2017 Summer Water Supply Season – Retrospective
Prepared: February 5, 2018, Portland Water Bureau

The following retrospective describes the 2017 drawdown season including the weather, demands, groundwater use, water efficiency and conservation, and fish flows.

Weather

The accumulation of snowpack during the winter of 2016-17 was above average. Snow was not a large contributor to summer supply from Bull Run in 2017 because the spring snowmelt was finished by early June, before drawdown of the reservoirs began. It is typical for snow to only be a small contributor to supply in the Bull Run watershed due to its elevation. When the snowpack is significantly greater than normal, however, it can help delay the onset of drawdown. For the winter of 2016-17, the low elevation snow monitoring site at South Fork (2690' elevation) recorded a maximum accumulation of 15.1 inches of snow water equivalent (SWE; the depth of liquid water if the snowpack was completely melted). The mid-elevation site at North Fork (3060' elevation) recorded a maximum of 31.7 inches SWE. The highest elevation site at Blazed Alder (3650' elevation) had a maximum of 43.4 inches SWE. The maximum SWE accumulation for 2017 at South Fork was 166% of the 1999-2016 average. The North Fork maximum SWE was 114% of average, and the Blazed Alder SWE was 117% of average. The timing of maximum snowpack was mid-March for all three sites. Snow water equivalent data are presented graphically in Figure 1.

Precipitation during 2017 was, overall, slightly above average in the Bull Run watershed. Total rainfall for the calendar year was 81.7 inches at Headworks, approximately 1.7 inches more than the annual average from 1899-2016. Figure 2 shows monthly precipitation at Headworks. The driest month was July, with no observed rain recorded at Headworks during the month. March was the wettest month, with 15.1 inches of rainfall recorded at Headworks, or 168% of the historical March average. February was nearly that wet, with 14.6 inches of recorded rain, which was 175% of the historical February average.

Temperatures in the Bull Run watershed in 2017 were cooler than average January through April and October through December. They were above average May through September, most notably in August, when temperatures were 2.2 °C above average.

Demand

Historic winter base demand peaked between 1979 and 1991 at an average of approximately 100 million gallons per day (MGD). Since then winter base demand (November-March) has declined, with demand over the past 5 years approximately 15% lower at an average of about 85 MGD. In 2017, demand ran about 97% of the average for the previous five years; Figure 3 shows demand from 2017 and the preceding five-year period, based on 7-day moving averages. Monthly averages (not shown) ranged from 91% to 102% of the monthly averages for the previous five years. For all months except January, July, and August, demand in 2017 was less than the previous five years' average. These demand numbers reflect the total amount of water supplied to serve Portland retail and wholesale customers, and is not equivalent to the total amount of water that is metered and billed.

Bull Run Supply

Drawdown of the Bull Run Reservoirs began on June 22, about two weeks earlier than the historical onset of drawdown. The reservoirs reached their minimum storage on September 17, when 3.2 of 9.9 billion gallons (BG) of usable storage (32%) remained in the reservoirs. The reservoirs completed filling on October 21, though increased downstream releases for fish resulted in a few subsequent small drawdowns. Figure 4 shows the 2017 drawdown of the Bull Run Reservoirs.

Groundwater Use

Each year, the Portland Water Bureau (PWB) operates the Columbia South Shore Well Field to exercise equipment and identify repair needs. The 2017 groundwater maintenance operation was conducted concurrent with the 100% groundwater run that occurred between February 13 and March 15. A total of 2.3 BG of groundwater were delivered to the distribution system over 31 days. Groundwater was also run for seven hours on September 7, to augment the Bull Run supply during a temporary shortage in treatment chemicals, supplying approximately 10.3 MG.

Groundwater Use Model

Since 2007, a probabilistic Groundwater Use Model has been incorporated into summer supply planning. The Groundwater Use Model uses current-year demand projections, historical reservoir inflows, and anticipated fish flow releases into the Lower Bull Run River to develop a series of reservoir drawdown curves—one for each weather year from 1940 to 2016. These projected drawdown curves are used to determine suggested groundwater pumping rates based on the remaining volume of Bull Run storage above baseline elevations, and the calendar date. These pump rates are set such that they would have kept the Bull Run Reservoirs above their baseline storage levels for all 77 of the historic weather years, while minimizing the volume of pumped groundwater and maintaining a relatively constant pumping rate throughout the drawdown season. The Groundwater Use Model is based on the assumption that the temperatures and precipitation patterns in 2017 would be within the range of observed weather since 1940.

The Groundwater Use Model was run in the spring of 2017 before drawdown began. The model does not incorporate weather forecasts and is therefore run only once each year. Subsequent application of the Groundwater Use Model involves comparison of the actual course of drawdown to the groundwater pumping curves generated by the model. Figure 5 shows the groundwater pumping curves that were developed, along with the actual reservoir volumes that were observed during the drawdown season. During drawdown, if the actual storage volume in the Bull Run Reservoirs drops below a groundwater pumping curve, then the pumping rate corresponding to that curve is recommended to augment supply.

