

# Wyoming's Water Use

Data Collection and Management

Charlie Ferrantelli  
State Engineer's Office  
*Interstate Streams Division*





**Groundwater Use Reporting**

**Climate Data Management**

**Irrigated Lands Mapping**

# Groundwater Use Reporting



# Groundwater Use Reporting

- SEO GW Division reporting: pumping totals and water levels for certain well types or locations (municipal, industrial, irrigation wells)
  - Historically hard copy scans, some electronic data (if you were lucky)
  - No way to enforce or know whether someone had reported
  - Unable to compile all data
- LCCA Order was the tipping point – 100s to 1000s of permits to require annual and monthly pumping reports. How to enforce?



من غير ان يكون هناك نظام من الرقابة والسيطرة والادارة الجيدة لن يكون هناك اي نوع من التقييم الجيد  
لنا فقط وسنعا مع شيخ كان حارو في القيمة وكلم وهو تالم بكلمات لا تفهمها مثل القدر بفكر له العاطف اترتت . سكت  
انواع اصحابنا طوعك ، تاج حمر ، بدس في ، من عه انما في الفتح . على تعلم فائمة الكلمات التالية هذا النص ، مفضل .  
بدا ، فدا ، بيت ، لمر .

كلمة تخرج مقلتي صرناح لبعبة وروو بزكنا راينظ ظاهرا  
المعروا واما كلان عفيف للجي . ماتت قواله  
شيخ ابي الحمر بلسي . عدا وعلنا طقلت وسفينا  
مهم شيخ . كذا عادي في الحصة يتكلم وهو تالم  
بكلمات لا افهمها مثل انتقن بلسله العفدا  
رستك . ماتت راجح ما بلنج اوصينا ظهرك ، في  
كس سس . صرناح انا في الفتح . صرناح فائمة الكلم



# Groundwater Use Reporting

Wyoming State Engineer's Office

Administering Wyoming's Water Resources

Home Ground Water Surface Water Interstate Streams Agency Divisions Documents/Data Regulations/Instructions Applications/Forms

## Metering and Reporting

**Electronic Water Data Reporting now available!**

The State Engineer's Office - Ground Water Division is pleased to announce the ability to submit Water Use and/or Water Level Reports electronically through the *Online Reporting Web Application*.

The first time you use the tool, you will need to register. To register, you will need a valid email address and will need to complete this *FORM*. Once the completed FORM is submitted, our office will email a link to the *Online Reporting Web Application* to you.

The *Online Reporting Web Application* is currently offered as a TEST PROGRAM. As such, users may encounter unexpected errors. Please report any problems or suggestions to [mailto:the.Online.Reporting.Web.Application.user.feedback@wy.gov](mailto:mailto:the.Online.Reporting.Web.Application.user.feedback@wy.gov).

Wyoming State Engineer's Office

### ONLINE WATER REPORTING

Welcome to the Wyoming State Engineer's Office Online Water Reporting Web Application

This web application may be used by all appropriators that are required to report their monthly or annual water use, as well as water levels, as may be required by their Permit Conditions, a State Engineer Order, or any other rule or regulation.

Please select the appropriate option from the menu in the top left hand corner. Use the reference below if you are uncertain which reporting option to use. Based on your permit(s), you may need to submit data under multiple reporting options.

- Monthly Water Use Reporting**  
Choose this option for all permits that require reporting of water use on a monthly basis. Including all permits that were issued on a Temporary/Time Limited basis.
- Annual Water Use Reporting**  
Choose this option for all permits that require reporting of monthly water use on an annual basis. This includes all permits that require reporting on a Calendar Year or Water Year basis, including water use reporting for the Laramie County State Engineer Order.
- Water Level Reporting**

