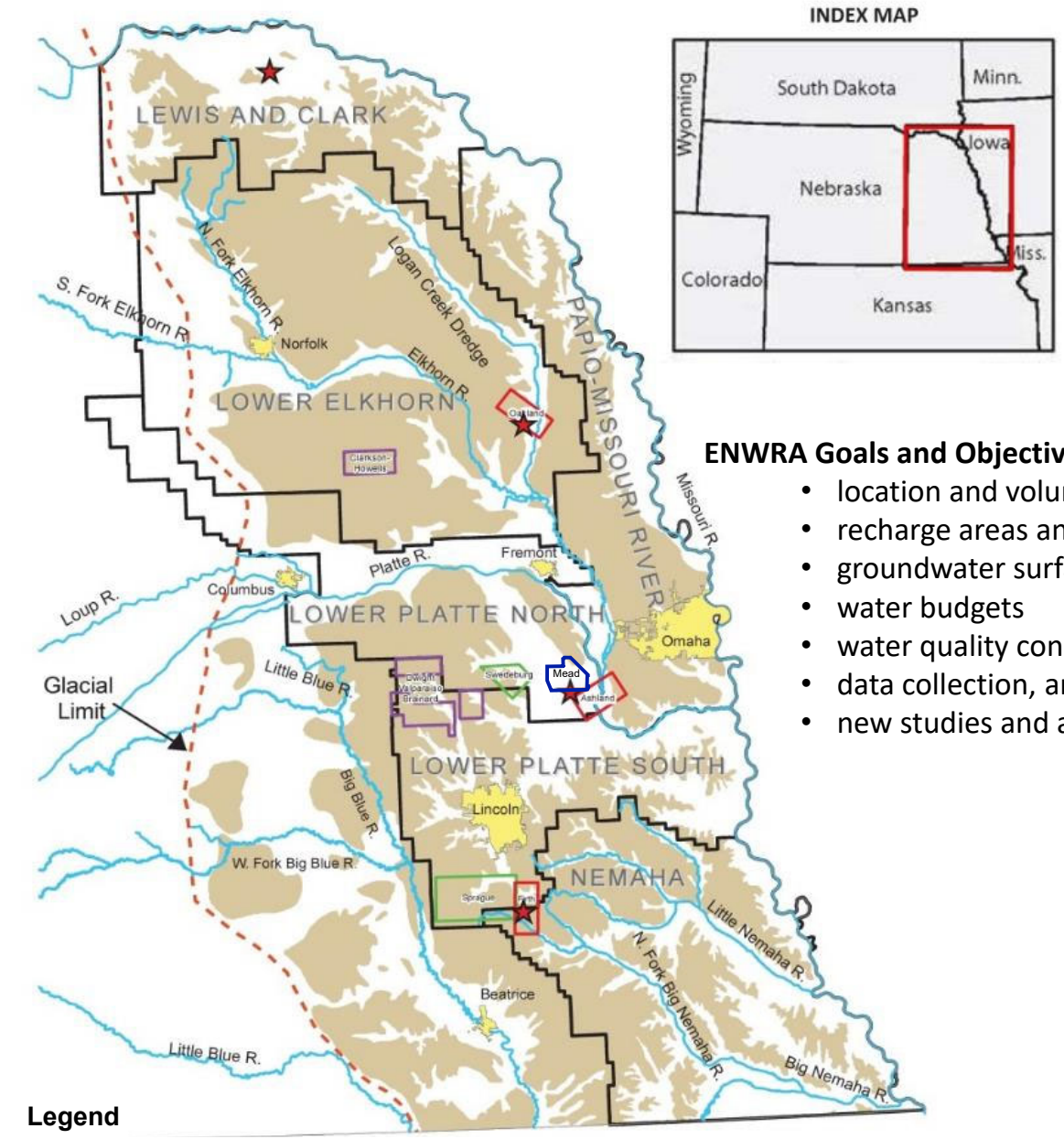
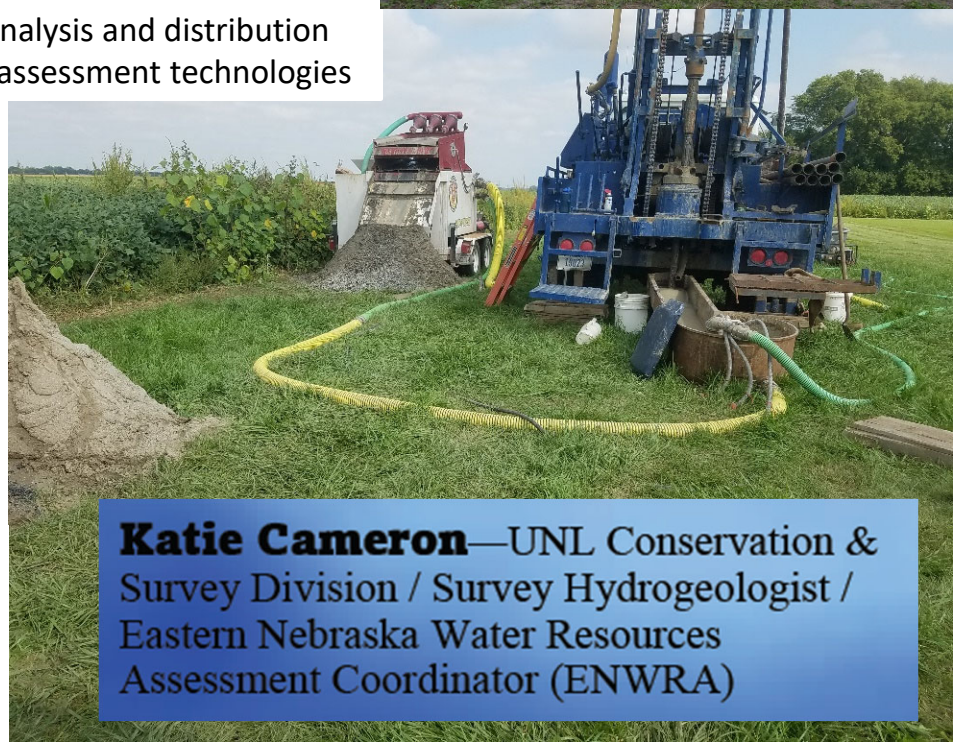
ENWRA STUDY SITES



ENWRA Goals and Objectives:

- location and volume of aquifers
- recharge areas and rates
- groundwater surface water interactions
- water budgets
- water quality concerns
- data collection, analysis and distribution
- new studies and assessment technologies

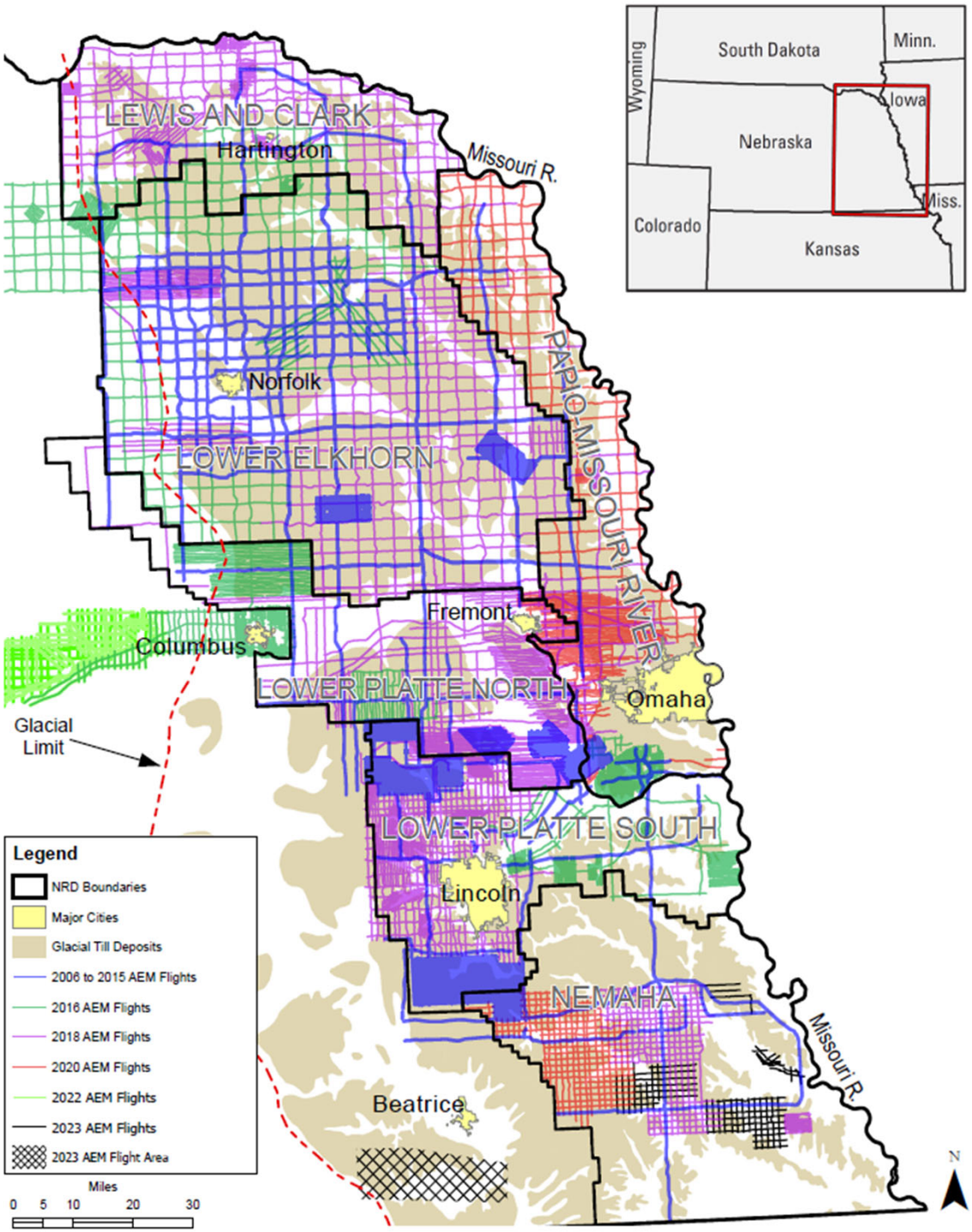


Katie Cameron—UNL Conservation & Survey Division / Survey Hydrogeologist / Eastern Nebraska Water Resources Assessment Coordinator (ENWRA)

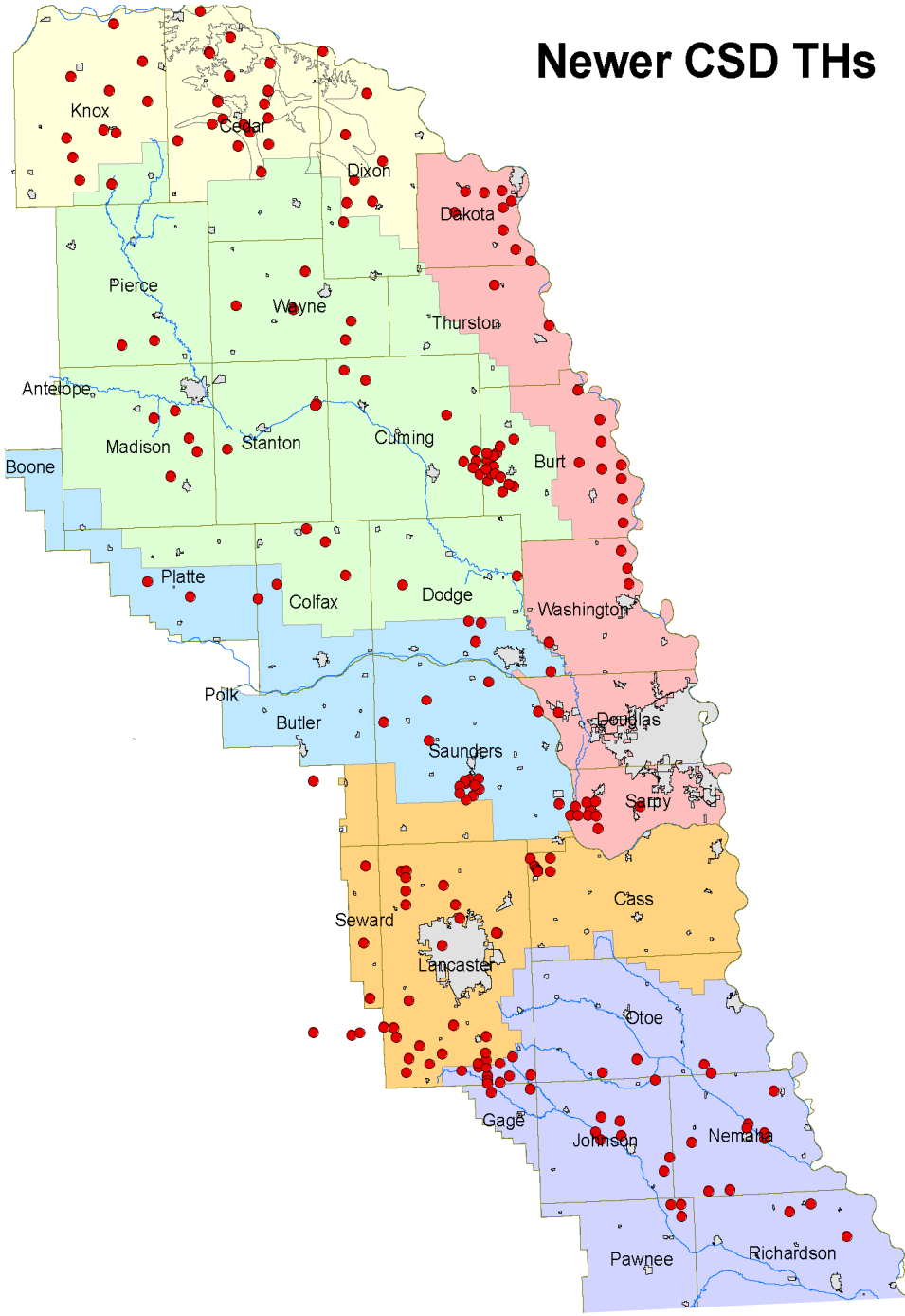
Legend

- ENWRA NRD Boundaries
- Major Cities
- Major Rivers
- Glacial Till Deposits
- Recharge Stations
- 2007 Ashland, Oakland, and Firth Pilot Study Sites
- 2009 Sprague and Swedeburg Flights
- 2012 USACE Flights at Mead
- 2013 Clarkson-Howells and Dwight-Valparaiso-Brainard Flights

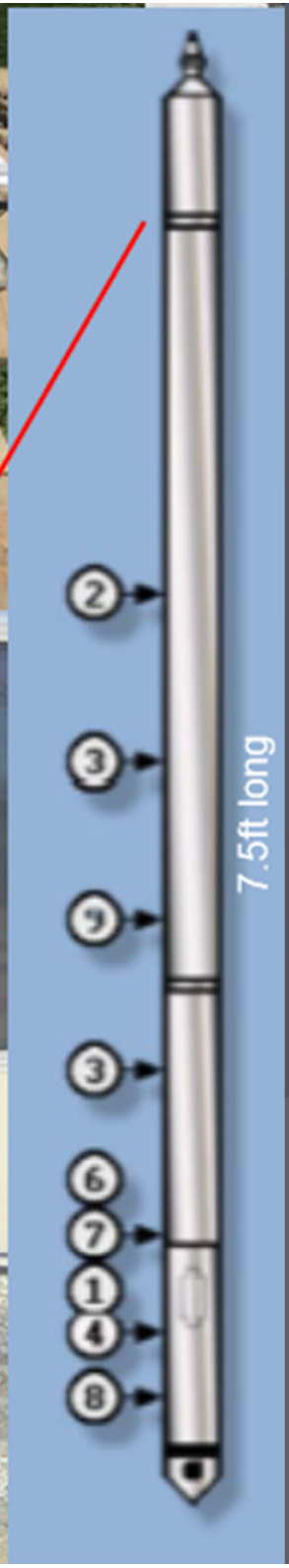
ENWRA STUDY AREA



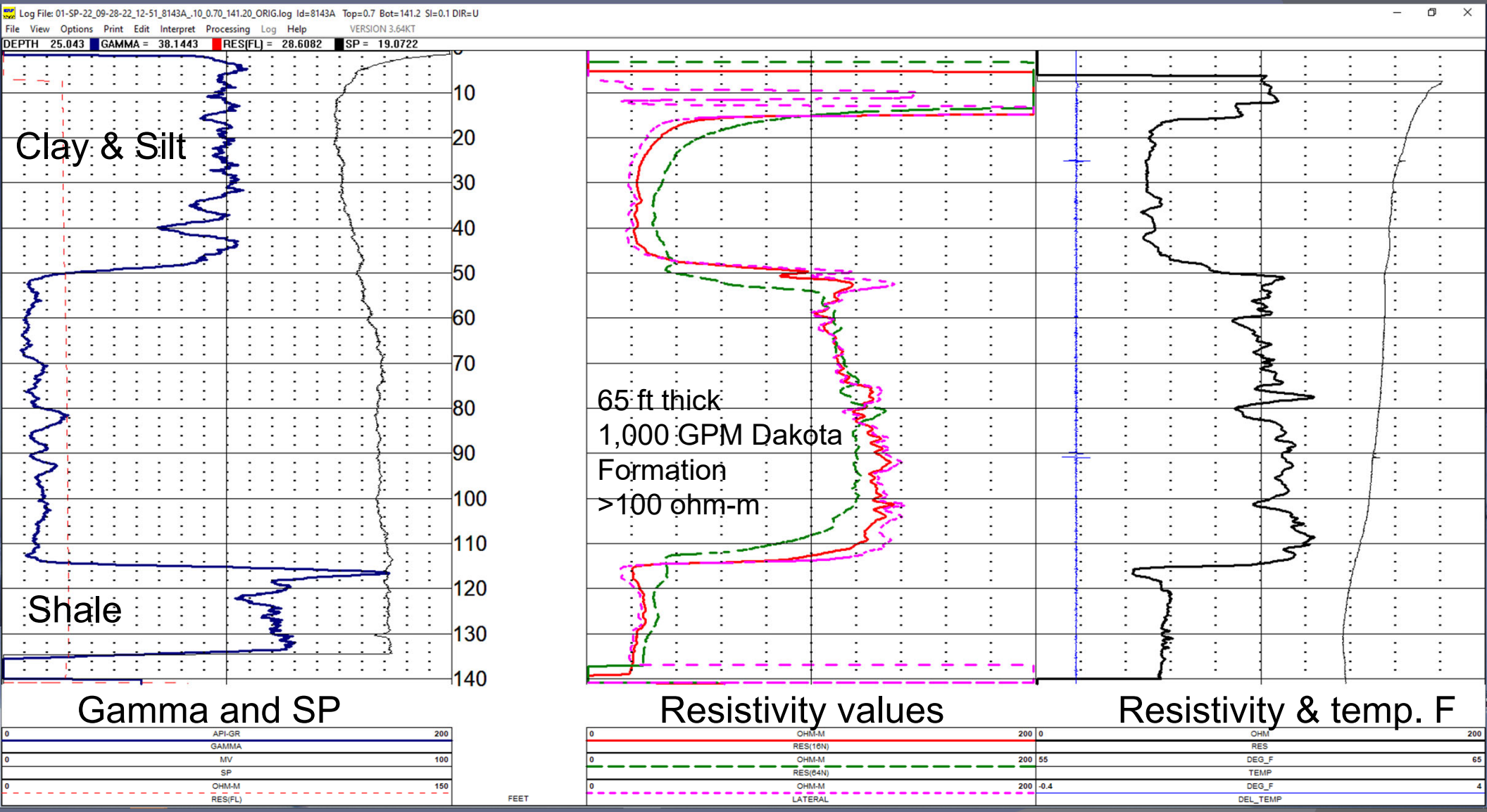
Newer CSD THs



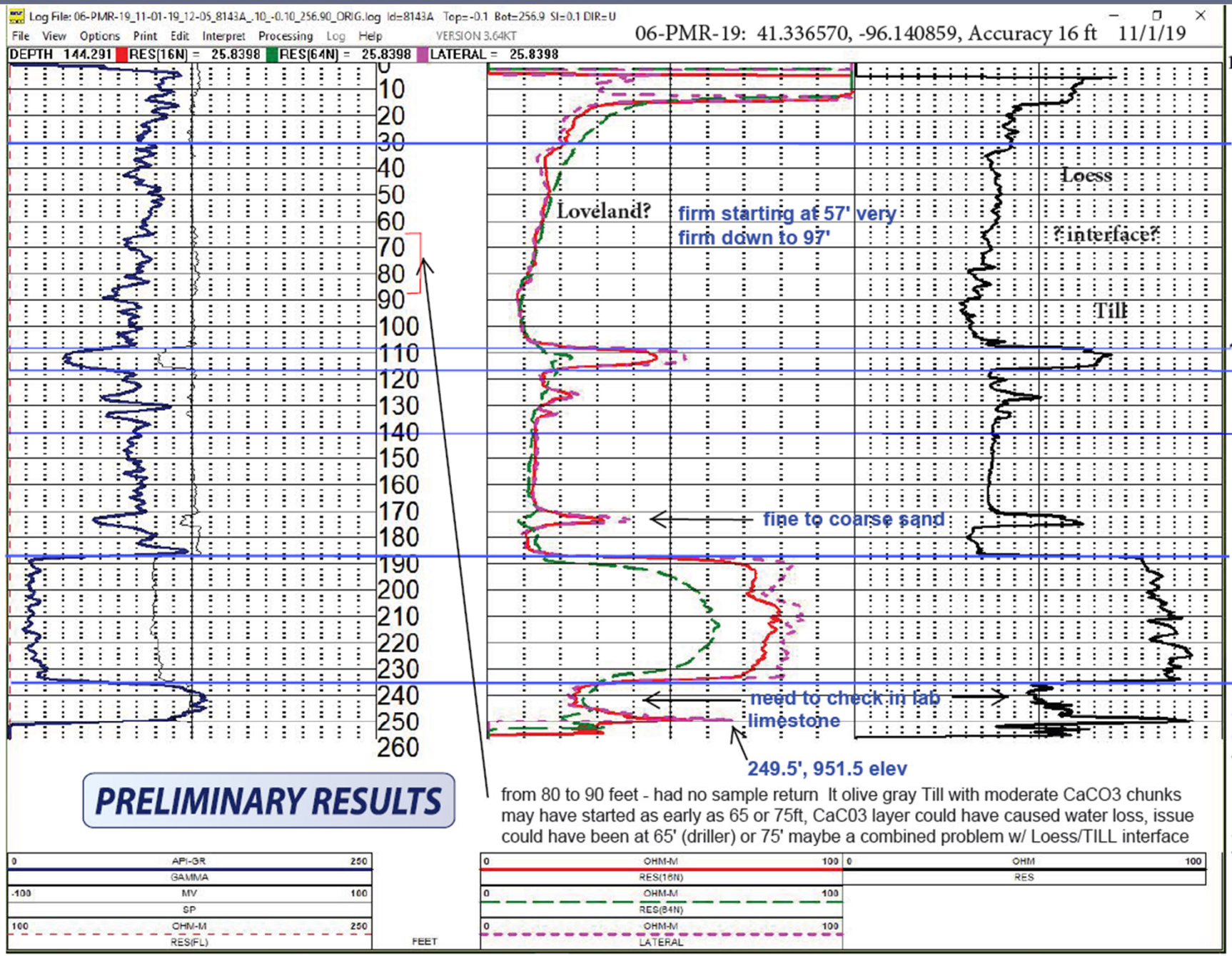

NEBRASKA
19850


2
3
5
3
6
7
1
4
8
7.5ft long

Downhole Geophysical Logs



Downhole Geophysical Logs



Test Holes – for CSD online

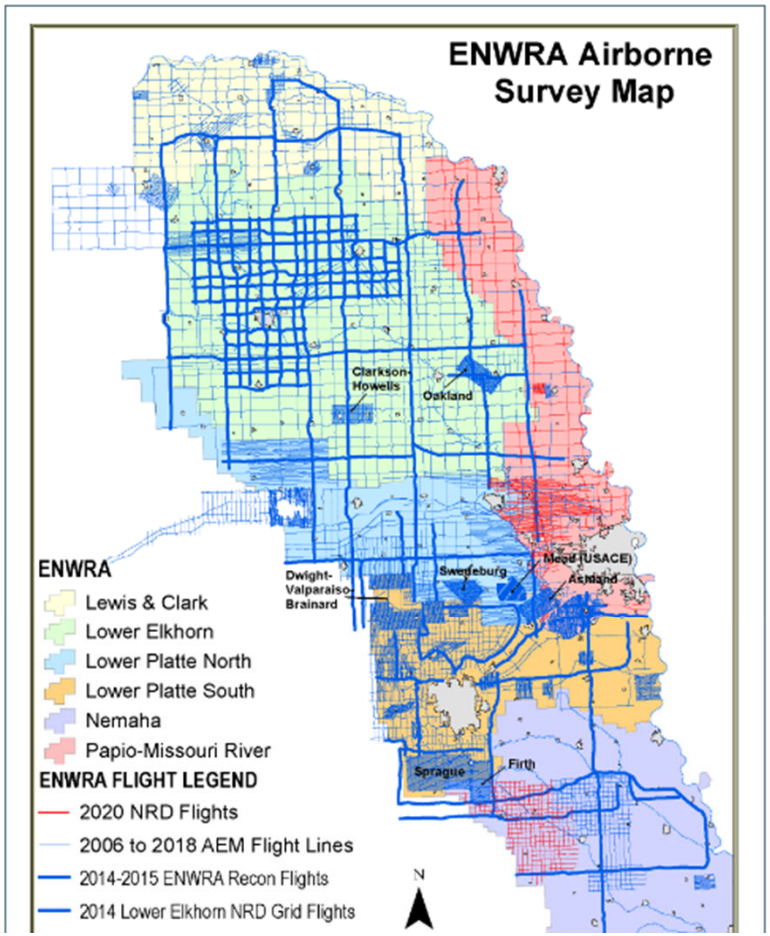
Screen at 860-880’ in Dakota fine sand near Tarnov, NE

