SPF WATER ENGINEERING

April 4, 2018

Shelley Keen
Idaho Department of Water Resources
322 East Front Street
Boise, ID 83720

VIA EMAIL (shelley.keen@idwr.idaho.gov)

Subject: 2017 Annual Water Level Monitoring Report (Permit 61-12090)

Dear Mr. Keen:

This report summarizes water level data collected from the Elk Creek Village monitoring well (MW-1) and the Elk Creek Village production well (PW-1) (Figure 1). Monitoring of groundwater production and groundwater levels in these wells is required under Permit 61-12090. Monitoring protocols are outlined in a monitoring plan dated February 15, 2012, which was approved by IDWR on March 26, 2012.

PW-1 is not yet being used for production, but groundwater levels have been measured in both PW-1 and MW-1 since October 3, 2011. Transducers and dataloggers have measured and recorded water levels on 6-hour intervals in both wells since that date as well (with exceptions – see below). Manual water level measurements and transducer data downloads occurred on a bimonthly basis through the first year-and-a-half of monitoring (through June 2013), with quarterly measurements and downloads since that time.

Manual Water Level Monitoring

Prior to the January 16, 2018 monitoring event, manual water level measurements were typically made with the same Powers Electric line sounder to maintain consistency (although the sounding tape was replaced in January 2015). Due to concerns about the Powers sounder line stretching and giving inaccurate measurements, an 800-foot non-stretch Waterline electric sounder was used for water level measurements in January and March 2018 and will continue to be used for future monitoring. Manual groundwater level measurements collected in MW-1 and PW-1 are listed in Table 1.

Table 1. Manual depth to water observations at MW-1 and PW-1

Date	**MW-1** Depth to Water (ft, BTOC)	**PW-1** Depth to Water[1] (ft, BTOC)
10/3/2011	354.73	343.90
12/9/2011	354.65	342.40
2/17/2012	354.18	342.26
4/6/2012	353.87	342.00
6/28/2012	353.72	342.06
8/30/2012	353.73	343.30
10/18/2012	353.76	342.28
12/27/2012	353.27	341.79
2/13/2013	353.50	341.80
3/8/2013[2]	353.50	---
4/19/2013	353.50	241.46
6/25/2013	353.15	341.61
9/26/2013	353.02	341.76
12/18/2013	353.12	341.58
3/25/2014	352.85	341.18
7/9/2014	351.62	340.40
9/4/2014	351.58	340.35
12/15/2014	351.46	340.19
3/30/2015	355.62	344.26
10/2/2015	356.90	344.50
12/23/2015	355.33	344.47
3/15/2016	354.65	344.53
6/21/2016	355.42	344.50
10/6/2016[3]	355.25	---
10/28/2016[3]	---	344.50
12/19/2016	356.25	343.75
3/1/2017	354.90	343.25
4/6/2017[3]	355.90	---
6/30/2017	354.42	343.13
9/15/2017	353.89	343.28
1/16/2018[4]	356.54	345.04
3/28/2018	356.54	344.90

[1]PW-1 depth to water measured relative to top of oil

[2]Off-cycle monitoring at MW-1 to repair the water level transducer

[3]Only one well sounded or could not sound due to oil

[4]Water levels measured with non-stretch sounder instead of Powers starting January 2018

Continuous Water Level Monitoring

Solinst Levelogger pressure transducers were installed in MW-1 and PW-1 in October 2011. A Solinst Barologger was installed in MW-1 so levelogger data could be corrected to compensate for fluctuations in atmospheric pressure. The leveloggers in MW-1 and PW-1 were each suspended on approximately 400 feet of stainless steel cable attached to an I-bolt affixed to the top of the well casing. This setting depth submerged the leveloggers between 40 and 60 feet below the typical static water level in each well. As of October 2011, all pressure transducers are set to record data points (water column depth for leveloggers and barometric pressure for the barologger) on 6-hour intervals.

Data is downloaded from the loggers during each monitoring event. Manual water levels are measured with an electric line sounder during each monitoring event and recorded. For the 2017 annual report, monitoring events took place on March 1, June 30, and September 15, 2017 as well as January 16, 2018. An extra manual measurement was taken at MW-1 on April 6, 2017 due to replacement of the levelogger. The manual measurement and barometric data were used to create a calibrated time series of the recorded water level data from each well for the 2017 monitoring year (Figure 2).

