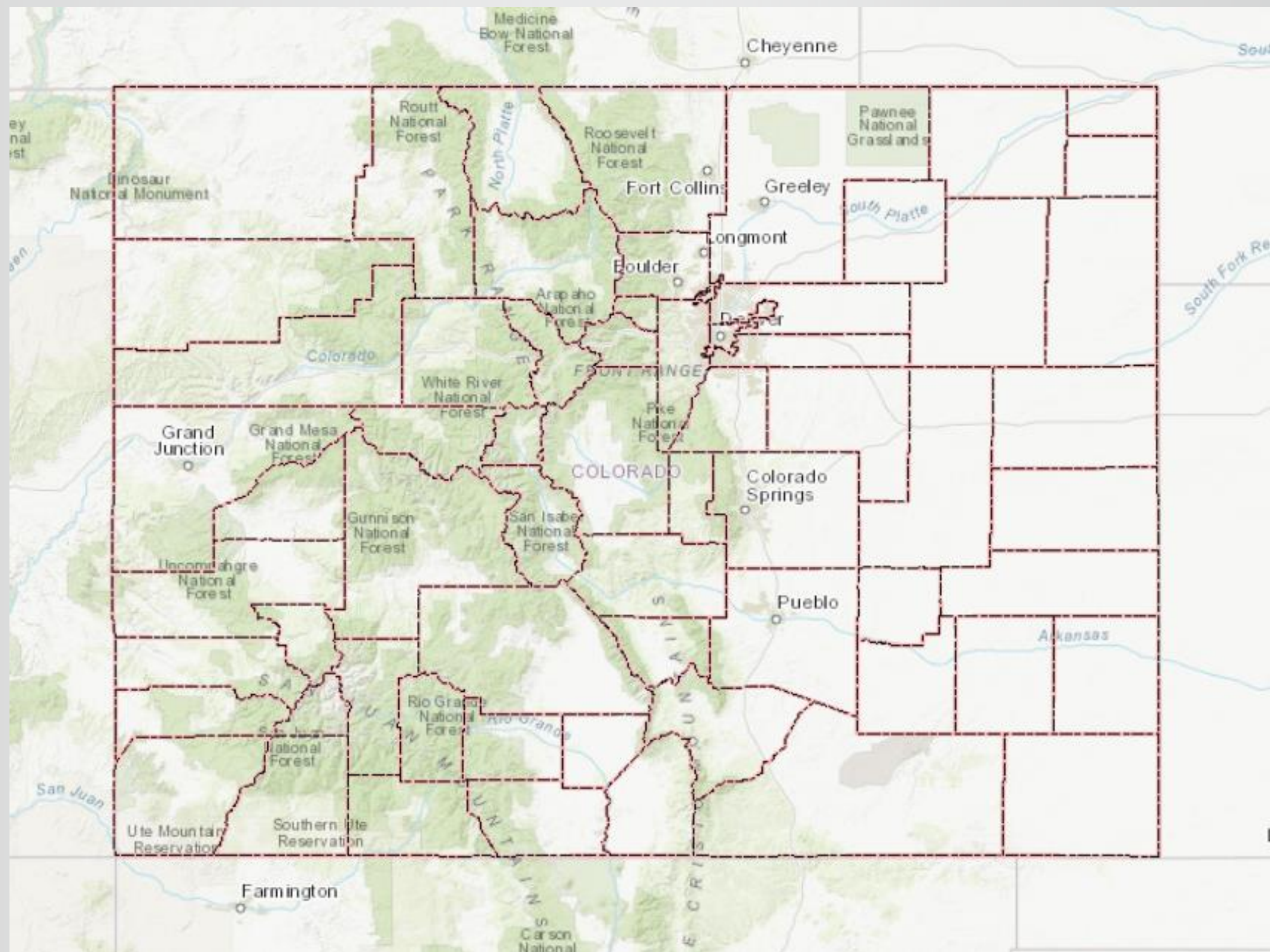


# ***Using GIS for Irrigated Acreage Accounting in Colorado's Republican and Rio Grande Basins***

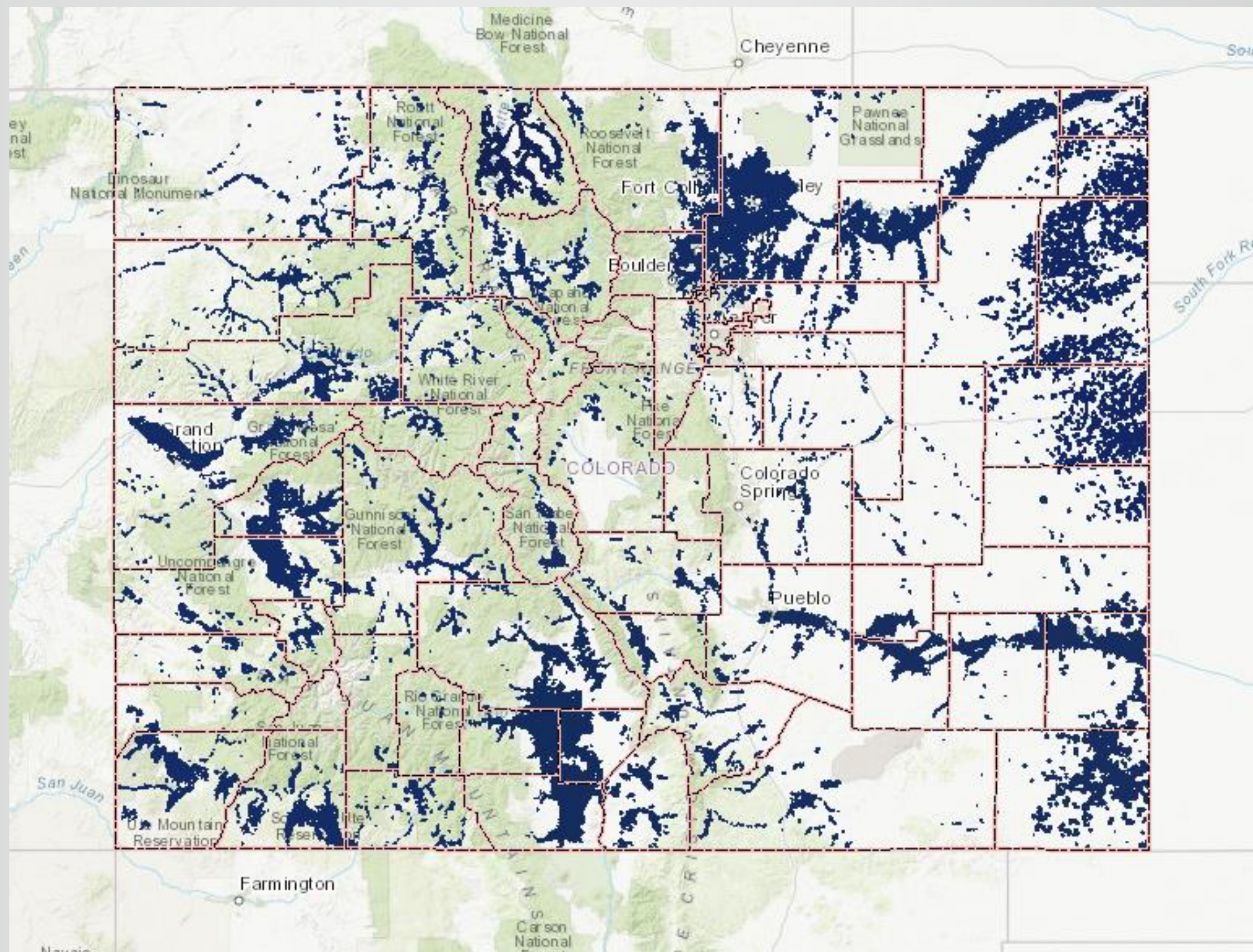
ESRI Southwest Users Conference  
Alison Keener  
GIS Analyst  
Colorado Division of Water Resources (DWR)



