

# Montana Association of Dam and Canal Systems (MADCS)

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Water Commissioners/Water Distribution

Department of Natural Resources  
and Conservation (DNRC)



# What's covered

- Redbooks-why are they important?
- Water Measurement-Water Commissioner how-to?
  - Flumes
  - Weirs
  - Stream gages
- Distribution examples-"A day in the life of a Water Commissioner"



# Red Books

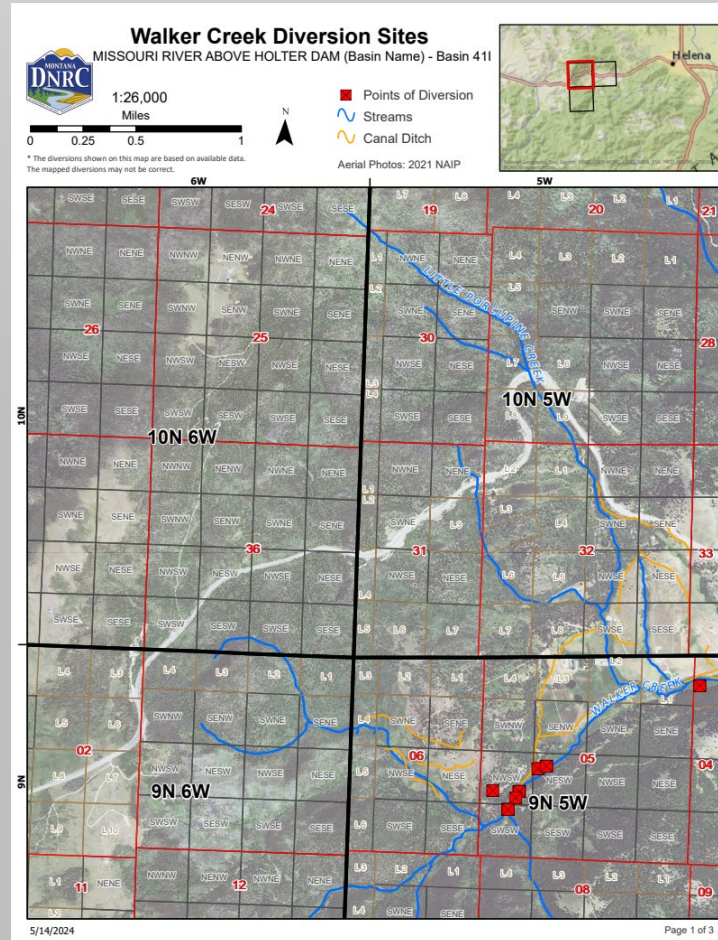
aka Tabulations

- What are Redbooks?
  - Tabulations of water rights
- Process (where do they come from)
  - Petition to Water Commissioner
- Current status



