IN THE OFFICE OF THE STATE ENGINEER
OF THE STATE OF NEVADA

#1316

ORDER

INVESTIGATION TO DETERMINE THE PERENNIAL YIELD OF THE DRY VALLEY HYDROGRAPHIC BASIN (07-095) WITHIN WASHOE COUNTY, NEVADA

I. PURPOSE

WHEREAS, the purpose of this Order is to give notice of the State Engineer's investigation to consider the perennial yield of the Dry Valley Hydrographic Basin (Dry Valley).

WHEREAS, holders of existing rights and other interested parties are encouraged to submit reports to the Office of the State Engineer evaluating existing studies and literature available regarding the perennial yield of Dry Valley.

II. NECESSITY

WHEREAS, the Dry Valley basin spans the border between Nevada and California. Dry Valley Creek, within the Dry Valley, is tributary to the Long Valley Creek, within the Long Valley Groundwater Basin (Long Valley) in California.[1] The Long Valley Creek, a fully appropriated, adjudicated stream, is a main source of recharge to the Honey Lake basin, which is located in California.[2]

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[1] California Department of Water Resources, *California Bulletin 118 Groundwater Basins, North Lahontan Hydrologic Region, Honey Lake Valley Groundwater Basin* (Updated 2/27/04), available at *https://bit.ly/2Y3CzLp* (last accessed June 15, 2020); California Department of Water Resources, *California Bulletin 118 Groundwater Basins, North Lahontan Hydrologic Region, Long Valley Groundwater Basin* (Updated 2/27/04) (Long Valley Groundwater Basin), available at *https://bit.ly/2AtXBdp* (last accessed June 15, 2020).

[2] Long Valley Groundwater Basin, p. 1; *In the Matter of the Determination of the Rights of Various Claimants to the Waters of the Long Valley Creek Stream System within Lassen, Sierra and Plumas Counties, California, Decree No. 12999*, Superior Court of the State of California, In and For the County of Lassen (August 6, 1976), available at *https://bit.ly/3d3rGO5* (last accessed June 15, 2020); Water Boards California, *Appropriated Streams layer*, available on-line at *https://bit.ly/3fp318b* (last accessed June 15, 2020).

WHEREAS, the current committed groundwater appropriations and applications to appropriate water from the groundwater source may exceed the perennial yield, within the Nevada portion of Dry Valley.[3]

WHEREAS, the State Engineer shall review applications for placing water to beneficial use and must determine if there is unappropriated water in the proposed source of supply.[4]

III. PERENNIAL YIELD

WHEREAS, perennial yield is the primary guideline used by the State Engineer to determine water availability where the source of supply is a groundwater basin. The perennial yield of a groundwater reservoir may be defined as the maximum amount of groundwater that can be withdrawn each year, over the long term, without depleting the groundwater reservoir. Perennial yield is ultimately limited to the maximum amount of natural discharge that can be utilized for beneficial use. The perennial yield cannot be more than the natural recharge to a groundwater basin and in some cases is less.[5]

WHEREAS, Dry Valley is bounded on the north, east and south by fault-controlled mountain blocks. Groundwater recharge to the basin occurs through infiltration of precipitation in the surrounding mountain blocks. Groundwater discharge on the valley floor occurs through evapotranspiration (ET) by phreatophytic vegetation and subsurface groundwater outflow to Long Valley in California.[6]

WHEREAS, previous water resource investigations have made several different estimates of groundwater recharge and discharge in Dry Valley; these investigations include peer-reviewed studies, consulting reports, groundwater modeling, development of empirical and statistical relationships, and correspondence among researchers.