67° 9:53

SEO Water Use Data Entry  
script.google.com

Wyoming State Engineer's Office

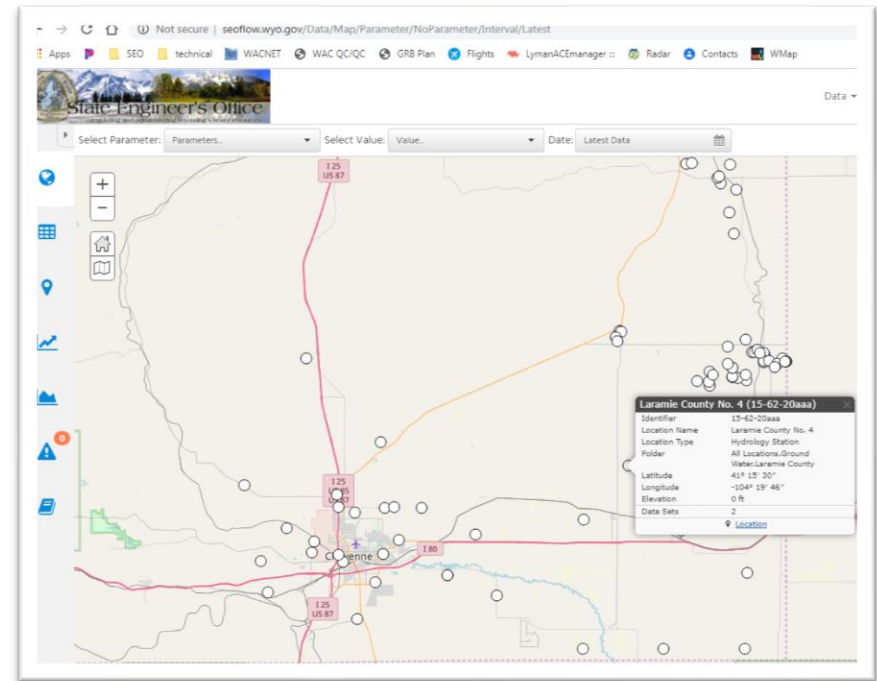
PERMIT DETAIL	WATER USE	WATER LEVEL	
WR Number	Permit No	Permit No Suffix	Facility Name
P10007.0W	10007	.0W	WERNER #4
Appropriator Information			
Company	First Name	Last Name	
CARPENTER FARMS			

- SEO GW Division, realizing the need, developed an online reporting tool for statewide wells
  - Google Forms
  - So far ~1900 well permits
  - Website or even on smart phone
- Now have data for
  - Permit compliance/enforcement
  - Water right history & disputes
  - Hydrologic data
  - Saved lots of money

# Groundwater Use Reporting

## Possible future improvements

- Data available to public through “SEOflow” web-portal (MWs, gauge data)
  - Very cool!
- Internal connections with other permitting database: help with application processing
- Assist applicants with Temporary Water Use Agreements: allows water to be used elsewhere



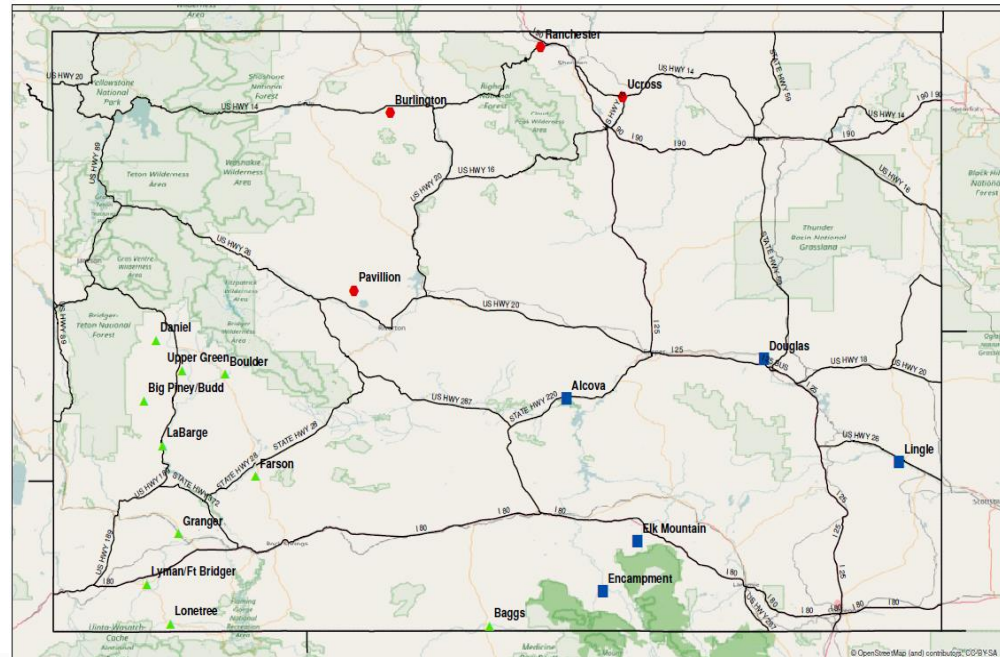
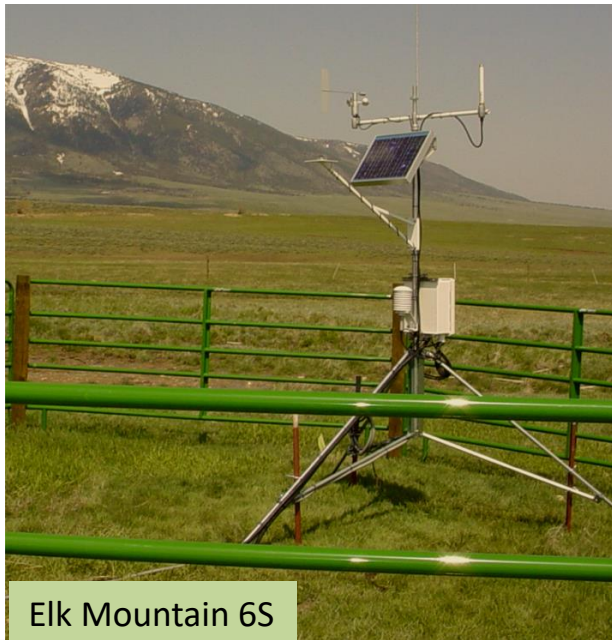
<http://seoflow.wyo.gov>