# Red Books

<https://dnrc.mt.gov/Water-Resources/Water-Rights/Water-Distribution-Projects>



## 2024 Priority Date Index - Walker Creek Distribution Area

Enf. Date	Priority	Owner	Owner (first)	Ver. Type	POD #	Use	Qtr Sect.	Sect.	Twp Rng	Source	Diversion Name	Period of Diversion	Period of Use	Cfs	Gpm
1864-11-05	411 89074 00	HELENA, CITY OF		REXM	2	MUNICIPAL	NESEW	4	9NSW	WALKER CREEK	WALKER CREEK INTAKE	01/01 to 12/31	01/01 to 12/31	5.63	2526.74
1865-02-10	411 89075 00	HELENA, CITY OF		REXM	2	MUNICIPAL	NESEW	4	9NSW	WALKER CREEK	WALKER CREEK INTAKE	01/01 to 12/31	01/01 to 12/31	8.12	3644.25
1886-02-05	411 120860 00	RV RANCH CO		REXM	1	IRRIGATION	NWNWSW	4	9NSW	WALKER CREEK	O'CONNELL DITCH	03/01 to 10/31	03/01 to 10/31	5	2244
1886-07-01	411 30069691	SWNRMM LLC		REXM	1	IRRIGATION	SENWSW	5	9NSW	WALKER CREEK	CLAUSEN-CARSON DITCH	05/01 to 09/01	05/01 to 09/01	.53	238
1886-07-01	411 89449 00	NISTLER	ROXIE	ERSV	1	IRRIGATION	SENWSW	5	9NSW	WALKER CREEK	CLAUSEN-CARSON DITCH	05/01 to 09/04	05/01 to 09/04	.37	170
1886-07-01	411 30069690	NISTLER	JOSEPH	ERSV	1	IRRIGATION	SENWSW	5	9NSW	WALKER CREEK	CLAUSEN-CARSON DITCH	05/01 to 09/04	05/01 to 09/04	.37	170
1892-05-17	411 30069690	SWNRMM LLC		REXM	1	IRRIGATION	SENWSW	5	9NSW	WALKER CREEK	CLAUSEN-CARSON DITCH	05/01 to 09/01	05/01 to 09/01	.53	238
1892-05-17	411 89448 00	ZINN RANCH LLC		ERSV	1	IRRIGATION	SENWSW	5	9NSW	WALKER CREEK	CLAUSEN-CARSON DITCH	05/01 to 09/04	05/01 to 09/04	.37	170
1893-06-08	411 127868 00	PRENDERGAST FAMILY LLC		REXM	1	STOCK	N2NW	4	9NSW	WALKER CREEK		01/01 to 12/31	01/01 to 12/31		
1893-06-08	411 127871 00	PRENDERGAST FAMILY LLC		REXM	1	IRRIGATION		4	9NSW	WALKER CREEK	PENDERGAST DITCH	05/01 to 09/01	05/01 to 09/01	.94	425
1894-04-30	411 127870 00	PRENDERGAST FAMILY LLC		REXM	1	IRRIGATION		4	9NSW	WALKER CREEK	PENDERGAST DITCH	05/01 to 09/01	05/01 to 09/01	1	448.8
1895-08-23	411 30069689	SWNRMM LLC		REXM	1	IRRIGATION	SENWSW	5	9NSW	WALKER CREEK	CLAUSEN-CARSON DITCH	05/01 to 09/01	05/01 to 09/01	.53	238
1895-08-23	411 89447 00	ZINN RANCH LLC		ERSV	1	IRRIGATION	SENWSW	5	9NSW	WALKER CREEK	CLAUSEN-CARSON DITCH	05/01 to 09/04	05/01 to 09/04	.37	170
1896-04-13	411 30052602	SWNRMM LLC		REXM	1	IRRIGATION	SENWSW	5	9NSW	WALKER CREEK	CLAUSEN-CARSON DITCH	05/01 to 09/01	05/01 to 09/01	3.56	1597.72
1896-04-13	411 30052604	CUMMINGS	BRIAN	REXM	1	IRRIGATION	SENWSW	5	9NSW	WALKER CREEK	CLAUSEN-CARSON DITCH	05/01 to 09/01	05/01 to 09/01	3.56	1597.72
1896-04-13	411 30122525	ZAFRIDOU	VASILIKI	REXM	1	IRRIGATION	SENWSW	5	9NSW	WALKER CREEK	CLAUSEN-CARSON DITCH	05/01 to 09/01	05/01 to 09/01	3.56	1597.72
1896-04-13	411 30122525	NISTLER FAMILY TRUST		REXM	1	IRRIGATION	SENWSW	5	9NSW	WALKER CREEK	CLAUSEN-CARSON DITCH	05/01 to 09/01	05/01 to 09/01	3.56	1597.72
1896-04-13	411 89446 00	SWNRMM LLC		REXM	1	IRRIGATION	NESWSW	5	9NSW	WALKER CREEK	CLAUSEN-CARSON DITCH	05/01 to 09/01	05/01 to 09/01	3.56	1597.72
1900-06-02	411 89647 00	ZINN RANCH LLC		CHAU	1	IRRIGATION; STOCK; FISH AND WILDLIFE	SENWSW	5	9NSW	WALKER CREEK	CLAUSEN-CARSON DITCH	05/15 to 09/15	05/15 to 09/15; 05/15 to 09/15; 05/15 to 09/15	1.25	561
1900-06-02	411 89647 00	ZINN RANCH LLC		CHAU	2	IRRIGATION; STOCK; FISH AND WILDLIFE	NWNWSW	5	9NSW	WALKER CREEK	CLAUSEN-CARSON DITCH	05/15 to 09/15	05/15 to 09/15; 05/15 to 09/15; 05/15 to 09/15	1.25	561
1900-06-02	411 89648 00	ZINN RANCH LLC		CHAU	1		SWNWSW	5	9NSW	WALKER CREEK, NORTH FORK	CLAUSEN-CARSON DITCH	05/15 to 09/15		1.25	561

