

Subject: **Powder/Tongue River Basin Plan
Irrigation Diversion Operation and Description
Task 2A**

Date: March 2002

Prepared by: HKM Engineering Inc.

INTRODUCTION

In accordance with the scope of services, an inventory of the diversions located within the Powder River and Tongue River Basins were completed. This inventory is intended to be used for future planning and to provide information for water availability modeling of the basins.

DIVERSION SELECTION

The initial selection of diversions to be inventoried was based on a review of the State Engineer's Office hydrographers' annual reports. Those ditches with a recorded diversion of 10 cfs or greater were selected. The list of these diversions was submitted to the State Engineer's Office Division Two superintendent and hydrographers/commissioners for review and refinement. The commissioners eliminated several diversions and added others. Finally, to ensure that the data summarized here fully represented the drainages in the Powder/Tongue River Basin, commissioners were asked to add the ditches they considered key to the water use in the drainages. The resulting list of diversions provides a broad coverage of data and the significant data available on diversion operations in the Powder/Tongue River Basin.

METHODOLOGY

Data Gathering for Operation Memoranda

Each of the major ditches listed were visited in the field. During these field inspections, points of diversion and flow measurement facilities were photographed and located with a Garmin GPS II Plus handheld GPS unit. The removal of the selective availability dithering in May, 2000 and its capacity for averaging readings over time gave this handheld GPS receiver the ability to receive locations to within ± 12 feet in many cases. These measurements are provided for general location purposes only; no guarantee can be made of their accuracy.

Travel with a hydrographer/commissioner was required in most cases to access Powder/Tongue River Basin headgates and flow measurement devices. In parts of the northern Powder/Tongue River Basin, area landowners were relied upon to obtain the necessary data. Follow-up interviews with landowners and all commissioners provided the supplemental information used in the following technical reports detailing each diversion.

Compilation of Diversion Records

In accordance with the scope of services, diversion records have been compiled for the selected ditches as defined in the preceding section. The diversion records when associated with the acreage served will provide a basis for determining the actual water use for irrigation in the study area. Actual water use is commonly significantly less than theoretical water use based on crop consumptive irrigation requirements, waste/seepage, deep percolation, and conveyance losses. This is expected to be especially true within this study area where forage crops rather than cash crops constitute the predominant demand

for irrigation water. Information on actual monthly water use for irrigation is important to the development of water availability models that realistically simulate existing conditions in the area.

Records of ditch diversions are available in several forms and from several sources as summarized below. The records for the sites maintained by the Wyoming State Engineer's Office (SEO) are contained in the Hydrographers' Annual Reports beginning in 1980.

1. Records of total monthly diversion volumes are available for several ditches equipped with continuous flow recorders. These records are available for a number of sites maintained by the SEO as well as a few sites maintained by the United States Geological Society (USGS). The USGS records were obtained directly from the local USGS office in Cheyenne or from USGS Water Resources Data publications.
2. Records of total monthly diversion volume are available from the SEO for some ditches with periodic, instantaneous measurements (spot measurements). In these instances, SEO personnel have made estimates of missing daily values to complete the monthly records.
3. Pre-1980 records of daily and monthly diversions are available through the Water Resources Data System (WRDS) database for several of the ditches.
4. Records of periodic, instantaneous measurements (spot measurements) are available from the SEO for many ditches in the study area. HKM estimated the missing daily diversion records for these ditches to estimate the total monthly diversion volumes.

In many cases, monthly diversion volumes for a given ditch may be derived from multiple forms of data and from multiple sources. Where records of various forms or from various sources are available for a concurrent period of time, for a given ditch, monthly volumes from USGS continuous flow records are given preference, monthly volumes from SEO continuous flow records are then used when available, and monthly volumes derived from SEO spot measurements are then used as necessary to complete the record. Monthly diversion volumes from the WRDS database are used to the extent available to fill-out the record prior to 1980 when diversion records were first published in the Hydrographers' Annual Reports.

