BELLE FOURCHE IRRIGATION DISTRICT

WATER CONSERVATION PLAN

Topical Report RSI-1824

prepared for

Belle Fourche Irrigation District
P.O. Box 225
Newell, South Dakota 57760

January 2005

RESPEC
CONSULTING & SERVICES

BELLE FOURCHE IRRIGATION DISTRICT
WATER CONSERVATION PLAN

Topical Report RSI-1824

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1.0 INTRODUCTION

This 5-Year Water Conservation Plan outlines water conservation goals of the Belle Fourche Irrigation District for 2005 through 2009. It also examines efficiency trends over the last 10 years and provides a summary of the most significant accomplishments toward water conservation goals achieved in the last few years. A complete description of the District organization and history of the Belle Fourche Project is included in Appendix F. A copy of the latest Cooperative Agreement between the Bureau of Reclamation and the Belle Fourche Irrigation District (draft) is included in Appendix G.

2.0 DELIVERY EFFICIENCY TRENDS

2.1 GENERAL

The average efficiency for delivery of water to farmers was 49 percent over the last 5 years, with a volume of losses, or unused water, averaging 63,200 acre-feet per year. In the last 10 years, the average efficiency was 47 percent, with the volume of losses averaging 61,900 acre-feet per year. These efficiencies were computed by dividing the total volume of water billed to farmers by the total volume of water released from the dam for the irrigation season. Volumes released from the dam are from United States Bureau of Reclamation (USBR) records available on the Hydromet Internet site. Volumes billed to farmers are from District records. These efficiency figures do not include deliveries to the Johnson lateral.

The terms "losses" and "unused water" are used synonymously in this report and refer to the portion of water released from the dam that is not delivered to farmers but lost to seepage/evaporation or discharged from the ends of canals and laterals. Table 2-1 and Figure 2-1 provide efficiency figures and volumes of losses for the last 10 years.

Table 2-1. Delivery Efficiency Trends

Irrigation Data					Precipitation		
Year	Dam Releases (acre-ft)	Billed (acre-ft)	Unused (acre-ft)	Efficiency (acre-ft)	Annual (in)	May-Sept (in)	% of Mean
1995	108,529	43,523	65,006	40%	19.13	12.08	123%
1996	127,601	46,041	81,560	36%	19.60	11.11	113%
1997	102,092	49,889	52,203	49%	12.68	8.65	88%
1998	113,770	62,315	51,455	55%	23.54	13.40	136%
1999	90,758	37,845	52,913	42%	18.75	13.74	140%
2000	133,186	64,652	68,534	49%	13.36	7.61	77%
2001	128,039	68,606	59,433	54%	10.78	7.92	81%
2002	140,900	66,387	74,513	47%	10.41	8.01	82%
2003	111,617	55,819	55,798	50%	12.75	7.52	77%
2004	110,473	52,656	57,817	48%		8.20	83%

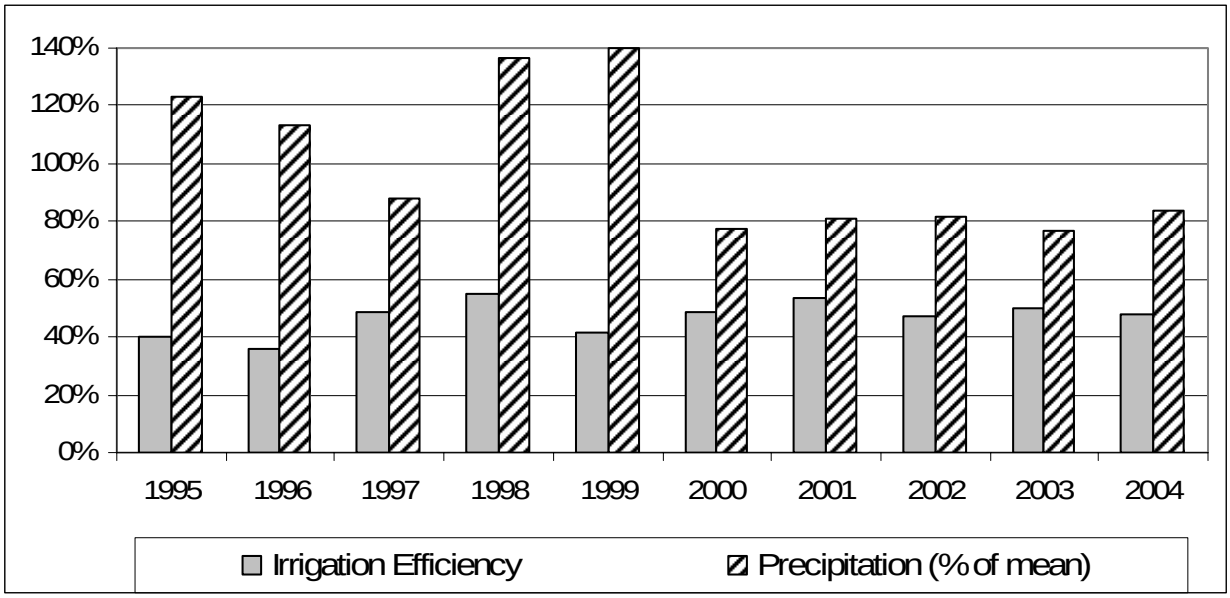

Figure 2-1. Delivery Efficiency Versus Precipitation.

2.2 EFFICIENCY AND PRECIPITATION

Precipitation data were included in Table 2-1 and Figure 2-1 for the purpose of exploring correlations between efficiency and precipitation. Surprisingly, there does not appear to be a significant correlation between delivery system efficiency for an irrigation season and the volume of precipitation received during the irrigation season. The percentage of mean precipitation shown in Figure 2-1 was computed using average precipitation for the months of May to September.

Table 2-2 shows the percent of water delivered in September and October versus total precipitation for the months of May to September. The general trend is that for years with high precipitation, a greater percentage of deliveries occur in September and October, indicating that farmers are possibly electing to apply the remainder of their allotments in September and October regardless of the actual need for irrigation water. This may be an issue to explore for reduction of unused water.

Appendix A includes a graph that shows daily discharges from the dam versus precipitation for the 2004 irrigation season. This shows that orders from farmers do fall off dramatically in the few days after a major precipitation event but then quickly return to levels before the precipitation.

Table 2-2. End-of-Season Delivery Trends

Description	1996	1997	1998	1999	2000	2001	2002	2003	2004
% of Deliveries in September & October	20	19	19	24	20	16	8	10	15
Precipitation, May – September (inches)	11.1	8.7	13.4	13.7	7.6	7.9	8.0	7.5	8.2

2.3 OTHER EFFICIENCY COMPARISONS

Appendix A includes tables and graphs showing detailed 2004 efficiency data, as well as a set of graphs showing the efficiency percentage and volume of unused water, by month, for Years 2000–2004. July and August are consistently months with the greatest efficiency based on percentage by volume, but they are also months with the greatest volumes of unused water.

3.0 WATER BUDGET INVESTIGATIONS

Data collected in the 2004 season was used to begin the process of better quantifying components of the water budget. Efforts were made to separate Transportation Losses from Operational Losses and to distinguish between losses on the North and South Canals versus those on laterals. Transportation Losses include evaporation and seepage, although volumes lost to evaporation are so small compared to seepage that Transportation Losses are essentially all seepage. Operational Losses are discharges from the ends of canals or laterals. Several water budgets are shown below, providing a distribution of water released from the dam, at different levels of detail.

Some of the data for the budget computations were obtained from the 1998 Water Management Study conducted by the Bureau of Reclamation [1998]. A comparison of 2004 water budget figures to those from the study is also included.

Efforts will continue in future years to produce more refined water budgets and to identify areas within the District where the greatest volume of losses are occurring. This will be accomplished by continued refinement of Daily Ditch Rider Water Cards, deployment of more data loggers across the District to monitor actual discharges in canals and laterals, and continued emphasis by District management of the importance of water conservation.

The term “data logger” is used in this report as reference to a continuous stage recording device. Data loggers were typically used in flumes or at weirs, so the stage readings could be converted to discharge using equations from the Bureau of Reclamation [2001] publication *Water Measurement Manual* (third edition).

3.1 2004 DISTRICT WATER BUDGET

The 2004 District Water Budget is shown in Table 3-1 and Figure 3-1. It provides a distribution of all water released from the dam during the irrigation season. An on-farm efficiency of 50 percent is used for the budget, meaning that only 50 percent of water delivered to crops is absorbed. The remaining 50 percent becomes groundwater or surface runoff. This efficiency rate is from the 1998 Water Management Study. It is believed that this efficiency should now be slightly higher than 50 percent, as six pivot irrigation sprinklers have been added on the District for an estimated savings of 300 acre-feet per year, but the 50 percent figure is used here for simplicity.

Table 3-1. 2004 District Water Budget

Water Distribution	Volume (acre-feet)	%
Dam Releases	110,473	
Delivered & Billed	52,656	
Delivered & Not Billed	10,531	
Total Deliveries	63,187	
Absorbed by Crops	**31,594**	28.6
On-Farm Waste	**31,594**	28.6
Losses (Unused)	**47,286**	42.8

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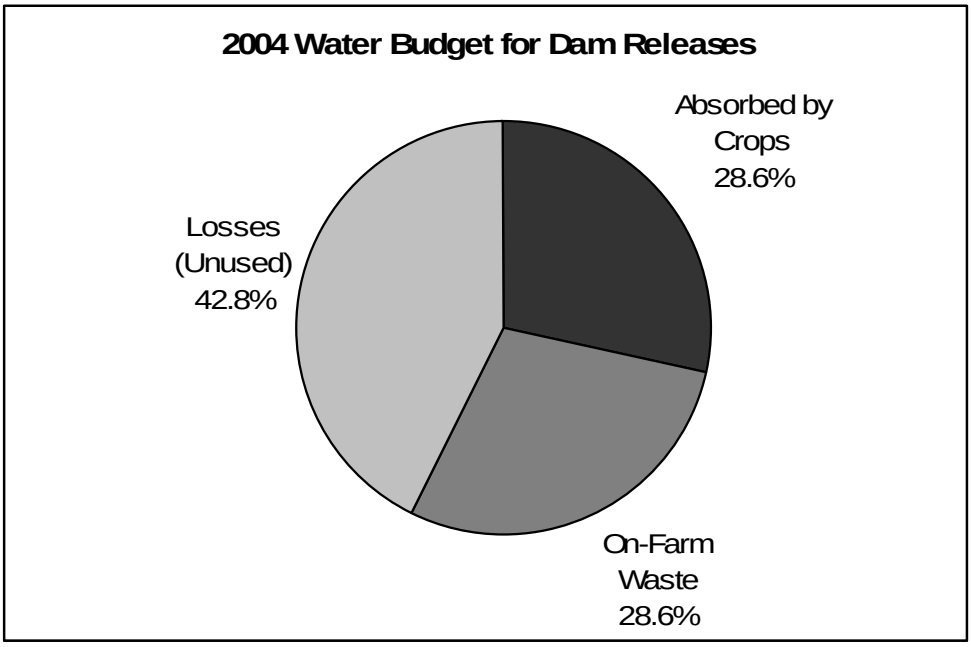

Figure 3-1. 2004 District Water Budget.

3.2 DELIVERIES AND LOSSES

A water budget showing the distribution of delivered water and losses is shown in Table 3-2 and Figure 3-2.

Table 3-2. Distribution of Deliveries and Losses

Water Distribution	Volume (acre-feet)	%
Dam Releases	110,473	
Delivered & Billed	**52,656**	47.7%
Delivered & Not Billed	**10,531**	9.5%
Transportation Losses	**22,395**	20.3%
Operational Losses	**24,891**	22.5%

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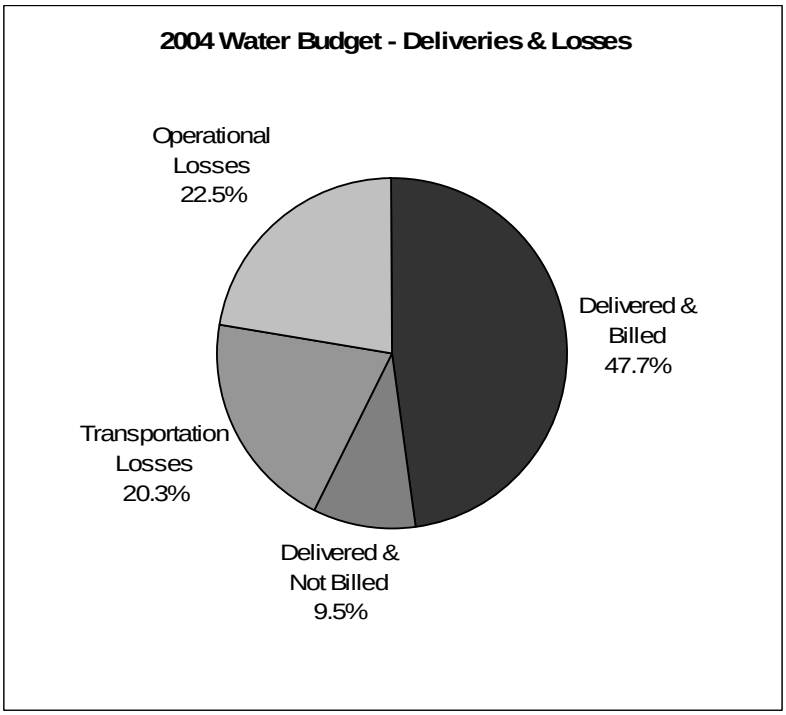

Figure 3-2. Distribution of Deliveries and Losses.

Terminology and methodology for the Deliveries & Losses Budget is as follows:

- Delivered & Billed: The volume of water billed to farmers, per District records. The term "billed" is used to indicate that the volume is counted toward the farmer's annual allotment of water. Farmers are not actually billed for their irrigation water.
- Delivered & Not Billed: Volume of water delivered to farmers but not billed. Reasons for delivery without billing include: generous deliveries by Ditch Riders to give farmers the

benefit of the doubt and to compensate for inaccurate flow measurement devices, farmers tampering with gates, or flow measurement devices. The 1998 Water Management Study estimated that 15 percent more water was actually delivered to farmers than what District records showed. A figure of 20 percent is used for the 2004 Water Budget, as indications are that the figure is at least this high. This 20 percent includes use of water by farmers from turnouts near ends of canals or laterals. This is water that would have otherwise become Operational Losses but must still be accounted for in the budget.

- Transportation Losses: Includes both evaporation and seepage. However, volumes of evaporation are very small compared to seepage, so Transportation Losses are essentially equal to seepage losses.
- Operational Losses: Excess water discharged from ends of canals or laterals. This water is typically put into the system to ensure that all deliveries can be met or for the purpose of building up pressure heads to make deliveries.

3.3 DETAILED DISTRIBUTION OF LOSSES

The water budget in Table 3-3 and Figure 3-3 provides a distribution of losses into Transportation and Operational components for the North and South Canals versus laterals. The distribution of losses presented in the 1998 Water Management Study (WMS) is also shown for comparison. It should be noted that budgets computed in the 1998 WMS were based on data for August and September only, resulting in distribution of a much smaller volume of water.

The 2004 Water Budget was developed using the following approach and assumptions:

- Canal Versus Lateral Losses: Daily Ditch Rider Water Cards were used to establish the volume of water that was turned down laterals. This was compared to the volume used within each Ride, based on daily flume measurements. These measurements produced the division between losses occurring on the North and South Canals versus losses occurring on laterals. It was assumed that the volume of water actually turned down laterals was 10 percent greater than that shown on Daily Ditch Rider Water Cards. The 1998 Water Management Study estimated that volumes turned down laterals were 15 percent greater than District records indicated.
- Transport Versus Operational Losses on Canals: Graphs of the South Canal (Appendix B) comparing water used within each Ride versus water ordered were used to locate time periods when the difference between these two lines were fairly consistent and minimal. It was assumed that during these periods, losses were nearly all seepage. This was used as a basis for separation of Total Losses into Transportation and Operational. This same split was then used for the North Canal.

Comparison of the 2004 Water Budget to the water budget from the 1998 WMS indicates that Operational Losses on the North and South Canals were 10 percent of Total System Losses (canals and laterals) in 2004 versus 26 percent in 1998.

For Transportation Losses, the 2004 Water Budget shows the North and South Canal Transportation Losses to be 18 percent of Total Losses. This is a volume of 8,346 acre-feet, which is 0.38 cubic feet per second (cfs) per mile of canal, or 0.43 cfs per mile of unlined canal. The WMS water budget shows Transportation Losses on the entire system to be 38 percent of total losses. No split was provided between canals and laterals. The WMS also presented results of seepage studies on the South Canal from 1991 and 1992, which produced an average of 3.5 cfs per mile. It is presumed that the seepage studies were conducted on portions of canals with the highest seepage rates, so the seepage rate of 0.43 cfs per mile associated with the 2004 Water Budget is not unreasonable compared to 3.5 cfs per mile from the studies. A summary of the seepage studies included in the WMS is included in Chapter 8.0.

Table 3-3. Transportation and Operational Losses

Distribution of Losses					
Losses Component	**Volume**		**% of Total Losses**	**csf/Mile**	**cfs/Unlined Mile**
	Acre-Feet	**cfs**			
2004 Water Budget					
Transportation					
Canals	8,346	35	17.7	0.38	0.43
Laterals	14,049	60	29.7	0.13	0.18
Operational					
Canals	4,780	20	10.1	0.22	0.25
Laterals	20,111	85	42.5	0.19	0.25
Total Losses	47,286	200			
Dam Releases	110,473	468			
1998 Water Management Study					
Transportation	7,800	33	37.9	0.06	0.08
Operational					
Canals	5,400	23	26.2	0.24	0.28
Laterals	7,400	31	35.9	0.07	0.09
Total Losses	20,600	87			
Dam Releases	55,600	236			

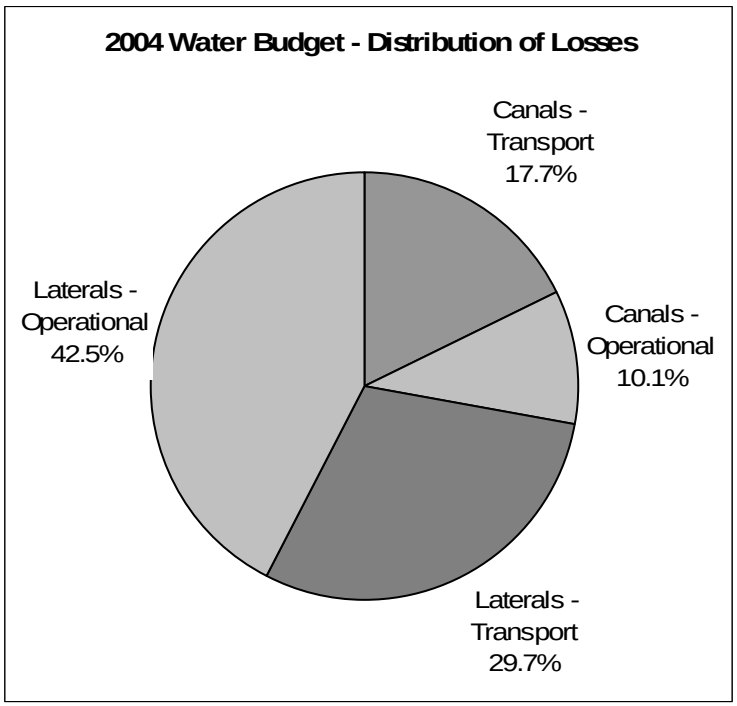

Figure 3-3. Transportation and Operational Losses.

- Transportation Versus Operational Losses on Laterals: The 2004 investigations of the Gillette and Vale laterals were used as a basis for separation of Total Losses on laterals into Transportation and Operational Losses. The division used was 40 percent Transportation and 60 percent Operational.

  The 2004 Water Budget shows that Operational Losses on laterals make up 40 percent of Total System Losses (canals and laterals) versus 36 percent for the 1998 WMS budget.

  The 2004 Water Budget shows that Transportation Losses on laterals make up 30 percent of Total System Losses. This is a volume of 14,049 acre-feet, which is 0.13 cfs per mile of canal, or 0.18 cfs per mile of unlined canal. Total Transport Losses (canals and laterals) are 48 percent of Total System Losses, versus 38 percent from the WMS budget. The WMS provided results of seepage studies on several laterals from 1991 and 1992 (summary provided in Chapter 8.0). The results of these studies indicated a range of 0.5 to 5.0 cfs per mile, with an average of 1.9 cfs per mile. It is presumed that the seepage studies were conducted on laterals with the highest seepage rates, so although the seepage rate of 0.18 cfs per mile associated with the 2004 Water Budget does seem low, it is not completely unreasonable compared to 1.9 cfs per mile from the studies. However, it may be an indication that the 2004 Water Budget tends to underestimate Transportation Losses on laterals and overestimate Operational Losses.

A comparison of Total Losses on the North and South Canals versus Total Losses on laterals, by month, is provided in Figure 3-4. The graphs were developed using USBR records for dam releases, Daily Ditch Rider Water Cards for volumes of water turned down laterals, and volumes of water delivered and billed to farmers. The volume turned down laterals was increased by 10 percent over that shown on water cards for the North and South Canals, as was done for the 2004 Water Budget.

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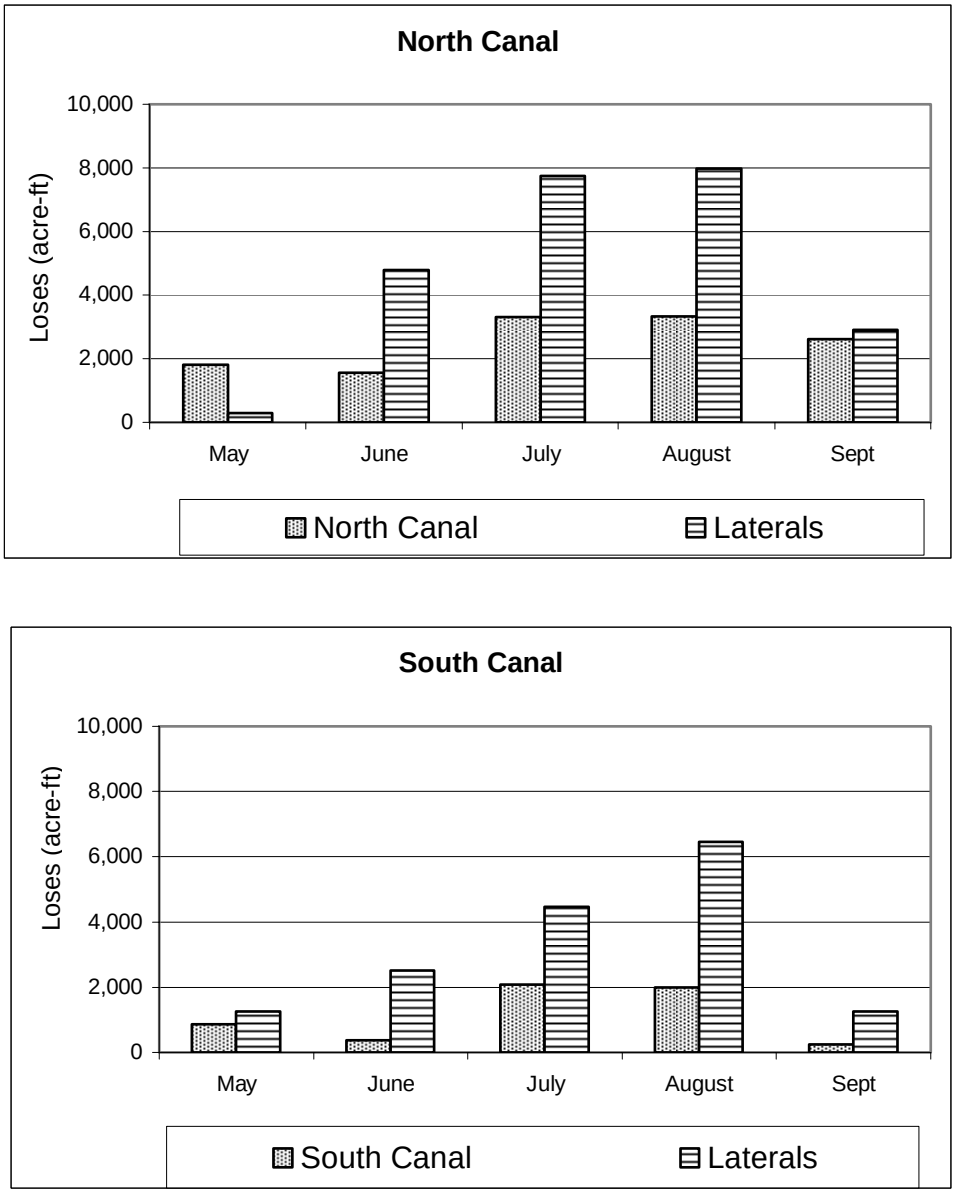

Figure 3-4. Losses on Canals Versus Laterals.

Figure 3-5 shows the volume of losses per irrigated area for each Ride. Values shown are the volume of losses (acre-feet) per 1,000 acres of irrigated land.

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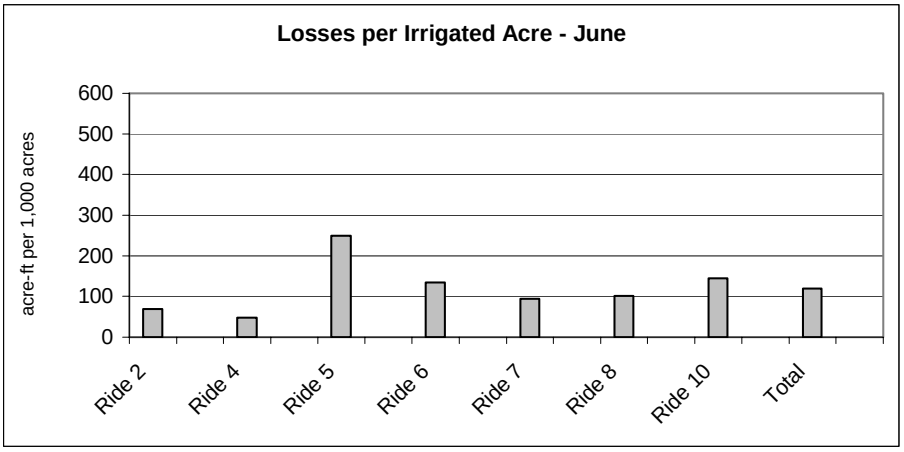
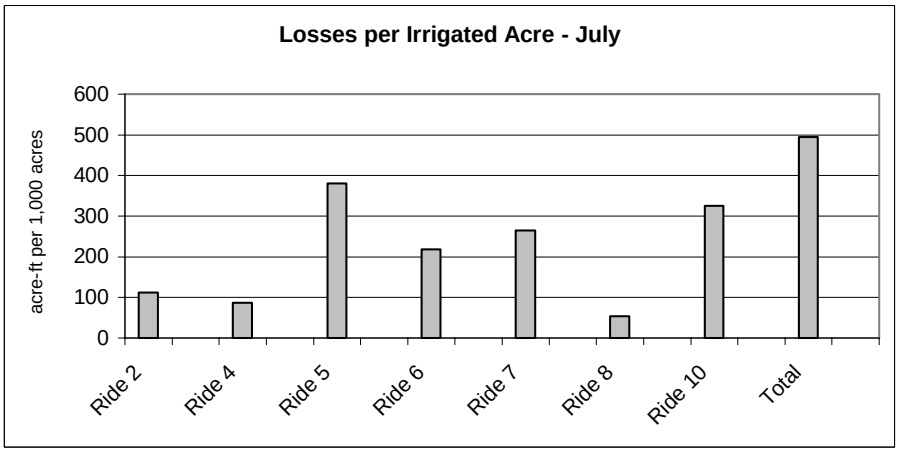




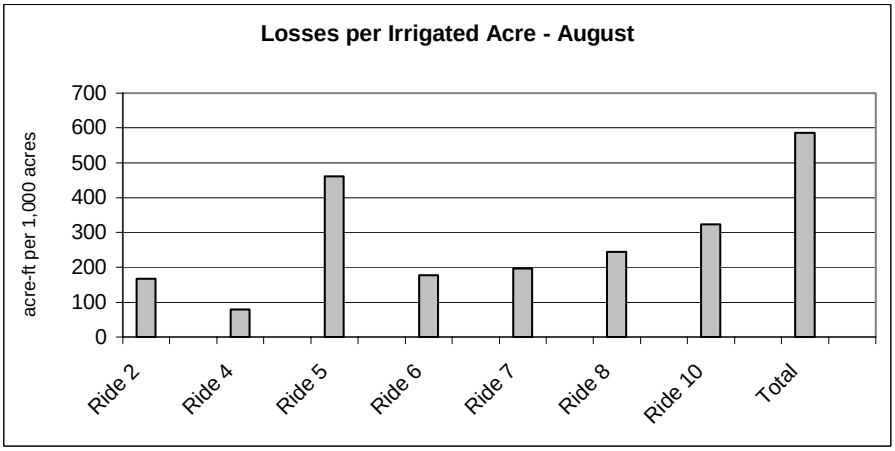


Figure 3-5. Losses per Irrigated Acre.

4.0 WATER CONSERVATION ACCOMPLISHMENTS–LAST 5 YEARS

4.1 POLICY ISSUES

During the 2004 season, the Irrigation Board approved plans by District management to begin strict enforcement of the policy for penalties to farmers caught tampering with turnout gates or flow measurement devices for unauthorized deliveries. The policy is as follows: for the first offense, the farmer is fined $150, denied deliveries for a period of 3 days, and billed for those 3 days at the estimated rate of delivery at the time that tampering was discovered; for the second offense, the farmer is denied deliveries for the rest of the irrigation season. Strict enforcement of this policy in the future should be a strong deterrent to farmers who may have taken this issue lightly in the past.

4.2 IMPROVED FLOW MEASUREMENT CAPABILITIES

Accurate measurement of discharges in canals, laterals, and at farmer turnouts is considered essential to the District's water conservation efforts. Progress has been made in the last few seasons to identify measurement structures that are not functioning properly and to identify critical locations currently without a flow measurement device. One of the focuses in 2004 was the study of submerged flumes across the District and the effect that submergence has on flow measurement accuracy. Several of the flumes on the North and South Canals have been found to submerge under some conditions, and an increased appreciation was gained for the need to collect both upstream and downstream well measurements from the flumes to allow for submergence corrections.

A study of a submerged Parshall Flume on the Gillette lateral in 2004 resulted in development of a stage-discharge curve that will allow better estimates of discharges in the flume. It is estimated that this will result in a reduction in Operational Losses of 100 acre-feet per year. A more complete discussion of the study is included in Chapter 8.0.

4.3 2004 BENTONITE APPLICATION ON INLET CANAL

In the spring of 2004, bentonite was applied to the portion of the Inlet Canal that has caused the greatest problems in terms of seepage. These problems were due not only to volumes of water being lost to seepage, but also damage to farmland and structures caused by over-saturation of ground adjacent to the canal. Approximately 2,000 linear feet of the canal were treated. The bentonite was obtained from Colony, Wyoming, and was applied with a modified fertilizer spreader using a boom that could reach approximately one-half the distance across the width of the Inlet Canal. In most areas, application could be done from both sides of the canal, although one section could only be treated effectively from one side.

The canal was not dewatered for the application because of the loss in volume of diverted Belle Fourche River water that would have resulted. It was understood that application of bentonite in wet conditions would not be as successful as if the canal were dewatered, but dry conditions in the past few years made loss of irrigation water an unacceptable option. Despite obstacles, the application has been considered successful, particularly in reducing seepage areas that were putting the District at risk for liability from damage to land and structures. This is based on visual observations of high seepage areas which had formed small ponds adjacent to the canal. However, this application was considered to be a fairly temporary solution, and the critical need for a more permanent lining solution on the Inlet Canal is discussed later in Chapter 6.0.

The District estimates that total seepage losses on the Inlet Canal average 10 cfs and that nearly all of these losses occur in the 2-mile stretch where the canal prism is elevated. Assuming 75 percent reduction in seepage for the section treated with bentonite, this would result in a water savings of approximately 1,000 acre-feet per year.

4.4 AUTOMATED GATE OPERATOR

In August of 2004, an automated gate operator was installed on the right gate of the Townsite Check Structure, on the North Canal. This is the check structure located just downstream of the Townsite Lateral headgate. The automated operator is set to adjust the gate so as to hold the water surface behind the check structure at a certain level, and it has been mostly successful at doing so. However, the fact that other check structures upstream of the Townsite Check are still under manual operation does limit the success of the one automated operator. A series of check structures equipped with automated operators would be even more effective in eliminating variable discharges in the North Canal, and this issue is discussed in greater detail in Chapter 5.0.

4.5 OTHER

4.5.1 Lining Projects

2002: 1,400 linear feet of the South Canal was lined with polyvinyl chloride (PVC).
2003: 450 linear feet of a Lateral A sublateral was lined with PVC.

Estimated water conservation, using 3.5 cfs/mile for the South Canal, 2.0 cfs/mile for the sublateral, and an average season of 120 days–250 acre-feet per year.

4.5.2 Pipeline Projects

Conversion of open ditch laterals to pipe. Linear feet (lf) of replacement.

2000: 2,850 lf on a Townsite sublateral, 2,070 lf on an Indian Creek sublateral.
2001: 400 lf on the Coyote lateral, 400 lf on a Townsite sublateral, 1,900 lf on the Alice lateral.
2002: 2,380 lf on the Mawer lateral, 2,160 lf on the Burke lateral.
2003: 480 lf on the South Canal 24.4 lateral.
2004: 910 lf on the Vale .05 sublateral.

Total length of open ditch replaced with pipe was 13,550 lf, or 2.6 miles. Assuming a seepage rate of 2.0 cfs/mile for replaced open ditches, estimated water conservation was 1,250 acre-feet per year.

4.5.3 Headgates/Turnouts

Repair or replacement of an average of 50–60 per year.

4.5.4 Appurtances

Flow Meters: Repair or replacement of an average of 20–25 per year. All problematic digital units installed in 2002 have now been replaced.

Valves: Repair or replacement of an average of 20 per year. Cathodic protection is installed with all new valves and is added for existing valves that are repaired.