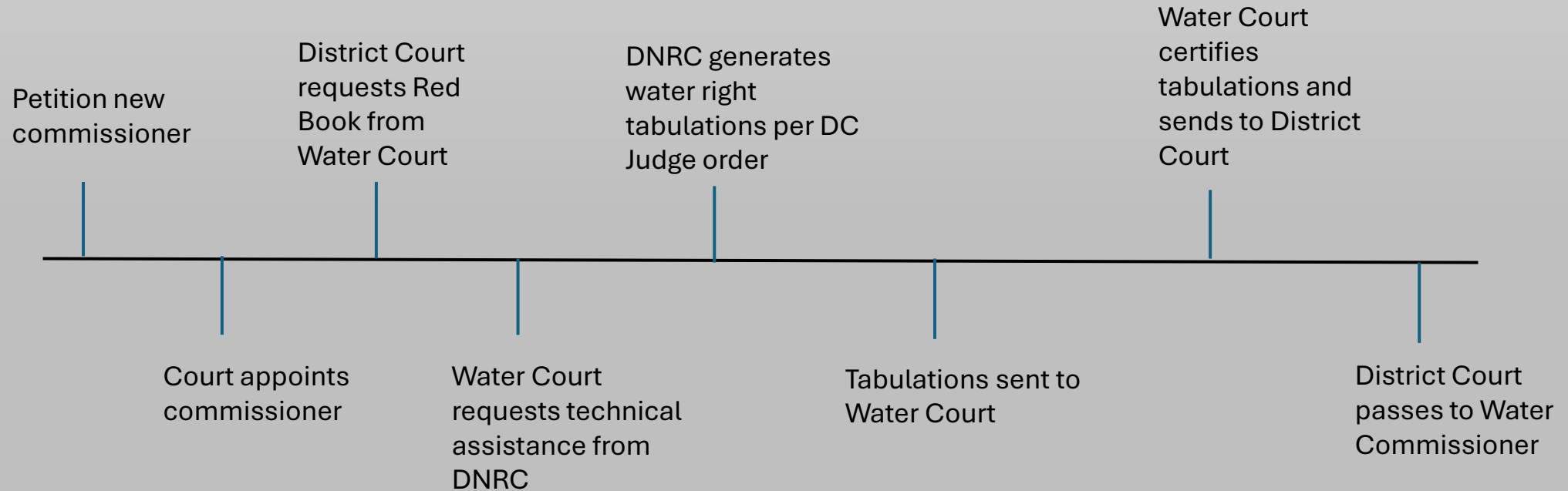
5/14/2024

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# Red Books

<https://dnrc.mt.gov/Water-Resources/Water-Rights/Water-Distribution-Projects>



# Red Books

## Current Status

- All digital format
  - <https://dnrc.mt.gov/Water-Resources/Water-Rights/Water-Distribution-Projects>
- User downloadable
  - Paperless tabulations/maps
- Water Rights Query system overhaul-<https://gis.dnrc.mt.gov/apps/WRQS/>
- BETA-mobile mapping application
  - OnX for water rights/distribution



# How to?

Title 85-5-101MCA: Water Commissioner duties

An appointee of the District Court responsible for the measurement and delivery of water based upon the priority of water rights for a specific stream, ditch, reservoir, or other watercourse.

