Historical Crop Consumptive Use Analysis

Gunnison River Basin

Final Report

2015

Acknowledgments

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1.0 Executive Summary

The Gunnison River Basin historical crop consumptive use analysis was performed on a monthly basis for the period from 1950 through 2013 as part of the Colorado River Decision Support System (CRDSS). The CRDSS project was developed jointly by the State of Colorado Water Conservation Board and the Division of Water Resources. The objective of the historical crop consumptive use portion was to quantify 100 percent of the basin's historical crop consumptive use. This report documents the input and results of the historical crop consumptive use analysis completed in April 2015.

Information used in this model dataset is based on available data collected and developed through the CDSS, including information recorded by the State Engineer's Office. The model dataset and results are intended for basin-wide planning purposes. Individuals seeking to use the model dataset or results in any legal proceeding are responsible for verifying the accuracy of information included in the model.

1.1 Background

The Gunnison Basin is located in western Colorado and encompasses approximately 7,800 square miles. Elevation in the basin ranges from over 14,000 feet in the headwaters to 4,550 feet at Grand Junction. Major tributaries to the Gunnison River include the East, Tomichi, North Fork, and Uncompahgre Rivers. Most stream flow originates from snowmelt in the surrounding mountains. Average annual precipitation in the basin ranges from as little as 8 inches in the Uncompaghre Valley near the town of Delta to more than 40 inches in the high mountains.

1.2 Approach

The Gunnison River historical crop consumptive use analysis was performed using StateCU, a generic, data driven consumptive use model and graphical user interface. The objective of the model is to develop monthly consumptive use estimates for the assessment of historical and future water management policies. Key information used by the model to assess historical consumptive use include irrigated acreage, crop types, monthly climate data, diversion records, and well information.

The historical crop consumptive use analysis was originally performed to provide information and consumptive use estimates for the basin surface water model (StateMod) analysis of the Gunnison River Basin. Data used in the historical crop consumptive use has been revised, as well as documented, under this recent effort.

1.3 Results

Table 1 presents the average annual acreage and historical crop consumptive use analyses results for the 1950 to 2013 study period. As shown, the irrigation water requirement averages 593,638 acre-feet per year while water supply-limited consumptive use averages 497,372 acre-feet per year. The average annual shortage in the basin is 16 percent. Higher shortages occur in the Tomichi basin (District 28) and the North Fork basin (District 40).

Table 1
Average Annual Acreage and Consumptive Use Results
1950 through 2013

Water District – Basin	Average Acres	Irrigation Water Requirement (acre-feet)	Supply-Limited CU (acre-feet)	Percent Short
28–Tomichi Creek	26,955	56,856	44,174	22%
40–North Fork	84,715	209,704	155,690	26%
41-Lower Uncompahgre	79,590	171,884	165,321	4%
42-Lower Gunnison	7,471	21,700	17,930	17%
59-East River	32,604	70,912	58,398	18%
62-Upper Gunnison	16,890	31,750	27,689	13%
68-Upper Uncompahgre	15,298	30,833	28,170	9%
Gunnison Basin	263,524	593,638	497,372	16%

Figure 1 presents historical acreage by crop type for the 2010 irrigated acreage assessment. The irrigated land coverages for 1993, 2005, and 2010 were considered in the analysis. As shown, grass pasture is grown on the majority of irrigated land in the basin to support cattle ranching.

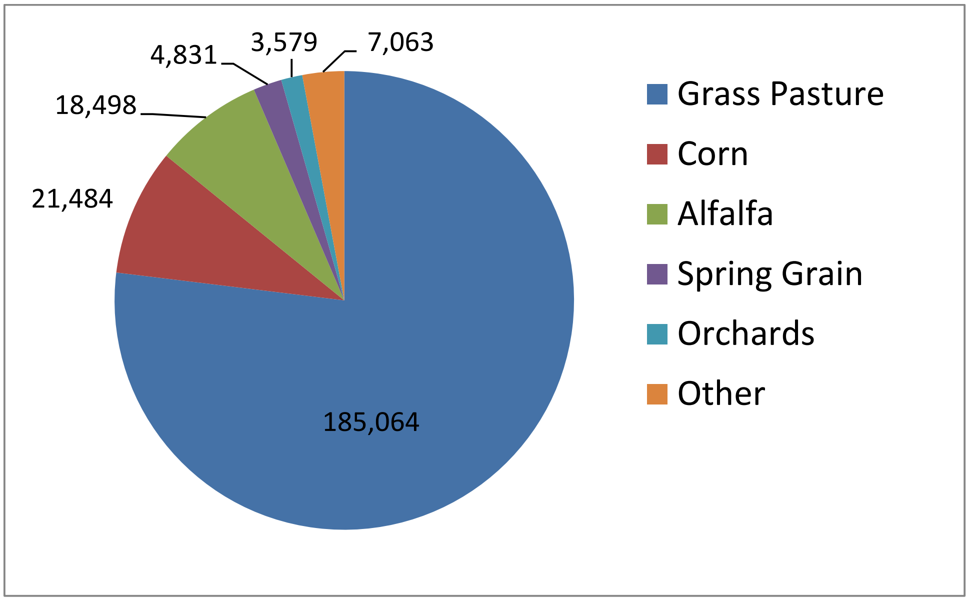


Figure 1: 2010 Irrigated Acreage by Crop Type

Figure 2 presents the annual historical acreage, irrigation water requirement, and supply limited consumptive use for the study period. Although there are minor changes in irrigated acreage between 1993, 2005, and 2010, the pronounced yearly variations in irrigation water requirement are attributed to climate variability in the analysis (temperature and precipitation). The percent of irrigation water requirement not satisfied averaged 16 percent over the study period. Shortages averaging 17 percent from 1990 through 1996 are consistent with normal average flows. Shortages increased to a 24 percent average over a period in the early 2000s due to drought conditions. Shortages reached a maximum in 2002 of approximately 35 percent.

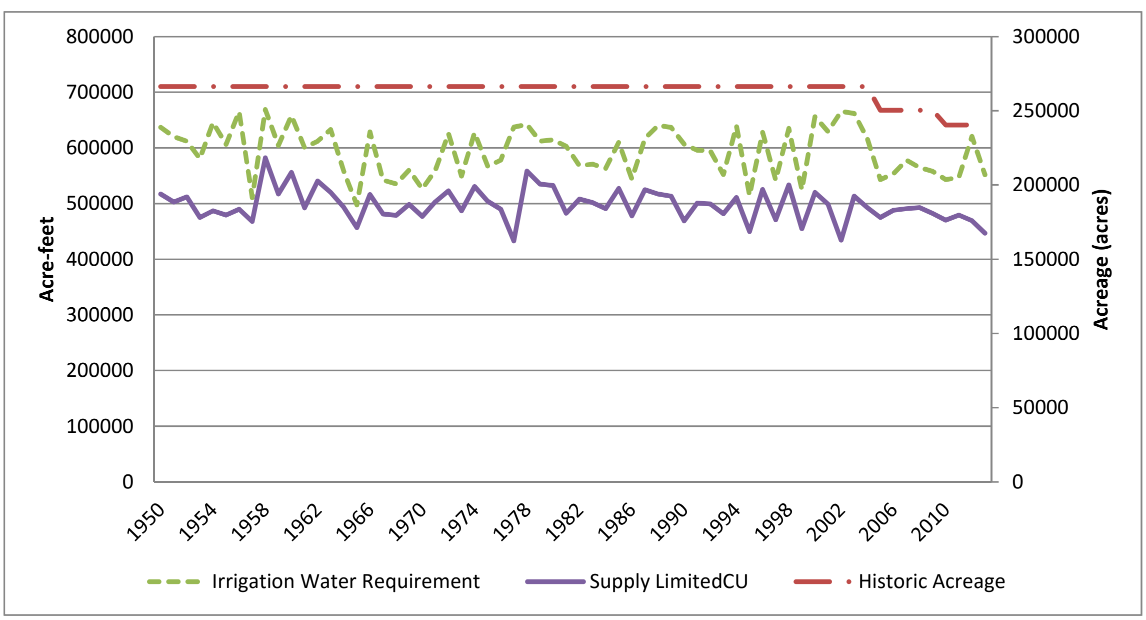


Figure 2: Historical Acreage, Irrigation Water Requirement, and Supply Limited CU 1950 through 2013

Figure 3 shows the annual estimated diversions from surface water to meet crop irrigation requirement and the average annual calculated system efficiency. The average annual surface water diversions from 1950 through 2013 were 1,916,627 acre-feet.

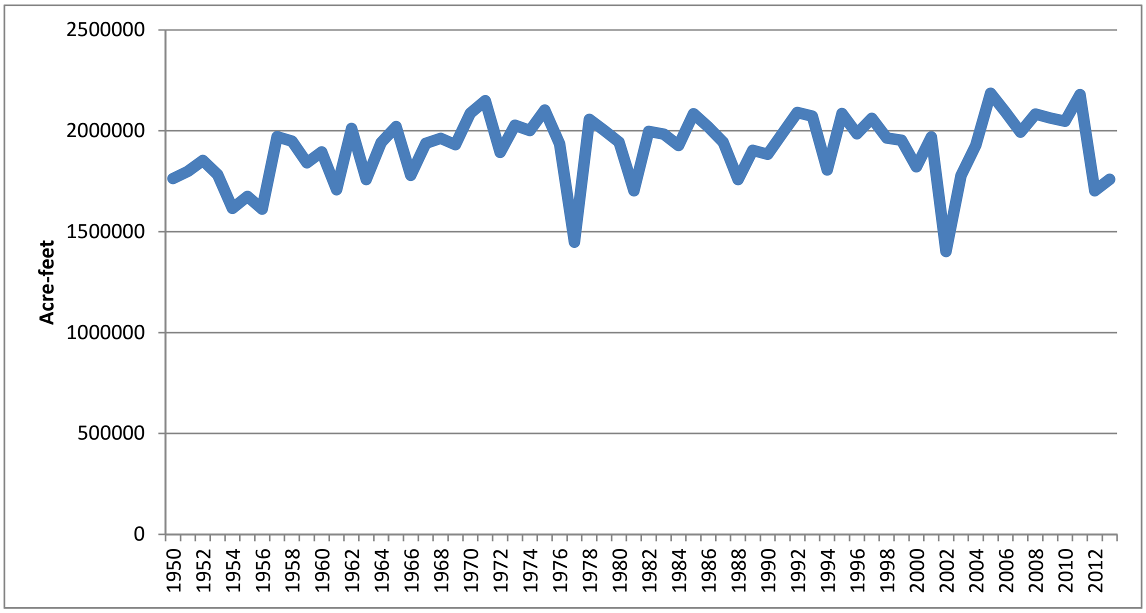


Figure 3: Average Annual Surface Water Diversions1950 through 2013

2.0 Introduction

The estimation of historical crop consumptive use in the Gunnison River Basin and the tool used to perform the analysis are documented in three major reports as follows:

1. This report describes the climate and crop data from HydroBase used in the historical consumptive use analysis, and the parameters used in analysis, including Blaney-Criddle crop coefficients and characteristics. The document summarizes the results of the analysis, total irrigation water requirement, and the supply-limited total consumptive use for the Gunnison River Basin.

2. Gunnison River Basin Water Resources Planning Model User's Manual describes the development of the Gunnison River Basin StateMod surface water model. The document summarizes the process and results of developing the structure list of historical diversions for the historical consumptive use analysis.

3. The StateCU Documentation describes the consumptive use model and graphical user interface used to perform the crop consumptive use analyses conducted as part of the Colorado River Decision Support System.

This Historical Crop Consumptive Use Analysis Report has not attempted to reiterate the detailed analyses and results of the previous efforts performed in support of the final historical crop consumptive use analysis. Instead, it summarizes the major results of each technical memorandum. Supporting memorandum and reports are available on the CDSS website.

2.1 Basin Description

The Gunnison River basin is approximately 7,800 square miles in size, ranging in elevation from 14,000 feet in the headwaters to 4,550 feet at Grand Junction. Average annual rainfall varies from more than 40 inches in the high mountains to as little as 8 inches in the Uncompaghre Valley near the town of Delta. Temperatures generally vary inversely with elevation, and variations in the growing season follow a similar trend. The town of Gunnison has an average growing season of 144 days, while the growing season at Grand Junction has been estimated at approximately 228 days.

The Gunnison River begins at the confluence of the East and Taylor rivers, about 10 miles upstream from the city of Gunnison. The flow is increased as the river is joined by Cochetopa and Tomichi Creeks near the town of Gunnison. Just downstream, the river has carved through Precambrian rocks to form the Black Canyon of the Gunnison. Annual flow through the town of Gunnison is 505,100 acre-feet per year (United States Geological Survey [USGS] gage near Gunnison) for 1950-2013.

The Uncompahgre River is the largest tributary to the Gunnison River, entering from the south near the town of Delta. Average annual flow of the Uncompahgre near the confluence is 218,000 acre-feet (USGS gage at Delta) for 1950-2013. The average annual flow of the Gunnison River near Grand Junction is over 1.7 million acre-feet (USGS gage near Grand Junction) for 1950-2013. Approximately 60 percent of this flow is attributable to snowmelt runoff in May, June, and July.

Figure 4 shows the Water Districts represented in the Gunnison Basin StateCU model.

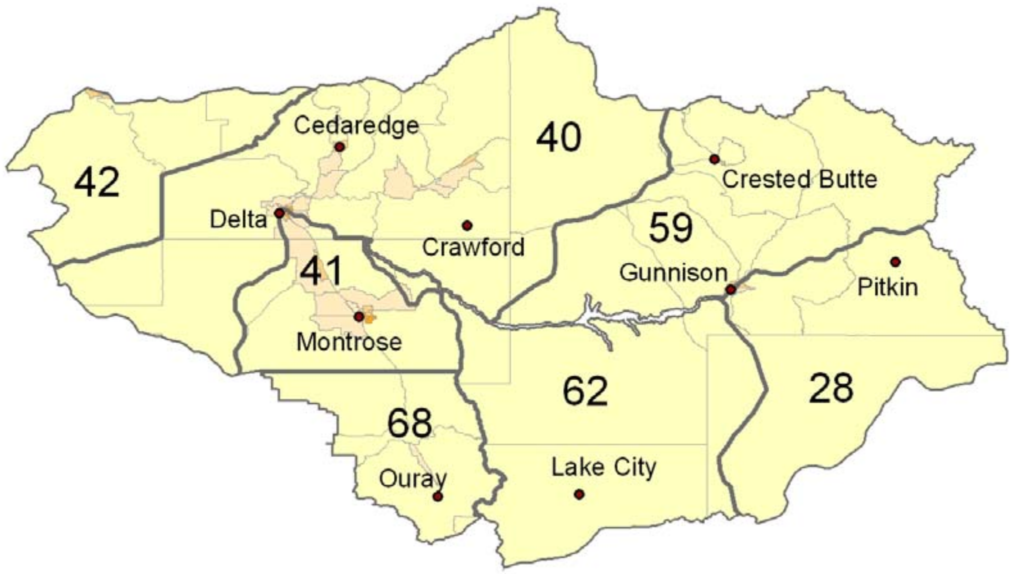


Figure 4: Gunnison River Basin

2.2 Definitions

Several terms used in this report have been broadly used in other studies. The following definitions are consistent with the American Society of Civil Engineers Manuals and Reports on Engineering Practice No. 70 - Evapotranspiration and Irrigation Water Requirement.

Potential Evapotranspiration (ET) The total amount of water that would be used for crop growth if provided with an ample water supply, also called potential consumptive use.

Effective Precipitation The portion of precipitation falling during the crop-growing season that is available to meet the evapotranspiration requirement of the crop.

Winter Effective Precipitation The portion of precipitation falling during the non-growing season that is available for storage in the soil reservoir, and subsequently available to crops during the next growing season.

Irrigation Water Requirement The amount of water required from surface or ground water diversions to meet crop consumptive needs. Calculated as potential evapotranspiration less effective precipitation and stored winter precipitation.

Water Supply-Limited Consumptive Use The amount of water actually used by the crop, limited by water availability; also called actual consumptive use.