# Climate Data Management



# Climate Data Management

- Agricultural climate stations – 19 SEO sites
  - Wyoming Agricultural and Climate Network (WACNet)
  - Consumptive use reporting per Upper Colo River Compact, Modified N Platte Decree, Bear River Basin?
  - Regional studies, databases, local public benefits
  - Ability for Penman-Monteith ET calcs





# Climate Data Management

- WACNet managed by the SEO (4) and WRDS (3)
  - Installation, programming, upgrades, O&M, QA/QC
  - Data transmitted by cell hourly to WRDS website

UNIVERSITY OF WYOMING

Water Resources Data System & Wyoming State Climate Office

Home Data & Products Water Library Wyoming Climate Wyoming Weather CoCoRaHS Sitemap Education & Outreach Cooperative Projects Water Links Contact

Wyoming Agricultural Climate Network (WACNet)  
Wyoming State Engineer's Office

Station Map | WACNet Home

Current Conditions

Station	TIMESTAMP	Air Temp (°F)	Rel Humid (%)	Solar Radiation (watts/m²)	10cm Soil Temp (°F)	Wind Speed (mi/s)	Wind Dir (°)	Wind Spd (mph)	Wind Dir StDev	Rain (mm)
Alcova 14W	2019-09-10 13:00:00	72.14	25	180.3	63.23	5.84	0.2	13.07	0.00	0.0
Baggs 2E	2019-09-10 11:00:00	68.74	34	360.4	nan	5.35	235.3	11.97	21.42	0.0
Big Piney 11W	2019-09-10 13:00:00	63.68	35	517.1	56.86	4.68	185.9	10.48	22.32	0.0
Boulder 2SE	2019-09-10 13:00:00	63.34	35	769.7	59.13	3.21	177.6	7.17	24.10	0.0
Burlington 2NE	2019-09-10 13:00:00	65.35	44	343.9	nan	4.21	326.6	9.41	16.38	0.0
Daniel 8S	2019-09-10 12:00:00	58.91	44	724.5	55.40	4.96	157.2	11.10	13.96	0.0
Daniel 10NW	2019-09-10 13:00:00	59.29	47	654.0	nan	4.83	114.7	10.81	24.88	0.0
Douglas 4NW	2019-09-10 12:00:00	76.03	34	694.6	60.15	5.68	137.7	12.70	14.27	0.0
Elk Mountain 6S	2019-09-10 13:00:00	85.66	38	627.0	53.91	8.26	249.1	18.48	28.05	0.0
Encampment SNE	2019-09-10 13:00:00	69.87	31	682.1	60.69	5.60	237.8	12.52	19.16	0.0
Farson 5S	2019-09-10 11:00:00	59.63	51	655.1	52.38	2.92	208.8	6.54	47.51	0.0
Granger SNW	2019-09-10 12:00:00	64.76	34	458.5	nan	6.31	245.3	14.12	15.42	0.0
LaBarge 2S	2019-09-10 12:00:00	59.83	50	724.1	nan	2.36	307.3	5.27	29.87	0.0
Lingle 2W	2019-09-10 08:00:00	61.34	99	131.6	69.22	1.07	114.5	2.38	31.05	0.0
Lonetree	2019-09-10 13:00:00	58.01	53	324.5	nan	5.03	97.5	11.24	13.80	0.0
Lyman 1SW	2019-09-10 13:00:00	67.64	36	657.4	54.66	2.80	299.8	6.27	25.84	0.0
Pavillion 2N	2019-09-10 13:00:00	63.48	47	747.0	nan	3.02	106.8	6.76	20.55	0.0
Ranchester 2W	2019-09-10 13:00:00	65.46	60	202.3	nan	1.61	198.2	3.61	44.65	0.0
Ucross 1W	2019-09-10 13:00:00	70.05	51	480.7	nan	2.07	71.4	4.62	23.25	0.0
Heart Mountain	2019-09-10 13:00:00	62.33	43	747.0	60.66	5.08	345.2	8.27	20.79	0.0
Shendan	2019-08-25 02:00:00	59.25	80	0.1	84.00	0.69	86.3	2.06	15.66	0.0
Worland	2019-09-10 13:00:00	67.05	53	nan	61.74	1.42	339.9	3.48	0.14	0.0
RogerResearch	2019-06-16 11:00:00	57.43	70	671.5	55.17	1.09	21.4	3.00	52.67	0.0