## Headgates



Non-functional



Functional



# How to?

## Measuring Devices-Flumes



5' Parshall flume



3' Cutthroat flume





# How to?

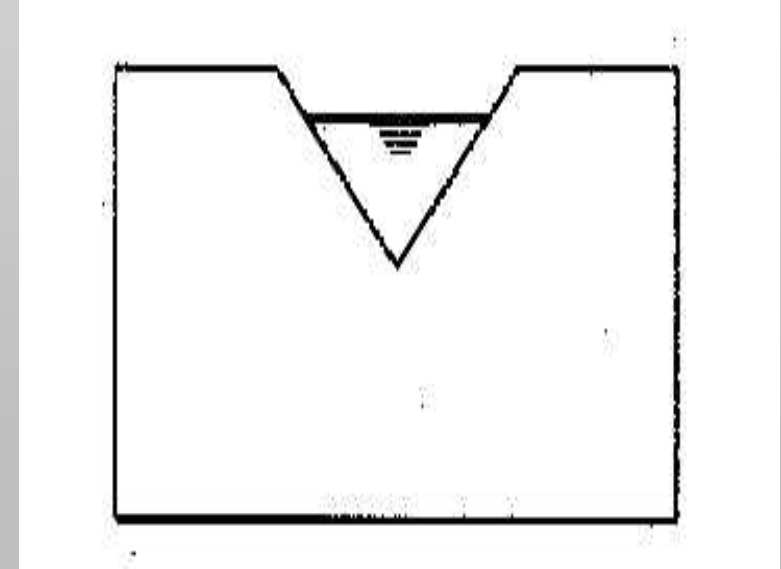
## Measuring Devices-Weirs



6' Cipolletti weir



3' Contracted  
Rectangular



Triangular or V-notch



# How to?

## Surface water devices



[DNRC Real-time stream gage](#)



Calibrated weir stick



Sontek IQ



# Distribution examples

Based on the Water Court decree, an irrigator has the right to divert 500 inches of water.

1) What is their water right in cubic feet per second (cfs)?

$$500 \text{ in.} / 40 \text{ in.} = \underline{12.5 \text{ cfs}}$$

2) Convert their water right to gallons per minute (gpm).

$$12.5 \text{ cfs} * 448.8 \text{ gpm} = \underline{5610 \text{ gpm}}$$

3) How many acre-feet (af) is the irrigator entitled to in 10 days?

$$12.5 \text{ cfs} * 1.986 \text{ acre-feet/cfs} * 10 \text{ days} = \underline{248 \text{ acre feet}}$$

4) A different irrigator is entitled to 600 acre-feet over a period of 20 days. Assuming irrigation is non-stop, what is their flow rate in cfs?

$$600 \text{ ac-ft} \text{ divided by } 20 \text{ days} = 30 \text{ ac-ft/d}$$

$$30 \text{ ac-ft} \text{ divided by } 1.983 \text{ ac-ft/cfs} = \underline{15.1 \text{ cfs}}$$

1 cfs = 40 m.i.

