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June 10, 2011

James Cefalo
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900 North Skyline Dr., Ste. A
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Re: *In the Matter of Application for Transfer No. 76779 in the Name of
the City of Pocatello*

Dear Mr. Cefalo:

Enclosed are the **originals** and one set of copies of the *City of Pocatello's Expert Report of Greg Sullivan, Spronk Water Engineers*, and Mike Creamer's *Affidavit of Service*. Please file the enclosed Report and Affidavit in the above-referenced matter and return conformed copies of each document to our office in the postage-paid envelope provided for your use.

Your assistance is appreciated.

Sincerely,

Caralea Hopingardner
Legal Assistant to Michael C. Creamer

Enclosures
5902-6_1187464_1.DOC

ORIGINAL

**BEFORE THE DEPARTMENT OF WATER RESOURCES
OF THE STATE OF IDAHO**

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Michael C. Creamer

SUBSCRIBED AND SWORN to before me this 10th day of June, 2011.





Notary Public for the State of Idaho
Residing at Boise, Idaho
My commission expires 5/21/2016

CERTIFICATE OF SERVICE

I hereby certify that on the 10th day of June, 2011, a true and correct copy of the foregoing was served upon the following individual(s) by the means indicated:

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Michael C. Creamer

**Expert Report
Chesterfield Reservoir Transfer
City of Pocatello**

Transfer Application No. 76779

Prepared for:

City of Pocatello

Prepared by:

**Spronk Water Engineers, Inc.
Gregory K. Sullivan, P.E.**



June 10, 2011

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**Expert Report
Chesterfield Reservoir Transfer
City of Pocatello**

Transfer Application No. 76779

1.0 Introduction

The City of Pocatello (“City” or “Pocatello”) has submitted an Amended Application for Transfer¹ (“Application”) of 3,100 acre-feet of storage water in Chesterfield Reservoir to be acquired from the Portneuf-Marsh Valley Canal Company (“PMVCC”) in accordance with a March 3, 2010 Storage Water Agreement between the City and the PMVCC.

The City proposes to take delivery of water released from storage at various points within its current or future water service area where it will be re-diverted for municipal, irrigation, and recharge uses, or delivered through a designated reach of the Portneuf River for aesthetic, recreation, aesthetic, wildlife, and fish propagation (“ARW Uses”) purposes. Detailed descriptions of the storage water rights to be transferred and the City’s proposed uses of the storage water by the City are contained in the Application and in the Report in Support of the City of Pocatello’s Application for Transfer of Water Rights (“Transfer Report”), included with the Application as Attachment #9.

Five notices of protests were filed in response to the Application. This expert report was prepared to provide additional information and support for the City’s proposed storage water transfer, and to respond to issues raised by the protestants to the Transfer.

2.0 Summary of the Amended Transfer

Pursuant to the Storage Water Agreement, Pocatello has contracted to acquire the first 3,100 acre-feet per year (“af/y”) of yield to Water Right Nos. 29-53 and 29-589 in Chesterfield Reservoir (“Acquired Storage Water Rights”). The PMVCC will deliver the water from Chesterfield Reservoir at a rate of up to 50 cubic feet per second (“cfs”) to a point at or near the headgate of the Portneuf-Marsh Valley Canal (“PMVC”) located approximately three miles east

¹ Pocatello’s Application for Transfer was assigned Transfer No. 76779 by IDWR.

of McCammon as shown in **Figure 1**. The storage water deliveries will then be transported further downstream in the Portneuf River channel to Pocatello for use by the City. A summary of the water rights held by the PMVCC, including the two storage water rights involved with the transfer, is provided in **Table 1**.

The Application requests approval for a change of period of use, place of use, points of re-diversion, and nature of use of the Acquired Storage Water Rights to facilitate use by the City, summarized as follows:

- Change the period of use of water released from storage from April 15 - September 15 to January 1 - December 31. Pocatello did not request to change the period when water may be diverted to storage.
- Change the place of use from the PMVCC service area to the current and future Pocatello service area. The PMVCC service area is shown in **Figure 2**². The projected future Pocatello service area is shown in **Figure 3** and includes the City limits, areas currently served by the City, areas that may be served by the City in the future, the Airport Service Boundary, and the City Biosolids Program Area.
- Change the point of re-diversion of storage releases from the Portneuf-Marsh Valley Canal headgate shown in **Figure 2** to various points of re-diversion located within the future Pocatello service area shown in **Figure 3**.
- Change the nature of use from irrigation to include municipal, ground water recharge, recreation, aesthetic, wildlife, and fish propagation uses (“ARW Use”).

More details regarding the proposed uses of the Acquired Storage Water Rights by Pocatello are provided in Section 4.0 of the Transfer Report.

3.0 Summary of Protestants’ Concerns with Proposed Transfer

The following entities and individuals filed a Notice of Protest to the City’s Application (“Protestants”):

- Portneuf Watershed Users Association, Inc. (“PWUA”)

² The place of use for the PMVCC shown on Figure 2 in the Application and Amended Report was in error and is corrected in Figure 2 in this report.

- McCammon Ditch Company
- Symons Farm & Ranch
- John Schwarz
- A&B Irrigation District, Burley Irrigation District, Milner Irrigation District, North Side Canal Company, and Twin Falls Canal Company (“Surface Water Coalition”)

The issues raised by the Protestants in the Notices of Protest and responses to discovery requests are summarized in **Table 2**. There were four primary concerns with the proposed transfer identified by the Protestants as follows:

1. Concerns regarding the delivery of the Acquired Water Storage Rights to the City without assessment of transit loss (PWUA, McCammon Ditch Company, Schwarz).
2. Concerns regarding the accurate measurement of inflows and outflows to Chesterfield Reservoir, tributary inflows, and Pocatello’s delivery and re-diversion of the Acquired Water Storage Rights (Symons Farm and Ranch, McCammon Ditch Company, PWUA).
3. Concerns regarding the potential flooding of lands adjacent to the Portneuf River that may result from the transfer (PWUA, McCammon Ditch Company, Symons Farm and Ranch).
4. Concerns that the transfer will result in enlargement of the Acquired Storage Water Rights resulting in injury to other water users, and other violations of the standards for water right transfers set forth in IC 42-4222 (SWC, PWUA, McCammon Ditch Company).

The primary concerns identified by the Protestants area addressed in Sections 4 – 7 of this report.

4.0 Measurement

Concerns have been raised regarding measurement of Chesterfield Reservoir inflows and outflows, and measurement of Pocatello’s storage water delivered past the Portneuf-Marsh Valley Canal (“PMVC”) headgate. These concerns are addressed below.

4.1 Chesterfield Reservoir

The partial decrees for Chesterfield Reservoir Water Right Nos. 29-53 and 29-589 include the following provision:

Suitable measuring devices shall be installed on the Portneuf River above the flow line of the Portneuf-Marsh Valley Irrigating Company Reservoir at which point the water comes into the reservoir at T6S R38E S11 NWSESW and immediately below the dam of said reservoir at T6S R39E S19 SWSWSW so that the water released may be accurately determined. The normal flow of the Portneuf River may not be obstructed by the reservoir with reference to the amount of water delivered through the reservoir during the irrigating season.

A Parshall flume to measure releases from the reservoir is located in the channel approximately 500 feet downstream of the dam. The District 29 Watermaster, Steve Hebden, records releases from the reservoir at the outflow flume daily during the irrigation season. (personal communication, Hebden, 2010) Reservoir spills enter the river channel downstream of the Parshall flume and therefore are not measured.

It has been suggested that there should be a recording device installed at the outflow flume to obtain a continuous record of the reservoir releases. Such a device could provide a more accurate daily average of release rates from reservoir storage. Pocatello supports the installation of a measuring device at this location and would agree to pay for the installation of a device approved by IDWR for this purpose.

The upstream portion of the reservoir is located on the Fort Hall Indian Reservation ("Reservation") as shown in **Figure 1**. The PMVCC reportedly holds a flowage easement granted by the United States that includes the right to store water in the reservoir and a right of access to the reservoir across Indian lands. Based on discussions with Mr. Hebden, a device to measure the Portneuf River inflow to the reservoir reportedly existed on Indian lands at or near the site specified in the partial decrees, but that the device was removed by an unknown party and has not been replaced. When the Portneuf River is on regulation and water rights are being curtailed, Mr. Hebden visits the upstream measurement site and estimates the inflow to the reservoir. It is, however, necessary for him to obtain a "trespass permit" from the Shoshone-Bannock Tribe each year to gain access to the measurement location. Mr. Hebden indicated that he makes a conservatively high estimate of the reservoir inflow, and then adds this amount to the water that he is releasing from the reservoir for the PMVCC. Assuming that Mr. Hebden is consistent in estimating reservoir inflow at higher than actual reservoir inflow, it is likely that

this results in a portion of PMVCC's storage water being delivered to other Portneuf River water users.

Certain of the Protestants have taken the position in this Transfer proceeding that a permanent gage should be installed upstream of the Reservoir to more accurately measure the inflow. While there are physical limitations governing the location and type of measuring structure that may be installed upstream of the reservoir, it appears that a device could be installed that would provide for more accurate inflow measurements. The City supports the installation of a device to measure the reservoir inflow. However, the City has no legal right to access the Reservation lands to install, operate, or maintain such a device. Section 10(I) of the City's Storage Water Agreement with the PMVCC provides in part that:

The City shall have no ownership interest in the Chesterfield Reservoir structure or other physical facilities of the Company's Water System, nor any responsibility for, or obligation or liability associated with the Company's ownership, operation and/or maintenance of the Chesterfield Reservoir or other portions of its Water System. The Company shall exercise due care in the operation and maintenance of the Chesterfield Reservoir and its Water System to ensure the continued ability to divert into storage, store and release the Acquired Storage Water Rights as contemplated by this Agreement.

Consequently, the legal right of access and the responsibility for operation and maintenance of such a device lies with the PMVCC.

Water is diverted to storage in the Reservoir from Toponce Creek through the Toponce Feeder Canal. When the Portneuf River is on regulation, there are no diversions to the reservoir through the feeder canal. It is not necessary to measure diversions to storage through the feeder canal as the reservoir may divert all the water that is available in Toponce Creek up to the canal capacity, less any amounts that are passed to satisfy the demands of downstream users on Toponce Creek.

The water level elevation in the reservoir is measured daily during the irrigation season by observation of a staff gage located on the face of the dam. The stage measurements are

converted to storage volumes using a stage-capacity relationship developed through a hydrographic survey of the reservoir in 1997 (IDWR, 1997).

4.2 Delivery of Storage Water to Pocatello

Pocatello proposes to take delivery of the Acquired Storage Water Rights from the PMVCC near the headgate of the Portneuf-Marsh Valley Canal at either the Sorenson Hydropower Facility³ or at the existing streamflow gage on the Portneuf River that is used to measure the required 10 cfs bypass flow when the Sorenson Hydropower Facility is operating. These two locations are labeled as the “Delivery Points” in **Figure 1**.

If deliveries to the City are taken through the Sorenson Hydropower Facility, the City’s water would be diverted at the PMVC headgate, conveyed down the upper portion of the PMVC, and then turned out through the Sorenson Hydropower Facility. Water may be delivered back to the Portneuf River at the hydropower facility either through the penstocks or through a bypass overflow pipe. When water is being sent through the penstocks, deliveries may be computed based on the amount of power being generated converted to a flow rate using the generator rating curves.

To deliver water through the bypass overflow pipe, it would be necessary to install a measuring device on the pipe near where it discharges to the river. This device would likely consist of a length of steel pipe welded to the outflow pipe, and equipped with an inline flow meter. Pocatello will cooperate with the owners of the Sorenson Hydropower Facility and consult with IDWR and the Watermaster in the design and installation of the measuring device.

The preferred method for measuring the deliveries of stored water to the City would be through the Sorenson Hydropower Facility. However, there may be times when it is not possible to divert the City’s water into the PMVC (e.g., when the canal is shut down for maintenance). Therefore, in such instances, Pocatello proposes to measure deliveries of storage water past the

³ The hydroelectric facility is referred to in the Application and this report as the “Sorenson Hydropower Facility.” This facility is owned and operated under an agreement among the PMVCC, Portneuf Irrigating Company, McCammon Ditch Company, and Marsh Valley Development, Inc., which is owned by Ted Sorenson, et.al.

PMVC headgate at the rated section of the river located near the bridge on access road to the Sorenson Hydropower Facility. It would be necessary to periodically rate this section and shift the rating table to maintain reasonably accurate flow measurements from the installed gage. Pocatello will cooperate with the owners of the Sorenson Hydropower Facility and consult with IDWR and the Watermaster in the operation and maintenance of this gage.

4.3 Re-Diversion Points

After being measured past the PMVC at either of the Delivery Points, deliveries of the City's storage water would be conveyed down the Portneuf River for re-diversion at one or more of the Points of Re-diversion listed in the upper portion of **Table 3** and shown on **Figures 1 and 2**. Pocatello will install measuring devices at the Points of Re-diversion that are acceptable to IDWR.

5.0 Transit Losses

The City has proposed that the Acquired Storage Water Rights be delivered from Chesterfield Reservoir to Pocatello without being assessed a transit loss. Several of the Protestants object to the City's proposal and believe that a transit loss should be assessed in delivering the stored water to the City. The following information and analysis is provided to support the City's proposal that no transit loss be assessed. The supporting information is organized by reach of the Portneuf River from upstream to downstream.

5.1 Portneuf River between Chesterfield Reservoir and the Portneuf-Marsh Valley Canal Headgate

The partial decrees for Chesterfield Reservoir provide that water is delivered from the reservoir for diversion at the Portneuf-Marsh Valley Canal without assessment of a conveyance loss. The City maintains that it is entitled to the benefit of this condition in the delivery of the Acquired Storage Water Rights to the vicinity of the Portneuf-Marsh Valley Canal headgate.

The "no transit loss" provision of the Chesterfield Reservoir storage rights originated in the 1921 Bannock County District Court decree entered in the case of Union Grain Elevator Company v.

McCammon Canal Company, et. al. This “no transit loss” provision was reaffirmed in partial decrees issued by the SRBA Court.

5.2 Portneuf River between the PMVC Headgate to Pocatello

Studies performed by the U.S. Geological Survey (“USGS”), have shown that the reach of the Portneuf River between the PMVC headgate and the City of Pocatello is a gaining stream. The gaining nature of this reach was verified by an analysis of the flows of the Portneuf River between the USGS gages at Topaz and at Pocatello that was described in the Transfer Report. That analysis showed that the Portneuf River gained an average of 46,400 af/y (average of 128 cfs) during April – September of the 1988 – 2007 study period, of which 22,100 af/y (61 cfs) was contributed by Marsh Creek. During October – March, the river gained an average of 38,600 af/y (107 cfs), of which 25,200 af/y (70 cfs) came from Marsh Creek. The results indicate that the Portneuf River from the Topaz gage to the Pocatello gage is a gaining stream. Therefore, there should be little or no transit loss experienced in delivering the Acquired Storage Water Rights below the PMVCC to Pocatello except for temporary bank storage.

