

Technical Memorandum 1.1

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Platte River Basin Water Plan

Technical Memorandum 1.1

SUBJECT: Platte River Basin Water Plan
Section 1.1 – Basin Plan Mapping and Geographical Information System (GIS)

PREPARED BY: Trihydro Corporation

DATE: August 1, 2005

PURPOSE: The Platte River Basin Plan is a planning tool developed for the Wyoming Water Development Office. It presents estimated current and estimated future uses of water in Wyoming's Platte River Basin. The Plan is not used to determine compliance with or administration of state law, federal law, court decrees, interstate compacts, or interstate agreements.

1.1 **BASIN PLAN MAPPING**

1.1.1 **Introduction**

The term "mapping" may be applied to two components of the Platte River Basin Plan. The base component includes preparation of a Basin Plan project Geographic Information System (GIS) map-based database, which includes data sets that were developed during this project and that are discussed in various parts of the Basin Plan. The second project mapping component includes use of the project GIS to generate maps for use as figures in Basin Plan technical memoranda and the final report.

In accordance with the scope of work for this Basin Plan, Plan documents typically address various water-related Basin issues on the basis of seven subbasins of Wyoming's Platte River Basin, including:

- Above Pathfinder subbasin
- Pathfinder to Guernsey subbasin
- Guernsey to State Line subbasin
- Upper Laramie subbasin
- Lower Laramie subbasin
- Horse Creek subbasin
- South Platte subbasin

Figure 1.1.1 shows these seven subbasins and some major features and sites within the subbasins.

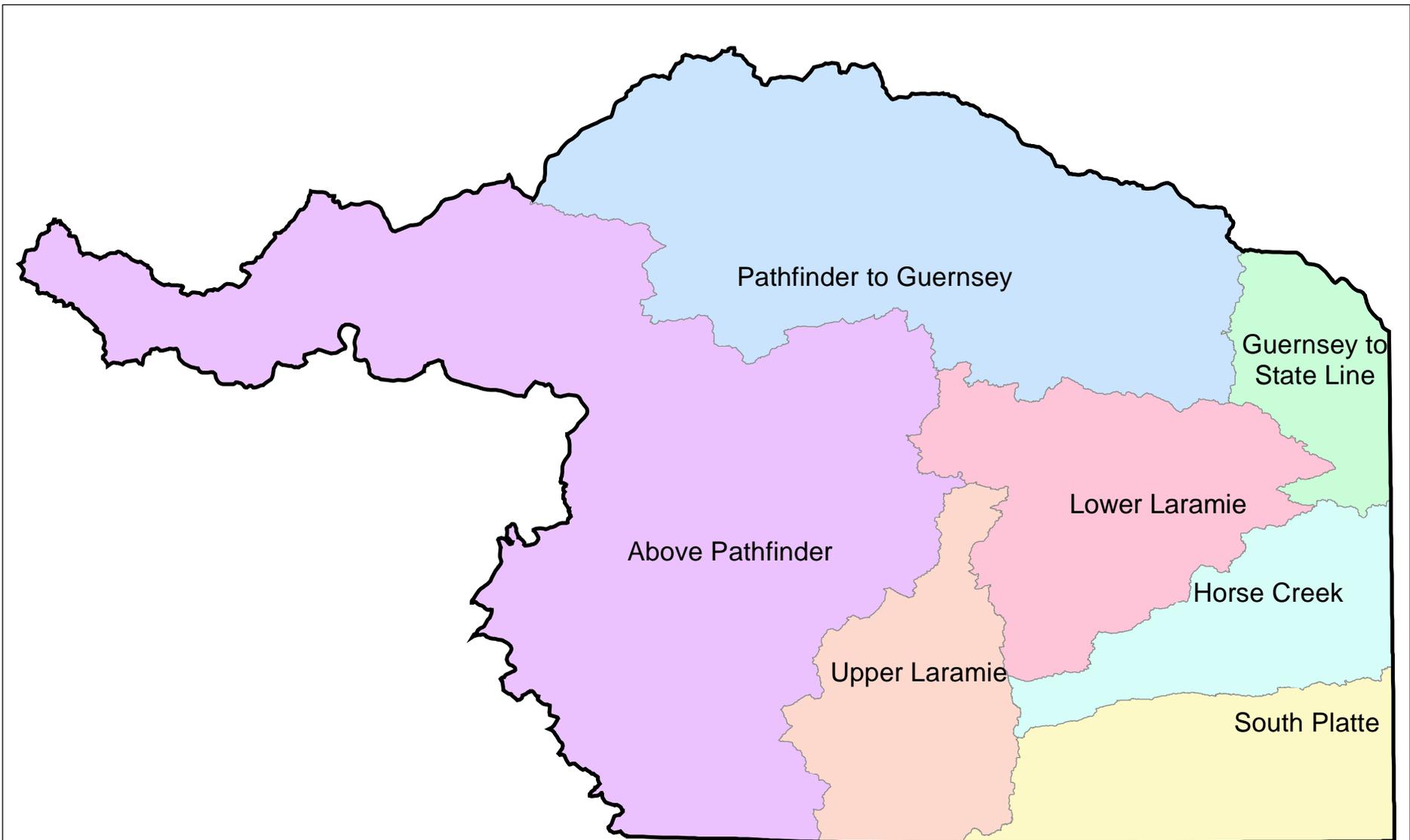
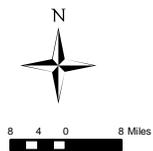


