



BLACKFOOT CHALLENGE IRRIGATION SCHEDULING PROGRAM

ANNUAL REPORT 2018

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PROGRAM SUMMARY

For the past 9 years the Blackfoot Challenge Irrigation Scheduling Program has provided information to help irrigators apply the right amount of water at the right time to meet crop goals. Weekly reports are circulated basin-wide to irrigators and water managers that include irrigation tips, drought strategies, soil and crop management options and other information. 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 year had good snowpack, soil moisture storage and early growing season rainfall which combined to produce record crops. Water was more available for the first time in years for late-season irrigation.

PROGRAM COMPONENTS

Information is distributed to over 100 irrigators, water managers and interested parties throughout the drainage including:

- Weekly reports summarizing weather, crop water use, soil moisture conditions, crop management, drought strategies, and a calendar of recommendations for the entire season,
- An annual report summarizing irrigation, weather and trends,
- The Blackfoot Challenge Web site which posts all weekly reports and irrigation guide specific to the Blackfoot drainage
- A revision of the Blackfoot Irrigation Guide in 2018.

2018 PROGRAM HIGHLIGHTS

- 6-12 inches of rain fell on Blackfoot croplands during the 2018 growing season depending on location (the historic average is about 7 inches).
- Early season soil moisture was the best in the 9 years of this program, many soils were full on May 1.
- Cool, moist weather dominated the early growing season – perfect for crop production.
- 2018 potential crop water use in inches: hay = 25, pasture = 21, grains = 16-19
- 2018 was only the 3rd year with below average crop water use since the program began 9 years ago.
- High soil moisture levels, a good snowpack and well-timed rainfall combined to make a great year for crop production in the Blackfoot Drainage. One irrigator had a 4-ton/acre first cutting of hay after applying only 1 inch of irrigation (the rest came from soil moisture and rainfall). His second cutting was 2 tons which is the best I have seen in this area.
- Good water availability and warm weather in September allowed second cuttings, new seedings and much more fall pasture for many.

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 (4-7+ inches). A few drops were reported but virtually no rain fell on Blackfoot croplands again. Crops again responded well to warm temperatures and clear skies with impressive growth spurts in some fields. A condensed 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 80s and 90s. The 30 and 90 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 1.70 inches for most crops last week - still above normal. It will continue to be high next week with hot temperatures and low humidity. The table and chart on Page 2 illustrate crop water use throughout the whole season.

WATER USE IN INCHES	LAST WEEK	SECT. AVERAGE	SEASON TOTAL
HAY CROPS	1.7	1.7 (1.5 - 1.8)	13.20
PASTURE	1.4	1.4 (1.3 - 1.6)	11.50
SPRING GRAINS (wheat, barley)	1.3	1.3 (1.2 - 1.5)	7.0
WINTER WHEAT	1.3	1.3 (1.2 - 1.5)	14.0
LAWNS	1.6	1.6 (1.5 - 1.8)	12.0

SOIL MOISTURE - ADD WHAT YOU CAN
Ideally you have a full soil profile and are ready for your first cutting. However, most of those in the Blackfoot Drainage on Planet Earth are struggling to boost 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.

2018 WEATHER

2018 was a “perfect storm” for local crop weather. The winter snowpack on May 1 was 175% of normal in the Blackfoot drainage and soils were nearly full to their water holding capacities. April rainfall was 150% of normal. Every week throughout April, May and June had rain, usually $\frac{1}{4}$ to $\frac{3}{4}$ inch but up to 2 inches some weeks at some sites. Little rain fell after July 1 but temperatures were not as high as in recent years so crop water use was not as high. Streamflows dropped quickly but not enough to trigger drought response plans. Temperatures were higher than normal throughout September extending the growing season and boosting hay and pasture production for those who still had water. Some irrigation systems were still operating on September 30 which is very late for the Blackfoot.

2018 CROP WATER USE

Crop water use in 2018 was slightly below average for the year and much lower than average for April, May and June. Figure 1 lists potential crop water use for all crops in 2018. Hay used 25 inches, pasture 21 inches and small grains 16-19 inches. Record crops were harvested due to low crop water use in the early summer, good soil moisture and well-timed rain.



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 water availability, 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. Most 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, start a new crop or keep alfalfa happy. Many cease irrigating due to water availability, water rights, stream flows or other reasons (fishing?).

