RECLAMATION

Managing Water in the West

Leasburg Dam State Park Groundwater Assessment—2016

U.S. Department of the Interior
Bureau of Reclamation
Fisheries and Wildlife Resources Group
Denver, Colorado

April 2017

Mission Statements

The U.S. Department of the Interior protects America's natural resources and heritage, honors our cultures and tribal communities, and supplies the energy to power our future.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Leasburg Dam State Park Groundwater Assessment—2016

prepared for

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and

Leasburg Dam State Park
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Radium Springs, NM 88054

by

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Contents

Page

Figures

Introduction

The floodplain of the Rio Grande surrounding Radium Springs, New Mexico provides critical riparian habitat for many wildlife species, in a section of the Rio Grande where riparian habitat is typically sparse. Indeed, Leasburg Dam State Park is encompassed by the Audubon New Mexico Lower Rio Grande Bosques Important Bird Area (National Audubon Society 2013). The endangered Southwestern Willow Flycatcher (*Empidonax traillii extimus*; SWFL) and threatened Yellow-billed Cuckoo (*Coccyzus americanus*; YBCU) are two of the most notable species reliant upon this area for either breeding and/or migratory stopover habitat. In 2016, 8 resident SWFLs and 14 migrant Willow Flycatchers (*Empidonax traillii*) were documented in the Radium Springs Reach of the Rio Grande (Dillon et al. 2017). All were detected north of Leasburg Dam State Park, but the southernmost SWFL territory was less than 700 meters (m) north of the dam. Additionally, six YBCU territories were documented in the Radium Springs Reach in 2016, the southernmost territory located approximately 2.5 kilometers (km) north of Leasburg Dam State Park (Dillon et al. 2017). The presence of these two federally listed species have led to efforts to restore native riparian vegetation in many locations along the Lower Rio Grande, NM.

A fundamental aspect of successful management, enhancement, or restoration of riparian ecosystems is knowledge of site-specific hydrological dynamics. Plant species selected for restoration efforts must be able to tolerate the growing conditions that characterize the study area (Griggs 2009). Although river dynamics in riparian systems are typically easily observed and quantified, additional effort is required to assess groundwater characteristics. Nevertheless, the depth and seasonal fluctuations of the water table are key determinants of vegetation community composition, and of critical importance when considering vegetation management and restoration options (Shafroth et al. 2000; Dwire et al. 2006). The Bureau of Reclamation (Reclamation) installed six groundwater monitoring wells in Leasburg Dam State Park in 2016. The objective of this study was to provide resource managers within Reclamation and Leasburg Dam State Park with groundwater data that can be used in association with available river flow data to make informed management decisions regarding the riparian ecosystem.

Methods

Six groundwater monitoring wells were installed in the western floodplain of the Rio Grande in Leasburg Dam State Park in 2016. Two wells were installed upstream of Leasburg Dam and four wells were installed downstream of the dam (Figure 1; Attachment 1). Wells ranged from 4.4 to 6.1 feet (ft) in depth (μ = 5.6 ft). Wells 1, 2, and 6 were dry at the time of well installation and Wells 3, 4, and 5 each contained a few inches of water. Wells were installed in accordance with Army Corps of Engineers (2000) methodology. A HOBO Water Level Logger was inserted into each well and attached to the well cap with a stainless steel wire. The loggers were programmed to record water table depth and groundwater temperature every two hours. Data were downloaded from the loggers using HOBOware Pro software (Onset Computer Corporation 2015).

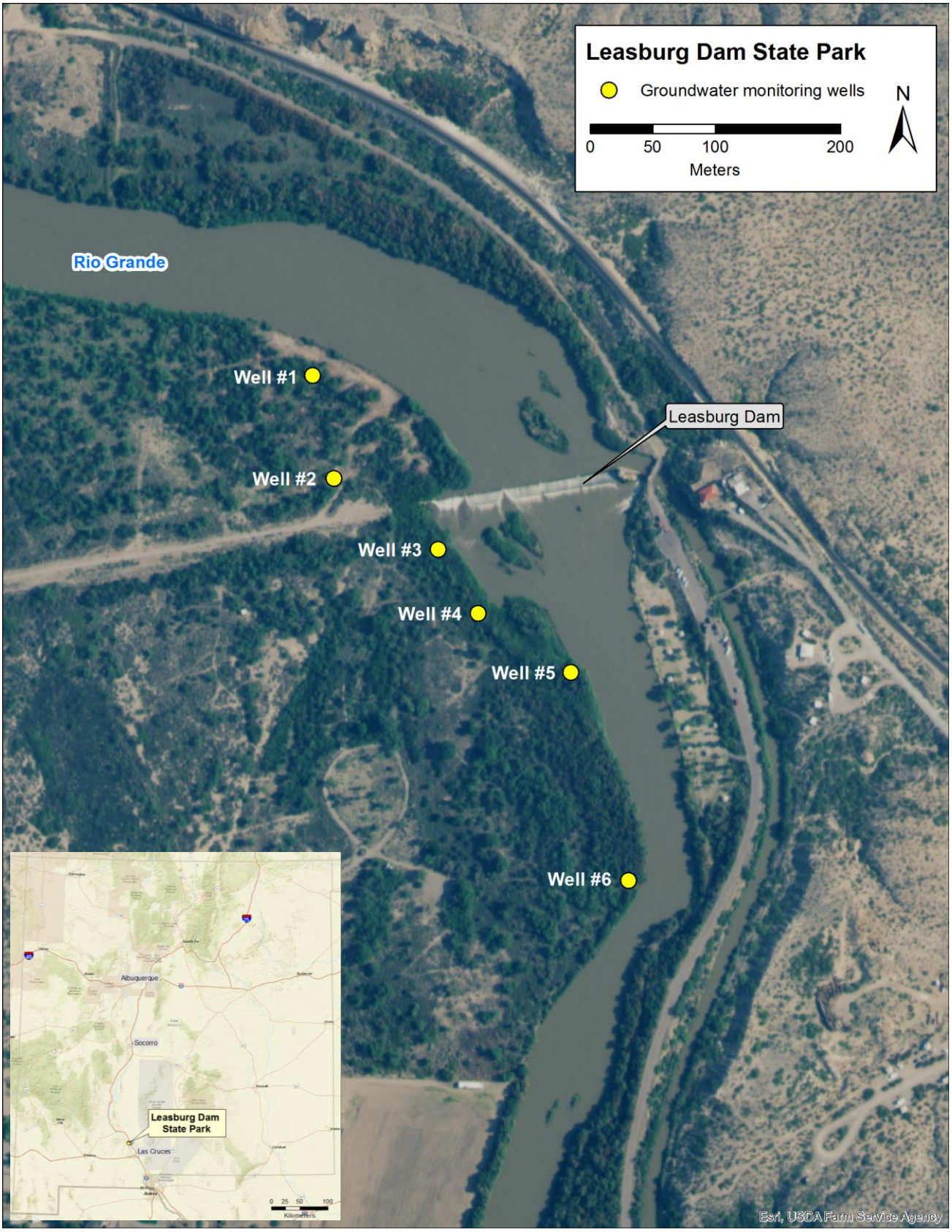

Figure 1. Groundwater monitoring well locations in Leasburg Dam State Park.

