MEMO

State of Idaho
Department of Water Resources
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Date: February 17, 2015

To: Gary Spackman, P. E., Director

From: Tim Luke, Water Compliance Bureau

Subject: Staff memorandum/comments regarding IGWA's 3rd Mitigation Plan: SPF Water Engineering's Proposed Flow Measurements at Sandy Ponds and Aquifer Recharge Measurement (60% Submittal)

This staff memorandum was prepared to provide comments regarding the following documents:

- *Technical Memorandum to Randy Budge from Bob Hardgrove, P.E., SPF Water Engineering, January 9, 2015, Regarding IGWA's 3rd Mitigation Plan: Flow Measurements at Sandy Ponds and Aquifer Recharge Measurement, Supplemental Memo to July 28, 2014 60% Submittal*.
- *Technical Memorandum to Randy Budge from Bob Hardgrove, P.E., SPF Water Engineering, July 28, 2014, Regarding IGWA's 3rd Mitigation Plan: Flow Measurements at Sandy Ponds and Aquifer Recharge Measurement, 60% Submittal*.

The January 9, 2015 memo referenced above is a one page document that makes one clarification to the July 28, 2014 memo concerning the method for measuring Pond 2 outflow to the Sandy Pipe. For purposes of this staff memorandum, the "SPF Memo" refers to the second memo above dated July 28, 2014.

This IDWR staff memorandum combines the review and comments provided by Water District 36A ("WD36A") watermaster Frank Erwin, and IDWR staff members Tim Luke, Cindy Yenter (who is also the Water District 130 watermaster), Corbin Knowles, and Stuart VanGreunigen. The following comments provided in this memorandum are focused on SPF's proposed measurement devices, equipment and procedures that were presented in the SPF Memo.

Purpose of SPF Memo

The stated objective of the SPF Memo is the completion of a 60% design "for determining aquifer recharge occurring at Sandy Ponds." The SPF Memo was prepared at the request of legal counsel representing the Idaho Ground Water Appropriators, Inc ("IGWA"). The SPF Memo focuses on measurements necessary for collection of data necessary to determine "aquifer recharge for the Sandy Ponds area resulting from pond seepage" by "subtracting pond outflows

from pond inflows." The SPF Memo also provides recommendations for measuring discharge to the Martin-Curren Ditch ("Curren Ditch") and pumping rates from the Sandy Vault pumps because those measurements "may eventually be desired." IDWR concurs that the latter measurements are not necessary for determining aquifer recharge but they may be important for determining additional mitigation benefits or may be necessary for the administration and regulation of IGWA's Application for Permit No. 36-17011. Although not necessary for this memo, IDWR staff has provided several comments regarding measurement of flows to the Curren Ditch and from the Sandy Vault pumps.

Water Balance Equation for Recharge Calculation

IDWR staff has no comments regarding use of the proposed water balance equation (Equation 1) as shown on page 3 of the SPF Memo. This equation and approach is acceptable for recharge calculation provided that standard measurement devices and adequate recording devices are installed and maintained to measure and record pond inflows and outflows. IDWR staff recommends that IGWA be responsible for compiling the necessary data for use in the equations and computation of annual aquifer recharge from the Sandy Ponds. IDWR staff would likely review the measurement data and computation of water balance equations as part of ongoing post-audit review of annual IGWA mitigation activities.

Measurement of Inflows to Sandy Ponds

All inflow to Sandy Ponds occurs through conveyance of water through the North Side Canal Company ("NSCC") W-26 Lateral. SPF proposes measurement of the inflow using a standard contracted rectangular weir installed in an existing diversion check structure located 0.2 miles upstream of the first Sandy Pond, or Pond 3. Water level behind the weir is currently measured by NSCC using an ultrasonic sensor. Data are collected by NSCC using telemetry equipment. The sensor and telemetry equipment are owned and maintained by NSCC. SPF proposes use of the NSCC equipment for measuring and recording inflows to the ponds.