There are numerous small diversions from the Portneuf River that irrigate a relatively narrow area adjacent to the river along the reach between the McCammon Ditch headgate and Pocatello. Based on information obtained from IDWR’s water rights database, there are 110 irrigation water rights with partial decrees along this reach that have a combined diversion entitlement of approximately 30.5 cfs. Based on the irrigated areas reported in the partial decrees, approximately 560 acres are irrigated from water rights that divert from the Portneuf River below the McCammon Ditch headgate to Pocatello. Assuming typical irrigation consumptive use of two af/y per acre, the consumptive use along the McCammon to Pocatello reach from these water rights would total approximately 1,120 af/y, or an average of 3.1 cfs during the period from April – September.

Based on discussions with Tim Luke, head of IDWR’s Water Distribution Section, routine water administration on the Portneuf River between McCammon and Pocatello has not been employed because historically there has always been sufficient flow in the river to satisfy the limited quantity of authorized diversions to water rights along the reach.

Based on the gaining nature of the Portneuf River, and the general sufficiency of the existing Portneuf River flow to satisfy the existing water rights, it is my opinion that Pocatello's storage water can be delivered down the Portneuf River from McCammon to Pocatello without assessment of a transit loss.

5.3 Transit Loss on Deliveries Through Sorenson Hydropower Facility

A concern was raised regarding the conveyance loss that may occur if the Acquired Storage Water Rights are diverted at the PMVC headgate and then measured back to the Portneuf River through the Sorenson Hydropower Facility three miles downstream of the river headgate. The McCammon Ditch Company claims that the ditch loss through this three mile reach of the PMVC should be determined and deducted from the deliveries to Pocatello.

In connection with partnership agreements between the National Resources Conservation Service ("NRCS") and PMVCC shareholders under the federal Agricultural Water Enhancement Program ("AWEP"), the NRCS estimated that the seepage losses in the PMVCC system are in the range of three percent to 18 percent of the water diverted. The mid-point of this range is approximately 10 percent. Given that the PMVCC system has over 25 miles of ditch, the amount of a 10 percent seepage loss that occurs in the first three miles of the PMVC would likely be no more than a few percent of the diversions. Since the McCammon Ditch headgate is only approximately 0.5 miles downstream of the PMVCC headgate, the amount of return flow attributable to this seepage loss that would be available for diversion by the McCammon Ditch would be minimal at best.

Further, deliveries of storage water to Pocatello will likely only be run through the PMVC when the canal is being used to deliver water for irrigation and/or water for hydropower production. As a result, the addition of Pocatello's storage water on top of the water that is already being diverted would not materially increase the conveyance loss occurring in the three mile canal reach. The portion of any incremental additional canal seepage loss resulting from conveyance of Pocatello's storage water through the first 0.5 miles of the PMVC that would accrue to the river upstream of the McCammon Ditch headgate would be immaterial and immeasurable.

Pursuant to its agreement with the City, any conveyance loss through this section of the PMVC that would be assessed to the Acquired Storage Water Rights would need to be made up to the City by the PMVCC.

6.0 Flooding

Several Protestants have raised concerns regarding the potential for increased flooding of lands adjacent to the Portneuf River as a result of the proposed Transfer. According to certain of the Protestants, historical releases from Chesterfield Reservoir, at times, have contributed to flooding of their lands adjacent to the Portneuf River when moss or algae growth reduces the channel capacity. They are concerned that releases of storage water for delivery to Pocatello, when added to the releases to the PMVCC, will exacerbate the flooding problem.

A site visit to the flood prone area occurred on May 19, 2011. Attendees to the site visit included representatives of (a) Pocatello, (b) the PMVCC, (c) the Portneuf Watershed Users Association, (d) Symons, (e) Schwarz, and (f) the McCammon Ditch Company. During the site visit, the Protestants who were concerned about the flooding were asked to show the attendees the areas where the flooding occurs. In response, the Protestants identified the lands upstream of Lava Hot Springs within or near the areas served by the Dempsey – Topaz Canal as shown in **Figure 4**.

According to provisional data from the USGS streamflow gage on the Portneuf River at Topaz, the average daily flow was 698 cfs on May 18 and 646 cfs on May 19. These flows were attributable to spring runoff of snowmelt and recent precipitation events. The river was out of its banks in several of the areas where the Protestants indicated they had experienced flooding. Photographs taken during the site visit showing the flooded areas are included in **Figure 5**.

The Protestants claim that the growth of moss that accumulates in the river channel through the irrigation season reduces the channel flow capacity. They claim that the reduction in channel capacity results in flooding comparable to that which was observed to be occurring on the date of the site visit, but at lower rates of flow. They claim that flooding as a result of reservoir releases can occur almost any time that water is being released from the reservoir.

To quantify the conditions during which claimed historical flooding may have occurred, daily records of streamflows and reservoir releases were compiled for the period from 2002 – 2009, which is a period when concurrent records were available. Charts showing the daily flows at the stream gage and the daily reservoir releases are provided in **Figure 6**. Each colored line in the charts represents the daily flows for a particular year. The light brown area, light yellow area, and grey area represent the 90th percentile, 75th percentile and 50th percentile of daily flows during the 2002 – 2009 period.

Releases from Chesterfield Reservoir historically have varied based on irrigation demands of the PMVCC and the supply available in the reservoir. As shown in the lower chart in **Figure 6**, the maximum release from the reservoir during the 2002 – 2009 period was 160 cfs in 2006. More typically, the maximum reservoir releases during the mid-May – early August period are in the range of 120 cfs to 140 cfs.

Information obtained during the site visit and from documents produced by Protestants through discovery indicated that channel capacity restrictions due to moss growth between Chesterfield Reservoir and headgates for the Dempsey, Topaz and Lava canals becomes a problem beginning in late June and through the end of August. By late August, river flows and reservoir releases typically have decreased as a result of declining natural flow and irrigation demand, respectively.

Based on this understanding of historical water conditions on the Portneuf River, and the areas and alleged causes of seasonal flooding described by the Protestants, the City proposes that during the months of July and August, storage water released from Chesterfield Reservoir at the request of the City will be limited so that, when combined with those releases made at the request of PMVCC, the total release rate does not exceed 140 cfs, which is the historical maximum daily release by PMVCC during the months of July and August for the period 2002-2009. This will serve to maintain the status quo with respect to total daily releases from storage post-transfer as compared to historical maximum releases over the same period.

7.0 Enlargement and Injury

Several Protestants have objected to the proposed Chesterfield Reservoir storage Transfer on the basis that that the Transfer will result in enlargement of the Chesterfield Reservoir storage water rights, and injury to other water rights.

The City maintains that the Chesterfield Reservoir storage rights entitle the reservoir to one fill of the storage capacity each year. Through its acquisition of 3,100 acre-feet of the senior storage water rights, Pocatello is entitled to the benefit of the one-fill rule, by which up to 16,410 acre-feet under the senior storage water rights may be diverted to storage every year as and when the rights are in priority, and that some or all of the stored water may thereafter be beneficially used in that year. The Transfer does not contemplate that more than 16,410 acre-feet may be diverted to storage in the Reservoir in any one year if the Transfer is approved.

Pursuant to the 2009 Storage Water Agreement, Pocatello has contracted to purchase the first 3,100 acre-feet of yield to water rights 29-53 and 29-589 under a 1912 priority date. Historical records for operation of Chesterfield Reservoir, summarized in **Table 4**, show that annual reservoir releases for irrigation from 1997 – 2009 averaged 7,816 af/y, ranging from a low of 3,125 acre-feet in 2005 to a high of 17,061 af/y in 2007. These records show that the first 3,100 af/y of yield from the reservoir was used every year during the thirteen year period of record. Based on the foregoing, there will be no enlargement of the Chesterfield Reservoir storage water rights as a result of the proposed transfer.

Idaho Code § 42-222(1) states, “[t]he transfer of the right to the use of stored water for irrigation purposes shall not constitute an enlargement in use of the original right even though more acres may be irrigated, if no other water rights are injured thereby.” The City interprets this statute the way it historically has been applied such that a portion of an existing storage right that is not deemed to be needed by the space-holder may be transferred, assigned or leased/rented to additional users for various uses, provided no other no other water rights are injured.

To evaluate potential injury to other water rights resulting from the transfer, a computer model to simulate the operation of Chesterfield Reservoir was developed. The model simulates the use of

Chesterfield Reservoir as a source of irrigation supply for the PMVCC and the use of the Transfer Storage Water by Pocatello. The model includes the following three components:

1. Reservoir operations model of Chesterfield Reservoir
2. Simulation model of PMVCC irrigation
3. Simulation model of Pocatello use of the Transferred Storage Rights.

The remainder of this section of the report describes the development of the Chesterfield Reservoir Operations Model (“CROM”), and use of the model to evaluate potential benefit or impact of the Transfer on other water rights.

7.1 Conceptual Model

In addition to the Chesterfield Reservoir storage water rights, the PMVCC holds a natural flow water right for 176.85 cfs with a priority date of December 18, 1907. Diversions to irrigation under the natural flow water right typically begin in late April or early May. Because this right is relatively junior compared to other Portneuf River natural flow water rights, the PMVCC natural flow diversions are typically curtailed for the benefit of more senior water rights after the spring runoff. When the natural flow water supply is insufficient to meet its irrigation demands, the PMVCC begins releasing water to supplement the natural flow supply. Diversions under the natural flow water right are typically curtailed completely in June or July, after which time the Chesterfield Reservoir releases are the sole source of PMVCC irrigation water.

The operation of Chesterfield Reservoir affects the flow of the Portneuf River in two ways. When water is diverted to storage, the flow of the Portneuf River is depleted. When water is released from the reservoir and re-diverted for use downstream, the portion of those releases that are not consumed return to the Portneuf River resulting in accretions to the river. The net effect on the flow of the Portneuf River resulting from the operation of the reservoir is computed as the diversions to storage minus the return flows to the river resulting from use of the stored water. When the diversions exceed the return flows, a net depletion to the river occurs. When the return flows exceed the diversions a net accretion occurs. The term “depletions” as used hereinafter

means both net depletions and net accretions (i.e., negative depletions). The term “depletion” is also used to refer to the change in Portneuf River flows resulting from the Transfer.

The CROM was developed to answer the question about whether there would be an increase in depletions or change in timing of depletions to the Portneuf River as a result of the proposed Transfer. The model answers this question by simulating the effect of the Chesterfield Reservoir operation on the flow of the Portneuf River resulting from (a) the current (pre-Transfer) irrigation use by the PMVCC and (b) the proposed future (post-Transfer) uses by Pocatello. The difference between the post-Transfer depletions and the pre-Transfer depletions computed by the model represents the projected depletion or accretion to river flows resulting from the Transfer.

The final step in the modeling analysis is to determine whether the changes in the river flows computed by the CROM occur at a time when beneficial uses under downstream, in-priority water rights would potentially be impacted or benefited. If the change in river flows resulting from the Transfer occurs when the downstream water users already have a sufficient supply, then there is deemed to be no effect on the downstream water rights. If the change in river flows occurs when an in-priority downstream water right is not being satisfied, then the change in the river flow resulting from the Transfer may cause an effect on downstream water rights. The effect can be positive (increase in supply available to fill the affected water right) or negative (decrease in supply).

It was assumed that any changes in Portneuf River flows resulting from the Transfer could potentially affect only downstream users on the Snake River, including members of the Surface Water Coalition. There are several reasons for this assumption.

- Diversions to storage in Chesterfield Reservoir only occur during the storage season when water users on the Portneuf River are not diverting under their natural flow water rights, or their natural flow water right demands are fully satisfied.
- Return flows from the use of reservoir water under the PMVCC system accrue to the Portneuf River downstream of any Portneuf River water rights that may be short of supply (see the discussion in Section 5.2 regarding the limited number of Portneuf River

water rights between McCammon and Pocatello and the typically sufficient available supply water).

- Return flows from Pocatello's use of the stored water will also accrue to the lower reach of the Portneuf River where the supply is adequate.
- Based on the above points, any changes in diversions to storage or changes in return flows to the Portneuf River can only potentially affect downstream water users on the Snake River.

The CROM simulates use of the entire amount of the Chesterfield Reservoir supply for irrigation use under the PMVCC system in the pre-Transfer condition. The reservoir is simulated as a supplemental irrigation water supply for the users under the PMVC. Water is released from the reservoir for irrigation use when the supply from the PMVCC natural flow water right is insufficient to meet the PMVCC irrigation demand. In the post-Transfer condition, the first 3,100 acre-feet of reservoir yield is simulated for use by Pocatello. The remainder of the reservoir yield is simulated as a supplemental irrigation supply for the PMVCC as in the pre-Transfer scenario.

7.2 Study Period and Available Water Use Records

The CROM simulates operation of Chesterfield Reservoir over a historical study period using a monthly time-step. Historical data regarding the operation of Chesterfield Reservoir and the PMVC was necessary as input data for the model and as data to calibrate the model. Based on the availability of these data, a study period from 1997 through 2009 was selected for the model. This period contains a variety of hydrologic conditions, including one of the most extreme droughts of record from 2001 – 2005.

The District 29 Watermaster keeps records of the operation of Chesterfield Reservoir and diversions for the PMVCC. As described in Section 4.1, the records for Chesterfield Reservoir include (a) estimates of Portneuf River inflows to the reservoir (limited records available), (b) releases from the reservoir when the PMVCC is taking delivery of stored water and/or when the Portneuf River is on regulation, and (c) the reservoir water level elevation.

Diversions from the Portneuf River into the PMVC are measured daily at a flume located approximately one mile downstream of the headgate. The Watermaster allocates the measured diversions to (a) the natural flow water rights and/or releases from Chesterfield Reservoir to PMVCC shareholders, (b) natural flow diversions to the Portneuf Irrigating Company (“PIC”) shareholders under the Arimo Ditch, and (c) natural flow diversions to users under the Cutler Ditch. The diversion records for the PMVCC do not differentiate between natural flow diversions and diversions of water released from Chesterfield Reservoir.

The following is a summary of the available records for Chesterfield Reservoir and PMVCC diversion used to construct the CROM:

- Chesterfield Reservoir Inflows – Daily records/estimates of Portneuf River inflows to the reservoir are available for the years 1992 - 2000.
- Chesterfield Reservoir Releases – Combined daily releases from the reservoir to the PMVCC and inflow being passed through the reservoir are recorded when the Portneuf River is on regulation, and these records are available from 1988 – present.
- Chesterfield Reservoir Storage - Beginning and end of season water level elevation records were available from the PMVCC from 1997 – present. The records prior to 1997 were reportedly lost in a fire.
- PMVC Diversions – Daily records of the combined diversions under the PMVCC natural flow water right and of water released from Chesterfield Reservoir are available from 1988 – present.