ENWRA

Eastern Nebraska Water Resources Assessment

NRDS: Papio-Missouri River NRD Nemaha NRD

2020 Airborne Electromagnetic Survey (AEM)



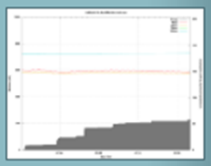
3125 Portia St
PO Box 83581
Lincoln, NE 68501
402.476.2729
kcameron_enwra@lpsnrd.org

News

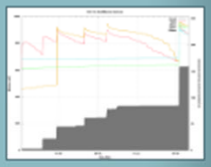
ENWRA Groundwater Recharge Mapping and Focus Area Assessments (Water Sustainability Fund [WSF] #5312) was awarded in December 2021. The USGS-UNL CSD project team concluded Phase 1 regional activities in 2022 and Phase 2 work with the Focus Areas is underway in 2023 with the ENWRA NRDs. Annual status report available here: WSF 2023 Annual Report # 5312

Moisture at Weather Stations:

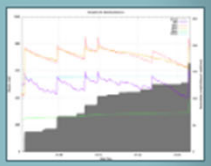
Oakland



Firth



Ashland

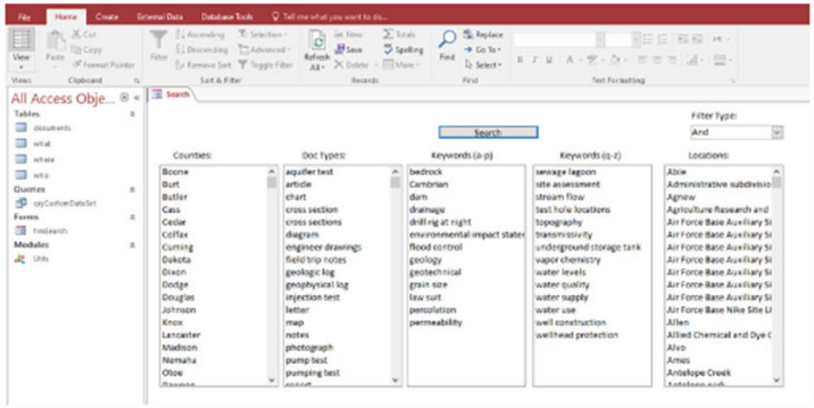


Fordyce

folders. Dropbox is free for users but when downloading data, please save to your computer hard drive (choose direct download) so as to not fill up space on your personal dropbox account (300 MB).

ENWRA Archive

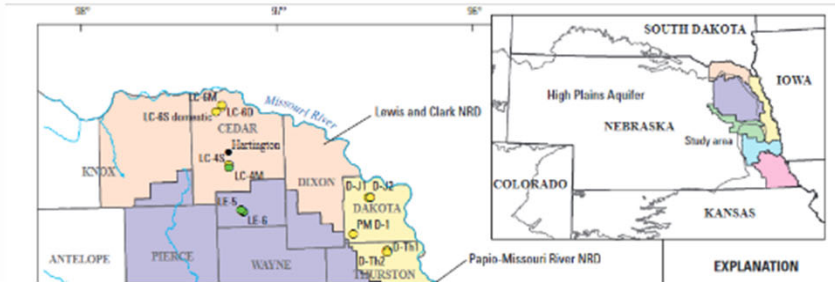
Click here to access ENWRA's Archive data folders prepared by Dana Divine of the Conservation and Survey Division (CSD) of the School of Natural Resources at Univerity of Nebraska-Lincoln in 2011 (includes some additional archived sources gathered to-date). Dropbox is free for users but when downloading data, please save to your computer hard drive (choose direct download) so as to not fill up space on your personal dropbox account (**Warning files total 5.7 GB**). It is recommended you download the access database and then return to the Dropbox for copies of the PDF files associated with your search. You can select "no thanks" to the sign-up for a Dropbox account and still download the files (Dropbox no longer works in Internet Explorer browser).



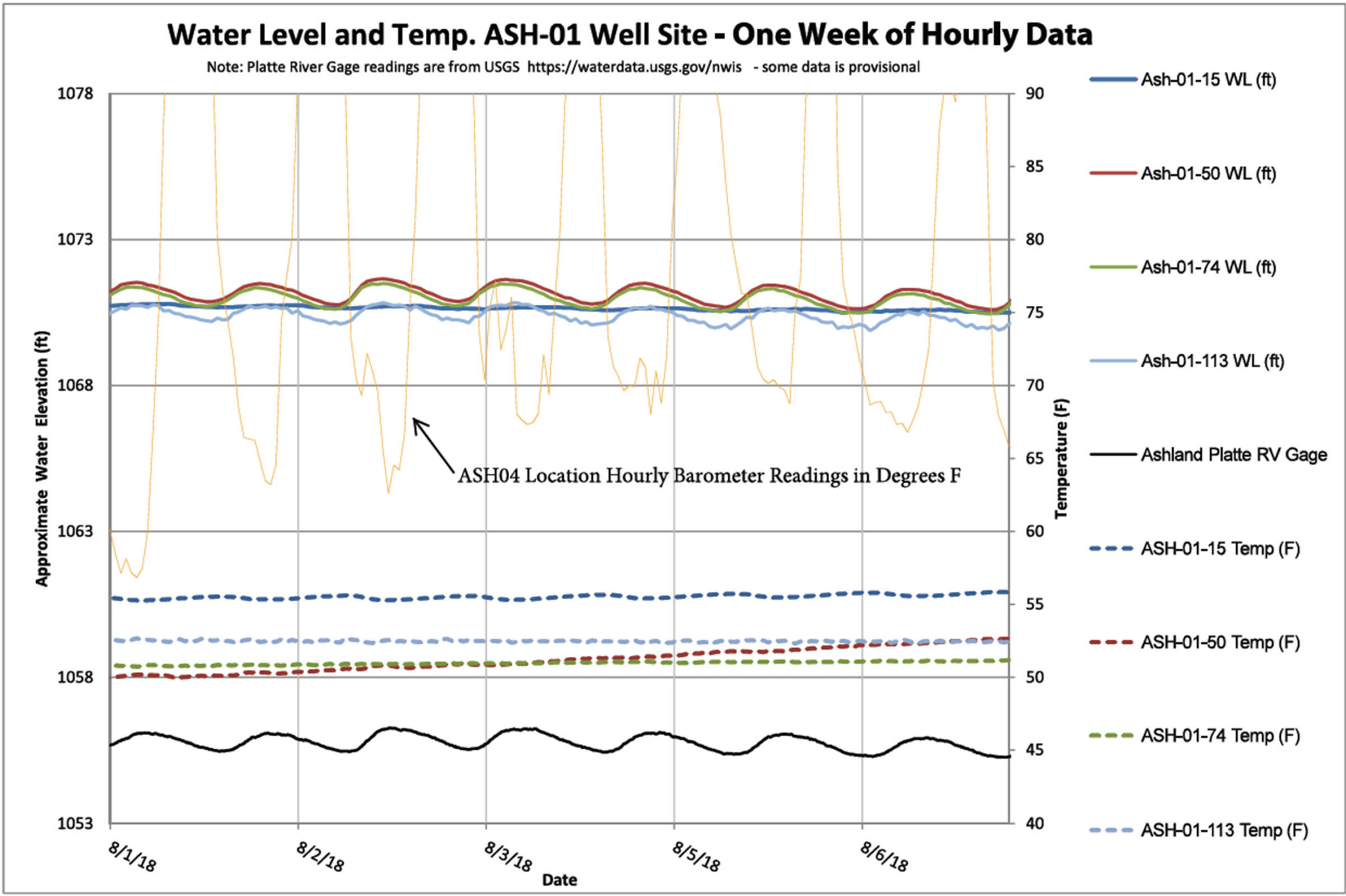
Secondary Bedrock Aquifer Sampling and Age-Dating Project (Water Sustainibility Fund #4125)

The following USGS online publication was approved for release and has been made available to the public: USGS Scientific Investigations Report 2021–5055 Suggested citation: Hobza, C.M., and Flynn, A.T., 2021, Groundwater quality and age of secondary bedrock aquifers in the glaciated portion of eastern Nebraska, 2016–18: U.S. Geological Survey Scientific Investigations Report 2021–5055, 42 p. This publication is available online only (https://doi.org/10.3133/sir20215055).

Click here for a link to a presentation of the results from December 9, 2020. An additional talk was presented at the March 2, 2021 NRD Water Programs conference.

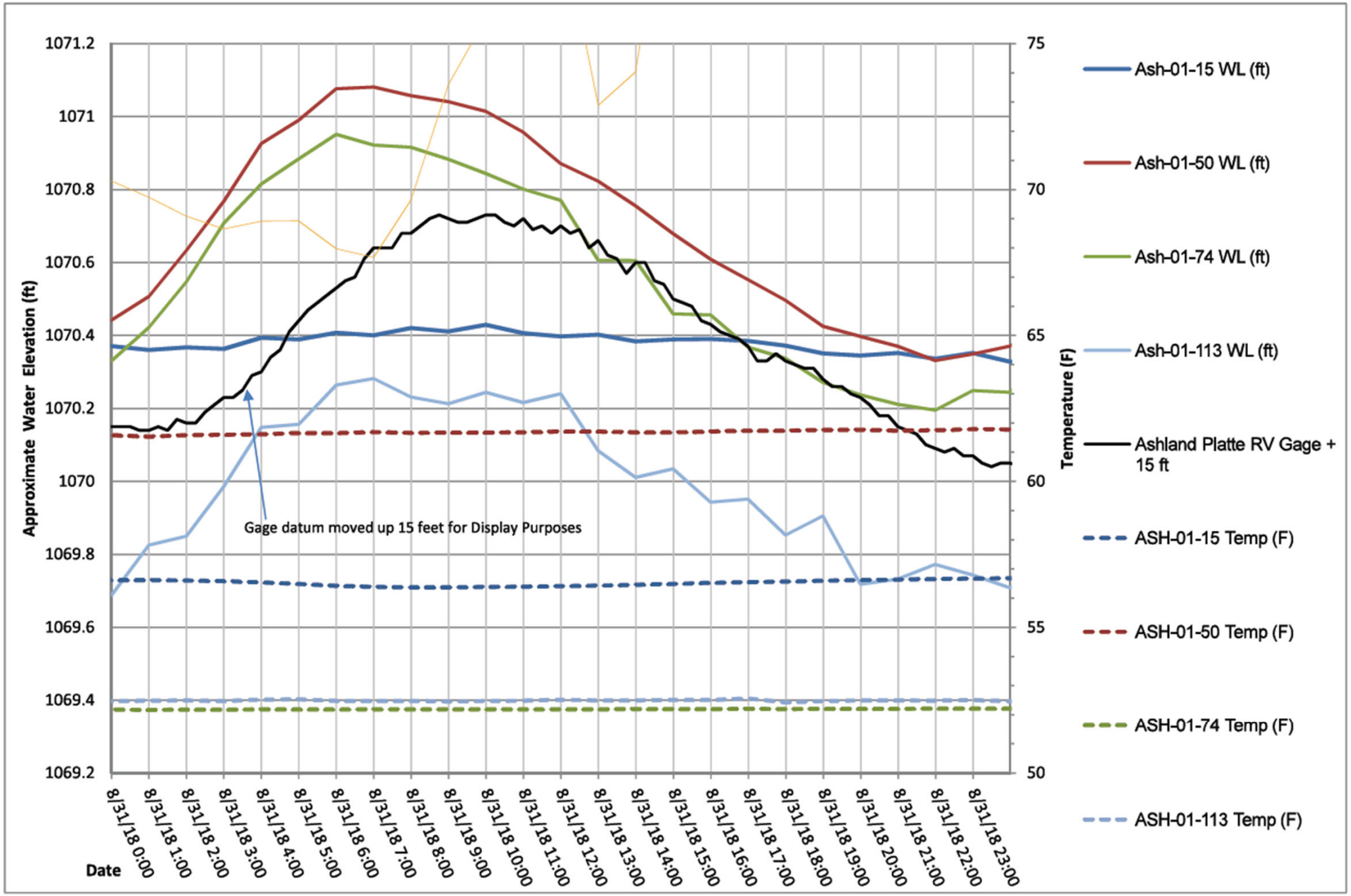


Water Level and Temp. ASH-01 Well Site - One Week of Hourly Data



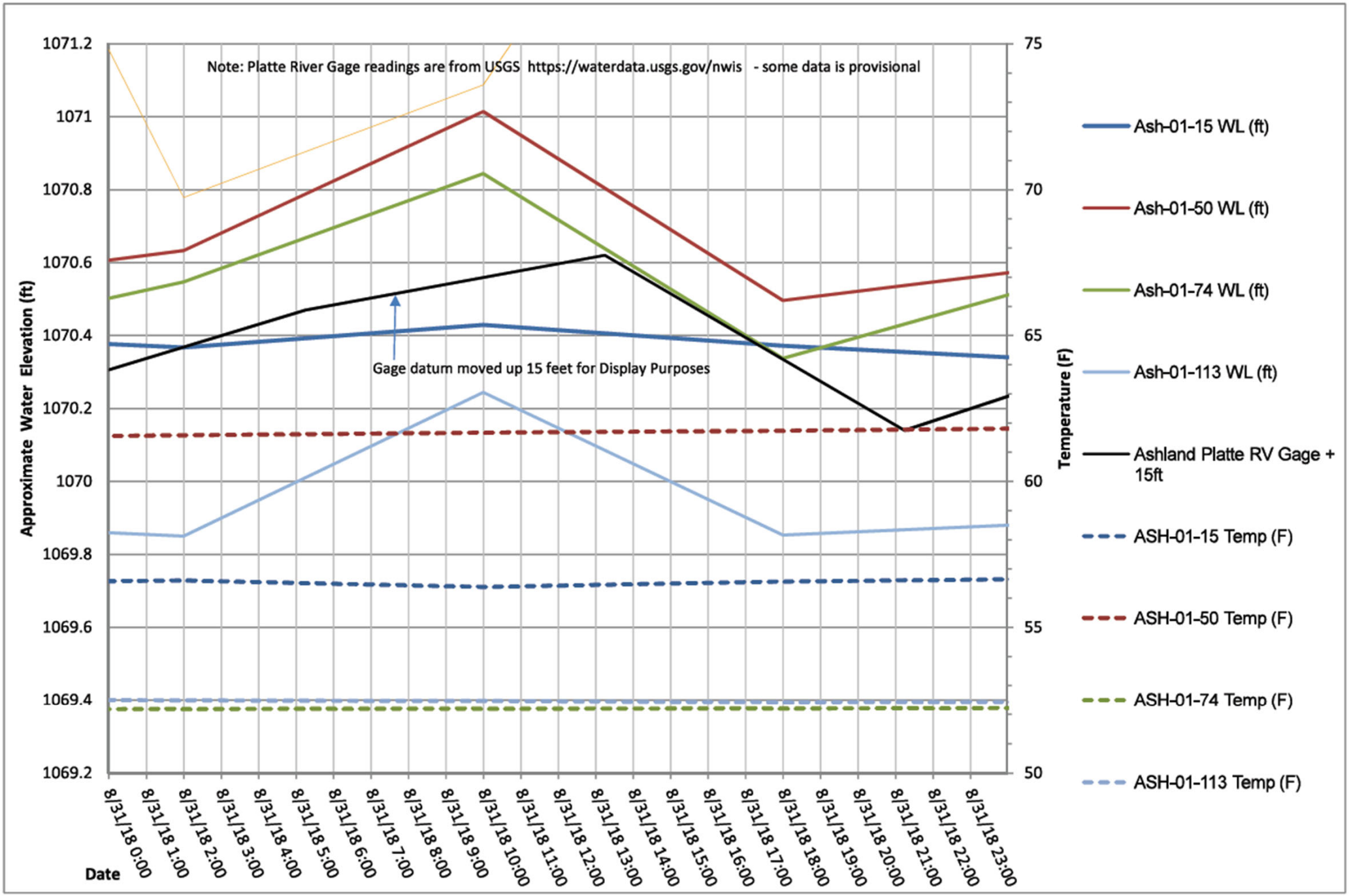
Note: 15 Minute Readings are Displayed for the Platte River Gage at Ashland

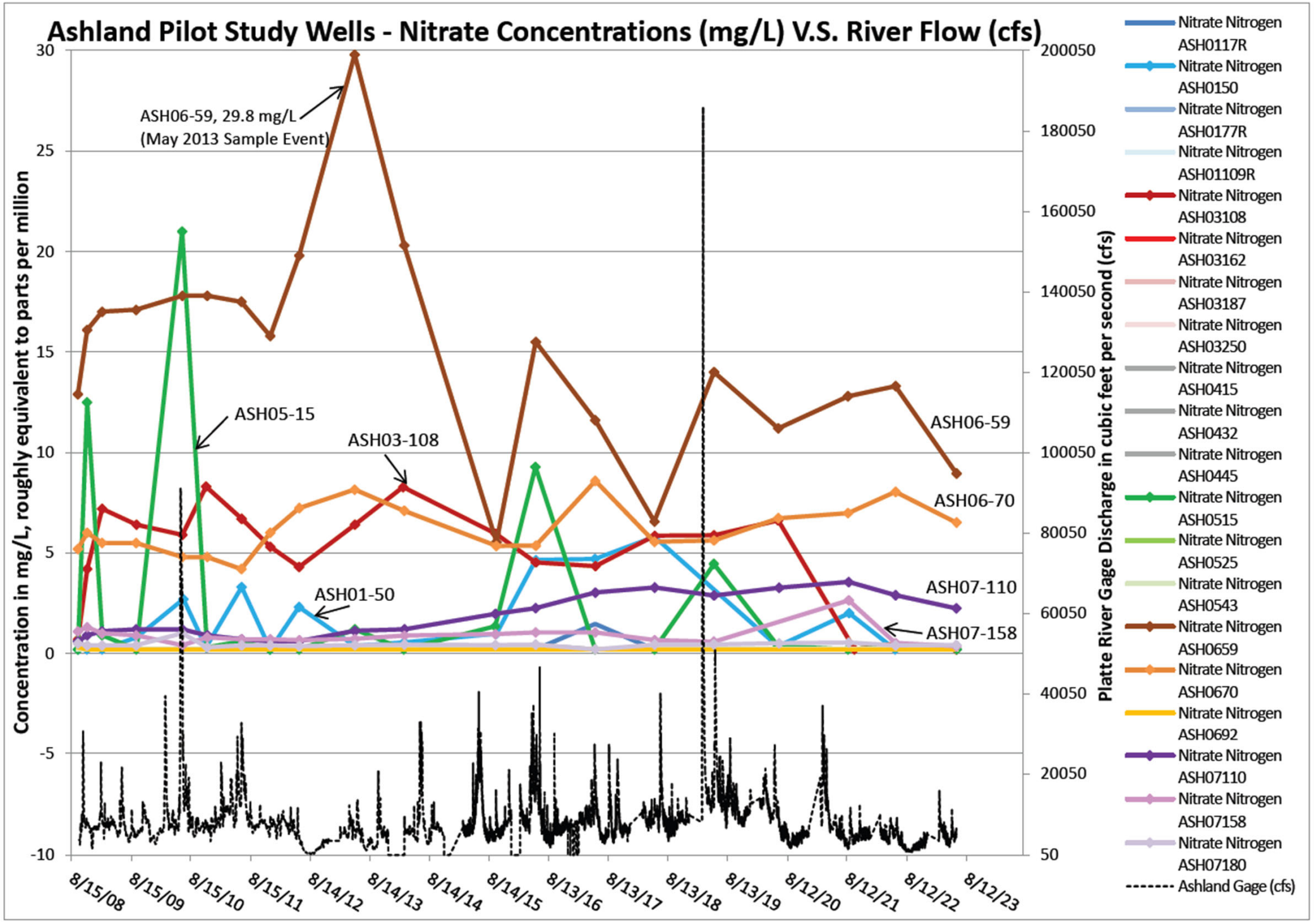
Water Level & Temp. ASH-01 Well Site - Summer Day of Hourly Data



Note: Platte River Gage readings are from USGS https://waterdata.usgs.gov/nwis - some data is provisional