Instream Flows and Fish Habitat Management

The bureau managed water releases downstream of Bull Run Reservoir 2 to meet minimum flow requirements and water temperature targets for the lower Bull Run River, which are required by the Bull Run Water Supply Habitat Conservation Plan (HCP). This was the fourth year that PWB was using the new gate levels on the Reservoir 2 north tower intake to meet downstream water temperature targets.

Normal spring conditions, as defined in the HCP, occurred in 2017. Spring conditions are considered normal under the HCP when drawdown starts June 15 or later. Minimum flow levels in 2017 were 120 cfs until June 15, then ramped down by 5 cfs per day until drawdown began on June 22. At that time, minimum levels decreased to summertime ranges of 20-40 cfs to manage for temperature. Each day's flow target was determined by the temperature of the water being released from Headworks and the forecast maximum air temperature for that day. These flow variations were designed to meet the water temperature goal of keeping the 7-day average of the daily maximum water temperatures at the warmest point on the Bull Run River below the temperature target, which moves according to temperatures observed at the Little Sandy River. The year 2017 was the fourth year following these temperature targets, and conversations with regulators are ongoing.

Critical fall downstream flows were implemented in 2014 and 2015 and therefore could not be implemented in 2016, nor can they be declared in 2018 and 2019 (declarations cannot be made for more than two consecutive years or four years after declaring). They were available, however, to be implemented in 2017 if critical tributary inflow conditions had occurred. August and September cumulative inflows to Bull Run Reservoirs were greater than the tenth percentile for all historic years (1940-2016). Therefore, critical fall conditions were not met, and normal downstream flows were implemented October and November. Minimum flow levels increased on October 1 to be 50% of the reservoir inflow (calculated on a weekly basis) with a minimum of 70 cfs and a maximum of 400 cfs. On November 1, the targets changed to 40% of the reservoir inflow with a minimum of 150 cfs and a cap of 400 cfs. Starting in December, the minimum flow in the lower Bull Run River was set at 120 cfs and will remain there until spring 2018. Figure 6 shows mean daily flow for the Lower Bull Run River throughout the drawdown season.

The bureau met downstream water temperature targets in the HCP for 2017 with the exception of some days in the fall. Figure 7 shows temperature of the Lower Bull Run River. Throughout the management season, the bureau presented the 2017 water temperature information to the Oregon Department of Environmental Quality, the National Marine Fisheries Service, and the Oregon Department of Fish and Wildlife. Those agencies directed PWB to continue to monitor water temperatures in the lower Bull Run River and to work with them each year, starting in May, on operational measures to improve performance of the system for temperature control.

Cold Water Transfer

The bureau conducted a cold water transfer in 2017 to move the bottom-most cold water from Reservoir 1 downstream into Reservoir 2, where it would be available for release to town or downstream. The transfer started on August 9 and continued through September 18, releasing a total of 5.6 BG of bottom water from Reservoir 1 via Dam 1 needle valves (using the 895’ elevation gates) into Reservoir 2. The temperature effect of these releases was most apparent in the upper and middle elevations of Reservoir 2. An earlier outage of Powerhouse 1 required that water be released through the needle valves July 24 through August 4. Because of the relatively small capacity of needle valve gates at the 930’ and 965’ levels, both of those gates had to be opened to safely provide enough flow to meet demand. Therefore, some cooler water was sent into Reservoir 2 at that time. An estimated 0.9 BG of water from the 930’ level was sent downstream during that period.

Water Efficiency and Conservation

The bureau's water efficiency program worked with commercial, industrial, government, residential and multi-family customers to help them meet their water efficiency goals in 2017. Water efficiency education, outreach, and assistance activities were carried out throughout the summer supply season, which are summarized below.

- Provided on-site water efficiency surveys, water-use analysis, irrigation system review, high water-use investigations as requested by commercial customers. Customers served included manufacturers, offices, retail, and particularly restaurants and multifamily buildings.
- Continued testing the implementation of automatic meter reading devices as part of a pilot project that can potentially help customers observe and respond to daily water use.
- Distributed water efficiency devices and information at the customer service walk-in center. These kits include showerheads, aerators, and toilet leak tablets.
- Provided $50 rebates to replace old toilets with high-efficiency toilets for residential, commercial, and multifamily customers.