Figure 1.1.1
Watershed Subbasins
Platte River Basin Water Plan

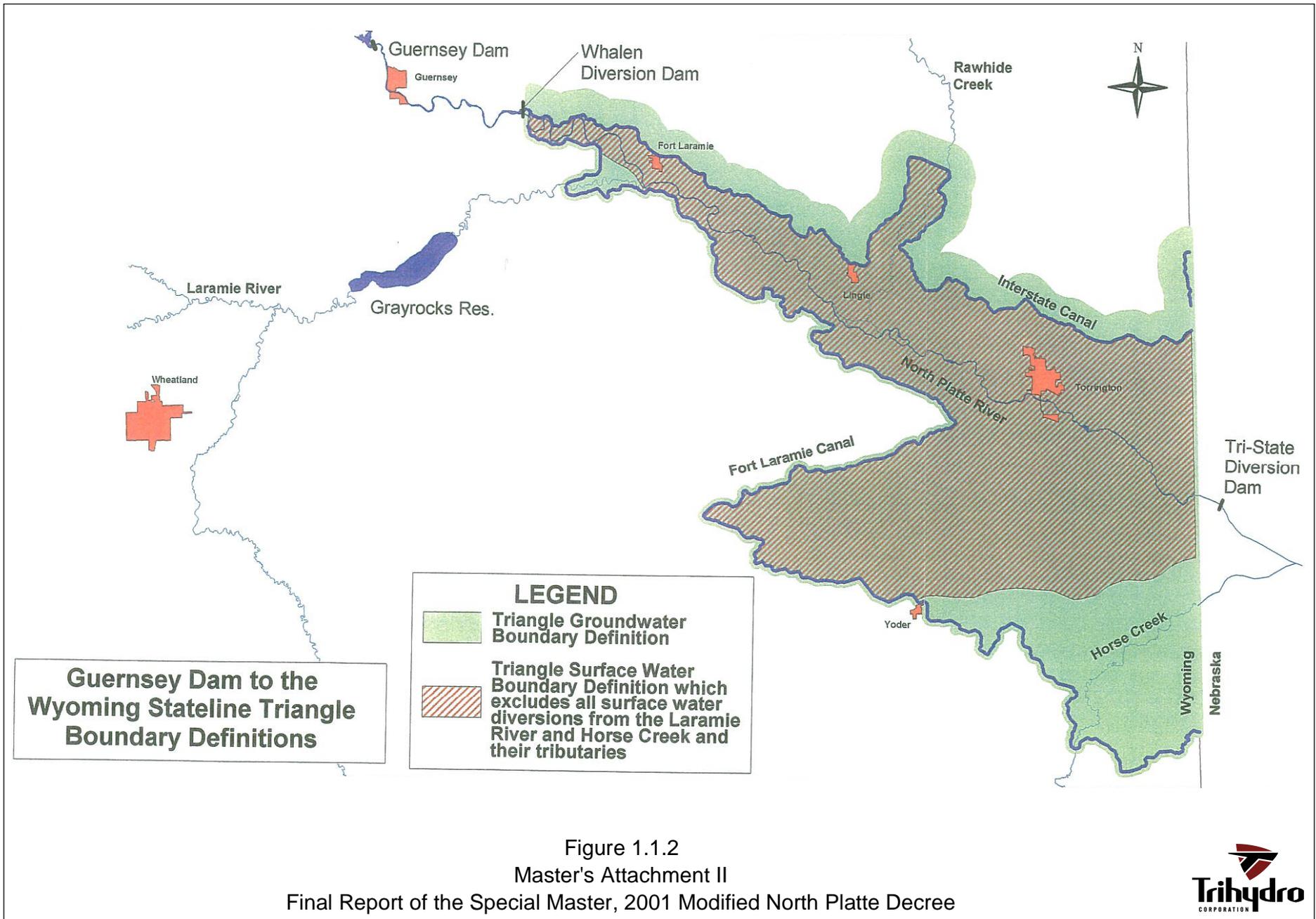


Delineation of Platte River Basin subbasins during this project was completed primarily on the basis of Wyoming Level 6 Hydrologic Unit Boundaries (1:24,000 scale). These boundaries were completed by the University of Wyoming and the U.S. Geological Survey (USGS) in 2002 and were attributed using USGS hydrologic unit codes (HUCs). Early in this project, these HUCs were digitally clipped to the Platte River Basin boundary that had been provided for use during this project by the Wyoming Water Development Commission (WWDC). The WWDC Basin boundary was presumably based on the 1:250,000 scale USGS HUCs.