River flow rate data were acquired from the Leasburg Cable River Gauge (Elephant Butte Irrigation District 2017), located approximately 2.5 kilometers (km) downstream from the dam, the closest gauging station with flow rate data to the study area. The rate of river flow was plotted and compared to water table data acquired from wells to determine whether groundwater levels were governed primarily by river flows or upland run-off and springs. Additionally, groundwater temperature at each well was plotted and compared with another study site with similar characteristics for reference. The site used for comparison was EB-09, which is located in the receded pool of the Elephant Butte Reservoir. The water table in three of the six wells located in EB-09 is regulated primarily by river flow rates, and the water table in the other three is regulated primarily by upland run-off and underground springs.

Results

All groundwater monitoring wells were installed on 16 March 2016 and the data were downloaded on 27 October 2016. The pattern of seasonal variation in water table depth was nearly identical in all six wells (Figure 2, Attachment 2). The water table was at its shallowest sustained depth at all wells in approximately early April and mid-June to mid-July, at which time it was between two and four feet below the soil surface. The water table spiked briefly in August to within two feet of surface level at most wells. In mid-March and after 1 October the water table was below or approaching the bottom of the monitoring wells, approximately 6 ft below the soil surface or greater. The water table was consistently lowest in Well 2, which was located the furthest from the Rio Grande, but the pattern of variation in depth to groundwater at this well followed the same pattern as the other five wells (Figures 2 and 3). Importantly, Wells 3, 4, and 5 all contained a small amount of water in mid to late March and after 1 October, when the other three wells were dry.

Results

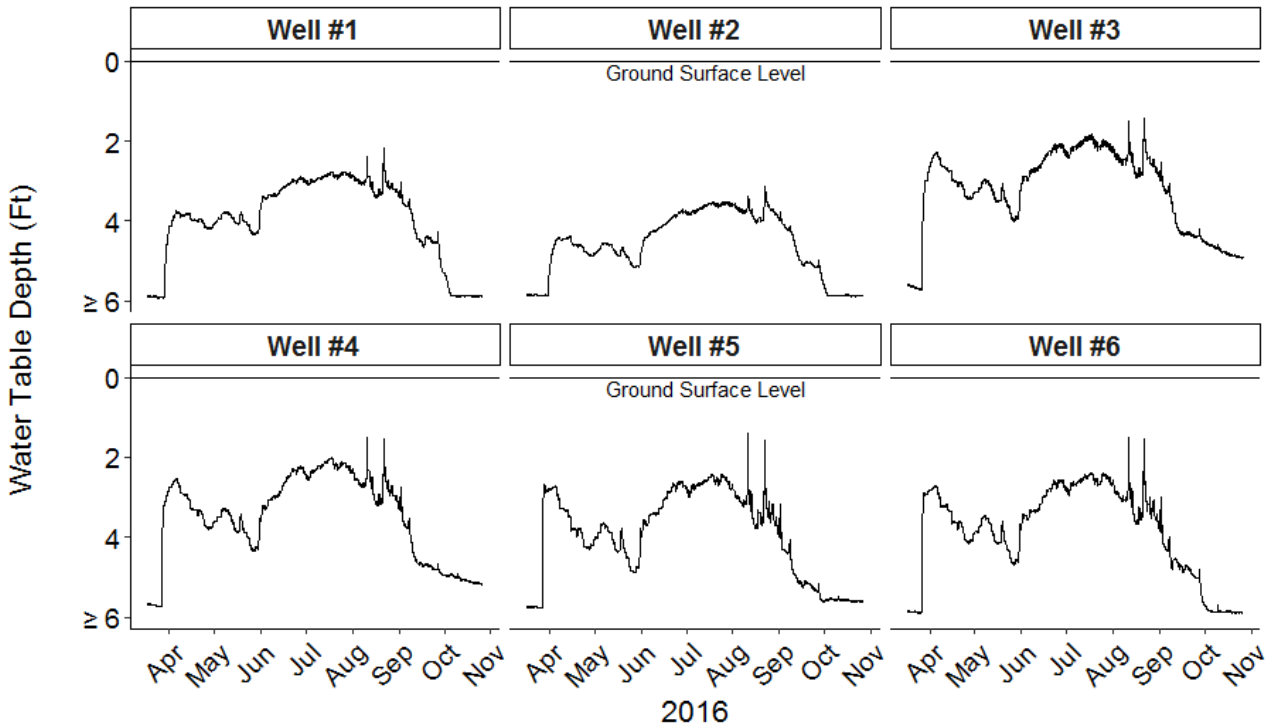

Figure 2. Water table depth between late March and late October 2016 at six groundwater monitoring wells. Plots display water table depth as a well profile, such that 0 ft indicates that the water table is at the level of the soil surface and 4 ft indicates that the height of the water table is 4 ft below the soil surface. All wells were ~6 ft deep, so values of that depth (i.e., in March and October) indicate that the water table was ≥6 ft below the surface.

Graphical analysis of mean daily river flow data indicated a seasonal pattern in flow variation that matched the observed pattern of variation in groundwater depth (Figures 2 and 3, Attachment 2). The river reached sustained peaks in flow rate in early April and mid-June to mid-July at approximately 1500 to 2000 cubic feet per second (cfs). River flow rate spiked to over 2000 cfs briefly in August, and dropped to zero prior to April and after 1 October.