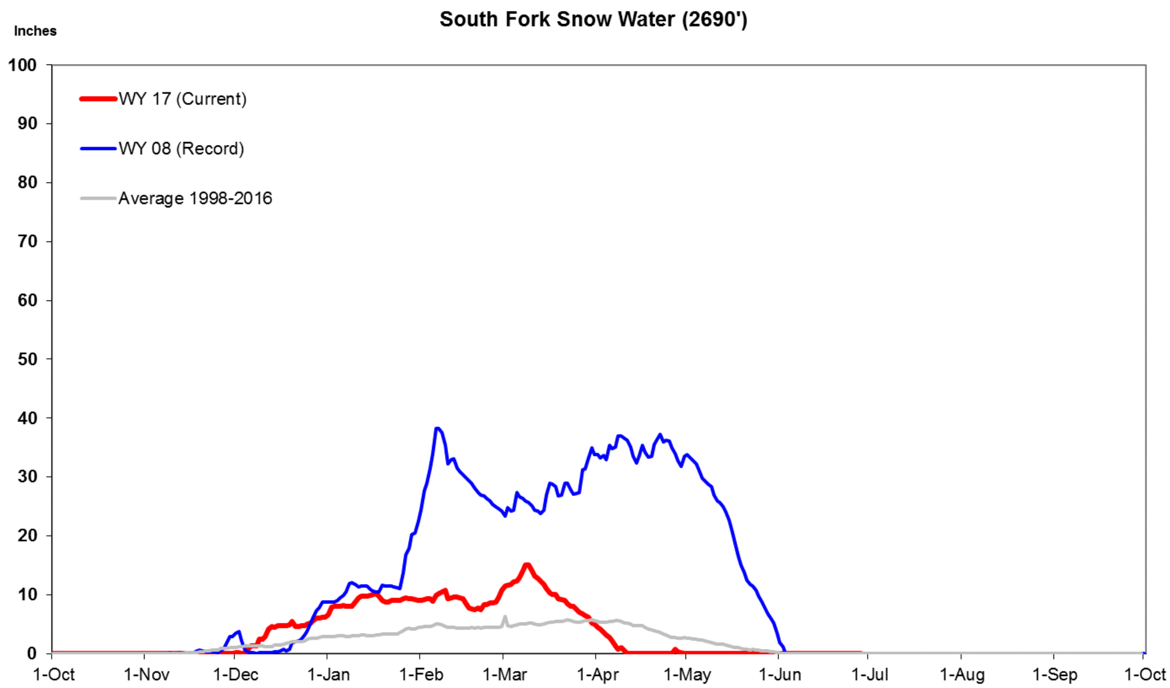
- Provided rebates for improving the water efficiency of automatic irrigation systems.
- Published a Customer Newsletter with water conservation information that was included in all bills that were sent out in the summer.
- Published blogs and social media messages regarding water conservation.
- Attended community events around the city during the summer, distributing water efficiency devices and information.
- Maintained the water-wise demonstration garden at the East Portland Neighborhood office in Hazelwood neighborhood to showcase water-efficient plant choices and irrigation technology.
- Partnered with the Portland Bureau of Transportation's Smart Trips program to deliver water conservation information by bicycle to new customers in the city. The Portland Water Bureau component of this program is called "Smart Drips."
- The PWB is a member of the Regional Water Providers Consortium (RWPC), and an active participant in the Conservation subcommittee. The bureau achieves public education and communication goals through the RWPC's regional conservation programming. Below is a summary of key offerings completed in the summer:

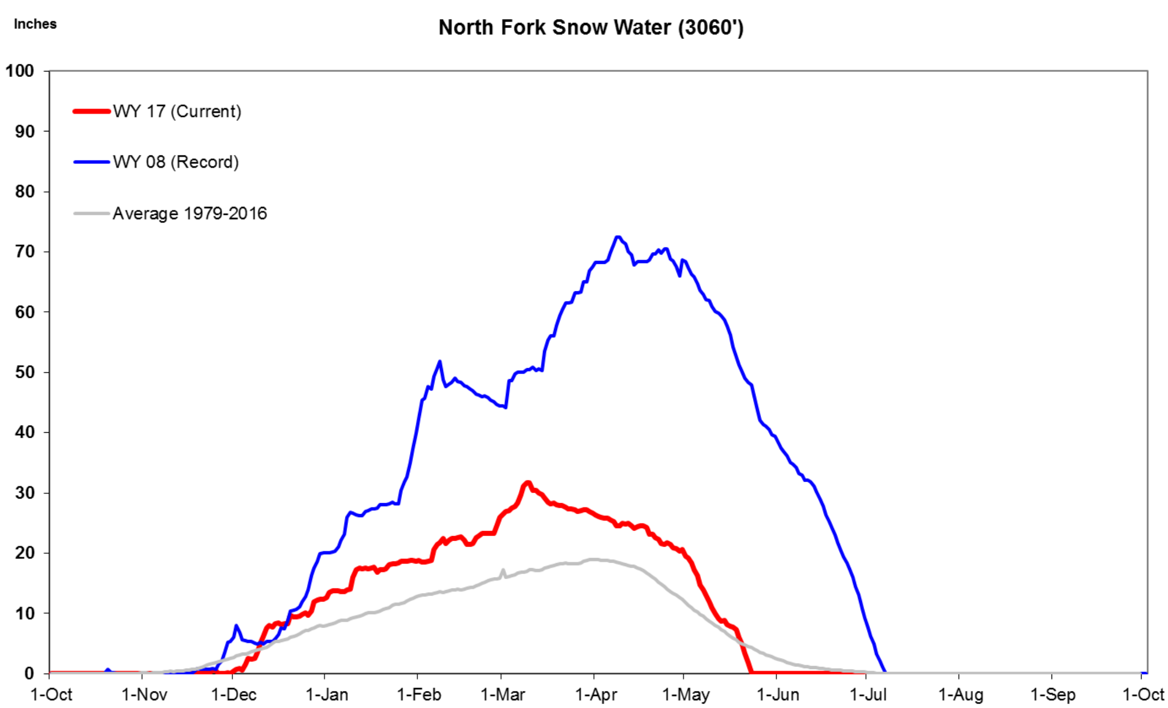
    - Alpha Media radio stations created two water conservation-focused mobile app features, which ran June through August on seven radio stations resulting in 334,980 impressions.
    - Placed ad spots and conducted on-air interviews during evening news programs on KGW Channel 8, Garden Time, and KUNP Univision television. Messaging was in English (KGW and Garden Time) and Spanish (KUNP).
    - Distributed outreach materials focused on using water efficiently outdoors to residential customers at the Portland Home & Garden Show (February), the Association of Landscape Designers annual garden tour (June), and at media partner events throughout the summer.
    - Summer outreach messaging was also distributed through the RWPC's website www.conserveh2o.org, social media (5+ messages per week on Facebook and Twitter), and through the RWPC's summer e-newsletter, which reached approximately 800 recipients.
    - Provided the Weekly Watering Number (WWN) on www.conserveh2o.org and via a weekly listserv that reached approximately 1,100 recipients from April-September. The WWN is the amount of water in inches to apply to lawns and gardens based on local weather conditions and evapotranspiration.