Key to analysis of the historical operation of Chesterfield Reservoir was knowledge of how much storage water was used each year. Because the records of releases from the reservoir included both releases to the PMVCC shareholders and inflow being passed through the reservoir, these release data could not be used to determine the amount of storage water used by the PMVCC. Instead, the historical reservoir releases to the PMVCC shareholders were determined based on the difference between the beginning-of-season and end-of-season reservoir contents. The reservoir content data were determined from the reported beginning-of-season and end-of-season reservoir water level elevations. These stage data were converted to the volume of water in storage using a stage – capacity table that was developed with the assistance of IDWR

in 1997. The 1997 – 2009 study period for the model was dictated by the availability of the reservoir storage records.

7.3 Chesterfield Reservoir Simulation

The CROM simulates the storage and release operations of Chesterfield Reservoir, including inflows, outflows, evaporation, and changes in storage volume. Inflows to the reservoir are stored up to the available 20,405 acre-feet capacity of the reservoir. Water is released from storage as necessary to meet the simulated PMVCC irrigation demands that remain after the natural flow supply.

Historical inflows to the reservoir during the storage season were determined based on the difference between the storage contents at the beginning of the irrigation season and the contents at the end of the prior irrigation season. These seasonal inflows were distributed monthly with 5 percent of the seasonal inflows in each of the months of November – February, 15 percent in March, 25 percent in April, and 40 percent in May.

The historical reservoir inflow data derived from the difference between the beginning-of-season and end-of-season reservoir contents do not include spills from the reservoir in years that the reservoir filled (1997, 2000, 2006, 2007, and 2009). The amount of reservoir spill was estimated as 24 percent of the monthly Topaz gage flow in May (the month in which the spill was assumed to occur). This percentage represents the portion of the Topaz gage watershed area that is upstream of Chesterfield Reservoir, including Toponce Creek. The estimated spills averaged 6,714 acre-feet, and ranged from 3,165 acre-feet in 2007 to 12,915 acre-feet in 1997. The estimated volumes were added to the monthly inflow volumes determined from the beginning and end of season reservoir contents to compute the total monthly reservoir inflows.

The study period begins in 1997, which was a spill year, and therefore, the starting reservoir storage content was set at 20,405 acre-feet (full). Monthly inflows during an assumed November - May storage season are diverted to storage when storage space is available in the reservoir. There are no reservoir inflows simulated during June – September as these inflows typically need to be passed through the reservoir for the benefit of downstream senior natural flow water rights.

Water is released from storage during the months of May – September to meet the PMVCC irrigation demand that remains after consideration of the supply available from the historical monthly natural flow diversions. The PMVCC demand analysis is described in Section 7.4.

Annual evaporation from the reservoir is assumed to be three percent of the simulated beginning of season reservoir contents. The annual evaporation is distributed monthly using a monthly distribution used in Colorado water rights administration (Colorado State Engineer's Office, 2003).

The model performs a water budget simulation of the reservoir inflows and outflows during each month of the study period. The end-of-month reservoir contents are computed as the beginning-of-month contents plus the monthly inflows that are stored minus the monthly reservoir releases and monthly evaporation. The computed end-of-month storage content is used as the beginning of month contents for the next month.

7.4 PMVCC Irrigation Simulation

Irrigation water use under the PMVCC system is simulated using a typical irrigation water budget analysis methodology. Monthly irrigation water demands were computed based on irrigated area, reported cropping pattern, and climate data. The monthly irrigation water demands are met first by the historical yield of the PMVCC natural flow water rights, and then by releases of water from Chesterfield Reservoir. Surface water return flows and ground water return flows are computed from simulated canal losses and on-farm losses. The various components of the model simulation of the PMVCC irrigation system are described in this section.

7.4.1 Crop Water Demand

According to the partial decree for the PMVCC water rights, there are 5,103 acres irrigated under the PMVCC system. Aerial photo images from 2004, 2006, and 2009 were reviewed to verify the irrigated area. Irrigated fields within the service area were delineated on the 2004 image as

shown in **Figure 7**. The delineated area totals approximately 5,183 acres, which generally confirms the SRBA acreage, and the SRBA acreage was used in the modeling analysis.

Interviews with PMVCC shareholder and former board member, Ron Jolley and with Eric Olson, PMVCC Superintendent, indicated the cropping pattern under the PMVCC system is typically comprised of 70% alfalfa, 15% spring grain, 10% pasture grass, and 5% winter wheat. Monthly crop irrigation requirements (“CIR”) over the 13-year study period were compiled for these crops from data contained in *Evaporation and Consumptive Irrigation Requirements for Idaho* (Allen and Robinson, 2009). The CIR data represent the amount of irrigation water that a crop would consume, in addition to precipitation, if it received a full water supply. The CIR data represent the upper limit of crop irrigation water consumption.

CIR data contained in the Allen and Robison report were computed using the ASCE Standardized Penman-Montieth procedure which is generally recognized as the most accurate methodology for computing crop water demands. Climate data used in the analysis were obtained from the National Weather Service climate station at McCammon.

The computed CIR values for crops grown under the PMVCC system during the 1997 – 2009 study period are summarized in **Table 5**. The crop-weighted average irrigation water demand averaged 27.5 inches per year, ranging from 22.3 inches in 1997 to 31.9 inches in 2001. The monthly CIR values were converted to feet and multiplied by the 5,103 acres irrigated to compute the monthly CIR volumes in acre-feet shown in **Table 6**. The annual CIR volume averaged 11,676 af/y over the study period.

7.4.2 Irrigation Diversion Demand

The demand for irrigation water at the PMVC river headgate was compute based on the monthly CIR data with consideration of on-farm irrigation efficiency and canal conveyance losses.

Farm irrigation efficiency represents the amount of water consumed by the crops divided by the amount of water delivered to the farm. The maximum farm irrigation efficiency represents the reasonable upper limit of the amount of applied irrigation water, expressed as a percentage of

farm delivery, that can be delivered to the root zone of the crop either for immediate use, or stored for later use. The maximum farm irrigation efficiency varies depending on the method of irrigation water application and the management of the irrigation system.

According to Ron Jolley, approximately 90 percent of the lands under the PMVCC system are irrigated by sprinklers, with the remainder irrigated using gravity application methods. Design farm irrigation efficiencies for sprinklers generally range from 60 percent to 85 percent for sprinklers and 30 percent to 75 percent for gravity methods (Dreher and Tuthill, 1999, Idaho Irrigation Water Conservation Task Force, 1994). The farm water delivery demand is computed as the monthly CIR volume divided by the maximum farm irrigation efficiency, and therefore, the farm headgate demand is inversely proportional to the maximum farm irrigation efficiency. The maximum farm irrigation efficiency is an input parameter in the CROM model and was set at 85% as part of the model calibration.

Water is delivered from the river headgate to the farms under the PMVCC system via an approximately 25 mile earthen canal. The first 4.2 miles of canal are shared with the Portneuf Irrigating Company (“PIC”), and this shared portion is sometimes referred to as the “Big Canal.” At the end of the Big Canal, there is a bifurcation structure and the canal splits into the Downey Canal, which delivers water to the PMVCC water users, and the Arimo Canal which delivers water to the PIC users.

Water is lost to canal seepage, evaporation, and operational spills as it is delivered from the river headgate to the farms. An analysis of the canal conveyance losses in the PMVCC and PIC systems by the NRCS in connection with the AWEPP project grant indicated that the total conveyance loss in the two systems ranges from approximately 30 – 35 percent of the water diverted as follows (USDA, 2011):

Summary of NRCS Canal Loss Estimates

Source of Loss	Percent Loss
Geological Seepage	3% - 18%
Evaporation Loss	4%
Operational Loss	10% - 25%
Total Loss	30% - 35%

The demand for irrigation water at the river headgate is computed as the farm headgate water demand divided by the canal conveyance efficiency (100% minus canal loss %). The canal conveyance loss is an input parameter to the model and was set at 30 percent through calibration of the model. The 30 percent loss was distributed as 10 percent to seepage, 4 percent to evaporation and 16 percent to operational spills based on the relative amounts of these losses reported in the NRCS study.

The computed monthly diversion demand was assumed to be met first by the natural flow diversions, and then by storage releases. As described previously, the historical PMVC diversion records do not distinguish between diversions of natural flow water and storage releases. The portion of the historical daily diversion diversions that was comprised of storage releases was determined as follows:

1. From 1997 - 2001, when there is no data available for daily Chesterfield Reservoir releases, it was assumed that natural flow water was used in the first portion of the irrigation season and storage water was used in the latter portion of the irrigation season. More specifically, the reported daily diversions at the PMVC headgate were allocated to storage in reverse order starting from the last day of the irrigation season until the accumulated volume of storage diversions since the end of the irrigation season equaled the annual volume of storage water used. The remaining diversions through the start of the irrigation season were assumed to be natural flow water use.
2. From 2002 – 2009, there are records of total releases from Chesterfield Reservoir. During this period, the storage releases were computed similarly to the method used for the 1997 – 2001 period, except that the daily storage diversions were limited to the release from storage on the prior day (allowing for travel time from the reservoir).

As described previously, the reservoir release records include water released from storage to the PMVCC and natural inflow that is passed through the reservoir. Several sensitivity runs were made of the model assuming various rates of assumed inflow to the reservoir that were included in the daily releases. This had the effect of extending the period of storage releases and extending the period of natural flow releases. However, it had no effect on the annual volume of storage diversions and natural flow diversions, as the annual storage diversions are based on the beginning-of-season and end of season reservoir contents, and the annual natural flow diversions are computed as the total reported PMVC diversions minus the annual storage diversions. It was determined that the model results were insensitive to the assumed natural inflow to the reservoir, and therefore the assumed natural inflow was set at zero for purposes of analysis. These sensitivity analyses are summarized in Section 7.7.2

The daily natural flow diversions determined procedure described above were totaled for each month of the study period, and these values were used as input data in all runs of the model. The monthly demand for storage water is computed in the model as the total diversion demand less the historical natural flow diversions.

7.4.3 Consumptive Use of Irrigation Water

After computing the monthly demand for storage water, the model then simulates the PMVCC irrigation operations. Water is released from storage up to the storage water demand, limited by the amount of water available in the reservoir. Farm headgate deliveries are computed each month as the combined river headgate diversions of natural flow water and storage releases less the simulated conveyance losses using the canal loss percentage input by the model user.

The consumptive use of irrigation water is the monthly volume of the farm water delivery that is consumed by evapotranspiration (soil evaporation and plant transpiration). The consumptive use is computed as the lesser of the CIR or the available irrigation water supply. The available irrigation water supply is determined each month as the sum of the monthly farm water delivery

multiplied by the maximum farm irrigation efficiency plus any soil moisture storage carried over from the prior month.

As part of the irrigation water budget, a soil moisture reservoir is simulated beneath the irrigated fields. The soil moisture reservoir represents the available water holding capacity of the soils within the crop root zone. The available water holding capacity of the soil is defined as the difference between the field capacity and the wilting point. The field capacity of the soil is the amount of water that can be held in the soil against gravity. The wilting point represents the soil moisture storage below which the crop is unable to extract additional water.

The available water holding capacity data for soils underlying the PMVCC irrigated area were compiled from the USDA Natural Resources Conservation Service Web Soil Survey Geographic database ("WSS") (USDA, 2009). A weighted-average soil moisture holding capacity was determined based on the WSS data and a typical root depth of three feet for pasture grass (USDA, 1997). Based on these inputs, a total available soil moisture holding capacity of six inches within the root zone was computed and used in the analysis.

The soil moisture reservoir was simulated in a manner similar to a surface water reservoir. Irrigation water delivered to the crop root zone (farm deliveries x maximum farm irrigation efficiency) was compared to the monthly CIR. Root zone water deliveries in excess of the crop requirements were stored in the root zone, up to the soil moisture reservoir capacity, for carryover to the next month. When the monthly irrigation water delivery was insufficient to meet the CIR, then water was withdrawn from soil moisture to help meet the CIR.

Because the PMVCC system is water-short when the reservoir water supply is limited, the soil moisture reservoir was allowed to become depleted under deficit conditions.

The water budget analysis described above is repeated in the model for each month of the study period to compute the monthly consumptive use of irrigation water.

7.4.4 Irrigation Return Flows

The portion of the PMVCC diversions that is not consumed returns to the stream either as surface runoff or through the subsurface. Irrigation return flows result from canal seepage, operational spills, and on-farm losses, and these return flows were simulated in the model.

Canal seepage losses and operational spills as a percentage of the water diverted are input parameters to the model. The monthly diversions are multiplied by the loss percentages to compute the canal losses. The computed operational spills are assumed to return to the stream in the same month as the water is diverted. Canal seepage return flows are delayed in returning to the stream as they pass through the subsurface. The model computes the canal seepage return flows by applying a unit response function to the monthly seepage values. A unit response function expresses the portion of the seepage that returns to the stream in the month the seepage occurs, and in the subsequent months. The unit response function for the canal seepage was computed using the Glover procedure described below.

On-farm losses occur through surface runoff from the irrigated fields and from deep percolation below the root zone of the irrigated crops. Surface runoff return flows return in the same month as the irrigation application. Deep percolation returns to the stream are delayed similar to canal seepage, and these return flows were also computed using a unit response function derived using the Glover Procedure.

Ground water return flows from canal seepage and deep percolation losses are lagged to the stream using unit response functions computed using the Alluvial Water Accounting System Model ("AWAS") developed by the Integrated Decision Support ("IDS") Group at Colorado State University utilizing the Glover method. (IDS, 2007; Glover, 1974; Schroeder, D.R., 1987). The Glover method is a commonly used analytical method in computing ground water return flows in analyses of water right transfers in Colorado and elsewhere in the West. Input data used in the Glover analysis include aquifer transmissivity and specific yield, average distance from the aquifer boundary to the stream (W) and average return flow distance (X).

The aquifer transmissivity was determined based on review of pump test data for wells in the area using an empirical relationship by which transmissivity is estimated based on the pumping rate and drawdown from the test (IDWR, Well Driller Reports, Driscoll, 1986). An aquifer specific yield of 0.20 was assumed, which is typical of unconfined aquifers such as that in the Portneuf River valley. The aquifer width and distance to the stream were determined from GIS analysis (Bod, Kauffman, Miller, and Venkatakrishnan, 1978). The following is a summary of the input parameters and results of the Glover analyses to determine response functions for canal seepage and deep percolation return flows.

- Transmissivity - 29,436 gpd/ft
- Specific Yield – 0.20 ft/ft
- Average Return Flow Distance to Stream (on-farm (losses) – 10,856 feet
- Average Distance from Aquifer Boundary to Stream (on-farm losses) - 14,583 feet
- Average Return Flow Distance to Stream (canal losses) – 8,360 feet
- Average Distance from Aquifer Boundary to Stream (canal losses) - 11,307 feet

The lagging of return flows results in return flows that extend beyond the end of the study period in 2009. To maintain a water balance and equilibrium in the model results, the lagged return flows beyond the end of the study period are wrapped around to the beginning of the study period so that there is a water balance between the simulated diversions, consumptive use, return flows and change in reservoir storage.