The following terms are commonly used in the CDSS efforts:

Irrigated Parcel An irrigated "field" having the same crop type, irrigation method (sprinkler or flood), and water source - not divided by a large feature, such as river or highway.

Ditch Service Area The area of land that a ditch system has either the physical ability or the legal right to irrigate. Note that a ditch service area often includes farmhouses, roads, ditches, fallow fields and undeveloped lands. Therefore a ditch service area is typically greater than the land irrigated under that ditch.

Key Diversion Structure A ditch system that is modeled explicitly in both the StateCU historical consumptive use model efforts and the StateMod water resources planning model. Ditch systems are generally defined as key if they have relatively large diversions, have senior water rights, or are important for administration.

Diversion System Structure A group of diversion structures on the same tributary that operate in a similar fashion to satisfy a common demand.

Aggregated Diversion Structure A group of non-key structures. Aggregated diversions are typically aggregated based on location; e.g. diverting from the same river reach or tributary.

HydroBase The State of Colorado's relational database used in the CDSS efforts. HydroBase contains historical, real-time, and administrative water resources data.

Data Management Interface (DMI) A CDSS program that allows data to flow from HydroBase to the CDSS models using an automated data-centered approach.

StateMod The CDSS water allocation model used to analyze historical and future water management policies.

3.0 Model Development

The Gunnison River historical crop consumptive use analysis was performed using StateCU, a generic data driven consumptive use model and graphical user interface. The objective of the model is to develop monthly consumptive use estimates for the assessment of historical and future water management policies.

The model originated at the USBR and has undergone substantial enhancements while being applied to the Colorado Decision Support System. The *StateCU Documentation* provides a complete description of the model and its capabilities.

3.1 Modeling Approach

The general methodology used to estimate historical consumptive use for the Gunnison River Basin is as follows (See the *StateCU Documentation* for a more complete description of the calculation methods):

1. A Gunnison River Basin structure scenario was developed that includes 100 percent of the 2005 and 2010 irrigated acreage in the Gunnison River using the key, diversion system, and aggregated structures and their associated acreage and crop patterns (see **Section 4.3**).
2. Climate stations were assigned to each structure based on spatial determination of climate station weights by hydrologic unit code (HUC).
3. Potential ET was determined using the SCS Modified Blaney-Criddle consumptive use methodology with TR-21 crop characteristics for acreage below 6500 feet and the Original Blaney-Criddle consumptive use methodology with high-altitude crop coefficients developed for Denver Water for acreage above 6,500 feet. As recommended in the ASCE Manuals and Reports on Engineering Practice No. 70, Evapotranspiration and Irrigation Water Requirements (1990), an elevation adjustment of 10 percent adjustment upward for each 1,000 meters increase in elevation above sea level was applied to the Modified Blaney-Criddle method, i.e. for crops below 6,500 feet. The SCS effective rainfall method outlined in the SCS publication Irrigation Water Requirement Technical Release No. 21 (TR-21) was used to determine the amount of water available from precipitation, resulting in irrigation water requirement.
4. Water supply-limited consumptive use was determined by including diversion records, conveyance efficiencies, application efficiencies, and soil moisture interactions. The model determined water supply-limited consumptive use by first applying surface water to meet irrigation water requirement for land under the ditch system. If excess surface water still remained, it was stored in the soil moisture reservoir. Then if the irrigation water requirement was not satisfied, surface water stored in the soil moisture reservoir was used to meet remaining irrigation water requirement.

3.2 File Directory Convention

To assist in the file organization and maintenance of official State data, the files associated with a historical consumptive use analysis will install to the default subdirectory \cdss\data\ *Analysis_description*\StateCU. *Analysis_description* is **gm2015** for the Gunnison River crop consumptive use analysis, updated in 2015. Note that these directory conventions are not a requirement of the model, simply a data management convention for official State data.

3.3 File Naming Convention

Specific file names or extensions are not a requirement of the model except for the StateCU response file (*.rcu). Standard extensions have been adopted by the State for data management purposes, and are outlined in **Section 4.0 Data Description**.

3.4 Data Centered Model Development

Nearly all the StateCU input files have been generated from HydroBase using the data management interfaces StateDMI (Version 2.18.00, 10/18.2007) and TSTool (Version 8.02.00, 12/03/2007). A description of these tools as applied to StateCU is included in **Section 4 Data Description,** where applicable.

3.5 Product Distribution

The StateCU model, CDSS input files, and associated documentation can be downloaded from the State of Colorado's CDSS web page at http://cdss.state.co.us.

4.0 Data Description

The following sections provide a description of each input file, the source of the data contained in the input file, and the procedure for generating the input file. More detailed information regarding the file contents and formats can be found in the *StateCU Documentation*.

1. Simulation information files
   - StateCU Response File ***Section 4.1***
   - StateCU Control File ***Section 4.2***
2. Structure specific files
   - StateCU Structure File ***Section 4.3***
   - Crop Distribution File ***Section 4.4***
   - Annual Irrigation Parameter File ***Section 4.5***
   - Historical Diversion File ***Section 4.6***
3. Climate data related files
   - Climate Station Information File ***Section 4.7***
   - Climate Data Files ***Section 4.8***
4. Blaney-Criddle specific files
   - Blaney-Criddle Crop Coefficient File ***Section 4.9***
   - Crop Characteristics File ***Section 4.10***

4.1 StateCU Response File (gm2015.rcu)

The StateCU response file contains the names of input files used for a StateCU analysis. The StateCU response file was created using a text editor for the Gunnison River Basin. Input file names in the response file can be revised through the StateCU Interface.

4.2 StateCU Model Control File (gm2015.ccu)

The StateCU Model control file contains the following information used in the historical consumptive use analysis:

- Beginning and ending year for simulation – The simulation period for the analysis was 1950 through 2013.
- Consumptive use analysis method – Monthly SCS Modified Blaney-Criddle, described in TR-21, and the monthly Original Blaney-Criddle analysis were used.
- Effective precipitation method – The SCS Effective Precipitation method, defined in TR-21 was used.
- Scenario type – The analysis was defined as a “structure” scenario.
- Soil moisture consideration – The soil moisture switch was set to “1” indicating the analysis should include soil moisture accounting.

- Initial soil moisture information – The initial soil moisture was set to 50 percent of the capacity for each structure.
- Winter carry-over precipitation percent – The winter carry-over precipitation defines the amount of non-irrigation season precipitation that is available for storage in the soil moisture reservoir. Winter carry-over precipitation was not used for this scenario; set to zero.
- Output options – The output summary switch was set to "3" indicating a detailed water budget output should be generated.

The StateCU model control file was created using a text editor for the Gunnison River Basin. Options in the model control file can be revised through the StateCU Interface.

4.3 StateCU Structure File (gm2015.str)

A structure file defines the structures to be used in the analysis. The structure file contains physical information and structure-specific information that does not vary over time including location information; available soil capacity; and assignments of climate stations to use in the analysis. Location information includes the latitude and county for each structure. The latitude is used in the Blaney-Criddle method to determine the hours of daylight during the growing season.

The Redlands Water & Power Company diverts water from the Gunnison basin for irrigation and power in the Colorado basin. To accurately represent the consumptive use of the Gunnison basin water exported for Redlands irrigation, the Redlands irrigation structure (420541_I) has been included in the Gunnison consumptive use analysis.

Key and Aggregate Structures

The structure file used in the historical consumptive use analysis was created using StateDMI to extract diversion structure location information stored in HydroBase. Early in the CDSS process it was decided that, while all consumptive use should be represented in the models, it was not practical to model each and every water right or diversion structure individually. Seventy-five percent of use in the basin, however, should be represented at strictly correct river locations relative to other users, with strictly correct priorities relative to other users, in both the StateCU and StateMod models. With this objective in mind, key structures to be “explicitly” modeled were determined by:

- Identifying net absolute water rights for each structure and accumulating each structure’s decreed amounts
- Ranking structures according to net total absolute water rights
- Identifying the decreed amount at 75 percent of the basin-wide total decreed amount in the ranked list

- Generating a structures/water rights list consisting of structures at or above the threshold decreed amount
- Field verifying structures/water rights, or confirming their significance with basin water commissioners, and making adjustments

Based on this procedure, 9 cubic feet per second (cfs) cutoff value was selected for the Gunnison River basin. Key diversion structures are generally those with total absolute water rights equal to or greater than 9.0 cfs. The Gunnison model includes approximately 471 key diversion structures. Of the 471 key diversions, there are 21 diversion systems structures. Diversion system structures represent a group of diversion structures on the same tributary that serve a single irrigation demand but are modeled under a single structure. In the Gunnison model, diversion systems are represented by structure WDID_D.

Note that several structures divert both for irrigation and for off-channel reservoir storage. To be consistent with the surface water modeling effort, the irrigation portion of the demands is represented by structure WDID_I.

In general, the use associated with irrigation diversions having total absolute rights less than 9.0 cfs were included in the StateCU and StateMod models at "aggregated nodes." These nodes represent the combined historical diversions, demand, and water rights of many small structures within a prescribed sub-basin. The aggregation boundaries were based generally on tributary boundaries, gage location, critical administrative reaches, and instream flow reaches. To the extent possible, aggregations were devised so that they represented no more than 2,200 irrigated acres. In the Gunnison model, 70 aggregated nodes were identified, representing over 53,000 acres of irrigated crops. The diversion system structures and aggregates are read by StateDMI from list files. StateDMI then develops the historical diversions by summing the historical diversions of the individual structures, and their irrigation water requirement is based on the total acreage associated with the aggregation.

As presented in **Table 2**, 76 percent of 2010 acreage with a surface water source was assigned to key structures. The approach and results for selecting key structures and aggregations are outlined in more detail **Appendix A.**

Table 2: Key and Aggregate Structure Summary

Structure Type	2005 Acres	Percent of Total Acreage	2010 Acres	Percent of Total Acreage	Number of Structures[1]
Key/Diversion System	192,754	77%	187,274	76%	471
Aggregated	57,659	23%	53,246	24%	70[(1)] (839)
Total Structures	**250,413**	**100%**	**240,520**	**100%**	**541**

(1) There are a total of 70 aggregated structures representing 839 individual structures.

Available Soil Moisture Capacities

Available soil moisture capacities were estimated from Natural Resources Conservation Service (NRCS) digital mapping and assigned to individual structures in the structure file. Soil moisture capacities for each structure, in inches of holding capacity per inch of soil depth, were provided for key and aggregate structures from comma separated list files. Structure soil moisture capacity by structure ranges from 0.0117 to 0.1465 inches per inch. Note that the Redlands irrigation structure was assigned an available soil moisture capacity of 0.0808, representative of Water District 42. **Table 3** summarizes the range of soil moisture capacities used in the consumptive use analysis by Water District.

Table 3: Average Soil Moisture Capacity (inches/inch)

District	Average AWC
28	0.1054
40	0.1179
41	0.1096
42	0.0828
59	0.1100
62	0.1012
68	0.1221
Basin Average	**0.1111**

Climate Station Assignment

Climate stations were selected for use in the consumptive use calculation based on their period of records and location with respect to irrigated land (see **Section 4.7** for more information on climate stations). Climate stations and respective weights were assigned to county/hydrologic unit code (HUC) combinations, originally based on USBR assignments. Structures were assigned to county and HUC areas based on the location of their irrigated acreage. Climate station weights were then assigned to structures based on this county/HUC area combination method. Note the Redlands irrigation structure was assigned the Grand Junction 6 ESE climate station, representative of Water District 42.

4.4 Crop Distribution File (gm2015.cds)

The crop distribution file contains acreage and associated crop types for each key and aggregate surface water structures for every year in the analysis period (1950 through 2013). The irrigated acreage assessment for 1993 was originally developed by the State Engineer's Office and the USBR. Each irrigated parcel was assigned a crop type and tied to a structure that provides water to the parcel. Acreage assessments representing 2005 and 2010 were also used in the analysis. The irrigated acreage, along with crop type identification, is available spatially through GIS shapefiles and is also available in HydroBase. **Table 4** summarizes the 2005 and 2010 acreage by crop type.

Table 4: Irrigated Acreage by Crop Type

Crop Type	2005 Acreage	2010 Acreage
Alfalfa	16,002	18,498
Corn Grain	16,515	21,484
Dry Beans	4,768	5,829
Grapes	62	140
Grass Pasture	188,787	185,801
Orchard with Cover	611	2,294
Orchard without Cover	3,610	1,285
Spring Grains	19,815	4,831
Vegetables	245	357
Total Acreage	250,413	240,520

1993 acreage and crop types were assigned to years 1950 through 2004 reflecting the limited change in irrigated acreage in the Gunnison River Basin. The year 2005 acreage and crop types were assigned to years 2005 through 2009. The year 2010 acreage and crop types were assigned to years 2010 through 2013. Note that the year 2000 coverage is omitted from the analysis. Redlands irrigation structure's acreage and crop type was set to the cropping information under Redlands Power Canal (724713) in Division 5. The crop distribution file used in the historic consumptive use analysis was created using StateDMI**.** StateDMI was used to extract the acreage and crop type information from HydroBase and develop the crop distribution file.

4.5 Annual Irrigation Parameter File (gm2015.ipy)

The annual irrigation parameter file contains yearly (time series) structure information required to run consumptive use simulations, including the following:

- conveyance efficiencies
- maximum flood irrigation efficiencies
- maximum sprinkler irrigation efficiencies
- acreage flood irrigated with surface water only
- acreage sprinkler irrigated with surface water only
- acreage flood irrigated with ground water only or supplemental to surface water
- acreage sprinkler irrigated with ground water only or supplemental to surface water
- maximum permitted or decreed monthly pumping capacity
- ground water use mode (ground water primary or secondary source)

The conveyance efficiency accounts for losses between the river headgate and the farm headgate, including losses through canals, ditches and laterals. The maximum flood irrigation and sprinkler efficiencies account for application losses between the farm headgate and the crops. Note that conveyance and maximum application efficiency data input data were not adjusted by year. However, a structure's overall, system efficiency may change by year due to changes in the percent of land served by sprinkler or flood application methods, or due to surface water supply in excess of crop requirement.

Maximum conveyance efficiency for all structures in the Gunnison River Basin is set at 100 percent. Therefore, the maximum flood irrigation and sprinkler irrigation efficiencies represent maximum overall system efficiency . The maximum flood irrigation system efficiency was set to either 40 or 50 percent based on water user information. The maximum sprinkler irrigation system efficiency was set to 72 percent. Efficiency numbers are derived and are not stored in HydroBase. Irrigation methods (flood vs sprinkler), however are stored in HydroBase. StateDMI was used to extract the time series information from HydroBase, set the derived efficiency values, and create the annual irrigation parameter file.

4.6 Historical Irrigation Diversion File (gm2015_cu.ddh)

The historical diversion file provides surface water supply information required to estimate supply-limited consumptive use. Irrigation diversions are provided for each modeled key and aggregate surface water diversion structure. **Figure 5** shows how surface water diversions for irrigation in the basin have changed over time. Surface water diversions for irrigation averaged approximately 1,916,627 acre-feet per year over the 1950 through 2013 study period. The variation seen in **Figure 5** is due to water supply limitations for the basin as a whole.