During this project, the Wyoming Level 6 Hydrologic Unit Boundaries were generalized to match the seven Platte River Basin subbasin boundaries that are described in Nebraska v. Wyoming Final Settlement Stipulation and Modified Decree documents, No. 108 Orig., 534 U.S. 40 (2001). The southern boundary of the Guernsey to State Line subbasin described in the Nebraska v. Wyoming Final Settlement Stipulation and Modified Decree documents does not match the Level 6 Hydrologic Unit Boundaries. As a result, a southern Guernsey to State Line subbasin boundary was developed during this project by digitizing a line along the Fort Laramie Canal alignment from Whalen Diversion Dam to a point near Yoder, then to follow the hydrologic divide between the North Platte River and Horse Creek drainages eastward to the Wyoming-Nebraska state line. This digitizing was based on year 2000 USGS digital orthophoto quarter quad (DoQQ) aerial photography.

The Nebraska v. Wyoming 2001 Modified Decree defined two zones or areas in the Whalen Diversion Dam to State Line reach of the North Platte River. These two different zones are referred to as the “Triangle Groundwater Boundary” and the “Triangle Surface Water Boundary” as illustrated on the Master’s Attachment II, in the Final Report, by Special Master Owen Olpin, dated October 12, 2001. The south Guernsey to State Line subbasin boundary for this project as described herein follows the “Triangle Surface Water Boundary”.

The 1945 North Platte Decree established a 75 percent/25 percent apportionment of natural flow between Nebraska and Wyoming in the Whalen Diversion Dam to Tri-State Dam reach of the North Platte River. The Modified Decree includes the estimated natural flow effects caused by Wyoming’s groundwater withdrawals from post-1945 decree wells in this “Triangle” area during the irrigation season. The Modified Decree apportionment coverage treats diversions from tributaries and drains within this apportionment as natural flow unless the depletions are replaced. As illustrated in the two different “Triangle” zones shown on the Master’s Attachment II to the Final Report of the Special Master in Nebraska v. Wyoming, No. 108 Orig., Horse Creek and Laramie River surface waters are excluded from this Modified Decree tributary and drain apportionment. There is no such exclusion for groundwater. Master’s Attachment II is included as Figure 1.1.2.



1.1.2 GIS Data

GIS layers have been produced or compiled for this Basin using standards and protocols developed in earlier basin plans. Most layers have simply been compilations or conversions of previously developed information. All data for the Basin Plan have been projected to geographic coordinates utilizing a NAD27 datum and then clipped to the prescribed Basin boundary. Each layer includes a metadata document adhering to FGDC or ISO standards depending on the original data source. Details on the original source of each data layer can be found in the metadata documents. Two layers merit a more detailed explanation.

1.1.2.1 Hydrography

At the start of this project, Basin Plan stream layers were to be mapped at a 1:24,000-scale. The stream layer was to be compiled from U.S. Forest Service (USFS) and U.S. Geological Survey (USGS) data and then supplemented with new linework. Early in the project, it became apparent that the USGS was planning to produce this data in collaboration with the University of Wyoming (UW). As a result, Basin Plan development on this layer was halted. Development of this information by the USGS and UW is in progress.

1.1.2.2 Water Rights

The majority of water within the Platte River Basin is consumed by agricultural irrigation. An estimate of existing agricultural irrigation is therefore central in the development of a comprehensive water use inventory. Mapping the irrigated lands within the Platte River Basin is the first step in estimating a water use inventory. This section describes the methodology used to complete an existing irrigated lands map. The methodology used can be divided into four general steps:

1. Creation of a digital irrigated lands map
2. Verification of delineated irrigated lands
3. Attribution of water rights to delineated irrigated lands
4. Explanation of the irrigated lands Geographic Information System (GIS)

Creation of a Digital Irrigated Lands Map

Unlike previous basin planning efforts, most irrigated croplands within the Platte River Basin had already been digitally mapped to support Nebraska v. Wyoming litigation.

Digital irrigated lands polygons came from four sources. First, mapping for the Guernsey to State Line, Pathfinder to Guernsey, Upper Laramie, Lower Laramie, and Horse Creek subbasins was obtained from States West Water Resources Corp. This information had been produced for the Wyoming State Engineer's Office (SEO) for use in the Nebraska v. Wyoming litigation. Five annual sets of irrigated lands delineations were also obtained from the SEO for the Above Pathfinder subbasin. These five years (1995-1999) of cropping patterns were overlaid to map the full area of lands that had been irrigated during that period. Additionally, the Laramie County Conservation District provided a partial layer of irrigated lands for Laramie County. This layer contained very detailed mapping for most irrigated fields within the county, but spatial accuracy was not acceptable. This layer was therefore used as a guide for re-delineating cropland polygons for Laramie County

based on color infrared digital aerial photography produced by the U.S. Geological Survey (USGS) in 2001 (commonly known as DoQQs). Irrigated lands within the South Platte subbasin were delineated using these DoQQs.

