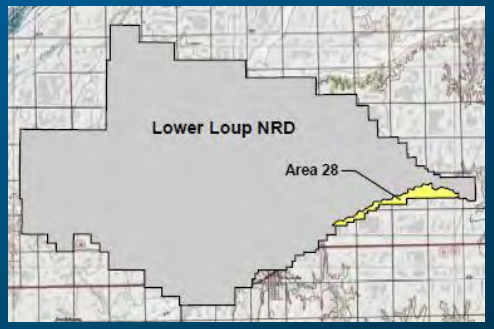
The Lower Loup Natural Resources District

Area 28 Groundwater Management Study



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Project Summary

October 25, 2012

- Project Goals
- Work Completed
- Project Results/Recommendations

Project Goals

- To identify/understand the sources of nitrate contamination and the hydrogeologic setting of Area 28.
- To provide recommendations on best management practices to help reduce nitrate levels in groundwater.

Project Task List

- ✓ Task 1 – Compile Existing Data
- ✓ Task 2 – Database Development
- ✓ Task 3 – GIS Mapping/Development
- ✓ Task 4 – Well Installation
- ✓ Task 5 – GW Well Sampling

- ✓ Task 6 – Age Dating Testing
- ✓ Task 7 – Isotope Testing
- ✓ Task 8 – Recharge Monitoring
- ✓ Task 9 – Project Management
- ✓ Task 10 – Status Presentations
- ✓ Task 11 – Report Preparation

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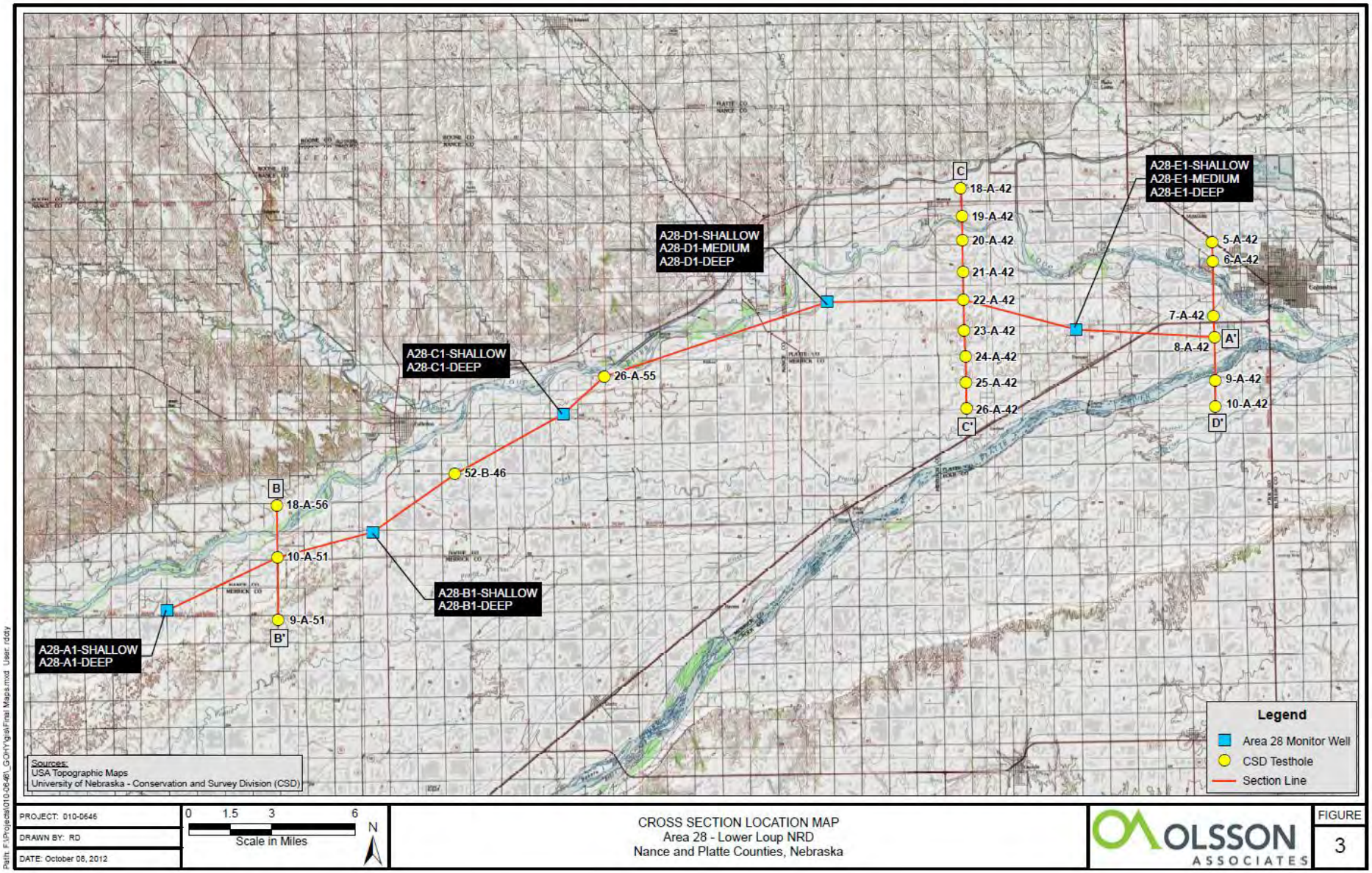
Task 4 – Well Installation

- Installed 12 permanent groundwater monitoring wells.

Permanent Monitoring Well Locations



PROJECT: 010-0646
DRAWN BY: RD
DATE: October 08, 2012

0 1.5 3 6
Scale in Miles
N

CROSS SECTION LOCATION MAP
Area 28 - Lower Loup NRD
Nance and Platte Counties, Nebraska

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FIGURE 3

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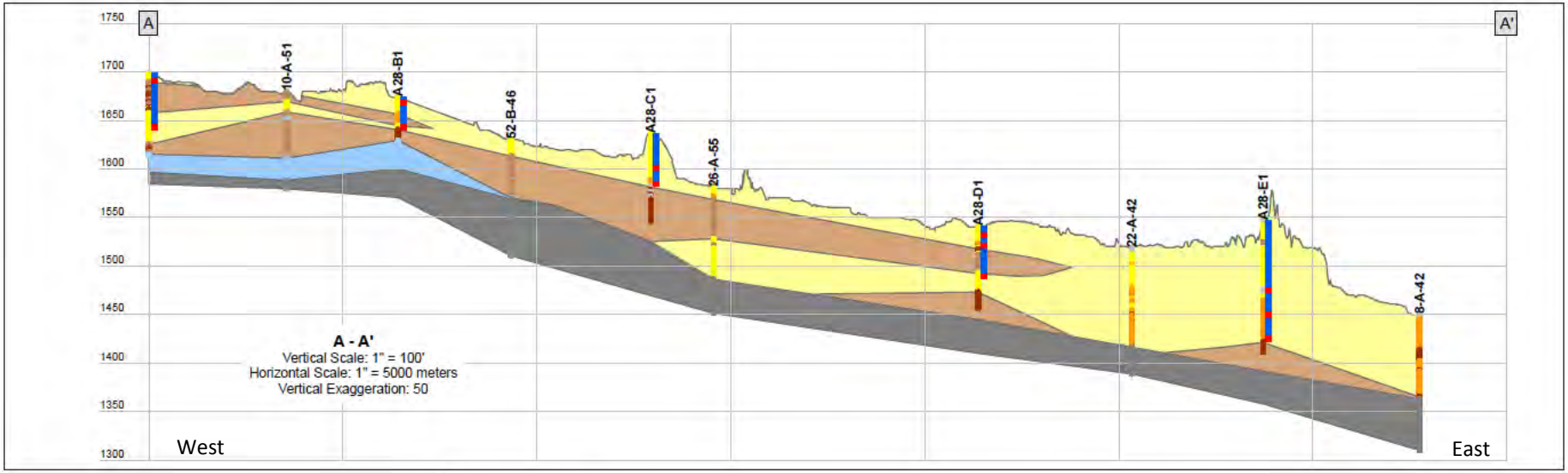
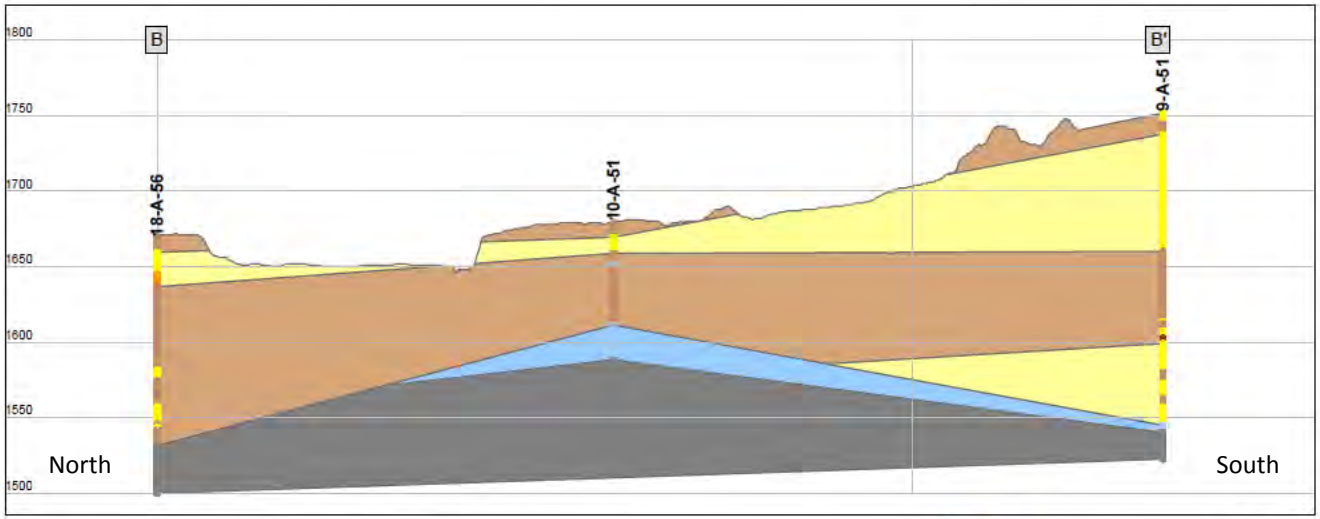
Geologic Cross Sections (A-A', B-B')



