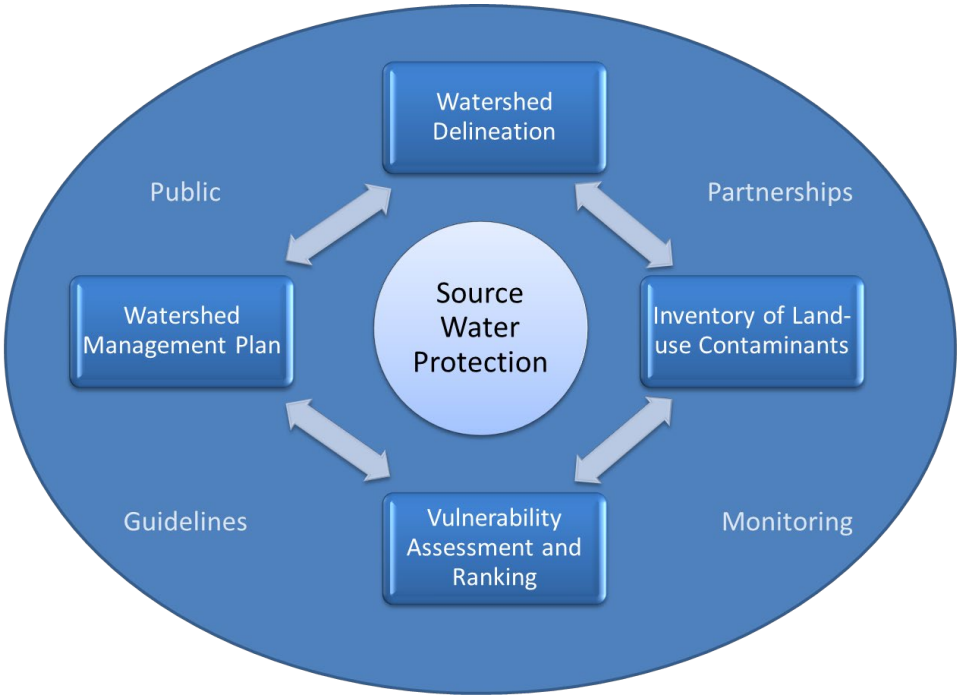
Source Water Protection Planning

Using THREATS to Reduce the Heavy Lifting

Steph Neufeld, M.Sc., Watershed Manager
ALMS Conference

Source Water Protection Planning

– 1st step in a multi-barrier approach to protect water quality and quantity and understand and mitigate potential risks



Source Water Protection Plan Components

American Water and Wastewater Association's (AWWA) Standard

Successful source water protection programs may vary widely in their details, but successful programs share six fundamental elements (AWWA 2010):

1. Source Water Protection Plan Vision
2. Characterization of Source Water and Source Water Protection Area
3. Source Water Protection Goals
4. Source Water Protection Action Plan
5. Program Implementation
6. Periodic Evaluation and Revision

THREATS

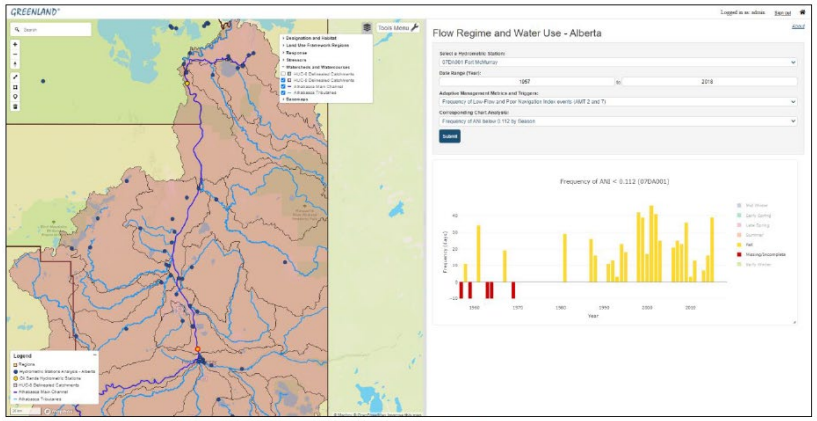
What can it do?

An Introduction to THREATS

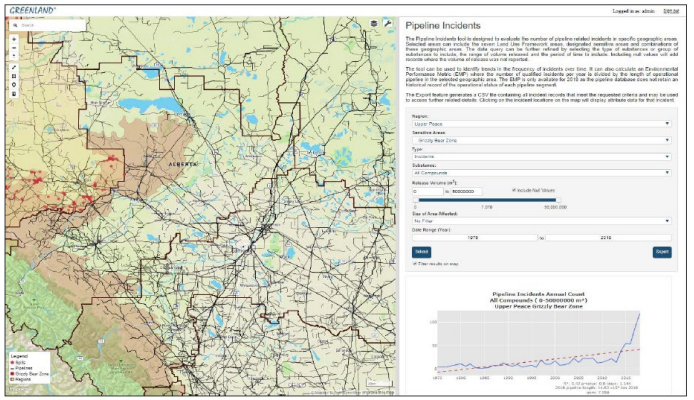
The Healthy Rivers Ecosystem Assessment System (THREATS) is a platform for accessing and viewing complex spatial and time series data. It can be customized to include data and tool sets that address specific requirements.

THREATS™
THE HEALTHY RIVER ECOSYSTEM ASSESSMENT SYSTEM

Information Platform for Decision Support and Evaluation of Cumulative Environmental Effects



THREATS™ – Athabasca River Flow Regime and Navigation Index Analysis



THREATS™ – Pipeline incidents metric for Alberta with temporal spill query and regard for sensitive land features (incl. wetlands, wildlife, fisheries, etc.)

Delineating Your Boundary

The first task in completing a SWP Plan is to define and delineate the area of concern which includes the entire watershed upstream of the source intake.

Often this watershed boundary is unique to the drinking water provider and will not follow a sub-watershed or larger basin watershed boundaries.

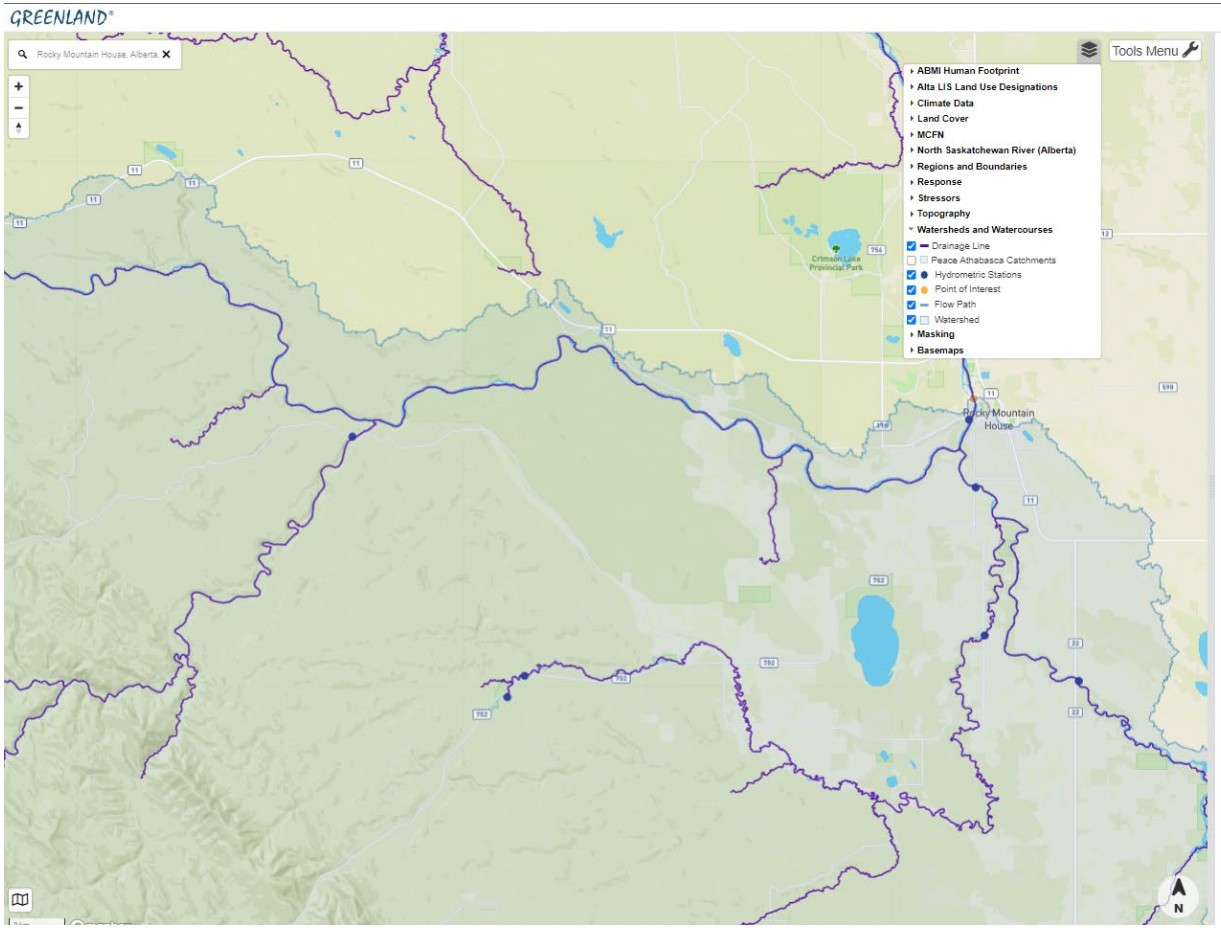
Delineation and mapping of the watershed can be achieved through use of a GIS program and using a digital elevation model.