Wyoming Agricultural and Climate Network  
Big Piney 11W

Station Map | WACNet Home  
Week at a Glance

Date	TMax (F)	TMin (F)	TAvg (F)	SoilTemp (F)	Avg Vapor Pressure (kPa)	Avg Sat Vapor Pressure (kPa)	Avg RH (%)	Solar Rad (w/m²)	Avg Wind Spd (mph)	Precipitation (")
2019-09-04	81.23	44.14	58.19	63.36	0.80	1.77	51	117.10	5.94	0.04
2019-09-05	87.82	38.55	62.42	63.14	0.77	2.17	47	265.00	5.72	0.00
2019-09-06	86.23	47.98	63.86	63.90	0.96	2.15	51	202.70	4.97	0.20
2019-09-07	75.76	37.94	56.82	63.52	1.12	1.65	73	140.00	5.63	0.04
2019-09-08	76.12	36.01	54.16	61.70	0.72	1.58	58	261.40	5.84	0.00
2019-09-09	55.83	36.07	46.06	59.32	0.91	1.07	85	72.93	4.55	0.44
2019-09-10	62.85	31.87	47.25	57.63	0.65	1.17	63	209.40	5.36	0.00

Click Image to Enlarge

Hourly Temperature (2 Days)

Click Image to Enlarge

Daily Max/Min Temperature (30 Days)

Download Hourly Data  
Download Daily Data

<http://www.wrds.uwyo.edu/WACNet/Stations.html>

# Climate Data Management

Lots of good things, but some challenges:

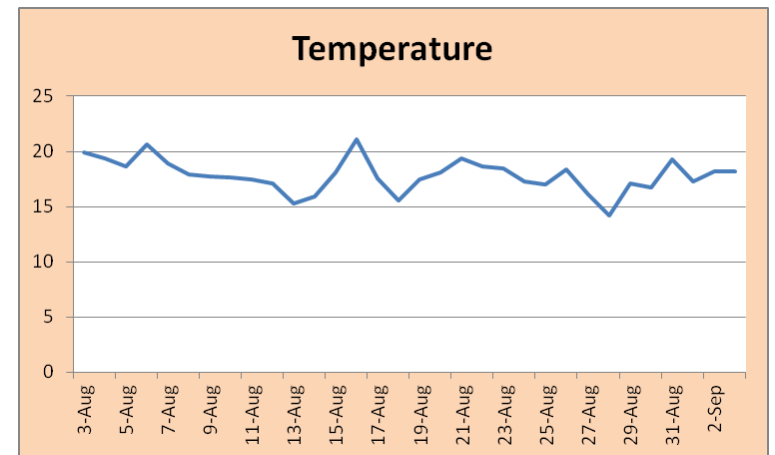
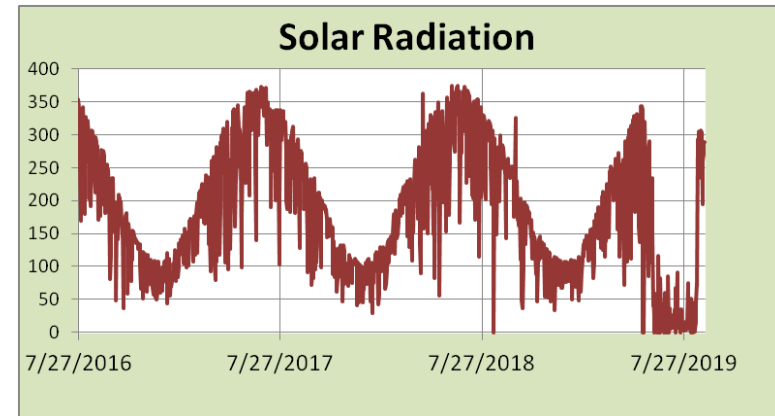
- Inconsistent table formatting
- Inconsistent parameters - hourly vs. daily tables
- QA/QC
- Inherited stations poor locations or changing conditions



