Blacksmith Fork Irrigation Company
System Description and Operation

Author: David Olsen
Last Update: July 02, 2013

1.1 Description

This document is a description of the Blacksmith Fork Irrigation Company canal system and operating policy. This paper is an attempt to document the verbal and historical knowledge of past and current directors, water masters and other irrigation company workers.

1.2 Water Rights

The Irrigation Company water rights on the Blacksmith Fork River entitle the Company to divert 50 CFS (Cubic Feet per Second) until July, then 40 CFS for the remainder of the year. The Providence & Millville Blacksmith Fork companies together with Hyrum, and Nibley must share the water in the river (1/3 each) up to the maximum water right. Hardware Ranch and Millers Inc. have secondary rights on the Blacksmith Fork River. The amount of water available in the river differs from year to year and throughout the season. The three companies meet together as needed to measure and adjust the diversions for equal flow. As an example during 2001 (a drought year) our 1/3 share was only 30 CFS in July and in 2002 the diversion flow decreased to 27 CFS.

The Providence Blacksmith Fork Irrigation company is entitled to 56% of the water in the canal. The Millville Blacksmith Fork Irrigation company has the remaining 44%. The genesis of the 56/44 split was based on irrigated acres. The original water rights list about 1000 acres to Millville's 800 or so.

1.3 Water Shares

The Irrigation Company has 1400 shares owned by approximately 330 shareholders (2004). Providence City currently owns 342 shares, 130 of these shares are in the lower canal. Current shareholders own all water shares. No shares are available for sale from the water company. From time to time shareholders may sell unused or unwanted shares. The best way to find shares available for sale is to ask around or advertise. Shares have currently been selling for around $750.00. City owned shares can be traded, but Utah State ordinance restricts shares owned by a city from being sold. The current assessment is $18.00 per share. Shares less than one full share (1/4, ½ etc.) are assessed at $18.00.

1.4 Stock Certificates

To transfer water shares to another party you must present a valid stock certificate. Fill in the appropriate sections on the back side of the certificate and mail or deliver the certificate to the water company secretary. A $20.00 fee is charged for new certificates. Stock certificates must be signed by both the President and Secretary and bear the water company's seal. A lost certificate affidavit can be issued by the secretary in cases where the original certificate has been lost and the company records show proper ownership. Yearly assessments and schedules are mailed to the current address of the stock holder.

1.5 Description of the Canal System

The Company shares river diversions with the Millville Irrigation Company. There are two river diversions: the "Upper" and the "Lower", which are described in detail below. The canals run through the cities of Nibley, Millville, and Providence, UT, and through unincorporated areas of Cache County, UT. The length of the system is about 7 miles.

1.6 River Diversion

The river diversion for the upper canal is located near the mouth of Blacksmith Fork Canyon and was constructed in 1986. Wooden boards can be installed on top of the dam during low water conditions. The water flow into the canal is measured in a 72-inch parshall flume.

The water travels for the first 2-miles in a concrete liner which was constructed in 1963. Near the coyote research station in Millville the liner empties into an open earthen ditch which continues into Millville and Providence.

1.7 Upper Canal

The river diversion for the upper canal is located on the Blacksmith Fork River, near the mouth of Blacksmith Fork Canyon; east of the residence at 5570 Hollow Road (41°37'48.66"N 111°48'13.41"W). The canal runs north for the first two miles in a concrete liner that ends near the USU Predator Research Station (41°39'26.77"N 111°49'6.97"W). This liner passes through areas of Nibley, Utah, just East of the Hollow Road area. At the liner end, the canal enters an earthen ditch that continues north into Millville and Providence.

The upper canal enters the Providence Company district near 150 E 300 N, Millville (41°41'12.40"N , 111°49'11.91"W). The Upper canal runs generally north into Providence where it meets the intersection of 500 South, Main St., Providence. From there, the canal continues north along Main St. and eventually reaches 100 N, about 150 East, Providence. From this point the canal divides into 3 streams that eventually become three separate tail streams in Providence. The first of these steams runs due west to Hwy 165 and 100 N (41°42'36.33"N 111°50'4.28"W), The second tail stream runs west, then north

along 100 E, then west along 200 N, Providence, and then north along 100 West to terminate near 400 N, 100 West, Providence (41°42'53.51"N 111°49'13.16"W). Finally, the third tail water stream runs north to terminate near 200 E, 300 North, Providence (41°42'51.98"N 111°48'41.88"W). All three of these tail water streams empty into the natural stream bed of Spring Creek. The upper canal supplies 3 to 4 concurrent city streams and the city exchange pump.