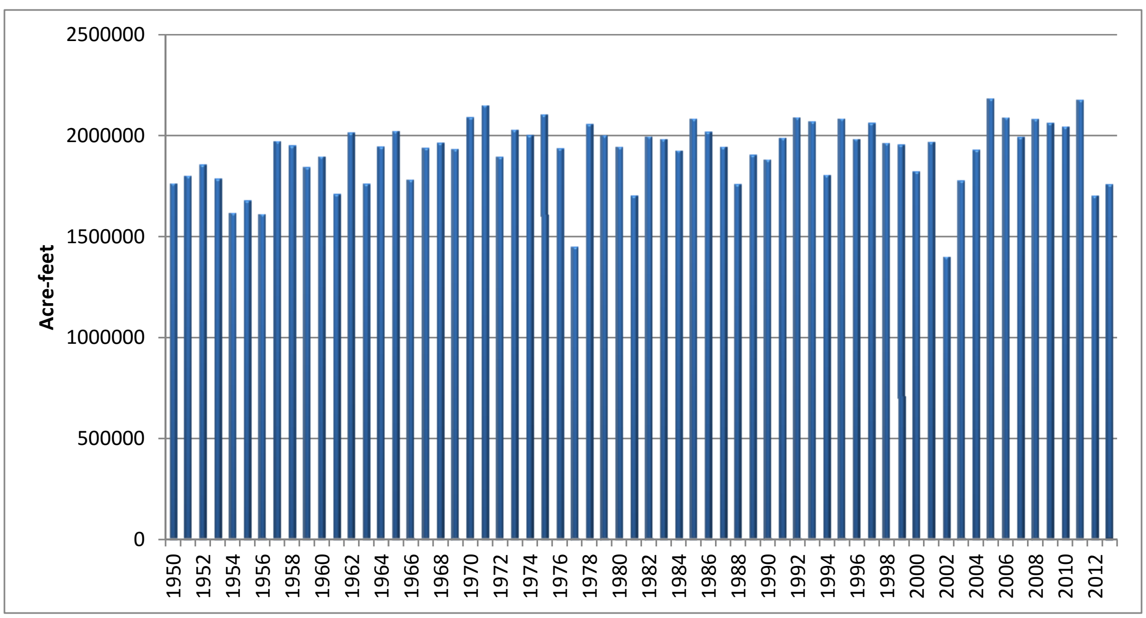


Figure 5: Total Annual Surface Water Irrigation Diversions

StateDMI was used to extract diversion records from HydroBase and fill missing diversion data**.** Diversion data for structures included in a diversion or aggregate structure are first extracted and filled, then combined with other structures' diversion data in the diversion system or aggregate structure. Note that diversion comments were considered when extracting data from HydroBase; for instance, if the diversion comment for a specific structure indicated the structure was not usable for a specific year, that year of data for that structure was set to zero.

Missing data were filled using a wet/dry/average pattern according to an 'indicator' gage. Each month of the streamflow at the indicator gage was categorized as a wet/dry/average month through a process referred to as 'streamflow characterization'. Months with gage flows at or below the 25th percentile for that month are characterized as 'dry', while months at or above the 75th percentile are characterized as 'wet', and remaining months are characterized as 'average'. Using this characterization, missing data points were filled based on the wet, dry, or average pattern. For example, a data point missing for a wet March was filled with the average of other wet Marches in the partial time series, rather than all Marches. The pattern streamflow gages used in the Gunnison River basin are the East River at Almont, CO (09112500), Uncompahgre River at Colona, CO (09147500), Gunnison River near Grand Junction, CO (09152500), and Colorado River near Cameo, CO (09095500). If missing data still existed after filling with a pattern file, historical monthly averages were used to fill the remaining data.

4.7 Climate Station Information File (COclim2015.cli)

The climate station information file provides climate station location information for climate stations used in the analysis, including latitude, elevation, county and HUC. A single climate station information file was developed for the entire western slope and therefore includes all key climate stations used in the Colorado River basin models (Gunnison, White, Yampa, Upper Colorado, San Juan/Dolores). **Table 5** lists the subset of climate stations used in the Gunnison River analysis, their period of record, and their percent complete for temperature and precipitation data. The climate station information file was created using StateDMI to extract location information stored in HydroBase based on a list of climate stations to be used in the analyses.

Table 5: Key Climate Station Information

Station ID	Station Name	WD	Period of Record	Elevation (feet)	Percent Complete (1950 – 2013)	
					Temperature	Precipitation
USC00051440	Cedaredge *	40	1948-2013	6244	95.18%	90.49%
USC00051609	Cimarron	40	1951-2013	6896	94.01%	92.06%
USC00051713	Cochetopa Creek	28	1948-2013	8000	99.74%	99.74%
USC00051959	Crested Butte	59	1910-2013	8860	98.44%	98.96%
USC00052196	Delta 3 E *	40	1900-2013	5010	92.45%	92.32%
USC00053489	Grand Junction 6 ESE	72	1962-2013	4760	79.69%	77.99%
USC00053662	Gunnison 3 SW	59	1900-2013	7640	95.59%	93.36%
USC00054734	Lake City	62	1958-2010	8670	78.39%	93.49%
USC00055722	Montrose No 2	41	1903-2013	5785	99.87%	99.87%
USC00056306	Paonia 1 SW *	40	1905-2013	5693	98.83%	97.79%
USC00057020	Ridgway	68	1982-2013	7200	47.92%	44.27%
USC00058184	Taylor Park	59	1948-2013	9206	98.70%	99.70%

* Represents a combined climate station whereby the data from two or more stations has been combined to create a single key climate station.

4.8 Climate Data Files (COclim2015.tmp, COclim2015.prc, COclim2015.fd)

StateCU requires historical time series data, in calendar year, for temperature, frost dates, and precipitation. The CDSS climate data files, developed using TSTool, contain monthly data for fifty-four stations. Note that a single set of climate data files were developed for the entire western slope and therefore include data for all key climate stations used in the Colorado River basin models (Gunnison, White, Yampa, Upper Colorado, San Juan/Dolores). **Table 6** summarizes the average annual temperature, frost dates and precipitation based on filled data for the subset of stations used in the Gunnison River analysis.

Table 6: Average Annual Filled Climate Values 1950 through 2013

Station Name	Station ID	Average Annual		Frost Dates - Degrees F			
		Temperature (Degrees F)	Precipitation (Inches)	Spring 28 Deg	Spring 32 Deg	Fall 32 Deg	Fall 28 Deg
Cedaredge *	USC00051440	49.2	12.56	26-Apr	17-May	2-Oct	17-Oct
Cimarron	USC00051609	41.6	13.21	31-May	19-Jun	11-Aug	16-Sep
Cochetopa Creek	USC00051713	37.9	10.86	6-Jun	20-Jun	9-Aug	11-Sep
Crested Butte	USC00051959	34.7	24.07	9-Jun	24-Jun	21-Jul	28-Aug
Delta 3 E *	USC00052196	50.6	7.13	2-May	16-May	15-Sep	24-Sep
Grand Junction 6 ESE	USC00053489	53.3	8.76	8-Apr	27-Apr	11-Oct	25-Oct
Gunnison 3 SW	USC00053662	37.7	10.10	4-Jun	20-Jun	11-Aug	9-Sep
Lake City	USC00054734	39.2	13.94	3-Jun	15-Jun	29-Aug	14-Sep
Montrose No 2	USC00055722	49.4	9.49	25-Apr	11-May	7-Oct	19-Oct
Paonia 1 SW *	USC00056306	49.9	14.49	25-Apr	10-May	6-Oct	18-Oct
Ridgway	USC00057020	42.7	17.09	29-May	14-Jun	21-Aug	12-Sep
Taylor Park	USC00058184	32.8	16.74	2-Jun	19-Jun	16-Aug	13-Sep

* Represents a combined climate station whereby the data from two or more stations has been combined to create a single key climate station.

Figures 6 and **7** show the 1950 through 2013 average monthly precipitation and temperature for the Gunnison 3 SW (USC00053662) climate station, located in the eastern portion of the Gunnison River Basin. Missing data for these climate stations were filled from 1950 through 2013 using **TSTool.** Month averages were used to fill missing precipitation data and linear regression techniques were used to fill missing temperature data**.**

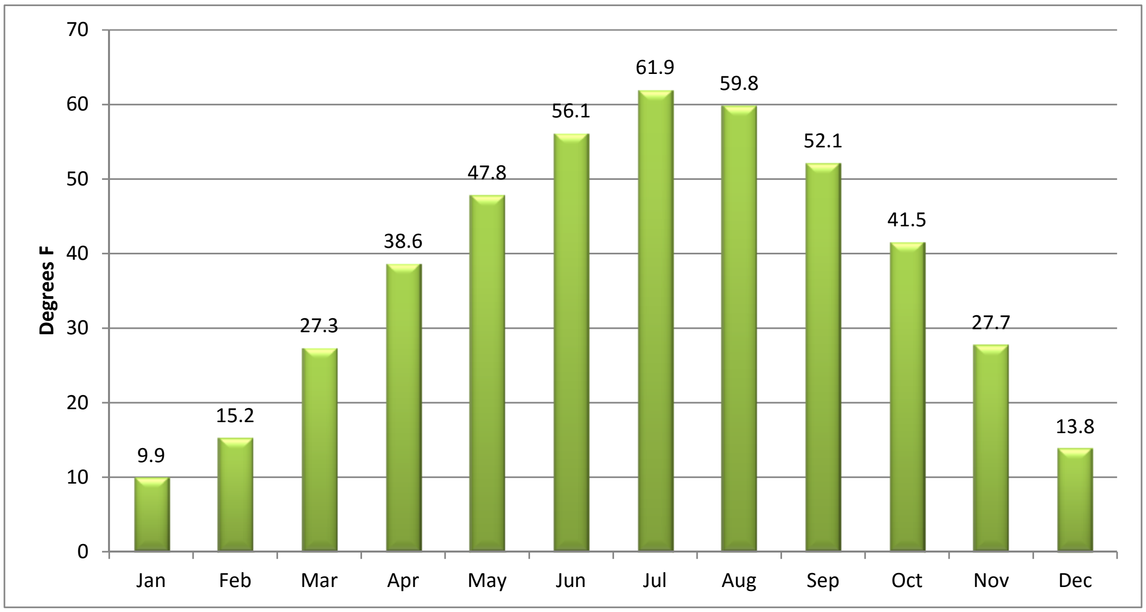


Figure 6: Average Mean Monthly Temperature Gunnison Climate Station 1950 through 2013

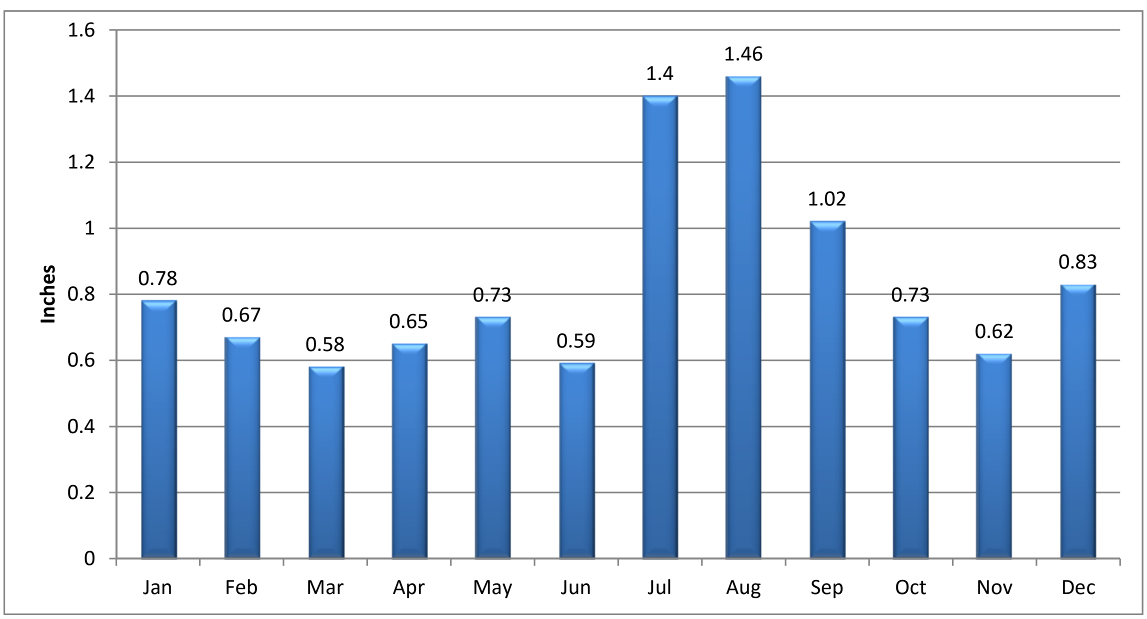


Figure 7: Average Mean Monthly Precipitation Gunnison Climate Station 1950 through 2013

4.9 Blaney-Criddle Crop Coefficient File (CDSS_wEA.kbc)

The Blaney-Criddle crop coefficient file contains crop coefficient data used in the CDSS historical consumptive use analysis. Standard TR-21 Blaney-Criddle crop coefficient curve data is available for the Modified Blaney-Criddle method. The crop coefficient file contains TR-21 curve data for several crops, however only nine TR-21 crops are modeled in the Gunnison River Basin; alfalfa, corn grain, dry beans, grapes, grass pasture, orchard with cover, orchard without cover, spring grains, and vegetables.

Structures with irrigated grass pasture acreage located above 6500 feet in elevation were assigned the Denver Water High Altitude crop coefficients, included in the CDSS.kbc file, for use with the Original Blaney-Criddle methodology. Additional details on high altitude crop coefficients can be found in the SPDSS Task 59.1 Technical Memorandum available on the CDSS website.

The flag to indicate an elevation adjustment to specific crops in the analysis is located in the crop coefficient file. It is recommended in the ASCE Manuals and Reports on Engineering Practice No. 70, Evapotranspiration and Irrigation Water Requirements (1990) that an elevation adjustment of 10 percent adjustment upward for each 1,000 meters increase in elevation above sea level should be applied to the Modified Blaney-Criddle method when using TR-21 coefficients, i.e. for crops below 6,500 feet. For this analysis, an elevation adjustment was applied for all Modified Blaney-Criddle crops. The elevation adjustment is applied based on the elevation of the structure, if provided in the structure file. However, in general, structure elevations are not available in HydroBase. If no structure elevation is provided, the elevation of the weighted climate station(s) is used for the elevation adjustment.

The crop coefficient file used in the historic consumptive use analysis was created using **StateDMI** to extract the representative crop coefficients from HydroBase.

4.10 Crop Characteristic File (CDSS_Adjusted.cch)

The crop characteristic file contains information on planting, harvesting, and root depth. Standard TR-21 Blaney-Criddle crop characteristics were adapted in the analysis. Crop characteristics from the Denver Water study were used for grass pasture above 6,500 feet in elevation. **Table 7** illustrates the crop characteristics for the crops grown in the Gunnison River basin, including high altitude grass pasture.

The crop characteristic file used in the historical consumptive use analysis was created using StateDMI by extracting the representative crop characteristics from HydroBase and develop the crop characteristics input file.

Table 7: Characteristics of Crops in the Gunnison River Basin

Crop Type	Source	Length of Season	Beginning Temperature	End Temperature
Alfalfa	TR-21	365	50	28
Corn Grain	TR-21	140	55	32
Dry Beans	TR-21	112	60	32
Grapes	TR-21	365	55	50
Grass Pasture	TR-21	365	45	45
Orchard with Cover	TR-21	365	50	45
Orchard w/out Cover	TR-21	365	50	45
Spring Grains	TR-21	137	45	32
Vegetables	TR-21	146	55	45
High Alt. Grass Pasture	Denver Water Study	365	42	42

5.0 Results

The Gunnison River Basin historic crop consumptive use results are a product of the input files described in **Section 4**. This section provides a summary of historical crop consumptive use and system efficiencies. Results for individual key and aggregated structures can be easily viewed and printed by obtaining the StateCU input files and StateCU model from the CDSS web site (see **Section 3.5**).

5.1 StateCU Model Result Presentation

Table 8 shows the average annual basin consumptive use water budget accounting for the period 1950 through 2013. The individual component results are discussed in detail in the following sections.

Table 8: Basin Average Annual Results 1950 through 2013 (acre-feet)

		Surface Water Diversion Accounting					Estimated Crop CU		
			Surface Water Diversion To:						
Water District	Irrigation Water Required	River Headgate Diversion	CU	Soil	Non-Consumed	Calculated System Efficiency	From SW	From Soil	Total
28	56,856	232,669	38,784	5,351	188,533	18%	38,784	5,390	44,174
40	209,704	456,104	140,918	14,731	300,456	29%	140,918	14,772	155,690
41	171,884	617,346	158,909	6,683	451,754	17%	158,909	6,412	165,321
42	21,700	53,236	16,575	1,358	35,303	34%	16,575	1,355	17,930
59	70,912	325,456	53,342	5,056	267,058	11%	53,342	5,055	58,398
62	31,750	125,205	25,274	2,440	97,490	19%	25,274	2,415	27,689
68	30,833	106,611	25,847	2,352	78,411	19%	25,847	2,322	28,170
Basin Total	593,638	1,916,627	459,650	37,971	1,419,005	20%	459,650	37,722	497,372

Irrigation Water Required is potential consumptive use less the amount of precipitation effective in meeting crop demands directly during the irrigation season. Note that a conveyance loss of 10 percent is factored directly into the maximum system application efficiencies, as discussed in **Section 4.5**. Therefore the *River Headgate Diversion* is adjusted for conveyance and application efficiency through the maximum application efficiency value. The *Non-Consumed* represents the total water not consumed by the crops; loss through canal conveyance or during application of the irrigation water. The non-consumed portion of diversions returns to the river and is available for re-diversion downstream.