IDWR has the following concerns with use of the current NSCC weir:

- WD36A watermaster Frank Erwin has expressed concern that the check structure may still be used for checking or raising the water level in the canal for upstream diversions by placing boards or stop logs in the structure. Mr. Erwin stated that he has observed boards sitting on the ditch bank next to the structure. A small head gate is located just upstream of the weir/check structure and it is not clear if this head gate is still in use. Placement of additional check boards or changes in check board height in the structure would obviously interfere with proper operation of the weir and invalidate weir measurements and transducer readings.
- Mr. Erwin further reported that he discussed the use of the check structure as proposed by SPF with NSCC manger Allan Hansten. Mr. Erwin reported that based on his conversation with Mr. Hansten, NSCC prefers that IGWA and NSCC maintain separate

measuring devices on the W-26 Lateral. This statement appears to contradict the statement in the SPF Memo that "Alan Hansten has stated that NSCC is willing to share this data" (SPF Memo, p. 4-5). IDWR has some doubt as to whether IGWA can rely on use of the NSCC recording and telemetry equipment and/or NSCC's willingness to share data with IGWA given the potential conflicting statements by Mr. Hansten.

- Two dry photos of the weir/check structure taken on February 9, 2015 (Figures 1, 2) raise several additional concerns.
    - First, the structure is located on a bend in the W-26 Lateral which may affect proper approach flow conditions. The US Bureau of Reclamation ("BOR") advises that channel curves may cause poor approach conditions (BOR, 1997, p 5-9). The weir structure should be set in a straight reach of channel, perpendicular to the line of flow (BOR, 1997, p 7-41). The wet photo of the structure dated May 7, 2014 that is included in the SPF Memo is a view of the structure taken from upstream. This photo appears to show negligible velocity approach, which is ideal or recommended for weir approach conditions. Although the approach flow looks acceptable in the wet photo attached to the SPF Memo, the photo does reveal a curve in the channel just upstream of the weir. It is not clear if the curve may result in some measurement error over the range of operating flows.
    - Second, the dry photo of February 9, 2015 shows that the sharp edged metal weir crest is attached to boards that are not set flush along the notch of the concrete check structure. The dry photo shows an open gap of perhaps several inches between the bottom of the boards and the concrete notch. Water behind the weir may discharge through this gap causing a small amount of water not to be measured. The gap could potentially have some effect on accurate measurement of the head in the weir pool. The gap also raises a question as to whether the weir crest is level. An unlevel weir crest may cause error in head measurements.
    - Third, the metal edge sides of the weir appear to be separate and different from the weir crest itself. All weir plates should have the same thickness for the entire boundary of the overflow crest (BOR, 1997, p 7-8). The vertical side edges of the weir appear to be set very close to the side of the concrete bulkhead on the downstream side of the weir opening. The close distance between the side edges of the weir plates to the concrete sides may affect side contraction of the weir.

Given the concerns raised above, IDWR staff recommends that IGWA design and install a separate standard contracted rectangular weir or other standard measuring device on the W-26 Lateral downstream of the existing NSCC structure. IGWA must obtain consent from NSCC to install a separate measuring device and any related recording or telemetry equipment if necessary.

Use of the existing NSCC structure may be possible under the following conditions:

- NSCC must verify that the check structure is no longer used as a check structure and is maintained strictly as a measurement device.
- Maintenance of the structure is provided so that the weir meets standard installation guidelines published by the BOR.
- Observations and calibration measurements should be made to assure that the weir is accurate across the operational range of flows.
- IGWA and NSCC enter into an agreement or Memorandum of Understanding ("MOU") regarding the shared use of the weir, equipment and data.

Measurement of Pond 1 Outflows

SPF proposes installation of a six (6) foot (ft) standard rectangular weir in an existing 2 ft high ditch check structure to measure outflows from Pond 1. The check structure is no longer used for diversion of water. SPF proposes installing a sharp crested weir blade on new check boards. Outflows from Pond 1 satisfy an irrigation pump diversion below the check structure operated by Butch Morris. The SPF Memo indicates that the Morris pump typically diverts about 1,100 gpm or 2.45 cfs, and outflows from Pond 1 rarely exceed this rate. WD36A watermaster Frank Erwin reports that Mr. Morris installed a new 100 HP pump this year. It is not clear if the new pump will divert more than the typical 2.45 cfs as reported in the SPF Memo. Mr. Erwin also reported that Mr. Morris recently constructed a pond in the ditch channel below the check structure.

A dry photo of the check structure was taken on February 9, 2015 (Figure 3). The photo shows that the check structure is silted-in and full of debris. The ditch channel above and below the structure is also full with debris. A significant amount of channel maintenance is required before the structure can be modified for a weir. Also, IDWR staff is concerned that the newly constructed pond downstream of the structure could potentially cause submergence of the weir, thereby affecting weir accuracy.