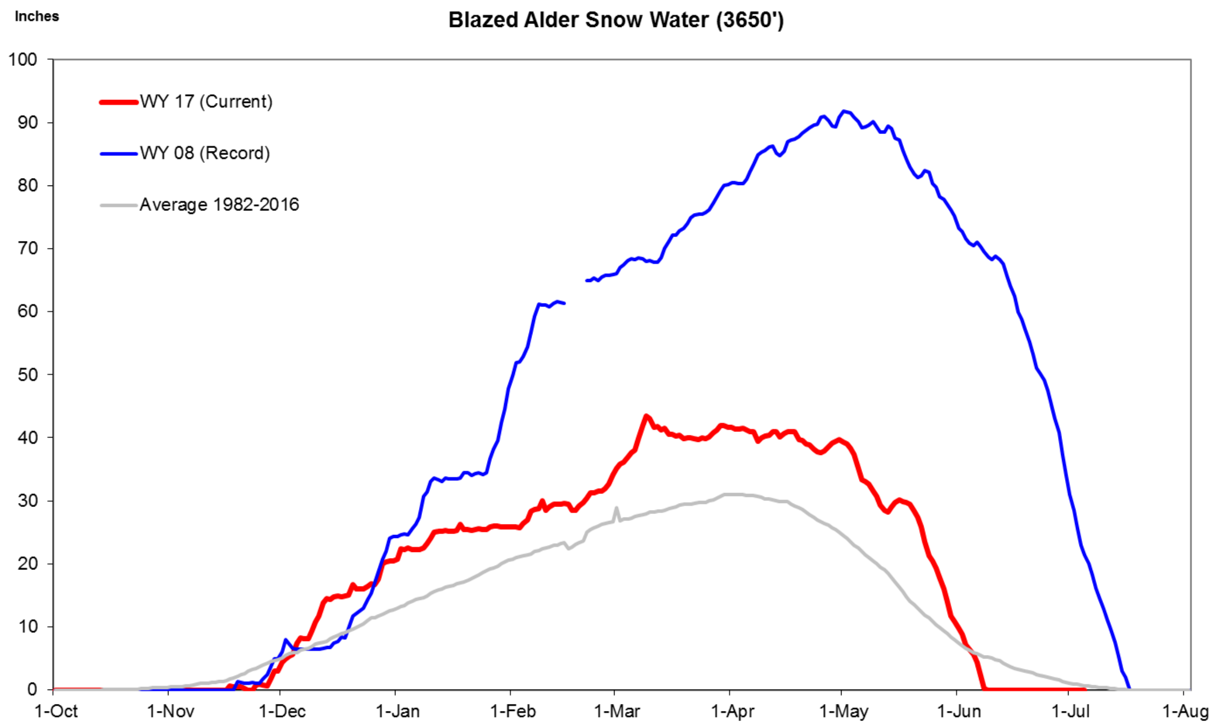
Conclusions

During the 2017 summer supply season, the PWB was able to meet all in-town and in-stream demands using its baseline resources—Bull Run Reservoirs, streamflow, conservation, and groundwater. Meetings of the Supply Planning Group, which occurred once a month, were integral to the successful management of summer operations. The group balances multiple objectives in order to ensure a reliable high-quality water supply for all users while effectively managing costs.