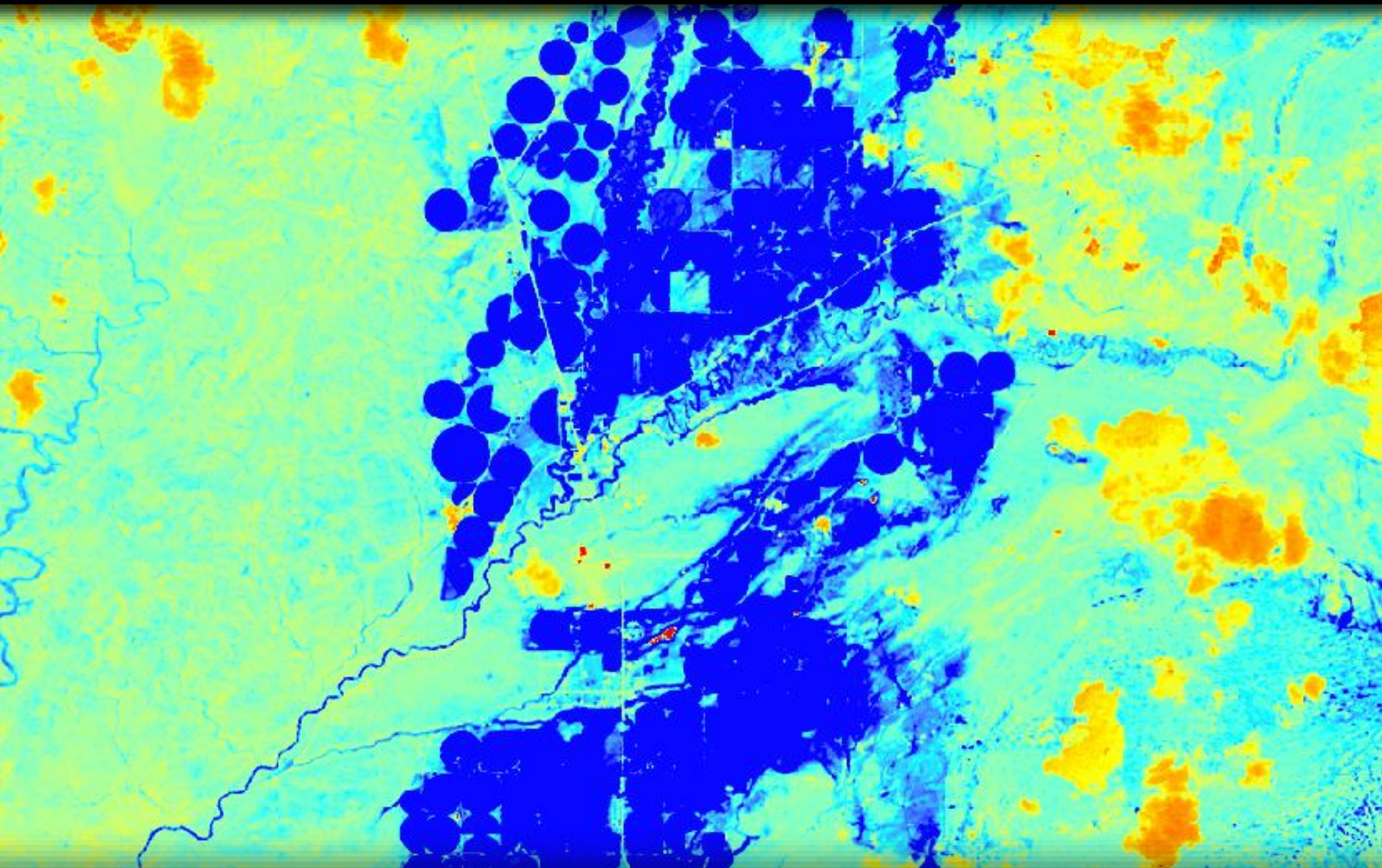
# Climate Data Management

## Improvements:

- Standardized formatting: daily/hourly, between stations, going back to the beginning
- New parameters, calculating missing parameters, where applicable
- QA historical data (soon)
- Automated red flags for data issues (soon)
- Website improvements
  - [Could use advice here...!](#)
  - Benefits users and caretakers?
  - Visual data: short- mid- & long-range time scales?

