RECEIVED
MAY 06 2013
DEPARTMENT OF
WATER RESOURCES

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

IN THE MATTER OF DISTRIBUTION FOR WATER TO WATER RIGHT NOS. 36-02551 AND 36-07694 (RANGEN, INC.)	**SPRONK WATER ENGINEERS, INC. EXPERT SUPPLEMENTAL REPORT DATED MAY 5, 2013 PREPARED FOR THE CITY OF POCATELLO**

Gregory K. Sullivan, P.E.
Spronk Water Engineers, Inc.
1000 Logan Street
Denver, Colorado 80203

Table of Contents

1.0 Introduction 1
2.0 Response to Brockway Supplemental Expert Report 2
3.0 Disaggregation of Rangen Water Supply 5
4.0 Effect of Curtailment on the Curren Tunnel Flow 7
5.0 References 10

Figure

Figure 1 Total Curren Tunnel Flow vs. Total Curren Spring Flow Regression, September 1993 – 2011

Appendix

Appendix A Rangen Flow Data Tables

Updated Figures[1]

Figure 2-3 Points of Diversion and Place of Use, 1962 and 1977 Water Rights, Rangen Inc.

Figure 2-7 Monthly Average Rangen Hatchery Flow vs. Curren Tunnel and Other Springs

Figure 2-5a Monthly Average Flow, Rangen Hatchery, 1966 - 2012

Figure 2-5b Monthly Average Flow, Rangen Hatchery, 1966 - 2012

Figure 2-5c Annual Average Flow, Rangen Hatchery, 1966 - 2012

Figure 2-6a Monthly Average Flows, Total Curren Tunnel (Predicted), 1966 – 1975

Figure 2-6b Monthly Average Flows, Total Curren Tunnel to Rangen (Predicted), 1966 – 1975

Figure 2-1 ESPAM 2.1 Predicted Increases in Spring Flows and River Reach Gains at Steady State from Curtailment of All ESPA Ground Water Rights Junior to July 13, 1962

[1] Except for Figure 1, all figures are updated versions of figures contained in prior SWE expert reports prepared on behalf of Pocatello for the Rangen Delivery Call. The figures are listed in the order referenced in the text of this report.

Figure 2-2 Predicted Increase in Curren Spring Flow at Steady State from Curtailment of Ground Water Rights Junior to July 13, 1962

Figure 8-1a Summary of Transient Response of Curren Spring to Pocatello ESPA Wells, Eastern Snake Plain Aquifer Model Version 2.1

Figure 8-2a Summary of Transient Response Curren Spring to Curtailment of Pocatello ESPA Wells with Priority Dates Junior to July 13, 1962, Eastern Snake Plain Aquifer Model Version 2.1

Figure 8-3a Curtailment Area for Different Assumed Trim Lines, Curtailment of Ground Water Rights Junior to July 13, 1962

Figure 8-4a Response of Curren Spring to Curtailment with Various Trim Lines, Eastern Snake Plain Aquifer Model Version 2.0

Updated Tables[2]

Table 2-1 Predicted Increase in Flow at Steady State from Curtailment of All ESPA Ground Water Rights Junior to July 13, 1962

Table 2-3 Predicted Increase in Curren Spring Flow at Steady State from Curtailment of Ground Water Rights Junior to July 13, 1962

[2] The tables are updated versions of tables contained in prior SWE expert reports prepared on behalf of Pocatello for the Rangen Delivery Call. The tables are listed in the order referenced in the text of this report.

Expert Supplemental Report
Dated May 5, 2013
Prepared for the
City of Pocatello

1.0 Introduction

On December 13, 2011, Rangen, Inc. ("Rangen") filed a Petition for Delivery Call ("Rangen Petition," or "Rangen Call") with the Idaho Department of Water Resources ("IDWR") seeking curtailment of ground water rights in the Eastern Snake Plain Aquifer ("ESPA") with priority dates junior to Rangen's Water Right Nos. 36-02551 (July 13, 1962 priority) and 36-07694 (April 12, 1977 priority). Spronk Water Engineers, Inc. ("SWE") has prepared the following expert reports for the Rangen Call on behalf of the City of Pocatello:

- Expert Report dated December 21, 2012 ("2012 Expert Report")
- Expert Rebuttal Report dated February 7, 2013 ("2013 Expert Rebuttal Report")
- Expert Response to IDWR Staff Memorandum dated April 5, 2013 ("2013 Response Report")

On April 22, 2013, the IDWR Director issued an Order Granting in Part and Denying in Part Rangen, Inc.'s Motion for Partial Summary Judgment Re: Source related to the source and point of diversion for Rangen's water rights ("April 2013 Order"). The ruling confirmed that the source of water for Rangen's water rights is the Martin-Curren Tunnel ("Curren Tunnel") and the point of diversion is limited to locations within a 10-acre tract of land identified as the SW1/4 of the SW1/4 of the NW1/4 of Section 32, Township 7 South, Range 14 East ("10-acre Tract"). An updated **Figure 2-3** from the 2013 Response Report is attached showing the location of the Curren Tunnel and the 10-acre Tract.

In response to the April 2013 Order, Rangen's expert, Dr. Charles Brockway, conducted flow measurements at the Rangen Hatchery and prepared a supplemental expert report with new opinions ("Brockway Supplemental Report").

I have prepared this report to respond to the data and opinions contained in the Brockway Supplemental Report. In addition, in response to the April 2013 Order, I have revised several of the figures and tables that were included in my prior reports to disaggregate Rangen's total historical water supply into the portion that was derived from the Curren Tunnel source and the portion that was derived from other sources and which historically has been diverted by Rangen at its Large Raceway Diversion located outside of the 10-acre Tract. None of the opinions contained in my prior reports have changed as a result of the additional information provided herein.

2.0 Response to Brockway Supplemental Expert Report

On April 22, 2013 Dr. Brockway visited the Rangen Hatchery to observe and measure the flows of the Curren Spring complex that supplies the fish propagation and domestic water uses at the Rangen Research Hatchery ("Rangen Hatchery"). The purpose of his visit was to identify and quantify the portion of Rangen's water supply that originates within the 10-acre Tract. During his site visit, Dr. Brockway walked along the Rangen's water delivery pipelines up to the outlet of the Curren Tunnel and across other parts of the 10-acre Tract. During his walk, Dr. Brockway took digital photographs of springs and seeps that contribute to Rangen's water supply. He also measured or estimated the flow of several of the springs and seeps. There were several tables and a map included in the Brockway Supplemental Report that summarize the locations of the springs and seeps and the measured or estimated flows. Copies of the digital photographs were provided by Dr. Brockway in response to a request from Pocatello. A deposition of Dr. Brockway was held on May 1, 2013 to inquire about his site visit and supplemental report.

Exhibit C to the Brockway Supplemental Report shows the location of his flow observations and photographs. These locations are marked on Exhibit C with numbers ranging from 140 – 192, and GPS coordinates for each location are attached to the report. The numerical order of the photographs indicates the order in which the photographs were taken and the walking path that Dr. Brockway followed during the site visit. The tour started near the Hatch House and progressed along the pipes that deliver water to the Hatch House, Greenhouse, and Small Raceways up to the Curren Tunnel that is the source for these pipes and continued in a counter-

clockwise direction generally along the perimeter of the heavily vegetated area of the Curren Spring complex. The remainder of the observations and photographs were along Billingsley Creek from the area of the Large Raceway Diversion east to the confluence with the outfall from the CTR Raceways.

Dr. Brockway testified in his recent deposition that there are numerous springs that emerge from the talus slope apart from the flow of the Curren Tunnel. These springs, along with the portion of the Curren Tunnel flow that is not diverted for use in the Hatch House, Greenhouse, or Small Raceways, supply the water that is diverted at the bottom of the talus slope at the Large Raceway Diversion. Dr. Brockway testified that he was unable to easily reconnoiter these springs due to the rugged terrain and dense vegetation within portions of the talus slope. As to spring and seeps that he was able to get to, Dr. Brockway was unable to measure the flows of most of them because they were inaccessible to his flow measuring equipment.

Instead of directly measuring or estimating the spring flow that arises within the 10-acre Tract, Dr. Brockway measured or estimated the flow into Billingsley Creek below the talus slope and outside of the 10-acre Tract from various pipe outfalls, and these flows totaled 0.38 cfs. He then subtracted this amount from the total Rangen flow of 12.44 cfs on that day (comprised as the sum of the flows in the CTR Raceways and at the Lodge Dam in Billingsley Creek). The difference of 12.06 cfs, or 97 percent of the total Rangen flow, is the portion of Rangen's total water supply that Dr. Brockway claims originates from sources within the 10-acre Tract.

Dr. Brockway's approach for estimating the flow that arises within the 10-acre Tract by subtracting the discrete point inflows to Billingsley Creek outside of the 10-acre Tract from the total Rangen flow does not consider other sources of flow that make up the total Rangen flow. Most of the flow that collects at the base of the talus slope and which is available for diversion at the Large Raceway Diversion is comprised of overland flow and underflow from the talus slope. Dr. Brockway did not attempt to identify how much of this flow arises inside the 10-acre Tract as opposed to outside the 10-acre Tract.

Dr. Brockway did not address the portion of the April 2013 Order that affirmed that the source of water for Rangen's water rights is the Curren Tunnel. Rangen diverts discharges from the Curren Tunnel within the 10-acre Tract at two locations. One location is within the Curren Tunnel via a 6-inch PVC pipe that delivers water for use in the Hatch House, Greenhouse, the on-site laboratory, and for domestic uses. This pipe is referred to by Rangen as the "6-inch white pipe."

Water that is not diverted into the 6-inch white pipe flows out of the Curren Tunnel into a collection box known as the Farmers' Box. The flow of the Curren Tunnel into the Farmers' Box used to be split between Rangen and three irrigation water users with water rights senior to Rangen's 1962 priority water right. A separate water source known as the Sandy Pipeline was developed for the three irrigation users in 2003, and there have been no significant deliveries of water from the Curren Tunnel to the senior irrigation users since that time. Apart from the diversions to the farmers that ended in 2002, water delivered into the Farmers' Box either spilled onto the talus slope, or was diverted into a pipeline that extends approximately 100 feet downhill to another collection box known as the Rangen Box. From there, water is either diverted into a steel pipeline that conveys water to the Small Raceways or spills from the Rangen Box onto the talus slope.

The spills of Curren Tunnel water onto the talus slope from the Farmers' Box and the Rangen Box co-mingle with the flows of other springs, and these flows are collected at the base of the talus slope and are diverted at the Large Raceway Diversion for delivery to the Large Raceways and the CTR Raceways. The Large and CTR Raceways are also supplied from the outflow of the Small Raceways. Dr. Brockway's observations during his April 2013 site visit indicated that there were several small springs between the Farmers' Box and the Rangen Box, but that most of these did not collect in the Rangen Box and instead flowed down the talus slope.

Based on my review of Dr. Brockway's supplemental report and my other work on the Rangen Delivery Call, it is my opinion that virtually all of the water that Rangen diverts from its two existing diversion facilities within the 10-acre Tract (the 6-inch white pipe diversion from within

the Curren Tunnel and the steel pipe diversion from the Rangen Box) originates as water discharged from the Curren Tunnel. Other water that originates within the 10-acre Tract apart from the discharge of the Curren Tunnel flows down the talus slope and can only be diverted by Rangen at the Lower Raceway Diversion located outside of the 10-acre Tract.

3.0 Disaggregation of Rangen Water Supply

Rangen currently quantifies its water use based on the sum of the measured flows in the CTR Raceways and the flow over the Lodge Dam in Billinsgley Creek. The sum of these flows represents the total flow available for Rangen's use and includes (a) discharges from the Curren Tunnel, (b) other spring flows arising within the 10 acre Tract, and (c) spring flows and other flows that originate outside of the 10-acre Tract. As a result of the Director's summary judgment ruling that the water supply that Rangen is authorized to divert is limited to the flow from the Curren Tunnel, we performed an analysis to disaggregate Rangen's historical water supply into the amounts that originate at the tunnel and the amounts derived from other sources. We had previously provided this information in the 2012 Expert Report for the period since 1993 when IDWR began measuring the flow of the Curren Tunnel. The analysis described herein uses the 1993-2011 data to back-cast the Curren Tunnel flow prior to 1993 when separate measurements are not available. The back-cast analysis is similar to an analysis performed by Dr. Charles Brendecke and reported in his December 21, 2012 report prepared on behalf of the Idaho Ground Water Appropriators ("IGWA").

From 1993 – 2011, IDWR measured the flow from the Curren Tunnel based on the depth of flow in the tunnel and a stage-discharge relationship. According to IDWR, these historical measurements do not include diversions into the 6-inch white pipe. Records of the flow of the 6-inch white pipe have been reported by Rangen to IDWR, and these records are available from beginning in 1996. The total flow of the Curren Tunnel may be computed as the sum of IDWR's measurements of the tunnel flow and the measurements of the 6-inch white pipe. A summary of the Curren Tunnel flows and the total Rangen flows from 1993 – 2011 is shown in the attached updated **Figure 2-7** from the 2012 Expert Report.

The Curren Tunnel flows prior to 1993 were estimated or back-casted using a linear regression relationship between the monthly records of the Curren Tunnel flow and the total Curren Spring flow. The linear regression equation was applied to the reported monthly total Curren Spring flows from 1966 – 1992 to compute the portion of the total flow of the Curren Spring complex that came from the Curren Tunnel prior to the time that the Curren Tunnel flow data became available in 1993.

A scatter plot of the total flows of the Curren Spring complex and the Curren Tunnel is shown in the attached **Figure 1**. The linear regression equation that relates these two data sets is shown below:

Curren Tunnel Flow = 0.7488 x Total Curren Spring Flow – 5.8636

The regression relationship has an R-squared value of 0.9465, which indicates an excellent correlation between the Curren Tunnel flow and the total Curren Spring flow.

The regression equation was used to compute the monthly Curren Tunnel flows from 1966 – 1992, and the results are plotted in an updated **Figure 2-5a** from 2012 Expert Report. The Curren Tunnel flow in **Figure 2-5a** reflects the total flow of the Curren Tunnel including diversions from the Farmers' Box for irrigation prior to 2003. **Figure 2-5b** was prepared to show the historical Curren Tunnel flow that was available for use by Rangen by subtracting the estimated and actual irrigation diversions from the total Curren Tunnel flow. The monthly average flows in **Figure 2-5b** are summarized as annual average flows in **Figure 2-5c**.

There has always been significant seasonal variability in the Curren Tunnel flow. An updated **Figure 2.6a** from the 2012 Expert Report is attached and shows the computed monthly total Curren Tunnel flows for each year from 1966 – 1975 when the tunnel flow was likely at its historical peak. The portion of the historical Curren Tunnel flow from 1966 – 1975 that was available for use by Rangen is shown in **Figure 2.6b**. During this period, the Curren Tunnel flow available to Rangen generally ranged from a low of 10 to 20 cfs in May to a high of 35 to

50 cfs in October. Only in October of 1971 and 1972 was there sufficient flow from the Curren Tunnel to fully satisfy Rangen's 1962 priority water right (36-2551).

Appendix A contains tables showing the backup data for the regression analysis. In addition, tables are provided in the appendix to show the monthly figures that were plotted in the figures described above. Additional details regarding the monthly flow figures are documented in the notes at the bottom of the tables.

4.0 Effect of Curtailment on the Curren Tunnel Flow

The prior expert reports prepared on behalf of Pocatello and the IDWR staff Memorandum summarize the simulated increase in the total Curren Spring flow resulting from curtailment of ESPA ground water rights junior to July 13, 1962. As a result of the Director's April 2013 Ruling, it is necessary to estimate the portion of increased Curren Spring flow that would occur at the Curren Tunnel. This information is not directly available from the Eastern Snake Plain Aquifer Model Version 2.1 ("ESPAM 2.1") because the Curren Spring is simulated as a single drain in the model. It may be possible to modify the model to separately simulate the flows of the Curren Tunnel and the talus slope springs, but it would be necessary to reconfigure and recalibrate the model to accomplish this.

In lieu of reconfiguring and recalibrating the ESPAM 2.1, the portion of the predicted increase in the total flow of the Curren Spring as a result of curtailment that would occur at the Curren Tunnel was estimated using the regression equation described in Section 3.0. The increased flow at the Curren Spring from curtailment was computed by multiplying the predicted increase in the total Curren Spring flow from the ESPAM 2.1 curtailment run (17.9 cfs at steady state) by the slope of the regression equation (0.7488). The result is an estimated increase in the flow of the Curren Tunnel at steady state of 13.3 cfs. An updated **Table 2-1** from the 2013 Response Report showing the results of the curtailment run is attached.

As described in the 2013 Response Report, a substantial portion of the increased flow from curtailment will accrue to water rights that are junior to Rangen's July 13, 1962 priority water right. The updated **Table 2-1** shows the percentages of the combined decreed flow rates for the water rights at each spring that are junior to Rangen's July 13, 1962 priority date.

An updated **Figure 2-1** from the 2013 Response Report is attached to show the estimated increase in the Curren Tunnel flow at steady state (13.3 cfs) that would result from curtailment of ESPA ground water rights junior to July 13, 1962.

Table 2-3 and Figure 2-2 of the 2013 Response Report showed the estimated increase in the monthly flows of the Curren Spring and the Curren Tunnel from curtailment. These results were based on the regression relationship developed by Dr. Brendecke. In reviewing Table 2-3 and Figure 2-2 it was discovered that Dr. Brendecke's regression equation had been applied incorrectly to estimate the portion of the increased flow from curtailment that would accrue to the Curren Tunnel. Updated versions of **Table 2-3** and **Figure 2-2** are attached with the regression equation described in this report applied to disaggregate the total Curren Spring flow into the portion that will accrue to the Curren Tunnel and the portion that will accrue to the talus slope springs.

The red dashed line in the upper chart in **Figure 2-2** shows the increased flow at the Curren Tunnel at steady state following curtailment. The predicted increase in flow following curtailment ranges from 10 cfs during February – April to about 18 cfs during August and September.

As shown in **Figure 2.5c**, the current average annual Curren Tunnel flow is approximately 5 cfs. Adding the approximately 13 cfs of increased flow to the Curren Tunnel results in a predicted total Curren Tunnel flow of about 18 cfs at steady state following curtailment. Review of the annual flow data in **Figure 2.5c** shows that the total Curren Spring flow that Rangen has been using in recent years (a portion of which was used in violation of Rangen's water rights based on the April 2013 Order) was last at 18 cfs in 2001. This means that if curtailment was ordered as

proposed by Rangen, the flow that would be available to Rangen at steady state from the Curren Tunnel would be approximately the same flow that Rangen was using from all sources in 2001. Based on this, Rangen's historical use of water prior to 2001 would seem to be of little relevance to their delivery call as Rangen could not expect a return to conditions that existed before that time, even if the curtailment that Rangen seeks actually occurs.

Figures 8-1 and 8-2 in the 2012 Expert Report illustrated the computed benefit to the Curren Spring flow that would result from curtailment of Pocatello's wells within the ESPA Area of Common Ground Water Supply. Updated **Figures 8-1a** and **8.2a** are attached to also show the estimated increase in the flow of the Curren Tunnel that would result from curtailment of Pocatello's ESPA wells. The results in **Figures 8-2a** shows that the Curren Tunnel flow would increase by approximately 0.014 cfs at steady-state from curtailment of Pocatello's ESPA wells. This equates to an increased flow of about 6 gallons per minute, which is less than the flow of a typical garden hose.

Figure 8-3 of the 2012 Expert Report shows the location of various assumed trim lines from IDWR's ESPAM 2.1 steady-state curtailment run. An updated **Figure 8-3a** is attached to illustrate the location of the trim lines relative to accrual of water to the Curren Tunnel rather than the Curren Spring.

Figure 8-4 in the 2012 Expert Report was prepared to illustrate the steady-state accrual of water to the Curren Spring for various trim lines. The information in the original Figure 8-4 was from ESPAM 2.0 runs made by IDWR. Figure 18 of the IDWR Staff Memorandum updated the results shown in Figure 8-4 based on runs of ESPAM 2.1. An updated **Figure 8-4a** is attached that shows the ESPAM 2.1 results from the IDWR Staff Memo. In addition, the updated **Figure 8-4a** shows the estimated steady-state accrual of water to the Curren Tunnel within various trim lines. The Curren Tunnel results shown in the updated **Figure 8-4a** are based on the Curren Spring results multiplied by the slope of the Curren Tunnel regression equation described herein (0.7488).

5.0 References

The following information was relied on in preparing this report.

1. AMEC Environment & Infrastructure, ESPAM 2.1 Model results provided by AMEC for effect of curtailment after 80 years (~ steady state), January 29, 2013.

2. Brendecke, C.M., Hydrology, Water Right and Groundwater Modeling Evaluation of Rangen Delivery Call, AMEC Environment & Infrastructure, Prepared for IGWA, December 21, 2012.

3. Brockway, C.E., Supplemental Data Re: Director's Ruling on Talus Slope Springs, Prepared for Rangen, Inc., April, 24, 2013.

4. Monthly Curren Tunnel Diversions to Irrigation Rights from George Lemmon provided by Rangen, Inc. 1992 – 1996.

5. Documents disclosed by Rangen on December 26, 2012, in January 2013 (Jan 1 Upload, Jan 4 Upload, floppy discs January 8, and Jan 30 Upload), and on February 19, 2013.

6. Idaho Department of Water Resources, 2013, GIS data, Available from: http://www.idwr.idaho.gov/GeographicInfo/gisdata/gis_data.htm.

7. Idaho Department of Water Resources, Diversion records for Total Rangen Fish Hatchery flow, Site ID: 360410089, March 1995 – 2011 and diversion records for Rangen Pipe, Site ID: 360410041, 2006 – 2011 Available from: http://maps.idwr.idaho.gov/qwraccounting/wra_select.aspx

8. Idaho Department of Water Resources, Staff memorandum in response to expert reports submitted for Rangen Delivery Call (In the Matter of Distribution for Water to Water Right Nos. 36-02551 and 36-07694), February 27, 2013.