The total irrigation return flows are computed as the sum of the canal seepage returns, operational spills, on-farm surface runoff, and on-farm deep percolation returns. The return flows are pro-rated between the amount resulting from natural flow diversions and the amount from use of stored water.

7.4.5 Pocatello Storage Water Use Simulation

The model simulates the use of stored water by Pocatello. User specified input parameters include (a) annual water usage, (b) the percentage of the storage water used for municipal

purposes, raw water irrigation, and ARW uses, and (c) the portion of the culinary municipal use that returns to the stream, and (d) the portion of the irrigation use that returns to the stream.

In accordance with the Storage Water Agreement, Pocatello is allocated the first portion of the storage yield up to the specified annual 3,100 af/y volume of use. Water simulated for municipal use is assumed spread evenly between a starting month and ending month specified by the model user. The simulated municipal water use is split between indoor culinary use and municipal irrigation use based on the relative monthly average amounts of such uses indicated in the City's water use records from the past 11 years.

Return flows to the Portneuf River at the City's wastewater treatment plant are computed as a specified percentage of the monthly water use. Irrigation return flows are computed using unit response functions computed using the Glover method as described above. For purposes of analysis, 90 percent of the culinary water use and 20 percent of the municipal irrigation water use is assumed to return to the Portneuf River.

Raw water irrigation by Pocatello may occur through irrigation of parks and golf courses, and/or from irrigation of the fields included in the City's Biosolids Program. Water simulated for raw water irrigation use is distributed throughout an assumed April – October irrigation season using monthly distribution derived from Pocatello's water use data. Irrigation return flows are computed as a percentage of the simulated use, and are lagged to the stream using unit response functions computed using the Glover method. For the model runs described herein, irrigation return flows were specified as 20 percent of the simulated irrigation water use.

Pocatello also seeks authorization under the Transfer to release water from storage for ARW uses including recreation, aesthetic, wildlife, and fish propagation uses. The model allocates the annual volume of the simulated in stream water use evenly between a beginning month and ending month specified by the model user. There is no simulated consumption of water released for ARW uses.

7.4.6 Stream Depletions

Stream depletions resulting from the operation of Chesterfield Reservoir water are computed in the model as the monthly volume of water diverted to storage minus the return flows from the use of stored water by the PMVCC and by Pocatello. Positive values indicate a net depletion in the flow of the stream, and negative values indicate a net increase in the flow of the stream. In general, the stream is depleted during the storage season as water is diverted to storage, while the stream is accreted during the irrigation season as a result of the return flows from the use of the storage releases.

7.5 Calibration

In order to instill confidence in the simulation results, the simulated operation of Chesterfield Reservoir in the CROM was calibrated to historical records. The calibration process involved varying the input parameters that affect the simulated irrigation water demand so that the simulated reservoir storage contents during the 1997 – 2009 study period reasonably matched the recorded historical contents. As the irrigation water demand increases, so does the simulated release of water from storage to meet the demand that remains after diversion of the historical yield to the PMVCC natural flow water right.

The input parameters that affect the PMVCC irrigation water demand include (a) crop water demand, (b) maximum farm irrigation efficiency, and (d) canal conveyance loss. Irrigation water demand is computed as follows:

$$\text{Diversion Demand} = \frac{(DF)(CIR)}{(MFE)(1.0 - CL)}$$

where:

DF = Demand Factor (decimal)

CIR = Crop Irrigation Requirement (af)

MFE = Maximum Farm Irrigation Requirement (decimal)

CL = Canal Loss (decimal)

The demand is directly proportional to the demand factor, CIR, and canal loss, and inversely proportional to the maximum farm irrigation efficiency. The demand factor is a lumped

parameter that incorporates various factors that may affect the irrigation water demand including fallowing of fields, cropping variations, deficit irrigation, desire to conserve stored water, and other management factors.

There are various combinations of DF, MFE, and CL that can achieve the same diversion demand. Therefore, the calibration parameters were selected not only so as to calibrate the model, but also to utilize values that were reasonable considering the available data and observed conditions. The following is a summary of the calibration parameter selection.

- Maximum Farm Irrigation Efficiency (MFE) – Most of the lands under the PMVCC system are irrigated by sprinklers, and sprinklers typically have a design efficiency ranging from 60 percent to 85 percent depending on the sprinkler type. A MFE value of 85 percent was used in calibrating the model.
- Canal Loss (CL) – According to the NRCS, the canal conveyance loss likely ranges from 30 percent to 35 percent of diversions. This value is within the range of conveyance losses for unlined canal systems similar in size that operated by the PMVCC. Reported conveyance losses for the members of the SWC, which operate larger irrigation systems, range from 12 percent to 50 percent. A CL value of 30 percent was used in calibrating the model, and is deemed reasonable.
- Demand Factor (DF) – Personal observations in the field and review of aerial photographs indicate that the lands under the PMVCC system are not in pristine condition. This is to be expected given the relatively low value of the crops that are raised under the PMVCC (e.g., compared to row crops raised under the irrigation systems operated by the members of the SWC). Acceptable crop yields can be achieved without fully irrigating alfalfa and pasture grass. Spring grains and winter wheat are more moisture sensitive, but can also suffer some water shortages and produce acceptable yields. Based on the foregoing factors, a DF value of 85 percent was deemed reasonable for use in the model calibration.

Visual and numerical results from the model were reviewed to assess the degree of model calibration. These included a graph of the predicted and observed reservoir storage contents, the mean error (difference) between the predicted and observed storage contents, and the r-squared value for the predicted and observed storage contents. **Figure 8** shows the results of the model calibration. The predicted storage contents clearly follow the observed reservoir contents throughout the study period. The r-squared value of 0.94 indicates a good match between the predicted and observed storage contents. The mean error computed of 174 acre-feet indicates there is minimal bias between the predicted and observed results.

The model calibration is judged to be excellent, especially given the human element that is present in the operation of an irrigation system. The irrigation water demand that is simulated in the model is shown to be a good predictor of storage reservoir water demand. Since the combination of input parameters that resulted in calibration of the model is not unique, several alternative calibrations were tested and the results of these alternatives is described in Section 7.7.1 as part of the model sensitivity analyses.

7.6 Model Simulations and Results

As described previously, the CROM was developed to assess the potential effects on downstream Snake River water users resulting from the proposed transfer by Pocatello of 3,100 af/y of Chesterfield Reservoir storage water. For purposes of describing the model results, the terms depletion and accretion will be used to describe the computed change in river flows resulting from the Transfer. The term “effect” will be used in describing changes in the water supply available for beneficial use by downstream Snake River water users. An “impact” represents a decrease in supply and a “benefit” represents an increase in supply to the downstream users.

The potential effects on downstream Snake River water users were computed by making two runs of the CROM - a pre-transfer run and a post-transfer run. The difference between the computed monthly depletions in the two runs represents the potential change in streamflows resulting from the proposed transfer. These changes in streamflows were evaluated based on the water supply conditions that existed downstream to assess the effect on downstream Snake River water users.

Changes in streamflows during the November – May storage season were assumed to affect downstream Snake River water users during years that American Falls Reservoir did not fill. Changes in streamflow during the May - October irrigation season were assumed to affect downstream users when water was not spilling past Milner Dam. Water spilling past Milner Dam during the irrigation season indicates that the available supply to downstream users is more than sufficient. A change in streamflow during times of a spill past Milner would simply change the amount of the spill.

Several model runs were made to evaluate the effect of the proposed uses that Pocatello seeks to make of the 3,100 acre-feet of transferred Chesterfield Reservoir water. The following is a summary of the results:

- All water used for municipal use -130 af/y (**benefit**)
- All water used for irrigation use +353 af/y (**impact**)
- All water used for ARW uses -912 af/y (**benefit**)

The results for the above scenarios are summarized in **Tables 7 - 9**.

As would be expected, the potential effect of the Transfer varies depending on the uses that Pocatello may make of the water. In general, as more of the transferred water is consumed by Pocatello, there is an increase in any impact to downstream users (or reduction of the benefit). To illustrate this relationship, several model runs were made to show the computed effects on downstream Snake River water at various levels of assumed consumptive use by Pocatello ranging from 0 percent - 100 percent. A summary of the results is provided in **Figure 9**.

The results in **Figure 9** indicate that the effect on downstream water users varies linearly from an average benefit of 912 af/y with zero consumptive use to an average impact of 699 af/y with consumptive use of 100 percent of the transferred water.

7.7 Sensitivity Analyses

Sensitivity analyses were performed on the CROM to determine the effect on the computed impacts to downstream Snake River water users resulting from (a) alternative model calibrations, and (b) changes in other selected input parameters. Descriptions of these analyses follow.

7.7.1 Calibration Sensitivity

As described in Section 7.5, the CROM was calibrated by three input parameters that affect the computed demand for irrigation water; the canal conveyance loss, the maximum farm irrigation efficiency, and the demand factor. These factors are applied to the monthly CIR volumes to compute the simulated monthly irrigation diversion demand.

The following parameter values were selected in calibrating the model.

- Maximum Farm Irrigation Efficiency (MFE) – 85%
- Canal Loss (CL) – 30%
- Demand Factor (DF) – 85%

Application of these factors using the demand equation described in Section 7.5 results in calibrated diversion demand of 1.43 times the crop weighted monthly CIR volume. Various combinations of the three calibration parameters can result in the same 1.43 factor. Any change to one of the three calibration parameters requires a corresponding change to the other calibration parameter(s) so that the same 1.43 multiplier results in the use of the demand equation.

Alternative model calibrations were developed with various combinations of maximum farm irrigation efficiencies ranging from 75 percent to 85 percent and canal loss percentages ranging from 20 percent to 50 percent. For each of the MFE and CL combinations, a compensating change was made to the demand factor to result in the 1.43 CIR multiplier that calibrates the model. Each of the recalibrated versions of the model was run assuming 100 percent municipal use of the transferred storage water by Pocatello, and the effect on downstream users was computed.

The results of these sensitivity analyses are summarized in **Table 10**. The annual effect on downstream water users computed by the model is relatively insensitive to changes in the calibration parameters. In general, as the maximum farm irrigation efficiency is reduced and as the canal conveyance loss is increased, there are minor increases in the computed impact (or reductions in the computed benefit). However, when there is a decrease in the assumed maximum farm irrigation efficiency and/or an increase in the assumed canal loss, a corresponding reduction in the demand factor is necessary to keep the model in calibration.

Decreases in the demand factor below approximately 80 percent do not appear reasonable without additional supporting information. Combinations of input parameters that include a demand factor of less than 80 percent are highlighted in grey in **Table 10**. This leaves reasonable calibration parameter combinations with assumed canal losses in the range of 20 percent to 30 percent, with a 103 af/y spread between the computed effects (effects range from a benefit of 163 af/y to a benefit of 60 af/y). The 103 af/y spread between computed effects represents 3.3 percent of the 3,100 af/y proposed to be transferred indicating that the model results are relatively insensitive to alternative combinations of calibration parameters.

The proposed input parameters selected for calibration were judged to be reasonable because (a) the 30 percent canal loss used in the model calibration is in the range of the losses estimated by the NRCS, (b) the demand factor of 85 percent seems reasonable based on actual observations in the field and review of aerial photographs, which indicate that the lands under the PMVCC are not in pristine condition, and (c) the model results are relatively insensitive to alternative calibrations.

7.7.2 Sensitivity to Other Input Parameters

The sensitivity of the computed impacts to Snake River water users resulting from changes to the following other input parameters was evaluated.

- Historical reservoir spill (+/- 50%)
- On-farm surface runoff fractions (+/- 50%)
- Soil moisture reservoir capacity (+/-50%)

- Natural inflow to Chesterfield Reservoir (0 cfs, 10 cfs, 20 cfs)
- Period of Pocatello water use (Jul – Aug, year-around)

The values or text in parentheses indicates the alternative values that were evaluated. The results of the sensitivity analyses are summarized in **Table 11**. The results showed that the computed impacts to Snake River water users were relatively insensitive to changes in the historical reservoir spill, the on-farm surface runoff fractions, and the soil moisture reservoir capacity. A 50 percent increase or decrease in the computed reservoir spill during the spill years results in a change in the computed impacts by no more than two percent of the proposed 3,100 af/y annual transfer.

Fifty percent increases or decreases to the on-farm surface runoff fractions and to the soil moisture reservoir results in negligible changes to the computed impacts (< 0.1%).

As described in Section 7.4.2, a simplifying assumption was made to set the simulated natural inflow to Chesterfield Reservoir to zero during times when water was being released from the reservoir. This assumption affects the periods during which the historical natural flow diversions and storage releases were estimated to have occurred. Alternative model simulations were made with assumed natural inflows to the reservoir of 10 cfs and 20 cfs during times when water was being released from the reservoir. The results from these runs show that this assumption has little effect on the computed impacts.

Changes in the season of use of the storage water for Pocatello's proposed municipal use of the transferred water results in a minor change to the computed impacts. Changing the season from April – October to July – August results in a change in the computed impact from a net benefit of 130 af/y to an impact of 186 af/y. This represents an increase in the impacts by 316 af/y, or approximately 10 percent of the proposed 3,100 af/y transfer. Expanding the season of use to year-around results in the net benefit increasing to 357 af/y, which is a decrease of 227 af/y, or 7 percent.

8.0 Replacement of Impacts to Downstream Snake River Users

As shown in **Figure 9**, the CROM predicts that Pocatello's proposed use of the transferred Chesterfield Reservoir water may impact downstream water users on the Snake River if the City's consumptive use of the storage releases exceeds approximately 60% percent of the water used. To avoid impacts to downstream users, the City proposes to perform an accounting of its uses of the stored water and, to the extent that its consumptive use exceeds 60% percent of the water used, the City will provide replacement water to the Snake River to offset the impact. The following is an outline for the proposed replacement plan.

1. The CROM results shown in **Figure 9** will be used as indices to determine the replacement water requirement, if any, resulting from the City's use of the transferred storage water.
2. At the beginning of each year, the City will project the amount of Chesterfield Reservoir water that it plans to use in the upcoming year and the percentage of that water that will be consumed.
3. The information in **Figure 9** will be used to determine the projected annual impact to Snake River water users resulting from the proposed use. The impacts shown in **Figure 9** will be scaled downward if the City's projected annual use is less than 3,100 acre-feet. Note that **Figure 9** includes replacement requirements (a) with construction of the proposed PMVC improvements (canal loss = 6 percent), and (b) without the proposed improvements (canal loss = 30 percent).
4. If the projected effect is a positive number (impact), then the City will make available an amount of water equal to the injurious impact as replacement water to be allocated to the affected Snake River water user(s) by IDWR.
5. At the end of each year, the City will determine the actual volume of Chesterfield Reservoir storage used by the City and the percentage of that water that was consumed. These figures will be used to determine the actual amount of replacement water that might be owed for the year. Any difference between the amount of replacement water actually made available to the Snake River water users, and the replacement water requirement determined at the end of the year will resolved in accordance with IDWR procedure.