Figure 1. Snow water equivalent, in inches, at snow monitoring sites in Bull Run during water year (WY) 2017







Inches
Blazed Alder Snow Water (3650')
100
90
80
70
60
50
40
30
20
10
0
WY 17 (Current)
WY 08 (Record)
Average 1982-2016
1-Oct
1-Nov
1-Dec
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug

Figure 2. Monthly precipitation at Headworks

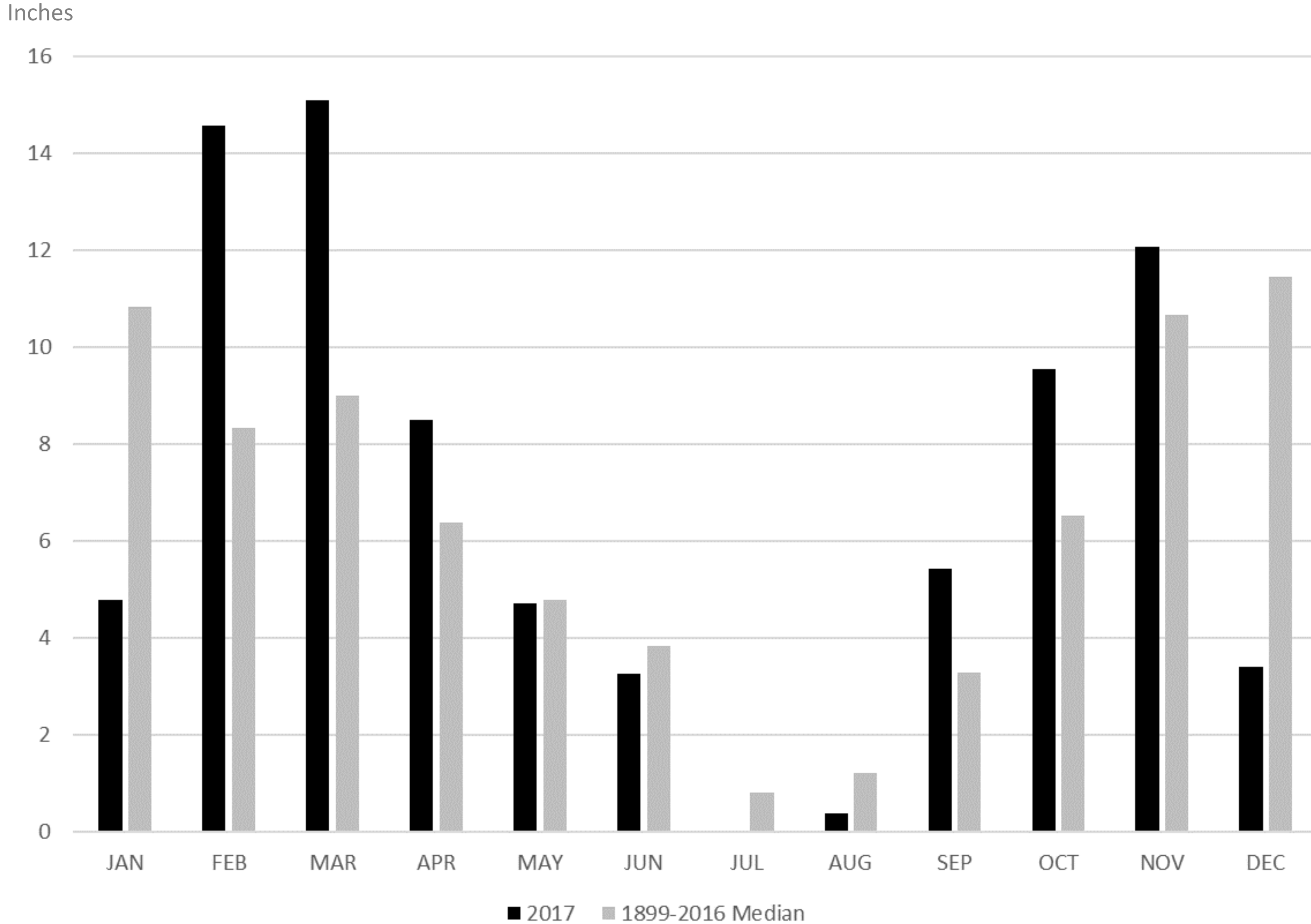


Figure 3. Current demand compared to previous five years; 7-day moving averages

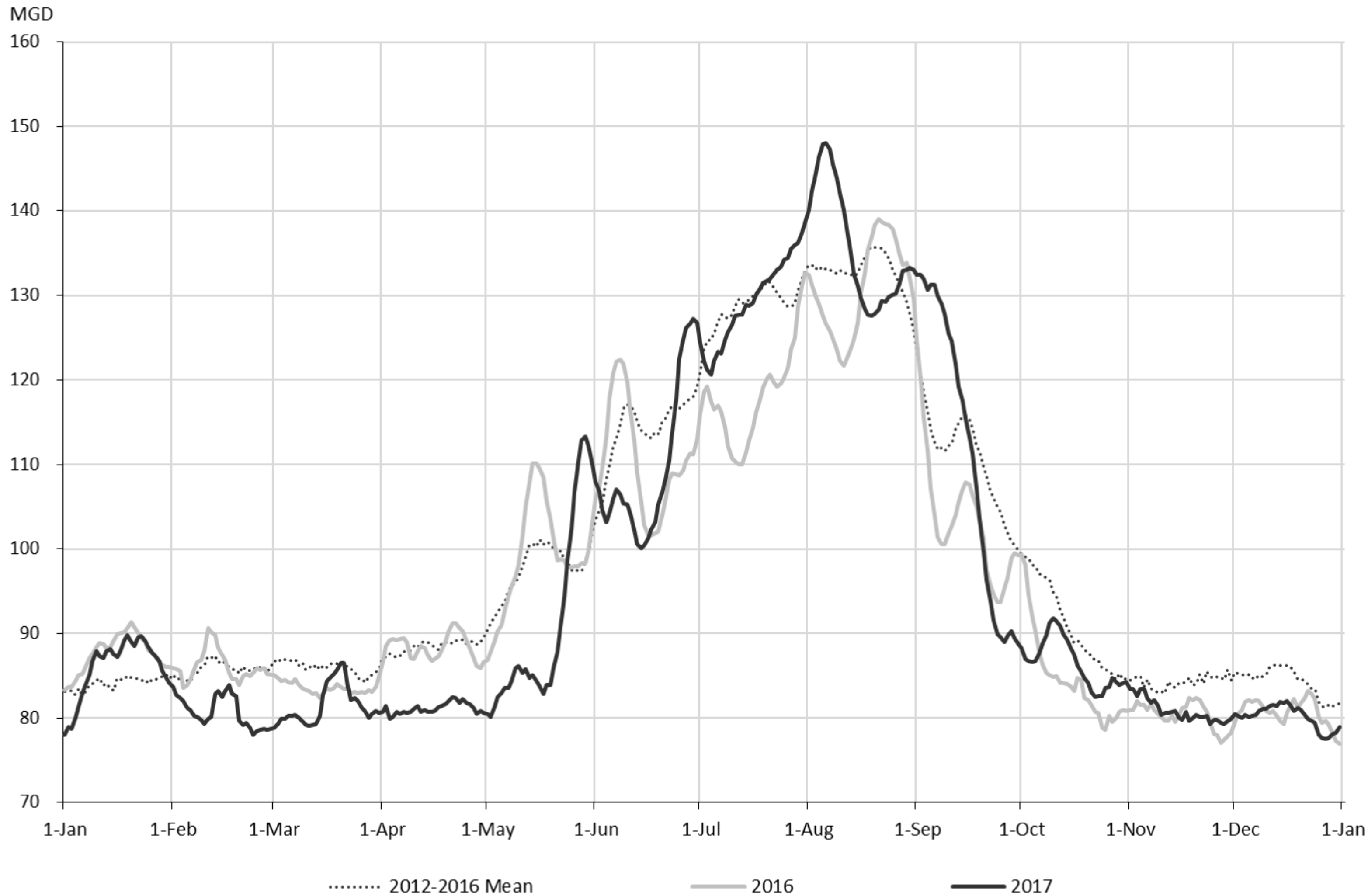


Figure 4. Bull Run Reservoirs drawdown and refill

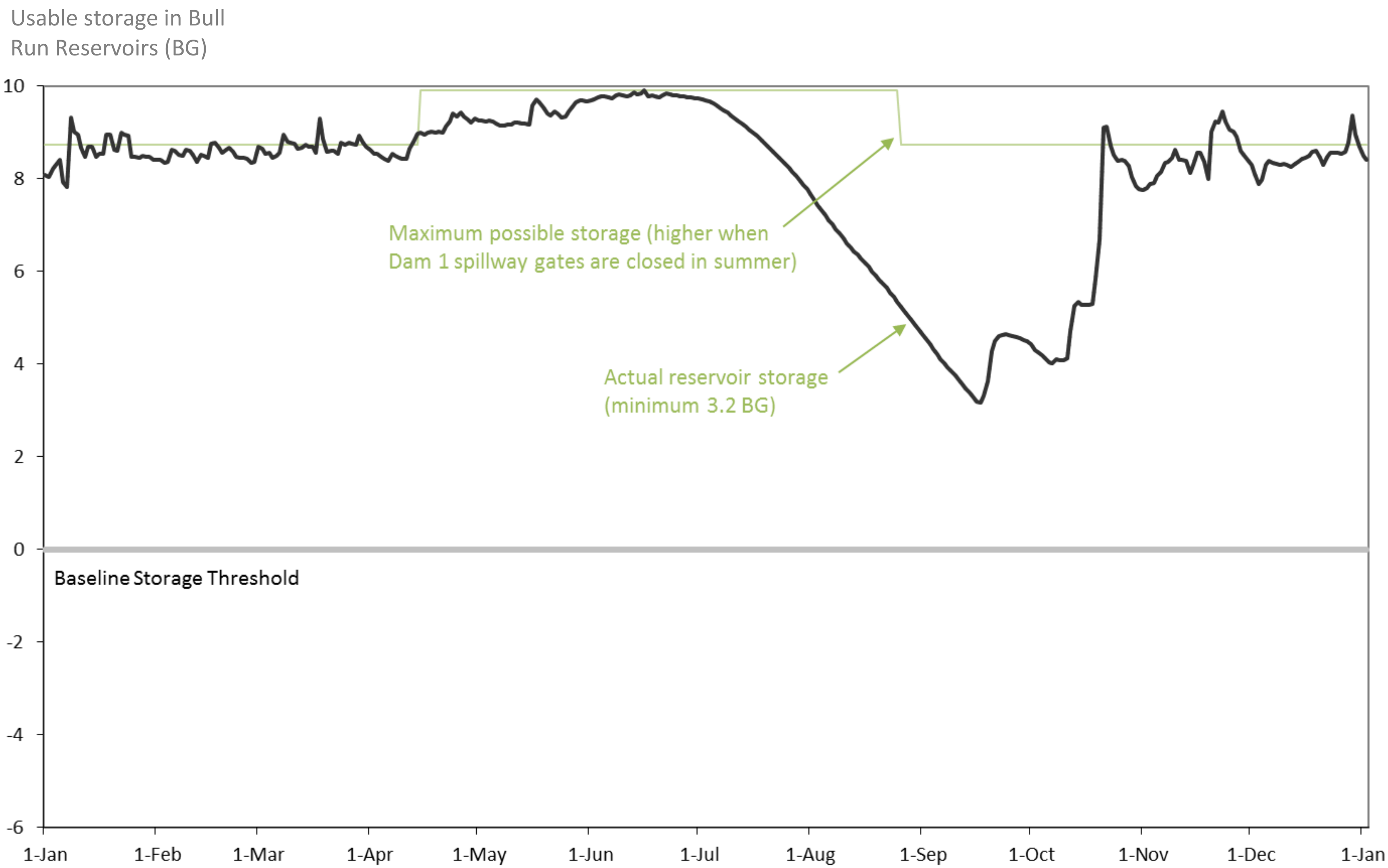


Figure 5. Observed Bull Run Reservoirs storage and modeled groundwater pump rates