9. Idaho Department of Water Resources, Response to Information Request, March 3, 2013.

10. Idaho Department of Water Resources, Decrees and Licenses downloaded from Water Right and Adjudication Database, 2013. Available from: http://www.idwr.idaho.gov/apps/ExtSearch/WRAJSearch/WRADJSearch.aspx.

11. Idaho Department of Water Resources, Order Granting in Part and Denying in Part Rangen, Inc.'s Motion for Partial Summary Judgment, Re: Source, April 22, 2013.

12. Photographs from Dr. Brockway in support of his supplemental data, Re: Director's Ruling on Talus Slope Springs, April 22, 2013.

13. Sullivan, G.K., Spronk Water Engineer's Expert Report In Matter of Distribution of Water to Rangen, Inc's Water Right Nos. 36-02551 and 36-07694, Prepared for Pocatello, December 21, 2012.

14. Sullivan, G.K., Spronk Water Engineer's Expert Rebuttal Report In Matter of Distribution of Water to Rangen, Inc's Water Right Nos. 36-02551 and 36-07694, Prepared for Pocatello, February 7, 2013.

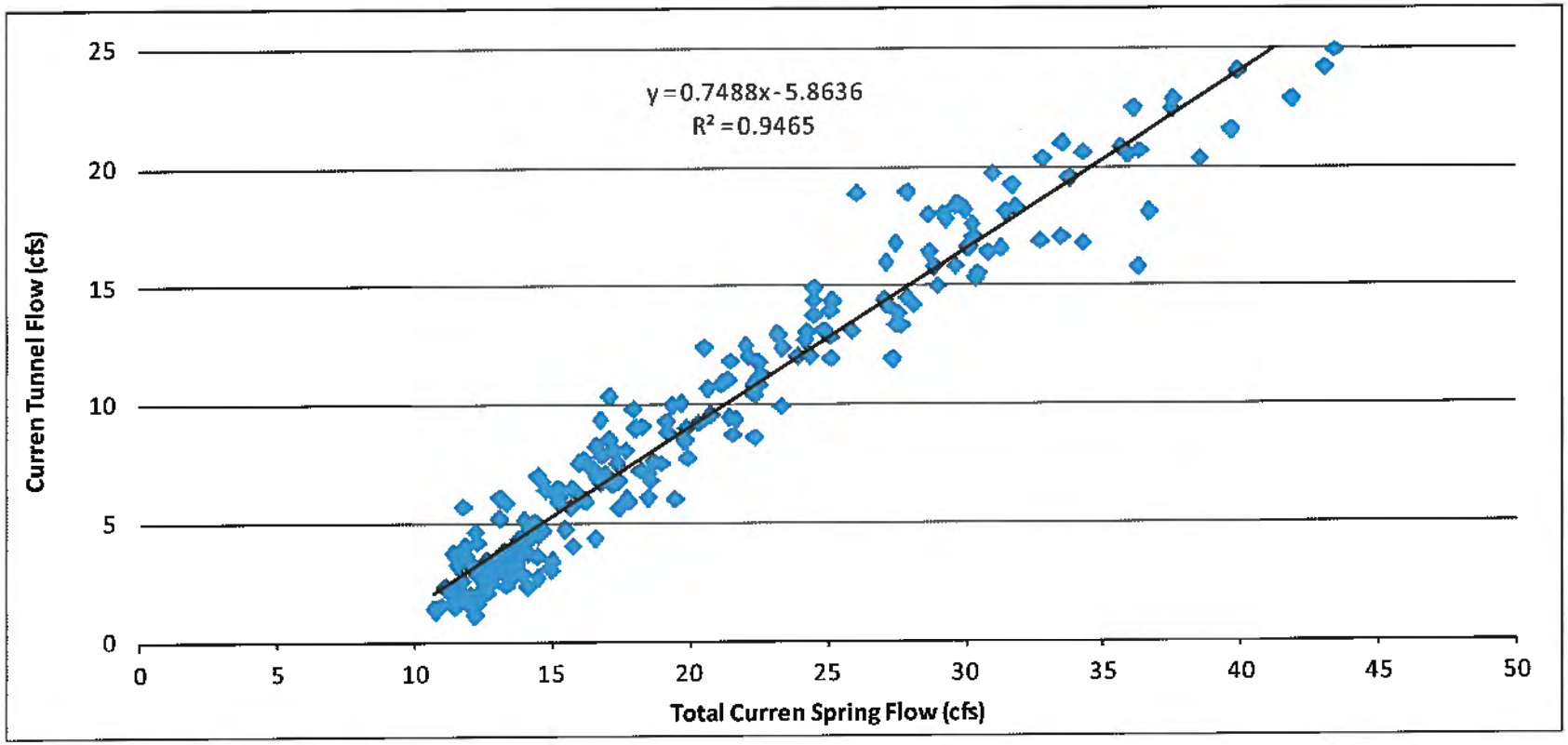
15. Sullivan, G.K., Spronk Water Engineer's Expert Response to IDWR Staff Memorandum In Matter of Distribution of Water to Rangen, Inc's Water Right Nos. 36-02551 and 36-07694, Prepared for Pocatello, April 5, 2013.

16. Sullivan, G.K., Spronk Water Engineer's Expert Response to IDWR Staff Memorandum In Matter of Distribution of Water to Rangen, Inc's Water Right Nos. 36-02551 and 36-07694, Prepared for Pocatello, April 5, 2013.

Figure

Figure 1

Total Curren Tunnel Flow vs.
Total Curren Spring Flow Regression
September 1993 - 2011



Notes:

(1) Curren Tunnel Flow equals the sum of Curren Tunnel flow measured by the IDWR (9/8/1993 - 2011) and 6" white pipe flows provide the IDWR (1996 - 2011). Missing Rangen pipe flow data from 9/1993 - 1995 estimated using the 1996-2011 avera

(2) Total Curren Spring Flow equal to the sum of (a) total Rangen Hatchery flow provided by Rangen (9/1993 - 2/1995) and total Rangen Hatchery provided by the IDWR (3/1995 - 2011) and (b) estimated diversions to farmers (irrigation) in 1997 and 1999 - 2002. Estimated diversions to farmers (irrigation) are equal to average 1992 - 1996 diversions provided by George Lemmon.

Appendix A

Table A-1

Monthly Average Flow
Martin-Curren Tunnel
September 1993 - 2011

Values in CFS

1a. IDWR Measured Tunnel Flow (1)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann Avg	Max	Min	Ann Total (AF)
1993									11.3	15.4	16.3	13.4				
1994	11.5	10.1	8.7	6.2	7.0	6.6	5.6	8.1	12.8	16.7	15.6	12.7	10.1	16.7	5.6	7,325
1995	10.8	9.2	8.4	6.5	5.8	7.1	6.6	7.7	11.9	16.0	16.5	14.9	10.1	16.5	5.8	6,417
1996	13.6	12.2	11.4	10.2	9.1	9.7	8.5	11.5	16.0	19.5	20.1	18.7	13.4	20.1	8.5	9,708
1997	17.5	16.4	16.0	15.1	13.6	14.1	17.1	17.2	21.6	23.2	23.9	23.2	18.2	23.9	13.6	13,217
1998	19.8		18.8	17.9	17.7	17.0	13.8	12.6	17.0	21.0	22.8	20.3	18.1	22.8	12.6	12,065
1999	18.1	16.8	15.4	14.2	12.8	13.3	12.0	13.2	17.7	21.9	22.3	20.3	16.5	22.3	12.0	10,701
2000	18.7	17.3	15.8	13.1	12.3	11.1	10.2	12.2	16.9	20.3	20.3	18.0	15.5	20.3	10.2	11,251
2001	15.7	14.2	12.1	9.4	7.1	6.1	5.8	6.7	9.2	11.9	13.0	11.6	10.2	15.7	5.8	7,382
2002	8.7	6.9	6.0	5.1	3.5	2.5	2.3	2.4	5.4	10.5	9.9	8.0	5.9	10.5	2.3	4,287
2003	6.5	5.1	4.6	3.2	2.6	2.3	1.9	3.2	6.1	9.8	9.0	7.5	5.1	9.8	1.9	3,259
2004	6.7	5.8	5.0	3.5	3.6	4.0	3.5	3.9	5.8	5.0	3.8	3.1	4.5	6.7	3.1	3,245
2005	2.6	2.2	2.1	2.0	2.0	1.5	1.1	1.3	3.1	6.4	5.7	4.5	2.9	6.4	1.1	2,082
2006	3.4	3.4	2.9	2.9	3.1	4.5	5.6	5.0	7.8	10.3	9.9	7.8	5.5	10.3	2.9	4,022
2007	5.1	4.7	3.6	2.5	2.7	3.6	3.0	2.7	8.1	11.8	10.7	8.9	5.6	11.8	2.5	3,520
2008	7.2	6.5	4.2	2.7	1.6	2.6	1.9	2.1	3.4	8.2	7.5	4.2	4.3	8.2	1.6	3,140
2009	3.3	2.9	2.0	1.1	1.2	1.6	1.8	1.4	3.9	8.7	6.7	5.5	3.3	8.7	1.1	2,419
2010	3.9	3.8	2.6	1.4	1.7	3.0	1.9	0.8	1.8	5.8	6.0	4.1	3.1	6.0	0.8	2,217
2011	3.0	2.9	2.6	2.6	2.8	2.4	1.9	2.0	4.4	8.2	9.3	6.9	4.1	9.3	1.9	2,543

1b. White Pipe (6-Inch) in Tunnel (2)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann Avg	Max	Min	Ann Total (AF)
1993									0.6	0.4	0.3	0.5				
1994	0.5	0.4	0.4	0.6	0.6	0.5	0.5	0.6	0.6	0.4	0.3	0.5	0.5	0.6	0.3	351
1995	0.5	0.4	0.4	0.6	0.6	0.5	0.5	0.6	0.6	0.4	0.3	0.5	0.5	0.6	0.3	323
1996	0.6	0.7	0.7	0.7	0.9	0.7	1.0	0.9	0.8	0.8	0.5	0.9	0.8	1.0	0.5	559
1997	0.9	0.7	0.7	0.8	0.9	0.9	1.0	0.9	0.9	1.0	1.0	0.8	0.9	1.0	0.7	627
1998	0.9	0.9	0.9	1.1	1.2	1.3	1.2	1.2	1.1	0.6	0.1	0.0	0.9	1.3	0.0	633
1999	0.0	0.1	0.1	0.3	0.6	0.9	0.8	1.2	0.7	0.5	0.6	0.7	0.6	1.2	0.0	358
2000	0.6	0.6	0.7	0.9	0.7	0.7	0.9	1.0	0.8	0.6	0.4	0.4	0.7	1.0	0.4	495
2001	0.3	0.3	0.3	0.6	0.7	0.9	1.0	0.1	0.4	0.1	0.1	0.5	0.4	1.0	0.1	325
2002	0.6	0.8	0.9	0.6	0.6	0.7	0.5	0.7	0.7	0.4	1.0	0.9	0.7	1.0	0.4	499
2003	0.9	1.1	0.6	0.2	0.3	0.2	0.2	0.2	0.3	0.1	0.2	0.2	0.4	1.1	0.1	262
2004	0.1	0.1	0.3	0.6	0.2	0.2	0.2	0.2	0.3	0.2	0.3	0.1	0.2	0.6	0.1	173
2005	0.3	0.1	0.3	0.2	0.3	0.2	0.3	0.2	0.2	0.2	0.3	0.2	0.2	0.3	0.1	168
2006	0.5	0.1	0.3	0.4	0.2	0.2	0.2	0.2	0.3	0.7	0.3	0.4	0.3	0.7	0.1	227
2007	0.7	0.1	0.1	0.4	0.7	0.2	0.2	0.6	0.5	0.1	0.1	0.4	0.3	0.7	0.1	214
2008	0.7	0.1	0.2	0.7	0.5	0.1	0.1	0.6	1.0	0.8	0.1	0.6	0.5	1.0	0.1	334
2009	0.5	0.1	0.2	0.6	0.5	0.1	0.1	0.3	0.7	0.4	0.1	0.5	0.3	0.7	0.1	243
2010	0.6	0.1	0.2	0.7	0.2	0.1	0.1	0.4	0.6	0.2	0.1	0.3	0.3	0.7	0.1	210
2011	0.4	0.1	0.1	0.5	0.5	0.1	0.1	0.3	0.6	0.3	0.1	0.4	0.3	0.6	0.1	186

Notes:

(1) Martin-Curren Tunnel flow provided by IDWR (September 8, 1993 - 2011).

(2) 6-inch white pipe flow (domestic, irrigation, hatch house, greenhouse, and lab) provided by IDWR from 1996 - 2011; flow from 1993 - 1995 estimated using average monthly flows from 1996 - 2011.

Table A-2

Monthly Average Flow
Martin-Curren Tunnel
September 1993 - 2011

Values in CFS

2a. Tunnel Flow to Farmers (1)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann Avg	Max	Min	Ann Total (AF)
1993									5.8	3.0	0.0	0.0				
1994	0.0	0.0	0.0	2.5	2.5	2.5	5.0	5.0	2.5	2.5	0.0	0.0	1.9	5.0	0.0	1,369
1995	0.0	0.0	0.0	2.0	3.0	3.5	3.0	3.2	2.0	0.0	0.0	0.0	1.4	3.5	0.0	1,012
1996	0.0	0.0	0.0	1.2	2.5	2.6	2.8	2.3	2.4	0.4	0.0	0.0	1.2	2.8	0.0	861
1997	0.0	0.0	0.0	2.1	3.0	3.1	3.6	3.9	3.3	1.7	0.0	0.0	1.7	3.9	0.0	1,256
1998	0.0	0.0	0.0	2.1	3.0	3.1	3.6	3.9	3.3	1.7	0.0	0.0	1.7	3.9	0.0	1,256
1999	0.0	0.0	0.0	2.1	3.0	3.1	3.6	3.9	3.3	1.7	0.0	0.0	1.7	3.9	0.0	1,256
2000	0.0	0.0	0.0	2.1	3.0	3.1	3.6	3.9	3.3	1.7	0.0	0.0	1.7	3.9	0.0	1,256
2001	0.0	0.0	0.0	2.1	3.0	3.1	3.6	3.9	3.3	1.7	0.0	0.0	1.7	3.9	0.0	1,256
2002	0.0	0.0	0.0	2.1	3.0	3.1	3.6	3.9	3.3	1.7	0.0	0.0	1.7	3.9	0.0	1,256
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2004	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2005	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2006	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2008	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2009	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2010	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2011	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

2b. Tunnel Flow to Small Raceways (2)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann Avg	Max	Min	Ann Total (AF)
1993									5.5	12.4	16.3	13.4				
1994	11.5	10.1	8.7	3.7	4.5	4.1	0.6	3.1	10.3	14.2	15.6	12.7	8.2	15.6	0.6	5,956
1995	10.8	9.2	8.4	4.5	2.8	3.6	3.6	4.5	9.9	16.0	16.5	14.9	8.7	16.5	2.8	5,405
1996	13.6	12.2	11.4	9.0	6.6	7.1	5.7	9.2	13.6	19.1	20.1	18.7	12.2	20.1	5.7	8,847
1997	17.5	16.4	16.0	13.1	10.6	11.0	13.5	13.3	18.2	21.5	23.9	23.2	16.5	23.9	10.6	11,961
1998	19.8		18.8	15.8	14.7	13.8	10.2	8.7	13.6	19.3	22.8	20.3	16.2	22.8	8.7	10,809
1999	18.1	16.8	15.4	12.2	9.8	10.2	8.4	9.3	14.4	20.2	22.3	20.3	14.8	22.3	8.4	9,445
2000	18.7	17.3	15.8	11.0	9.3	8.0	6.6	8.3	13.5	18.6	20.3	18.0	13.8	20.3	6.6	9,995
2001	15.7	14.2	12.1	7.3	4.1	3.0	2.2	2.8	5.8	10.3	13.0	11.6	8.5	15.7	2.2	6,126
2002	8.7	6.9	6.0	3.0	0.5	0.0	0.0	0.0	2.1	8.9	9.9	8.0	4.5	9.9	0.0	3,240
2003	6.5	5.1	4.6	3.2	2.6	2.3	1.9	3.2	6.1	9.8	9.0	7.5	5.1	9.8	1.9	3,259
2004	6.7	5.8	5.0	3.5	3.6	4.0	3.5	3.9	5.8	5.0	3.8	3.1	4.5	6.7	3.1	3,245
2005	2.6	2.2	2.1	2.0	2.0	1.5	1.1	1.3	3.1	6.4	5.7	4.5	2.9	6.4	1.1	2,082
2006	3.4	3.4	2.9	2.9	3.1	4.5	5.6	5.0	7.8	10.3	9.9	7.8	5.5	10.3	2.9	4,022
2007	5.1	4.7	3.6	2.5	2.7	3.6	3.0	2.7	8.1	11.8	10.7	8.9	5.6	11.8	2.5	3,520
2008	7.2	6.5	4.2	2.7	1.6	2.6	1.9	2.1	3.4	8.2	7.5	4.2	4.3	8.2	1.6	3,140
2009	3.3	2.9	2.0	1.1	1.2	1.6	1.8	1.4	3.9	8.7	6.7	5.5	3.3	8.7	1.1	2,419
2010	3.9	3.8	2.6	1.4	1.7	3.0	1.9	0.8	1.8	5.8	6.0	4.1	3.1	6.0	0.8	2,217
2011	3.0	2.9	2.6	2.6	2.8	2.4	1.9	2.0	4.4	8.2	9.3	6.9	4.1	9.3	1.9	2,543

Notes:

(1) Diversions to farmers provided by George Lemmon from 1992-1996; diversions to farmers from 1997-2002 estimated using the 1992-1996.

(2) Martin-Curren Tunnel flow provided by IDWR (Table A-1a) minus farmers diversions (Table A-2b).

Table A-3

Monthly Average Flow
Martin-Curren Tunnel
September 1993 - 2011

Values in CFS

3a. Total Tunnel Flow (1)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann Avg	Max	Min	Ann Total (AF)
1993									12.0	15.9	16.6	13.9				
1994	12.1	10.5	9.1	6.7	7.6	7.1	6.1	8.7	13.4	17.1	15.9	13.1	10.6	17.1	6.1	7,676
1995	11.3	9.6	8.8	7.1	6.4	7.6	7.1	8.3	12.5	16.5	16.8	15.4	10.6	16.8	6.4	6,740
1996	14.2	12.9	12.1	10.9	10.0	10.4	9.4	12.4	16.8	20.4	20.5	19.6	14.1	20.5	9.4	10,267
1997	18.3	17.1	16.7	15.9	14.5	15.0	18.1	18.2	22.5	24.2	24.9	24.0	19.1	24.9	14.5	13,843
1998	20.7		19.7	19.0	18.9	18.2	15.0	13.8	18.0	21.6	22.9	20.4	18.9	22.9	13.8	12,647
1999	18.2	16.9	15.6	14.5	13.4	14.2	12.8	14.4	18.5	22.4	22.9	21.0	17.1	22.9	12.8	11,059
2000	19.3	17.9	16.5	14.0	13.0	11.8	11.1	13.2	17.7	20.9	20.6	18.4	16.2	20.9	11.1	11,746
2001	16.0	14.4	12.4	10.0	7.8	7.0	6.8	6.9	9.5	12.0	13.1	12.1	10.7	16.0	6.8	7,708
2002	9.3	7.6	6.8	5.7	4.1	3.2	2.8	3.1	6.1	10.9	10.9	8.9	6.6	10.9	2.8	4,785
2003	7.3	6.2	5.2	3.4	2.9	2.6	2.1	3.4	6.5	9.9	9.1	7.8	5.5	9.9	2.1	3,521
2004	6.8	5.9	5.3	4.1	3.8	4.2	3.7	4.1	6.1	5.1	4.1	3.2	4.7	6.8	3.2	3,418
2005	2.9	2.3	2.4	2.2	2.3	1.7	1.4	1.5	3.4	6.5	6.0	4.7	3.1	6.5	1.4	2,250
2006	3.9	3.5	3.2	3.2	3.3	4.7	5.8	5.2	8.1	11.0	10.1	8.1	5.9	11.0	3.2	4,249
2007	5.7	4.8	3.7	2.9	3.3	3.7	3.2	3.4	8.6	11.9	10.7	9.3	5.9	11.9	2.9	3,734
2008	7.9	6.5	4.4	3.4	2.2	2.6	2.0	2.7	4.4	9.1	7.6	4.8	4.8	9.1	2.0	3,474
2009	3.8	3.0	2.2	1.7	1.7	1.6	1.9	1.7	4.6	9.1	6.8	6.0	3.7	9.1	1.6	2,662
2010	4.6	3.8	2.8	2.1	1.8	3.1	2.0	1.2	2.4	6.0	6.1	4.4	3.4	6.1	1.2	2,427
2011	3.5	2.9	2.8	3.1	3.3	2.5	2.0	2.3	5.0	8.6	9.4	7.3	4.4	9.4	2.0	2,729

3b. Tunnel Flow to Rangen (2)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann Avg	Max	Min	Ann Total (AF)
1993									6.2	12.9	16.6	13.9				
1994	12.1	10.5	9.1	4.2	5.1	4.6	1.1	3.7	10.9	14.6	15.9	13.1	8.7	15.9	1.1	6,307
1995	11.3	9.6	8.8	5.1	3.4	4.1	4.1	5.1	10.5	16.5	16.8	15.4	9.2	16.8	3.4	5,728
1996	14.2	12.9	12.1	9.7	7.5	7.8	6.6	10.1	14.4	20.0	20.5	19.6	13.0	20.5	6.6	9,406
1997	18.3	17.1	16.7	13.8	11.5	11.9	14.5	14.3	19.1	22.5	24.9	24.0	17.4	24.9	11.5	12,587
1998	20.7		19.7	16.9	15.9	15.1	11.4	9.9	14.7	19.9	22.9	20.4	17.0	22.9	9.9	11,391
1999	18.2	16.9	15.6	12.5	10.4	11.1	9.2	10.5	15.1	20.8	22.9	21.0	15.3	22.9	9.2	9,803
2000	19.3	17.9	16.5	11.9	10.0	8.7	7.5	9.3	14.3	19.2	20.6	18.4	14.5	20.6	7.5	10,490
2001	16.0	14.4	12.4	7.9	4.8	3.9	3.2	3.0	6.2	10.3	13.1	12.1	8.9	16.0	3.0	6,452
2002	9.3	7.6	6.8	3.6	1.1	0.1	0.0	0.0	2.7	9.2	10.9	8.9	5.0	10.9	0.0	3,629
2003	7.3	6.2	5.2	3.4	2.9	2.6	2.1	3.4	6.5	9.9	9.1	7.8	5.5	9.9	2.1	3,521
2004	6.8	5.9	5.3	4.1	3.8	4.2	3.7	4.1	6.1	5.1	4.1	3.2	4.7	6.8	3.2	3,418
2005	2.9	2.3	2.4	2.2	2.3	1.7	1.4	1.5	3.4	6.5	6.0	4.7	3.1	6.5	1.4	2,250
2006	3.9	3.5	3.2	3.2	3.3	4.7	5.8	5.2	8.1	11.0	10.1	8.1	5.9	11.0	3.2	4,249
2007	5.7	4.8	3.7	2.9	3.3	3.7	3.2	3.4	8.6	11.9	10.7	9.3	5.9	11.9	2.9	3,734
2008	7.9	6.5	4.4	3.4	2.2	2.6	2.0	2.7	4.4	9.1	7.6	4.8	4.8	9.1	2.0	3,474
2009	3.8	3.0	2.2	1.7	1.7	1.6	1.9	1.7	4.6	9.1	6.8	6.0	3.7	9.1	1.6	2,662
2010	4.6	3.8	2.8	2.1	1.8	3.1	2.0	1.2	2.4	6.0	6.1	4.4	3.4	6.1	1.2	2,427
2011	3.5	2.9	2.8	3.1	3.3	2.5	2.0	2.3	5.0	8.6	9.4	7.3	4.4	9.4	2.0	2,729

Notes:

(1) Martin-Curren Tunnel flow provided by IDWR (Table A-1a) plus six-inch white pipe flow provided by the IDWR (Table A-1b).