9.0 Proposed Terms and Conditions

Pursuant to the Storage Water Agreement, the PMVCC will deliver the Acquired Storage Water Rights to Pocatello at rates of up to 50 cfs near the headgate of the Portneuf-Marsh Valley Canal. As described above, the water will be measured at either of two Delivery Points (at a gage in the

Portneuf River or measured through the Sorenson Hydropower Facility). After being measured at the Delivery Points, the water will be left in the Portneuf River to flow downstream for re-diversion by the City at the proposed Points of Re-diversion, shown on **Figure 1**, or left in the river for the City's ARW uses.

The following terms and conditions are proposed regarding the use of the Acquired Storage Water Rights by Pocatello. These include the terms and conditions that were originally proposed in the Application Report, as well as additional proposed conditions.

1. The Acquired Storage Water Rights will be used for municipal, ground water recharge, irrigation, recreation, aesthetic, wildlife, and fish propagation purposes within the City's current and future service area, including extraterritorial service provided by the City.
2. The Acquired Storage Water Rights will be delivered by the PMVCC to Pocatello without conveyance loss at the Delivery Points located near the PMVCC Canal headgate.
3. Diversions to storage from Toponce Creek under the City's portion of Water Right 29-53 through the Toponce Feeder Canal will be limited to a total diversion rate of 164.43 cfs when combined with diversions under the remaining portion of Water Right 29-53 owned by the PMVCC.
4. Annual diversions to storage under the City's portion of Water Rights 29-53 and 29-589 will be limited to a total of 16,410 acre-feet when combined with diversions under the remaining portion of Water Rights 29-53 and 29-589 owned by the PMVCC.
5. The water measured at the Delivery Points will be left in the Portneuf River to flow downstream to Pocatello, and no transit loss should be assessed in delivering the water to Pocatello.
6. Annual delivery and use of water by Pocatello shall be limited to no more than 3,100 af/y at a rate of flow not to exceed 50 cfs.
7. During the months of July and August in each year, the quantity of storage water released to the City, when combined with the quantity of storage water released for the benefit of the PMVCC, shall not exceed 140 cfs.
8. Flows at the Delivery Points and Re-diversion Points will be measured and recorded daily. Records of the daily measurements will be summarized into monthly and annual totals and will be submitted annually to IDWR as part of the water use reporting submitted by the Watermasters for Water District 29 and 29D.
9. Pocatello will pay appropriate costs for the Watermaster services based on normal assessment procedures.

10. Pocatello will provide replacement water to offset impacts to downstream Snake River water users in accordance with the procedure described in Section 8.

In my opinion, the proposed transfer of 3,100 af/y from Chesterfield Reservoir for use by Pocatello, if operated in accordance with the above terms and conditions, will not result in injury to other water rights.

10.0 References

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Personal Communication with Ron Jolley, PMVCC Board Member.

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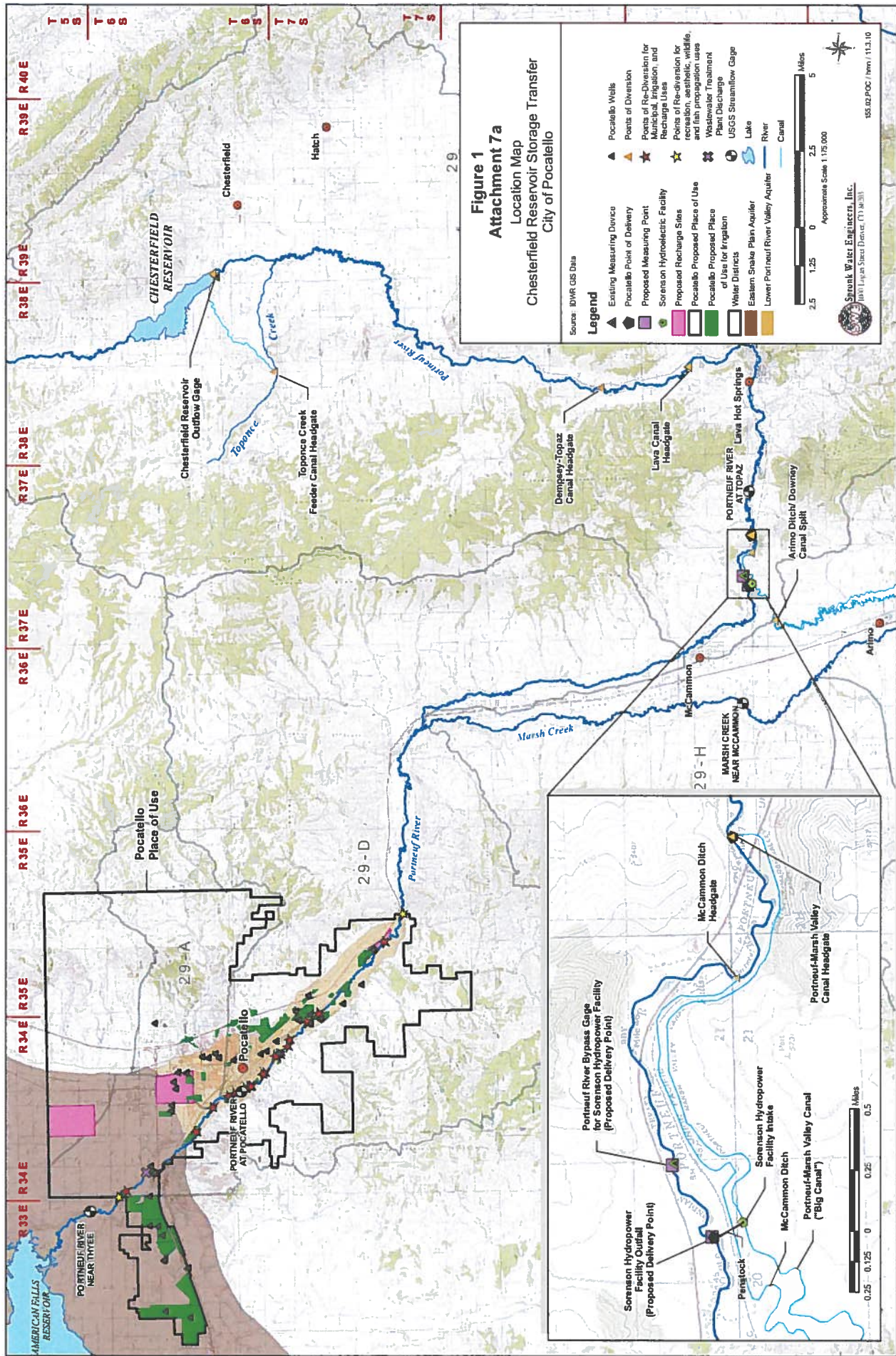
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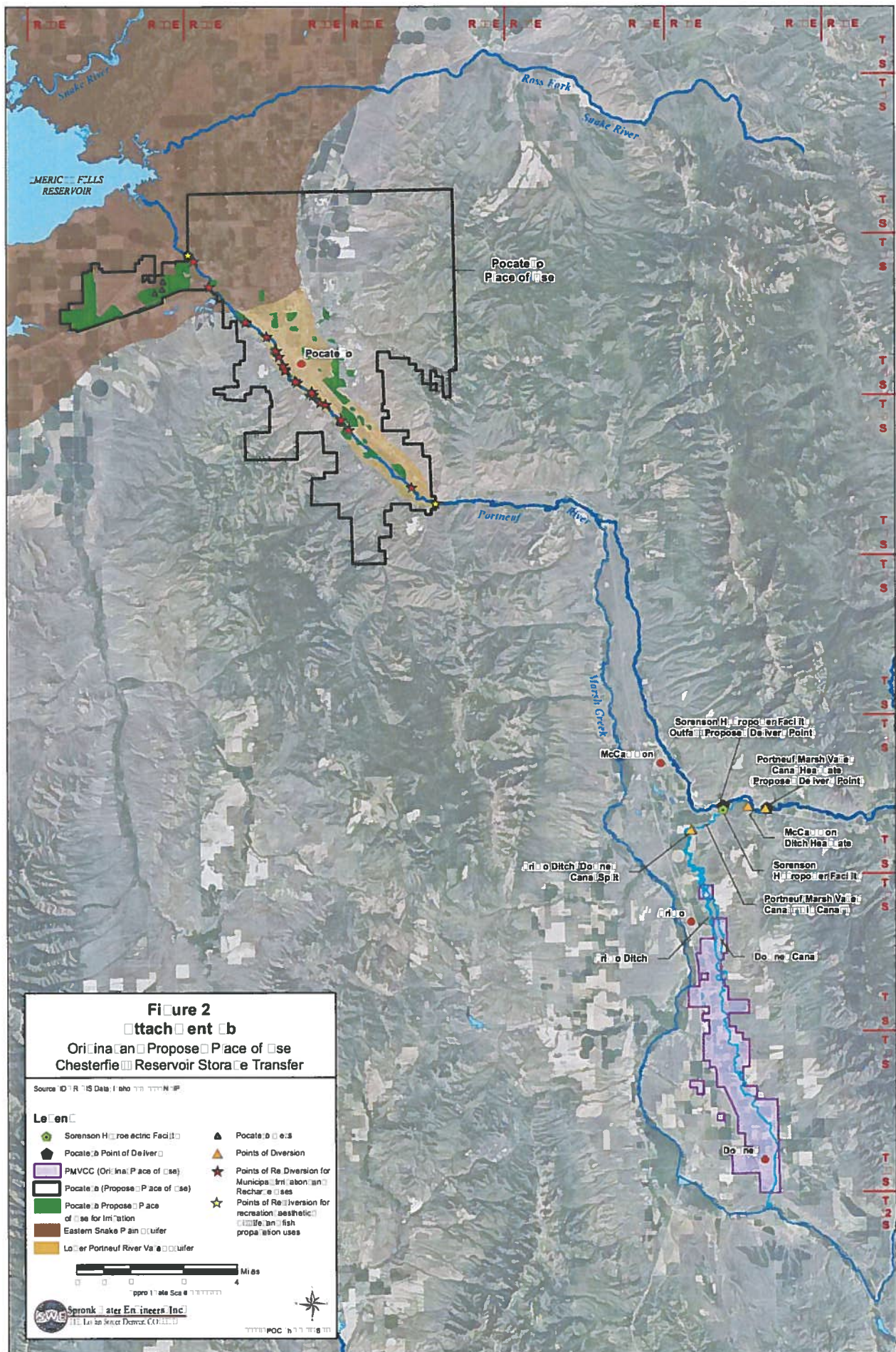
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Figures