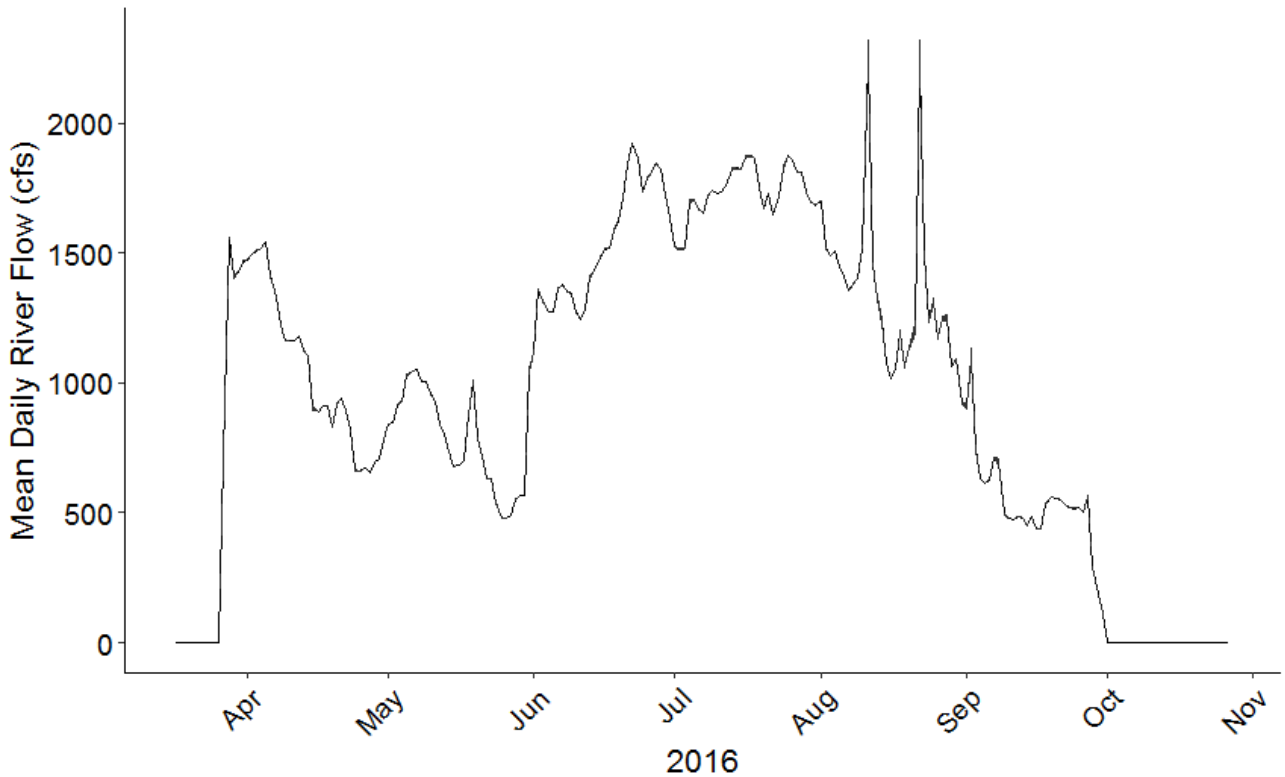

Figure 3. Mean daily flow of the Rio Grande between late March and late October 2016 at the Leasburg Cable River Gauge.

Seasonal variation in groundwater temperature followed a less uniform pattern among wells than did variation in groundwater depth. Groundwater temperatures in Wells 4 through 6, all located below Leasburg Dam, ranged from approximately 65 degrees Fahrenheit (F) to 82 degrees F (Figure 4). Groundwater temperature variation was unimodal in these wells, peaking in mid-August. Groundwater temperature in Wells 2 (located 30 m north of the dam) and 3 (located 30 m south of the dam) ranged from approximately 60 to 70 degrees F, and followed a bimodal pattern of seasonal variation. The highest groundwater temperatures at Wells 2 and 3 were observed in May-June and October-November, and were more than 10 degrees cooler than the maximum temperatures recorded at the other wells. Minimum groundwater temperature at Well 1 was less than 50 degrees F, 15 degrees cooler than any other well, but the maximum temperature was nearly 80 degrees F. Groundwater temperature peaked at Well 1 during the same time period as Wells 4 through 6 (Figure 4).