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[3] Nevada Division of Water Resources' Water Rights Database, Hydrographic Basin Summary, Dry Valley Hydrographic Basin (095), accessed June 11, 2020, official records in the Office of the State Engineer, available at <u>*http://water.nv.gov/undergroundactive.aspx*</u>.
[4] NRS 533.370(2).
[5] State Engineer's Office, *Water for Nevada, State of Nevada Water Planning Report No. 3* (Water Planning Report No. 3), October 1971, p. 13.
[6] David Berger, et al., *Estimates of Natural Ground-water Discharge and Characterization of Water Quality in Dry Valley, Washoe County, West-Central Nevada, 2002-2003* (Berger), Scientific Investigations Report 2004-5155, (U.S. Geological Survey and Washoe County, Nevada), 2004.

WHEREAS, water resource investigations in the Dry Valley are summarized as follows:

Rush and Glancy

The water budget of Dry Valley was first investigated by Rush and Glancy.[7] They estimated mean annual groundwater recharge of 2,400 afa using the Maxey-Eakin recharge approach.[8] Groundwater discharge from phreatophytic ET was estimated to be approximately 80 afa. Groundwater discharge from subsurface groundwater outflow to Long Valley was estimated from Darcy's Law to be 2,300 afa. The perennial yield was estimated at 1,000 afa, as the amount of subsurface outflow that could feasibly be captured by pumping.[9] This study was the basis for the State Engineer in 1971 to determine the perennial yield of Dry Valley to be 1,000 afa.[10]

Smith and Katzer

Water right applications were filed in 1999 and 2000 for a total of 3,000 afa, by a private party, to export water for municipal supply in the Washoe County service area. The applicant's consultant prepared a hydrogeologic study of Dry Valley that included estimates of recharge, discharge and perennial yield.[11] To estimate recharge, the authors replicated the method applied by Rush and Glancy with slightly different mapping tools that yielded an estimate of 2,670 afa. They also applied PRISM precipitation mapping and recharge coefficients developed by Nichols to estimate recharge of 11,000 afa.[12] They concluded with an estimate of recharge between 5,000 and 6,000 afa. Groundwater discharge as subsurface outflow was estimated to be 4,500 afa using the same Darcian flux approach as Rush and Glancy but using a higher gradient and a higher hydraulic conductivity. Groundwater discharge by phreatophytic ET was estimated to be 500 afa.

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[7] F. Eugene Rush and Patrick A. Glancy, *Water-Resources Appraisal of the Warm Springs-Lemmon Valley Area, Washoe County, Nevada* (Rush and Glancy), Water Resources—Reconnaissance Series Report 43, (Department of Conservation and Natural Resources, Division of Water Resources and U.S. Geological Survey), November 1967.

[8] *Id. See also* T.E. Eakin, et al., *Contributions to the Hydrology of Eastern Nevada*, Water Resources Bulletin No. 12, (State of Nevada, Office of the State Engineer and U.S. Geological Survey), May 1951.

[9] Rush and Glancy.

[10] Water Planning Report No. 3, p. 20.

[11] Dwight L. Smith and Terry Katzer, *Hydrogeology of Dry Valley, Washoe County, Nevada* (Smith and Katzer), Project No. 80200134 Report, (Stantec Consulting Inc. and Cordilleran Hydrology: Consultant report prepared for Intermountain Pipeline, Ltd.), July 2000.

[12] *See* William D. Nichols, *Regional Ground-water Evapotranspiration and Ground-water Budgets, Great Basin, Nevada* (Nichols), Professional Paper 1628, (U.S. Geological Survey, Las Vegas Valley Water District, and the Nevada Division of Water Resources), 2000.

The authors concluded that a perennial yield of 3,000 afa was conservative and well-supported by their hydrogeologic analysis.[13]

The State Engineer relied upon Smith and Katzer's report as the technical foundation to issue permits with a total combined duty of 2,996 afa in 2002.[14] Subsequent change applications were later approved within the same total combined duty of 2,996 afa.[15]