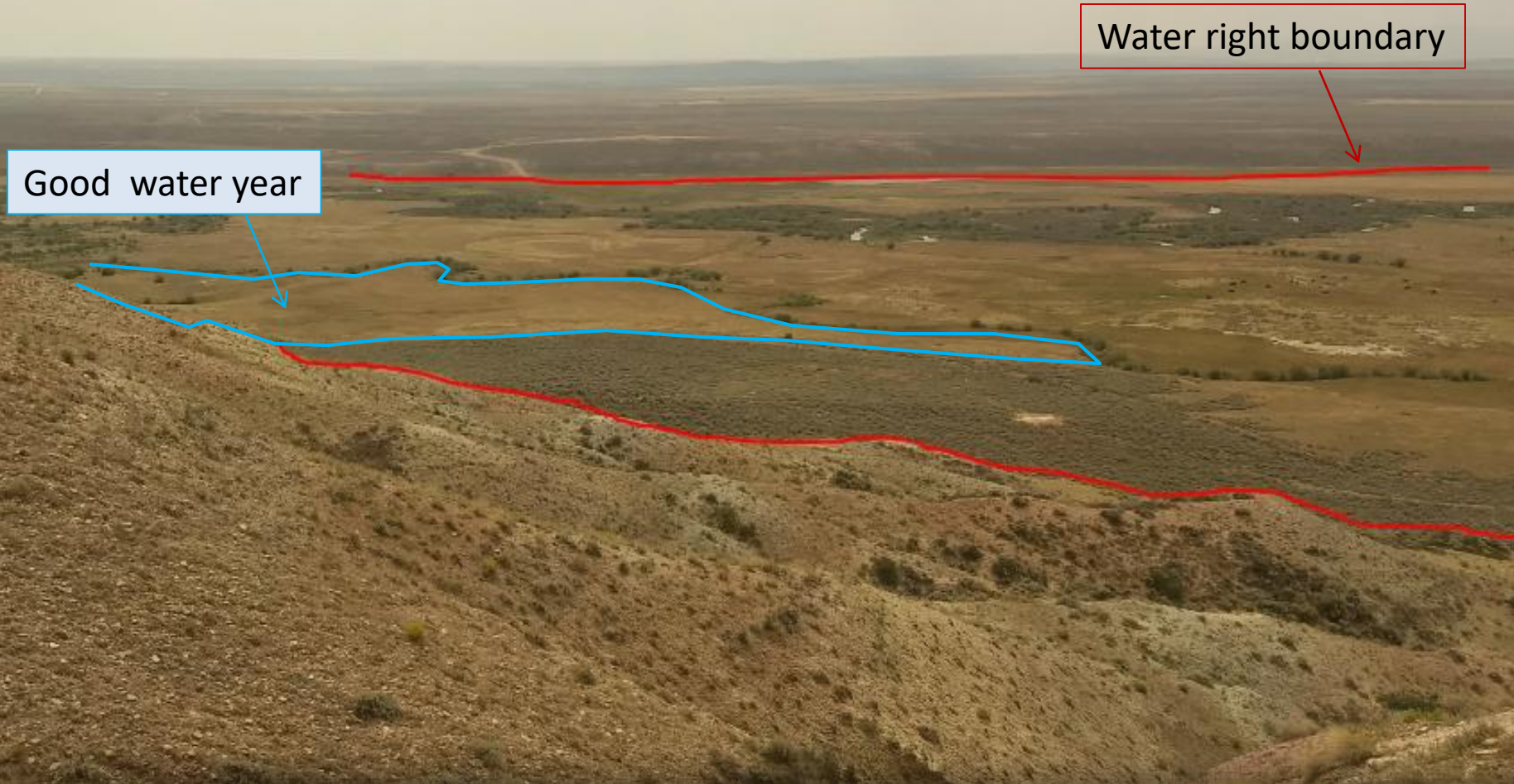


# Irrigated Lands Mapping



# Irrigated Lands Mapping

Why is this necessary?



