



GIS STANDARDS TECHNICAL MEMORANDUM V. 2

TO: Water Development Commission

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SUBJECT: GIS Standards Technical Memorandum Version 2

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1.0 Introduction

The purpose of this Technical Memorandum is to define standards for Wyoming Water Development Office's (WWDO) GIS deliverables. Creating standards allows for long-term and continuous use of collected data and a better understanding of what has been delivered to the WWDO. These standards are necessary to build a cohesive and comprehensive statewide geodatabase containing datasets.

The standards can also facilitate the development of water resources Decision Support System (DSS) river basin models. In such cases, standardization would allow the data to be effectively incorporated into a DSS and used to run scenarios that will assist Wyoming water resources decision making.

By implementing the GIS Data Framework Plan (2017), a clear understanding is gained of the data produced for projects funded by the Wyoming Water Development Commission (WWDC). This GIS Standards Technical Memorandum details the methods, data, and the available tools for meeting the standards.

Data created under WWDC projects must contain enough information and detail, both in the metadata and datasets, to ensure effective use. Legacy data are often unusable due to the lack of information associated with the dataset. These datasets are recreated each time a project is undertaken. The cost of building these datasets will be reduced by passing down data that are present within the statewide data model. The master datasets managed by the WWDO will be refined over time and become more valuable as input into water resources models and as components of a potential DSS. This document provides the necessary guidelines for creators and managers of data produced for the WWDO.

With Version 2 of the GIS Standards we have updated feature attributes and domains based on user feedback. Domains and code descriptions are now listed alphabetically in the Appendix. Within ArcCatalog metadata, summary and purpose descriptions are complete for all features and tables. Section 4.3 of this document contains a project guide for GIS feature creation associated with typical Water Development projects. With all geodatabase templates, we now include a project specific table that can be customized for individual projects. And finally, the water system schema has been simplified and improved to better integrate drinking water systems.

1.1 Tips for Working with these GIS Standards

1. **Attend a GIS orientation webinar prior to starting a new project.** Talk to your WWDO Project Manager about when this is offered.
2. **Use the project specific templates.** Geodatabase templates have been created that should be used to prepare the core datasets to meet the contractual requirements for GIS data delivered to the WWDO. These are described in GIS Features by Project Type, Section 4.3. Look at the data classes and figure out if they are germane to your project by looking at your Contract scope, talking to the WWDO and the sponsor.
3. **Add additional attributes as needed for your project.** Make sure the field is not already described in another template layer, and add the field definition to the metadata, including all coded values.

4. **Look at the field names and data types before collecting data.** The field names and types are listed in the default metadata. Format your GPS's data dictionary consistently to avoid time consuming transformations or making new fields.
5. **Consolidate similar spatial features into a single feature class.** Instead of creating dozens of individual feature classes, put all points in a single feature class, and use the Feature Type code to distinguish different types of features, e.g., valves from meters, headgates, pumps, etc. Valid values are pre-set for some fields. These domain values are referenced in the Appendix. If additional feature attributes are needed, add them to the dataset or create a stand-alone geodatabase table that can link the project specific attributes to the spatial features.
6. **Use the Load Data command in ArcCatalog** to migrate existing data feature classes in the template. Right click on a feature class in ArcCatalog and select Load. This wizard copies spatial features and migrates field values from the existing field to the template field name as long as the field types are the same (text to text or number to number). Conflation tools can also be used to migrate data into the geodatabase templates. Alternately, within ArcMap features can be copied into the geodatabase template.
7. **Assign an edit date only to features that you change.** Instead of auto filling all the features of a dataset with an edit date, only fill it if you changed it.
8. **Be sure to use the proper code when using the Field Calculator to fill a field that has a domain assigned.** See sponsors in the GIS Standards Technical Manual Appendix for a full list of domain values and descriptions.
9. **Review training webinar, Storymap, Geodatabase Diagram, GIS data, and templates** at <http://water.geospatialhub.org/pages/wwdc-gis-standards>

2.0 Standards & Formats

2.1 Metadata

The purpose of setting standards for metadata are to create data with validity. The WWDC invests funds for contractors to create new spatial data and update legacy spatial data within GIS. Metadata provides the history of each dataset allowing WWDO to understand the “who, what, why and where” of the data. When using the core geodatabase templates, metadata creation is minimal as the features are all described and fields are defined. If adding new fields to the templates, add the definitions to the metadata including all coded values. Any dataset created or modified for reports delivered to WWDO must meet two simple requirements:

Self-Sufficient

The data should be able to stand on its own as a single dataset.
Is this data layer by itself usable and understandable?

Receivable

Does this data meet the requirements I would ask for to be able to use this data?
Does this data contain the needed information for me to know where it came from and what it is?
Can I deliver this data to someone and would they understand what the data could be used for?

2.1.1 Geodatabase Metadata

The metadata standard for the WWDO’s spatial data is to update a minimum of five sections for each spatial layer that is delivered to the WWDO through project studies. The following five sections are required to be updated by the data creator and are based on the Federal Geographic Data Committee (FGDC) standards.

GEODATABASE METADATA REQUIREMENTS

| | |
|-------------------------------|---|
| Tags | Keywords which represent the data |
| Summary (Purpose) | Why the data were created WDO Project Name Geographic extent When the data were created Projection Scale |
| Description (Abstract) | What the data represent Details on Scale or Resolution Date the data represent (ground conditions) How the data were created (including the base source used) Completeness |
| Credits | Creator or editor of data |
| Use Limitations | Disclaimer (see below for default) <i>The Wyoming Water Development Commission (WWDC) and the Water Resources Data System (WRDS) do not warrant, endorse, or recommend the use of these data for any other purpose than originally developed. The user assumes the entire risk related to the use of these data. WWDC and WRDS are providing these data "as is," and disclaim any and all warranties, whether expressed or implied, including (without limitation) any implied warranties of merchantability or fitness for a particular purpose</i> |

At the end of this section an example of Esri’s ArcCatalog metadata is provided to illustrate requirements for preparing data for submittal to WWDO.

The data model contains core datasets, which are a required deliverable as part of WWDC projects. Auxiliary datasets are created through the studies by outside sources. The additional datasets created and delivered to the WWDO need to be "self-sufficient." A self-sufficient data set means that if an individual is only handed a single data set, that data set would be able to be projected correctly within GIS and the individual would be able to properly identify the attribute fields and field entries. Base datasets used in the project do not need to be delivered unless requested by the project sponsor. Examples would include NAIP Aerial Imagery or individual topographical maps that are used as backgrounds.

Point of Diversion

File Geodatabase Feature Class

Tags

River Basin Plan, State of Wyoming, Point of Diversion, Water Rights

Summary

[Why] These data were prepared for the Wyoming Water Development Commission Framework Water Plan to provide an edge matched coverage for statewide analysis. **[Geographic Extent]** These data are an aggregation of the GIS data prepared for the seven individual Wyoming Water Development Commission River Basin Plans to cover the entire state of Wyoming. **[Publication Date]** These data were compiled in 2007. **[Coordinate system or Projection]** GCS_North_American_1983 **[Scale]** 1:24,000

Description

[What the data represent] This dataset represents surface water right record diversion locations for the irrigated lands mapped for the state of Wyoming. **[Ground condition Date]** These data are an aggregation of the GIS data prepared for the seven individual Wyoming Water Development Commission River Basin Plans produced between 1999 and 2005. **[How data were created]** Points represent the record location current location was not verified. Most often these points were located based on the Township Section $\frac{1}{4}$, $\frac{1}{4}$ take from Wyoming State Engineers Office and moved to the closest surface water based on **[Base Source]** 2006 NAIP aerial photo. **[Completeness]** These points only include points of diversion greater than 10 cfs with an irrigation use type. All attribute information came from Wyoming State Engineers Office. Users working in a single river basin may wish to use the original data prepared for that basin. **[Linking tables, fields, and relationship type]** Links to POU with WDOSTRID field as many POD's to many POU's.

Credits

Jane Doe and John Smith, Brown Bear Mapp-a-lot, Inc.

Use limitations

The Wyoming Water Development Commission (WWDC) and the Water Resources Data System (WRDS) do not warrant, endorse, or recommend the use of these data for any other purpose than originally developed. The user assumes the entire risk related to the use of these data. WWDC and WRDS are providing these data "as is," and disclaim any and all warranties, whether expressed or implied, including (without limitation) any implied warranties of merchantability or fitness for a particular purpose.

Note: Additional metadata was intentionally left out of this example.

2.1.2 Feature Level Metadata

Metadata is also captured within attribute fields for feature classes. The fields are required during the data creation or modification process of the core datasets identified within the Data Framework Plan. The metadata attributes are updated when a spatial feature changes position, data is added or data is updated. The metadata fields track which WWDC project initiated the change, who modified the feature location or details, the date of the change and the horizontal accuracy of the feature. The horizontal accuracy is extremely important to track since these coordinates could improve the precision of data across agencies within Wyoming.

The purpose of this style of metadata is to track changes to datasets that have individual features that can change overtime or change accuracy. As specific datasets are passed on, changes will occur with added locations, updated accuracy, or changes in use or monitoring type. The following fields are populated when an individual feature is modified; since this information may not completely pertain to the overall dataset metadata.

FEATURE CLASS ATTRIBUTE METADATA STANDARD REQUIREMENTS

| | |
|-----------------------------------|--|
| <i>Contract_ID</i> | Project Contract Number |
| <i>Contractor</i> | Contractor Name |
| <i>Creation_Edit_Date</i> | Date of creation or last edit |
| <i>Horizontal Accuracy</i> | <p>Horizontal accuracy is setup as Geodatabase domains with a select set of values from which to choose. Examples of values are:</p> <ul style="list-style-type: none"> • Map Interpolated • GPS – Mapping Grade • Surveyed <p>Users of this data will understand the accuracy of the data based on these domain values. All domains are contained in the Appendix.</p> |

2.2 Coordinate System

The purpose of the Coordinate System standard is to keep the received data consistent. The driving factor for a consistent coordinate system is the long-term maintenance and storage of spatial data within a master geodatabase. The WWDO requires that spatial data delivered as part of a project be within a Geographic Coordinate System (GCS) based on the North American Datum 1983 (NAD83).

The Geographic Coordinate System was chosen to keep the consistency between the State Engineer’s Office (SEO) e-Permit downloadable coordinates, which the water system dataset is based on. In addition to the SEO’s data, the majority of outside data sources, such as the National Hydrography Dataset (NHD), is contained in geographic coordinates.

AN EXAMPLE OF THE REQUIRED COORDINATE SYSTEM

ARCGIS COORDINATE SYSTEM

* TYPE Geographic

* GEOGRAPHIC COORDINATE REFERENCE GCS_North_American_1983

* COORDINATE REFERENCE DETAILS

GEOGRAPHIC COORDINATE SYSTEM

WELL-KNOWN IDENTIFIER 4269

X ORIGIN -400

Y ORIGIN -400

XY SCALE 999999999.99999988

Z ORIGIN -100000

Z SCALE 10000

M ORIGIN -100000

M SCALE 10000

XY TOLERANCE 8.9831528411952133e-009

Z TOLERANCE 0.001

M TOLERANCE 0.001

HIGH PRECISION true

LEFT LONGITUDE -180

LATEST WELL-KNOWN IDENTIFIER 4269

WELL-KNOWN TEXT

```
GEOGCS["GCS_North_American_1983",DATUM["D_North_American_1983",SPHEROID["GRS_1980",6378137.0,298.257222101]],PRIMEM["Greenwich",0.0],UNIT["Degree",0.0174532925199433],AUTHORITY["EPSG",4269]]
```

3.0 Geospatial Tools, Templates, and Access

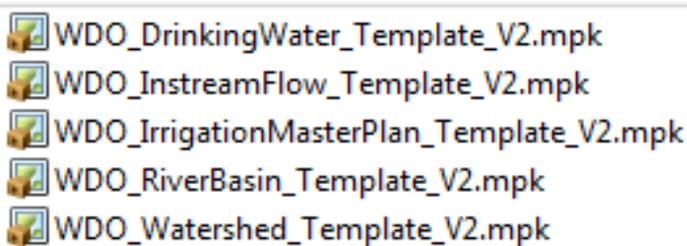
3.1 Map Package and Geodatabase Template Download

A map package (*.mpk) is a single, compressed file used to share an Esri ArcMap map document (*.mxd) and the associated data within that map document. The map package can also contain additional documentation to support the data and the map document. These capabilities make it the preferred method for sharing GIS projects and ensuring a consistent starting point.

There are six map packages available for download. Each map package contains symbolized maps and template geodatabases, one map and one geodatabase per version of ArcMap, versions 10.0 through 10.7 are supported.

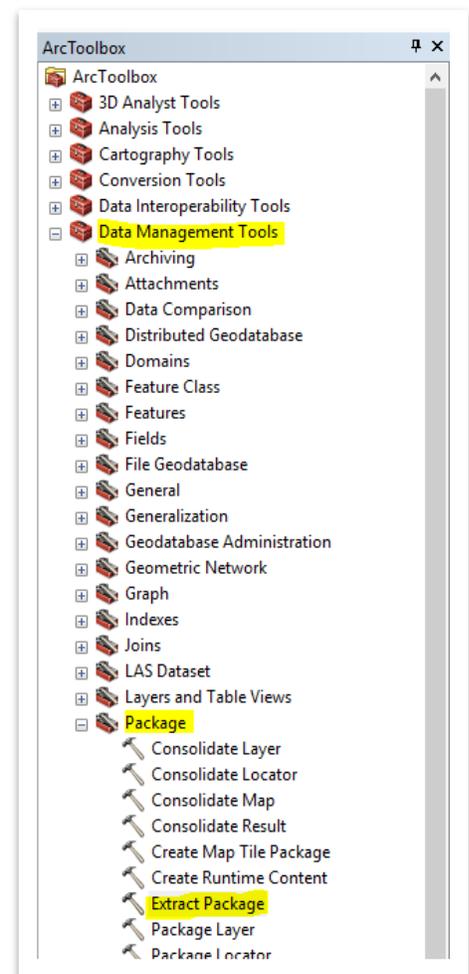
MAP PACKAGES AVAILABLE FOR DOWNLOAD

Map packages were developed to provide consistency in data collection



procedures and ensure end users are able to edit the data using the Esri Basic licensing. The map packages contain project specific geodatabase templates with the core datasets and the table relates that support the GIS standards detailed within this document. For additional information on the core datasets please refer to the Data Framework Plan.

1. The project specific map packages are available for download on the GIS Standards website, a link is available through the WWDO home page (<http://wwdc.state.wy.us/>), under “Agency Products.” There are two ways to open and use the map packages after download from the Water Hub (<http://water.geospatialhub.org/pages/wwdc-gis-standards>).
 - a. Double-click the map package. The map package will automatically extract itself to C:\Users\username\Documents\ArcGIS\Packages and automatically open ArcMap. The ArcMap project will contain the necessary feature classes, tables and relates that are blank and not populated. The information provided later in this document will explain the methods and descriptions for each of the core datasets displayed within the map package.
 - b. Run the Extract Package tool in ArcToolbox from either ArcMap or ArcCatalog. This allows the map package to be extracted to a user-defined location versus the default location under C:\Users\etc... listed above. Browse to the folder and select the location to extract the files. Once the extraction is complete the user will be able to browse to the same location and open the ArcMap project (.MXD) corresponding to the version of ArcMap installed on the user’s computer.



3.2 Permit Conversion Tools: Point of Diversion and Point of Use

The Permit Conversion Tools were created to streamline the process of creating the Point of Diversion (POD) and Point of Use (POU) feature classes from the e-Permit downloaded data at a Depth I detail.

Since Toolboxes are subject to the same version limitations within ArcMap, a version of Tools has been created for each 10.X version of ArcMap, it is not available on ArcGIS Pro. Use the Tool that corresponds to the installed version of ArcMap. Use the 10.3 version toolbox if running ArcMap 10.4. Esri did not revise the toolbox functionality between 10.3 and 10.4. Due to this limitation, creating a 10.4 version toolbox is not possible and not required. e_Permit_ToolsV2 of the Tool, runs on ArcCatalog 10.5 - 10.7. The [Permit Conversion Tools](http://water.geospatialhub.org/pages/wwdc-gis-standards) are available for download on the Water and Climate Hub (<http://water.geospatialhub.org/pages/wwdc-gis-standards>) and include a WWDO PLSS (Public Land Survey System) geodatabase which is required to run the tools.

