptable to the Tumalo Irrigation District whose systems will be used to divert and transport water from the Deschutes River to Tumalo Reservoir.

Water Diversions for Aquifer Recharge

Water diversion will occur between November 1 and February 28 of the year, only when water is available after existing senior instream water rights are met. Diversions will be coordinated with the regional water master to confirm water availability for recharge and to protect existing water rights including flow provisions of the Pelton Settlement Agreement.

Diversions will account for an existing instream flow right of 660 cfs. Accordingly, a cushion flow of 100 cfs is provided to protect this flow right during river flow variations that can occur during recharge diversions. Recharge diversions will occur only when river flows exceed 760 cfs.

Diversions will also account for channel maintenance flows in the Deschutes River. The Oregon Department of Fish and Wildlife (ODFW) conducted an analysis of channel maintenance flow requirements for the proposed recharge project. This analysis concluded that flows in the affected reaches of the Deschutes River under which channel maintenance functions begin to occur are about 1,250 cfs. Accordingly, to avoid interference with these channel maintenance flows, recharge diversions will not be made when flows reach this threshold.

Diversions will be controlled so that each increase or decrease in flow shall be no more than 50 cfs per hour. This provision is intended to prevent stranding of fish due to river level fluctuations.

Tumalo Irrigation District Operational Agreement

Water diversions and recharge operations will be conducted under an operational agreement with the Tumalo Irrigation District. An agreement between Avion, the DVWD and the Tumalo Irrigation District is presently in effect under which diversion testing has been conducted.

DIVERSION TESTING

Phased Approach to Permit Requirements

The technical burden for responding to permit application requirements is significant, warranting a step-wise approach based on feasibility considerations. Technical feasibility considerations were divided into two phases. Phase 1 comprised diversion testing to determine if winter diversions

and recharge are feasible before implementing geological investigations planned for Phase 2. The Phase 2 effort will focus on subsurface investigation that tracks the effects of recharge.

Winter Diversion Testing

A limited license LL-1184 was granted by the OWRD in 2010 for a five-year test period to implement diversions and recharge testing in the Tumalo Reservoir. Diversion testing was successfully conducted during 54 days of the winter of 2013-2014 with temperatures as low as 13 degrees Fahrenheit. Water infiltration into the reservoir over the 54-day time period was approximately 2,700 acre-feet. The diversion testing, water master coordination and TID coordination were successfully completed, proving that winter recharge operations could be conducted.

PRELIMINARY GROUND WATER MONITORING

Discussions with the OWRD following the diversion testing focused on general scoping of the Phase 2 geologic investigation requirements. OWRD input included suggestion that information on ground water elevations in the proposed recharge area be collected from well logs and evaluations be conducted to determine if infiltration of surface water could reach the aquifer system.




In response, a transducer was installed in a domestic well approximately one-quarter mile east of Tumalo Reservoir for collecting and storing water level data in the well. The water level in a well at Rock Springs Guest Ranch, about 2 miles east of the reservoir was periodically measured by Newton Consultants, Inc. staff. The data from these water level measurements show that water levels in the two wells respond to the irrigation season of the Tumalo Irrigation District. This means that water from irrigation canals, ditches and ponds is infiltrating into the ground and reaches the regional aquifer system. Data graphs are shown on the attached Figures 5 and 6.

PERMIT REQUIREMENTS

In general terms, remaining permit requirements include characterization of the geology and aquifer conditions at the proposed recharge site to track the effects of recharge. This includes determination of the volume of mitigation credits that can be developed from aquifer recharge and development of a storage account for the recharged water. A ground water monitoring system is also required.