1.8 Lower Canal

The lower canal has two sources. The lower diversion is South and West of Millville and supplies 3 to 4 CFS. This new structure was completed in the fall of 2002 and has a rock spillway. Water from this diversion flows North thru Millville, along the West side of Providence, then West along the Providence lane.

Excess water from the upper canal flows west in a concrete pipe along 300 North in Millville and is discharged into the lower canal near 300 North and 200 West. Normally insufficient water is available from the lower diversion for agricultural needs. Water must be transferred from the upper canal to the lower to provide sufficient flow on the lower canal.

The lower canal begins on the Blacksmith Fork River , approximately 400 E, 3900 S, Cache County (41°39'45.65"N 111°49'32.08"W). This lower canal enters the town of Millville near 300 South and Main street, and continues generally North to where the Providence Company district begins at about 300 N, 200 W, Millville (41°41'14.75"N 111°49'40.05"W). At this same location, the Upper canal joins via a buried pipe running to the West, from 300 N, 150 E, Millville. The Lower canal continues north into Providence, eventually reaching 300 S, 200 West, Providence; thence, the canal continues north along 200 W to the intersection of 200 West, 100 North, Providence (Zollinger Park). There, the canal joins with the Upper Canal stream and continues West in pipes westward along 100 North to the intersection of Highway 165 and into Spring Creek (41°42'36.33"N 111°50'4.28"W). Pipes run on both the north and south sides of 100 N., running to the West.

1.9 Water Flow Measurement

Canal water flow is measured in three parshall flumes.

Location	Throat Width
River Diversion	6-ft (72 in)
Liner End	6-ft (72-in)
300 North, Millville	4-ft (48-in)

The depth (Ha) is measured upstream from the throat at two-thirds the distance of the converging section. When properly maintained, all three flumes operate under free flow conditions where there is insufficient tailwater depth to reduce the discharge rate. The flume equations are as follows:

Q = Flow (Cubic Feet per Second)
W = Throat Width of Flume in Feet
H = Head in Feet

$Q = 4WH^X$ $(x = 1.522W^{.026})$

For a 72 inch flume: $Q=4(6)H^x$ (where $x = 1.522(6)^{.026}$)

For a 48 inch flume: $Q=4(4)H^x$ (where $x = 1.522(4)^{.026}$)

1.10 City Streams

City streams are 1.0 CFS and are supplied with 6-inch headgates. City streams are scheduled every 7-days + 16 hours.

1.11 Field Streams

Field streams are allocated by the watermaster and are generally not scheduled. The watermaster attempts to supply up to 3.0 CFS for field streams, lesser flows soak into the ground and make it difficult to cover the acreage in a reasonable time. Some field streams are scheduled and are assigned every 15 days + 8-hours. These streams are supplied with 8 to 12-inch headgates.

The farming needs for field streams are varied. Some crops such as grain only need one watering. Hay is watered at least twice, corn is watered four or five times and pasture is often watered every 2-weeks. The watermaster attempts to provide timely water depending on the farmers needs. Unfortunately, during hot weather the watermaster's request list can have 10 or more requests lined up. Historically some farm users have considered their shares sufficient to water a certain acreage. Full coverage however, is not guaranteed. Water shares are "shares" and do not guarantee certain amounts of water. Users who need only one watering cannot expect a seasons share of water in one session. The canal

system has no water storage capability. Some fields have gravely soil and are difficult to water. No guarantee is made that sufficient water will be available for such fields. As a guideline the watermaster will restrict field streams to 24 hours per 5 acres.

Many farmers poorly manage their water time and excess water can be seen running off their fields for extended periods of time or ponding at the bottom of the fields. The watermaster will shut off water to such users regardless of the number of shares held by the user. Please report conditions of water waste to the watermaster.