5.0 NEW INITIATIVES FOR WATER CONSERVATION

5.1 GENERAL

In addition to the new ideas and big projects described below, a significant amount of water will be saved by attention to the small details. These include ensuring that flow measurement devices across the District are accurate and used properly, and even more important, the development of receptive attitudes to water conservation. The greatest challenge to the District management in the next 5 years will be to convince District staff and farmers of the importance of water conservation. This will be done by a combination of education and persistent monitoring of activities on the District. Providing adequate training to District employees will continue to be a priority, both to keep them informed of recent developments in water conservation practices and to boost morale. It is also felt that continued use and refinement of Daily Ditch Rider Water Cards and deployment of data loggers across the District will go a long way toward improving water conservation.

5.2 IMPROVED MANAGEMENT OF NORTH AND SOUTH CANALS

Increased emphasis will be placed on management of check structures and monitoring of discharges on the North and South Canals, with a goal of reducing Operational Losses. This may be accomplished by adding a temporary position to the District for the 2005 irrigation season to provide the following types of support to the Water Master: daily assistance in monitoring flows along the canals, investigations to fully quantify travel times on the canals at all flow levels, identification of check structures that are contributing the most to operational inefficiencies, development of a computer program to optimize releases and management of check structures, and development of stage-discharge curves for check structures to provide more points along each canal where discharge can be monitored.

It is anticipated that immediate benefits of increased efficiency will be realized from this position in the 2005 season as a result of anticipated accomplishments and gain in information, and the position can be used in conjunction with plans for installing automated gate operators on check structure gates. Part of the responsibilities of the temporary position would be to identify check structures where the most benefit will be gained from automated gates and to monitor performance of the operators after installation.

The temporary position will no longer be needed once computer applications have been completely developed and the District staff trained to use the applications and when a sufficient number of automated operators have been installed so that remaining check structures can be managed by the Water Master and Ditch Riders.

5.3 AUTOMATION OF NORTH AND SOUTH CANAL CHECK STRUCTURES

Investigations conducted in 2004 concluded that check structures on the North and South Canals have a very significant impact on operational efficiency of the canals and also greatly contribute to operational efficiency on laterals. A full discussion on this topic is included in Chapter 7.0.

When discharges in the canals change, but gates on check structures are not adjusted accordingly, pooling of water behind check structures occurs. This can cause delays of up to several days for delivery of water to Ditch Riders at the lower end of the canals, resulting in delays for delivery to farmers. Taking this known problem into account, the Water Master must increase releases from the dam to compensate for potential loss of water at check structures. This water is eventually released from check structures and becomes unused water discharged from ends of the canals.

The impacts to laterals occur because the discharges entering laterals are controlled by both headgate settings and by the depth of water over headgates. Headgates are set to release a certain discharge to laterals, based on required deliveries to farmers and given the current water surface in the canal. When that water surface changes, so does the discharge entering the lateral. The result is either an increase in unused water discharged from the end of the lateral or failure to meet farmer orders.

Given the number of check structures, many with difficult access, continuous monitoring by Ditch Riders is considered to be impractical at current staff levels. Additionally, the check structures were not intended to be flow measurement devices, making estimation of the combined discharge, through gates and over boards, difficult at best. The recommended solution to this problem is the use of automated gate operators, similar to the one installed at the Townsite Check Structure on the North Canal in 2004 (Section 4.4). The ultimate goal for the District is for each check structure on the North and South Canals to have at least one gate equipped with an operator.

It is estimated that operators could be installed at $10,000 per operator. This cost would not include remote operation/monitoring capabilities, which is a long-term goal. However, operators installed would be completely compatible for future use of remote controls.

5.4 REMOTE INSTRUMENTATION

Installation of remote instrumentation to allow monitoring of discharges at key points around the District will be a significant step forward in water conservation. The initial investment for adding remote measurement capabilities to the District will be high, but the long-term payoffs in water savings and reduction of District staff time are anticipated to be

high as well. An initial investment of approximately $200,000 is the first priority to monitor discharges at critical points on the North and South Canals, from the District Office.

5.5 NEW FLOW MEASUREMENT STRUCTURES

Accurate flow measurement across the District is an important component to effectively managing the system and reducing losses. Evaluation of the effectiveness of existing flow measurement structures will continue, and investigations will be conducted as to the merits of replacing some nonfunctional structures and installing additional structures on laterals and on the North and South Canals. The first priority will be to ensure that all major laterals have accurate flow measurement structures, and the second priority will be to investigate the possibility of adding flow measurement structures on the North and South Canals. There are currently some very long stretches of the North and South Canals with no flow measurement capabilities, and investigations as to the costs and benefits of adding more flumes will be conducted.

5.6 OFF-STREAM STORAGE STRUCTURES

Investigations will be conducted as to the feasibility of adding small reservoirs adjacent to canals or laterals to store water in times of excess for use in times of need. The initial focus will be the North and South Canals–identifying locations where both inflow and outflow to the reservoir could be accomplished without the need for pumping.

6.0 WATER CONSERVATION GOALS–NEXT 5 YEARS

6.1 ROUTINE OFF-SEASON SYSTEM MAINTENANCE AND UPGRADES

As has been done in past years, the District will continue to utilize staff in the winter months to accomplish maintenance on the system and small improvement projects within the normal District budget. Some specific goals for the next 5 years are as follows:

- Clean and reshape canals and open laterals: 40 miles per year
- Clean drains: 20 miles per year
- Replace nonfunctional farmer turnouts: 50–60 per year
- Replace lateral check structures or headgate structures: 50 per year
- Convert sections of open-ditch laterals to pipe: 2,000–2,500 linear feet per year.

6.2 LINING OF INLET CANAL

This is considered to be the District's number one priority water conservation project, but it is addressed separately from other projects due to the unique timing and funding issues. Funding will need to be made available at a time when conditions allow for taking the Inlet Canal out of commission for several weeks to accomplish the work. The ultimate goal is to line 2 miles of the Inlet Canal with a geosynthetic product. The lining project would begin approximately 2 miles downstream of the Belle Fourche River Diversion Structure and end at the point where the canal changes from a built-up fill prism to cut. The estimated total cost of this project is $1,000,000. The canal would need to be dewatered to accomplish the work, so timing of conditions and funding will be an important factor. The project would be completed in phases with a minimal funding level to allow project initiation of $250,000.

District estimates are that seepage losses from the Inlet Canal average at least 10 cfs in the 2-mile stretch proposed for lining. Assuming 365 days per year of canal operation, the water savings would be **7,300 acre-feet per year**.

6.3 SCENARIOS FOR WATER CONSERVATION

Shown below are proposed projects that would provide for increased efficiency in delivery of releases from the dam. This increased efficiency equates to water savings which could provide benefits in several different forms: increase in water available for irrigation allotment; decrease in return flows to the Belle Fourche River; and eventually, wildlife and recreation benefits because of a decrease in the volume of water that must be taken from the reservoir

each year to meet irrigation needs. Three different funding scenarios are provided to give an indication of how accomplishments and water savings relate to different funding levels. The water savings shown for each scenario represent the cumulative water savings at that funding level–not an increase in savings compared to the previous scenario.

Estimated reductions in system losses are provided for each proposed project based on the 2004 Water Budget. However, the actual total savings benefit will not necessarily be the total of these numbers due to the fact that water saved may be put back into the system for delivery. For these calculations, a conservative assumption was used that all water saved because of reduction in losses will be put back into the system for delivery. Additionally, conservative methods are used for computing end benefits.

For each of the scenarios, three water savings figures are provided: (1) total estimated reduction in losses, based on the 2004 Water Budget; (2) resulting increase in volume of water available for delivery; and (3) estimated reduction in nonused flows to the Belle Fourche River. The last two numbers are different because of reductions in volume of water delivered to farmers but not billed. This reduction would certainly be a benefit, as it would serve to increase the annual irrigation allotment, providing more water for all farmers. However, it does not affect nonused water flows to the Belle Fourche River, as the water is delivered to farmers either way. For computation of reduction in nonused water flows, it was assumed that 90 percent of Operational Losses and 50 percent of Transportation Losses become return flow. These are very rough estimates and felt to be conservative (tend to underestimate volumes of return flows). Table 6-1 provides a summary of computations used to arrive at water savings figures.

6.4 PROPOSED PROJECTS–FUNDING SCENARIO #1

At funding levels similar to the last 5 years (operation and maintenance plus approximately $50,000 per year in Water Conservation funding), the District would focus on the priorities described below for water conservation. At the end of 5 years, the estimated annual water savings and benefits are: total reduction in losses–**5,500 acre-feet**, increase in volume available for delivery–**3,800 acre-feet**, and reduction in nonused water flows to the Belle Fourche River–**1,400 acre-feet**.

All water savings figures shown below are the total annual savings expected under this funding scenario at the end of 5 years.

1. Conversion of open-ditch laterals to pipelines, at an estimated rate of 2,000 linear feet per year. The 1998 Water Management Study presents seepage study results for several laterals from 1991 and 1992. Results varied from 0.5 to 5.0 cfs/mile, with an average of 1.9 cfs/mile. Using an average reduction in seepage of 2.0 cfs/mile for the converted laterals and using a 120-day delivery season, the volume of water saved for each

1,000 linear feet of pipe would be 90 acre-feet per year. At the end of 5 years, the savings would be **900 acre-feet per year**.

Table 6-1. Water Savings for Funding Scenarios (Acre-Feet)

Description	2004 Water Budget	Projected 2010 Water Budget		
		Funding Scenario #1	Funding Scenario #2	Funding Scenario #3
Dam Releases	110,473	110,473	110,473	110,473
Delivered & Billed	52,656	56,453	62,025	68,681
Increase in Deliveries		**3,797**	**9,369**	**16,025**
Delivery Efficiency	48	51	56	62
Delivered & Not Billed	10,531	8,468	6,202	3,434
Reduction in Over-deliveries		2,063	4,329	7,097
Total Delivered	63,187	64,921	68,227	72,115
Canal Losses				
Transportation	8,346	8,346	8,346	8,346
Operational	4,780	4,525	3,436	2,734
Lateral Losses		0	0	0
Transportation	14,049	13,590	13,153	12,127
Operational	20,111	19,091	17,311	15,151
Total Losses (Unused)	47,286	45,552	42,246	38,358
Reduction in Unused		1,734	5,040	8,928
Nonused Water Flows	33,599	32,222	29,422	26,333
Reduction in Nonused Water Flows		**1,377**	**4,178**	**7,266**

2. Increased accuracy in measurement of flows entering the laterals. It is estimated that the current volume of Operational Losses on the laterals could be reduced by 10 percent with continued emphasis by District management as to the importance of reducing operational losses and monitoring of improvements. Savings: **2,000 acre-feet per year** (10 percent of 20,111).

3. Increased accuracy in measurement of deliveries to farmers. Current estimates are that the volume of water actually delivered to farmers averages 20 percent greater than the volume billed. It is estimated that this figure could be reduced to 15 percent with

continued emphasis by District management on the importance of accurate deliveries and with the enforcement of policies on tampering with District equipment by farmers. Savings: **2,100 acre-feet per year** (Table 6-1, Reduction in Overdeliveries).

4. Increased operational efficiency for North and South Canals. Collection of data and potential use of computer applications for determination of accurate travel times on the canals at various discharges, better monitoring of actual discharges in canals throughout the day, and more efficient management of check structures. It is estimated that a 10 percent reduction in the current Operational Losses could be achieved. Savings: **500 acre-feet per year** (10 percent of 4,780).

6.5 PROPOSED PROJECTS–FUNDING SCENARIO #2

At an approximate funding level of $1.3 million over the next 5 years, the water conservation projects described below will be completed. At the end of the 5 years, the estimated annual water savings and benefits are: total reduction in losses–**13,300 acre-feet**, increase in volume available for delivery–**9,400 acre-feet**, and reduction in nonused water flows to the Belle Fourche River–**4,200 acre-feet**.

All water savings figures shown below are the total annual savings expected under this funding scenario at the end of 5 years.

1. Conversion of open-ditch laterals to pipelines would remain at 2,000 linear feet per year, as stated in Scenario #1. The volume of water saved for each mile of pipe would be 480 acre-feet per year. At the end of 5 years, the savings would be **900 acre-feet per year**.

2. Increased accuracy in measurement of flows entering the laterals. In addition to the education efforts and emphasis by District management described under funding Scenario #1, the following measures would be taken to further increase accuracy: use of data loggers for spot checks on the discharges in laterals and development of more stage-discharge curves for nonfunctional flow measurement devices. Improvements are also anticipated as a result of the automated gate operator installations on the North and South Canals. With these additional measures, it is estimated that the current volume of Operational Losses on the laterals could be reduced by 25 percent. Savings: **5,000 acre-feet per year** (25 percent of 20,111).

3. Increased accuracy in measurement of deliveries to farmers. Efforts described in Scenario #1 will be continued plus additional improvements are anticipated as a result of the automated gate operator installations on the North and South Canals. Estimated reduction in overdeliveries from 20 percent to 10 percent. Savings: **4,300 acre-feet per year** (Table 6-1, Reduction in Overdeliveries).

4. Increased operational efficiency for North and South Canals. The measures described in Scenario #1 would be implemented plus approximately 25 automated gate operators would be installed on North and South Canal check structures, and remote data transmission devices would be installed at several key flow measurement structures, to allow monitoring of discharges in the canals from the District Office. It is anticipated that this would result in a 50 percent reduction of current Operational Losses. Savings: **2,400 acre-feet per year** (50 percent of 4,780).

5. Lining projects. The District will continue to make progress in lining laterals or sections of the South Canal with high rates of seepage. The goal would be to average one project per year, for a total length of 1–2 miles over the 5-year period. Using 1.5 miles and a seepage rate of 2 cfs/mile, the savings would be **700 acre-feet per year.**

6. Off-Stream storage structures. Investigations will be conducted as to the costs and benefits associated with construction of small reservoirs that can be used to store water at times of excess, for later use. If investigations prove favorable, one structure may be constructed in the next 5 years and the success evaluated to determine gains from a number of structures across the District. No specific predictions are made at this time as to the water savings for this project.

7. Other. Substantial progress is anticipated in the District's goal to map all system canals and laterals and to build an automated system utilizing Geographic Information System (GIS) capabilities to provide a link between drawings and system data. No specific predictions are made as to the water savings for these measures, but there will certainly be a benefit in terms of more efficient operation and maintenance of the system.

6.6 PROPOSED PROJECTS–FUNDING SCENARIO #3

The maximum realistic accomplishments that could be achieved in the next 5 years, with sufficient funding, are presented in this scenario. The funding level required to support the accomplishments of this scenario would be approximately double that for Scenario #2. At the end of the 5 years, the estimated annual water savings and benefits are: total reduction in losses–**21,500 acre-feet**, increase in volume available for delivery–**16,000 acre-feet**, and reduction in nonused water flows to the Belle Fourche River–**7,300 acre-feet**.

All water savings figures shown below are the total annual savings expected under this funding scenario at the end of 5 years.

1. Conversion of open-ditch laterals to pipelines would be increased to approximately 1 mile per year. The volume of water saved for each mile of pipe would be 480 acre-feet per year. At the end of 5 years, the savings would be **2,400 acre-feet per year**.

2. Increased accuracy in measurement of flows entering the laterals. Actions from funding Scenario #2 plus replacement of inaccurate flow measurement devices. Estimated total

reduction in Operational Losses on the laterals is 40 percent. Savings: **8,000 acre-feet per year** (40 percent of 20,111).

3. Increased accuracy in measurement of deliveries to farmers. Actions from funding Scenario #2 plus replacement of inaccurate flow measurement devices. Estimated reduction in overdeliveries from 20 percent to 5 percent. Savings: **7,100 acre-feet per year**. (Table 6-1, Reduction in Overdeliveries).

4. North and South Canal Automation. Installation of automated gate operators on all North and South Canal check structures, plus remote data transmission devices, would be installed at several key flow measurement structures to allow monitoring of discharges in the canals from the District Office. Estimated total reduction in Operational Losses on the canals is 70 percent. Savings: **3,300 acre-feet per year** (70 percent of 4,780).

5. Lining projects. As stated for Scenario #2. Savings: **700 acre-feet per year.**

6. Off-Stream storage structures. As stated for Scenario #2. No specific savings estimated at this time.

7.0 2004 NORTH AND SOUTH CANAL INVESTIGATIONS

Investigations of factors affecting water delivery efficiency on the North and South Canals were conducted during the 2004 season using a combination of water card data and flow measurement data collected in the field. Primary goals of the 2004 investigations were: (1) assess volumes of losses on the canals and distinguish between Transportation Losses (seepage/evaporation) versus Operational Losses; (2) gain a better understanding of the factors affecting operational efficiency; (3) quantify travel times on the canals, from the dam to the various laterals; and (4) explore use of computer applications to increase operational efficiency.

Work on Items 3 and 4 is currently ongoing and more information will be presented in the spring of 2005. Chapter 5.0 addresses this in further detail. For Items 1 and 2, findings and conclusions are presented below and more detailed information is presented in Appendix C.

7.1 DISTRIBUTION OF LOSSES

A combination of water cards and daily measurements of discharges at flumes was utilized to assess volumes of losses on the North and South Canals during the 2004 season and to gain a better understanding of where the greatest losses are occurring and why. The greatest emphasis was placed on the South Canal, because the locations of flow measurement structures on the South Canal allowed estimation of the volumes of water used in each Ride. A summary of the total monthly losses occurring from the South Canal in each of the Rides is shown in Table 7-1. The losses on the South Canal were computed based on the total volume of water used within a Ride minus the volume of water turned down the laterals. The former is based on daily readings taken at flumes on the South Canal at the start of each Ride. The latter is based on Ditch Rider Daily Water Cards. Losses on the laterals were computed based on the volume of water sent down the laterals minus the volume of water delivered and billed to farmers. Using unadjusted data from water cards, the distribution of Total Losses on the system was 44 percent to canals and 56 percent to laterals.

However, as discussed in Chapter 2.0 and 8.0, there are strong indications that more water is actually turned down laterals than what is shown on the water cards. The 1998 Water Management Study conducted by the Bureau of Reclamation concluded that on the average, approximately 15 percent more water was turned down laterals than what the District records indicated. Using this information and observations from the 2004 irrigation season, an error of 10% was used for the 2004 Water Budget computations.

Table 7-1. Losses on South Canal Versus Laterals–Acre-Feet

Month	Ride 2		Ride 8		Ride 10		Total	
	Canal	Laterals	Canal	Laterals	Canal	Laterals	Canal	Laterals
June	insufficient data		632	747	90	1,000	722	1,747
July	1,018	643	2,572	399	73	2,247	3,663	3,289
August	746	1,042	1,294	1,794	1,620	2,236	3,660	5,072
Total Volume	1,764	1,685	4,498	2,939	1,783	5,483	8,045	10,107
Ave Daily cfs	14	14	24	16	10	30	16	20
Percentage	51	49	60	40	25	75	44	56
August – using 10% adjustment to orders								
Volume	415	1373	810	2,278	1056	2,800	2,280	6,452
Percentage	23	77	26	74	27	73	**26**	**74**

Another consideration in distributing losses was that South Canal data for the months of June and July was considered questionable because of known problems with flumes and with incomplete water card data. Therefore, use of August data only was considered a more accurate approach to development of the split between losses on the South Canal versus losses on laterals. Using August data with a 10 percent correction to the water cards, the split is estimated at 26 percent to canals and 74 percent to laterals. These figures were used for development of the 2004 Water Budget. The final split for the 2004 Water Budget, including both North and South Canals, was 28 percent to canals and 72 percent to laterals, as shown in the Distribution of Losses Water Budget (Figure 3-3).

The distribution of losses on the South Canal into Transportation Losses and Operational Losses was estimated utilizing the graphs in Appendix C, and this distribution was then used for both the North and South Canals for development of the 2004 Water Budget.

The South Canal distributions were estimated by comparing two lines on the monthly graphs: (1) the line representing the volume of water used in the Ride for each day and (2) the line representing the volume of water turned down the laterals for each day (from water card orders). Periods when these two lines were parallel and close together were considered times when Total Losses on the canal were nearly all Transportation Losses. It was assumed that the Operational Losses during those periods were 3 percent of the dam releases. The 3 percent figure is assumed to be the approximate lowest level of Operational Losses under which the North and South Canals would have been operated.

The data used for production of the graphs are subject to numerous sources of inaccuracy, including water card errors and the effects of check structures, as discussed in more detail in Section 7.2. Therefore, this distribution should be considered a very rough estimate. In the future, with improved emphasis on water card accuracy and use of continuous data loggers, this process will produce a more accurate distribution of losses over the system. The final estimated average distribution for the North and South Canals was 64 percent Transportation Losses and 36 percent Operational Losses.

7.2 EFFICIENCY FACTORS

Appendix B contains numerous graphs for the North and South Canals comparing daily releases from the dam to discharges ordered and delivered. More detail is provided for the South Canal because the location of flumes allows for easier analysis of the data. Appendix C contains graphs for the South Canal comparing discharge measurements taken at flumes to the discharge that should have been measured in the canal at that time, based on releases from the dam and Ditch Rider orders for water to be released to the laterals.

What these graphs demonstrate is the variable nature of discharges on the canals, and the fact that the Ditch Rider at the downstream end of the canals often does not receive the volume ordered for deliveries. It is believed that this problem is a combination of three factors: (1) volume of water actually released to laterals by Ditch Riders does not agree with their orders, (2) the effects of check structures on the canals, and (3) lack of sufficient numbers of flow measurement structures on the canals.

7.2.1 Lateral Releases

As discussed in Chapters 2.0 and 8.0, there are strong indications that the volume of water turned down laterals by Ditch Riders each day does not always match the volume that they ordered from the Water Master for that day. The assumed average of the difference between orders and actual releases to laterals which was used for the 2004 Water Budget was 10 percent greater (more water turned down laterals). Knowing that this is often happening, but with uncertainty as to when it will happen and by how much, forces the Water Master to increase releases from the dam to compensate and ensure that farmer orders at the bottom of the canals can be met. On occasions when discharges in the canals fall below the level required to meet orders, releases are often immediately increased at the dam, with the tendency to make the increase plenty high, to ensure that all of the water gets to the end of the canal this time, where angry farmers are waiting for it. The net result is an increase in Operational Losses on the North and South Canals.

The best way to address this problem will be for District management to continue emphasis as to the importance of accurate orders, by means of the Daily Water Cards, and the importance in managing releases to laterals to ensure that the discharges ordered agree with discharges

actually released to laterals. The use of portable data loggers will also serve as a valuable tool for District management for monitoring of actual discharges in the laterals for comparison to Water Card orders. Efforts will also continue for identification of inaccurate flow measurement structures on laterals and for modification or replacement of those not functioning properly.

7.2.2 Check Structures

Check structures on the North and South Canals act as small dams which can pool a considerable volume of water behind them. If the check structure gates are not constantly adjusted to compensate for changes in discharge in the canals, the pools fill and drain, causing the variable nature of discharges in the canal, which amplify with increasing distance from the dam. As a result, Ditch Riders at the bottom of the canals are often left without sufficient water to fill orders placed by farmers 1 or 2 days before. In an attempt to compensate for this known phenomena, the Water Master must often increase releases from the dam as insurance for delivery of the water ordered to compensate for volumes of water that are held up within a Ride by pooling behind the check structures. But, eventually this pooled water is released and then becomes excess water in the system to be discharged from the ends of the canals as unused water. Also, as described in Section 7.2.1, when shortages occur and farmer orders can not be filled, even more water is put into the system, but by the time it gets to the point of delivery, it may no longer be needed. The end result is significant increases in volumes of Operational Losses on the North and South Canals, and if the check structures could be continuously adjusted according to adjustments in canal discharge, the volume of these losses could be greatly decreased.

Investigations as to the details of check structure operations indicate that the continuous, reliable adjustment of check structures would be very difficult to achieve without the use of automation. Given the number of check structures, accessibility to the structures, and the complexity of the calculations required to anticipate the timing of changes and gate settings, it essentially could not be done with the current District staff. The best solution is installation of more automated gate operators on check structures, similar to the one installed on the North Canal Townsite Check, in 2004 (Section 4.4). The ultimate goal of the District is to have at least one of the gates on each check structure equipped with an automated gate operator.

7.2.3 Remote Instrumentation

The use of remote instrumentation would allow continuous monitoring of discharges at key points along the North and South Canals so that problems can be identified and corrected immediately, and it could also allow for remote adjustment of the automated gate operators on check structures. This would amount to a significant reduction in the demands placed on the time of the Ditch Riders so that they can place increased emphasis on the monitoring of discharges in laterals and farmer turnouts.

7.3 TRAVEL TIMES

A persistent problem in management of the North and South Canals is the estimation of travel times from the dam to various points along the canals. The time required for water to travel from the dam to the ends of the canals can be up to 3 days, but this time varies significantly, depending on the discharge in the canals. This makes it difficult for Ditch Riders to plan delivery times to farmers and to make adjustments to lateral headgates at the proper times.

During the 2004 irrigation season, data loggers were used at several locations along the canals, and that data will be used to develop estimates of travel times under different discharge conditions. This will be used in conjunction with computer modeling, as described below.

7.4 COMPUTER APPLICATIONS

Data collected during the 2004 irrigation season which will be used for computer modeling trials. The goal is to find or develop a computer model which can be utilized to address the travel time issue and optimize releases from the dam, adjustments to check structures, and adjustments to lateral headgates. Findings will be available in the spring of 2005.

8.0 2004 LATERAL INVESTIGATIONS

The Gillette and Vale laterals were chosen for investigations during the 2004 irrigation season. Goals for these investigations were: (1) evaluation of volumes and sources of losses on the laterals, and (2) exploration of the value of computer applications for improving operational efficiency.

8.1 EVALUATION OF LOSSES

An evaluation of losses on the laterals was performed using a combination of: (1) Daily Ditch Rider Water Cards; (2) Monthly Billing Cards; and (3) Data loggers, placed in the Parshall Flumes at the beginning of the laterals, and at the last measurement structures on the laterals, measuring unused water leaving the laterals. The Daily Water Cards were merged with the Monthly Billing Cards to provide the daily deliveries by lateral. This data is presented in Appendix C.

Total losses on the laterals were computed two different ways: (1) using the Ditch Rider's orders for the lateral, from the Daily Water Cards, compared to the daily deliveries made to farmers for that lateral, from the merged cards; and (2) for periods when a data logger was operating in the Parshall Flume, that data was used for the computation instead of the Ditch Rider orders. Total losses include Seepage/Evaporation and Operational Losses.

Tables 8-1 and 8-2 provide a summary of the findings from the lateral investigations. Table 8-3 provides a summary of seepage investigations conducted previously by the Bureau of Reclamation from the 1998 Water Management Study. The seepage data from the study allows for a comparison of the computed Gillette and the Vale lateral data to actual seepage measurements on other laterals around the District.

8.1.1 Gillette

A data logger was in the flume from July 26, 2004, to August 31, 2004. A summary of the computed losses using the two different methods is shown below. The losses based on the measured flume discharges are significantly higher than those based on the water cards, as the discharges measured in the flume were consistently greater than the Ditch Rider's estimates, based on his water cards.

Table 8-1. Summary of 2004 Lateral Investigations

Date	Units	Volume Turned Down Lateral			Delivered & Billed	Total Losses		Operational Losses		
		Water Card Orders	Measured in Flume	Percent Error						
		(volumes are in acre-feet)				Vol	%	Vol	% of Total	% of Losses
Gillette Lateral										
8/12-8/25	af	132	163	23	57	106	65	49	30	46
	cfs	4.7	5.8		2.0	3.8		1.8		
Vale Lateral										
8/26 to 9/11	af	135	215	59	74	153	71	63	29	41
	cfs	4.0	6.3		2.2	4.5		1.9		

Table 8-2. 2004 Lateral Investigations Statistics

Lateral	Turned Down Lateral (af)	Delivered & Billed (af)	Billing Errors 20%	Oper. Losses (Meas) (af)	Seepage Losses (af)	Length of Open Ditch (miles)	# days	Seepage Losses		Irrig. Acres	Losses/ Acre (af/acre)
								(cfs/mile)	(cfd)[a]		
Gillette	163	57	11.4	49	46	3.4	14	0.5	0.66	1.650	0.06
Vale	215	74	14.8	63	63	2.4	17	0.8	1.06	929	0.14
Average Distribution		34.7%	6.9%	29.7%	28.7%						

(a) cfd is cubic feet per day per square foot of wetted area. An average wetted perimeter of 12 feet was used.

Table 8-3. Seepage Data From 1998 Water Management Study

Study Area	Length (miles)	Seepage	
		cfs/mile	cfd[(a)]
1991 South Canal 1800+00 to 2000+00	3.7	2.91	2.19
1992 South Canal 1818+61 to 1986+00	3.10	5.47	4.38
1992 South Canal 457+63 to 584+47	2.35	2.35	0.91
Average for Canals		**3.58**	**2.49**
1991 Arpan Lateral	1.13	0.50	0.68
1992 Arpan Lateral	2.00	1.63	1.69
1991 Beals Lateral	0.41	2.63	4.59
1991 Beresford Lateral	6.74	1.83	2.31
1991 Deadman Lateral	1.80	0.90	0.99
1991 Finn Lateral	1.38	1.17	1.59
1991 Gillette Lateral	0.59	1.08	1.50
1991 Johnson Lateral	0.76	5.03	4.67
1992 Johnson Lateral	3.00	2.35	3.05
1991 LaFlamme Lateral	1.90	2.36	2.90
1991 Young Lateral	2.32	1.09	1.30
1992 Young Lateral	3.15	2.74	3.14
Average for Laterals		**1.94**	**2.37**

(a) cfd is cubic feet per day per square foot of wetted ditch prism.

July 26 to August 31:

Volume entering the Gillette per water cards–564 af or an average discharge of 7.6 cfs
Volume entering Gillette per data logger–695 af or 9.4 cfs
Volume delivered and billed–411 af or 5.6 cfs
Total Losses using water cards–153 acre-feet or 2.1 cfs
Total Losses using flume discharges–284 acre-feet or 3.8 cfs.

During the period of August 12, 2004, to August 25, 2004, data loggers were located both at the Parshall Flume and at the check Control Structure CS7, providing measurement of the actual discharge entering the Gillette and the discharge leaving the Gillette. The difference between the two measurements is the Total Losses on the lateral, and the discharge at CS7 is the Operational Losses. The Transportation Losses (seepage and evaporation) can then be

computed as the Total minus Operational. During this period, the estimated losses were as shown below. Using these figures and the above figures from July 26 to August 31, the projected breakdown of losses for the period of June 1 to September 21 are also provided.

August 12 to August 25:

Operational Losses of 49 acre-feet or an average discharge of 1.8 cfs
Transportation Losses of 57 acre-feet or 2.0 cfs.

June 1 to September 21:

Total Losses using water cards–515 acre-feet or an average discharge of 2.3 cfs
Projected Actual Total Losses–956 acre-feet or 4.3 cfs
Projected Operational Losses of 442 acre-feet or 2.0 cfs
Projected Transportation Losses of 514 acre-feet or 2.3 cfs.

8.1.2 Vale

During the period of August 26, 2004, to September 11, 2004, data loggers were located both at the Parshall Flume and at the division box Control Structure CS7, providing measurement of the actual discharge entering the Vale lateral and the discharge leaving the Vale lateral. The difference between the two measurements is the Total Losses on the lateral, and the discharge at CS7 is the Operational Losses. The Transportation Losses and projected losses were computed in the same manner as described above for the Gillette lateral.

August 26 to September 11:

Volume entering the Vale per water cards–135 af or an average discharge of 6.3 cfs
Volume entering Vale per data logger–215 af or 10.0 cfs
Volume delivered and billed–62 af or 1.8 cfs
Total Losses using water cards–73 acre-feet or an average discharge of 2.1 cfs
Total Losses using flume discharges–153 acre-feet or 4.5 cfs
Operational Losses–63 acre-feet or an average discharge of 1.9 cfs
Transportation Losses–90 acre-feet or 2.6 cfs.

June 1 to September 16:

Total Losses using water cards–549 acre-feet or an average discharge 2.5 of cfs
Projected Actual Total Losses–1,151 acre-feet or 5.3 cfs
Projected Operational Losses–474 acre-feet or 2.2 cfs
Projected Transportation Losses–677 acre-feet or 3.1 cfs.

8.1.3 Flow Measurement Device Investigations

A particularly problematic flume, the Parshall Flume on the Gillette lateral, was studied during the 2004 season, and the flume was found to be completely submerged to the extent that

submergence corrections provided in the Water Measurement Manual were of no real benefit. Numerous flow measurements were taken at the flume throughout the summer, utilizing a Pygmy flow meter, and a stage-discharge curve was developed. The curve and supporting data are included in Appendix D. Use of this curve will aid the Ditch Rider in estimating flows in the flume in the future. However, the curve is designed for use under steady conditions, so the Ditch Rider will need to let the flows stabilize after making adjustments at the headgate, before the curve can be accurately applied. Therefore, reconstruction of the flume, or installation of a different flow measurement structure, may be considered in the future.

During 2004, a data logger was located in this flume for over 1 month, and comparison of that data to Ditch Rider Daily Water Cards indicates that the actual volume of water which passed through the flume during that period was approximately 23 percent greater than what the Ditch Rider estimated. This resulted in a volume of unused water leaving the Gillette lateral that was nearly double that estimated by the Ditch Rider. Based on the data collected on the Gillette lateral and projections, it is estimated that the volume of unused water discharged from the Gillette lateral in the 2004 season was approximately 400 acre-feet. A reduction of this volume to 300 acre-feet is considered a reasonable expectation with future use of the stage-discharge curve for the flume.

8.2 COMPUTER APPLICATIONS

Data was collected on the Gillette and Vale laterals during the 2004 irrigation season which will be used for computer modeling trials. The goal is to find or develop a computer model which can be utilized to locate problem areas on a lateral and to enhance delivery efficiency by optimizing timing of deliveries and adjustments to check structures. Findings will be available in the spring of 2005.

9.0 2004 STUDY ON REUSE OF DRAIN WATER

A data logger that measured both stage and water quality was located in Drain 6 for the majority of the 2004 irrigation season. This is a major drain in the northwestern portion of the District, off of the North Canal. Water quality recorded by the logger was temperature, pH, turbidity, and specific conductance. A complete summary of the data is presented in Appendix E.