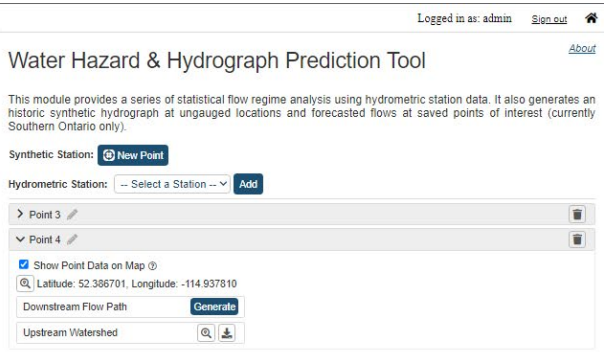
Similarly, this information may be available through the Watershed Planning and Advisory Council in which the drinking water watershed is in.

Alternatively, THREATS is able to generate delineated catchments at user specified outlets where data is available or pre-defined catchment areas can be loaded.

Source Watershed Delineation

Historically: Delineation and mapping of the watershed can be achieved through use of a GIS program and using a digital elevation model and expertise

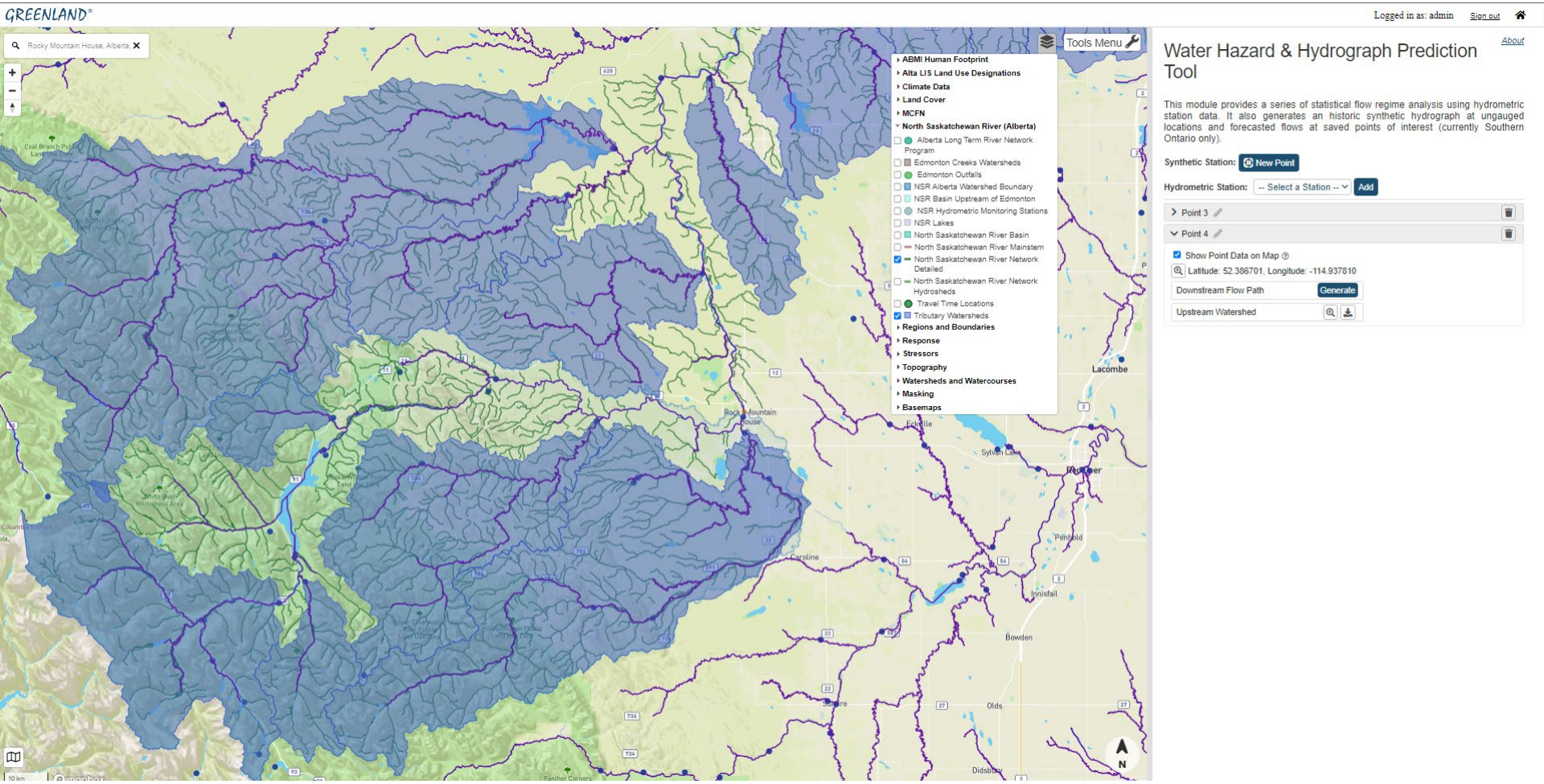




Drop a point on the map and delineate upstream drainage area and trace downstream flow.

Also done in AFETU

Pre-Loaded Watershed in THREATS



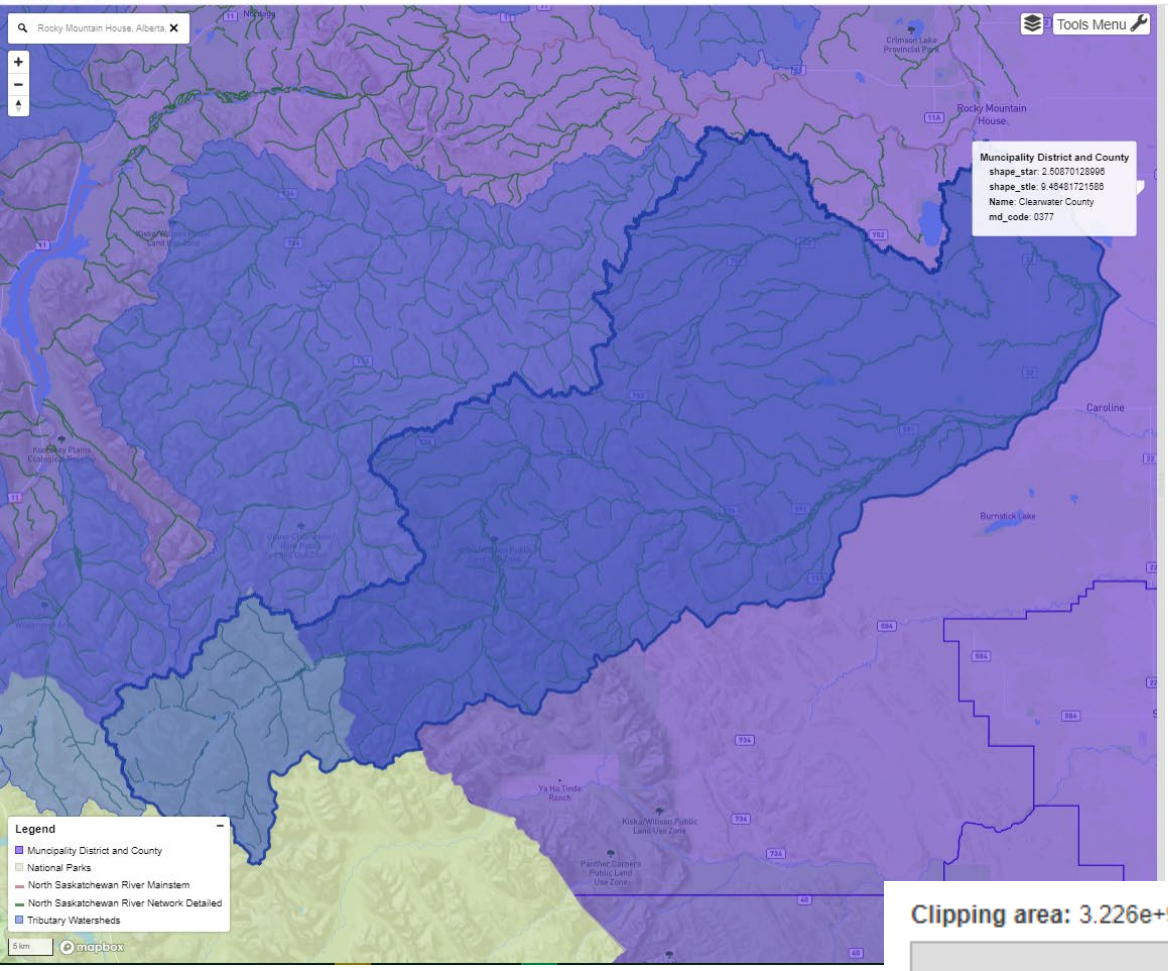
Land Use Mapping Considerations

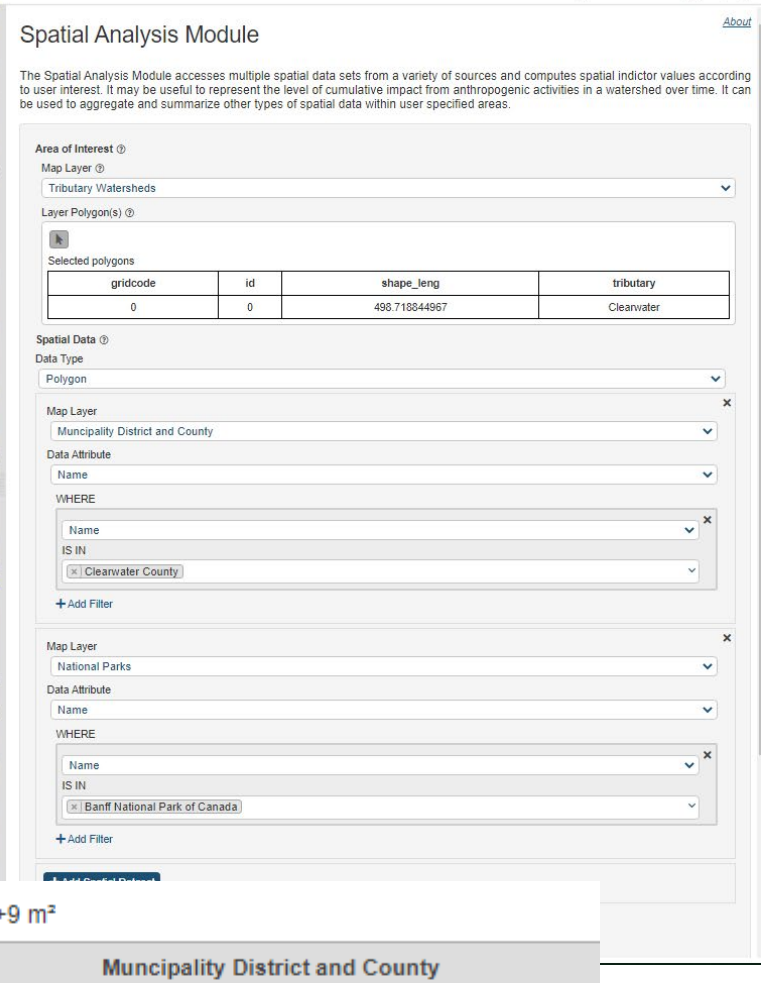
- Spatially displaying land activities in the watershed through GIS layer

- These layers may be related to
  - resource extraction
  - parks and protected areas
  - roads and other linear disturbance
  - urban footprints
  - agricultural practices
  - sewage disposal facilities
  - natural topography
  - land cover classes (wetlands, forested areas, etc.)