5.2 Historical Crop Consumptive Use

Table 9 presents the historical crop consumptive use analysis results for the 1950 to 2013 study period. Irrigation water requirement in the Gunnison River basin is satisfied from surface water diversions, resulting in an estimate of water supply limited consumptive use. The Gunnison River basin averages 593,638 acre-feet of water supply limited consumptive use annually. The average annual shortage in the basin is 16 percent. Note the consumptive use from surface water includes excess surface water stored in the soil moisture and then subsequently used by crops.

Table 9: Average Annual Consumptive Use Results 1950 through 2013

Water District	Average Acres	Irrigation Water Requirement (acre-feet)	Supply-Limited CU (acre-feet)	Percent Short
28–Tomichi Creek	26,955	56,856	44,174	22%
40–North Fork	84,715	209,704	155,690	26%
41-Lower Uncompahgre	79,590	171,884	165,321	4%
42-Lower Gunnison	7,471	21,700	17,930	17%
59-East River	32,604	70,912	58,398	18%
62-Upper Gunnison	16,890	31,750	27,689	13%
68-Upper Uncompahgre	15,298	30,833	28,170	9%
Gunnison Basin Total	263,524	593,638	497,372	16%

Figure 8 presents basin crop consumptive use results by year. As shown, the percent of irrigation water requirement not satisfied is directly related to water supply. Shortages averaging 16 percent from 1990 through 1997 are consistent with normal average flows. Shortages increased to a 24 percent average over a period in the early 2000s due to drought conditions. Shortages reached a maximum in 2002 of approximately 35 percent.

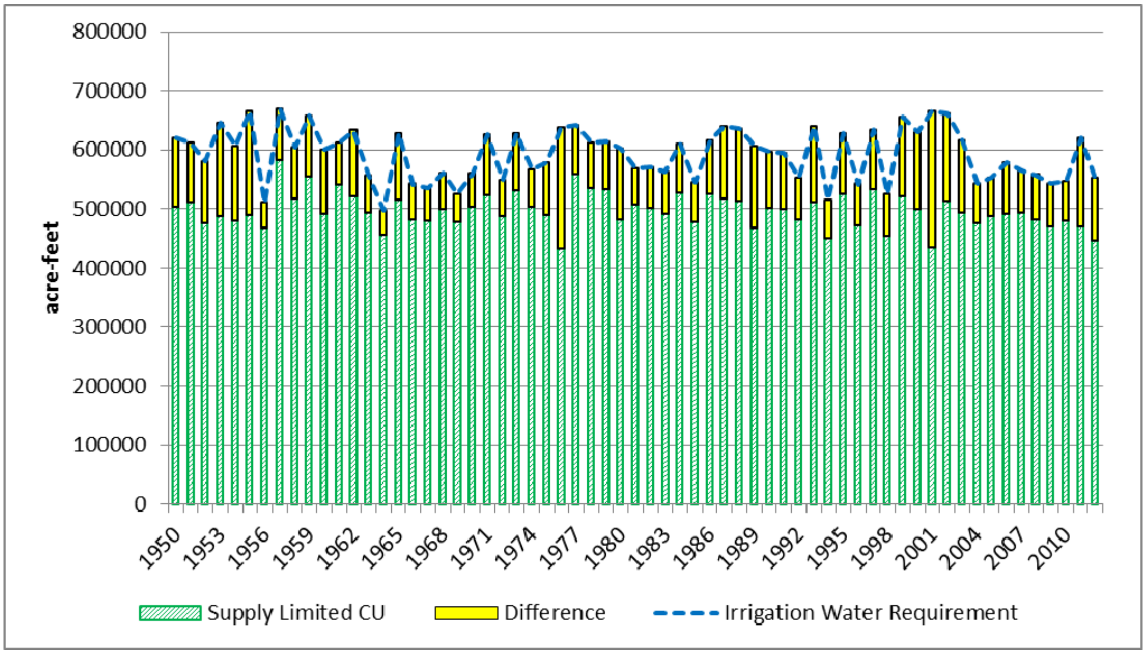


Figure 8: Irrigation Water Requirement and Supply Limited CU

Basin-wide average monthly shortages for the study period vary from a low of 11 percent in June to a high of 27 percent in October, as shown in **Table 10**.

Table 10: Average Monthly Shortage 1950 through 2013

Water District	Apr	May	Jun	Jul	Aug	Sep	Oct
28–Tomichi Creek	31%	24%	14%	17%	24%	37%	39%
40–North Fork	21%	14%	19%	28%	30%	36%	38%
41-Lower Uncompahgre	2%	2%	3%	4%	4%	4%	5%
42-Lower Gunnison	13%	3%	6%	18%	28%	27%	18%
59-East River	23%	22%	11%	13%	19%	29%	27%
62-Upper Gunnison	23%	14%	8%	8%	11%	19%	23%
68-Upper Uncompahgre	8%	15%	7%	6%	5%	8%	11%
Basin Total	16%	14%	11%	15%	18%	24%	27%

Figure 9 presents shortages by year. Shortages increased dramatically in the drought years in the early 2000s.

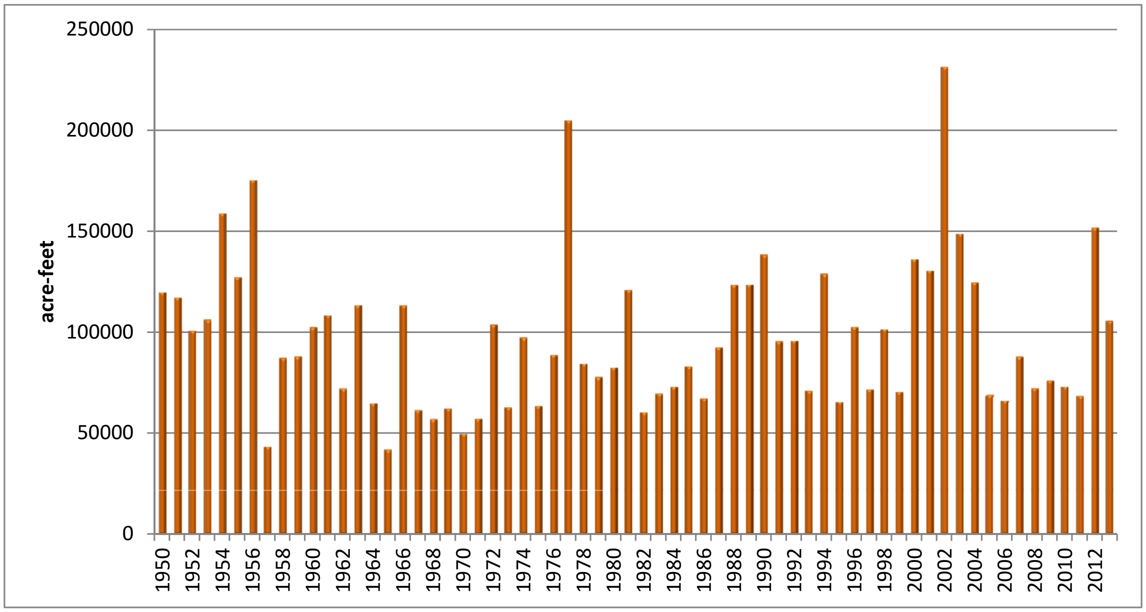


Figure 9: Annual Shortages

5.3 Estimated Actual Efficiencies

As described in the StateCU Documentation, the amount of surface water available to meet the crop demand is the river headgate diversion less conveyance losses and application losses. If the surface water supply exceeds the irrigation water requirement, water can be stored in the soil moisture up to its water holding capacity.

Maximum system efficiencies are provided as input to StateCU, as described in **Section 4.5**. Actual system efficiencies are calculated based on the amount of water available to meet crop demands and the application method (e.g. flood or sprinkler). In the 2005 irrigated acreage assessment, 4,884 acres (2 percent) were estimated to be irrigated by sprinklers, increasing slightly in 2010 to 7,068 acres (3 percent). The remaining acreage is irrigated with flood irrigation practices.

Table 11 provides the average monthly calculated system efficiencies for surface water supplies. Surface water system efficiencies have remained relatively constant throughout the study period, with the slight variations due to water availability.

Table 11: Average Monthly Calculate System Efficiencies

Water District	Apr	May	Jun	Jul	Aug	Sep	Oct
28–Tomichi Creek	28%	23%	18%	19%	26%	29%	23%
40–North Fork	27%	33%	37%	41%	37%	30%	23%
41-Lower Uncompahgre	12%	19%	33%	40%	35%	26%	13%
42-Lower Gunnison	34%	27%	36%	45%	40%	28%	27%
59-East River	18%	23%	20%	17%	17%	20%	12%
62-Upper Gunnison	29%	27%	20%	20%	27%	30%	22%
68-Upper Uncompahgre	19%	31%	30%	28%	24%	28%	24%
Basin Total	17%	25%	27%	30%	31%	26%	17%

6.0 Comments and Concerns

The historical crop consumptive use estimates are based on measured and recorded data; information from other studies; information provided by local water commissioners and users; and engineering judgment. The results developed for this project are considered appropriate to use for CDSS planning efforts. Areas of potential improvement or concern include:

- Historical Acreage. The irrigated acreage assessed for year 1993 serves as the basis for estimating historical acreage from 1950 to 2004 and is considered relatively accurate, as are irrigated acreage estimates for years 2005 and 2010. Diversion structures with irrigated acreage in either 2005 or 2010 were represented in the model. The model may not represent all acreage that was irrigated prior to 1993.
- System Efficiencies. Maximum system efficiency estimates were set primarily based on user-supplied information. Limited conveyance efficiency information exists for ditches in the basin. Canal loss studies, specifically for the larger systems, could improve the estimate of maximum system efficiencies used in the historical consumptive use estimate. Additionally, conveyance efficiency estimates based on soil type and ditch length, determined by the GIS soil type and canal coverages, could be used to also increase the accuracy of the maximum system efficiency estimates.
- Water Use. The results presented are based on an approach that attempts to represent how water is actually applied to crops in the basin. The approach used is based on engineering judgment and informal discussions with water users. The effort did not include determining surface water shares for each owner under a ditch or determining different application rates based on crop types. Instead historically diverted water was shared equally based on acreage under each ditch system. This basin-wide historical crop consumptive use analysis is appropriate for CDSS planning purposes; however, it should be used as a starting point only for a more detailed ditch level analysis.

Appendix A: Aggregation of Irrigation Diversion Structures

A-1: Gunnison River Basin Aggregated Irrigation structures

A-2: Identification of Associated Structures (Diversion System and Multi-structures)

A-1: Gunnison River Basin Aggregated Irrigation structures

Introduction

The original CDSS StateMod and StateCU modeling efforts were based on the 1993 irrigated acreage coverage developed during initial CRDSS efforts. Irrigated acreage assessments representing 2005 and 2010 have now been completed for the western slope basins. A portion of the 2005 and 2010 acreage was tied to structures that did not have identified acreage in the 1993 coverage, and, consequently, are not currently represented in the CDSS models. As part of this task, aggregate and diversion system structure lists for the western slope basins were revised to include 100 percent of the irrigated acreage based on both the 2005 and 2010 assessments. The update also included identification of associated structures and the development of "no diversion" aggregates—groups of structures that have been assigned acreage but do not have current diversion records.

The methodology for identifying associated structures is described more in-depth in **Section A-2** of this appendix. In general, associated structures—which divert to irrigate a common parcel of land—were updated to more accurately model combined acreage, diversions, and demands. These updates include the integration of the 2005 irrigated acreage, the 2010 irrigated acreage, as well as verification based on diversion comments and water right transaction comments. In StateCU, the modeling focus is on the irrigated parcels of land. Therefore, all associated structures are handled in the same way. The acreage is assigned to a single primary node, which can be supplied by diversions from any of the associated structures. In StateMod, there are two types of associated structures. Diversion systems represent structures located on the same tributary that irrigate common land. Diversions systems combine acreage, headgate demands, and water rights; StateMod treats them as a single structure. In contrast, multi-structure systems represent structures located on different tributaries that irrigate common land. Multi-structure systems have the combined acreage and demand assigned to a primary structure; however, the water rights are represented at each individual structure, and the model meets the demand from each structure when their water right is in priority.

"No diversion" aggregates are included in StateCU in order to capture 100 percent of irrigated acreage. However, they were not included in the StateMod modeling effort. Because the individual structures included in these aggregates do not have current diversion records, their effect on the stream cannot be accounted for in the development of natural flows. Therefore, it is appropriate that their diversions also not be included in simulation. The individual structures in the "no diversion" aggregates generally irrigate minimal acreage, often with spring water as a source. There is an assumption that the use will not change in future "what-if" modeling scenarios.

Approach

The following approach was used to update the aggregated structures in the Gunnison River Basin.

1. Identify structures assigned irrigated acreage in either the 2005 or 2010 CDSS acreage coverages.
2. Identify Key structures represented explicitly in the model. The process for determining key structures is outlined in **Section 4** of the report.
3. Identify Key structures that should be represented as diversion systems or multi-structures, based on their association with other structures as outlined in **Section A-2** of this appendix.
4. Aggregate remaining irrigation structures identified in either the 2005 or 2010 irrigated acreage coverages based on the aggregate spatial boundaries shown in Figure A-1. The boundaries were developed during previous Gunnison River Basin modeling effort to general group structures by tributaries with combined acreage less than 2,200.
5. Further split the aggregations based on structures with and without current diversions during the period 2000 through 2012.

Results

Table A-1 indicates the number of structures in the aggregation and the total the 2005 and 2010 aggregated acreage. All of the individual structures in the aggregates have recent diversion records.

Table A-1: Gunnison River Basin Aggregation Summary

Aggregation ID	Aggregation Name	Number of Structures	2005 Acres	2010 Acres
28_ADG009	Upper Tomichi	19	954	960
28_ADG010	Tomichi 1	11	846	1,005
28_ADG011	Cochetopa	7	343	290
28_ADG012	Tomichi 2	21	791	814
28_ADG043	West Pass	3	148	140
28_ADG044	Razor	2	91	91
40_ADG019	Gunnison below Tunnel	2	25	25
40_ADG020	Iron	6	1,684	1,727
40_ADG021	Smith Fork	10	616	448
40_ADG022	North Fork Gunn	20	1,319	1,321
40_ADG023	Minnesota	8	362	412
40_ADG024	North Fork Gunn 2	17	1,183	1,196
40_ADG025	Leroux	12	972	980
40_ADG026	Gunnison near Lazear	32	2,405	2,275
40_ADG027	Currant	14	1,534	1,497
40_ADG028	Upper Tongue	67	2,848	2,640
40_ADG029	Surface	16	922	893
40_ADG030	Tongue	31	2,884	2,527
40_ADG039	Gunnison below Delta	27	1,663	1,500
41_ADG035	Uncompahgre 3	1	295	276

41_ADG036	Uncompahgre 4	29	3,198	2,582
41_ADG037	Uncompahgre 5	12	1,347	1,259
42_ADG040	Gunnison near Grand Junction	34	1,568	1,421
59_ADG001	Taylor	13	518	277
59_ADG002	East 1	6	288	288
59_ADG003	Slate	8	527	527
59_ADG004	East 2	13	793	793
59_ADG005	East 3	12	930	892
59_ADG006	Ohio 1	15	732	732
59_ADG007	Ohio 2	29	1,788	1,664
59_ADG008	Gunnison near Gunnison	18	1,910	1,905
62_ADG013	Cebolla 1	33	942	932
62_ADG014	Cebolla 2	18	1,021	1,021
62_ADG015	Lake	33	1,090	882
62_ADG016	Gunnison Blue Mesa	29	992	986
62_ADG017	Gunnison Morrow Point	5	2,141	287
62_ADG018	Cimarron	6	4,568	4,377
68_ADG033	Dallas	20	1,580	1,575
68_ADG034	Uncompahgre 2	55	3,787	3,684

Table A-2 shows the number of structures in the “no diversions” (AND) aggregates and the total 2005 and 2010 acreage. None of the individual structures in the aggregates have recent diversion records.