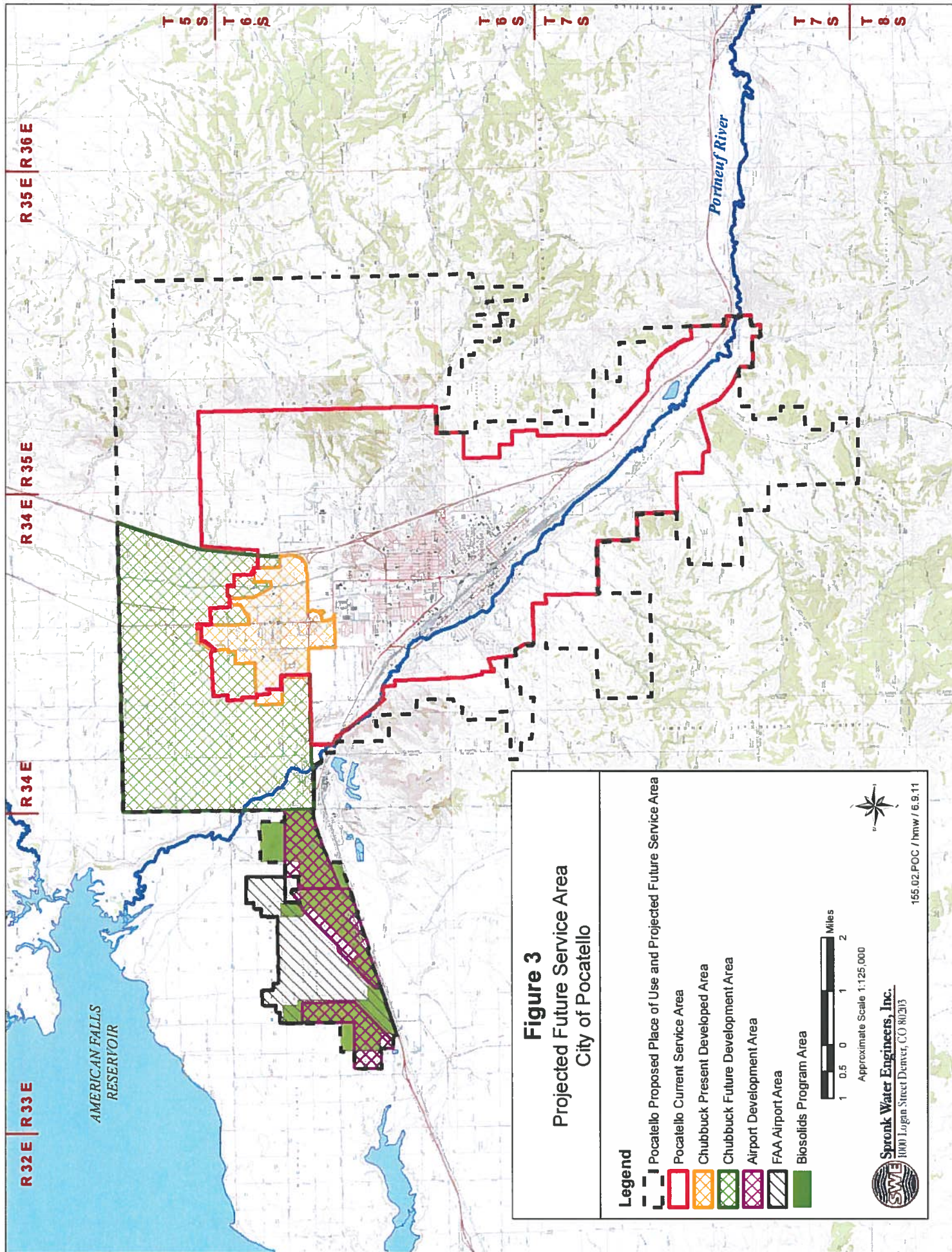


Figure 3

Projected Future Service Area City of Pocatello

Legend

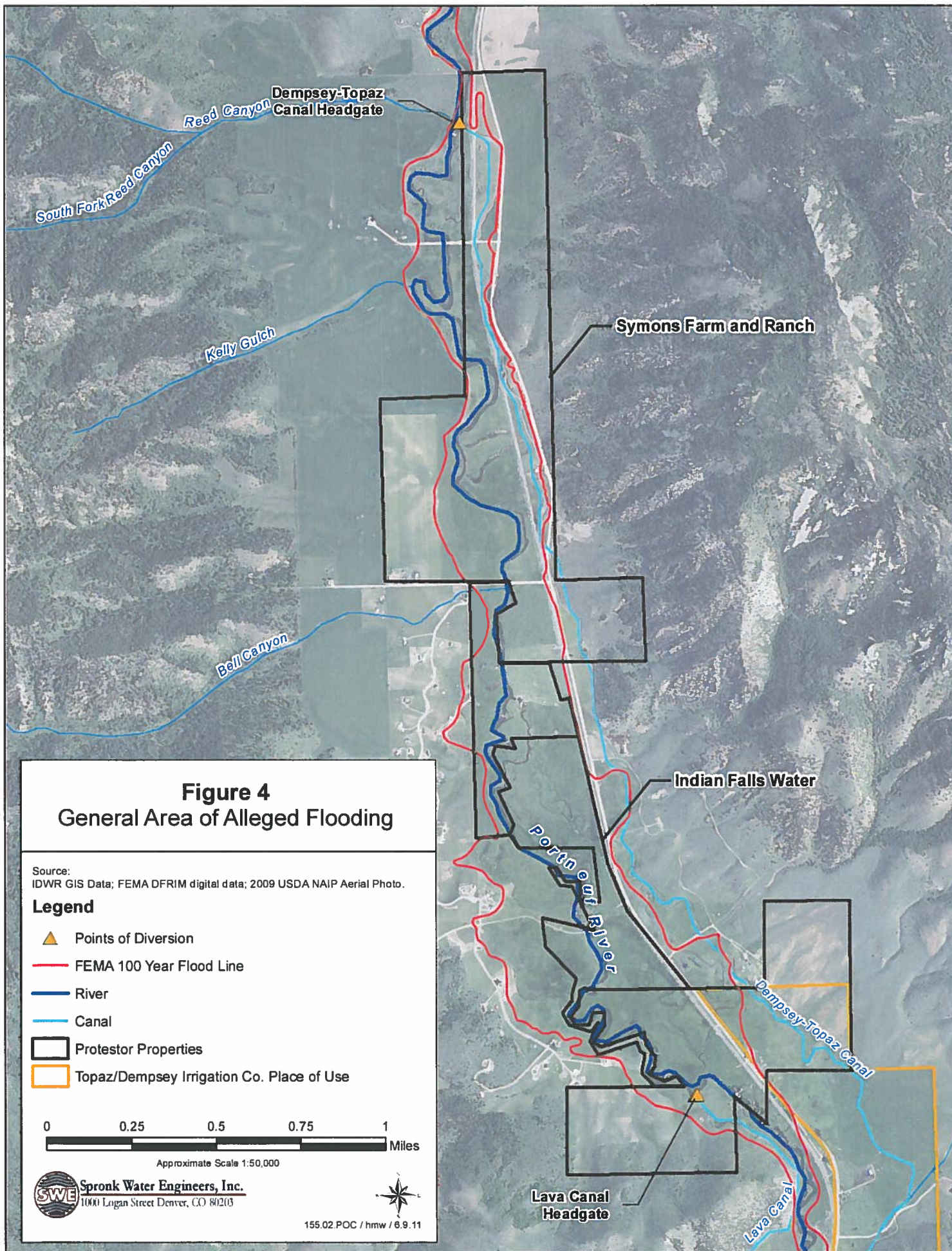
- Pocatello Proposed Place of Use and Projected Future Service Area
- Pocatello Current Service Area
- Chubbuck Present Developed Area
- Chubbuck Future Development Area
- Airport Development Area
- FAA Airport Area
- Biosolids Program Area

155.02 POC / hmw / 6.9.11

Miles
1 0.5 0 1 2

Approximate Scale 1:125,000

Sprink Water Engineers, Inc.
1000 Logan Street Denver, CO 80203



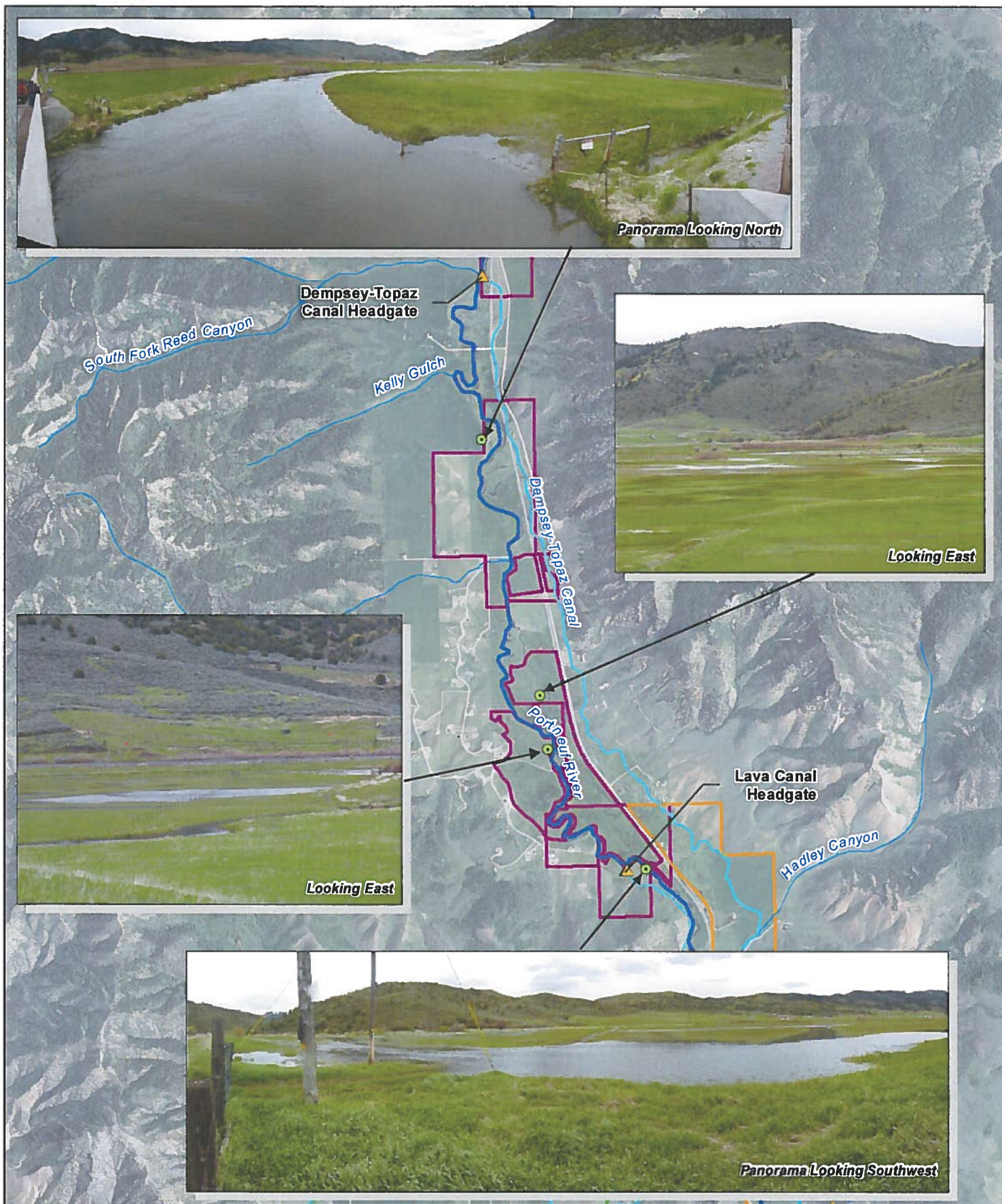
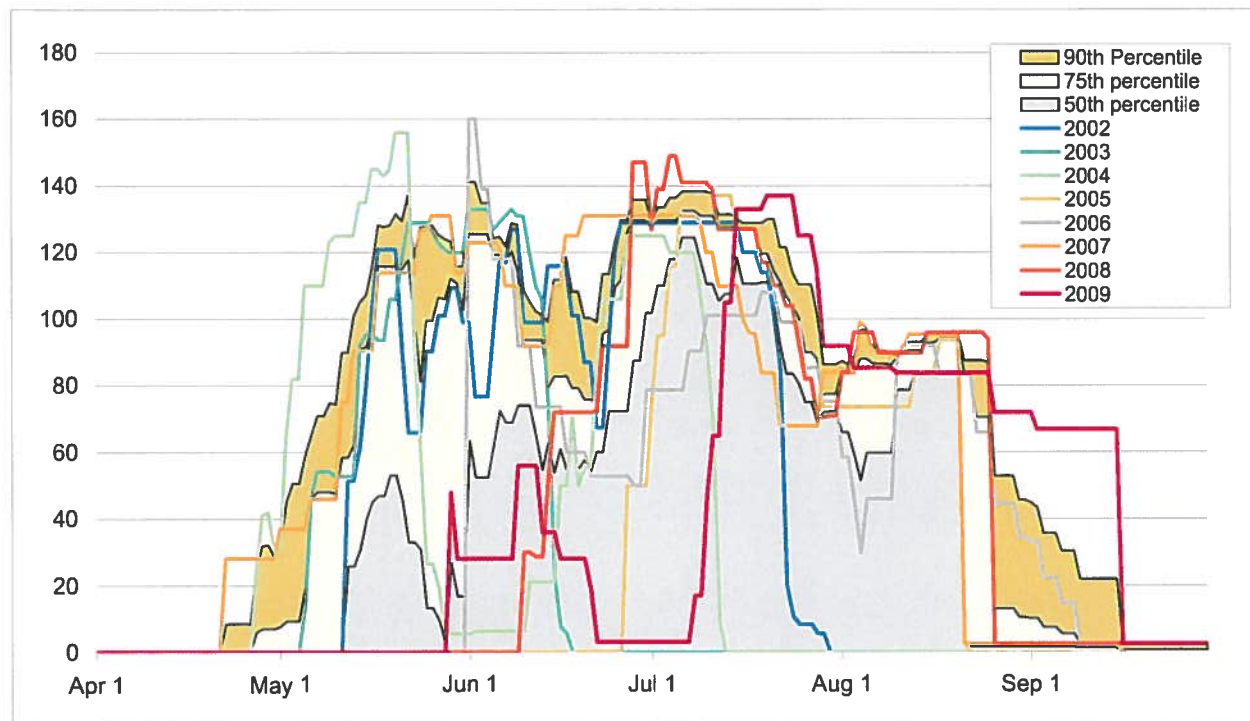


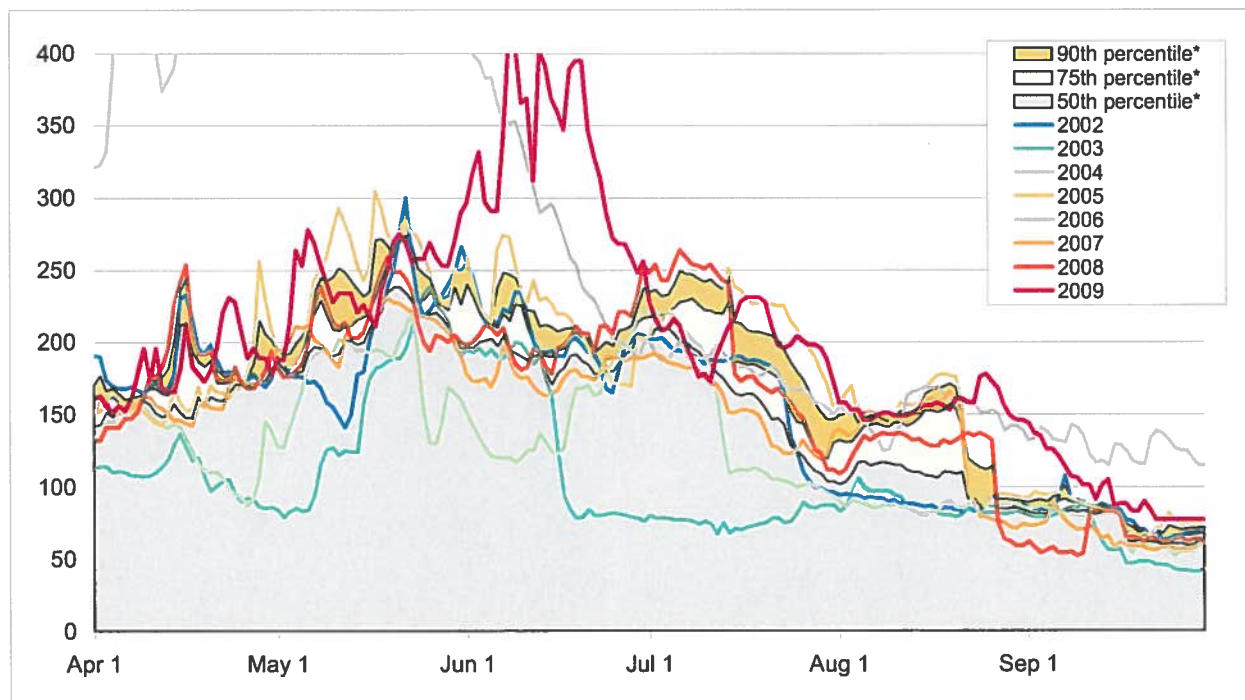
Figure 5
Photographs of Alleged Flood Prone Areas
May 19, 2011

Figure 6
Daily Releases from Chesterfield Reservoir (cfs)
2002 - 2009



Source - Water District 29 Watermaster records.

Portneuf River at Topaz Gage Flow (cfs)
2002 - 2009



Source - Water District 29 Watermaster records.