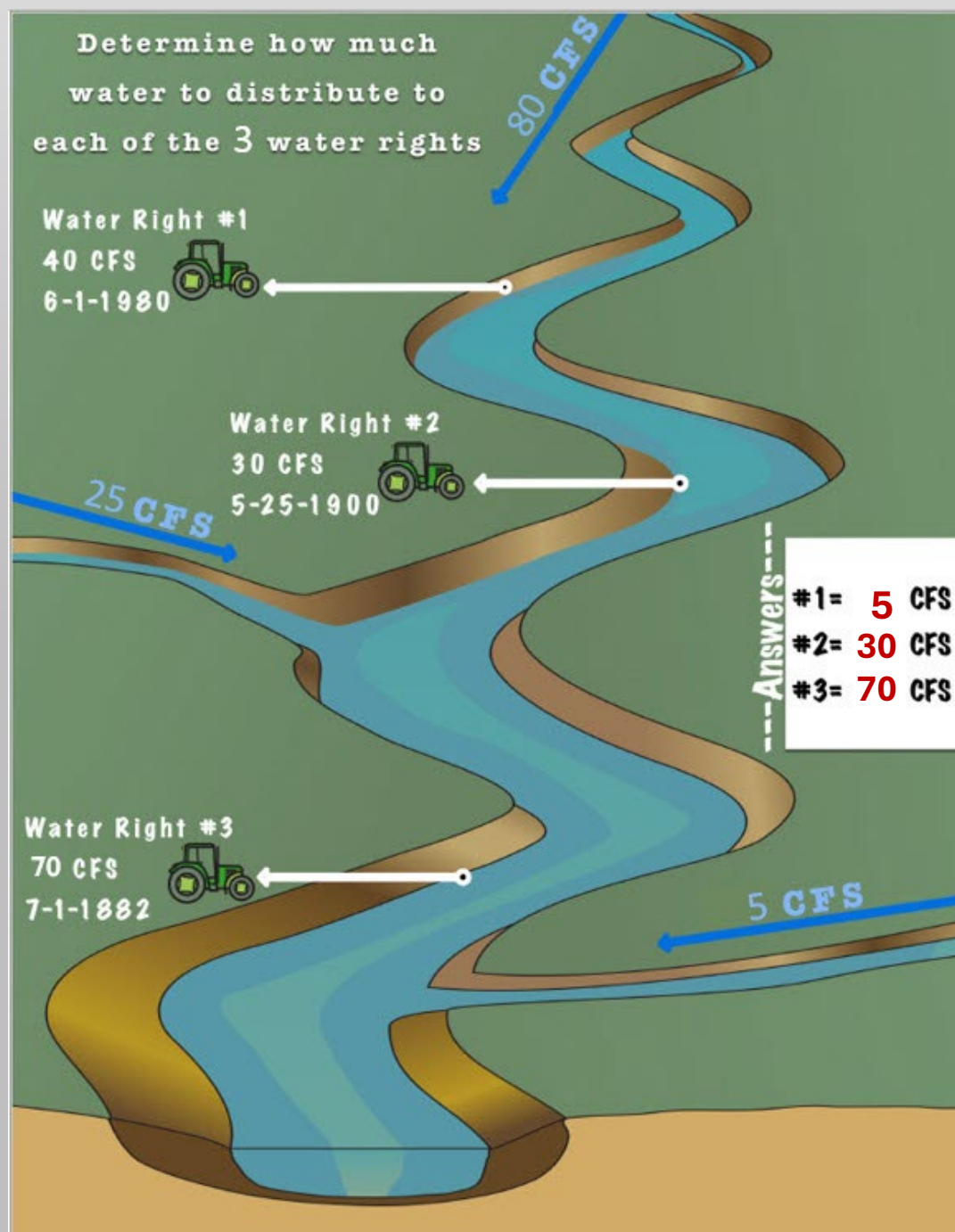
1 cfs = 448.8 gpm

1 cfs for 24 hrs = 1.983 acre-feet



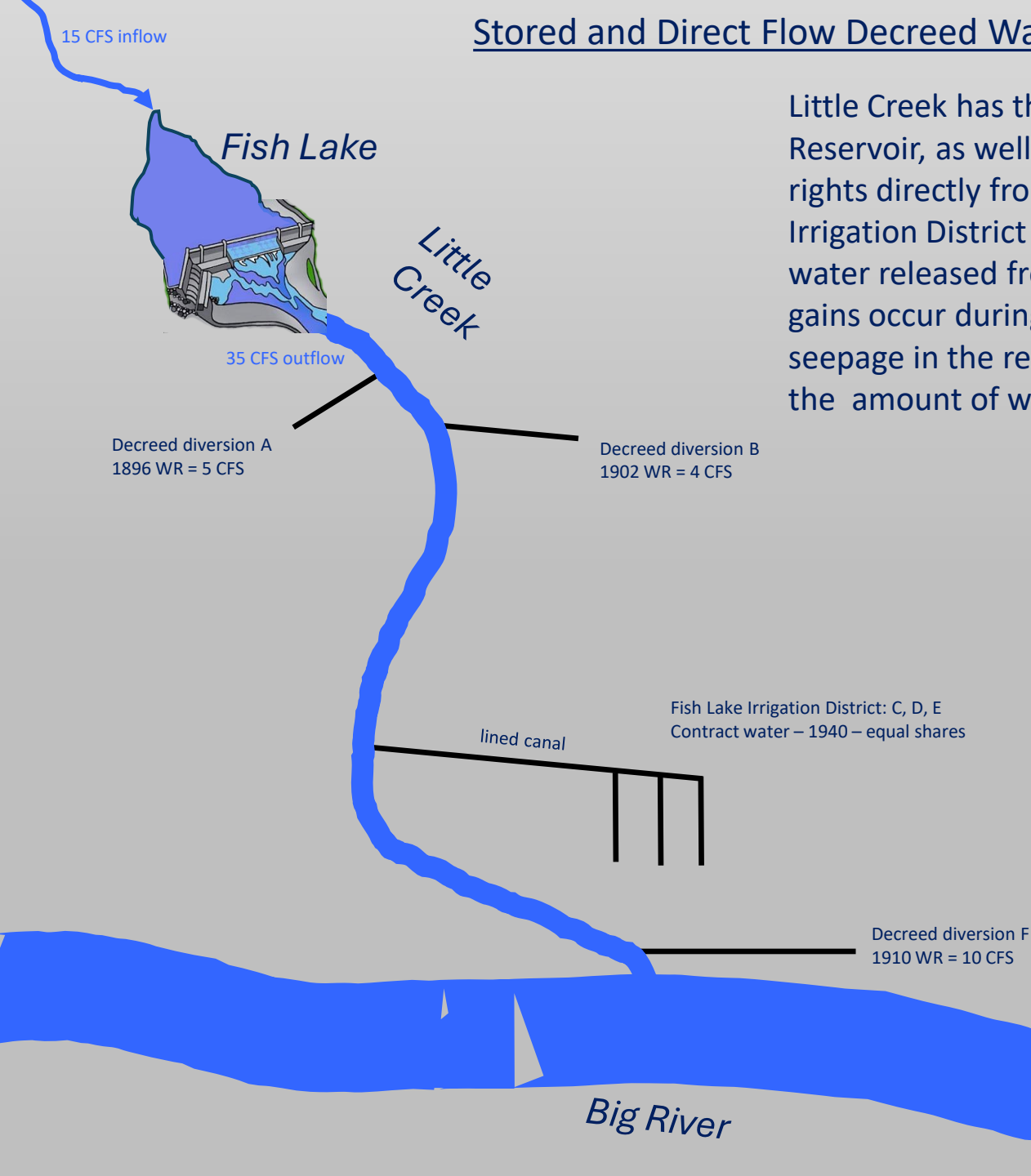
## Distribution examples

**Hint:** determine senior water right holder based on priority date



## Stored and Direct Flow Decreed Water:

## Distribution examples



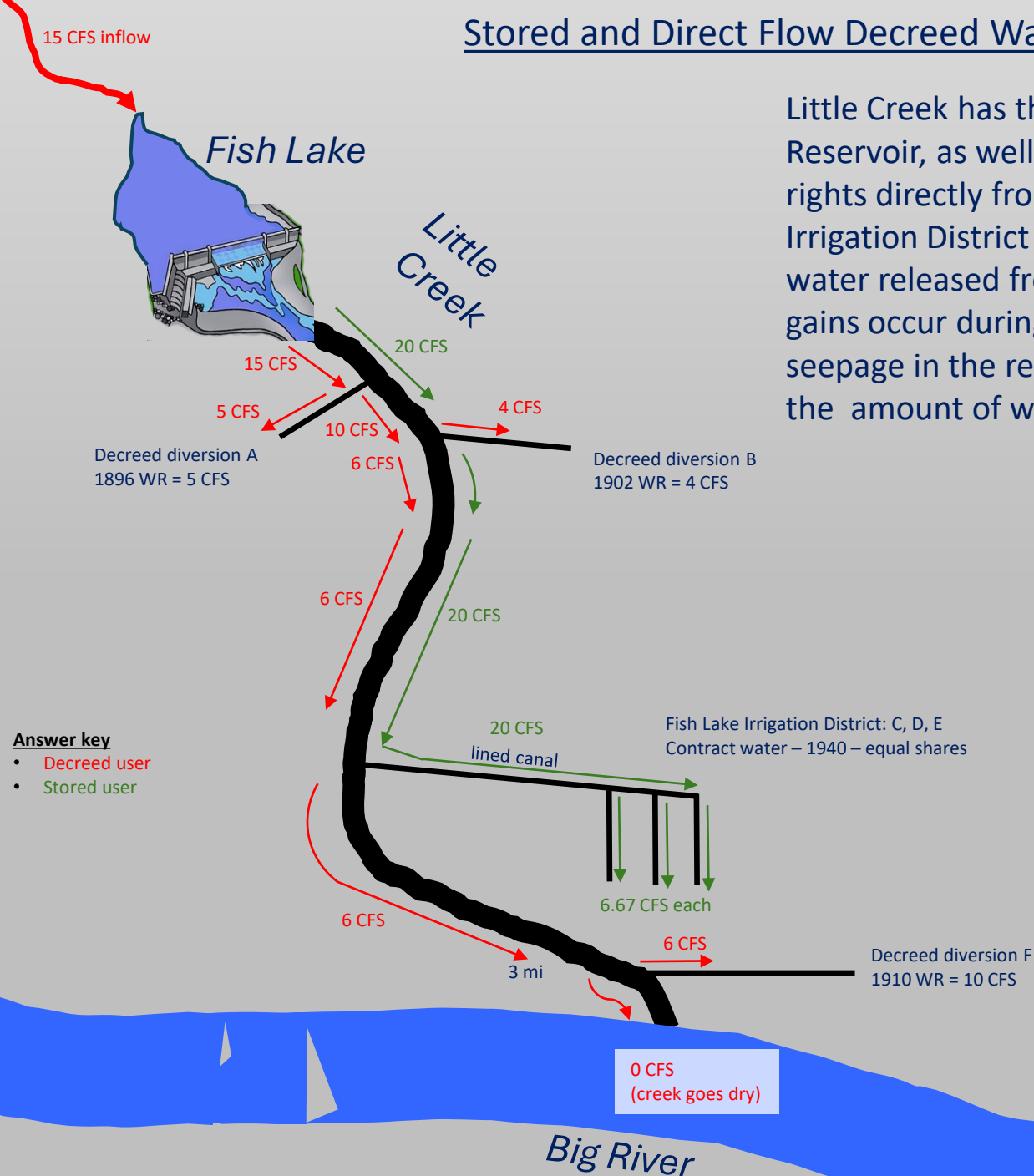
Little Creek has three water right contracts from Fish Reservoir, as well as three direct flow decreed water rights directly from the stream. The Fish Lake