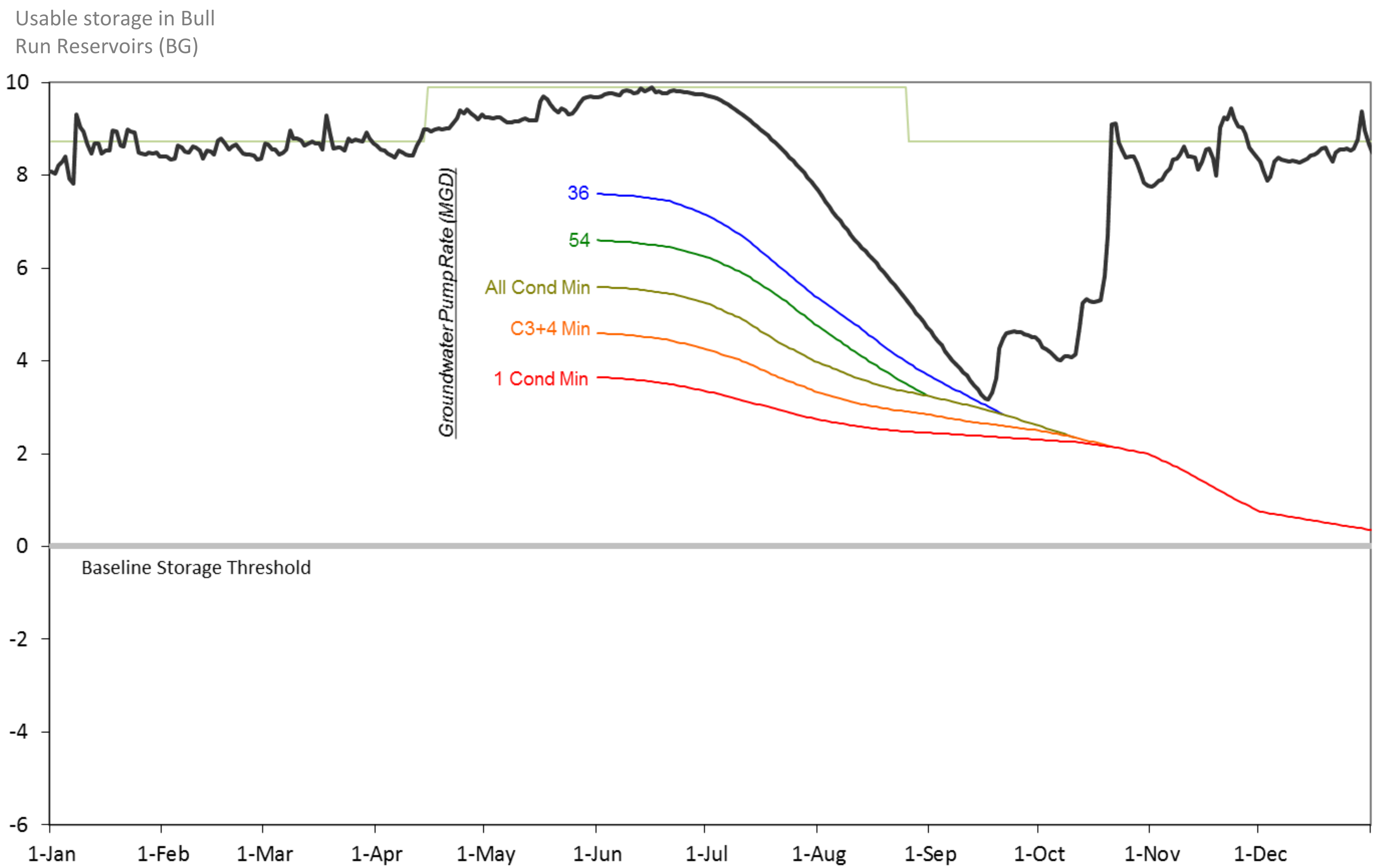


Figure 6. Mean daily flow at Lower Bull Run bridge, USGS 14140000