Legend

- No Sample
- Clay
- Silt
- Sand
- Gravel
- Limestone (Niobrara Formation)
- Shale (Carlile Formation)
- Sand and Gravel
- Silt and Clay
- Well Casing
- Screen Interval

B - B'
Vertical Scale: 1" = 75'
Horizontal Scale: 1" = 750 meters
Vertical Exaggeration: 10



Sources:
University of Nebraska - Conservation and Survey Division (CSD)

PROJECT: 010-0646 DRAWN BY: RD DATE: October 08, 2012	CROSS SECTION A - A' AND B - B' Area 28 - Lower Loup NRD Nance and Platte Counties, Nebraska	OLSSON ASSOCIATES	FIGURE 4

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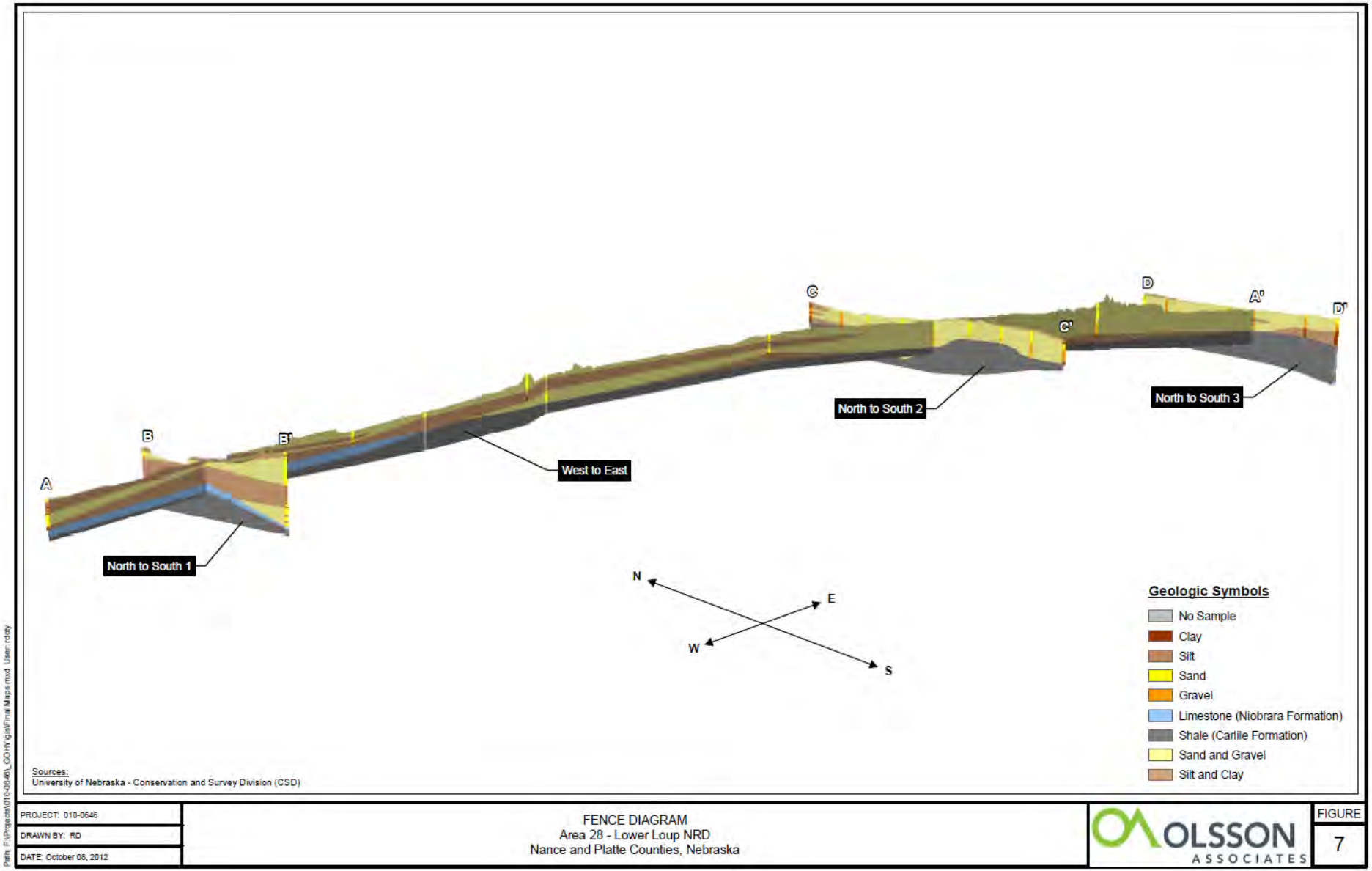
3D Fence Diagrams