An analysis of previously collected transducer data and manual water level measurements revealed some inconsistency in the water level data. It is believed that this was caused by stretching of the Powers sounder line which resulted in inaccurate manual water level measurements and consequently inaccurate calibration of the water level time series data. Due to the small fluctuations in the water level at this site (less than 1 foot per year) and the depth of the water level, the stretch of the Powers sounder was significant enough to overtake the water level data. For the 2017 report, a correction was applied to past transducer data to compensate for the inaccurate manual measurements. The correction resulted in much more consistent water level tracking. A barometric efficiency calculation was also used to remove some of the barometric effects on the transducer data to help line out the transducer recorded water level. To avoid the complications caused by stretching of the Powers sounder line, a non-stretch sounder was used in January and March of 2018 and will continue to be used for future monitoring. The plots below are included to demonstrate the difference between the uncorrected water level data (Figure 3) and the corrected water level data (Figure 4).

The gap in data from December 2016 to March 2017 is due to the levelogger in MW-1 being missing and believed to have become undone from the transducer cable. A replacement levelogger was reinstalled in MW-1 in conjunction with a new transducer cable on April 6, 2017. PW-1 received a new transducer cable on March 1, 2017, as preventative maintenance.

Analysis

Review of the manual water level measurements and corrected continuous water level recordings from October 2011 to March 2018 suggest:

(1) groundwater levels at the monitoring site are relatively stable with seasonal fluctuation of less than a foot each year, and;
(2) a very slight upward hydraulic gradient has been present during the monitoring period.

Please let me know if you have any questions regarding the data collected to date. The next quarterly sampling event is scheduled for June 2018.

Sincerely,

Sean T. Albertson, EIT

Cc: Brian Whitaker, Woods Erickson & Whitaker LLP (bwhitaker@woodserickson.com)
Norm Semanko, Parsons Behle & Latimer (nsemanko@parsonsbehle.com)

Attachment: Electronic data file (spreadsheet)

Report Figures

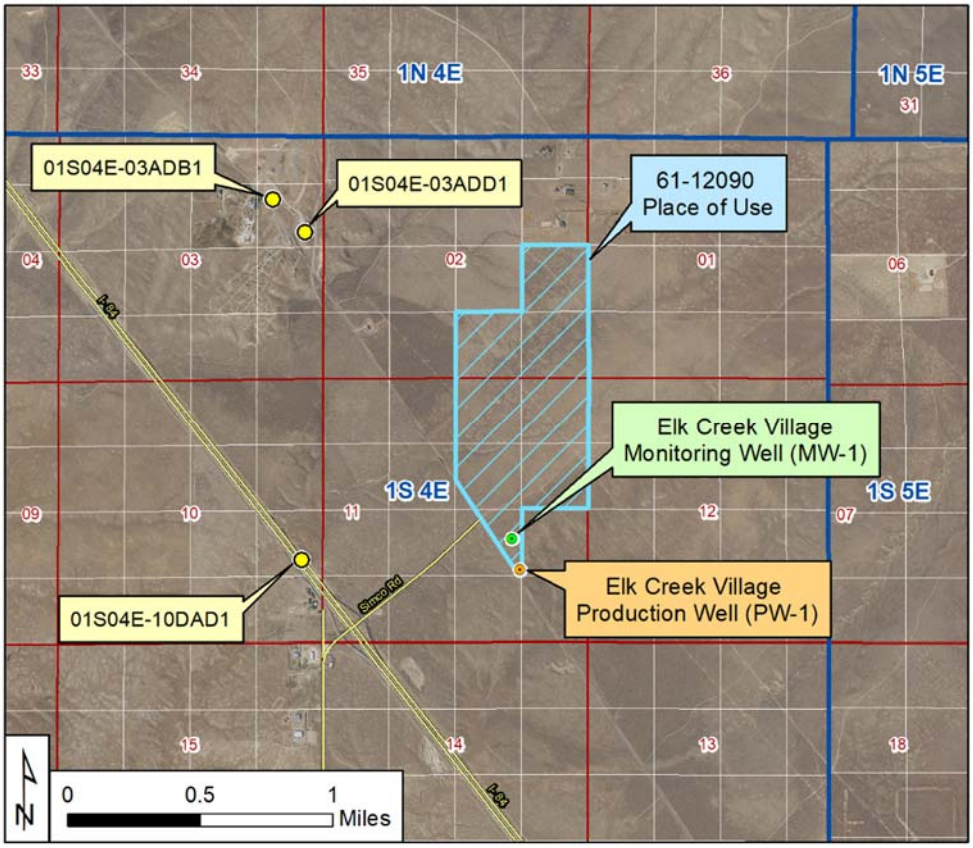

Figure 1. Elk Creek Monitoring Plan Base Map.

