



# BLACKFOOT CHALLENGE IRRIGATION SCHEDULING PROGRAM

## ANNUAL REPORT

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### SUMMARY

The Blackfoot Challenge Irrigation Scheduling Program provides information to help irrigators apply the right amount of water at the right time to meet crop goals. We work with individual irrigators to monitor weather, crops, irrigation and soil moisture across the drainage. Weekly reports give participants detailed information specific to their fields while a more general report is circulated basin-wide to other irrigators and water managers. Both include irrigation tips, drought strategies, soil and crop management options and other information focused on water use and conservation. Reports are also provided on the Challenge website. Our work has identified an overall irrigation strategy that can provide both good crop production and adequate late-season stream flows during dry years. This is the sixth year of the program.

### PROGRAM COMPONENTS

A variety of information and services are delivered in multiple ways. We continue to seek improvements to get information to irrigators when they need it in a form that's easy to use.

Information is distributed to approximately 100 irrigators, water managers and others throughout the drainage including:

- Weekly reports summarizing weather, crop water use, soil moisture conditions, crop management, drought strategies, and other information with summary tables and graphics
- An annual report summarizing irrigation, drought and other concerns
- A one-page irrigation calendar summarizing our most important recommendations throughout the irrigation season (see page 7)
- The Blackfoot Challenge Web site with our irrigation guide specific to the Blackfoot drainage and other irrigation information.

**BLACKFOOT CHALLENGE WEEKLY IRRIGATION REPORT**  
Friday, July 3, 2015

**Independence Day could have been declared as a holiday for irrigators – most of them are extremely independent. This one will be warm and dry following another week of high potential crop water use (2-3 inches). A few crops were reported but relatively no soil left on Blackfoot croplands again. Crops again responded well to warm temperatures and clear skies with impressive growth spurts in some fields. A coordinated overview of the entire irrigation season is presented on the last page of this report as a reminder to plan ahead. More information about irrigation is available on the Challenge website.**

**WEATHER - WARM LAST WEEK AND WARM NEXT**  
Very warm, dry weather prevailed last week and will continue next week. Only scattered showers are predicted. Temperatures will again be in the 80 and 90s. The 20 and 30 day forecasts continue to suggest above normal temperatures and normal rainfall. Low streamflows are becoming very low streamflows.

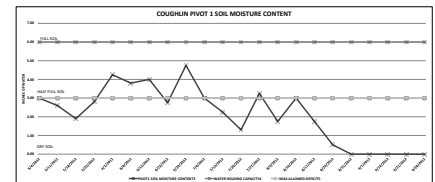
**HIGH CROP WATER USE CONTINUES**  
Crop water use continued to be above 1.5 inches for most crops last week – will allow normal. It will continue to be high next week with hot temperatures and low humidity. The table and chart on Page 5 illustrate crop water use throughout the whole season.

WATER USE BY END USE	LAST WEEK	WEEK TO DATE	SEASON TOTAL
GRAIN CROPS	1.8	10.5	12.3
PASTURE	1.2	6.8	8.0
SPRING GRASS	1.5	11.2	12.7
WINTER WHEAT	1.2	10.5	11.7

**SOIL MOISTURE - ADD WHAT YOU CAN**  
Ideally you have a full soil profile and are ready for the cutting. However, most of those in the Blackfoot Challenge on Planet Earth are struggling to find moisture at all. Do the best you can, leave time for the surface to dry out before cutting and get back on if you can as soon as possible.

Additional Information is provided to individual irrigator participants:

- Soil evaluations for texture and moisture holding capacity
- Soil moisture monitoring throughout the growing season
- Application amount and uniformity evaluations for each system
- Training in soil moisture evaluation
- Customized weekly reports with timely irrigation information and management options
- An annual report summarizing the season and future options



### 2015 PROGRAM HIGHLIGHTS

- 8 systems monitored for weekly soil moisture and crop water use totaling approximately 1200 acres. These farms have a total of approximately 1500 acres of irrigation that this information will be applied on.