The SEO has not developed a numbering system for the measurement sites. This presented a significant challenge in completing this task. Records are identified in the Hydrographers' Annual Reports only by the name of the ditch. Unfortunately, these names sometimes change over time. It therefore becomes very difficult to determine if the different names relate to a different site or a change in the name of a given site. To solve this problem, sites with similar names were summarized on tracking forms for all 20 years of record by listing the site name, source, district, and size of the Parshall measuring flume for each year. This information generally provided the clues necessary to make the determination. HKM also maintained close contact with Mike Whitaker, the Water Division II superintendent, and hydrographer / commissioners Carmine LoGuidice and Bill Knapp when questions arose.

The total monthly diversion volumes as calculated by the SEO and USGS or available from the WRDS database (categories 1, 2 and 3 above) are recorded directly on the diversion data summary sheets as provided herein with each respective ditch. The methodology used in estimating missing daily diversion rates and total monthly diversion volumes at spot measurement sites (category 4 above) is discussed in the following section. The resulting monthly diversion volumes for these sites are also recorded on the diversion data summary sheets for each ditch.

Interviews with landowners, ditch maintenance personnel, and SEO staff provided return flow amounts and locations where available.

ESTIMATED DAILY DIVERSION RATES AND MONTHLY DIVERSION VOLUMES

The monthly diversion volumes listed on the diversion data summary sheets derived from spot measurements were calculated using the following technique:

Daily diversion data were compiled for each year and each pertinent ditch from the Hydrographers' Annual Reports.

Example: Moreton Ditch, 1992:

Date	Flow (cfs)	Date	Flow (cfs)	Date	Flow (cfs)
5/4	5.36	8/1	1.80	8/28	1.26
5/11	1.26	8/5	13.05	8/31	1.26
5/15	10.16	8/7	12.38	9/2	1.26
5/18	0.00 (off)	8/10	7.53	9/8	7.53
5/26	18.60	8/15	11.25	9/9	7.15
5/29	16.00	8/17	2.15	9/11	7.53
6/1	0.00 (off)	8/19	2.39	9/14	7.53
6/3	3.77	8/21	2.78	9/16	1.80
6/5	1.27	8/24	2.39	9/21	2.15
6/12	0.00 (off)	8/26	2.92	9/23	2.15
7/31	1.26				

Lacking more information, it was assumed that the first date listed in the Annual Report is the date the ditch was turned on (i.e. there was no flow before that date), and the last date listed is the date that the ditch was turned off (i.e. there was no flow after that date). This assumption may result in an overestimate of the annual diversion volume in some cases but more typically would result in an underestimate where diversions at the beginning and end of the season are truncated from the record.

The ditch flow for each missing day from the first to the last readings was found by linear interpolation. The interpolation process requires a judgement regarding the maximum number of days between recorded ditch flows for which interpolated estimates will be made. For periods with more than this number of days without flow measurements, the month or months containing those dates are left blank and are considered missing. If the maximum number is set too low, the resulting monthly volumes calculated will contain many missing values. If the maximum number is set too high, interpolation will be attempted over an unreasonably long time period. Based on a review of the available data, a maximum of 52 days was selected as the allowable maximum between measurement dates for interpolation to occur. A summary of the maximum number of missing days is provided along with the first and last dates of measured diversions for each ditch.

After the missing daily flows are estimated, the total monthly diversion volumes are calculated by summing the estimated and measured values for each respective month.

