

To: Craig Saxton

From: Mat Weaver

Date: December 21, 2011

RE: Case Study – Technical Review of the 63-31283 Beneficial Use Field Exam’s Recommended Diversion Capacity

Introduction

This memo is a summary of my technical evaluation of the recommended diversion capacity proposed in the Beneficial Use Field Examination report of 3.00 cfs. It is my hope that this memo can serve as a case study that will be transferable for staff in their review of similar municipal water right permits.

Water right 63-31283 is for municipal beneficial use, there is no mention in the application or the permit that the use is for reasonably anticipated future needs (RAFN) therefore 63-31283 must be considered a non-RAFN water right. The diversion rate is for 3.00 cfs. Condition 190 is not included on the permit¹, as such, the diversion rate for the water right license must be determined from information traditionally provided with the beneficial use field report.

Relevant Policy Guidance

As set forth in the updated Application Processing Memo #18 (Jeff Peppersack November 19, 2009) the current standard in licensing diversion rates associated with municipal water rights is to identify and license the diversion capacity associated with beneficial use. This approach supplants the traditional practice of identifying the maximum diversion capacity to be used in licensing. However, the updated AP Memo #18 states the following caveat:

This guidance provided in this memo pertains to the review and processing of permits to be issued after the date of the memorandum. Existing permits issued prior to the date of this memorandum should be handled on a case-by-case basis when determining beneficial use for licensing purposes.

Permit 63-31283 was issued on October 31, 2001 and predates the latest version of AP Memo #18 (Peppersack 2009), as such it falls into the ‘case-by-case’ category described. In this event the diversion rate can be evaluated based on the standard described in the original AP Memo #18 document (Norm Young November 5, 1979), which is as follows:

¹ In connection with the proof of beneficial use submitted for this permit, the permit holder shall also submit a report showing the total annual volume, the maximum daily volume, and the maximum instantaneous rate of flow diverted from the point of diversion authorized for this permit during the development period. The report shall also show the maximum instantaneous rate of diversion, either measured or reasonably estimated by a qualified professional engineer, geologist, or certified water rights examiner, for the entire City of Nampa municipal water system. The report shall also describe and explain how water diverted under this permit provides an additional increment of beneficial use of water for the City of <Nampa> municipal water system as opposed to an alternative point of diversion for prior water rights already held and used by the City of <Nampa> for its municipal water system.

A municipal right should not be quantified by rate of flow beneficially used at the time of examination, but rather by the capacity of the diversion works.

Since our goal is to determine the 'capacity of the diversion works' the extraneous analysis that the Field Examiner conducted in the Beneficial Use Field Report is appropriate. Now all that remains is to review the technical analysis presented and determine if it is appropriate, thereby supporting the licensing of the water right (3.00 cfs) for a diversion rate that is greater than the flow rate (2.52 cfs) observed during the field exam.

Technical Review

The beneficial use field exam report (report) for 63-31283 describes two physical flow rate measurements of the Caldwell supply well #4B. The first measurement of 2.79 cfs (1,250 gpm) occurred on August 28, 2000 during the construction and development of the current well.² The timing of this measurement indicates that the pump test was conducted with a pump and pumping configuration different from the final constructed pump configuration. Therefore, although the diversion rate is indicative of the potential yield and capacity of the well, it is not indicative of the final constructed capacity of the well and pump system, or of beneficial use that occurred during the development period. The second measurement of 2.52 cfs (1,130 gpm) occurred on March 13, 2003 during the development period. This measurement was conducted on the final constructed configuration of the well and pump system. The second measurement is indicative of final constructed capacity and of beneficial use. The permitted diversion rate of 3.00 cfs is obviously greater than the measured diversion rate. To justify a licensed diversion rate of 3.00 cfs, which exceeds the measured flow rate, the field examiner has constructed a technical argument that relies on three key elements, they are: (1) the specific capacity of the well supports a diversion rate equal to or greater than 3.00 cfs, and this assertion is corroborated in part by the August 28, 2000 pump test; (2) total dynamic head (TDH) in the municipal system is at or near its maximum value in the winter/spring at the time of the field exam measurement, as such, during the summer when the pump works against a lower TDH, diversion rates will be higher; and (3) the pump is operated by a variable frequency drive (VFD) 'to allow the motor to be over-spiced to run the pump to the right of [in excess of] the performance curve', providing up to 10% more pumping capacity.