- 2015 growing season rainfall on croplands in was 3-5 inches (average = 6-8 inches)
- 2015 potential crop water use in inches: hay=29, pasture=24, grains=19 (higher than average)
- No over-irrigation among irrigation participants – all applied less than crop water use
- 2015 was the second drought year out of the last three years.
- 2015 river flows approached the lowest recorded levels ever and drought response plans were implemented.
- Despite the drought, those who irrigated with enthusiasm early in the season had good yields from first cuttings and were able to reduce irrigation withdrawals when river flows became low.

## 2015 WEATHER

2015 was another drought year similar to 2013. It was much drier than 2014 which was near normal and 2011 which was extremely wet and cold. Growing season rainfall was half of average for most local croplands. Except for a couple short periods, temperatures were above average throughout the growing season.



	<b><u>2015</u></b>	<b><u>AVERAGE</u></b>
Total (gross) growing season rainfall (May1-Sept30):	3-5 inches	6-8 inches
Effective (net) growing season rainfall:	1-4 inches	3-4 inches

An important lesson from this program is the dramatic difference between one year and the next. It is increasingly important for irrigators to pay attention to spring conditions and weather predictions which seem to be getting warmer and more variable. In the past few years the active part of the growing season has started anywhere from late-April to mid-June. This variation can hurt production unless growers are equally flexible. In 2011 when cool, cloudy, rainy conditions persisted into June, those who cut on their regular schedule had a smaller crop. Those who waited an extra week or two saw dramatic increases in production due to that wait. By comparison, in 2013 and 2015, those who irrigated early had a good crop by the time river flows caused drought restrictions. The lesson is to look ahead and be flexible.