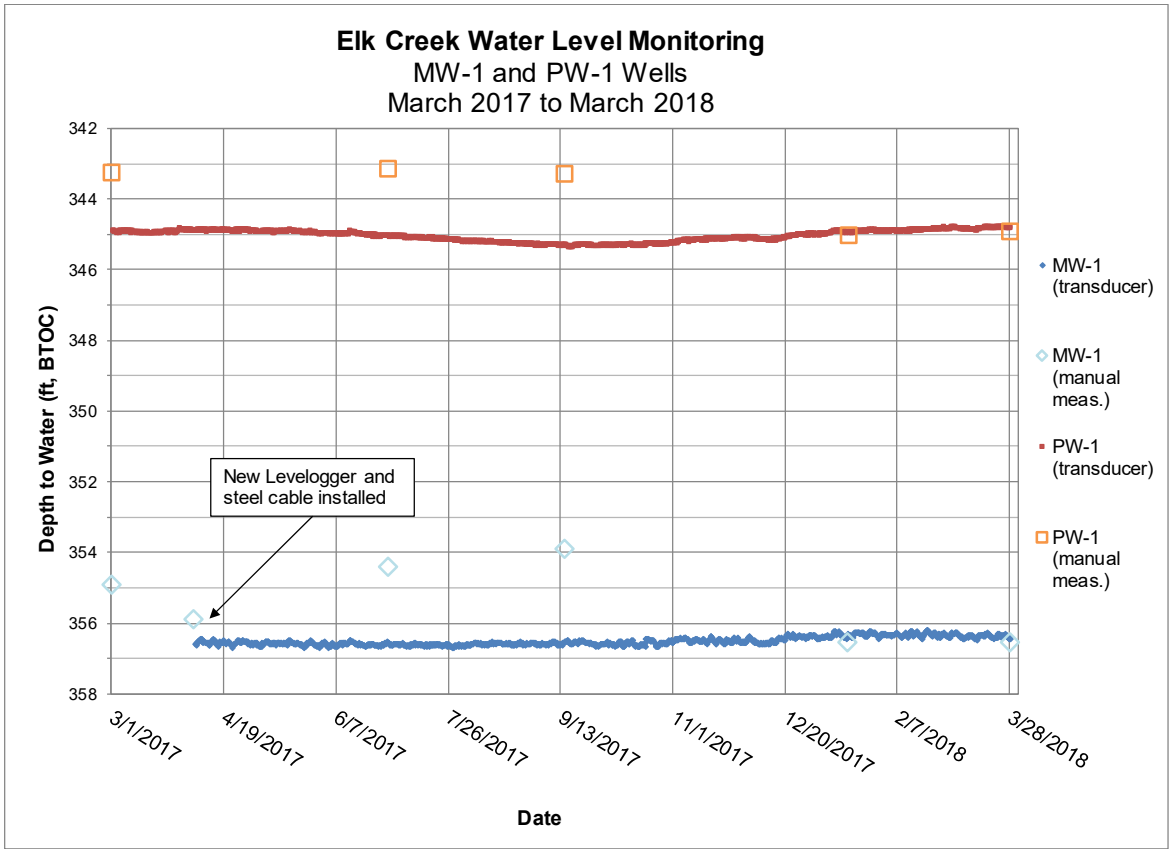

Figure 2. 2017 Annual Water Level Data

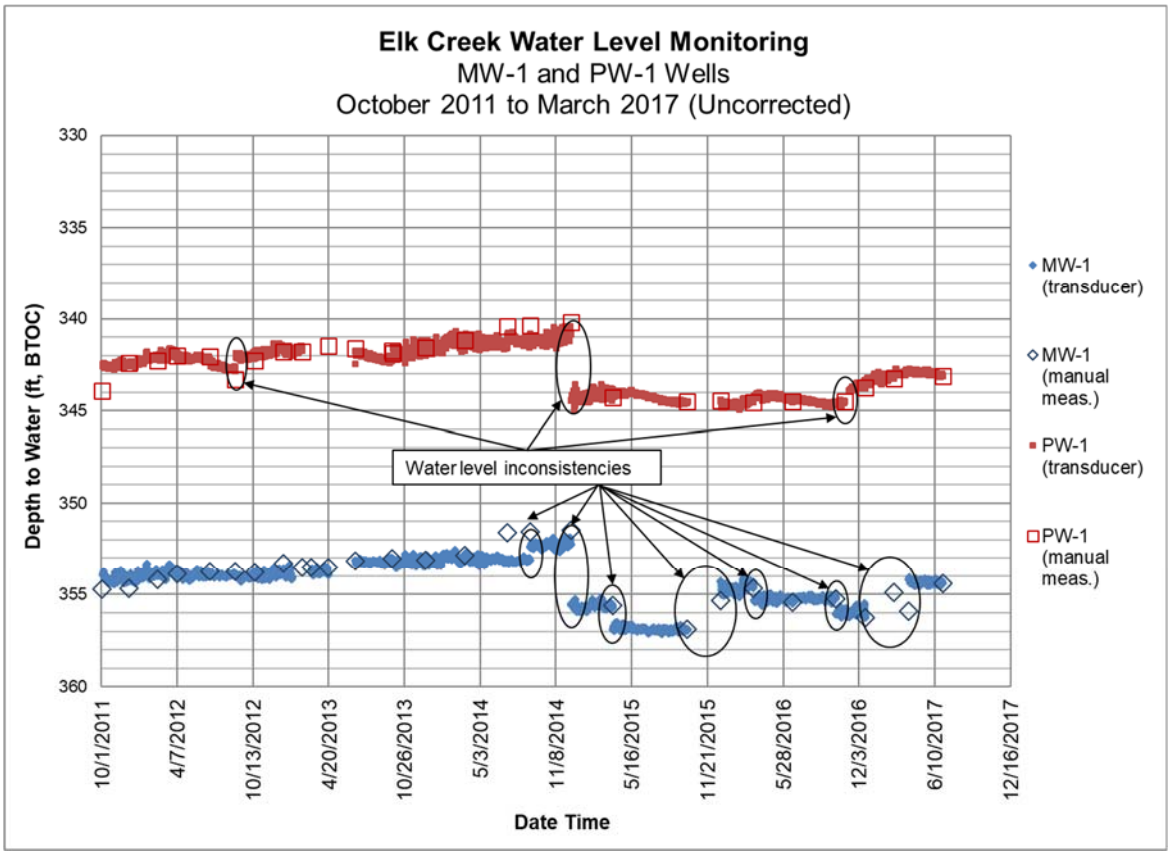

Figure 3. Uncorrected Water Level Data (Oct 2011 - Mar 2017)