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Division of Water Resources  
Department of Natural Resources



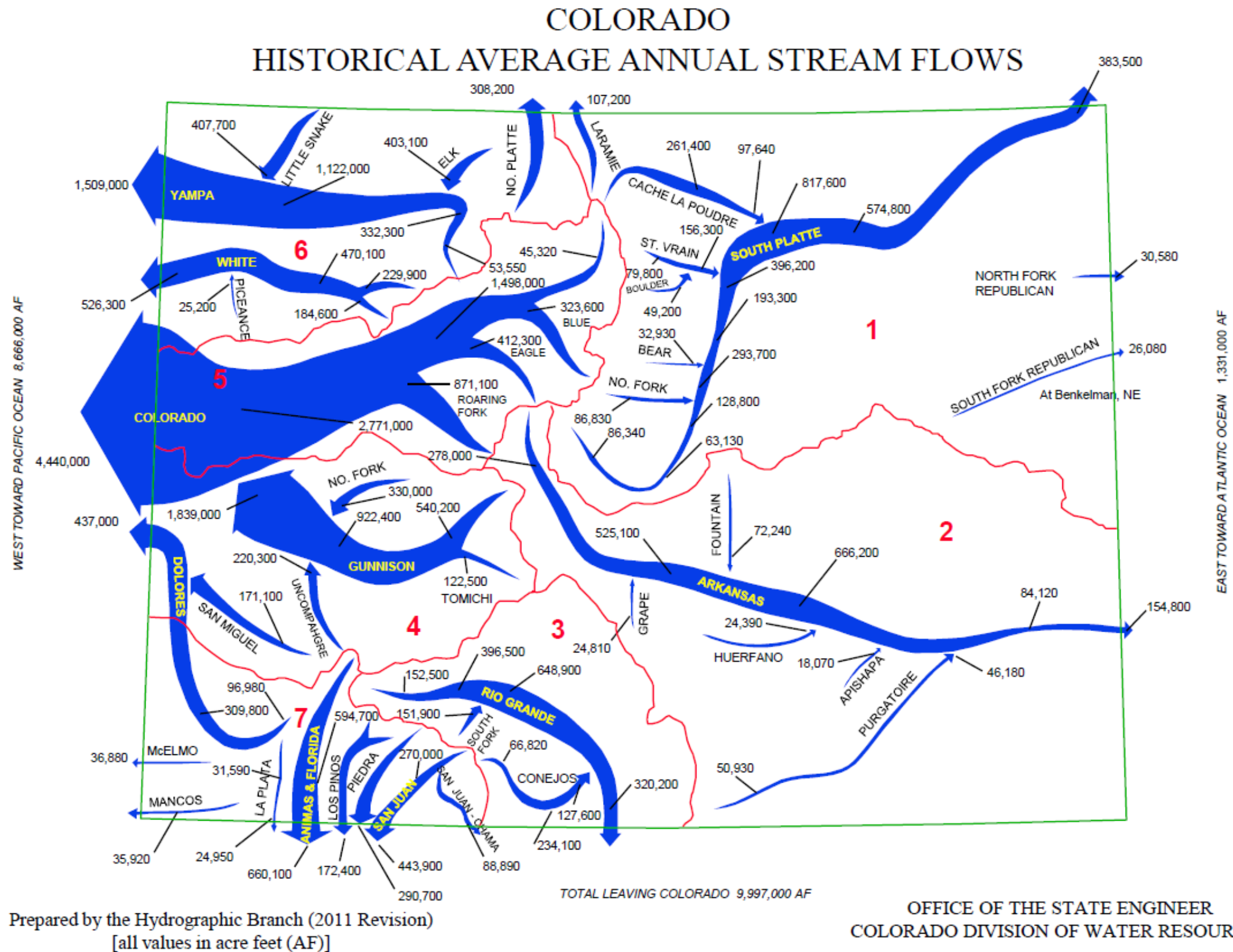




- 3.5 million acres irrigated using 89% of consumed water
- Tracking place of use of decreed water rights
- Spatial variable in groundwater modeling associated with interstate compacts