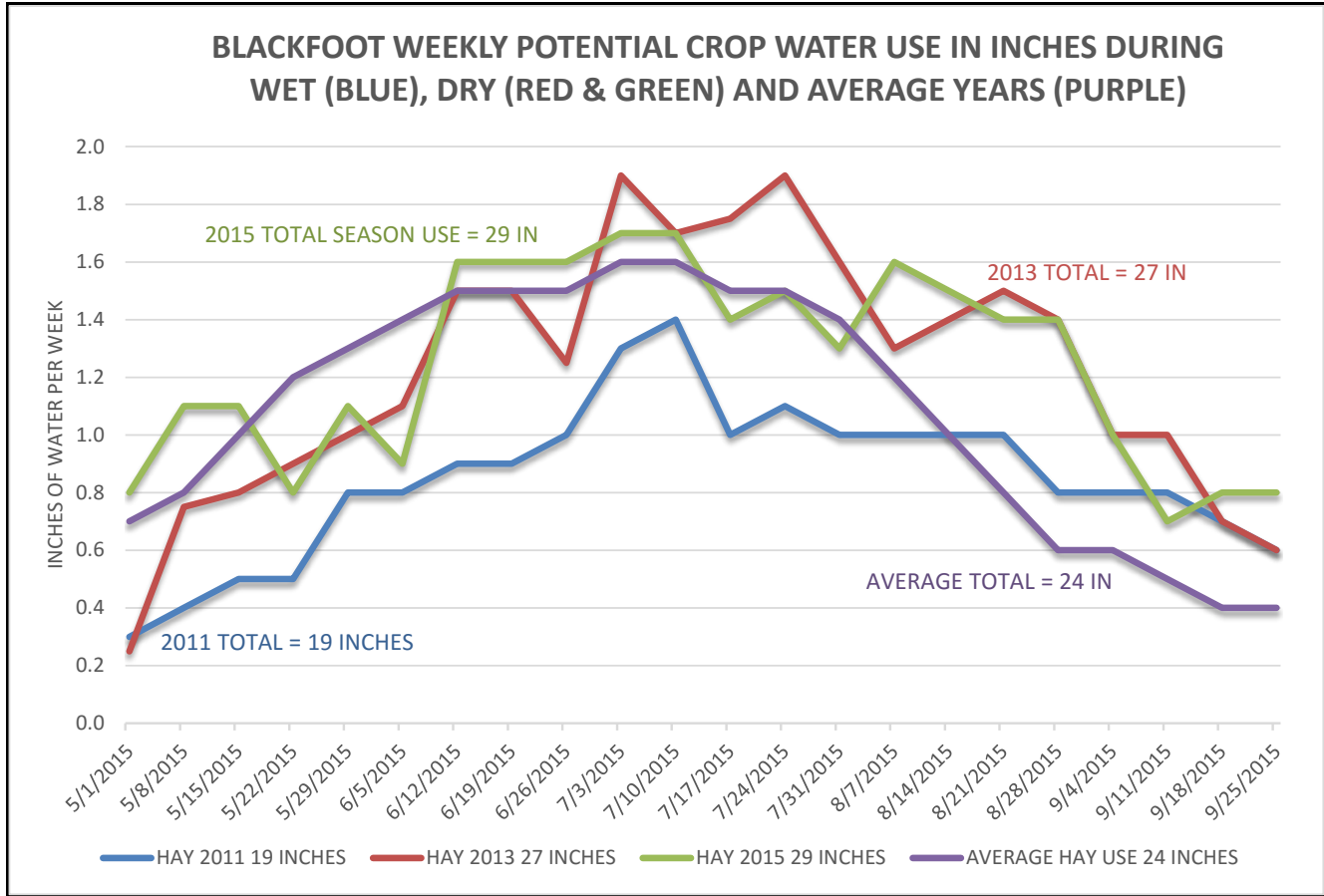
## 2015 CROP WATER USE

Crop water use in 2015 was the highest since our program started in 2010 (Figure 1). Crop water use for hay this year was 29 inches compared with an average of 24 over the past 6 years and a range of 21–29 inches. It is interesting to note that when I began this program in 2010 I estimated the average crop water use as only 21 inches based on long-term NRCS data. This creep upward in average crop water use is one indication of climate change. I have revised my average crop water use figure for hay upward to 24 inches.



Table 1 lists potential crop water use for all crops in 2015. Hay used 29 inches, pasture 24 inches and small grains 18-19 inches.

**FIGURE 1. Weekly Potential Crop Water use in 2015 (Green Line)**



It is important to remember that these **potential crop water use** figures are for a dense, robust stand that is well-irrigated, well-fertilized and mostly disease/insect free. Crops not in such good condition use less water. Actual crop water use across the drainage varies dramatically due to limitations in water, fertilizer, stand quality, micro-climate, management style, and many other factors. Working with individual irrigators across the drainage allows us to re-calibrate regional crop water use information to the Blackfoot area. It also provides accurate information for these irrigators at specific fields throughout the season and a record of using water efficiently.

One of the most significant results of this program is that it continues to reveal that over-irrigation is not common among sprinkler irrigators. Many sprinkler irrigators in the drainage apply only 50-75% of the **potential** crop water use when you consider the entire irrigation season. However, if you just consider the period before cutting, many irrigators participating in this program apply 75-100% of the **potential** crop water demand. This suggests irrigators are smartly concentrating on their first cutting which is where the most production is and the biggest bang for the buck. They then may irrigate in a more relaxed manner to produce pasture for the remainder of the season or cease irrigating due to water availability, water rights, streamflows or other reasons (fishing?).