Thomas and Albright

In 2003, Thomas and Albright estimated recharge using the Chloride Mass Balance (CMB) method. This method estimates recharge based on precipitation over the recharge area, the chloride concentration in the precipitation, and the chloride concentration in the groundwater. The study was strictly limited to the calculation of recharge and did not include a comparison with or calibration to discharge. The authors concluded that CMB recharge averages between 1,400 and 4,800 afa. Uncertainty in the estimate was attributed to a limited amount of data and the potential effects of surface runoff.[16] Peer review of the report by the U.S. Geological Survey (USGS) pointed to other potential sources of uncertainty including the location of precipitation data used in the study and the geologic setting of spring sample sites.[17]

U.S. Geological Survey

In 2004, the USGS published an investigation of groundwater discharge in Dry Valley.[18] The study was completed in cooperation with Washoe County to re-evaluate the groundwater resources of Dry Valley because estimating groundwater discharge has more certainty than estimating groundwater recharge from precipitation.[19] Two aquifer tests were conducted to calculate transmissivity of the unconsolidated sediments near the western side of Dry Valley.[20] Analysis of the aquifer test results showed that transmissivity was substantially less than

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[13] Smith and Katzer.
[14] File Nos. 64977, 64978, and 66400, official records in the Office of the State Engineer.
[15] State Engineer's Rulings 5568, 5622, and 5897, official records in the Office of the State Engineer.
[16] James M. Thomas and William H. Albright, *Estimated Groundwater Recharge to Dry Valley, Northwestern Nevada, using the Chloride Mass Balance Method* (Thomas and Albright), Publication No. 41191, (Division of Hydrologic Sciences, Desert Research Institute
University and Community College System of Nevada; Consultant report prepared for Intermountain Water Supply, Ltd), December 2003.
[17] David L. Berger, *Technical Review of Thomas and Albright*, Letter to James Thomas, (U.S. Geological Survey), December 12, 2003.
[18] Berger.
[19] *Id.*, p. 1.
[20] *See also* Keith J. Halford, *Aquifer Tests—Analysis of Multiple-Well, Multiple-Stress, Aquifer Test, Dry Valley, Nevada*, Memorandum to Devin Galloway, (U.S. Geological Survey), August 2003.

previously thought. The authors estimated subsurface outflow directly from Darcy's Law and concluded that subsurface outflow to Long Valley ranges from 50 to 250 afa. Rates of groundwater ET from phreatophytic shrubs in Dry Valley were evaluated using the Nichols remote sensing approach, resulting in an estimate of groundwater discharge by ET of 640 – 790 afa.[21]

InterFlow Hydrology Inc.

Interflow Hydrology Inc. completed a numeric groundwater flow model of the Dry Valley in 2005. Model construction was based on previously published work on the hydrogeology and geophysics of Dry Valley and the surrounding region. The groundwater budget in the calibrated steady state model was approximately 1,250 afa of groundwater inflow and outflow. Groundwater outflow was the sum of 440 afa of subsurface discharge to Long Valley, 550 afa phreatophyte ET and 270 afa of stream discharge. A model simulation with pumping of 3,000 afa resulted in what the authors said, "may produce excessive drawdown near the wells and significant induction of ground water from Long Valley." An alternative model scenario with 1,500 afa pumped showed lesser amounts of drawdown and groundwater flow induced from Long Valley, but still induced groundwater flow from Long Valley to reach steady state. Interflow described this scenario with pumpage of 1,500 afa as a conservative approach because of the potential for additional subsurface outflow occurring at the western end of Dry Valley through deep basin fill. They noted a lack of hydraulic data in the deeper sediments to confirm the existence and magnitude of outflow, and concluded that long-term monitoring would be an appropriate approach to gain a better understanding of the hydraulics of the basin, that may in the future support increased groundwater development.[22]

Widmer

In 2009, correspondence from Widmer to Smith documents a collaborative effort between Washoe County and the authors of previously completed analyses of the Dry Valley water budget to reach consensus and to resolve and/or reduce uncertainties. Widmer described recent data collection and ongoing analyses, including limitations of PRISM data and isotope data, implications for water budget studies, and his own observations and interpretation. In a concluding remark, Widmer expressed his belief that he and Smith were in concurrence of 1,100 to 1,240 afa groundwater flux within lower Dry Valley. Discharge included subsurface outflow

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[21] Berger.