- Many major rivers originate in Colorado
- 9 formal interstate compacts

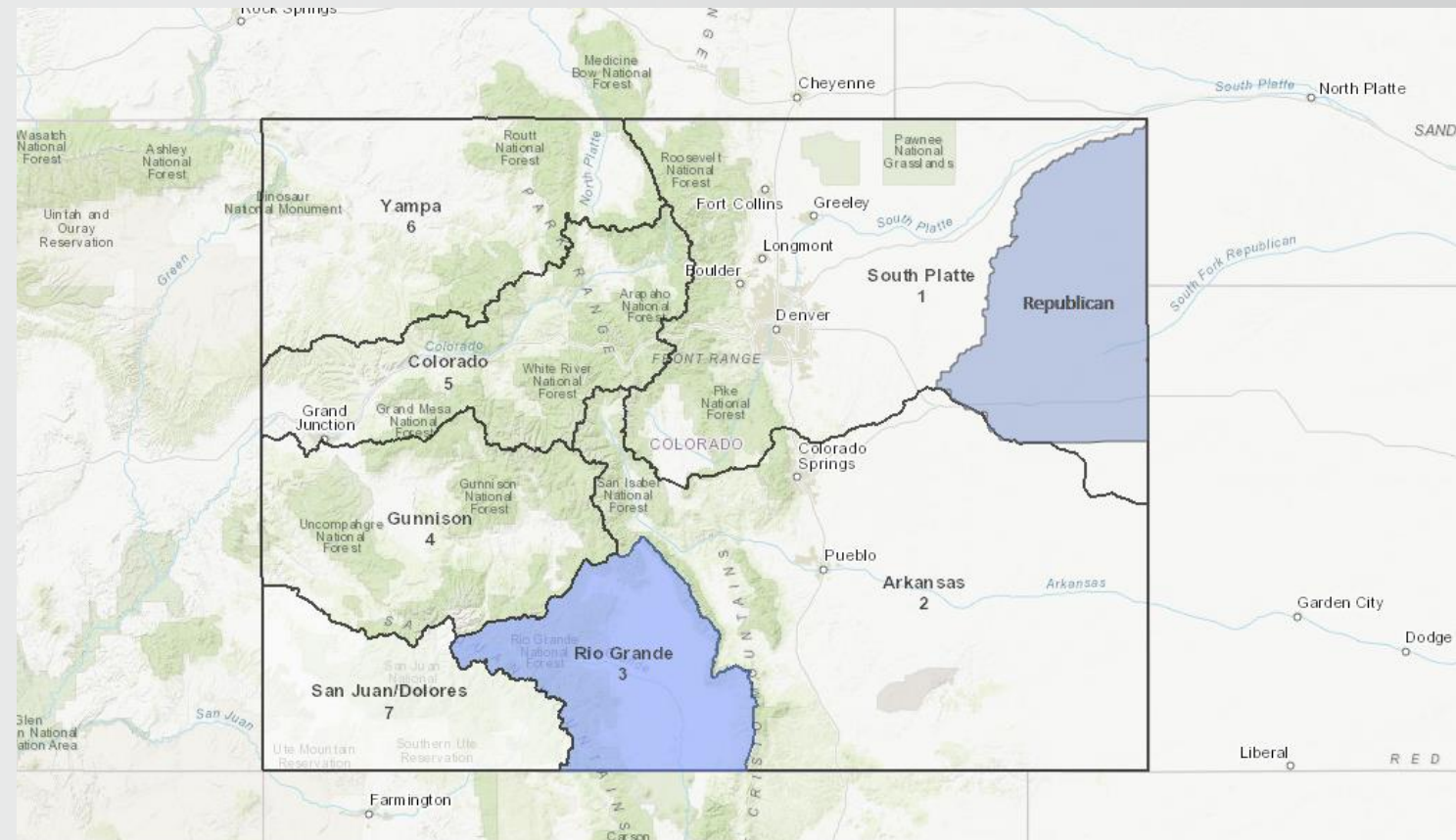


# Interstate Compacts and GW Models

- The Rio Grande Compact -1938
  - Water apportioned to CO, NM, TX
  - Rio Grande River Basin Rules - assist in compliance with Compact
  - **RGDSS Groundwater Model**
- The Republican River Compact - 1943
  - Water apportioned to CO, KS, NE
  - Annual accounting of all groundwater use required
  - **RRCA Groundwater Model** - water is the impact of pumping?

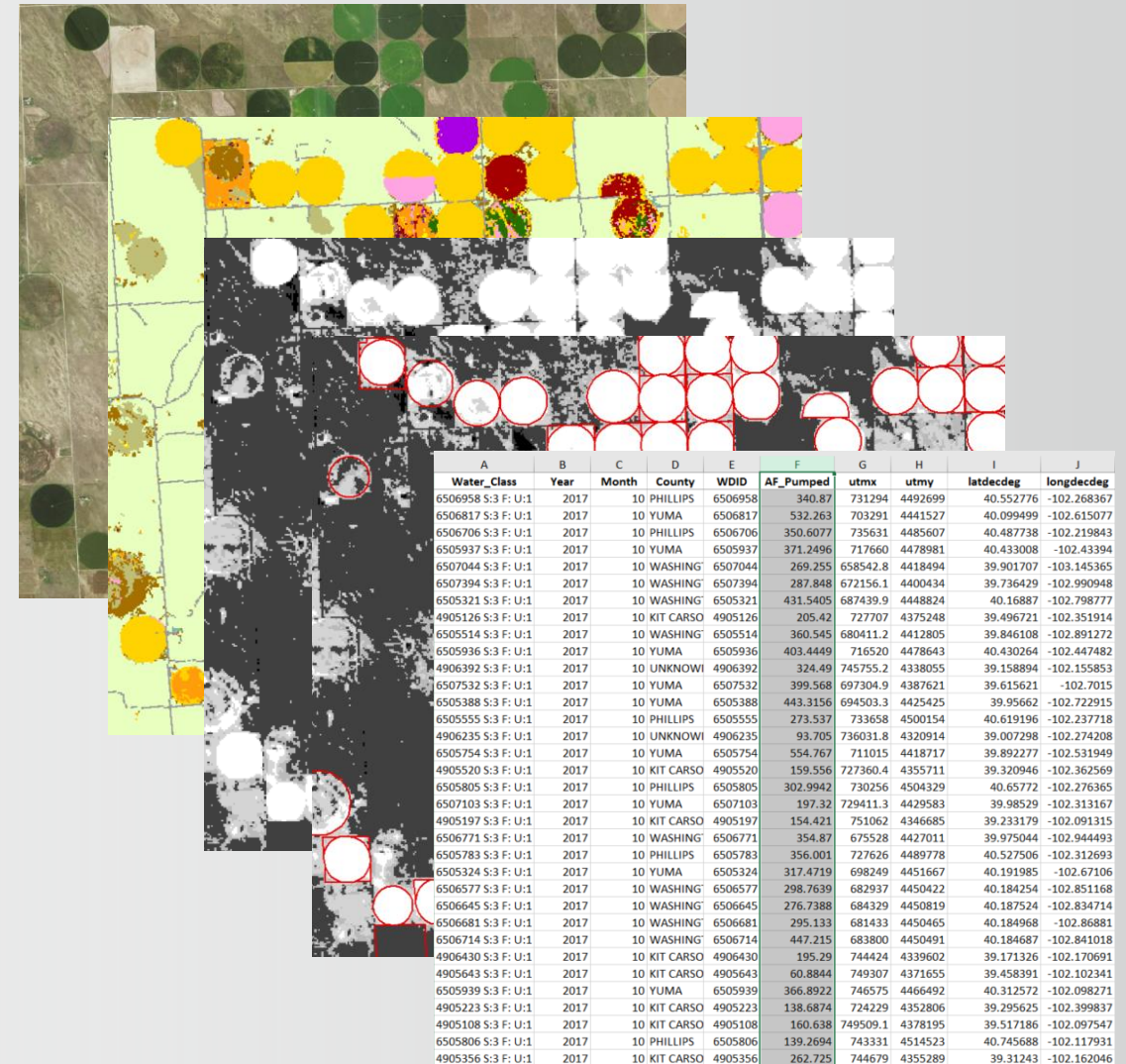
## GIS Datasets Used for Model

- Irrigated Parcels (polygon)
- Wells (point)
- Canals (polyline)
- Soils (polygon)
- Land Use (polygon) etc...



# Datasets Used in Production

- Aerial Imagery (NAIP)
- NASS CDL
- NDVI, Landsat 8 scenes
- Master Irrigated Parcel Layer
- Diversion Records from our database





# Master Parcel Layer

- Allows us to differentiate between irrigation and dryland farming
- Digitized decreed parcels based on well permits on file
- Ditch and/or well(s) data captured in attribute table
- Annual adjustments based on NAIP
- Add new pivots as needed

8/30/82

PERMIT INFORMATION SHEET

1 OWNER Fred L Wiesner

PERMIT NO. 17868-F

PRIORITY DATE 2-20-73

DIVISION CODE 1

PRIORITY NO. \_\_\_\_\_

COUNTY CODE 32

USE Irrigation & Livestock

WATER DISTRICT 49

DEPTH 197 feet

MANAGEMENT DISTRICT CODE 3

DESIGNATED BASIN CODE 1

ARE THERE EXPANDED ACRES UNDER THIS PERMIT? YES ☐ NO ☒ IF YES, SEE ADDITIONAL SHEET.