Example, Moreton Ditch, May, 1992:

Date	Flow (cfs)	Date	Flow (cfs)	Date	Flow (cfs)	Date	Flow (cfs)
5/1		5/10	1.85	5/19	2.33	5/26	18.60
5/2		5/11	1.26	5/20	4.65	5/27	17.73
5/3		5/12	3.45	5/21	6.98	5/28	16.87
5/4	5.36	5/13	5.71	5/22	9.30	5/29	16.00
5/5	4.77	5/14	7.94	5/23	11.63	5/30	10.67
5/6	4.19	5/15	10.16	5/24	13.95	5/31	5.33
5/7	3.60	5/16	6.77	5/25	16.28		
5/8	3.02	5/17	3.39	Total for May (cfs)			214.23
5/9	2.43	5/18	0.00	May (AF)			424.92

Notes: Shaded figures are interpolated.

Total for May (cfs): This figure is the sum of the daily values.

May (AF): This figure is the total cubic feet per second (cfs) for May converted to acre-feet.

Average, maximum, and minimum values for the period of record are calculated for each month of the irrigation season.

The raw spot measurement data is extensive and is therefore not provided in this memorandum. This information is available in digital form and can be provided if necessary.

The ditches included in this memorandum are as follows (Figure 1):

Memo Section	Name of Site	Map Location Number	Sub-Basin	Source	Headgate Location	
					Lat.	Long.
Big Goose Creek	Alliance Ditch Diversion	2	Tongue	Big Goose Cr.	N 44° 42' 9.9"	W 107° 10' 48.3"
	Big Goose & Beaver No. 1 Ditch Diversion	5	Tongue	East Fork Big Goose Cr.	N 44° 40' 12.0"	W 107° 9' 19.1"
	Big Goose & Beaver No. 2 Ditch Diversion	5	Tongue	Rapid Cr.		
	Grinnell Ditch Diversion on Big Goose Creek	21	Tongue	Big Goose Cr.	N 44° 49' 26.0"	W 106° 57' 56.2"
	Park Diversion Ditch	45	Tongue	East Fork Big Goose Cr.	N 44° 34' 12.2"	W 107° 12' 37.9"
	PK (Patrick) Ditch Diversion	51	Tongue	Big Goose Cr.	N 44° 41' 47.6"	W 107° 11' 24.8"
	Sheridan City Intakes - Big Goose Canyon Diversion	62	Tongue	Big Goose Cr.	N 44° 41' 46.8"	W 107° 11' 15.6"
Columbus Creek	Five Mile Ditch Diversion	16	Tongue	Columbus Cr.	N 44° 55' 1.2"	W 107° 22' 15.4"
Little Goose Creek	Burn Cleuch Ditch Diversion	7	Tongue	Little Goose Cr.	N 44° 43' 40.6"	W 106° 56' 37.7"
	Colorado Colony Ditch Diversion	33	Tongue	Little Goose Cr.	N 44° 35' 46.4"	W 107° 2' 20.8"
	Gerdel Ditch Diversion	20	Tongue	Little Goose Cr.	N 44° 41' 30.0"	W 106° 58' 59.0"
	Last Chance Ditch Diversion	10	Tongue	Little Goose Cr.	N 44° 37' 41.8"	W 107° 1' 44.7"
	Peralta Ditch Diversion (& Mountain Supply Ditch Diversion)	40, 48	Tongue	Little Goose Cr.	N 44° 32' 47.7"	W 107° 12' 37.4"
Tongue River	High Line Ditch Diversion	24	Tongue	Tongue River	N 44° 50' 48.9"	W 107° 18' 50.7"
	Interstate (Pennoyer) Ditch Diversion	27	Tongue	Tongue River	N 44° 56' 22.5"	W 106° 57' 42.8"
	OZ & K & Hanover Ditch Diversion	44	Tongue	Tongue River	N 44° 52' 49.2"	W 107° 15' 29.9"
	South Side Ditch Diversion	64	Tongue	Tongue River	N 44° 51' 24.7"	W 107° 17' 48.3"
	Tongue River No. 1 Ditch Diversion	69	Tongue	Tongue River	N 44° 50' 57.8"	W 107° 18' 13.5"
	York Ditch Diversion	72	Tongue	Tongue River	N 44° 52' 57.1"	W 107° 13' 43.9"
Wolf Creek	Garrard Ditch Diversion	19	Tongue	Wolf Cr.	N 44° 47' 22.9"	W 107° 13' 6.2"
	Grinnell Ditch Diversion on Wolf Creek	22	Tongue	Wolf Cr.	N 44° 46' 24.4"	W 107° 13' 55.5"