CROP WATER USE TRENDS

Crop water use in 2018 was below average for the first time in 7 years. You have to go back to cold, rainy 2011 to get another below average year. Figure 2 lists annual hay crop water use for all 9 years of this program showing an average of about 25 inches. There is a general increase in crop water use across all years with 2018 the first significant dip in 7 years. This trend of increasing crop water use is also reflected in the Deer Lodge Agrimet weather station data (Figure 3). These two sources suggest current average crop water use for hay is 25-28 inches. It's interesting to note that the NRCS irrigation guides from the 1980s lists crop water use for hay as 15 inches but now it is 25-28 inches. With all water rights already allocated in the Blackfoot drainage it will be increasingly important for irrigators to recognize early and take advantage of above average water years like 2018. Figure 4 illustrates crop water use in 2018 compared with wet, dry and average years.

FIGURE 1. POTENTIAL CROP WATER USE THROUGHOUT THE 2017 IRRIGATION SEASON

BLACKFOOT 2018 GROWING SEASON WEEKLY RAINFALL & CROP WATER USE (INCHES OF WATER)										
WEEK ENDING	RAIN ¹	2018 WEEKLY POTENTIAL CROP WATER USE ²						AVERAGE POTENTIAL CROP WATER USE ³		
	RAIN	HAY CROPS ⁴	PASTURE	SPRING GRAINS 5-1 START	SPRING GRAINS 5-15 START	WINTER WHEAT	LAWNS	LONGTERM AVERAGE HAY WATER USE	HOT WEEK HAY WATER USE	COOL WEEK HAY WATER USE
APRIL	1.50	0.50	0.40	0.10	0.10	0.50	0.50	1.00	1.50	0.50
5/4/2018	0.50	0.30	0.20	0.10	0.10	0.30	0.30	0.50	0.80	0.30
5/11/2018	0.50	0.50	0.40	0.10	0.10	0.50	0.50	0.80	1.00	0.50
5/18/2018	0.50	0.50	0.40	0.10	0.10	0.50	0.50	1.00	1.10	0.60
5/25/2018	0.25	0.80	0.70	0.30	0.10	0.80	0.80	1.20	1.30	0.80
6/1/2018	0.75	1.00	0.90	0.50	0.30	1.10	1.00	1.30	1.40	0.90
6/8/2018	0.20	1.20	1.00	0.80	0.50	1.30	1.10	1.40	1.50	1.00
6/15/2018	0.50	1.20	1.00	0.90	0.70	1.30	1.10	1.50	1.70	1.00
6/22/2018	1.25	0.80	0.70	0.80	0.60	1.00	0.80	1.50	1.90	1.10
6/29/2018	0.25	1.20	1.00	1.20	0.90	1.30	1.10	1.50	2.00	1.20
7/6/2018	0.01	1.30	1.00	1.50	1.20	1.50	1.20	1.60	2.10	1.30
7/13/2018	0.01	1.70	1.30	2.00	1.80	1.80	1.60	1.60	2.00	1.20
7/20/2018	0.01	1.60	1.30	1.90	1.90	1.90	1.50	1.50	2.00	1.20
7/27/2018	0.01	1.80	1.50	2.00	2.00	1.00	1.70	1.50	2.20	1.10
8/3/2018	0.01	1.60	1.30	1.70	1.90	0.50	1.50	1.40	1.70	1.00
8/10/2018	0.01	1.60	1.30	1.60	1.80	0.25	1.50	1.20	1.50	0.90
8/17/2018	0.01	1.60	1.30	1.40	1.60	0.10	1.50	1.00	1.30	0.70
8/24/2018	0.50	1.10	0.90	0.80	1.10	0.10	1.00	0.80	1.00	0.50
8/31/2018	0.20	1.00	0.80	0.25	0.50	0.10	0.90	0.60	0.80	0.40
9/7/2018	0.01	1.10	0.90	0.10	0.25	0.10	1.00	0.60	0.70	0.30
9/14/2018	0.01	1.10	0.90	0.10	0.10	0.10	1.00	0.50	0.70	0.30
9/21/2018	0.20	0.90	0.80	0.10	0.10	0.10	0.90	0.40	0.60	0.20
9/30/2018	0.01	0.80	0.60	0.10	0.10	0.10	0.70	0.40	0.60	0.20
TOTAL	7.20	25.20	20.60	18.45	17.85	16.25	23.70	24.80	31.40	17.20