Water Level and Temp. ASH-01 Well Site - Summer Day of 8Hour Data 2018




Ashland Pilot Study Wells - Nitrate Concentrations (mg/L) V.S. River Flow (cfs)
Concentration in mg/L, roughly equivalent to parts per million
Platte River Gage Discharge in cubic feet per second (cfs)
ASH06-59, 29.8 mg/L
(May 2013 Sample Event)
ASH05-15
ASH03-108
ASH06-59
ASH06-70
ASH01-50
ASH07-110
ASH07-158
30
25
20
15
10
5
0
-5
-10
200050
180050
160050
140050
120050
100050
80050
60050
40050
20050
50
8/15/08
8/15/09
8/15/10
8/15/11
8/14/12
8/14/13
8/14/14
8/14/15
8/13/16
8/13/17
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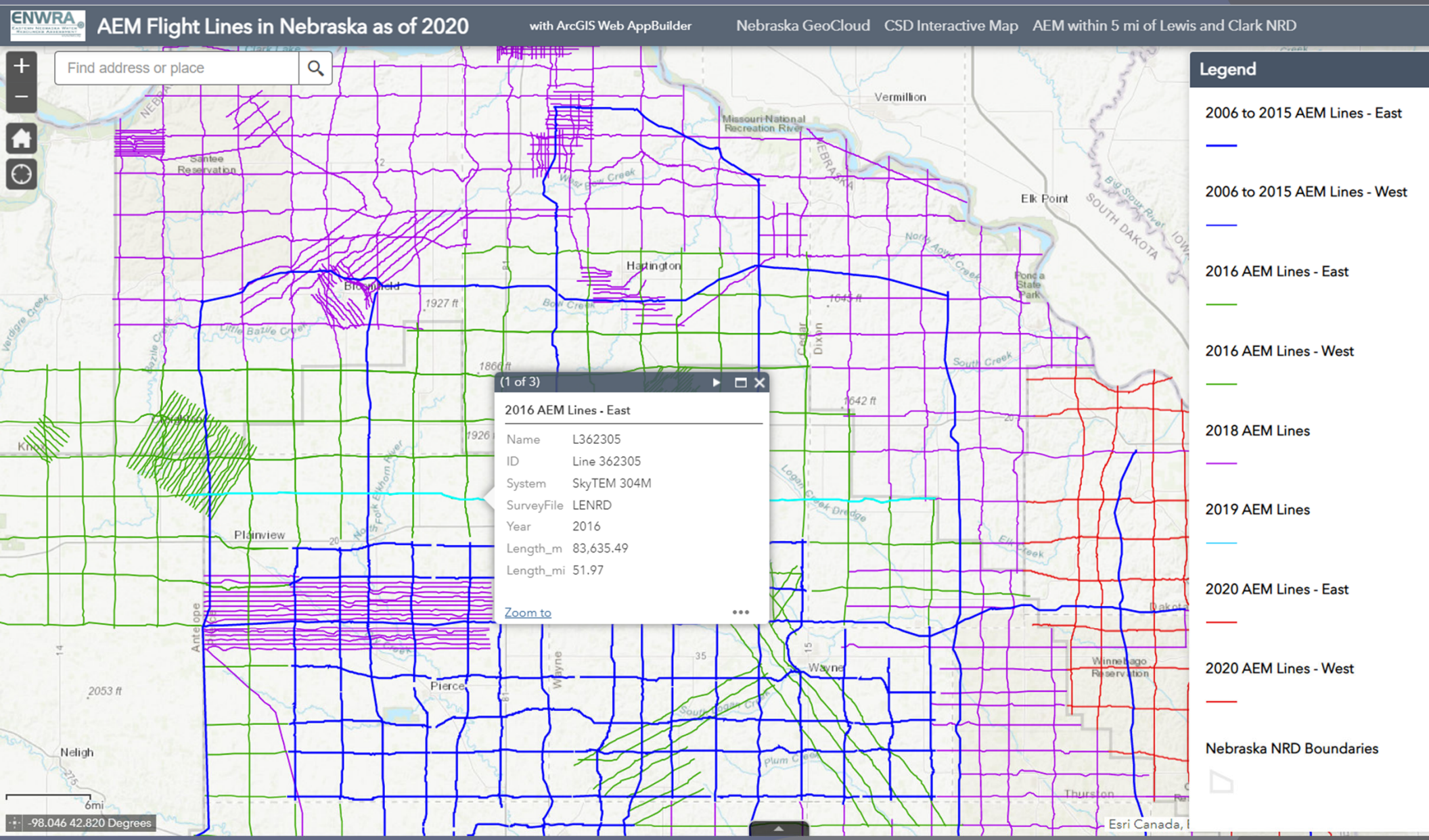
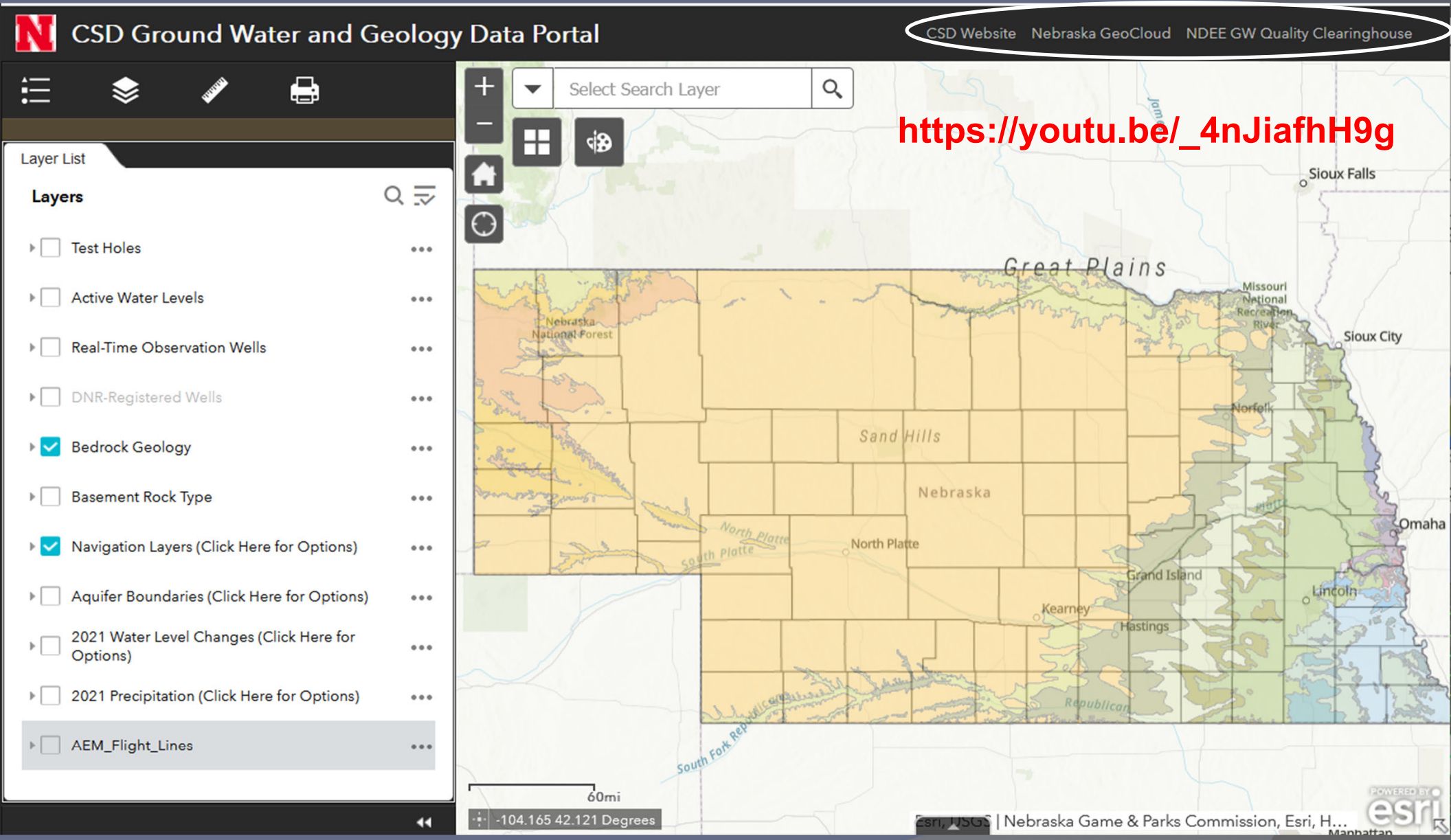
8/12/20
8/12/21
8/12/22
8/12/23
Nitrate Nitrogen ASH0117R
Nitrate Nitrogen ASH0150
Nitrate Nitrogen ASH0177R
Nitrate Nitrogen ASH01109R
Nitrate Nitrogen ASH03108
Nitrate Nitrogen ASH03162
Nitrate Nitrogen ASH03187
Nitrate Nitrogen ASH03250
Nitrate Nitrogen ASH0415
Nitrate Nitrogen ASH0432
Nitrate Nitrogen ASH0445
Nitrate Nitrogen ASH0515
Nitrate Nitrogen ASH0525
Nitrate Nitrogen ASH0543
Nitrate Nitrogen ASH0659
Nitrate Nitrogen ASH0670
Nitrate Nitrogen ASH0692
Nitrate Nitrogen ASH07110
Nitrate Nitrogen ASH07158
Nitrate Nitrogen ASH07180
Ashland Gage (cfs)

Website: enwra.org

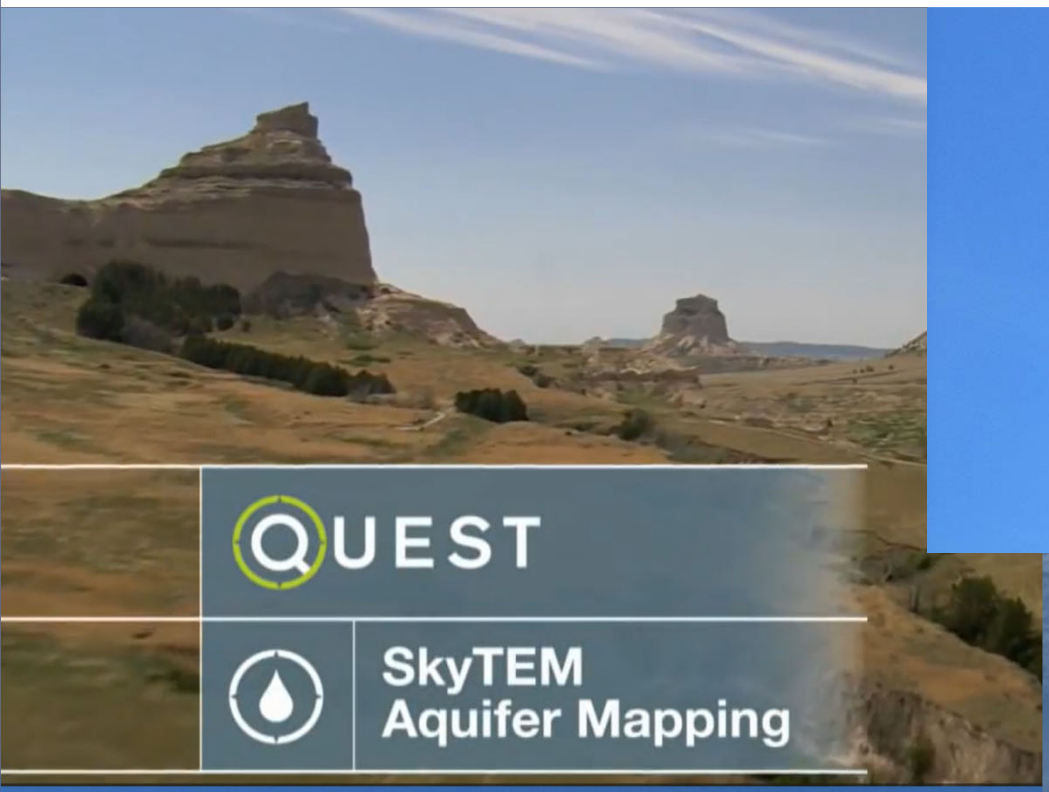


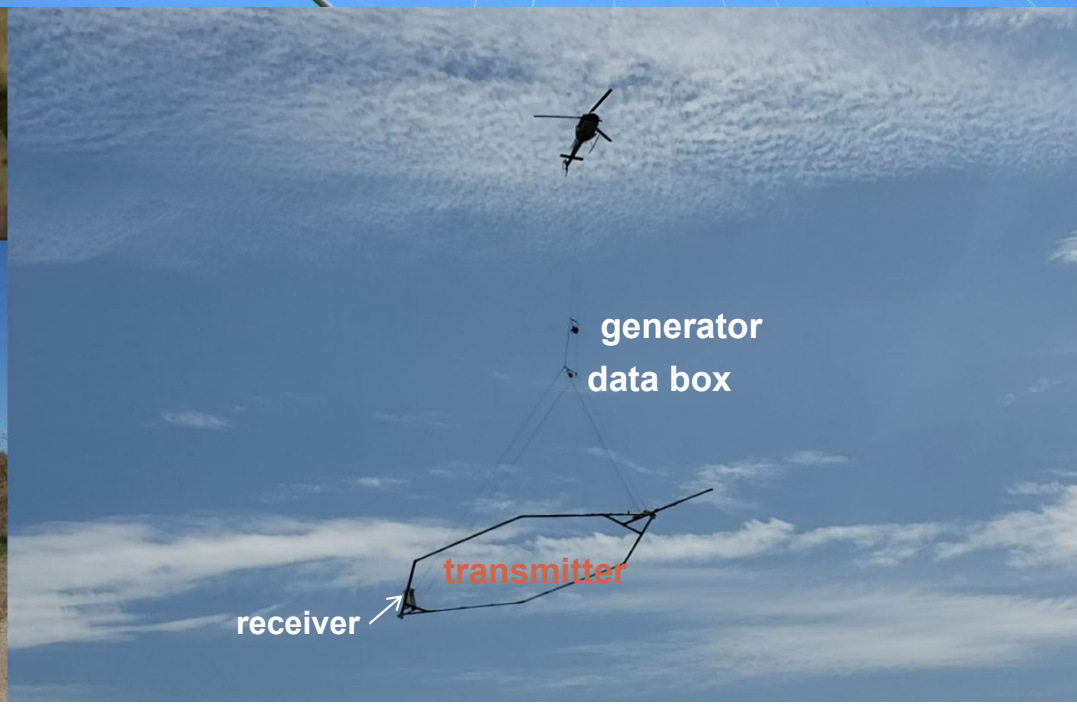
CSD Website: your State Geological Survey

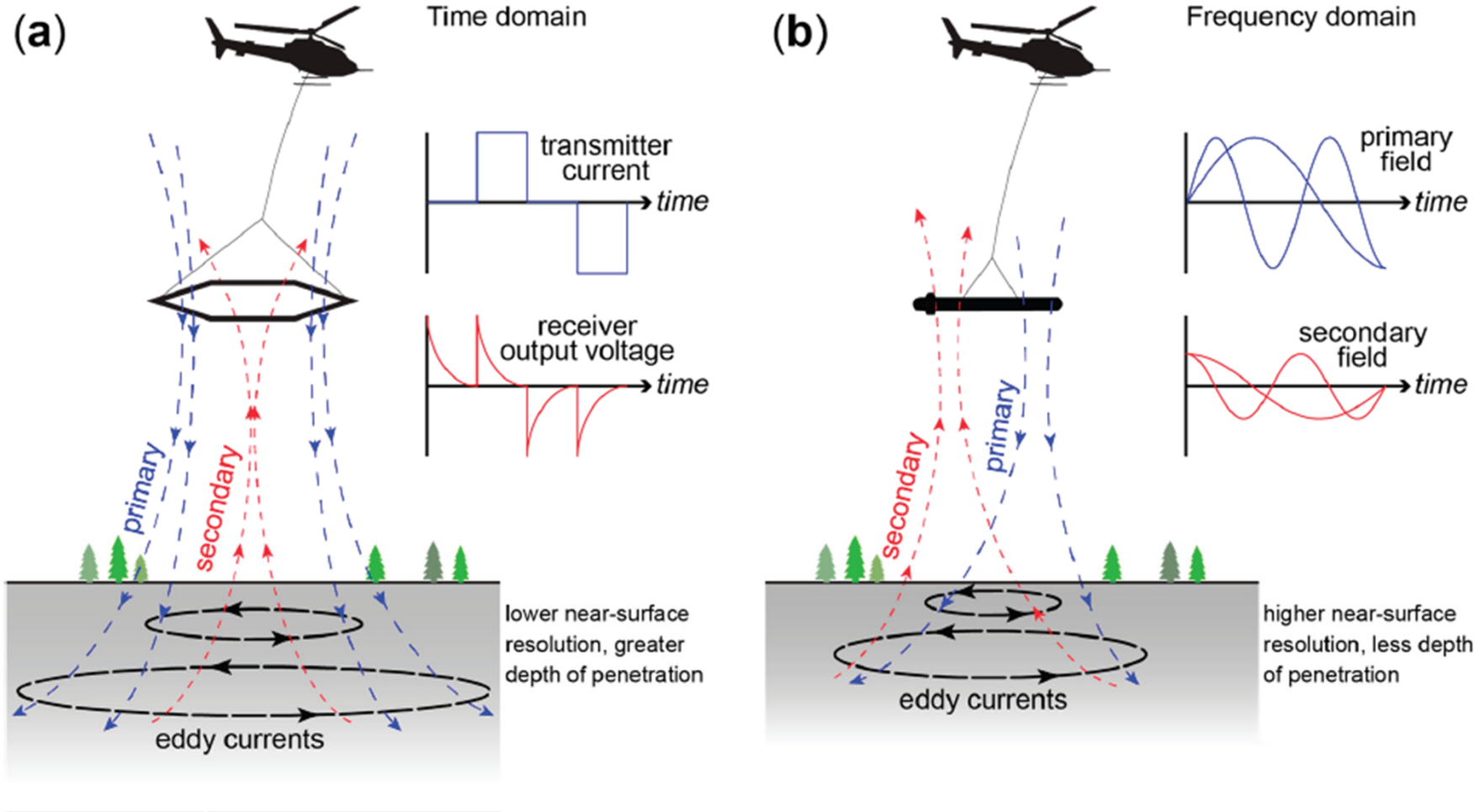


Click here to watch an educational video produced by QUEST NEBRASKA

net regarding AEM survey and Nebraska's groundwater. Please click here for a 2017 presentation of ENWRA AEM data by Aqua Geo Frameworks, LLC AGF Aqua Geo Frameworks







Korus, Jesse T., "Combining Hydraulic Head Analysis with Airborne Electromagnetics to Detect and Map Impermeable Aquifer Boundaries" (2018). http://digitalcommons.unl.edu/conservationsurvey/659

Figure 2. Comparison of airborne electromagnetic systems: (**a**) Time domain system; (**b**) frequency domain system.

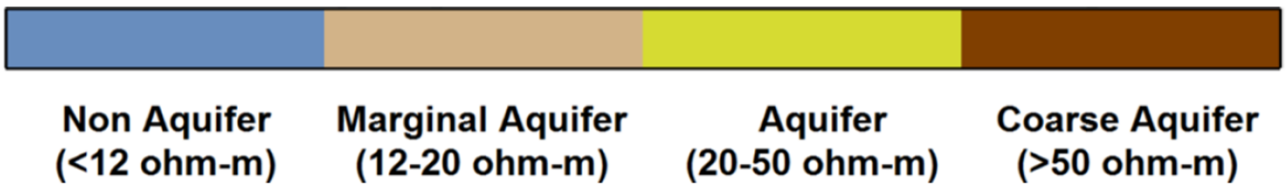
AEM Fundamentals *Resistivity applied to sediments*

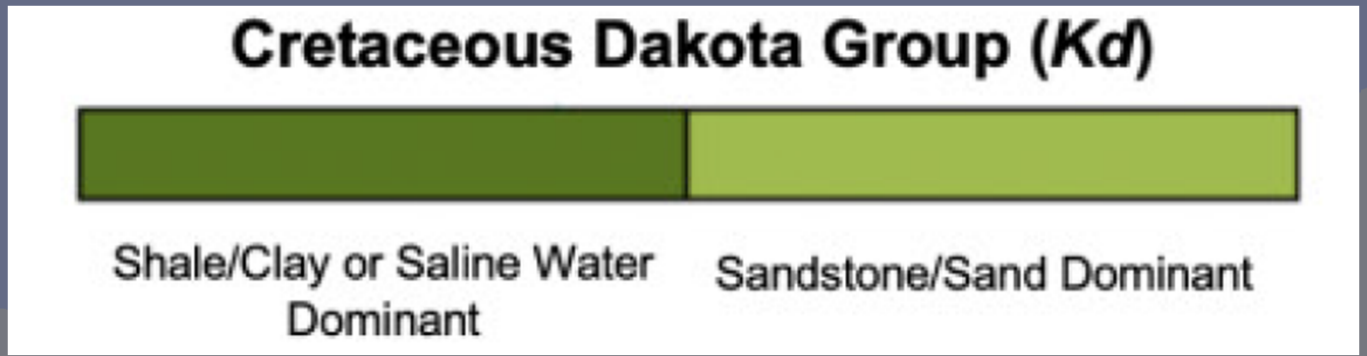
Finer-grained sediment

Decrease in resistivity

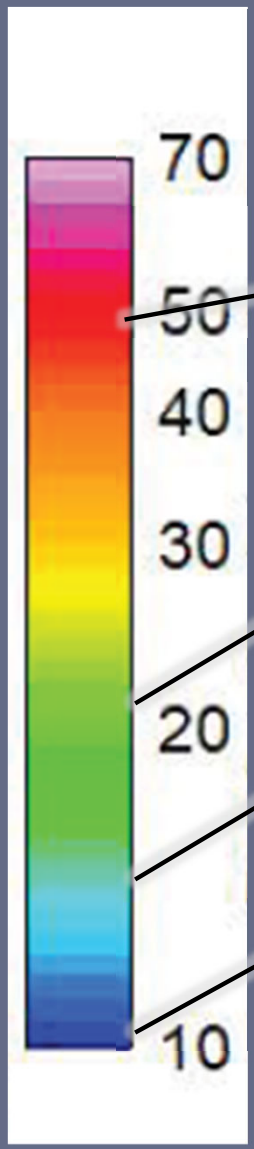
Increase in resistivity

Coarser-grained sediment

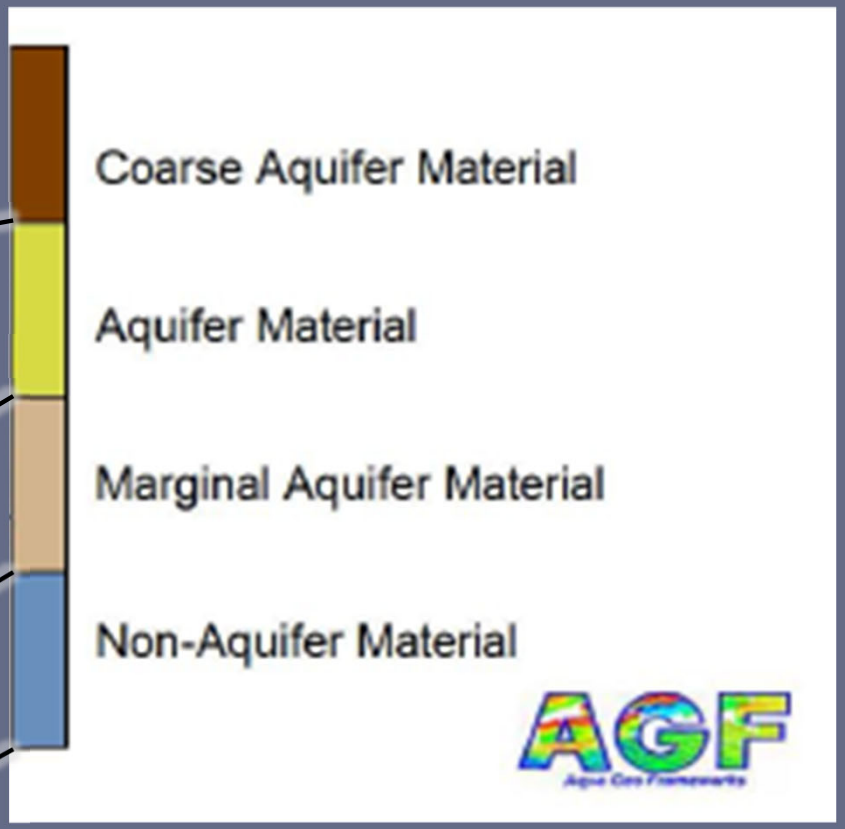




Resistivity (ohm-m):