PROJECT: 010-0646
DRAWN BY: RD
DATE: October 08, 2012

FENCE DIAGRAM
Area 28 - Lower Loup NRD
Nance and Platte Counties, Nebraska

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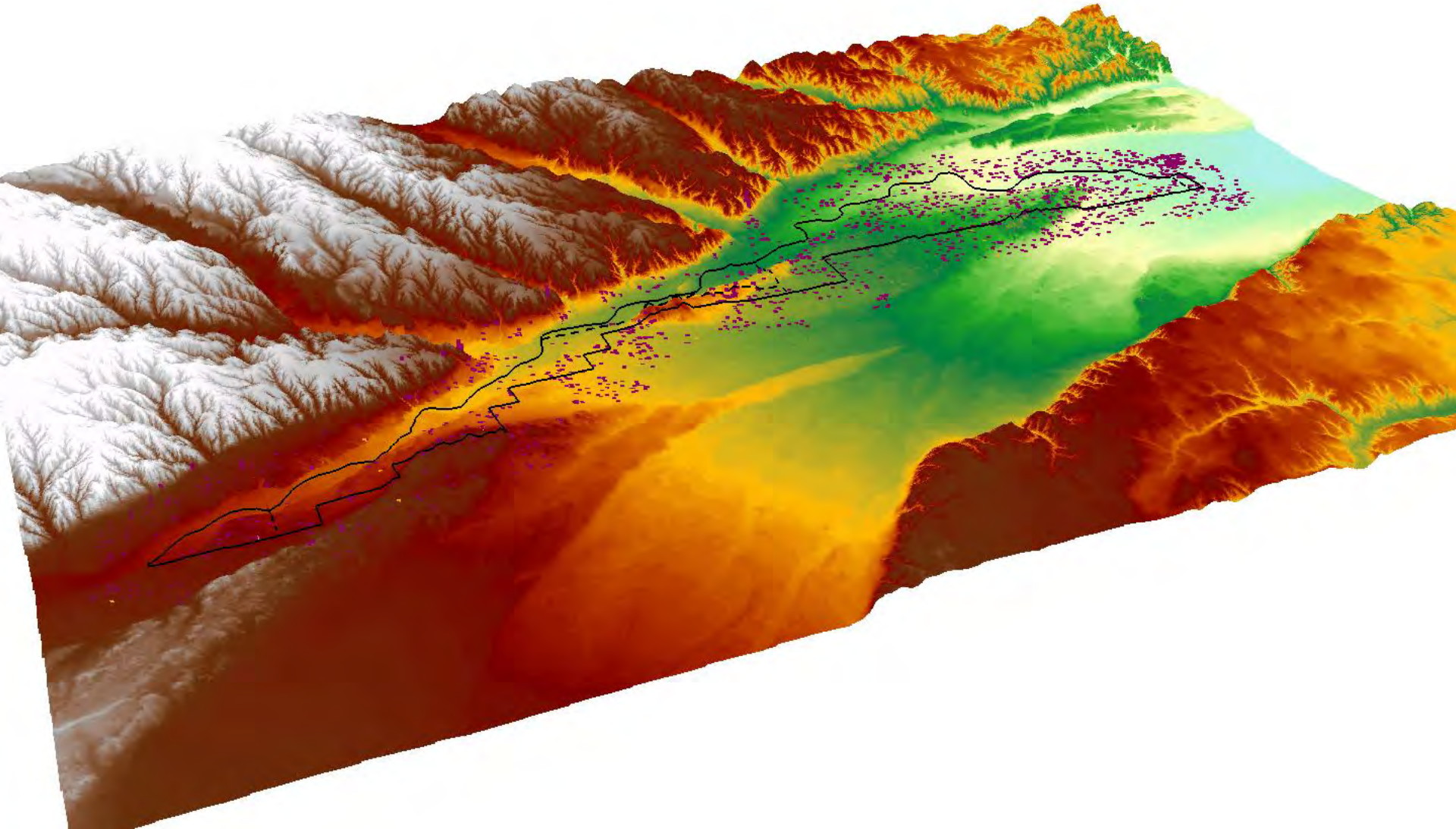
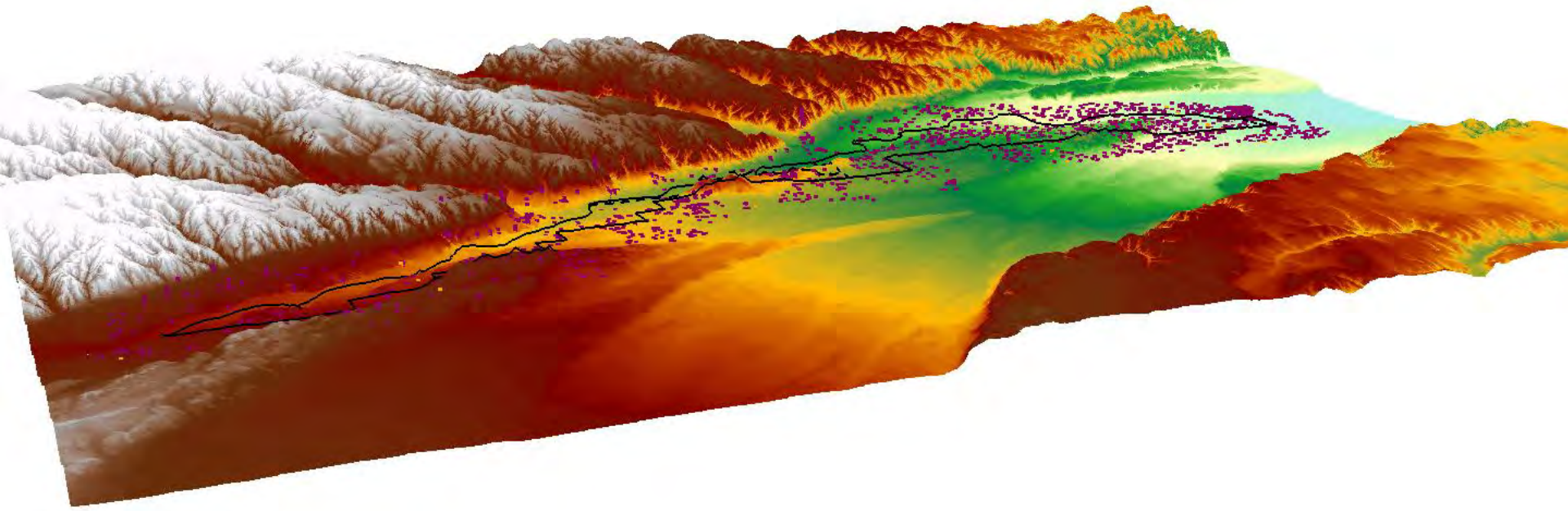
FIGURE 7