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

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

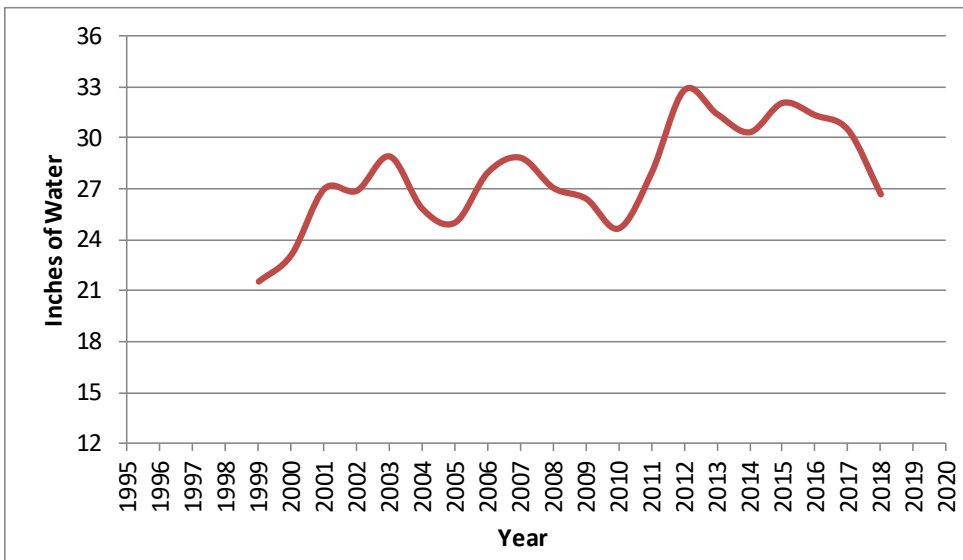
³ **Longterm average** water use for each crop each week based on long-term historic data.

⁴ Hay Crop water use drops approximately 2/3 the first week after cutting, 1/2 the second and 1/3 the third.

FIGURE 2. ANNUAL CROP WATER USE FOR HAY IN THE BLACKFOOT DRAINAGE 2010-2018

2010	20.8
2011	18.6
2012	25.7
2013	26.8
2014	25.2
2015	27.4
2016	26.6
2017	28.0
2018	24.0
AVERAGE	24.8

FIGURE 3. ANNUAL CROP WATER USE FOR HAY (DEER LODGE AGRIMET STATION)