Verification of Delineated Irrigated Lands

Two separate phases of verification were conducted on the irrigated lands data. Initially, the digital data provided by the Wyoming State Engineer's Office (SEO) through States West was reviewed. Errors caused by mislocated polygon labels were corrected and polygon overlaps were fixed. The Wyoming Water Development Commission (WWDC) directed that irrigated lands digital data that had been produced for the Wyoming State Engineer's Office (SEO) in support of litigation need not be verified during this Basin planning project. The next phase of irrigated lands verification was limited to only those areas not initially provided by SEO. After initial irrigated lands delineation for the South Platte subbasin, verification maps were plotted and reviewed by Randy Tullis, SEO Division I Superintendent, and other SEO Torrington-based staff. The South Platte subbasin irrigated lands mapping was subsequently revised in accordance with this SEO input.

Attribution of Water Rights to Delineated Irrigated Lands

Water rights attribution is the assignment of water rights data that is associated with delineated irrigated land polygons in the Basin Plan Geographical Information System (GIS). Water rights attribution provides a general overview of the agricultural water resources of a basin. The description of irrigated lands is not complete unless it includes a definition of the water rights granted to allow for the irrigation of the lands. Specifically, the water rights attribution provides information regarding the supply sources, the permitted areas of land, and the types of irrigation systems that are associated with GIS irrigated lands polygons.

Identification and attribution of water rights were addressed after incorporation of irrigated lands mapping into the Basin Plan GIS. A custom GIS application was developed for this purpose. This application allowed development during the attribution process of new GIS data directly and avoided the costly and time-consuming paper mapping process that had been conducted during water rights attribution for the six previous Wyoming basin plans. The water rights assigned to the irrigated polygons were identified from the original records on file in the offices of the Wyoming State Engineer (SEO) and State Board of Control. As water rights were determined to be associated to an irrigated polygon, an identification point feature was added to the GIS clearly referencing the appropriate polygon. Points of diversion for irrigation ditches that divert water at a rate of 10 cubic feet per seconds (cfs) or greater were added at the same time and automatically assigned unique identification numbers. Each water right point added to the GIS was attributed with its associated point of diversion ID in addition to SEO permit information for that right. This point of diversion identification number created a GIS link between the irrigated polygons, corresponding water right permit information, and the points of diversion.

The SEO and the State Board of Control maintain water right information. All water right data are referenced to irrigated lands through a Public Land Survey System (PLSS) description. The process of associating water rights to irrigated lands using a PLSS description limits accuracy. For example,

if water right permit #1086 irrigates five acres in the SW¹/₄ of the NW¹/₄ of a section of land, but the irrigated lands delineated in the GIS illustrate multiple polygons equaling 15 acres in the SW¹/₄ of the NW¹/₄ of the section, each of the polygons contained in the quarter-quarter section will be assigned the water right attribute of permit #1086. The opposite scenario is possible as well. Water right permit #225 may irrigate 15 acres in the SE¹/₄ of the NE¹/₄ of a section of land; however, the map illustrating the irrigated lands for the SE¹/₄ of the NE¹/₄ of that section may only contain a single 5-acre polygon, leaving 10 acres of permitted irrigated land excluded from the GIS map.

Explanation of the Irrigated Lands Geographic Information System (GIS)

The final products of the irrigated lands mapping tasks include the following GIS themes and database tables:

GIS Data Themes

Irrigated Lands (polygons)
Points of Diversion (points)