* 50th, 75th, and 90th percentile flows exclude 2006 and 2009 (2 wettest years)

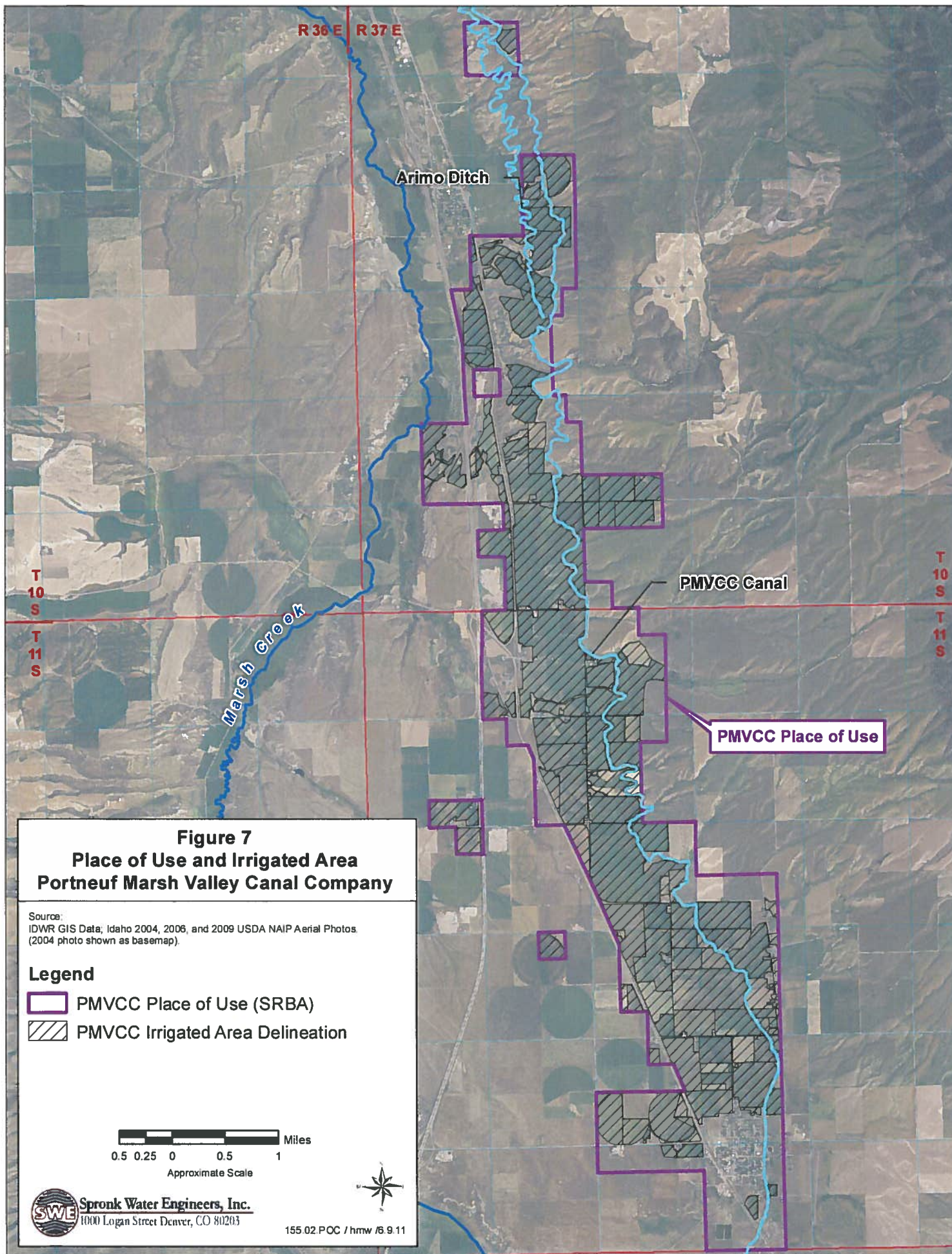
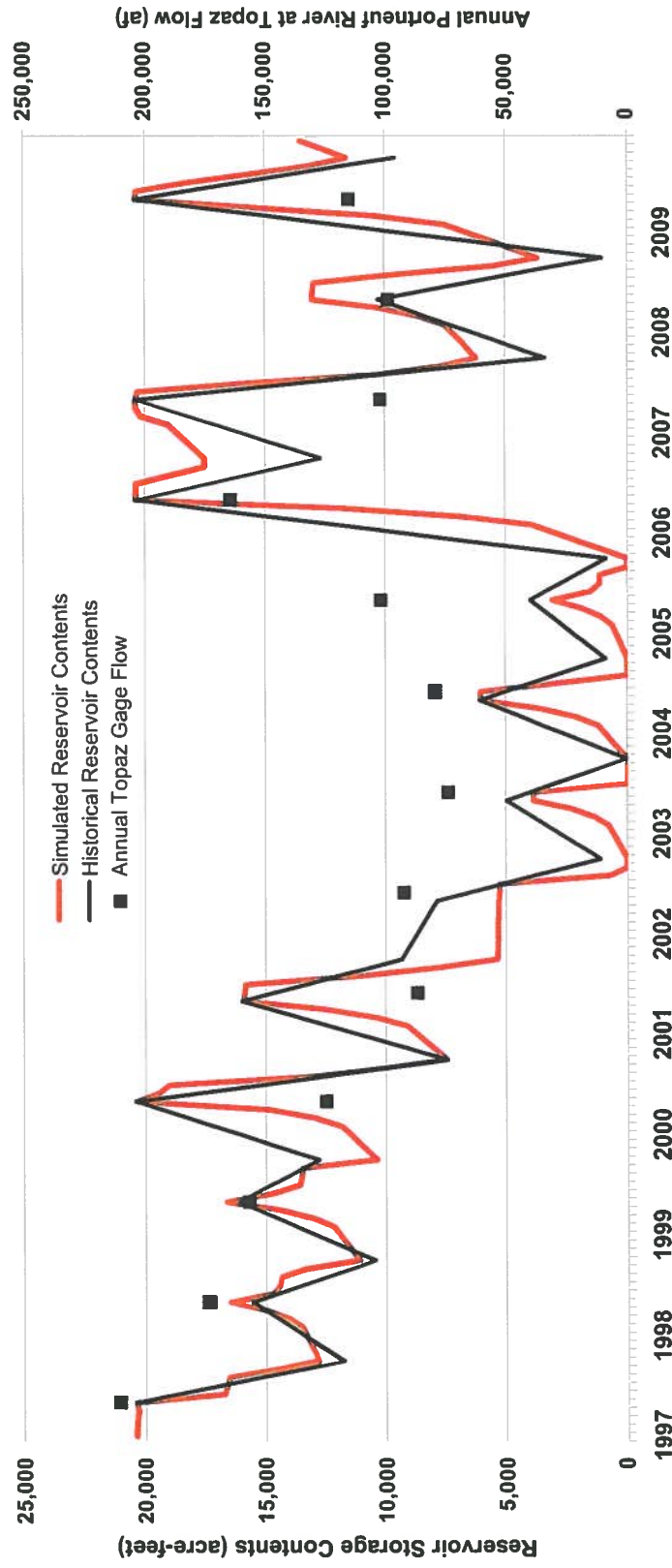


Figure 8

Summary of Calibration of Simulated Chesterfield Reservoir Contents (af)
Chesterfield Reservoir Operations Model
1997-2009



Calibration Parameters

Maximum Farm Irrigation Efficiency	85%
Canal Loss	30%
Demand Factor	85%

Calibration Statistics

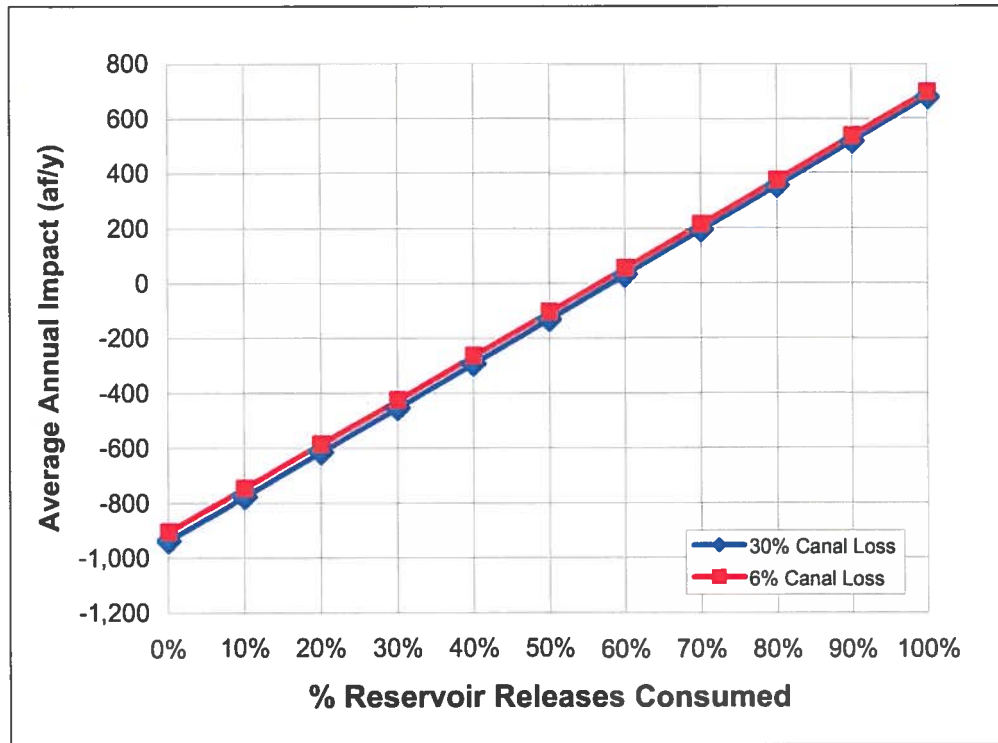
Mean Error (af)	174
Mean Absolute Error (af)	1,233
R-Squared	0.937

Notes

- (1) Historical data represents beginning and end of irrigation season reservoir contents.
- (2) Simulated data represents end-of-month reservoir contents.
- (3) Calibration statistics were computed based on the simulated and historical beginning of season and end of season contents.

Figure 9

**Average Annual Impact to Snake River Users vs.
% Chesterfield Reservoir Releases Consumed by Pocatello
(acre-feet)**



Notes:

- (1) Based on analysis using Chesterfield Reservoir Operations Model.
- (2) Annual use of 3,100 acre-feet by Pocatello every year from April - October.
- (3) Positive value means an impact to the Snake River water users.
- (4) Negative value means a benefit Snake River water users.

% CU	Average Annual Impact (ac-ft)	
	Canal Loss	
	30%	6%
0%	-939	-906
10%	-777	-746
20%	-615	-585
30%	-453	-425
40%	-291	-264
50%	-130	-104
60%	32	57
70%	194	217
80%	356	378
90%	518	538
100%	679	699

Tables

Table 1

**Summary of Water Rights
Portneuf-Marsh Valley Canal Company**

	Water Right No.	Source	Priority Date	Rate (cfs)	Annual Volume (ac-ft)	Diversion Season	Use Season
Natural Flow	29-52	Portneuf River	12/18/1907	176.85	n/a	4/15 - 9/15	4/15 - 9/15
	29-13318	Portneuf River	8/7/1932	176.85	n/a	4/1 - 10/31	4/1 - 10/31
Storage	29-53	Toponce Creek	7/6/1912	164.43	16,410	9/16 - 4/14	4/15 - 9/15
	29-589	Portneuf River	7/6/1912	n/a	16,410	1/1 - 12/31	4/15 - 9/15
	29-4060	Portneuf River Toponce Creek	4/1/1949	n/a	7,285	1/1 - 12/31	4/01 - 9/15

Source: Snake River Basin Adjudication Partial Decree.



Table 2
Summary of Issues Raised by Protestants
Chesterfield Reservoir Transfer
City of Pocatello

Issue	Surface Water Coalition*	Portneuf Watershed Users Association, Inc.	McCammon Ditch Company	Symons Farm & Ranch	John Schwarz
Injury to other water rights/enlargement in use of original water right					
River transit loss (incl. violation of IC 42-105)					
Ditch transit loss when water delivered through Sorenson Hydro					
Flooding on Portneuf River					
Adequacy of measurement					
Lack of information re: reuse of return flows, exchange, and mitigation					
Use of water by reuse, exchange or mitigation					
Explanation of re-diversion points					
Additional administrative burdens					
Need for "Federal Impact Statement" and "Federal Impact Hydrologic Statement"					
Year round use					
Effects with sediment discharge/TMDL					
Changes to over-adjudicated water system					
Mossing/aquatic plant growth					
Poor river maintenance					
Loss of recharge					
Water stacking					
Proof of Pocatello storage capacity					
Municipal need					
Effect of dryup on people of south Bannock County					
Amount of storage acquired					
No prior authorization or consent to use water					

* A&B Irrigation District, Burley Irrigation District, Milner Irrigation District, North Side Canal Company, and Twin Falls Canal Company.

Table 3

**Points of Re-diversion
City of Pocatello**

Municipal, Irrigation, and Recharge Uses

Point of Re-diversion	Location (1)	County
POD No. 1	T7S, R35E, Sec. 21, NW¼, NE¼, NW¼	Bannock
POD No. 2	T7S, R34E, Sec. 1, SE¼, SE¼, SE¼	Bannock
POD No. 3	T7S, R34E, Sec. 1, NE¼, NW¼, SE¼,	Bannock
POD No. 4	T6S, R34E, Sec. 36, SW¼, SW¼, SW¼	Bannock
POD No. 5	T6S, R34E, Sec. 35, NW¼, SE¼, SE¼	Bannock
POD No. 6	T6S, R34E, Sec. 35, NW¼, NW¼, SE¼	Bannock
POD No. 7	T6S, R34E, Sec. 35, NW¼, NW¼, SE¼	Bannock
POD No. 8	T6S, R34E, Sec. 35, SE¼, SE¼, NW¼	Bannock
POD No. 9	T6S, R34E, Sec. 34, NE¼, NE¼, NE¼	Bannock
POD No. 10	T6S, R34E, Sec. 34, NE¼, NE¼, NE¼	Bannock
POD No. 11	T6S, R34E, Sec. 27, NW¼, NW¼, SE¼	Bannock
POD No. 12	T6S, R34E, Sec. 27, NW¼, NW¼, SE¼	Bannock
POD No. 13	T6S, R34E, Sec. 27, SE¼, SE¼, NW¼	Bannock
POD No. 14	T6S, R34E, Sec. 27, NW¼, NE¼, NW¼	Bannock
POD No. 15	T6S, R34E, Sec. 22, NE¼, SW¼, SW¼	Bannock
POD No. 16	T6S, R34E, Sec. 21, NW¼, SE¼, NE¼	Bannock
POD No. 17	T6S, R34E, Sec. 16, NW¼, SW¼, SW¼	Bannock
POD No. 18	T6S, R34E, Sec. 7, SE¼, SW¼, NE¼	Bannock
POD No. 19	T6S, R34E, Sec. 6, SE¼, SW¼, NW¼	Power

Recreation, Aesthetic, Wildlife, and Fish Propagation Uses

Point of Re-diversion	Location (1)	County
Upstream terminus	T7S, R35E, Sec. 22, SE¼, NW¼, SW¼	Bannock
Downstream terminus	T6S, R34E, Sec. 6, SW¼, NW¼, NW¼	Power

Notes:

(1) Township, Range, Section, ¼¼¼ Section (10 ac), ¼¼ Section (40 ac), ¼ Section (160 ac).