1.12 Laterals

The Irrigation Company owns and maintains the canal and the associated right-of-way. The Irrigation Company does not own or maintain the laterals, head ditches, city ditches, culverts and other waterways not within the right-of-way of the canal. Maintenance of the laterals and city ditches is the responsibility of the individual water users. The right-of-way of the laterals is owned by the City and associated property owners.

Several stock holders in Providence have not used their water and over time the ditches have been filled in by neighbors and new construction. It is the responsibility of users to maintain their prescripted right-of way for their ditches. The Irrigation Company will not repair or restore lateral ditches to such users.

1.13 Spring Creek Trade

Historically Providence City has insufficient water shares in Providence Canyon to maintain their reservoirs and culinary water system. Years ago a “trade” was negotiated with the Irrigation Company to pump water from the Blacksmith Fork Irrigation system using shares owned by the City to the Spring Creek Irrigation system. The city then diverts water from the canyon springs to the culinary water system. This is done with a pump house located at 150 East 100 South in Providence. The pump discharges water to the Spring Creek system near 300 East Center. The pump is owned and maintained by Providence City. Currently Providence City uses all of their shares on the upper canal to provide for this transfer. The Irrigation Company currently discourages Providence City from leasing any of their shares on the upper canal. During low water years it is a struggle to maintain the 1-1/2 CFS pump flow rate without the pump running dry intermittently.

1.14 Water Flow

In response to many enquires as to “how much water is a share”, John Hubbard made the following calculations:

1 acre ft = 43,560 cu.ft. x 7.48 gallons /1 cu.ft. = 325,829 gal

Assume one share of water equals 1 acre ft per season.

The company has a total of 1402 shares = 1402 acre ft /season.

1402 acre ft = 456,812,258 gal (1402 x 325,829)

Convert company total per season to cu. ft.

(456,812,258 gal) / 7.48 gal per cu.ft = 61,071,157 cu.ft. per season

An irrigation season consists of 153 days (May,June,July,Aug,Sept).

153 days = 13,219,200 seconds (60 x 60 x24 x 153)

Calculate the flow for the company during the season:

(total water in cu.ft. divided by time in seconds)

61,071,157 cu ft. / 13,219,200 sec = 4.62 cfs (assuming no carrier water)

For a shareholder with 1 share (1 hour per share for a city stream):

1 acre foot = 325,829 gals

Over the season figure 5 months total or about 20 irrigation turns.

Divide 325,829 gal by 20 to get gallons per turn.

325,829 gal/ 20 turns = 16,291 gallons per turn.

Or in cu.ft., 16,291 gal / (7.48 gal /cu.ft.) = 2178 cu.ft. / turn.

At 1 cfs it would take 2178 seconds or 0.6 hours to deliver this.

At about 0.6 cfs this would take about an hour.
This is what a turn usually delivers with a 6-inch gate!

Another interesting calculation:

If 20 cfs is available at the coyote ranch.

20 cfs = 149.6 gal/ sec

The stream is divided between Millville (44%) and Providence (56%).

If we assume 56% of 20 cfs, we get 11.2 cfs or 83.8 gal/sec as our share.

83.8 gal/sec x 86,400 sec/day = 7,240,320 gallons/day

1.15 Water Flow

In 2003 (a low water year) the water flow was as follows:

River diversion	+27 CFS
Losses in liner	-1.5 CFS
Losses south of Millville	-7.0 CFS

Total	18.5 CFS

This must be split between Millville and Providence:

18 CFS x 56% = 10.3 CFS

Another 4 to 5CFS are lost in the canal between Millville and Providence

The upper canal flow into Providence City is typically divided as follows:

Providence city pump	1-1/2 CFS
3 city streams @ 1 CFS/ stream	3 CFS
1 farm stream	3 CFS
ditch loss	½ CFS

Total	8 CFS

Eight to nine CFS are needed in the flume at 300 North in Millville to meet the minimum needs in Providence.