Water right boundary

Good water year

# Irrigated Lands Mapping

How currently being done at SEO:

- North Platte: acreage inspectors manually map irrigated lands

Decree regulations:

- Acreage cap of intentionally irrigated lands; those that can be controlled.
- 10 yr running average of CU

# Irrigated Lands Mapping

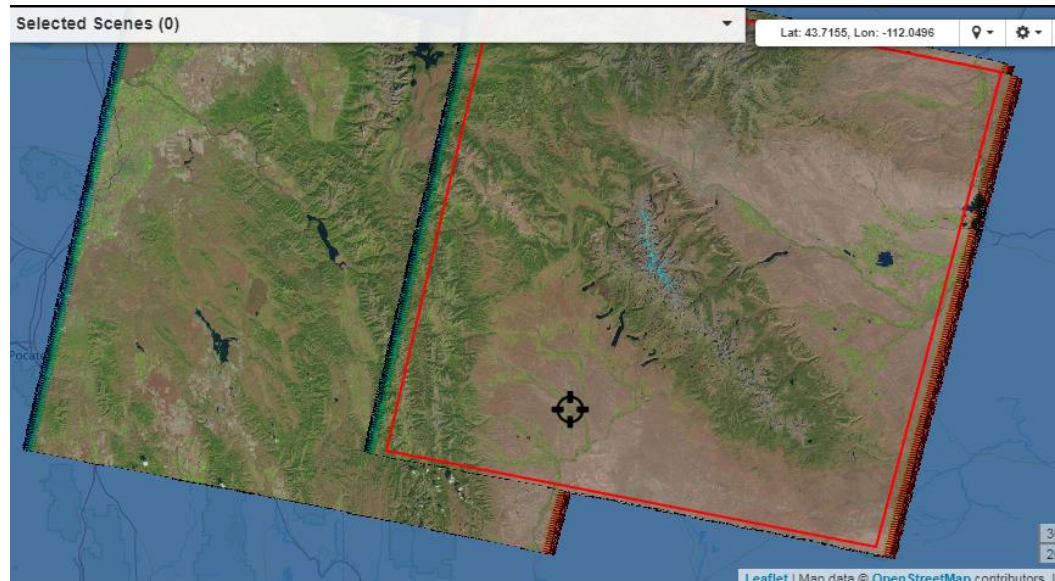
Normalized Difference Vegetation Index (NDVI) in Green/Little Snake basins

$$\text{NDVI} = \frac{(\text{NIR} - \text{Red})}{(\text{NIR} + \text{Red})}$$

Compact regulations: Upper Colo River Compact: WY gets 14% of total consumptive use of Upper Division states

# Irrigated Lands Mapping

- USGS EROS & GloVis
  - Challenge was that it required several steps to obtain all the correct scenes, examine the clear dates, compile multiple dates, and mosaic together.





# Irrigated Lands Mapping

- ClimateEngine.org
  - Team: DRI and Univ of ID
  - Free, takes care of these issues and other tools
    - Combine scenes
    - Review dates quickly
    - Avg, max, min multiple dates
    - Time series



Western Regional  
Climate Center  
Providing climate services since 1976



# Irrigated Lands Mapping

NDVI date range

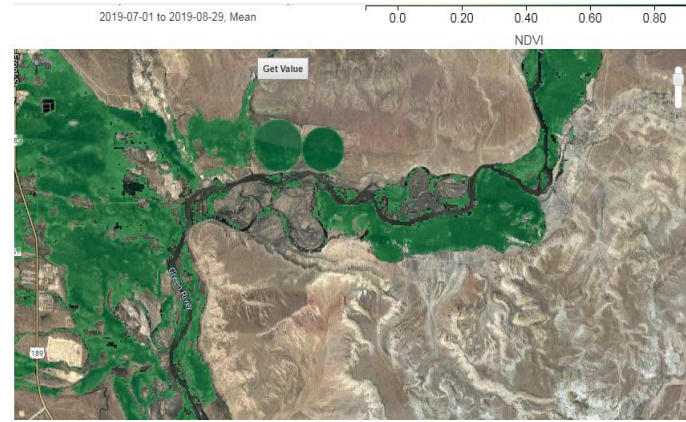


Computation Resolution (Scale): 30 m

Processing  
Statistic (over day range): Mean  
Calculation: Values

Time Period  
Period of Record: 1984-01-01 to 2019-08-29  
Year: 2018  
Season: Last 60 Days of Data  
Start Date: 2019-07-01  
End Date: 2019-08-29