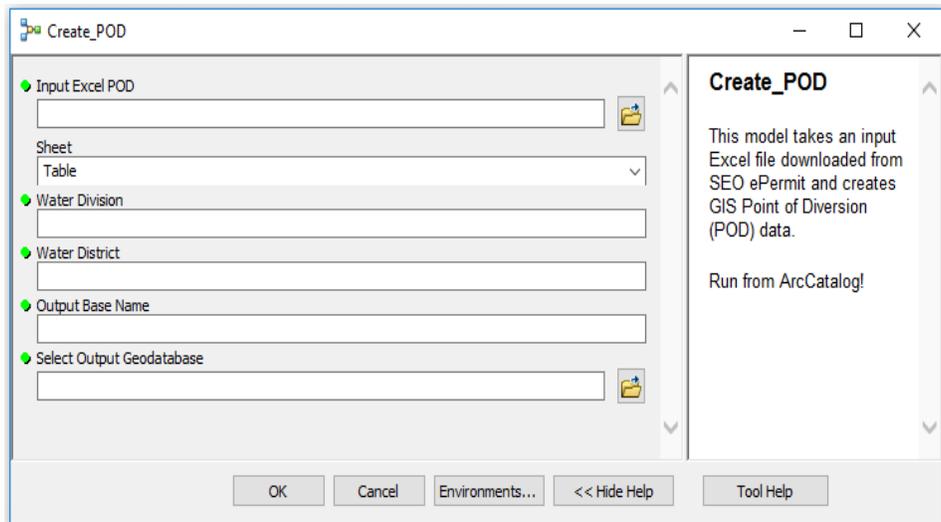
PERMIT CONVERSION TOOLBOX VERSIONS

-  e_Permit_Tools10-1or2_V2.tbx
-  e_Permit_Tools10-3_V2.tbx
-  e_Permit_Tools10_V2.tbx
-  e_Permit_ToolsV2.tbx

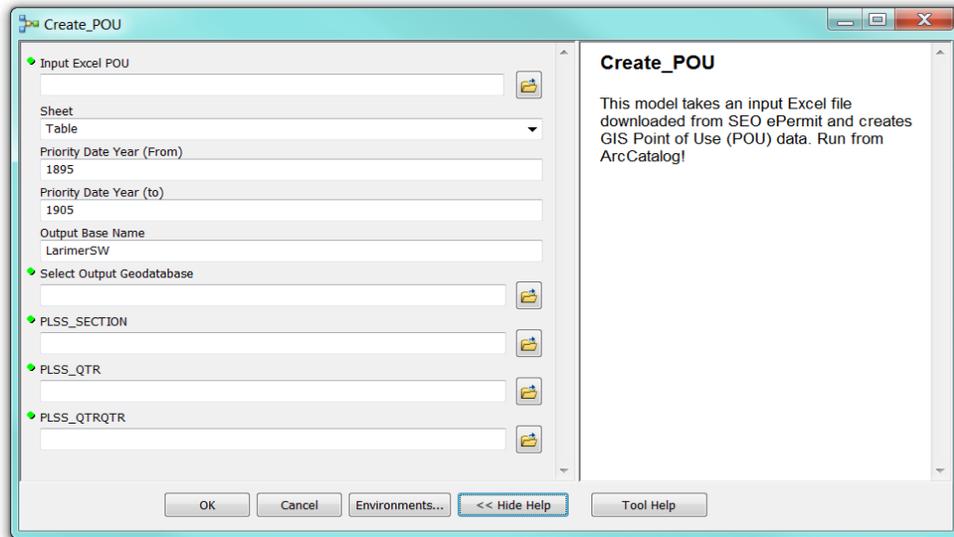
ESRI ARCGIS TOOLBOX VIEW OF THE E-PERMIT CONVERSION TOOLS:

-  e_Permit_ToolsV2.tbx
 -  Create_POD
 -  Create_POU
 -  POD sub-script

POD CONVERSION TOOL DIALOG AND INPUTS

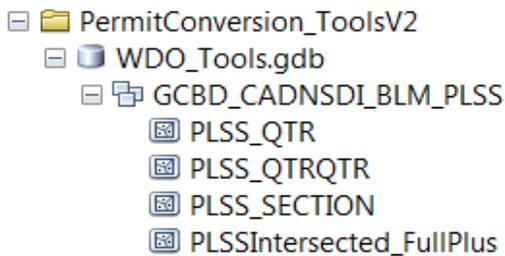


POU CONVERSION TOOL DIALOG AND INPUTS



Use the “**Show Help>>**” function to view help comments for each field in the POD and POU tool interfaces. **Create POU requires the supplied PLSS layers from Water and Climate Hub for proper use.**

PLSS LAYERS REQUIRED BY THE POU TOOL



Note: PLSS Data is included in e-Permit Conversion Tool Download

3.2.1 Methods for Preparing Data for and

Running Conversion Tools

Step 1: Downloading Water Right Data from e-Permit

Downloads from e-Permit contain the state of Wyoming’s water right permits, including expired, canceled or abandoned permits. These data download in a Microsoft Excel format with a maximum of 10,000 permit records (as of 2019). There are multiple methods to limit record searches to under 10,000; the suggested method is downloading based on water right type (Groundwater, Spring Water, etc.) and Priority Date.

The permit data contains Point of Diversion and Point of Use data. The Point of Diversion data is the default data set on the e-Permit search interface. Appendix A includes e-Permit Water Rights Search Guidelines provided by the SEO to assist in understanding the contents of e-Permit and Tab Books. It also contains some suggested methods to download bulk data.

Including Point of Use Details is NOT recommended as the system will only provide 10 POU records per POD record. POU records should be searched and downloaded without POD information. See the instructions below for specifics on how to download each type of record.

Point of Diversion (POD)

Point of Diversion data comes with Latitude/Longitude coordinates that in many cases represents the centroid of a section, or section quarter-quarter (North American Datum 1983). Log into the SEO's e-Permit system and Search for water rights selecting the following fields in each tab:

- Choose Search Option: **Find Water Rights (Detailed)**
- TAB: **WR NUMBER OR FACILITY NAME**
 - Point of Diversion (POD): Check **"Point of Diversion or Well Details"** Do NOT check "Include Point of Use Details." The output of this search is limited to 10 records per permit. One section could have as many as 16 records if it is recorded down to the quarter-quarter level, as many irrigation rights are.
- TAB: **LOCATION PARAMETERS**
 - Select from drop down
 - **WATER DIVISION:**
 - **DISTRICT:**
 - You will need to download each District separately for the "Study Area" in which you are working
 - **The selection in this tab may need to be adjusted to download less than 10,000 water right records (the maximum Excel export size). This equates to 400 "pages" in e-Permit.**
- TAB: **WATER RIGHT PARAMETERS**
 - At a minimum, divide the download by the following Diversion Types:
 - **Reservoir Storage** (units: acre-feet, "AF")
 - **Stream Diversion** (units: cubic feet per second, "CFS")
 - **Ground Water** (units: gallons per minute, "GPM")
 - **Spring diversion** (units: cubic feet per second, "CFS")
 - For POD records, these data sets must be downloaded individually due to the different units of measurement in each Diversion Type (AF, CFS or GPM).
- The downloaded dataset will contain three worksheets in an Excel format:
 - Tab "Table" : POD Water right records
 - Tab "Table 1": Water right record count
 - Tab "Table 2": Water right grid count

Point of Use (POU)

Point of Use comes in GCDB (Geographic Coordinate Data Base). GCDB uses section/township/range and can give descriptions down to the quarter or quarter-quarter, or Government Lot and/or Tract, if applicable. The GCDB layer is part of the Permit Conversion Tools provided by the WWDO to be used by the consultant. A specially formatted version is used by the POD and POU tools. Log into the SEO's e-Permit system and Search for Water Rights selecting the following fields in each tab:

- Choose Search Option: **Find Water Rights (Detailed)**
- TAB: **WR NUMBER OR FACILITY NAME**

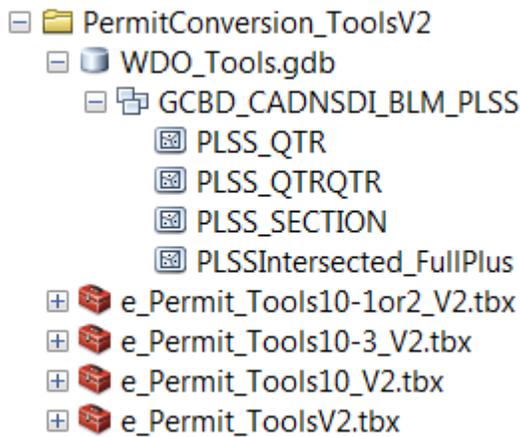
- Point of Use (POU): Check **“Point of Use Details”** box. Needs to be run separate from POD in order to get accurate downloads and work with the tools.
- **TAB: LOCATION PARAMETERS**
 - Select from drop down, **County or Township and Range**
- **TAB: WATER RIGHT PARAMETERS**
 - At a minimum, divide the download by Priority Dates. This may need to be adjusted **to download less than 10,000 water right records (the max Excel export size). This equates to 400 “pages” in e-Permit.**
- The downloaded dataset will contain three worksheets in an Excel format:
 - Tab “Table”: POD Water right records, this table is the only one needed by the Tool.
 - Tab “Table 1”: Water right record count
 - Tab “Table 2”: Water right grid count
- The POU output needs to be edited in Excel before it will work with the Tool
 - Add new field “POUQTR,” and populate it using the two right characters of the Qtr-Qtr field. In the new field, create a REPLACE function [=REPLACE(RIGHT([Qtr-Qtr cell ID],5),3,3," ")]. Note: Qtr-Qtr cell ID in the function will need to be edited to reflect the corresponding row and cell number (i.e. S2).
 - Edit fields so there are no spaces, no special characters, and field types are properly formatted.
 - Change Field Name Qtr-Qtr to QtrQtr
 - Change Field Name Survey Type, Survey Number, Survey Suffix to Survey
 - Change the field type of “Acres” to a number instead of a general or text field
 - The downloaded excel file needs to be resaved as a 97-2003 Workbook .xls worksheet
- Please note that the Latitude and Longitude fields included with the POU excel file are the location of the POD, not the POU.

Step 2: Run tools in ArcCatalog

Use the **“Show Help>>”** function in the Tool for information on all inputs.

Required Inputs

- Excel e-Permit input files.
 - Follow the e-Permit downloading procedures (Per Step 1 above. See Also Appendix A for more information).
 - **Excel files from e-Permit must be saved as 97-2003 versions even though they have an .xls extension. This must occur to allow the tool to navigate to and find the files.**
- Three PLSS input layers are formatted and supplied for use with the POU tool. They are included with the Permit Conversion Tool download on the Water and Climate Hub. The Bureau of Land Management’s (BLM) PLSS input layers are critical for the tool to run successfully!



Managing Outputs

- It is suggested a “working” geodatabase be used for outputs, and only place final products in Geodatabase templates as some editing is needed. Any file geodatabase can be used for the Output Geodatabase, however the tool runs faster on a local drive.

Step 3: Remove duplicates and irrelevant records for your study (for more information see Appendix A)

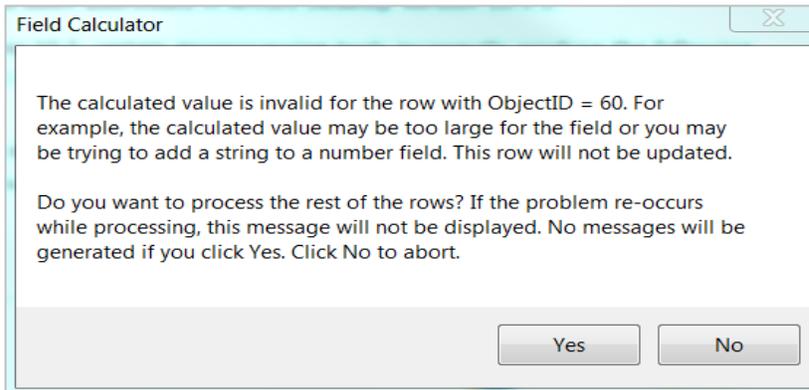
- Delete water right records whose quantities are below the mapping threshold needed for the project.
- Remove records with cancelled, abandoned, or expired status from the Excel tables. If using the Permit Conversion Tools, these records are automatically removed in the POU/POD feature class output.
- Delete permit (P) records that have been fully adjudicated, e.g., converted to Certificate Records (CR) or Order Records (OR).
 - After downloading the PODs from e-Permit in Excel, filter for “Fully Adjudicated” in the WR Status field.
 - From the fully adjudicated records, delete any records with a WR Number that does NOT begin with “CR” or “OR.” These are the permits that have been adjudicated and duplicated in the information provided under the Certificate Record or Order Record.
- Partially adjudicated permits (surface water only) – These records will still need to be manually reconciled to remove duplicate flow or acreage counts. This may require using e-Permit to view the scanned permit and understand what portion has been adjudicated.

Step 4: Run the Permit Conversion Tools

Notes on POD and POU outputs:

- A bug in ArcGIS Desktop 10.5, may cause the following error message when running the tool. This error will not affect the output of the tool. This error has been addressed in ArcGIS Desktop Version 10.5.1.
 - BUG-000102024 - In ArcGIS Desktop 10.5-7, certain geoprocessing tools incorrectly produce the following warning message, "WARNING 001102: You must have at least the ArcEditor License to run this tool with the specified data."

- A bug in ArcGIS Desktop 10.7 may launch a hidden dialog box behind ArcCatalog when you get this message in the geoprocessing window, “Empty value for ObjectID = [].” Hit yes on the dialog box to continue processing.



- The tools will automatically input the date for you in the data outputs. However this date in the output is based off the day the tool was run, not the date of download. It is recommended to run the tool on downloaded data as soon as possible to keep the date correct.
- The POD tool converts some fields to numeric field types to allow for statistical calculations.
- Outputs have an auto formatted name
 - (POD or POU) + Output Base Name + Water Division + Water District + (FC or Table or Error Table)
 - Example: POD_BASENAME_00_0000_FC
- **These tools are unable to express POU down to tracts and lots, due to different ways tracts and lots are written in datasets. Tract and lot data are retained in the Survey Field (of the _ErrorTable or _FC) but not used to map POU.**
 - POU data in the _ErrorTable containing tracts and lots should be plotted manually into the _FC (as needed) to map POU output data to the tract and lot.
- The GIS features (_FC) are converted to points (POD) and polygons (POU). These layers created by the tool already have some unneeded data removed, such as Abandoned, Expired and Cancelled records. Also some POU records may show an active POU but the POD is listed as inactive. These records will have to be manually addressed.
- The Tables (_Tables) created by the tool contain every entry downloaded from e-Permit.
- The Layer outputs may still contain permits that have received a Certificate Record. These permits will have to manually be removed to prevent duplication of data (see Step 3 and Appendix A).
- The Error Tables contain all records that did not get created in the feature class (FC). This includes removed records like Abandoned, Expired, and Cancelled as well as records that fail PLSS formatting and records outside of Wyoming. The POU _Table will have fewer records than the sum of the POU _FC plus the POU _Error Table due to the multiple records created in the _FC for the lots/tracts.

Suggested method for pulling permitted amounts and permitted acres for e-Permit data:

- There may be multiple POU records for a single Permit or Certificate Record number. To find the total permitted acreage, summarize the PermitNum field in the POU layer table and choose SUM on the Acres_Number field as the summary statistic.

- **Note:** Never summarize the Appropriation field in the POU table as this field value represents the total amount for the permit, not the amount allocated to the quarter-quarter in that section.
- To display Amount (cfs, gpm, acft) and Acres permitted in a linked water right table, first summarize on the POD layer and POU layer table data based on the permit field and use the “Sum” function on the permitted amount (cfs, gpm, acft in the POD layer) or acres amount (in the POU layer). Join both amount and acres to the linking table (WS_WDOSTRID_TO_SEOWaterrights) using the permit field and then run “Summarize” on the WDOSTRID field with amount and acres as outputs. This will allow the data to be directly linked to the features showing all permitted amounts and acres for that feature.
 - **Note:** Caution is needed in summarizing surface rights associated with a reservoir. These units are sometimes in acre-feet instead of cfs. A possible fix is to convert the acre-feet number to cfs and indicate in the “Comment” field this was done.

Disclaimer on POD and POU Tools:

The POD and POU Tools are intended to save time creating GIS data from SEO e-permit data. These tools do a superficial attempt at cleaning the data with removal of Abandoned, Expired and Cancelled Records. The outputs of these tools cannot be seen as direct inputs into models or other data analysis. These tools are merely meant to get all users to the same starting point with useable fields populated and points/polygons created.

3.3 Manual Procedures for Replicating e-Permit Conversion Tool Output

Note: The manual procedures presented here provide a detailed breakdown of the steps the tool is following.

Prepare e-Permit Water Rights

User will have to download and add/adjust fields prior to displaying data spatially.

Step 1: Remove duplicates and irrelevant records (for more information see Appendix A)

- Delete water right records whose quantities are below the mapping threshold needed for the project.
- Remove records with cancelled, abandoned, or expired status.
- Delete records that have been converted to Certificate Records (adjudicated). Only keep the adjudicated record. After downloading the PODs from e-Permit Excel file, filter for “Fully Adjudicated” in the WR Status field. From the fully adjudicated records, delete any records with a WR Number that does NOT begin with “CR” or “OR”. These are the permits that have been adjudicated and duplicated in the information provided under the Certificate Record.
- Partially adjudicated (surface water rights only) – These records will still need to be manually reconciled to remove duplicate flow or acreage counts. This may require using e-Permit to view the scanned permit.

Step 2: Combine and format downloaded water right data

If you downloaded multiple SEO Districts then combine each diversion type into one spreadsheet. DO NOT combine different ‘diversions’; they contain a different unit of measurement in the same column under “Appropriation” (e.g.—cfs or gpm).

Add the following fields and complete the information:

- POD Sheets
 - DateDownloaded
 - WaterDivison
 - WaterDistrict
- POU Sheets
 - DateDownloaded
 - WaterDivision
 - WaterDistrict
 - QTRQTR_CLEAN: Populate this field by removing ¼ from the POUQTRQTR

Step 3: Creating Point Feature Classes

- Within ArcGIS, import the tables from the Excel documents for each diversion type for both its Points of Diversion and Points of Use.
- You will need to create a Point of Diversion “feature class from XY table” from the Points of Diversion table.

There should be three types of features for each Diversion Type:

- Points of Diversion: *points*
 - These points will be displayed spatially and can be edited as needed.
- Points of Diversion: *table*
 - This dataset is used as an unedited reference and a linking table for some features.
- Points of Use: *table*
 - This table is used to create the Points of Use polygons. After creating the Points of Use polygons, the table will no longer be needed.

The Points of Diversion: *points* and the Points of Use: *polygons (after creation)* can be edited and is used to display data. The Points of Diversion: *table* is a reference and linking table and should not require editing.

Attaching Points of Use to PLSS Layer

This step requires multiple inputs prior to creating the point of use polygons as the PLSS layer and the Point of Use: *table* needs to be prepared prior to creating the polygons. At this time, unneeded data could also be removed from the Point of Use: *table* and Point of Diversion: *points* before being displayed spatially (this process is described and explained separately in Step 3 below).

Step 1: Preparing the Cadastral National Spatial Data Infrastructure (NSDI)

If the PLSS base layer was not provided by WWDO, download the Cadastral National Spatial Infrastructure (NSDI) dataset from the BLM. Point of Use data comes in various sizes, therefore, the “PLSSIntersected” layer is needed in order to create Section, Quarter and Quarter-Quarter feature class data layers.

Note: WWDO has these three datasets prepared for use when creating the points of use polygons. If these datasets were not provided, contact your WWDO representative. If the three data layers were provided, go to Step 2.

Using “PLSSIntersected”, three layers will be created:

- A PLSS layer to the Section
- A PLSS layer to the Quarter
- A PLSS layer to the Quarter-Quarter

Note: It makes the process faster if the PLSS layer is clipped to a buffered project area prior to adding fields and/or manipulating the data.

To “PLSSIntersected Layer” add the following fields and populate using *Field Calculator (ArcGIS)*:

| Field Name | Formula in ArcGIS Field Calculator |
|-------------------|---|
| PLSS_SECTION | [TWNSHPN0]&[TWNSHPDIR]&[RANGENO]&[RANGEDIR]&[FRSTDIVNO] |
| PLSS_QTR | [TWNSHPN0]&[TWNSHPDIR]&[RANGENO]&[RANGEDIR]&[FRSTDIVNO]&[QSEC] |
| PLSS_QTRQTR | [TWNSHPN0]&[TWNSHPDIR]&[RANGENO]&[RANGEDIR]&[FRSTDIVNO]&[QQSEC] |

Step 2: Prepare the e-Permit Water Right Point of Use: table__

This table is created from the e-Permit Water Right Download described in the above section. This process will need to be completed on each Point of Use dataset, to allow the dataset to properly link to the PLSS layer.