Table A-2: No Diversion Aggregation Summary

Aggregation ID	Aggregation Name	Number of Structures	2005 Acres	2010 Acres
28_AND009	Upper Tomichi	1	18	18
28_AND010	Tomichi 1	4	318	318
28_AND011	Cochetopa	16	610	742
28_AND012	Tomichi 2	7	328	340
28_AND043	West Pass	8	302	302
40_AND019	Gunnison below Tunnel	2	72	76
40_AND021	Smith Fork	1	37	37
40_AND022	North Fork Gunn	3	75	75
40_AND026	Gunnison near Lazear	1	98	126
40_AND027	Currant	2	47	43
40_AND028	Upper Tongue	4	252	247
40_AND029	Surface	2	9	10
40_AND030	Tongue	1	11	20
40_AND038	Roubideau	1	5	0
40_AND039	Gunnison below Delta	6	138	102

41_AND035	Uncompahgre 3	2	15	14
41_AND036	Uncompahgre 4	7	312	254
41_AND037	Uncompahgre 5	5	181	156
42_AND040	Gunnison near Grand Junction	3	67	75
59_AND002	East 1	3	169	169
59_AND003	Slate	7	329	329
59_AND004	East 2	7	680	678
59_AND005	East 3	2	168	168
59_AND006	Ohio 1	4	216	216
59_AND007	Ohio 2	2	83	83
59_AND008	Gunnison near Gunnison	3	271	300
62_AND013	Cebolla 1	3	40	40
62_AND015	Lake	5	267	235
62_AND016	Gunnison Blue Mesa	5	561	594
62_AND018	Cimarron	1	254	254
68_AND034	Uncompahgre 2	3	123	123

Table A-3 indicates the structures in the diversion systems and multi-structures.

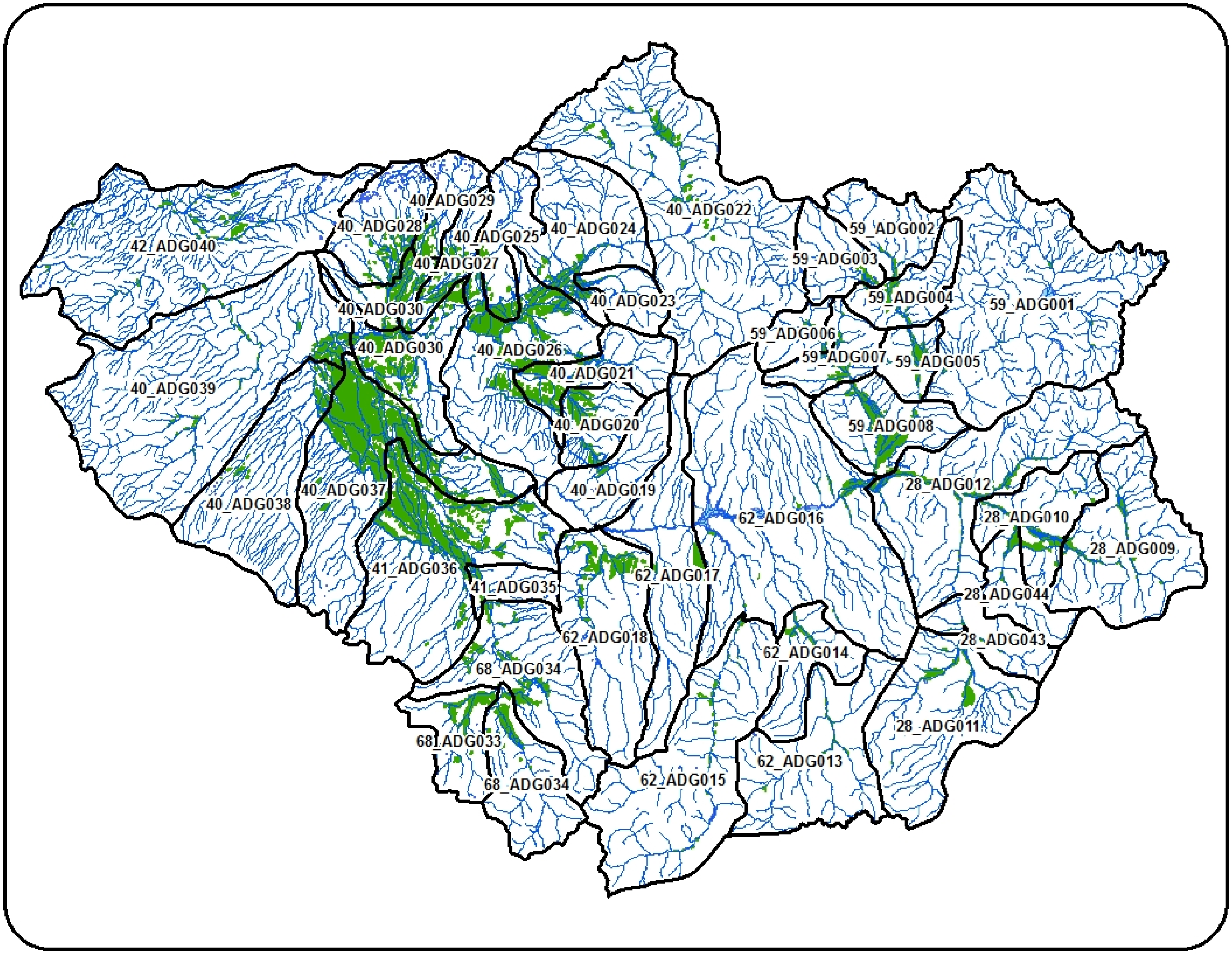
Table A-3: Diversion System and Multi-Structure Summary

Diversion System ID	Diversion System Name	WDID
2800564_D, TOMI_GILBERTSON NO 1	GILBERTSON NO 1 DITCH	2800564
	GILBERTSON NO 2 DITCH	2800565
2800568_D, LOS _GOVERNMENT DITCH	GOVERNMENT DITCH	2800568
	MCDOWELL VAN TUYL NO 1 D	2800637
2800571_D, TOMI_GRIFFING NO 1 D	GRIFFING NO 1 DITCH	2800571
	GRIFFING NO 2 DITCH	2800572
2800586_D, HIRDMAN_SYSTEM	HIRDMAN DITCH NO 3	2800586
	HIRDMAN DITCH NO 1	2801272
	HIRDMAN DITCH NO 2	2801273
2800660_D, NORMAN_SYSTEM	NORMAN DITCH	2800660
	NORMAN DITCH AP	2800780
2800683_D, SHARP_SYSTEM	SHARP DITCH	2800683
	SHARP DITCH AP	2801585
2800697_D, SUTTON_SYSTEM	SUTTON NO 1 AMENDED D	2800695
	SUTTON NO 2 AMENDED D	2800696
	SUTTON NO 3 AMENDED D	2800697
	SUTTON NO 5 DITCH	2800699
2800566_D, GOODRICH_SYSTEM	GOODRICH DITCH	2800566
	GOODRICH DITCH ALT PT	2800953
4000701_D, CEDAR_PARK_SYSTEM	CEDAR PARK DITCH	4000701
	CEDAR PARK EXT A ENL D	4001230

4000703_D, DIRT_EAGLE DITCH	EAGLE DITCH	4000703
	EAGLE NO1 DITCH	4001239
4000753_D, SURF_BONITA DITCH	BONITA DITCH	4000753
	OLD RELIABLE DITCH	4000772
4000808_D, MORTON_SYSTEM	MORTON DITCH	4000808
	MORTON DITCH NO 2	4000809
4000820_D, ALFA_STELL DITCH	STELL BUTTES ENLG DITCH	4000820
	FOGG DITCH	4000759
	STELL DITCH	4000819
	CIRCLE DITCH	4000791
4000891_D, GUNN_NORTH DELTA CAN	NORTH DELTA CANAL	4000891
	NORTH DELTA CANAL	4000730
4001166_D, MUDD_LARSON NO 2 DIT	LARSON NO 2 DITCH	4001166
	LARSON DITCH	4001165
4001437_D, ROUB_HAWKINS DITCH	HAWKINS DITCH	4001437
	ENTERPRISE DITCH	4001434
4100534_D, UNCO_IRONSTONE CANAL	IRONSTONE CANAL	4100534
	SATISFACTION DITCH	4100558
4100568_D, Sunrise DivSys	SUNRISE DITCH(HAPPY CYN)	4100568
	SUNRISE DITCH	4101680
6200736_D, CEBO_SAMMONS IRG D N	SAMMONS IRG D NO 4	6200736
	SAMMONS DITCH	6200733
6200812_D, YOUMANS NO 4 DITCH	YOUMANS IRG D NO 1	6200809
	YOUMANS NO 4 DITCH	6200812
4000944_D, LERO_OVERLAND DITCH	OVERLAND DITCH	4000944
	STULL DITCH	4000942
	OVERLAND DITCH	4000585
4000503, GRANDVIEW CANAL Multistructure	GRANDVIEW CANAL	4000503
	ASPEN DITCH	4000508
4000501, NEEDLE ROCK DITCH Multistructure	NEEDLE ROCK DITCH	4000501
	ASPEN CANAL	4000509

Figure A-1 shows the spatial boundaries of each aggregation. **Exhibit A**, attached, lists the diversion structures represented in each aggregate. **Exhibit B** lists the diversion structures represented in each no diversion aggregate. Both **Exhibit A** and **Exhibit B** provide a comparison of the 2005 and 2010 irrigated acreage assigned to each structure.

Figure A-1: Aggregate Structure Boundaries



Recommendations

As part of this modeling update, various lists have been developed for review and reconciliation by the Water Commissioner. The lists include:

- Structures tied to irrigated acreage that do not have current diversion records
- Structures tied to irrigated acreage that do not have water rights for irrigation
- Structures that have current diversion records coded as irrigation use, but do not have irrigated acreage in either 2005 or 2010
- Structures that have irrigation water rights, but do not have irrigated acreage in either 2005 or 2010
- More than one structure is assigned to the same irrigated parcel, however there was no indication that the structures serve the same acreage in either diversion comments or water rights transaction comments.

Exhibit A: Diversion Structures in each Aggregate

Aggregation ID	Structure Name	WDID	2005 Acres	2010 Acres
28_ADG009, Upper Tomichi	Gee Canal	2800563	147	147
	J T Horn Ditch	2800598	69	69
	Long Branch Ditch	2800625	21	21
	Long Branch Rgr Sta Dno1	2800626	20	20
	Long Branch Rgr Sta Dno2	2800627	4	0
	Means Bros No 1 Ditch	2800639	22	21
	Means Bros No 10 Ditch	2800640	75	75
	Means Bros No 11 Ditch	2800641	75	75
	Templeton Ditch	2800705	41	41
	Weddle Ditch	2800713	46	46
	Cole D Cole Clark De & E	2800746	206	189
	Hellmuth D Nos 1&2	2800962	22	48
	Hicks Creek Ditch	2800965	22	22
	Dawson Creek Ditch	2800969	36	36
	Tank 7 Ditch No 1	2800996	24	24
	Tank 7 Ditch No 2	2800997	24	24
	Big Bend Ditch	2801118	46	46
	Mccalister Ditch	2801129	36	36
	Long Brnch/Weddle Hgt1-4	2801184	21	21
28_ADG010, Tomichi 1	Gratehouse Ditch	2800570	25	25
	Gulch No 1 No 2 Ditches	2800575	80	80
	Knowles Barrett Ditch	2800611	33	211
	Knowles Ditch	2800612	383	383
	Munson Creek Ditch	2800656	109	100
	Munson Ditch	2800657	9	0
	Spruce Creek Ditch	2800893	39	39
	Willard Ditch	2800948	33	33
	Willard No 2 Ditch	2800949	33	33
	Mcgowan Irrigating D Alt	2801630	61	61
	D A Mcconnell D Alt Pt	2801649	40	40
28_ADG011, Cochetopa	Cochetopa Meadows Ditch	2800533	7	7
	Curtis Ditch No 1	2800540	8	8
	Curtis Ditch No 2	2800541	23	23
	Leahy Ditch	2800813	25	25
	Stevens Ditch	2800897	113	78
	Crarys Los Pinos No2 Ditch	2800968	43	77
	Willow Creek Ditch	2801012	123	72
28_ADG012, Tomichi 2	Alder Ditch	2800504	7	7
	Cabin Creek Ditch	2800519	21	28
	Cheeney No 1 Ditch	2800524	21	58

	Clovis Metroz No 2 Ditch	2800531	34	36
	Graham Ditch	2800569	52	44
	Jennings Elsen Ditch	2800599	53	53
	Lobdell Alder Creek	2800620	23	23
	Lockwood Ditch	2800623	65	65
	Bever Ditch	2800720	42	26
	Deering Spring Ditch	2800773	50	50
	Dipping Vat Ditch	2800774	56	56
	Marthas Spring Ditch	2800819	44	44
	Piloni Homestead Ditch	2800862	56	56
	Mclain Spring	2800885	65	65
	Waterman Ditch	2800937	4	4
	Hartman Ditch No 1	2800959	20	18
	Mcdowell Van Tuyl No 2 D	2801565	78	78
	Clovis Metroz No1 Alt 1	2801634	17	17
	Clovis Metroz No1 Alt 2	2801635	51	53
	Clovis Metroz No1 Alt 3	2801636	17	17
	Clovis Metroz No1 Alt 4	2801637	17	17
28_ADG043, West Pass	Funk Ditch No 77	2800792	64	64
	Spring Ditch	2800892	64	64
	Gwendolyn K Hack Ditch	2800957	19	11
28_ADG044, Razor	Aurora Ditch	2800724	45	45
	Willis Ditch	2800733	45	45
40_ADG019, Gunnison Below Tunnel	Don Meek No 1 Ditch	4000540	18	18
	Don Meek No 2 Ditch	4000541	7	7
40_ADG020, Iron	Cathedral Ditch	4000519	97	97
	Clear Fork Ditch	4000528	294	331
	Fluke Ditch	4000544	484	489
	Georgia Ditch	4000550	38	38
	Maher Ditch	4000569	594	594
	Mcmillan Ditch	4000573	178	178
40_ADG021, Smith Fork	Anderson Ditch	4000507	30	30
	Barnard Ditch	4000512	57	57
	Bean Ditch	4000514	11	11
	Buck Canon Ditch	4000518	29	29
	Diamond Joe Ditch	4000537	47	47
	Jersey Ditch	4000561	32	31
	Reeder Ditch 1 And 2	4000594	23	23
	Reeder Ditch No 3	4000595	23	23
	Shadeland Ditch	4000604	334	168
	Upper Mcleod Ditch	4000614	28	28