WELL LOCATION NW 1/4 NW 1/4, Section 4, Township 7 S, Range 51 West

1190 feet from the N section line, 800 feet from the W section line.

PERMIT STATISTICS 400 Acre-feet/year, 1000 G.P.M., 160 Acres

DESCRIPTION OF IRRIGATED ACRES: the NW 1/4 of sec. 4, T7S, R51W

INITIALS DD DATE 7-24-81

2 DATE COMPLETED 8-20-74, DATE ISSUED 11-26-73, BENEFICIAL USE MUST HAVE BEEN BY 11-26-76, ACTION CODE 0

STAFF COMMENTS \_\_\_\_\_

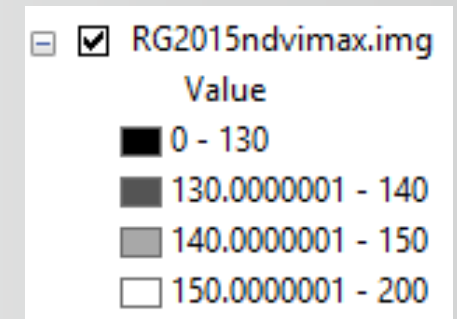
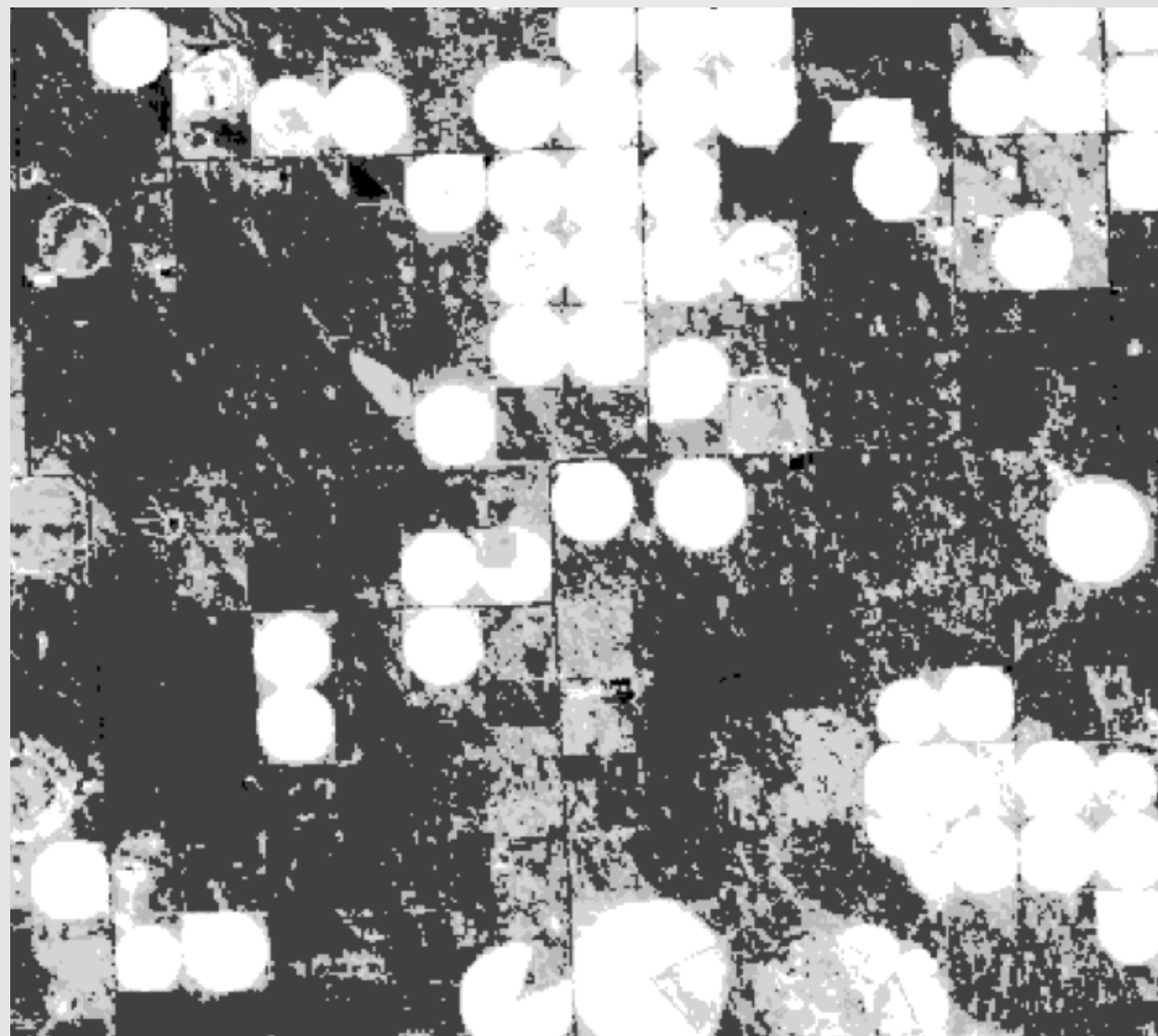
INITIALS DD DATE 7-24-81