Results

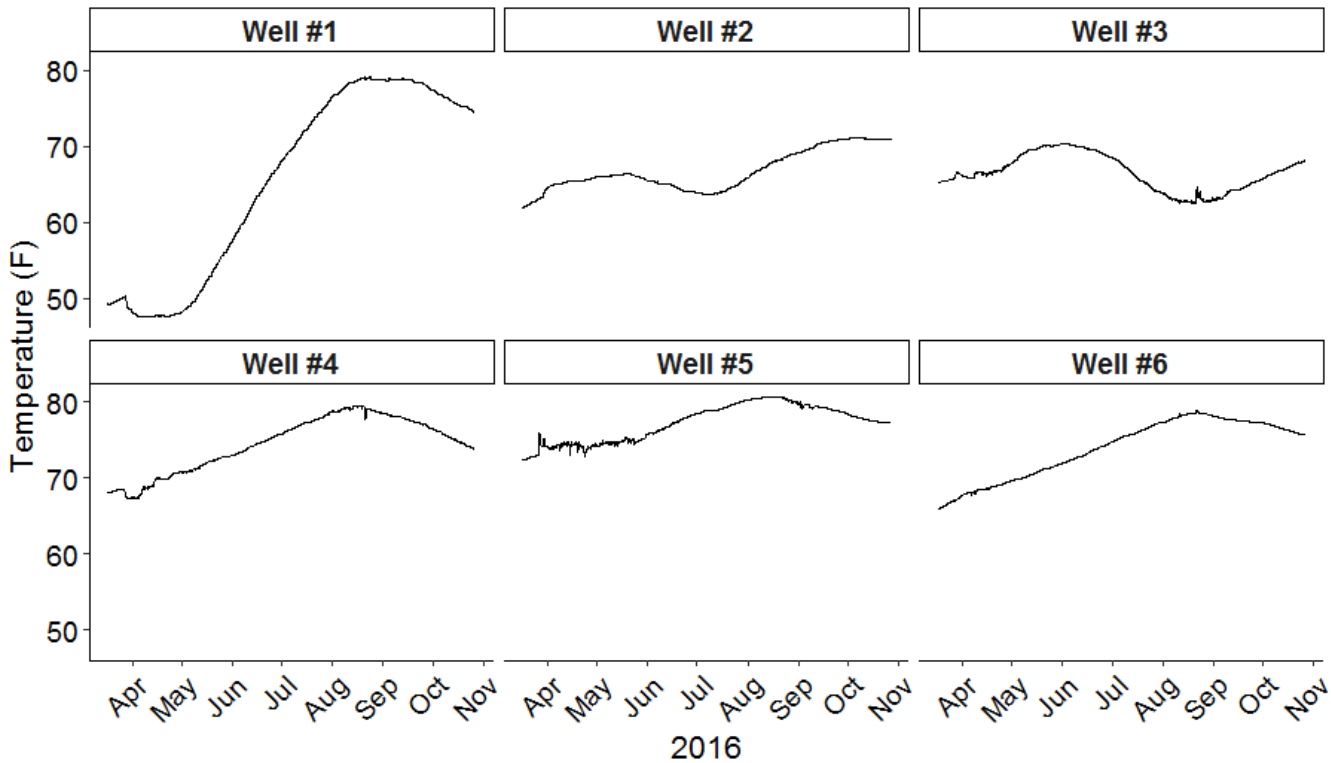

Figure 4. Groundwater temperature by well between late March and late October 2016.

Discussion

Leasburg Dam State Park currently provides valuable habitat for nearly 250 avian species, including upland, riparian, and aquatic species (Sullivan et al. 2017). Effective management of this habitat for these and other taxa, or potential enhancement or expansion of available habitat, requires a comprehensive understanding of ecosystem function. Particularly in riparian ecosystems, hydrological dynamics are a key determinant of the type of vegetation community that can be feasibly and naturally sustained.

Data from all six groundwater monitoring wells installed in Leasburg Dam State Park strongly indicated that the depth to groundwater in these locations is dependent on flow rates of, and perhaps distance to, the Rio Grande. At all wells, water table depth tracks river flow rate with a high level of precision: even seemingly small changes in the flow rate of the Rio Grande are reflected in corresponding changes in groundwater level (Figures 2 and 3). Although the pattern is mimicked slightly less closely at Well 2, the well located furthest from the river, the overall pattern is the same. When the river drops to zero cfs the water table dropped outside the range of measurement of half of these wells—more than six feet below the soil surface. However, Wells 3, 4, and 5 held a small amount of water before upstream dam releases in March as well as after the river flow rate dropped to zero cfs in October. All three of these wells were located just below the dam and may have continued to hold water due to slower drying of the basin below the dam compared to other locations upstream. Ultimately, the changes in flow rates of the Rio Grande at this location, and therefore the depth to groundwater, are predominately regulated by water releases from Caballo Reservoir (Figure 5; Elephant Butte Irrigation District 2017). Together these data suggest that underground springs or upland run-off do help contribute to a higher water table in the State Park, as evidenced by Wells 3 through 5, but that fluctuations in the water table are still highly dependent upon river flow rates. Moreover, even in the three locations where the wells suggested a slightly higher water table, the depth to groundwater is still beyond the reach of most young, native riparian vegetation species. The establishment and long-term health of that vegetation is dependent on the flows of the Rio Grande. Alternatively, bank lowering would enable the planting of vegetation in closer proximity to the water table.

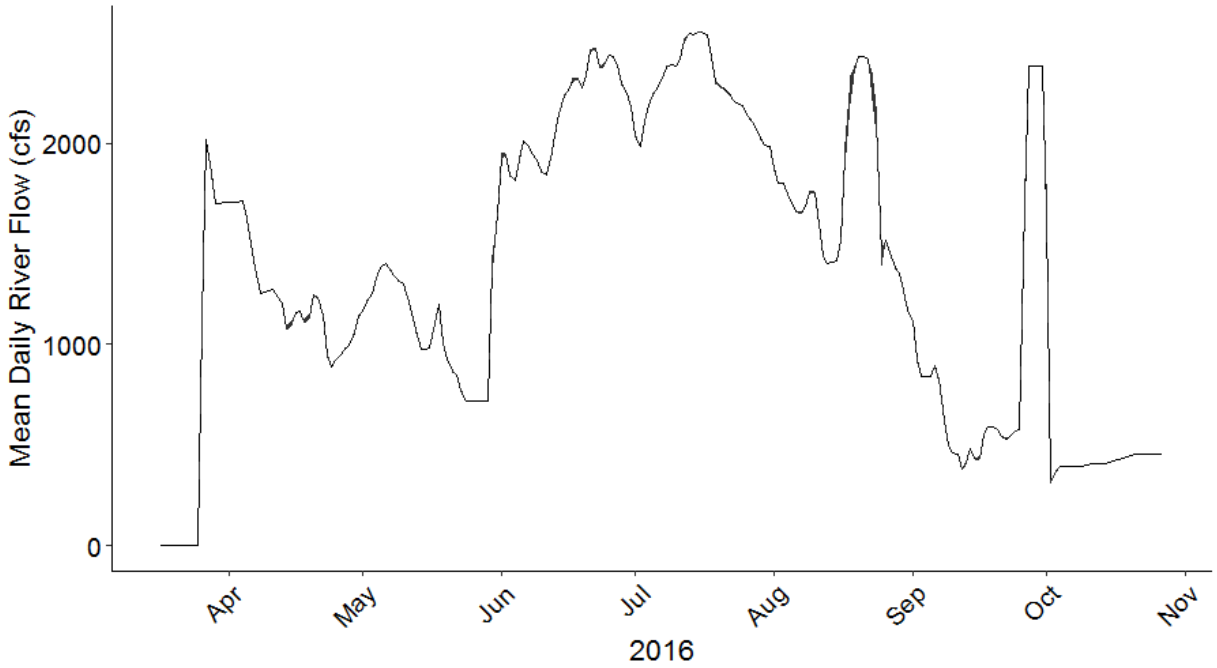

Figure 5. River flow rate out of Caballo Reservoir between March and November 2016.

Alternatively, the temperature of groundwater in all wells did appear to be highly influenced by underground geothermal seepages. Although there was variation between wells, groundwater temperature typically varied between 65 and 80 degrees F. When compared to groundwater temperatures at EB-09, temperatures at Leasburg Dam State Park average 15 degrees F warmer than those at EB-09 (Figure 6). Differences in the pattern and variation of groundwater temperatures observed among wells at Leasburg Dam State Park (Figure 4) are likely due to variation in proximity to geothermal seepages and the thermal intensity of those seepages. Indeed, Radium Springs is an area known of geothermal activity.