[22] Dwight L. Smith, *Numeric Ground-Water Flow Modeling, Dry Valley Hydrographic Basin, Washoe County, Nevada* (Interflow), (InterFlow Hydrology, Inc., Consultant report prepared for Intermountain Water Supply, Ltd.), April 2005.

to Long Valley of 300-580 afa, which Widmer estimated more precisely to be 400 +/- 50 afa, and groundwater ET by phreatophytes of 700 afa.[23]

Huntington

In 2010, Huntington prepared an independent summary and analysis of the Dry Valley water budget at the request of a private party.[24] In this report, he summarized work previously completed by others and also presented a new analysis of groundwater ET by phreatophytes in Dry Valley. Review of the groundwater ET analysis completed by Berger found that extensive bare soil areas in the original analysis were in fact covered with phreatophytic shrubs, and that application of the Nichols approach with the revised land cover resulted in groundwater ET of 1,751 afa. However, this review also noted that the Nichols' approach has previously been critiqued by the State Engineer because the data used to develop the empirical equation were largely derived from Ash Meadows in Amargosa Valley, Nevada and Owens Valley, California, which are areas that have less precipitation, longer growing season, and greater evaporative demand, so the method is likely to be biased high in northern Nevada.[25] The new analysis by Huntington computed groundwater ET from plant cover type and published groundwater ET rates that were previously applied by the State Engineer in nearby Red Rock Valley in Ruling 5816. Huntington concluded that groundwater ET in Dry Valley is 1,000 afa, and total groundwater discharge by ET and subsurface outflow to Long Valley ranges from 1,200 to 1,800 afa.[26]

Beamer

In 2013, Beamer developed an empirical relationship with uncertainty bounds between flux tower estimates of ET and remotely sensed vegetation indices, and applied it to estimate annual groundwater ET from phreatophytes.[27] The study assessed multiple hydrographic basins

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[23] Michael C. Widmer, *Dry Valley cross sections and ground water flux estimate* (Widmer 2009a), Letter Report to Dwight Smith, March 17, 2009; Michael C. Widmer, *Preliminary Dry Valley Resource Assessment* (Widmer 2009b), Technical Memorandum to Dwight Smith, May 29, 2009.

[24] Justin L. Huntington, *Review and Analysis of Recharge and Discharge Estimates for Dry Valley, Washoe County, Nevada* (Huntington), (Consultant report submitted to United Management Corporation), December 2010.

[25] *Id.*, p. 2. *See also* State Engineer's Ruling 5816, official records in the Office of the State Engineer.

[26] Huntington, pp. 10, 13.

[27] Jordan P. Beamer, et al., *Estimating Annual Groundwater Evapotranspiration from Phreatophytes in the Great Basin Using Landsat and Flux Tower Measurements* (Beamer et al.), (Journal of the American Water Resources Association), June 2013, p. i.

within the Great Basin; Dry Valley was included in those assessed. Using the developed approach, Beamer estimated the annual groundwater ET to be 1,310 afa.[28]

Minor

In 2019, Minor developed a statistical relationship between annual ET estimates derived from Eddy Covariance and Bowen Ratio stations located in phreatophyte areas and remotely sensed vegetation indices, and evaluated the uncertainty in the estimates.[29] The study assessed multiple hydrographic basins within the Great Basin; Dry Valley was included in those assessed. The potential groundwater discharge boundaries for Dry Valley used by Minor were smaller than those areas used by Berger, Huntington, and Beamer.[30] Minor estimated the annual groundwater ET to be 1,000 afa.[31] The variation between the groundwater ET estimates produced by Minor and the previous studies were attributed to different methods and assumptions but were within the 90-percent prediction intervals.[32]