Collection of Drain 6 data was done for the purpose of exploring the possibility of using the water in the drain for irrigation. Potentially, water from the drain could be pumped to the Indian Creek lateral, approximately 1 mile to the north, where it could be used as irrigation water. Conclusions drawn from analysis of the data are that the water quality is suitable for irrigation, but the average discharge in the drain is not sufficiently high to make the project feasible, particularly in consideration of the fact that pumping would be required. During the period of June 25 to July 20, the range of discharges in the drain was 0.5 cfs to 7.9 cfs, with an average of 3.9 cfs.

Further investigations may be conducted in the future on other locations within the District where drain water could be reused without pumping. However, these investigations are considered low priority compared to other water conservation projects discussed earlier in this report.

10.0 REFERENCES

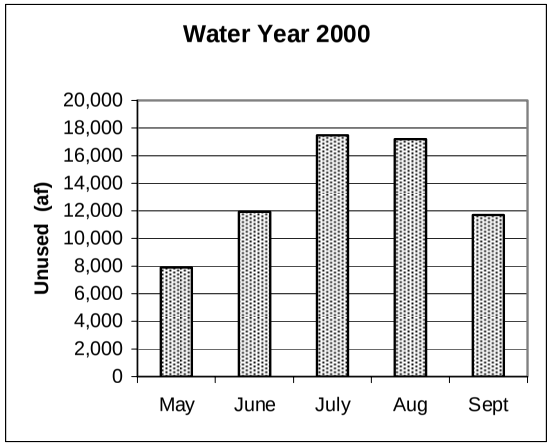
Bureau of Reclamation, 1998. *Water Management Study*, prepared by Bureau of Reclamation, Dakotas Area Office, May.

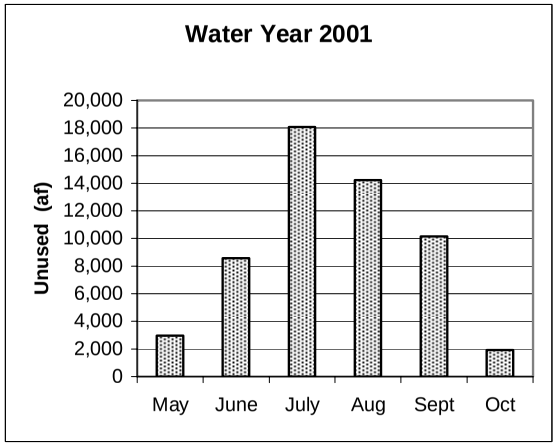
Bureau of Reclamation, 2001. *Water Measurement Manual*, 3rd Edition, prepared by U.S. Department of the Interior, Bureau of Reclamation.

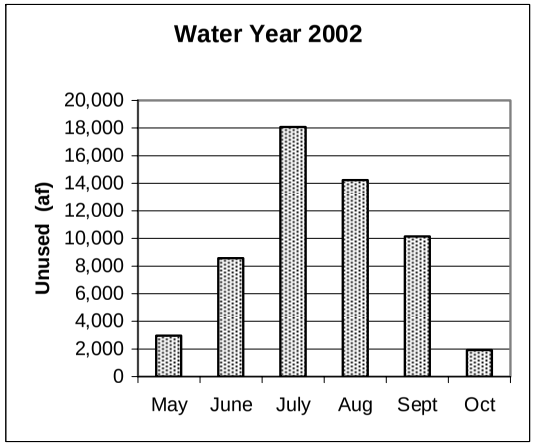
APPENDIX A

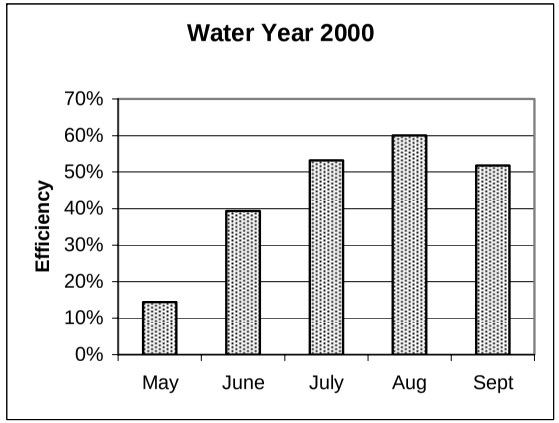
DELIVERY EFFICIENCY DATA

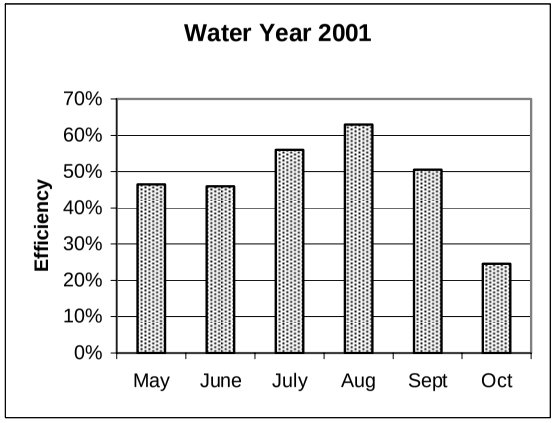
Appendix A.1
Delivery Efficiency by Month for 2000 to 2004

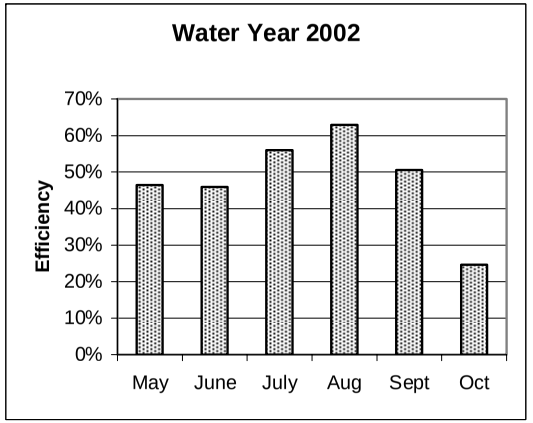




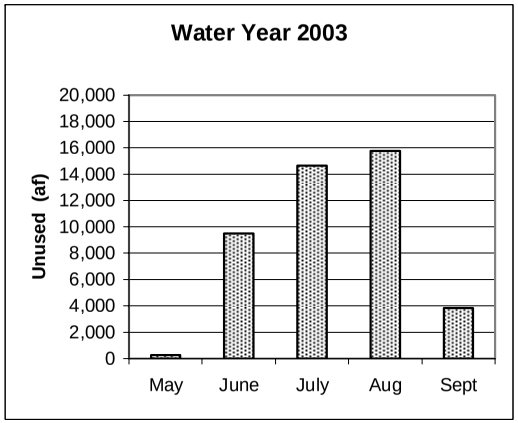


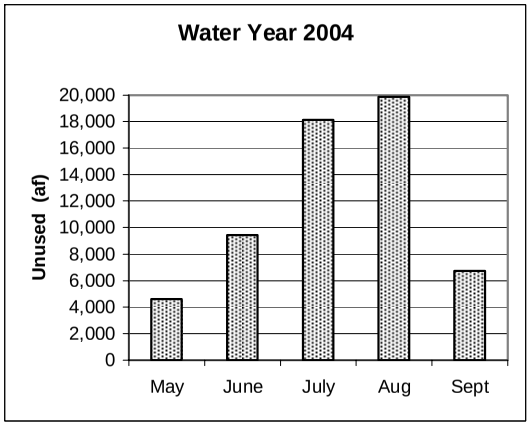


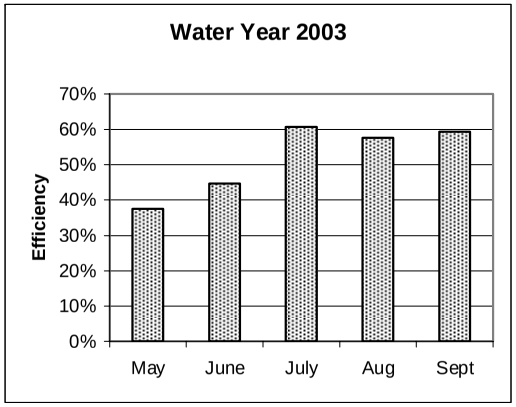


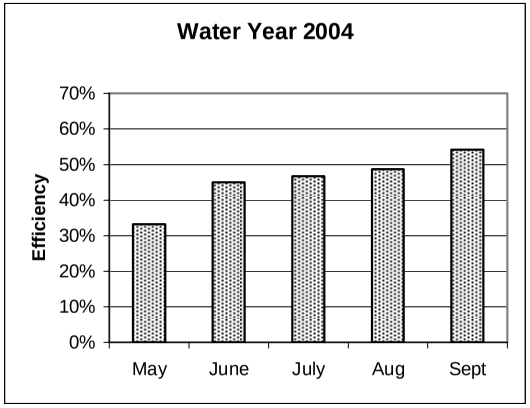


Appendix A.1
Delivery Efficiency by Month for 2000 to 2004









Appendix A.2
2004 Delivery Data–Season Summary
USBR Hydromet Records

Month	North Canal						South Canal						Total Released	Total Billed	Overall Efficiency
	Ordered	Released	Billed	Canal	% of Total Losses		Ordered	Released	Billed	Canal	% of Total Losses				
	(af)	(af)	(af)	Pad	Canal	Laterals	(af)	(af)	(af)	Pad	Canal	Laterals			
May	692	2,579	475	73%	90%	10%	2,779	3,923	1,801	29%	54%	46%	6,502	2,276	35%
June	9,656	11,588	5,237	17%	30%	70%	4,546	5,365	2,497	15%	29%	71%	16,953	7,734	46%
July	15,153	18,437	7,391	18%	30%	70%	11,807	15,069	8,518	22%	50%	50%	33,506	15,909	47%
August	18,144	21,366	10,158	15%	29%	71%	13,800	17,167	8,729	20%	40%	60%	38,533	18,887	49%
Sept	8,742	11,242	5,708	22%	45%	55%	3,178	3,737	2,237	15%	37%	63%	14,979	7,945	53%
June - August	42,953	51,391	22,786	16%	29%	71%	30,153	37,601	19,744	20%	42%	58%	88,992	42,530	48%
To Date	52,387	65,212	28,969	20%	35%	65%	36,110	45,261	23,782	20%	43%	57%	110,473	52,751	48%

Notes: "Canal Pad" is the additional water added to the North or South Canal in addition to Ditch Rider Orders. It includes Transportation Loses, Operational Losses, and allowance for the fact Ditch Riders often turn more water down the laterals than what Water Cards reflect.

% of Total Losses - Canals vs. Laterals: Total Losses is the difference between the volume released from the dam and the volume billed to farmers. As used in this table, the term also includes the volume delivered to farmers but not billed. Shown are the percentages of the Total Losses attributed to the North or South Canal vs. that attributed to the laterals. These percentages are based entirely on orders from the Water Cards, with no adjustment.

Adjustments in Table below are based on the assumption that there is a 10% error on volume turned down laterals for the North & South Canals. This means that on the average, Ditch Riders turn 10% more water down laterals than what is shown on their Water Cards.

Volumes of Losses (acre-ft)										
	North Canal					**South Canal**				
	Unadjusted		with Adjustments			Unadjusted		with Adjustments		
	Canal	Laterals	Canal	Laterals	Total	Canal	Laterals	Canal	Laterals	Total
May	1,887	217	1,818	286	2,104	1144	978	866	1,256	2122
June	1,932	4,419	966	5,385	6,351	819	2049	364	2,504	2868
July	3,284	7,762	1,769	9,277	11,046	3262	3289	2,081	4,470	6551
August	3,222	7,986	1,408	9,800	11,208	3367	5071	1,987	6,451	8438
Sept	2,500	3,034	1,626	3,908	5,534	559	941	241	1,259	1500
June-Au	8,438	20,167	4,143	24,462	28,605	7,448	10,409	4,433	13,424	17,857
To Date	12,825	23,418	7,586	28,657	36,243	9,151	12,328	5,540	15,939	21,479

Appendix A.3
2004 Delivery Data–Season Summary
Belle Fourche Irrigation District Water Master Records

Month	North Canal							South Canal							Total Released	Total Billed	Overall Efficiency
	Ordered	Released	Billed	Canal	% of Total Losses			Ordered	Released	Billed	Canal	% of Total Losses					
	(af)	(af)	(af)	Pad	Canal	Laterals		(af)	(af)	(af)	Pad	Canal	Laterals				
May	692	2690	475	74%	90%	10%		2,779	4,188	1,801	34%	59%	41%		6,878	2,276	33%
June	9,656	11562	5237	16%	30%	70%		4,546	5,706	2,497	20%	36%	64%		17,268	7,734	45%
July	15,153	18670	7391	19%	31%	69%		11,807	15,366	8,518	23%	52%	48%		34,036	15,909	47%
August	18,144	21522	10158	16%	30%	70%		13,800	17,196	8,729	20%	40%	60%		38,718	18,887	49%
Sept	8,742	11042	5708	21%	43%	57%		3,178	3,620	2,237	12%	32%	68%		14,662	7,945	54%
June - August	42,953	51,754	22,786	17%	30%	70%		30,153	38,268	19,744	21%	44%	56%		90,022	42,530	47%
To Date	52,387	65,486	28,969	20%	36%	64%		36,110	46,076	23,782	22%	45%	55%		111,562	52,751	47%

Notes: Dam Releases shown in this table are from the monthly Water Master sheets. Those shown in the Appendix A.2 table are from USBR Hydromet records.

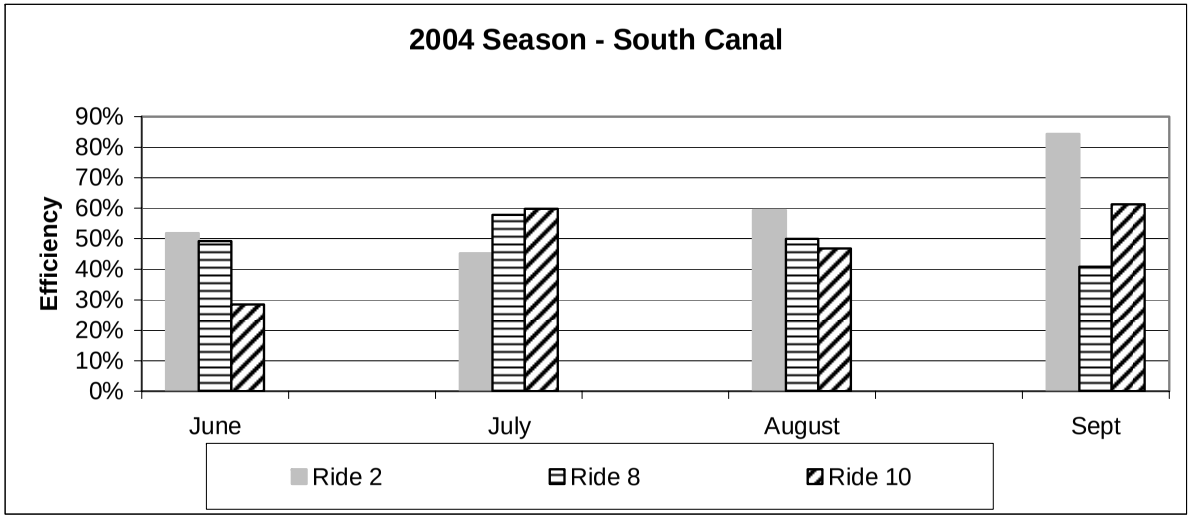
"Canal Pad" is the additional water added to the North or South Canal in addition to Ditch Rider Orders. It includes Transport Losses, Operational Losses, and allowance for the fact Ditch Riders often turn more water down the laterals than what their Water Cards reflect.

% of Total Losses - Canals vs. Laterals: Total Losses is the difference between the volume released from the dam and the volume billed to farmers. As used in this table, the term also includes the volume delivered to farmers but not billed. Shown are the percentages of the Total Losses attributed to the North or South Canal vs. that attributed to the laterals. These percentages are based entirely on the orders from the Water Cards, with no adjustment.

Appendix A.4
2004 Delivery Data–South Canal Summary

Volumes in acre-ft

				Ride 2				Ride 8				Ride 10				South Canal Total		
Month	Dam Releases	River Siphon Flume	Vale Flume	Rel.	Billings	Effic.		Rel.	Billings	Effic.		Rel.	Billings	Effic.		Rel.	Billings	Effic.
May	4188	?	2172		302				838				661			4188	1801	43.0%
June	5606	4330	1428	1276	661	51.8%		2902	1430	49.3%		1428	406	28.4%		5606	2497	44.5%
July	15366	11538	5774	3828	1731	45.2%		5764	3334	57.8%		5774	3454	59.8%		15366	8518	55.4%
August	17196	13372	7264	3824	2272	59.4%		6108	3049	49.9%		7264	3408	46.9%		17196	8729	50.8%
Sept	3620	2492	1314	1128	951	84.3%		1178	481	40.8%		1314	805	61.3%		3620	2237	61.8%
To Date	45976	31732	17952	10056	5916.65	58.8%	0	15952	9131	57.2%	0	15780	8734	55.3%		**45976**	**23782**	**51.7%**

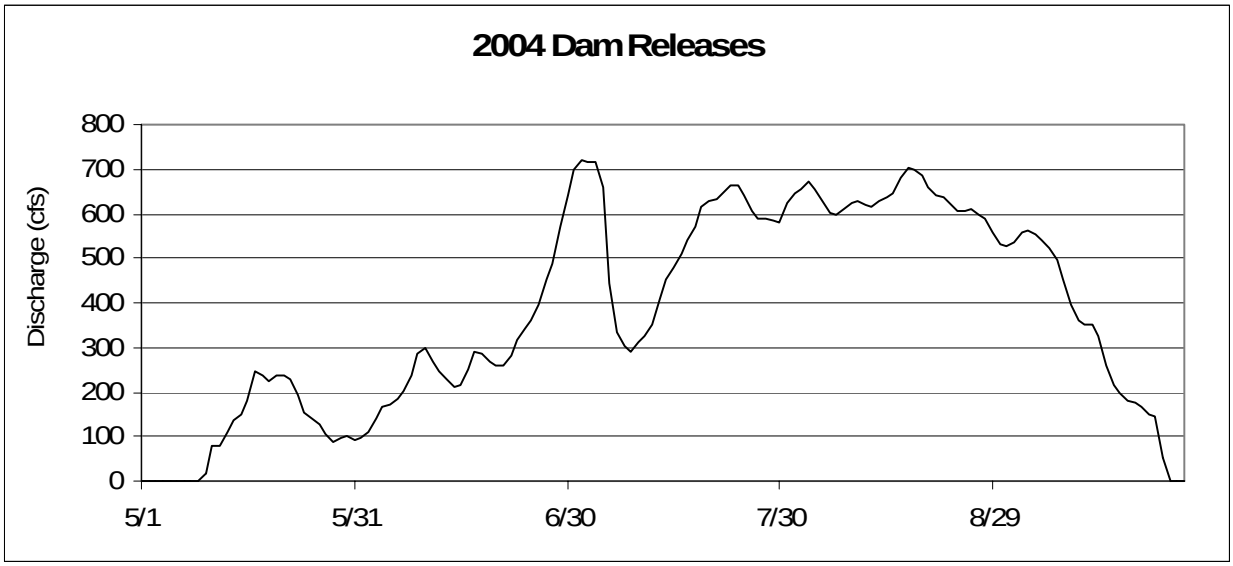


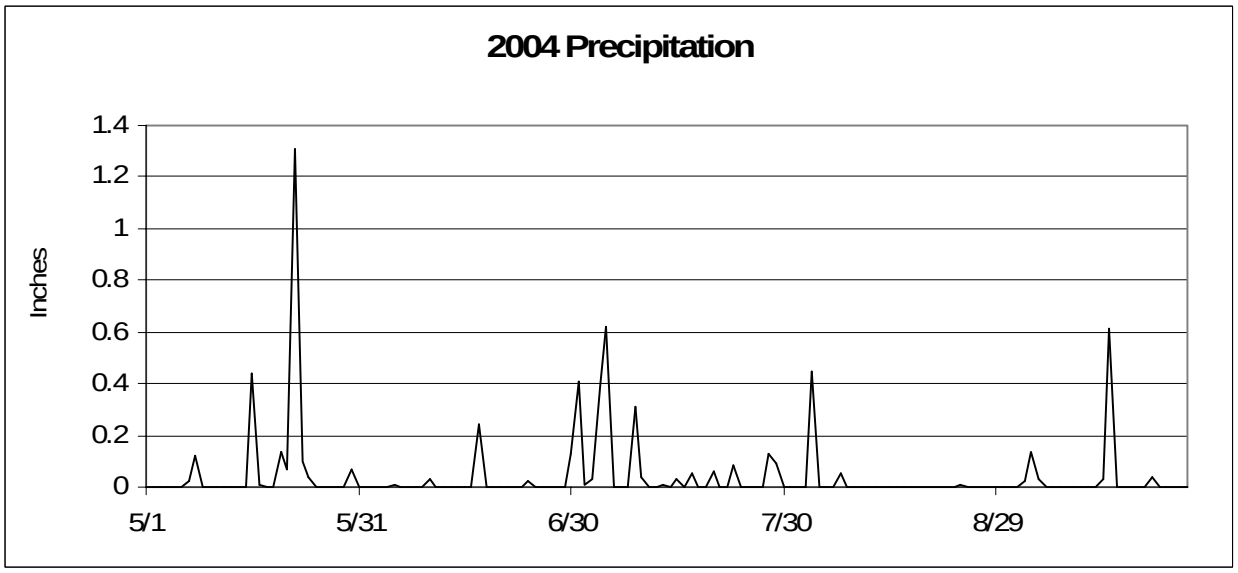
Appendix A.5
2004 Delivery Data–Month by Ditch Rider

	May					June					July				
	Ordered (af)	Billed (af)	Losses/ Waste Vol (af)	%	Effic. %	Ordered (af)	Billed (af)	Losses/ Waste Vol (af)	%	Effic. %	Ordered (af)	Billed (af)	Losses/ Waste Vol (af)	%	Effic. %
South Canal															
Ride 2	494	302	192	39%	**61%**	964	661	303	31%	**69%**	2374	1731	643	27%	**73%**
Ride 8	978	838	140	14%	**86%**	2176	1430	747	34%	**66%**	3732	3334	399	11%	**89%**
Ride 10	1307	661	646	49%	**51%**	1406	406	1000	71%	**29%**	5701	3454	2247	39%	**61%**
North Canal															
Ride 2	140	87	53	38%	**62%**	559	360	199	36%	**64%**	639	465	174	27%	**73%**
Ride 4	74	78	-4	-5%	**105%**	1343	915	428	32%	**68%**	2896	2124	773	27%	**73%**
Ride 5	93	38	55	59%	**41%**	2829	926	1903	67%	**33%**	4088	1186	2903	71%	**29%**
Ride 6	246	147	99	40%	**60%**	2281	1105	1177	52%	**48%**	3335	1415	1921	58%	**42%**
Ride 7	139	135	4	3%	**97%**	2644	1931	713	27%	**73%**	4195	2202	1993	48%	**52%**

	August					September				
	Ordered (af)	Billed (af)	Losses/ Waste Vol (af)	%	Effic. %	Ordered (af)	Billed (af)	Losses/ Waste Vol (af)	%	Effic. %
South Canal										
Ride 2	3314	2272	1042	31%	**69%**	1420	951	469	33%	**67%**
Ride 8	4842	3049	1793	37%	**63%**	974	481	493	51%	**49%**
Ride 10	5644	3408	2236	40%	**60%**	784	805	-21	-3%	**103%**
North Canal										
Ride 2	480	301	179	37%	**63%**	446	359	87	20%	**80%**
Ride 4	3640	2390	1250	34%	**66%**	1920	1755	165	9%	**91%**
Ride 5	5668	2153	3515	62%	**38%**	2050	1134	916	45%	**55%**
Ride 6	3452	1887	1565	45%	**55%**	2034	1420	614	30%	**70%**
Ride 7	4904	3427	1477	30%	**70%**	2292	1040	1252	55%	**45%**

Appendix A.6
Dam Releases Versus Precipitation
2000 to 2004





APPENDIX B

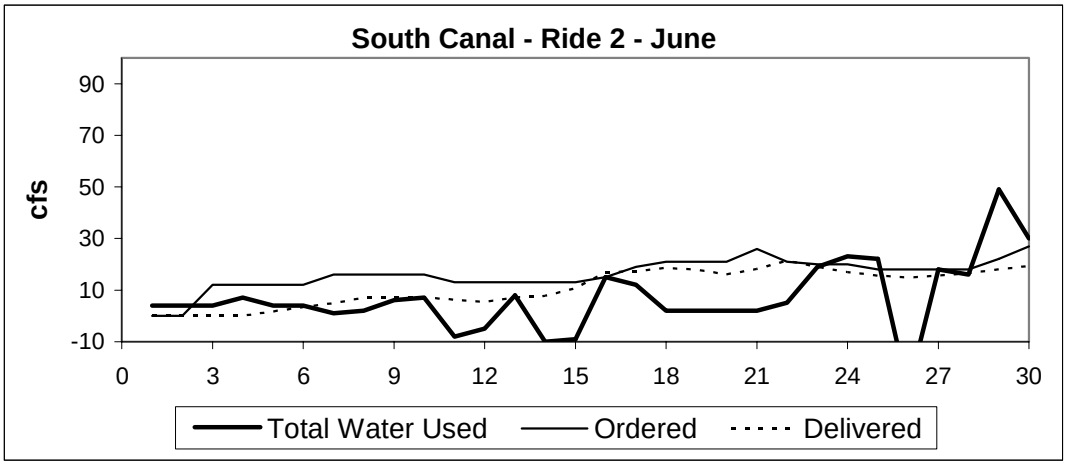
2004 WATER BUDGET COMPUTATION DATA

Appendix B.1
2004 Water Budget Computations

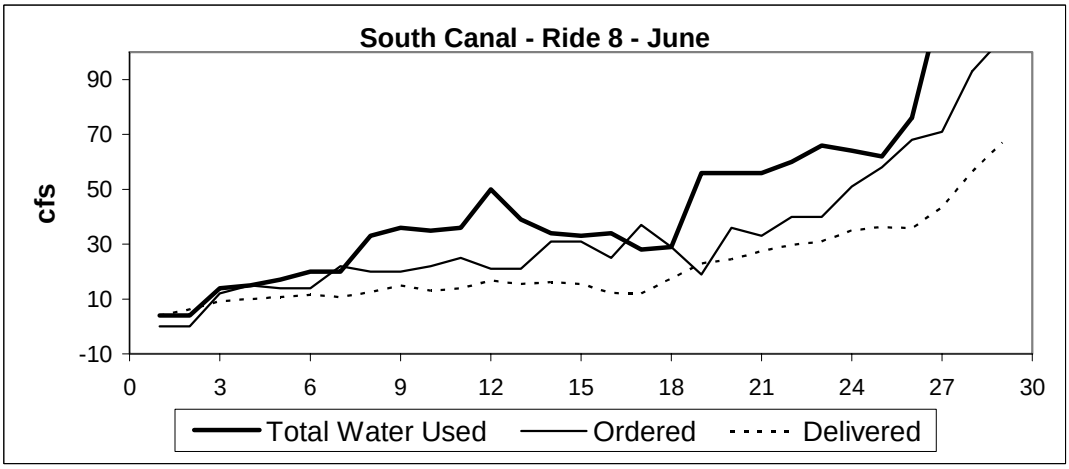
	System				Canals			Laterals					
Time Period	Volume Ordered	Volume Released	Volume Delivered	Losses & Errors	Transport	Operational	Canal Losses	Order Errors	Volume Entering Laterals	Transport	Operational	Delivered & Not Billed	Lateral Losses & Errors
								10%				20.0%	
South Canal													
May & Sept	5,957	7,660	4,038	3,622	778	329	1,107	596	6,553	575	1,132	808	2,515
22 days													
June-August	30,153	37,601	19,744	17,857	3,254	1,179	4,433	3015	33,168	3,435	6,041	3949	13,424
92 days													
Total	36,110	45,261	23,782	**21,479**	4,032	1,508	**5,540**	3,611	39,721	4,010	7,173	4,756	**15,939**
North Canal													
May & Sept	9,434	13,821	6,183	7,638	1,061	2,383	3,444	943	10,377	1,070	1,887	1237	4,194
30 days													
June-August	42,953	51,391	22,691	28,700	3,254	889	4,143	4,295	47,248	8,968	11,051	4538	24,557
92 days													
Total	52,387	65,212	28,874	**36,338**	4,315	3,272	**7,586**	5,239	57,626	10,039	12,938	5,775	**28,752**
Totals													
May & Sept	15,391	21,481	10,221	11,260	1,839	2,712	4,551	1,539	16,930	1,646	3,019	2,044	6,709
June-August	73,106	88,992	42,435	46,557	6,507	2,068	8,575	7,311	80,417	12,403	17,092	8,487	37,982
Total	88,497	110,473	52,656	**57,817**	8,346	4,780	**13,126**	8,850	97,347	14,049	20,111	10,531	**44,691**
Losses - Percentage of Total Losses					17.7%	10.1%				29.7%	42.5%		

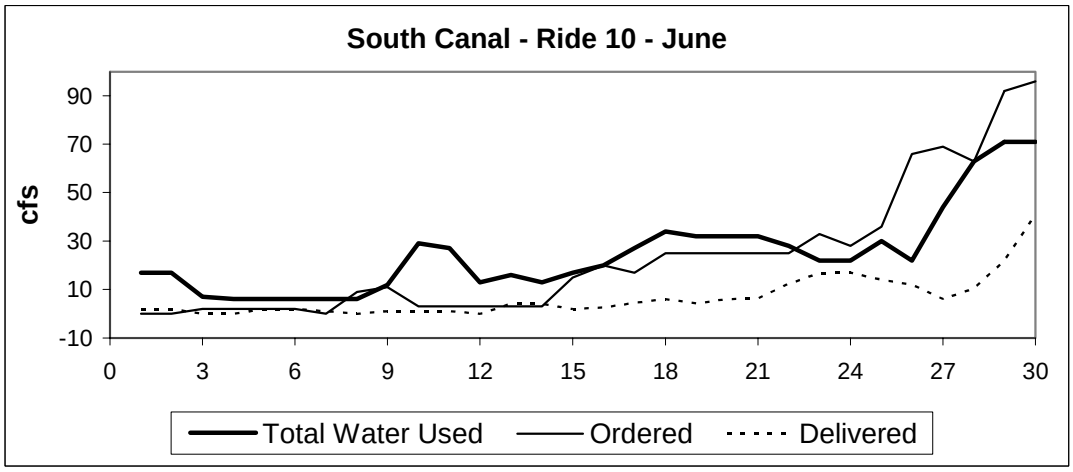
Note: The total volume delivered was corrected slightly after preparation of this table.
The volume shown in Appendix A.2 and A.3 tables (52,751 acre-ft) is the final volume of deliveries.