**TABLE 2. POTENTIAL CROP WATER USE THROUGHOUT THE 2015 IRRIGATION SEASON**

<b>BLACKFOOT 2015 GROWING SEASON WEEKLY RAINFALL &amp; CROP WATER USE (INCHES OF WATER)</b>										
	<b>RAIN<sup>1</sup></b>	<b>2015 WEEKLY POTENTIAL CROP WATER USE<sup>2</sup></b>						<b>AVERAGE POTENTIAL CROP WATER USE<sup>3</sup></b>		
	<b>RAIN</b>	<b>HAY CROPS<sup>4</sup></b>	<b>PASTURE</b>	<b>SPRING GRAINS 5-1 START</b>	<b>SPRING GRAINS 5-15 START</b>	<b>WINTER WHEAT</b>	<b>LAWNS</b>	<b>LONGTERM AVERAGE HAY WATER USE</b>	<b>HOT WEEK HAY WATER USE</b>	<b>COOL WEEK HAY WATER USE</b>
<b>April</b>	0.50	0.90	1.00	0.00	0.00	1.20	1.10			
<b>5/1/2015</b>	0.01	0.80	0.90	0.10	0.00	1.10	0.90	0.50	0.80	0.20
<b>5/8/2015</b>	0.01	1.10	1.00	0.20	0.00	1.20	1.10	0.70	0.90	0.30
<b>5/15/2015</b>	0.10	1.10	0.90	0.20	0.00	1.20	1.00	0.80	1.00	0.50
<b>5/22/2015</b>	0.25	0.80	0.60	0.25	0.20	0.90	0.80	1.00	1.10	0.70
<b>5/29/2015</b>	0.25	1.10	0.80	0.40	0.30	1.20	1.00	1.20	1.20	0.80
<b>6/5/2015</b>	0.50	0.90	0.80	0.50	0.40	1.00	0.90	1.30	1.30	0.90
<b>6/12/2015</b>	0.00	1.60	1.40	1.10	0.90	1.60	1.50	1.40	1.50	1.00
<b>6/19/2015</b>	0.00	1.60	1.40	1.50	1.25	1.70	1.50	1.50	1.70	1.10
<b>6/26/2015</b>	0.00	1.60	1.30	1.70	1.60	1.70	1.50	1.50	1.90	1.10
<b>7/3/2015</b>	0.00	1.70	1.40	1.80	1.80	1.80	1.60	1.50	2.00	1.20
<b>7/10/2015</b>	0.00	1.70	1.40	1.80	1.80	1.80	1.60	1.60	2.10	1.30
<b>7/17/2015</b>	0.01	1.40	1.10	1.50	1.50	1.00	1.30	1.60	2.00	1.20
<b>7/24/2015</b>	0.01	1.50	1.20	1.60	1.60	0.50	1.40	1.50	1.90	
<b>7/31/2015</b>	0.50	1.30	1.10	1.40	1.40	0.25	1.20	1.50	2.20	1.10
<b>8/7/2015</b>	0.01	1.60	1.30	1.70	1.70	0.00	1.50	1.40	1.70	1.00
<b>8/14/2015</b>	0.01	1.50	1.20	1.60	1.70	0.00	1.40	1.20	1.50	0.90
<b>8/21/2015</b>	0.10	1.40	1.10	1.00	1.00	0.00	1.30	1.00	1.30	0.70
<b>8/28/2015</b>	0.01	1.40	1.10	0.50	0.50	0.00	1.20	0.80	1.00	0.50
<b>9/4/2015</b>	0.50	1.00	0.80	0.25	0.25	0.00	0.90	0.60	0.80	0.40
<b>9/11/2015</b>	0.50	0.70	0.60	0.00	0.00	0.00	0.70	0.50	0.70	0.30
<b>9/18/2015</b>	0.30	0.80	0.70	0.00	0.00	0.00	0.80	0.50	0.70	0.30
<b>9/25/2015</b>	0.01	0.80	0.60	0.00	0.00	0.00	0.80	0.40	0.60	0.20
<b>9/30/2015</b>	0.01	0.50	0.40	0.00	0.00	0.00	0.50	0.40	0.60	0.20
<b>TOTAL</b>	<b>3.59</b>	<b>28.80</b>	<b>24.10</b>	<b>19.10</b>	<b>17.90</b>	<b>18.15</b>	<b>27.50</b>	<b>24.40</b>	<b>30.50</b>	<b>15.90</b>

<sup>1</sup> Rainfall should be reduced to account for immediate evaporation from crop and soil surfaces (0.1-May and Sept, 0.15-June and August, 0.2-July)

<sup>2</sup> This years maximum water use by healthy crops that are well-fertilized and irrigated, disease and insect-free. Will vary across the drainage.

<sup>3</sup> Average water use for each crop each week based on long-term historic data.

<sup>4</sup> Hay Crop water use should be reduced by approximately 2/3 the first week after cutting, 1/2 the second and 1/3 the third.