3 DISTRICT COMMENTS \_\_\_\_\_



# *MaxNDVI Coverage*

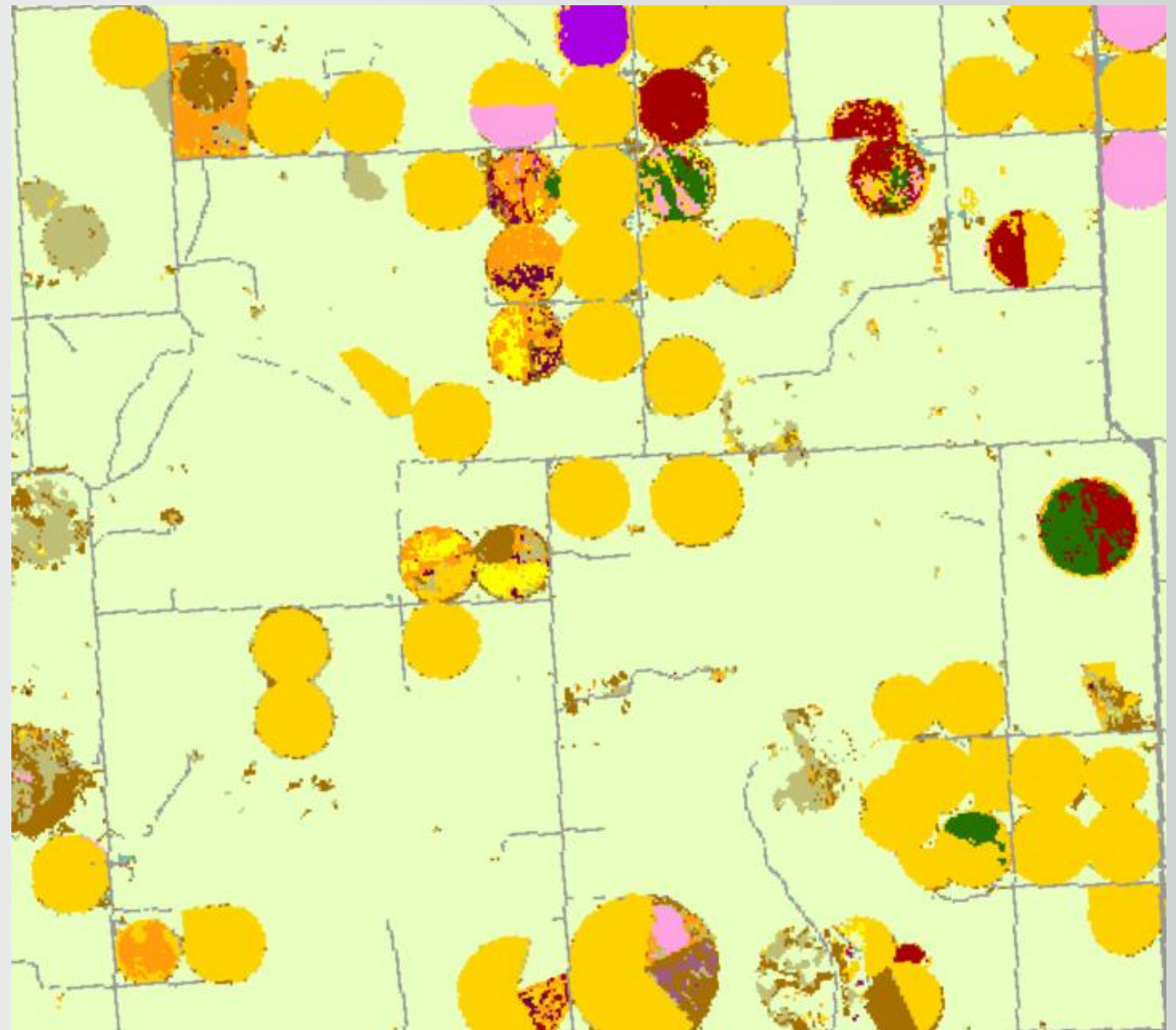
- Landsat 8 scenes from ~May-Oct of growing season
- Composite of the highest NDVI values from each pixel
- NDVI threshold image - parcels were irrigated at any time during growing season?
- 0-200;  $\geq 150$  = potentially irrigated





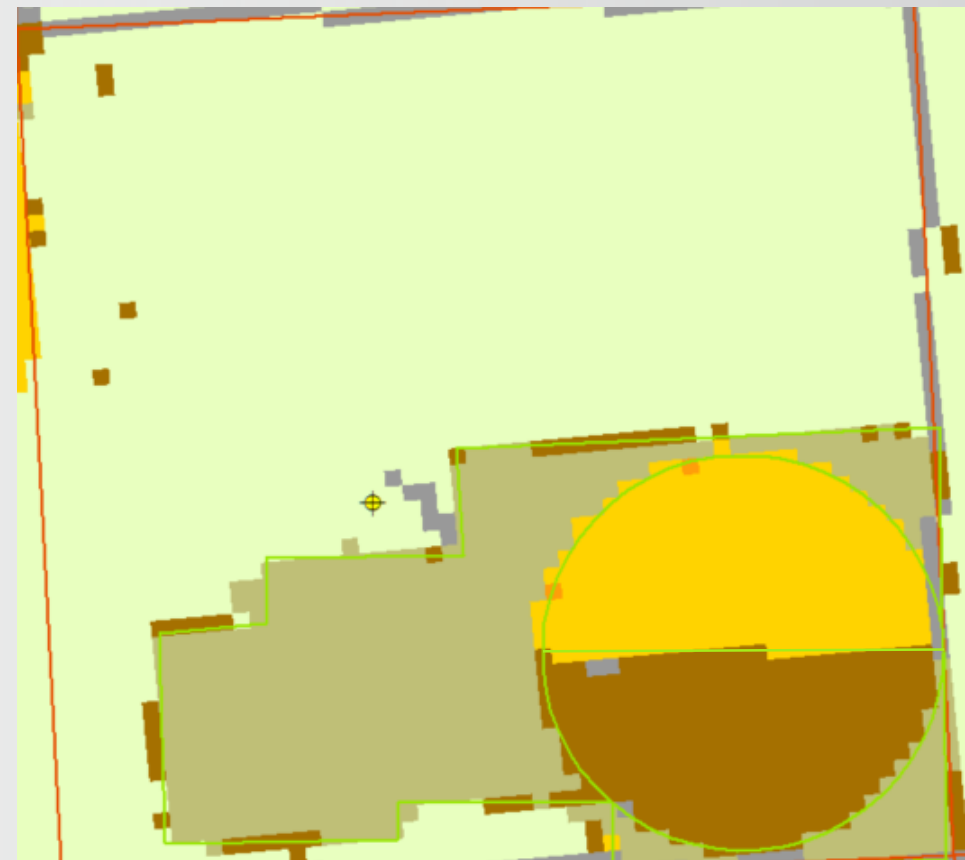
# NASS CDL Coverage

- National Agricultural Statistics Service Crop Data Layer
- Published nation-wide since 2008
- Describes irrigated and non-irrigated land cover
- Ground truthing conducted by Farm Service Agency



# *Edit Working Layer*

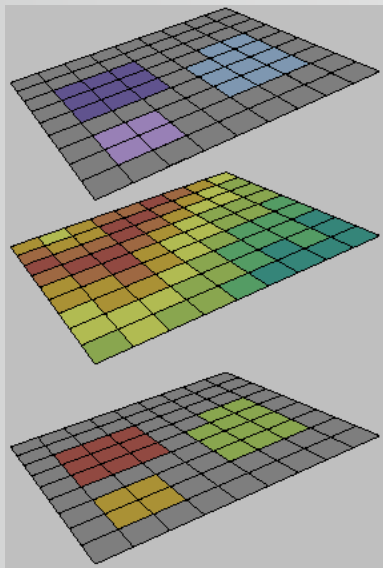
- Split polygons in the working layer based on MaxNDVI and CDL