WHEREAS, groundwater outflow from Dry Valley to adjacent basins through fracture flow has been postulated based on geologic mapping and the presence of springs on the northwest end of Warm Springs Valley.[33] Interflow suggested that this may explain the difference between discharge estimated by Berger and much higher recharge values that were previously estimated.[34] Widmer disagreed with Interflow's suggestion; his interpretation was that the geologic data indicates fault structures are likely barriers to groundwater flow, and that groundwater movement within these structures is improbable.[35] Widmer opined that the imbalance in the water budget was more likely attributed to the uncertainty in recharge estimates, rather than an unaccounted-for fate of groundwater outflow.[36]

WHEREAS, to the extent that groundwater outflow from Dry Valley to adjacent basins occurs through fracture flow, it has not been shown to be available for development within Dry Valley without negatively affecting existing water rights in the adjacent basins where the groundwater eventually discharges.

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[28] *Id.*, p. 528.
[29] Blake A. Minor, *Estimating Annual Groundwater Evapotranspiration from Hydrographic Areas in the Great Basin Using Remote Sensing and Evapotranspiration Data Measured by Flux Tower Systems* (Minor), Master's Thesis, (University of Nevada Reno), December 2019.
[30] *Id.*, p. 36.
[31] *Id.*, p. 40.
[32] *Id.*, pp. 45, 49.
[33] Smith and Katzer; Berger.
[34] Interflow, p. 14. *See also* Berger.
[35] Widmer 2009b.
[36] *Id.*

WHEREAS, the State Engineer finds that the amount of groundwater in Dry Valley that originates from recharge in the basin and also discharges within the basin is a sound measure of the upper limit of water available for development that can occur each year over the long term without depleting the groundwater reservoir and without conflicting with existing rights.

WHEREAS, in an undeveloped basin the long-term mean annual recharge and discharge are equal, and groundwater discharge is generally accepted to be more accurately measurable than recharge. Groundwater discharge in Dry Valley via phreatophytic ET has been variably estimated or calculated in previous analyses to be as low as 80 afa and as high as 1,751 afa.

IV. AUTHORITY

WHEREAS. the State Engineer is designated by the Nevada Legislature to perform the duties related to the management of the water resources belonging to the people of the State of Nevada.[37]

WHEREAS, the State Engineer is empowered to make such reasonable rules and regulations as may be necessary for the proper and orderly execution of the powers conferred by law.[38]

WHEREAS, the State Engineer is encouraged to consider the best available science in rendering decisions concerning the availability of surface and underground sources of water in Nevada.[39]

WHEREAS, the State Engineer must consider that any new development will be reliant on the groundwater supply for innumerable years to come.

WHEREAS, California's Sustainable Groundwater Management Act, signed into law in 2014, provides a framework for sustainable groundwater management in California. The State Engineer finds that pursuant to the principle of comity, consideration of the effects of groundwater development on existing rights in California is appropriate even if not statutorily required, and to do so will aid in promoting harmony and building goodwill between the states.

WHEREAS, the State Engineer finds that he has a duty to take proactive steps to assure the best management practices exist in a basin so as to prevent imposing an avoidable problem.

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[37] NRS Chapters 532; 533; 534; 535; and 536.
[38] NRS 532.120.
[39] NRS 533.024(1)(c).

V. ORDER

NOW THEREFORE, the State Engineer orders that:

1. Any stakeholder with interests that may be affected by water right development within the Dry Valley Hydrographic Basin may file a report in the Office of the State Engineer in Carson City, Nevada, no later than the close of business on **January 8, 2021**. Reports filed with the Office of the State Engineer should provide an evaluation of the existing studies and literature available with regards to the perennial yield of the Dry Valley Hydrographic Basin, within the Nevada portion.

2. The State Engineer will, under separate cover, notice an administrative hearing to take place on January 20, 2021, to take comment on the submitted reports.

Tim Wilson, P.E.
TIM WILSON, P.E.
State Engineer

Dated at Carson City, Nevada this

7th day of October 2020.