Database Tables

Water Rights Table
Linking Table

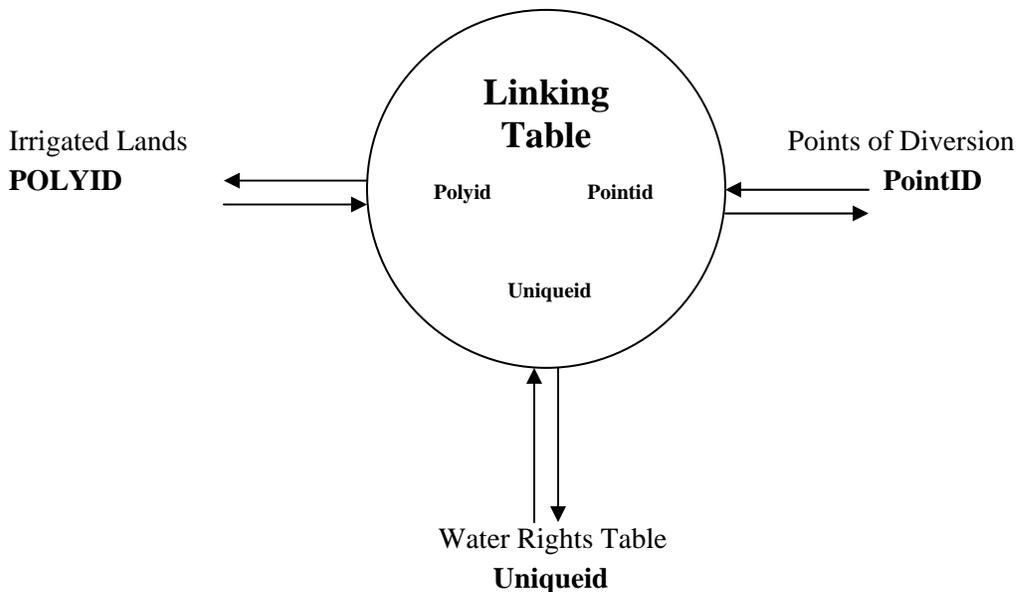
The GIS data themes are located in the latitude and longitude coordinate system based on the North American Datum of 1927 (NAD27). Final GIS data was provided in ArcView shapefile format (*.shp). Descriptions of the GIS data theme attributes and the database table fields are tabulated in Table 1.1.1.

To assist with the understanding of the data contained in the Water Rights Table, a brief description of Wyoming's water rights terminology can be found in Appendix 1.1.A.

Table 1.1.1 Irrigated lands Geographical Information System (GIS) attribute table

Irrigation Attribute Table (PLTirrag)	
POLYID (linking field)	Assigned number – unique for each polygon
SOURCE	Who created the original polygon delineations
AREA_METER	Area of the polygons in square meters (area values calculated in UTM, Zone 13, NAD 27)
AREA_FEET	Area of the polygons in square feet (area values calculated in UTM, Zone 13, NAD 27)
AREA_ACRES	Area of the polygons in acres (area values calculated in UTM, Zone 13, NAD 27)
Points of Diversion Attribute Table (PLTpods)	
PointID (linking field)	Assigned number – unique for each point
POINT_X	The longitude of the point (decimal degrees/NAD 27)
POINT_Y	The latitude of the point (decimal degrees/NAD 27)
Water Rights Table (PLTwtrrights)	
UniquelD (linking field)	Assigned number – representing a unique permit occurrence
PERMIT_NO	Permit number as assigned by the Wyoming State Engineer's Office (SEO). The word "None" or a blank in this field indicates there is no SEO permit information for this parcel of land.
SOURCE	Source of supply for appropriation. A blank or the numbers 999 in this field indicate that there is no SEO permit information for this parcel of land.
FACILITY	Facility name. A blank or the numbers 999 in this field indicate that there is no SEO permit information for this parcel of land.
PDATE	Priority date of appropriation in year, month and day (YYYYMMDD). The numbers 0 or 999 in this field indicate that there is no SEO permit information for this parcel of land.
PAMOUNT	Amount of appropriation. The numbers 999 in this field indicate that there is no SEO permit information for this parcel of land.
UNIT	Measure of appropriation in cubic feet per second (cfs), gallons per minute (gpm), or acre-feet (acft)
PACRES	Number of irrigated acres allowed under appropriation
TYPE	Type of supply of appropriation. Original supply (OS), supplemental supply (SS), secondary supply (SE) and additional supply (AS)
STATUS	Adjudicated (adj), unadjudicated (una), cancelled (can)
USES	Type of beneficial use – examples: irrigation (irr), domestic (dom), stock (sto), municipal (mun)
Source_Att	Name of firm responsible for compiling the data from SEO

As shown in Table 1.1.1, each of the data theme and database tables contains linking fields. These fields relate or link the information among the various tables, which allows for interactive table and data theme selections to occur within the Irrigated Lands GIS. Specifically, the linking table acts as the hub that connects spokes of the irrigated lands, the points of diversion and the water rights table as shown on the schematic below.



These interactive links result in the ability to query or select the irrigation data using one or all of the methods listed below:

- selecting one or more point(s) of diversion on the GIS Basin map results in the selection of all associated irrigated land polygons serviced by the selected point(s) of diversion as well as tabulated water right information associated to these polygons;
- selecting one or more irrigated land polygons on the GIS Basin map results in the selection of all points of diversion servicing the selected irrigated lands as well as all tabulated water rights information associated with these polygons; and
- selecting one or more water right(s) in the Water Rights Table results in the selection of all irrigated lands and points of diversion on the GIS map that are associated with the selected water right(s).