Aquifer Material Interpretation:



Brown = sand-rich, coarse intervals of the aquifer

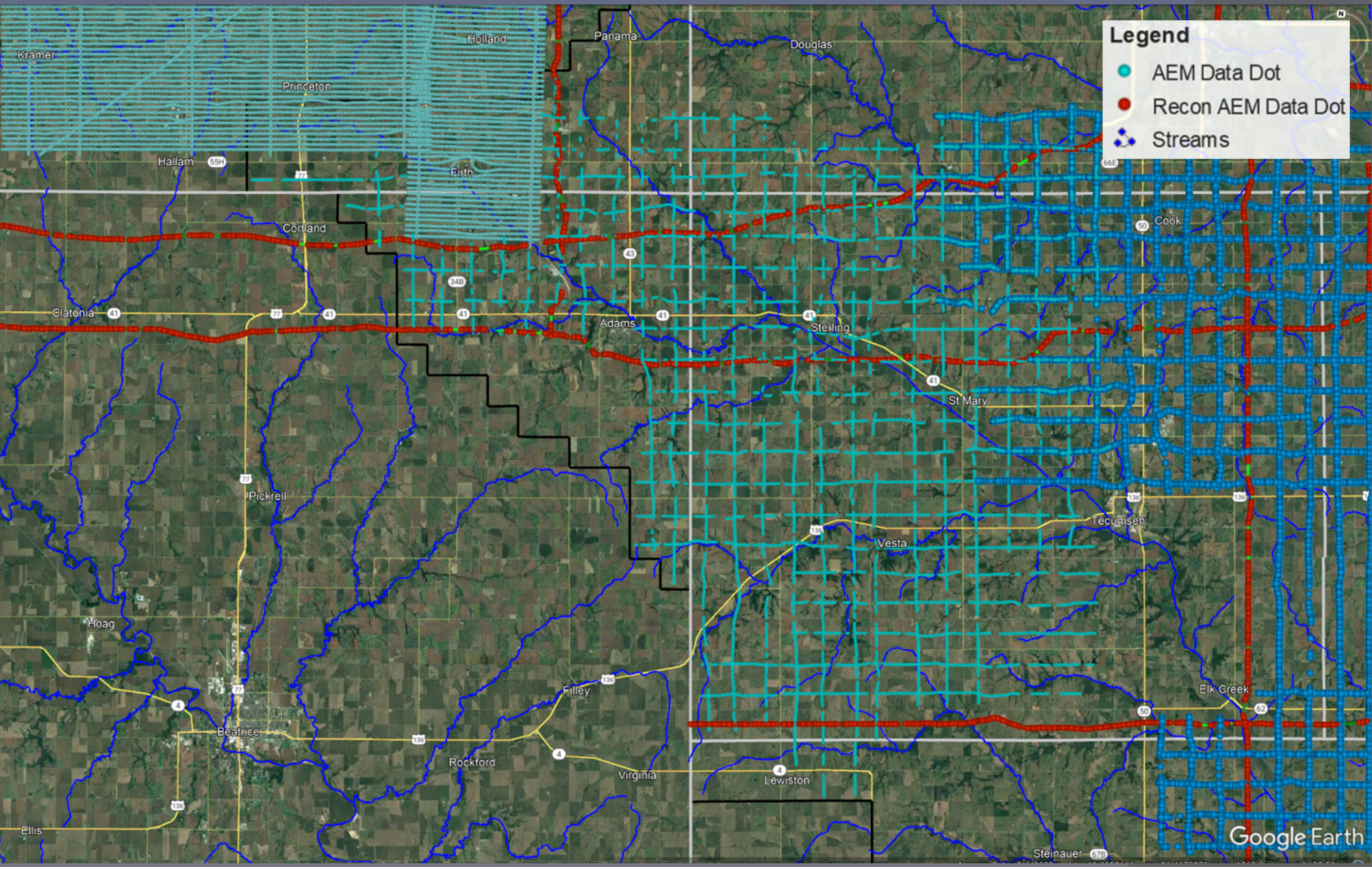
Yellow = aquifer

Tan = marginal aquifer

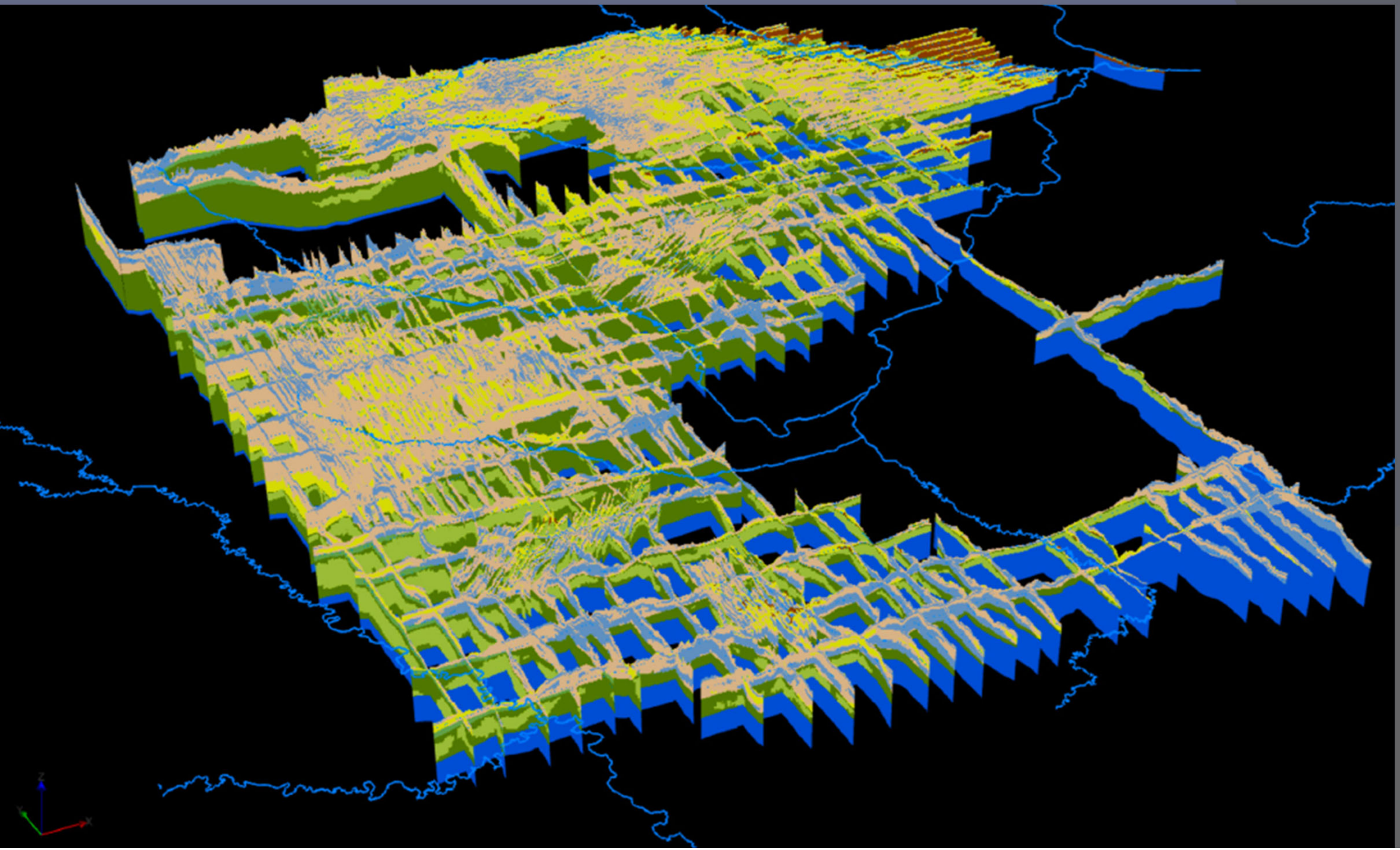
Blue = non-aquifer material

Resistivity thresholds based on 58+ ground truth borehole and geophysical logs assessed from across the ENWRA area

Google Earth datasets on enwra.org



Example 3D Fence Results



Example Block Flight Results

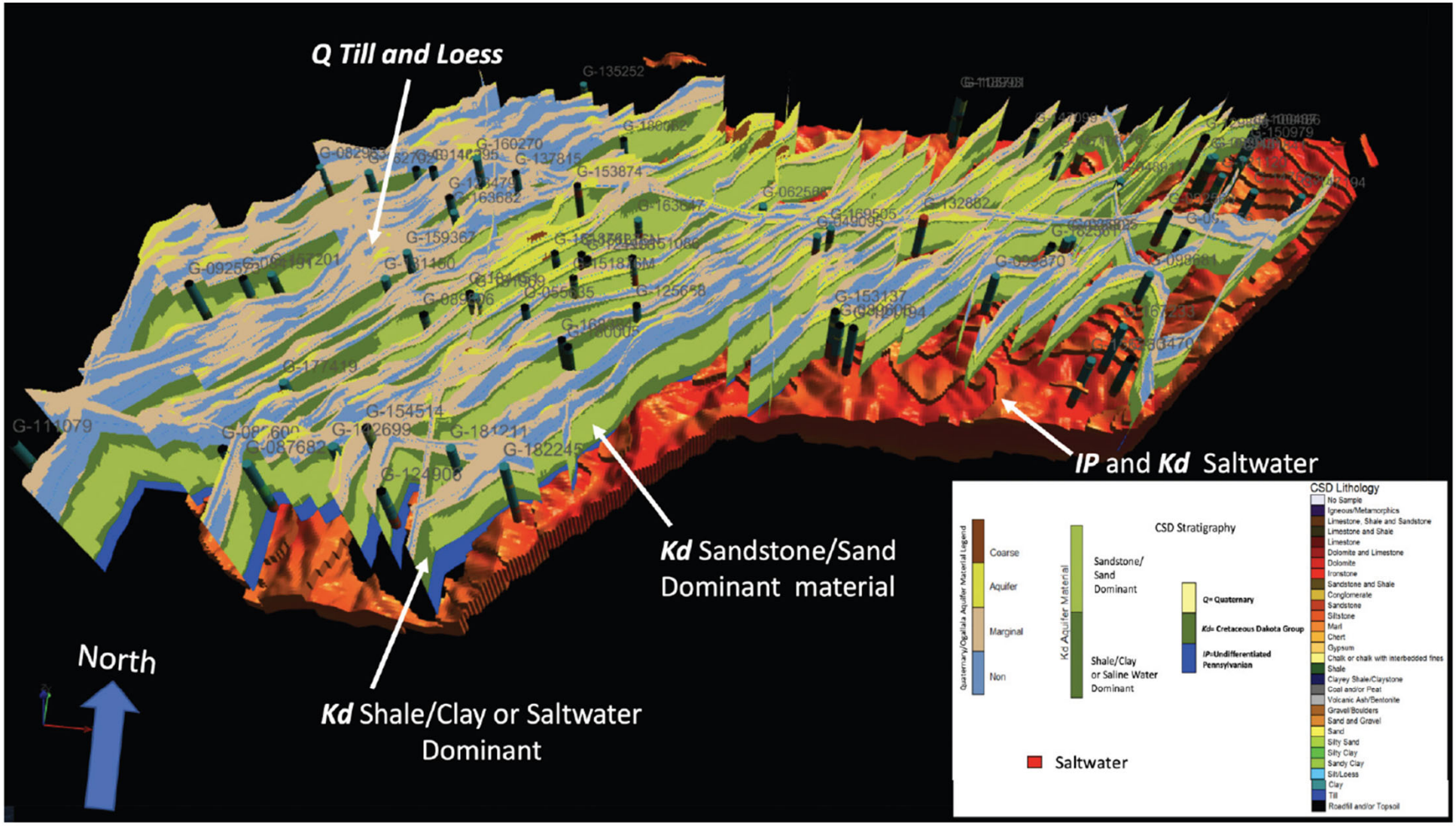


Figure 3-237. 3D voxel model looking north showing the saltwater areas (red) in the Emerald Pleasant Dale Block. A fence diagram of all *Q*,

Salt water in Dakota

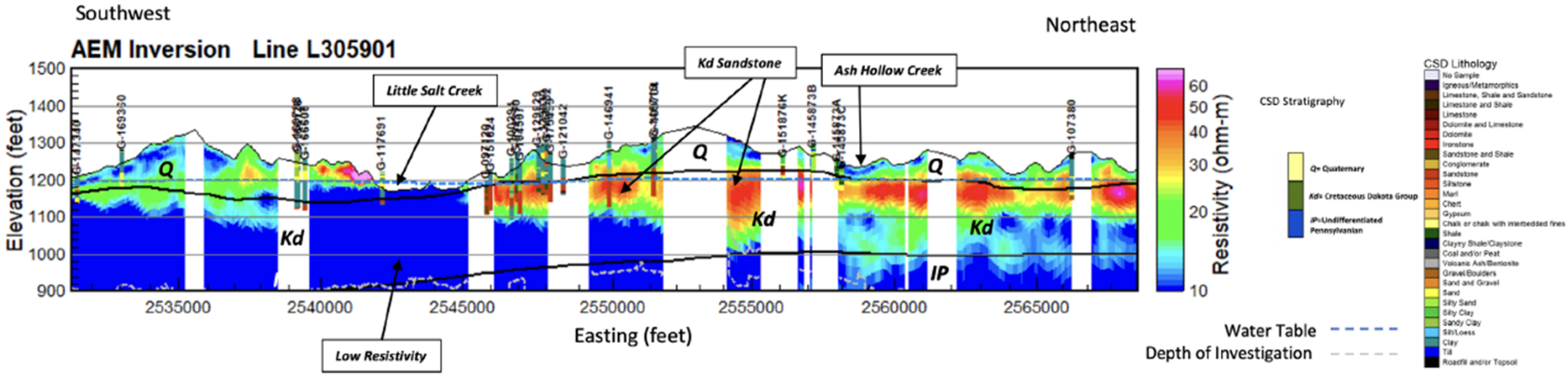
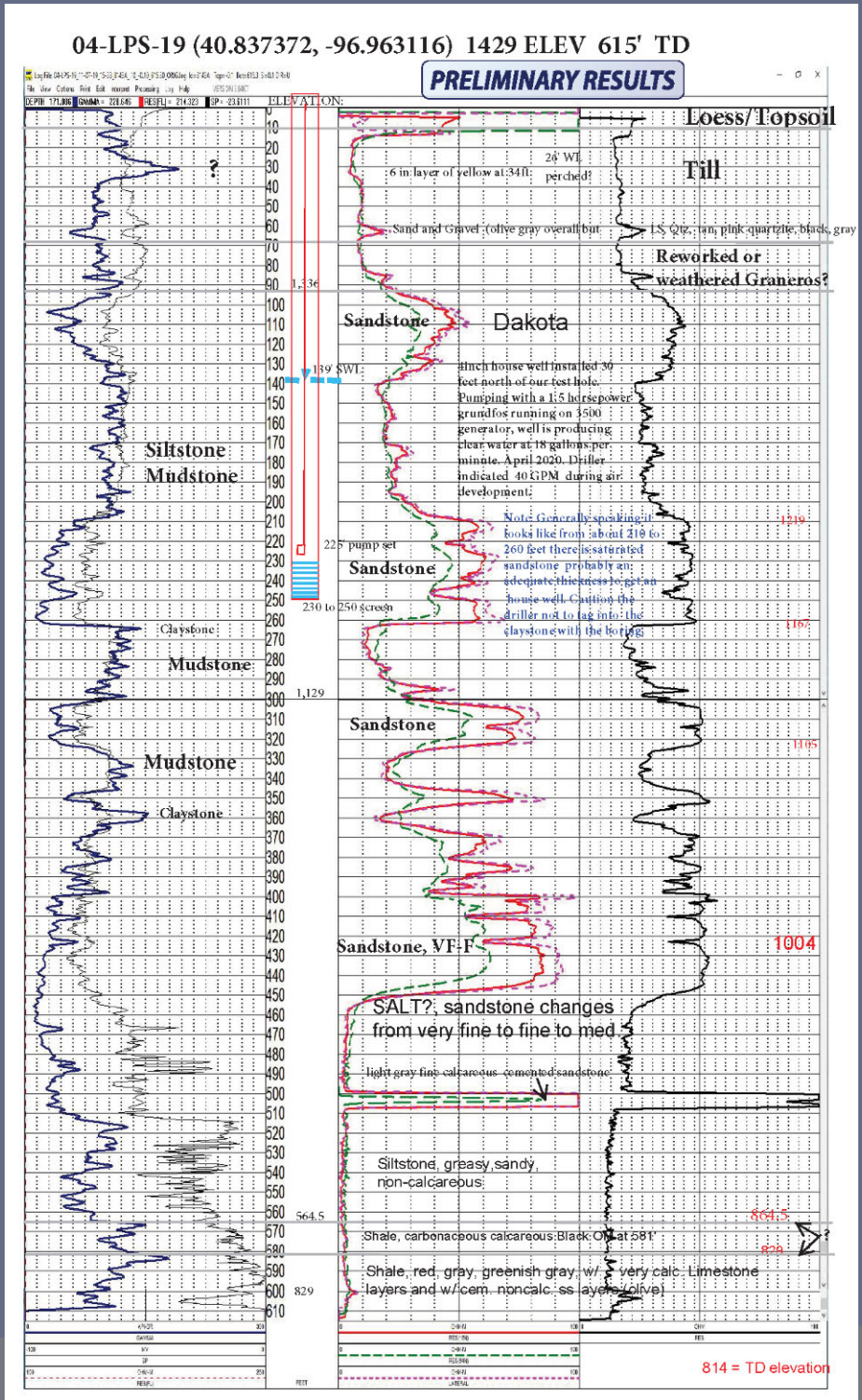


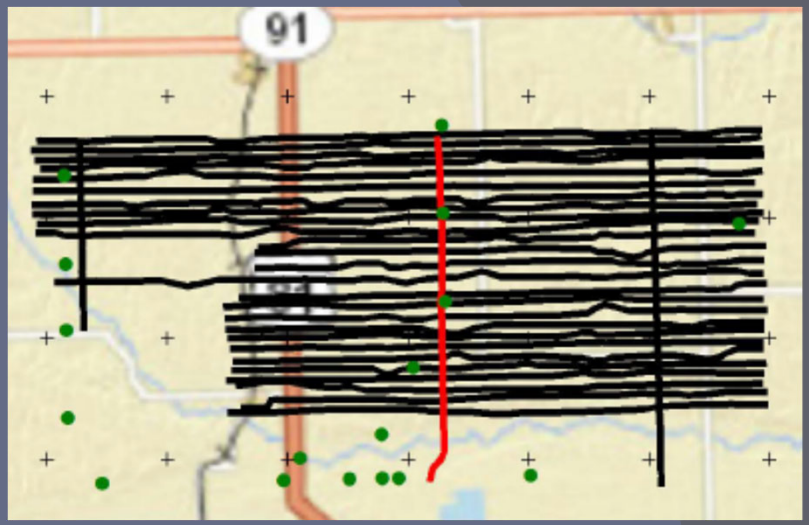
Figure 3-11. 8-mile-long southwest-northeast line, L305901. Nebraska DNR borehole lithology logs are indicated on the AEM inverted earth models if they are within ¼ mile of the flight line. Interpretations of the top geologic units are indicated by the black lines. Gaps indicate areas removed due to coupling. Projection is North American Datum of 1983 (NAD 83) State Plane Nebraska (feet) and the elevation values are referenced to the North American Vertical Datum of 1988 (NAVD 88).



- Cautioned the driller not to tag into the claystone with the boring advancement
- April 2020: 4-inch house well installed 30 feet north of our test hole. Pumping with a 1.5 horsepower grundfos running on 3500 generator, well is producing clear water at 18 gallons per minute. Driller indicated 40 GPM during air development.

Groundwater Quantity

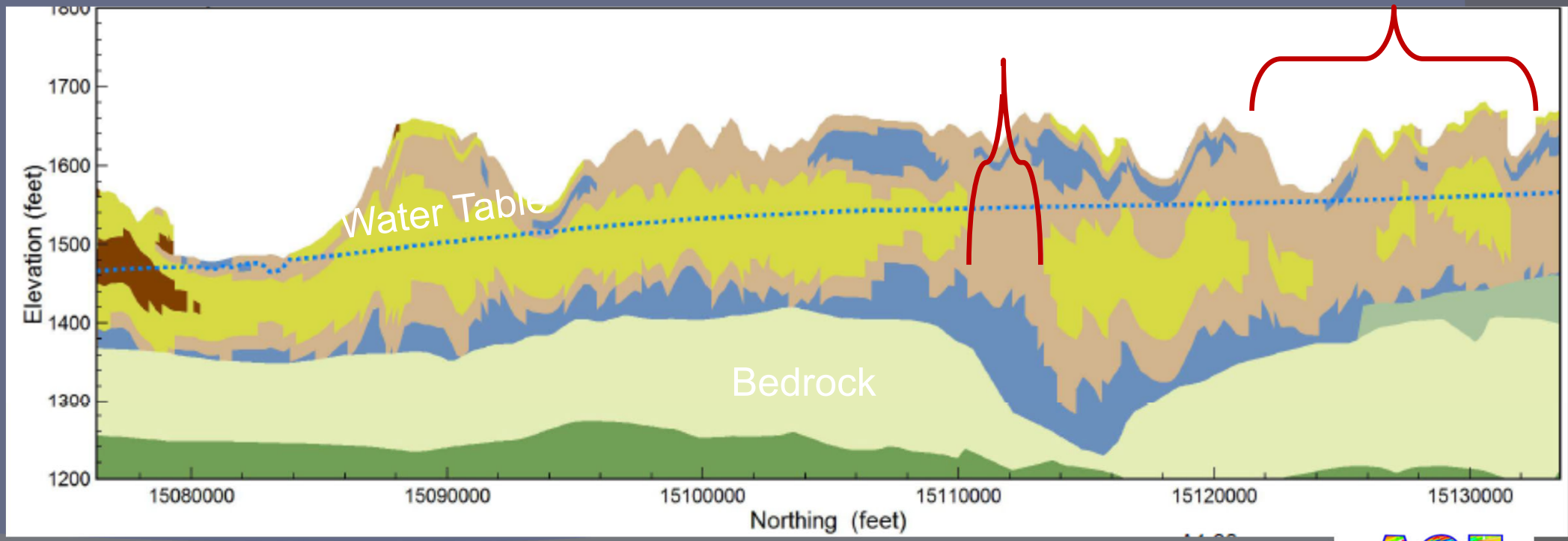
Where are the most likely areas for well interference to occur?