40_ADG022, North Fork Gunnison	Ault Ditch	4001071	68	68
	Beuten Ditch	4001082	193	193
	Bever Hide Ditch	4001085	22	22
	Big Rock Ditch	4001086	11	13
	Buzzard Ditch No 1	4001090	45	45
	Buzzard Ditch No 2	4001091	45	45
	Elk Ditch	4001125	33	33
	Frey Ditch	4001137	19	19
	Galpin No 2 Ditch	4001139	50	50
	Homestead Ditch	4001148	42	42
	Hutchins Ditch	4001151	86	86
	J F Toland Ditch	4001157	77	77
	Layton And Cloone Ditch	4001167	20	20
	Lost Cabin Ditch	4001172	61	61
	Mcmillan Ditch No 1	4001179	38	38
	Norris Ditch	4001184	106	106
	Sperry Ditch	4001203	124	124
	Spring Gulch Ditch	4001204	38	38
	Oak Leaf Ditch	4001279	119	119
	Ridge Ditch	4001756	119	119
40_ADG023, Minnesota	Clough Ditch	4000964	15	14
	East Fork Ditch No 1	4000977	37	88
	Emmons Harding Ditch	4000981	23	23
	Harding Kerns Ditch	4000993	34	34
	Lane Ditch	4001009	60	60
	Sweezy Turner Ditch	4001051	77	77
	Clark & Wade D	4001232	78	78
	Layton Ditch	4001250	38	38
40_ADG024, North Fork Gunnison 2	Ballard Ditch	4000951	43	43
	Bruce Ditch	4000960	28	28
	Gopher Ditch	4000989	11	11
	Hadley Ditch No 2	4000991	86	86
	Miller Ditch	4001018	23	23
	Oak Mesa Ditch	4001027	103	103
	Paonia Fruit Ditch	4001028	13	13
	Reynolds Ditch	4001033	387	379
	Vogel Ditch	4001057	26	34
	Deer Trail Ditch	4001113	78	84
	Fawcett Ditch	4001130	9	9
	Feldman Ditch	4001131	0	5
	Holybee Ditch	4001155	10	10
	Lennox Ditch	4001169	49	49

	Majnik Ditch	4001173	12	12
	Terror Ditch	4001208	295	295
	Hadley Ditch	4001276	10	12
40_ADG025, Leroux	Enos T Hotchkiss Ditch	4000921	17	17
	Orchard Ditch	4000934	52	52
	Richie Ditch	4000938	94	94
	Ross Ditch	4000939	34	34
	Shindledecker Ditch	4000940	40	45
	Smith Ditch	4000941	114	114
	Wilcox Ditch	4000943	47	52
	H S Johnson Ditch	4001001	298	322
	Miller Waste Ditch	4001019	56	29
	Riddle Stephens Ditch	4001034	82	82
	W F Duke Ditch	4001059	52	52
	Duke Ditch	4001847	86	86
40_ADG026, Gunnison Near Lazear	Freeman Ditch No 2	4000547	8	8
	Scrub Oak Ditch No 1	4000602	11	11
	Scrub Oak Ditch No 2	4000603	33	33
	Smiths Fork Cr Canon D	4000606	49	49
	Oasis No 1 Ditch	4000811	136	136
	Big Gulch Ditch	4000915	186	186
	Fleming Ditch	4000922	150	153
	Isom Ditch	4000925	34	36
	Little Mary Ditch	4000927	439	437
	Clements Ditch	4000963	41	41
	Crane Ebersol Ditch	4000968	35	38
	Davenport Ditch	4000971	53	61
	Estes Ditch	4000982	27	21
	Hotchkiss No 1 Ditch	4000998	48	48
	Hotchkiss No 2 Ditch	4000999	42	42
	Hotchkiss No 3 Ditch	4001000	42	42
	Kelley Ditch No 2	4001006	120	120
	Kelley No 1 Ditch	4001007	12	18
	Langford Caddick Ltl D	4001010	15	15
	North Fork Orchard Co D	4001025	183	39
	Runyon Ditch	4001039	114	114
	Whipple Gulch Ditch	4001066	44	44
	Woods No 2 Ditch	4001068	27	27
	Kascak Seepage Ditch	4001233	13	13
	Watson Ditch No 2	4001247	40	40
	White Waste Ditch	4001257	43	45
	Larson Bro Ditch No 2	4001299	69	69

	Frank Allen Ditch	4001614	16	16
	J M Beal Seep Ditch	4001678	19	18
	Needle Rock D Hgt No 5	4001733	139	139
	Hall S Ditch Enlargement	4002482	64	64
	West Reservoir	4003411	153	151
40_ADG027, Currant	Alfalfa Run Seep Ditch	4000788	9	9
	Chandler Ditch	4000790	0	22
	Currant Creek No 1 Ditch	4000793	35	0
	Dry Creek Ditch	4000796	290	290
	Evergreen Ditch	4000799	155	150
	Fuller Ditch No 2	4000802	69	51
	Gallant Ditch	4000803	147	135
	Mcneil Ditch	4000806	31	38
	Mineral Springs Ditch	4000807	11	11
	Oak Park Ditch	4000813	254	254
	Rimrock Ditch	4000817	99	99
	Welch Ditch	4000823	101	101
	Whiting Ditch	4000826	205	208
	Burt And Thompson Ditch	4001272	128	128
40_ADG028, Upper Tongue	Billys Cross Ditch	4000629	8	8
	Broncho Ditch	4000630	53	47
	Cherokee Ditch	4000631	59	46
	Church Ditch	4000633	8	8
	Cottonwood Ditch	4000634	7	7
	Horse Park Ditch	4000638	42	42
	I E Baker Ditch	4000640	28	28
	Kiser Ditch	4000643	44	44
	Oak Leaf Ditch	4000652	3	3
	Red Bluff Ditch	4000654	114	113
	Roseberry Ditch	4000655	126	126
	Roosevelt Ditch	4000657	19	19
	States Ditch	4000660	20	20
	Sweitzer Ditch	4000663	12	12
	Texas Ditch	4000664	58	58
	Tipple Ditch	4000665	8	8
	Wonders Ditch	4000667	56	53
	Adobe Ditch	4000696	27	27
	Blake Ditch	4000697	49	49
	B And M Ditch	4000698	12	12
	Bryson Ditch	4000699	17	17
	Carbon Ditch	4000700	59	79
	Eckert Ditch	4000704	11	11

	Edgar Ditch	4000705	8	8
	Gabriel Ditch	4000707	6	6
	Gallagher Ditch	4000708	35	35
	Gard Ditch	4000710	23	23
	Genes Ditch	4000711	8	8
	Gilger Ditch	4000712	15	15
	Hansen Ditch	4000714	10	9
	Happy Hollow Ditch	4000715	74	56
	H J Neighbors Ditch	4000716	15	15
	Humper Ditch	4000717	64	64
	Kile Ditch	4000721	8	8
	Lone Friday Ditch	4000724	29	29
	Morris Ditch	4000729	12	12
	Obert Ditch	4000731	89	86
	Orchard Ditch	4000732	10	10
	Parker Ditch	4000734	29	29
	Perkins Ditch	4000735	57	57
	Pratt Ditch	4000737	7	7
	Red Haw Ditch	4000738	41	42
	R And K Ditch	4000739	8	8
	Sandstone Bluff Ditch	4000741	265	266
	Sessions Ditch	4000742	14	14
	Shoup Ditch	4000743	43	42
	Stillwagon Ditch	4000744	48	48
	Sunrise Ditch	4000745	42	31
	Todd Ditch	4000746	44	43
	West Ditch	4000747	122	122
	Williams Ditch No 2	4000749	31	30
	Cook Ditch	4000755	55	112
	Hoosier Ditch	4000841	183	144
	Loucks Ditch	4000843	70	70
	Mt View Mesa No 1 Ditch	4000845	100	0
	Oak Creek No 2 Ditch	4000847	77	52
	Pumpkin Swag Seep Ditch	4000850	23	23
	Right Hand Ditch	4000851	31	31
	Sanburg Ditch	4000852	55	21
	Short Cut Ditch	4001231	13	3
	Valley View Ditch	4001235	114	114
	Perkins Ditch	4001240	39	35
	Bourn Ditch	4001266	50	50
	Stillwagon No 2 Ditch	4001295	6	6
	Stillwagon No 3 Ditch	4001296	10	10

	Roy J Tompson Ditch	4001496	7	7
	Clark-Wetterick Mesa D	4002256	18	0
40_ADG029, Surface	Lookout Ditch	4000648	69	83
	Beeson Ditch	4000671	37	24
	C And D Ditch	4000672	67	62
	Cold Water Ditch	4000677	57	57
	Gregg Ditch	4000679	56	27
	Gurney Ditch	4000680	114	139
	Hard Labor Ditch	4000681	32	6
	Harris Ditch	4000682	11	8
	Jackson Ditch	4000684	20	13
	Klondyke Ditch	4000685	68	68
	Metzger Ditch	4000687	22	22
	Paradise Ditch	4000688	118	118
	Reed Ditch	4000689	41	41
	Rose Ditch	4000690	0	13
	Trickle Ditch	4000693	200	202
	Wild Cherry Ditch	4000694	11	11
40_ADG030, Tongue	Shamrock Ditch	4000646	91	91
	Daisy Ditch	4000702	36	26
	Forked Tongue Ditch	4000706	178	178
	Kennicott & Mower D	4000720	139	100
	Lucky Ditch No 1	4000726	26	26
	Park Ditch	4000733	185	192
	Pioneer Ditch	4000736	66	66
	Big Fall Ditch	4000752	35	33
	Eric Johnson Ditch	4000757	33	33
	Hal Ditch	4000763	61	14
	Kohler Waste Water D	4000767	59	49
	Omega Ditch	4000773	217	216
	Shepherd Ditch	4000779	139	194
	Stillwater Ditch	4000780	105	58
	Sunflower Ditch	4000782	6	0
	Weir And Johnson Ditch	4000786	29	29
	Zanola And Pelazini D	4000787	84	84
	Desert Ditch	4000795	79	79
	Fuller Ditch	4000801	9	0
	Hillside Ditch	4000804	8	3
	Oasis Ditch 1St Enlt	4000812	218	33
	Peterson Ditch	4000815	11	24
	Hixon Ditch No 1	4000839	10	10
	Hixon Ditch No 2	4000840	29	29

	Mcmurray Ditch	4000844	134	124
	Pumpkin Swag Ditch	4000849	160	160
	Shoemaker Ditch	4000903	11	13
	Baker Ditch No 1	4001292	59	63
	Broad Ax Ditch	4001341	20	4
	Sunflower Ditch	4001385	559	545
	Maud S Ditch	4001473	87	49
40_ADG039, Gunnison below Delta	Alkali Ditch	4000854	193	193
	Bass Ditch	4000857	8	8
	Bever Ditch Pipeline	4000858	86	86
	Blumberg Ditch	4000859	50	50
	Blumberg No 2 Ditch	4000860	50	50
	Boise Ditch	4000862	4	3
	Campbell Ditch	4000866	74	74
	Capt H A Smith Ditch	4000867	19	19
	Cowger Ditch	4000872	41	31
	Elk Horn Ditch	4000875	39	39
	Granite Rock Ditch	4000876	40	40
	Harry Walker Ditch	4000878	66	36
	John W Musser Ditch	4000882	106	106
	Mccarthy Ditch	4000887	56	56
	Mccarthy Ditch No 2	4000888	17	17
	Mow Ditch	4000890	8	8
	Obergfell Baldwin Ditch	4000892	283	282
	Palmer Ditch	4000894	203	86
	Peeples Pump&Pipe	4000896	80	80
	Poverty Ditch	4000898	22	22
	Red Squirrel Ditch	4000899	45	45
	Schafer Ditch	4000901	21	21
	Tatum Burton Ditch	4000910	48	44
	Wilbur Ditch	4000911	39	39
	Independent Ditch	4001304	18	18
	North Fork Ditch	4001325	14	13
	Rio Dominguez Ditch	4200542	35	35
41_ADG035, Uncompahgre 3	Buckhorn Ditch	4100509	295	276
41_ADG036, Uncompahgre 4	Albush Ditch	4100500	107	107
	Bancroft D	4100503	0	103
	C A Palmer Ditch	4100511	6	6
	Cedar Park Ditch	4100512	234	250
	Enlt Of Garrett Ditch	4100521	500	0
	Fansher Horsefly No 2 D	4100522	188	187

	J. C. Frees Private Ditch	4100526	50	50
	Glendening Ditch	4100529	30	30
	Heath Ditch	4100533	31	31
	J H Anderson D No 1	4100535	253	253
	Keller Brothers Ditch	4100536	24	24
	Menke Mc Collum Ditch	4100541	16	43
	Miles Ditch	4100543	72	72
	Mock Ditch	4100544	56	56
	Neugart Ditch	4100546	24	22
	Rice Ditch	4100551	67	58
	S E Dillon Ditch	4100555	50	50
	Sampson Frasier Ditch	4100556	68	68
	Sampson Frasier Cont	4100557	10	10
	Supply Ditch	4100569	34	29
	Woodgate Callaway Ditch	4100572	262	439
	Kearny Ditch	4100579	45	45
	Spring Valley Ditch	4100842	21	21
	Cross 7 Ranch Ditch	4101006	31	31
	J H Anderson D No 2	4101133	61	61
	Loutsenhizer Ditch	4101744	35	35
	Tierra Colo Ditch	6800759	722	462
	Williams D Nos 1,2&3	6800784	38	38
	Thrasher Ditch	6800935	164	0
41_ADG037, Uncompahgre 5	Baldy Ditch	4100501	0	0
	Beach No 1 D	4100504	17	17
	Beach No 2 D	4100505	19	19
	Chaparral D No 2	4100513	54	54
	Darter & Haugsted Ditch	4100516	197	192
	Garren Lewis Ditch	4100528	66	39
	Grays Creek Ditch	4100530	0	0
	Mccollum Ditch	4100539	29	29
	Spring Ditch	4100565	126	149
	Angel Dry Cr D System	4100731	47	47
	Short Ditch	4100772	29	29
	Oscar Richards Ditch	6200703	251	203
42_ADG040, Gunnison near Grand Junction	Anderson Ditch	4200501	37	41
	Bales Williams Morrison	4200503	38	36
	Bauer Ditch	4200504	369	250
	Black Ditch	4200505	6	6
	Bowen Private Ditch	4200507	98	82
	Brandon Ditch	4200509	52	141
	East Creek Ditch	4200515	8	0

	F B Grant Ditch	4200516	7	7
	Florence H Berry Ditch	4200517	4	0
	Gunnison Pumping Plant	4200521	75	75
	Helmke Ditch	4200522	47	46
	Ira Vincent Ditch	4200523	32	32
	Johnson Cr Ditch Hdgt No 1	4200526	27	27
	Johnson Cr Ditch Hdgt No2	4200527	14	14
	Lurvey Ditch #1	4200531	105	48
	M J Woodring Ditch	4200534	12	12
	Northwestern Ditch	4200536	102	100
	Raber Coal Cr Supply D	4200538	5	26
	Shropshire Ditch	4200544	27	27
	Snyder Creek Supply Ditch	4200546	21	21
	Unaweep Ditch	4200547	27	27
	Wadlow Pumping Plant	4200548	8	0
	Washburn & Downing Ditch	4200549	48	48
	William J Ponsford D	4200551	4	4
	Wm H Williams Ditch	4200552	25	29
	Laurent Ditch	4200554	178	178
	Anderson Ditch 4	4200556	17	17
	Ladder Gulch Ditch	4200609	45	0
	Vanpelt Cox Seepage D	4200630	1	1
	F B Grant Ext	4200639	20	20
	Johnson Creek Ditch No2	4200650	41	41
	Brandon D City Of Gj	4200822	27	27
	Brandon D Lockhart Draw	4200823	27	27
	M J Woodring Res	4203621	11	11
59_ADG001, Taylor	Axtell Ditch	5900513	47	10
	Elmer Ditch	5900552	39	35
	Lowline Ditch	5900618	33	30
	Summerville Ditch	5900685	5	5
	Elmer No 2 Ditch	5900714	16	14
	Churchill Ditch	5900718	84	84
	Summerville Ditch No 2	5900726	5	5
	Doctor Ditch	5900861	4	4
	Doctor No 2 Ditch	5900862	0	4
	Korn Ditch	5900959	84	84
	Murdie Mesa Irg D	5901026	28	0
	Pieplant Ditch	5901063	135	0
	Tincup Town Ditch	5901168	37	0
59_ADG002, East 1	Beitler Ditch No 1	5900517	48	48
	F E And A C Jarvis Ditch	5900555	53	53