Path: F:\Projects\010-0646_GOAP\gis\Final Maps.mxd User: rday

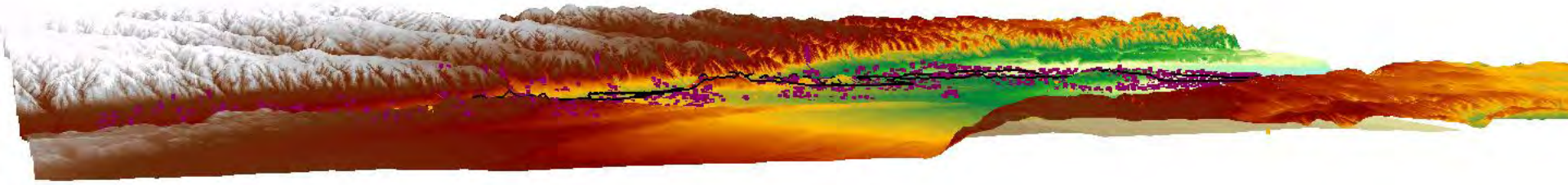
3D Hydrogeology of Area 28



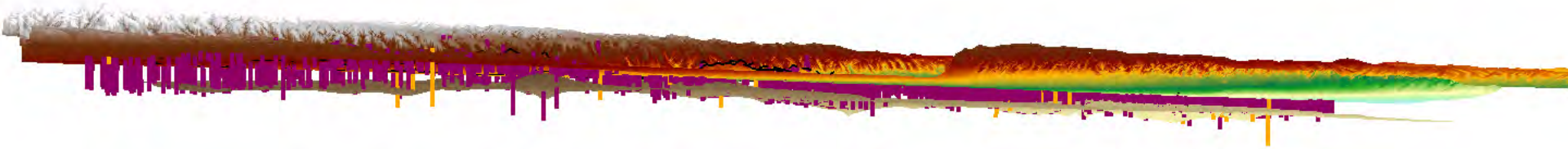
3D Hydrogeology of Area 28



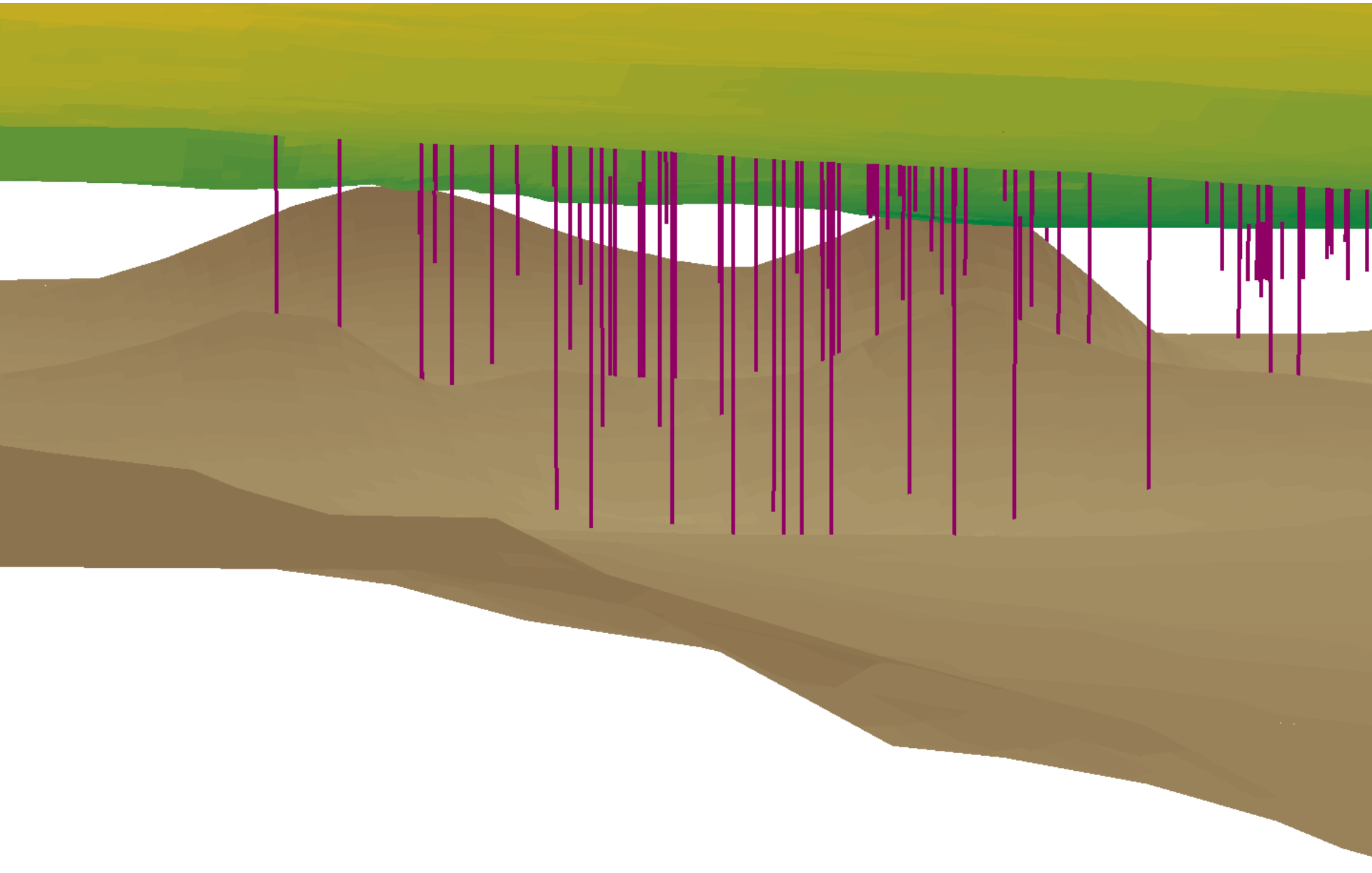
3D Hydrogeology of Area 28



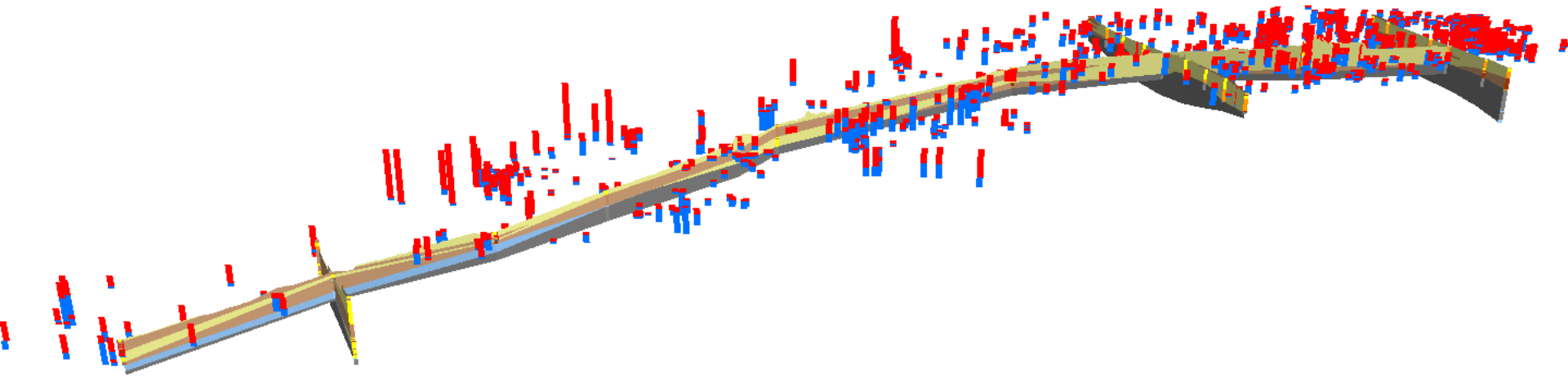
3D Hydrogeology of Area 28



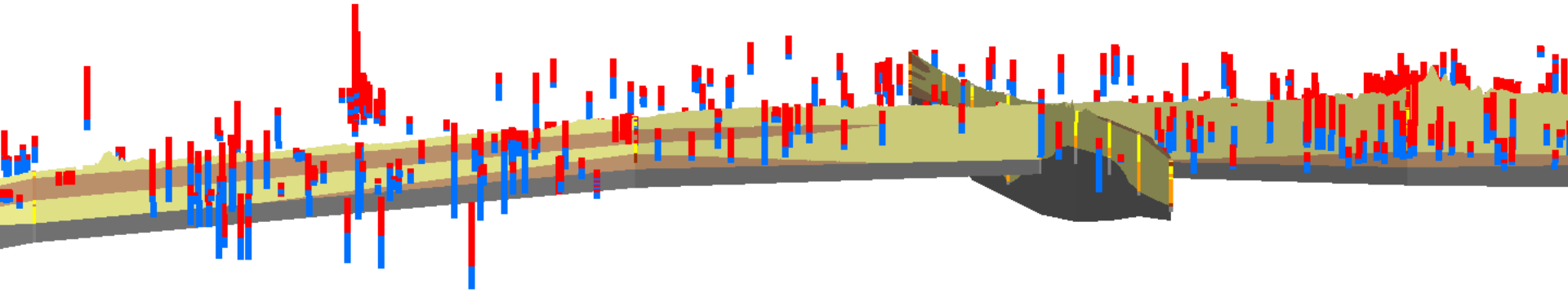
3D Hydrogeology of Area 28



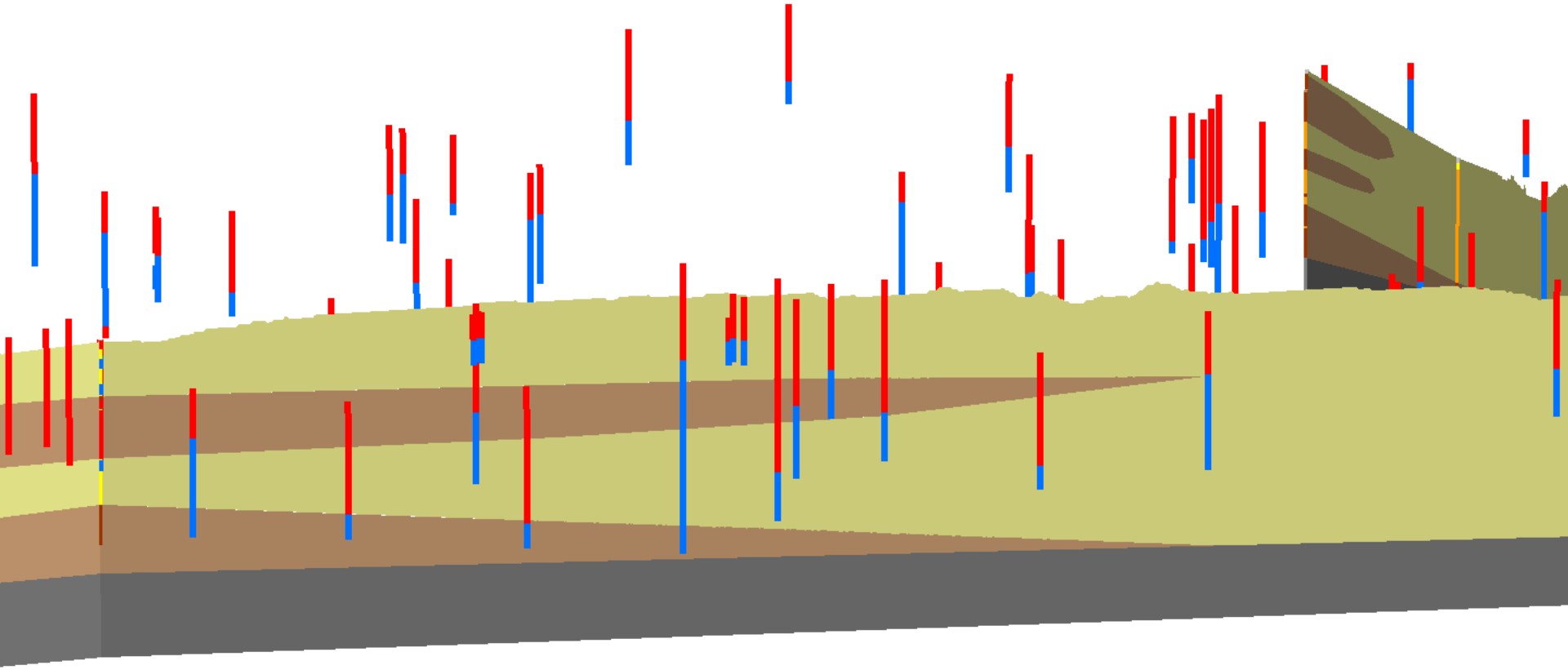
3D Hydrogeology of Area 28



3D Hydrogeology of Area 28

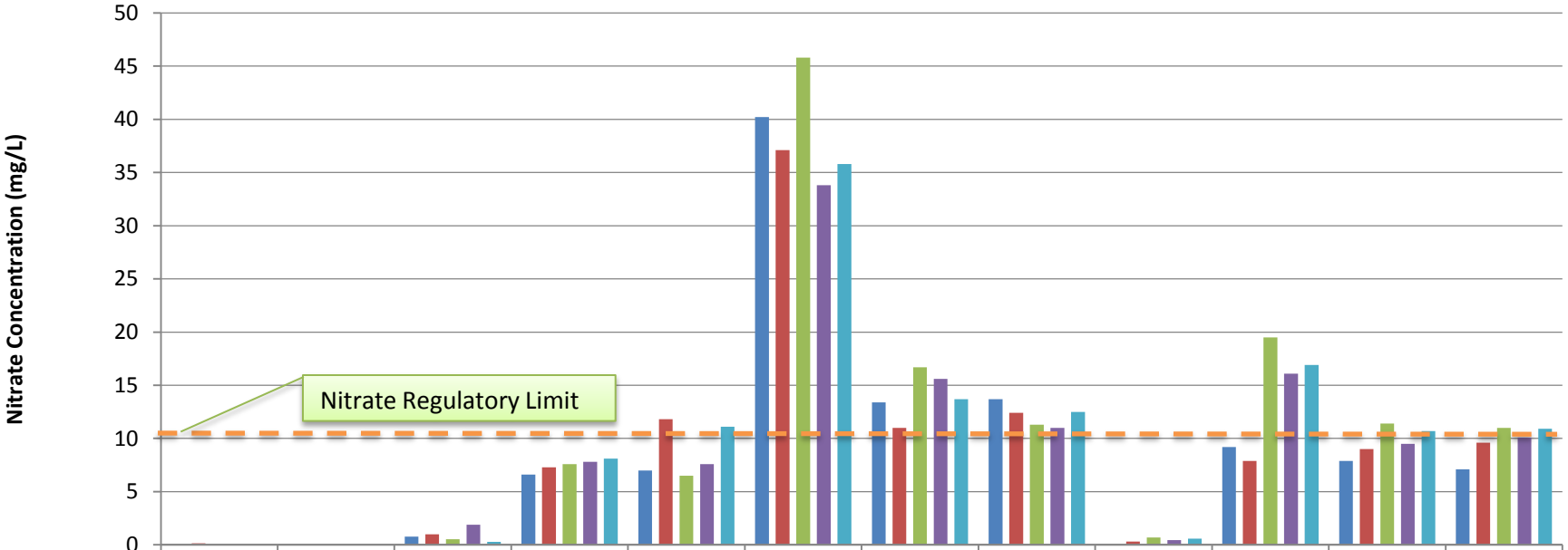


3D Hydrogeology of Area 28



Task 5 – GW Well Sampling

Area 28 Nitrate Sampling Results



	A28-A1 Shallow	A28-A1 Deep	A28-B1 Shallow	A28-B1 Deep	A28-C1 Shallow	A28-C1 Deep	A28-D1 Shallow	A28-D1 Medium	A28-D1 Deep	A28-E1 Shallow	A28-E1 Medium	A28-E1 Deep