Memo Section	Name of Site	Map Location Number	Sub-Basin	Source	Headgate Location	
					Lat.	Long.
Clear Creek	Big Bonanza Ditch Diversion	3	Powder	Clear Cr.	N 44° 29' 32.2"	W 106° 33' 23.8"
	Clear Creek Land & Ditch Co. Ditch Diversion	9	Powder	Clear Cr.	N 44° 20' 2.1"	W 106° 42' 53.2"
	Crown Ditch Diversion	12	Powder	Clear Cr.	N 44° 19' 28.8"	W 106° 44' 24.6"
	Des Moines Ditch Diversion	13	Powder	Clear Cr.	N 44° 26' 52.4"	W 106° 34' 34.3"
	Four Lakes & French Creek Ditch Diversion	17	Powder	North Fork Clear Cr.	N 44° 20' 15.9"	W 106° 59' 56.6"
	Frank G. Hopkins Ditch Diversion	18	Powder	Clear Cr.	N 44° 24' 50.3"	W 106° 36' 2.2"
	Hillyer & Onslow Ditch Diversion	25	Powder	Clear Cr.	N 44° 24' 6.3"	W 106° 36' 52.2"
	Johnson-Holt Ditch Diversion	29	Powder	Clear Cr.	N 44° 19' 46.3"	W 106° 45' 28.9"
	Kendrick Ditch Diversion	30	Powder	Clear Cr.	N 44° 49' 47.96"	W 106° 6' 49.67"
	Pratt & Ferris No. 2 Ditch Diversion	54	Powder	Clear Cr.	N 44° 37' 1.1"	W 106° 24' 7.3"
	Pratt & Ferris No. 3 Ditch Diversion	55	Powder	Clear Cr.	N 44° 39' 46.7"	W 106° 21' 55.1"
	Redman Ditch Diversion	58	Powder	Clear Cr.	N 44° 21' 47.2"	W 106° 38' 59.1"
	Roberts Ditch Diversion	59	Powder	Clear Cr.	N 44° 34' 40.9"	W 106° 27' 31.7"
Six Mile Ditch Diversion	63	Powder	Clear Cr.	N 44° 19' 44.9"	W 106° 45' 15.3"	
Crazy Woman Creek	Cook Ditch Diversion	11	Powder	Crazy Woman Cr.	N 44° 11' 53.7"	W 106° 46' 29.1"
	Devoe #1 Ditch Diversion	14	Powder	Crazy Woman Cr.	N 44° 3' 45.9"	W 106° 40' 44.5"
	John R. Smith Ditch Diversion	28	Powder	Crazy Woman Cr.	N 44° 4' 12.0"	W 106° 36' 20.1"
	Kennedy Ditch Diversion	31	Powder	Crazy Woman Cr.	N 44° 10' 42.6"	W 106° 44' 18.2"
	Mitchell & Long Ditch Diversion	37	Powder	Crazy Woman Cr.	N 44° 4' 47.2"	W 106° 38' 28.0"
	Moreton Ditch Diversion	38	Powder	Crazy Woman Cr.	N 44° 3' 0.5"	W 106° 44' 38.8"
	North Fork Ditch Diversion	43	Powder	Crazy Woman Cr.	N 44° 10' 19.2"	W 106° 44' 48.0"
	PX Ditch Diversion	57	Powder	Crazy Woman Cr.	N 44° 10' 7.7"	W 106° 44' 54.3"
	Teddy Miller Ditch Diversion	66	Powder	Crazy Woman Cr.	N 44° 2' 54.6"	W 106° 43' 7.8"
	Thompson & Matthews Ditch Diversion	67	Powder	Crazy Woman Cr.	N 44° 11' 39.5"	W 106° 47' 8.0"
Thompson Brothers Ditch Diversion	68	Powder	Crazy Woman Cr.	N 44° 10' 26.9"	W 106° 45' 50.3"	
French Creek	Hopkins Ditch Diversion	26	Powder	French Cr.	N 44° 21' 59"	W 106° 47' 14"
	Penrose Ditch Diversion (& Penrose Johnson Ditch Diversion)	46, 47	Powder	French Cr.	N 44° 21' 27.9"	W 106° 50' 6.4"