Appendix B.2
2004 Daily Water Distribution
South Canal Graphs

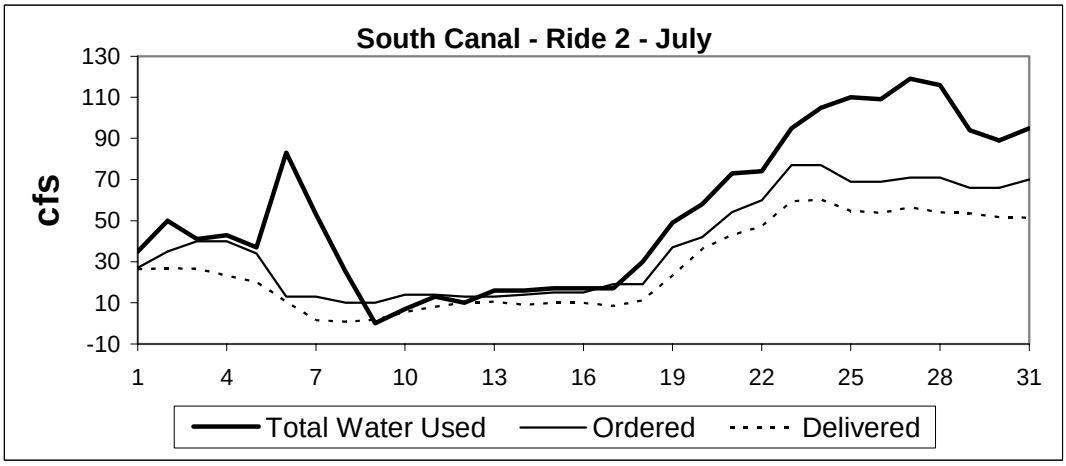


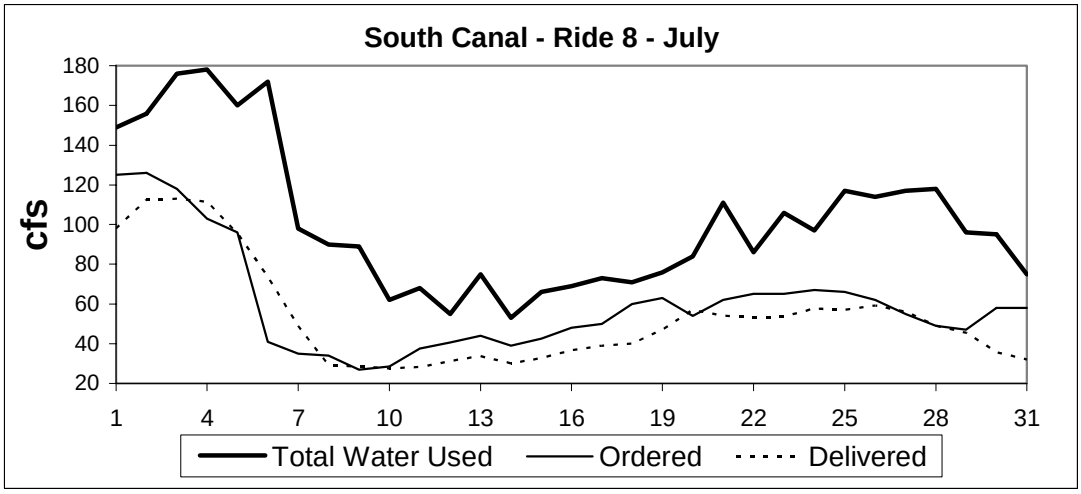
Note: Flume gauge problems caused data errors for Ride 2 from 6/10 to 6/30

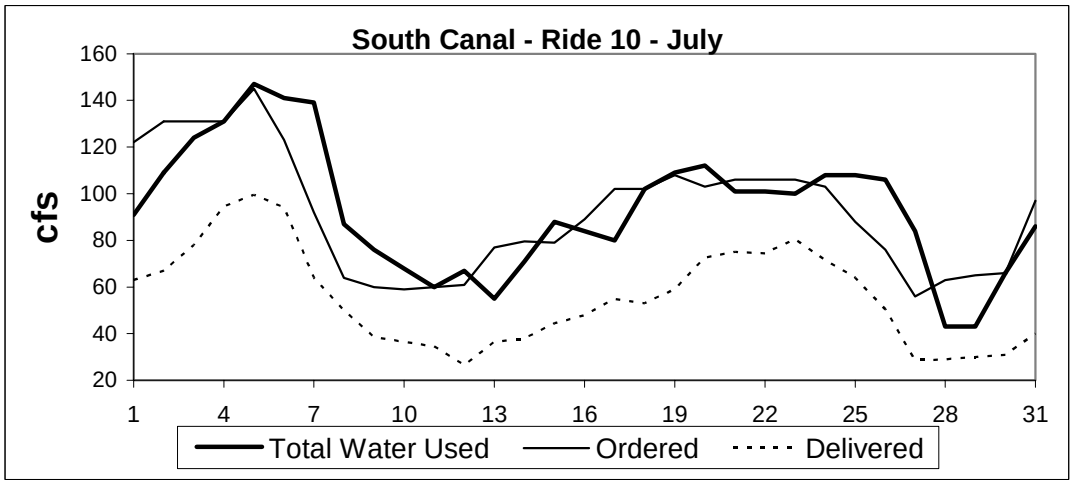




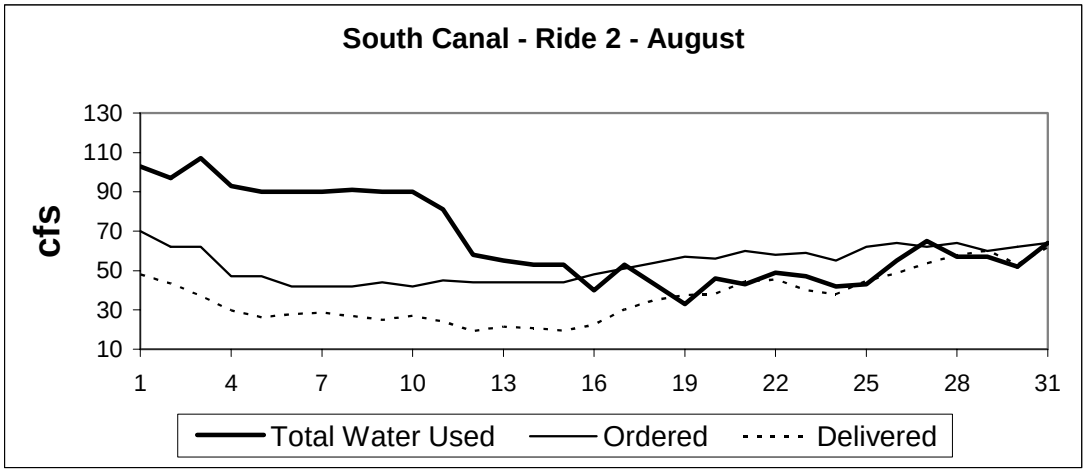
Appendix B.2
2004 Daily Water Distribution
South Canal Graphs

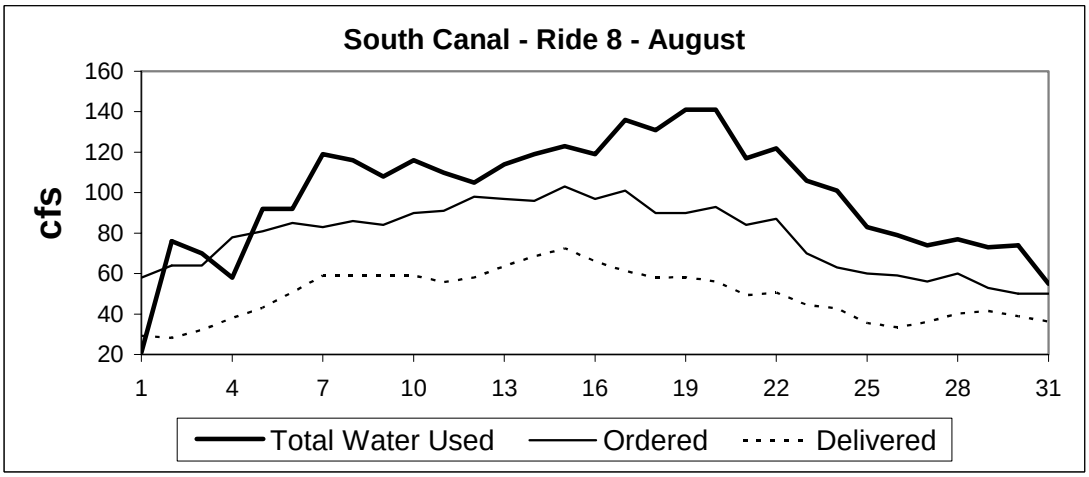


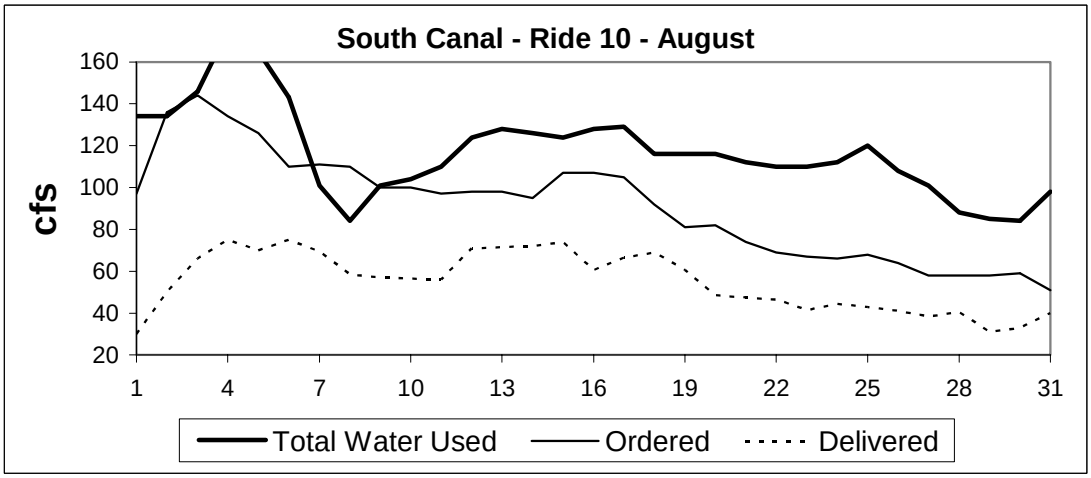




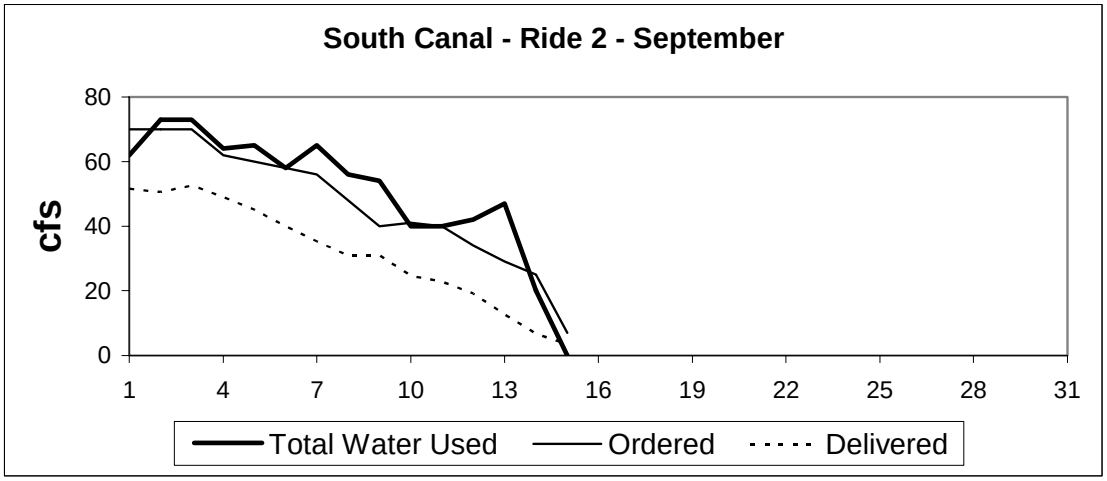
Appendix B.2
2004 Daily Water Distribution
South Canal Graphs

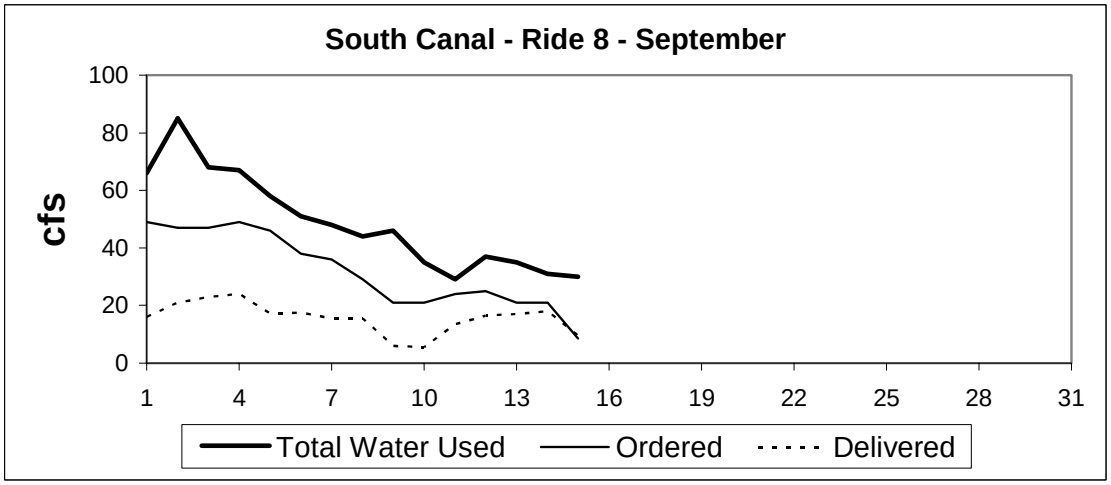


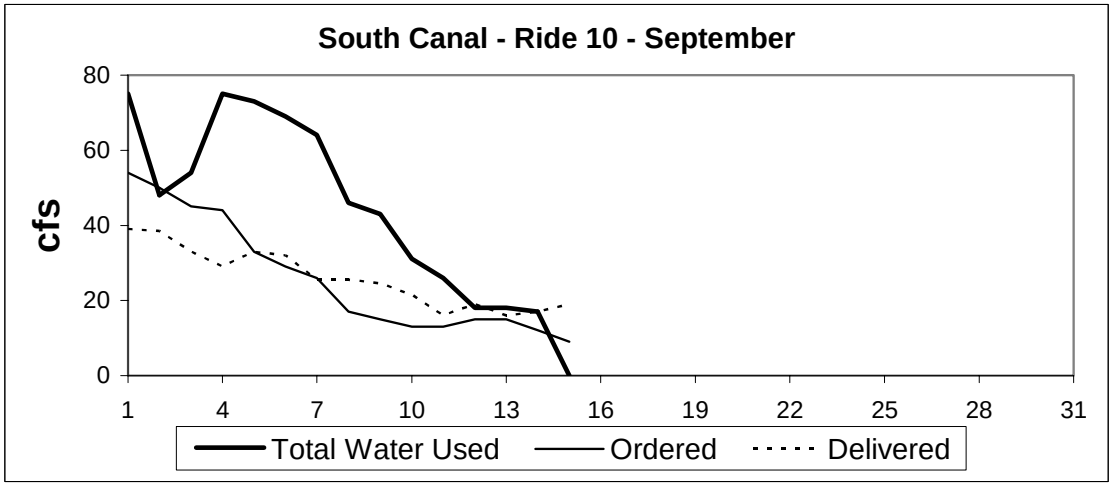




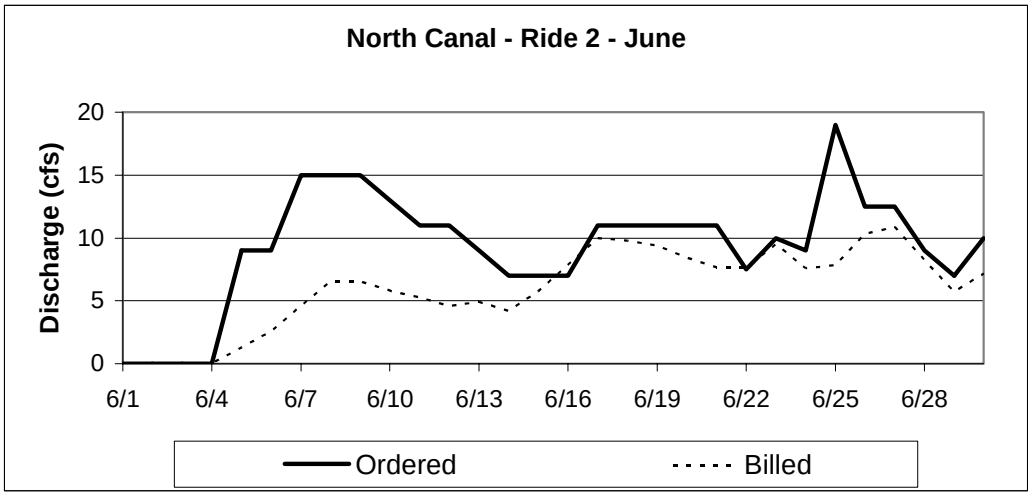
Appendix B.2
2004 Daily Water Distribution
South Canal Graphs

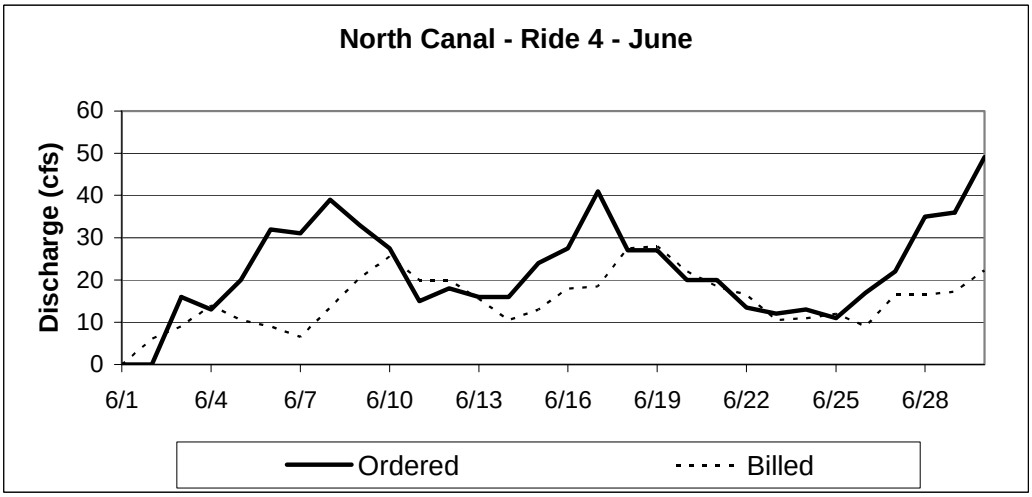


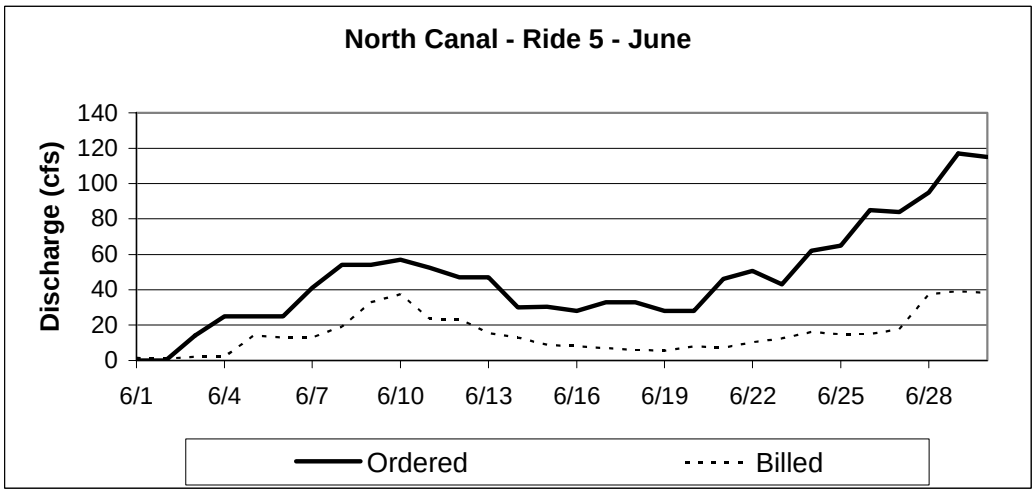




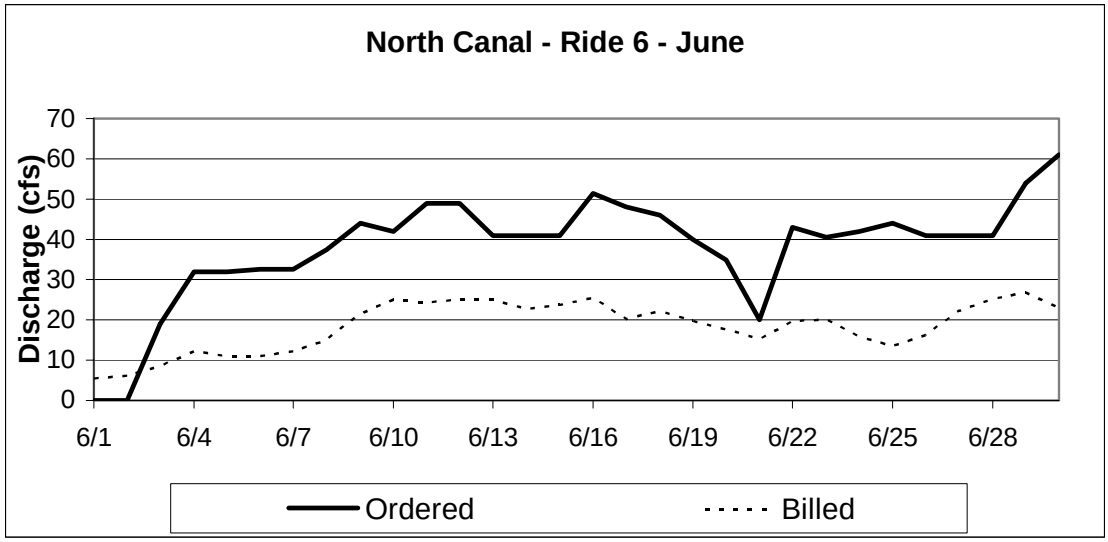
Appendix B.3
2004 Daily Water Distribution
North Canal Graphs

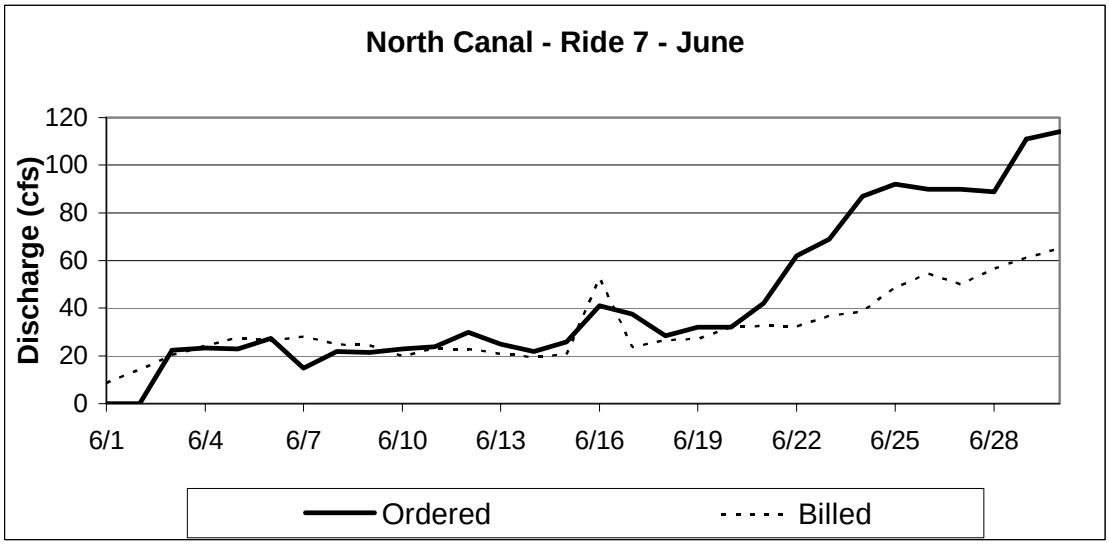




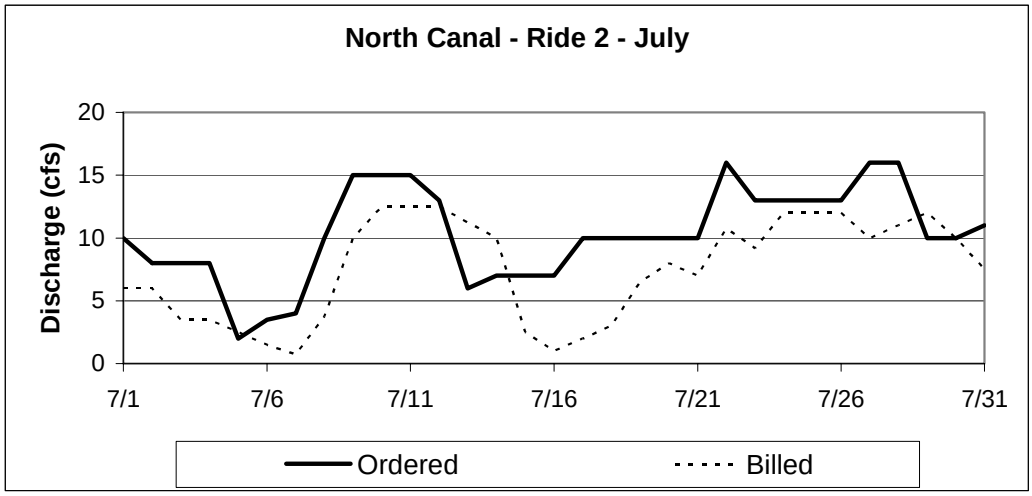


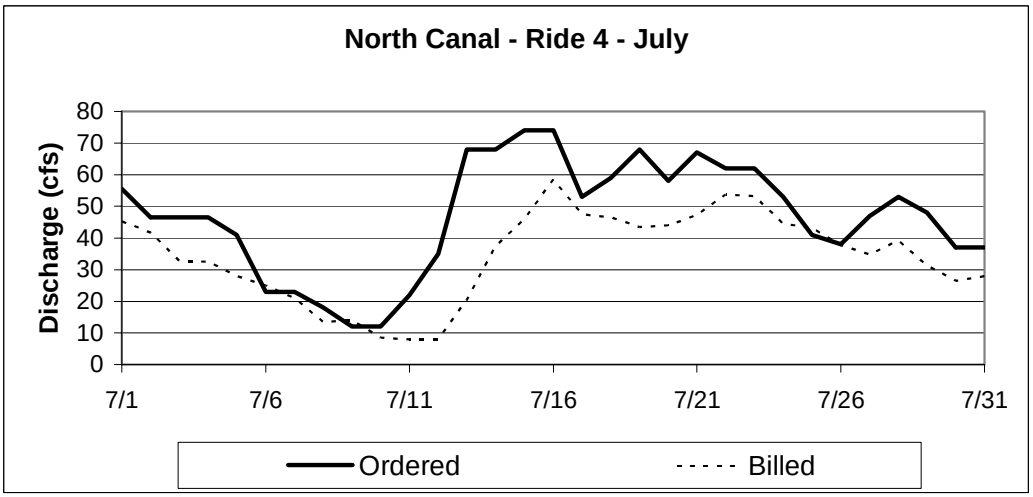
Appendix B.3
2004 Daily Water Distribution
North Canal Graphs

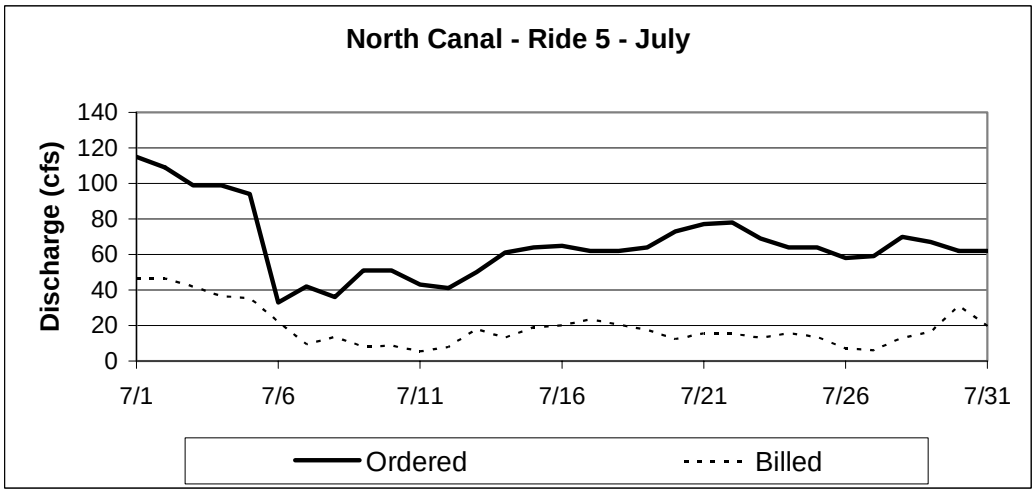




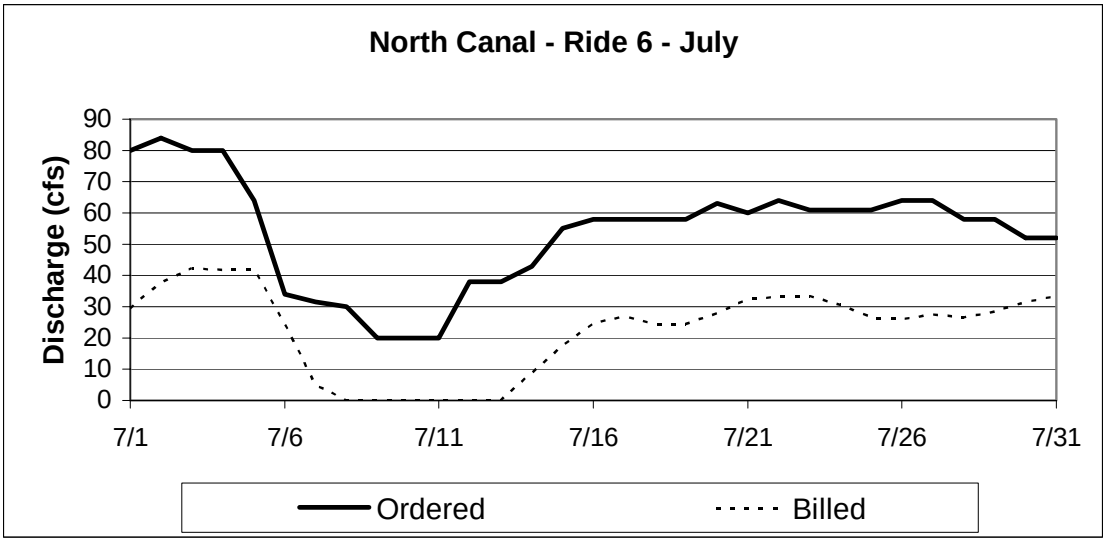
Appendix B.3
2004 Daily Water Distribution
North Canal Graphs

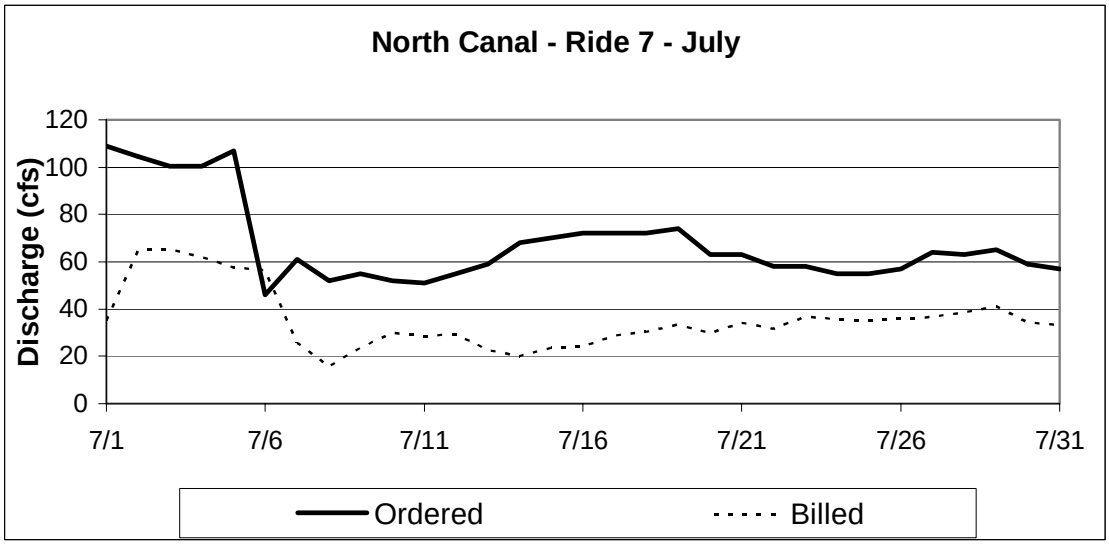




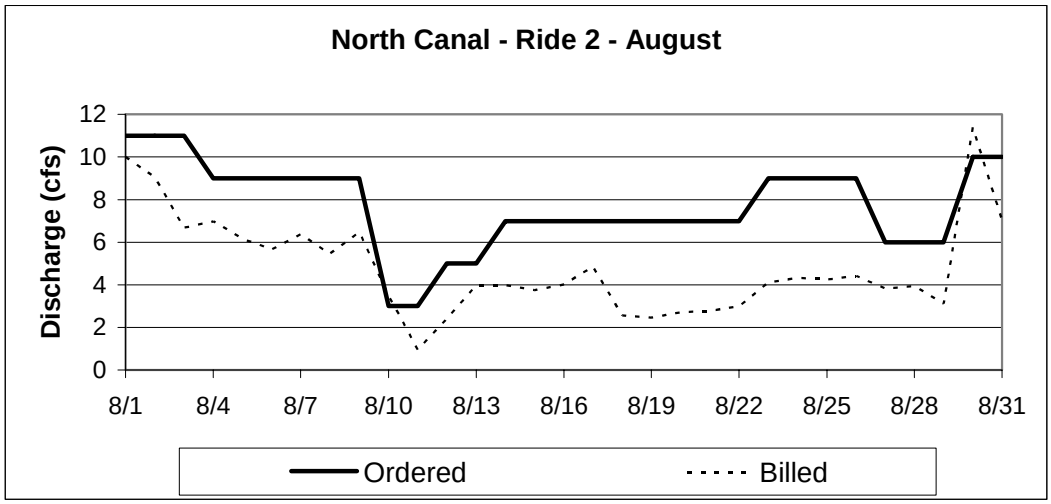


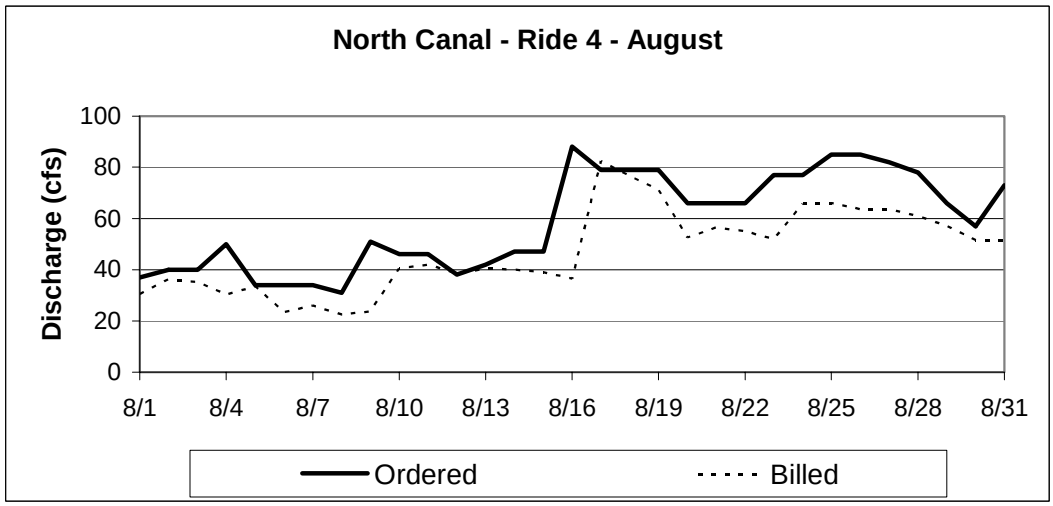
Appendix B.3
2004 Daily Water Distribution
North Canal Graphs