Table 4

**Summary of Chesterfield Reservoir Storage Records
1997 - 2009**

Date	(1,2) Beg of Season Gage Height (feet)	(1) End of Season Gage Height (feet)	(3) Beg of Season Storage (ac-ft)	(3) End of Season Storage (ac-ft)	(4) Storage Used (ac-ft)
1997	46.6	38.8	20,405	11,757	8,648
1998	42.6	37.3	15,554	10,448	5,106
1999	43.1	39.9	16,107	12,784	3,323
2000	46.6	33.3	20,405	7,438	12,967
2001	43.0	35.9	15,995	9,317	6,679
2002	33.9	17.5	7,847	1,083	6,764
2003	29.1	0.0	4,967	0	4,967
2004	31.1	16.3	6,061	875	5,186
2005	27.0	16.1	3,969	844	3,125
2006	46.6	39.8	20,405	12,688	7,717
2007	46.6	25.5	20,405	3,345	17,061
2008	37.1	17.1	10,281	1,011	9,270
2009	46.6	36.2	20,405	9,552	10,853
Avg			14,062	6,242	7,820
Max			20,405	12,784	17,061
Min			3,969	0	3,125

Notes:

- (1) Beginning and End of Season Gage Height reported by Ron Jolley, PMVCC Board member, from PMVCC minutes.
- (2) When reservoir was reported full, 46.6 gage height is assumed, based on the 1997 Chesterfield Reservoir stage-capacity curve.
- (3) Beginning and End of Season Storage determined from the reported gage height and the 1997 Chesterfield Reservoir stage-capacity curve.
- (4) Storage Used computed as the End of Season Storage minus the Beg of Season Storage.

Table 5

**Monthly Computed Crop Irrigation Requirements (in)
Portneuf-Marsh Valley Canal Company**

Year	May	Jun	Jul	Aug	Sep	Total
1997	5.6	5.1	6.0	3.0	2.6	22.3
1998	2.7	5.8	7.2	4.8	3.5	24.0
1999	3.0	6.2	6.7	3.7	4.8	24.4
2000	6.3	7.7	9.2	4.8	3.8	31.8
2001	7.4	7.9	7.9	4.9	3.8	31.9
2002	4.6	6.7	7.4	4.5	3.5	26.8
2003	5.9	7.5	8.7	4.1	4.4	30.6
2004	4.9	6.5	7.1	4.3	3.4	26.2
2005	4.6	5.1	6.9	6.1	3.0	25.6
2006	5.4	8.0	7.4	4.5	2.9	28.1
2007	6.9	7.2	8.4	4.4	3.4	30.2
2008	2.3	7.7	7.7	6.4	4.1	28.1
2009	4.6	6.7	7.4	4.5	3.8	27.1
Avg	4.9	6.8	7.5	4.6	3.6	27.5
Min	2.3	5.1	6.0	3.0	2.6	22.3
Max	7.4	8.0	9.2	6.4	4.8	31.9



Table 6

**Monthly Computed Crop Irrigation Requirements (af)
Portneuf-Marsh Valley Canal Company**

Year	May	Jun	Jul	Aug	Sep	Total
1997	2,393	2,186	2,533	1,274	1,091	9,477
1998	1,146	2,457	3,061	2,058	1,467	10,189
1999	1,281	2,616	2,865	1,564	2,030	10,356
2000	2,675	3,267	3,933	2,027	1,620	13,523
2001	3,150	3,339	3,370	2,078	1,620	13,558
2002	1,953	2,852	3,147	1,933	1,508	11,394
2003	2,493	3,199	3,690	1,756	1,875	13,013
2004	2,081	2,767	3,016	1,847	1,430	11,142
2005	1,953	2,163	2,925	2,573	1,256	10,870
2006	2,296	3,403	3,151	1,895	1,225	11,970
2007	2,944	3,053	3,556	1,850	1,441	12,844
2008	968	3,263	3,280	2,703	1,723	11,938
2009	1,953	2,852	3,147	1,933	1,620	11,506
Avg	2,099	2,878	3,206	1,961	1,531	11,675
Min	968	2,163	2,533	1,274	1,091	9,477
Max	3,150	3,403	3,933	2,703	2,030	13,558



Table 7

Summary of Results
from Pocatello's Transfer of Chesterfield Reservoir Storage
Chesterfield Reservoir Operations Model
100% Municipal Use

Selected Input Parameters

PMVCC Irrigation Use		City of Pocatello Use	
Irrigated Area (ac)	5,103	Reservoir Use (af)	3100
Conveyance Loss	30%	Municipal Use (% total)	100%
Farm Irrigation Efficiency	85%	Raw Irrigation Use (% total)	0%
Demand Factor	15%	In-Stream Use (% total)	0%
		Indoor Returns	90%
		Irrigation Returns	20%

Average Annual Results (af)

	Pre- Transfer	Post- Transfer	Average Change	Average Effect ⁽²⁾
Diversions to Storage	6,953	7,186	233	142
Releases from Storage				
To PMVCC	7,236	4,365	-2,871	
To Pocatello	0	3,080	3,080	
Total	7,236	7,444	208	
Consumptive Use of Storage				
PMVCC	640	563	-77	
Pocatello	0	1,502	1,502	
Total	640	2,065	1,425	
Returns of Storage Water				
PMVCC	2,603	1,570	-1,033	
Pocatello	0	1,578	1,578	
Total	2,603	3,148	545	272
Annual Depletions⁽¹⁾	4,350	4,038	-312	-130 (Net Benefit)

Notes

- (1) Depletions = Diversions to Storage minus Returns of Storage Water
(2) Positive Effect = Increase in depletions; decrease in supply resulting in an impact to downstream users.
Negative Impact = Decrease in depletions; increase in supply resulting in a benefit to downstream users.

Simulated Chesterfield Reservoir Contents (af)

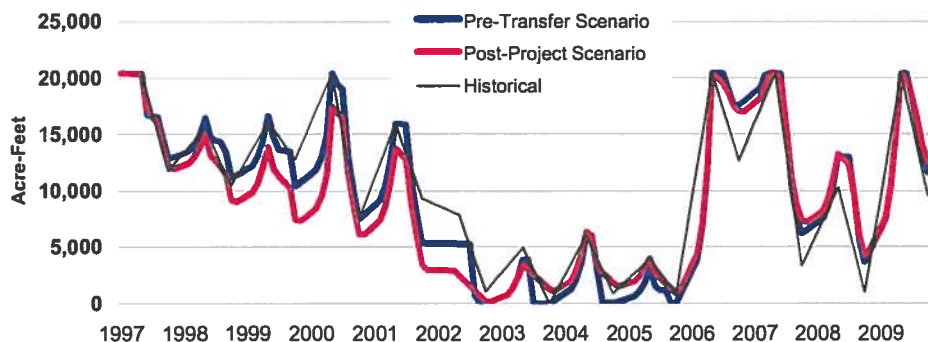


Table 8

Summary of Results
from Pocatello's Transfer of Chesterfield Reservoir Storage
Chesterfield Reservoir Operations Model
100% Irrigation Use

Selected Input Parameters

PMVCC Irrigation Use		City of Pocatello Use	
Irrigated Area (ac)	5,103	Reservoir Use (af)	3100
Conveyance Loss	30%	Municipal Use (% total)	0%
Farm Irrigation Efficiency	85%	Raw Irrigation Use (% total)	100%
Demand Factor	15%	In-Stream Use (% total)	0%
		Indoor Returns	90%
		Irrigation Returns	20%

Average Annual Results (af)

	Pre- Transfer	Post- Transfer	Average Change	Average Effect ⁽²⁾
Diversions to Storage	6,953	7,159	206	134
Releases from Storage				
To PMVCC	7,236	4,606	-2,630	
To Pocatello	0	2,853	2,853	
Total	7,236	7,459	223	
Consumptive Use of Storage				
PMVCC	640	568	-72	
Pocatello	0	2,282	2,282	
Total	640	2,851	2,210	
Returns of Storage Water				
PMVCC	2,603	1,657	-946	
Pocatello	0	571	571	
Total	2,603	2,228	-376	-219
Annual Depletions⁽¹⁾	4,350	4,931	582	353 (Net Impact)

Notes

- (1) Depletions = Diversions to Storage minus Returns of Storage Water
(2) Positive Effect = Increase in depletions; decrease in supply resulting in an impact to downstream users.
Negative Impact = Decrease in depletions; increase in supply resulting in a benefit to downstream users.

Simulated Chesterfield Reservoir Contents (af)

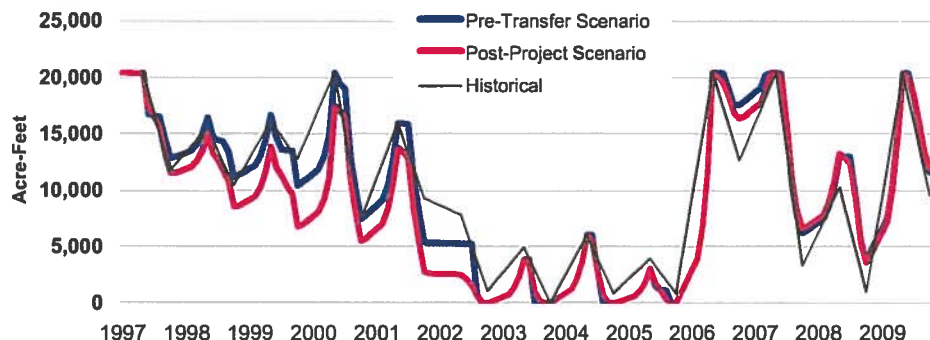


Table 9

Summary of Results
from Pocatello's Transfer of Chesterfield Reservoir Storage
Chesterfield Reservoir Operations Model
100% ARW Use

Selected Input Parameters

PMVCC Irrigation Use		City of Pocatello Use	
Irrigated Area (ac)	5,103	Reservoir Use (af)	3100
Conveyance Loss	30%	Municipal Use (% total)	0%
Farm Irrigation Efficiency	85%	Raw Irrigation Use (% total)	0%
Demand Factor	15%	In-Stream Use (% total)	100%
		Indoor Returns	90%
		Irrigation Returns	20%

Average Annual Results (af)

	Pre- Transfer	Post- Transfer	Average Change	Average Effect ⁽²⁾
Diversions to Storage	6,953	7,186	233	142
Releases from Storage				
To PMVCC	7,236	4,365	-2,871	
To Pocatello	0	3,080	3,080	
Total	7,236	7,444	208	
Consumptive Use of Storage				
PMVCC	640	563	-77	
Pocatello	0	0	0	
Total	640	563	-77	
Returns of Storage Water				
PMVCC	2,603	1,570	-1,033	
Pocatello	0	3,080	3,080	
Total	2,603	4,650	2,047	1,054
Annual Depletions⁽¹⁾	4,350	2,536	-1,814	-912 (Net Benefit)

Notes

- (1) Depletions = Diversions to Storage minus Returns of Storage Water
 (2) Positive Effect = Increase in depletions; decrease in supply resulting in an impact to downstream users.
 Negative Impact = Decrease in depletions; increase in supply resulting in a benefit to downstream users.

Simulated Chesterfield Reservoir Contents (af)

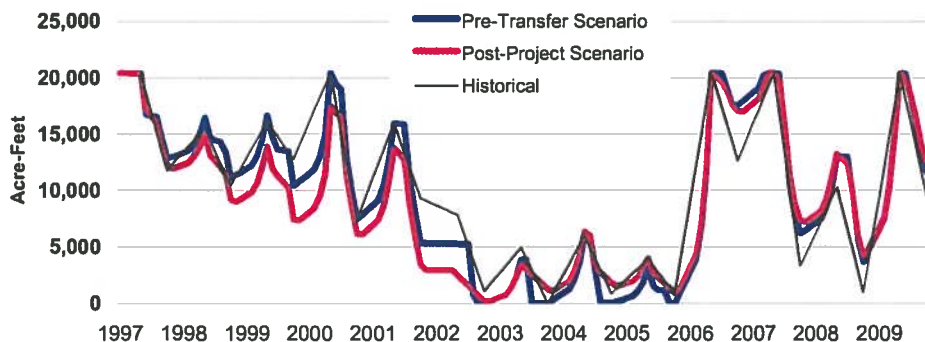


Table 10

**Sensitivity Analysis
Alternative Model Calibrations
Chesterfield Reservoir Operations Model**

Calibration Parameters (1)			CIR Multiplier	Average Effect(2) (af/y)
Farm Efficiency	Canal Loss	Demand Factor		

Proposed Calibration

85%	30%	85%	1.43	-130
------------	------------	------------	-------------	-------------

85% Farm Irrigation Efficiency

85.0%	20.0%	97.1%	1.43	-163
85.0%	30.0%	85.0%	1.43	-130
85.0%	40.0%	72.9%	1.43	-87
85.0%	50.0%	60.7%	1.43	-27

80% Farm Irrigation Efficiency

80.0%	20.0%	91.4%	1.43	-111
80.0%	30.0%	80.0%	1.43	-80
80.0%	40.0%	68.6%	1.43	-40
80.0%	50.0%	57.1%	1.43	16

75% Farm Irrigation Efficiency

75.0%	20.0%	85.7%	1.43	-60
75.0%	30.0%	75.0%	1.43	-31
75.0%	40.0%	64.3%	1.43	7
75.0%	50.0%	53.6%	1.43	57

Notes

- (1) These combinations of irrigation system parameters will calibrate the simulated historical reservoir releases in the Chesterfield Reservoir Operations Model to the same degree (97% correlation coefficient).
- (2) Average annual effect on downstream Snake River water users assuming 100% municipal use of 3,100 af/y of Chesterfield Reservoir releases by the City of Pocatello.
Positive Effect = Decrease in supply resulting in an impact to downstream users.
Negative Impact = Increase in supply resulting in a benefit to downstream users.
- (3) Calibration parameters in the shaded area require a demand factor less than or equal to 75% to calibrate the model.



Table 11

**Sensitivity Analysis
Selected Input Parameters
Chesterfield Reservoir Operations Model**

Parameter Multiplier	Parameter Value	Average Effect (af/y)	Change (% of 3,100 af/y)
<i>Chesterfield Reservoir Spill Volume (af/y)</i>			
1.5	10,071	-68	2.0%
1.0	6,714	-130	
0.5	3,357	-152	-0.7%
<i>On-Farm Surface Runoff (% Loss)</i>			
1.5	30%	-128	0.1%
1.0	20%	-130	
0.5	10%	-132	-0.1%
<i>Soil Moisture Reservoir Capacity (inches)</i>			
1.5	9.0	-130	0.0%
1.0	6.0	-130	
0.5	3.0	-130	0.0%
<i>Natural Inflow to Reservoir During Releases (cfs)</i>			
	0	-130	
	10	-130	0.0%
	20	-113	0.6%
<i>Pocatello Municipal Use Period</i>			
	Jul-Aug	186	10.2%
	Apr-Oct	-130	
	Jan-Dec	-357	-7.3%

Notes

- (1) The sensitivity analyses were conducted by making alternative runs of the base run of the CROM (100% municipal use by Pocatello) by varying the selected input parameters individually.
- (2) The numeric parameters were varied by +/- 50 percent, and the computed average annual impact to Snake River water users was determined (col. 3). The exception to this was the simulated natural inflow to Chesterfield Reservoir that was set to 10 cfs and 20 cfs in the sensitivity runs.
- (3) The change in the computed impact as a percentage of the 3,100 af/y proposed transfer is also shown (col. 4).