# Zonal Statistics

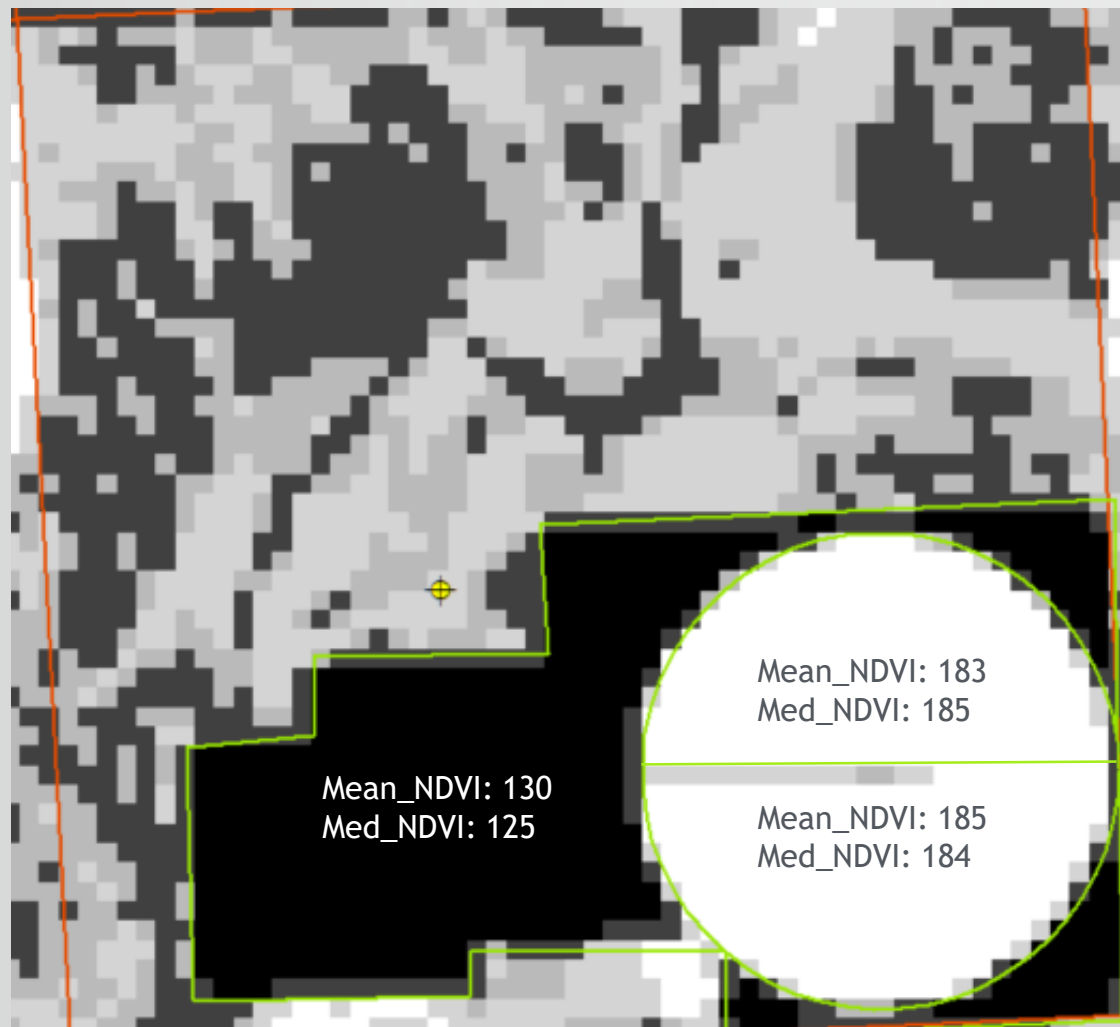
- Edited parcel layer polygons define the zones
- Calculate mean and median for maximum NDVI
- Extract data values at parcel level via added fields



MEAN_NDVI	MED_NDVI	MAJ_FRAC	MAJ_CROP	NASS_CROP
189.892	191	0.534	4	Sorghum
189.509	191	0.958	5	Soybeans
189.432	190	0.982	5	Soybeans
188.913	189	0.98	36	Alfalfa
188.88	189	0.99	5	Soybeans
188.777	189	0.923	5	Soybeans
188.724	190	0.81	5	Soybeans
188.641	189	0.682	5	Soybeans
188.622	189	0.97	5	Soybeans
188.618	190	0.937	5	Soybeans
188.612	189	0.879	36	Alfalfa
188.545	189	0.963	36	Alfalfa
188.536	190	0.915	36	Alfalfa
188.487	189	0.993	5	Soybeans



# Zonal Statistics





# Classification of Parcels

*First, code high probability irrigated crops*

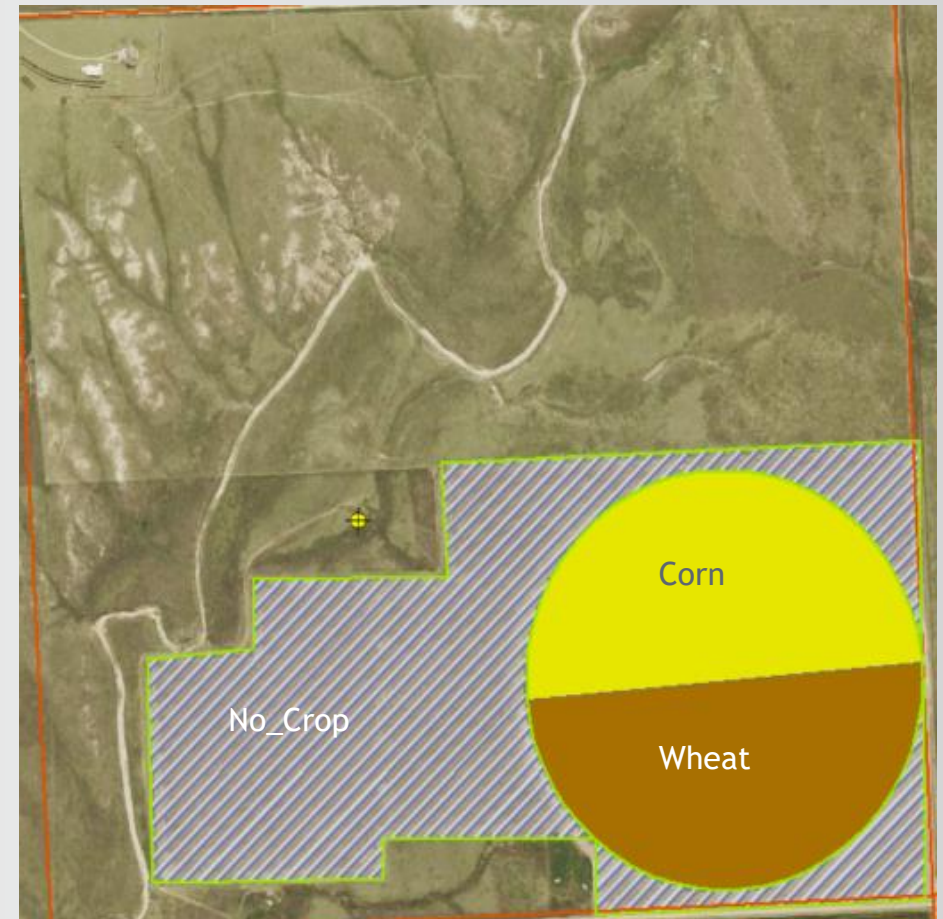
- *Majority Fraction > .70 and Mean NDVI  $\geq 150$*
- *Code “Crop\_SRC” field as NASS*