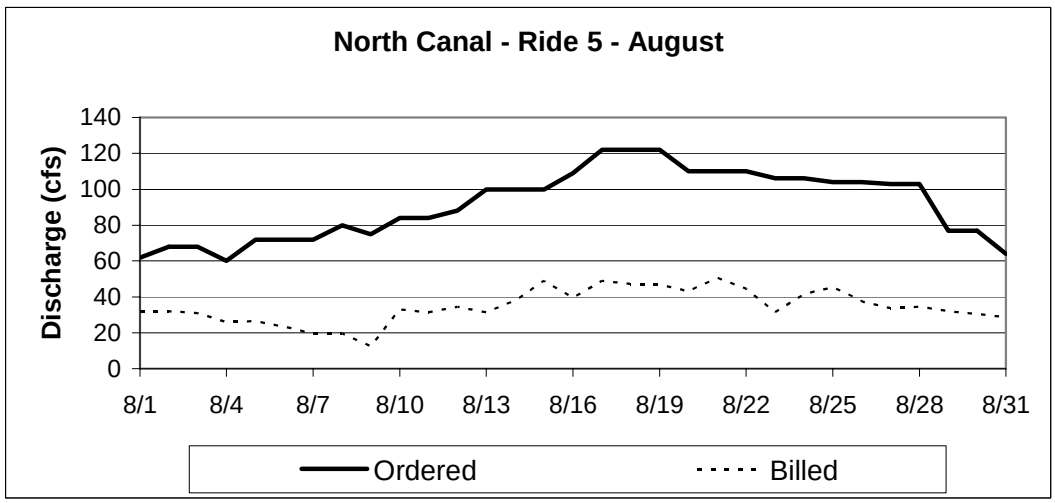




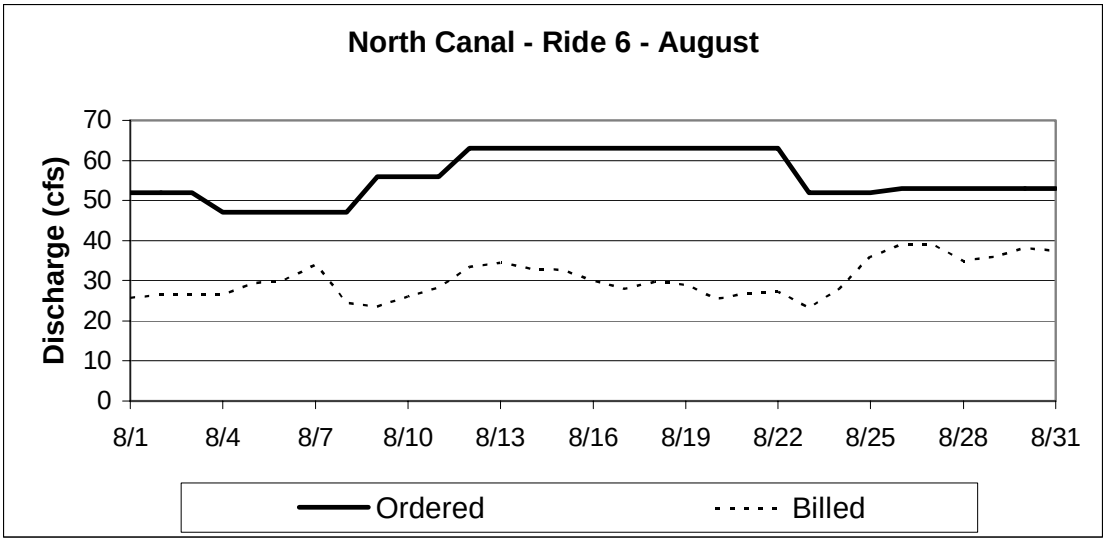
Appendix B.3
2004 Daily Water Distribution
North Canal Graphs

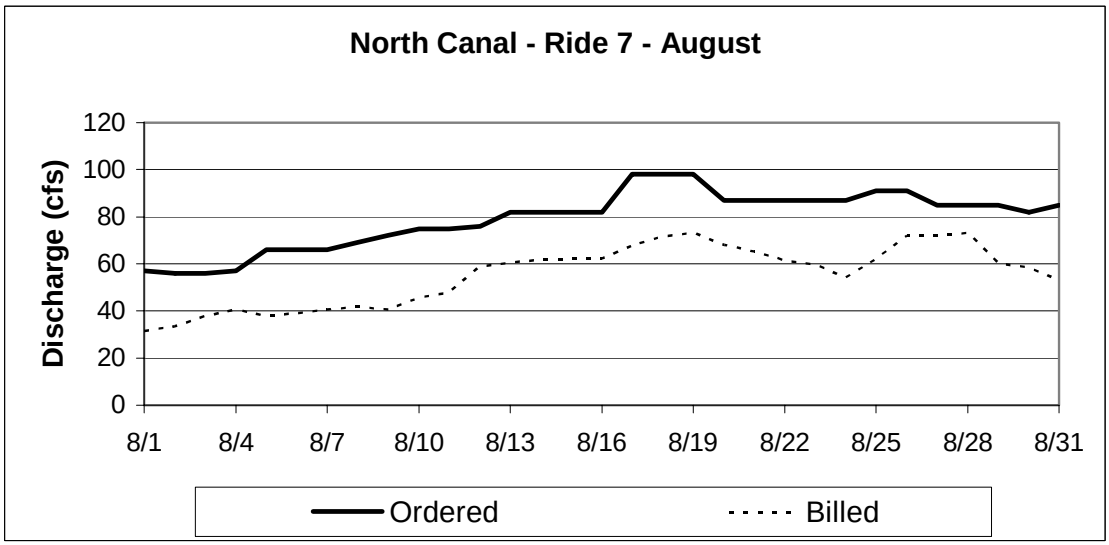






Appendix B.3
2004 Daily Water Distribution
North Canal Graphs

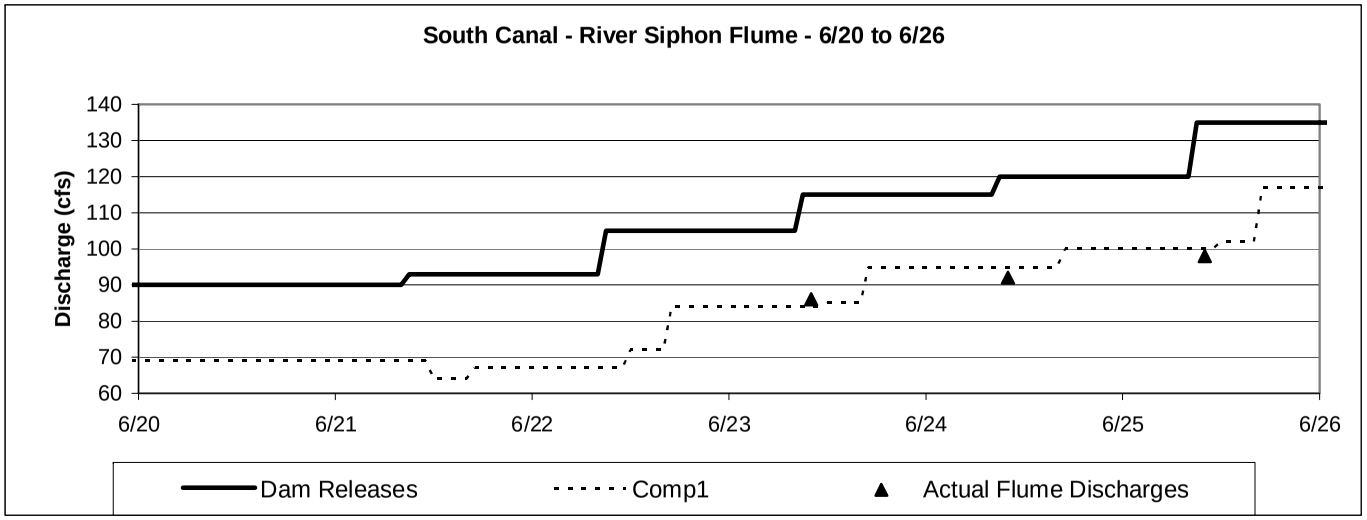


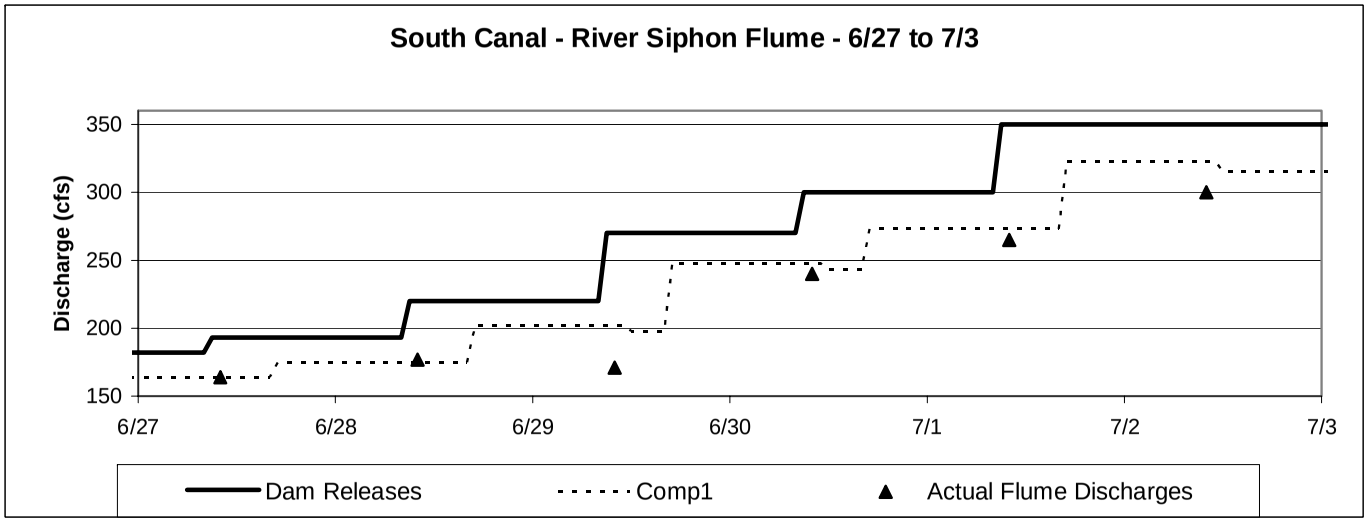


APPENDIX C

2004 NORTH AND SOUTH CANAL INVESTIGATIONS

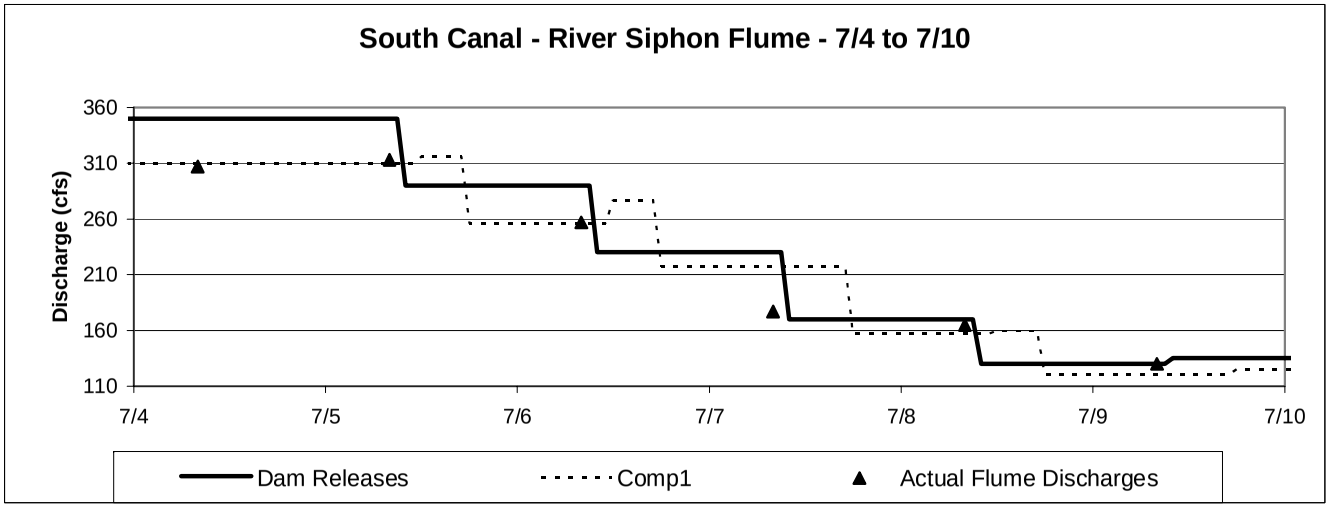
Appendix C.1
2004 South Canal Investigations
Flume Discharge Monitoring

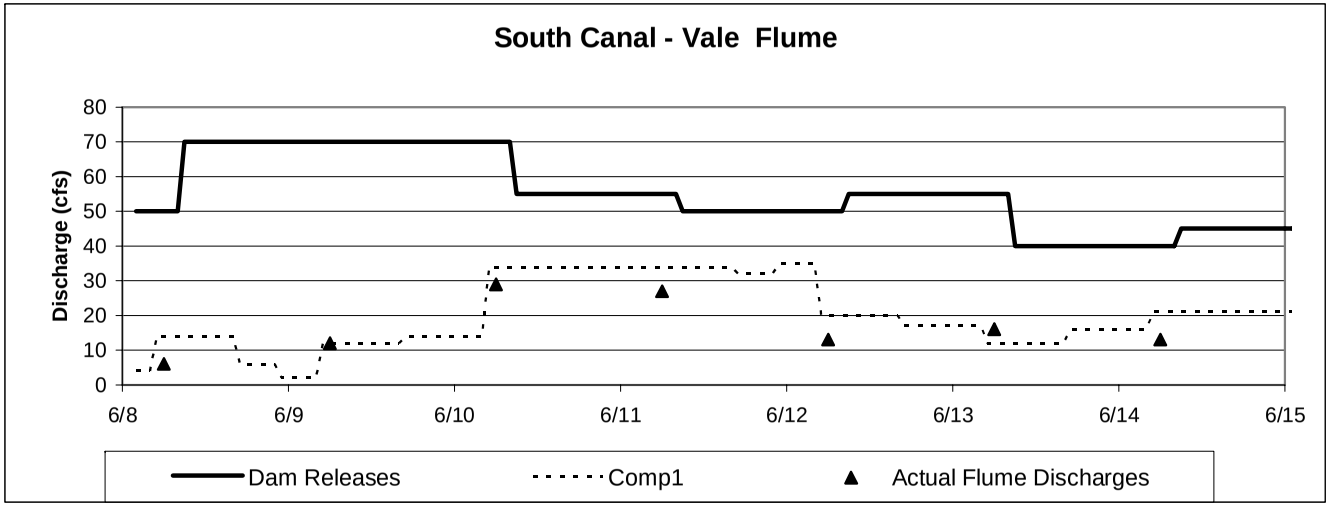




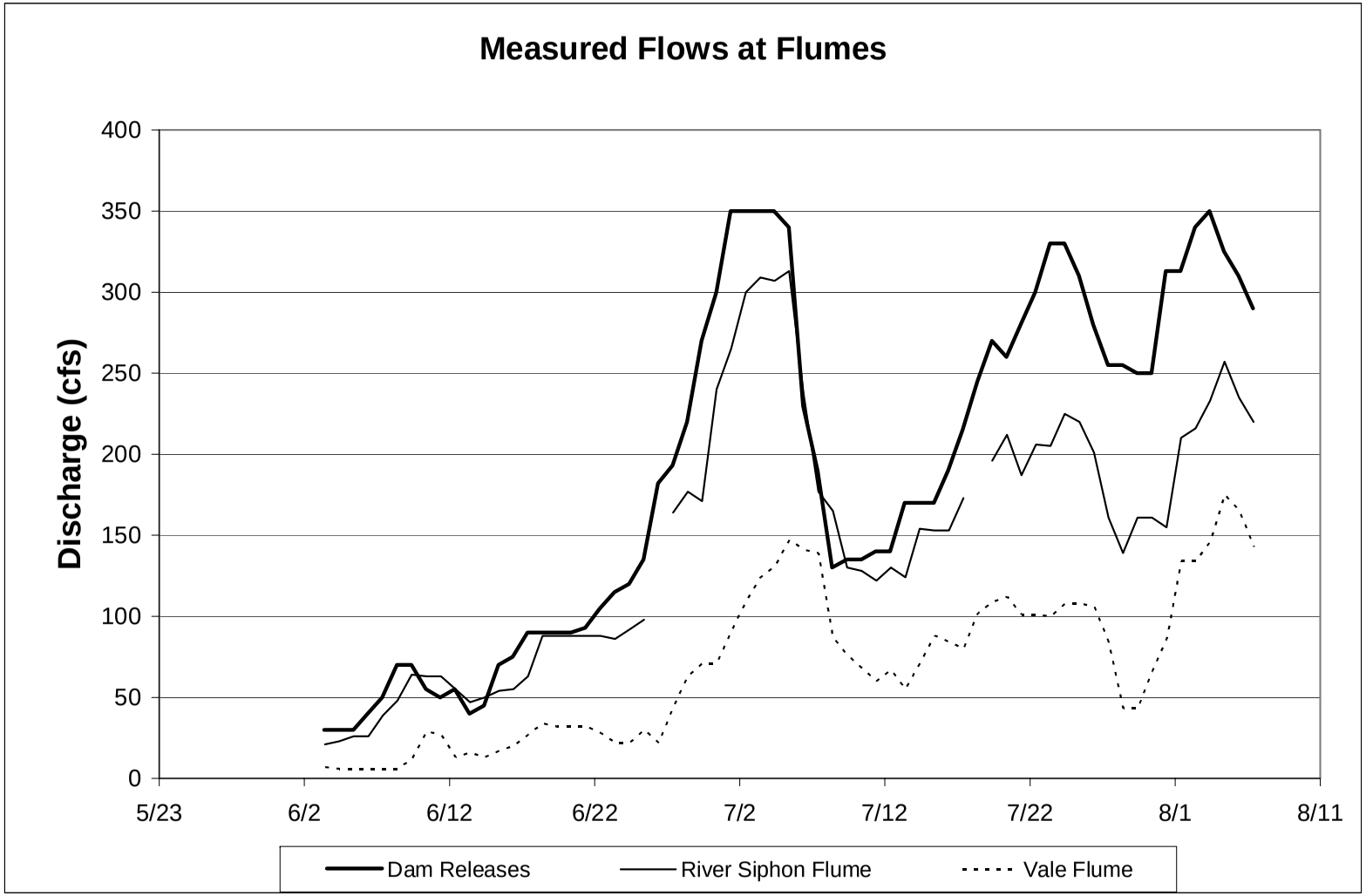
Comp1 Line is the computed discharge for the River Siphon Flume using Dam Releases - Ride 2 Orders

Appendix C.1
2004 South Canal Investigations
Flume Discharge Monitoring





Appendix C.2
2004 South Canal Investigations
Average Daily Flume Discharges



Appendix C.3
2004 South Canal Investigations
Flume Discharge Computations

	Measured Discharges at Flumes				Computations River Siphon				Computations Vale Flume					Computations End of South Canal			
	Dam	River Siphon	Vale Flume		Ave Q	Ave V	**Travel Time**		Ave Q	Ave V	Incr. Travel Time	**Total Travel Time**		Ave Q	Ave V	Incr. Travel Time	**Total Travel Time**
	(cfs)	(cfs)	(cfs)		(cfs)	(fps)	**(hrs)**		(cfs)	(fps)	(hrs)	**(hrs)**		(cfs)	(fps)	(hrs)	**(hrs)**
Monthly Averages																	
June	100	80	26		90	1.78	**6.6**		53	1	27	**33.6**		13	0.67	37.7	**71.3**
July	248	192	93		220	2.37	**4.9**		143	1.32	20.6	**25.5**		47	0.98	25.9	**51.4**
August	321	229	150		275	2.53	**4.6**		189	1.41	19.2	**23.8**		75	1.11	22.8	**46.6**
Weekly Averages																	
6/6-6/12	56	51	14		53	1.48	**7.9**		33	0.87	31.2	**39.1**		7	0.55	46.2	**85.3**
6/13-6/19	71	64	23		68	1.63	**7.1**		43	0.95	28.6	**35.7**		11	0.65	39.2	**74.9**
6/20-6/26	120	90	27		105	1.86	**6.2**		58	1.02	26.6	**32.8**		13	0.67	37.7	**70.5**
6/27-7/3	290	232	82		261	2.47	**4.7**		157	1.35	20.1	**24.8**		41	0.94	26.9	**51.7**
7/4-7/10	216	208	113		212	2.33	**5.0**		160	1.36	19.9	**24.9**		56	1.03	24.6	**49.5**
7/11-7/17	171	144	72		157	2.11	**5.5**		108	1.22	22.3	**27.8**		36	0.91	27.9	**55.7**
7/18-7/24	288	205	105		247	2.43	**4.8**		155	1.35	20.1	**24.9**		52	1.01	25	**49.9**
7/25-7/31	273	171	77		222	2.37	**4.9**		124	1.26	22.3	**21.5**		38	0.93	27.4	**48.9**
8/1-8/7																	

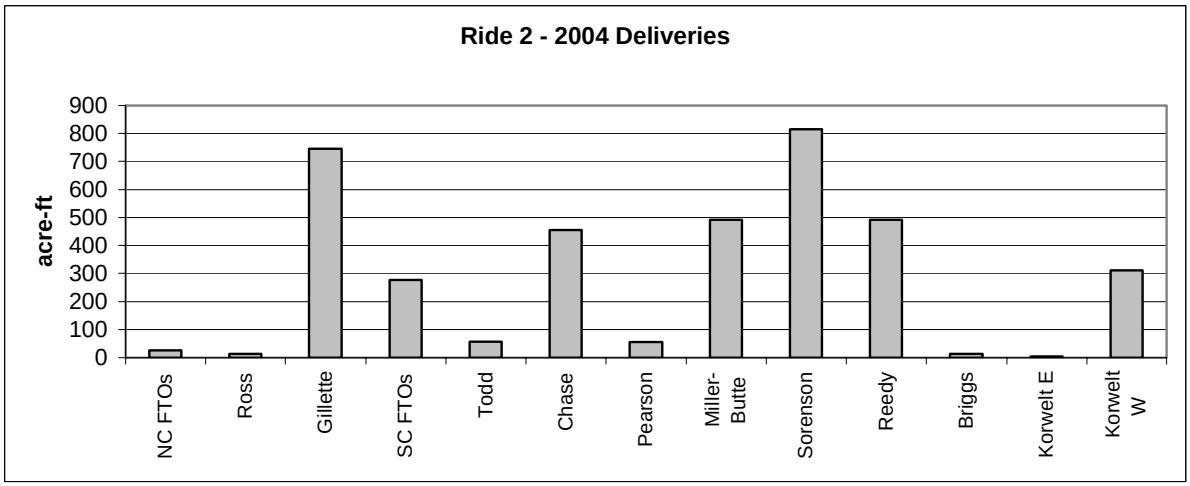
APPENDIX D

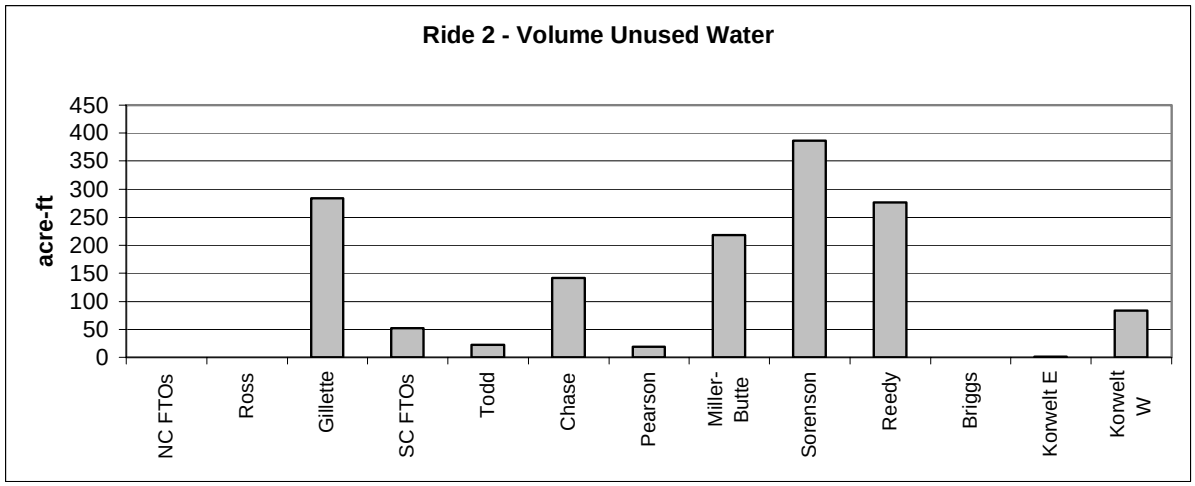
2004 LATERAL INVESTIGATIONS

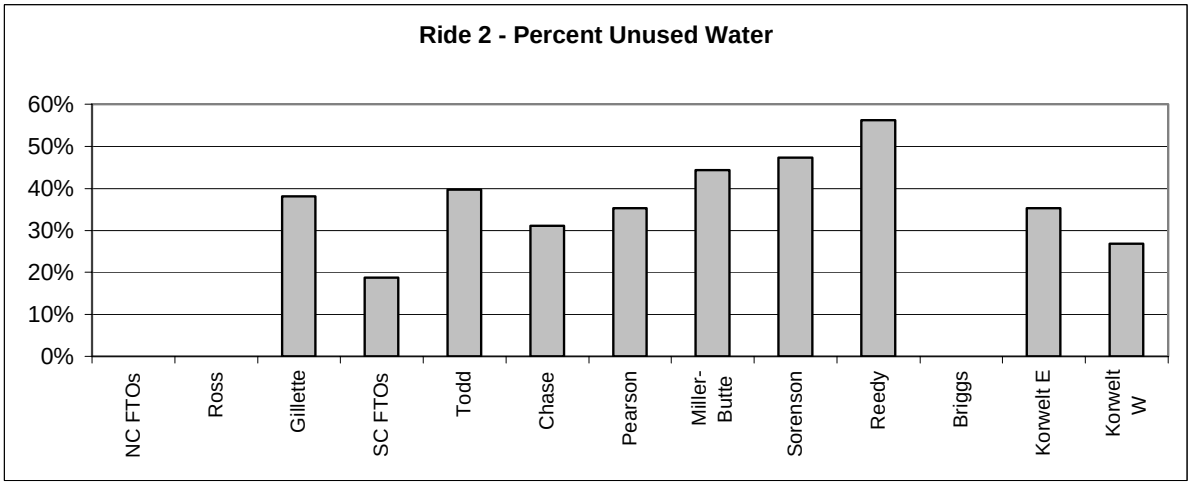
Appendix D.1
Deliveries and Unused Water, by Lateral
Rides 2 and 8

	Water Cards															
	NC FTOs	Ross	Gillette	SC FTOs	Todd	Chase	Pearson	Miller-Butte	Sorenson	Reedy	Briggs	Korwelt E	Korwelt W	TOTAL	Water Master Sheets	Difference from Water Cards
All figures are in cfs unless otherwise noted																
Ride 2																
Call Cards																
Deliveries	23	8	779	266	55	390	50	446	788	510	9	5	309	3636		
Waste	0	0	249	65	24	207	24	262	415	258	1	1	87	1594		
Total Ordered	23	8	1028	330	80	597	73	708	1202	769	10	6	396	5230	5416	186
														acre-ft	10832	373
Billed	26	12	744	278	57	456	54	490	816	492	12	4	312	3749		
Computed Waste	0	0	284	52	23	142	19	218	386	276	0	2	84	1480		
Percent Waste	0%	0%	38%	19%	40%	31%	35%	44%	47%	56%	0%	35%	27%	39%		
	South Canal	12.5	Jenks	Butte Hall	Hewitt	Ash	Alice	Shaw/Baldwin	Beals	Meyers	Hampton	Ashley	Vale	TOTAL	Water Master Sheets	Difference from Water Cards
Ride 8																
Total for Season																
Call Cards																
Deliveries	1351	12	204	225	85	0	145	1469	551	184	60	45	769	5100		
Waste	749	0	0	0	0	0	2	111	67	42	9	0	83	1061		
Total Ordered	2099	12	204	225	85	0	147	1580	618	226	69	45	852	6158	6351	193
														acre-ft	12702	386
Billed	1256	11	184	199	81	0	136	1355	504	172	55	41	569	4562		
Computed Waste	843	1	20	26	4	0	10	225	114	54	13	4	282	1596		
Percent Waste	67%	7%	11%	13%	4%	0%	7%	17%	23%	31%	0%	11%	50%	35%		

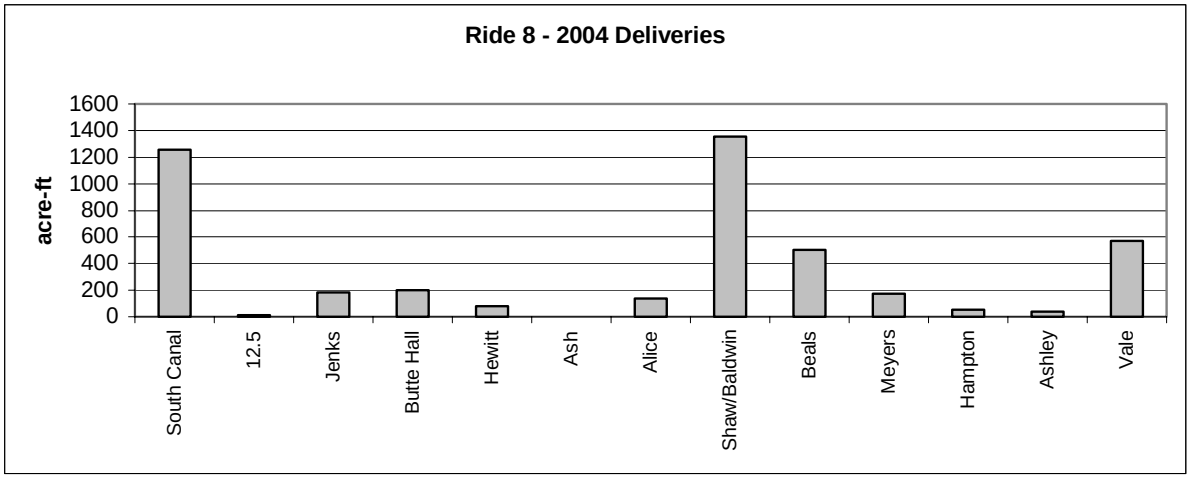
Appendix D.2
Deliveries and Unused Water, by Lateral
Ride 2

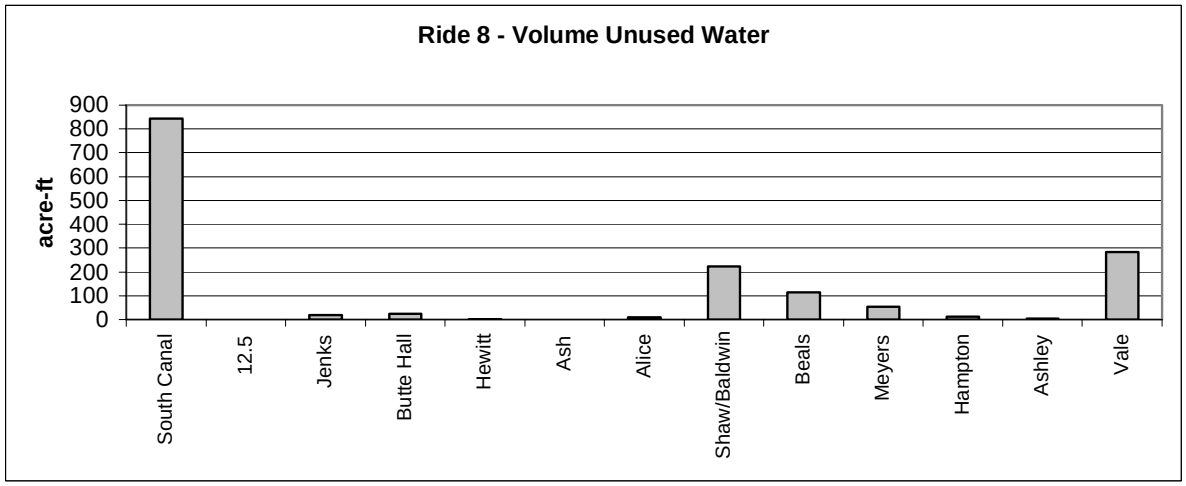


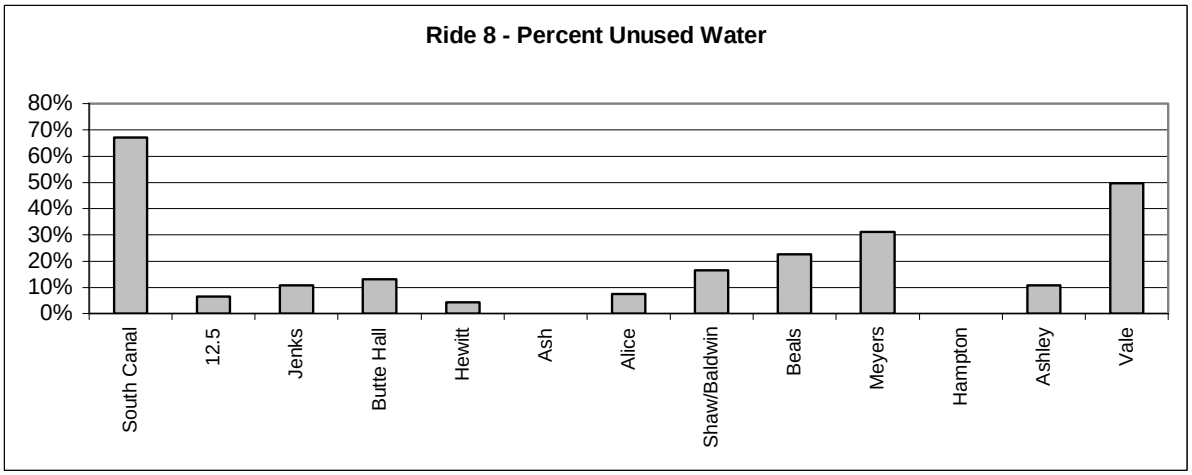




Appendix D.3
Deliveries and Unused Water, by Lateral
Ride 8







Appendix D.4
Summary of Water Card Data
Ride 2

All figures are in cfs unless otherwise noted

	Water Cards																Water Master Sheets		
	NC FTOs	Ross	Gillette	SC FTOs	Todd	Chase	Pearson	Miller-Butte	Sorenson	Reedy	Briggs	Korwelt E	Korwelt W	NC Total	SC Total	TOTAL	NC	SC	Total
May																			
Call Cards																			
Deliveries	0	0	38	15	0	8	0	17	22	54	0	0	15	38	131	169			
Waste	0	0	17	0	2	0	0	10	10	16	0	0	0	17	38	55			
Total Ordered	0	0	55	15	2	8	0	27	32	70	0	0	15	55	169	**224**	70	247	**317**
Billed	0	0	34	12	0	37	0	40	35	33	0	0	12	29	170	198			
Computed Waste	0	0	21	3	2	-29	0	-13	-3	37	0	0	3	26	-1	26			
June																			
Call Cards																			
Deliveries	4	8	205	28	2	50	6	31	28	9	5	0	12	217	170	386			
Waste	0	0	59	0	4	39	0	64	77	53	0	0	0	59	236	295			
Total Ordered	4	8	264	28	6	89	6	95	104	61	5	0	12	276	406	**681**	280	482	**762**
Billed	7	12	213	46	3	82	10	51	45	14	7	0	20	356	279	511			
Computed Waste	-3	-5	51	-18	3	7	-4	44	59	47	-3	0	-8	-81	126	170			
July																			
Call Cards																			
Deliveries	0	0	229	109	15	82	7	125	288	190	0	3	119	229	937	1166			
Waste	0	0	59	7	1	33	0	54	81	65	0	0	6	59	247	306			
Total Ordered	0	0	288	116	16	115	7	179	369	255	0	3	125	288	1172	**1471**	320	1187	**1507**
Billed	0	0	216	102	14	77	6	118	272	179	0	2	112	216	883	1099			
Computed Waste	0	0	71	14	2	37	0	62	97	76	0	0	13	72	289	372			
August																			
Call Cards																			
Deliveries	19	0	138	79	20	164	33	162	330	165	5	2	128	156	1086	1242			
Waste	0	0	70	39	9	88	21	82	175	78	1	1	64	70	560	630			
Total Ordered	19	0	208	118	29	252	54	244	505	243	6	3	191	226	1646	**1872**	240	1657	**1897**
Billed	19	0	151	81	20	169	34	166	339	170	5	2	131	160	1116	1286			
Computed Waste	-1	0	57	37	9	83	20	78	166	74	1	1	60	66	530	586			

Appendix D.4
Summary of Water Card Data
Ride 2

	Water Cards																Water Master Sheets		
	NC FTOs	Ross	Gillette	SC FTOs	Todd	Chase	Pearson	Miller-Butte	Sorenson	Reedy	Briggs	Korwelt E	Korwelt W	NC Total	SC Total	TOTAL	NC	SC	Total
September																			
Call Cards																			
Deliveries	0	0	170	35	19	86	4	111	120	93	0	0	36	170	504	674			
Waste	0	0	45	18	8	47	2	52	72	47	0	0	17	45	264	308			
Total Ordered	0	0	214	53	27	134	6	162	193	140	0	0	53	214	768	982	223	710	**933**
Billed	0	0	130	36	20	90	4	115	125	97	0	0	38	165	490	655			
Computed Waste	0	0	84	17	7	44	2	47	67	43	0	0	15	49	277	327			
Total for Season																			
Call Cards																			
Deliveries	23	8	779	266	55	390	50	446	788	510	9	5	309	809	2827	3636			
Waste	0	0	249	65	24	207	24	262	415	258	1	1	87	249	1345	1594			
Total Ordered	23	8	1028	330	80	597	73	708	1202	769	10	6	396	1058	4160	5230	**1,133**	**4,283**	**5,416**
																acre-ft	**2,266**	**8,566**	**10,832**
Billed	26	12	744	278	57	456	54	490	816	492	12	4	312	926	2937	3749			
Computed Waste	-3	-5	284	52	23	142	19	218	386	276	-2	2	84	132	1222	1480			
Percent Waste	0.0%	0.0%	38%	19%	40%	31%	35%	44%	47%	56%	0%	35%	27%	14%	42%	39%			

Note: For the months of August & September, the total South Canal Waste was noted on the Water Card, but it was not distributed among the laterals. Therefore, the waste was proportioned among the laterals based on the orders.