DESCHUTES BASIN



-  Instream water rights
-  State Scenic Waterways
-  USGS study area

**Proposed
Aquifer
Recharge
Site**

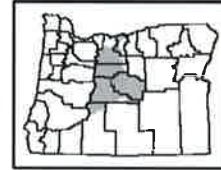
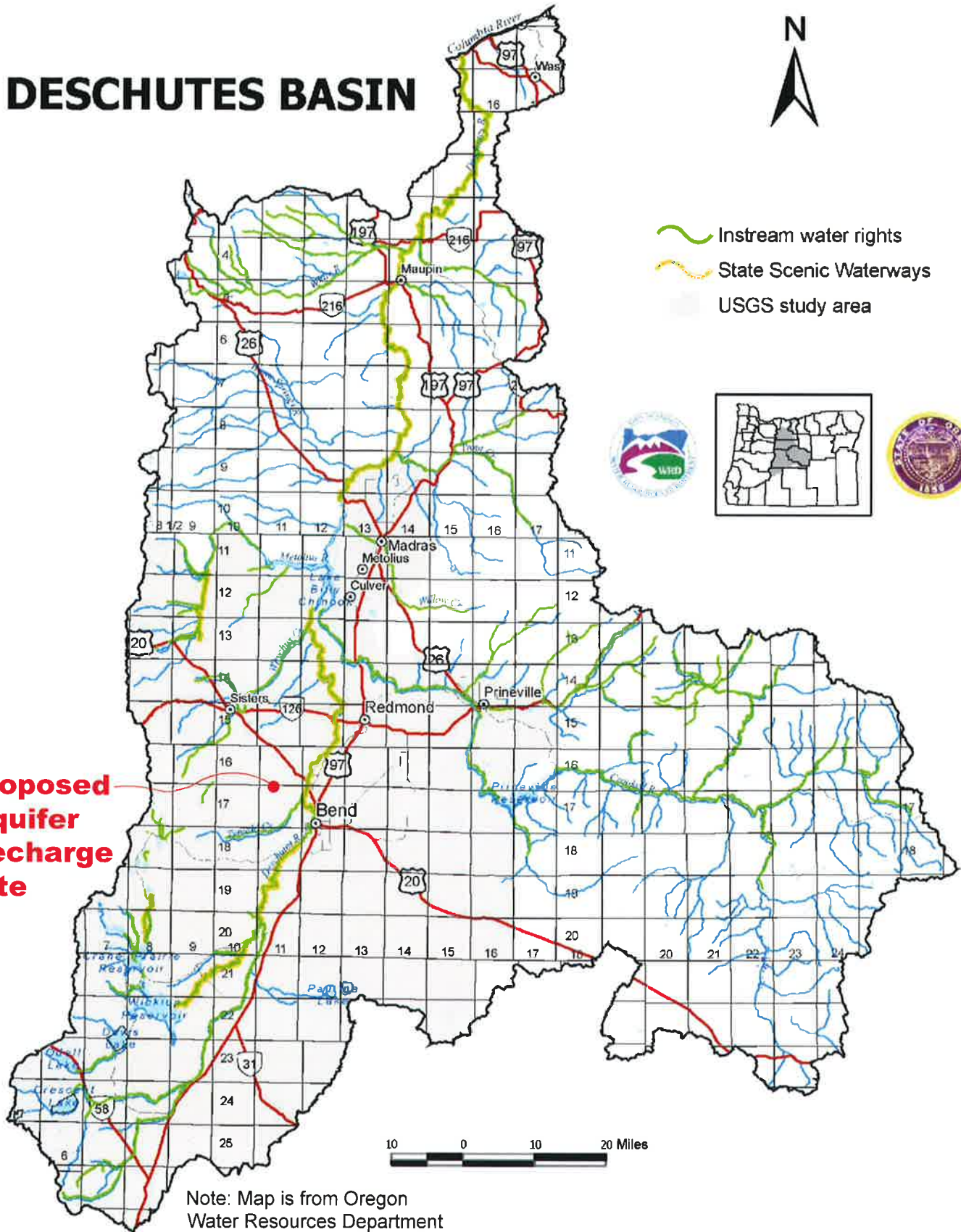
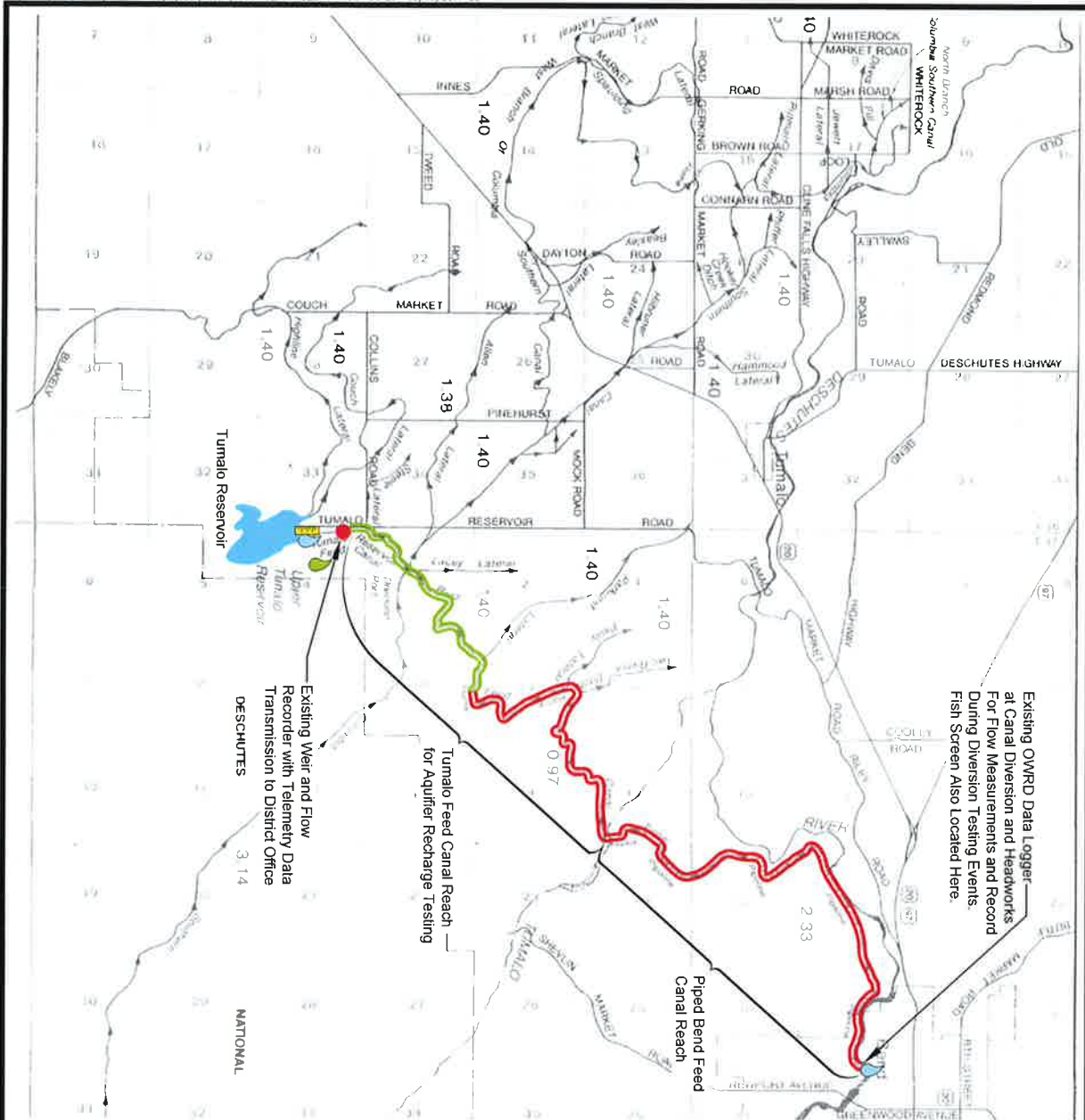