IDWR does not recommend use of the check structure for installation of a weir to measure the Pond 1 outflow. Instead, IDWR staff recommends installing a standard measuring device closer to the outlet of Pond 1 if at all possible. IDWR may consider use of the existing check structure only if the channel is thoroughly cleaned and channel maintenance is routinely provided; the weir is not affected by submergence from the downstream Morris pond; and a standard weir is installed in the structure pursuant to BOR published guidelines.

If a weir is installed in the check structure, IDWR staff recommends a 3 to 4 ft wide weir instead of the proposed 6 ft weir length. A 6 ft rectangular weir measuring 2.45 cfs will have a required head measurement between 0.24 and 0.25 ft (BOR, 1997, p. A-2). The BOR recommends that weir head measurements be greater than 0.2 ft to maintain proper free flow conditions over the weir crest. The typical head measurement for the proposed 6 ft weir, assuming a constant flow of 2.45 cfs, is very close to the minimum required head. IDWR is concerned that the 6 ft weir

may not accurately measure Pond 1 outflows should the discharge drop below the normal 2.45 cfs rate. A 6 ft weir with a 0.2 ft head measurement would be limited to 1.78 cfs. Due to concerns about minimum operation heads and proper free flow conditions, IDWR recommends installation of a narrower weir, such as 3 or 4 ft, to assure proper free flow conditions over a potential broader range of flows. A 3 ft weir in a 2 ft check structure will measure flows between about 0.9 and 3.5 cfs. A 4 ft weir in a 2 ft check structure will measure flows between about 1.18 and 4.6 cfs. A 6 ft weir in a 2 ft check structure will measure flows over 7.0 cfs, but it may be too wide to accurately measure flows below 2.45 cfs.

WD36A watermaster Erwin recommends installing a stepped weir from 3 to 4 ft, up to the full width of the check structure to handle both low and high flows. Mr. Erwin indicated that flood flows are sometimes passed through the ditch below Pond 1. The stepped weir concept is acceptable to IDWR but if high flows are to be measured, a maximum weir length of 6 ft is recommended given that the check structure width is 8.75 ft, and the BOR recommends at least 1 ft between the weir opening and channel sides. Since SPF proposes installing a weir blade on new check boards, the 3 to 4 ft weir length should work for most flows and can be removed to accommodate any potential flood flows, which are likely rare and of short duration.

Pond 2 Outflows to Sandy Pipe

The SPF Memo of January 9, 2015 revised the proposed method of measuring outflow from Sandy Pond 2 described in the first memo dated July 28, 2014. In the January 8, 2015 memo, SPF states that "a concrete weir vault will be placed directly downstream of Pond 2, intercepting the Sandy Pipe. A sharp-crested rectangular weir will be installed on a baffle wall within the vault." The memo goes on to say that data collected "will be transmitted to IDWR offices via Campbell Scientific radio telemetry equipment." The January 15, 2015 memo includes no drawing or proposed dimensions of the weir, the vault or the baffle wall.

IDWR staff does not recommend accepting this proposed method of measurement without further information from SPF regarding dimensions and design of the weir, vault and baffle wall. IDWR would have accepted the original method of measuring Pond 2 outflow proposed by the July 28, 2014 SPF Memo, or installation of an ultrasonic meter in the pipe above the point where the pipe discharges to the Sandy Pipe Vault.

IDWR staff does not agree with the assumption that data collected "will be transmitted to IDWR offices." IDWR has no agreement or arrangement to accept data from IGWA at the Sandy Ponds measuring sites. Until such agreements are in place, IDWR staff recommends that IGWA collect data directly and report those data to IDWR on an annual basis.

Pond Evaporation

The SPF Memo proposes estimating daily pond evaporation using mean monthly evapotranspiration ("ET") data published by the University of Idaho for a location near

Hagerman. Use of mean monthly data is acceptable but IDWR may use actual daily ET data available from the nearest local Agrimet station in any post-audit review of recharge calculations.