Memo Section	Name of Site	Map Location Number	Sub-Basin	Source	Headgate Location	
					Lat.	Long.
Piney Creek	Dunlap Ditch Diversion	15	Powder	Piney Cr.	N 44° 34' 36.5"	W 106° 36' 23.0"
	Leiter Ditch Diversion	34	Powder	Piney Cr.	N 44° 32' 5.6"	W 106° 49' 8.9"
	Mead & Coffeen Ditch Diversion	36	Powder	North & South Piney Cr.	N 44° 34' 47.1"	W 106° 53' 36.1"
	Piney & Cruse Ditch Diversion	49	Powder	North & South Piney Cr.	N 44° 34' 43.0"	W 106° 53' 11.8"
	Piney Divide Ditch Diversion & Little Piney Ditch Diversion	50	Powder	South Piney Cr.	N 44° 33' 38.3"	W 106° 54' 46.2"
		35	Powder	Little Piney Cr.	N 44° 32' 33.3"	W 106° 52' 4.6"
	Prairie Dog Ditch Diversion	52	Powder	North & South Piney Cr.	N 44° 34' 40.1"	W 106° 52' 56.6"
	Pratt & Ferris No. 1 Ditch Diversion	53	Powder	Piney Cr.	N 44° 34' 1.1"	W 106° 33' 27.1"
Rock Creek & South Piney Diversion	60	Powder	South Piney Cr.	N 44° 28' 21.0"	W 107° 1' 52.2"	
Powder River	Big Four Ditch Diversion	4	Powder	Red Fork Powder River	N 43° 39' 32.0"	W 106° 47' 32.7"
	Morgareidge & Frances Ditch Diversion	39	Powder	North Fork Powder River	N 43° 52' 54.9"	W 106° 51' 10.6"
	Sahara Ditch Diversion	61	Powder	Powder River	N 43° 41' 33.6"	W 106° 31' 53.0"
	Vruwink (Kaycee) Ditch Diversion	71	Powder	Middle Fork Powder River	N 43° 41' 4.6"	W 106° 41' 29.4"
Rock Creek	Hallie Ditch Diversion	23	Powder	Rock Cr.	N 44° 27' 16.0"	W 106° 52' 11.3"
	Lake DeSmet (M&M) Ditch Diversion	32	Powder	Rock Cr.	N 44° 26' 6.8"	W 106° 48' 55.2"
	Mowry Basin Ditch Diversion	41	Powder	Rock Cr.	N 44° 26' 46.4"	W 106° 54' 30.7"
	Prince Albert Ditch Diversion	56	Powder	Rock Cr.	N 44° 22' 16"	W 106° 40' 25"
Pass Creek	Acme Ditch Diversion	1	Tongue	Pass Cr.	N 44° 56' 47.9"	W 107° 31' 16.7"
	Church Ditch Diversion	8	Tongue	Pass Cr.	N 44° 57' 52.3"	W 107° 27' 56.3"
	Summit Ditch Diversion	65	Tongue	Pass Cr.	N 44° 58' 38.4"	W 107° 26' 52.0"
	Tschirgi No. 2 Ditch Diversion	70	Tongue	Pass Cr.	Currently a pumping diversion	