Appendix D.5
Summary of Water Card Data
Ride 8

All figures are in cfs unless otherwise noted

	Water Cards														
	South Canal	12.5	Jenks	Butte Hall	Hewitt	Ash	Alice	Shaw/Baldwin	Beals	Meyers	Hampton	Ashley	Vale	TOTAL	Water Master Sheet
May															
Call Cards															
Deliveries	122	0	28	47	0	0	30	119	45	25	4	0	13	432	
Waste	0	0	0	0	0	0	1	26	14	2	0	0	4	46	
Total Ordered	122	0	28	47	0	0	31	145	59	27	4	0	17	**478**	**489**
Billed	120	0	27	46	0	0	29	117	44	24	4	0	9	419	
Computed Waste	2	0	1	1	0	0	2	28	15	2	0	0	8	59	
June															
Call Cards															
Deliveries	232	0	57	83	0	0	12	284	135	26	14	11	108	960	
Waste	4	0	0	0	0	0	1	33	10	1	0	0	14	61	
Total Ordered	236	0	57	83	0	0	13	317	144	27	14	11	122	**1021**	**1088**
Billed	177	0	43	63	0	0	9	217	103	20	11	8	64	715	
Computed Waste	58	0	13	19	0	0	4	100	41	7	3	2	57	306	
July															
Call Cards															
Deliveries	532	0	35	11	31	0	34	479	168	67	23	7	380	1767	
Waste	40	0	0	0	0	0	0	20	8	14	3	0	19	103	
Total Ordered	572	0	35	11	31	0	34	499	175	81	26	7	399	**1867**	**1866**
Billed	519	0	34	11	30	0	33	467	164	65	22	7	312	1664	
Computed Waste	53	0	1	0	1	0	1	31	11	16	3	0	86	203	
August															
Call Cards															
Deliveries	393	12	81	85	44	0	61	523	163	64	12	28	236	1700	
Waste	565	0	0	0	0	0	0	23	24	24	1	0	34	671	
Total Ordered	958	12	81	85	44	0	61	546	187	88	12	28	270	**2371**	**2421**
Billed	368	11	76	80	41	0	57	490	152	60	11	26	152	1524	
Computed Waste	590	1	5	5	3	0	4	56	34	28	1	2	118	846	

Appendix D.5
Summary of Water Card Data
Ride 8

	South Canal	12.5	Jenks	Butte Hall	Hewitt	Ash	Alice	Shaw/Baldwin	Beals	Meyers	Hampton	Ashley	Vale	TOTAL	Water Master Sheet
September															
Call Cards															
Deliveries	72	0	4	0	10	0	8	64	42	2	8	0	32	242	
Waste	140	0	0	0	0	0	0	10	12	1	6	0	13	181	
Total Ordered	212	0	4	0	10	0	8	74	54	3	13	0	45	**422**	**487**
Billed	72	0	4	0	10	0	8	64	42	2	7	0	32	240	
Computed Waste	140	0	0	0	0	0	0	10	12	1	6	0	13	182	
Total for Season															
Call Cards															
Deliveries	1351	12	204	225	85	0	145	1469	551	184	60	45	769	5100	0
Waste	749	0	0	0	0	0	2	111	67	42	9	0	83	1061	0
Total Ordered	2099	12	204	225	85	0	147	1580	618	226	69	45	852	6158	6351
														acre-ft	**12,702**
Billed	1256	11	184	199	81	0	136	1355	504	172	55	41	569	4562	
Computed Waste	843	1	20	26	4	0	10	225	114	54	13	4	282	1596	
Percent Waste	67%	7%	11%	13%	4%	0%	7%	17%	23%	31%	0%	11%	50%	35%	

Appendix D.6
Summary of Losses
Gillette Lateral

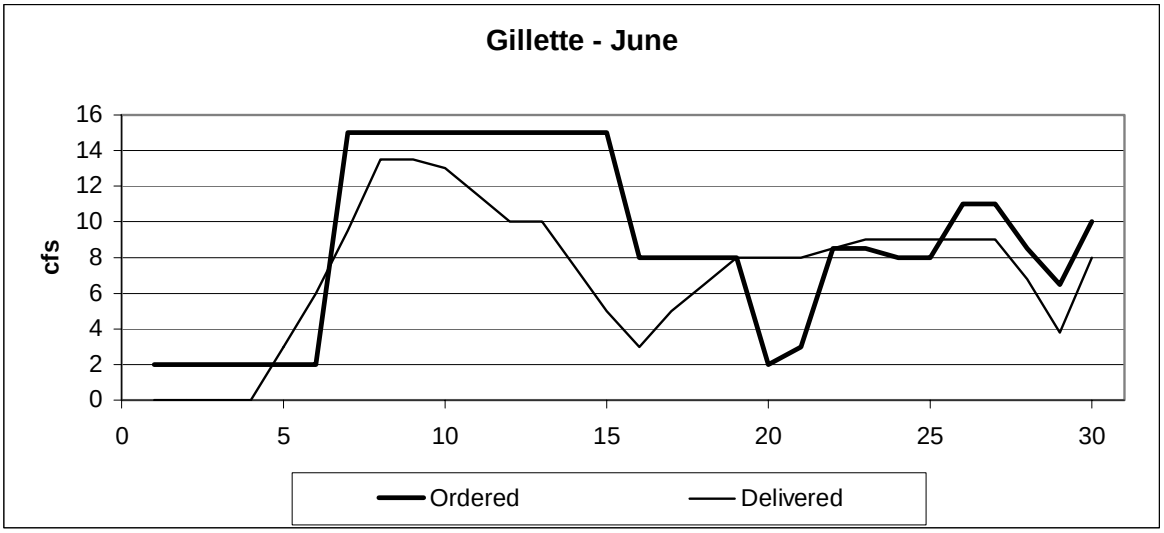
Dates	Computed Total Losses (M1)		Computed Total Losses (M2)		Measured Operational Losses		Computed Evaporation/Seepage	
	Vol	Ave. Daily	Vol	Ave. Daily	Vol	Ave. Daily	Vol	Ave. Daily
	(af)	(cfs)	(af)	(cfs)	(af)	(cfs)	(af)	(cfs)
6/1-6/30	102	1.6						
7/1-7/31	130	2.1						
7/13-7/19	53	3.8			14	1.0	38	2.7
7/26-7/31	39	3.3	71	5.9				
8/1-8/31	114	1.8	214	3.4				
8/12-8/25	**75**	**2.7**	**106**	**3.8**	**49**	**1.7**	**57**	**2.0**
7/26-8/31	153	2.1	284	3.8				
7/13-7/19 & 8/12-8/25	128	3.0			63	1.5	95	2.3
Total - June to September	515	2.3						

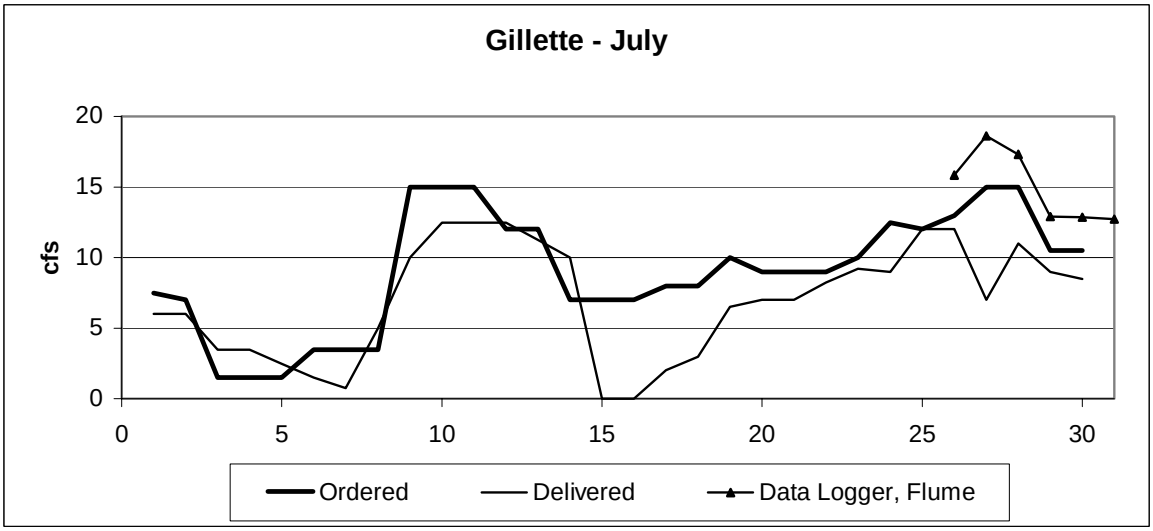
Notes:
(1) Computed M1: the computed volume of unused water, based on Ditch Rider Orders minus Deliveries
(2) Computed M2: the computed volume of unused water, based on measured discharges in the Parshall Flume minus Deliveries
(3) Measured: Actual discharges measured at the last Check Structure on the Gillette (CS7) using a data logger. This water represents the Operational Losses for the Gillette
(4) Evap/Seepage: Computed minus Measured

Appendix D.7
Logger Data
Gillette Lateral

Comparisons: Ditch Rider Orders to Water Delivered & Billed
to Discharges Measured in the Parshall Flume, using a Data Logger

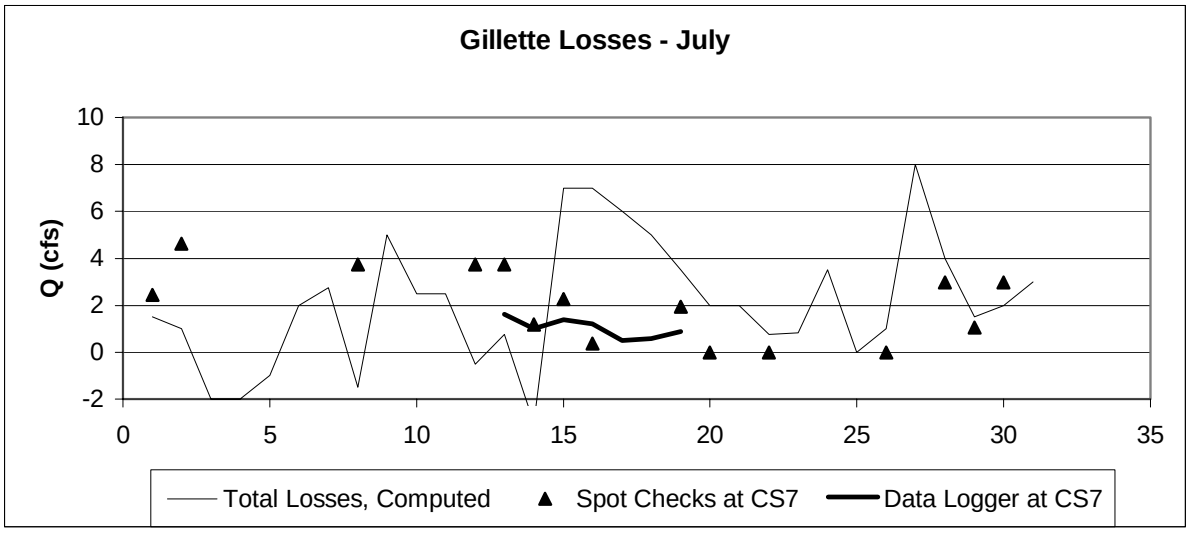
Note: The data logger recorded water depth in the flume every 15 minutes. These depths were converted to discharges based on a stage-discharge curve developed from numerous manual measurements taken in the flume during the 2004 season, using a Pygmy velocity meter. The average daily discharges are shown on the graphs.

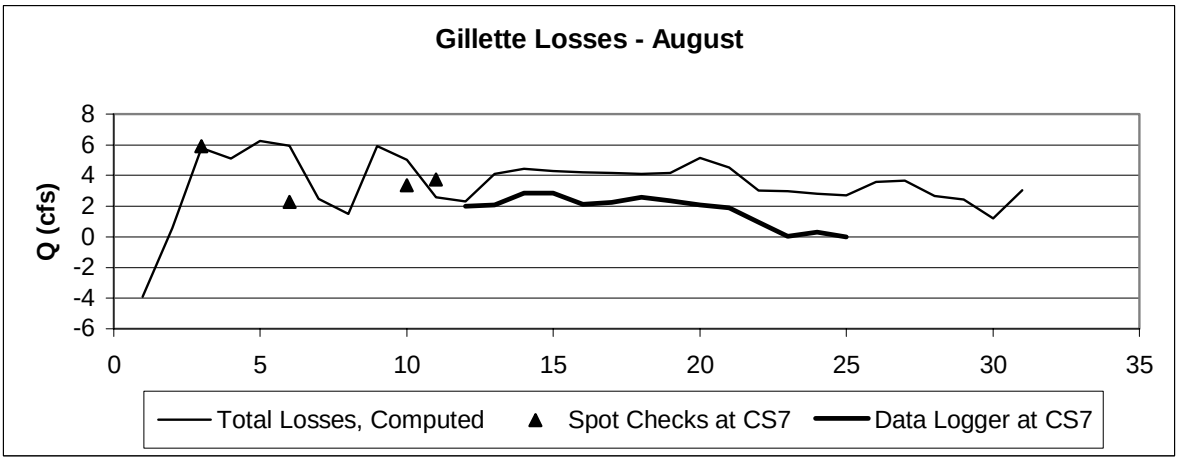




Appendix D.8
Operational Losses
Gillette Lateral

Operational Losses for Gillette Lateral





Notes:

(1) "Computed" lines show the total losses, or unused water, on the Gillette based on the volume of water entering the Gillette minus deliveries to farmers. For July, the Ditch Rider orders are used for the Computed line; for August, the actual discharges measured in the Parshall Flume are used.

(2) Spot Checks are manual measurements of the instantaneous discharge at CS7, based on the head over the weir.

(3) The Data Logger recorded depths in the weir pool every 10 minutes. These depths were converted to discharges using the Contracted Rectangular Weir discharge equation, with a weir coefficient of 2.6, which was developed based on several flow measurements taken in the channel just downstream of the weir, using a Pygmy velocity meter. Also used for development of the coefficient were comparisons of numerous measurements taken at each of the flow measurement devices on the Gillette on the same days.

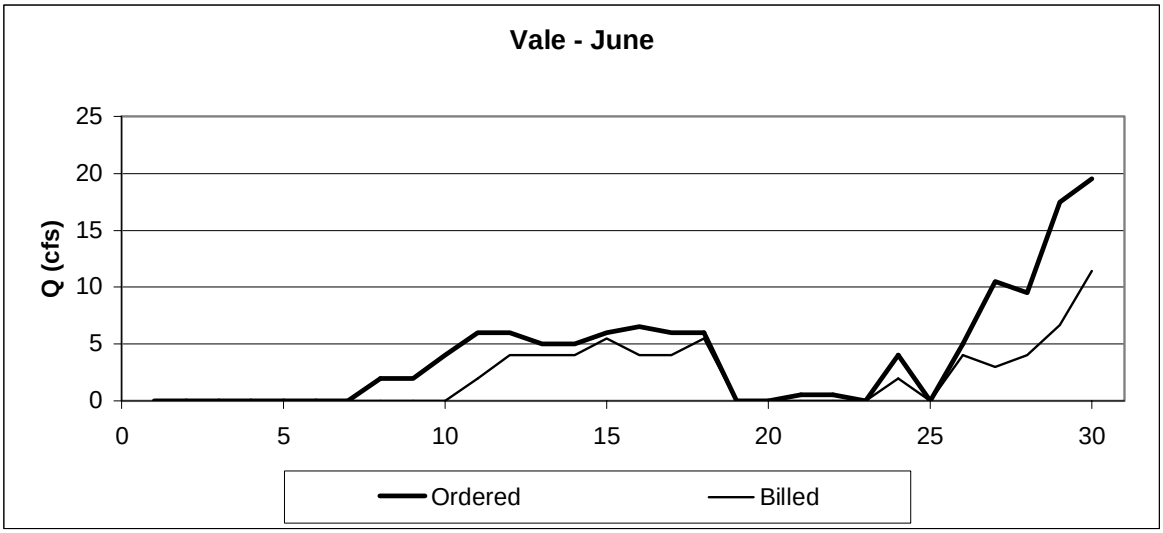
Appendix D.9
Summary of Losses
Vale Lateral

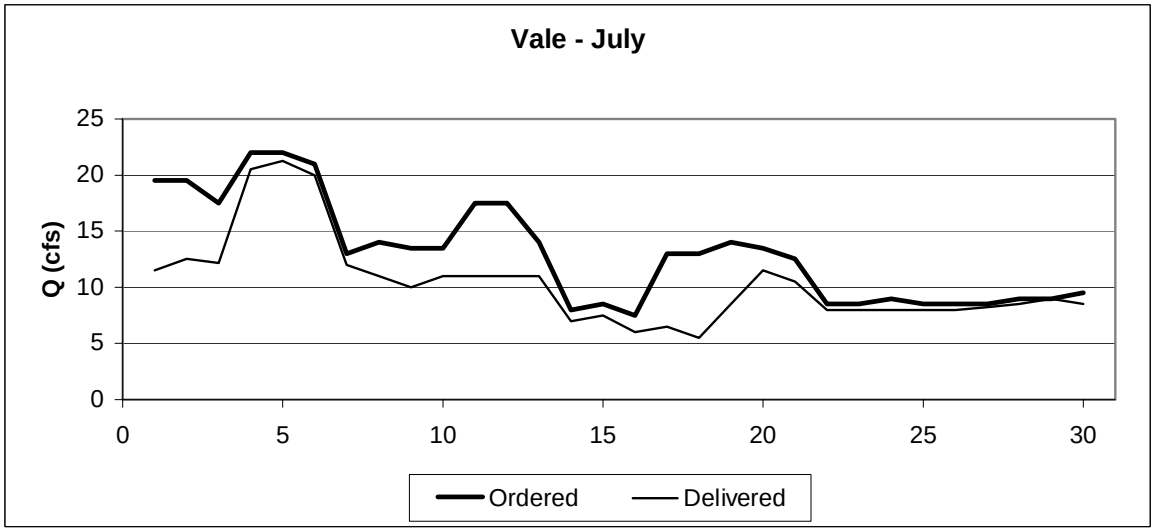
Dates	Computed Total Losses (M1)		Computed Total Losses (M2)		Measured Operational Losses		Computed Evaporation/Seepage	
	Vol	Ave. Daily	Vol	Ave. Daily	Vol	Ave. Daily	Vol	Ave. Daily
	(af)	(cfs)	(af)	(cfs)	(af)	(cfs)	(af)	(cfs)
6/1-6/30	115	1.9						
7/1-7/31	173	2.8						
8/1-8/31	237	3.8						
9/1-9/16	25	0.8						
8/26-9/11	73	2.1	153	4.5	63	1.9	90	2.6
Total, June-Sept	549	2.5						

Notes:
(1) Computed M1: the computed volume of unused water, based on Ditch Rider Orders minus Deliveries
(2) Computed M2: the computed volume of unused water, based on measured discharges in the Parshall Flume minus Deliveries
(3) Measured: Actual discharges measured at the last Check Structure on the Gillette (CS7) using a data logger
(4) Evap/Seepage: Computed minus Measured
(5) Operational Losses: Computed minus Evap/Seepage

Appendix D.10
Logger Data
Vale Lateral

Comparisons: Ditch Rider Orders to Water Delivered & Billed
to Discharges Measured in the Parshall Flume, using a Data Logger

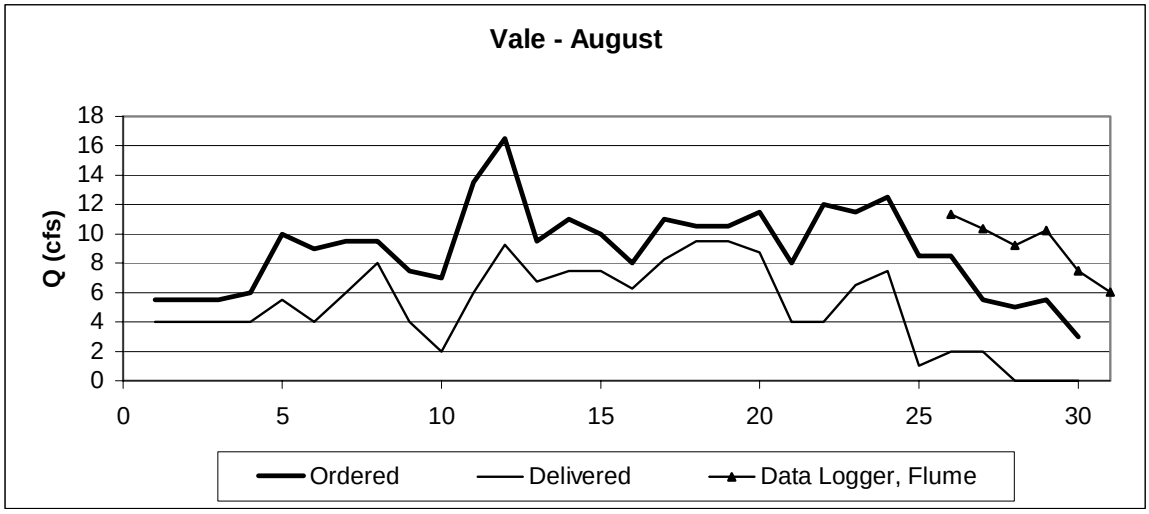


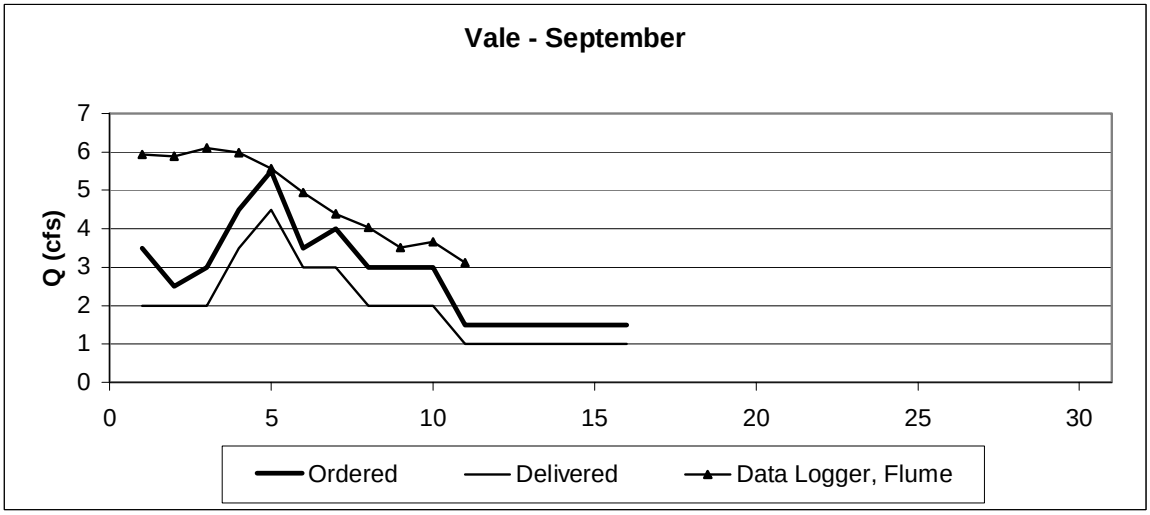


Note: The data logger recorded water depth in the flume every 15 minutes. These depths were converted to discharges using the Parshall Flume Free-Flow Discharge Equation (Water Measurement Manual, 3rd Edition). The average daily discharges are shown on the graphs.

Appendix D.10
Logger Data
Vale Lateral

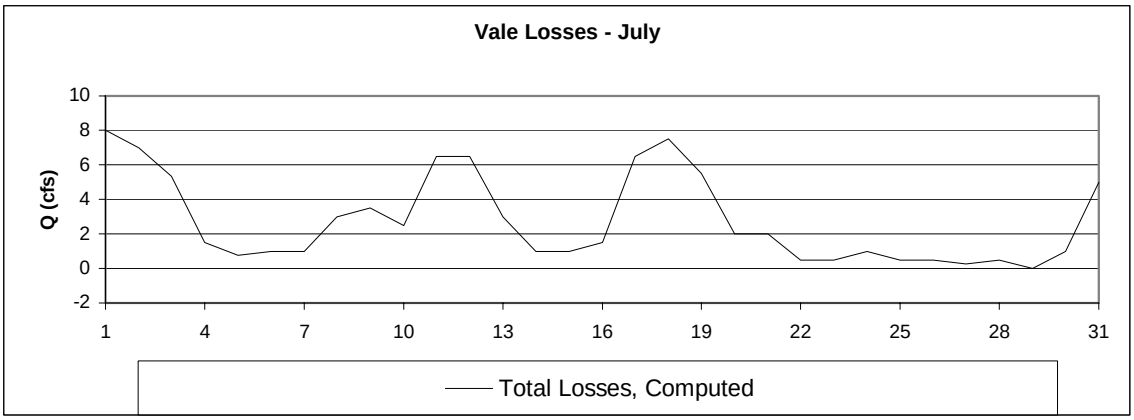
Comparisons: Ditch Rider Orders to Water Delivered & Billed
to Discharges Measured in the Parshall Flume, using a Data Logger

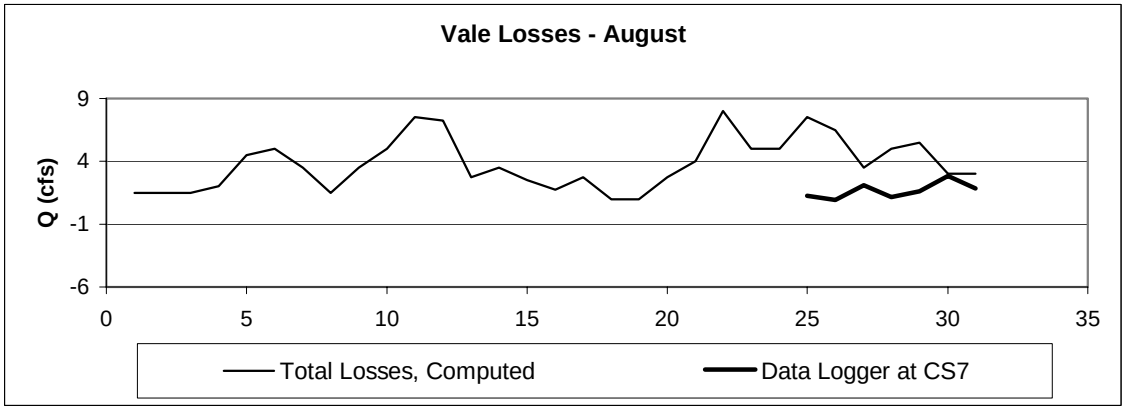


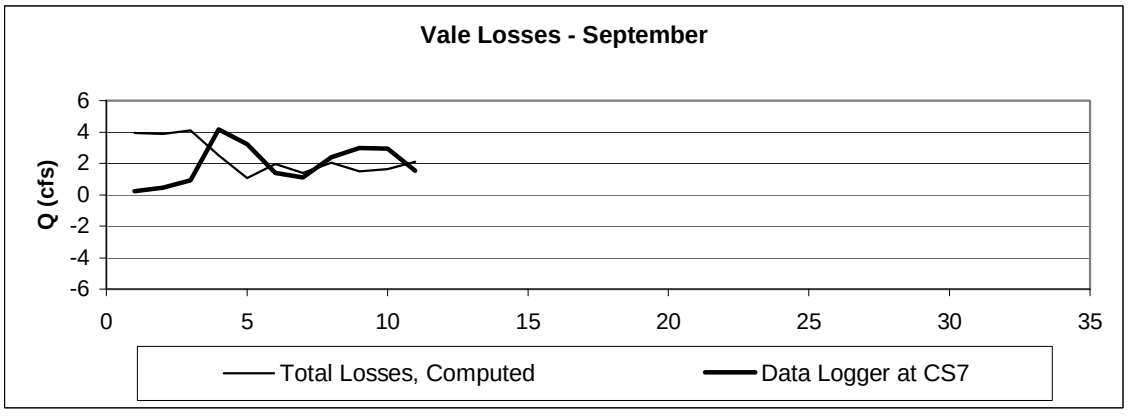


Appendix D.11
Operation Losses
Vale Lateral

Operational Losses on Vale Lateral





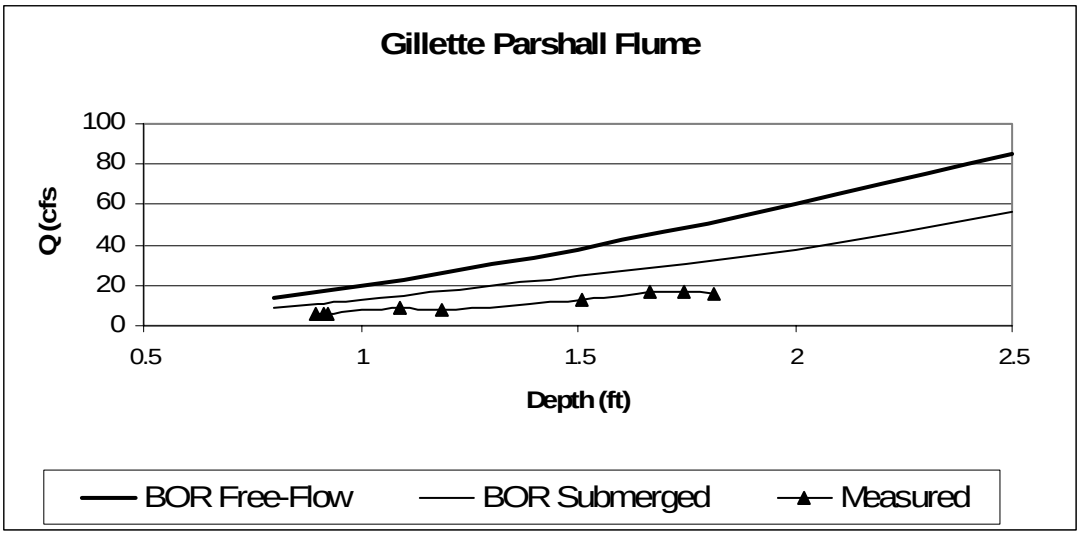


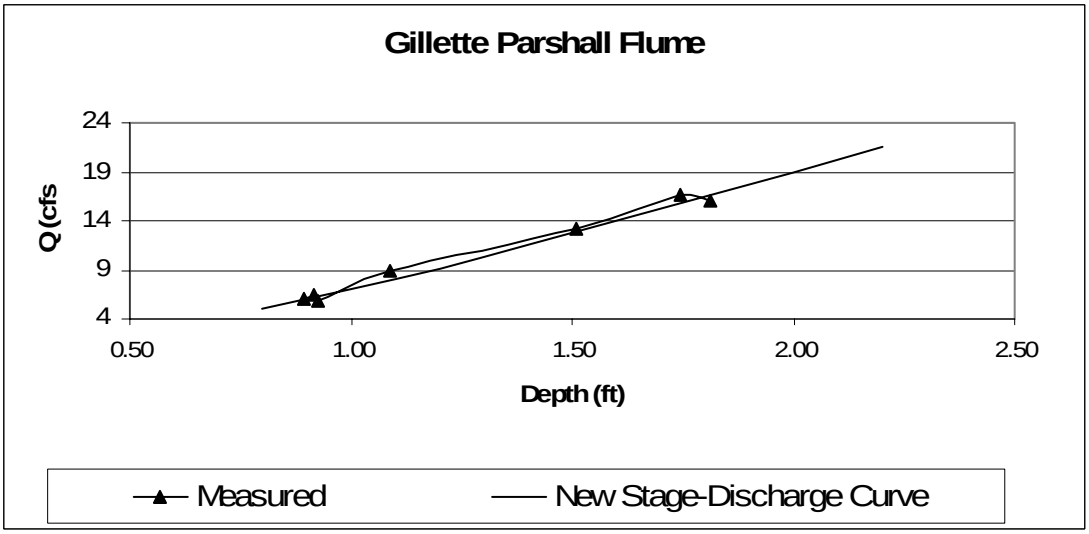
Notes:

(1) "Computed" lines show the total losses, or unused water, on the Vale based on the volume of water entering the Vale minus deliveries to farmers. For July & August, the Ditch Rider orders are used for the Computed line; for September, the actual discharges measured in the Parshall Flume are used.