1/4/2011	0	0	0.78	6.6	7	40.2	13.4	13.7	0	9.2	7.9	7.1
6/27/2011	0.15	0	1	7.3	11.8	37.1	11	12.4	0.3	7.9	9	9.6
10/26/2011	0	0	0.53	7.6	6.5	45.8	16.7	11.3	0.68	19.5	11.4	11
2/28/2012	0	0	1.9	7.8	7.6	33.8	15.6	11	0.45	16.1	9.5	10.1
4/18/2012	0	0	0.29	8.1	11.1	35.8	13.7	12.5	0.59	16.9	10.7	10.9

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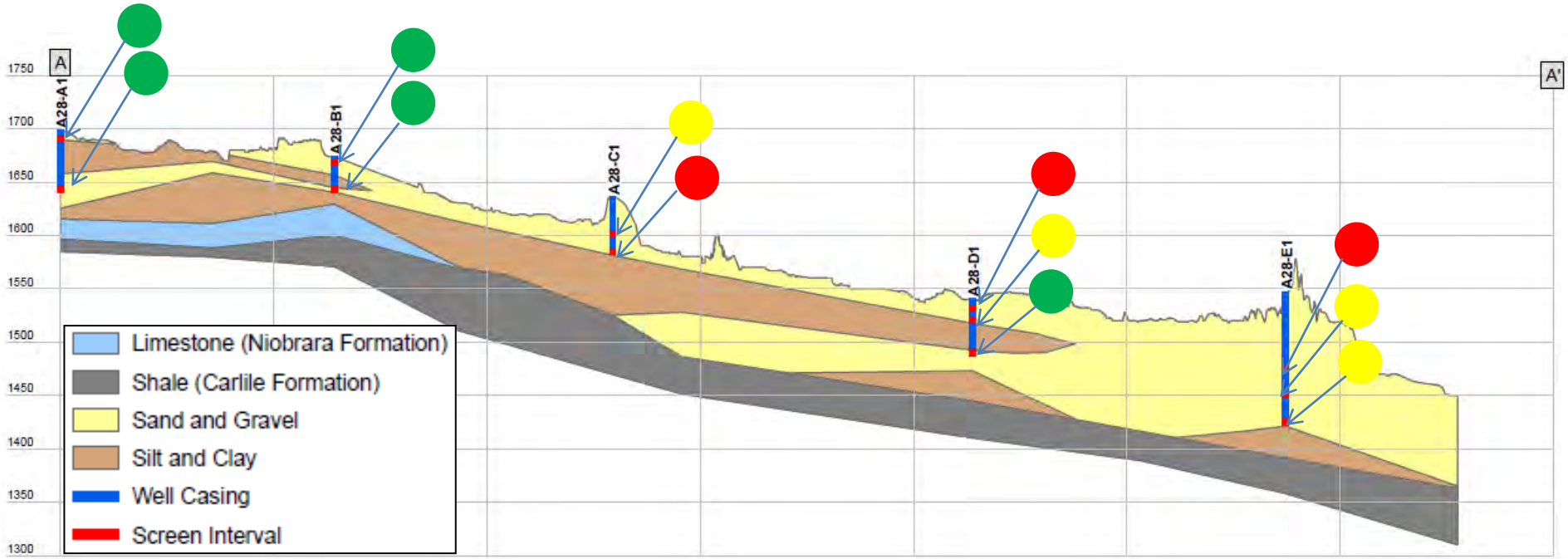
Average Groundwater Sample Results



- Confining units have influenced nitrate concentrations
- Nitrate contamination increases to the east
- Nitrate contamination highest in shallow wells, lowest in confined wells
- Exception to this is A28-C1 Deep

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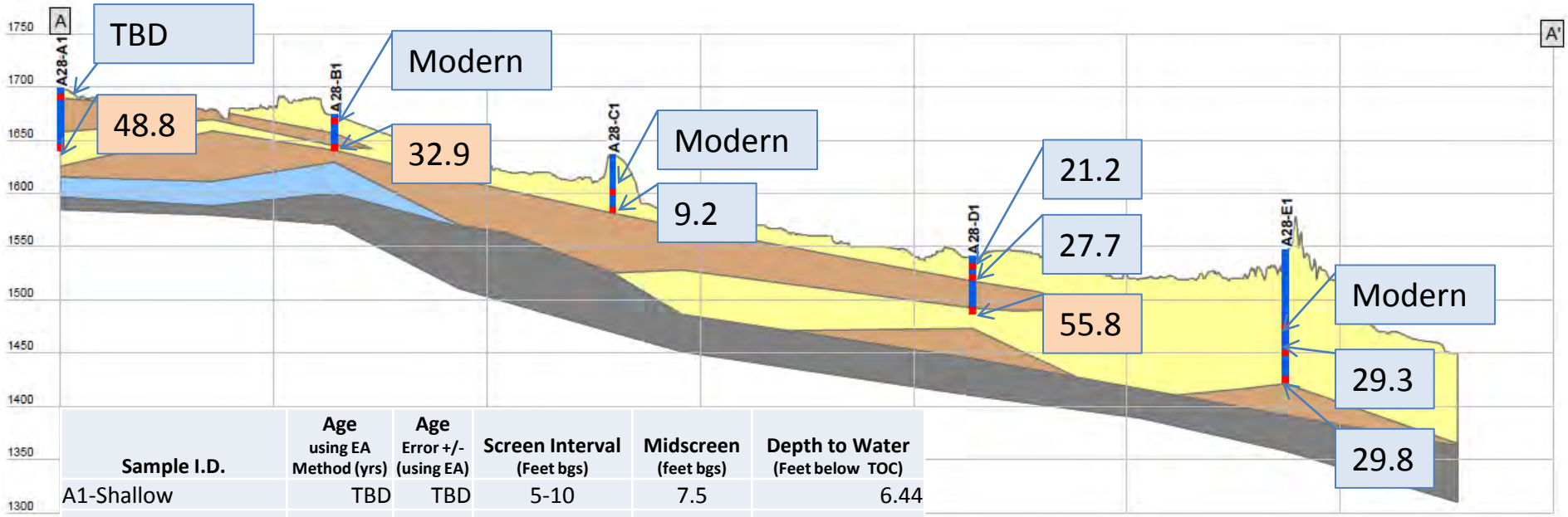
Task 6 - Groundwater Age Dating