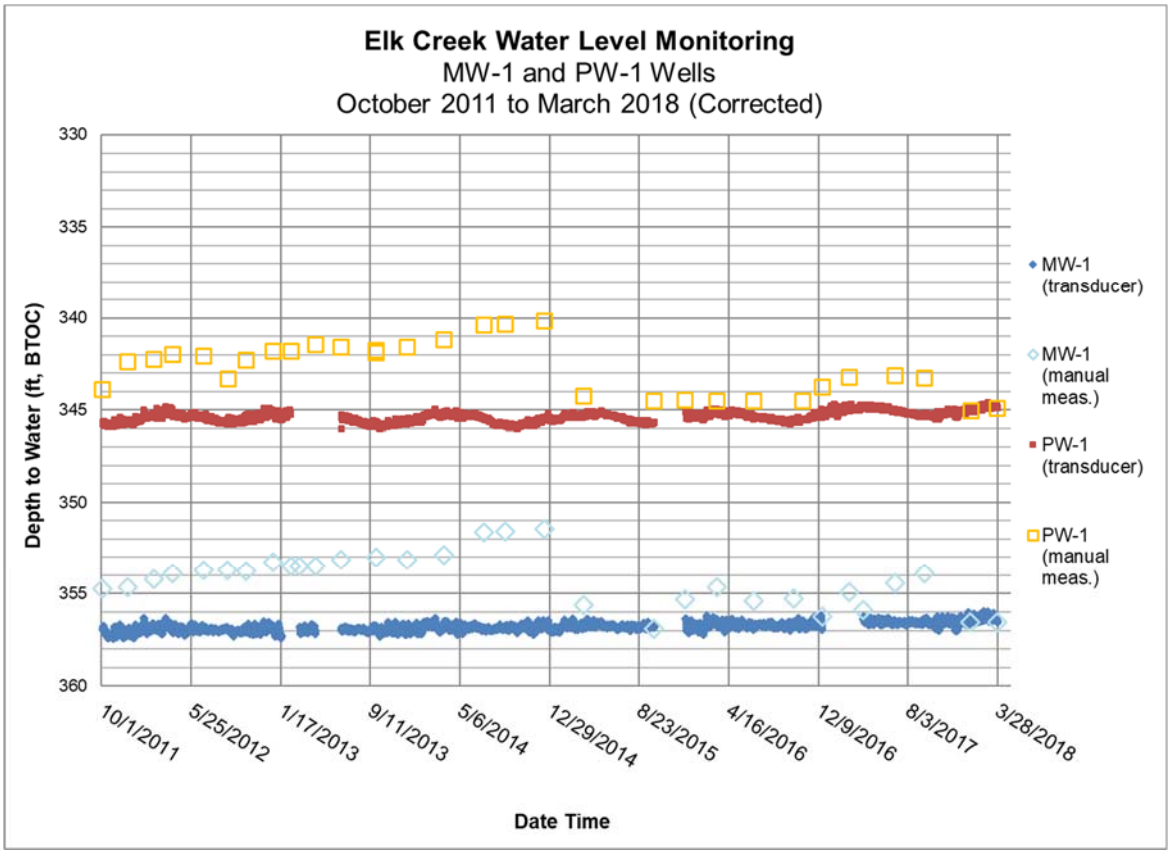

Figure 4. Corrected Water Level Data (Oct 2011 - Mar 2018)