1.1.3 Irrigation Water Rights Attribution

Assigning irrigation diversion water rights information to irrigated lands that have been delineated in Platte River Basin Plan Geographical Information System (GIS) electronic mapping is called water rights attribution. In this Basin Plan, water rights attribution involved determining and assigning the following information to irrigation diversion facilities:

- Wyoming State Engineer's Office (SEO) diversion permit number
- The name of the water supply source for the diversion
- The diversion facility name
- The diversion water right permit priority date
- The amount of the appropriation for the facility in units of cubic feet per second of irrigation water flow
- The permitted number of acres that may be irrigated using water conveyed through the diversion in question
- The type of water supply

Water rights attribution was completed during this project after delineation of Platte River Basin irrigated acreages and incorporation of irrigated acreage polygons into the Basin Plan Geographical Information System (GIS) electronic mapping. Irrigation diversions that are permitted to convey irrigation water at rates of 10 cubic feet per second (10 cfs) or more to lands identified as irrigated lands polygons in the project Geographical Information System (GIS) were identified from original records on file at the Wyoming State Engineer's Office (SEO) and State Board of Control. Water rights attribution was not completed for areas within the basin previously completed for the Wyoming State Engineer's Office (SEO). Each attributed diversion water right was assigned an identification number, which was electronically placed in the permitted quarter-quarter on the project GIS irrigated acreage map. The diversion identification numbers provide electronic GIS links to tabulated diversion water right information of the categories that are summarized above.

The irrigation diversion water rights attribution process was not intended to link attributed irrigation diversions to specific delineated plots of irrigated lands. Rather, each attributed diversion was linked to delineated GIS irrigated polygons in the quarter-quarter(s) for which the diversion has been permitted to provide irrigation water. The actual area of the irrigated acreage polygon(s) within the quarter-quarter(s) may or may not match the acreage for which the attributed diversion is permitted to provide irrigation water. A complete description of water rights attribution activities completed during the preparation of this plan is provided in the GIS layer metadata.

Two examples of project GIS irrigated acreage mapping, numbered irrigation diversions, and tabulated GIS database information regarding selected, numbered irrigation diversions are shown in Figures 1.1.3 and 1.1.4.

PODID	PERMIT_NO	SOURCE	FACILITY	PDATE	PAMOUNT	UNIT	PACRES	TYPE	STATUS
638	Terr.	Pass Creek	Rankin & Crone Ditch	18850000	7.1 cfs		500 os		adj
638	Terr.	Pass Creek	Rankin & Crone Ditch	18850000	7.1 cfs		500 os		adj
1271	Terr.	Pass Creek	Rankin&Crone (Knuth No.2)	18800500	1.4 cfs		100 os		adj
1271	Terr.	Pass Creek	Knuth No.2 Ditch	18880900	0.7 cfs		50 os		adj
1272	Terr.	Rattlesnake Creek	Rattlesnake No.1 Dit	18850400	2.3 cfs		160 os		adj
1273	Terr.	Rattlesnake Creek	Elk Mtn. No.1 Ditch	18880900	0.3 cfs		24 os		adj
1274	Terr.	Rattlesnake Creek	Rattlesnake No.2 Ditch	18891219	2 cfs		140 os		adj
1275	8010	Rattlesnake Creek	Greyhound Ditch	19070508	2.1 cfs		144 os		adj