Isolated areas of aquifer material

SOUTH

NORTH



AGF
Aqua Geo Frameworks, LLC.

WSF #5312

- ENWRA Recharge and Focus Areas
- 3 Phase collaborative effort with the ENWRA NRDs, UNL-CSD and the U.S. Geological Survey
- Phase 1 will focus on the entire ENWRA region and AEM with NWIS
- Phase 2 - Focus Area Work - better than 1995 Water Contours
- Phase 3 - Regional Recharge Map Refinements, Report and Recommendations

ENWRA $240,000 project with the USGS and CSD: $144k WSF award, $74k USGS Cooperative Dollars, $96k ENWRA local funds

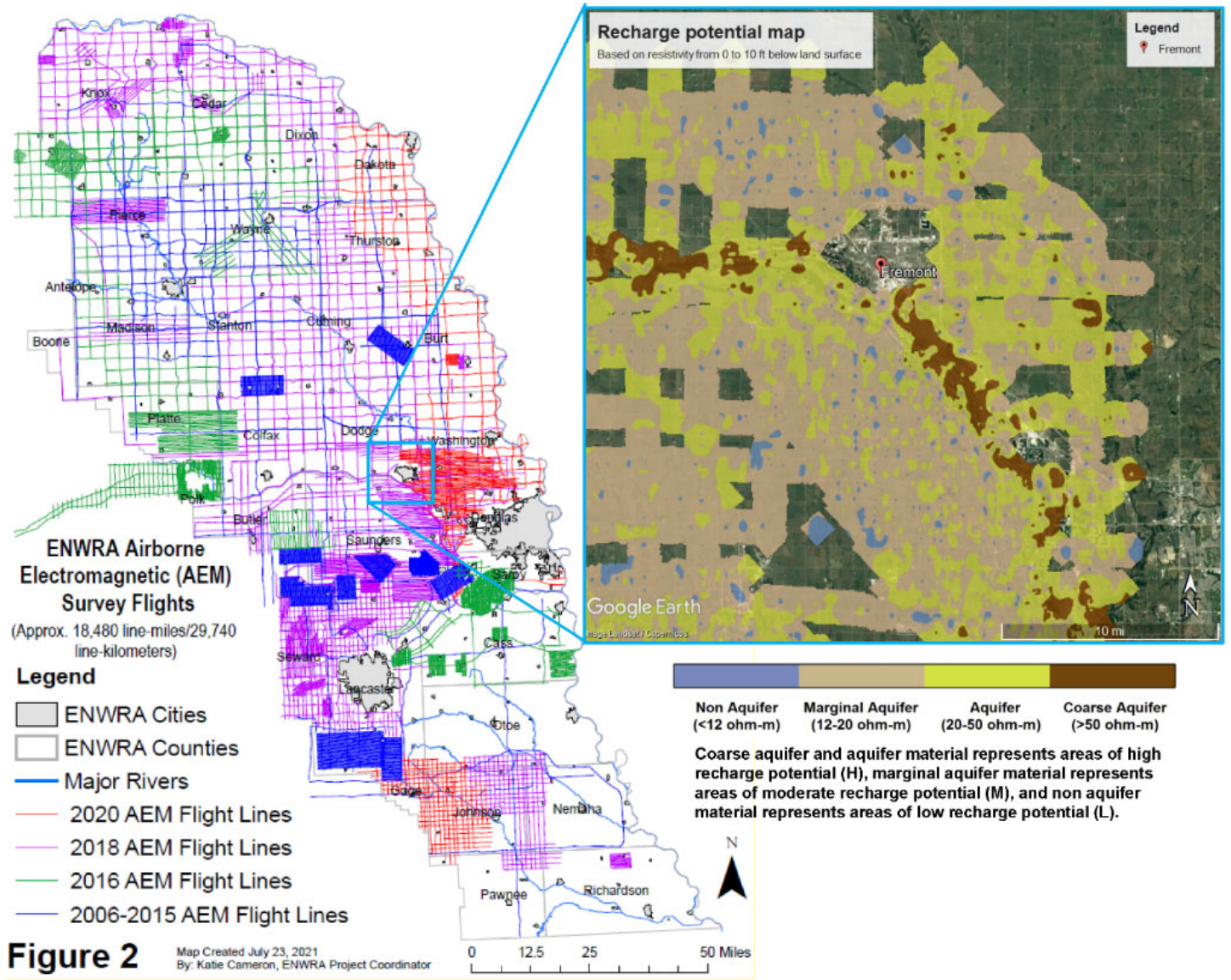
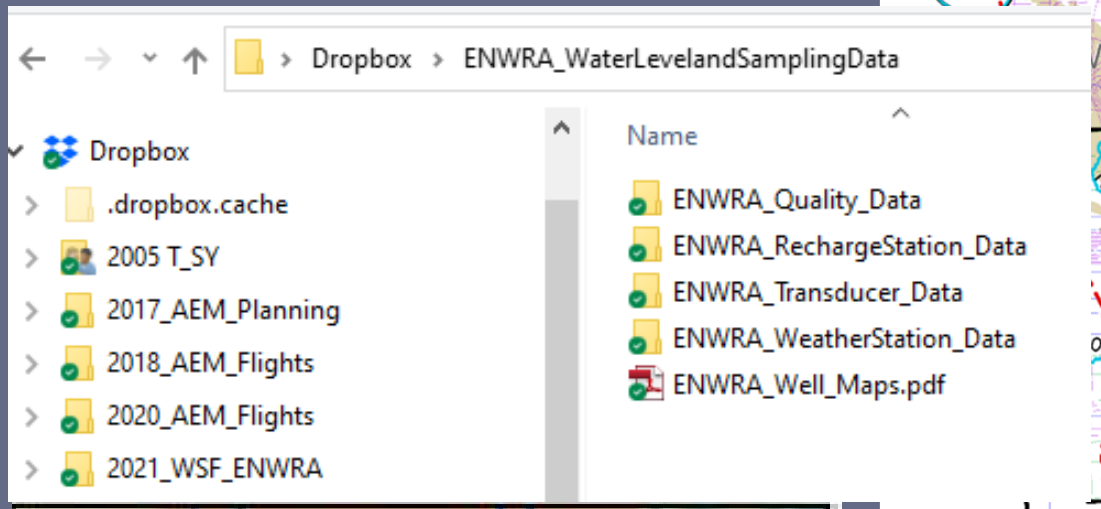
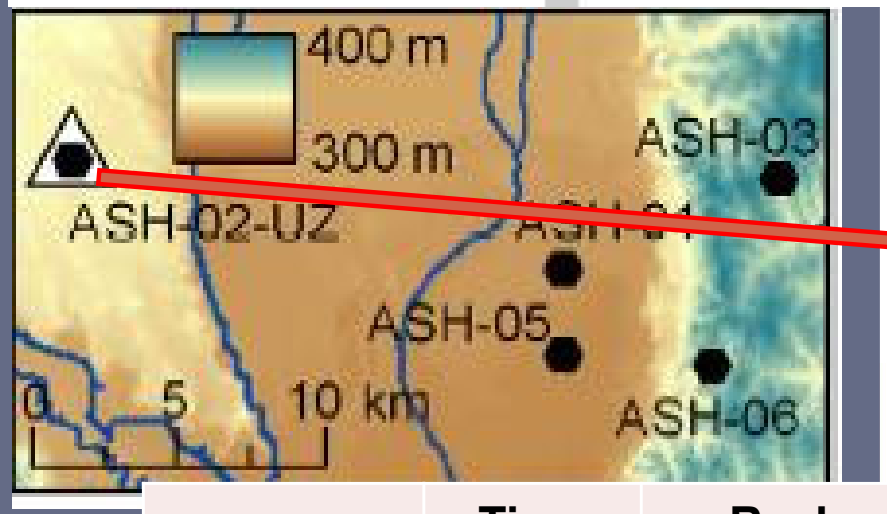


Figure 2 Map Created July 23, 2021
By: Katie Cameron, ENWRA Project Coordinator

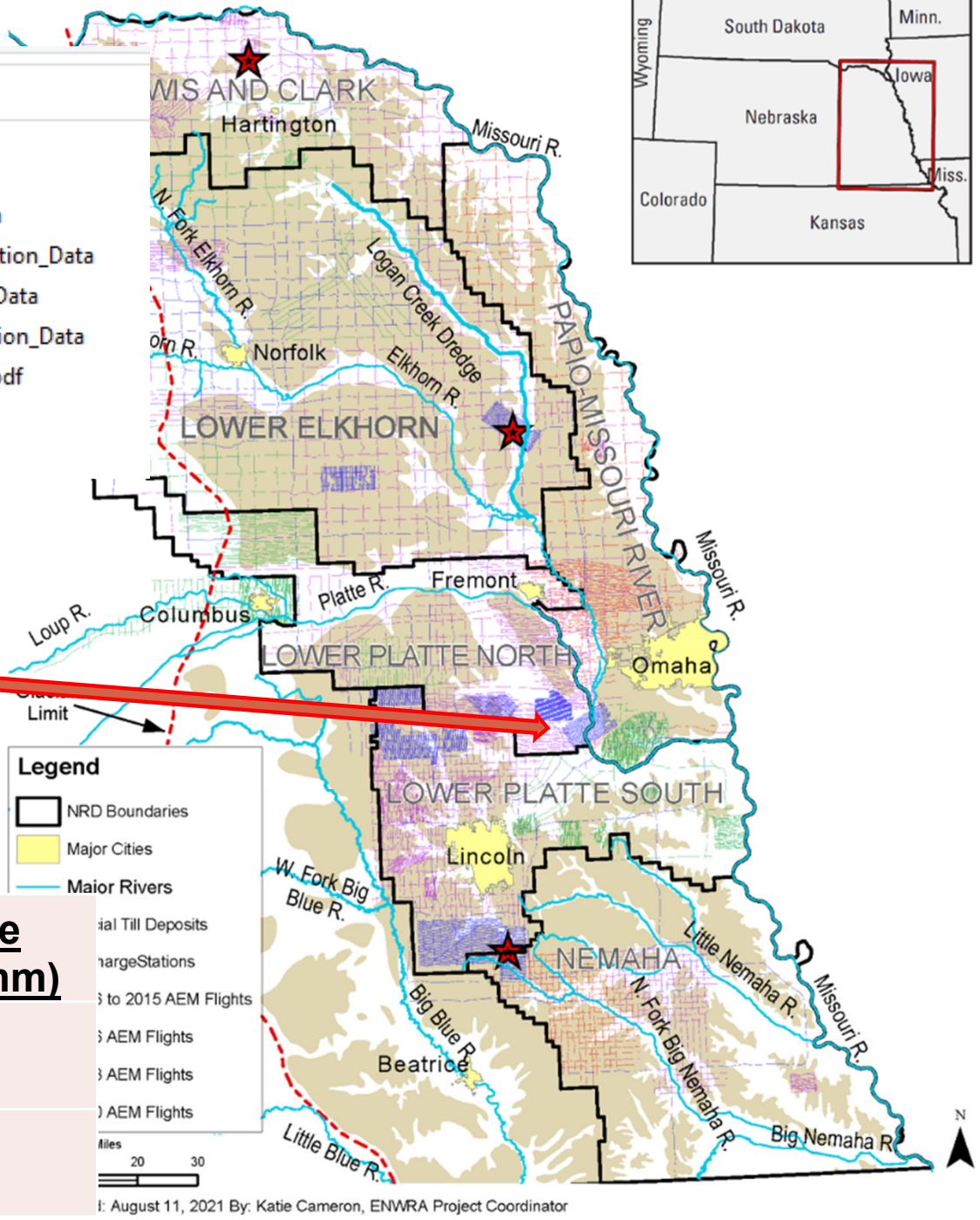
Recharge

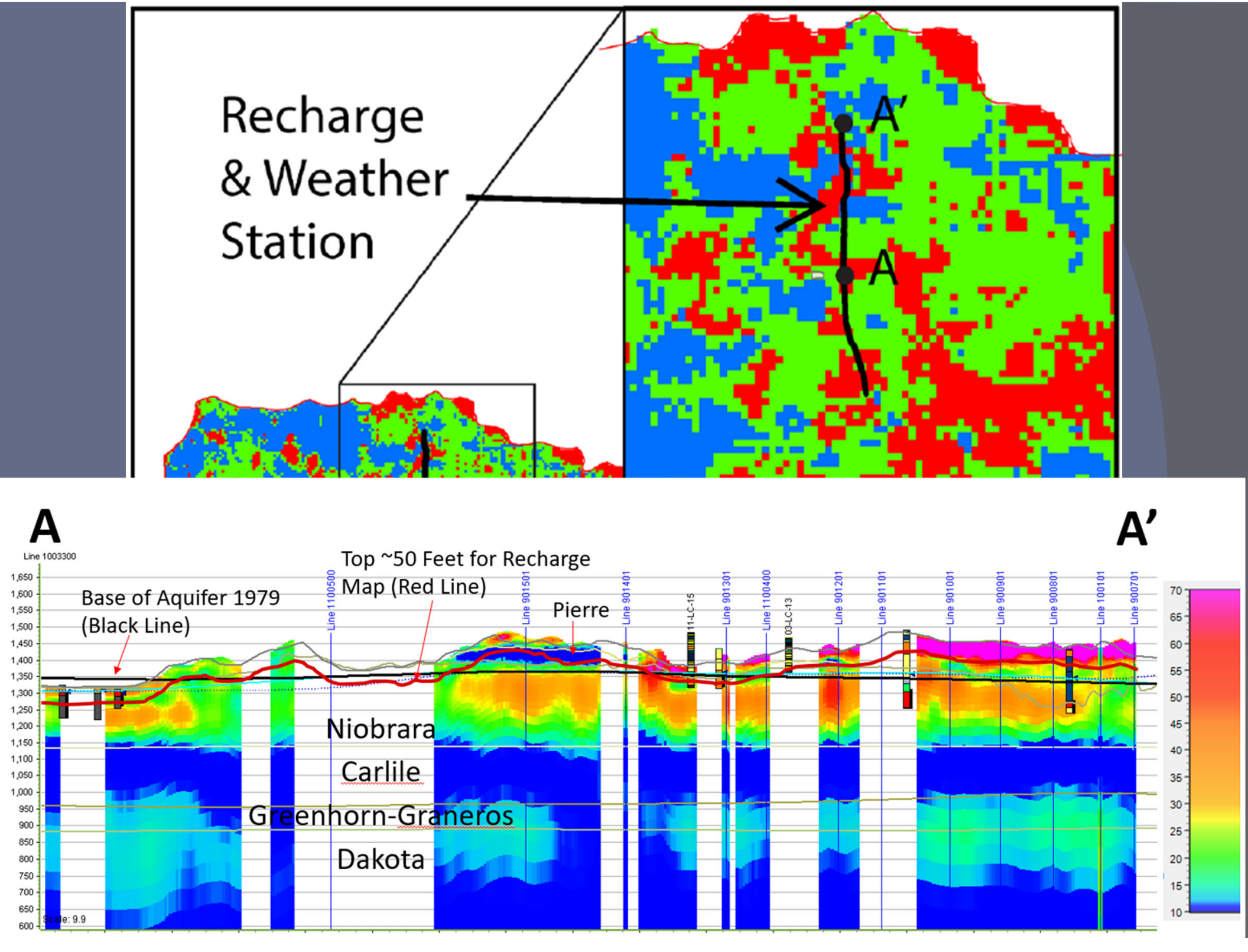




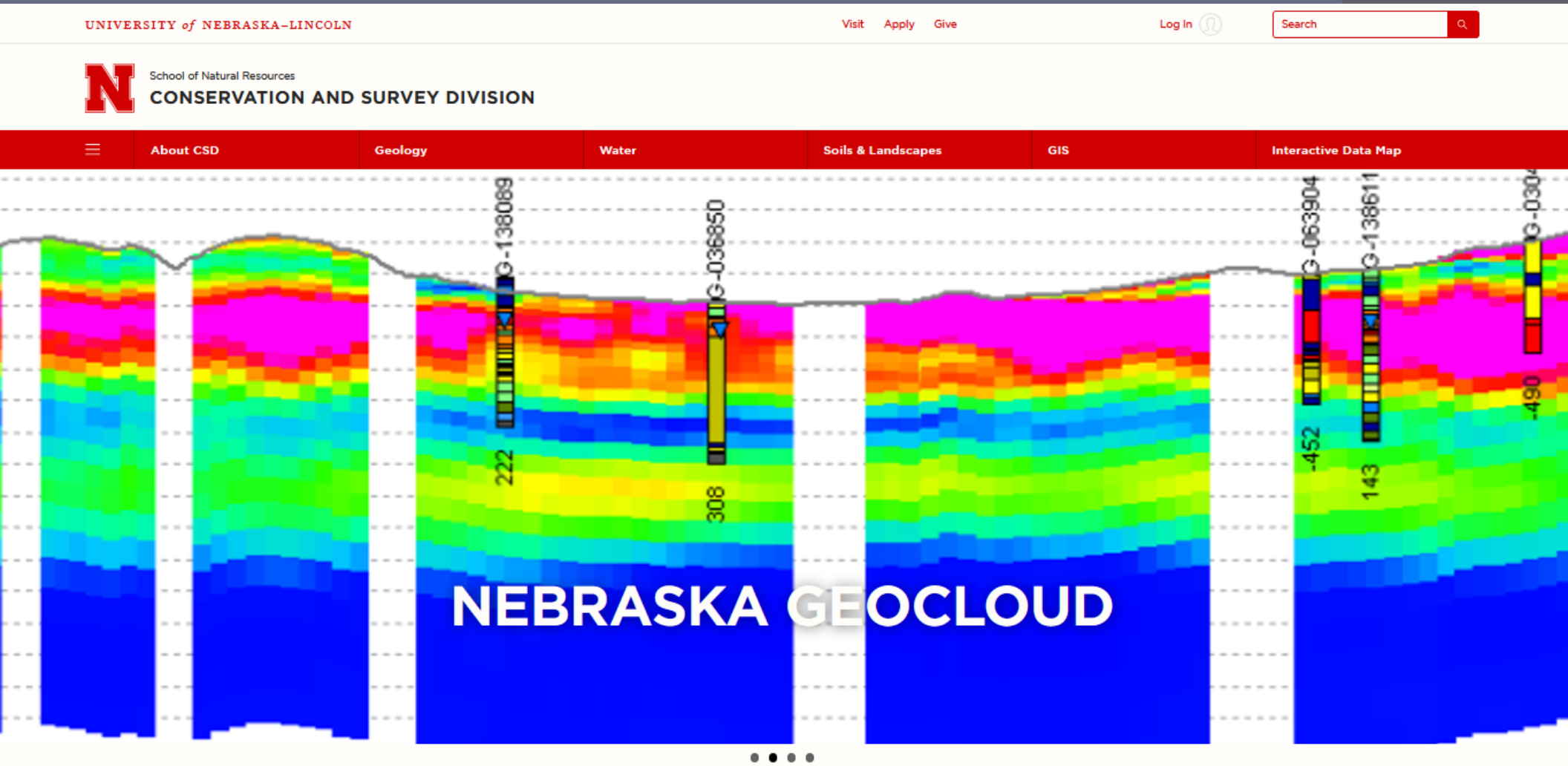
Well	Time Period	Recharge Amount (mm)
USGS MUD-95	6/16-3/17	233
USGS Valley	6/16-3/17	404

ENWRA STUDY AREA




Recharge
& Weather
Station
A'
A
A
A'
Line 1003300
Top ~50 Feet for Recharge
Map (Red Line)
Base of Aquifer 1979
(Black Line)
Pierre
Niobrara
Carlile
Greenhorn-Graneros
Dakota
Line 1100500
Line 901501
Line 901401
11-LC-15
Line 901301
Line 1100400
03-LC-13
Line 901201
Line 901101
Line 901001
Line 900901
Line 900801
Line 1001101
Line 900701
Scale: 9.9

Nebraska GeoCloud Access & Standards

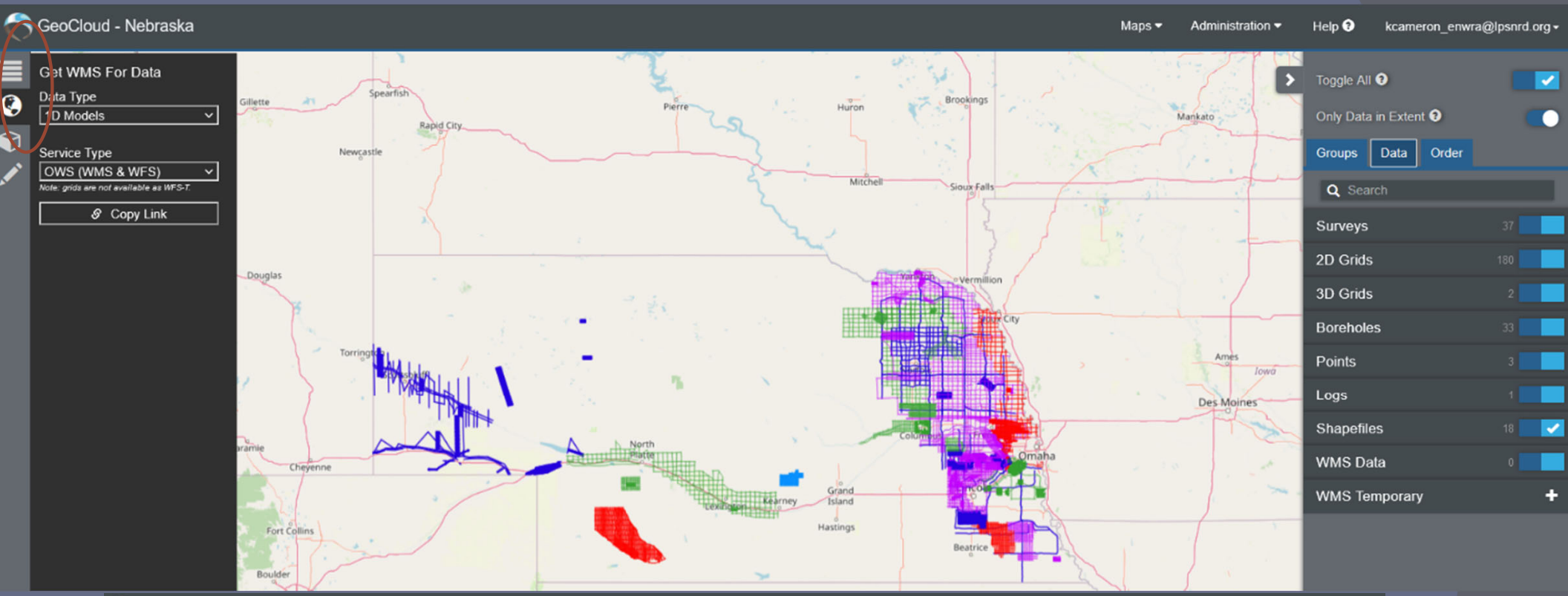


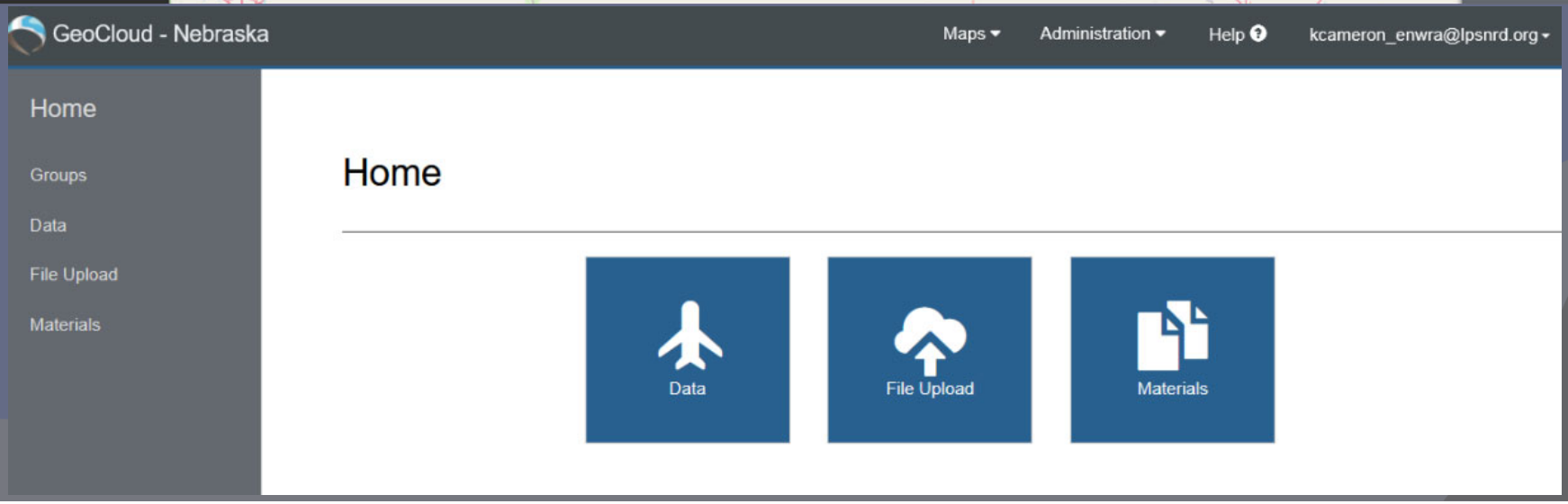
The Nebraska GeoCloud (NGC) is a web-based digital platform for geophysical, geological, and groundwater data and models. The purpose of the NGC is to archive Nebraska's vast volume of data and make it accessible to both model builders and model users. The NGC consists of databases, web servers, and web interfaces designed for data storage, sharing, and distribution. It contains one interface for Projects and another interface for Data. Projects may include software files, reports, and other information related to a project. It can be used to store and share project files, or it can be used as the final repository for completed projects. The Data interface is built upon structured databases that support the upload and download of data and models used in typical hydrogeological studies. Users can access the data contained in this part of the NGC via the GeoScene3D data portal. These data can also be viewed on an interactive web map and they are accessible via a web map service (WMS) in GIS programs (e.g. ArcGIS, QGIS). To request a user account to the NGC, please contact Jesse Korus at jkorus3@unl.edu.