Irrigation District relies solely on the 20 CFS of stored water released from the dam. No seepage losses or gains occur during conveyance. If evaporation and seepage in the reservoir are negligible, determine the amount of water at each location.



## Stored and Direct Flow Decreed Water:

# Distribution examples

Little Creek has three water right contracts from Fish Reservoir, as well as three direct flow decreed water rights directly from the stream. The Fish Lake Irrigation District relies solely on the 20 CFS of stored water released from the dam. No seepage losses or gains occur during conveyance. If evaporation and seepage in the reservoir are negligible, determine the amount of water at each location.



$$A = 5 \text{ CFS}$$

$$B = 4 \text{ CFS}$$

$$C = 6.67 \text{ CFS}$$

$$D = 6.67 \text{ CFS}$$

$$E = 6.67 \text{ CFS}$$

$$F = 6 \text{ CFS}$$

# WATER DISTRIBUTION IN MONTANA

QUESTIONS??

THANK YOU!

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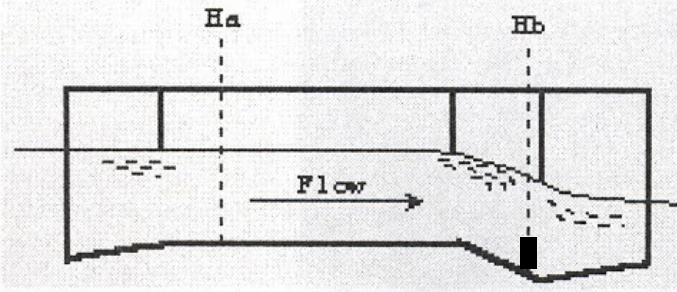