To the Points of Use: *table*, add and populate the following Fields using *Field Calculator (ArcGIS)*:

| Field Name | Formula in ArcGIS Field Calculator |
|-------------------|---|
| PLSS_SECTION | [POUTNS]&[POURNNG]&[POUSEC] |
| PLSS_QTR | [POUTNS]&[POURNNG]&[POUSEC]&[POUQTR] |
| PLSS_QTRQTR | [POUTNS]&[POURNNG]&[POUSEC]&[QTRQTR_CLEAN*] |

* This field was created in Excel after the download and described in earlier directions.

After populating all Fields (Section, Quarter and Quarter-Quarter), remove or correct data created by Field Calculator (ArcGIS).

This is done by using ArcGIS “Select by Attributes” and then filling in selected entries using Field Calculator with the formula Field = “[blank]”. The goal is to have only one entry for all created fields. Data remaining in more than one field will result in duplicated data.

Remove the extra and incorrect data using the following rules:

- For all entries with complete quarter-quarter data remove any filled in PLSS_QTR and PLSS_SECTION data
- For all entries with [All] listed for quarter-quarter remove any filled in PLSS_QTRQTR data

- For all entries with [All] listed for quarter-quarter BUT not [All] listed for quarter, remove PLSS_QTRQTR and PLSS_SECTION data
- For all entries with [All] listed for quarter, remove any filled in PLSS_QTR and PLSS_QTRQTR data
- For all entries missing quarter data, remove PLSS_QTRQTR and PLSS_QTR data
- For all entries missing quarter-quarter data BUT quarter data is NOT missing, remove PLSS_QTRQTR and PLSS_SECTION data
- For all entries with 000 or other invalid section numbers, remove any filled in PLSS_QTR and PLSS_QTRQTR data
- For all entries with 000 or other invalid section numbers, replace PLSS_SECTION with INVALID and review per project guidelines
- For all entries missing Section data, replace PLSS_SECTION with MISSING and review per project guidelines

After correcting and removing data, each data point should only have one field of PLSS_SECTION, PLSS_QTR and PLSS_QTRQTR filled in. These three fields should contain valid data or MISSING/INVALID in PLSS_SECTION if relevant.

Note: Some INVALID PLSS_SECTIONS may contain data in the PLSS e-Permit field and some segmented e-Permit data will not match the SEO combined PLSS field. Some Points of Use will be missing the PLSS information completely or have “filler” information that is not useful.

- The section number may have 000 (Sections are numbered 01 to 36)
- PLSS data may be missing completely from e-Permit

Step 3: Attaching Point of Use: *table* to PLSS Layer

This step describes the procedure for creating PLSS layers for each complete data set of Section, Quarter and Quarter-Quarter. The three data layers for each Point of Use will be combined to create a final Point of Use Layer to represent each Diversion Type.

Using the Make Query Table tool in ArcGIS, join each created PLSS layer (PLSS_SECTION, PLSS_QTR, PLSS_QTRQTR) to Point of Use: *table* by the corresponding created and filled in fields. Using this tool accurately accounts for the one-to-many relationship between the PLSS layer and the POU table.

Export Data from the joined PLSS layers to create a new layer only containing the Section/Quarter/Quarter-Quarter that have a Point of Use water right.

Merge all three (Section, Quarter, and Quarter-Quarter) to create one layer that contains all the Point of Use for the Diversion Type.

Optional: Downloading the Tabulation of Adjudicated Water Rights (Tab Book)

Tab Books can also be downloaded from e-Permit and used as a reference for the water right diversion data. In e-Permit, under the Reports tab at the top of the page (next to Search), Tab Books can be found. Download in Excel to link to “Downloaded Water Right Data.” Tab Books describe adjudicated water rights and are a convenient

cross-reference to be used in conjunction with e-Permit. However, they do not reflect any unadjudicated water rights or water rights in the process of being updated. For more information on using Tab books for water rights see Appendix A, Section E.

4.0 Feature Mapping & Attribution

This section describes the data model, describes the core GIS datasets and provides detail on the types of GIS features that are normally collected through Water Development projects. The data templates and database are likely to change over time due to project sponsor and WWDO needs.

4.1 Geodatabase Structure

The figure on the right shows the master database view in ArcCatalog. Few projects will need to update or develop all of the listed feature classes (FC) and tables. The standardized feature classes, tables and valid values (Geodatabase Domains), along with the relationships that assist with linking the data tables together are diagrammed starting in Section 4.2.

Geodatabase structure does not allow tables to be stored within feature datasets. To efficiently associate data tables to the features and overall core data sets, the naming conventions for the tables include a prefix corresponding to the related feature datasets as follows:

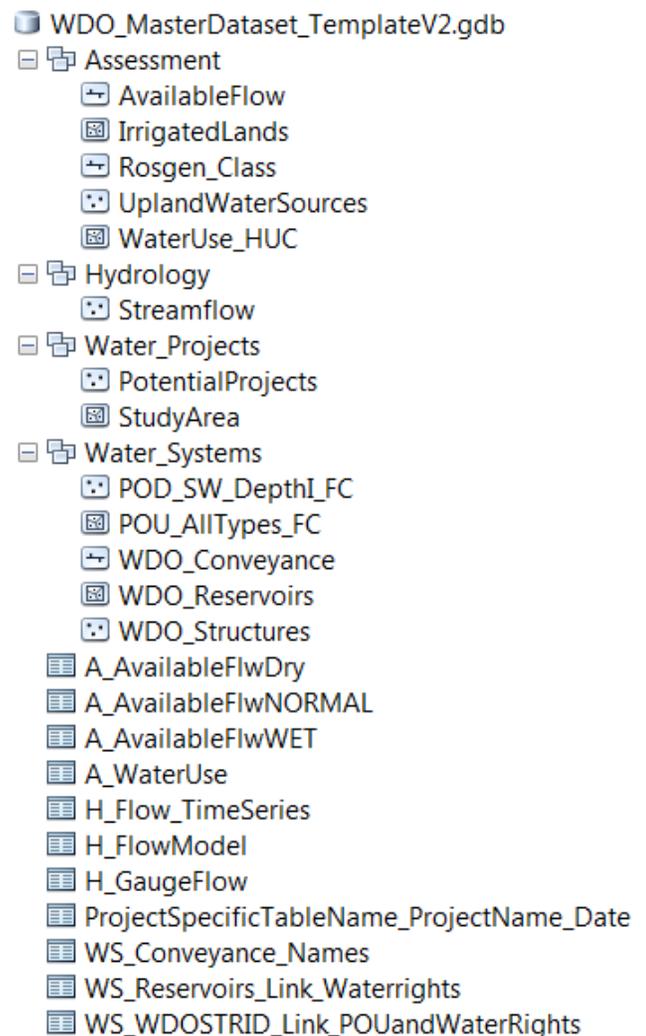
- A - Assessment Dataset
- H - Hydrology Dataset
- WP - Water Projects Dataset
- WS - Water System Dataset

The Project Specific Table included in the template is for custom attributes specific to your project. The Project Specific Table(s) should be linked to the GIS features as needed and labeled with the appropriate prefix as shown above.

4.2 Working with Existing Data

Building off of existing GIS datasets is encouraged. When creating a new GIS for the project sponsor, data should be migrated from existing sources into the geodatabase template. Feature attributes should be populated and or verified, accuracy updated, and metadata fields updated if changes are made.

To import data into the geodatabase templates use the Load Data command in ArcCatalog. Right click on a feature class in ArcCatalog and select Load. This wizard copies spatial features and migrates field values from the existing field to the template field name as long as the field types are the same (text to text or number to number). Conflation tools can also be used to migrate data into the geodatabase templates. Alternately, within ArcMap, features can be copied into the geodatabase template. The attributes of the copied features will not transfer if the field names or formats do not match.



4.3 GIS Features by WWDC Study Type

This section defines core GIS data developed for standard planning projects. Each project will have its own unique data collection needs that likely go beyond this general list. Users should consult their scope of work and the WWDO project manager for specific data needs. The tables below show the feature classes with an item description of what should be included in each class and important notes about any linking data or uses. Attributes that are not part of the core datasets can be included as a separate table and linked through the SITE_NO field.

BASIN PLANNING & MODELING

| | Item Description | Notes |
|---------------------------|--|--|
| Streamflow | Location of stream flow gauges or modeled flow nodes within the study area. | Should have links to time series data table or modeled data |
| WDO_Structures | Location of major structures in a water system, including diversions, meters, headgates, dam outlets, wells, return flow locations, water storage tanks (potable). | Can link to conveyance, meter data, condition assessment data, water right permit data, model data |
| POU_[e-Permit]_FC | Point of Use location of water use by quarter-quarter. Derived from e-Permit conversion tool. | Tract and lot POU records will not plot using conversion tool |
| WDO_Conveyances | Water transmission, canals, ditches, pipelines | Use Convey_ID field to link to project specific data, ie., size, material, age, photos, etc. |
| WDO_Reservoirs | Non-stock water reservoirs | Requires linking table to derive capacity data from permit information |
| Study Area | Outer boundary of the project study area. | |
| Potential Projects | Projects identified in within the study area. | Projects that could be developed from study should include estimated cost and additional water if applicable |
| Irrigated Lands | Lands currently irrigated | |
| Water Use | Water use (amounts and use types) by watershed | |
| Available Flow | Legally available water for wet, normal, and dry years. | |

WATERSHED STUDIES

| | Item Description | Notes |
|-----------------------|--|---|
| Streamflow | Location of stream flow gauges or modeled flow nodes. | Should have links to time series data table or modeled data |
| WDO_Structures | Location of major structures in a water system, including diversions, meters, headgates, dam outlets, wells, return flow locations, water storage tanks (potable). | Links to POU and permits through linking table (WDOSTRID_Link_WaterRights). |

| | | |
|-----------------------------|---|---|
| POU_[e-Permit]_FC | Point of Use location of water use by quarter-quarter. Derived from e-Permit conversion tool. | Tract and lot POU records will not plot using conversion tool. |
| WDO_Conveyances | Water transmission, canals, ditches, pipelines | Use Convey_ID field to link to project specific data, ie., size, material, age, photos, etc. |
| WDO_Reservoirs | Non-stock water reservoirs > 100 acft | Requires linking table to derive capacity data from permit information |
| Study Area | Outer boundary of the project study area. | |
| Potential Projects | Projects identified within the study area. | Projects that could be developed from study should include estimated cost and if applicable, any additional water needed. |
| Rosgen_Class | Geomorphology as Rosgen Stream Class. | |
| Irrigated Lands | Lands currently irrigated | |
| Upland Water Sources | Livestock tanks and livestock reservoirs, springs | |

IRRIGATION DISTRICT MASTER PLAN

| | Item Description | Notes |
|---------------------------|--|---|
| Streamflow | Location of stream flow gauges or modeled flow nodes. | Should have links to time series data table or modeled data |
| WDO_Structures | Location of major structures in a water system, including diversions, flumes, headgates, dams, outlets, wells, return flow, pump, culvert. | Links to conveyance, diversion data, permit data, model data. Use SITE_NO field to link to project specific data, ie., size, condition, material, age, photos, etc. |
| POU_[e-Permit]_FC | Point of Use location of water use by quarter-quarter. Derived from e-Permit conversion tool. | Tract and lot POU records will not plot using conversion tool. |
| WDO_Conveyances | Water transmission, canals, ditches, pipelines, and natural channels. | Use SITE_NO field to link to project specific data, ie., size, material, age, photos, etc. |
| WDO_Reservoirs | Non-stock water reservoirs > 100 acft, or water storage tanks | Requires linking table to derive capacity data from permit information |
| Study Area | Outer boundary of the project study area. | |
| Potential Projects | Projects identified within the study area. | Projects that could be developed from study should include estimated cost and if applicable, any additional water needed. |
| Irrigated Lands | Lands currently irrigated | |

DRINKING WATER MASTER PLAN

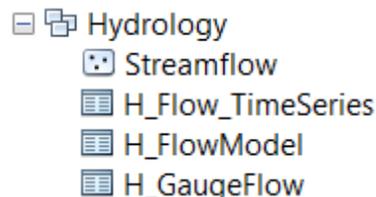
| | Item Description | Notes |
|---------------------------|---|---|
| WDO_Structures | Location of major structures in a water system, including diversions, meters, headgates, dams, outlets, wells, valves, water storage tanks (potable). | Links to conveyance, diversion data, permit data. Use SITE_NO field to link to project specific data, ie., size, condition, material, age, photos, etc. |
| POU_[e-Permit]_FC | Point of Use location of water use by quarter-quarter. Derived from e-Permit conversion tool. | Tract and lot POU records will not plot using conversion tool. |
| WDO_Conveyances | Water transmission, canals, ditches, pipelines | Use Convey_ID field to link to project specific data, ie., size, material, age, photos, etc. |
| WDO_Reservoirs | Raw water reservoirs | Use SITE_NO field to link to project specific data, ie., size, condition, material, age, photos, etc. |
| Study Area | Outer boundary of the project study area. | |
| Potential Projects | Projects identified within the study area. | Projects that could be developed from study should include estimated cost and if applicable, any additional water needed. |

INSTREAM FLOW

| | Item Description | Notes |
|------------------------------|---|---|
| Streamflow | Location of stream flow gauges or modeled flow nodes. | Should have links to time series data table or modeled data |
| POD_[GW, SW e-Permit] | Point of Diversion Location, surface water or groundwater, derived from e-Permit conversion tool. | Requires cleanup in Excel prior to using conversion tool. Links to POU and permits. |
| POU_[e-Permit]_FC | Point of Use location of water use by quarter-quarter. Derived from e-Permit conversion tool. | Tract and lot POU records will not plot using conversion tool. |
| WDO_Conveyances | Water transmission, canals, ditches, pipelines | |
| Study Area | Outer boundary of the project study area. | |
| Potential Projects | Instream flow reaches | |
| Available Flow | Legally available water for wet, normal, and dry years. | |

4.4 Hydrology Feature Dataset

The hydrology dataset is intended to represent streamflow statistics, stream gauges, and modeled streamflow nodes. This is critical for the development of Watershed Studies, River Basin Plans, Instream flow Studies, and Reservoir projects.

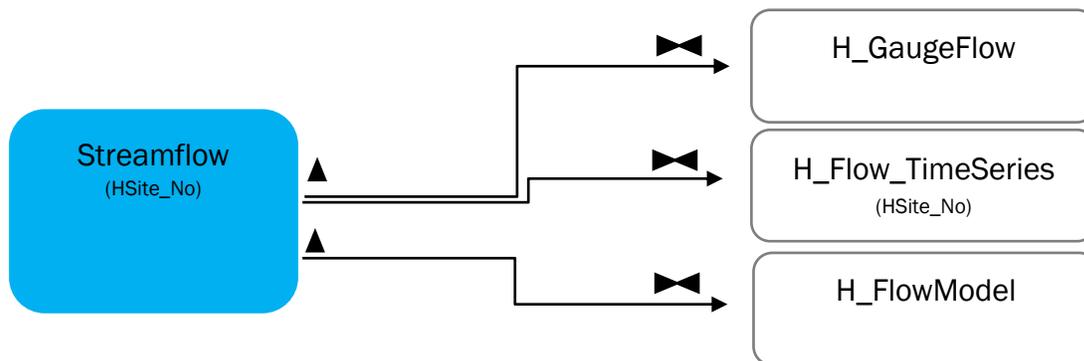


Dataset Usage: The Hydrology Feature Dataset allows for physical locations to be linked to model calculated flows and monitored flow data. This dataset should be utilized in Watershed Studies for estimated flow mapping, projects with temporary gauges installed, and modeling projects. The end user will be able to query and compare the data by having both the modeled and monitored flow data linked to the same physical location with GIS. This data will assist in calibrating the model, as well as, providing the end user with data for further analysis. Streamflow locations should be snapped to the National Hydrology Dataset (NHD flowline), and boundary calculations should utilize HUC boundaries and codes.

4.4.1 Feature Class Streamflow: Links, and Methods

Streamflow – Physical location of node or gauge used in flow statistic. This dataset also contains fields for the most recent Normal Year statistics for each month and Annual Total volumes for Wet, Normal and Dry years. The unit field is especially important to populate as some units may be acre-feet, cubic-feet/Second or as a percentage of the average monthly or annual flow, depending on the project. The field HSite_No, or Node_ID is the unique ID that links the feature class to the table data. HSite_No can be a gauge number or project specific. It links to the tables H_Flow_TimeSeries and H_GaugeFlow. Node_ID is developed through the modeling process and varies by project.

Domains: **NodeType** and **HorizontalAccuracy**



4.4.1.1 Table H_FlowModel

H_FlowModel – Data table containing Dry, Normal and Wet month and year data for each node. Links to Streamflow Feature Class by Node_ID

4.4.1.2 Table H_GaugeFlow

Table H_GaugeFlow – Data table containing gauge flow data in cubic-feet per second (cfs). Links to Streamflow Feature Class by HSite_No. Reports streamflow or runoff volumes for a given location. This dataset contains

the most recent normal year volume or discharge statistics for each month and may contain annual total volumes for wet, normal and dry years. Units can be reported in cubic-feet per second (cfs), acre-feet (AF), or percent of average, as indicated in the units and described in the Statistic field. Many water development projects develop stream flow estimates and install temporary gauges. These data should be contained here.

4.4.1.3 Table H_Flow_TimeSeries

Table H_Flow_TimeSeries - Data table containing time series data collected for the study and/or real-time streamflow data. Links to Streamflow Feature Class by HSite_No.

Methods: Aquarius (SEOflow), State Engineer's Office (SEO) Annual Hydrographer Reports

Aquarius is the real-time streamflow data provider for the SEO. Data can be downloaded for each stream gauge, one at a time, for the stream gauges within a project area. Contact SEO for the Excel spreadsheet of stream gauges within the project area. Multiple points, each of a different data type, may be present for a single stream gauge location. Thus, graphically selecting stream gauges from the Aquarius site is not the preferred download method. As stated in the Structure Unique ID creation guidelines (Appendix C) all measurement locations in the project area must be given a Unique ID (WDOSTRID) or have the gauge ID used in Site Number as determined by project requirements.

Gauges from Aquarius can range from a single data type to over ten different data types. WWDO is mostly concerned with discharge data but data needs can vary by project. As the data set types are not constant you may have to download different data types for a gauge. Some gauges may be missing the data you need depending on the available data for each individual gauge in the project area.