Figure 1



Existing OMRD Data Logger at Canal Diversion and Headworks For Flow Measurements and Record During Diversion Testing Events. Fish Screen Also Located Here.

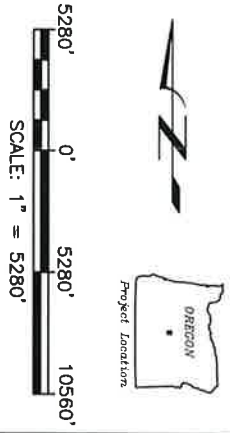
Existing Weir and Flow Recorder with Telemetry Data Transmission to District Office

Tumalo Feed Canal Reach for Aquifer Recharge Testing


Piped Bend Feed Canal Reach

EXPLANATION




- 1.40 - Seepage Rate in ft³/ft²/day
- 1.3 cfs Per Mile (USGS, 2001, BOR 1997)
- Piped Reach, No Recharge
- Approx. Locations Where Surface Water Samples Were Taken.
- Approx. Locations Where Ground Water Samples Were Taken.
- Approx. Location of Rain Gage



Contour Interval 50 Feet
Datum is Mean Sea Level and National Geodetic Vertical Datum of 1929
Map No. 112-100-899

 <p>Newton Consultants Inc. Earth, Water and Rock Specialists Ph: 541 504 5000 Fax: 541 504 5961</p>		<p>Tumalo Reservoir, Feed Canal & Diversion Locations Tumalo Feed Canal Reach Proposed for Aquifer Recharge Testing</p>	
DESIGNED BY: D. Newton	DRAWN BY: S. Schenck	DATE: May 2017	PROJECT NO: 450-116/969-104
			FIGURE 2

EXPLANATION

-  Approx. Locations Where Surface Water Samples Were Taken.
-  Approx. Locations Where Ground Water Samples Were Taken.
-  Approx. Location of Rain Gage



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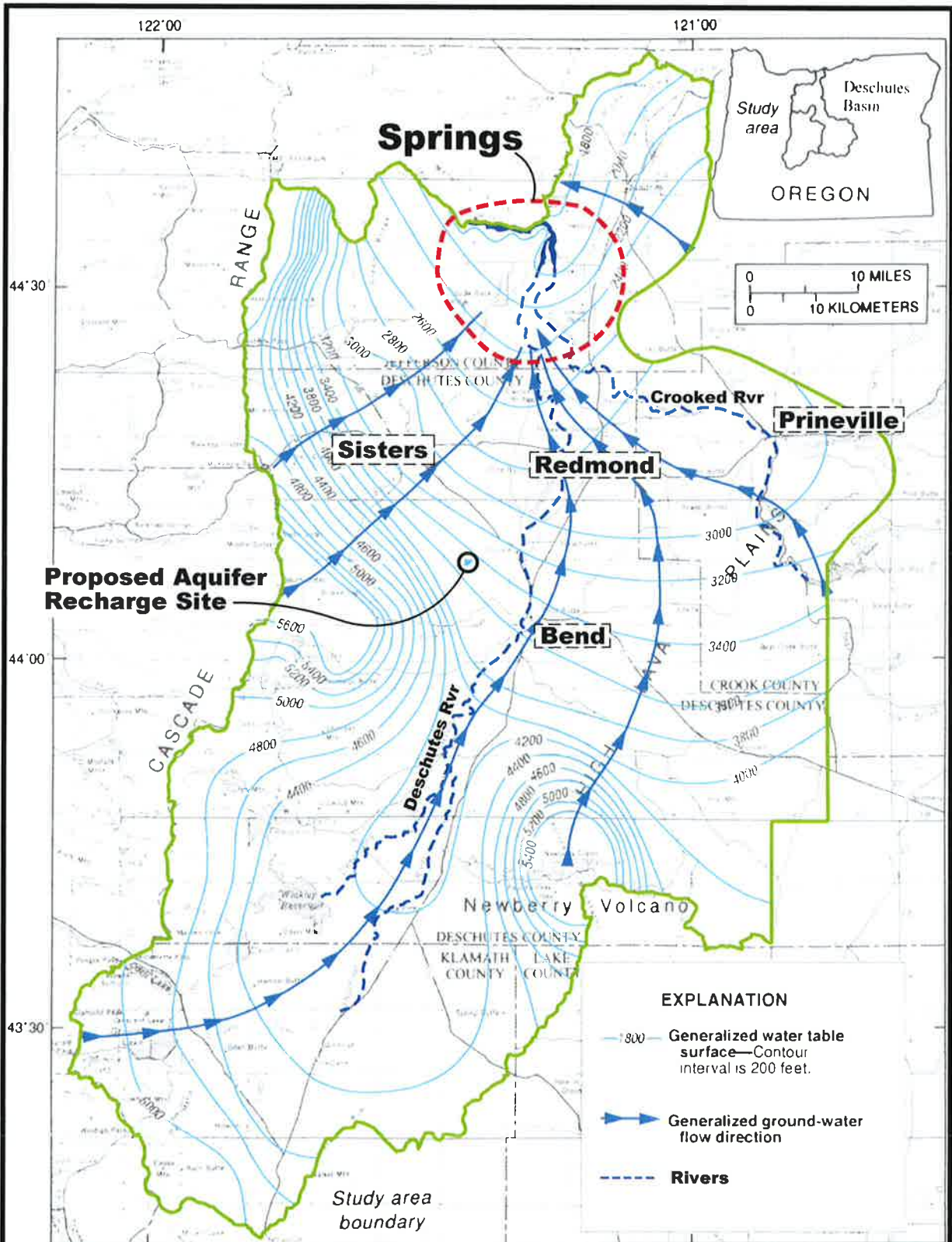
DESIGNED BY: **D. Newton**
 DRAWN BY: **S. Schenck**