(2) Total Martin-Curren Tunnel flow (Table A-3a) minus diversions to farmers (irrigation) from 1993 - 2002 (Table A-2a).

Table A-4

Monthly Average Flow
Martin-Curren Tunnel
1996 - 2011

Values In CFS

4a. Predicted Total Tunnel Flow (1)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann Avg	Max	Min	Ann Total (AF)
1993									14.6	21.2	17.5	14.7				
1994	12.3	10.8	9.0	6.9	8.3	6.8	8.7	10.8	14.8	19.1	15.7	13.5	11.4	19.1	6.8	8,257
1995	11.0	9.6	10.2	7.9	6.0	6.1	4.9	6.5	10.6	17.2	19.7	16.8	10.5	19.7	4.9	6,604
1996	14.4	12.9	12.0	10.9	8.6	6.9	6.6	9.5	14.7	18.6	20.9	19.4	12.9	20.9	6.6	9,398
1997	17.9	16.8	16.6	16.3	14.3	15.8	16.0	17.6	21.1	26.3	26.6	23.9	19.1	26.6	14.3	13,841
1998	21.3	19.4	17.3	15.0	13.6	16.5	12.4	12.4	15.5	23.8	25.4	22.9	18.0	25.4	12.4	12,995
1999	21.5	18.6	16.9	15.0	14.7	15.1	12.2	12.9	16.4	22.1	22.2	19.2	17.2	22.2	12.2	11,288
2000	17.8	16.0	15.6	12.9	11.4	10.9	10.1	12.7	16.7	20.8	19.7	16.3	15.1	20.8	10.1	10,946
2001	14.4	12.4	11.6	11.6	9.0	6.5	6.7	8.0	10.1	12.9	12.2	10.7	10.5	14.4	6.5	7,599
2002	9.3	8.1	7.1	7.1	5.9	5.3	5.0	5.3	7.4	10.8	9.9	8.5	7.5	10.8	5.0	5,401
2003	6.4	5.5	4.6	3.9	3.8	3.7	2.9	3.1	5.1	7.5	7.8	6.2	5.0	7.8	2.9	3,265
2004	5.1	4.1	3.9	2.9	2.6	3.3	3.0	3.0	3.9	4.9	4.4	3.7	3.7	5.1	2.6	2,711
2005	3.3	2.7	2.4	2.7	2.7	2.8	2.2	2.1	3.4	5.9	5.5	4.6	3.4	5.9	2.1	2,434
2006	4.0	3.5	3.6	3.7	2.8	3.3	2.9	3.9	7.0	9.9	8.8	7.3	5.1	9.9	2.8	3,671
2007	5.8	5.1	4.9	4.1	4.3	4.5	3.7	3.1	6.9	10.2	9.5	8.4	5.9	10.2	3.1	3,742
2008	6.7	5.5	4.7	4.2	3.6	3.6	2.6	2.9	4.4	7.6	7.1	5.7	4.9	7.6	2.6	3,541
2009	4.7	4.0	3.5	3.1	2.3	2.7	3.0	3.3	5.0	7.6	7.0	6.2	4.4	7.6	2.3	3,163
2010	5.0	4.2	3.4	3.1	3.0	3.6	2.9	3.2	4.7	7.4	7.9	6.5	4.6	7.9	2.9	3,316
2011	5.3	4.5	4.2	3.9	3.7	4.1	3.4	3.4	4.7	8.9	10.3	7.7	5.3	10.3	3.4	3,398

4b. Predicted minus Measured Total Tunnel Flow (2)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann Avg	Max	Min	Ann Total (AF)
1993									2.6	5.4	0.9	0.9				
1994	0.3	0.4	-0.1	0.2	0.7	-0.3	2.6	2.2	1.4	2.1	-0.2	0.3	0.8	2.6	-0.3	581
1995	-0.3	0.0	1.5	0.8	-0.4	-1.5	-2.1	-1.8	-1.9	0.7	2.9	1.5	-0.1	2.9	-2.1	-136
1996	0.2	0.0	-0.1	0.1	-1.5	-3.6	-2.8	-3.0	-2.2	-1.7	0.4	-0.2	-1.2	0.4	-3.6	-869
1997	-0.4	-0.3	0.0	0.4	-0.1	0.7	-2.1	-0.5	-1.4	2.2	1.7	-0.1	0.0	2.2	-2.1	-2
1998	0.6		-2.5	-4.0	-5.3	-1.7	-2.5	-1.4	-2.5	2.2	2.6	2.6	-1.1	2.6	-5.3	348
1999	3.4	1.7	1.3	0.4	1.3	0.9	-0.6	-1.5	-2.1	-0.3	-0.7	-1.9	0.2	3.4	-2.1	229
2000	-1.5	-1.8	-0.9	-1.1	-1.6	-0.9	-1.0	-0.4	-0.9	-0.1	-0.9	-2.1	-1.1	-0.1	-2.1	-800
2001	-1.6	-2.0	-0.9	1.6	1.2	-0.5	-0.1	1.1	0.6	0.9	-0.9	-1.4	-0.2	1.6	-2.0	-109
2002	0.0	0.4	0.3	1.4	1.8	2.1	2.2	2.2	1.3	-0.1	-1.0	-0.4	0.8	2.2	-1.0	616
2003	-0.9	-0.7	-0.7	0.5	0.8	1.1	0.9	-0.3	-1.3	-2.4	-1.4	-1.6	-0.5	1.1	-2.4	-256
2004	-1.7	-1.8	-1.4	-1.1	-1.2	-1.0	-0.7	-1.1	-2.2	-0.3	0.3	0.5	-1.0	0.5	-2.2	-708
2005	0.3	0.4	0.0	0.5	0.5	1.1	0.7	0.6	0.1	-0.6	-0.5	0.0	0.3	1.1	-0.6	183
2006	0.1	0.0	0.4	0.4	-0.6	-1.5	-2.9	-1.3	-1.1	-1.0	-1.3	-0.8	-0.8	0.4	-2.9	-579
2007	0.1	0.3	1.2	1.2	1.0	0.7	0.4	-0.2	-1.7	-1.7	-1.2	-0.9	-0.1	1.2	-1.7	8
2008	-1.2	-1.0	0.3	0.9	1.4	1.0	0.6	0.2	0.0	-1.5	-0.5	0.9	0.1	1.4	-1.5	67
2009	0.8	1.1	1.3	1.4	0.7	1.0	1.1	1.6	0.4	-1.5	0.1	0.2	0.7	1.6	-1.5	501
2010	0.4	0.3	0.6	1.0	1.2	0.6	0.9	2.0	2.2	1.4	1.8	2.1	1.2	2.2	0.3	889
2011	1.9	1.6	1.5	0.8	0.4	1.6	1.4	1.1	-0.3	0.4	0.9	0.4	1.0	1.9	-0.3	669
Avg	0.0	-0.1	0.1	0.3	0.0	0.0	-0.2	0.0	-0.5	0.2	0.2	0.0	-0.1	1.6	-1.9	228

Notes:

(1) Predicted Martin-Curren Tunnel using SWE's regression of Total Curren Spring Flow vs. Total Martin-Curren Tunnel flow.

(2) Predicted Total Martin-Curren Tunnel flow (Table A-4a) minus measured Total Martin-Curren Tunnel flow (Table A-3a).

Table A-5

Monthly Average Flow
Martin-Curren Tunnel
1996 - 2011

Values In CFS

Predicted Total Tunnel Flow[1]

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann Avg	Max	Min	Ann Total (AF)
1966	33.2	30.2	27.8	23.0	19.7	28.1	32.6	34.0	40.9	46.5	37.9	31.0	32.1	46.5	19.7	23,221
1967	27.0	23.6	19.1	21.5	22.3	29.6	30.8	33.7	38.2	46.1	44.6	42.3	31.6	46.1	19.1	22,898
1968	33.7	28.4	25.0	21.1	21.7	27.8	32.0	38.2	45.2	45.2	43.2	41.4	33.6	45.2	21.1	24,388
1969	32.2	26.6	22.7	19.1	19.8	28.2	31.3	37.9	43.5	44.2	42.6	37.0	32.1	44.2	19.1	23,263
1970	31.4	26.1	25.6	20.1	20.0	26.0	31.8	38.6	43.6	46.0	41.5	39.1	32.5	46.0	20.0	23,551
1971	31.7	25.0	23.4	22.0	24.5	26.6	32.3	39.4	42.7	49.3	46.7	41.6	33.8	49.3	22.0	21,939
1972	35.4	30.2	26.3	24.5	28.5	37.6	39.8	44.5	49.5	51.1	45.2	44.1	38.1	51.1	24.5	27,657
1973	37.5	30.9	28.7	22.3	23.8	25.7	33.9	35.4	37.4	43.4	40.3	35.5	32.9	43.4	22.3	23,842
1974	27.2	29.0	24.9	20.9	19.9	26.6	29.4	35.3	38.5	46.3	41.2	37.5	31.4	46.3	19.9	22,732
1975	26.3	24.0	18.7	19.2	22.1	23.7	26.5	33.0	35.8	37.5	36.2	37.8	28.4	37.8	18.7	18,261
1976	31.6	27.3	24.9	18.9	21.0	22.6	23.7	29.5	36.4	40.3	38.1	33.8	29.0	40.3	18.9	21,064
1977	29.4	23.7	22.4	20.5	18.5	21.8	20.3	19.5	22.5	23.3	25.9	22.3	22.5	29.4	18.5	16,288
1978	19.1	16.2	16.7	15.3	14.8	14.6	15.0	19.3	31.5	26.2	24.3	21.5	19.5	31.5	14.6	14,147
1979	19.9	16.8	16.1	12.5	9.3	13.2	14.4	21.2	29.9	29.9	25.7	22.8	19.3	29.9	9.3	12,583
1980	20.0	17.9	14.7	13.5	11.1	17.3	18.6	20.0	22.4	29.6	24.9	20.3	19.2	29.6	11.1	13,939
1981	17.4	14.1	10.9	11.9	9.1	10.2	14.7	19.1	21.8	23.4	24.8	19.7	16.4	24.8	9.1	11,909
1982	17.1	16.7	16.4	12.6	12.2	11.4	15.9	18.9	26.2	29.1	29.8	25.5	19.3	29.8	11.4	13,985
1983	21.8	18.9	18.3	15.3	16.8	15.9	20.4	26.4	29.7	33.0	30.5	29.1	23.0	33.0	15.3	14,899
1984	24.8	24.2	22.1	19.3	17.7	20.3	22.5	25.7	26.3	29.8	28.4	27.2	24.0	29.8	17.7	17,445
1985	24.2	22.8	21.2	20.0	17.9	17.3	18.8	28.1	30.8	33.1	30.9	26.0	24.2	33.1	17.3	17,557
1986	22.4	21.5	20.2	18.4	19.8	19.7	22.7	31.3	33.5	35.8	32.7	30.8	25.7	35.8	18.4	18,655
1987	26.6	22.7	21.2	17.1	16.7	20.7	22.0	28.0	28.3	33.3	29.6	28.1	24.5	33.3	16.7	16,041
1988	22.3	19.5	17.2	14.8	14.9	16.7	16.5	20.9	23.9	29.7	26.4	22.5	20.4	29.7	14.8	14,846
1989	19.9	17.6	15.6	10.8	11.5	12.9	14.7	20.6	20.3	26.3	23.1	21.6	17.9	26.3	10.8	12,969
1990	19.8	17.9	15.7	9.8	10.8	12.8	14.0	16.9	20.5	25.5	20.8	18.2	16.9	25.5	9.8	12,228
1991	15.6	14.5	14.6	7.5	8.3	9.0	9.7	14.7	20.2	20.8	18.7	18.3	14.3	20.8	7.5	9,246
1992	14.7	11.3	10.5	6.4	5.9	5.7	7.7	8.2	10.1	12.7	9.4	8.3	9.2	14.7	5.7	6,708
1993	6.7	6.9	5.7	6.4	4.5	5.5	6.0	9.9	14.6	21.2	17.5	14.7	10.0	21.2	4.5	7,226
1994	12.3	10.8	9.0	6.9	8.3	6.8	8.7	10.8	14.8	19.1	15.7	13.5	11.4	19.1	6.8	8,257
1995	11.0	9.6	10.2	7.9	6.0	6.1	4.9	6.5	10.6	17.2	19.7	16.8	10.5	19.7	4.9	6,604
1996	14.4	12.9	12.0	10.9	8.6	6.9	6.6	9.5	14.7	18.6	20.9	19.4	12.9	20.9	6.6	9,398
1997	17.9	16.8	16.6	16.3	14.3	15.8	16.0	17.6	21.1	26.3	26.6	23.9	19.1	26.6	14.3	13,841
1998	21.3	19.4	17.3	15.0	13.6	16.5	12.4	12.4	15.5	23.8	25.4	22.9	18.0	25.4	12.4	12,995
1999	21.5	18.6	16.9	15.0	14.7	15.1	12.2	12.9	16.4	22.1	22.2	19.2	17.2	22.2	12.2	11,288
2000	17.8	16.0	15.6	12.9	11.4	10.9	10.1	12.7	16.7	20.8	19.7	16.3	15.1	20.8	10.1	10,946
2001	14.4	12.4	11.6	11.6	9.0	6.5	6.7	8.0	10.1	12.9	12.2	10.7	10.5	14.4	6.5	7,599
2002	9.3	8.1	7.1	7.1	5.9	5.3	5.0	5.3	7.4	10.8	9.9	8.5	7.5	10.8	5.0	5,401
2003	6.4	5.5	4.6	3.9	3.8	3.7	2.9	3.1	5.1	7.5	7.8	6.2	5.0	7.8	2.9	3,265
2004	5.1	4.1	3.9	2.9	2.6	3.3	3.0	3.0	3.9	4.9	4.4	3.7	3.7	5.1	2.6	2,711
2005	3.3	2.7	2.4	2.7	2.7	2.8	2.2	2.1	3.4	5.9	5.5	4.6	3.4	5.9	2.1	2,434
2006	4.0	3.5	3.6	3.7	2.8	3.3	2.9	3.9	7.0	9.9	8.8	7.3	5.1	9.9	2.8	3,671
2007	5.8	5.1	4.9	4.1	4.3	4.5	3.7	3.1	6.9	10.2	9.5	8.4	5.9	10.2	3.1	3,742
2008	6.7	5.5	4.7	4.2	3.6	3.6	2.6	2.9	4.4	7.6	7.1	5.7	4.9	7.6	2.6	3,541
2009	4.7	4.0	3.5	3.1	2.3	2.7	3.0	3.3	5.0	7.6	7.0	6.2	4.4	7.6	2.3	3,163
2010	5.0	4.2	3.4	3.1	3.0	3.6	2.9	3.2	4.7	7.4	7.9	6.5	4.6	7.9	2.9	3,316
2011	5.3	4.5	4.2	3.9	3.7	4.1	3.4	3.4	4.7	8.9	10.3	7.7	5.3	10.3	3.4	3,398

Notes:

(1) Predicted Martin-Curren Tunnel using SWE's regression of Total Curren Spring Flow vs. Total Martin-Curren Tunnel flow.

Table A-6

Monthly Average Flow
Martin-Curren Tunnel
1966 - 2011

Values in CFS

Estimated and Actual Diversions to Farmers

	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann Avg	Max	Min	Ann Total (AF)
(1)	1966	0.5	0.4	0.4	2.3	8.4	7.8	8.4	7.5	5.2	2.2	0.8	0.5	3.7	8.4	0.4	2,698
	1967	0.4	0.4	0.8	6.9	8.8	9.4	8.4	8.5	7.8	5.6	0.9	0.0	4.8	9.4	0.0	3,508
	1968	0.3	0.3	0.2	0.0	9.1	6.5	8.4	0.4	3.9	0.6	0.6	0.5	2.6	9.1	0.0	1,869
	1969	0.3	0.0	0.0	0.6	8.7	8.8	6.9	9.6	5.2	2.7	1.0	0.5	3.7	9.6	0.0	2,697
	1970	0.7	0.3	0.3	0.3	8.2	7.8	8.4	7.5	4.4	2.2	0.8	0.5	3.4	8.4	0.3	2,516
	1971	0.5	0.4	0.4	3.3	7.4	5.8	8.4	9.3	8.0	0.0	0.8	1.0	3.8	9.3	0.0	2,671
	1972	1.0	1.0	0.4	4.7	7.5	8.7	9.0	9.6	4.9	2.2	0.8	0.5	4.2	9.6	0.4	3,044
	1973	0.5	0.5	0.5	0.5	9.2	7.8	9.4	7.5	2.5	2.2	0.8	0.5	3.5	9.4	0.5	2,550
(1)	1974	0.0	0.4	0.4	2.3	8.4	7.8	8.4	7.5	5.2	2.2	0.8	0.5	3.7	8.4	0.0	2,670
(1)	1975	0.5	0.4	0.4	2.3	8.4	7.8	8.4	7.5	5.2	2.2	0.8	0.5	3.7	8.4	0.4	2,668
(2)	1976	0.4	0.4	0.3	2.3	8.1	7.6	8.1	7.3	5.1	2.2	0.8	0.5	3.6	8.1	0.3	2,614
(2)	1977	0.4	0.4	0.3	2.3	7.8	7.3	7.9	7.1	5.0	2.2	0.7	0.4	3.5	7.9	0.3	2,528
(2)	1978	0.4	0.3	0.3	2.3	7.4	7.0	7.6	6.9	4.9	2.1	0.7	0.4	3.4	7.6	0.3	2,443
(2)	1979	0.3	0.3	0.3	2.3	7.1	6.7	7.3	6.6	4.8	2.1	0.6	0.4	3.2	7.3	0.3	2,336
(2)	1980	0.3	0.3	0.3	2.2	6.8	6.5	7.0	6.4	4.7	2.1	0.6	0.3	3.1	7.0	0.3	2,274
(2)	1981	0.3	0.3	0.2	2.2	6.5	6.2	6.7	6.2	4.6	2.0	0.5	0.3	3.0	6.7	0.2	2,189
(2)	1982	0.3	0.2	0.2	2.2	6.2	5.9	6.4	6.0	4.4	2.0	0.5	0.3	2.9	6.4	0.2	2,104
(2)	1983	0.2	0.2	0.2	2.2	5.9	5.6	6.2	5.8	4.3	2.0	0.4	0.3	2.8	6.2	0.2	2,003
(2)	1984	0.2	0.2	0.2	2.2	5.5	5.3	5.9	5.6	4.2	1.9	0.4	0.2	2.7	5.9	0.2	1,935
(2)	1985	0.2	0.2	0.2	2.2	5.2	5.1	5.6	5.4	4.1	1.9	0.3	0.2	2.5	5.6	0.2	1,850
(2)	1986	0.2	0.1	0.1	2.2	4.9	4.8	5.3	5.2	4.0	1.9	0.3	0.2	2.4	5.3	0.1	1,765
(2)	1987	0.1	0.1	0.1	2.1	4.6	4.5	5.0	5.0	3.9	1.8	0.2	0.1	2.3	5.0	0.1	1,671
(2)	1988	0.1	0.1	0.1	2.1	4.3	4.2	4.7	4.7	3.8	1.8	0.2	0.1	2.2	4.7	0.1	1,590
(2)	1989	0.1	0.1	0.1	2.1	3.9	3.9	4.4	4.5	3.6	1.8	0.1	0.1	2.1	4.5	0.1	1,494
(2)	1990	0.1	0.0	0.0	2.1	3.5	3.6	4.1	4.2	3.5	1.7	0.1	0.0	1.9	4.2	0.0	1,391
(2)	1991	0.0	0.0	0.0	2.1	3.1	3.2	3.7	4.0	3.4	1.7	0.0	0.0	1.8	4.0	0.0	1,281
	1992	0.0	0.0	0.0	2.5	4.0	4.0	4.0	4.0	4.0	2.5	0.0	0.0	2.1	4.0	0.0	1,516
	1993	0.0	0.0	0.0	2.1	3.0	3.0	3.2	5.0	5.8	3.0	0.0	0.0	2.1	5.8	0.0	1,522
	1994	0.0	0.0	0.0	2.5	2.5	2.5	5.0	5.0	2.5	2.5	0.0	0.0	1.9	5.0	0.0	1,369
	1995	0.0	0.0	0.0	2.0	3.0	3.5	3.0	3.2	2.0	0.0	0.0	0.0	1.4	3.5	0.0	1,012
	1996	0.0	0.0	0.0	1.2	2.5	2.6	2.8	2.3	2.4	0.4	0.0	0.0	1.2	2.8	0.0	861
(3)	1997	0.0	0.0	0.0	2.1	3.0	3.1	3.6	3.9	3.3	1.7	0.0	0.0	1.7	3.9	0.0	1,256
(3)	1998	0.0	0.0	0.0	2.1	3.0	3.1	3.6	3.9	3.3	1.7	0.0	0.0	1.7	3.9	0.0	1,256
(3)	1999	0.0	0.0	0.0	2.1	3.0	3.1	3.6	3.9	3.3	1.7	0.0	0.0	1.7	3.9	0.0	1,256
(3)	2000	0.0	0.0	0.0	2.1	3.0	3.1	3.6	3.9	3.3	1.7	0.0	0.0	1.7	3.9	0.0	1,256
(3)	2001	0.0	0.0	0.0	2.1	3.0	3.1	3.6	3.9	3.3	1.7	0.0	0.0	1.7	3.9	0.0	1,256
(3)	2002	0.0	0.0	0.0	2.1	3.0	3.1	3.6	3.9	3.3	1.7	0.0	0.0	1.7	3.9	0.0	1,256
(4)	2003																
(4)	2004																
(4)	2005																
(4)	2006																
(4)	2007																
(4)	2008																
(4)	2009																
(4)	2010																
(4)	2011																

Notes:

(1) Average 1967 - 1973 farmers diversions from Curren Tunnel log books were used in years of missing data 1966 and 1974 - 1975.