1.16 Carrier Water

The canal is 6-miles long and becomes smaller and smaller as it travels North. Eventually the canal ends near 200 North in Providence, a waste ditch continues North into Spring Creek. If users close too many headgates the canal overflows into the street. If someone in Millville or elsewhere opens a 18-inch field stream

gate the canal dries up. The system currently has no water storage capability anywhere in the system. The watermaster must work continually to maintain proper flow in each segment of the canal. Unfortunately, it's a hopeless task and from time to time the canal may be dry in some segments. To provide water for users near the end of the canal the watermaster attempts to adjust the system for a positive flow. The goal is to have approximately 0.5-CFS excess "carrier water" in the system. Often users will drive by and see this water going to waste into spring creek and complain - "water is being wasted". However, without a positive flow, small changes anywhere along the canal will dry up the last user.

1.17 Time per Share

A stockholder "share" is a proportional share of the available water. During times of drought water use must be restricted, unfortunately, there is no practical way to control the amount of water released by the headgates. Users open their headgates all the way up regardless of the available water. The only practical way to manage total usage is by adjusting the time for each share. During drought seasons less concurrent streams are operated via shortened schedules. The Board of Directors meet each year and based on snow pack forecasts, assigns the time/share for the season. The time/share has been 1:00 hr/share for the last several years. During 1992 the rate was 3/4-hrs/share and in 1994 1:15 /share.

During average water years 4-concurrent city streams are scheduled. On low-water years 3-concurrent streams are scheduled.

1.18 Backer Boards

Many of the canal headgates have provisions for backer boards. Backer boards are installed to raise the level of the canal to provide sufficient release of water at the headgate. Headwater is the depth of water above the culvert invert at the entrance end of the culvert. Users are asked to be considerate when installing backer boards. Some segments of the canal have very little fall. Installing backer boards can create an upstream pool which may take 15 or so minutes to fill. During those fifteen minutes all of the downstream users will be without water.

If the culvert outlet is open to the atmosphere it is likely that the entrance geometry will control the headwater and the culvert will be on "inlet" control. Hydraulic capacity of a culvert is directly affected by the headwater depth. The company policy is that backer boards can be installed to raise the water only to the TOP of the headgate culvert. Backer boards should be removed after use to prevent additional water loss into the surrounding soil from the elevated pool.

1.19 Stream Scheduling Process

Currently the Irrigation Company issues new schedules every year. This allows for changes to consolidate transferred shares and to accommodate leased shares. Please do not use schedules from prior (old) years.

It is reasonable to reschedule the use of the shares of people who don't want to give up the shares, but have no intention or possibility of using them.

1. The water turn cycle time is 7 days + 16 hours (184 hours).
2. Shares to be scheduled are organized into six streams. Generally, Stream 1 is the furthest upstream, then Stream 2, etc. Within each stream, turns are organized so that Turn 1 is the furthest upstream, then turn 2, etc. This is most efficient as it allows the next turn to start without having to run water down a dry ditch for a long time.
3. Streams are paired, so that Stream 1 runs first, then Stream 2, and then repeat at the beginning of the next cycle.
4. The total time for each pair of streams must be less than the cycle time. In recent years, one hour watering time per share has been allocated.
5. Streams 1, 3, and 5 start at the same time, so that at any given time, there may be three streams running. Since each pair of streams stream does not have a full 184 shares scheduled, there are some gaps at the end of particular streams.
6. The schedules have been generated in Microsoft Excel format, then merged with a Word file.
7. Field Streams and the water belonging to Providence City are not on schedules. The water on the lower canal has also not been scheduled. The watermaster schedules field streams on a request basis.
8. Providence City may divert and pump up to ____% of the available stream based on the shares they have available.

1.20 Mixed Users

The Irrigation Company currently has two types of traditional users:

1. Upper canal (city users)
    a. Scheduled: 7-Day + 16 hour (8 day)
    b. Use “city” headgates

2. Lower Canal (field users)
    a. No schedule: 15-day + 8 hour, appointment with watermaster
    b. Use larger “field” headgates

Recent urban growth on the west side of Providence has created the need for additional scheduling flexibility for these new water users. Former agricultural land has been converted to housing, which has different irrigation needs. Users on the new pressurized lateral along 300 South have specifically requested special scheduling for their needs:

- 15 days is too long between turns for watering lawns and gardens.
- A 12-inch headgate is too big for pumping or urban use.
- 1-hour per share is not long enough for sprinkling.
- Users want to pump and sprinkle instead of flood irrigate.
- A pressurized lateral allows effective use of less than the full stream normally supplied by a canal headgate.