Discharge to Martin-Curren Ditch Data Collection Plan

The SPF Memo provides a recommend plan for measurement and collection of flows that discharge to the Martin-Curren Ditch ("Curren Ditch") from the Sandy Pipe even though such measurement is not necessary to determine aquifer recharge. IDWR staff agrees that measurement of discharge to the Curren Ditch is not necessary to compute aquifer recharge as proposed by IGWA's third mitigation plan. However, IDWR does offer the following comments regarding measurement of the discharge to the Curren Ditch and the irrigation pumps from the Sandy Vault.

SPF proposes to measure discharge to Curren Ditch by installing a suppressed rectangular weir in the Sandy Pipe Vault. The vault receives water from the Sandy Pipe, or the outflow of Sandy Pond 2. Several irrigation pumps discharge from the vault before water exists the vault to the Curren Ditch. SPF's suppressed rectangular weir design meets BOR published standards. However, IDWR staff has concerns with potential high flow turbulence and proper velocity approach in the vault upstream of the weir. Both IDWR staff and the watermaster have, in the past, observed high, turbulent flows in the vault above the existing baffle wall and proposed weir location. The 12 ft length of open channel in the vault above the weir may not be adequate for velocity approach criteria as described by the BOR (BOR, 1997, p. 2-28).

IDWR staff recommends the Curren Ditch discharge be measured using a closed conduit flow meter installed at or near the end of the pipe discharging to the ditch. The pipe outlet would need to be modified or constructed in a manner to maintain a full pipe flow at the meter location.

IDWR staff and the WD36A watermaster recommend installing flow meters on the three pumps or pipes discharging from the Sandy Vault. This direct method of measurement is preferred over the calculated method of vault pumping that relies on the measured difference between vault inflow and outflow. Each pump serves different lands under separate ownership. Direct measurement of the three pumps will provide accountability relating to the delivery of waste water for irrigation under IGWA's pending water right application 36-17011.

The WD36A watermaster and IDWR staff also recommend that the pipe entering the Sandy Vault (known as the Morris-Crandlemire Pipe) have a lockable valve to facilitate watermaster control for use under the Morris exchange agreement.

Ownership and O&M

The SPF Memo states that "it is unclear if the North Snake Ground Water District ("NSGWD") will retain ownership of the proposed measurement equipment or if they will pursue transferring ownership of the equipment to IDWR for inclusion in the existing IDWR monitoring network."

IDWR staff note that the current IDWR monitoring network is maintained primarily for the purpose of providing necessary data for the ongoing operation and calibration of the Eastern Snake Plain Aquifer Model ("ESPAM"). Data collection associated with recharge from Sandy Ponds would not benefit the aquifer model. IDWR staff does not support IDWR ownership and maintenance of equipment associated with or used for an IGWA recharge or mitigation project. Except for equipment and monitoring sites supporting the ESPAM, IDWR does not own or maintain measuring devices and monitoring equipment used for diversions and beneficial uses under water rights or approved mitigation plans.

IDWR staff strongly recommends that all measuring device and related monitoring, recording and telemetry equipment remain under the ownership of IGWA or NSGWD. Future replacement of equipment and all replacement costs should be the responsibility of IGWA or NSGWD. IDWR staff further recommends that IGWA or NSGWD assume primary responsibility for operation and programming of equipment, as well as collection of data. Under this recommendation, IGWA or NSGWD would be responsible for reporting all measurement data and aquifer recharge estimates to IDWR on an annual basis, or more frequently if necessary. Staff further recommends that the WD36A watermaster have access to measurement sites to make periodic measurements or observations using installed measuring devices.

IDWR may consider involving IDWR staff to work with IGWA or NSGWD regarding operation and programming of equipment if that approach is more efficient for each of the parties. If there is interest in this option, IDWR staff recommends that IDWR enter into an agreement or MOU with IGWA, NSGWD and perhaps WD36A regarding operation and programming of equipment, and collection of data. Such agreement, if implemented, should also address responsibility for calculating water balance equations and reporting annual aquifer recharge estimates. IDWR staff recommends that consultants for IGWA be responsible for reporting and calculating aquifer recharge estimates. IDWR staff should be responsible for reviewing water balance equations and computations supporting aquifer recharge estimates.

References Cited

US Department of Interior, Bureau of Reclamation, Water Measurement Manual, Third Edition, 1997.

Figure 1. Upstream view of NSCC weir structure, 2/9/2015

Figure 2. Downstream view of NSCC weir structure, 2/9/2015

Figure 3. Check structure in outlet channel below Pond 1, 2/9/2015