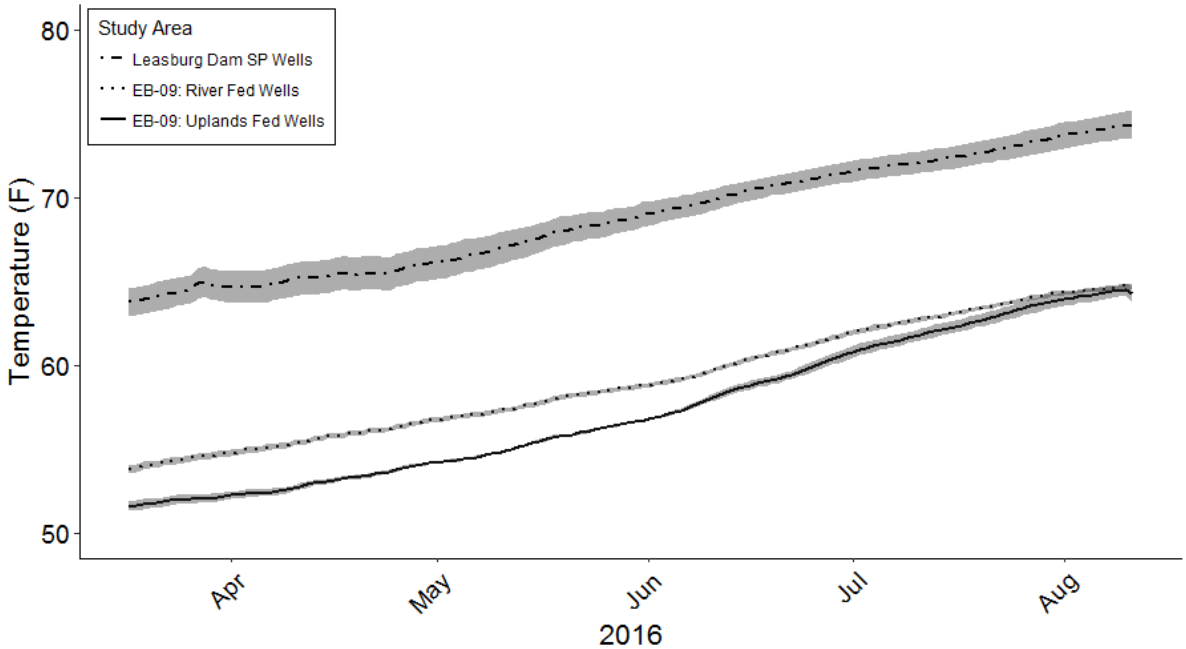

Figure 6. Groundwater temperatures at Leasburg Dam State Park compared to EB-09.
The dotted line indicates average groundwater temperature at wells fed primarily by Rio Grande flows, and the solid line indicates average groundwater temperature at wells fed primarily by uplands run-off and seepage.

Conclusions

It is likely that the depth of the water table in Leasburg Dam State Park is highly dependent on the flow rate of the Rio Grande and, ultimately, water releases from Caballo Reservoir. When river flow rates are reduced to zero cfs, the water table drops to 6 ft or greater below the soil surface in most locations. When the Rio Grande was flowing at its highest rate during the study period (1500-2000 cfs), the water table was within 2 ft of the soil surface. Although it is suspected that underground springs do help maintain the water table at slightly less than six feet from the soil surface, regardless of lack of surface flows, this is still too deep to be available to most young, native riparian plant species. Additionally, subterranean geothermal seepages in Leasburg Dam State Park heat the groundwater to temperatures considerably above average for a riparian area. Although evaluating soil type and mineral content was beyond the scope of this study, it is likely that this geothermal activity also alters soil chemistry. These river-dependent hydrological dynamics as well as soil chemistry and groundwater temperature can be limiting factors to growth of some plant species, and are important to take into consideration when evaluating the potential success of alternative vegetation management or restoration strategies.

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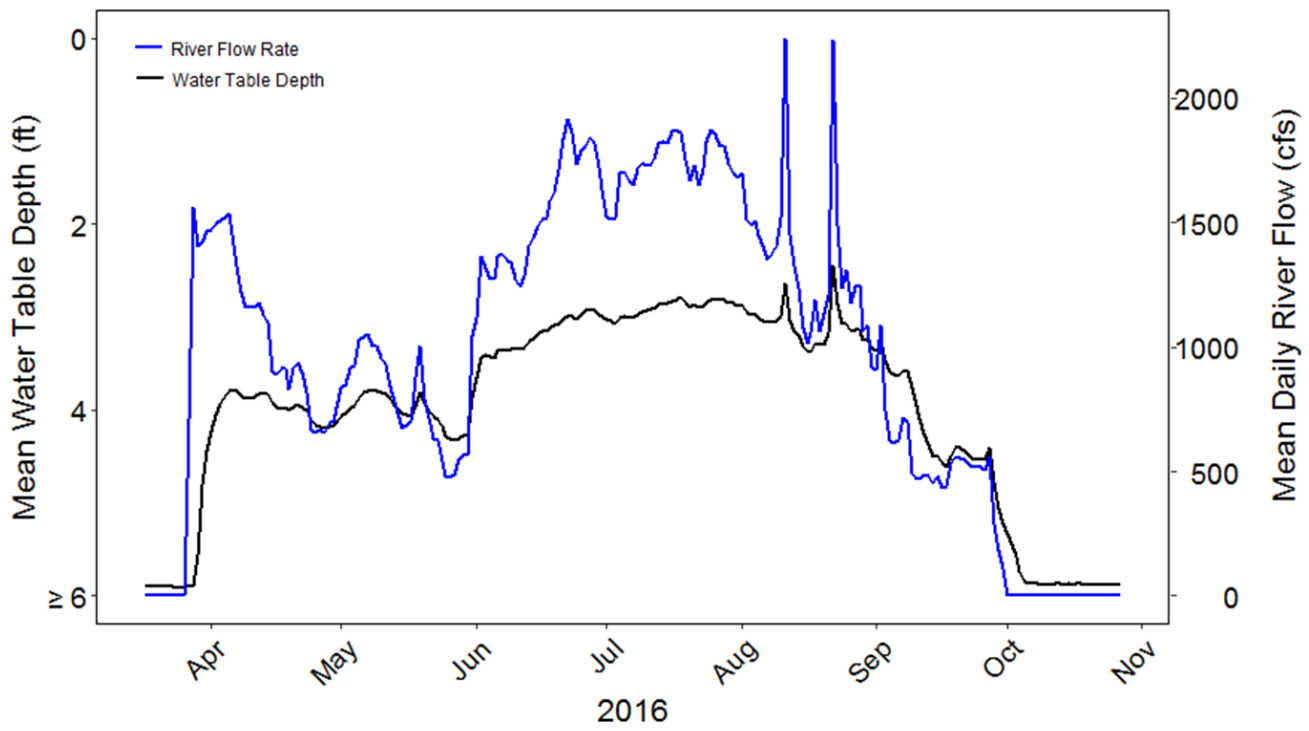
Attachment 1: Groundwater Monitoring Well Locations