(2) Average monthly flows from 1976 - 1991 were estimated using an interpolation between the 1967 - 1/1974 averages and and the 1992 - 1996 averages.

(3) Average 1992 - 1996 farmers diversions were used in years of missing data from 1997 - 2002.

(4) There are minimal farmers diversions from 2002 - 2011 after construction of the Sandy pipeline.

Table A-7

Monthly Average Flow
Martin-Curren Tunnel
1996 - 2011

Values in CFS

Predicted Tunnel Flow to Rangen [1]

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann Avg	Max	Min	Ann Total (AF)
1966	32.8	29.8	27.4	20.6	11.3	20.3	24.1	26.5	35.6	44.3	37.1	30.5	28.4	44.3	11.3	20,523
1967	26.6	23.2	18.3	14.6	13.5	20.2	22.4	25.3	30.5	40.5	43.7	42.3	26.8	43.7	13.5	19,390
1968	33.4	28.1	24.8	21.1	12.6	21.3	23.6	37.8	41.3	44.6	42.6	40.9	31.0	44.6	12.6	22,519
1969	31.9	26.6	22.7	18.5	11.1	19.4	24.4	28.3	38.3	41.5	41.6	36.5	28.4	41.6	11.1	20,566
1970	30.7	25.8	25.3	19.8	11.8	18.1	23.4	31.1	39.2	43.8	40.7	38.6	29.0	43.8	11.8	21,035
1971	31.3	24.6	23.0	18.7	17.1	20.8	23.9	30.2	34.7	49.3	46.0	40.6	30.0	49.3	17.1	19,268
1972	34.4	29.2	25.9	19.8	21.0	29.0	30.8	34.9	44.6	48.9	44.5	43.6	33.9	48.9	19.8	24,613
1973	37.0	30.4	28.2	21.8	14.6	17.8	24.5	27.9	35.0	41.2	39.5	35.1	29.4	41.2	14.6	21,292
1974	27.2	28.5	24.5	18.6	11.5	18.8	21.0	27.8	33.3	44.0	40.4	37.0	27.7	44.0	11.5	20,062
1975	25.9	23.6	18.3	16.9	13.7	15.9	18.1	25.5	30.6	35.3	35.4	37.3	24.7	37.3	13.7	15,593
1976	31.1	26.9	24.6	16.6	12.9	15.0	15.6	22.2	31.3	38.1	37.3	33.4	25.4	38.1	12.9	18,450
1977	29.0	23.3	22.0	18.2	10.8	14.6	12.4	12.5	17.5	21.1	25.2	21.9	19.0	29.0	10.8	13,760
1978	18.7	15.8	16.4	13.0	7.4	7.6	7.5	12.4	26.6	24.1	23.7	21.1	16.2	26.6	7.4	11,703
1979	19.5	16.5	15.8	10.2	2.2	6.4	7.1	14.5	25.2	27.8	25.1	22.4	16.1	27.8	2.2	10,247
1980	19.7	17.6	14.5	11.2	4.3	10.8	11.6	13.5	17.8	27.6	24.3	19.9	16.1	27.6	4.3	11,664
1981	17.1	13.9	10.7	9.7	2.6	4.1	8.0	12.9	17.3	21.4	24.3	19.4	13.4	24.3	2.6	9,720
1982	16.8	16.4	16.2	10.4	6.0	5.5	9.4	12.9	21.7	27.1	29.3	25.2	16.4	29.3	5.5	11,881
1983	21.6	18.7	18.1	13.1	11.0	10.2	14.3	20.6	25.4	31.0	30.1	28.8	20.2	31.0	10.2	12,895
1984	24.6	24.0	22.0	17.1	12.2	15.0	16.6	20.1	22.0	27.8	28.1	26.9	21.4	28.1	12.2	15,510
1985	24.1	22.6	21.0	17.8	12.7	12.3	13.2	22.7	26.6	31.2	30.6	25.8	21.7	31.2	12.3	15,708
1986	22.3	21.3	20.1	16.2	14.9	15.0	17.4	26.1	29.5	33.9	32.4	30.6	23.3	33.9	14.9	16,890
1987	26.4	22.6	21.1	15.0	12.1	16.2	17.0	23.0	24.4	31.5	29.4	27.9	22.2	31.5	12.1	14,370
1988	22.2	19.4	17.1	12.7	10.6	12.5	11.8	16.2	20.1	27.9	26.2	22.4	18.3	27.9	10.6	13,255
1989	19.8	17.5	15.6	8.7	7.6	9.0	10.3	16.1	16.6	24.5	23.0	21.5	15.8	24.5	7.6	11,475
1990	19.8	17.8	15.7	7.7	7.3	9.2	9.9	12.7	17.0	23.8	20.7	18.1	15.0	23.8	7.3	10,836
1991	15.5	14.5	14.6	5.4	5.2	5.8	6.0	10.8	16.8	19.1	18.7	18.3	12.6	19.1	5.2	7,965
1992	14.7	11.3	10.5	3.9	1.9	1.7	3.7	4.2	6.1	10.2	9.4	8.3	7.2	14.7	1.7	5,192
1993	6.7	6.9	5.7	4.3	1.5	2.5	2.8	4.9	8.8	18.2	17.5	14.7	7.9	18.2	1.5	5,705
1994	12.3	10.8	9.0	4.4	5.8	4.3	3.7	5.8	12.3	16.6	15.7	13.5	9.5	16.6	3.7	6,888
1995	11.0	9.6	10.2	5.9	3.0	2.6	1.9	3.3	8.6	17.2	19.7	16.8	9.2	19.7	1.9	5,592
1996	14.4	12.9	12.0	9.7	6.1	4.3	3.8	7.2	12.3	18.2	20.9	19.4	11.8	20.9	3.8	8,537
1997	17.9	16.8	16.6	14.2	11.3	12.7	12.4	13.7	17.8	24.6	26.6	23.9	17.4	26.6	11.3	12,585
1998	21.3	19.4	17.3	12.9	10.6	13.4	8.8	8.5	12.2	22.1	25.4	22.9	16.2	25.4	8.5	11,739
1999	21.5	18.6	16.9	12.9	11.7	12.0	8.6	9.0	13.0	20.5	22.2	19.2	15.5	22.2	8.6	10,032
2000	17.8	16.0	15.6	10.8	8.4	7.8	6.5	8.8	13.4	19.1	19.7	16.3	13.4	19.7	6.5	9,690
2001	14.4	12.4	11.6	9.5	6.0	3.4	3.1	4.1	6.8	11.2	12.2	10.7	8.8	14.4	3.1	6,343
2002	9.3	8.1	7.1	5.1	2.9	2.1	1.4	1.4	4.0	9.1	9.9	8.5	5.7	9.9	1.4	4,145
2003	6.4	5.5	4.6	3.9	3.8	3.7	2.9	3.1	5.1	7.5	7.8	6.2	5.0	7.8	2.9	3,265
2004	5.1	4.1	3.9	2.9	2.6	3.3	3.0	3.0	3.9	4.9	4.4	3.7	3.7	5.1	2.6	2,711
2005	3.3	2.7	2.4	2.7	2.7	2.8	2.2	2.1	3.4	5.9	5.5	4.6	3.4	5.9	2.1	2,434
2006	4.0	3.5	3.6	3.7	2.8	3.3	2.9	3.9	7.0	9.9	8.8	7.3	5.1	9.9	2.8	3,671
2007	5.8	5.1	4.9	4.1	4.3	4.5	3.7	3.1	6.9	10.2	9.5	8.4	5.9	10.2	3.1	3,742
2008	6.7	5.5	4.7	4.2	3.6	3.6	2.6	2.9	4.4	7.6	7.1	5.7	4.9	7.6	2.6	3,541
2009	4.7	4.0	3.5	3.1	2.3	2.7	3.0	3.3	5.0	7.6	7.0	6.2	4.4	7.6	2.3	3,163
2010	5.0	4.2	3.4	3.1	3.0	3.6	2.9	3.2	4.7	7.4	7.9	6.5	4.6	7.9	2.9	3,316
2011	5.3	4.5	4.2	3.9	3.7	4.1	3.4	3.4	4.7	8.9	10.3	7.7	5.3	10.3	3.4	3,398

Notes:

(1) Predicted Martin-Curren Tunnel using SWE's regression of Total Curren Spring Flow vs. Total Martin-Curren Tunnel flow (Table A-5) minus farmers diversions from the Martin-Curren Tunnel (Table A-6).

Predicted Total Martin-Curren Tunnel = .7491 x Total Rangen Flow - 5.6357

Table A-8

Monthly Average Flow
Martin-Curren Tunnel
1996 - 2011

Values In CFS

AMEC Predicted Total Tunnel Flow [1]

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann Avg	Max	Min	Ann Total (AF)
1966	33.5	30.5	28.0	23.2	20.0	28.4	32.8	34.2	41.1	46.7	38.1	31.2	32.3	46.7	20.0	23,397
1967	27.3	23.8	19.4	21.8	22.5	29.9	31.1	34.0	38.5	46.4	44.9	42.5	31.8	46.4	19.4	23,074
1968	33.9	28.7	25.2	21.3	21.9	28.1	32.2	38.5	45.5	45.5	43.4	41.6	33.8	45.5	21.3	24,565
1969	32.4	26.9	23.0	19.4	20.1	28.4	31.5	38.2	43.7	44.5	42.8	37.2	32.3	44.5	19.4	23,439
1970	31.7	26.4	25.8	20.4	20.2	26.2	32.0	38.9	43.8	46.3	41.8	39.3	32.7	46.3	20.2	23,728
1971	32.0	25.2	23.7	22.2	24.7	26.9	32.6	39.7	42.9	49.6	47.0	41.9	34.0	49.6	22.2	22,101
1972	35.6	30.4	26.6	24.8	28.7	37.9	40.1	44.8	49.7	51.4	45.5	44.3	38.3	51.4	24.8	27,835
1973	37.7	31.1	29.0	22.5	24.0	25.9	34.1	35.6	37.7	43.7	40.5	35.8	33.1	43.7	22.5	24,019
1974	27.4	29.2	25.2	21.2	20.1	26.9	29.6	35.6	38.7	46.5	41.4	37.7	31.6	46.5	20.1	22,908
1975	26.6	24.3	18.9	19.5	22.3	24.0	26.7	33.2	36.0	37.7	36.5	38.0	28.6	38.0	18.9	18,421
1976	31.8	27.5	25.2	19.2	21.3	22.8	24.0	29.7	36.6	40.5	38.3	34.1	29.2	40.5	19.2	21,240
1977	29.6	24.0	22.6	20.7	18.8	22.1	20.5	19.8	22.8	23.5	26.1	22.5	22.7	29.6	18.8	16,461
1978	19.3	16.4	16.9	15.6	15.0	14.8	15.3	19.5	31.7	26.4	24.6	21.7	19.8	31.7	14.8	14,319
1979	20.1	17.1	16.3	12.7	9.6	13.4	14.7	21.4	30.2	30.1	26.0	23.1	19.5	30.2	9.6	12,741
1980	20.3	18.1	15.0	13.7	11.4	17.5	18.9	20.2	22.7	29.9	25.2	20.5	19.4	29.9	11.4	14,111
1981	17.7	14.4	11.1	12.1	9.3	10.5	15.0	19.3	22.1	23.7	25.1	19.9	16.7	25.1	9.3	12,080
1982	17.3	16.9	16.6	12.9	12.4	11.6	16.1	19.2	26.4	29.3	30.0	25.8	19.5	30.0	11.6	14,157
1983	22.1	19.2	18.6	15.5	17.1	16.1	20.7	26.7	29.9	33.2	30.8	29.3	23.3	33.2	15.5	15,057
1984	25.1	24.4	22.4	19.5	18.0	20.6	22.8	25.9	26.5	30.0	28.7	27.4	24.3	30.0	18.0	17,619
1985	24.5	23.1	21.4	20.2	18.1	17.6	19.0	28.3	31.0	33.3	31.1	26.2	24.5	33.3	17.6	17,731
1986	22.7	21.7	20.4	18.6	20.1	20.0	23.0	31.5	33.8	36.0	32.9	31.0	26.0	36.0	18.6	18,829
1987	26.8	23.0	21.4	17.4	16.9	21.0	22.2	28.2	28.5	33.5	29.9	28.3	24.8	33.5	16.9	16,200
1988	22.5	19.8	17.4	15.0	15.1	16.9	16.8	21.2	24.1	29.9	26.7	22.8	20.7	29.9	15.0	15,019
1989	20.1	17.8	15.9	11.0	11.7	13.1	15.0	20.8	20.5	26.5	23.4	21.9	18.1	26.5	11.0	13,141
1990	20.1	18.1	15.9	10.0	11.1	13.0	14.2	17.1	20.7	25.8	21.0	18.4	17.1	25.8	10.0	12,399
1991	15.8	14.7	14.8	7.7	8.5	9.3	9.9	15.0	20.4	21.0	18.9	18.6	14.6	21.0	7.7	9,402
1992	14.9	11.5	10.7	6.6	6.1	6.0	7.9	8.4	10.3	12.9	9.6	8.5	9.5	14.9	6.0	6,878
1993	6.9	7.1	5.9	6.6	4.8	5.8	6.2	10.1	14.8	21.5	17.7	15.0	10.2	21.5	4.8	7,396
1994	12.6	11.1	9.2	7.2	8.5	7.0	8.9	11.1	15.0	19.4	15.9	13.7	11.6	19.4	7.0	8,427
1995	11.2	9.9	10.5	8.2	6.2	6.3	5.2	6.7	10.8	17.4	20.0	17.1	10.8	20.0	5.2	6,759
1996	14.7	13.1	12.2	11.2	8.8	7.1	6.9	9.7	14.9	18.9	21.2	19.6	13.2	21.2	6.9	9,569
1997	18.2	17.0	16.9	15.0	12.3	13.7	13.5	15.0	18.9	25.3	26.8	24.2	18.1	26.8	12.3	13,073
1998	21.5	19.6	17.5	15.2	13.8	16.8	12.7	12.7	15.8	24.0	25.7	23.1	18.2	25.7	12.7	13,167
1999	21.8	18.8	17.1	13.7	12.6	13.0	9.7	10.2	14.1	21.1	22.4	19.4	16.2	22.4	9.7	10,504
2000	18.1	16.3	15.8	11.6	9.4	8.8	7.6	10.0	14.5	19.7	20.0	16.5	14.0	20.0	7.6	10,177
2001	14.6	12.7	11.8	10.2	7.0	4.4	4.2	5.3	7.9	11.9	12.5	10.9	9.4	14.6	4.2	6,828
2002	9.5	8.3	7.3	5.8	3.9	3.2	2.5	2.6	5.1	9.8	10.1	8.7	6.4	10.1	2.5	4,629
2003	6.7	5.7	4.8	4.1	4.0	3.9	3.2	3.3	5.4	7.8	8.0	6.4	5.3	8.0	3.2	3,419
2004	5.3	4.3	4.1	3.2	2.9	3.5	3.3	3.2	4.1	5.1	4.6	4.0	4.0	5.3	2.9	2,879
2005	3.5	2.9	2.7	2.9	2.9	3.0	2.4	2.4	3.7	6.1	5.7	4.9	3.6	6.1	2.4	2,601
2006	4.3	3.8	3.8	3.9	3.0	3.5	3.1	4.1	7.2	10.2	9.1	7.5	5.3	10.2	3.0	3,839
2007	6.1	5.3	5.1	4.3	4.6	4.7	3.9	3.4	7.1	10.4	9.8	8.7	6.1	10.4	3.4	3,896
2008	6.9	5.7	4.9	4.4	3.8	3.9	2.9	3.1	4.7	7.8	7.3	5.9	5.1	7.8	2.9	3,709
2009	4.9	4.3	3.8	3.3	2.6	2.9	3.2	3.5	5.2	7.8	7.2	6.5	4.6	7.8	2.6	3,331
2010	5.2	4.4	3.6	3.3	3.3	3.9	3.1	3.5	4.9	7.6	8.2	6.7	4.8	8.2	3.1	3,484
2011	5.6	4.8	4.5	4.2	3.9	4.3	3.6	3.6	4.9	9.1	10.6	8.0	5.6	10.6	3.6	3,552

Notes:

(1) Predicted Total Martin-Curren Tunnel flow computed using regression of total Curren Tunnel flow with Total Rangen flow provided in Figure 3-9 Brendecke's 2012 Expert Report (AMEC).

Predicted Total Martin-Curren Tunnel = .7491 x Total Rangen Flow - 5.6357

Table A-9

Monthly Average Flow
Martin-Curren Tunnel
1996 - 2011

Values In CFS

Difference (AMEC minus SWE Predicted Total Tunnel Flow) [1]

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann Avg	Max	Min	Ann Total (AF)
1966	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	176
1967	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	176
1968	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	177
1969	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	176
1970	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	176
1971	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.2	0.2	0.2	0.3	0.2	161
1972	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.2	0.2	0.2	0.3	0.2	178
1973	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	176
1974	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	176
1975	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	160
1976	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	176
1977	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	173
1978	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	172
1979	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	158
1980	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	173
1981	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	171
1982	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	172
1983	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	159
1984	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	174
1985	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	174
1986	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	174
1987	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	159
1988	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	173
1989	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	172
1990	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	172
1991	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	156
1992	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	170
1993	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	170
1994	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	170
1995	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	155
1996	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	171
1997	0.2	0.2	0.2	-1.3	-2.0	-2.1	-2.5	-2.7	-2.3	-1.0	0.2	0.2	-1.1	0.2	-2.7	-769
1998	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	172
1999	0.2	0.2	0.2	-1.3	-2.0	-2.1	-2.5	-2.7	-2.3	-1.0	0.2	0.2	-1.1	0.2	-2.7	-784
2000	0.2	0.2	0.2	-1.3	-2.0	-2.1	-2.5	-2.7	-2.3	-1.0	0.2	0.2	-1.1	0.2	-2.7	-769
2001	0.2	0.2	0.2	-1.3	-2.0	-2.1	-2.5	-2.7	-2.3	-1.0	0.2	0.2	-1.1	0.2	-2.7	-771
2002	0.2	0.2	0.2	-1.3	-2.0	-2.1	-2.5	-2.7	-2.3	-1.0	0.2	0.2	-1.1	0.2	-2.7	-772
2003	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	154
2004	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	168
2005	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	168
2006	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	168
2007	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	154
2008	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	169
2009	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	168
2010	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	168
2011	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	154

Notes:

(1) AMEC's predicted Total Martin-Curren Tunnel flow (Table A-8) minus SWE's predicted Martin-Curren Tunnel flow (Table A-5).