Sample I.D.	Age using EA Method (yrs)	Age Error +/- (using EA)	Screen Interval (Feet bgs)	Midscreen (feet bgs)	Depth to Water (Feet below TOC)
A1-Shallow	TBD	TBD	5-10	7.5	6.44
A1-Deep	48.8	0.6	53-58	55.5	8.16
B1-Shallow	-7.0	1.3	4-9	6.5	7.2
B1-Deep	32.9	10.3	29-34	31.5	6.9
C1-Shallow	0.1	0.7	32-37	34.5	37.72
C1-Deep	9.2	3.0	49-54	51.5	38.11
D1-Shallow	21.2	0.5	7-12	9.5	6.86
D1-Medium	27.7	0.5	18-23	20.5	6.54
D1-Deep	55.8	23.1	49-54	51.5	6.64
E1-Shallow	0.6	0.5	70-75	72.5	73.57
E1-Medium	29.3	2.8	95-100	97.5	73.03
E1-Deep	29.8	2.8	120-125	122.5	73.51

Notes:
Cross section lithology symbols described in Figure 4
Pink boxes indicate confined conditions
bgs = below ground surface
EA= Excess Air Method
TOC = top of casing
TBD = To Be Determined – analysis pending at the time of report publication

Results and relative age interpretations from the University of Utah, Dissolved and Noble Gas Laboratory

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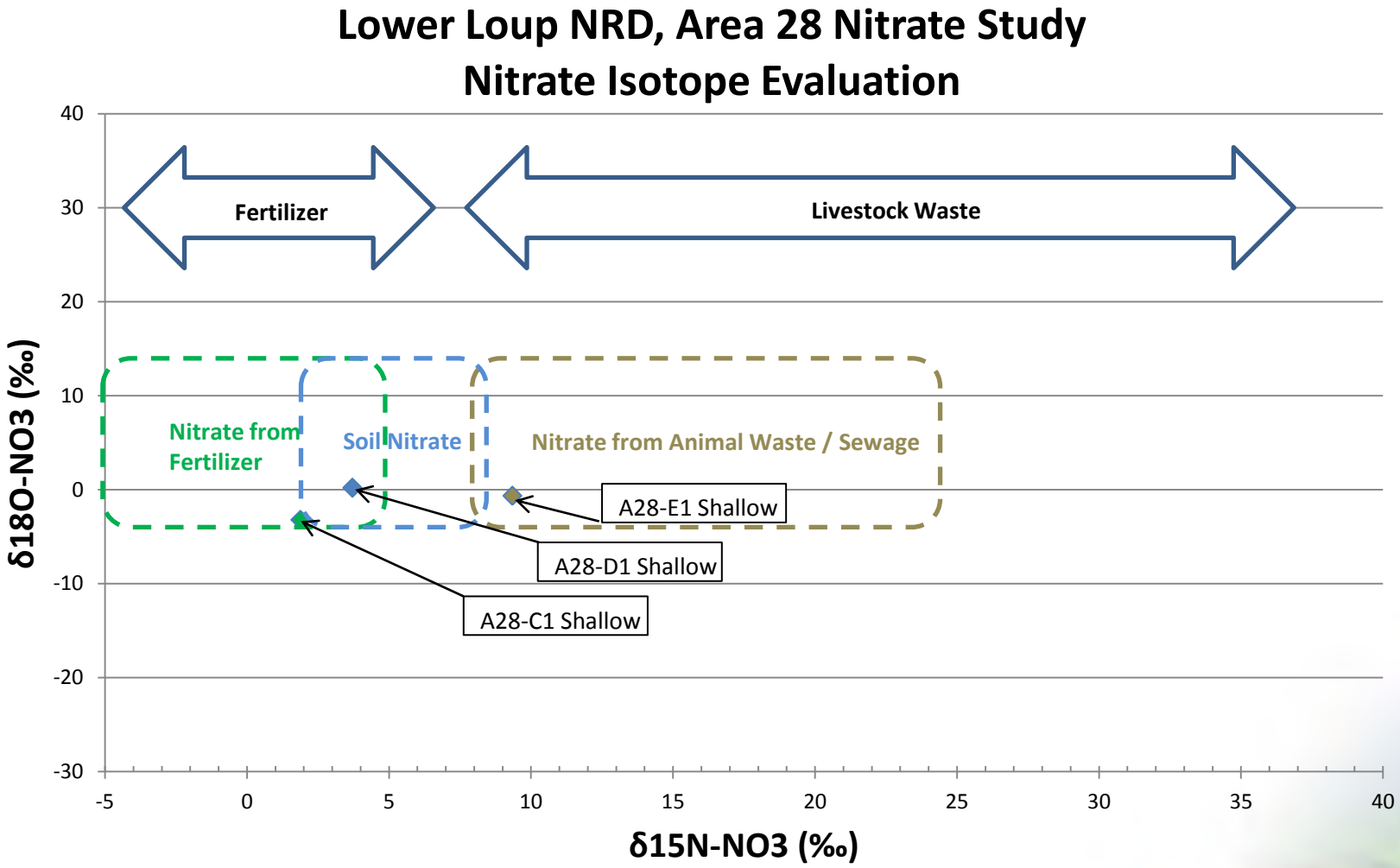
Task 7 - Nitrogen Isotope Analyses



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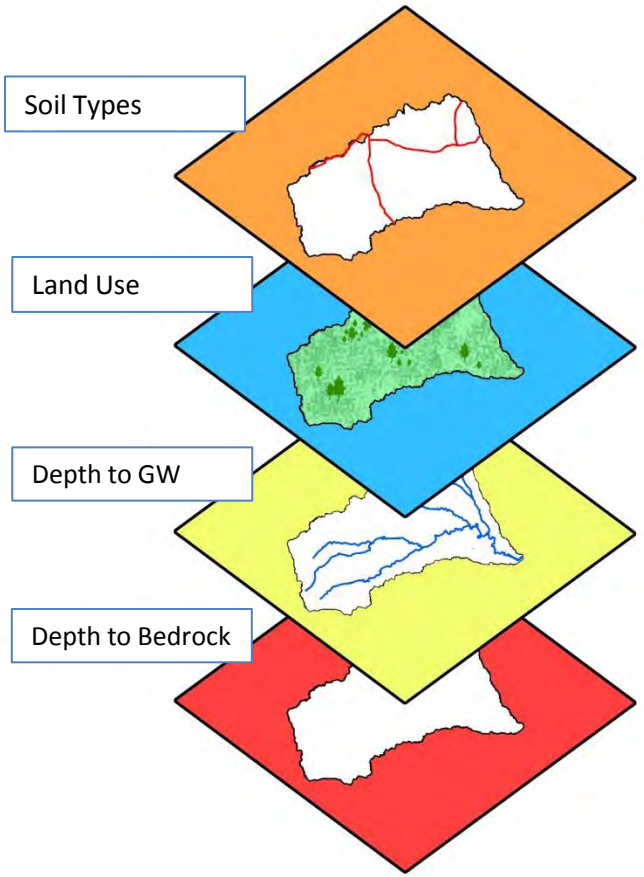
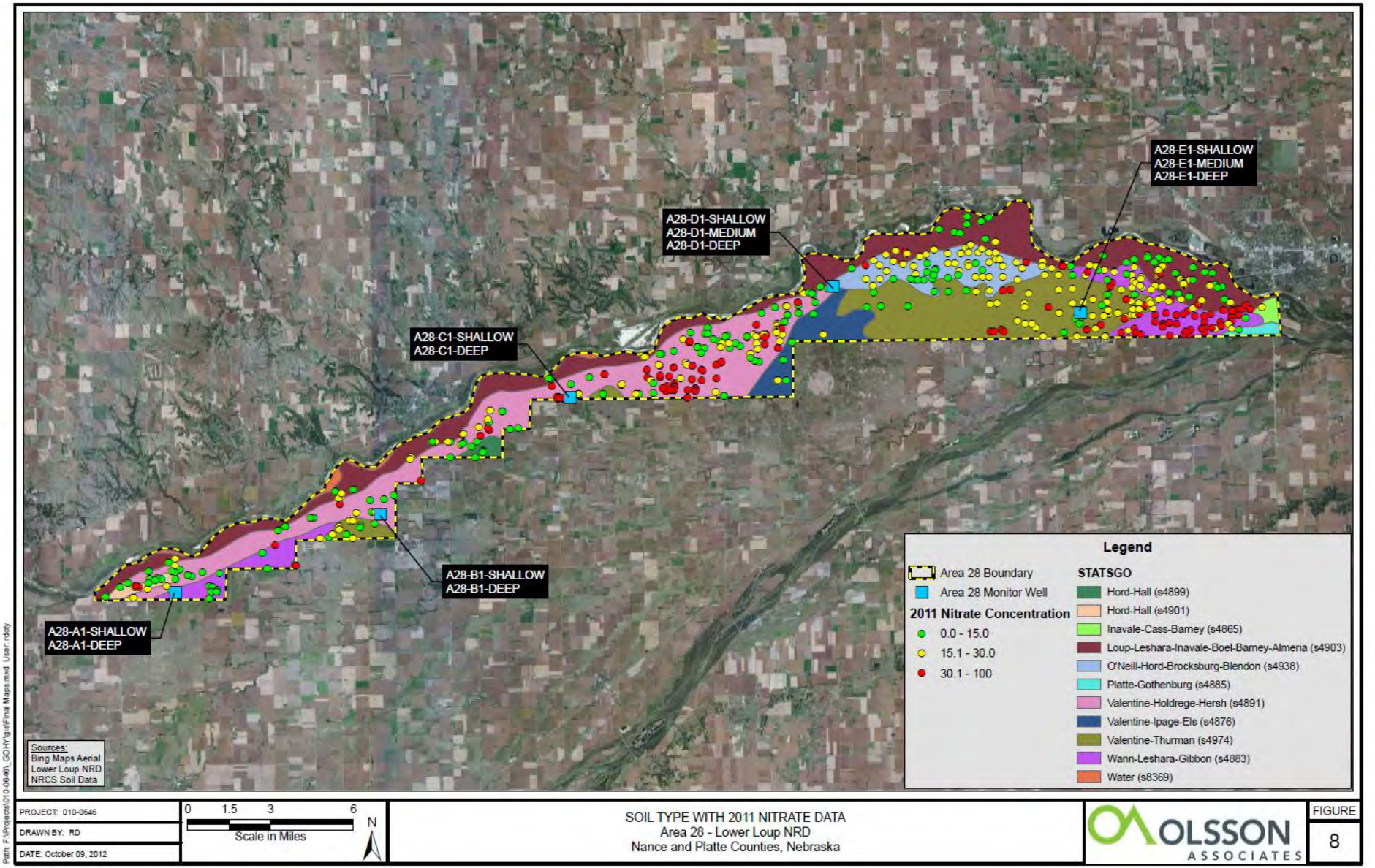
Task 3 – GIS Mapping Interpretation