- **THREATS contains an ever-expanding library of relevant map layers and temporal data**

Sub-basins and Municipal Boundaries





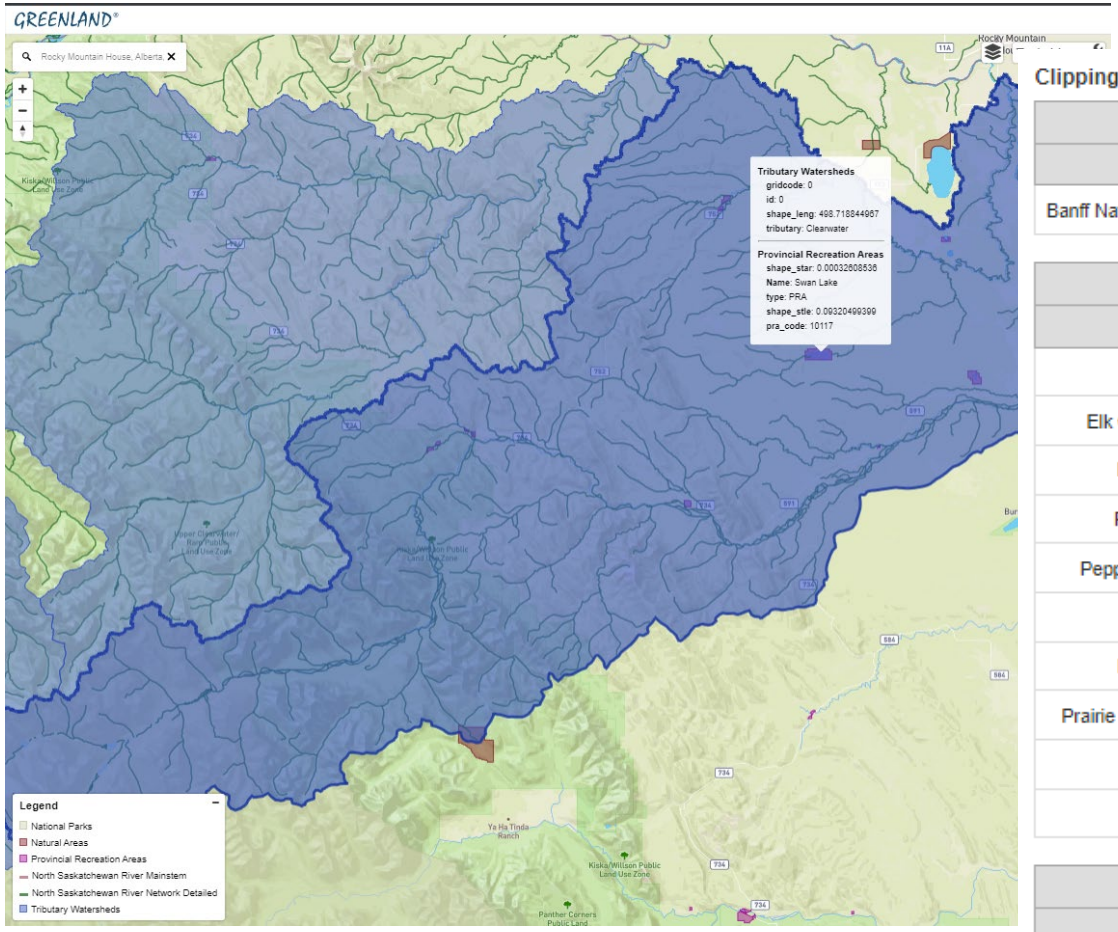
Approximately 87% of Clearwater tributary drainage area is within Clearwater County. The remaining 13% is within Banff National Park.

Clipping area: 3.226e+9 m²

Muncipality District and County			
Name	Data Field Count	sum_clipped_dim (m²)	Ratio
Clearwater County	1	2.796e+9	0.866676

National Parks			
Name	Data Field Count	sum_clipped_dim (m²)	Ratio
Banff National Park of Canada	1	4.305e+8	0.133443

Parks and Protected Areas Analysis with THREATS



Approximately ***%

Clipping area: 3.226e+9 m²

National Parks			
Name	Data Field Count	sum_clipped_dim (m²)	Ratio
Banff National Park of Canada	1	4.305e+8	0.133443

Provincial Recreation Areas			
Name	Data Field Count	sum_clipped_dim (m²)	Ratio
Elk Creek	1	1.615e+5	0.0000501
Elk Creek Fish Pond	1	8.256e+4	0.0000256
Mitchell Lake	1	2.157e+5	0.0000669
Peppers Lake	1	1.599e+5	0.0000496
Peppers Lake Staging	1	1.517e+5	0.000047
Phyllis Lake	1	1.094e+6	0.0003392
Prairie Creek	1	3.808e+5	0.000118
Prairie Creek Group Camp	1	1.279e+5	0.0000396
Seven Mile	1	3.708e+5	0.0001149
Strachan	1	3.225e+5	0.0001

Natural Areas			
Name	Data Field Count	sum_clipped_dim (m²)	Ratio
Chedderville	5	2.326e+6	0.000721
Clearwater Ricinus	1	6.817e+5	0.0002113
Scalp Creek	1	2.951e+6	0.0009145

Land Cover Using ABMI Data Hosted in THREATS with Spatial Analysis

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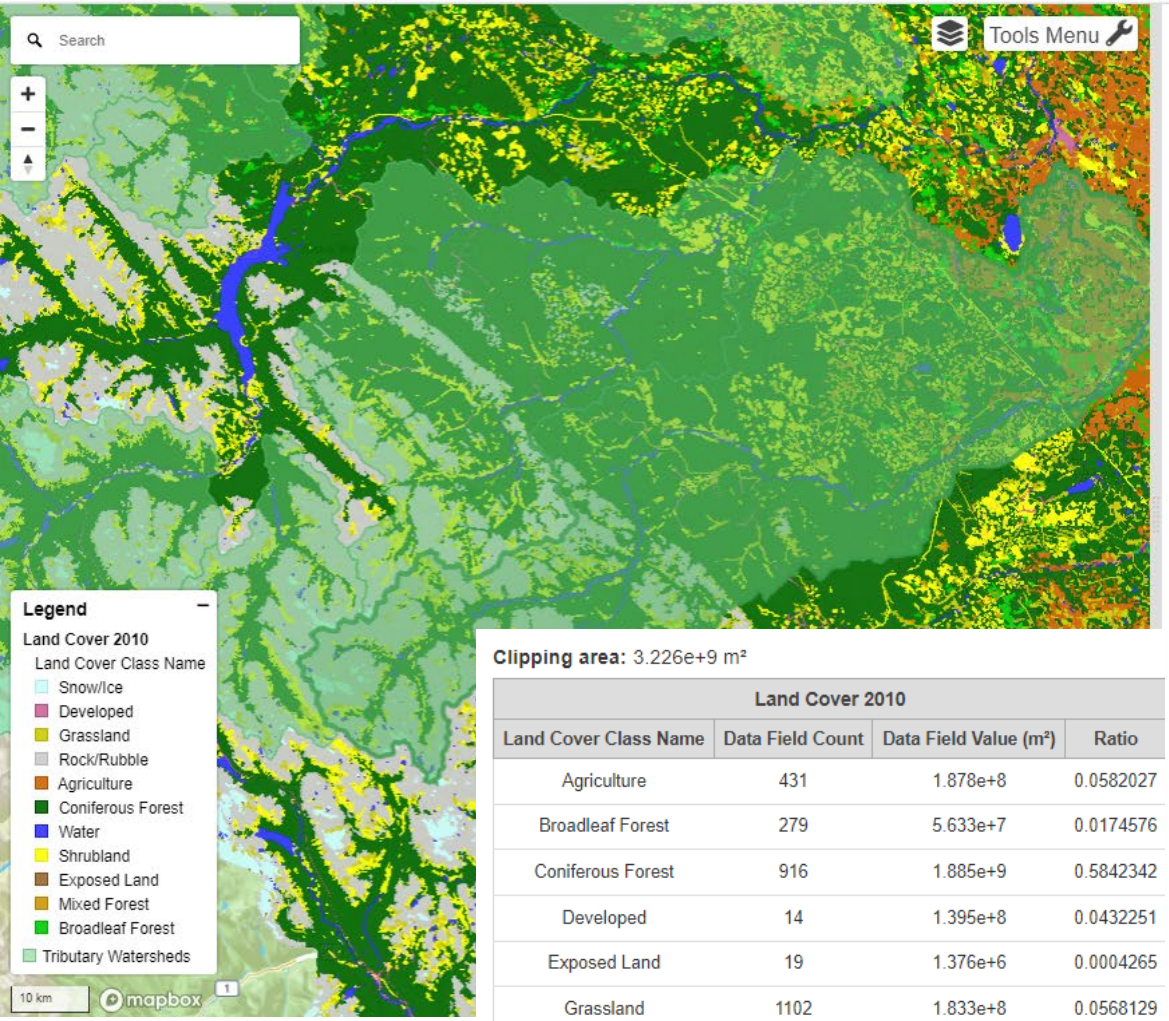


Clipping area: 3.226e+9 m²

Land Cover 2010			
Land Cover Class Name	Data Field Count	Data Field Value (m²)	Ratio
Agriculture	431	1.878e+8	0.0582027
Broadleaf Forest	279	5.633e+7	0.0174576
Coniferous Forest	916	1.885e+9	0.5842342
Developed	14	1.395e+8	0.0432251
Exposed Land	19	1.376e+6	0.0004265
Grassland	1102	1.833e+8	0.0568129
Mixed Forest	128	2.209e+7	0.0068458
Rock/Rubble	130	4.629e+8	0.14347
Shrubland	1160	2.181e+8	0.0676058
Snow/Ice	37	1.203e+7	0.0037277
Water	119	5.805e+7	0.0179916

Spatial Analysis Module

About

The Spatial Analysis Module accesses multiple spatial data sets from a variety of sources and computes spatial indictor values according to user interest. It may be useful to represent the level of cumulative impact from anthropogenic activities in a watershed over time. It can be used to aggregate and summarize other types of spatial data within user specified areas.