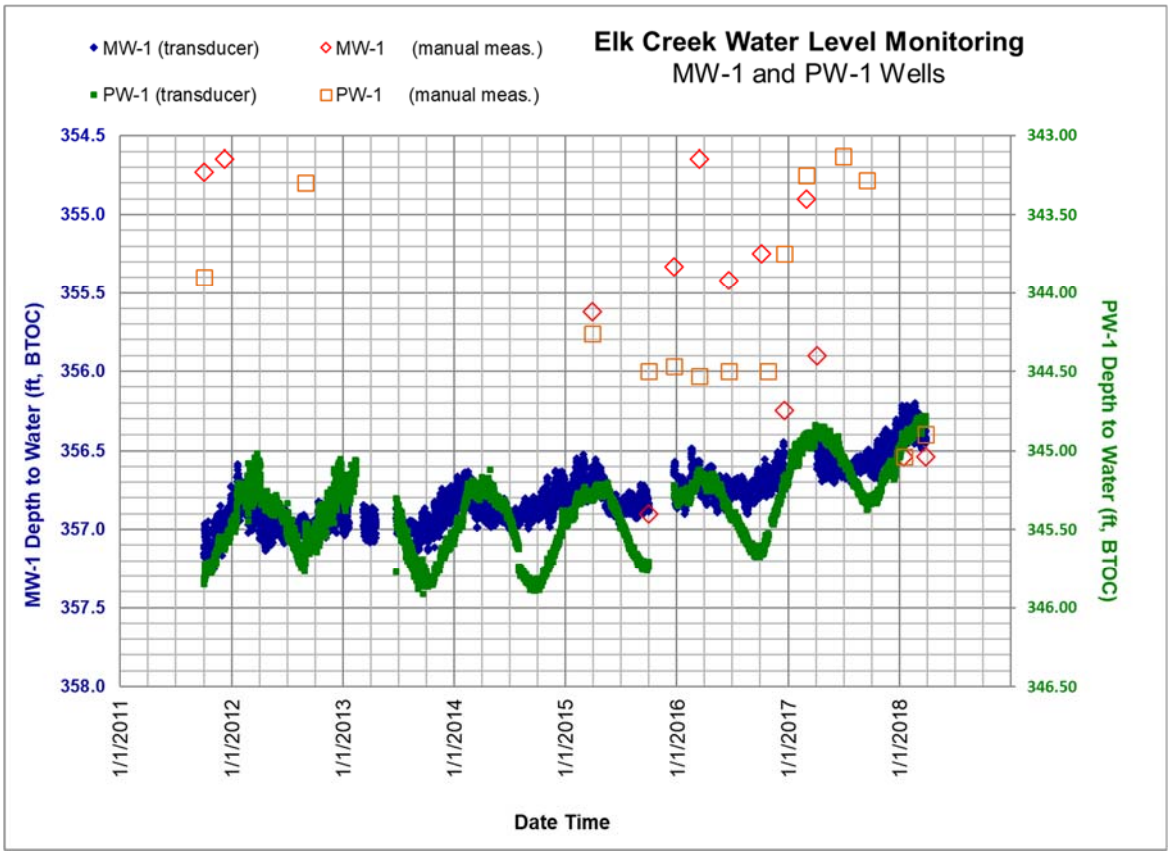

Figure 5. Corrected Water Level Data, Small Scale (Oct 2011 - Mar 2018)