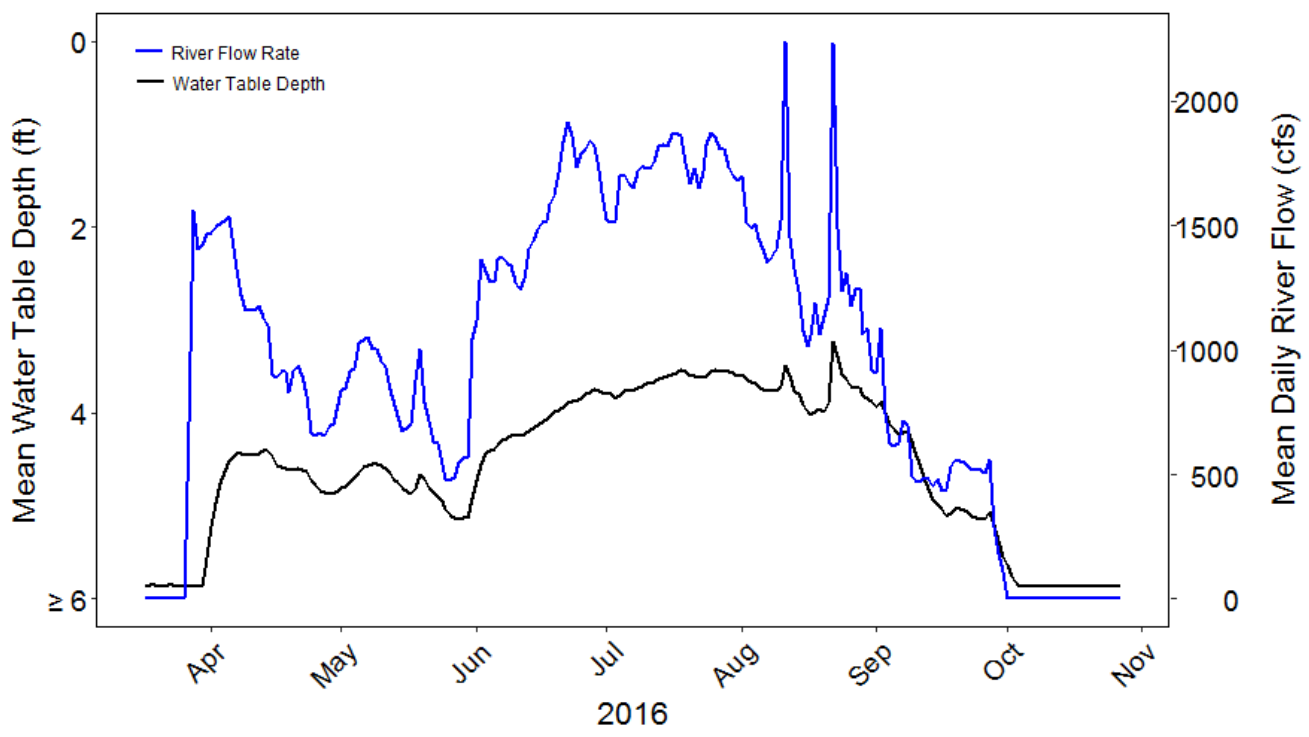
Well Number	Location (UTM NAD 83 Zone 13N)	Well depth (m)	Distance to river (m)
Well #1	319123, 3597254	1.8	24
Well #2	319140, 3597172	1.9	88
Well #3	319223, 3597115	1.7	14
Well #4	319255, 3597064	1.3	18
Well #5	319329, 3597017	1.8	13
Well #6	319375, 3596851	1.8	12

Attachment 2: Daily River Flow and Water Table Depth by Well

Well #1


River Flow Rate
Water Table Depth
Mean Water Table Depth (ft)
0
2
4
≥ 6
Mean Daily River Flow (cfs)
2000
1500
1000
500
0
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
2016