Request User Access | Nebraska Geocloud Projects | Nebraska Geocloud Data

Nebraska GeoCloud Data Map & Upload

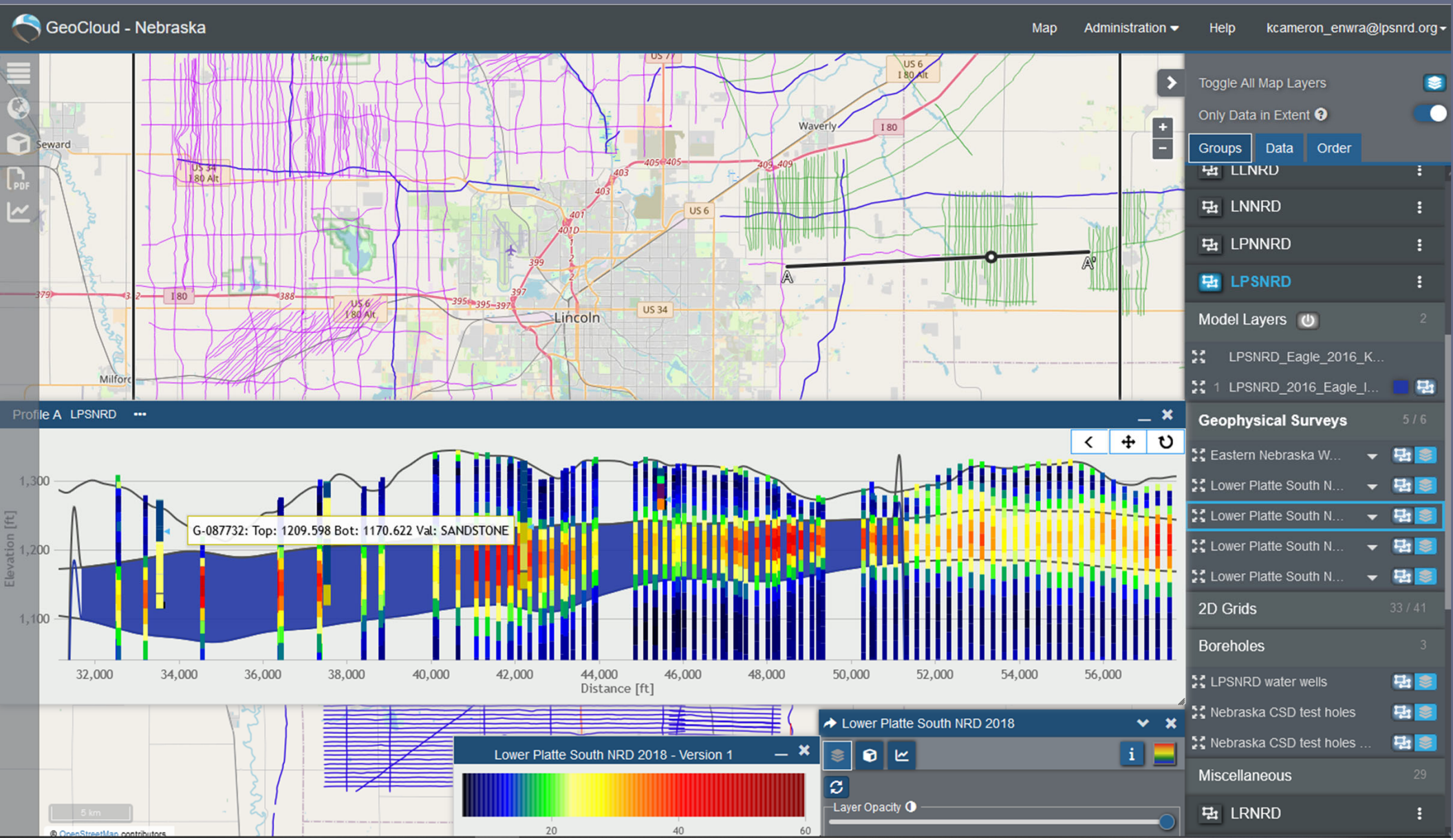
https://youtu.be/Fs4OsWJQhe8





Nebraska GeoCloud

https://news.unl.edu/newsrooms/today/article/california-turns-to-nebraska-know-how-on-aquifer-analysis-groundwater/

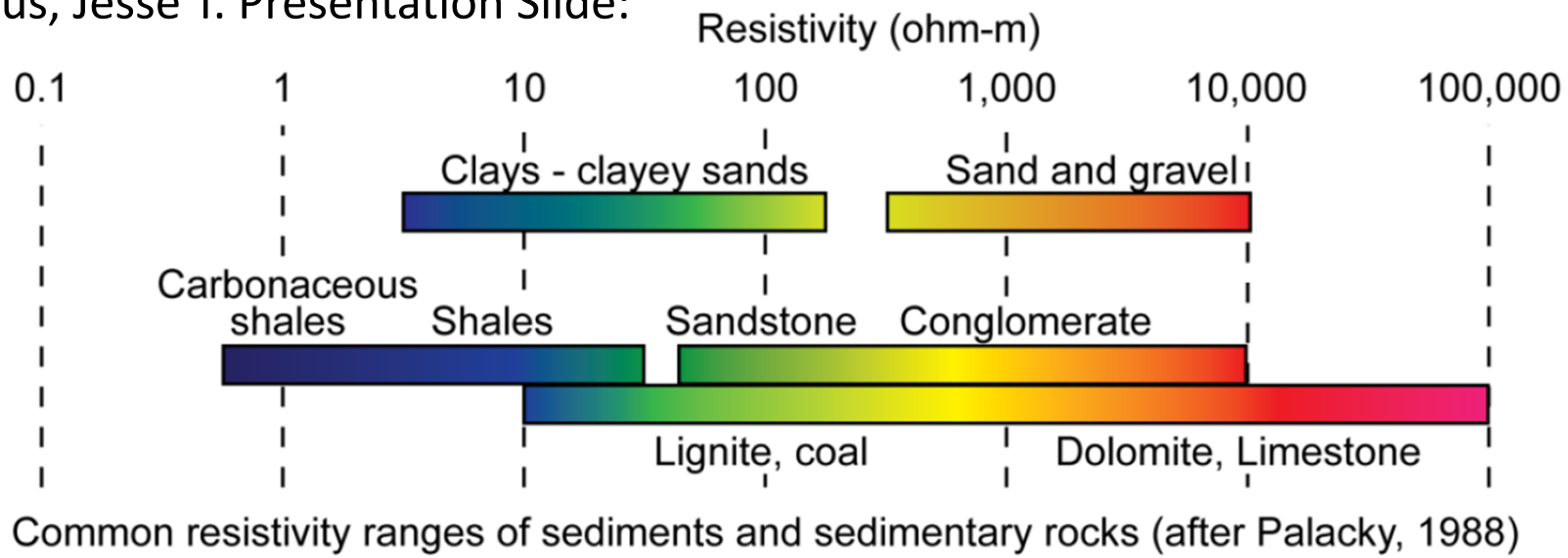


CONSERVATION AND SURVEY DIVISION
School of Natural Resources

Resistivity ranges of rocks & sediments

Nebraska's Natural Resources Districts www.nrdnet.org
Protecting Lives • Protecting Property • Protecting the Future

Korus, Jesse T. Presentation Slide:



Common resistivity ranges of sediments and sedimentary rocks (after Palacky, 1988)

Water for Food
DAUGHERTY GLOBAL INSTITUTE
at the University of Nebraska

USGS
science for a changing world

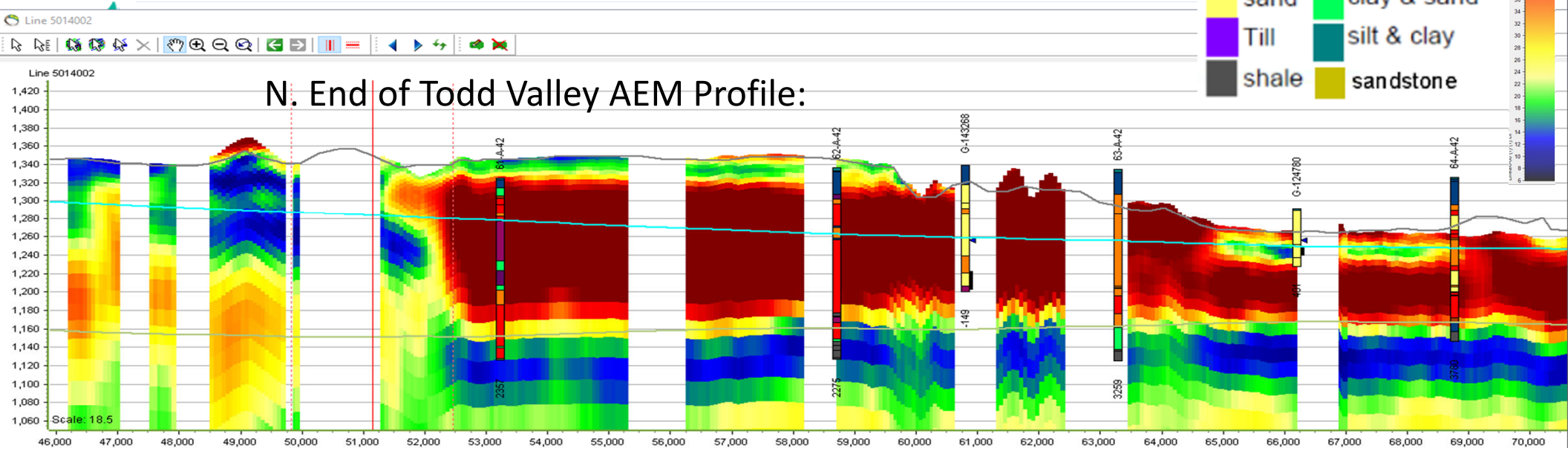
GEOScene3D

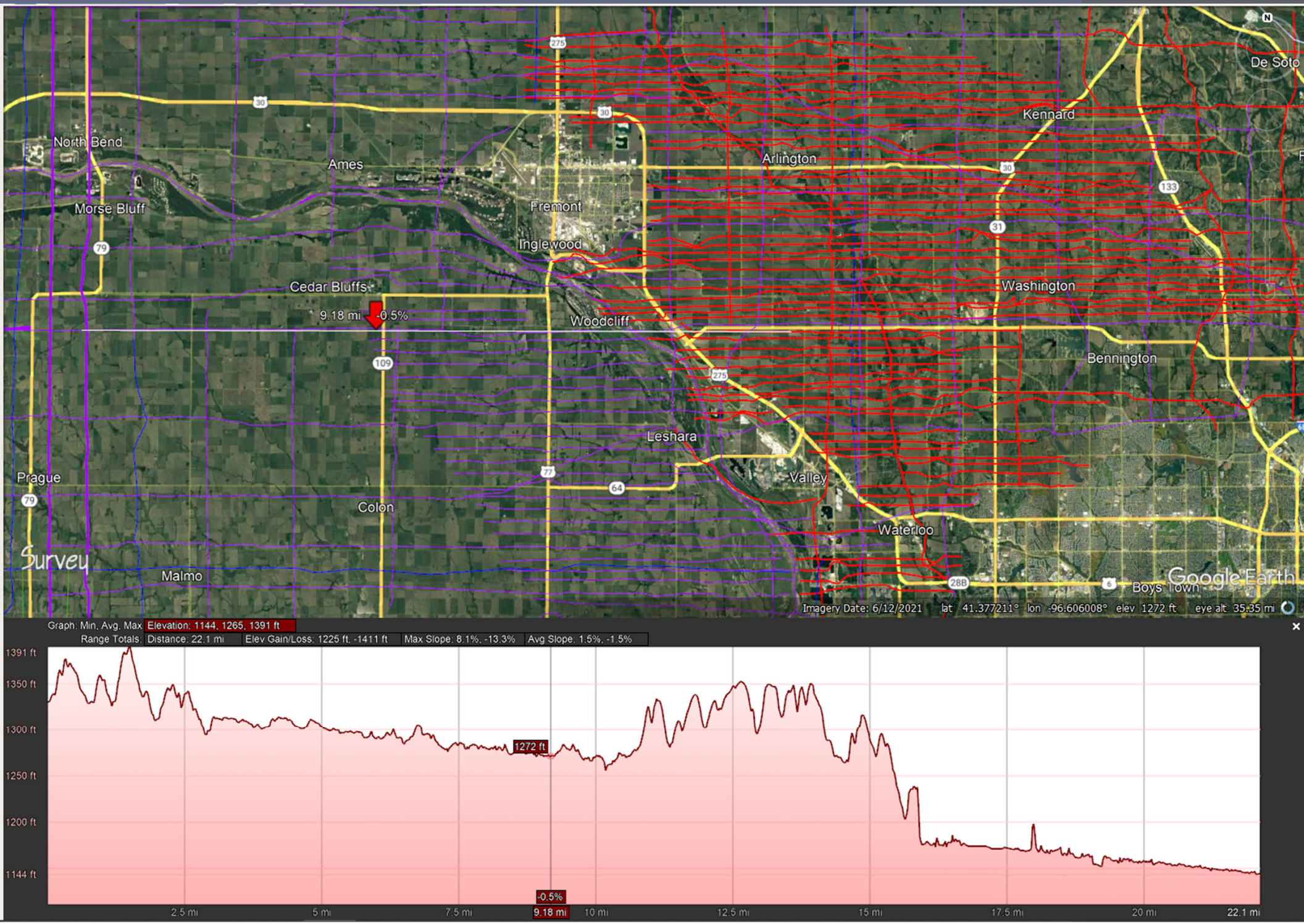
GEOClo

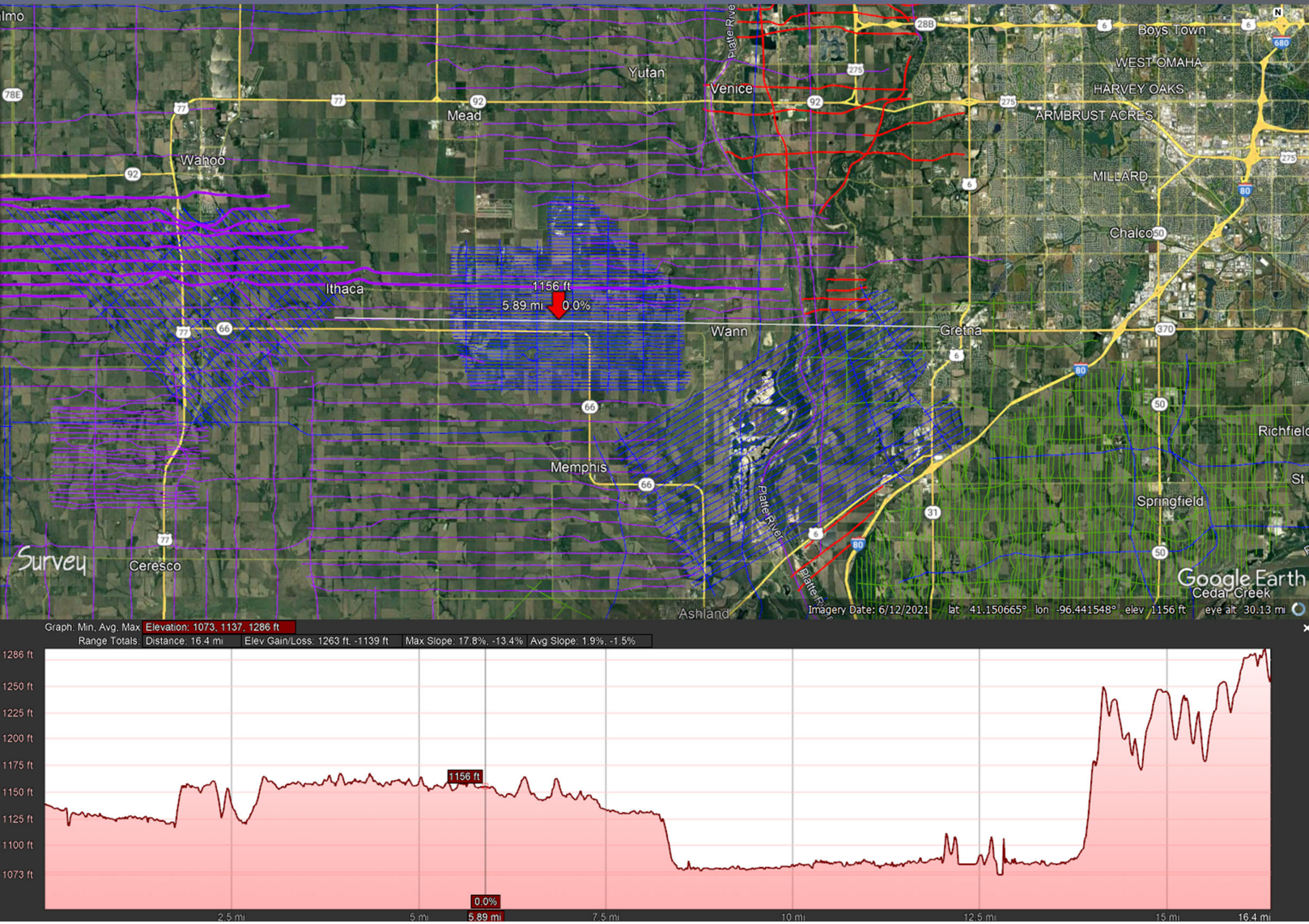
Log Materials:

- clay
- gravel
- sand
- Till
- shale
- sand & gravel
- sand & clay
- clay & sand
- silt & clay
- sandstone

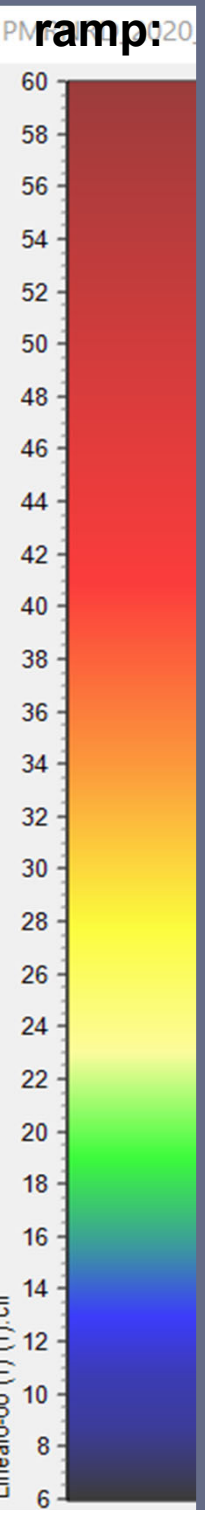
N. End of Todd Valley AEM Profile:




North Bend
Ames
Morse Bluff
Fremont
Inglewood
Arlington
Kennard
De Soto
Cedar Bluffs
9.18 mi -0.5%
Woodcliff
Washington
Bennington
Leshara
Valley
Prague
Colon
Waterloo
Malmo
Survey
Boys Town
Google Earth
Imagery Date: 6/12/2021 lat 41.377211° lon -96.606008° elev 1272 ft eye alt 35.35 mi
Graph: Min, Avg, Max Elevation: 1144, 1265, 1391 ft
Range Totals: Distance: 22.1 mi Elev Gain/Loss: 1225 ft, -1411 ft Max Slope: 8.1%, -13.3% Avg Slope: 1.5%, -1.5%
1391 ft
1350 ft
1300 ft
1250 ft
1200 ft
1144 ft
1272 ft
-0.5%
2.5 mi
5 mi
7.5 mi
9.18 mi
10 mi
12.5 mi
15 mi
17.5 mi
20 mi
22.1 mi