Table A-10

Monthly Average Flow
Rangen Total Flow
1996 - 2011

Values in CFS

Total Rangen Flow [1]

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann Avg	Max	Min	Ann Total (AF)
1966	52.2	48.2	44.9	38.5	34.2	45.4	51.3	53.2	62.4	69.9	58.4	49.2	50.7	69.9	34.2	36,680
1967	43.9	39.3	33.4	36.6	37.6	47.4	49.0	52.9	58.9	69.4	67.4	64.3	50.0	69.4	33.4	36,248
1968	52.8	45.8	41.2	36.0	36.8	45.0	50.5	58.9	68.2	68.2	65.5	63.1	52.7	68.2	36.0	38,253
1969	50.8	43.4	38.2	33.4	34.3	45.5	49.6	58.5	65.9	66.9	64.7	57.2	50.7	66.9	33.4	36,736
1970	49.8	42.7	42.0	34.7	34.5	42.5	50.3	59.4	66.0	69.3	63.3	60.0	51.2	69.3	34.5	37,121
1971	50.2	41.2	39.1	37.2	40.5	43.4	51.0	60.5	64.8	73.7	70.2	63.4	52.9	73.7	37.2	34,486
1972	55.1	48.1	43.0	40.6	45.9	58.1	61.0	67.3	73.9	76.1	68.2	66.7	58.7	76.1	40.6	42,619
1973	57.9	49.1	46.2	37.6	39.6	42.1	53.1	55.1	57.8	65.8	61.6	55.3	51.8	65.8	37.6	37,510
1974	44.1	46.5	41.1	35.8	34.4	43.4	47.1	55.0	59.2	69.6	62.8	57.9	49.7	69.6	34.4	36,027
1975	43.0	39.9	32.8	33.5	37.3	39.5	43.2	51.9	55.6	57.9	56.2	58.3	45.8	58.3	32.8	29,575
1976	50.0	44.3	41.1	33.1	35.9	38.0	39.5	47.2	56.4	61.6	58.7	53.0	46.6	61.6	33.1	33,815
1977	47.1	39.5	37.7	35.2	32.6	37.0	34.9	33.9	37.9	38.9	42.4	37.6	37.9	47.1	32.6	27,421
1978	33.3	29.4	30.1	28.3	27.6	27.3	27.9	33.6	49.9	42.8	40.3	36.5	33.9	49.9	27.3	24,562
1979	34.4	30.3	29.3	24.5	20.3	25.4	27.1	36.1	47.8	47.7	42.2	38.3	33.6	47.8	20.3	21,992
1980	34.6	31.7	27.5	25.8	22.7	30.9	32.7	34.5	37.8	47.4	41.1	34.9	33.5	47.4	22.7	24,299
1981	31.1	26.7	22.4	23.7	20.0	21.5	27.5	33.3	37.0	39.1	41.0	34.1	29.8	41.0	20.0	21,573
1982	30.6	30.1	29.7	24.7	24.1	23.0	29.0	33.1	42.8	46.7	47.6	41.9	33.6	47.6	23.0	24,345
1983	37.0	33.1	32.3	28.2	30.3	29.0	35.1	43.1	47.5	51.9	48.6	46.7	38.6	51.9	28.2	25,084
1984	41.0	40.1	37.4	33.6	31.5	35.0	37.9	42.1	42.9	47.6	45.8	44.1	39.9	47.6	31.5	28,982
1985	40.2	38.3	36.1	34.5	31.7	31.0	32.9	45.3	48.9	52.0	49.1	42.5	40.2	52.0	31.0	29,116
1986	37.8	36.5	34.8	32.4	34.3	34.2	38.2	49.6	52.6	55.6	51.5	48.9	42.2	55.6	32.4	30,582
1987	43.3	38.2	36.1	30.7	30.1	35.5	37.2	45.2	45.6	52.3	47.4	45.3	40.6	52.3	30.1	26,610
1988	37.6	33.9	30.8	27.6	27.7	30.1	29.9	35.8	39.7	47.5	43.1	37.9	35.1	47.5	27.6	25,510
1989	34.4	31.3	28.7	22.2	23.2	25.0	27.5	35.3	34.9	42.9	38.7	36.7	31.7	42.9	22.2	22,989
1990	34.3	31.7	28.8	20.9	22.3	24.9	26.5	30.4	35.2	41.9	35.6	32.1	30.4	41.9	20.9	21,999
1991	28.6	27.2	27.3	17.8	18.9	19.9	20.8	27.5	34.8	35.6	32.8	32.3	27.0	35.6	17.8	17,535
1992	27.4	22.9	21.8	16.4	15.7	15.5	18.1	18.8	21.3	24.8	20.4	18.9	20.2	27.4	15.5	14,643
1993	16.8	17.0	15.4	16.4	13.9	15.2	15.8	21.0	27.3	36.2	31.2	27.5	21.1	36.2	13.9	15,320
1994	24.3	22.3	19.8	17.1	18.9	16.9	19.4	22.3	27.6	33.4	28.8	25.8	23.1	33.4	16.9	16,696
1995	22.5	20.7	21.5	18.4	15.8	15.9	14.4	16.5	22.0	30.7	34.2	30.3	21.9	34.2	14.4	14,007
1996	27.1	25.0	23.8	22.4	19.3	17.0	16.7	20.5	27.4	32.7	35.8	33.7	25.1	35.8	16.7	18,235
1997	31.8	30.2	30.0	27.5	24.0	25.8	25.5	27.5	32.7	41.3	43.3	39.8	31.6	43.3	24.0	22,898
1998	36.2	33.7	30.9	27.8	26.0	29.9	24.5	24.4	28.6	39.6	41.8	38.4	31.8	41.8	24.4	23,023
1999	36.6	32.6	30.4	25.8	24.4	24.9	20.5	21.2	26.4	35.7	37.4	33.4	29.1	37.4	20.5	19,006
2000	31.6	29.2	28.6	23.0	20.1	19.3	17.7	20.9	26.8	33.9	34.2	29.6	26.2	34.2	17.7	19,047
2001	27.1	24.4	23.3	21.2	16.8	13.4	13.1	14.6	18.0	23.4	24.2	22.1	20.1	27.1	13.1	14,561
2002	20.3	18.6	17.3	15.3	12.7	11.7	10.8	11.0	14.3	20.6	21.1	19.1	16.1	21.1	10.8	11,626
2003	16.4	15.2	13.9	13.0	12.9	12.7	11.7	12.0	14.7	17.9	18.2	16.1	14.6	18.2	11.7	9,548
2004	14.6	13.3	13.0	11.8	11.4	12.2	11.9	11.8	13.1	14.3	13.7	12.8	12.8	14.6	11.4	9,304
2005	12.2	11.4	11.1	11.4	11.5	11.5	10.7	10.7	12.4	15.7	15.2	14.0	12.3	15.7	10.7	8,919
2006	13.2	12.6	12.7	12.8	11.5	12.2	11.7	13.0	17.2	21.1	19.6	17.6	14.6	21.1	11.5	10,571
2007	15.6	14.6	14.4	13.3	13.6	13.8	12.7	12.0	17.0	21.4	20.6	19.1	15.7	21.4	12.0	10,184
2008	16.7	15.2	14.1	13.5	12.6	12.7	11.3	11.7	13.7	17.9	17.3	15.4	14.3	17.9	11.3	10,413
2009	14.1	13.2	12.6	12.0	11.0	11.4	11.8	12.2	14.5	18.0	17.1	16.2	13.7	18.0	11.0	9,893
2010	14.5	13.4	12.4	12.0	11.9	12.7	11.7	12.1	14.1	17.7	18.4	16.5	13.9	18.4	11.7	10,098
2011	15.0	13.9	13.5	13.1	12.7	13.3	12.3	12.4	14.1	19.7	21.6	18.1	15.0	21.6	12.3	9,726

Notes:

(1) Total Rangen monthly flow as provided by Rangen (1966 - 2/1995) and total Rangen monthly flow as provided by the IDWR (3/1995 - 2011).

Table A-11

Monthly Average Flow
Total Curren Spring Flow
1996 - 2011

Values In CFS

Estimated Total Spring Flow [1]

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann Avg	Max	Min	Ann Total (AF)
1966	52.2	48.2	44.9	38.5	34.2	45.4	51.3	53.2	62.4	69.9	58.4	49.2	50.7	69.9	34.2	36,680
1967	43.9	39.3	33.4	36.6	37.6	47.4	49.0	52.9	58.9	69.4	67.4	64.3	50.0	69.4	33.4	36,248
1968	52.8	45.8	41.2	36.0	36.8	45.0	50.5	58.9	68.2	68.2	65.5	63.1	52.7	68.2	36.0	38,253
1969	50.8	43.4	38.2	33.4	34.3	45.5	49.6	58.5	65.9	66.9	64.7	57.2	50.7	66.9	33.4	36,736
1970	49.8	42.7	42.0	34.7	34.5	42.5	50.3	59.4	66.0	69.3	63.3	60.0	51.2	69.3	34.5	37,121
1971	50.2	41.2	39.1	37.2	40.5	43.4	51.0	60.5	64.8	73.7	70.2	63.4	52.9	73.7	37.2	34,486
1972	55.1	48.1	43.0	40.6	45.9	58.1	61.0	67.3	73.9	76.1	68.2	66.7	58.7	76.1	40.6	42,619
1973	57.9	49.1	46.2	37.6	39.6	42.1	53.1	55.1	57.8	65.8	61.6	55.3	51.8	65.8	37.6	37,510
1974	44.1	46.5	41.1	35.8	34.4	43.4	47.1	55.0	59.2	69.6	62.8	57.9	49.7	69.6	34.4	36,027
1975	43.0	39.9	32.8	33.5	37.3	39.5	43.2	51.9	55.6	57.9	56.2	58.3	45.8	58.3	32.8	29,575
1976	50.0	44.3	41.1	33.1	35.9	38.0	39.5	47.2	56.4	61.6	58.7	53.0	46.6	61.6	33.1	33,815
1977	47.1	39.5	37.7	35.2	32.6	37.0	34.9	33.9	37.9	38.9	42.4	37.6	37.9	47.1	32.6	27,421
1978	33.3	29.4	30.1	28.3	27.6	27.3	27.9	33.6	49.9	42.8	40.3	36.5	33.9	49.9	27.3	24,562
1979	34.4	30.3	29.3	24.5	20.3	25.4	27.1	36.1	47.8	47.7	42.2	38.3	33.6	47.8	20.3	21,992
1980	34.6	31.7	27.5	25.8	22.7	30.9	32.7	34.5	37.8	47.4	41.1	34.9	33.5	47.4	22.7	24,299
1981	31.1	26.7	22.4	23.7	20.0	21.5	27.5	33.3	37.0	39.1	41.0	34.1	29.8	41.0	20.0	21,573
1982	30.6	30.1	29.7	24.7	24.1	23.0	29.0	33.1	42.8	46.7	47.6	41.9	33.6	47.6	23.0	24,345
1983	37.0	33.1	32.3	28.2	30.3	29.0	35.1	43.1	47.5	51.9	48.6	46.7	38.6	51.9	28.2	25,084
1984	41.0	40.1	37.4	33.6	31.5	35.0	37.9	42.1	42.9	47.6	45.8	44.1	39.9	47.6	31.5	28,982
1985	40.2	38.3	36.1	34.5	31.7	31.0	32.9	45.3	48.9	52.0	49.1	42.5	40.2	52.0	31.0	29,116
1986	37.8	36.5	34.8	32.4	34.3	34.2	38.2	49.6	52.6	55.6	51.5	48.9	42.2	55.6	32.4	30,582
1987	43.3	38.2	36.1	30.7	30.1	35.5	37.2	45.2	45.6	52.3	47.4	45.3	40.6	52.3	30.1	26,610
1988	37.6	33.9	30.8	27.6	27.7	30.1	29.9	35.8	39.7	47.5	43.1	37.9	35.1	47.5	27.6	25,510
1989	34.4	31.3	28.7	22.2	23.2	25.0	27.5	35.3	34.9	42.9	38.7	36.7	31.7	42.9	22.2	22,989
1990	34.3	31.7	28.8	20.9	22.3	24.9	26.5	30.4	35.2	41.9	35.6	32.1	30.4	41.9	20.9	21,999
1991	28.6	27.2	27.3	17.8	18.9	19.9	20.8	27.5	34.8	35.6	32.8	32.3	27.0	35.6	17.8	17,535
1992	27.4	22.9	21.8	16.4	15.7	15.5	18.1	18.8	21.3	24.8	20.4	18.9	20.2	27.4	15.5	14,643
1993	16.8	17.0	15.4	16.4	13.9	15.2	15.8	21.0	27.3	36.2	31.2	27.5	21.1	36.2	13.9	15,320
1994	24.3	22.3	19.8	17.1	18.9	16.9	19.4	22.3	27.6	33.4	28.8	25.8	23.1	33.4	16.9	16,696
1995	22.5	20.7	21.5	18.4	15.8	15.9	14.4	16.5	22.0	30.7	34.2	30.3	21.9	34.2	14.4	14,007
1996	27.1	25.0	23.8	22.4	19.3	17.0	16.7	20.5	27.4	32.7	35.8	33.7	25.1	35.8	16.7	18,235
1997	31.8	30.2	30.0	29.6	27.0	28.9	29.1	31.4	36.0	43.0	43.3	39.8	33.3	43.3	27.0	24,153
1998	36.2	33.7	30.9	27.8	26.0	29.9	24.5	24.4	28.6	39.6	41.8	38.4	31.8	41.8	24.4	23,023
1999	36.6	32.6	30.4	27.8	27.4	28.1	24.1	25.1	29.7	37.4	37.4	33.4	30.8	37.4	24.1	20,262
2000	31.6	29.2	28.6	25.0	23.1	22.4	21.3	24.8	30.2	35.6	34.2	29.6	28.0	35.6	21.3	20,303
2001	27.1	24.4	23.3	23.3	19.8	16.6	16.7	18.5	21.4	25.0	24.2	22.1	21.9	27.1	16.6	15,817
2002	20.3	18.6	17.3	17.4	15.7	14.9	14.4	14.9	17.7	22.3	21.1	19.1	17.8	22.3	14.4	12,882
2003	16.4	15.2	13.9	13.0	12.9	12.7	11.7	12.0	14.7	17.9	18.2	16.1	14.6	18.2	11.7	9,548
2004	14.6	13.3	13.0	11.8	11.4	12.2	11.9	11.8	13.1	14.3	13.7	12.8	12.8	14.6	11.4	9,304
2005	12.2	11.4	11.1	11.4	11.5	11.5	10.7	10.7	12.4	15.7	15.2	14.0	12.3	15.7	10.7	8,919
2006	13.2	12.6	12.7	12.8	11.5	12.2	11.7	13.0	17.2	21.1	19.6	17.6	14.6	21.1	11.5	10,571
2007	15.6	14.6	14.4	13.3	13.6	13.8	12.7	12.0	17.0	21.4	20.6	19.1	15.7	21.4	12.0	10,184
2008	16.7	15.2	14.1	13.5	12.6	12.7	11.3	11.7	13.7	17.9	17.3	15.4	14.3	17.9	11.3	10,413
2009	14.1	13.2	12.6	12.0	11.0	11.4	11.8	12.2	14.5	18.0	17.1	16.2	13.7	18.0	11.0	9,893
2010	14.5	13.4	12.4	12.0	11.9	12.7	11.7	12.1	14.1	17.7	18.4	16.5	13.9	18.4	11.7	10,098
2011	15.0	13.9	13.5	13.1	12.7	13.3	12.3	12.4	14.1	19.7	21.6	18.1	15.0	21.6	12.3	9,726

Notes:

(1) Total Curren Spring flow is equal to the sum of (a) total Rangen monthly flow data (Table A-10) and (b) farmers diversions in 1997 and from 1999 - 2002 (Table A-6).

Table A-12

Monthly Average Flow
Total Curren Spring Flow
1996 - 2011

Values In CFS

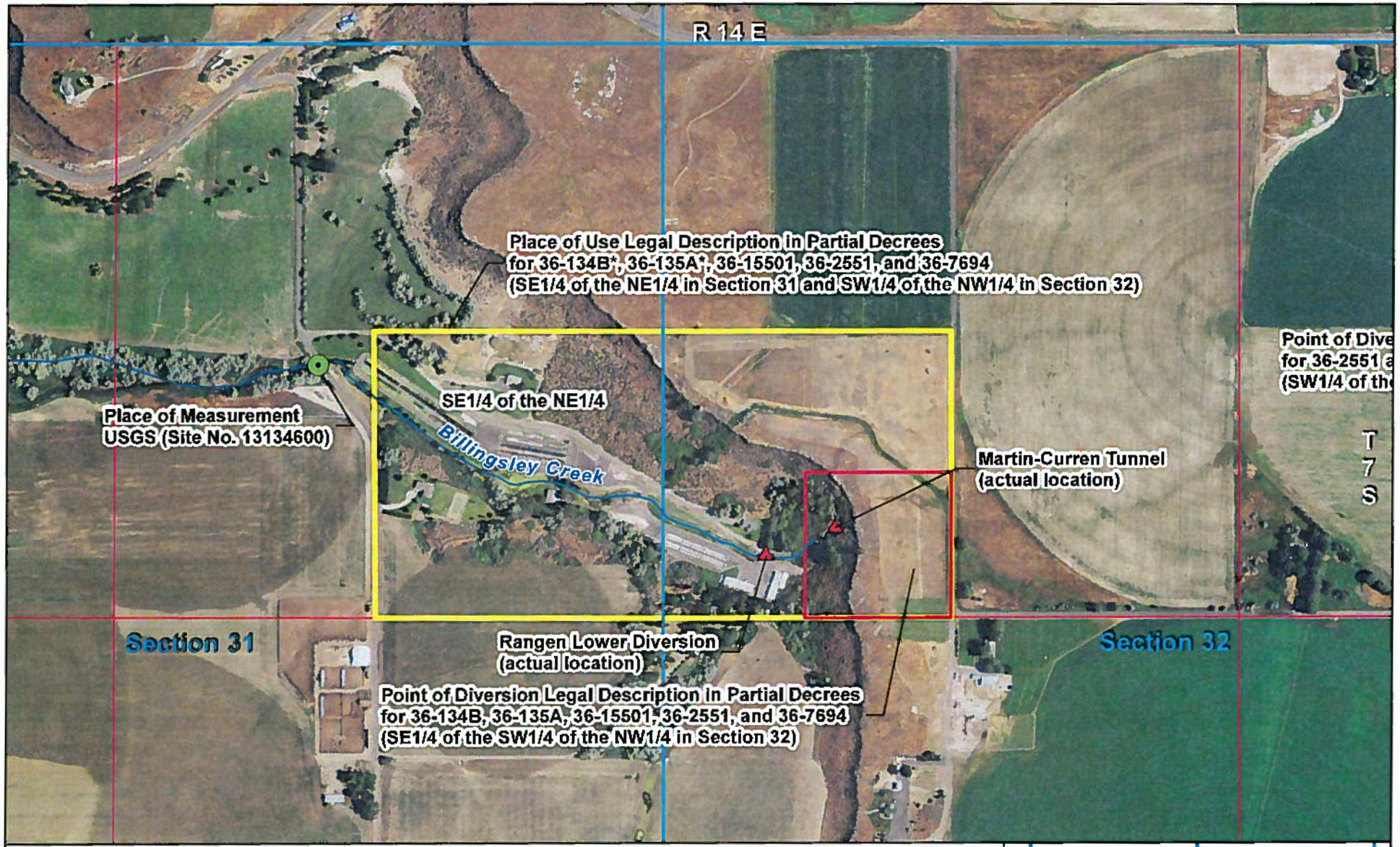
Estimated Total Curren Spring Flow to Rangen[1]