To accommodate these needs the following new policy has been implemented:

1. A new optional weekly schedule (7 days + 16 hours) for field stream headgates.
2. To accommodate sprinkling, the schedules can be overlapped and adjusted such that multiple concurrent users on a lateral use smaller amounts of water for a longer period of time
3. Users must have water shares. Shares can be owned or leased. Providence City has been leasing their unused shares on a year-to-year basis with no guaranteed renewal based on the city’s needs.
4. No changes to the water schedule will be considered after April 1.

To make this work, the users on a common lateral must work together and with the Irrigation Company secretary to arrange a joint water schedule for all involved. Please note to be fair to all water users, the Irrigation Company does not permit pumping directly from the canal. Pumping from an open lateral, pressurized lateral, or “air-box” which is fed by a standard canal headgate is allowed.

1.21 De-mossing

Algae and other aquatic plants grow in the canal. During hot weather the plants grow into a dense mat, which severely restricts the water flow. In the past chemicals have historically been used to kill the plants. Once each season xylene was injected into the canal south of Millville. Unfortunately xylene is toxic to fish and must not be allowed into Spring Creek under any condition. The EPA has discouraged the use of xylene and the cost of the chemical has become prohibitive. Other alternatives are available but all are very expensive and require application throughout the growing season. Several years ago a licensed pesticide applicator in Cache Valley was killed in an accident while applying an alternative chemical (magnacide).

For safety and cost reasons Irrigation Company has NOT applied de-mossing chemicals the past several years. While the resulting moss buildup does restrict the water flow, the flow has been found to be still workable. The canal between 4th and 5th south in Provicence has been problematic for moss growth because this segment is shallow and has no grass cover on the banks. The watermaster has been mechanically cutting the moss is this segment with a gas powered cutter with good success.

1.22 Watermaster

The watermaster works for the six months of April to September. Responsibilities include: measuring and controlling the river diversion, monitoring the canal and turnouts, allocating field streams and cleaning gratings. The Watermaster schedules maintenance and coordinates water users and other irrigation companies on the Canal. The Watermaster must have a current driver's license and reliable transportation. The Watermaster works daily 1-2 hours in the morning and 1-2 hours in the afternoon (hours are flexible). The company provides a $200/month truck allowance. The Irrigation Company provides a cell phone and basic tools.

Trash piles which accumulate near the trash racks and gratings have historically been disposed of by Providence City. The City bills the Irrigation Company for this work. Currently the Irrigation Company has been paying the watermaster an extra fee each month to do this work. Normally the watermaster or canal worker will pile material removed from the trash rack nearby and allow it to dry. The accumulated material is generally removed each week.

1.23 Board of Directors

The Irrigation Company is governed by a president and three directors, each having 2-year elected terms. One of the directors is appointed by Providence City as the city is the majority stockholder. The president is paid $100/ year and the directors $50/ year. The secretary and watermaster are salaried and hired by

the president and directors. The president and directors do not have keys to the headgates, keys are held and maintained by the watermaster.

1.24 Insurance

The Irrigation Company pays workman's comp for the watermaster. An insurance policy is purchased to cover liability for the Irrigation Company. Directors Insurance is also purchased to indemnify the president and directors.

The canal system is inherently dangerous, especially for children. Please immediately report any missing gratings or dangerous conditions.

1.25 Canal Right-of-Way

The installation of headgates, culverts and other changes to the canal within the canal right of way require written permission from the Irrigation Company. Many Salt Lake canal companies require a fee for engineering review and inspection of such changes. Currently however, the irrigation company does not require such fees.

The right of way generally extends ten feet from the center of the canal. The canal company works to preserve and protect its right-of-way. Periodically a track hoe is hired to clean and maintain the canal. Fences, trees, dog pens and other encroachments will be removed by the track hoe. In the spring, canal workers routinely burn the dry grass in and along the canal bank.

End.