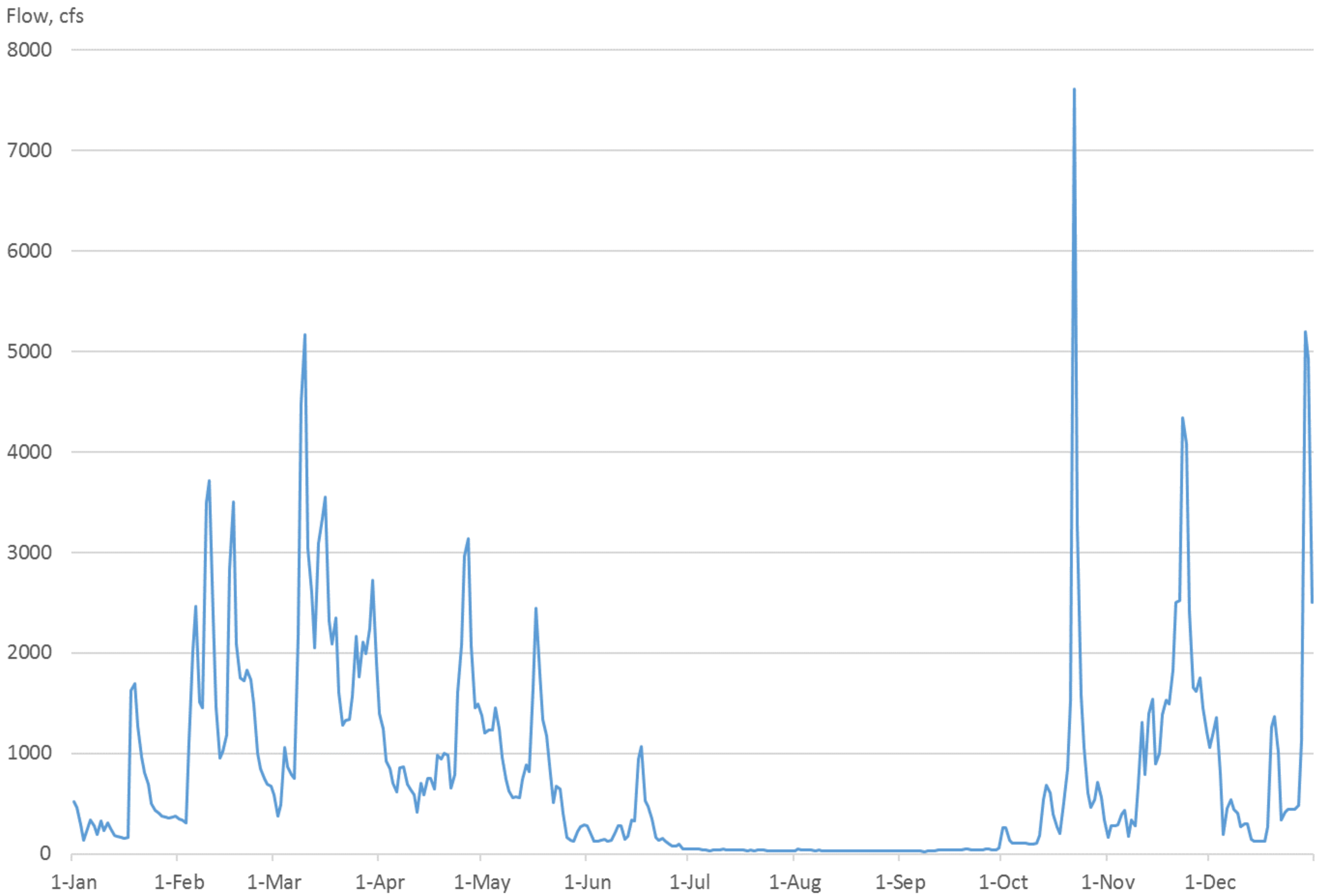


Figure 7. Water temperature of the Lower Bull Run River, summer 2017