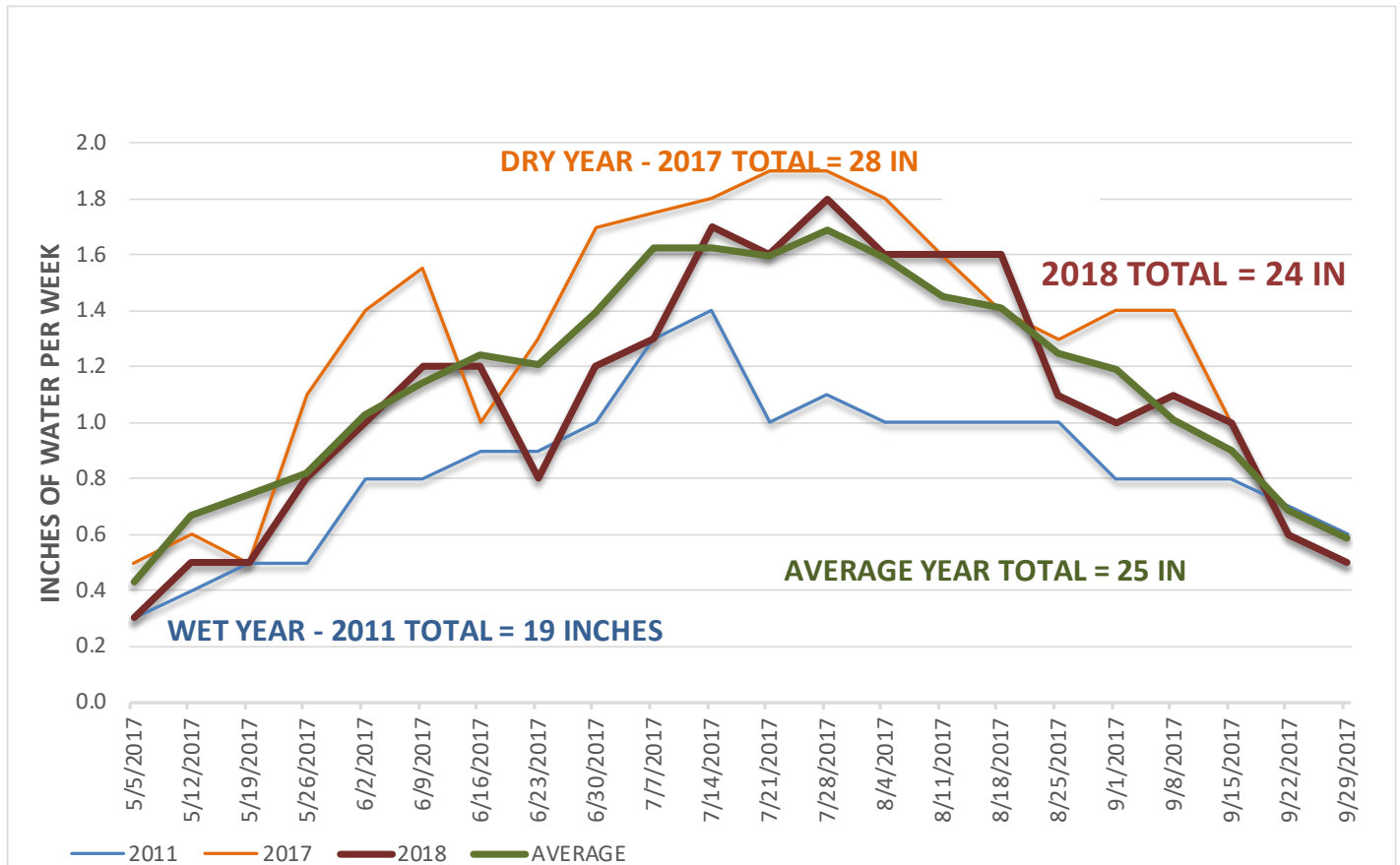


2018	26.7
2017	30.5
2016	31.4
2015	32.1
2014	30.4
2013	31.4
2012	32.9
2011	28.0
2010	24.7
2009	26.4
2008	27.1
2007	28.9
2006	28.0
2005	25.0
2004	25.8
2003	28.9
2002	26.9
2001	27.0
2000	23.1
1999	21.6
AVERAGE	27.8

2018 SOIL MOISTURE

Early season soil moisture in 2018 was the best in years due to a good snowpack and spring rains. This year did not see a long period between snowmelt and the start of the growing season when the soil could dry out. At the beginning of May most local root zones were nearly full to their water holding capacity. Many soils had moisture penetration much deeper than normal which contributed to crop growth. Cool, rainy conditions throughout April, May and June helped irrigators keep soil moisture high due to lower than average crop water use. These high soil moisture contents translated into good crop yields. After July 1, rainfall mostly ended and soil moisture became more difficult to maintain. However, water was more available than in recent years for irrigation during this period. Rainfall did not pick up until October so irrigation was essential for second cuttings, fall pasture and new plantings.

FIGURE 4. Weekly and Total Potential Crop Water for Hay Comparing 2018 with wet and dry years.



2018 IRRIGATION TIPS

Irrigation tips were provided each week according to crop stage, weather conditions and other factors. This year’s tips concentrated on application rates, uniformity, and below-average crop water use during the early season due to cooler, wetter weather. Tips were expanded this year to include soil health concerns and to respond to irrigator questions. These discussions highlighted new crop choices, diversifying plantings and monitoring soil health improvements. We invite everyone interested in Soil Health to join the Soil Health listserv and receive announcements about this important topic. Anyone who wants to sign up can email (jennifer@blackfootchallenge.org) or Brad (brad@blackfootchallenge.org).

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 8). Our work in 2018 continues to confirm the validity and value of this strategy.

Our individual recommendations have come 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
- taking advantage of occasional wet years for 2nd cuttings, new plantings and cover crops

In dry years, irrigators who applied water early and kept pouring it on up until haying in mid-July had excellent crops. In wet years like 2018, irrigators who took advantage of the abundant moisture and longer growing season had great production, great second cuttings and abundant fall pasture.

There is little doubt that the future will only get more challenging for Blackfoot irrigators. However, with this challenge will likely come opportunities to influence critical water decisions and participate in future water markets from here to the Pacific Ocean. All while living and irrigating in a great place!

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, evaluate spring soil moisture and weather to determine start date.
- Evaluate season weather 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.