Area of Interest

Map Layer: Tributary Watersheds

Layer Polygons

Selected polygons

shape_leng	tributary	gridcode	id
498.718844967	Clearwater	0	0

Spatial Data

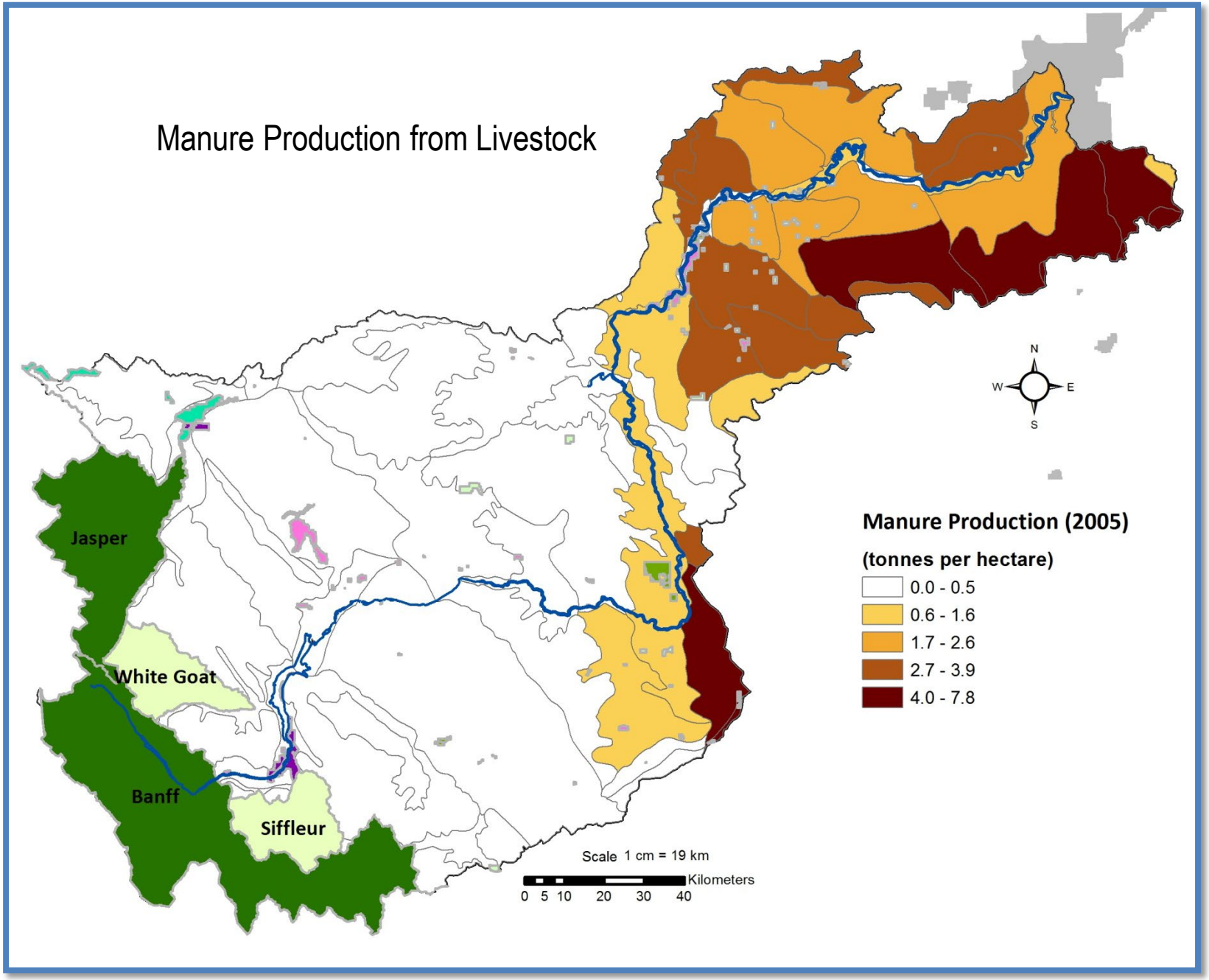
Data Type: Polygon

Map Layer: Land Cover 2010

Data Attribute: Land Cover Class Name

Attribute Values: Agriculture, Broadleaf Forest, Coniferous Forest, Developed, Exposed Land, Grassland, Mixed Forest, Rock/Rubble, Shrubland, Snow/Ice, Water

+ Add New


Manure Production from Livestock
Jasper
White Goat
Banff
Siffleur
N
W
E
S
Manure Production (2005)
(tonnes per hectare)
0.0 - 0.5
0.6 - 1.6
1.7 - 2.6
2.7 - 3.9
4.0 - 7.8
Scale 1 cm = 19 km
Kilometers
0 5 10 20 30 40

Land Use Inventory: Livestock

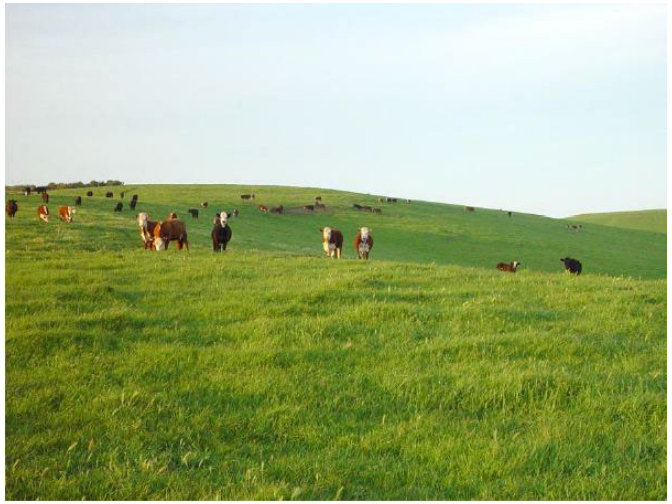
THREATS Spatial Analysis Module is being updated to enable spatial weighting of attribute table data. This is a particularly import feature for data like Census of Agriculture which has more than 120 numeric value fields associated with CCS polygons. The new module will be able to summarize data similar to the following:

Table xx. Livestock number and density by livestock type.

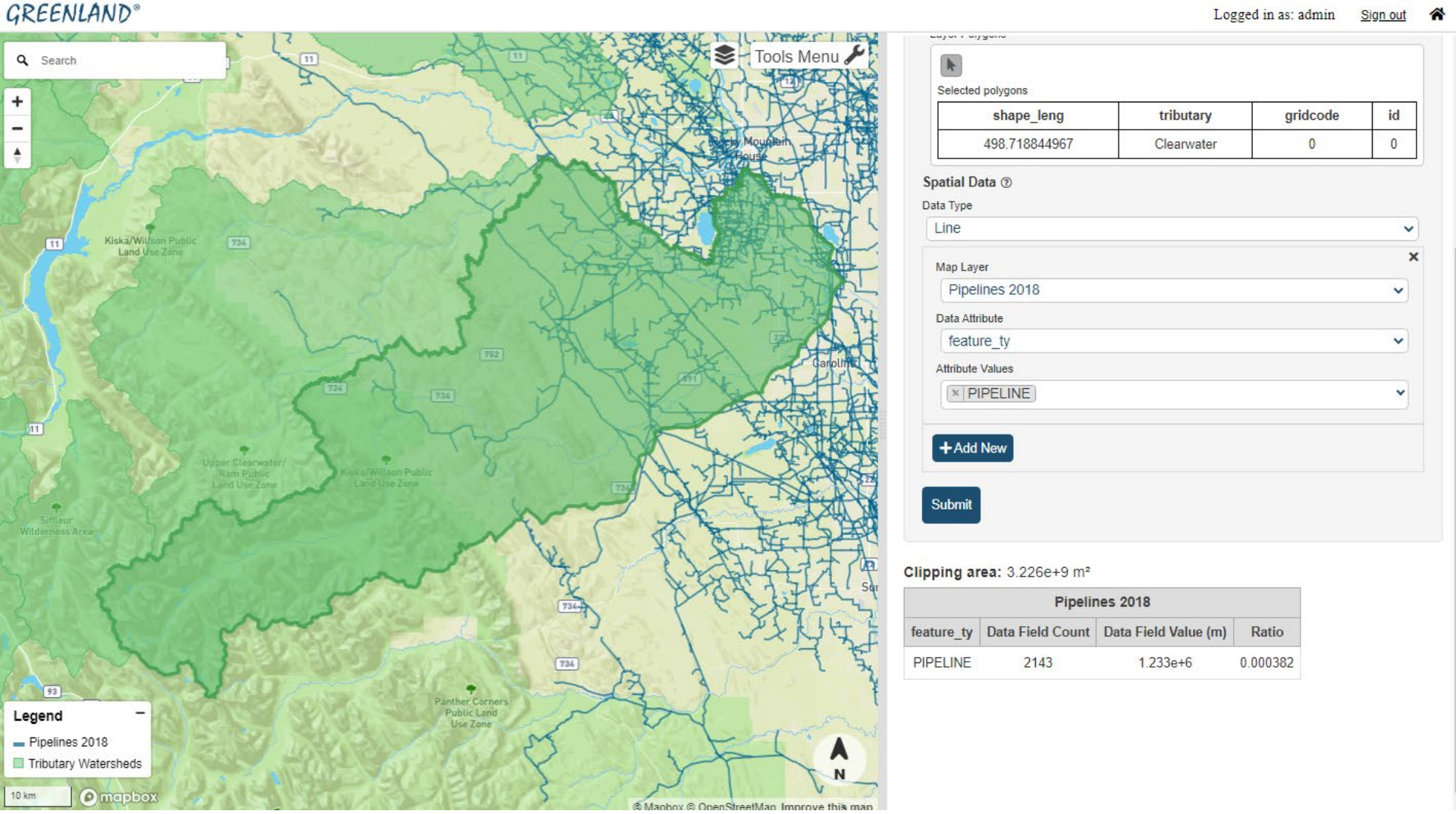
Livestock Type	Number	Density (individuals/km^2)
Cattle	19878	13.3
Sheep	431	0.29
Pigs	9	0.006
Poultry	89845	60.2

Table xx. Livestock number and density by livestock type.