*Next, code high probability of no crop*

- *CDL = Fallow and Mean NDVI < 150*
- *Code “Crop\_SRC” field as SAT*

*Remaining parcels are visually inspected by crop type*

- *Code “Crop\_SRC” field as INTERP*

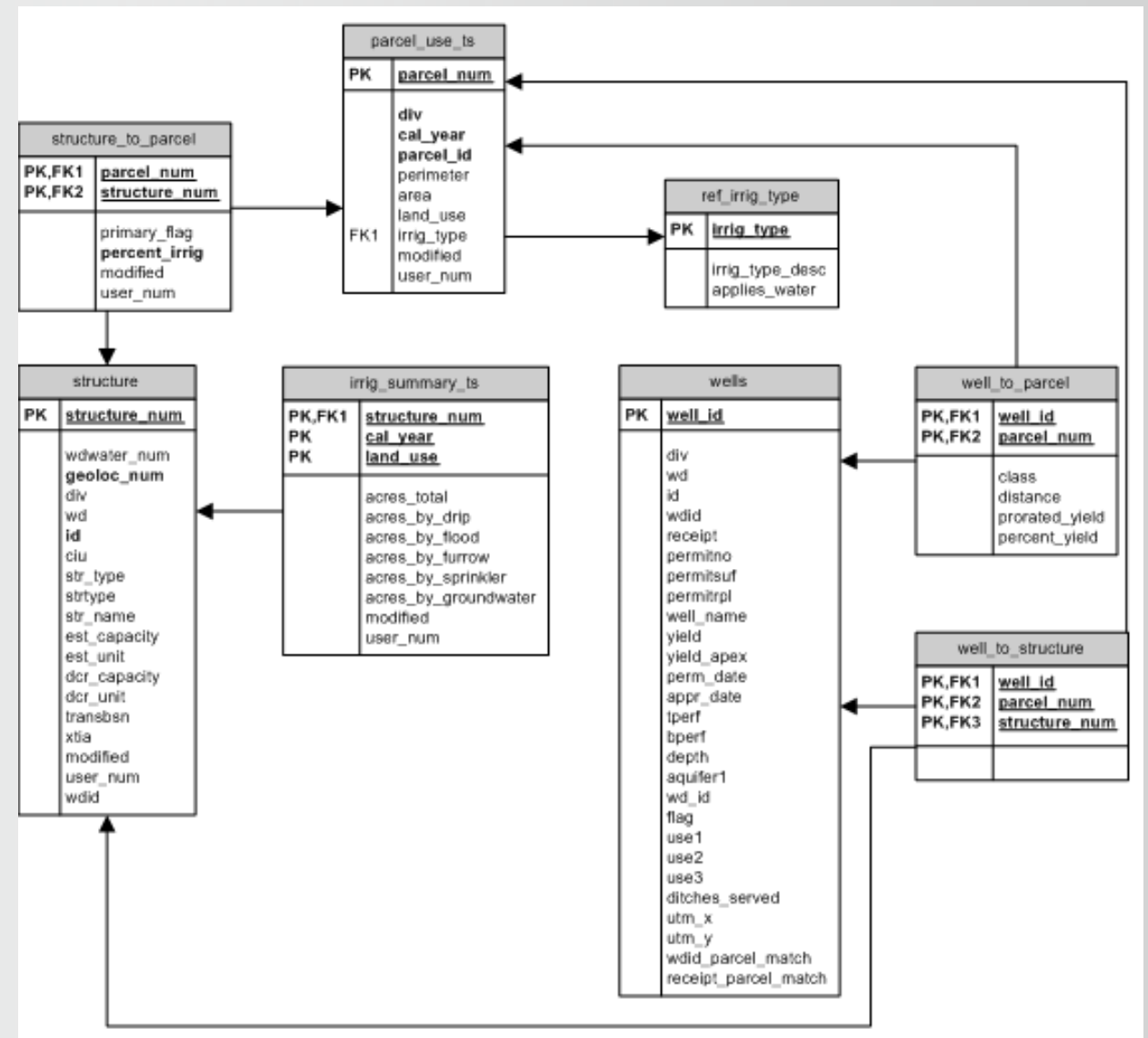




# QA/QC

## HydroBase QAQC checks:

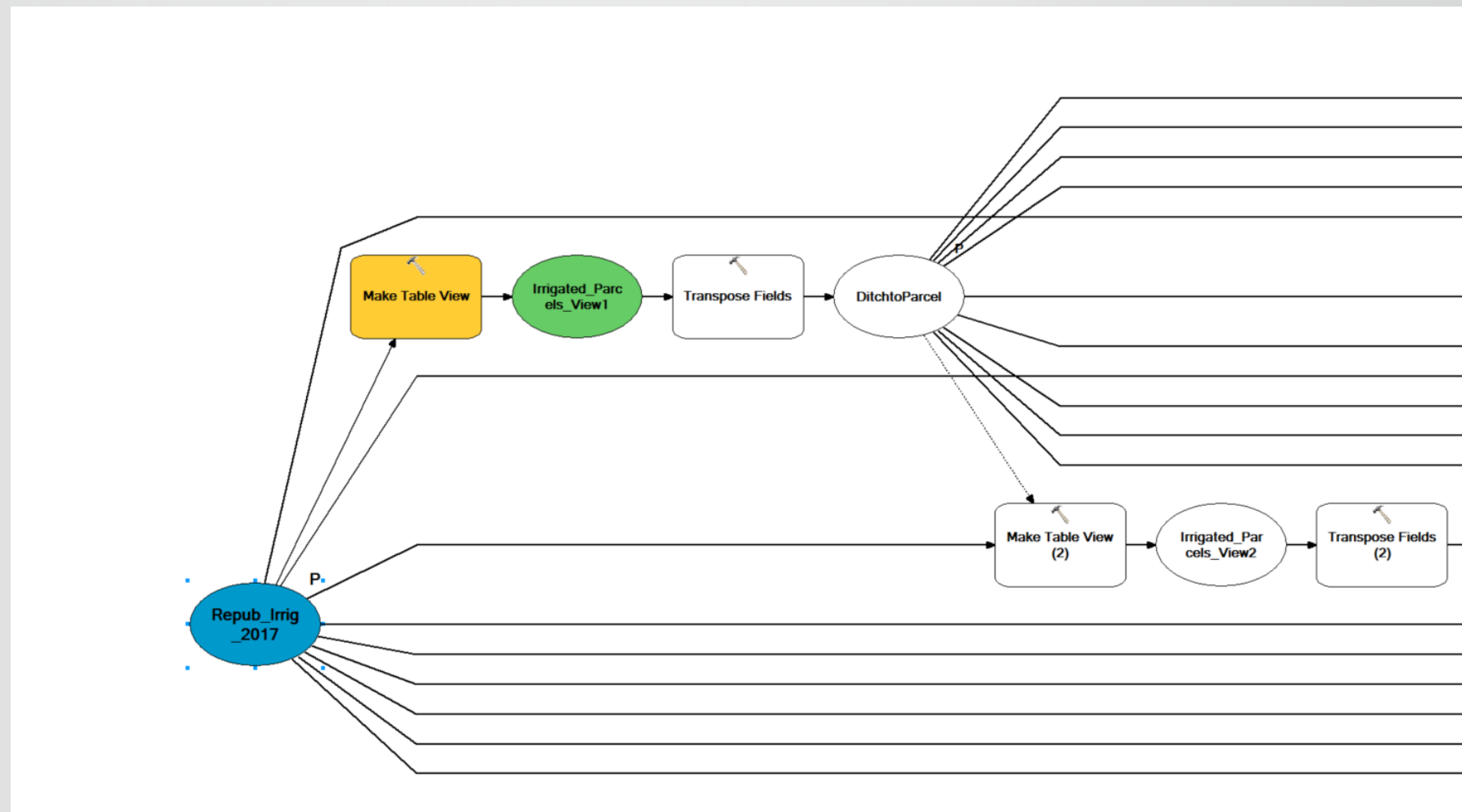
- WDIDs exist
- Valid crop types
- Valid irrigation types
- No duplicate WDID associations on a single parcel