Yutan
Venice
Mead
Wahoo
Boys Town
WEST OMAHA
HARVEY OAKS
ARMBRUST ACRES
MILLARD
Chalco
Ithaca
1156 ft
5.89 mi
0.0%
Wann
Gretna
Memphis
Springfield
Ceresco
Ashland
Platte River
Survey
Google Earth
Cedar Creek
Imagery Date: 6/12/2021 lat 41.150665° lon -96.441548° elev 1156 ft eye alt 30.13 mi
Graph: Min, Avg, Max Elevation: 1073, 1137, 1286 ft
Range Totals: Distance: 16.4 mi Elev Gain/Loss: 1263 ft, -1139 ft Max Slope: 17.8%, -13.4% Avg Slope: 1.9%, -1.5%
1286 ft
1250 ft
1225 ft
1200 ft
1175 ft
1150 ft
1125 ft
1100 ft
1073 ft
1156 ft
0.0%
2.5 mi
5 mi
5.89 mi
7.5 mi
10 mi
12.5 mi
15 mi
16.4 mi

AEM color ramp:



GeoCloud Logged Materials Legend:

- fill
- fill and soil
- fill and clay
- fill and silt
- fill and sand
- fill and gravel
- soil and fill
- soil
- soil and clay
- soil and silt
- soil and sand
- soil and gravel
- peat
- peat and clay
- peat and gravel
- clay and fill
- clay and soil
- clay and peat
- clay
- clay and till
- clay and silt
- clay and sand
- clay and gravel
- till and clay
- till
- silt and fill
- silt and soil
- silt and clay
- silt
- silt and sand
- silt and gravel
- sand and fill
- sand and soil
- sand and clay
- sand and silt
- sand
- sand and gravel
- gravel and fill
- gravel and soil
- gravel and clay
- gravel and till
- gravel and silt
- gravel and sand
- gravel
- coal and sand
- coal and ash
- clay and claystone
- claystone and clay
- claystone
- claystone and sand
- shale and coal
- clay and shale
- shale and clay
- shale
- sand and shale
- shale and sand
- shale and sandstone
- gravel and shale
- shale and gravel
- shale and limestone
- shale and chert
- clay and siltstone
- siltstone and clay
- siltstone and claystone
- silt and siltstone
- siltstone
- sand and siltstone
- siltstone and sand
- siltstone and sandstone
- gravel and siltstone
- siltstone and gravel
- sandstone and soil
- clay and sandstone
- sandstone and clay
- sandstone and shale
- silt and sandstone
- sandstone and silt
- sandstone and siltstone
- sand and sandstone
- sandstone and sand
- sandstone
- sandstone and gravel
- gravel and sandstone
- sandstone and limestone
- sandstone and chert
- conglomerate and gravel
- clay and limestone
- limestone and clay
- limestone and shale
- silt and limestone
- sand and limestone
- limestone and sand
- limestone and sandstone
- gravel and limestone
- limestone and gravel
- limestone
- limestone and ash
- limestone and chert
- clay and ash
- ash
- clay and chert
- chert and clay
- chert and shale
- chert
- no result

ENWRA
Eastern Nebraska Water Resources Assessment

Well Log Legend:

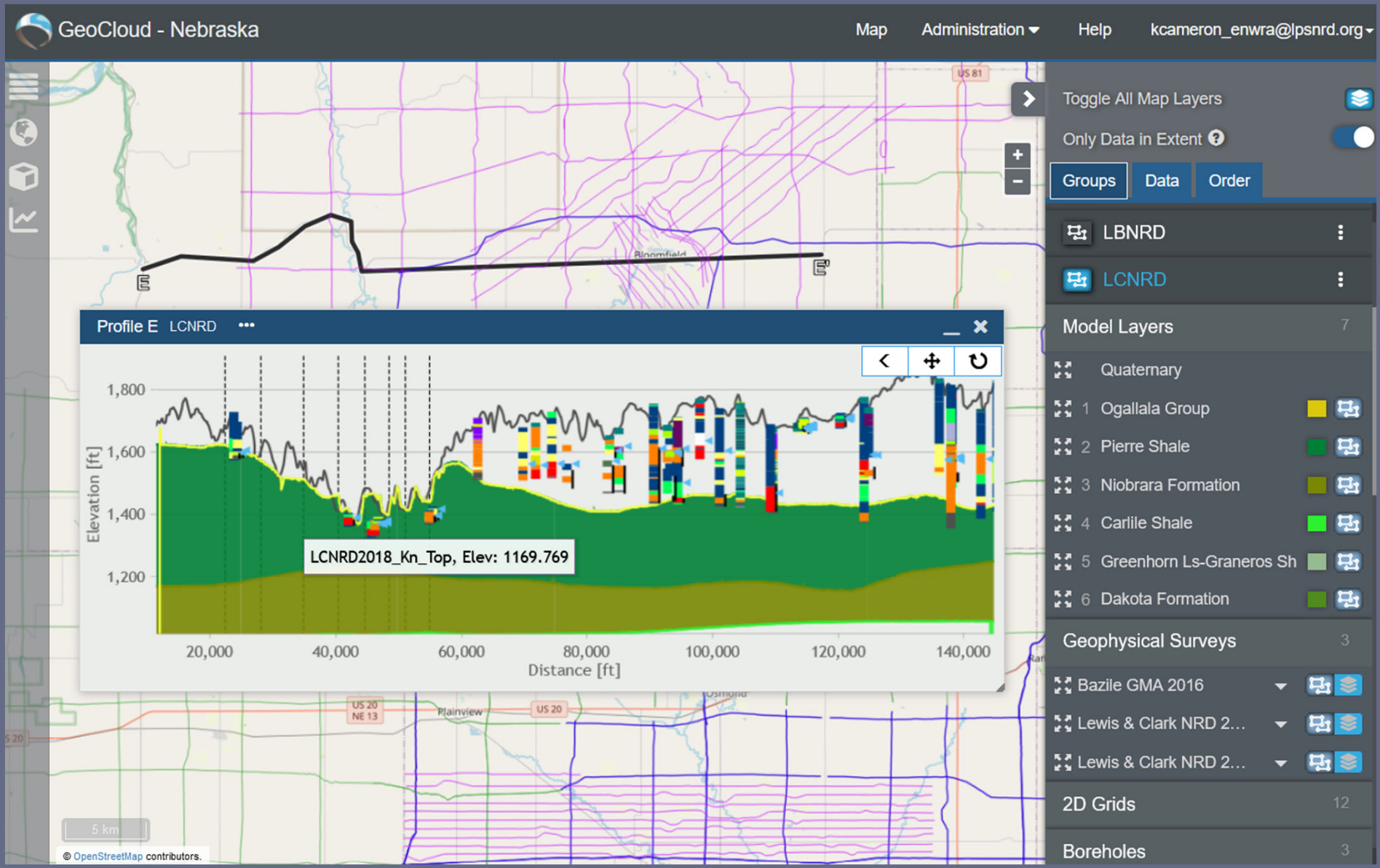
- SILT_silt
- CLAY_
- SAND AND CLAY_
- SAND_sand
- SAND AND GRAVEL_
- GRAVEL_
- SANDSTONE_
- CLAY AND SHALE_

profile overlays

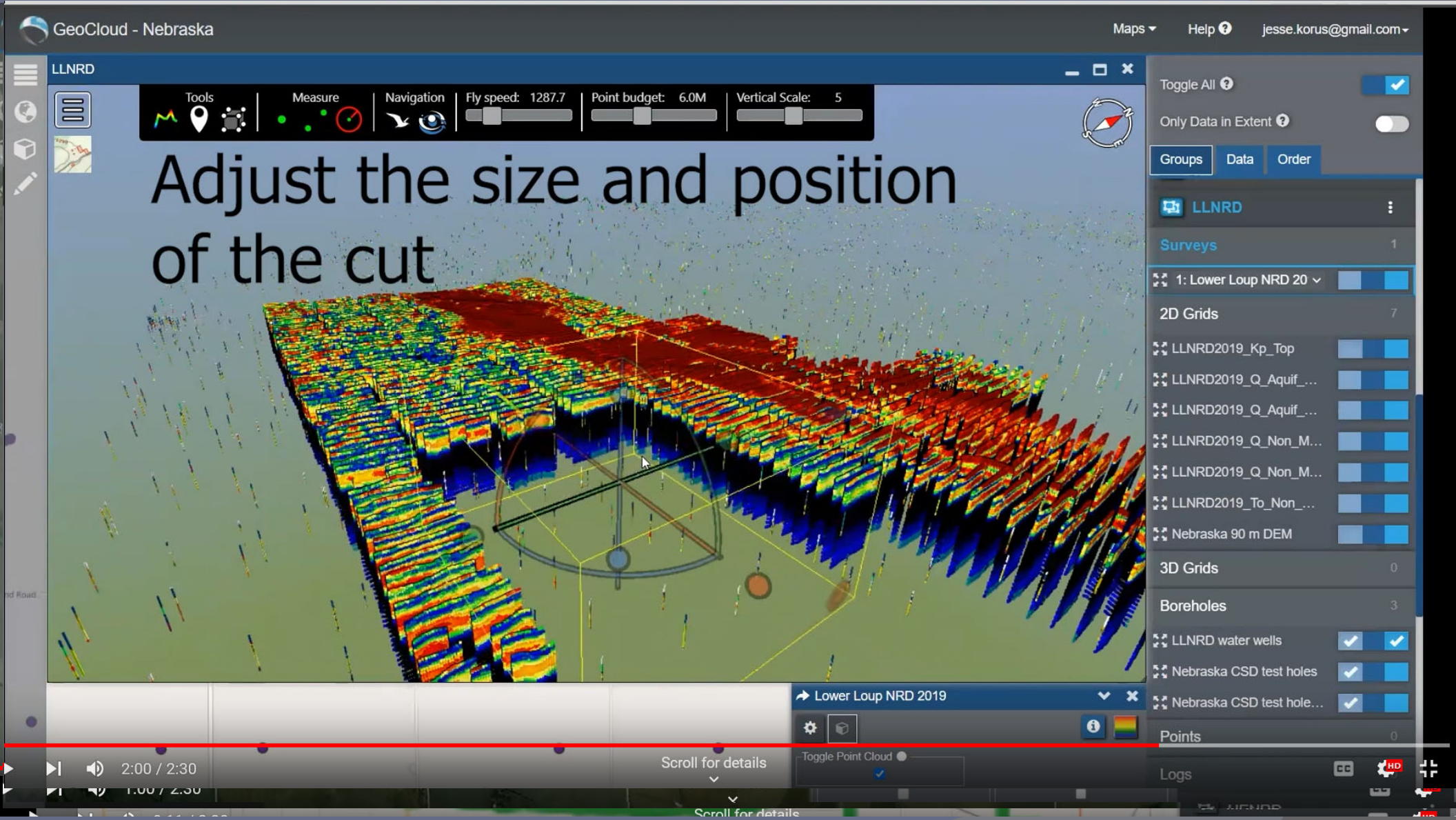
- LiDAR-derived terrain surface
- steeply dipping surfaces (interpretive thrust faults)
- resistivity contrast
- K bedrock surface
- stratigraphic contact
- DOI upper
- DOI lower

Korus, Jesse T

Nebraska GeoCloud

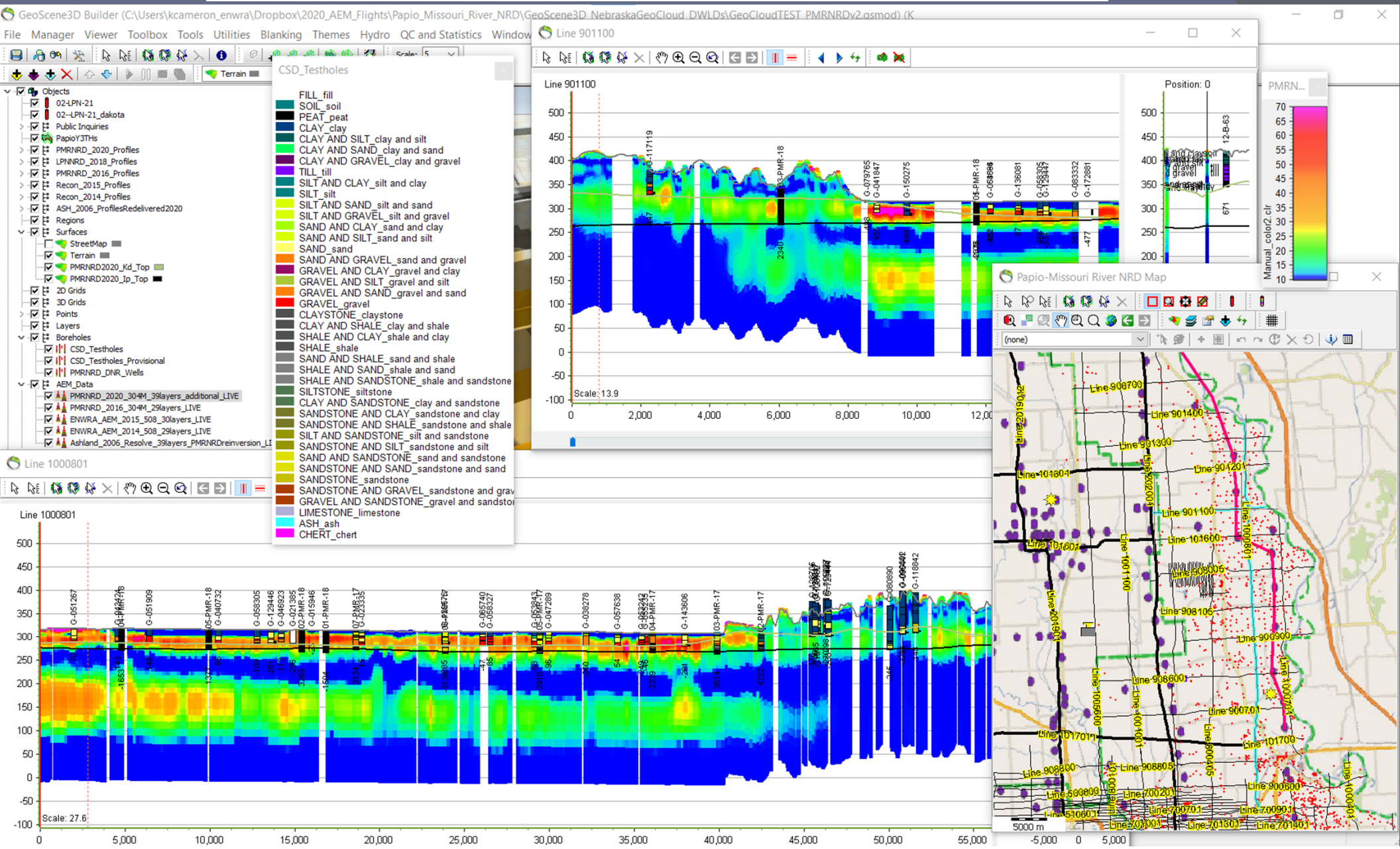


Nebraska GeoCloud Enhancements



Nebraska GeoCloud Nebraska Viewer

- https://geoscene3d.com/Download



Q & A

Thank You

Glacial Processes

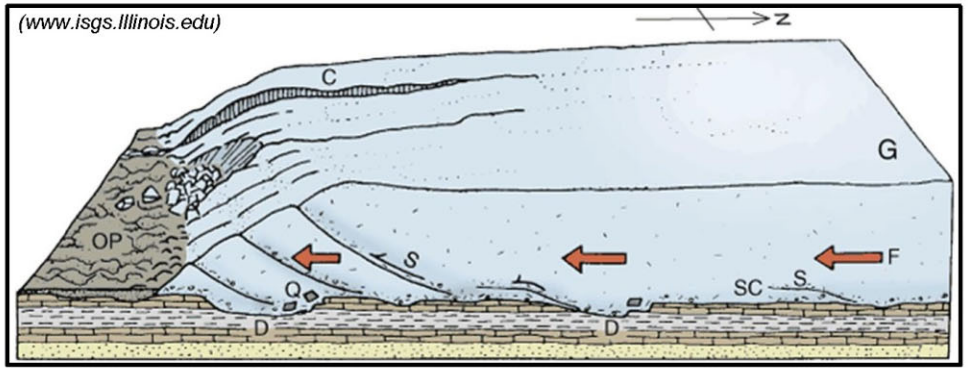
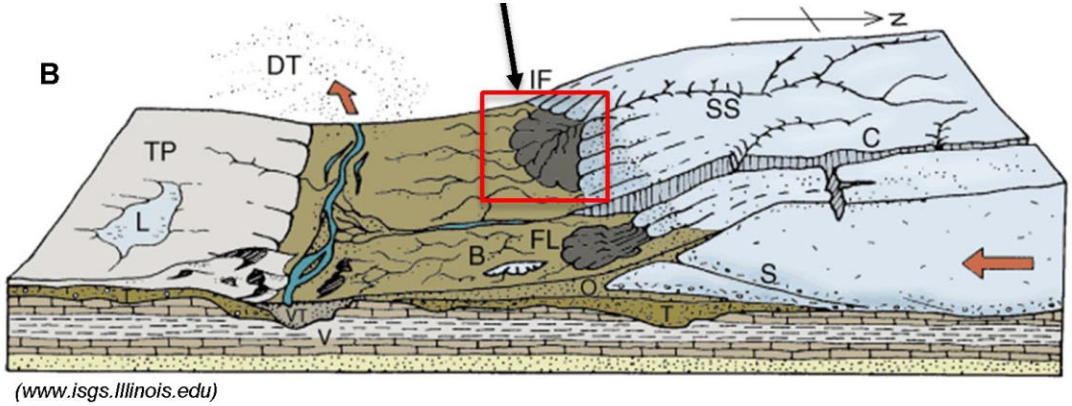


Figure 3-6 – Schematic diagram showing the "plucking" process of bedrock material within the ice sheet that becomes part of the till deposits in the end and ground moraines.



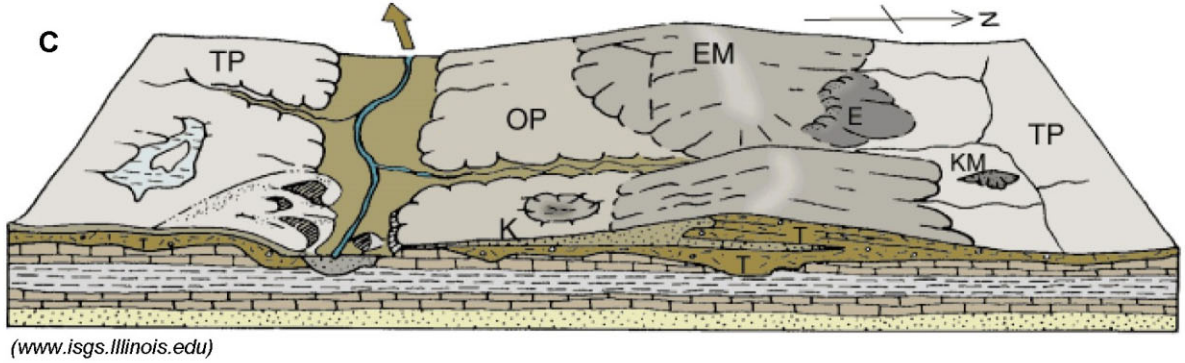
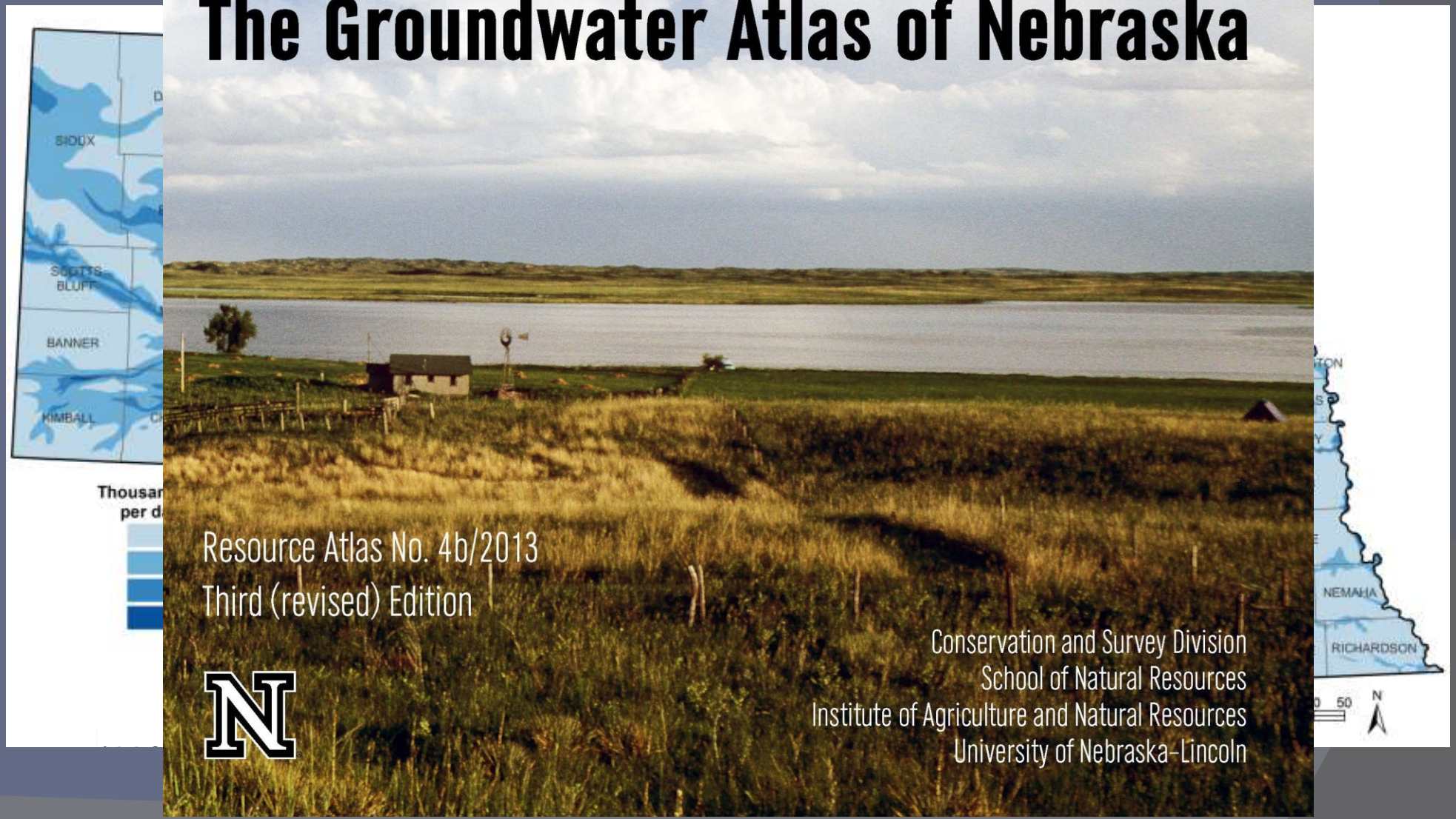


Figure 4-13 – Example of possible outwash fan feature in the east block (A) with the glacial margin environment from which these deposits possibly originated (B), and the remnant post-glacial landscape indicating an outwash plain (OP) to the left of the moraine structure (EM). Note that the AEM profile in 23a is facing westward.