(2) The Data Logger recorded depths in the CS& weir box every 10 minutes. These depths were converted to discharges using the Suppressed Rectangular Weir discharge equation, with a weir coefficient of 3.33

Appendix D.12
Gillette Lateral Parshall Flume
Development of Stage-Discharge Curve





Notes:

(1) BOR Free-Flow line is the computed discharge using the Free-Flow Parshall Flume equation.
(2) BOR Submerged line is the computed discharge using adjustments for submergence.
(3) Measured points are discharge measurements using a Pygmy flow meter.

Appendix D.12
Gillette Lateral Parshall Flume
Discharge Table

DEPTH - DISCHARGE TABLE FOR GILLETTE FLUME			
Depth	Q_1	Q_2	Q_3
	Stable	Increasing	Decreasing
(ft)	(cfs)	(cfs)	(cfs)
0.50	2.45	2.77	2.13
0.60	3.25	3.67	2.83
0.70	4.11	4.66	3.59
0.80	5.04	5.70	4.39
0.90	6.02	6.81	5.24
1.00	7.04	7.96	6.13
1.10	8.10	9.16	7.06
1.20	9.20	10.41	8.02
1.30	10.33	11.69	9.01
1.40	11.49	13.00	10.02
1.50	12.69	14.35	11.06
1.60	13.90	15.73	12.12
1.70	15.14	17.13	13.20
1.80	16.40	18.56	14.30
1.90	17.68	20.00	15.41
2.00	18.98	21.47	16.55
2.10	20.29	22.96	17.69
2.20	21.62	24.47	18.85
2.30	22.97	25.99	20.03
2.40	24.33	27.53	21.21
2.50	25.70	29.08	22.41
2.60	27.08	30.64	23.61
2.70	28.48	32.22	24.83
2.80	29.89	33.81	26.05
2.90	31.30	35.41	27.29
3.00	32.72	37.02	28.53

Q_1 = Stabilized Discharge

Q_2 = Discharge immediately after opening headgate 2"

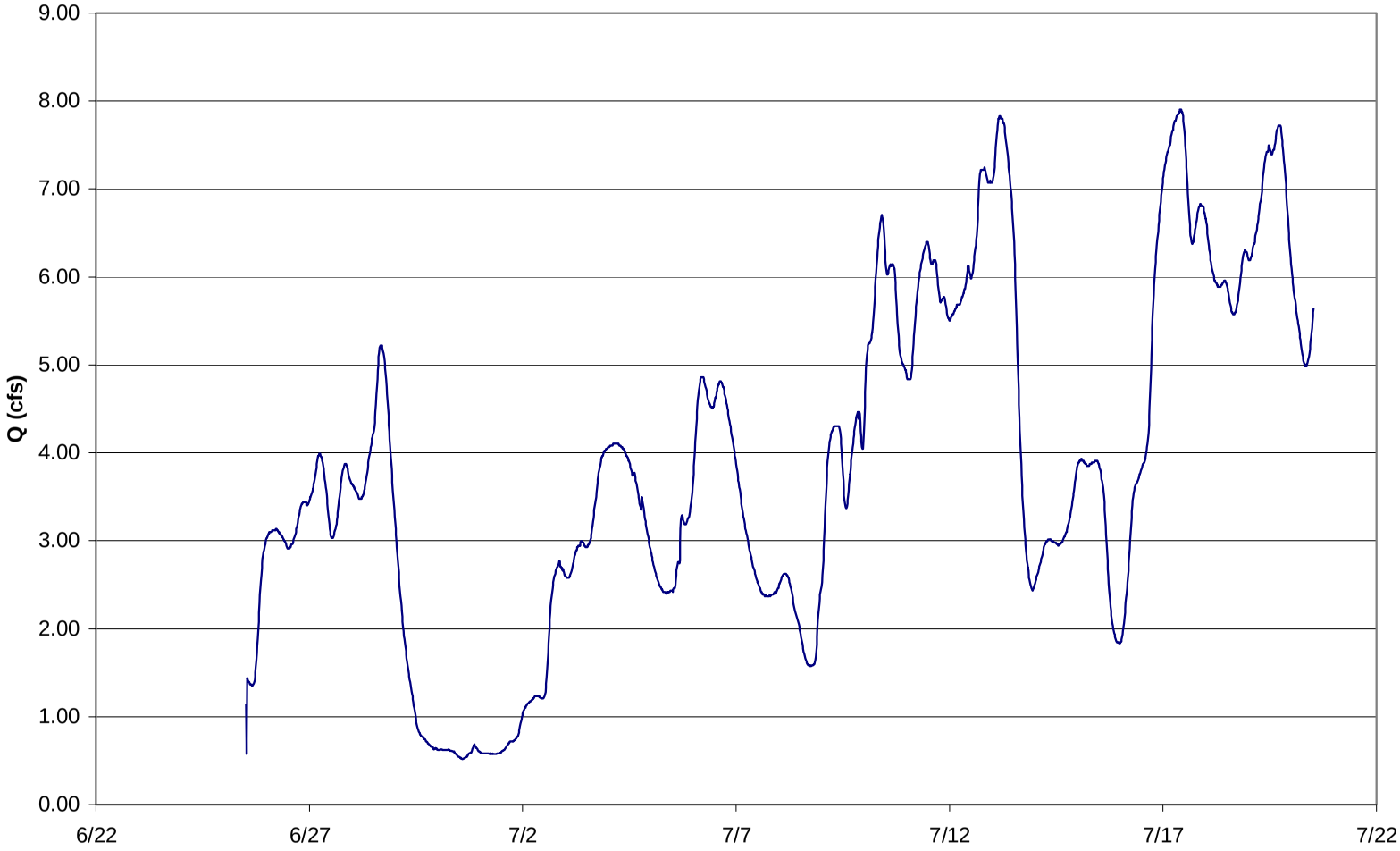
Q_3 = Discharge immediately after closing headgate 2"

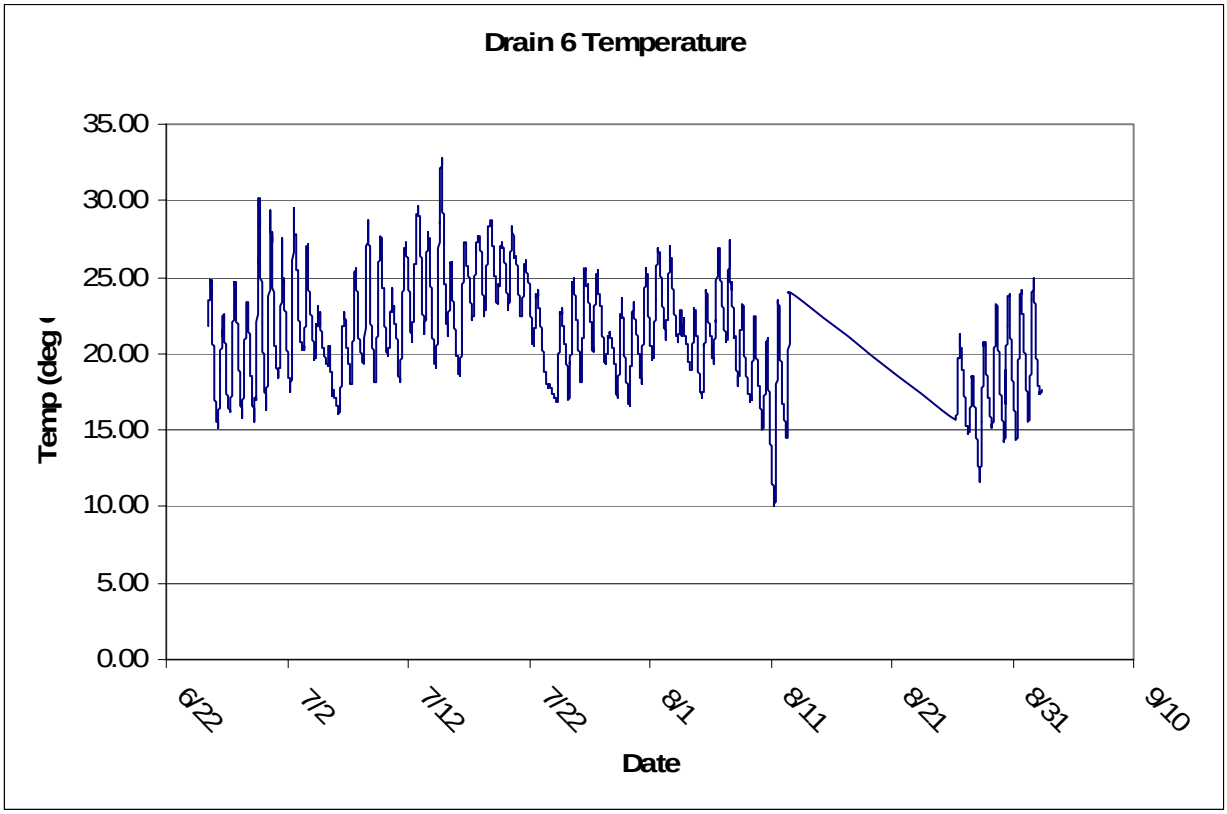
APPENDIX E

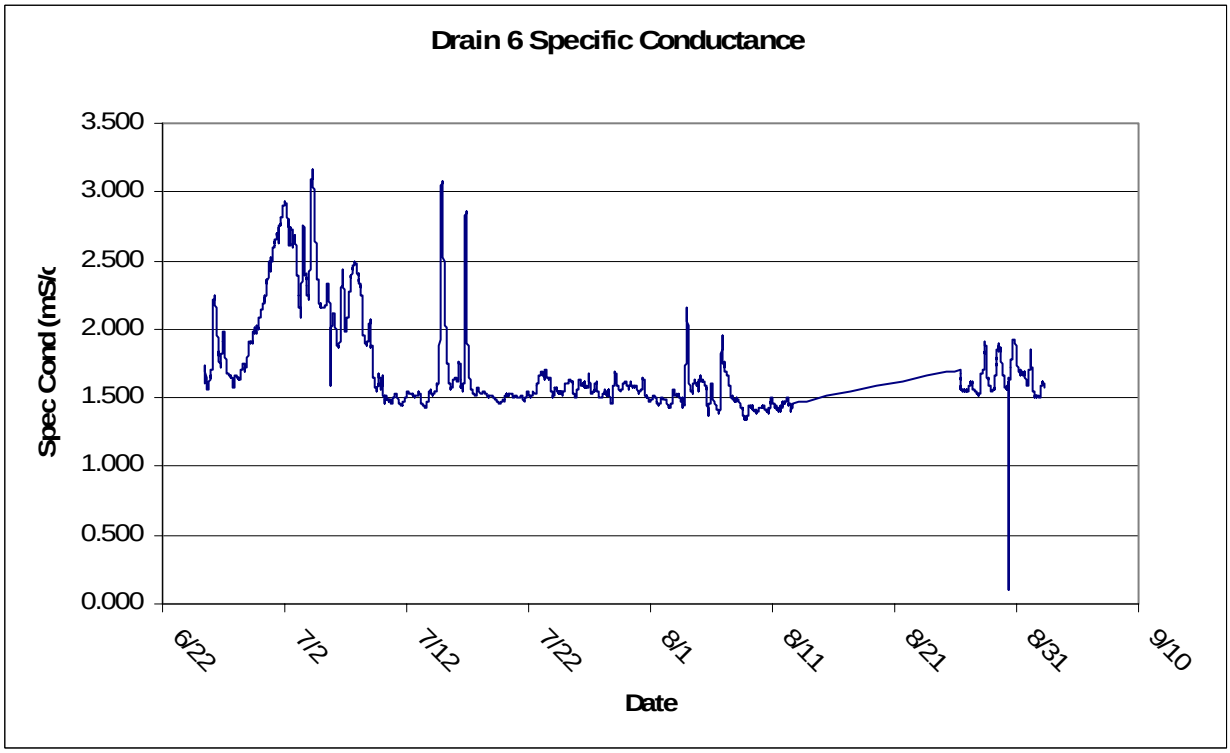
2004 DRAIN 6 INVESTIGATIONS

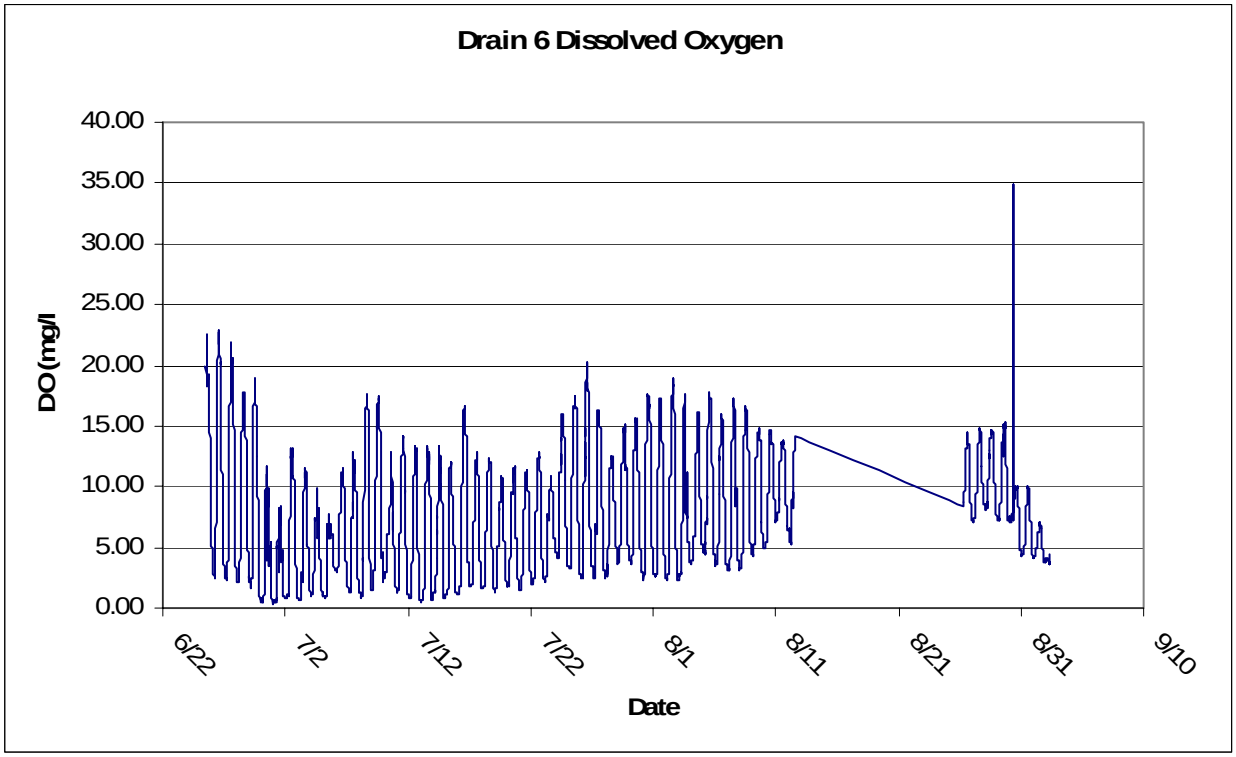
Appendix E.1
2004 Drain 6 Investigations

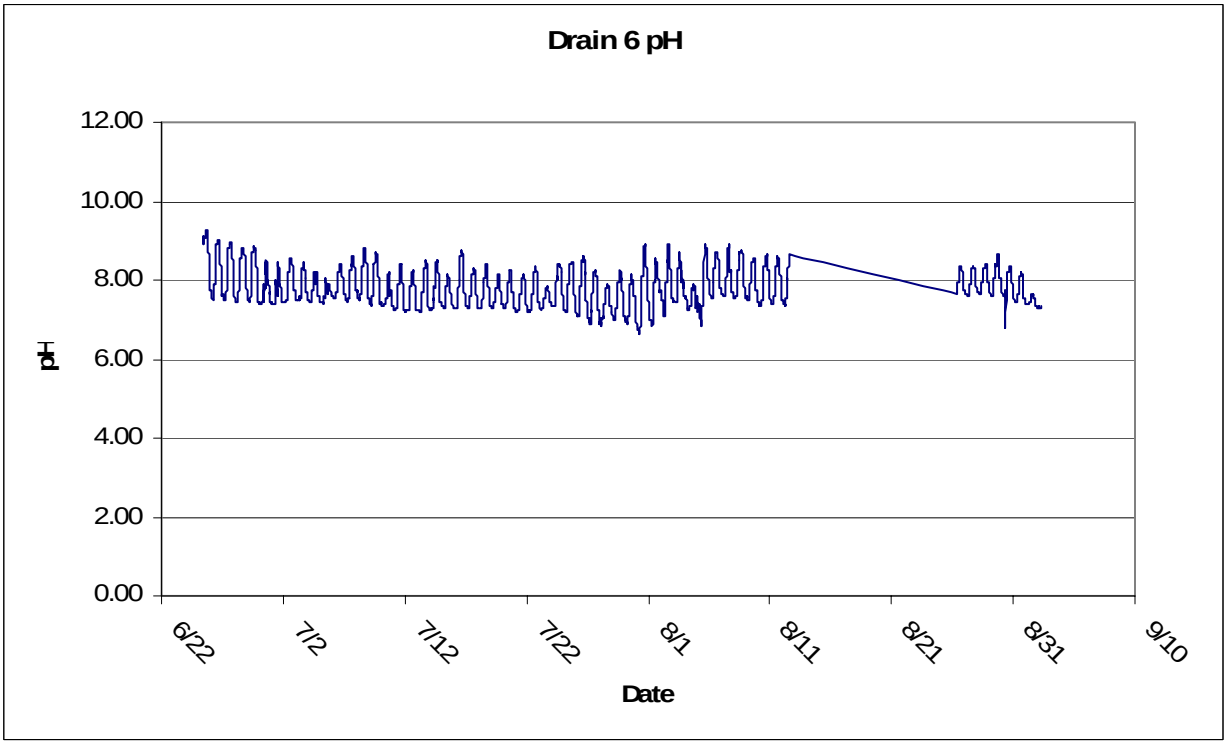
Drain 6

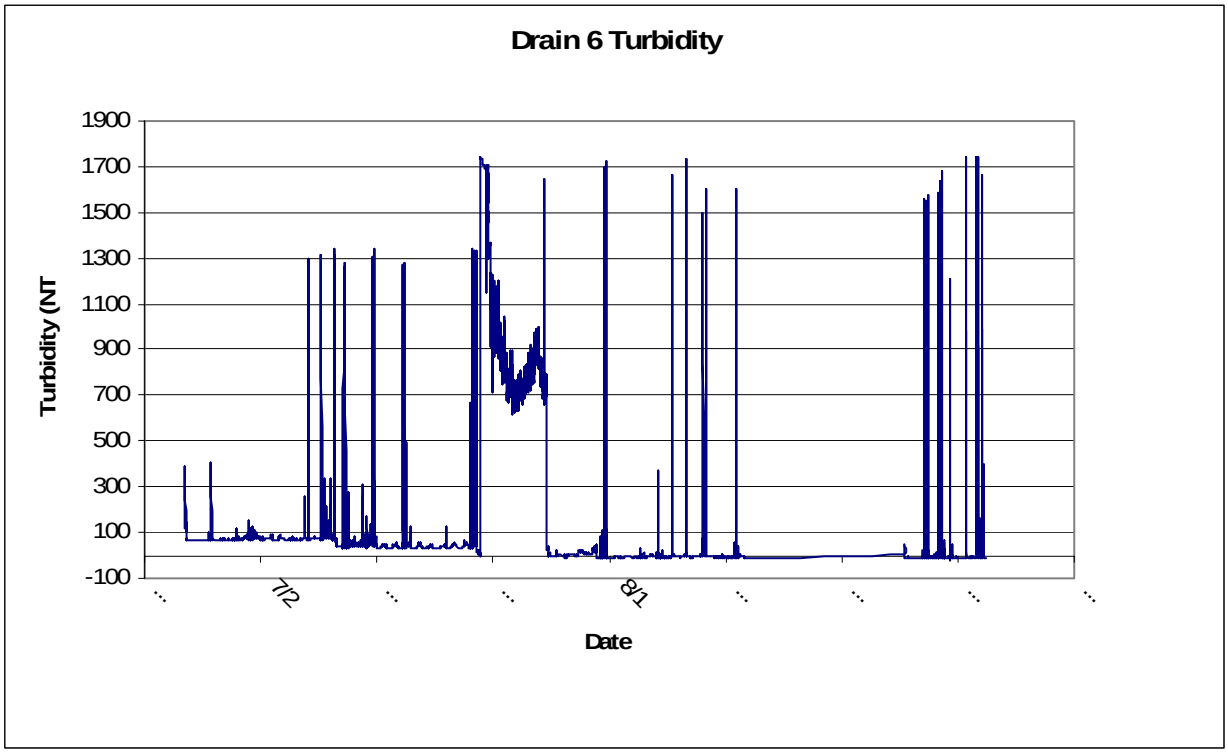



Drain 6 Temperature
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Temp (deg
6/22
7/2
7/12
7/22
8/1
8/11
8/21
8/31
9/10
Date


Drain 6 Specific Conductance
3.500
3.000
2.500
2.000
1.500
1.000
0.500
0.000
Spec Cond (mS/c
6/22
7/2
7/12
7/22
8/1
8/11
8/21
8/31
9/10
Date


Drain 6 Dissolved Oxygen
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
DO (mg/l
6/22
7/2
7/12
7/22
8/1
8/11
8/21
8/31
9/10
Date


Drain 6 pH
12.00
10.00
8.00
6.00
4.00
2.00
0.00
pH
6/22
7/2
7/12
7/22
8/1
8/11
8/21
8/31
9/10
Date


Drain 6 Turbidity
1900
1700
1500
1300
1100
900
700
500
300
100
-100
Turbidity (NT
7/2
8/1
Date

APPENDIX F

INFORMATION AND HISTORY FOR BELLE FOURCHE IRRIGATION DISTRICT

APPENDIX F

INFORMATION AND HISTORY FOR BELLE FOURCHE IRRIGATION DISTRICT

(from 1998 Belle Fourche Irrigation District Water Conservation Plan)

I. DESCRIPTION OF DISTRICT

A. History

Investigations for the development of the Belle Fourche Project began in 1903 following the passage of the Reclamation Act of 1902. The project was authorized for construction in 1904 at an estimated cost of about $2,100,000, and actual construction began in 1905 on the diversion dam, inlet canal and storage reservoir. The first unit of the project was opened to settlement by public notice in June 1907 and the first irrigation water was delivered to 12,000 acres of project lands in 1908 via the Johnson Lateral off the Inlet Canal and a temporary channel through the un-completed Orman Reservoir and into the South Canal. Orman reservoir was completed in 1911 and with the addition of the second portion of the North Canal in June of 1912, the basic construction features of the project were essentially complete.

An organization of the water users known as the Belle Fourche Valley Water Users Association was formed in 1904 and later succeeded by the Belle Fourche Irrigation District in 1923. The success of early project settlers was limited by their lack of experience in irrigated agriculture. Their success was further limited by the heavy textured soils and the absence of adequate subsurface drainage which necessitated a high level of specialized management practices for profitable production. Contracts negotiated with the Government in 1914 and 1927 relieved water users from paying construction charges during certain years. In addition the 1927 contract provided a loan to finance a drainage system to alleviate damage from alkali and water logging in the heavier soils. Construction commenced in 1928 and by 1934 more than 200 miles of deep open drains were completed.

The District evolved to where they now serve 57,100 acres with the principle crop being alfalfa and hay production to support the livestock enterprises within and outside the District boundaries. Alfalfa and hay production accounts for about 65% of crop production, with small grains and corn accounting for most of the remainder of crops produced. Irrigation methods are almost entirely flood and furrow irrigation with more and more irrigators upgrading from open ditch to gated pipe to apply the water on farm.

The District began their Rehabilitation and Betterment Program in 1985 to improve the efficiencies in their delivery system. The diversion dam as well as many new check structures, farm turnouts, and measurement devices will be replaced. There will also be several portions

of canal and lateral lining and numerous lateral pipelines installed. The District Rehab program has greatly improved the water use efficiency, but most years still see an irrigation water shortage. Farmers within the project boundaries use their water allotments (often less than 1 acre foot per acre) where they can get the most return knowing they will not be able to meet the full demand of all irrigated acres.

B. Location and Facilities

The Belle Fourche Project is located immediately north of the Black Hills in Western South Dakota. The project area, about 12 miles wide on the average, consists of the valley of the winding Belle Fourche River, the narrow valleys of tributary streams, the high river terraces, and the rolling foothills forming the local watersheds. This 30 mile long area lies below the city of Belle Fourche almost entirely within Butte County with the remainder, a few square miles in the south eastern portion, falling within the boundaries of Meade County.

The two major irrigation structures of the Belle Fourche Project consist of the Diversion Dam and the Belle Fourche Reservoir (originally known as Orman Dam.) The remainder of the facilities consist of 94 miles of main canals, 450 miles of laterals, 255 miles of open drains, and 7 miles of pipe drains.

The Diversion Dam is located on the Belle Fourche River about 2 miles down stream from the city of Belle Fourche. It is a concrete weir structure that diverts water from the Belle Fourche River into the Inlet Canal which discharges into the Belle Fourche Reservoir. The six and one-half mile long Inlet Canal is capable of conveying a total capacity of 1350 cfs from the Diversion Dam to the Belle Fourche Reservoir. This includes the Crow Creek drainage located one mile below the Diversion Dam. The Inlet Canal and Johnson Lateral, which is a sub-lateral off the Inlet Canal, serves 2,400 acres of land that are not accessible from the Belle Fourche Reservoir.

The Belle Fourche Reservoir is an off-stream storage facility located on the Owl Creek drainage basin with a total storage capacity of 192,000 acre feet (185,000 acre feet active conservation storage). The primary water supply for project use is diverted from the Belle Fourche River , plus the intermittent flows from the two hundred square mile Owl Creek drainage upstream from the Belle Fourche Reservoir. This reservoir also provides incidental recreation, fish and wildlife enhancement, and flood control benefits inherent to the overall operation of the reservoir.

The delivery system consists of two main canals plus a network of major and minor laterals that serve 54,200 acres down stream of the reservoir. The North Canal with a capacity of 600 cfs serves approximately 35,100 acres while the South Canal with a capacity of 350 cfs serves approximately 19,100 acres. A project map (Exhibit “A”) is attached to show the District features mentioned above.

C. Size

The Irrigation District currently serves 56,600 acres including 2,400 acres off the Inlet Canal and 54,200 acres off the delivery system below the reservoir. There will be only minor acreage changes due to reclassification since the District wishes to stay between 56,000 and 57,000 irrigated acres at the present time due to the limited supply of water.

D. Terrain and Soils

The project lands consist of the flood plains along the Belle Fourche River and the smaller contributing watersheds, plus the high river terraces above the flood plains with rolling hills and ridges through out the area. Soils vary from sandy loam along the Belle Fourche River and tributaries to clay loams and heavy clay in the higher terraces and ridges found largely on the north side of the river. The lighter soils on the project can be worked earlier in the spring and with less difficulty than heavier clay soils. This is especially true during a wet year. The light sandy soils are accommodating to a wide variety of crops including corn and beans but the clay loam and heavy clay soils are more restrictive in their yields of certain crops and are limited to mostly small grains and alfalfa/grass hays. Exhibit "B" shows an overview of the soil types within the project.

E. Climate

The climate, typical of the northern plains states, is semi-arid. The summers are hot and windy during the day, but cool during the nights. The winters are cold and dry with light snowfalls that seldom remain on the ground for any length of time.

The recorded temperature extremes are from 110 degrees Fahrenheit in the summer to minus 38 degrees Fahrenheit in the winter. The average daily temperature in the winter is about 20 degrees Fahrenheit with the average daily temperature in the summer being about 70 degrees Fahrenheit. The average growing season is about 130 days extending from mid May to latter part of September.

The annual precipitation varies widely from year to year with the average being about 15 inches per year, most of which occurs spring and early summer (78% of annual precipitation is received during the growing season.) Extremes vary from 9 inches annually for the five driest consecutive years to 25 inches for the five wettest consecutive years.

F. Organizational Structure and Operating Rules

The District has a Board of Directors elected by the water users to serve a three year term. The seven member board is made up of District farmers who represent the people in their area. The District staff is made up of a manager, general foreman, watermaster, administrative

assistant, secretary-treasurer, seven ditchriders, and a year around operations and maintenance crew of approximately eight people.

District revenues are based on a per acre assessment with every farmer paying assessments on the number of irrigated acres they own. Assessments are set at a rate to fund operation and maintenance annually and for capital improvements over an extended time period. The organization and governing authority of the District is further defined in the By-laws of the District (Exhibit "C") and Board Policies (Exhibit "D"). The Board of Directors is provided additional governing guidance through the federal contract with the Bureau of Reclamation ("Exhibit "E") and South Dakota state law.

II. WATER RESOURCES INVENTORY

A. Surface Water Supply

The Belle Fourche Irrigation District's water supply is diverted from the Belle Fourche River down the Inlet Canal, and into the reservoir. The Belle Fourche River drainage basin above the diversion dam covers 4,310 square miles, with an average (1953-1974) flow of 160,000 acre feet annually. Diversions from the river during that period (1953-1974) averaged 117,000 acre feet annually, indicating that the capacity of the Inlet Canal is not always large enough and valuable water is passed on downstream. Owl Creek drainage above the reservoir does contribute 9,700 acre feet annually to reservoir inflows.

The Bureau of Reclamation has a water right with the State of South Dakota to divert all of the Belle Fourche River until its storage right of 185,000 acre feet at the reservoir is met annually. The water right does require the District to bypass 5 cfs at the Diversion Dam to keep in-stream flows alive and meet downstream domestic use. Once the reservoir fill requirements are met water must be passed on down the river to meet downstream junior water rights although this is not usually a problem since down steam tributaries and return flows from irrigation are usually sufficient to meet those junior water rights. These, water rights, dated July of 1904, are held under U.S. Water Withdrawal Nos. 0376-1 and 0377-1 and are recorded at the office of the Register of Deeds at the Butte County courthouse in Belle Fourche, South Dakota. Withdrawal No. 0376-1 was originally numbered 18874 and is recorded on page 12 in Book 17 of Misc. Records. Withdrawal No. 0377-1 was originally numbered 18875 and is recorded on pages 13 and 14 in Book 17.

The District also has a water right to serve 2400 acres above the reservoir off the Inlet Canal and Johnson Lateral. This water comes from the natural flows of the Belle Fourche River and Redwater during the summer irrigation and the District must show justified use or need for that water on the Inlet Canal or Johnson Lateral. If flows in the river exceed the need on the Inlet and Johnson it is bypassed on down the river to meet junior rights. If no downstream

needs exist then excess flows in the river will be taken into the reservoir to meet irrigation demands there.

Keyhole Dam was built on the Belle Fourche River in Wyoming about 146 miles upstream from the Diversion Dam to provide supplemental water for the Belle Fourche Project. Built in the early 1950's, this dam not only supplements the reservoir but also provides a consistent supply of water for the 2400 acres served by the Inlet Canal and Johnson Lateral during low flows in the Belle Fourche River. The District has contracted with the Bureau of Reclamation for 7.7% (14,307 acre feet) of storage in Keyhole Reservoir with an option to purchase additional water from U.S. storage if needed. The Keyhole Contract (Exhibit "E") is included as part of the 1984 Repayment Contract and specifics can be found there.

B. Other Water Supplies

The Belle Fourche Irrigation District has no other water supplies. There are no groundwater pumping sites at this time and the District has no downstream reuse ponds. This option has been looked at, but when everything was factored in these return flows catch ponds were not very feasible. Good location sites for catch ponds were not available and storage capacity wasn't adequate for the dollars involved.

C. Drainage From the District

The primary drainage on the project includes the tributary streams of Owl Creek, Indian Creek, Horse Creek, Dry Creek and Willow Creek on the north side of the Belle Fourche River, plus cottonwood Creek and Nine Mile Creek on the south side of the river. These streams all carry irrigation return flows back to the Belle Fourche River and then move east off the project as shown on the project map (Exhibit "A"). This natural drainage is enhanced by 250 miles of open drain system which extends throughout the project. The Butte County Drainage plan was drafted in 2001.

APPENDIX G

COOPERATIVE AGREEMENT

Cooperative Agreement
Between
Bureau of Reclamation
And
Belle Fourche Irrigation District
For
Water Conservation Implementation, Demonstrations and Education

I. AUTHORITY

This Cooperative Agreement (agreement) is entered into between the United States of America, acting through the Department of Interior, Bureau of Reclamation, hereinafter referred to as "Reclamation", and Belle Fourche Irrigation District, hereinafter referred to as "District", pursuant to the Energy and Water Development Appropriations Act of 2004, P.L. 108-137, for water conservation implementation, demonstrations, and education activities. This agreement will replace agreement number 97-FC-60-08940 which expires on September 30, 2004.

II. BACKGROUND AND OBJECTIVE

Reclamation, through the Water Conservation Field Services Program (WCFSP), provides assistance to encourage the development of Water Management/Conservation Plans (WMCP) and the implementation of water conservation measures in the operations of recipients of water from Federal projects. The WCFSP provides assistance to water users with emphasis in the following four areas: preparation of WMCP, implementation of effective water management measures, demonstration of innovative conservation technologies, and promotion of conservation information and education. Technical and financial assistance is provided for activities identified in WMCP which are adopted and are shown to be economically feasible.