# Relational Tables

- Model Builder
  - Refreshes the relationship table and relationship class between wells/ditches and the parcels they irrigated
  - Shapefiles of irrigation-related wells and ditches



# Where to Access our Data

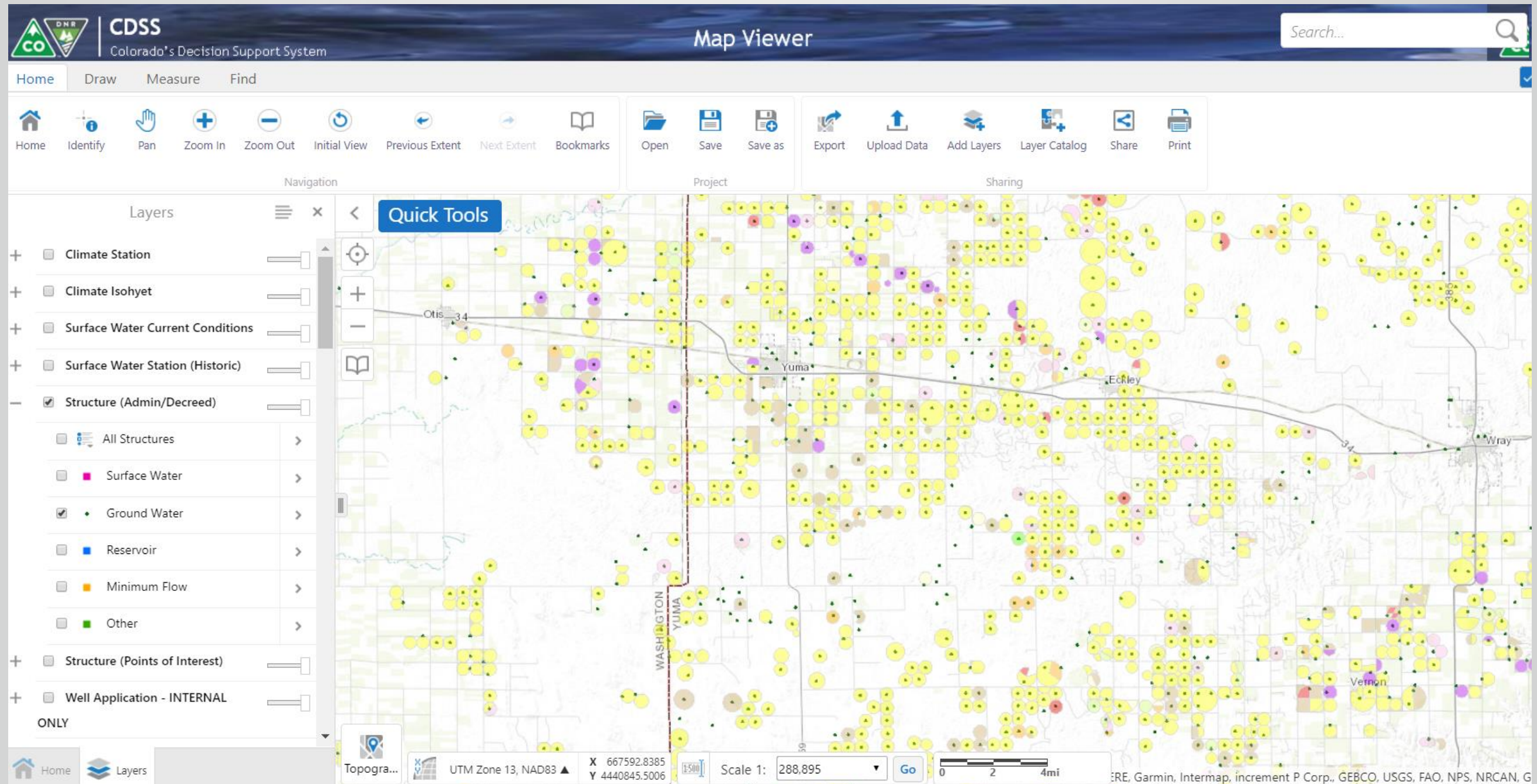
TITLE/DESCRIPTION	FILE TYPE	LAST UPDATED
<a href="#">Division 1 Irrigated Lands</a> (1956, 1976, 1987, 1997, 2001, 2005, 2010, 2015)	Geodatabase, Zipped Shapefiles	11/22/2017
<a href="#">Division 1 - Republican Irrigated Lands</a> (2010, 2015, 2016)	Geodatabase, Zipped Shapefiles	8/23/2017
<a href="#">Division 2 Irrigated Lands</a> (2003, 2010, 2015)	Geodatabase, Zipped Shapefiles	8/23/2017
<a href="#">Division 3 Irrigated Lands</a> (1936, 1998, 2002, 2005, 2009 - 2015)	Geodatabase, Zipped Shapefiles	8/23/2016
<a href="#">Division 4 Irrigated Lands</a> (1993, 2000, 2005, 2010, 2015)	Geodatabase, Zipped Shapefiles	5/22/2017
<a href="#">Division 5 Irrigated Lands</a> (1993, 2000, 2005, 2010, 2015)	Geodatabase, Zipped Shapefiles	12/15/2016
<a href="#">Division 6 Irrigated Lands</a> (1993, 2000, 2005, 2010, 2015)	Geodatabase, Zipped Shapefiles	2/2/2017
<a href="#">Division 6, Dist 47 Irrigated Lands</a> (1952, 1956, 1976, 1987, 2001, 2005, 2010-2015)	Geodatabase, Zipped Shapefiles	9/21/2016
<a href="#">Division 7 Irrigated Lands</a> (1993, 2000, 2005, 2010, 2015)	Geodatabase, Zipped Shapefiles	11/22/2017

<http://cdss.state.co.us/GIS/Pages/AllGISData.aspx>





# Where to Access our Data




<http://water.state.co.us/DataMaps/GISandMaps/MapView/MapView/Pages/FAQ.aspx>



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Department of Natural Resources

# Where to Access our Data



Structures

[Export](#) [Help](#)

Structure Name	WEST MAUSOLEUM LK (0703003)	Associated Permits	
Structure Type	WELL	Water Source Type	Tributary
CIU Code	Active structure but diversion records are not maintained (U)	Water Source	GROUNDWATER: CLEAR CREEK

Structure Overview

Diversion Records

Water Rights

Measuring Points

Irrigated Lands

Imaged Documents

Coming Soon

CWCB | DWR | DNR | Colorado.gov | Terms of Use | Privacy Policy



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