Land Use	Area (ha)	Area Density (ha/km^2)
Cropland	16991	11.4
Improved Pasture	8562	5.7
Unimproved Pasture	38720	25.9
Total Agricultural Land	73206	49.0

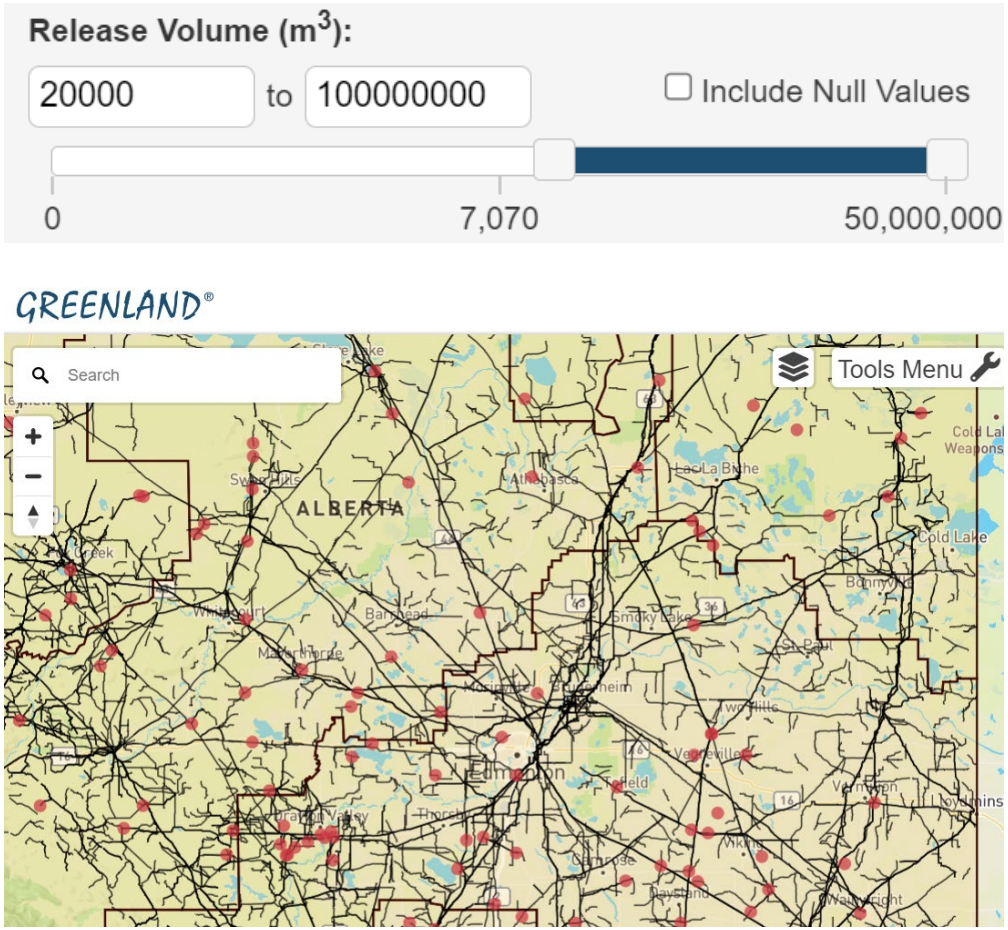


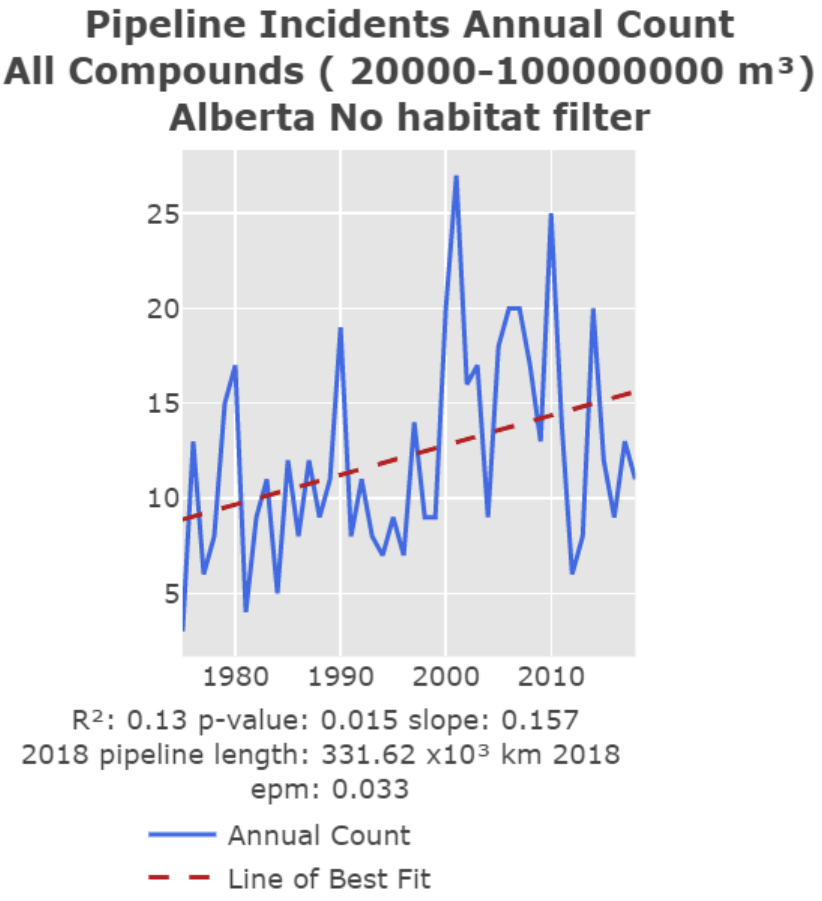
Pipelines Analysis using THREATS.



THREATS also has a separate pipeline historic releases and impacts module

Pipeline Incidents Module





- Contributions from the University of Alberta and Greg Goss

Forest Management Areas Analysis in THREATS

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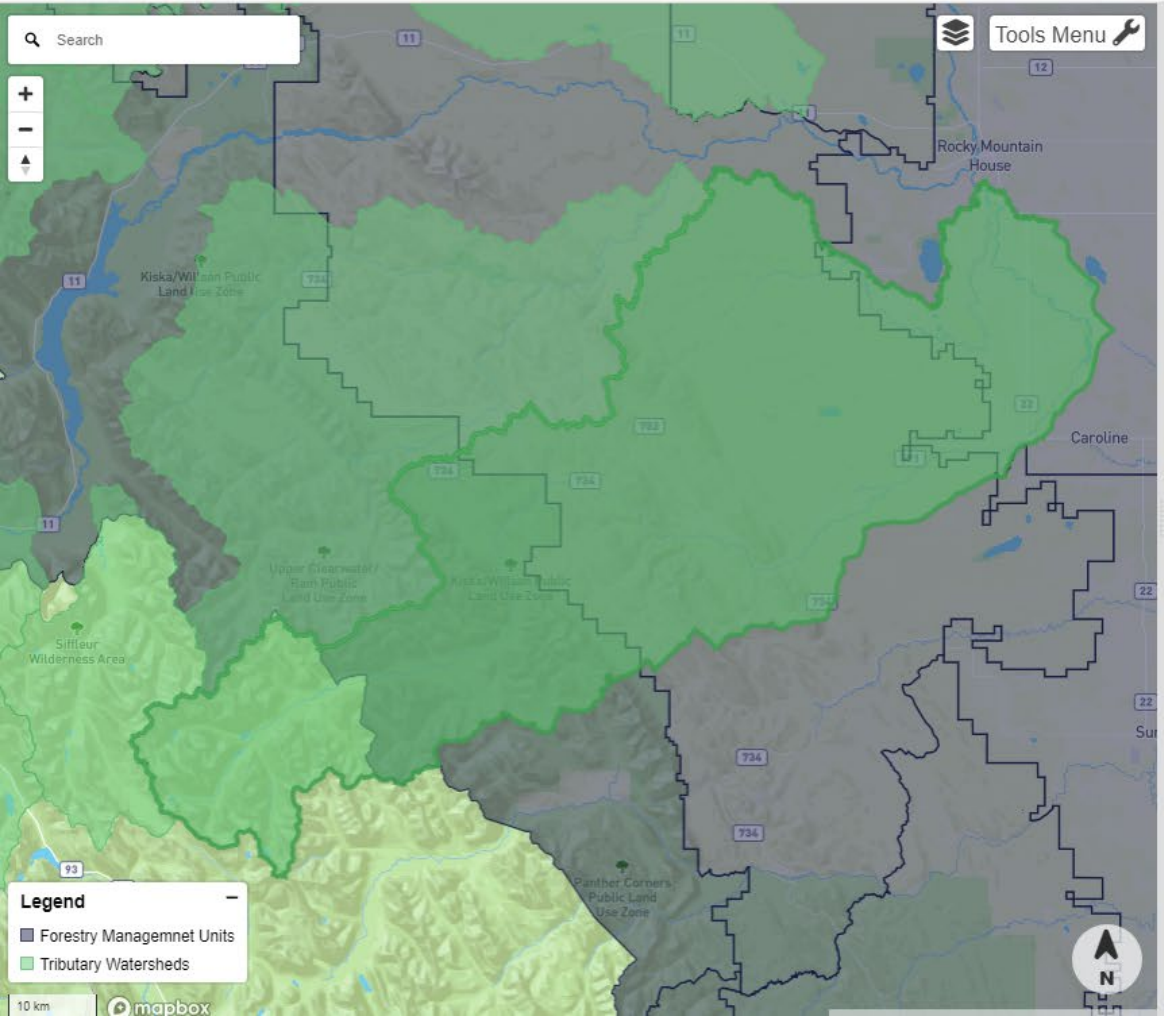