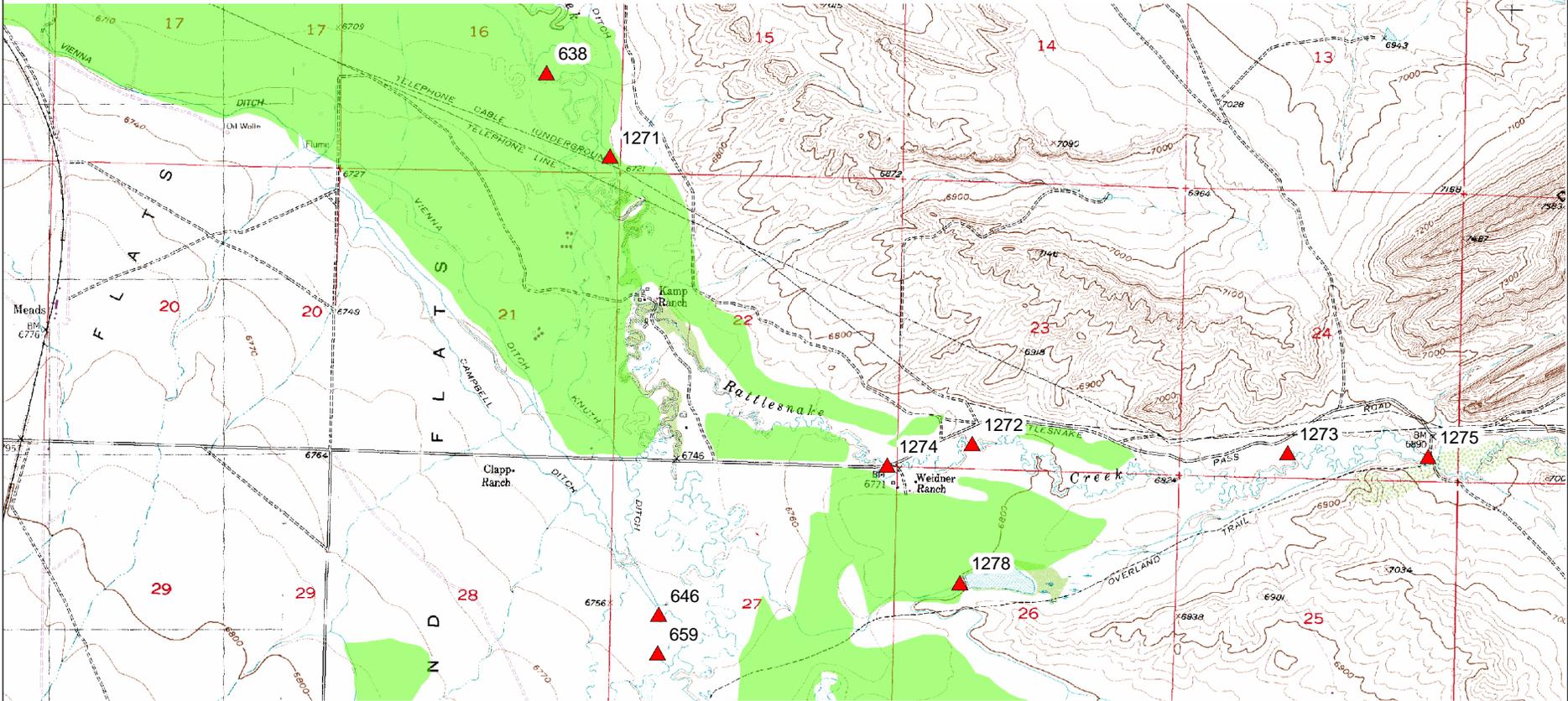


Figure 1.1.3
 Example - Attributed Irrigation Diversions
 Above Pathfinder Dam Subbasin
 Platte River Basin Water Plan



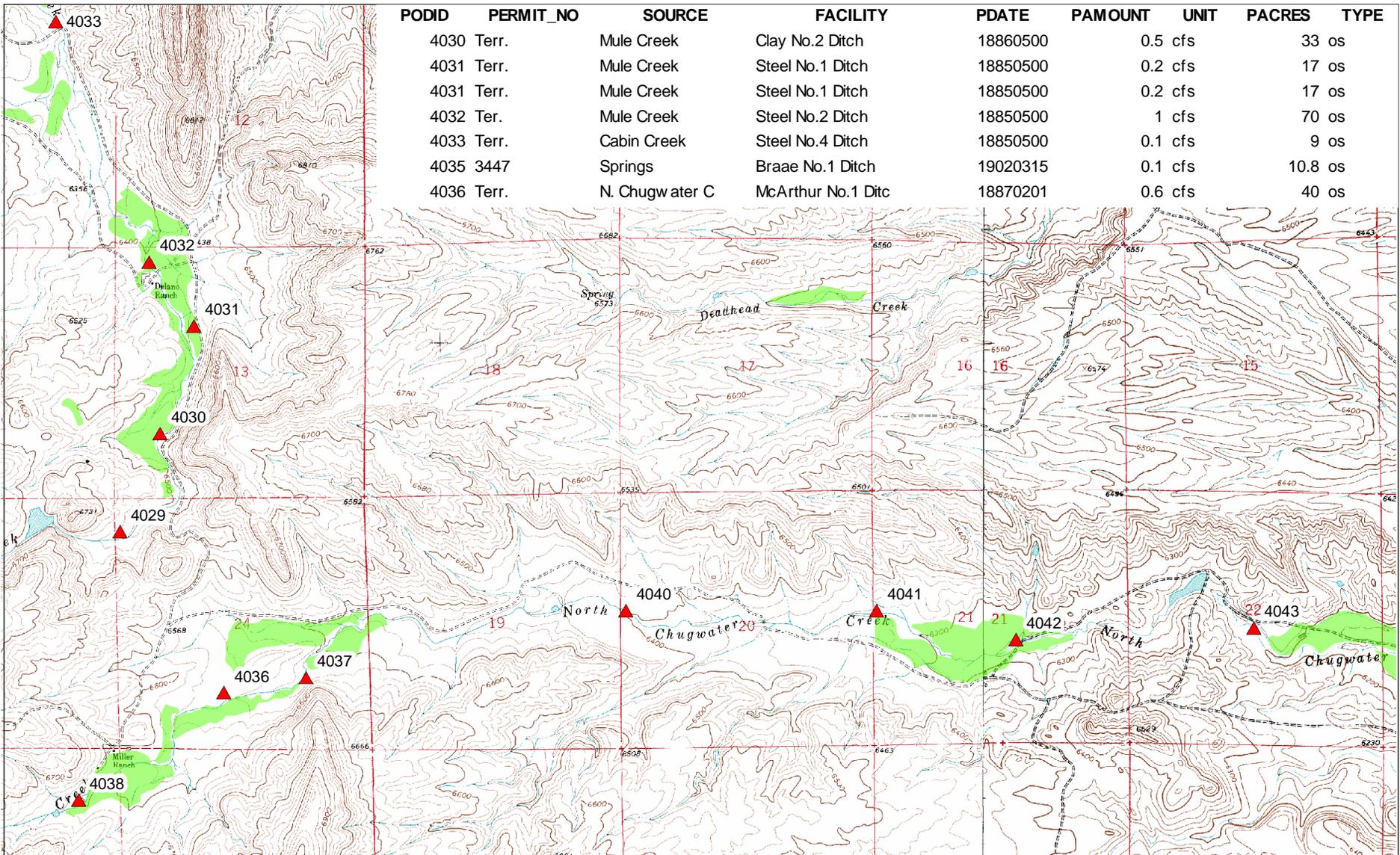
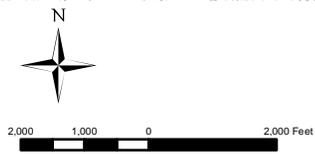