After downloading each data type, formatting will be required prior to uploading to ArcGIS. The gauge identification number will need to be added to each entry to properly link the data to the gauge's physical location. It is advisable to keep each data type separate and with proper titles identifying the data type.

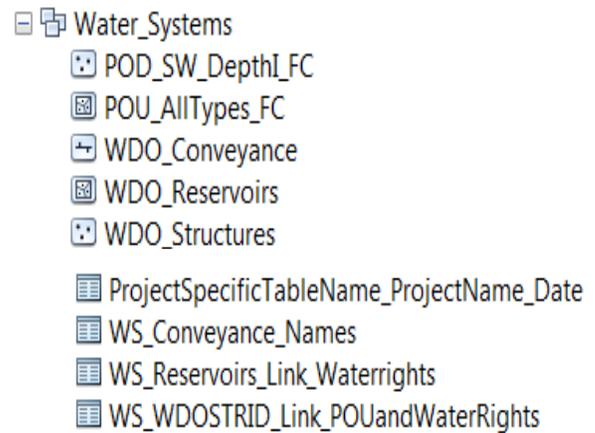
Overall make sure the data downloaded from Aquarius meets your needs and formats before attempting to input into data models. Data access procedures could also change as Aquarius updates are executed on an ongoing basis. Contact Aquarius administrators at the SEO for any questions on data.

Note: Discharge data sets may have overlapping dates and come with different timestamp styles. Timestamp data can be daily or by the hour. Make sure you understand the data downloaded before entering into models to avoid repeated data or dissimilar data.

4.5 Water System Feature Dataset

Water system infrastructure is critical to the mission of WWDC and its project sponsors. Water infrastructure location, condition, and size is key to understanding how water is distributed across the landscape.

Dataset Usage: Water Systems Feature Dataset allows for spatial representation of diversions, wells, pipelines, water tanks, reservoirs, etc. The mapped locations within this dataset can be linked to structural materials, efficiencies, current conditions, and other data needed in the analysis of these systems. This data contains or links directly to permitted water right information from the e-Permit system. Spatially representing this information will allow the end user to assess the permitted water and reference data based on areas of interest.



Depending on project requirements, different ‘Depths’ of detail are required for project data or GIS deliverables. The depth is the amount of detail captured for a feature and how much effort will be expended tracking this feature.

Any questions on the detail or completeness of the depth should be discussed with the WWDO project manager.

e-Permit

The Wyoming State Engineer's Office maintains an online water rights database (e-Permit). The e-Permit system is often used to understand the permitted water use and the location of infrastructure throughout the state. WWDC consultants often map out the water rights to understand sources of water, where water is used, and how much is potentially used.

Depth I Mapping Detail

At a Depth I, each record in e-Permit has a point on a map. A Depth I requires no location manipulation or association. Depth I requires only basic data clean up (removal of expired, missing, or known erroneous data). Depending on the scope of services in the WWDC contract, Depth I may only require mapping water rights of a certain use type or diversion amount. There is minimal data manipulation from the e-Permit download into the GIS mapping for Depth I. The location of the automated points should be taken with some caution; often the coordinates are based on the centroid of a section, or quarter section. The main advantage of this approach is to link directly to POU data without going through a linking table. This can be very helpful for a sponsor that just wants to click on a point and see all the lands that receive water from it.

Features

- **POD** – This dataset represents the Points of Diversion.
- **POU** – Generalized water right Points of Use created from Wyoming State Engineer's Office e-Permit database.
- **Reservoirs** –Raw water storage greater than 100 acft of capacity.

- **Conveyance** - Conveyances represent facilities designed to transport water from its source to the Point of Use, and within the distribution system, where applicable.

Example: Depth I for water right permit data requires: downloading data from e-permit, digitally representing data within GIS and removing unnecessary data (expired, missing or known erroneous data). Linking Points of Diversion to Points of Use is a key step in understanding the permitted water rights within the area of study. The outcome of a Depth I mapping exercise will produce a Point of Diversion (point) and Point of Use (polygon) layer within GIS, with the associated permit information linked to the mapped features.

Depth II Mapping Detail

At Depth II, a single diversion or reservoir is spatially represented and linked to many associated attributes. Points of Diversion that are spatially related (in the same location), require consolidation into a single diversion feature and that single feature needs to be designated with a unique ID to relate to the many water rights in that location. Displaying the data as a single spatial point for associated diversion records and a single spatial location for reservoirs allows for associated data to be queried and summarized for that location. Looking at a single diversion allows users to see permits attached, the number of permits, total cfs (cubic-feet per second) for that location, and the Point of Use for that single diversion. The points of diversion are also related to conveyances allowing the end user to see the direction of the flow and how water reaches each diversion along the drainage system (e.g. stream point of diversion linked to the conveyance transporting the water from the diversion).

Features and Tables

- **Structures** – This dataset represents diversions, wells, meters, spillways, water storage tanks, etc.
- **Reservoirs** – Raw water storage greater than 100 acft of capacity.
- **Conveyance** - Conveyances represent facilities designed to transport water from its source to the Point of Use, and within the distribution system where applicable.
- **Linking Tables** – These tables allow for a single feature to be linked to many records, such as ground conditions, photos, water rights, etc.
- **Water Right Tables** – Generated from Wyoming State Engineer's Office e-Permit database
- **Custom Tables** – Attributes that are not part of the core database but needed for a project or model.

Example: Depth II water system data may have multiple associated water permits linked to a single diversion point within the GIS. For advanced queries, conveyances are created and/or associated to a diversion point linking the conveyance to the point of diversion. The conveyances and diversions will have unique IDs assigned to each feature. Depth II mapping is best used in preparing the information for modeling, where not all, but the majority of the information is captured with a basin or drainage feature.

Depth III Mapping Detail

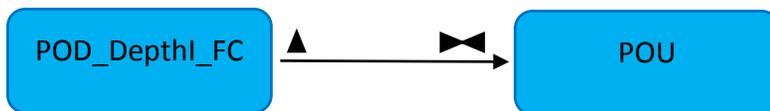
Depth III mapping detail requires the data to be mapped at a Depth II detail prior to additional data manipulation. Depth III requires all of the water right data points (Points of Diversion and Points of Use) be given unique IDs and mapped at the highest level of accuracy available. The additional step of mapping the Point of Use according to the SEO mylar ditch and petition maps is part of this effort. This is sometimes referred to as the Water Right Service Area.

Example: Mapping Depth III water systems will include irrigated lands and service areas linked to the diversions supplying water to the irrigation systems as well as relevant permit information. Diversion locations are at least mapping grade GPS accuracy. Diversion type, efficiency, model and construction details are also required to complete the datasets.

4.5.1 Feature Class: POD_[SW, GW, Spring, Resv]DepthI_FC*: Links and Methods

POD_[GW, SW, Resv]_FC – This dataset represents the points of diversion feature class (FC) mapped to a Depth I. Each record in the e-Permit water rights database has a point on a map, even duplicates. A Depth I requires no location manipulation or association (see Section 4.5 above for full description). Records should be separated by groundwater, surface water, and reservoir. Initial mapping can be automated by using the supplied Permit Conversion tool (see Section 3) to simplify the process. Attributes are carried over from the e-Permit download. This feature class can be linked to Point of Use (use WR_Number field) and Conveyance (use FacilityName field). This is not a comprehensive listing of points of diversion for all water rights in the State of Wyoming. **These data are incomplete, water rights information is only available through researching the water rights on file with the State Engineer’s Office and Board of Control.** See Section 3, **Tool Procedures: Point of Diversion and Point of Use Depth I Mapping** for additional detail.

**FC is added by the POD tool to differentiate between the feature class and tables. Name of Feature Class or Table can vary*



4.5.2 Feature Class: POU_[SW, GW, RESERVOIR]: Links and Methods

POU – Generalized water right Points of Use created from the State Engineer's Office e-Permit database. Water right information is generalized to the Public Lands Survey System, specifically a section, or section quarter-quarter depending on the records stored in e-Permit. The section boundaries come from the BLM’s Cadastral National Spatial Data Infrastructure (CADNSDI) publication data set for a rectangular and non-rectangular Public Land Survey System (PLSS) data set. It is important to note the right may not apply to the entire quarter-quarter, only a portion of it. This is not a comprehensive listing of Points of Use for all water rights in the State of Wyoming. **These data are incomplete, water rights information is only available through researching the paper water rights on file with the State Engineer’s Office and the Board of Control.**

Methods: Running the e-Permit Conversion Tool

The methods used to derived the Depth I Point of Diversion and Point of Use data are described in detail in Section 3.2, *Permit Conversion Tools: Point of Diversion and Point of Use*. Outputs of the tool will need to be investigated to clean up duplicate adjudicated permit records and unmapped or mis-located records.

4.5.3 Feature Class Reservoirs: Links and Methods

WDO_Reservoirs (No stock water tanks) – this FC contains existing conditions of open water storage greater than 100 acft of capacity. WWDO will supply a data layer for the starting point on this data set. This data set uses NHD water bodies with additional columns in the attribute table.

Domains: **HorizontalAccuracy**



*Not included in the geodatabase templates. The table is generated through the permit conversion tool described in Section 3.

4.5.3.1 Linking Table WS_Reservoirs_Link_WaterRights: Links and Methods

WS_Reservoirs_link_WaterRights – this linking table connects a single polygon reservoir feature to associated water right permit information. Permanent_ID is the linking field to the feature class WDO_Reservoirs. Permanent_ID is found in NHD Waterbodies or created at time of feature creation.

Methods: Linking Table Creation

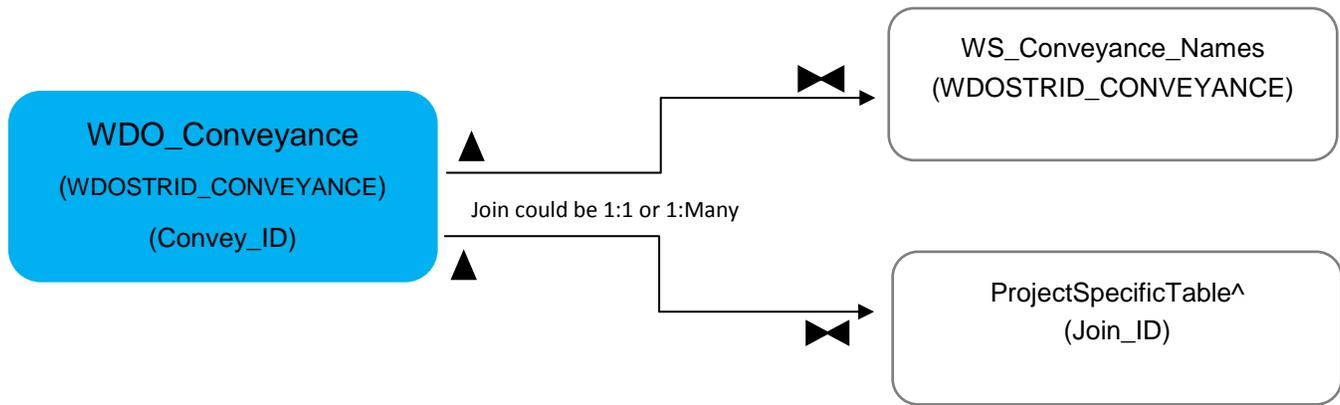
Linking tables are needed in Depth II and Depth III data layers to avoid data repetition. Linking tables can be reused from project to project but QA/QC is required when using data that has been passed on, due to changes over time to the permits.

All WWDO linking tables contain a similar set of four fields. Two of the four fields are from the Feature Class and the other two fields are from the water right. The Feature Class fields are the Unique ID of the feature and the primary name used for the feature. The water right fields are the water right Permit, CR or OR number and the supplied name from the water right for the feature. The names are used to QA/QC the link. Some features may have small changes in the name on the water right, or be completely different; these will need to be checked from different sources or during the QA/QC process if it is a reused data set. The linking tables are related to the feature via the features WDOSTRID. In addition, the linking tables are related to the water right via its WR_Number. See Appendices for more details on Structure Creation and Unique ID (WDOSTRID).

4.5.4 Feature Class Conveyance: Links, and Methods

WDO_Conveyance - Conveyances represent facilities designed to transport water from its source to the point of use and within the distribution system where applicable. GIS Features can be digitized or GPS'd in the field found in municipal "as built" plans or found on permit maps in the State Engineer's Office. The conveyance feature types can vary and include the following: pipelines, natural channels, canals, or ditches. See *Appendices for WDOSTRID and WDOSTRID_CONVEYANCE field creation details.*

Domains: **ConvType, HorizontalAccuracy and Seepage** (listed above)



^ This project specific table should be customized for your project. Add fields to this table needed for your project that are not part of the core dataset. Examples could include photo links, diversion records, current conditions, materials, field observations, etc.

4.5.4.1 Table WS_Conveyance_Names: Links and Methods

WS_Conveyance_Names - Contains additional or associated names for WDO Conveyances. Depending on data sources or water right permit information, different spelling and different names can be used for the same conveyance. This table connects to the feature class by the unique ID “WDOSTRID CONVEYANCE”, and should be used for QA/QC purposes only.

Methods: Conveyance Creation

One of the major datasets within the water systems are the conveyances, which include irrigation ditches, tributaries, major streams and pipelines. The conveyance can be any linear feature that transports water to a location from a water source. In addition to the data from previous WWDC projects, conveyance system features are available through the NHD, the SEO’s linen plats, as built plans, and water right permit maps. All of these sources should be used in conjunction with the latest aerial photos to map and attribute conveyance.

The digital linen plats (<https://sites.google.com/a/wyo.gov/seo/documents-data/linenplats>) are not horizontally accurate and can contain ditches that were permitted but never built. However they are good for naming features that are observable with aerial photos. The first page of each township map includes a general ditch map followed by surface water rights and finally groundwater rights.

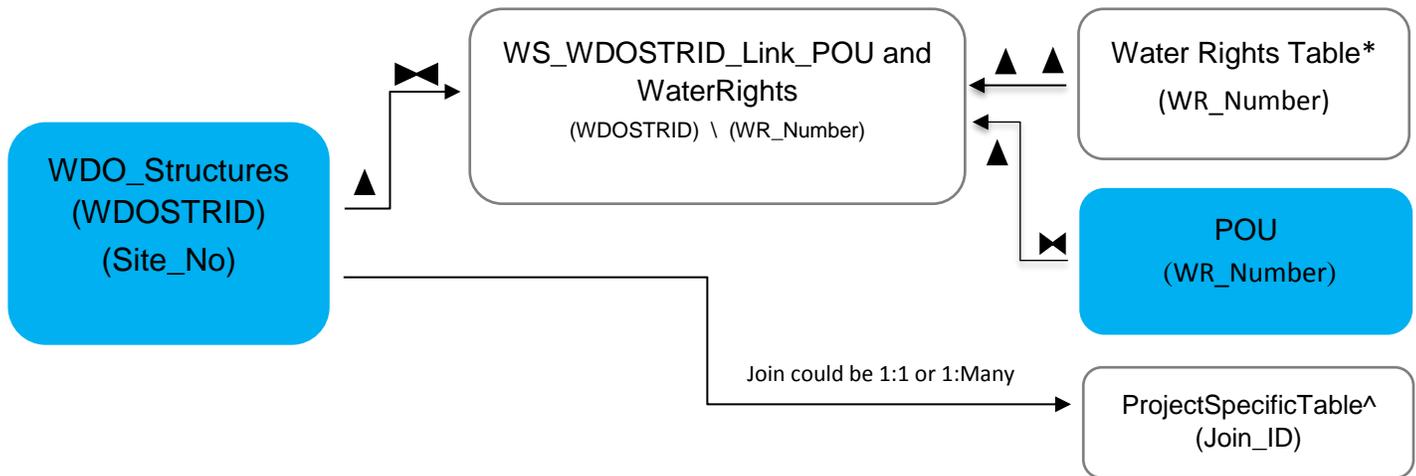
The most accurate source of conveyance mapping are the surveyed ditch maps available from the State Engineer’s Office Surface Water Division and petition maps from the Board of Control. These maps are often available digitally, but need to be georeferenced and features mapped into the GIS in order to be used.

4.5.5 Feature Class Structures: Links and Methods

WDO_Structures – these are water infrastructure point features that are part of irrigation, reservoir, and drinking water systems. Includes diversions, wells, meters, spillways, water storage tanks, and other important structures as determined by WWDO and project sponsors.

The **WDOSTRID** is used to link to SEO Water Rights and POU GIS features through the linking table **WS_WDOSTRID_link_POUandWaterRights**. **SITE_NO** is the unique ID of new or existing features (i.e. USGS Gauges) that link to project specific data, not part of the template datasets. This field is the unique ID for each feature created for an individual project. Site Number will be unique to each Project ID and users will have to pull data by Project ID to guarantee the ID remains unique.

Domains: **TypeStructure** and **HorizontalAccuracy**



*Not included in the geodatabase templates. The table is generated through the e-Permit conversion tool described in Sectifield observations, etc.

4.5.5.1 Linking Table **WS_WDOSTRID Link_POUandWaterRights**: Links and Methods

WS_WDOSTRID_link_POUandWaterRights – This linking table connects Structures to all the SEO water rights associated with the structure.

Methods: Linking Table Creation

Linking tables are needed in Depth II and Depth III data layers to avoid data repetition. Linking tables can be reused from project to project but QA/QC is required when using data that has been passed on, due to changes over time to the permits.

All WWDO linking tables contain a similar set of four fields. Two of the four fields are from the feature class and the other two fields are from the water right. The feature fields are the Unique ID of the feature and the primary name used for the feature. The water right fields are the water right permit, CR or OR number and the supplied name from the water right for the feature. The names are used to QA/QC the link. Some features may have small changes in the name on the water right, or be completely different; these will need to be checked from different sources or during the QA/QC process if it is a reused data set. The linking tables are related to the feature via the features WDOSTRID. In addition, the linking tables are related to the water right via its WR_Number. See Appendices for more details on Structure Creation and Unique ID (WDOSTRID).

4.6 Assessment Feature Dataset

This dataset typically represents the current condition of the system or landscape being studied.