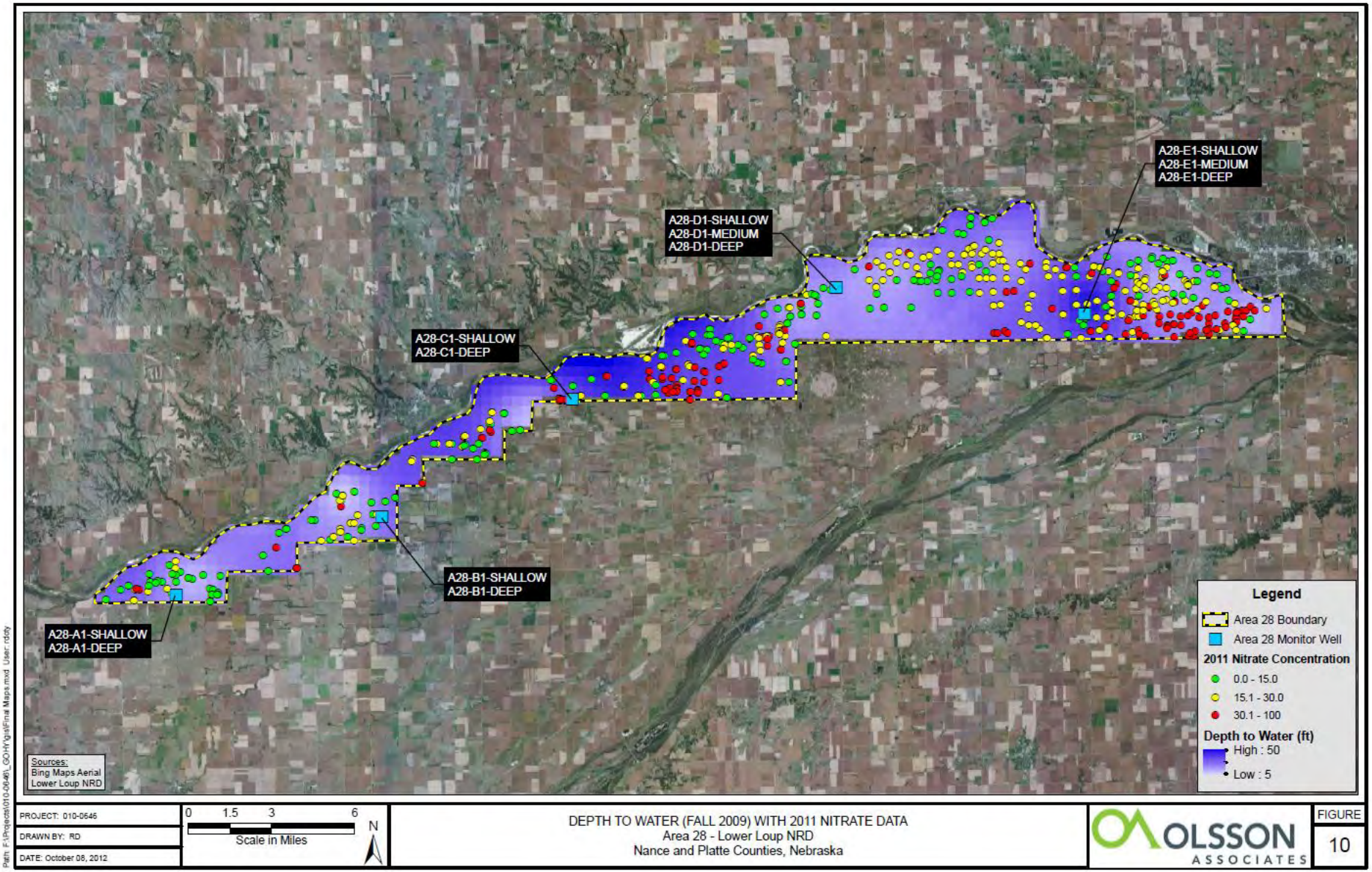
- Prepare GIS maps and datasets illustrating the hydrogeology and nitrate contamination
  - Why? to see if there is any correlation between the distribution of nitrates and mapped datasets.