Selected polygons

shape_leng	tributary	gridcode	id
498.718844967	Clearwater	0	0

Spatial Data

Data Type: Polygon

Map Layer: Forestry Managemnet Units

Data Attribute: Name

Attribute Values: R10, R11, RO1

+Add New

Submit

Clipping area: 3.226e+9 m²

Forestry Managemnet Units			
Name	Data Field Count	Data Field Value (m²)	Ratio
R10	1	1.706e+9	0.5288721
R11	1	6.585e+8	0.2040802
RO1	3	4.309e+8	0.1335532

Land Use Mapping Considerations

- Accessing a comprehensive suite of GIS layers and synthesizing these layers into useful maps and completing data analysis is not straightforward.
- Availability of Data Layers
- Capacity (either technical expertise or monetary)
- Leveraging an established partnership (AESRD or WPAC)
- Engaging consultant
- The best option is to share resources with organizations doing basin planning at the larger scale.
- For example, as part of their watershed planning activities WPACs often have in-house databases and have established data sharing agreements.
  - NSWA versus Okotoks

Water Quality Assessment Considerations

- An integral part SWPP includes gathering scientific data to assess source water quality and quantity, fostering collaborative long-term monitoring programs to evaluate source waters and effluent impacts, and participating in research partnerships to understand evolving contaminants of concern.

- This work also includes investigating linkages between water quality and quantity and environmental influences (land use, climate change, etc.).

- For a small, or even large, municipality/drinking water provider this task can be monumental.

- Compiling the necessary monitoring data to characterize the source watershed alone is a challenge. This is in part because historical sampling programs may have not been designed to characterize water quality in the defined source water area.

- Historically much of the water quality monitoring of rivers and streams has been completed by AEP

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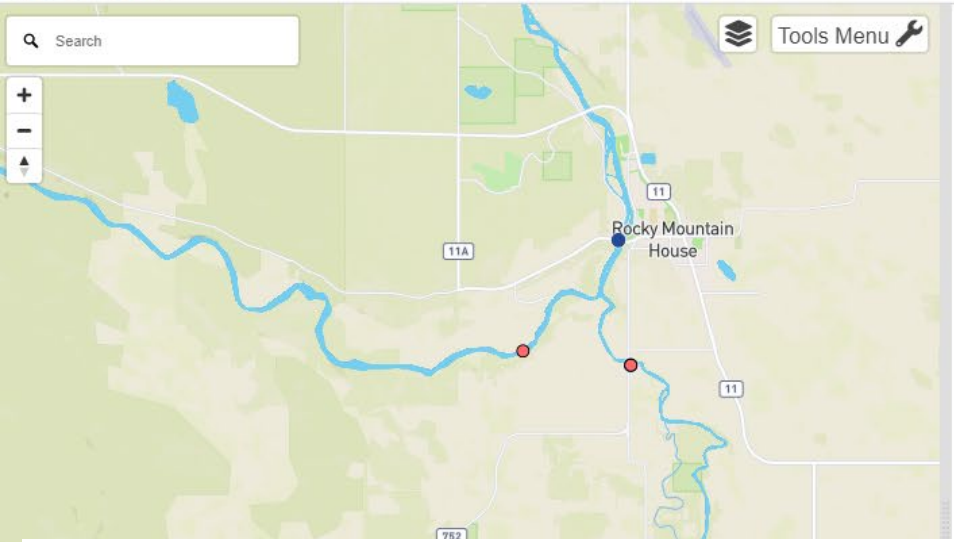


Water Quality

About

Province/Territory:

All

Chemical/Parameter: Clear Selection

Total suspended solids

No Fraction Specified

Guideline: View List

None

Locations:

-- Select a Location --

CLEARWATER RIVER AT ROCKY MOUNTAIN HOUSE x

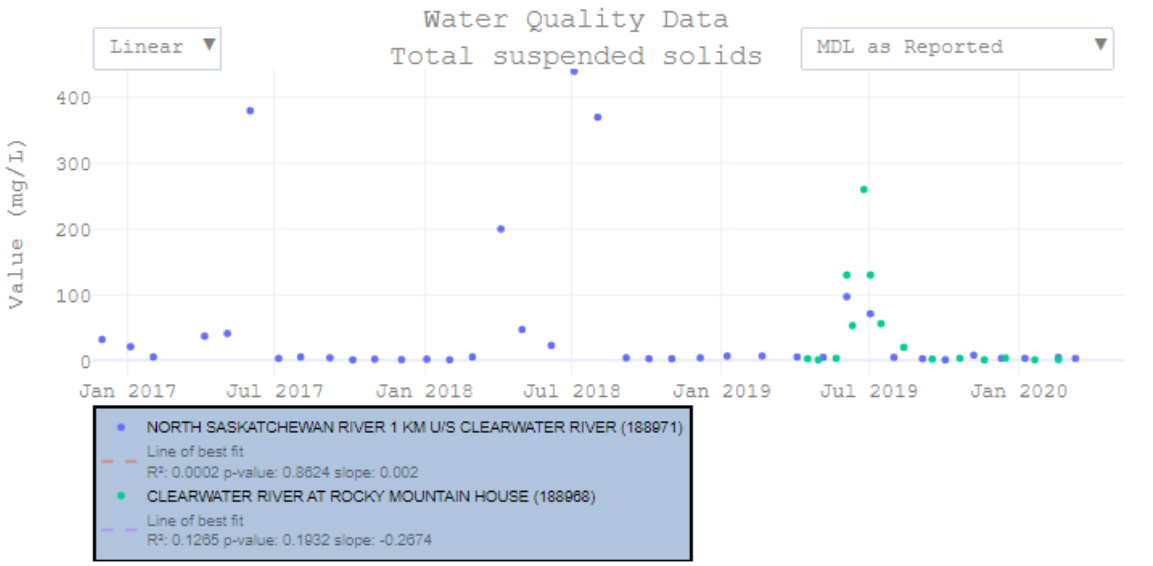
NORTH SASKATCHEWAN RIVER 1 KM U/S CLEARWATER RIVER x

Clear Selection

yy to mm/dd/yyyy

Subplots:

Line Graph



CLEARWATER RIVER AT ROCKY MOUNTAIN HOUSE (188968), Source
NORTH SASKATCHEWAN RIVER 1 KM U/S CLEARWATER RIVER (188971), Source

TSS Compared for Clearwater River and North Sask at Rocky Mountain House

Group 1

CLEARWATER RIVER AT WSC GAUGE 20 KM U/S CONFLUENCE WITH NORTH SASKATCHEWAN RIVER ×

CLEARWATER RIVER AT ROCKY MOUNTAIN HOUSE ×

Hydrometric Station: ⓘ *Clear Selection*

CLEARWATER RIVER NEAR DOVERCOURT (05DB006)

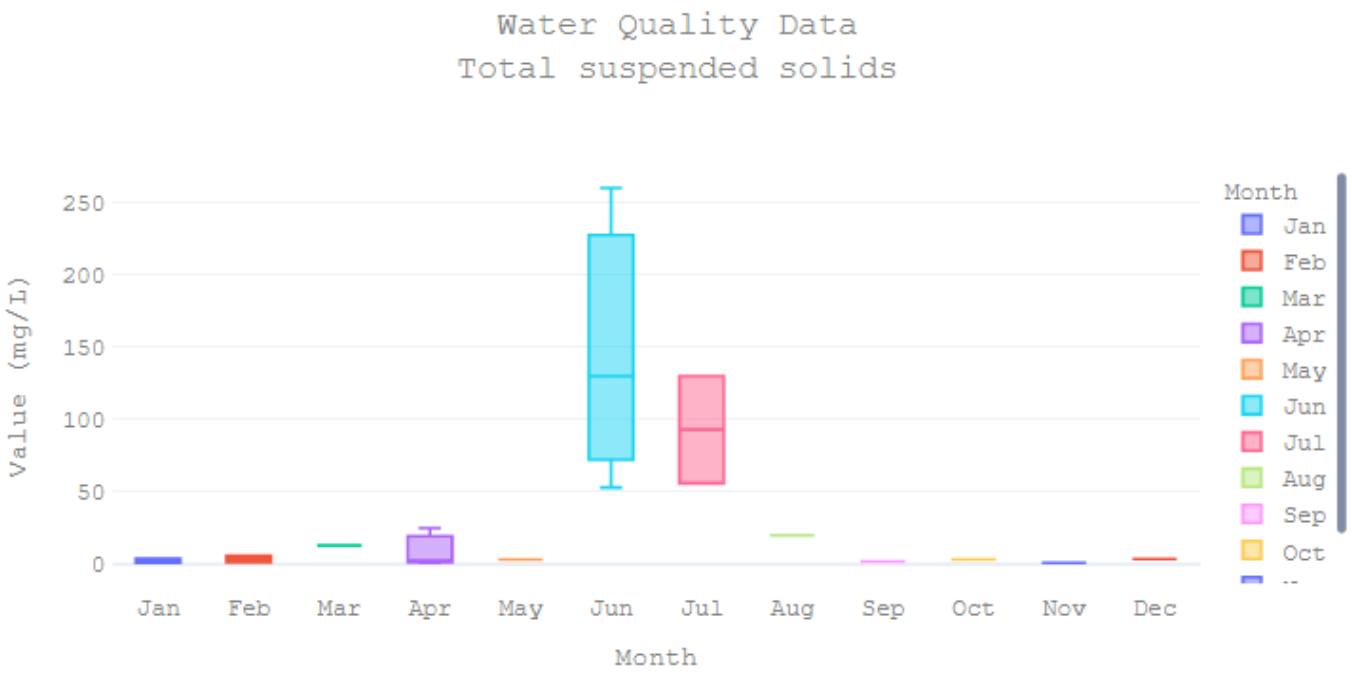
Start and End Dates:

mm/dd/yyyy to mm/dd/yyyy

Submit

Subplots:

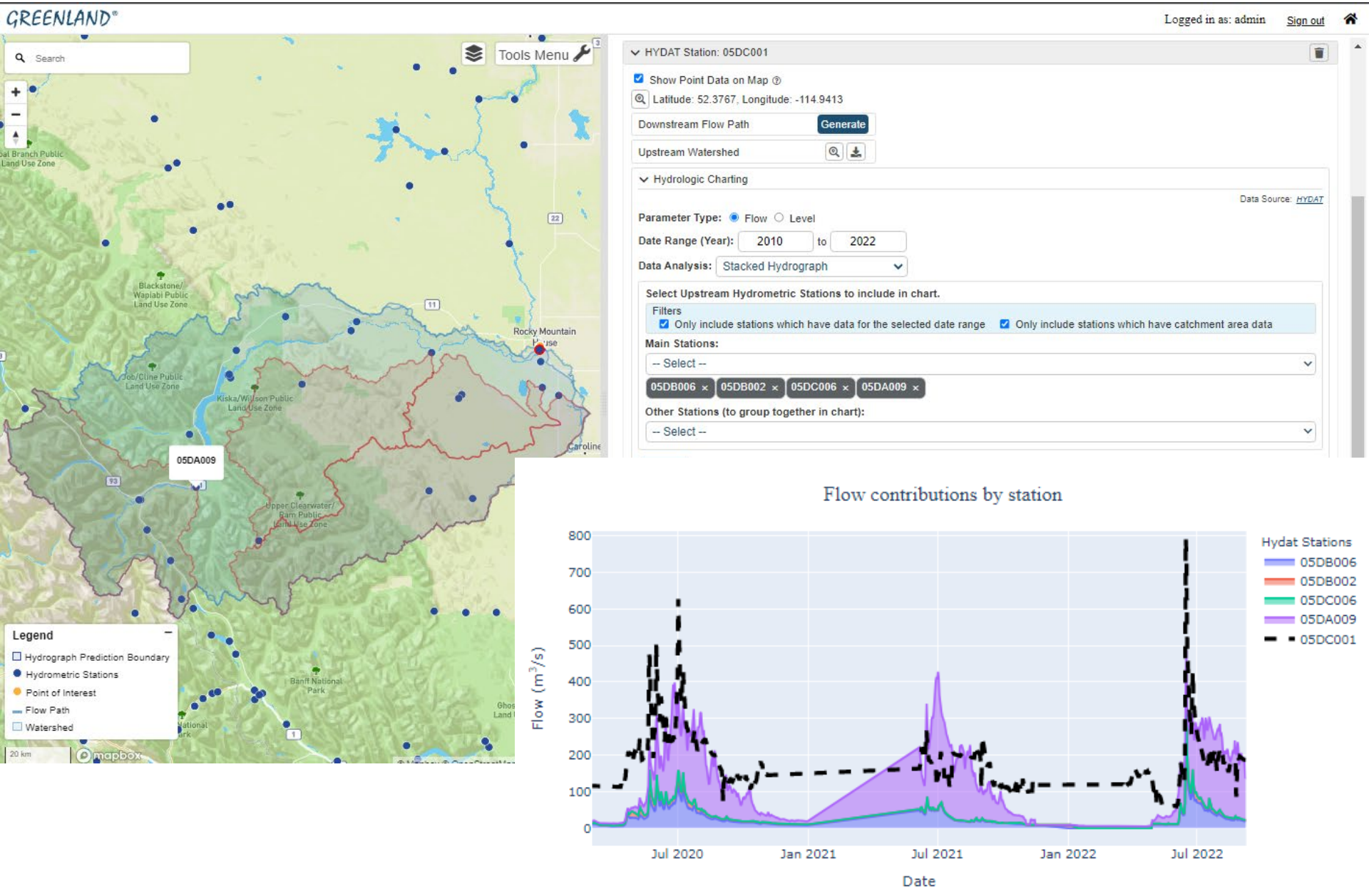
Box Plot - Month



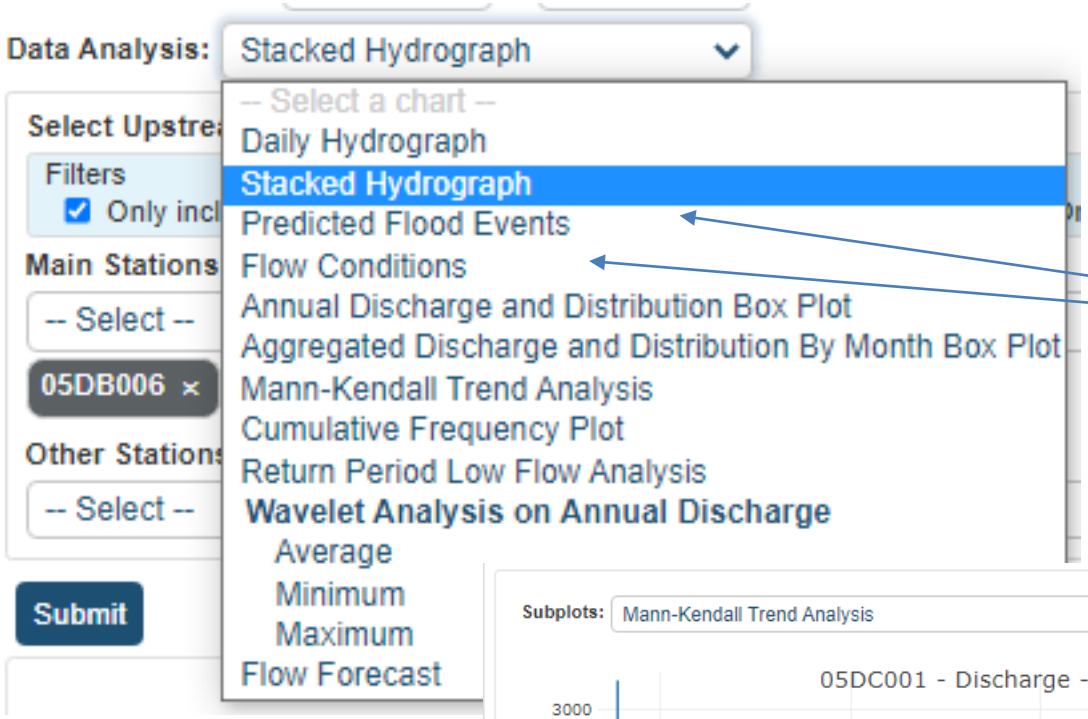
CLEARWATER RIVER AT WSC GAUGE 20 KM U/S CONFLUENCE WITH NORTH SASKATCHEWAN RIVER (188952), Source
CLEARWATER RIVER AT ROCKY MOUNTAIN HOUSE (188968), Source

TSS Analysis: 2 stations in relative proximity grouped together.