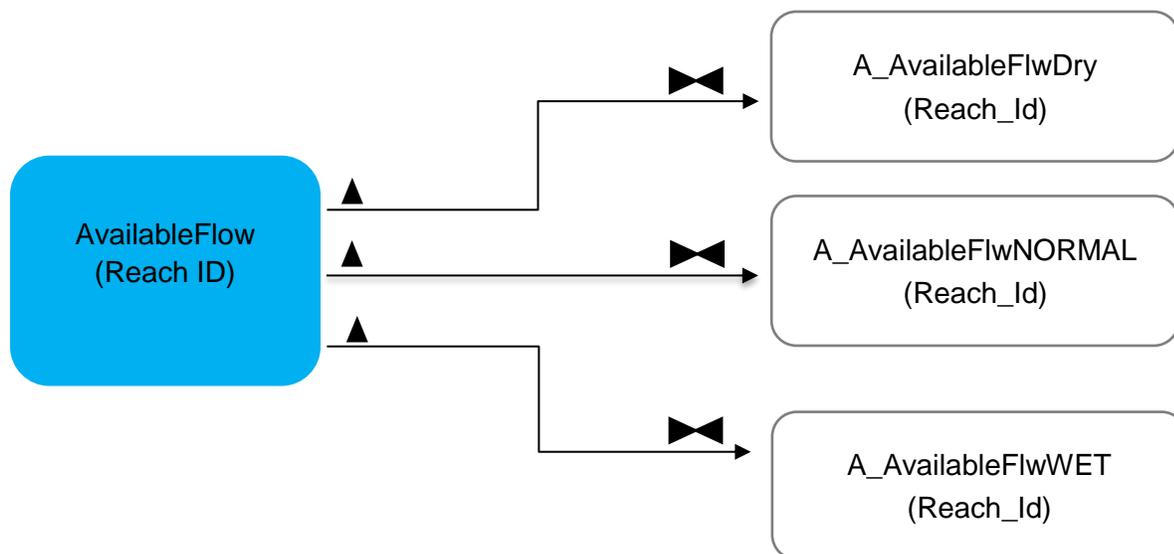
Dataset Usage: The Assessment Feature Dataset is ground assessment data used to inform reconnaissance and feasibility studies. Available flow is spatially represented by stream reaches with this dataset. On the ground feature sets include irrigated lands, upland water storage and Rosgen geomorphology.

- [-] Assessment
 - [+] AvailableFlow
 - [+] IrrigatedLands
 - [+] Rosgen_Class
 - [+] UplandWaterSources
 - [+] WaterUse_HUC
 - [+] A_AvailableFlwDry
 - [+] A_AvailableFlwNORMAL
 - [+] A_AvailableFlwWET
 - [+] A_WaterUse

4.6.1 Feature Class Available Flow: Links, and Methods

AvailableFlow – this feature class contains estimates of legally available water at a given stream location under a given hydrologic condition; wet, normal, and dry. Existing sources include information found in the WWDC River Basin Plan water availability estimates.

Domains: **NodeType** and **HorizontalAccuracy**



4.6.1.1 Table A_AvailableFlw[Dry, NORMAL, WET]: Links, Methods

A_AvailableFlw - “Available water” at a reach terminus is defined as the minimum of the physically available flow at that point, and “available water” at all downstream reaches. These downstream demands fall into three general categories: diversions, instream flow constraints, and compact/decre constraints. These calculations

were made on a monthly basis, and annual availability is computed as the sum of monthly availabilities. All units of water are in acre-feet.

4.6.2 Feature Class Irrigated Lands: Attributes, Links, and Methods

IrrigatedLands – this feature class contains lands intentionally irrigated in a given year. Irrigated lands are categorized based on irrigation status and the delivery system type used to serve these lands. Common sources used to derive these data include: WWDC - River Basin Plans, NAIP – NDVI, Landsat 8, SEO, and discussions with water users. Ancillary data include water right Point of Use data and riparian areas.

Domains: **IrrMethod**, **IrrStatus** and **HorizontalAccuracy**

Methods: Irrigated Lands Creation

The fundamental criterion used in the identification of irrigated lands is as follows: “irrigated land is all land that can be identified as receiving water induced by the work of man.” This interpretation is consistent with that used in the Upper Colorado River Compact and the North Platte River Decree (O’Grady, et al., Green River Basin Plan Technical Memorandum, 2000).

Previously delineated irrigated lands should be used as a foundation for current mapping. The best sources are the original WWDC River Basin Plans, WWDC Irrigation District Master Plans, and WWDC Dam and Reservoir Plans. Remotely sensed imagery from Landsat or similar resolution data sources is recommended if it characterizes the entire irrigation season and not just a single day in the season. The Irrigation Status attribute should be utilized to code current state of irrigation, as follows:

A - Full service irrigation (receives a full water supply);

B - Partial service irrigation (receives a reduced water supply due to limited water availability or the inability to provide complete field coverage);

C - Incidental irrigation or subirrigation (beneficial use resulting from incidental irrigation such as ditch seepage to areas below a canal);

E - Idle irrigation (lands not currently receiving water, due to nonfunctional delivery facilities or inadequate water);

H - Minor beneficial use (lands that receive some beneficial use on occasion such as lands served by "kick-out" ditches on ephemeral streams)

AB – Full and partial mix of irrigation within a single polygon

Additional ancillary sources include place of use (POU) mapping of irrigation permits. This helps target areas that are intentionally irrigated from those that may be wild vegetation. This document describes methods used to map the POU using e-Permit data. Riparian areas of non-cultivated vegetation cover should not be included in the irrigated lands layer. These areas can be eliminated using land cover datasets (National Land Cover Dataset,

Landfire, etc.), aerial photos, or previously delineated riparian areas from local sources. Remotely sensed imagery from Landsat or similar resolution imagery are also used to derive irrigated lands.

It is commonly recognized that all lands capable of being irrigated are not always irrigated in a given year. A number of factors influence the actual farming and irrigation practices in a given year resulting in greater or fewer acres actually being irrigated. These factors include the availability of water, local, regional and global economic conditions, severe weather, and individual decisions each landowner makes with respect to the use of his/her land in a given year.

4.6.3 Feature Class Rosgen Class: Links, and Methods

Rosgen_Class – Geomorphic analysis of perennial streams, classified according to the Rosgen system. Rosgen analysis should be snapped to the NHD flowline.

Domains: **RosgType**, **RiparianVeg** and **HorizontalAccuracy**

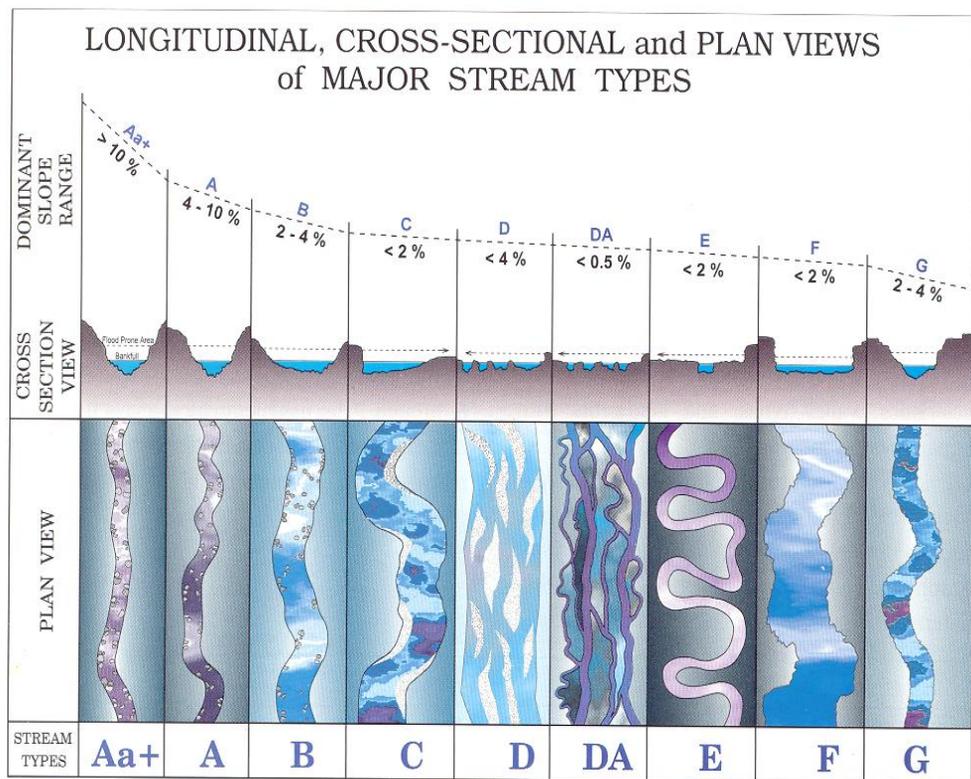
Methods: Rosgen Creation

Methods as modified from the Upper North Platte Watershed Study, Anderson Consulting Engineering, Inc. (2015):

The streams evaluated are divided into reaches based upon definable geographic factors (e.g. confluences with tributaries, major road crossings, etc.) or where their geomorphic character displayed changes. Each reach is evaluated in light of the characteristics required at the Level I classification. These parameters are channel slope, channel shape, channel patterns, and valley morphology.

The Level I classification effort is conducted primarily using existing

information incorporated into the project GIS. Several analytical tools can be integrated into the GIS to allow the evaluation of various geomorphic parameters. Because the digital elevation model is limited to a 10-meter grid, elevations and subsequent slope calculations are approximate. Stream alignments should be digitized using aerial photography, representing the best available estimate of current channel alignment.



MAJOR STREAM TYPES WITHIN THE ROSGEN CLASSIFICATION SYSTEM (ROSGEN, 1996)

The purpose of the Level I geomorphic classification is to provide an inventory of the study area's overall stream morphology, character, and condition. It is intended to serve as an initial assessment for use in more detailed assessments and to determine the location and approximate percentage of stream types within the basin. The results of the Level I classification can be integrated directly into the project Geographic Information System (GIS) providing a graphical "snapshot" of the basin. Based upon this initial effort, potential stream reference reaches can be identified for further study in Level II classification efforts. The end product of the Level I classification is the determination of the major stream types, A through G.

This figure shows the major stream types within the Rosgen Classification System along with their relative locations within a typical watershed. Brief descriptions of the stream classification are presented in the domain **RosgType**.

4.6.4 Feature Class Upland Water Sources: Links, and Methods

UplandWaterSources – this feature class contains existing conditions of springs, stock wells, stock tanks, or small ponds/lakes/reservoirs. Common sources used to derive these data include: SEO e-Permit (surface water stock use and groundwater wells), Wyoming State Geological Survey inventory of springs, and discussions with water users. Ancillary data include aerial photos.

Domains: **Upland_Type**, **Status**, **RiparianVeg** and **HorizontalAccuracy**

Methods: Upland Water Creation

Typical upland water sources include reservoirs, developed springs, and stock tanks. This includes all water sources utilized by livestock and/or wildlife throughout the year. Mapping of existing water sources provides valuable information for the completion of watershed management plans and also aids in determining placement of new water sources.

Use multiple years of aerial imagery to evaluate reservoir conditions by overlaying maps of reservoir sites and use years that provide the highest resolution aerial photography available. This is done in order to more accurately determine the status of each reservoir over time and reduce error as much as possible due to dry or wet water years. Reservoirs can then be classified into three categories based on functionality.

Functional –Reservoirs that contain water in multiple years of photography or show no signs of physical breaches or sedimentation are determined to be functional.

Non-Functional – Reservoirs that show apparent signs of physical breach or are visibly filled with sediment are determined to be non-functional.

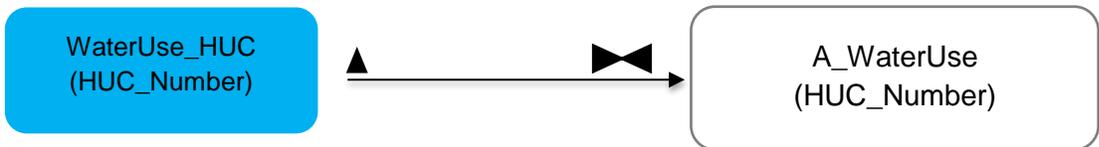
Potential - Reservoirs that contain water in one year of photography or show no visible signs of damage are determined to be potential water sources.

4.6.5 Feature Class Water Use_HUC: Links, and Methods

WaterUse_HUC – This feature class is the NHD Hydrologic Unit Code (HUC) for the area in which the study was conducted. Data tables are linked to this HUC by the NHD HUC number. This feature class represents water

use within a study area. The area of analysis should coincide with a NHD Hydrologic Unit Code (HUC). The HUC code for which the study was conducted is included in the attributes. HUC_Number is the linking field to A_WaterSupplies table.

Domains: **DryWetAverage**

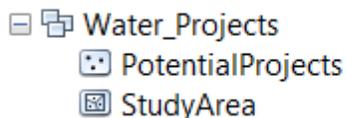


4.6.5.1 Table A_WaterUse: Links and Methods

A_WaterUse - this table includes current consumptive water use by watershed hydrologic unit code (HUC). It links back to Water Use_HUC by NHD HUC_Number. the table contains details on water use by type in acre-feet. Sources are derived from WWDC River Basin Plans and SEO data.

4.7 Water Projects Feature Dataset

The Water Projects Feature dataset includes the study area boundaries for potential projects, the existing projects that are under construction or completed, and the individual study results of potential projects that are recommended to develop additional water resources.



Dataset Usage: The Water Projects Feature Dataset allows users to query the locations of past studies, current or completed water projects and potential projects that were identified in the study area. The end user will also be able to query the information to identify how much funding is needed to complete the potential projects.

4.7.1 Feature Class Study Area: Links, and Methods

StudyArea – The study area boundary is required by each WWDC commissioned project. Study areas can be as large as river basins or as small as irrigation districts or municipalities.

4.7.2 Feature Class Existing Projects: Links, and Methods (updated and maintained internally by WWDO)

ExistingProjects – this feature class contains existing projects that fall underneath the WWDC funding. The projects included within this feature class should be actively funded projects or projects that have reached completion.

Domains: **PrjType, WaterType and HorizontalAccuracy**

4.7.3 Feature Class Potential Projects: Links, and Methods

PotentialProjects – this feature class contains potential projects developed as a result of Level I and Level II studies. An entire project can be represented by a single point. If the geographic extent of the project is large, place a GDBC at the start of the project or in the center of the study area.

Domains: **PrjType**, **WaterType** and **HorizontalAccuracy**

Appendices

[Appendix A: e-Permit Water Rights Search Guidelines provided by State Engineer's Office \(2017\)](#)

[Appendix B. Wyoming Water Divisions and Water Districts Map](#)

[Appendix C. Unique ID \(WDOSTRID\) Creation](#)

[Appendix D. Domain Values and Descriptions](#)

[Appendix E. References](#)

Appendix A: e-Permit Water Rights Search Guidelines provided by State Engineer's Office (2017)

Section A: Brief background on water rights in Wyoming

Wyoming water law dates back to territorial days and is based on the doctrine of prior appropriation. Under this doctrine, the first person to put the water to beneficial use has the first right, meaning, "first in time is first in right." Therefore, water rights in Wyoming are regulated by priority date.

Surface water

Surface water rights are assigned a specific flow rate of water at the headgate; this is typically 1 cubic foot per second (cfs) per 70 acres of irrigated land. Permits are issued for: 1) diverting water through ditches or pipelines, 2) storage in reservoirs, 3) enlargements to existing ditch or storage facilities, 4) instream flow purposes, 5) temporary industrial water hauls, and 6) weather modification.

For surface water rights, an applicant obtains a permit from the State Engineer and then proceeds to establish the water right by applying the water to beneficial use in accordance with the terms of the permit. A proof of appropriation is submitted to the State Board of Control to initiate adjudication procedures in accordance with Wyoming statutes and state regulations.

Groundwater

Groundwater rights are assigned an instantaneous volumetric rate in gallons per minute (gpm) and an annual volumetric quantity in acre-feet (acft). Groundwater developments include (to name a few): water wells, springs for domestic and stock watering use (for 25 gpm or less), geothermal developments, certain excavations developed during mining and/or construction activities, and for coalbed methane extraction activities.

The use of groundwater is not administered in exactly the same manner as is the use of surface water. Prior to commencement of construction of a groundwater development, a permit to appropriate groundwater must be obtained from the State Engineer. Upon completion of construction, application of the water to beneficial use, and submission of proper documents, a field inspection is conducted by Groundwater personnel and a proof is presented to the State Board of Control for adjudication. Not all groundwater permits are required to be adjudicated; domestic, stock, test and temporary use permits are exempt.

Adjudications and changes

The State Board of Control is a quasi-judicial body with sole jurisdiction over adjudication, administration and amendments of water rights in Wyoming. The adjudication procedure involves a field inspection of the water right to ensure that the water is being put to a beneficial use as specified under the permit. Amendments or corrections of unadjudicated permits are generally accomplished by petition to the State Engineer. For more information about Board of Control documentation associated with the status of a water right, see [Section C](#).

Section B: Water right data sources

Bulk SEO permit data can be downloaded electronically from three sources: Tab Books, e-Permit and scanned linen plat maps.

Tab Books

Tab Books are a tabulated catalog of adjudicated surface and groundwater rights (and unadjudicated stock reservoirs) organized by SEO Division. Surface water rights are shown under the heading of the stream from which a diversion is made (according to the best information available). Groundwater rights are organized by SEO District and county.

e-Permit

Water right data can also be obtained online via the SEO's web-based e-Permit database (<http://seoweb.wyo.gov/e-Permit/Common/Login.aspx>). This relational database of existing permits displays information based on filter search parameters that can display data affiliated with a permit's Point of Diversion (POD) and data affiliated with a permit's Point of Use (POU).

Linen Plats

Information from linen plats represent indexed adjudicated water rights that may be useful for general reference of ditch names and locations. These maps are organized by township and show adjudicated records and permitted irrigation acreages by section. The first page of each Township map includes a general ditch map followed by surface water rights and finally groundwater rights. Scanned copies are available on the SEO website (<https://sites.google.com/a/wyo.gov/seo/documents-data/linenplats>). It is important to note that these scans should be considered provisional data products and subject to revision because they are continuously updated as new adjudications occur.

Section C: Water right nomenclature

Documentation

See [Section F](#) for discussion about how to interpret key data fields associated with this documentation for large-scale data analysis.

- Permit number = The unique identifier assigned to a water right.
- Certificate of Appropriation (CR) = The official Board of Control document which provides all pertinent adjudication information for a water right.
- Order Record (OR) = These Board of Control documents are created for new adjudications and petition actions that seek to change or amend an adjudicated water right. ORs are not available on e-Permit at this time (although a few are used when no CR is available to attach other Board of Control documents).
- Amended Certificate = These are certificates issued on an order record precipitated by a petition to amend or replace an original CR. They are also issued for appropriations and court decrees that were never issued an original certificate. e-Permit searches performed for proof documents will direct users to the CR or OR, not to the proof document itself.
- Proof = Documents used to verify the beneficial use of water within the terms of the permit as part of the adjudication process.