DATE: **May 2017**

PROJECT NO. **450-116/969-104**

FIGURE **3**

Tumalo Feed Canal - Inflow to Reservoir Tumalo Feed Canal Reach Proposed for Aquifer Recharge Testing



Base modified from U.S. Geological Survey
1:500,000 state map, 1982



USGS Generalized Regional Ground Water Flow Map
Aquifer Recharge - Hydrologic Factors

DESIGNED BY D. Newton	DRAWN BY S. Schenck	DATE May 2017	PROJECT NO. 450-116/969-104	FIGURE 4
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MCNULTY 2014 START 4-10-14_2014

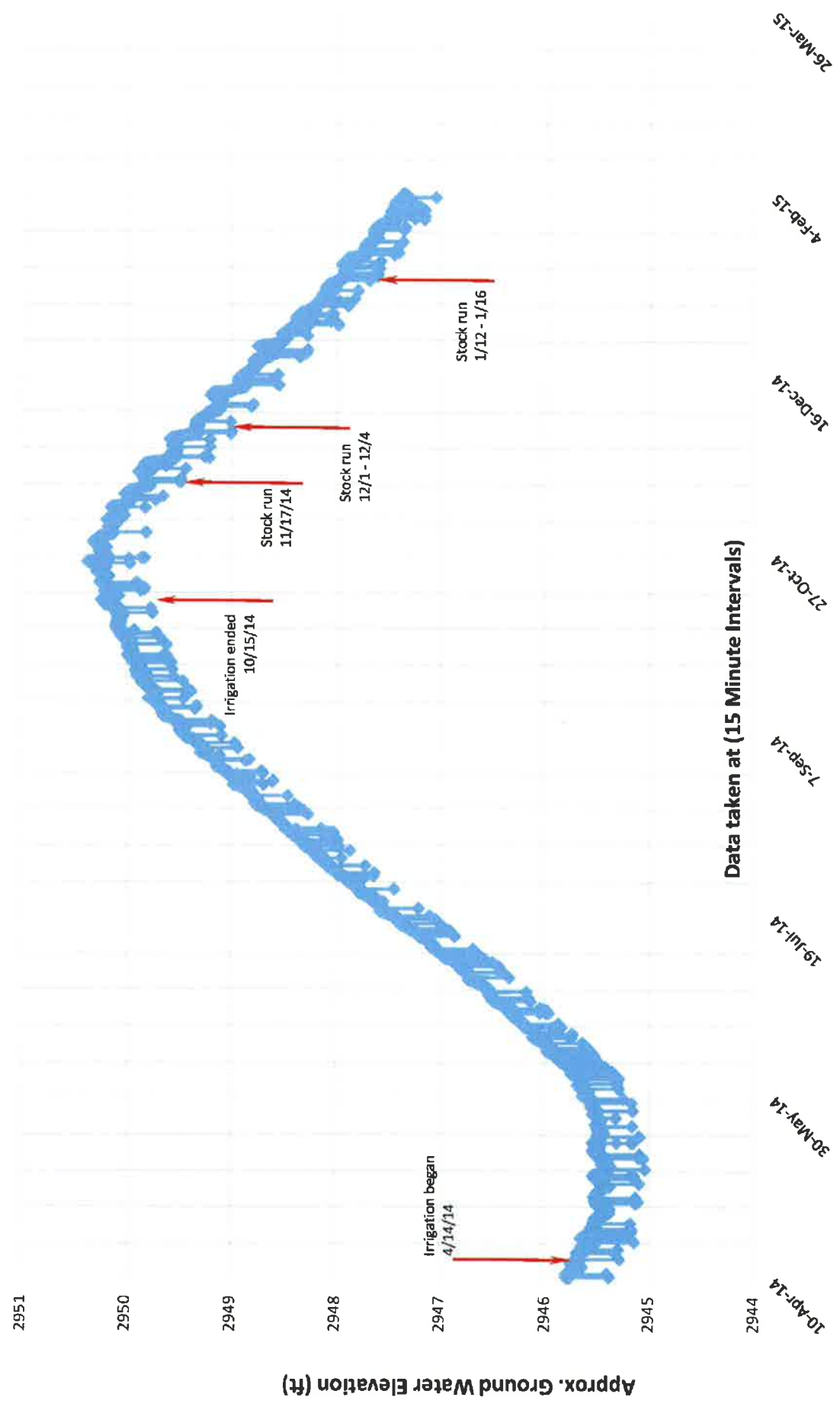


Figure 5

Rock Springs Ranch Well Response

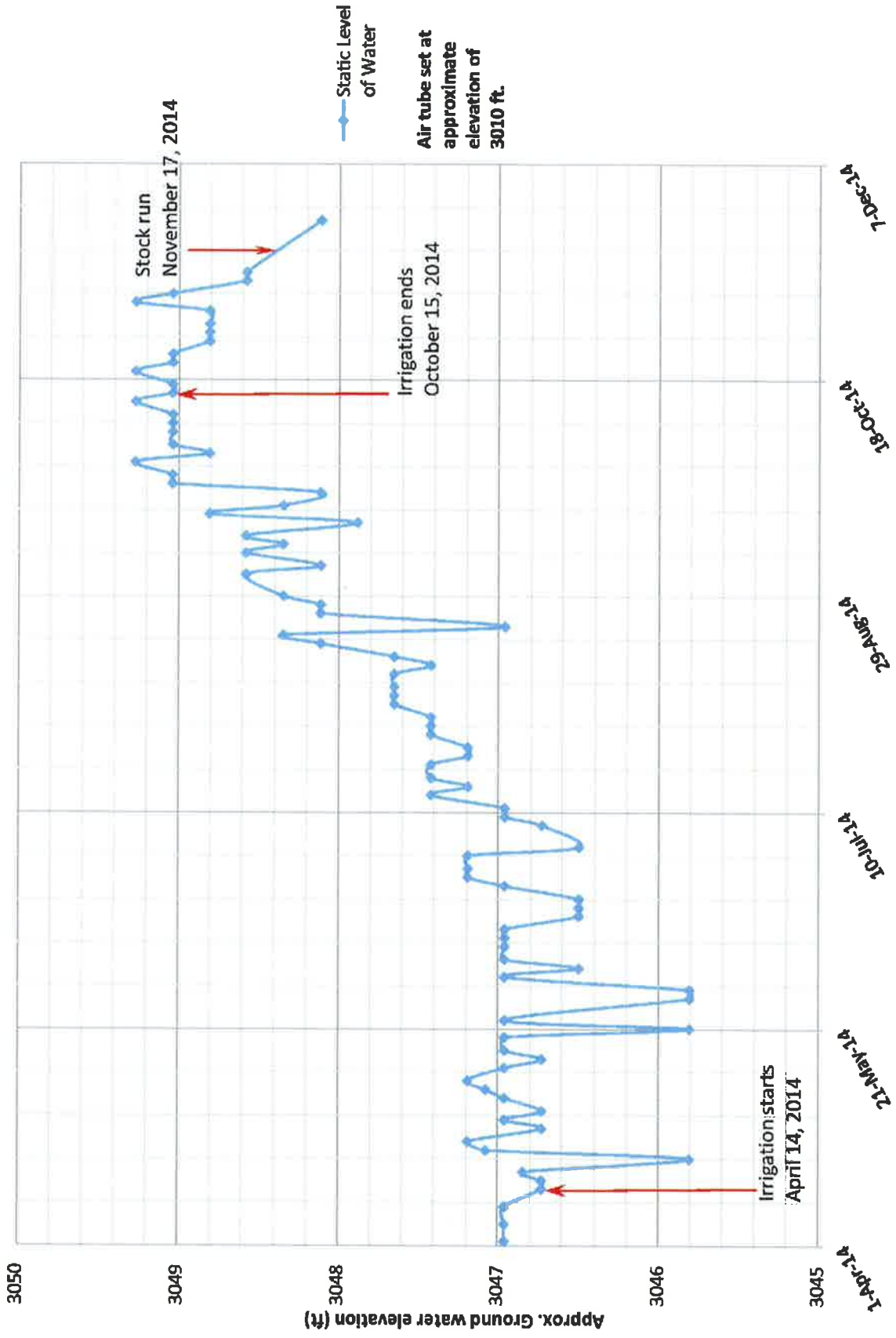


Figure 6