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann Avg	Max	Min	Ann Total (AF)
1966	51.7	47.8	44.5	36.2	25.8	37.6	42.9	45.7	57.2	67.7	57.6	48.7	46.9	67.7	25.8	33,982
1967	43.5	38.9	32.6	29.7	28.8	38.0	40.6	44.4	51.1	63.8	66.5	64.3	45.2	66.5	28.8	32,740
1968	52.5	45.5	41.0	36.0	27.7	38.5	42.1	58.5	64.3	67.6	64.9	62.6	50.1	67.6	27.7	36,384
1969	50.5	43.4	38.2	32.8	25.6	36.7	42.7	48.9	60.7	64.2	63.7	56.8	47.0	64.2	25.6	34,039
1970	49.1	42.4	41.7	34.4	26.3	34.7	41.9	51.9	61.6	67.1	62.5	59.5	47.8	67.1	26.3	34,605
1971	49.7	40.8	38.7	34.0	33.2	37.6	42.6	51.3	56.9	73.7	69.5	62.4	49.2	73.7	33.2	31,815
1972	54.1	47.1	42.6	35.9	38.4	49.5	52.0	57.7	69.1	73.9	67.5	66.2	54.5	73.9	35.9	39,576
1973	57.4	48.6	45.7	37.1	30.4	34.3	43.7	47.6	55.4	63.6	60.8	54.8	48.3	63.6	30.4	34,960
1974	44.1	46.1	40.7	33.5	26.0	35.6	38.7	47.5	54.0	67.4	62.0	57.4	46.1	67.4	26.0	33,357
1975	42.5	39.5	32.4	31.2	28.9	31.7	34.8	44.4	50.4	55.7	55.4	57.8	42.1	57.8	28.9	26,907
1976	49.6	43.9	40.8	30.8	27.8	30.4	31.4	39.9	51.3	59.4	57.9	52.5	43.0	59.4	27.8	31,201
1977	46.7	39.1	37.4	32.9	24.8	29.7	27.0	26.8	32.9	36.7	41.7	37.2	34.4	46.7	24.8	24,893
1978	32.9	29.1	29.8	26.0	20.2	20.3	20.3	26.7	45.0	40.7	39.6	36.1	30.6	45.0	20.2	22,118
1979	34.1	30.0	29.0	22.2	13.2	18.7	19.8	29.5	43.0	45.6	41.6	37.9	30.4	45.6	13.2	19,656
1980	34.3	31.4	27.2	23.6	15.9	24.4	25.7	28.1	33.1	45.3	40.5	34.6	30.3	45.3	15.9	22,025
1981	30.8	26.4	22.2	21.5	13.5	15.3	20.8	27.1	32.4	37.1	40.5	33.8	26.8	40.5	13.5	19,384
1982	30.3	29.9	29.5	22.5	17.9	17.1	22.6	27.1	38.4	44.7	47.1	41.6	30.7	47.1	17.1	22,241
1983	36.8	32.9	32.1	26.0	24.4	23.4	28.9	37.3	43.2	49.9	48.2	46.4	35.8	49.9	23.4	23,081
1984	40.8	39.9	37.2	31.4	26.0	29.7	32.0	36.5	38.7	45.7	45.4	43.9	37.3	45.7	26.0	27,047
1985	40.0	38.1	35.9	32.3	26.5	25.9	27.3	39.9	44.8	50.1	48.8	42.3	37.7	50.1	25.9	27,266
1986	37.6	36.4	34.7	30.2	29.4	29.4	32.9	44.4	48.6	53.7	51.2	48.7	39.8	53.7	29.4	28,817
1987	43.2	38.1	36.0	28.6	25.5	31.0	32.2	40.2	41.7	50.5	47.2	45.2	38.3	50.5	25.5	24,939
1988	37.5	33.8	30.7	25.5	23.4	25.9	25.2	31.1	35.9	45.7	42.9	37.8	32.9	45.7	23.4	23,920
1989	34.3	31.2	28.6	20.1	19.3	21.1	23.1	30.8	31.3	41.1	38.6	36.6	29.7	41.1	19.3	21,495
1990	34.2	31.7	28.8	18.8	18.8	21.3	22.4	26.2	31.7	40.2	35.5	32.1	28.5	40.2	18.8	20,607
1991	28.6	27.2	27.3	15.7	15.8	16.7	17.1	23.5	31.4	33.9	32.8	32.3	25.2	33.9	15.7	16,254
1992	27.4	22.9	21.8	13.9	11.7	11.5	14.1	14.8	17.3	22.3	20.4	18.9	18.1	27.4	11.5	13,127
1993	16.8	17.0	15.4	14.3	10.9	12.2	12.6	16.0	21.5	33.2	31.2	27.5	19.1	33.2	10.9	13,798
1994	24.3	22.3	19.8	14.6	16.4	14.4	14.4	17.3	25.1	30.9	28.8	25.8	21.2	30.9	14.4	15,327
1995	22.5	20.7	21.5	16.4	12.8	12.4	11.4	13.3	20.0	30.7	34.2	30.3	20.5	34.2	11.4	12,995
1996	27.1	25.0	23.8	21.2	16.8	14.4	13.9	18.2	25.0	32.3	35.8	33.7	23.9	35.8	13.9	17,375
1997	31.8	30.2	30.0	27.5	24.0	25.8	25.5	27.5	32.7	41.3	43.3	39.8	31.6	43.3	24.0	22,898
1998	36.2	33.7	30.9	25.8	23.0	26.8	20.9	20.5	25.2	37.9	41.8	38.4	30.1	41.8	20.5	21,767
1999	36.6	32.6	30.4	25.8	24.4	24.9	20.5	21.2	26.4	35.7	37.4	33.4	29.1	37.4	20.5	19,006
2000	31.6	29.2	28.6	23.0	20.1	19.3	17.7	20.9	26.8	33.9	34.2	29.6	26.2	34.2	17.7	19,047
2001	27.1	24.4	23.3	21.2	16.8	13.4	13.1	14.6	18.0	23.4	24.2	22.1	20.1	27.1	13.1	14,561
2002	20.3	18.6	17.3	15.3	12.7	11.7	10.8	11.0	14.3	20.6	21.1	19.1	16.1	21.1	10.8	11,626
2003	16.4	15.2	13.9	13.0	12.9	12.7	11.7	12.0	14.7	17.9	18.2	16.1	14.6	18.2	11.7	9,548
2004	14.6	13.3	13.0	11.8	11.4	12.2	11.9	11.8	13.1	14.3	13.7	12.8	12.8	14.6	11.4	9,304
2005	12.2	11.4	11.1	11.4	11.5	11.5	10.7	10.7	12.4	15.7	15.2	14.0	12.3	15.7	10.7	8,919
2006	13.2	12.6	12.7	12.8	11.5	12.2	11.7	13.0	17.2	21.1	19.6	17.6	14.6	21.1	11.5	10,571
2007	15.6	14.6	14.4	13.3	13.6	13.8	12.7	12.0	17.0	21.4	20.6	19.1	15.7	21.4	12.0	10,184
2008	16.7	15.2	14.1	13.5	12.6	12.7	11.3	11.7	13.7	17.9	17.3	15.4	14.3	17.9	11.3	10,413
2009	14.1	13.2	12.6	12.0	11.0	11.4	11.8	12.2	14.5	18.0	17.1	16.2	13.7	18.0	11.0	9,893
2010	14.5	13.4	12.4	12.0	11.9	12.7	11.7	12.1	14.1	17.7	18.4	16.5	13.9	18.4	11.7	10,098
2011	15.0	13.9	13.5	13.1	12.7	13.3	12.3	12.4	14.1	19.7	21.6	18.1	15.0	21.6	12.3	9,726
Avg	33.1	30.0	28.0	23.5	20.3	22.9	24.2	28.6	34.5	41.1	40.1	36.8	30.2	42.2	19.6	21,380.3

Notes:

(1) Total Curren Spring Flow (Table A-11) minus reported total Rangen flow (Table A-6).

Updated Figures



*The place of use for 36-134B and 36-135A in the partial decrees includes the SW/4 of the NE/4 in Section 31.
Source:
IDWR GIS files (wr_pou and idhydro).
Partial Decrees and Licenses for Rangen Inc
PLSS GIS files for Gooding County, ID (BLM)
2011 USDA NAIP aerial photo for Gooding County, ID
USGS personal commications (March 2013).

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

Figure 2-3
Points of Diversion and Place of Use
1962 and 1977 Water Rights
Rangen Inc.

400 200 0 400 800 Feet

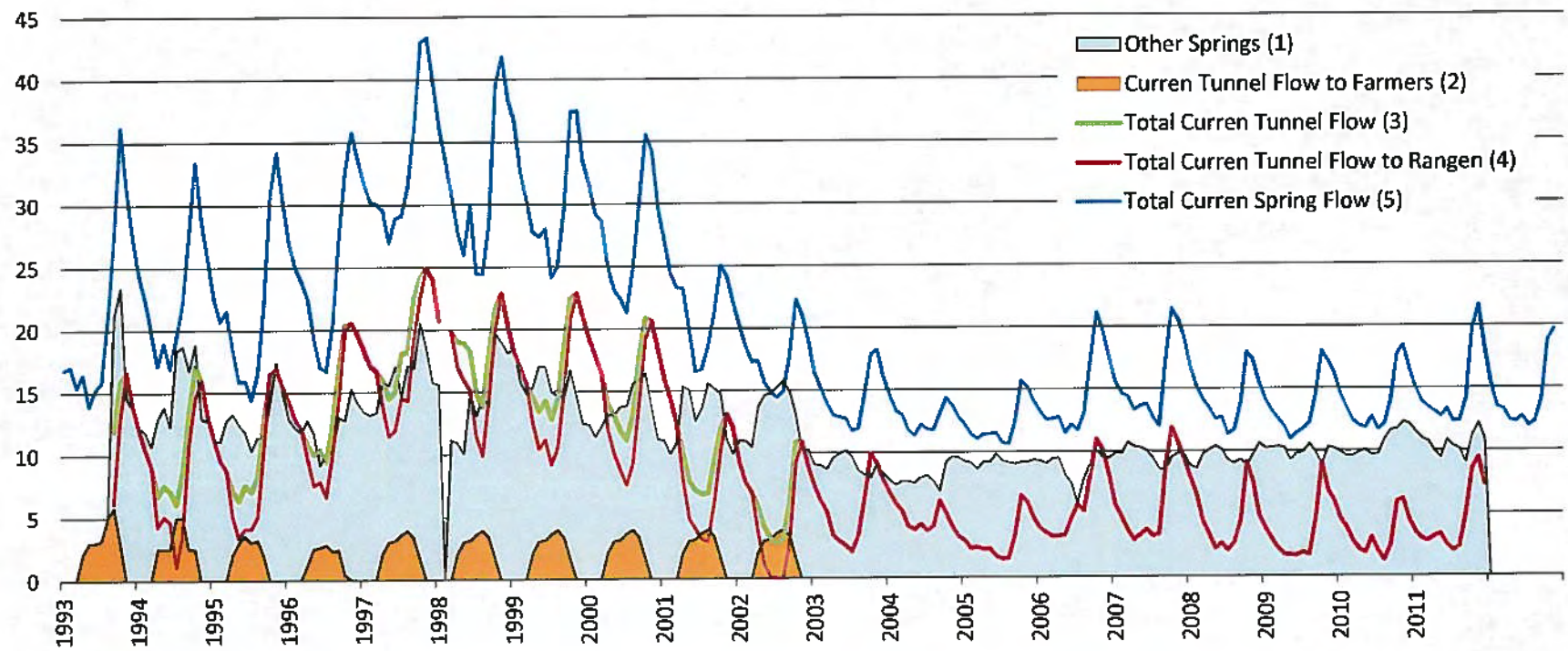
155.02.POC / hw / 4/26/2013

NW 1/4	NE 1/4 (SE1/4 NE1/4, SW1/4 NW1/4)	NW 1/4	NE 1/4
31 SW 1/4	SE 1/4	SW 1/4	32 SE 1/4

Figure 2-7

Monthly Rangen Hatchery Flow vs. Curren Tunnel and Other Springs 1993 - 2011

Values in CFS



Notes:

(1) Computed as Total Curren Spring Flow (5) minus Total Curren Tunnel Flow (3).

(2) Curren Tunnel to farmers from 1993 - 1996 provided by George Lemmon. The 1997 - 2002 diversions to farmers were estimated based on the 1992 - 1996 average monthly diversions. Diversions to farmers from the Curren Tunnel ceased after 2002 with the construction of the Sandy Pipeline to supply the irrigation water rights from the North Side Canal.

(3) Total Curren Tunnel Flow includes flow measured in tunnel by the IDWR plus measured flow to the 6" white pipe provided by the IDWR. White pipe data available from 1996 - 2011; missing data from 1993 - 1995 filled using the 1996-2011 average monthly Rangen pipe flows.

(4) Total Curren Tunnel Flow to Rangen is equal to the Total Curren Tunnel flow (3) minus Curren Tunnel flow diversions to farmers (2).

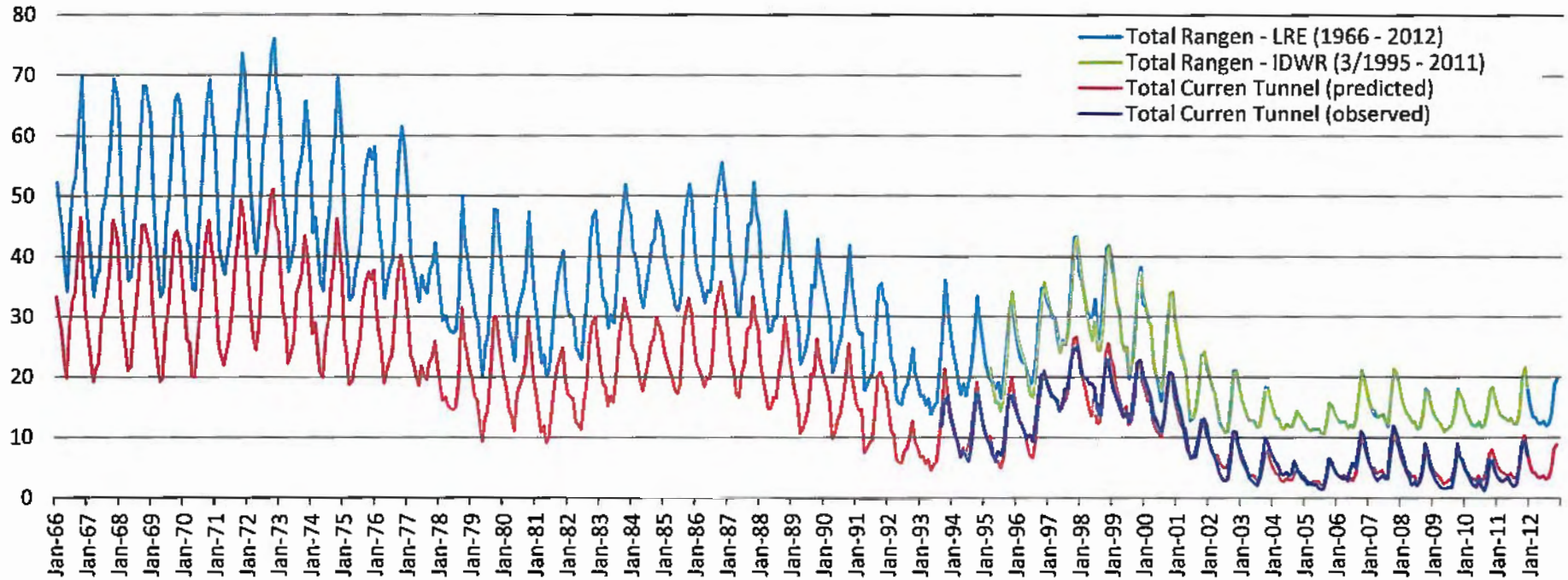
(5) Total Curren Spring Flow is equal to Total Rangen Hatchery flow data provided by Rangen (1993 - Feb 1995) and IDWR (March 1995 - 2011) plus diversions to farmers in years when they are not included in the total (1998 and 1999 - 2002).

Spronk Water Engineers, Inc.

Updated 5/5/2013

Figure 2-5a

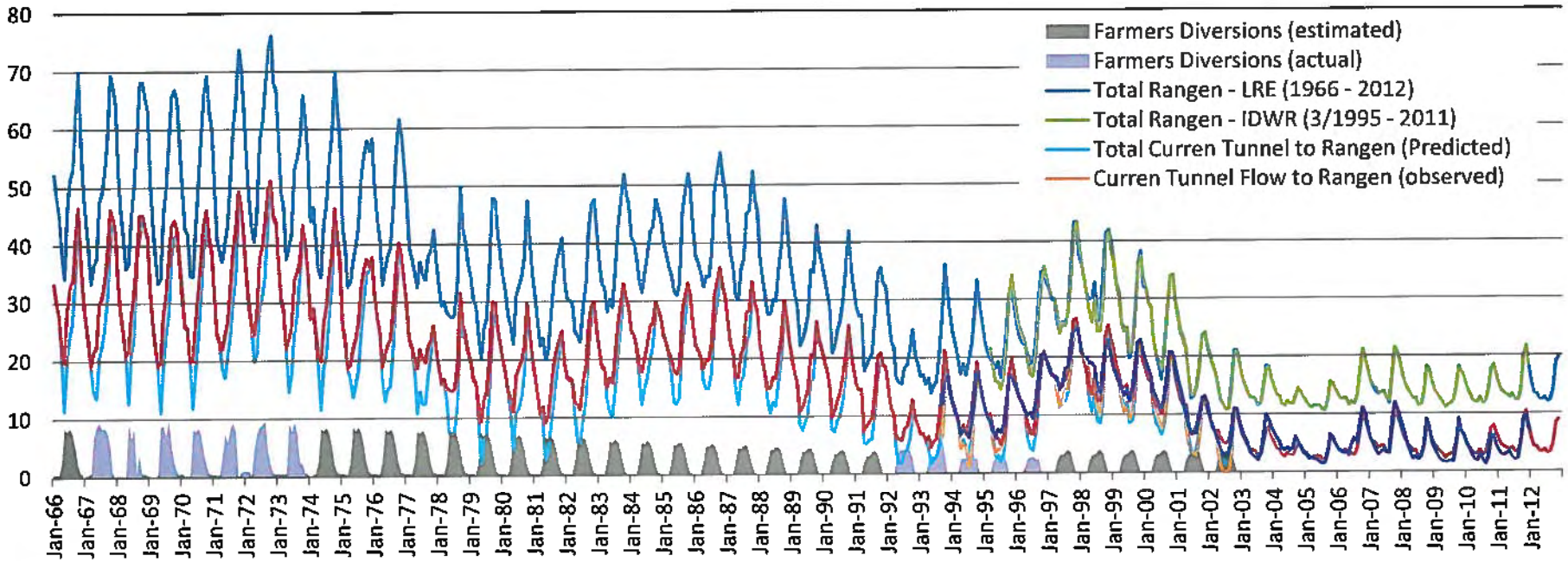
Monthly Average Flow
Rangen Hatchery
1966 - 2012
Values in CFS



Source: (1) Total Rangen monthly flow data reported by Rangen (1966 - 2012) and reported by IDWR (March 1995 - 2011).
(2) Total Curren Tunnel (observed) is equal to measured Curren Tunnel flow provided by the IDWR (9/8/1993 - 2011) plus the 6" white pipe flow provided by the IDWR (data available from 1996 - 2011; missing data from 1993 - 1995 filled in using monthly average flows).
(3) Total Curren Tunnel (predicted) is equal to Total Curren Tunnel flow back-casted/predicted using SWE's regression between Total Curren Tunnel vs. Total Curren Spring Flow.

Figure 2-5b

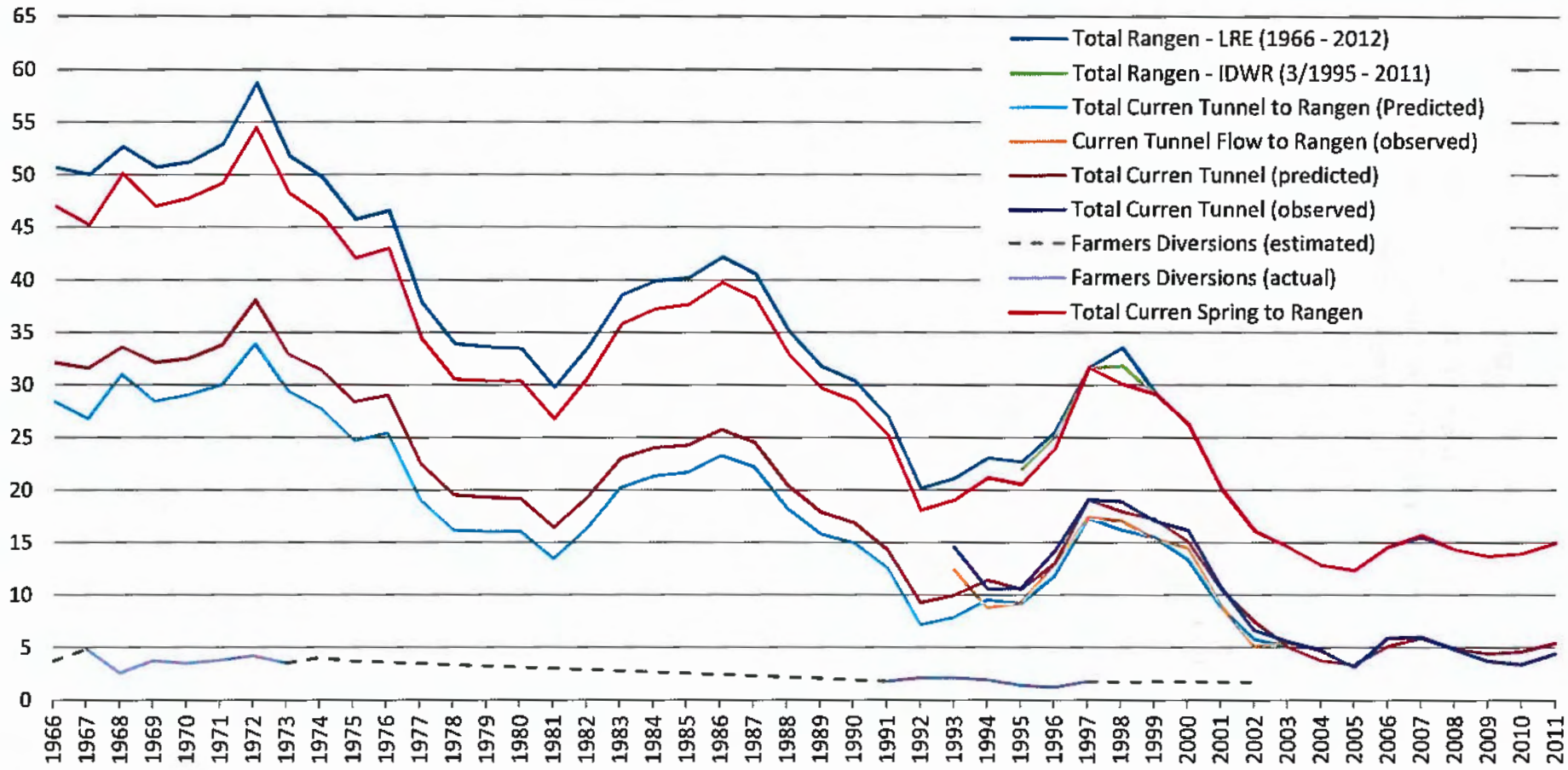
Monthly Average Flow
Rangen Hatchery
1966 - 2012
Values in CFS



Source:
(1) Total Rangen monthly flow data reported by Rangen (1966 - 2012) and reported by IDWR (March 1995 - 2011).
(2) Total Curren Tunnel (observed) is equal to measured Curren Tunnel flow provided by the IDWR (9/8/1993 - 2011) plus 6" white pipe flow provided by the IDWR (data available from 1996 - 2011; missing data from 1993 - 1995 filled in using monthly average flows).
(3) Total Curren Tunnel (predicted) is equal to Total Curren Tunnel flow back-casted/predicted using SWE's regression between Total Curren Tunnel vs. Total Curren Spring Flow.
(4) Total Curren Tunnel to Rangen (observed) is equal to measured Curren Tunnel flow provided by the IDWR (9/8/1993 - 2011) plus 6" white pipe flow provided by the IDWR (data available from 1996 - 2011; missing data from 1993 - 1995 filled in using monthly average flows) minus diversions to farmers.
(5) Total Curren Tunnel to Rangen (predicted) is equal to Total Curren Tunnel flow back-casted/predicted using SWE's regression between Total Curren Tunnel vs. Total Curren Spring minus diversions to farmers.
(6) Diversions to farmers (actual) data is from 1967 - 1973 and 1992 - 1996; provided by George Lemmon (1992 - 1996).
(7) Diversions to farmers (estimated) in 1966 and 1974 - 1975 are equal to average monthly 1967 - 1973 diversions. Missing data from 1976 - 1991 filled in using a monthly interpolation between the 1967 - 1973 and 1992 - 1996 averages. Missing data from 1997 - 2002 filled in using the 1992 - 1996 average.