There are three standard means of determining the flow rate associated with a well diversion: (1) physical measurement, (2) pump curves, and (3) theoretical calculations. Ideally, a direct physical measurement of peak flow rate can be conducted during a field exam to establish the maximum physical diversion rate of a given well and pump configuration. Unfortunately, it is not always possible to obtain a physical measurement, or to obtain a physical measurement of the peak flow rate. In instances when a physical measurement cannot be obtained, we can rely on an indirect means of determining the flow rate. Our first substitution choice for a physical measurement is the estimate of flow rate from a pump curve specific to the pump associated with the well under consideration. Pump performance curves are pump-specific graphical depictions of the relationship between total dynamic head (TDH) and discharge (cfs), among other parameters, prepared by the pump manufacturer. Because pump curves are specific

² The well log for ID# 336725 indicates this well was a replacement of an existing well (later abandoned) and that well construction started on July 5, 2000 and was completed on July 25, 2000. The well log itself is dated September 15, 2000.

to the pump under consideration they are preferable to a theoretical calculation, which relies on an assumed efficiency value by the field examiner.

The report for 63-31283 includes a pump curve for the Goulds submersible pump (Model No. 9CHC10086C, Serial No. 2422387-F, two stage, 6.5625" impeller trim) set in Caldwell's #4B supply well. The pump performance curve encompasses diversion rates from 0 – 2.98 cfs (0-1,339 gpm). According to the performance curve a pumping rate of 2.98 cfs can be obtained when TDH equals ~240 feet. Assuming friction head and minor losses are negligible, TDH is equal to the sum of the pressure head of the system the pump is working against and the vertical head. From the field exam we know that the observed specific capacity of the well was 0.042 cfs/foot.³ Therefore, the drawdown associated with a diversion rate of 3.00 cfs would be 71.4 feet (i.e. 3.00 cfs/0.042 cfs/foot). If we assume that vertical head is equal to the static water surface depth plus drawdown (63.6 feet + 71.4 feet = 135 feet), we can solve for an allowable system pressure of 105 feet (45.5 psi) by subtracting the vertical head from the TDH. A system pressure of 45.5 psi is in excess of DEQ's applicable minimum pressure requirement of 40 psi as set forth in IDAPA 58.01.08 552.01.b.v, and therefore is a legitimate operating system pressure. It is unknown if system pressures are ever as low as 45.5 psi, but there is no legal or administrative reason that would prevent us from considering this system pressure in our analysis.

We must also confirm that the required net positive suction head required (NPSHR) is maintained when pumping at 2.98 cfs. In the case of submersible pumps, NPSH is equal to the depth of water above the pump intake. From the pump performance curves we see that at 2.98 cfs a NPSHR of approximately 43 feet is necessary to avoid cavitation. The available NPSH provided at a diversion rate of 2.98 cfs is 83.3 feet (218.5 feet – 71.6 feet – 63.6 feet), well in excess of the NPSHR and therefore acceptable.

In conclusion, the specific capacity of the well, the physical configuration of the pump, and the subsequent system pressure, all support recognizing the maximum diversion rate of 2.98 cfs associated with the pump performance curves.

We have shown that it is reasonable to expect that the pump likely operates at a maximum pumping rate of 2.98 cfs at some point during the operational year. This value is greater than 99% of the permitted diversion rate of 3.00 cfs. The field examiner has identified that the pump is controlled with a VFD device that allows for the 'over-speeding' of the motor and pump up to the manufacturer's recommended limit of 110%.⁴ Although pump performance curves supporting an 'over-sped' operating configuration have not been provided, without exactly quantifying the additional capacity associated with 'over-speeding', we can safely assume that over-speeding of the system likely supports an additional 0.02 cfs of pumping capacity. Thus, we have confirmed the field examiners recommendations with our own technical understanding and review, and can confidently accept the recommendation of a licensed diversion rate of 3.00 cfs.

³ Specific capacity is the yield of the well divided by the drawdown. For the observed conditions during the field exam this would be equal to 2.52 cfs/(123.6 feet – 63.6 feet), which equals 0.042 cfs/foot.

⁴ In the literature for Franklin Submersible Motors I could find discussion that acknowledges and condones over-speeding of the motor, but I could not find a recommended quantification or metric of an acceptable limit of over-speeding, e.g. 110% of maximum pumping capacity.