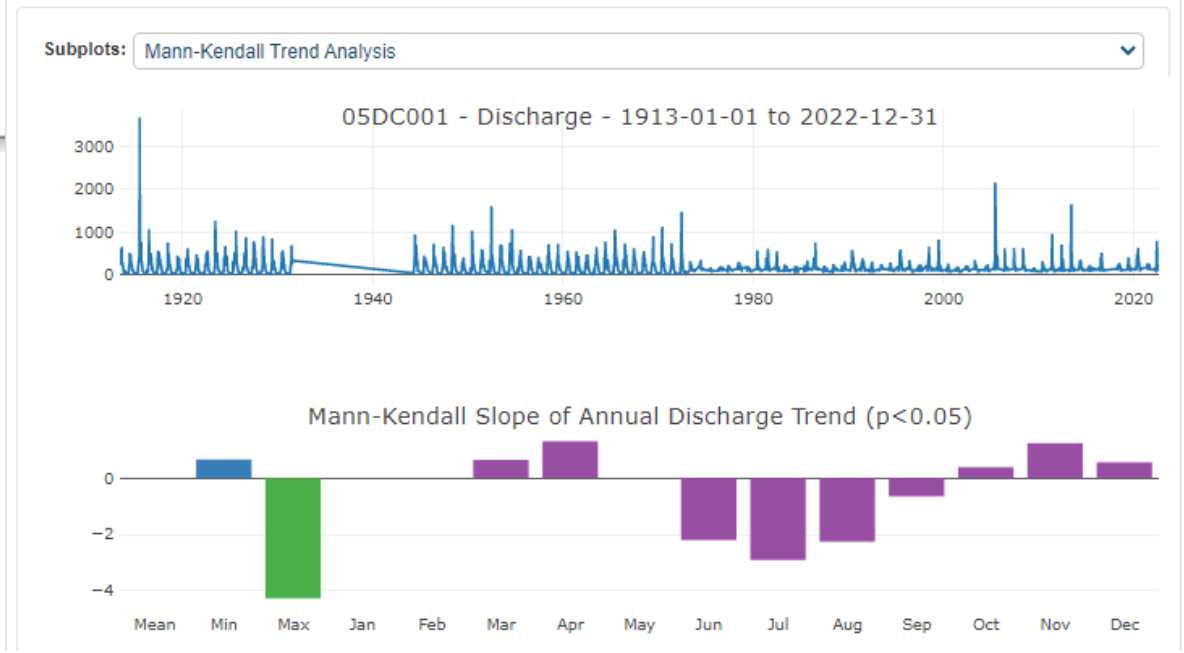
Water Yield Data for Sub-basins



THREATS Hydrometric Station Analysis Functions



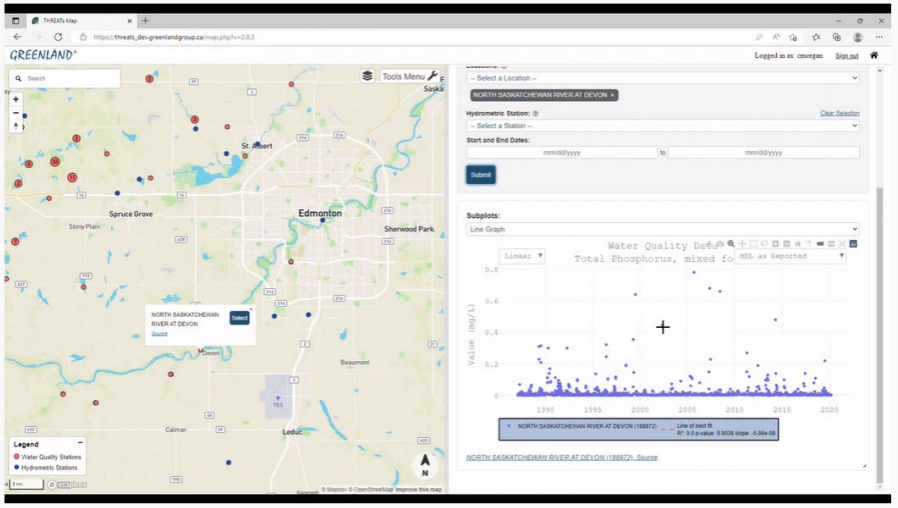
Daily flow compared with normal and return period flows



Additional THREATS Information & Tutorials

- Each module has an “About” section
- Tutorial videos being developed for select modules

THREATS - Air quality assessment tool



THREATS - Water Quality Module Instructional Demo / Tutorial

THREATS Hydrograph Analysis Against Normal Flows

Hydrologic Charting

Data Source: HYDAT

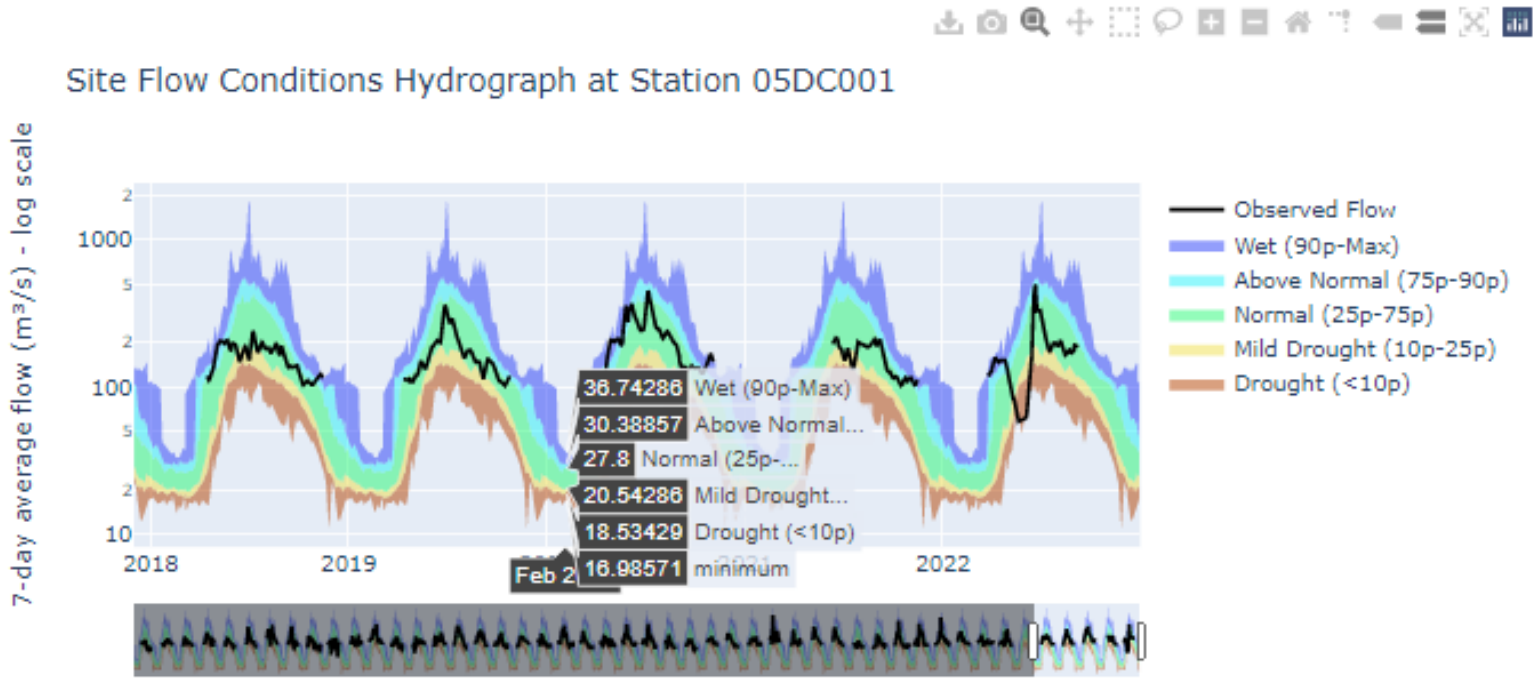
Parameter Type: (•) Flow ( ) Level

Date Range (Year): 1974 to 2022

Data Analysis: Flow Conditions

Window (Days): 7

Submit



THREATS Climate Analysis Against Long-Term Normals

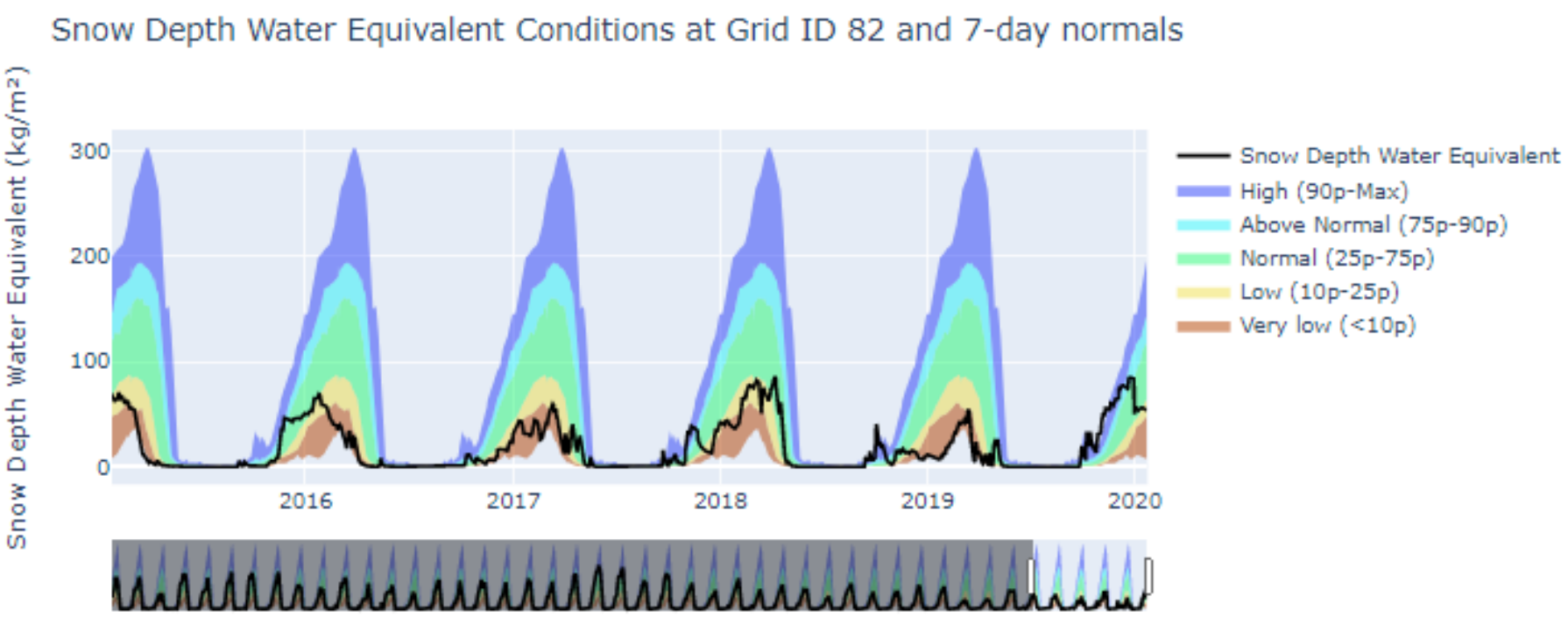
Global Land Data Assimilation System (GLDAS) Historic Climate Module

Date Range: 01/01/1975 to 01/24/2020

GLDAS Grid Cell: Select From Map

Id: 82 Latitude: 51.789493 Longitude: -115.684000

Parameter: Snow Depth Water Equivalent



Overview of THREATS Capabilities and Benefits

- Time efficient compared to traditional/manual data collection
- Variety of analysis types including water quality, hydrology, air, land and geospatial
- Enables both a widespread and deep understanding of the site/project
- Widening our repertoire leads to improved decision making
- Leads to costs savings in saved working hours and applications

THREATS™
THE HEALTHY RIVER ECOSYSTEM ASSESSMENT SYSTEM

Conclusion

- To complete source water protection planning good data is needed
- This data needs to be summarized and assessed to inform risk
- Although that process still requires expertise, a tool that pulls data together and allows some assessment is a big step in forwarding source water protection planning in Alberta