Figure 2-5c

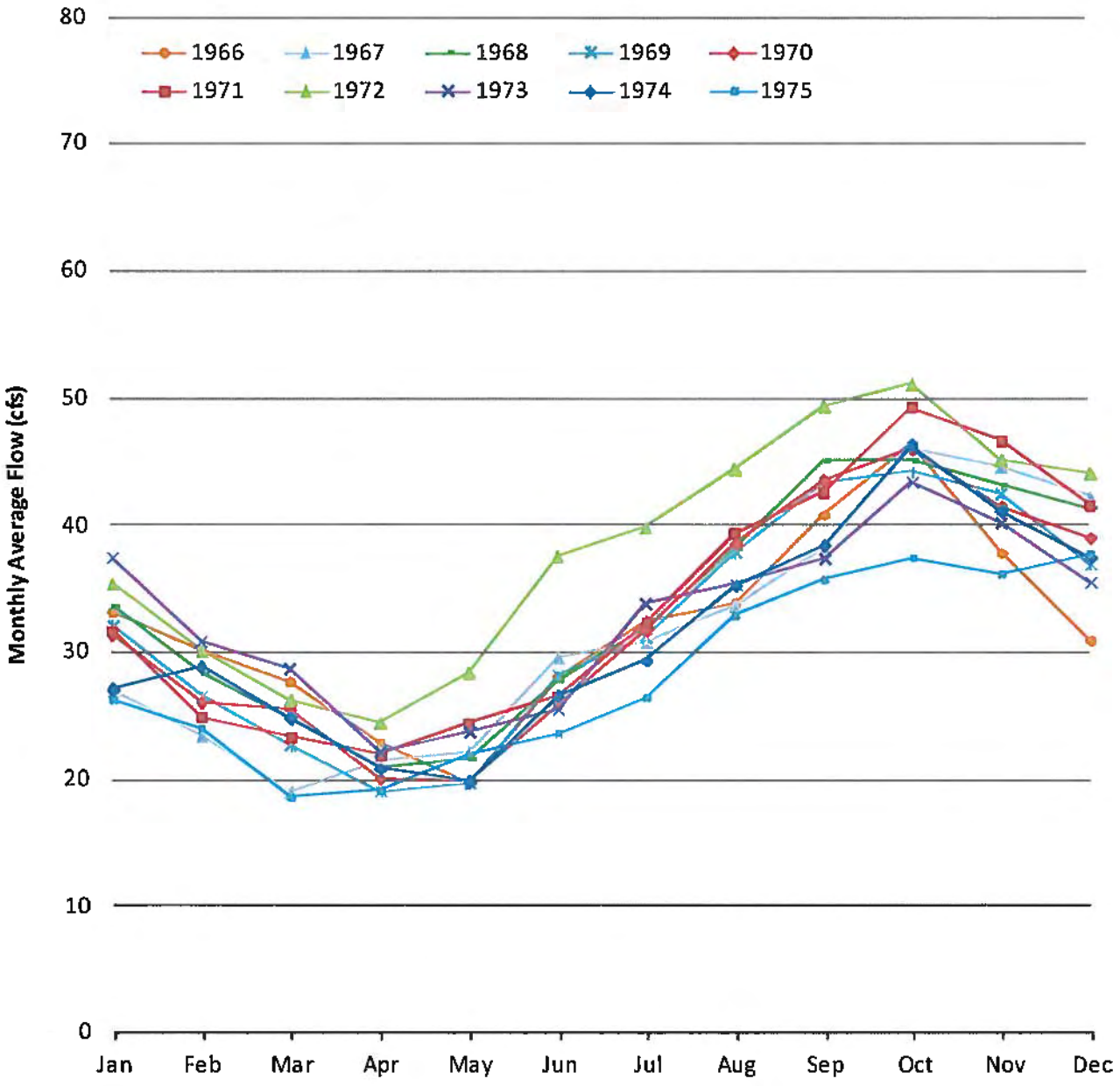
Annual Average Flow
Rangen Hatchery
1966 - 2012
Values in CFS



Source: Annual averages of monthly average flows presented in Figure 2-5b.
Annual average Total Curren Spring Flow to Rangen computed as the Total Curren Spring after diversions to farmers.

Figure 2-6a

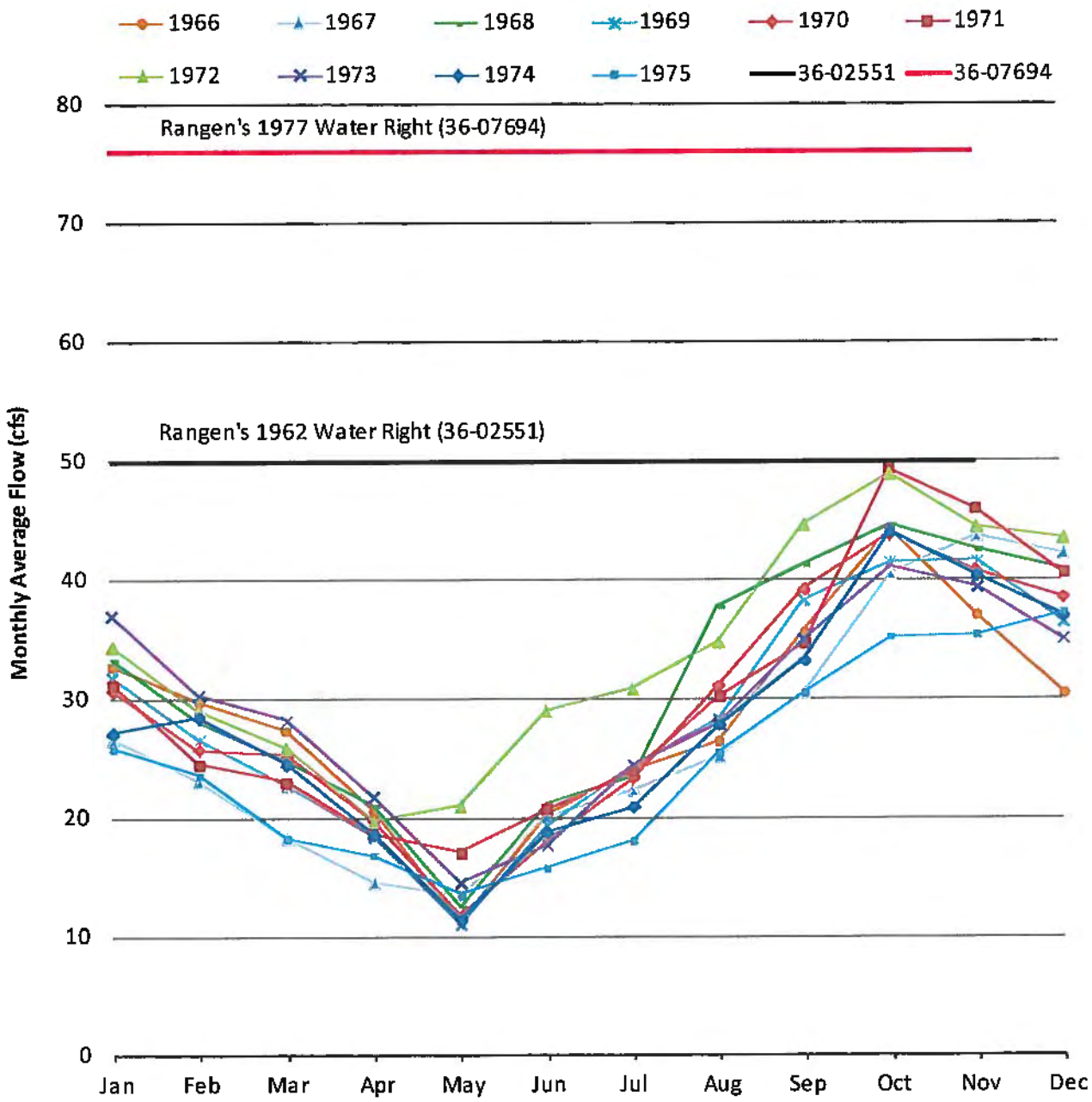
Monthly Average Flows
Total Curren Tunnel (Predicted)
1966 - 1975
Values in CFS



Source: (1) Curren Tunnel flow back-casted/predicted using regression between Curren Tunnel and Total Curren Spring flow.

Figure 2-6b

Monthly Average Flows
Total Curren Tunnel to Rangen (Predicted)
1966 - 1975
Values in CFS



Source: (1) Total Curren Tunnel flow back-casted/predicted using regression between Total Curren Tunnel flow and Total Curren Spring flow minus diversions to farmers (actual data from 1967 - 1973) Missing data for 1966 and 1974 - 1975 filled in using 1967 - 1973 average.

(2) Rangen's 1962 and 1977 water rights include Rangen's senior water right (1.46 cfs).

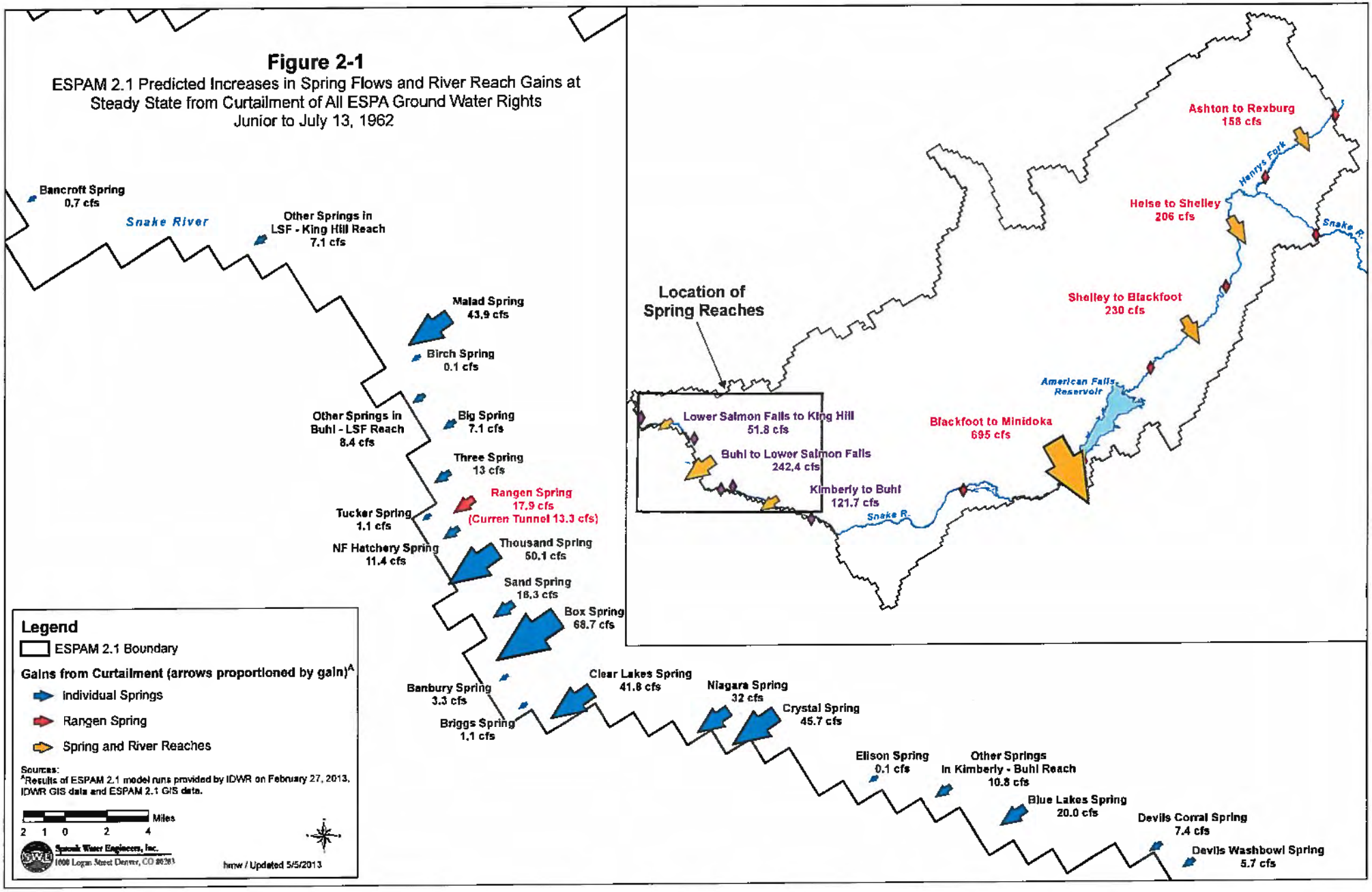
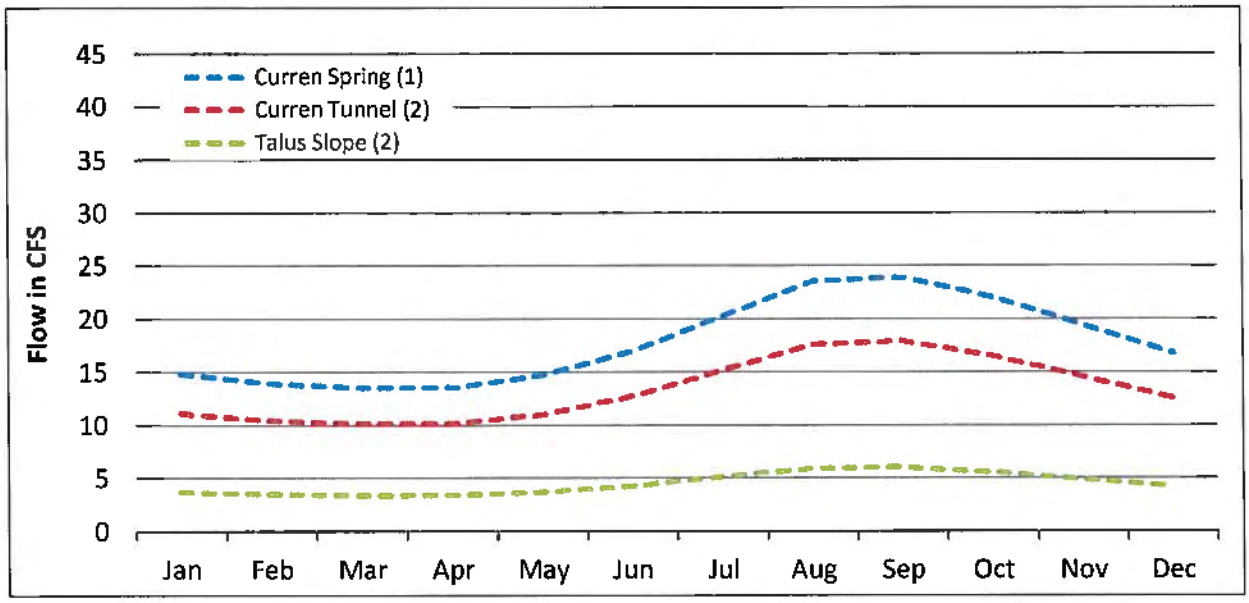


Figure 2-1
ESPAM 2.1 Predicted Increases in Spring Flows and River Reach Gains at Steady State from Curtailment of All ESPA Ground Water Rights Junior to July 13, 1962
Bancroft Spring 0.7 cfs
Snake River
Other Springs in LSF - King Hill Reach 7.1 cfs
Malad Spring 43.9 cfs
Birch Spring 0.1 cfs
Other Springs in Buhl - LSF Reach 8.4 cfs
Big Spring 7.1 cfs
Three Spring 13 cfs
Rangen Spring 17.9 cfs (Curren Tunnel 13.3 cfs)
Tucker Spring 1.1 cfs
NF Hatchery Spring 11.4 cfs
Thousand Spring 50.1 cfs
Sand Spring 18.3 cfs
Box Spring 68.7 cfs
Banbury Spring 3.3 cfs
Briggs Spring 1.1 cfs
Clear Lakes Spring 41.8 cfs
Niagara Spring 32 cfs
Crystal Spring 45.7 cfs
Ellison Spring 0.1 cfs
Other Springs in Kimberly - Buhl Reach 10.8 cfs
Blue Lakes Spring 20.0 cfs
Devils Corral Spring 7.4 cfs
Devils Washbowl Spring 5.7 cfs
Legend
ESPAM 2.1 Boundary
Gains from Curtailment (arrows proportioned by gain)A
Individual Springs
Rangen Spring
Spring and River Reaches
Sources:
AResults of ESPAM 2.1 model runs provided by IDWR on February 27, 2013, IDWR GIS data and ESPAM 2.1 GIS data.
Miles
2 1 0 2 4
Spronk Water Engineers, Inc.
1000 Logan Street Denver, CO 80203
hmw / Updated 5/5/2013
Location of Spring Reaches
Lower Salmon Falls to King Hill 51.8 cfs
Buhl to Lower Salmon Falls 242.4 cfs
Kimberly to Buhl 121.7 cfs
Snake R.
Blackfoot to Minidoka 695 cfs
American Falls Reservoir
Shelley to Blackfoot 230 cfs
Heise to Shelley 206 cfs
Ashton to Rexburg 158 cfs
Henrys Fork
Snake R.

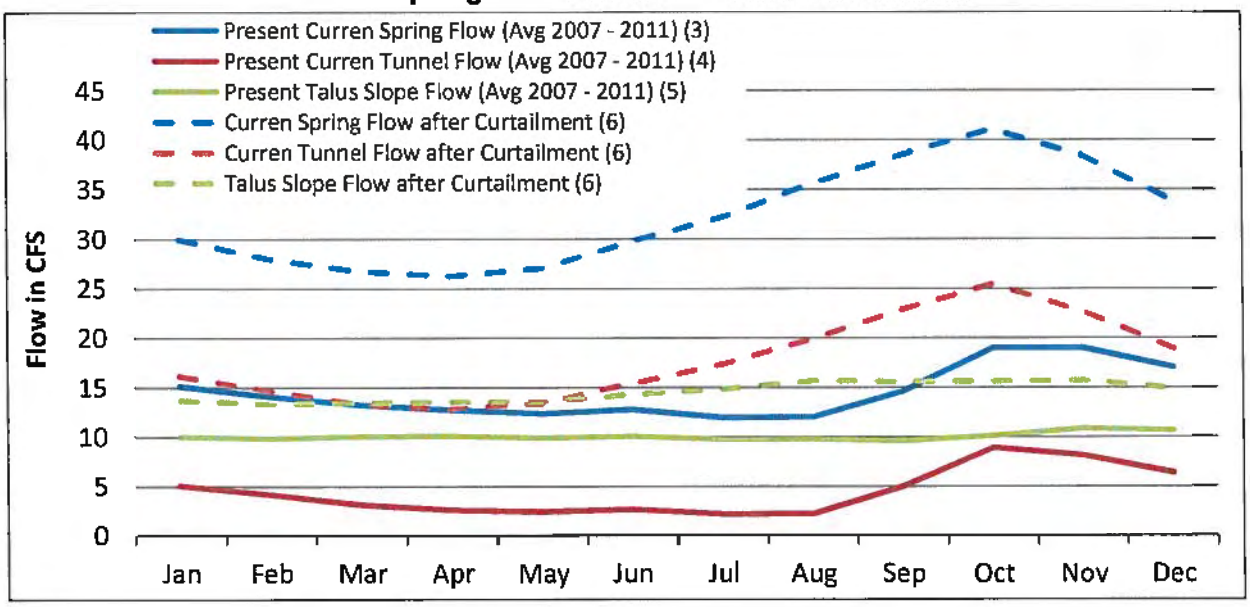
Figure 2-2

Predicted Increase in Curren Spring Flow at Steady-State from Curtailment of Ground Water Rights Junior to July 13, 1962

Steady-State Increase in Curren Spring Flow Following Curtailment



Curren Spring Flow Before and After Curtailment



Notes:

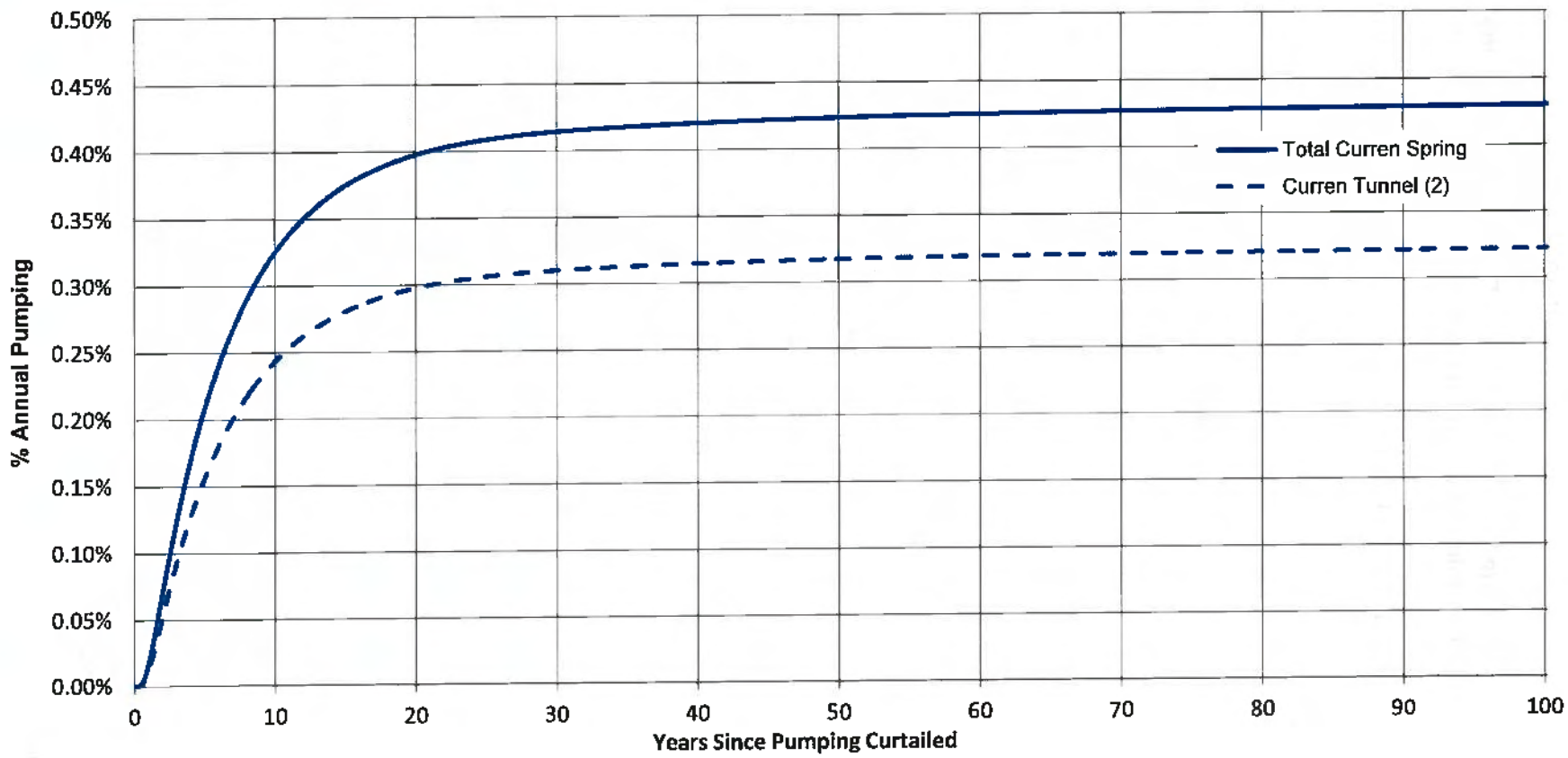
(1) ESPAM 2.1 Model results provided by AMEC for effect of curtailment after 80 years (~ steady state).
(2) Curren Tunnel Flow calculated using Total Curren Spring vs. Curren Tunnel regression (SWE).
(3) Monthly Rangen flow data provided by IDWR.
(4) Curren Tunnel flow data provided by IDWR plus 6" white pipe flow data provided by the IDWR.
(5) Calculated as present Curren Spring flow (3) minus present Curren Tunnel flow (4).
(6) Calculated as present flow (3, 4, 5) plus predicted increase in flow (1, 2).