	Jarvis Ditch	5900601	48	48
	Meads Ditch No 1	5900635	68	68
	Beitler Ditch No 2	5900751	48	48
	Panion Ditch	5901055	23	23
59_ADG003, Slate	Breem Ditch	5900525	256	256
	Coal Cr Ditch	5900539	5	5
	Meridian Ditch	5900638	65	65
	Rozich Ditch	5900661	84	83
	Spann Nettick Ditch	5900678	51	51
	Willson Ditch	5900708	24	24
	Kapushion Ditch	5900968	5	5
	Renas Ditch	5901209	38	38
59_ADG004, East 2	Adams Cement Creek Ditch	5900502	2	2
	Baxter Ditch	5900515	111	111
	Cement Cr Ranger Sta	5900536	30	30
	Jones Highline Ditch	5900605	30	30
	Mcclenathan Ditch	5900626	145	145
	Meads No 3 Ditch	5900637	229	229
	Rozman No 1 Ditch	5900662	30	30
	Rozman No 2 Ditch	5900663	55	55
	Yarnell Ditch	5900712	27	27
	Tim & Helen Morgan Ditch	5900727	8	8
	Granite Ditch	5900921	82	82
	Maxson Ditch	5901250	14	14
	Obaid Ditch	5901736	30	30
59_ADG005, East 3	Ahrens Ditch	5900503	140	140
	Alkali Ditch	5900507	37	0
	Bear Gulch Ditch	5900516	249	248
	Dennis Alkali Cr Ditch	5900545	44	44
	Happy Hollow Highline D	5900576	21	21
	John Lorr Ditch	5900603	57	57
	L R Spann Ditch	5900611	59	59
	Mcdonald Ditch	5900628	89	89
	Shackleford Ditch	5900669	52	52
	Watt No 2 Ditch	5900703	57	57
	Danni Ditch	5900716	21	21
	Red Mt Highline Ditch	5901076	104	104
59_ADG006, Ohio 1	Allison Ditch	5900508	141	141
	Castle Creek No 1 Ditch	5900532	29	29
	Castle Creek No 2 Ditch	5900533	29	29
	Gafney Ditch	5900559	37	37
	Kunze Ditch	5900610	43	43

	Polisic No 1 Ditch	5900652	53	53
	Sunki No 1 Ditch	5900687	29	29
	Sunki No 3 Ditch	5900688	150	150
	Valentines Ditch	5900698	67	67
	William Elze Ditch	5900705	29	29
	Buffington Ditch	5900717	6	6
	Keever Ditch	5900974	49	49
	Spring Branch Ditch	5901139	30	30
	Sunki No 2 And Sunki-Res	5901469	30	30
	Sawmill Ditch	5901766	12	12
59_ADG007, Ohio 2	Carmine Ditch	5900530	94	94
	East Wilson Ditch	5900551	25	25
	Mcglashan E Side Irr D	5900629	114	114
	Mcglashan W Side Ohio Cr	5900632	100	99
	Mckee Desert Land No 2D	5900633	74	74
	Mckee No 1 Ditch	5900634	49	49
	Milton White Ditch	5900639	89	89
	N Willow Run Ditch	5900642	4	4
	Ohio Creek No 1 Ditch	5900643	65	65
	Park Ditch	5900648	34	34
	Smith Ditch	5900676	39	39
	Squirrel Creek No3 Ditch	5900681	43	43
	Squirrel Creek No6 Ditch	5900682	82	82
	Price Creek Ditch	5900721	29	29
	Price Creek Ditch No 3	5900723	33	33
	Price Creek Ditch No 4	5900724	33	33
	Squirrel Creek No2 Ditch	5900725	16	16
	Black Diamond Springs D	5900776	8	8
	Campbell Ditch E Branch	5900792	152	176
	Campbell Ditch W Branch	5900793	151	5
	Dollard Desert Land D	5900863	130	130
	Howard Eilbrecht Ditch	5900954	9	9
	Mckee Ditch	5901006	57	57
	Mckee No 2 Ditch	5901007	25	25
	South Willow Run D	5901135	88	88
	Squirrel Cr Highline D	5901141	82	82
	Mount Carbon Ditch	5901200	113	113
	Kubler Ditch	5901792	25	25
	Cabin Ditch	5901794	25	25
59_ADG008, Gunnison near Gunnison	Biebel No 1 Ditch	5900519	85	85
	Channel Ditch	5900538	79	79
	Dooley Antelope Irg D	5900547	16	16

	Elmer Marshall No1 Ditch	5900553	204	204
	Geo Smith No 1 Ditch	5900561	5	5
	Geo Smith No 2 Ditch	5900562	44	44
	Gunnison And Tomichi Valley Ditch Association Ditc	5900571	338	338
	Hamor Ditch	5900577	5	5
	Home Ditch	5900590	233	233
	Palisades Ditch No 2	5900647	24	24
	Peter Purrier East Ditch	5900650	109	109
	Slough Ditch	5900673	177	177
	Smith And Wilson Ditch	5900675	31	31
	Sunshine Irg Ditch	5900690	23	23
	Thornton No 1 Ditch	5900694	71	71
	Wilson No 2 Ditch	5900710	204	204
	Elmer Marshall No2 Ditch	5900713	204	204
	Dos Rios Ditch	5900864	58	53
62_ADG013, Cebolla 1	A Doering Spg Cr D	6200501	39	39
	Bandit Ditch	6200545	25	25
	Cathedral Branch Irr D	6200552	40	40
	Cliff Irr Ditch	6200562	38	38
	Cliff Irr Ditch No 2	6200563	14	14
	Creede Trail Irr Ditch	6200575	35	35
	Ferris Ditch	6200596	8	8
	Hatcher Ditch	6200619	57	57
	Johnson E Side Ditch	6200645	16	16
	Johnson W Side Ditch	6200646	11	11
	Lower Spring Cr Irr D	6200664	28	28
	Maybell Ditch No 1	6200669	63	63
	Mendenhall Ditch	6200677	27	27
	Mineral Creek No 1 D	6200684	49	49
	Mineral Creek No 2 D	6200685	54	54
	Mineral Creek No 3 D	6200686	17	17
	O R Bowers No 1 D	6200696	22	21
	Orin Bowers No 4 D	6200697	18	18
	Orin Bowers No 6 D	6200699	18	18
	Rock Creek Ditch	6200730	10	10
	Rock Creek Irr Ditch	6200731	27	18
	Stavely Ditch	6200762	17	17
	W S Thompson Ditch	6200805	4	4
	Youmans Irg D No 2	6200810	26	26
	Youmans Ditch No 3	6200811	29	28
	Youmans No 1 Ditch	6200825	28	28

	Bear Creek Ditch	6200841	6	6
	Cadwell Ditch	6200894	6	7
	Pasture Creek Ditch	6201080	18	18
	Wrights Cathedral Ditch	6201180	45	45
	Youmans House Gulch D	6201187	3	3
	Holman Ditch No 1	6201334	74	74
	Holman Ditch No 2	6201513	74	74
62_ADG014, Cebolla 2	Bailey R & Rs Wilson D	6200520	35	35
	Dry Powderhorn Ditch	6200582	102	102
	Foster Ditch No 2	6200603	69	69
	Hot Springs Ditch	6200637	19	19
	John W Andrews Ditch	6200643	25	25
	Mcgregor Ditch	6200671	49	49
	Nichols Powderhorn Ditch	6200693	36	36
	Powderhorn Ditch	6200712	36	36
	Powderhorn Irg Ditch	6200713	201	201
	Radeka Ditch	6200719	28	28
	Sammons Ditch No 3	6200735	60	60
	Sammons Powderhorn D	6200739	47	47
	Schecker Ditch	6200741	53	53
	Schnepf Highline Ditch	6200743	70	70
	Wegener-Knoll Ditch	6200791	24	24
	Youmans Waste Water D	6200813	88	88
	R B Wilson D No 1 2 3	6201089	34	34
	Barrett Ditch	6201519	46	46
62_ADG015, Lake	Addington No 1 D	6200500	61	61
	Antonio Ferraro D No 1	6200508	57	31
	B And B Ditch	6200519	28	28
	Baker No 2 Ditch	6200524	28	28
	Carr Irrigating Ditch	6200548	20	40
	Carris Thompson Ditch	6200549	22	7
	Carson Creek No 2 D	6200551	6	4
	Childs Park Ditch	6200559	3	3
	Copeland Elk Cr D	6200570	113	0
	D C Baker No 1 D	6200580	24	17
	Freeman Ditch	6200606	10	10
	French Ditch No 1	6200607	7	7
	French Ditch No 2	6200608	31	31
	French Ditch No 3	6200609	31	31
	F S William D No 1	6200611	11	11
	Hunter Elk Creek Ditch	6200639	57	57
	Johnson Ditch	6200644	23	23

	Lake Fork Irr Ditch	6200652	11	11
	Reece Richart No 1 D	6200722	24	24
	Reece Richart No 2 D	6200723	24	24
	Reece Richart No 3 D	6200724	24	24
	Seeley Ditch No 3	6200746	41	41
	Steele Ditch	6200763	33	0
	Sunnyside Ditch	6200766	48	48
	Thompson Irr Ditch	6200776	81	81
	Trout Creek No 1 Ditch	6200777	17	17
	Vickers Bros No 2 Ditch	6200786	10	10
	Wilson Ditch	6200802	47	47
	Youmans Irg Ditch	6200808	41	39
	Vickers Ditch No 1	6200822	39	39
	Norsworthy Pump	6201459	5	5
	Thomas Roach Ditch #2	6201493	84	54
	Water Gulch Ditch	6201794	26	26
62_ADG016, Gunnison Blue Mesa	Airport Ditch	5900504	93	91
	Brunton No 1 Ditch	5900526	30	30
	Carron Ditch	5900531	14	14
	Greegh Ditch	5900568	60	60
	Jones Brunton Ditch	5900604	60	60
	Lawrence Ditch	5900614	31	31
	Sun Creek Ditch	5900686	31	31
	Teed Ditch	5900693	26	26
	Ute Trail Ditch	5900697	93	91
	Bagg Ditch	5900715	5	5
	Steenbergen Ditch	5901473	5	5
	Alder Ditch	6200502	20	20
	Austin Ditch	6200510	92	92
	Beaver Creek Ditch	6200525	66	67
	Big Willow Springs D	6200530	21	0
	Browning Ditch	6200536	33	33
	Carr Ditch	6200547	12	12
	Cottonwood Ditch	6200572	14	14
	Lake Fork Ditch	6200651	8	8
	Moore Ditch No 1	6200689	21	21
	Moore Ditch No 2	6200690	21	21
	Soderquist D No 1	6200752	34	34
	Soderquist D No 2	6200753	34	34
	South Beaver Creek Ditch	6200754	45	46
	Indian Creek North Ditch	6201000	31	31
	Johnson Gulch Ditch	6201008	12	0

	Lower Lake Ditch	6201047	5	5
	Beaver Creek Ditch East	6201249	61	78
	Beaver Creek Ditch West	6201250	17	29
62_ADG017, Gunnison Morrow Point	Beaver Ditch	6200527	159	153
	Hazel Ditch	6200620	61	61
	Pine Creek Ditch	6200708	1,848	0
	Squirrel No 1 Ditch	6200760	47	47
	Squirrel Ditch No 2	6200761	25	25
62_ADG018, Cimarron	Mcminn Ditch	6200673	87	86
	Peterson & Riley Ditch	6200707	24	0
	Schildt-Brown Ditch	6200742	87	86
	Stumpy Ditch	6200765	157	146
	Vanderburg D	6200782	49	49
	Cimarron Cnl Coal Cr	6200815	4,164	4,010
68_ADG033, Dallas	Barker Ditch	6800506	18	18
	Burger Ditch	6800513	36	36
	Dallas Placer Ditch	6800545	109	109
	Evans Ditch	6800573	225	225
	Harrison No 1 Ditch	6800597	19	19
	Horn Ditch	6800608	29	29
	James Stewart Ditch	6800619	9	9
	Lischke Ditch	6800640	28	0
	Lischke No. 2 Ditch	6800641	9	37
	Lower Pleasant Valley	6800643	200	200
	Mike Cuddigan Ditch	6800663	35	35
	Oakes Jerome Ditch	6800679	268	263
	Oakes Woodruff Eggleston	6800680	181	181
	P J Nash Ditch	6800684	9	9
	Reynolds Ditch	6800708	11	11
	Scott Mcneil Ditch	6800724	54	54
	Sherbino Ditch	6800727	94	94
	Sibert Ditch	6800731	52	52
	Switzerland Ditch	6800752	59	59
	Wood Perry Ditch	6800781	135	135
68_ADG034, Uncompahgre 2	Babb Ditch	6800505	95	95
	Bigbee Ditch	6800509	74	74
	Brooke Ditch	6800510	77	77
	Brown Ditch	6800511	69	69
	Cannon Ditch	6800516	64	64
	Cassidy Ditch	6800520	2	2
	Cedar Creek Ditch	6800522	96	96
	Chaffee Ditch	6800523	91	91

	Chipeta Cutler Ditch	6800527	8	8
	Climax Ditch	6800531	43	43
	Coal Creek Ditch	6800532	51	51
	Daine Ditch	6800542	21	21
	East Side Ditch	6800565	56	62
	Flora Ditch	6800579	11	11
	Gibson Ditch	6800587	160	160
	Haney Coal Creek Ditch	6800590	28	0
	Hayes Teague Ditch	6800601	14	15
	Heath Ditch	6800602	0	23
	Hyde Ditch	6800612	32	32
	Johnson Ditch	6800621	167	167
	Jolly Ditch	6800624	82	82
	Mcdonald Cuddigan Ditch	6800655	85	85
	Mcdonald Ditch	6800656	33	33
	Middle Miller Ditch	6800660	28	0
	Miller Branch Ditch	6800664	28	139
	Nate Creek No 1 Ditch	6800673	125	125
	Nate Creek No 2 Ditch	6800674	37	37
	Nate Creek No 3 Ditch	6800675	66	66
	Nate Creek No 4 Ditch	6800676	37	82
	Phillips Ditch	6800690	45	45
	Plummer D Nos 1 & 2	6800694	72	72
	Portland Ditch	6800697	16	16
	Private Ditch Shaven	6800700	16	16
	Private Ditch Stealey	6800701	33	33
	Reservoir Ditch	6800704	64	35
	Rhoades Ditch	6800709	1	1
	Rocky No 1 Ditch	6800715	10	10
	Rocky No 2 Ditch	6800716	23	23
	Rocky No 3 Ditch	6800717	43	43
	Sharen No 1 Ditch	6800725	15	15
	Springfield Corrie Ditch	6800744	97	108
	Stanton Ditch	6800747	104	104
	Stealey Owl Creek Ditch	6800749	51	51
	Stough Ditch	6800750	27	27
	Strayer Ditch	6800751	324	324
	Taylor Ditch	6800755	101	101
	Thomas Cow Trail Ditch	6800756	408	222
	Vance Ditch	6800767	263	263
	Ward Ditch	6800771	13	13
	West Miller Ditch	6800774	28	0

	White Ditch	6800778	53	53
	Adam Thomas Ditch	6800793	170	170
	Orvis Ditch	6800907	67	67
	Smith-Brown Ditch	6801263	13	13
	Collin Ditch	6801386	49	48

Exhibit B: Diversion Structures in each "No Diversion Records" Aggregate

Aggregation ID	Structure Name	WDID	2005 Acres	2010 Acres
28_AND009, Upper Tomichi	Agate No 1 Ditch	2800502	18	18
28_AND010, Tomichi 1	Cox Irrigating Ditch	2800537	51	51
	Rahm Spring No 2 Ditch	2800881	67	67
	Hoover Seepage Ditch	2800985	110	110
	S Davidson&Co Fdr D No 2	2801580	89	89
28_AND011, Cochetopa	J M Ellis No 2 Ditch	2800596	25	25
	J M Ellis No 3 Ditch	2800597	25	25
	Coleman Coch Sp&D No 10	2800747	21	55
	Coleman Coch Sp&D No 13	2800748	41	41
	Coleman Coch Sp&Pd No 12	2800750	0	34
	Coleman Coch Sp&D No 7	2800752	40	40
	Coleman Coch Sp&Pd No 4	2800754	68	69
	Coleman Coch Sp&Pd No 6	2800755	40	40
	Irwin Ditch	2800852	0	34
	Sharpe Spring No 8	2800856	76	88
	Sharpe Spring No 9	2800857	76	88
	Sharpe Spring No 10	2800858	76	88
	Waste Water Ditch	2800935	15	15
	Coleman Coch Sp&Pl No 3	2801006	68	69
	Qtr Circle Circle Rch Sp	2801050	8	8
	Mcdonough Res First Enlt	2803591	28	20
28_AND012, Tomichi 2	Cheeney No 2 Ditch	2800525	21	23
	Flick Ditch No 3	2800561	34	34
	Head No 1 Ditch	2800584	35	35
	Lobdell Ditch	2800621	43	43
	Parlin No 1 Ditch	2800669	178	182
	Hartman Ditch No 2	2800960	18	18
	Odom Ditch No 2	2801619	0	6
28_AND043, West Pass	Charles W Hack No 2 D	2800522	13	13
	Funk Ditch No 1	2800562	49	49
	Funk Ditch No 5	2800793	49	49
	Funk Floodwater Ditch	2800794	28	28
	Lockett Ditch	2800814	13	13
	Funk Waste Water Ditch	2801011	64	64
	Funk Upper Ditches 1&2	2801027	36	36
	Gould Well	2805074	49	49
40_AND019, Gunnison Below Tunnel	Curley Spring Pl	4000534	52	56
	Ramblin 80 Spring No1	4002133	20	20