GET MAP LAYER



Testing thresholds, e.g.,  $NDVI > 0.5$

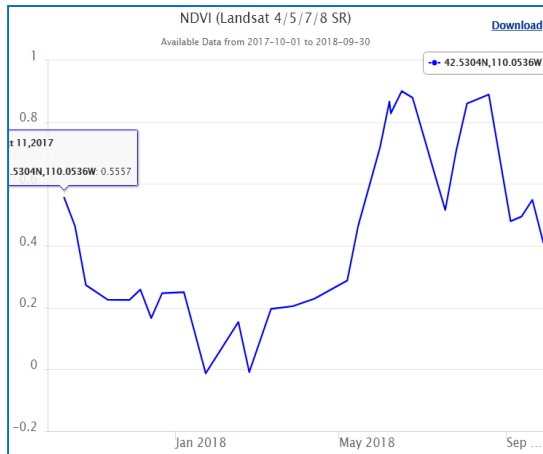
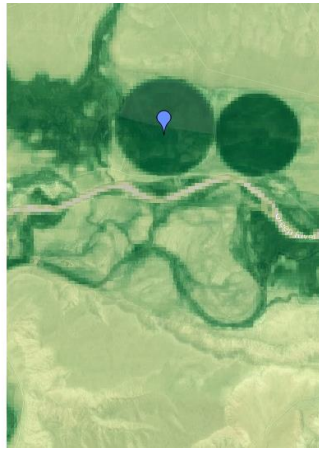
Variable 1

Variable 1  
Type: Remote Sensing  
Dataset: Landsat 4/5/7/8 Surface Reflectance  
Variable: NDVI (Vegetation Index)

Computation Resolution (Scale): 30 m

Time Period  
Period of Record: 1984-01-01 to 2019-08-29  
Season: Last Northern Water Year (Oct - Sept)  
Start Date: 2017-10-01  
End Date: 2018-09-30

GET TIME SERIES

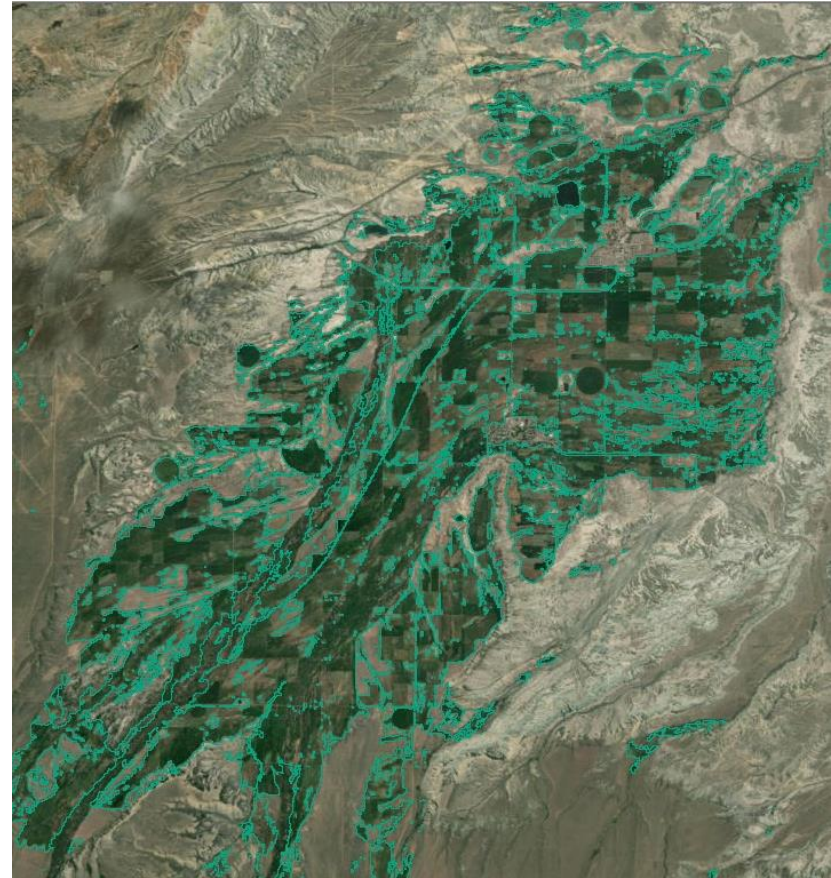


Time series of NDVI: e.g., useful for cutting dates, season length

# Irrigated Lands Mapping

## Challenges

- Determining the threshold value
- Masking out non-irrigated areas
  - High elevation
  - Natural vegetation
  - Seepage growth?
- Inter-field boundaries
  - Not annual task
  - Open-ET Wyoming fields
  - How to divide blob using useful polygons



Bridger Valley, WY

The End



The End...