Figure 8-1a

Summary of Transient Response of Curren Spring to Pocatello ESPA Wells [1]

Eastern Snake Plain Aquifer Model Version 2.1

Annual Impact on Curren Spring as % Annual Pocatello Well Pumping



Note: (1) Wells within the ESPA Area of Common Ground Water Supply.
(2) Impact to Curren Tunnel equal to 74.88% of total impact to the Curren Spring based on the Curren Tunnel vs. Total Curren Spring regression.

Spronk Water Engineers, Inc.

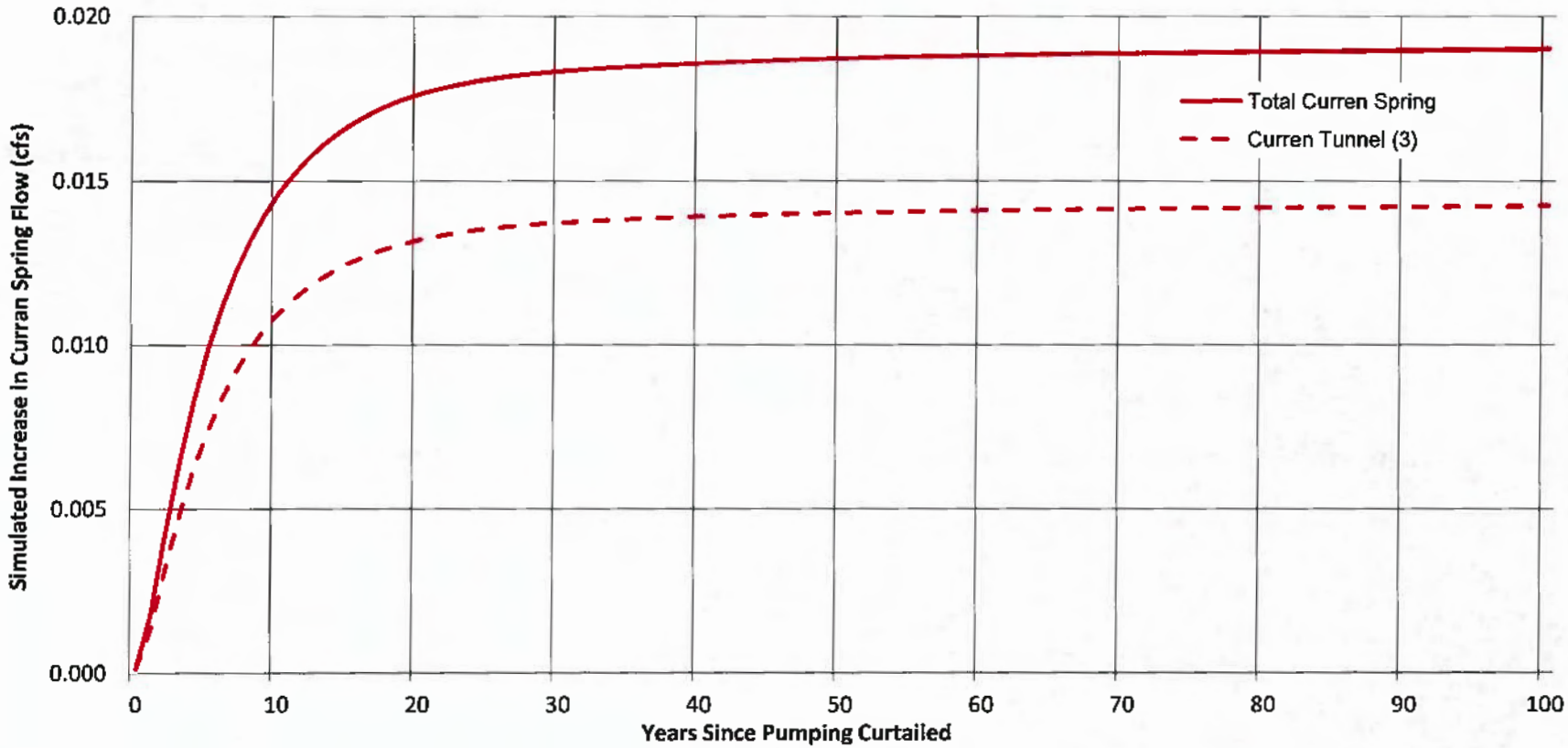
Updated 5/5/2013

Figure 8-2a

Summary of Transient Response of Curren Spring to Curtailment of Pocatello's ESPA Wells (1) with Priority Dates Junior to July 13, 1962

Eastern Snake Plain Aquifer Model Version 2.1

Increase in Curren Spring Flow (cfs)



Notes: (1) Wells within the ESPA Area of Common Ground Water Supply.
(2) The response from curtailment assumes that the impact of Pocatello's current level of pumping had reached steady state prior to curtailment. In actuality, Pocatello's current level of pumping has not reached steady-state and therefore, the transient response to curtailment would be less than the amounts shown.
(3) Impact to Curren Tunnel only equal to 74.88% of total impact to the Curren Spring based on the Curren Tunnel vs. Total Curren Spring regression.

Spronk Water Engineers, Inc.

Updated 5/5/2013

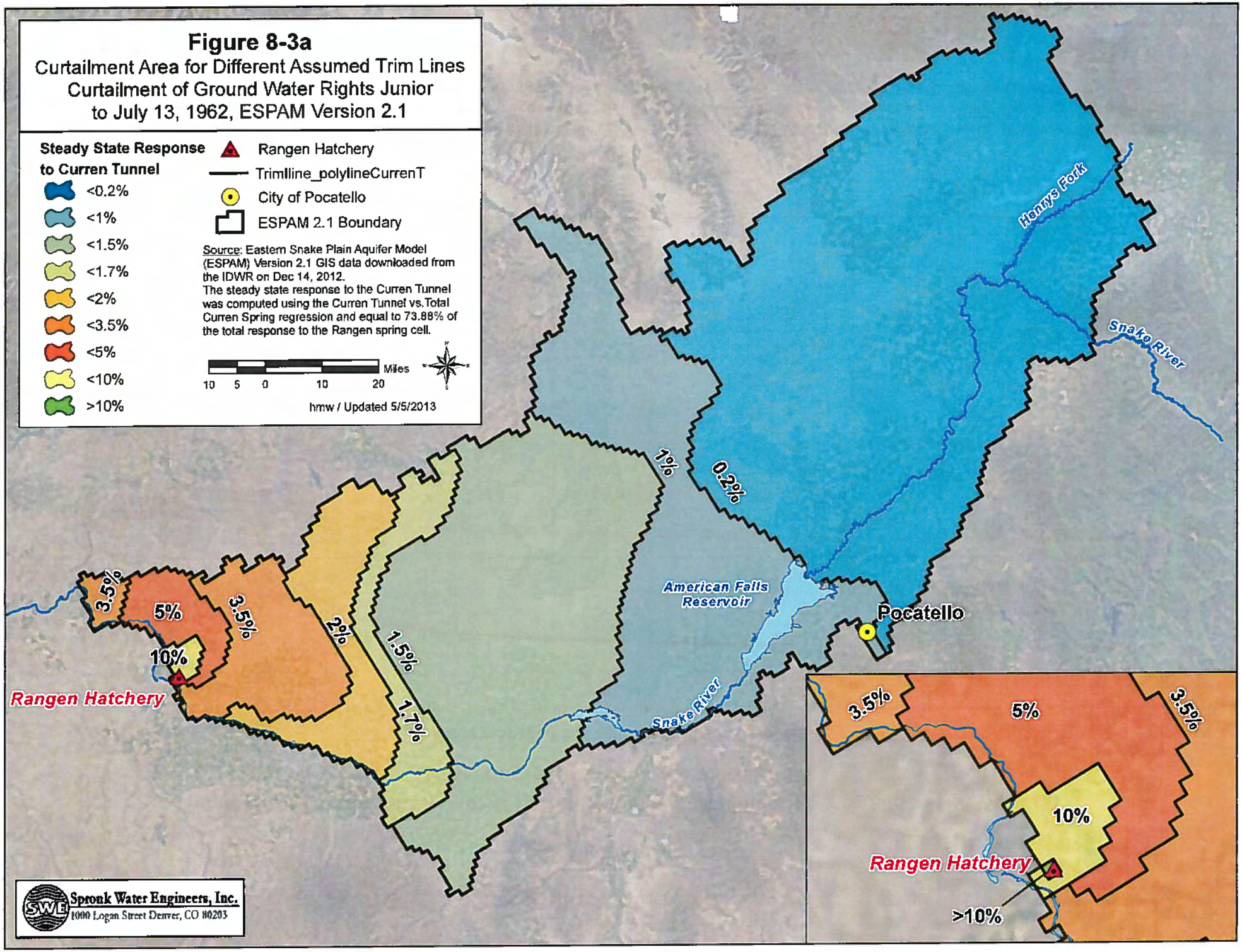
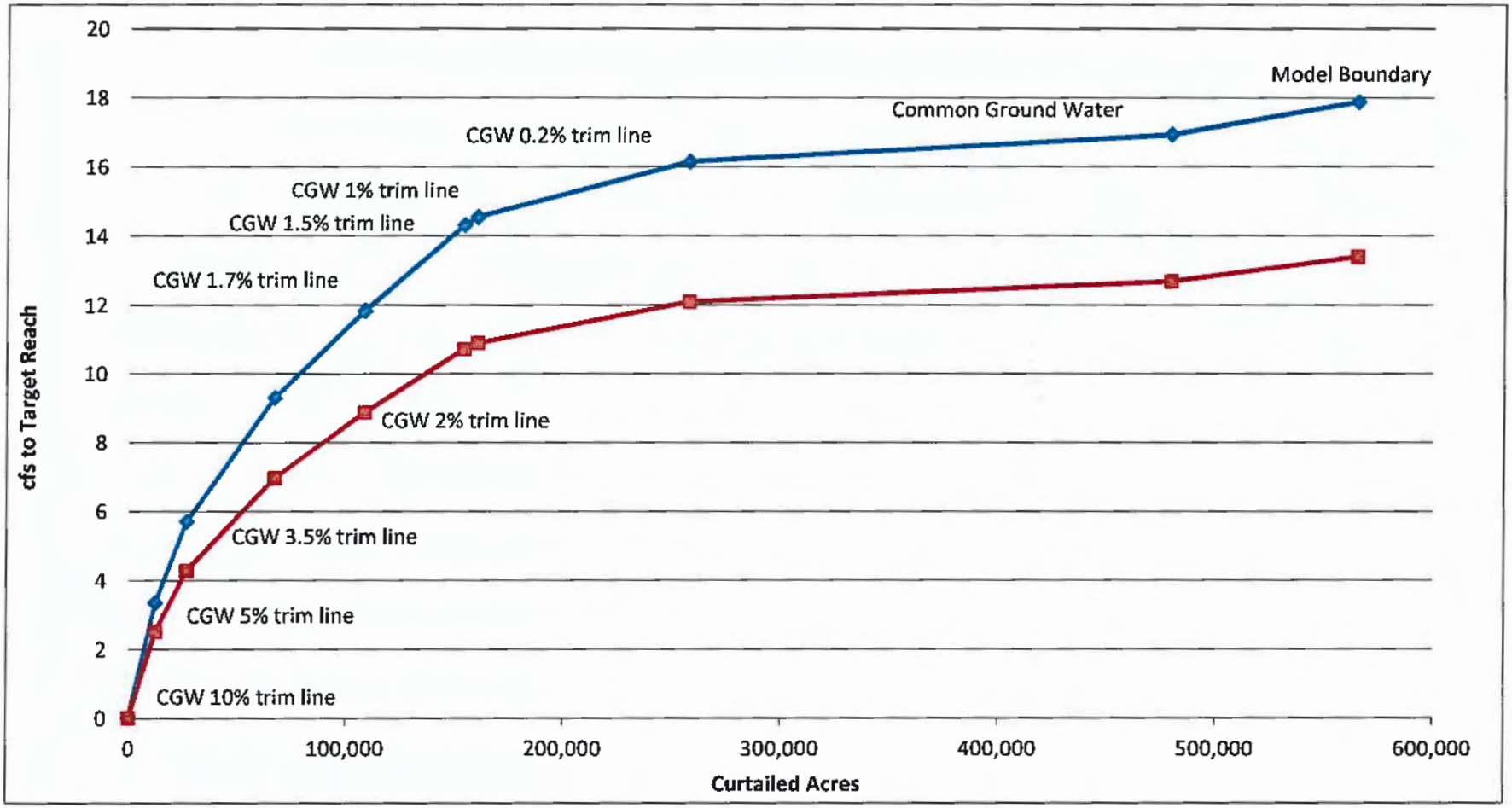


Figure 8-3a
Curtailment Area for Different Assumed Trim Lines
Curtailment of Ground Water Rights Junior
to July 13, 1962, ESPAM Version 2.1
Steady State Response
to Curren Tunnel
<0.2%
<1%
<1.5%
<1.7%
<2%
<3.5%
<5%
<10%
>10%
Rangen Hatchery
TrimIline_polylineCurrenT
City of Pocatello
ESPAM 2.1 Boundary
Source: Eastern Snake Plain Aquifer Model (ESPAM) Version 2.1 GIS data downloaded from the IDWR on Dec 14, 2012.
The steady state response to the Curren Tunnel was computed using the Curren Tunnel vs.Total Curren Spring regression and equal to 73.88% of the total response to the Rangen spring cell.
Miles
10 5 0 10 20
hmw / Updated 5/5/2013
Henry's Fork
Snake River
1%
0.2%
American Falls Reservoir
Pocatello
3.5%
5%
3.5%
10%
2%
1.5%
1.7%
Rangen Hatchery
Snake River
3.5%
5%
3.5%
10%
Rangen Hatchery
>10%
Sponk Water Engineers, Inc.
1000 Logan Street Denver, CO 80203

Figure 8-4a

Response of Curren Spring to Curtailment within Various Trim Lines
Eastern Snake Plain Aquifer Model Version 2.1



Source: IDWR 2/15/2013 Rangen Scoping Calculations provided by the IDWR.
Impact to the Curren Tunnel is equal 74.88% of total impact to the Curren Spring based on SWE's Total Curren Tunnel vs. Total Curren Spring regression.

Updated Tables

Table 2-1

Predicted Increase in Flow at Steady State from Curtailment of All ESPA Ground Water Rights Junior to July 13, 1962 (1)

	Increased Flow (cfs)	Increased Flow (% Total)	(2) Spring Rights Junior to 7/13/1962 (%)
Spring Reach: Kimberly to Buhl			
Niagara	32.0	1.9%	91%
Crystal	45.7	2.7%	100%
Blue Lakes	20.0	1.2%	
Elison	0.1	0.0%	
Devils Corral	7.4	0.4%	
Devils Washbowl	5.7	0.3%	100%
Other Springs	10.8	0.6%	100%
Total Kimberly to Buhl	**121.7**	**7.1%**	**98%**
Spring Reach: Buhl to Lower Salmon Falls			
Clear Lakes	41.8	2.5%	83%
Briggs	1.1	0.1%	43%
Banbury	3.3	0.2%	84%
Box	68.7	4.0%	100%
Sand	18.3	1.1%	95%
Thousand	50.1	2.9%	60%
NF Hatchery	11.4	0.7%	57%
(3) Rangen	17.9	1.0%	30%
Tucker	1.1	0.1%	30%
Three	13.0	0.8%	74%
Big	7.1	0.4%	29%
Birch	0.1	0.0%	
Other Springs	8.4	0.5%	81%
Total Buhl to Lower Salmon Falls	**242.4**	**14.2%**	**63%**
Spring Reach: Lower Salmon Falls to King Hill			
Bancroft	0.7	0.0%	100%
Malad	43.9	2.6%	100%
Other Springs	7.1	0.4%	79%
Total Lower Salmon Falls to King Hill	**51.8**	**3.0%**	**99%**
River Reaches			
Ashton to Rexburg	158	9.3%	
Heise to Shelley	206	12.1%	
Shelley to Near Blackfoot	230	13.5%	
Near Blackfoot to Minidoka	695	40.8%	
Total (All Spring and River Reaches)	**1,705**	**100.0%**	

Notes:

(1) Results of ESPAM 2.1 model runs provided by IDWR on February 27, 2013.

(2) Percentage of water rights with spring water sources in the ESPAM 2.1 spring cells that have partial decrees or licenses that are junior to Rangen's July 13, 1962 water right. Computed as:

Total rate of diversion for junior water rights / total rate of diversion for all water rights.

Water rights were identified from IDWR water right points of diversion shapefile intersected with ESPAM 2.1 spring cells.

(3) Of the 17.9 cfs that would accrue to the Rangen spring cell, an estimated 13.3 cfs would accrue at the Curren Tunnel; this is approximately 75% of the total curtailment gain based on a regression of Curren Tunnel vs. Total Curren Spring flow.

Table 2-3

Predicted Increase in Curren Spring Flow at Steady-State from Curtailment of Ground Water Rights Junior to July 13, 1962

Values in CFS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Steady State Increase in Curren Spring Flow after Curtailment			Curren Spring Flow Before and After Curtailment					
				Curren Spring		Curren Tunnel		Talus Slope	
Month	Curren Spring	Curren Tunnel	Talus Slope	Present Flow (2007 - 2011)	After Curtailment (Steady State)	Present Flow (2007 - 2011)	After Curtailment (Steady State)	Present Flow (2007 - 2011)	After Curtailment (Steady State)
Jan	14.8	11.1	3.7	15.1	29.9	5.1	16.2	10.0	13.7
Feb	13.9	10.4	3.5	14.1	28.0	4.2	14.6	9.9	13.4
Mar	13.5	10.1	3.4	13.2	26.8	3.2	13.3	10.1	13.5
Apr	13.6	10.1	3.4	12.7	26.3	2.6	12.8	10.1	13.5
May	14.7	11.0	3.7	12.4	27.1	2.5	13.5	9.9	13.6
Jun	17.0	12.7	4.3	12.8	29.8	2.7	15.4	10.1	14.3
Jul	20.2	15.2	5.1	12.0	32.2	2.2	17.4	9.7	14.8
Aug	23.5	17.6	5.9	12.0	35.6	2.3	19.9	9.8	15.7
Sep	23.9	17.9	6.0	14.6	38.5	5.0	22.9	9.6	15.6
Oct	22.1	16.5	5.5	19.0	41.1	8.9	25.4	10.1	15.6
Nov	19.4	14.5	4.9	19.0	38.4	8.1	22.7	10.9	15.7
Dec	16.8	12.6	4.2	17.0	33.8	6.4	19.0	10.7	14.9
Avg	17.8	13.3	4.5	14.5	32.3	4.4	17.7	10.1	14.5
Min	13.5	10.1	3.4	12.0	26.3	2.2	12.8	9.6	13.4
Max	23.9	17.9	6.0	19.0	41.1	8.9	25.4	10.9	15.7

Notes:

(1) ESPAM 2.1 Model results provided by AMEC for effect of curtailment after 80 years (~ steady state).
(2) Curren Tunnel Flow calculated using Total Curren Spring vs. Curren Tunnel regression (SWE).
(3) Total Curren Spring flow (1) minus Curren Tunnel flow (2).
(4) Monthly Rangen flow data provided by IDWR.
(5) Increase in Curren Spring flow (1) plus present Curren Spring flow (4).
(6) Curren Tunnel flow data provided by IDWR plus 6" white pipe flow data provided by the IDWR.
(7) Increase in Curren Tunnel flow (2) plus present Curren Tunnel flow (6).
(8) Average total Curren Spring flow (4) minus average Current Tunnel flow (6).
(9) Increase in Talus Slope Flow (3) plus present Talus slope (8).