Well #2


River Flow Rate
Water Table Depth
Mean Water Table Depth (ft)
0
2
4
≥ 6
Mean Daily River Flow (cfs)
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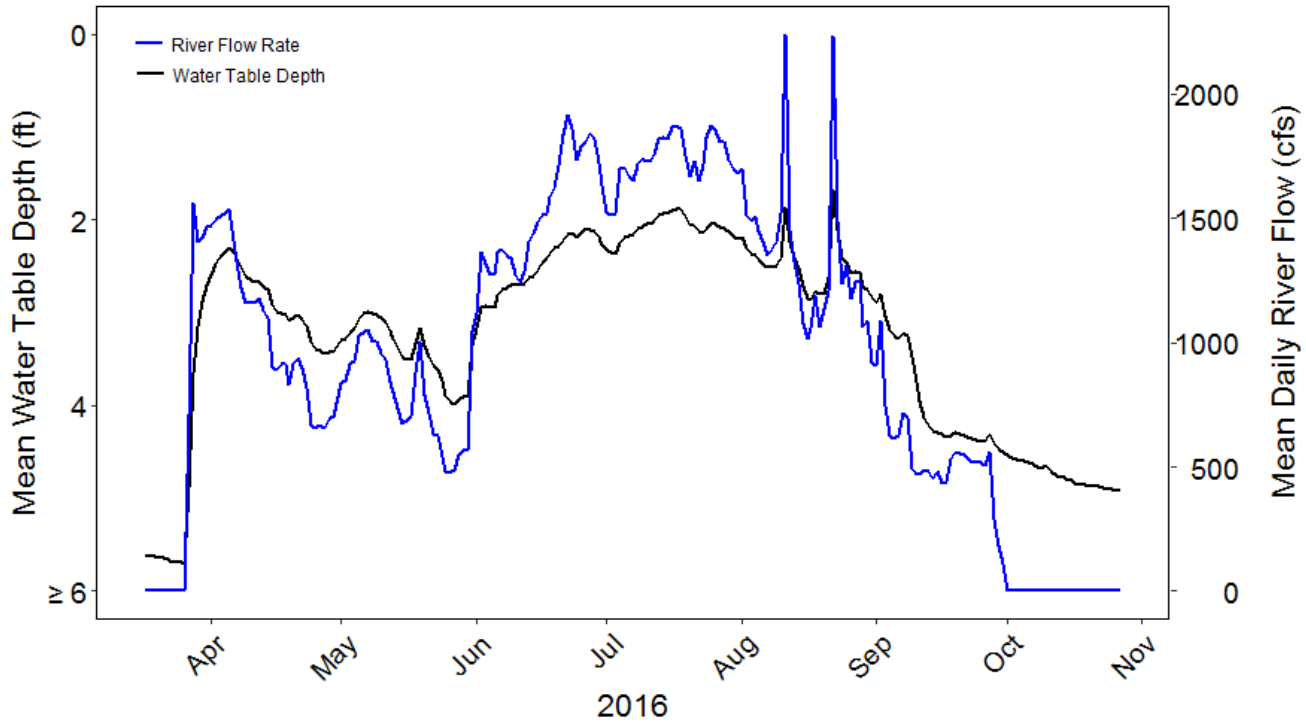
Well #3


River Flow Rate
Water Table Depth
Mean Water Table Depth (ft)
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≥ 6
Mean Daily River Flow (cfs)
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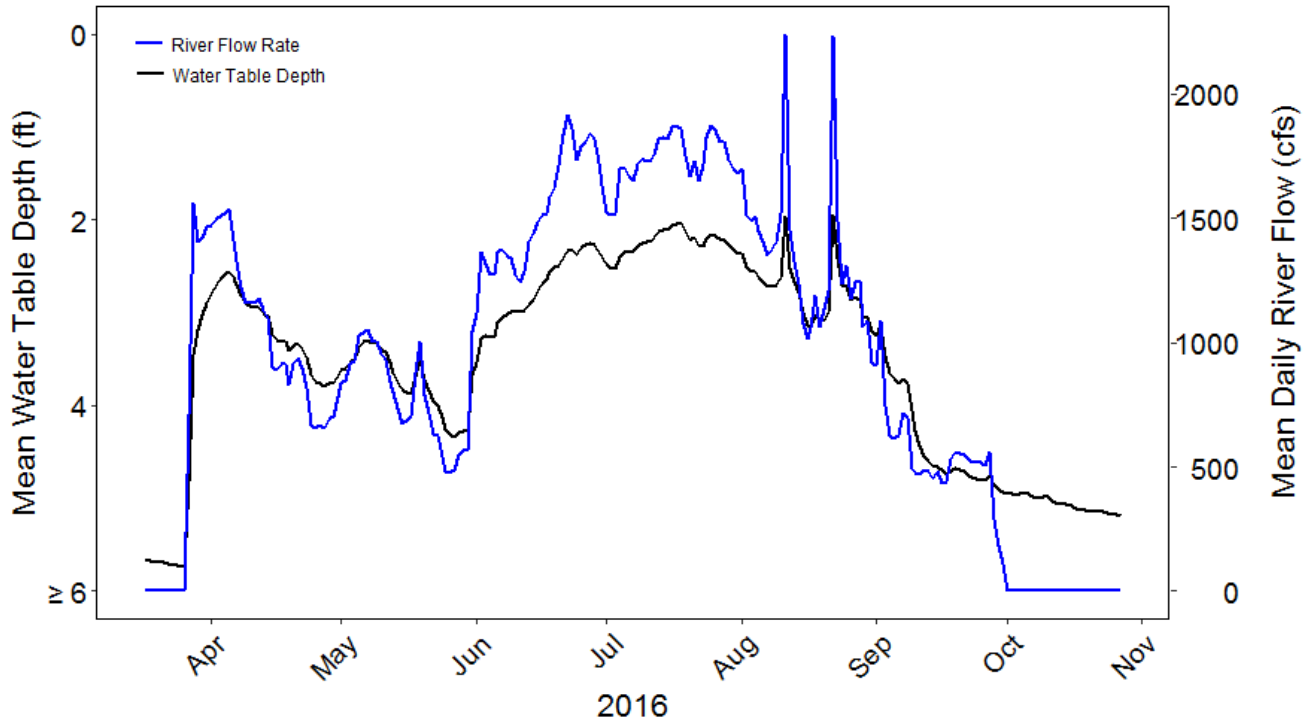
Well #4