Status

Water right status is important for large-scale data analysis because some inactive records may need to be removed from a dataset (e.g. – canceled permits) and/or some data may need to be reconciled to remove duplication. While point of diversion (POD) status will generally be the same as point of use (POU) status in an e-Permit data download, there are several important distinctions to note that are discussed in this section.

Point of Diversion (POD) status

Status descriptions for water right data in an e-Permit POD data download are described below. POD records with a status that generally should be removed from a dataset are marked below with an asterisk "*" (see [Section E](#) for discussion about data sorting).

- Fully Adjudicated = A determination by the SEO Board of Control that water has been and is being beneficially applied to the land to the extent and means set out in the permit. The adjudication process culminates in the issuance of a Certificate of Appropriation (reflected as a Certificate Record (CR). See [Section D](#) for how to interpret certificate record data fields.
- Partially adjudicated = A portion of the water right under a permit has been put to beneficial use and verified through the adjudication process. This applies to surface water permits only.
- Complete = All permit documentation has been submitted and processed by the SEO; this usually represents a current permit. This does *not* necessarily represent a permit that has been adjudicated.
- Incomplete = A permit has been issued but the permit has not been adjudicated. A water right is considered incomplete until all required notices are received in an acceptable form.

- Unadjudicated = This status is only used for groundwater permits where adjudication is required (domestic and stock are exempt) and for which all documentation has been received pending a field inspection.
- Abandoned* = An adjudicated permit for surface water or groundwater that has either 1) not been used for five successive years (when water is available to satisfy the right) and has been submitted and verified through the statutory procedure to be declared abandoned, or 2) the water right holder has requested abandonment of the water right. This status will only be seen on a record associated with a Certificate Record and not on a permit record, except on a well permit.
- Canceled* = A permit that has been canceled prior to adjudication.
- Expired* = A permit that has exceeded the time limit for completion therefore active status has been revoked. (These types of permits may be reinstated through a specific SEO process).

Point of Use (POU) status

There are some differences in the meaning of a water right's status under a POU dataset. The information can be found under the column header "POUStatus" in the POU dataset. Adjudicated POU records will be listed as "Adjudicated" (as opposed to "fully adjudicated" in a POD download). Differences also apply to expired, eliminated and abandoned water right statuses associated with POU records. As such, these records should be removed from a POU dataset:

- Abandoned – This represents a *portion* of a permit that has been abandoned and confirmed through statutory requirements under Board of Control abandonment procedures.
- Expired – Some records correspond with permits that have been partially adjudicated (see discussion on irrigated acreage in [Section G](#)).
- Eliminated – This represents a *portion* of a permit that has been eliminated through a Board of Control action.

Supply type

- Original supply = The first water supply for an irrigation water right. In most cases, surface water original supply is limited by statute to 1 cfs per 70 acres at any given time; groundwater supply is limited to what the well can produce.
- Secondary supply = Surface water stored in a reservoir with documentation that attaches a reservoir permit to specific lands. Records for this supply type receive the same priority date of the reservoir to which it is attached.
- Supplemental supply = Surface water applied to lands for which a surface water appropriation already exists. The total amount of water under both the original and supplemental supply shall not exceed 1 cfs per 70 acres at any given time.
- Additional supply = Groundwater applied to lands for which an original groundwater and/or surface water appropriation already exists. Additional supply only applies to water rights with irrigation as a beneficial use.

Territorial water rights

Another special category of water rights to consider are territorial water rights. Prior to statehood in 1890, a water right could be established by a procedure predicated on the use of water and the filing of a claim with territorial officials. Water rights with priority dates before 1890 are termed “territorial” water rights.

The water right numbers displayed in e-Permit for a territorial water right actually represent its proof number because permits were not issued prior to statehood. Additionally, territorial water rights are located based on Township/Range/Section (PLSS) information only (i.e.- not with latitude/longitude coordinates) unless the certificate was part of a Board of Control petition. Typically there is only a map to represent the POD or POU when there has been a petition involving these water rights.

Section D: Overview of e-Permit data fields

The following attributes are key features that are important for large-scale data analysis. Detailed e-Permit water right search instructions can be found on the SEO website (<http://seo.wyo.gov/regulations-instructions>). Note that POD and POU datasets provide information that represent different attributes of a water right; each requires a slightly different search method as described in [Section E](#).

Excel column headers

The e-Permit datasets are downloaded into an Excel file. The attributes of primary concern for large-scale data analysis are:

- Permit Number = Listed under “WR Number” column
- Certificate or Order Record Number = Listed under “WR Number” column
- Point of Diversion = Coordinates captured in the “Latitude” and “Longitude” columns; PLSS also available under “Township/Range/Section/QR” columns from a point of diversion dataset download.
 - For older groundwater permits, latitude and longitude were automatically generated by the e-Permit system and represent the centroid of the Quarter-Quarter.
 - For all groundwater permits granted on or after April 1, 2006, GPS coordinates are required.
- Point of Use = PLSS available under “PLSS” and “Township/Range/Section/QR” columns; available only through a POU data download.
- Facility Name = Listed under “FacilityName”
- Permitted beneficial use = Listed under “Uses” column
- Appropriation = Listed under “Appropriation” column
 - For permits with uses other than irrigation, units are cfs (surface water) or gpm (groundwater).
 - For reservoir storage permits, units are in acre-feet (AF).
- Acreage = Listed under “Acres” column for irrigation water rights regardless of source type.
- Supply type = Listed under “SupplyType” column
- Capacity = Listed under “Total Capacity (AF/Yr)” and represents the total permitted capacity for a reservoir supply permit; available only through a POD data download.
 - It is best to disregard “Active/Inactive Capacity (AF)” or “Size of Reservoir (AF).” An explanation of these capacities can be found by consulting the scanned permit.

e-Permit syntax

The most common categories that are important for large-scale data analysis are listed below:

- Permit Prefixes (i.e.- X[permit number].#X)
 - P = Permit
 - T = Territorial water right
 - C = Court awarded water right
 - Y = Federal award (includes federal reserved water rights)
 - CR = Certificate Record
 - OR = Order Record
- Permit Suffixes (i.e.- X[permit number].#X)
 - D = Ditch
 - E = Enlargement
 - R = Reservoir
 - S = Stock Reservoir
 - F = Instream Flow
 - W = Well Permit
 - - = Unknown (usually with territorial water rights)
 - P = Stock or domestic groundwater well with a priority date prior to May 24, 1969
 - G = Well Registration
 - C = Well Statement of Claim
- Certificate Records
 - “CR CC##/###” for ditch certificates
 - “CR CR##/###” for reservoir certificates
 - “CR [CA or CB]##/###” for other surface water permits, typically with territorial water rights
 - CR UW##/### for groundwater well certificates
- Beneficial Uses
 - A guide to e-Permit syntax is available for reference on the SEO website under the “Home” dropdown menu (<http://seo.wyo.gov/home>).

Section E: How to download large-scale water rights data

There are two approaches to downloading large quantities of water rights data. The first approach is using the Excel-formatted SEO Tabulation of Adjudicated Water Rights (“Tab Book”) data from e-Permit. The second approach is a full download of all water rights (regardless of status) from e-Permit.

Electronic Tab Book data

When logged into e-Permit, go to the “Reports” tab and select Board of Control under the “Type” drop-down menu.

Because the Tab Book data represent adjudicated water rights, it is safe to assume that the appropriation, acreage, location of the point of diversion, and CR numbers represent accurate permit data. The CRs from this list correspond directly to a permit number on the same row (which is not readily apparent from an e-Permit data download). Below is an example of a raw data download from the Division 4 Surface Water Tab Book:

| A | B | C | D | E | F | G | H | I | J | |
|----|---|--|------------------------------------|------------|---------------------|-----------|--------|-------------------------|-----------|---------|
| 1 | | | | | | | | | | |
| 2 | Tabulation of Adjudicated Water Rights of the State of Wyoming- Water Division Number IV, Surface Water June 2016 | | | | | | | | | |
| 3 | Permit No. | Facility Name | Appropriator | Priority | Use | C.F.S./AF | Acres | HG LOC | Proof No. | CR NO. |
| 4 | T8599.0- | MYERS IRRIGATING DITCH | MYERS LAND AND LIVESTOCK COMPANY; | 05/01/1862 | IRR_SW | 4.000 | 280 | 014N - 119W | 8599 | CR CC2: |
| 5 | T8600.0- | PIPE LINE STEAM PUMP PLANT AND UNION PACIFIC RAILROAD COMPANY; | | 12/31/1869 | IRR_SW, RAI | 0.600 | 4.5 | 013N - 120W | 8600 | CR CC2: |
| 6 | | (Point of diversion and means of conveyance changed to the Evanston Pipeline, 31-14-119, April 18, 1934. Point of diversion and means of conveyance changed to 12-13-20. Pt | | | | | | | | |
| 7 | T8601.0- | BARTLETT IRRIGATING DITCH ACT CI SARAH FADDIS; | | 10/01/1871 | IRR_SW | 0.500 | 35 | 016N - 121W | 8601 | CR CC2: |
| 8 | | (Point of diversion and means of conveyance changed from 25-16-121, to the Chapman Canal, 36-16-121, February 15, 1990.) | | | | | | | | |
| 9 | T8602.0- | BARTLETT IRRIGATING DITCH ACT CI ENOCH TURNER J; | | 10/01/1871 | IRR_SW | 0.940 | 66 | 016N - 121W | 8602 | CR CC2: |
| 10 | | (Point of diversion and means of conveyance changed from 25-16-121, to the Chapman Canal, 36-16-121, February 15, 1990.) | | | | | | | | |
| 11 | T8603.0- | S. P. DITCH ACT JOHN SIMS DITCH | ROCKY MOUNTAIN COAL AND IRON COMF | 12/07/1871 | IRR_SW | 2.280 | 160 | 015N - 120W | 8603 | CR CC2: |
| 12 | | (Point of diversion changed to 7-15-120, April 16, 1930. Point of diversion and means of conveyances changed to the John Sims Ditch, diverting in the same section, township & | | | | | | | | |
| 13 | T8604.0- | KNODER DITCH | MYERS LAND AND LIVE STOCK COMPANY; | 12/31/1872 | IRR_SW | 2.780 | 195 | 013N - 120W | 8604 | CR CC2: |
| 14 | T8605.0- | BEAR RIVER CANAL | DAVID REES; | 12/31/1874 | DOM_SW, IRR_SW, STO | 22.980 | 1609 | 018N - 120W | 8605 | CR CC2: |
| 15 | | (Includes irrigation of lands in Utah.) | | | | | | | | |
| 16 | T8608.0- | EVANSTON WATER DITCH | BEAR RIVER DEVELOPMENT COMPANY; | 03/28/1875 | IRR_SW | 7.160 | 501.19 | 014N - 120W - 01 - SESE | CR CC2: | |
| 17 | | (Also 4 c.f.s. for municipal purposes for Town of Evanston. This 4 c.f.s. is evidently a duplication of the 4 c.f.s. adjudicated under Evanston Water Supply Ditch, which was origin | | | | | | | | |

Some pointers to improve efficiency when sorting Tab Book data in Excel include:

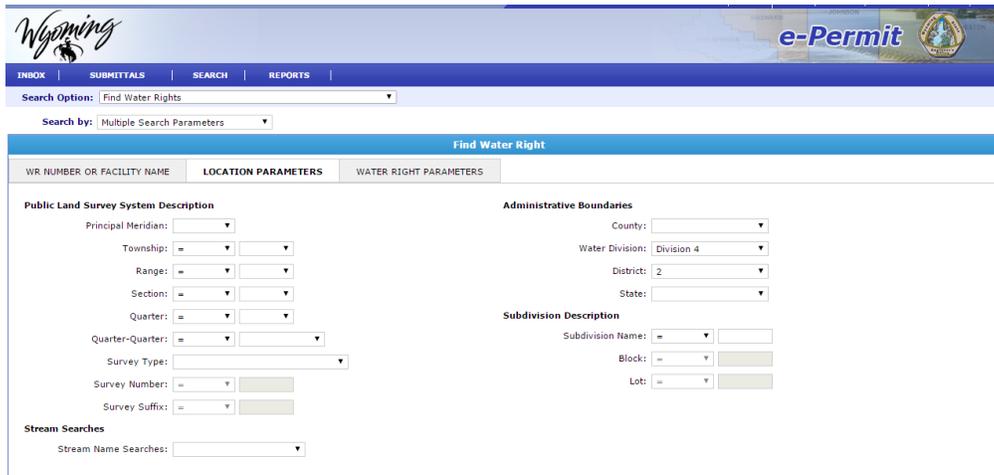
1. Sort water right records into categories of basins/tributaries of interest.
2. Combine all data for a water right into one row (i.e. create new attribute fields for description and stream source) and filter by attribute.
3. Download the tabulation book in the Excel format that does not include comments for easier data management.

Data from e-Permit

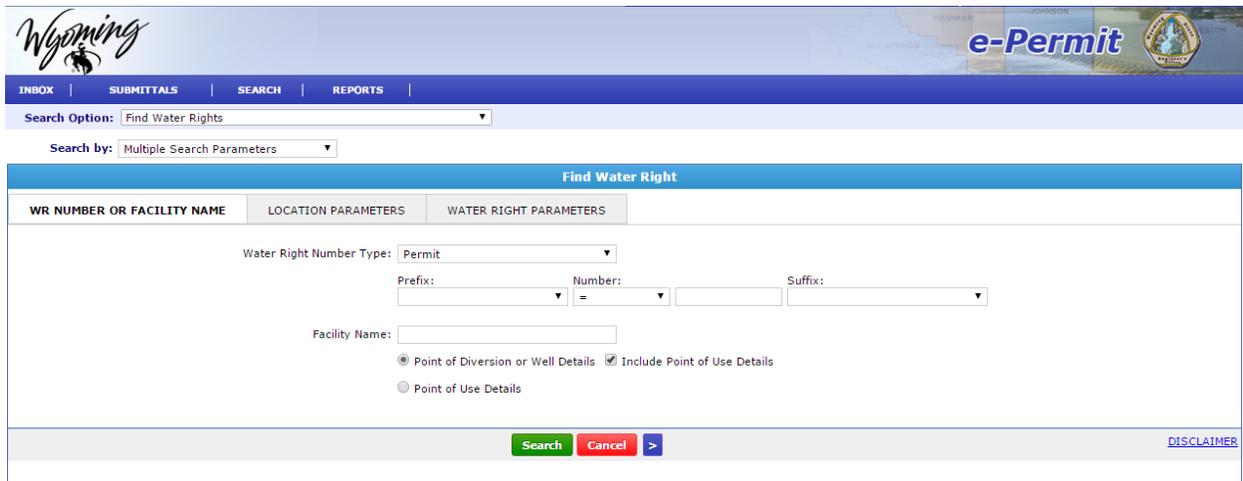
At this time, the e-Permit database is limited to producing 10,000 records per query. Since basin-wide bulk data queries may result in many more than 10,000 records, the following steps outline useful parameters to follow to ensure as many records as possible are captured. Do not click “Search” until all of the following five steps are completed.

Step 1: Under “Location Parameters” tab -- Indicate the appropriate SEO Division and Districts of interest. A key to SEO Division and District boundaries can be found on the SEO’s Board of Control web page: <http://seo.wyo.gov/agency-divisions/board-of-control>. The data can also be searched by Stream Name, but since

there are many duplicate stream source names throughout the state, this should only be done if a Water Division is also selected. A screenshot of what a location parameters query looks like follows:



Step 2: Under “WR Number or Facility Name” tab – After selecting location parameters, Select “Permit” under Water Right Number Type and check boxes for both “Point of Diversion or Well Details” and “Include Point of Use Details.”



Step 3: (optional): Under “Water Right Parameters”, select the Diversion Type, Water Right Status, or Primary Beneficial Use of water right.

Step 4: Click the Search button. This will produce a table showing the water right permits and how many were found.

Step 5: To generate the report click on “Export Excel” to obtain the data in Excel format. The first tab will display the point of diversion details:

| WR# | WR Num | Priority | Da | Priority | Te | Summary | Company | First Name | Last Name | Facility No | Uses | Twn | Rng | Sec | Qtr-Qtr | Survey Ty | Total Flov | Total dep | Static | Wat | Well | Log | Str | |
|-----|---------|-----------|-----------|----------|-----------|---------|---------|------------|------------|-------------|-------------|------|------|-----|----------|-----------|------------|------------|-----------|--------|------|------|-----|-----|
| 1 | WRP0D1C | WR Num | Priority | Da | Priority | Te | Summary | Company | First Name | Last Name | Facility No | Uses | Twn | Rng | Sec | Qtr-Qtr | Survey Ty | Total Flov | Total dep | Static | Wat | Well | Log | Str |
| 2 | 869 | P1007.0W | 08/07/196 | | Cancelled | | | MATT & M | FAILONI | FAILONI # | IRR_GW | 022N | 118W | 29 | NE1/4NE1 | | 700 | | | | | | | |
| 3 | 983 | P100914.0 | 11/13/199 | | Complete | | | DEAN J | NELSON | BLUE SPRL | DOM_GW | 026N | 119W | 22 | NW1/4SE1 | | 25 | 70.00 | | | 40 | | | |

The second tab will display the point of use details:

| WRID | CertNum | PermitNum | PriorityDate | PriorityText | Summary | FullName | Company | FirstName | LastName | FacilityName | Uses | PLSS | POUPM | POUTNS | POURNG | POUSEC | POUQTR | PO |
|------|---------|-----------|--------------|--------------|-----------|----------|---------|-----------|----------|--------------|--------|------------|-------|--------|--------|--------|--------|----|
| 888 | | P1007.0W | 08/07/196 | | Cancelled | MATT & I | | MATT & M | FAILONI | FAILONI # | IRR_GW | 06 022N 06 | 022N | 118W | 33 | NW | SW | |
| 888 | | P1007.0W | 08/07/196 | | Cancelled | MATT & I | | MATT & M | FAILONI | FAILONI # | IRR_GW | 06 022N 06 | 022N | 118W | 33 | NW | SW | |

Section F: Reconciling water right data

The following section describes how to initiate data reconciliation with the following goals:

- **Step 1:** Capture the most up-to-date information for a water right;
- **Step 2:** Identify and remove duplicate records; and
- **Step 3:** Improve data analysis efficiency.

Step 1: Compare Tab Book fully adjudicated water rights with e-Permit records and remove any duplicates.

The best place to start reconciling e-Permit data is to compare Tab Book adjudicated water right information with e-Permit data. This is because if a water right has been proofed through the adjudication process, the most accurate information will be captured in the CR record (not necessarily in the permit record).