Figure 1.1.4

Example - Attributed Irrigation Diversions
 Lower Laramie Subbasin
 Platte River Basin Water Plan



APPENDIX 1.1.A

WYOMING WATER RIGHTS TERMINOLOGY

Appendix 1.1.A – Wyoming Water Rights Terminology

Water Right Priority Related Terminology

Surplus Water: Whenever the supply of water in a stream reaches the point where there is water available over and above the needed to fill all appropriations with a priority on or before March 1, 1945, then this stream has surplus water available. When surplus flows are available during the water year, they are divided proportionally among the irrigation water right holders with priorities on or before March 1, 1945, up to an additional one c.f.s. for each 70 acres irrigated. Rights with priorities later than March 1, 1945, may be regulated to meet the demands for surplus water made by the owners of water rights with priorities earlier than or equal to March 1, 1945 (see W.S. 41-4-317 through W.S. 41-4-324). Surplus water only applies to irrigation water rights that are based on the statutory diversion rate of one c.f.s. per 70 acres, and not to volumetric awards made in acre-feet per acre.

Excess Water: Whenever the supply of water in a stream exceeds the amount required to satisfy all existing appropriations established on or before March 1, 1985, the stream is said to be in excess flow condition. When excess flows are available during the water year, they may be beneficially used by irrigation water rights holders with priorities dating from March 2, 1945 through March 1, 1985, up to an additional one c.f.s. for each 70 acres irrigated (see W.S. 41-4-329 through W.S. 41-4-331). Excess water only applies to irrigation water rights that are based on the statutory diversion rate of one c.f.s. per 70 acres, and not to volumetric awards made in acre-feet per acre.

Above two definitions taken from Rules and Regulations, Part IV, State Board of Control, 2004

Territorial Appropriation: This is an appropriation of water with a priority date prior to statehood. These rights were filed under a system of statement of claims to water under territorial law rather than a permit system. They were adjudicated after statehood by the then-established State Board of Control. No permits numbers were assigned to those water rights, and they can be identified by the proof number.

Water Right Type of Supply Related Terminology

Original Supply: Original supply is a water right attached to a specific point of use of lands where it is the primary source of supply.

Secondary Supply: Secondary supply is water taken from a reservoir to be used at a different point of use. Water is carried through a ditch or pipeline and is permitted under either a ditch or enlargement permit. This may be the first source of water applied to a point of use, or it may be in addition to an Original Supply.

Supplemental Supply: The appropriation of water as a supplemental supply is defined in detail by W.S. 41-3-113. In general, it involves the appropriation of direct flow water from another surface water source to augment or supplement the available water for an existing appropriation for which the original source of supply does not provide a full supply. The amount of water, which may be diverted is the amount available, in priority, to bring the total water diverted from all surface water sources up to the original appropriated amount.

Additional Supply: Additional supply means underground water for irrigation use which is appurtenant to lands that have a direct flow supply of surface water or have an original supply from another underground water source (W.S. 41-3-901(a)(vii)).

Water Right Status Related Terminology

Unadjudicated Permit: This is a permit that has not been adjudicated before the Board of Control. It can be in the construction stage through the application of water to beneficial use. When the permit is issued by the State Engineer, the applicant is given time limits to complete construction and apply the water to beneficial use. While all this is taking place the permit is considered to be unadjudicated.

Adjudicated Permit: This is a permit where the notice of completion of beneficial use has been filed, proof of appropriation prepared, a field inspection made with the finding that the facility is built within the terms of the permit, the proof advertised, and the proof considered and adjudicated by the State Board of Control. After these items are completed, an order of the Board and the Certificate of Appropriation are prepared, issued, and recorded by the county clerk of the county where the water is used and made a matter of record in the Tabulation of Adjudicated Water Rights.