40_AND021, Howard Ditch	Howard Ditch	4000558	37	37
40_AND022, North Fork Gunn	Martin Ditch No 1	4001174	19	19
	Martin Ditch No 2	4001175	19	19
	Snooks Ditch	4001198	38	38
40_AND026, Gunnison Near Lazear	Watson Ditch No 1	4001064	98	126
40_AND027, Currant	West Gilmer Ditch	4000824	11	6
	Tim S Spring No 3	4002814	37	37
40_AND028, Upper Tongue	Wetterick Mesa Ditch	4000748	7	7
	Granby Ditch	4000946	50	50
	Lake Fork Ditch	4001269	187	183
	Sheldon Ditch	4001530	8	8
40_AND029, Surface	Carbonate Camp Ditch	4000673	9	9
	Gorsuch Feeder D No 6	4001440	0	1
40_AND030, Tongue	Ewing Ditch	4001273	11	20
40_AND038, Roubideau	Long Park D Hgt No 4	4001311	5	0
40_AND039, Gunnison Below Delta	Pickett Corral Ditch	4000897	26	6
	South Fork Ditch	4000905	33	10
	Leonard Ditch	4001244	23	28
	Little John Spring Pl	4001330	0	1
	Seep Creek Ditch & Pond	4001997	40	40
	Trial Ditch A	4002269	16	16
41_AND035, Uncompahgre 3	Lee Waste Ditch	4100668	1	1
	K Bar Spring And Ditch	4101782	14	13
41_AND036, Uncompahgre 4	Ball Ditch	4100502	43	43
	Freeman Ditch	4100525	41	41
	Robuck Sunrise Feeder D	4100552	57	57
	Menke North Ditch Enlt	4100686	45	45
	Antler Spring	4100754	1	0
	Mcpheeters Spring	4100868	16	0
	Amber Spring	4101733	111	69
41_AND037, Uncompahgre 5	Subterranean Ditch	4100567	44	31
	Markley D No 1 And No 2	4100675	54	55
	Sandy Ditch	4100703	0	12
	Caswell No 1 Ww Ditch	4100799	18	26
	Manska/Gray Wastewater Ditch	4100908	65	32
42_AND040, Gunnison Near	Jacks Pumping Plant	4200524	66	66

Grand Junction	Raber Davis Ditch	4200539	1	1
	Zane Siminoe Ditch #2	4200645	0	8
59_AND002, East 1	Meads No 2 Ditch	5900636	68	68
	Strand Ditch No 2	5900683	48	48
	F E And A C Jarvis Ditch	5901218	53	53
59_AND003, Slate	Halazon Ditch	5900575	71	71
	Columbine Res & Ditch	5900830	23	23
	Decker Ditch	5900853	23	23
	Decker Ditch No 2	5900854	23	23
	Warren Ditch	5901177	23	23
	Lori S Spring And Ditch	5901376	142	142
	Lake Grant Reservoir	5903684	23	23
59_AND004, East 2	Bottenfield Ditch	5900523	228	228
	Columbine Ditch	5900540	15	15
	Imobersteg Willow Cr D	5900598	82	80
	Lacy D Spr Hdgt 1	5900612	9	9
	Anna Rozich Springs D	5900757	30	30
	Columbine Ditch	5900829	166	166
	Squaw Creek Ditch	5901140	148	148
59_AND005, East 3	Alkali Ditch	5900506	35	35
	Sampson Spann Ditch	5900664	133	133
59_AND006, Ohio 1	Castle Pk Fdr Ditch	5900534	35	35
	Castle Pk Fdr Ditch No 2	5900797	35	35
	Middle Feeder Silka Dtch	5901013	73	73
	Upper Feeder Silka Ditch	5901171	73	73
59_AND007, Ohio 2	Annie Irg Ditch	5900511	48	48
	Frank Weinert Ditch	5900905	35	35
59_AND008, Gunnison Near Gunnison	Gooseberry Ditch	5900565	0	29
	Gun Island Ac Inc Ditch	5900927	200	200
	Harris Ditch	5901564	71	71
62_AND013, Cebolla 1	East Ditch	6200585	8	8
	Hopfer Ditch	6200636	10	10
	Lower Meadow Channel	6201164	23	23
62_AND015, Lake	Thompson D No 2	6200775	81	81
	Vickers Bros No 1 Ditch	6200785	18	15
	Whinnery Elk Cr&Narrow G	6200794	84	54
	Boyd Waste Water Ditch	6200876	42	42
	Moore Ditch Alt Pt	6201709	42	42
62_AND016, Gunnison Blue Mesa	Thompson Ditch	5901163	141	141
	Steers Gulch Enl K O 1	5901341	221	221
	Crowley Irg Ditch	6200576	34	34
	George Andrews No 2 D	6200613	83	99

	John A Adams Ditch	6200642	83	99
62_AND018, Cimarron	Butte Ditch	6200892	254	254
68_AND034, Uncompahgre 2	Erickson Ditch	6800570	50	50
	Jackson Ditch	6800617	22	22
	Whitehouse Ditch	6800777	52	52

A-2: Identification of Associated Structures (Diversion Systems and Multi-structures)

Background

The previous CDSS Western Slope models include associated structures which divert to irrigate common parcels of land. These associations were primarily based on information provided directly during meetings with Water Commissioners, and were not based on information from the original 1993 irrigated acreage assessment. The original CDSS 1993 irrigated acreage assessment was based on the USBR identification of irrigated land enhanced with a water source (ditch identifier) that served that land. Many of the irrigated acreage parcels covered more than one ditch service area and, in lieu of spending significant time splitting the parcels by ditch service area, more than one ditch was assigned. For CDSS modeling purposes, the acreage was simply "split" and partially assigned to each ditch.

Introduction

For the recent 2005 and 2010 acreage assessments, there was significant effort spent trying to refine irrigated parcels based on the legal and physical ditch boundaries so, where possible, there was only one ditch assigned to each irrigated parcel in Divisions 5, 6, and 7. Division 4 efforts concentrated on a few areas, but not the entire basin. To model these ditches as accurately as possible, it is important to understand if the acreage that is still assigned to more than one ditch is actually irrigated by all assigned ditches in a comingled fashion or, alternatively, if the acreage should be "split" and the structures should be modeled as having no association. Ditches combined for modeling because the supplies are believed to be comingled are termed "associated structures" for the CDSS modeling effort.

Some associated structures can be identified based on the HydroBase water rights transaction table because they are decreed alternate points or exchange points, while others can be identified based on Water Commissioner accounting procedures, generally documented in their comments accessible through Hydrobase. In the models, associated structures are represented as diversion systems if the structures are located on the same tributary or multi-structure systems if they are located on different tributaries. As part of Task 3, the associated structures were updated to more accurately model the combined acreage, diversions, and demands. These updates include the integration of the 2005 irrigated acreage, the 2010 irrigated acreage, as well as verification of associated structures based on diversion comments and water right transaction comments.

Approach

The following steps were used to identify associated structures in Divisions 5, 6, and 7. Because the Division 4 parcels have not yet been refined to the ditch service level, no effort was made to determine additional associated structures. Note, however, the parcels that require additional refinement have been identified and provided to Division 4. These updates should be included with the next acreage assessment.

Updating the associated structures was a multi-step process that involved 1) identifying potential associated structures by integrating the 2005 and 2010 CDSS irrigated acreage, 2) verifying the associated structures using the diversion and water right transaction comments, and 3) making recommendations on how to best represent the associated structures in the CDSS Western Slope models.

1) *Develop an Associated Structure List Based on Revised 2005and 2010 CDSS Irrigated Acreage*

   An initial associated structure list was developed by combining the CDSS revised 2005 and 2010 irrigated acreage. During this process the overlapping similarities between the two irrigated acreage coverages were integrated, resulting in a list of associated structures containing unique IDs. An illustrative example is presented below. In this example, the 2005 irrigated acreage coverage contains parcel A assigned to structures 1, 2, and 3; while the 2010 irrigate acreage coverage contains parcel B assigned to structures 2 and 4. Parcel A and B are integrated, resulting in an association comprised of structures 1, 2, 3, and 4.

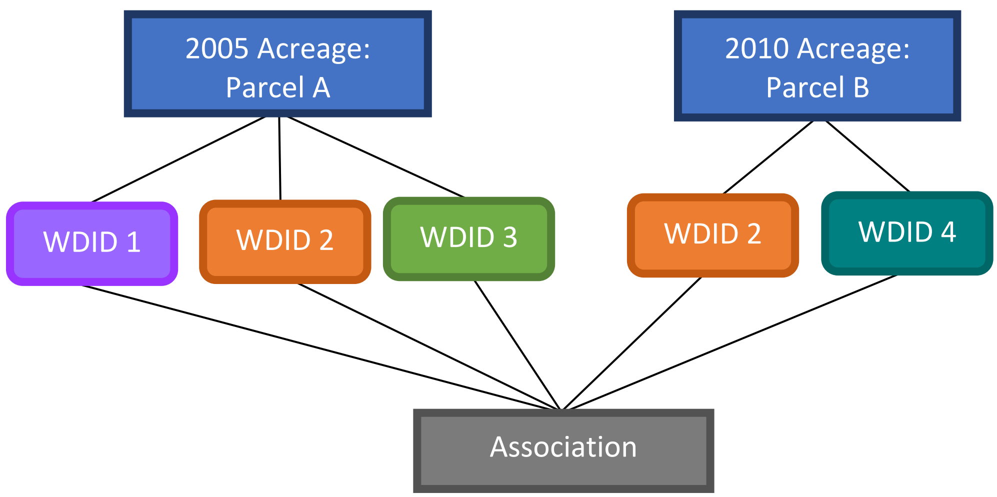


Figure A-2. Example of integrating the CDSS irrigated acreage coverage to identify associated structures.

2) *Verify the Associations Using Diversion and/or Water Right Transaction Comments*

   Once a unique list of associated structures was developed, each association was verified using diversion comments and/or water right transaction comments. If the diversion comments and/or water right transaction comments could not verify structure associations, then unverified structures were removed from the list of associated structures (i.e., their diversions will not be treated as commingled). Types of verification included comments identifying structures as alternate points of diversion, points of exchange, acreage reported under alternative structure, same points of diversion, and water right transfers.

   Below is an example of the verification methodology using the diversion and/or transaction comments for the association shown in step 1.

Table A-4. Example of Integrating the Diversion and Water Right Transaction Comments for Verification.

WDID	Verification Comment	Source	Verified?
1	Irrigates Y Ranch	Diversion Comment	N
2	Water right transferred to WDID 4	Transaction Comments	Y
3	Acreage is recorded under WDID 2	Diversion comments	Y
4	-	-	Y

Given this example, WDID 1 was not verified by the comments and, thus, not included in the final list of associated structures.

3) *Recommend a Modeling Approach for Representing Associated Structures in the CDSS Western Slope Models*

Using the refined associated structure list developed in step 2, recommendations on how to best represent the associated structures in the CDSS models were provided. These recommendations were based on the following criteria:

- If located on non-modeled tributaries, the associated structures were added to appropriate aggregates.
- Associated structures were explicitly modeled—either in diversion systems or multi-structure systems—if the net water rights for at least one structure in the association exceeded a specific threshold identified in previous modeling efforts. In general, the thresholds represent 75% of the net water rights and are listed in **Table A-5**.

Table A-5. Water Right Thresholds for Explicit Modeling

CDSS Model	Water Right Threshold (CFS)
Yampa	5
White	4.8
Upper Colorado	11
San Juan/Dolores	5/6.5

Structures located on the same tributary were modeled as diversion systems, while structures located on different tributaries were modeled as a multi-structure system. Note, diversions systems combine acreage, headgate demands, and water rights; and the model treats them as a single structure. Contrastingly, multi-structure systems have the combined acreage and demand assigned to a primary structure; however, the water rights are represented at each individual structure, and StateMod meets the demand from each structure when their water right is in priority. **Figure A-3** illustrates how a diversion system is modeled, while **Figure A-4** illustrates how a multi-structure system is modeled.

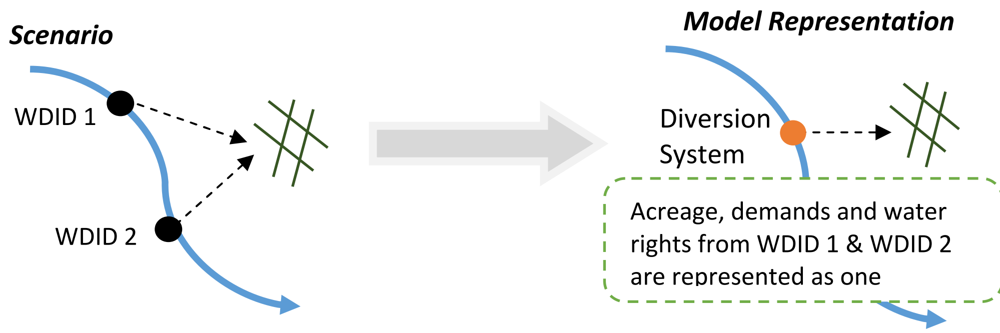


Figure A-3. Model Representation of a Diversion System.

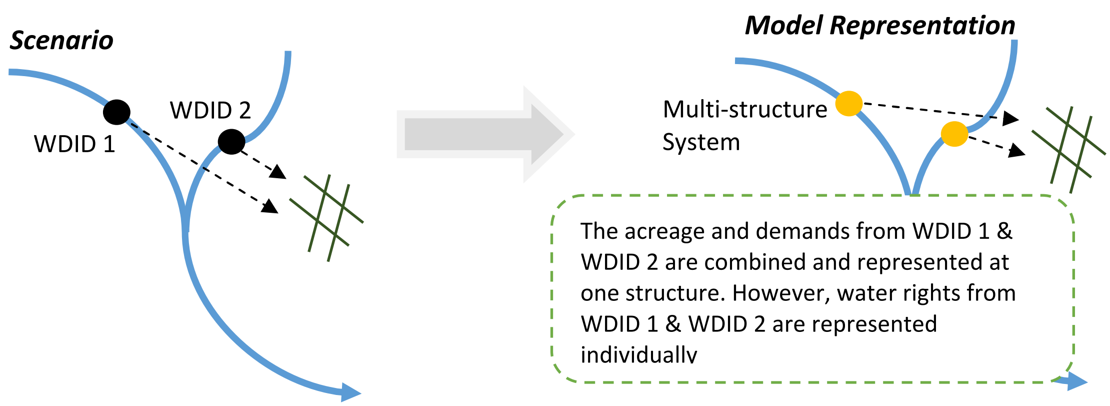


Figure A-4. Model Representation of a Multi-structure System.

- The structure with the most irrigated acreage—based on the 2005 and 2010 CDSS coverages—was selected as the modeled structure for each diversion system.
- The structure with the greatest net water rights was selected as the primary structure for multi-structure systems.

- If none of the structures in an association exceeded the water right threshold identified in Table 2 and have contemporary diversion records, the structures were modeled in an aggregate.
- If all structures in an associated did not have diversion records, the structures were placed in a “no diversion” aggregate.