## 2015 SOIL MOISTURE

Early season soil moisture in 2015 was far below average. At the beginning of May most local fields had soil moisture contents of  $\frac{1}{4}$  to  $\frac{1}{2}$  their full water holding capacity. This was due to low snow and rainfall combined with early snowmelt and warm temperatures. Many irrigators had difficulty keeping soil moisture high due to higher than average crop water use throughout the season. Remember that soil moisture levels do not have to be kept high to produce a decent (if not superior) crop. The crop will use moisture as it is applied and if you keep applying it, the crop will respond. We encourage folks to keep soil moisture levels high first because this is how you get the best production. This is also how you provide a reserve in case of equipment problems, water shortage or other irrigation interruption.

## 2015 IRRIGATION TIPS

Irrigation tips were provided each week according to the crop stage, weather conditions and other factors. This year's tips concentrated on application rates, uniformity, above average crop water use due to warmer weather and critical crop watering periods. Tips were expanded this year to include water quality concerns and to respond to irrigator questions.

## 2015 DROUGHT INFORMATION AND STRATEGIES

This year was the driest during our six year program and similar to 2013. Two of the last 3 years have been drought years confirming a warming/drying climate in the Blackfoot drainage. Our weekly reports included streamflow information for the Blackfoot River, tips on how to irrigate during drought and perspectives on drought from elsewhere. This year we reached critical streamflow levels and drought response efforts were implemented. Observations throughout the drainage suggested that most irrigators responded to low streamflow by cutting back on irrigation withdrawals during the critical low flow period in August. Drought strategies include irrigating earlier in the season, growing crops that use less water, keeping soil water holding capacities full and others.

## A BEST-MANAGEMENT STRATEGY FOR BLACKFOOT IRRIGATORS?

This program was designed to help individual irrigators which in turn might help water management across the entire drainage. We have combined experience from the best local irrigators with our own knowledge and with results from monitoring to fine-tune recommendations. We have spread this wealth of information as Irrigation Tips in our weekly reports and irrigation guide. This strategy is condensed into our irrigation calendar (page 7).

These individual recommendations seem to be coming together in an overall strategy for irrigation that can ***provide both good crop production and late-season stream flows*** for fish and recreationists. This might be considered a best management practice for irrigation in the Blackfoot drainage and a landscape-scale solution for water resources. The main points of this practice are:

- early evaluation of the coming irrigation season in April,
- heavy irrigation early in the season to fill up the soil water holding capacity,
- heavy irrigation throughout June and up to cutting in early-mid July
- reduced irrigation or no irrigation during low water flows in late July and August

Despite the very dry year, irrigators who applied water early and kept pouring it on up until haying in mid-July had excellent crops. This same thing happened in 2013 when warm temperatures gave us an extra month of very active growing season on the front end (May). Irrigators who recognized the early year took advantage of it and had some of the best crops ever, then felt good about reducing irrigation during the low flow period.

## WINTER READING LIST

Folks (including the younger generation) have asked me about good books on irrigation and other related subjects of local interest so here are a few suggestions:

**Cadillac Desert by Marc Reisner** has become the classic story of irrigation in the western United States. This book boosted the modern era of water conservation into the spotlight. You can see episodes of a documentary-style movie adaptation of the same name on YouTube but the book itself is worth reading.

**Dirt by D Montgomery, Topsoil and Civilization by VG Carter, and Conquest of the Soil Through 7,000 Years by WC Lowdermilk** all reveal that most places man has lived very long have lost their soils and gone downhill from there. Let's be smarter. The Lowdermilk pub is avail free online and from NRCS.

**Green Fields of Montana: A Brief History of Irrigation by Stanley Howard** is dry and more for the dedicated irrigation enthusiast in Montana but has many interesting facts.

**Your Water Footprint: The Shocking Facts about How Much Water We Use to Make Everyday Products by Stephen Leahy** reveals how much water we really use. You can read a similar NY Times article at: <http://nyti.ms/1BeT82i>

**Elixir by Brian Fagan** and **Water: The Epic Struggle for Wealth, Power and Civilization by Steven Solomon** are examples of the many recent water histories. **The History of the World in Four Glasses by Tom Standage** uses water and other beverages to spin a historical tale of thirst.