Figure 1

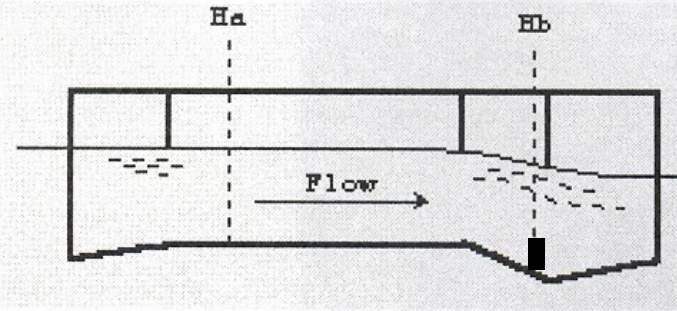


Figure 2

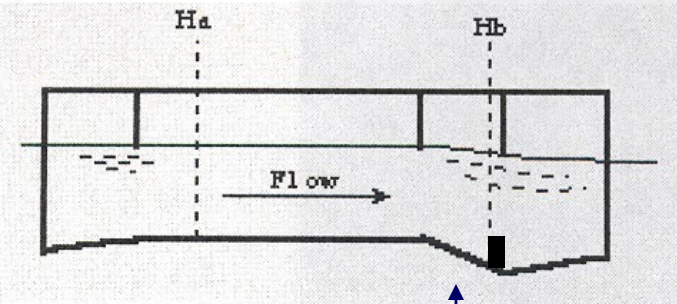


Figure 3

throat

## Free Flow

Defn. When the downstream water elevation does not influence flow through the measuring device.

## Submerged Flow

Determined by  
Ratio:  $H_b/H_a$

Defn. Occurs when the downstream elevation of the water surface of the flume or weir is high enough to retard flow.





- Poor condition or no measuring device
- Bad Location
- Improper Function
  - accuracy/condition
  - submergence
  - not level crosswise
  - not level lengthwise
- Non-Standard Structure

# Long Throated Flumes



Ramp Flume

Replogle Flume

Broad-Crested Weir

(all very similar)



## Montana Flume (short parshall)

- low head loss requirement
- facilitates sediment
- no approach velocity requirement
- wide range of flows
- easy to build
  
- cannot measure submergence, must have free flow

# Flumes and Weirs

**Flume** – shaped, open-channel flow sections that force flow to accelerate.



**Weir** – an overflow structure built perpendicular to an open channel axis to measure the rate of flow. Slope  $> 0.5\%$

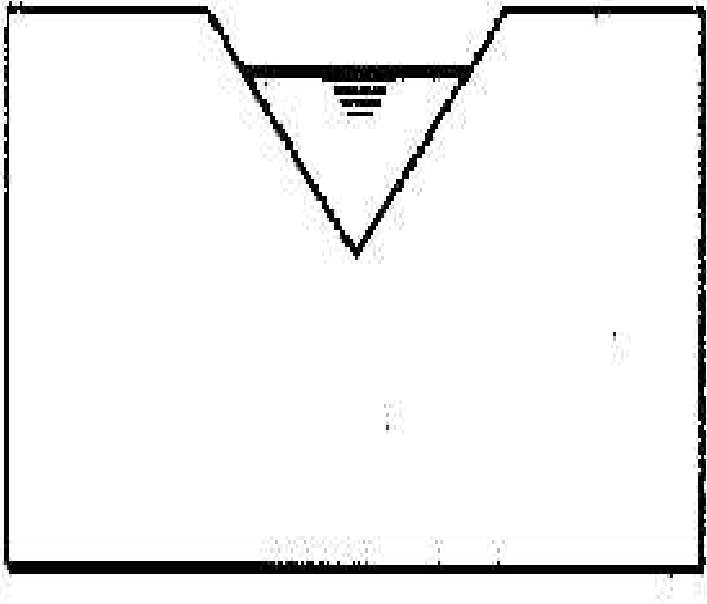


# Sharp Crested Weir



**Cipolletti Contracted** - Trapezoidal in shape with sides that incline outwardly at a slope of 1 horizontal to 4 vertical. May be more accurate at lower stages than rectangular weir.

# Sharp Crested Weir



Contracted Triangular or V-Notch

Measures flows up to 4.3 cfs or 1.25 feet of head

# Weir Installation Specifications

Maximum Head = H

Distance to Measuring Point = 4H

Crest to ditch bank = 2H

Bottom of Ditch to Crest = 3H