River Flow Rate
Water Table Depth
Mean Water Table Depth (ft)
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≥ 6
Mean Daily River Flow (cfs)
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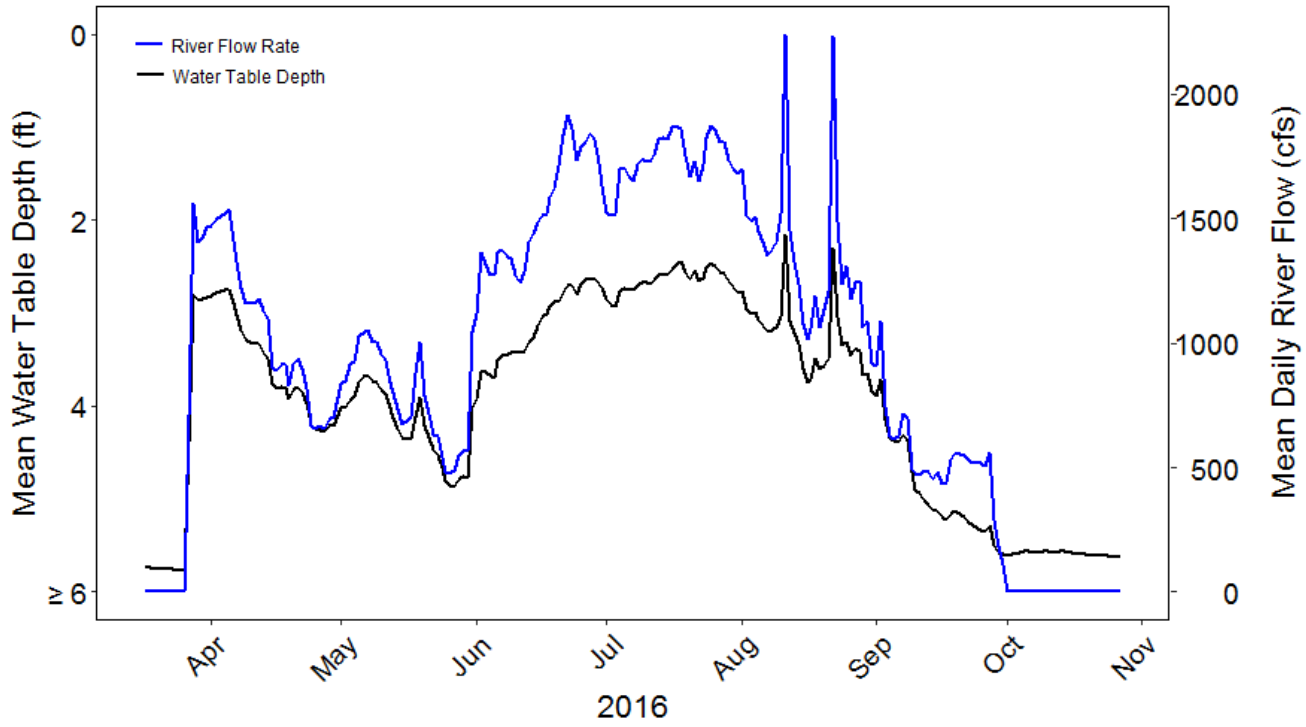
Well #5


River Flow Rate
Water Table Depth
Mean Water Table Depth (ft)
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2
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≥ 6
Mean Daily River Flow (cfs)
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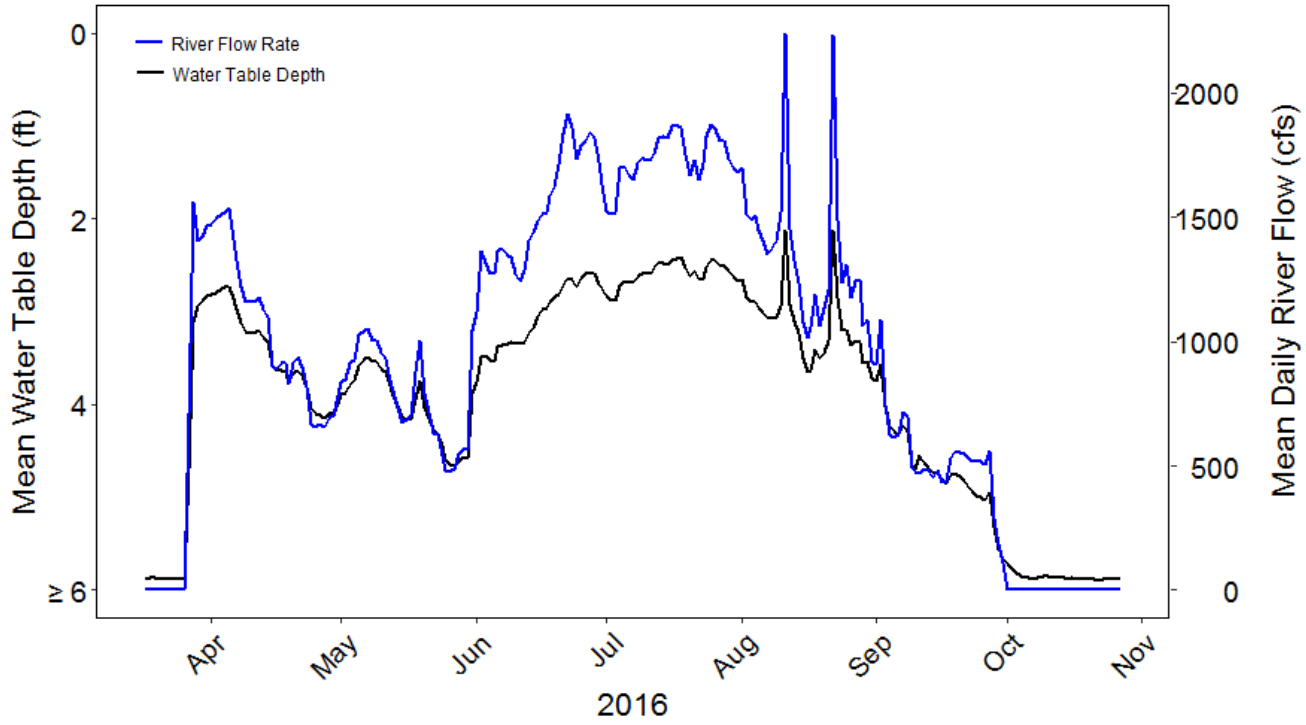
2016

Well #6


River Flow Rate
Water Table Depth
Mean Water Table Depth (ft)
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PEER REVIEW DOCUMENTATION

PROJECT AND DOCUMENT INFORMATION

Project Name Leasburg Dam State Park Groundwater Assessment WOID FA088

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Team Leader Darrell Ahlers, 86-68290, Wildlife Biologist

Document Author(s)/Preparer(s) K. Dillon and D. Ahlers

Peer Reviewer S. Dave Moore, 86-68290, Wildlife Biologist

Peer Reviewer _____

REVIEW REQUIREMENT

Part A: Document Does Not Require Peer Review

Explain _____

Part B: Document Requires Peer Review: SCOPE OF PEER REVIEW

Peer Review restricted to the following Items/Section(s):	Reviewer:
Complete Document Subject to Review	S. Dave Moore

REVIEW CERTIFICATION

Peer Reviewer - I have reviewed the assigned Items/Section(s) noted for the above document and believe them to be in accordance with the project requirements, standards of the profession, and Reclamation policy.

Reviewer: S. Dave Moore Review Date: February 20, 2017 Signature: [signature]

Reviewer: _____ Review Date: _____ Signature: _____

I have discussed the above document and review requirements with the Peer Reviewer and believe that this review is completed, and that the document will meet the requirements of the project.

Team Leader: Darrell Ahlers Date: 4/4/2017 Signature: [signature]