**The Botany of Desire by Michael Pollan** is an interesting history of man's relationship and co-evolution with plants. **Cod by Mark Kurlansky** and **Four Fish by Paul Greenberg** present fascinating examples of ocean food systems trying to adapt to modern pressure.

**The Great Warming by Brian Fagan** points out past climate shifts that affected man - between 800 and 1200 AD the world became much warmer (wheat grown in Greenland) and much drier (Chaco Canyon, Sahara).

**A Peoples History of the United States by Howard Zim** and **Who Discovered America by Gavin Menzies** give whole new perspectives on what we learned in history class. Did Portuguese fishermen follow cod to America decades before Columbus and the Chinese mine iron ore in the Great Lakes hundreds of years before?

I hesitate to suggest books by non-scientists but they seem to be doing more to promote soil so here are a few: **Cows Save the Planet: And Other Improbable Ways of Restoring Soil to Heal the Earth** by Judith D. Schwartz, **The Soil Will Save Us: How Scientists, Farmers, and Foodies Are Healing the Soil to Save the Planet** by Kristin Ohlson , **Grass, Soil, Hope: A Journey Through Carbon Country** by Courtney White.

## THE BLACKFOOT DRAINAGE IRRIGATION SEASON IN BRIEF

This is a summary of general activities and recommendations with more detail provided throughout our irrigation guide.

### APRIL – GET READY AND PLAN YOUR IRRIGATION STRATEGY!

- Get your irrigation system ready – perform maintenance and test system.
- Evaluate weather conditions and predictions then plan for drought if needed.



### MAY – CHECK SOIL MOISTURE & BE READY FOR UNUSUAL HEAT OR COLD!

- Check the soil moisture content at the start of growing season (May 1) and fill up the soil to its water holding capacity during early irrigations (2-4 inches).
- Watch for dry soil conditions, especially with new plantings and apply water to ensure good germination and emergence.
- Irrigate deeply at least once early in the season to promote deep root growth.
- Apply 2-5 inches of irrigation to hay and pasture crops in May depending on weather. Apply 0-2 inches to spring grains and new plantings as needed based on weather and growth. Apply extra water to fill up the soil (2-4 in).

### JUNE – THIS IS THE TIME TO MAKE YOUR BIGGEST EFFORT SO POUR IT ON!

- Apply 6-8 inches of irrigation in June to hay and pasture crops and winter wheat depending on weather.
- Apply 5-8 inches to spring grains and new plantings as needed based on weather and growth.
- Consider irrigating deeply to fill up soil root zone and promote deep root growth.
- Be sure small grains are irrigated well during their critical periods of boot, bloom and early heading.



### JULY – POUR IT ON UNTIL HARVEST AND RETURN QUICKLY

- Apply 1 - 2 ½ inches of irrigation per week in July to all crops - depending on weather.
- Cutting is a critical stress period for hay crops, especially alfalfa so irrigate deeply to fill up the root zone before cutting then get back across the field quickly after cutting. Crop water use declines when hay is cut so this is a good opportunity to fill up the soil again. Irrigate at least once after cutting.
- Stop irrigating small grains at the milk to soft dough stage but be sure there are 1- 2 inches of soil moisture left at this stage to prevent kernels from shrinking.

### AUGUST- KEEP IRRIGATING SMALL GRAINS UNTIL KERNELS MATURE, BE DROUGHT AWARE!

- Apply 1 - 2 inches of irrigation per week in August to hay and pasture crops for full production depending on weather. Irrigate new plantings as needed.
- Many folks irrigate for pasture following their one hay cutting. Irrigate according to how much pasture you seek and with consideration for other water needs in the drainage, especially in drought years.
- Reduce river withdrawals by rotating systems and reducing the amount of irrigation at one time.



### SEPTEMBER – APPLY AS NEEDED/AVAILABLE & GET READY FOR SPRING!

- Apply ½ - 1 ½ inches of irrigation per week in September to hay and pasture crops for full production depending on weather. Irrigate new plantings as needed. Prepare the system for winter and an early start next spring.