Section 210(b) of the Reclamation Reform Act (RRA) of October 12, 1982, (96 Stat. 1263; 43 United States Code (U.S.C.) § 390jj) contains provisions requiring contractors to prepare and submit a WMCP for Reclamation's approval. All irrigation and municipal and industrial (M&I) districts, including paid-out districts, that have executed contracts or water service contracts, pursuant to Federal Reclamation Law or the Water Supply Act of 1958, as amended (43 U.S.C. § 390b), are required to develop a WMCP.

The Belle Fourche Project was authorized under the Reclamation Act of 1902 and construction began under the authority of the Secretary of the Interior May 10, 1904. The Dam is located in western South Dakota about 10 miles east of the city of Belle Fourche on the Owl Creek drainage. The system includes 94 miles of canals, 450 miles of laterals and 232 miles of drains.

The Belle Fourche Project was developed exclusively for irrigation. It has secondary benefits as a minimal flood control structure as well as recreation, fish and wildlife. The Belle Fourche Irrigation District manages an irrigable area of 57,068 acres.

The District's average annual water use is 110,000 acre-feet, which requires them to prepare a Water Conservation Plan under RRA guidelines. The District has requested assistance in developing and implementing a WMCP to increase the efficiency of District facilities and increase water application efficiency within the District. Reclamation staff will review and provide advisory comments and recommendations to the District on their identified goals and measures, including the potential for environmental effects related to measures proposed in the plan. In addition to providing assistance to the District in water conservation planning, Reclamation staff may also provide technical assistance to the District to help collect data, develop resource inventories, conduct planning surveys, design and evaluate potential efficiency measures, develop water budgets, perform studies and investigations, and conduct preliminary environmental evaluations, which generally assist in the development of the District's WMCP.

III. PUBLIC BENEFIT

The purpose of this agreement is to provide a mechanism for Reclamation to provide technical and financial assistance through the WCFSP to the District for water conservation information and educational activities, preparation or revision of a WMCP, and to assist with implementation of economically feasible measures identified in the plan. Implementation of responsible water conservation measures will improve the District's operations, management, and use of water from a Federal project. The District, water users, and the public will benefit from funding provided under this agreement by more efficient use of the water resource achieved through implementation of the District's WMCP.

Reclamation's funding and participation in the District's WMCP will: (1) benefit the public by ensuring efficient utilization of our natural resources, water stored in Belle Fourche Reservoir and by encouraging water conservation, thus, allowing water to remain within the reservoir for future irrigation; (2) benefit the public such as recreation and fisheries; (3) maximize the usefulness of Federal facilities (Belle Fourche Dam and Reservoir, District Irrigation Facilities).

IV. STATEMENT OF WORK

Reclamation will:

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1. Obligate funds not to exceed $80,000 in Federal fiscal year 2005, for equipment purchases and improvements to irrigation facilities and systems.

2. Provide the District with training and assistance with water management.

3. Provide funding for 50-50 cost-share improvements in irrigation facilities such as automation on existing structures, installation of pipelines and/or lining in the delivery system.

4. Review and approve the annual budget of planned projects and the annual report of expenditures and conservation measures funded through this agreement.

5. Review and approve specifications for equipment purchases, prior to the expenditure of funds obligated under this agreement.

6. Assist the District in evaluating modifications to irrigation facilities, evaluating potential environmental impacts and obtaining any necessary environmental compliance.

The **District** shall:

1. Submit an annual budget of planned projects for Reclamation's approval by December 31 of each year.

2. Prepare an annual report of expenditures and conservation measures funded through this agreement and submit to Reclamation by March 15 of each year.

3. Submit specifications for equipment purchases to Reclamation for approval, , prior to expenditures of funds obligated under this agreement.

4. Document water savings by obtaining sufficient measurements to determine the efficiency of improvements funded through this agreement and estimate the amount of water conserved annually. The District is encouraged to solicit assistance from state and local agencies to assist with the measurements and reporting of water conserved.

5. The District is responsible for identifying cooperators, and coordinating any demonstration programs implemented or funded through this agreement. The District may solicit assistance from state and local agencies to assist with the demonstrations.

V. SPECIAL PROVISIONS

V.1 IMPLEMENTATION

This agreement becomes effective on the date shown in Block 17a of Form 7-2277 (United States of America, Department of the Interior, Bureau of Reclamation, Assistance Agreement) and shall remain in effect until September 30, 2010.

V.2 PAYMENT POLICY (Reclamation 11/03)

Acceptance of a financial assistance agreement from Reclamation creates a legal responsibility on the part of the recipient organization to use the funds and property provided in accordance with the terms and conditions of the agreement. Reclamation has a reversionary interest in the unused balance of funding and in any funds improperly applied.

Payments to recipients are made in accordance with the basic standards and methods stated in the payment regulations at 43 CFR 12.61 or 43 CFR 12.922, as applicable to this agreement. These requirements are intended to minimize the time elapsing between the transfer of funds from the Federal government and the disbursement of these funds by the recipient.

Payment will be made in advance or by reimbursement as follows:

(1) Advance Payment -- Recipients shall be paid in advance provided (1) they maintain or demonstrate the willingness and ability to maintain procedures to minimize the time elapsing between the transfer of funds and their disbursement by the recipient, (2) they comply with reporting requirements for timely submission of financial status reports, and (3) they impose these same

standards on subrecipients. The debarred or suspended status of a subrecipient can be checked at http://www.epls.gov/.

Advances to recipients shall be limited to the minimum amounts needed and shall be timed to be in accordance with the actual, immediate cash requirements of the recipient in carrying out the purpose of the agreement. The timing and amount of cash advances shall be as close as administratively feasible (generally no more than 3 days) to actual disbursements for direct program costs and the proportionate share of allowable indirect costs.

(2) Reimbursement -- Reimbursement shall be the preferred method of payment when a recipient (1) does not meet the requirements for advance payment stated above; (2) does not have financial management systems that meet the standards in 43 CFR 12.60 or 43 CFR 12.921, as applicable; or (3) has been converted to payment restrictions for non-compliance with the terms and conditions of the agreement. Reimbursement is also the preferred method of payment for agreements involving construction.

V.3 PAYMENT METHOD (Reclamation 11/03)

Electronic Funds Transfer -- Payments under this agreement will be made to recipients by electronic funds transfer (EFT) unless the recipient qualifies for exemption from this payment method. Reclamation utilizes the Automated Clearinghouse (ACH) Vendor Express payment system for EFT. Whether funds are paid in advance or as a reimbursement, the actual payment will be made through Vendor Express. Vendor Express allows the Government to transfer funds to a recipient's financial institution along with explanatory information regarding the payment.

Enrollment -- Upon award, recipients will receive a copy of the SF-3881, ACH Vendor/Miscellaneous Payment Enrollment Form. This form is required to implement the Vendor Express system and to notify Reclamation of any change or corrections to financial institution information.

Requesting Payments -- Requests for advance or reimbursement may be made by the following methods:

(1) SF-270, Request for Advance or Reimbursement -- On a quarterly basis, recipients may submit an original of a properly certified SF-270 form to the address identified in Block [8], page 1, of this agreement. For advance payments, this form may be submitted on a monthly basis, at least two weeks prior to the date on which funds are required, and on the basis of expected disbursements for the succeeding month and the amount of Federal funds already on hand. Requests for reimbursement may be submitted on a monthly basis, or more frequently if authorized by the GCAO. Requested funds are delivered to the recipient via ACH Vendor Express. This form is available on the Internet at http://www.whitehouse.gov/omb/grants/grants_forms.html.

(2) SF-271, Outlay Report and Request for Reimbursement for Construction Programs -- The SF-271 shall be used for construction agreements paid by the reimbursement method, letter of credit, electronic funds transfer, or Treasury check advance, except where the advance is based on periodic requests from the recipient, in which case the SF-270 shall be used. This request may be submitted on a quarterly basis, but no less frequently than on an annual basis. Recipients may submit an original and two copies of a properly certified SF-271 form to the address identified in Block [8],

page 1, of this agreement. This form is available on the Internet at http://www.whitehouse.gov/omb/grants/grants_forms.html.

(3) Automated Standard Application for Payments (ASAP) -- Recipients may utilize the Department of Treasury ASAP payment system to request advances or reimbursements. ASAP is a recipient-initiated payment and information system designed to provide a single point of contact for the request and delivery of Federal funds. Once a request is made through ASAP, funds are provided to the recipient either through ACH or Fedwire. Further information regarding ASAP may be obtained from the ASAP website at http://www.fms.treas.gov/asap. Upon award, you will be provided with information regarding enrollment in the ASAP system.

V.4 REPORTING REQUIREMENTS AND DISTRIBUTION (Reclamation 11/03)

Failure to comply with the reporting requirements contained in this agreement may be considered a material non-compliance with the terms and conditions of the award. Non-compliance may result in withholding of payments pending receipt of required reports, denying both the use of funds and matching credit for all or part of the cost of the activity or action not in compliance, whole or partial suspension or termination of the agreement, recovery of funds paid under the agreement, withholding of future awards, or other legal remedies.

(1) Financial Reports -- All financial reports shall be signed by an Authorized Certifying Official for the recipient's organization. The following forms are available at http://www.whitehouse.gov/omb/grants/grants_forms.html.

(a) SF-269 or SF-269a, Financial Status Report -- This form is utilized to report total expenditures for the reporting period. The SF-269 must be used if the recipient is accountable for the use of program income; otherwise, the SF-269a may used.

An original of this form shall be submitted quarterly within 30 days following the end of each reporting period.

A final SF-269 or SF-269a shall be submitted within 90 days following completion of the agreement.

(b) SF-272, Report of Federal Cash Transactions -- This report shall be submitted by recipients that draw down cash advances by means of electronic funds transfer or Treasury check. Recipients shall identify in the "Remarks" section the amount of cash advances received in excess of 3 days prior to disbursement and explain actions taken to reduce excess balances.

An original and two copies of this form shall be submitted on a quarterly basis within 15 days following the end of the reporting period.

(2) Program Performance Reports

(a) Interim Reports -- Recipients shall submit an original and two copies of program performance reports on a semi-annual basis within 30 days following the end of each reporting period. Program performance reports shall contain the following:

(i) A comparison of actual accomplishments with the goals and objectives established for the reporting period;

(ii) Where project output can be quantified, a computation of the cost per unit of output;

(iii) When appropriate, reasons why goals and objectives were not met; and

(iv) Other pertinent information including, when appropriate, analysis and explanation of cost overruns or high unit costs.

(b) Annual Reports -- An original annual program performance report shall be submitted within 90 days following the end of each year of the agreement. Copies of this report may be required to be included with any application for continuing support of the agreement.

(c) Final Report -- An original and two copies of the final program performance report shall be submitted no later than 90 days following the expiration or termination of the agreement.

(3) Significant Developments -- During the term of the agreement, the recipient must immediately notify the GCAO if any of the following conditions become known:

(a) Problems, delays or adverse conditions which will materially impair their ability to meet the objectives of the agreement;

(b) Favorable developments which enable the recipient to meet time schedules and objectives sooner than or at less cost than projected or to produce more beneficial results than originally planned.

This notification is to include information on the actions taken or contemplated to resolve problems, delays, or adverse conditions, and any assistance needed from Reclamation to help resolve the problem.

(4) Report Distribution

Copies of reports shall be distributed as follows:

	GCAO (Block 6, Pg 1)	GCAOR (Block 8, Pg 1)
Financial Reports		1
Performance Reports		2
Significant Developments		1

V.5 MODIFICATIONS (Reclamation 08/03)

Any changes to this agreement shall be made by means of a written modification. Reclamation may make changes to the agreement by means of a unilateral modification to deal with administrative matters, such as changes in address, no-cost time extensions, the addition of previously agreed upon funding, or deobligation of excess funds at the end of the agreement. Additionally, a unilateral modification may be utilized by Reclamation if it should become necessary to suspend or terminate the agreement in accordance with 43 CFR 12.83 or 43 CFR 12.961, as applicable.

All other changes shall be made by means of a bilateral modification to the agreement. No oral statement made by any person, or written statement by any person other than the GCAO, shall be allowed in any manner or degree to modify or otherwise effect the terms of the Agreement.

All requests for modification of the Agreement shall be made in writing, provide a full description of the reason for the request, and be sent to the attention of the GCAO. Any request for project extension shall be made at least 45 days prior to the expiration date of the agreement or the expiration date of any extension period that may have been previously granted. Any determination to extend the period of performance or to provide follow-on funding for continuation of a project is solely at the discretion of Reclamation.

V.6 RECIPIENT'S PROJECT MANAGER (Reclamation 08/03)

The Recipient's Project Manager for this Agreement shall be:

Mr. Clint Pitts
District Manager
Belle Fourche Irrigation District
P.O. Box 225, 209 Dartmouth
Newell, SD 57760
(605) 456-2541
e-mail: bfid1@sdplains.com

V.7 KEY PERSONNEL (Reclamation 08/03)

The Recipient’s key personnel for this agreement are identified as follows:

Mr. Clint Pitts
District Manager
Belle Fourche Irrigation District
P.O. Box 225, 209 Dartmouth
Newell, SD 57760
(605) 456-2541
e-mail: bfid1@sdplains.com

In accordance with 43 CFR 12.70(d)(3)) or 43 CFR 12.925, as applicable, the Recipient shall request prior approval from Reclamation before making any changes in the key personnel identified above.

V.8 GRANT AND COOPERATIVE AGREEMENT OFFICER'S REPRESENTATIVE (GCAOR) (Reclamation 08/03)

The GCAOR for this agreement will be:

Bureau of Reclamation
Attn: Gary C. Velder (DK-700R)
Address: 515 9th Street
Rapid City, SD 557701
Telephone: (605) 395-9757, extension 3010
E-mail: gvelder@gp.usbr.gov

The GCAOR is authorized to act only on technical matters during the term of this Agreement. The GCAOR and the Recipient's Project Manager shall work closely to insure that all requirements of the Agreement are being met. The GCAOR's responsibilities include, but are not limited to, the following:

(a) Assist the Recipient concerning the accomplishment of the tasks described in the Agreement;

(b) Provide information to the Recipient which assists in the interpretation of the tasks; and

(c) Review, and where required, approve reports and information to be delivered to the Government.

Technical assistance must be within the general scope of the Agreement. The GCAOR does not have the authority to and may not issue any technical assistance which:

(a) Constitutes an assignment of additional work outside the general scope of the Agreement;

(b) In any manner causes an increase or decrease in the total estimated cost or the time required for performance; or

(c) Changes any of the expressed terms, conditions, or specifications.

V.9 FUNDS AVAILABLE FOR PAYMENT (Reclamation 08/03)

The Government's obligation under this Agreement is contingent upon the availability of appropriated funds from which payment for Agreement purposes can be made. No legal liability on the part of the Government for any payment may arise until funds are made available to the GCAO for this Agreement, and until the Recipient receives notice of such availability, to be confirmed in writing to the Recipient by the GCAO.

Pursuant to the Act of Congress of June 17, 1902 (32 Stat. 388), and acts amendatory thereof or supplementary thereto, all commonly known as Reclamation Law, funds for payment under the first year of this agreement are included in the fiscal year 2004 Energy and Water Development Appropriation Act, Public Law 108-137. Funding for any optional year of the agreement is contingent upon subsequent Congressional funding.

V.10 REIMBURSABLE COSTS AND LIMITATIONS (Reclamation 08/03)

(1) The Recipient shall provide all personnel, services, facilities, equipment, materials and supplies, and perform all travel which may be necessary and appropriate for the proper performance of this Agreement. Costs so incurred will be paid for as provided herein. Reclamation's obligation to provide funding to the Recipient for costs incurred in these connections shall be limited to the Recipient's direct and indirect costs associated with this Agreement. All such direct and indirect costs must be determined to be allowable under the regulations contained in 48 CFR Subpart 31.2 or an OMB Cost Principle Circular, as applicable, which are incorporated herein through the General Provisions of this agreement.

(2) The recipient shall not incur costs or obligate funds for any purpose pertaining to operation of the program or activities beyond the expiration date stated in the agreement. The only costs which are authorized for a period of up to 90 days following the award expiration date are those strictly associated with closeout activities for preparation of the final report.

(3) Reclamation shall not be obligated to provide funding to the Recipient and the Recipient shall not be obligated to continue performance under the Agreement or to incur costs in excess of the costs set forth in the annual project budget unless the GCAO has furnished the Recipient a modification to increase the available funding for the Agreement.

V.11 BUDGET REVISIONS (Reclamation 08/03)

The Recipient shall follow the requirements of 43 CFR 12.70(c) or 43 CFR 12.925, as when making revisions to budget and program plans. Additionally, approval shall be requested for transfers of amounts budgeted for indirect costs to absorb increases in direct costs or vice-versa

V.12 PROCUREMENT STANDARDS (Reclamation 08/03)

When utilizing Federal funds for the procurement of supplies and other expendable property, equipment, real property, and other services under this agreement, the Recipient shall utilize the Procurement Standards set forth at 43 CFR 12.76 or 43 CFR 12.940 -12.948, as applicable. The Recipient may be required to submit evidence that its procurement procedures are in compliance with the standards stated therein. Additional guidance for contracting with small and minority firms, and women's business enterprises is included in the General Provisions section of this agreement.

V.13 PROPERTY STANDARDS (Reclamation 08/03)

All property, equipment and supplies acquired by the Recipient with Federal funds shall be subject to usage, management, and disposal in accordance with the Property Standards at 43 CFR 12.72 - 12.73, or 43 CFR 12.930 - 12.937, as applicable.

V.14 PROPERTY STANDARDS -- REAL PROPERTY (Reclamation 08/03)

In accordance with 43 CFR 12.71 or 43 CFR 12.932, as applicable, if real property is acquired in whole or in part under this agreement, it shall be subject to the following regulations:

(1) Title -- Title to real property acquired under this agreement shall vested upon acquisition in the Recipient or Subrecipient, shall be used for the originally authorized purpose of the project as long as it is needed, and shall not be disposed of or encumbered without Reclamation approval.

(2) Disposition -- When the real property is no longer needed for the originally authorized purpose, the Recipient or Subrecipient shall request disposition instructions from Reclamation. The instructions shall provide for one of the following alternatives:

(2.1) Transfer -- The Recipient may be permitted to transfer the property to another Federally-sponsored project if the Recipient determines that the property is no longer needed for the purpose of the original project. Use in other projects or programs shall be limited to those that have purposes consistent with those authorized for support by the Department of the Interior.

(2.2) Retention of Title -- The Recipient may be allowed to retain the title after compensating Reclamation for that percentage of the current fair market value of the property attributable to the Federal government's financial participation in the project.

(2.3) Sale of Property -- The Recipient may be directed to sell the property under guidelines provided by Reclamation, and to compensate Reclamation in an amount calculated by applying Reclamation's percentage of participation in the cost of the original purchase to the proceeds of the sale after deduction of any actual and reasonable selling and fix-up expenses. When the Recipient is directed to sell the property, sales procedures shall be followed that provide for competition to the extent practicable and result in the highest possible return.

(2.4) Transfer of Title -- The Recipient may be directed to transfer title to the Federal Government or to an eligible third-party. The Recipient shall be entitled to compensation for its attributable percentage of the current fair market value of the property.

V.15 INSPECTION (Reclamation 08/03)

Reclamation has the right to inspect and evaluate the work performed or being performed under this agreement, and the premises where the work is being performed, at all reasonable times and in a manner that will not unduly delay the work. If Reclamation performs inspection or evaluation on the premises of the Recipient or a subrecipient, the Recipient shall furnish and shall require subrecipients to furnish all reasonable facilities and assistance for the safe and convenient performance of these duties.

V.16 AUDIT (Reclamation 09/03)

Recipients are responsible for obtaining audits in accordance with the Single Audit Act Amendments of 2004 (31 U.S.C. 7501-7507) and revised OMB Circular A-133, “Audits of States, Local Governments, and Non-Profit Organizations.” Audits shall be made by an independent auditor in accordance with generally accepted government auditing standards covering financial audits. Additional audit requirements applicable to this agreement are found at 43 CFR 12.66 or 43 CFR 12.926, as applicable. General guidance on the single audit process is included in a pamphlet titled,

"Highlights of the Single Audit Process" which is available on the internet at http://www.dot.gov/ost/m60/grant/sincontact.htm. Additional information on single audits is available from the Federal Audit Clearinghouse at http://harvester.census.gov/sac.

V.17 ENFORCEMENT (Reclamation 08/03)

In accordance with 43 CFR 12.83 or 43 CFR 12.962, as applicable, if the recipient materially fails to comply with any term of this agreement, whether stated in a Federal statute or regulation, an assurance, in a State plan or application, a notice of award, or elsewhere, Reclamation may take one or more of the following actions as appropriate:

(1) Temporarily withhold cash payments pending correction of the deficiency by the recipient or subrecipient or more severe enforcement action by the awarding agency;

(2) Disallow (deny both use of funds and any matching credit for) all or part of the cost of the activity or action not in compliance;

(3) Wholly or partly suspend or terminate the current award for the recipient's or subrecipient's program;

(4) Withhold further awards for the program; or

(5) Take other remedies that may be legally available.

V.18 TERMINATION (Reclamation 08/03)

In accordance with 43 CFR 12.84 or 43 CFR 12.961, as applicable, and except as provided for in the Enforcement Provision, above, this agreement may be terminated in whole or part only as follows:

(1) By the awarding agency with the consent of the recipient or subrecipient in which case the two parties shall agree upon the termination conditions, including the effective date and in the case of partial termination, the portion to be terminated, or

(2) By the recipient or subrecipient upon written notification to Reclamation, setting forth the reasons for such termination, the effective date, and in the case of partial termination, the portion to be terminated. However, if, in the case of a partial termination, the awarding agency determines that the remaining portion of the award will not accomplish the purposes for which the award was made, the awarding agency may terminate the award in its entirety under either the Enforcement Provision or paragraph 1 of this Provision.

V.19 PREAWARD INCURRENCE OF COSTS -- COST SHARING OR MATCHING AGREEMENTS (Reclamation 08/03)

The Recipient shall be entitled to have incurred costs for this agreement, in a total amount not to exceed $80,000, for allowable costs incurred on or after October 1, 2004, which if had been incurred after this agreement was entered into, would have been allowable under the provisions of the agreement.

In accordance with the cost sharing or matching requirements of this agreement, the recipient is eligible to receive reimbursement for a portion of these total allowable costs in an amount not to exceed $80,000.

V.20 RIGHTS TO DATA (Reclamation 08/03)

For recipients subject to the administrative standards set forth in OMB Circular A-110, the following provision, as implemented by 43 CFR 12.936(c), shall apply:

-The Federal Government has the right to:

(a) Obtain, reproduce, publish or otherwise use the data first produced under an award; and

(b) Authorize others to receive, reproduce, publish, or otherwise use such data for Federal purposes.

21 DUN AND BRADSTREET (D&B) DATA UNIVERSAL NUMBERING SYSTEM (DUNS) REQUIREMENT (Reclamation 09/03)

Effective October 1, 2003, applicants for Federal grants or cooperative agreements must provide a D&B DUNS number with their application. This number is to be included in Block 6 of your SF-424 Application for Federal Assistance, along with your Employer Identification Number.

If you do not have a DUNS number, one may be obtained at no cost by calling the dedicated toll-free DUNS Number Request Line at 1-866-705-5711.

Individuals who would personally receive a grant or cooperative agreement award from the Federal government, apart from any business or non-profit organization they operate, are exempt from the requirement to provide a DUNS number with their application. Reclamation must, however, have a DUNS number for payment processing purposes, and will therefore obtain a DUNS number for any individual who is awarded a grant or cooperative agreement.

Approved List of Conservation Measures Eligible for Cost-Share Funding Assistance Through Cooperative Agreement Between Reclamation and Belle Fourche Irrigation District

1. Purchase of gated pipe (10" or 12") to replace furrow, siphon tube, or other less efficient flood irrigation methods

2. Purchase of surge valves, lay-flat irrigation tubing for use with surge valves, and associated fittings

3. Convert center-pivot sprinkler packages from above-truss sprinklers to drop tubes and low pressure sprinklers

4. Rehabilitating flood irrigated fields by leveling or reducing the length of runs to match soil type and/or capacity of water delivery system

5. Purchase and installation of lining or pipe in open earth ditches

6. Installation or replacement of control structures and/or measuring devices

7. Improvements to water recording methods (computers, etc.)

8. Reuse drainage where possible

9. Provide education information to water users (meetings, newsletters, attend water management workshops, etc.)

10. Maintenance of pipeline systems

11. Change irrigation delivery system to more efficient method

    a. Replacing a furrow-open ditch system or siphon tube system with gated pipe or sprinkler system
    b. Replacing gated pipe with sprinkler system
    c. Replacing solid set, tow line, or side roll (wheel line) sprinkler system with a center-pivot sprinkler system

12. Purchasing and installing irrigation scheduling equipment/tools.

13. Other practices which Reclamation and the District mutually agree have demonstrated the ability to conserve water.

(Note: Items #1 through #4 are on-farm efficiencies that may be implemented, but must be made available to the entire project equally.)

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AWARD INSTRUMENT DETERMINATION

1. Title and description of proposed project: Belle Fourche Irrigation District Water Management/Conservation, Demonstration, and Implementation.

Reclamation's Water Conservation Field Services Program (WCFSP) provides assistance to water users with emphasis in the following four: preparation of Water Management and Conservation Plans, implementation of effective and economically feasible water management measures, demonstration of innovative conservation technologies, and promotion of conservation information and education. The purpose of this agreement is to provide a mechanism for Reclamation, through the WCFSP, to provide financial assistance for demonstration and implementation of water conservation measures within the Belle Fourche Irrigation District. Funding will be provided to cost-share improvements in irrigation water delivery and new technologies will be demonstrated which may conserve water and increase water delivery efficiency.

Funding and participation in this cooperative agreement will: (1) benefit the public by ensuring efficient utilization of our natural resources, water stored in Belle Fourche Reservoir and electrical energy used for irrigation; (2) benefit the public by encouraging water conservation, thus, allowing water to remain within the reservoir ~~and the river system~~ for other uses, such as recreation and fisheries; (3) maximize the usefulness of Federal facilities (Belle Fourche Dam and Reservoir, District Irrigation Facilities).

2. Statutory Authority:

Statute or Public Law Number:
Fish and Wildlife Coordination Act of 1958, 85 Stat. 621; 16 United States Code (U.S.C.) § 661, as amended.
P.L. 108-137, Energy and Water Development Appropriations Act, 2004.

b. Provide information on which section(s) of the statute authorize financial assistance:
16 U.S.C. § 661, section (1) *"to provide assistance to, and cooperate with, Federal, State, and public or private agencies and organizations in the development, protection, rearing, and stocking of all species of wildlife, resources thereof, and their habitat..." In addition, Reclamation's 255 Departmental Manual (DM) 14.1 states, "The Commissioner, Bureau of Reclamation, is delegated so much of the authority of the Secretary under the Fish and Wildlife Coordination Act, 16 U.S.C. 661 et seq., as is necessary to provide assistance, through grants or cooperative agreements, to public or private organizations for the improvement of fish and wildlife habitat associated with water systems or water supplies affected by Reclamation projects."*

SEC. 212. The Secretary of the Interior, acting through the Commissioner of the Bureau of Reclamation, is authorized to enter into grants, cooperative agreements, and other agreements with irrigation or water districts to fund up to 50 percent of the cost of planning, designing, and constructing improvements that will conserve water, increase water use efficiency, or enhance water management through measurement or automation, at existing water supply projects within the states identified in the Act of June 17, 1902, as amended, and supplemented: Provided, That when such improvements are to Federally owned facilities, such funds may be provided in advance on a non-reimbursable basis to an entity operating affected

transferred works or may be deemed non-reimbursable for non-transferred works: Provided further, That the calculation of the non-Federal contribution shall provide for consideration of the value of any in-kind contributions, but shall not include funds received from other Federal agencies: Provided further, That the cost of operating and maintaining such improvements shall be the responsibility of the non-Federal entity: Provided further, That this section shall not supersede any existing project-specific funding authority. The Secretary is also authorized to enter into grants or cooperative agreements with universities or non-profit research institutions to fund water use efficiency research.

c. CFDA Number or Pseudo Code:

3. Authorization of appropriations: FY05 Appropriations P.L. 108-137.

4. Proposed recipient: Belle Fourche Irrigation District

a. Competitive award: N/A

b. Noncompetitive award:

(1) Name of recipient: Belle Fourche Irrigation District

(2) Type of organization: District

(3) Cite the exception to the requirement for competition:

This financial assistance action is made without competition in accordance with the following exception provided for in the Reclamation Manual:

[ ] (i) Awards which are statutorily mandated or based on a statutory formula;

[ ] (ii) Awards for $25,000 or less;

[ ] (iii) Awards made for $100,000 or less for the continuation of a project by the initial recipient;

[ ] (iv) Awards made to satisfy a particular need or problem which cannot adequately be generalized for the purpose of competition;

[ ] (v) Awards where there is insufficient time available (due to a compelling and unusual urgency involving an emergency or a substantial danger to health or safety) for adequate competitive procedures to be followed:

[X] (vi) Awards where it is impracticable to secure competition (e.g., when there are no other eligible recipients); or

[ ] (vii) Awards where award without competition is consistent with Federal law or Executive order (i.e., where the existence of the assistance project must be confidential for purposes of national security, defense, or law enforcement).

(4). Set forth the supporting data in sufficient detail to provide the basis for the exception [not required for exceptions (i) through (iii)]: The award will be made on a noncompetitive basis to the District because there are no other eligible recipients since Reclamation's WCFSP Directives and Standards (WTR 01-02), in Section 4., part D., subsection 3; states *"Reclamation may provide financial assistance to agricultural and M&I water user entities or other Federal and non-Federal entities to assist in the development and implementation of efficiency measures, including the performance of associated environmental activities necessary to support the installation of such measures."* In addition, contracting with the District on a non-competitive basis is beneficial to the government because it is most economical.

Reclamation entered into a water service contract with the District on October 27, 1949 (Contract Nos. Ilr-1555 and 14-06-600-1949A). Due to their familiarity with project operations the District is unique in their ability to conduct activities identified under this agreement and implement water conservation measures. Funding provided for the activities identified under this agreement will improve the recipients operations, management, and water utilization efficiency from the Federal project.

(5). Address whether there will be recurring or future need for this or similar assistance (and, if so, whether further actions will be processed on a competitive basis): There will be a recurring need for Federal financial assistance on an annual basis for each year the agreement is in place. Future actions will also be processed on a non-competitive basis.

5. Indicate the type of business instrument proposed for award of this action

a. Type of instrument: Cooperative Agreement

b. If the award instrument will be a cooperative agreement, include an explicit statement of the anticipated nature, character, and extent of Federal programmatic involvement: Over the next 5 years the ~~Dakotas Area~~ Rapid City Field Office Water Conservation Coordinator and other Reclamation staff are expected to have substantial involvement in providing technical assistance to encourage, facilitate and assist in the implementation of water management and conservation activities. Reclamation staff will provide technical assistance to the District to help collect data, develop resource inventories, design and evaluate potential efficiency measures, develop water budgets, perform studies and investigations, and conduct appropriate environmental evaluations and compliance.

6. Estimate the amount of funding and any other type of assistance that will be provided to the recipient during the term of the agreement: $425,000 as follows:

FY 2005 - $5,000 technical, $80,000 financial
FY 2006 - $5,000 technical, $80,000 financial
FY 2007 - $5,000 technical, $80,000 financial
FY 2008 - $5,000 technical, $80,000 financial
FY 2009 - $5,000 technical, $80,000 financial

Funding provided through Reclamation's Water Management and Conservation Program fund (WMC), cost authority A10-1316-DKA1-001-00-0-0, and Project Specific Program budgets will be made on a discretionary basis. Reclamation' share shall not exceed 50% for implementation activities funded through Reclamation's Efficiency Incentives Program (EIP), cost authority A10-1775-DKO1-300-00-0-0. Reclamation estimates over the next 5 years providing pertinent conservation related information on a

periodic basis, an estimated $5,000 annually in technical assistance, and an estimated $80,000 in FY 2005 and $80,000 annually thereafter to assist with the implementation of the recipient's water management/conservation activities.

7. Estimate the amount of cost share or matching and other types of contributions that will be provided by the recipient during the term of the agreement: Recipient will match Reclamation's financial contribution which is estimated to be $400,000 over the life of the agreement. Approximately $80,000 in FY 2005 and $80,000 annually thereafter in the form of cash, materials, supplies, use of facilities, and in-kind services.

8. Based on the foregoing information, discuss how the proposed project will assist the recipient in carrying out the public purpose of support or stimulation authorized by the above law: The purpose of this agreement is to provide a mechanism for Reclamation to provide technical and financial assistance through the WCFSP to assist with implementation of economically feasible water management/conservation measures. With financial assistance provided under this agreement, fish and wildlife habitat associated with water systems or water supplies affected by the Belle Fourche Project will be improved through implementation of effective water conservation measures which will improve the recipients operations, management, and use of water from the Federal project. The District, local counties, water users, and public will benefit from the project by more efficient use of the water resource. The Federal government will not be receiving any form of a deliverable product or service, unless otherwise authorized by statute.

DETERMINATION:

Based on the foregoing information, I hereby determine that there is legislative authority to enter into this transaction which is for a public purpose of support or stimulation, and that in accordance with the statutory criteria at 31 U.S.C. 6301 et seq., the proper award instrument for the proposed action is a cooperative agreement.

Prepared by: _____
Name Date

Rapid City Field Office Water Conservation Coordinator
Title

Approved by: _____
Name Date

_____
Title

REVIEW:

In accordance with 505 DM 2.6.E(1)(a), a review of the determination of award instrument shall be made at an organizational level separate from the level where the determination was made to insure objectivity in the decision-making process and to ensure that financial assistance instruments are not being used to circumvent applicable Federal procurement laws or regulations. Accordingly, I have reviewed the above award instrument determination pursuant to 505 DM 2.6.E(1)(a) and concur in this determination. Where

applicable, this review also certifies approval for the issuance of a noncompetitive financial assistance action for which the Government's share exceeds $300,000 (including all anticipated modifications).

Reveiewed by: _____

Name Date

_____

Title