To help visualize how data are displayed differently, below is a screenshot of the data fields for two different permits from an electronic Tab Book download (in gray), a POD e-Permit download (in blue) and a POU e-Permit download (in green).

| TAB BOOK DOWNLOAD | | | | | | | | | | | | | | | | | |
|---|--------------------|---------------|-------------------|-------------------|------------|----------|------------|-----------|--------------|--------------|--------|------------|-------|-----------|--------|--------------------------------------|--|
| Tabulation of Adjudicated Water Rights of the State of Wyoming- Water Division Number IV, Surface Water June 2016 | | | | | | | | | | | | | | | | | |
| Permit No. | Facility Name | Appropriator | Priority | Use | C.F.S/AF | Acres | HG LOC | Proof No. | CR NO. | | | | | | | | |
| P2193.0D | LOWHAM NO. 2 DITCH | ELIZA LOWHAM; | 06/19/1899 | IRR_SW | 0.780 | 55 | 012N - 115 | 8878 | CR CC28/267 | | | | | | | | |
| (Adjudicated as from Branch of Mill Creek.) | | | | | | | | | | | | | | | | | |
| P2194.0D | LOWHAM NO. 3 DITCH | ELIZA LOWHAM; | 06/19/1899 | IRR_SW | 0.640 | 45 | 012N - 115 | 8879 | CR CC28/268 | | | | | | | | |
| (Adjudicated as from Branch of Mill Creek.) | | | | | | | | | | | | | | | | | |
| ePERMIT POD SEARCH RESULTS | | | | | | | | | | | | | | | | | |
| WRPODID | WR Number | PriorityDate | PriorityText | Summary | WRStat | Company | FirstName | LastName | FacilityName | Uses | Twn | Rng | Sec | Qtr-Qtr | Survey | Total Flow(CFS)/ Appropriation (GPM) | |
| 631722 | P2193.0D | 06/19/1899 | 06/19/1899 | Fully Adjudicated | | | MICHAEL | LOWHAM | Lowham D | IRR_SW | 012N | 119W | 08 | NW1/4N | | 0.78 | |
| 5016059 | CR CC28/267 | 06/19/1899 | Fully Adjudicated | | | | ELIZA | LOWHAM | LOWHAM | IRR_SW | 012N | 119W | 07 | SE1/4NE A | | 0.78 | |
| 631737 | P2194.0D | 06/19/1899 | 06/19/1899 | Fully Adjudicated | | | MICHAEL | LOWHAM | Lowham D | IRR_SW | 012N | 119W | 06 | NW1/4S | | 0.64 | |
| 5016062 | CR CC28/268 | 06/19/1899 | 06/19/1899 | Fully Adjudicated | | | ELIZA | LOWHAM | LOWHAM | IRR_SW | 012N | 119W | 06 | NW1/4S A | | 0.64 | |
| ePERMIT POU SEARCH RESULTS | | | | | | | | | | | | | | | | | |
| WRID | CertNum | PermitNum | PriorityDate | PriorityText | Summary | FullName | Company | FirstName | LastName | FacilityName | Uses | PLSS | POUPM | POUTNS | ... | Acres | |
| 630261 | | P2193.0D | 06/19/1899 | 06/19/1899 | Fully Adju | MICHAEL | | MICHAEL | LOWHAM | Lowh | IRR_SW | 06 012N 06 | 012N | | 20 | | |
| 630261 | | P2193.0D | 06/19/1899 | 06/19/1899 | Fully Adju | MICHAEL | | MICHAEL | LOWHAM | Lowh | IRR_SW | 06 012N 06 | 012N | | 5 | | |
| 630261 | | P2193.0D | 06/19/1899 | 06/19/1899 | Fully Adju | MICHAEL | | MICHAEL | LOWHAM | Lowh | IRR_SW | 06 012N 06 | 012N | | 25 | | |
| 630261 | | P2193.0D | 06/19/1899 | 06/19/1899 | Fully Adju | MICHAEL | | MICHAEL | LOWHAM | Lowh | IRR_SW | 06 012N 06 | 012N | | 5 | | |
| 2503465 | CR CC28/267 | CR CC28/267 | 06/19/1899 | 06/19/1899 | Fully Adju | ELIZA LC | | ELIZA | LOWHAM | LOWH | IRR_SW | 06 012N 06 | 012N | | 20 | | |
| 2503465 | CR CC28/267 | CR CC28/267 | 06/19/1899 | 06/19/1899 | Fully Adju | ELIZA LC | | ELIZA | LOWHAM | LOWH | IRR_SW | 06 012N 06 | 012N | | 25 | | |
| 2503465 | CR CC28/267 | CR CC28/267 | 06/19/1899 | 06/19/1899 | Fully Adju | ELIZA LC | | ELIZA | LOWHAM | LOWH | IRR_SW | 06 012N 06 | 012N | | 5 | | |
| 2503465 | CR CC28/267 | CR CC28/267 | 06/19/1899 | 06/19/1899 | Fully Adju | ELIZA LC | | ELIZA | LOWHAM | LOWH | IRR_SW | 06 012N 06 | 012N | | 5 | | |
| 630275 | | P2194.0D | 06/19/1899 | 06/19/1899 | Fully Adju | MICHAEL | | MICHAEL | LOWHAM | Lowh | IRR_SW | 06 012N 06 | 012N | | 35 | | |
| 630275 | | P2194.0D | 06/19/1899 | 06/19/1899 | Fully Adju | MICHAEL | | MICHAEL | LOWHAM | Lowh | IRR_SW | 06 012N 06 | 012N | | 10 | | |
| 2503466 | CR CC28/268 | CR CC28/268 | 06/19/1899 | 06/19/1899 | Fully Adju | ELIZA LC | | ELIZA | LOWHAM | LOWH | IRR_SW | 06 012N 06 | 012N | | 10 | | |
| 2503466 | CR CC28/268 | CR CC28/268 | 06/19/1899 | 06/19/1899 | Fully Adju | ELIZA LC | | ELIZA | LOWHAM | LOWH | IRR_SW | 06 012N 06 | 012N | | 35 | | |

Given these differences, Tab Book permit number and CR number can be used as the first step to guide the reconciliation between permit number records and CR records. Since this will only apply to adjudicated water rights, it is best to use data from the CR rows and eliminate the corresponding permit record data. This step will remove the chances for double-counting total acreage (POU) or appropriation (POD) data. Be sure to retain

permit number and capture it somewhere in the CR record. Additionally, facility names/names of the applicants may not match up word-for-word; using CR data will be the way to capture the most up-to-date information.

To do this: After downloading from e-Permit, filter out “Fully Adjudicated” in the WR Status field. From the fully adjudicated records, delete any records with a WR Number that does NOT begin with “CR” or “OR”. These permits have been adjudicated and are duplicates of the Certificate Record. If any record is fully adjudicated, the Certificate Record information supersedes the permit.

Step 2: Remove inactive permit information from the e-Permit datasets

Retain records with the following POD status:

- *Fully adjudicated* – These permit records and corresponding CRs or ORs are already accounted for using Step 1.
- *Complete*
- *Incomplete*
- *Blank* – Water right status has not been captured in e-Permit; these should be considered active.
- *Unadjudicated* – This is old nomenclature for incomplete water rights; not many of these water rights will be in the system but if encountered, they should be considered active.
- *Partially adjudicated* – These records (surface water permits only) will still need to be manually reconciled to remove duplicates. This may require using e-Permit to view the scanned permit.

Discard the following water rights with these POD statuses:

- *Cancelled* -- Note that records with this status could be reinstated; for the purposes of analysis do not include them.
- *Abandoned* – Same as above.
- *Expired* – Same as above

The data from these fields represent the information removed from an adjudicated water right; the adjudicated portion will show up under a permit with status marked as “complete” (if verified by SEO staff) or “Fully adjudicated” (if awaiting verification). Note that technically this information could be reinstated at any time but for the purposes of analysis, do not include.

Step 3: Filter remaining e-Permit data

In the e-Permit dataset, there is no easy method to match CRs/ORs with the correct permits without manual verification. Below are ideas to help with sorting data. Some additional, general pointers are discussed in the next section.

- *Additional filtering* -- Some records could match up by additional parameters (such as priority date, facility name, appropriator name, beneficial use, etc.). Filtering data to match these attributes could help find duplicate records.

- *Diversion duplication* -- The POU dataset contains a single record for each Township/Section/Division. The “Appropriation” Field duplicates the entire diversion amount for each record and should not be used for analysis.
- *Domestic and stock water permits* – Adjudication is not required by statute for permits for these types of uses; many basins have a large number of these permits, therefore a separate data analysis may be beneficial.
- *Determining changes*– If changes have occurred since the last dataset was downloaded from e-Permit, under “Water Right Parameters” select “>” in “Last Edit Date” and input the date of previous download. The search results will only return records that have been modified after the last edit date.

Section G: Other important considerations

Wyoming's water rights system inherently presents complexities when it comes to interpreting permit information. This section describes some important considerations while reviewing water rights data. For structures with complex operations or several associated permits, or for permits with many changes or little to no available data, it may be necessary to consult with SEO technical staff.

Enlargements

- An enlargement water right must be obtained when a permitted facility is used to convey water from the same source to a new area(s) of use. Enlargements are also used to add a new use to an existing water right (not including reservoirs); groundwater permits can be enlarged for additional use types, point of use locations, volumetric quantity and flow rate.
- Enlargements will result in multiple POD e-Permit records that will overlap for the same point of diversion or well. More information on enlargement regulations is available on the SEO website: (<https://sites.google.com/a/wyo.gov/seo/applications-forms>).

Verification

- The SEO is in the process of verifying permit documentation in e-Permit for all of its surface water records and adjudicated groundwater rights. Due to the large volume of permit records on file with the SEO, not all have been through the verification process. Surface water records for ditches and all reservoirs have been verified, whereas enlargements are in process as of May 2019.
- Accordingly, the permit status indicated under the POD or POU record may vary depending on whether or not permit documentation has been verified. Generally speaking once a permit or CR is verified by SEO staff, POU data that have been eliminated or abandoned will be deleted from the dataset. Also, once a POU is adjudicated, it will be deleted from the Permit and only show up on the CR.

Facility names

- In some cases facility names may not be unique and therefore may not match a facility location.
- Additionally, these structures may have been recorded at different locations but stored under the same Facility Name, or may represent laterals off of the facility. If this occurs, it will be necessary to double check e-Permit maps and/or consult with SEO staff to reconcile.

Supply type

- *Secondary supply permits* – Since this type of permit is what ties the original reservoir supply permit to the land, the POU appropriation indicates acreage. Secondary permits are not required to include specific areas of irrigation. POU's may overlap for secondary permits if the associated acreage is also served by an original or supplemental supply permit.
- *Supplemental supply permits* – The POU will and should overlap for supplemental permits.

Water right status

- *Abandoned or cancelled permits* – Since some surface water permits may be reinstated over time, it may be of use to develop an approach and criteria for cataloguing that includes abandoned or cancelled permits in the dataset. Potential criteria may include consideration of permit date, a defined permitted acreage/water right threshold, water rights for lands without a current water right, and/or the length of time in which the water right was last put to beneficial use.

Irrigated acreage

- *For adjudicated permits* – The most up-to-date number of acres irrigated is captured under a permit's certificate record. Be aware that petitions often modify existing appropriations, so all CRs for a water right should be examined.
- *For partially adjudicated permits* -- The total amount of a permit minus what has been adjudicated will be captured under POUs marked as "Expired."

SEO e-Permit Reference Table of Values

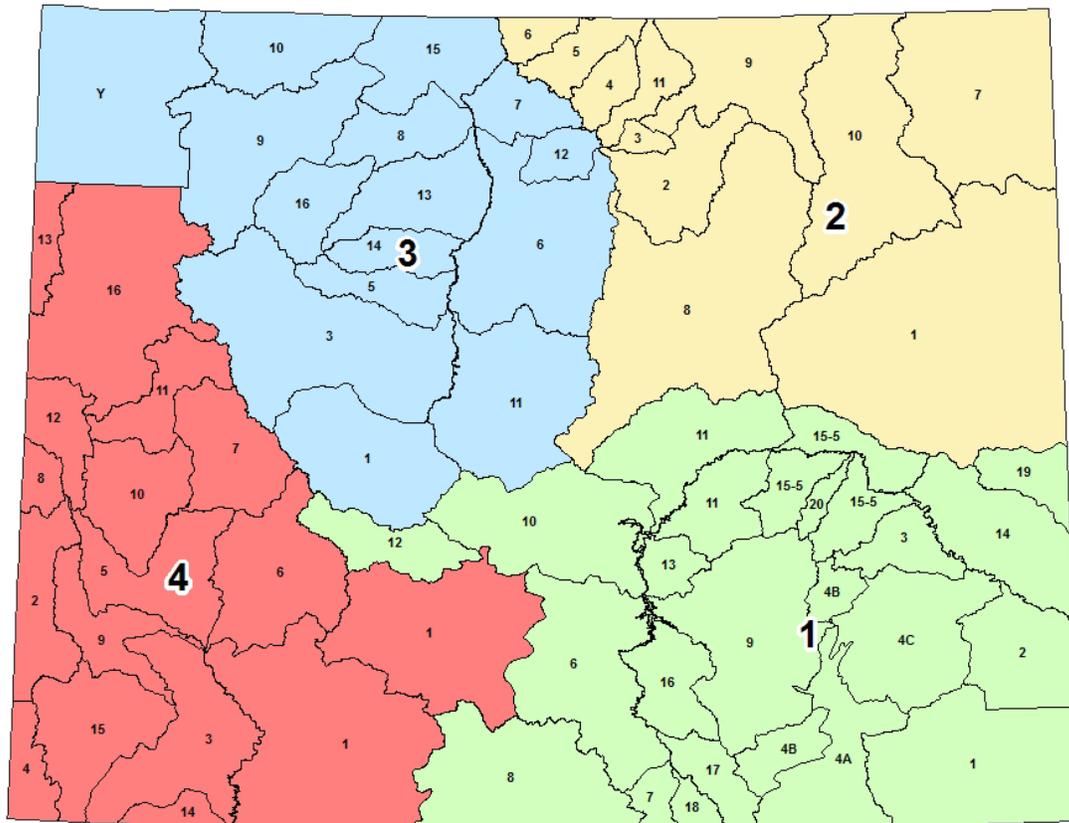
| Unique Identifiers | Common e-Permit Number Prefixes | Common e-Permit Suffixes | POD Location | POU Location | Common Beneficial Uses | Supply Types |
|-----------------------------|---------------------------------|--------------------------|---------------------|--------------|------------------------|--------------------------|
| Permit Number | Permit (P) | Ditch (D) | Latitude/ Longitude | PLSS only | Domestic (DOM) | Original |
| Certificate Record No. (CR) | Territorial (T) | Enlargement (E) | PLSS | | Irrigation (IRR) | Secondary (Reservoirs) |
| Order Record No. (OR) | Court Awarded (C) | Reservoir (R) | | | Stock Water (STK) | Supplemental |
| | Federal Award (Y) | Stock Reservoir (S) | | | Industrial (IND) | Additional (Groundwater) |
| | | Instream Flow (F) | | | Municipal (MUN) | |
| | | Well (W) | | | Miscellaneous (MISC) | |
| | | Unknown (-) | | | Reservoir Supply (RES) | |
| | | Pre-1969 wells (P) | | | Commercial (COM) | |

| Permit Status | Surface water | Groundwater | Acceptable for Data Analysis? | Reference Data Associated with this Record Type |
|-----------------------|---------------|-------------|-------------------------------|---|
| Fully Adjudicated | x | x | Yes | CR/OR |
| Partially Adjudicated | x | x | Yes | Permit or CR/OR |
| Complete | x | x | Yes | Permit |
| Blank | x | x | Yes | Permit or CR/OR |
| Incomplete | x | x | Yes | Permit |
| Unadjudicated | x | x | Yes | Permit |
| Abandoned | x | x | No | CR |
| Canceled | x | x | No | Permit |
| Expired | x | x | No | Permit |
| Eliminated | x | x | No | CR |

| Appropriation Type | Unit of measurement | Limitations |
|---------------------------|---------------------|---|
| Surface water | cfs | 1 cfs per 70 acres |
| Groundwater | gpm | |
| Reservoir storage | AF | |
| Reservoir supply capacity | AF/year | |
| Irrigation permits | Acres | 40 ac. Quarter-Quarter; 640 ac. Section |

Appendix B. Wyoming Water Divisions and Water Districts Map

There are four Water Divisions in Wyoming subdivided into Water Districts. (See image below). A feature class of this data is supplied with WWDO base datasets. See SEO website for more details.



Appendix C. Unique ID (WDOSTRID) Creation

Tracking structures and preparing data for modeling input requires the structures to have a unique ID. The guideline was created to force standardization in the naming of structures, while allowing for easy input into modeling software. Using a standardized ID and reusing this naming convention throughout the state will allow for the end users of the data to identify and understand the structures. Using these guidelines will improve modeling inputs and structure recognition when it is formatted into input files. The guidelines follow a logical naming convention that allows the user to see order of structures along flow lines.

By using the standards below in creation of a Unique ID, future users of the data are able to identify the point and its location.

Structure ID Example: 1234AAA5678B

Structure Unique ID created for use by the Wyoming Water Development Office will follow the following standards and naming conventions.

1. This ID number will be called WDOSTRID
2. The ID number will be Eleven Digits
 - a. A Letter can be added to the end of the ID (B) in certain circumstances (listed below in creation details) making a Twelve Digit ID
3. The first two numbers (12) will be Water Division
4. The second two numbers (34) will be Water District
5. The first set of letters (AAA) will be the shortened NHD Major Tributary or Flow Name
6. The last four numbers (5678) will be Unique to each Structure in the Water District.
7. The last letter (B) will be used to identify related Structures and/or Conveyances as described in the Four Digit ID Creation below
8. Out of State Structures will have two letter State ID for (12) followed by Water District upstream or downstream for (34). Unique Number for (5678) will follow normal naming conventions
 - a. If the monitored Structures are on a flowline that leaves the state and then re-enters the state continue using the District (34) exited until it enters the next District.
 - b. Use the Water District upstream when possible only use the downstream Water District when the flow has yet to enter Wyoming.

Note: *If points enter and exit a District from the same state remember to continue on the same numbers (5678) to avoid repeats*



Creation of the three letter Flow Name (AAA)

Flow Names and Letters used will be provided with created datasets any added or newly created flow names should be provided to WDO in deliverables.