Transmissivity of the Aquifers



Field Logs

CONSERVATION AND SURVEY DIVISION
School Of Natural Resources

BOREHOLE LOG SHEET
for description of cuttings

Altitude _____

Bore/Well Number _____ Report No. _____

T.D. _____ Date _____ County _____

Loc. in section: _____ ft. N/S of N/S quarter, half, or section line. Sec. _____

_____ ft. W/E of W/E quarter, half, or section line T. _____ N

Located in (circle): Upland, side slope, terrace, bottomland, ravine, sand dunes. R. _____ E/W

GPS Location: _____ Datum: _____

Recorder: _____

Drilling Crew: _____

N

SYMBOLS	$CaCO_3$ CONTENT	HYD. PRESS.	DRILLING ACTION
	N: non calcareous VS: very slightly calc. S: slightly calcareous C: calcareous VC: very calcareous	Blank: none L: Low M: Medium F: Full	E: Even, smooth C: Crunchy I: Intermittently rough r: Slightly rough R: Mod. rough R: Very rough

WATER LEVEL MEASUREMENTS
Date _____
Time _____
Tape Held _____
Water Cut _____
Depth to water _____
Hole open to _____ ft. * _____
*C=caved; P=plugged

DRILLING TIME RECORD					DEPTH		Hydraulic Pressure	Drilling Action	FIELD LOG			
DEPTH		TIME			DEPTH				Description: primary lithology, secondary lithology & abundance, grain size, sorting, roundness, composition, diagenetic features	Color h	Color v/c	$CaCO_3$ Cont.
From	To	From	To	min.	From	To						

1 Indicate **PRIMARY LITHOLOGY**
Go to 1a, 1b, or 1c.

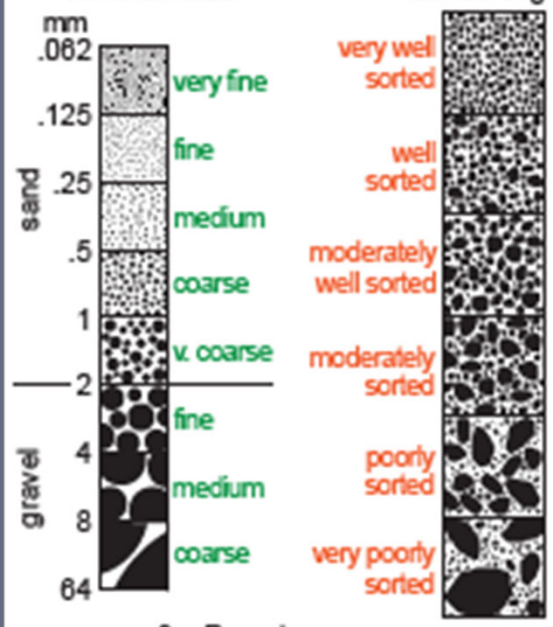
2 Indicate **SECONDARY LITHOLOGY** (use same terms as in 1 above) and **ABUNDANCE**

2a. Estimate the abundance of clay by extruding a ribbon of wet kneaded sample between thumb and index finger:

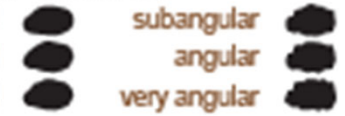
RIBBON LENGTH	% CLAY	ABUNDANCE
<1"	<27	clayey
1"-2.5"	27-40	very clayey

2b. Estimate the abundance of visible grains using this chart:

3 Indicate **GRAIN SIZE, SORTING, and ROUNDNESS** for sands/sandstones and gravels/conglomerates



3c. Roundness



4 Indicate **COLOR** | **5** Indicate **COMPOSITION** of grains visible to naked eye or under low mag.

6 Indicate **CALCIUM CARBONATE CONTENT** based on effervescence in dilute HCl

7 Indicate **DIAGENETIC FEATURES** (post-depositional features)

8 Indicate **SEDIMENTARY STRUCTURES** (cores only) | **9** Indicate **POROSITY** (cores only)

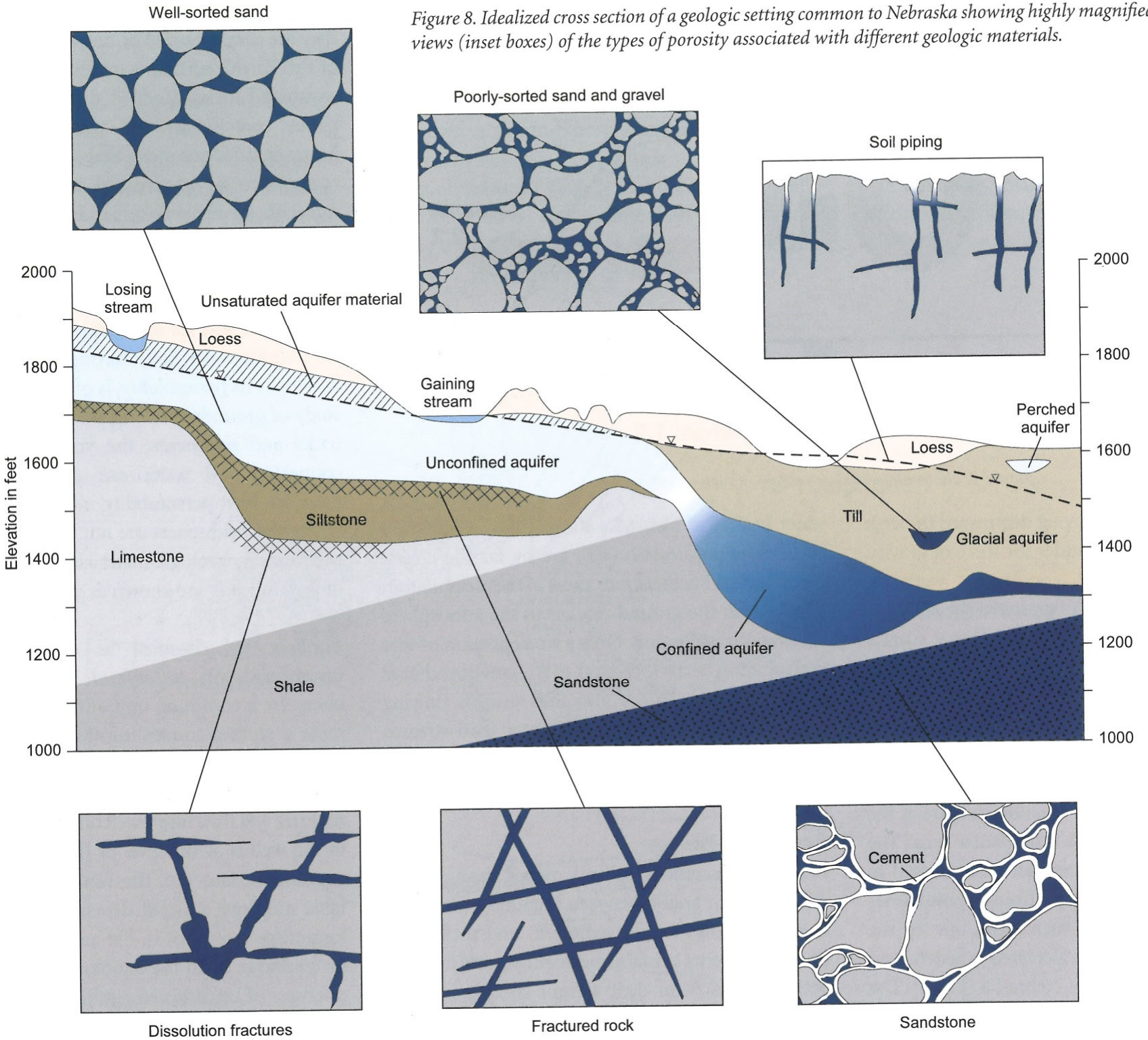
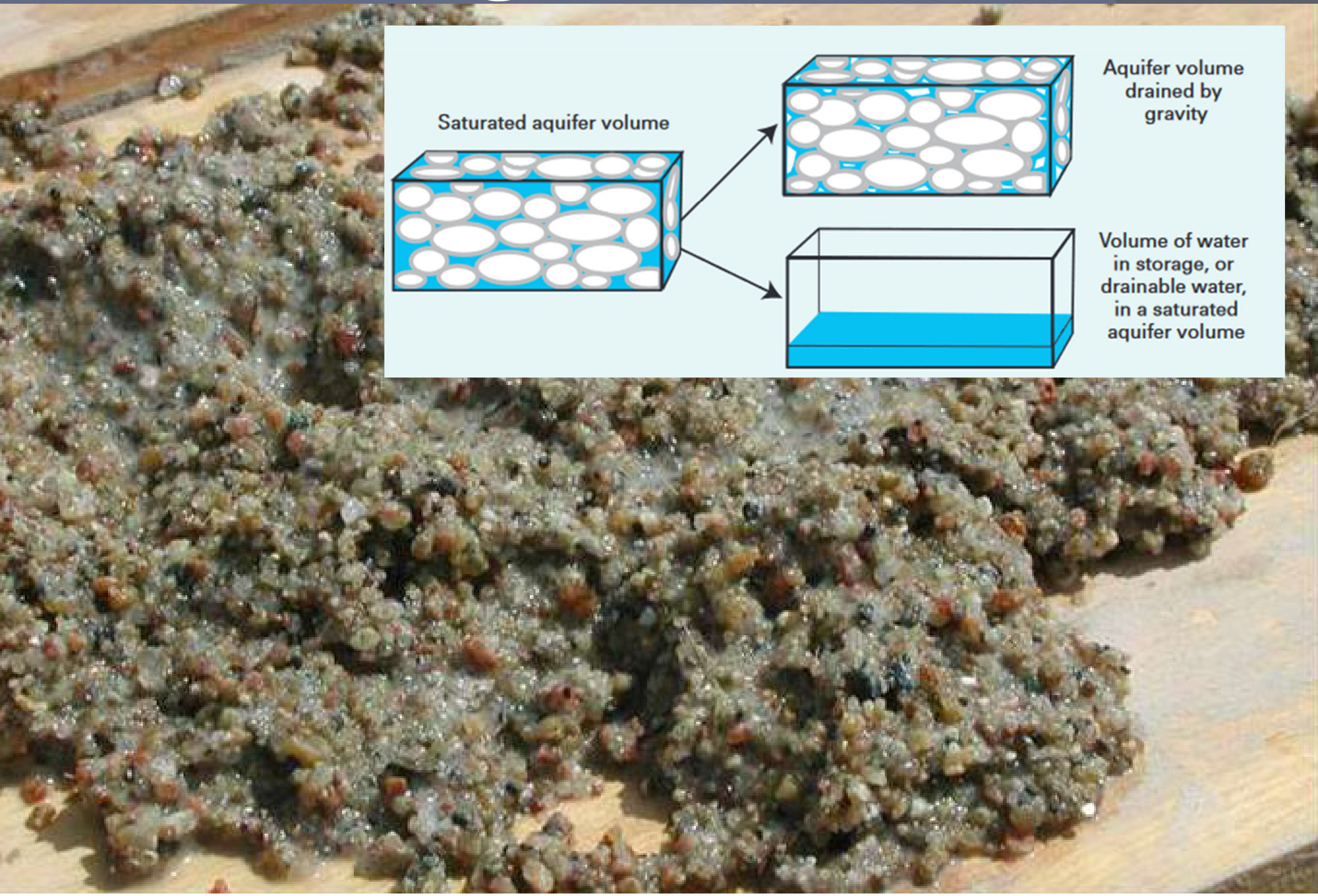
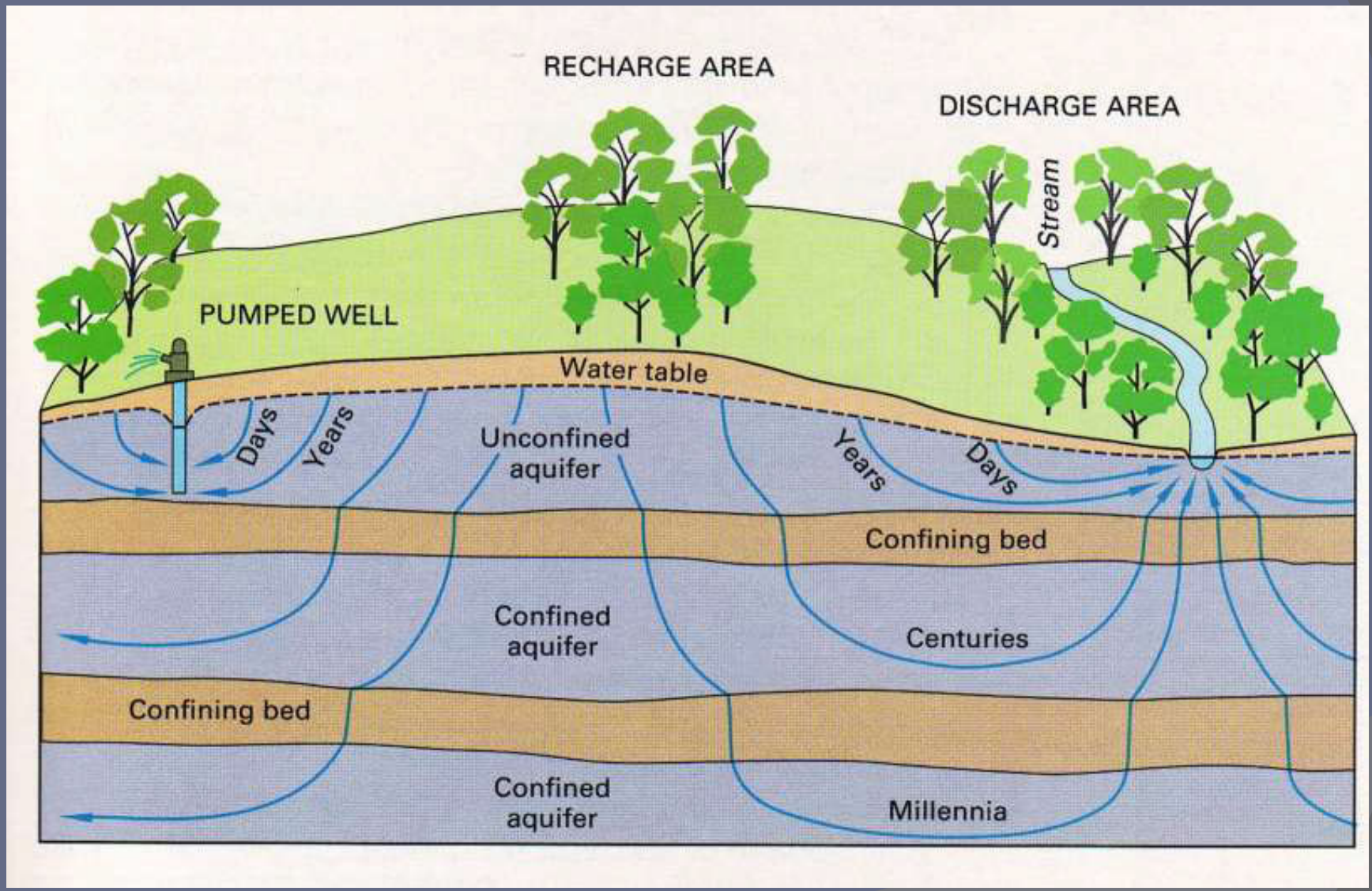


Figure 8. Idealized cross section of a geologic setting common to Nebraska showing highly magnified views (inset boxes) of the types of porosity associated with different geologic materials.

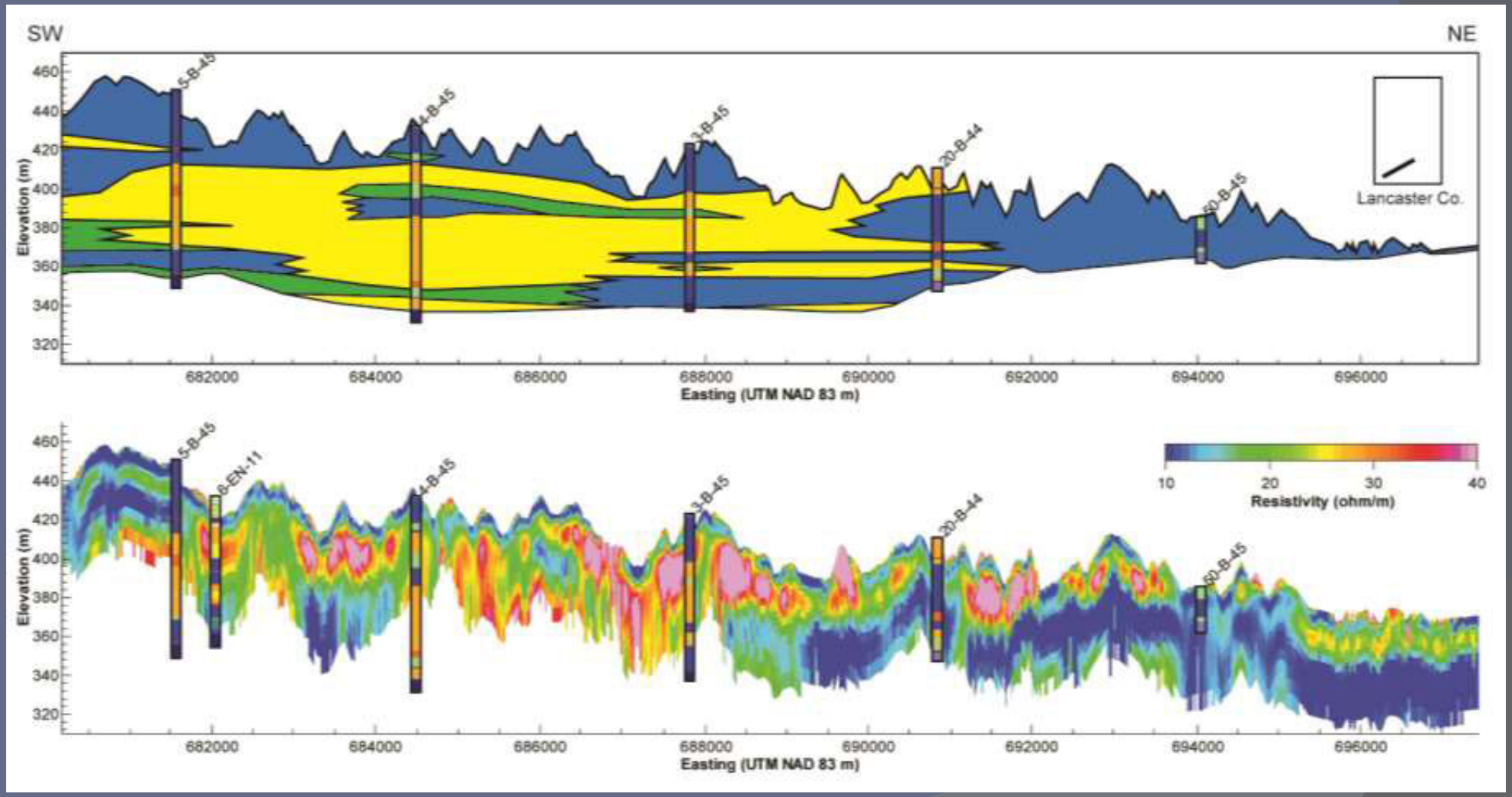
Like a sponge



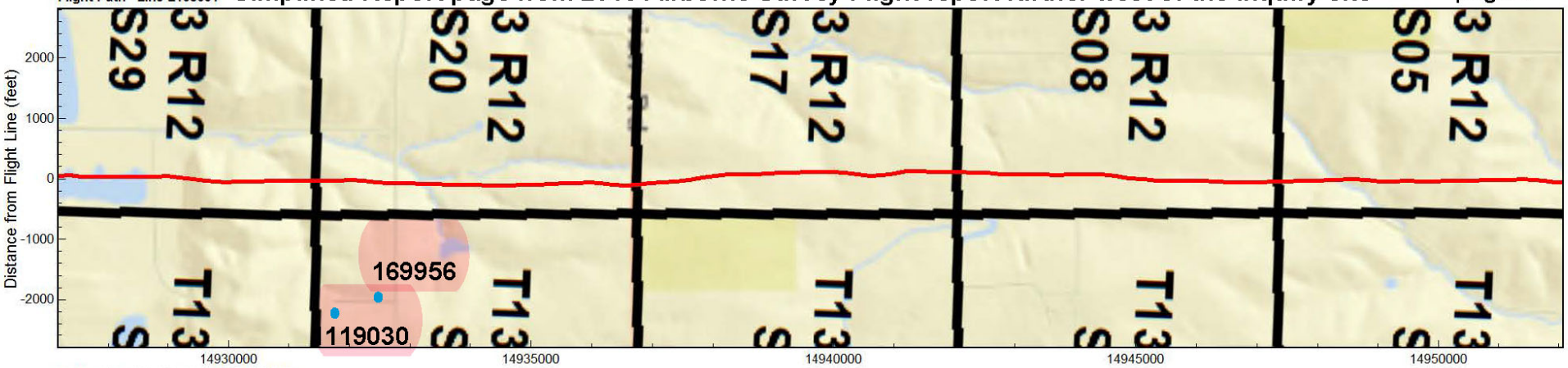
Aquifer Complexity



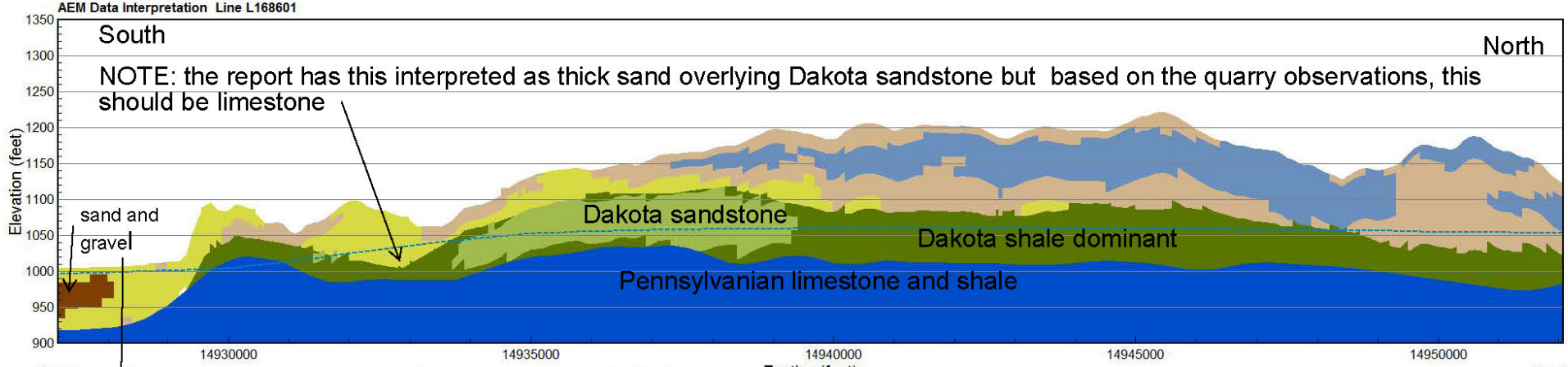
New understandings with AEM



Flight Path Line L168601 **Simplified Report page from 2016 Airborne Survey Flight report further west of the inquiry site**



AEM Data Interpretation Line L168601



South

Note well logs shown on data view within 1000 feet
(numbers below wells are offset distances relative to the flight line)

Interpreted geological sections from AEM data and flight path location map provided in conjunction with Google Earth kmz file. The projected