1. Flow Name will be found from the NHD flowline map.
2. The first two Letters will be the first two letters of the Name followed by the flow type.
 - a. Example: Smith's Fork would be SMF. Bear River would be BER.
3. If there are more than two words in the name use the first letter of the first two words
 - a. Example: Red's Raging River would be RRR. Bob's Green Butterfly Stream would be BGS.
4. Do not repeat Flow Name in the same District, if a Flow name was used in a previous district it is given priority, if a Flow Name is the Main or Major Flow it is given priority.
 - a. Example: Red River is the major river in Red Basin, Read River feeds into the Red River. Red River would be RER, Read River would use the third letter in its name and would be RAR
5. Flow Names (AAA) for standing bodies of water will reflect the body of water
 - a. Example: Dave Lake would be DAL.
 - b. This will allow for standing bodies of water to be separated from points along moving water.
6. If a NHD Name is not given or cannot be found use the stream name given in the water right. Ditch maps associated with the water right can also be a good reverence for names.

Creation of the four number (5678) Unique Structure ID in each Water District.

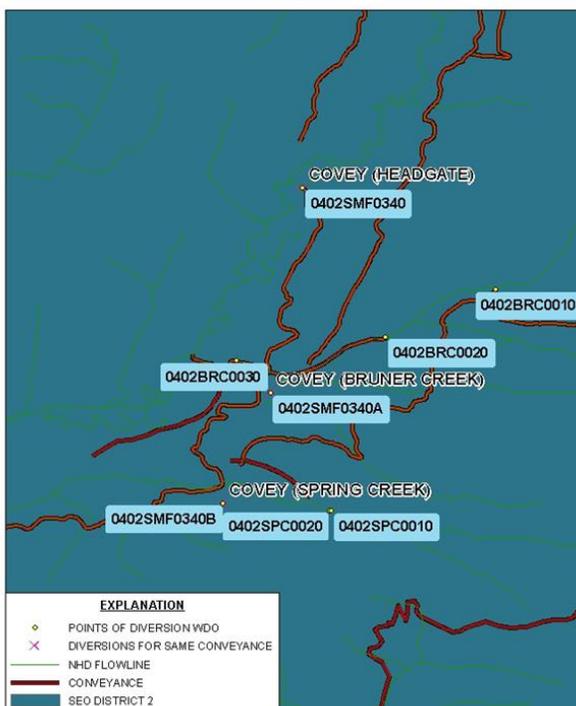
The adding of a Letter to Secondary Structure, Secondary Gauges and Secondary Diversions is to allow each feature to contain a truly Unique ID but allow for easy association of connected water features. Secondary Unique ID's may not be needed in your modeling depending on the secondary feature and the project needs. The project will determine need and uses. Letters added to the end of the Unique ID will follow certain criteria. Letters starting at 'A' are for duplicated points, (multiple gauges per feature, secondary diversion points, etc.). Letters starting at 'S' are the conveyances attached to the diversion. Letters starting at 'R' is a reused ID Number, the original ID holder is no longer in service.

Any water right data or relate tables will associate with the Unique ID eleven-digit primary number (no letter or 'R'). The IDs with letters will be used on a case by case basis.

Due to adding, moving or removal of Structure the four digit (5678) may not be in exact upstream to downstream order over time. Using the numbering convention above will allow for easier naming and the ability to locate and organize. The four digit (5678) cannot be assumed to be the exact order of the Structure and must be reviewed before using as the Upstream to Downstream Structure for Modeling or Mapping.

1. This 4 digit number restarts in each District change
 - a. Example: District Border Structure 0102AAA0040 is follow by 0103AAA0010 in the next district
2. This 4 digit number will restart for each new letter set (AAA)
 - a. Example: Red River enters the District and starts over at RER0010. Blue Stream is a major tributary of the Red River the up most upstream Structure ID would be BLS0010
3. ID Number will start in the tens place (7) and the tens place is to remain empty until a missed/added Structure ID is created
 - a. Example: first point would be 0010, second point would be 0020
4. The ID Numbers will start upstream and go downstream
 - a. We have decided to create the standard of Upstream to Downstream for convenience and to follow the example of HEC_RAS modeling
5. At Branches: ID Numbers will follow the Left Branch till termination or another branch point and then return to point of branching.
 - a. Example: the main river "Y"s, follow the left branch of the "Y" downstream until it "Y"s again then return and Label the right branch until it branches or terminates (assuming that both branches of the "Y" are downstream flows)
 - b. **Note:** *This would only apply if the Branches contain the same NHD Major Tributary or Flow Name OR The Branch contains no NHD Designations that are usable*
6. Structures added after creation of Structure IDs will use the tens place (7) of the established Structure Upstream of it and the ones place (8) in order of when it was placed
 - a. Example: If a Structure were added in between Original Structure 0020 and 0030 it would be 0021 assuming it was the first Structure added. The second added Structure between 0020 and 0030 would be 0022
7. In Districts follow a left to right pattern, when not following the upstream to downstream pattern
 - a. Example: River "A" in district, Start on the left until the confluence then number right branch
8. For Structures out of State: Treat the Structure as if they have entered an new District, but use the District (34) of exited or entered District (See above image for example)

- a. Example: Upstream Structures entering Wyoming from Utah, enters District 19. Because it is the First Upstream Structure it would be 0010, its full ID would be UT19XXX0010 and the following Structure in Wyoming and District 19 would be 0010 or XX19XXX0010 (Full ID)
 - b. Example: Downstream Structure in Colorado after leaving Wyoming, exits District 23. The Structure in Colorado would be CO23XXX0010 (Full ID)
9. If the monitored Structures leave then re-enter the state they are to continue on the number sequence of the District exited until it enters the next District.
10. Structure sharing a conveyance or water feature will have a 'Primary' Structure and the secondary structures will have a Letter added to the end of the Unique ID. Letters for associated structures will start at "A"
- a. Example: Smith Ditch pulls water from three sources: Red River, Peter's Pond, and Lost Stream. The Red River Diversion is the largest Diversion point and will be called the 'Primary' and given ID Number: 1234RER5678. Peter's Pond is the first Structure downstream from 'Primary' its ID Number is 1234RER5678A. Lost Stream ID: 1234RER5678B.
 - b. 'Primary' Structure can also be the Structure carrying the ditch name.
 - i. Example: John Ditch pulls from two sources on the Red River: Rita Diversion and John Ditch Diversion. Rita Diversion is upstream but all water right permits reference John Ditch, John Ditch would be the 'Primary' (1234RER5678) and Rita would get the Letter (1234RER5678A).
 - c. Example: Three Water Gauges cover Smith Lake, the 'Primary' Gauge measuring downstream flow will be given ID Number 1234SML5678 and the two secondary gauges will add letter of A and B.
 - d. **Note:** All water right permit Information will only be tied to the 'Primary' Unique ID.



11. Water gauge locations derived from USGS Stream Gauges or Wyoming equivalent will be given a Unique ID

12. Structures entering the same conveyance BUT have different gauges will have multiple points with each point containing a gauge ID at the point of the gauge
 - a. Example: Daniel Ditch diverts off the Red River and exits the state. The head-gate diversion has a gauge and the state line has a flow meter, both will receive Unique ID's and the state line flow meter will be designated as a 'secondary'. The Primary Unique ID for the head-gate is 1234RER5678, the secondary ID for the state line gauge would be 1234RER5478A.
13. Mapped Conveyances will have the same Unique ID as the corresponding Point of Diversion's Structure ID **BUT** will have the Letter 'S' added to the end of the ID.
 - a. Example: Smith Ditch is off of Smith Diversion. Smith Diversion ID is 1234XXX5678. Smith Ditch would be ID 1234XXX5678**S**
14. All Mapped Conveyances will have a head-gate mapped and the head-gate given a Unique ID.
15. Structures that are moved will retain the same Unique ID
16. Structures Removed will retain given Unique ID until all ones places (8) are used then first Structure's number that was removed will be reused with a letter following starting at "R" ["R" stands for "Replaced"]. Original Structure Numbers will not be re-used (0010, 0020, etc.)
 - a. Example: 0010 to 0019 have been used. 0013 was removed from service first. The new Structure requiring ID would become 0013R
17. If an Original Structure Number (0010, 0020, etc.) is removed from service and reporting. This Original Point will remain in the database mapped for naming/location purposes and have that removal noted.
18. All Points of Diversion with a significant number of Active Water Rights associated to it or a number designated by the project manager will have a Unique ID created and a point placed on the map.
 - a. Example: Smith's Diversion has 13 Active Water Rights, a single point of diversion will be created for it and this point will have a Unique ID.
 - b. **Note:** This number is a guide, depending on your project area you may be required to create Unique IDs for a smaller number of Water Rights
19. All Active Water Rights or diversions with over 10 CFS will have a Unique ID created and a point placed on the map.
 - a. **Note:** This number is a guide, depending on your project area you may be required to create Unique IDs for a smaller number of Water Rights

Appendix D. Domain Values and Descriptions

Description and codes as of April 11, 2019. For a full understanding of the geodatabase and all its relationships, see the Geodatabase Diagram poster at <http://water.geospatialhub.org/pages/wwdc-gis-standards>

Condition - Domain

| | |
|-------------|---|
| DomainName | Condition |
| Description | Existing state of repair or development |
| FieldType | String |
| Domain Type | CodedValue |

| Code | Name |
|-----------|----------------------------------|
| Exists | Existing feature |
| Potential | Possible project for development |
| Unknown | Status not known |
| Disrepair | Used but in need of work |
| Unusable | Built but not in use |
| Abandoned | No longer in use |

ConvType - Domain

| | |
|-------------|---------------------|
| DomainName | ConvType |
| Description | Water facility type |
| FieldType | String |
| Domain Type | CodedValue |

| Code | Name |
|------|---------------------|
| P | Pipeline |
| O | Open Ditch/Canal |
| OL | Open Lateral |
| PL | Pipe Lateral |
| N | Natural Watercourse |

DryWetAverage - Domain

| | |
|-------------|--------------------------------|
| DomainName | DryWetAverage |
| Description | Year Type: Dry, Wet or Average |
| FieldType | String |
| Domain Type | CodedValue |

| Code | Name |
|------|--------------|
| D | Dry |
| W | Wet |
| Av | Average |
| No | Normal |
| Miss | Data Missing |

HorizontalAccuracy - Domain

| | |
|-------------|-----------------------------|
| DomainName | HorizontalAccuracy |
| Description | Horizontal Accuracy of Data |
| FieldType | String |
| Domain Type | CodedValue |

| Code | Name |
|-------|--|
| GPS1 | GPS Survey Grade: Accuracy < 1 inch |
| GPS2 | GPS Map Grade: Accuracy < 1 meter (sub meter units) |
| GPS3 | GPS Recreation Grade: Accuracy > 15 feet |
| DIGA1 | Digitized From Aerial - < 6 inch resolution: Accuracy < 12 inch |
| DIGA2 | Digitized From Aerial - 6 inch to 1 meter resolution: Accuracy 12 inches to 2 meters |
| DIGA3 | Digitized From Aerial - > 1 meter resolution: Accuracy > 2 meters |
| DIGT | Digitized From Topo: Accuracy +/- 40 feet (USGS 24k series) |

| | |
|------|---|
| SEC | PLSS Section: Accuracy 640 acres |
| QTR | PLSS Quarter: Accuracy 160 acres |
| QTR2 | PLSS Quarter-Quarter: Accuracy 40 acres |
| QTR4 | PLSS Quarter-Quarter-Quarter-Quarter: Accuracy 10 acres |
| HIS | Historical Drawing: Accuracy Not Applicable |
| UNK | Unknown |

UplandType - Domain

DomainName UplandType
 Description Upland Water Source Type
 FieldType String
 Domain Type CodedValue

| Code | Name |
|------|----------------|
| WT | Well Tank |
| T | Tank |
| P/R | Pond/Reservoir |
| G | Guzzler |
| O | Other |
| SP | Spring |

IrrMethod - Domain

DomainName IrrMethod
 Description Method used for Irrigation
 FieldType String
 Domain Type CodedValue

| Code | Name |
|------|-------|
| FL | Flood |
| P | Pivot |

| | |
|----|-----------------------------|
| O | Other |
| M | Multiple Irrigation Methods |
| UK | Unknown |

IrrStatus - Domain

DomainName IrrStatus
 Description Irrigation Use at time of Assessment
 FieldType String
 Domain Type CodedValue

| Code | Name |
|------|--|
| A | Full Service Irrigation |
| B | Partial Service Irrigation |
| C | Incidental Irrigation or Subirrigation |
| E | Idle Irrigation |
| H | Minor Beneficial Irrigation |
| AB | Full and Partial Mix of Irrigation |

NodeType - Domain

DomainName NodeType
 Description Streamflow or runoff feature type
 FieldType String
 Domain Type CodedValue

| Code | Name |
|------|------------------------------|
| G | Gauge |
| D | Diversion |
| TR | Tributary Inflow |
| O | Other Node |
| WS | Watershed estimate of runoff |

WWDOPrjType - Domain

DomainName WWDOPrjType
Description Type of potential project water project as defined by Water Development Office
FieldType String
Domain Type CodedValue

| Code | Name |
|------|----------------------------|
| 1 | Dam-Reservoir |
| 2 | Lining |
| 3 | Pipe Conversion |
| 4 | Structural |
| 5 | Automation |
| 6 | Ditch-Canal |
| 7 | Diversion |
| 8 | Bypass |
| 9 | Other |
| 10 | SWPP-Channel Stabilization |
| 11 | SWPP-Fish Barrier |
| 12 | SWPP-Well |
| 13 | SWPP-Environmental |
| 14 | SWPP-Irrigation |
| 15 | SWPP-Spring Development |

ResvStatus - Domain

DomainName ResvStatus
Description Current Water Source Status
FieldType String
Domain Type CodedValue

| Code | Name |
|------|----------------|
| NF | Non-Functional |

| | |
|------|---------------------------|
| F | Functional |
| Eph | Ephemeral or intermittent |
| Potn | Potential |

RiparianVeg - Domain

DomainName RiparianVeg
 Description Riparian Vegetation Condition
 FieldType String
 Domain Type CodedValue

| Code | Name |
|---------|---------------------------------------|
| NA | Not Applicable |
| B | Bare Ground |
| G | Grasses |
| Low | Little Riparian Vegetation <10% |
| Partial | Partial Riparian Vegetation |
| Full | Significant Riparian Vegetation > 70% |

RosgTConfidence - Domain

DomainName RosgTConfidence
 Description Confidence in Assessment of Rosgen Channel Type
 FieldType String
 Domain Type CodedValue

| Code | Name |
|------|-------------------------------|
| A | Field Assessed |
| B | LiDAR |
| C | Aerial Photos |
| D | Other (Explained in Comments) |

RosgType - Domain

DomainName RosgType
Description Rosgen Channel Type
FieldType String
Domain Type CodedValue

| Code | Name |
|------|---|
| A | A-Type channels are relatively steep channels that form in headwater areas as well as within bedrock canyons |
| B | B-Type channels tend to form downstream of headwater channels, in areas of moderate slope, moderate entrenchment, and stable channel boundaries |
| C | C-Type channels characterized by relatively low slopes, meandering planforms, and pool/riffle sequences. The channels tend to occur in broad alluvial valleys, and they are typically associated with broad floodplain areas; they are not entrenched and still have 'access' to their floodplains. |
| D | D-Type braided channel with longitudinal and transverse bars. Very wide channel with eroding banks. Slope <.04 High width to depth ratio that is > 40. |
| E | E-Type Channels form as single threads with defined, accessible floodplain areas. The fine-grained, vegetation-reinforced banklines allow for the development of steep banks, very sinuous planforms, and relatively deep, U-shaped channel cross sections. |
| F | F-Type Channels typically have relatively low slopes (<2%), similar to C and E channel types. However, F-Type channels are entrenched, which means the floodplain is quite narrow relative to the channel width. |
| G | G-Type Channels are narrow, steep entrenched gullies. G-Type channels typically have high bank erosion rates and a high sediment supply. Channel degradation and side slope rejuvenation processes are typical. |

Seepage - Domain

DomainName Seepage
Description Observed Seepage Assessment
FieldType Double
Domain Type CodedValue

| Code | Name |
|------|--|
| 0 | Not Assessed |
| 1 | No evidence of channel seepage is present. |
| 2 | Some evidence of channel seepage is present. Usually indicated by presence of large trees/brush or other riparian vegetation downhill from channel. Also indicated by areas with highly alkaline soils on the surface. |
| 3 | Evidence of channel seepage is present. In addition to the aforementioned vegetation, surface water is present and visible outside the channel. |

StorageType - Domain

DomainName StorageType
 Description Water Storage Type
 FieldType String
 Domain Type CodedValue

| Code | Name |
|------|-------------------------|
| SW | Surface Water Reservoir |
| T | Water Tank |
| L | Lake/Pond |
| ASR | Aquifer |
| TR | Treatment Reservoir |

TypeStructure - Domain

DomainName TypeStructure
 Description Type of water infrastructure
 FieldType Integer
 Domain Type CodedValue

| Code | Name |
|------|-----------|
| 1 | Diversion |

| | |
|----|--------------------|
| 2 | Check |
| 3 | Headgate/Turn-out |
| 4 | Weir |
| 5 | Dam |
| 6 | Culvert |
| 7 | Meter |
| 8 | Pump |
| 9 | Siphon |
| 10 | Vent |
| 11 | Undershot |
| 12 | Spillway |
| 13 | Outlet - water |
| 14 | Drop |
| 15 | Splitter |
| 16 | Well |
| 17 | Bridge |
| 18 | Water Tank |
| 19 | Valve |
| 20 | Pipe |
| 21 | Other-See Comments |
| 22 | Lined |
| 23 | Fire Hydrant |
| 24 | Manhole |

UnitOfMeasure - Domain

DomainName UnitOfMeasure
 Description Units used in Streamflow Statistic
 FieldType String
 Domain Type CodedValue

| Code | Name |
|------|-----------|
| AF | acre-feet |

| | |
|---------|-----------------------|
| CFS | cubic-feet per second |
| Percent | Percent of Average |

WDODevmType - Domain

DomainName WDODevmType
Description Development Type - New water Supply or rehabilitation or both
FieldType String
Domain Type CodedValue

| Code | Name |
|------|----------------------|
| 1 | New Supply |
| 2 | Rehabilitation |
| 3 | New Supply and Rehab |

Appendix E. References

Anderson Consulting Engineering, Inc. (2015). *Upper North Platte Watershed Study*. Prepared for Wyoming Water Development Commission.

Lowham Walsh (2017). *Owl Creek Watershed Study and Management Plan*. Prepared for Wyoming Water Development Commission.

O'Grady, et al. (2000). *Green River Basin Plan Technical Memorandum*. Prepared for Wyoming Water Development Commission.

Trihydro Corporation (2017). *Bear River Data Model Pilot Project: GIS Data Framework Plan*. Prepared for Wyoming Water Development Commission.