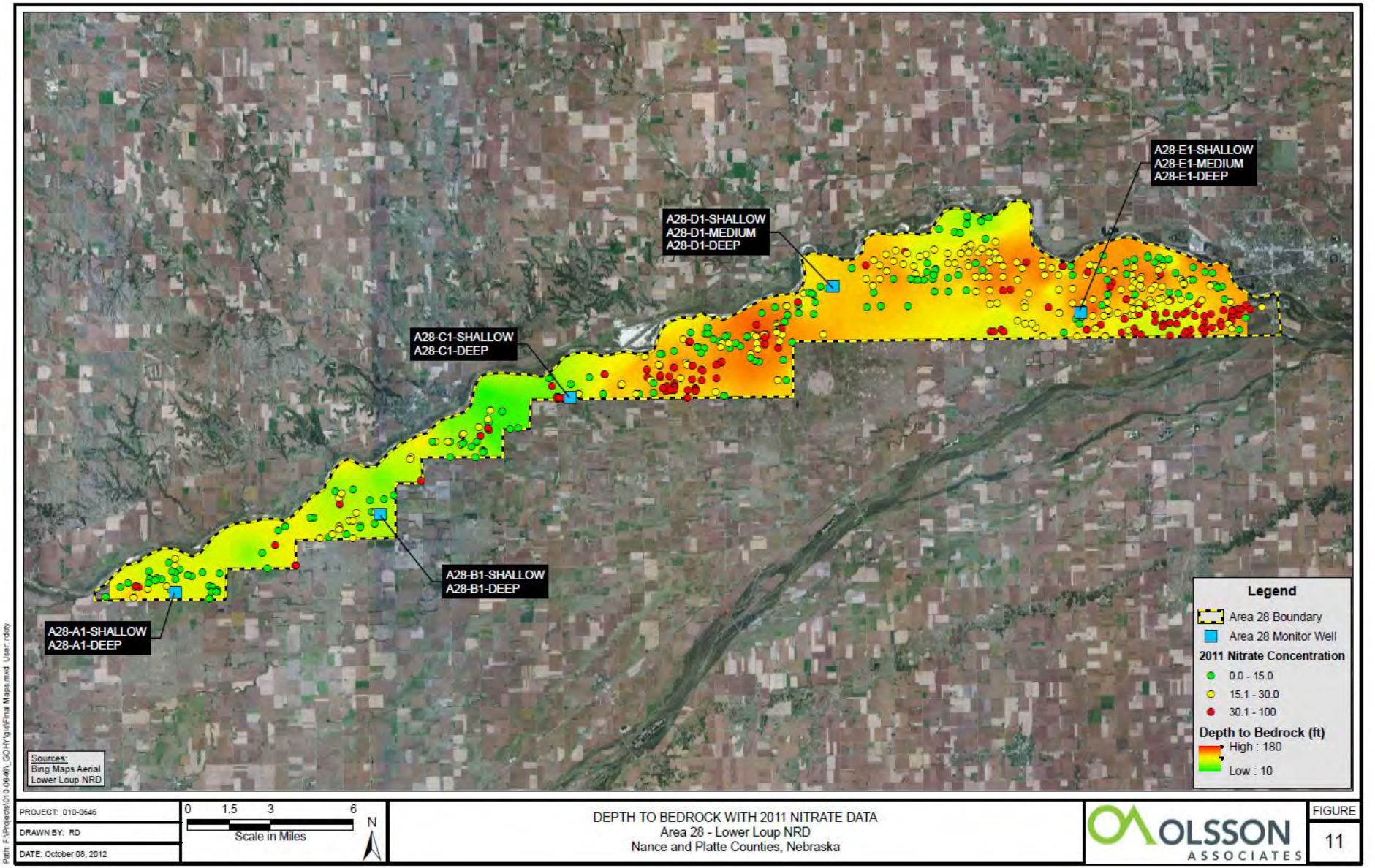
STATSGO Soils and 2011 Nitrates



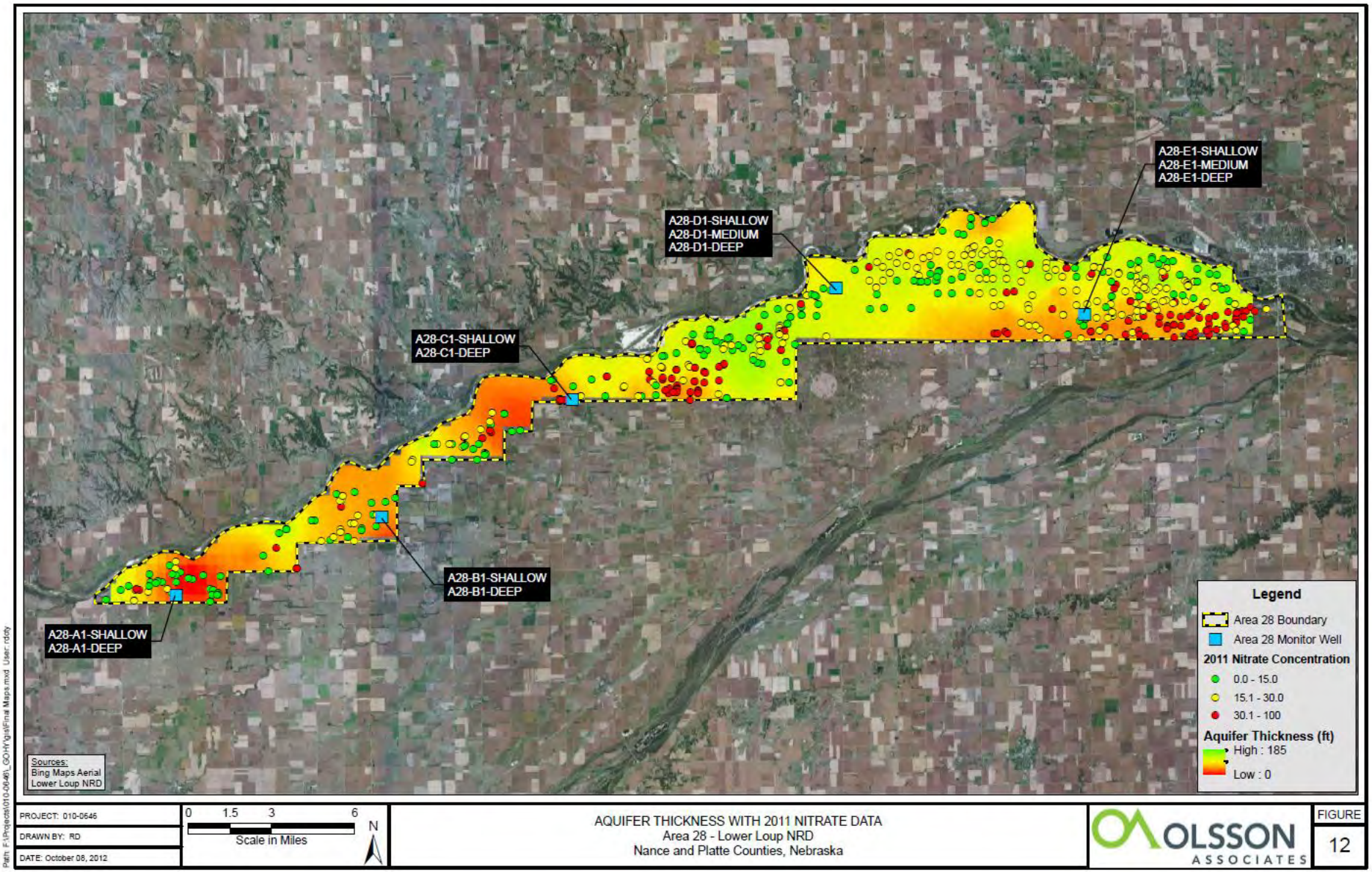
Depth to Water and 2011 Nitrates



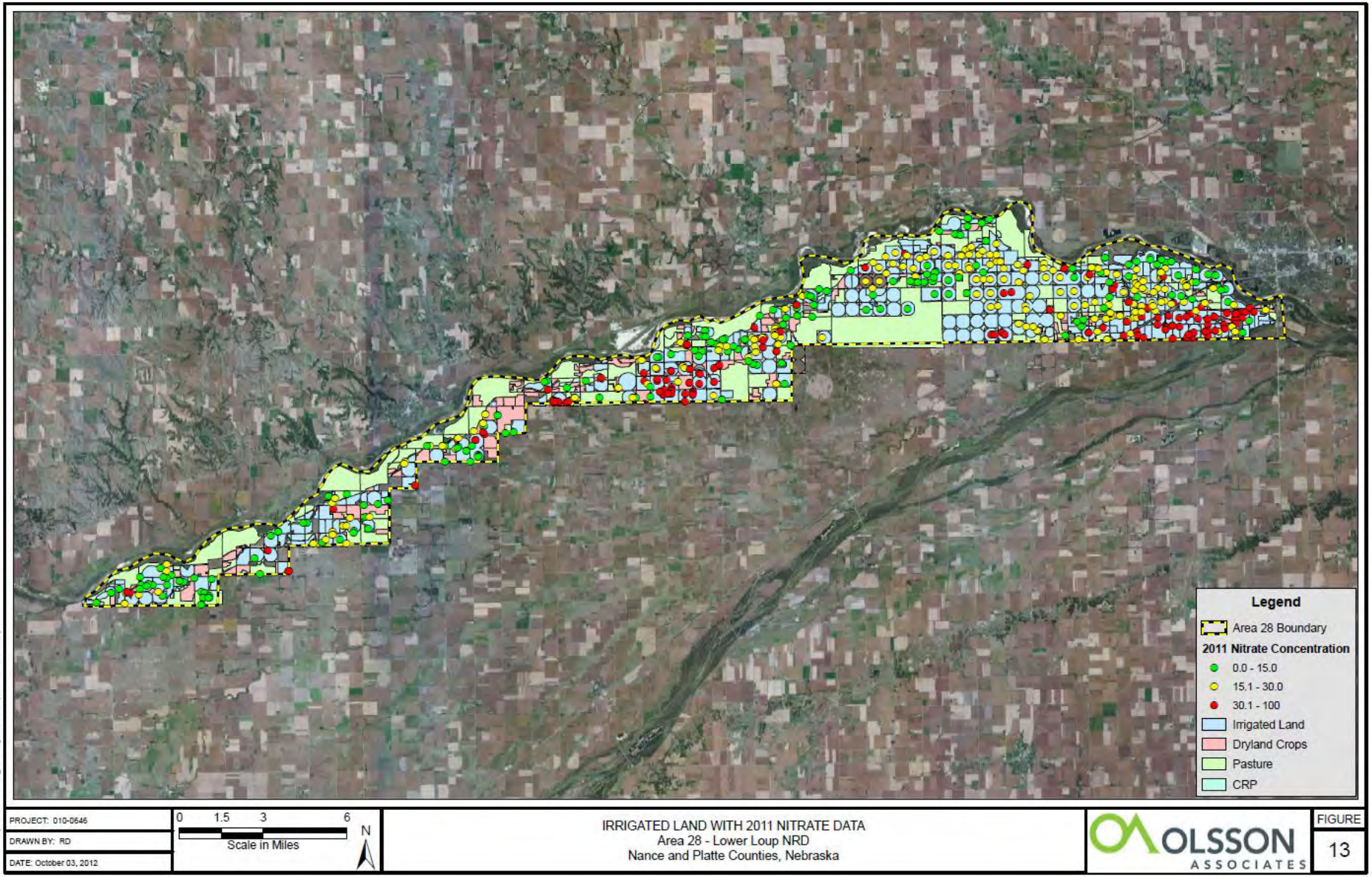
Depth to Bedrock and 2011 Nitrates



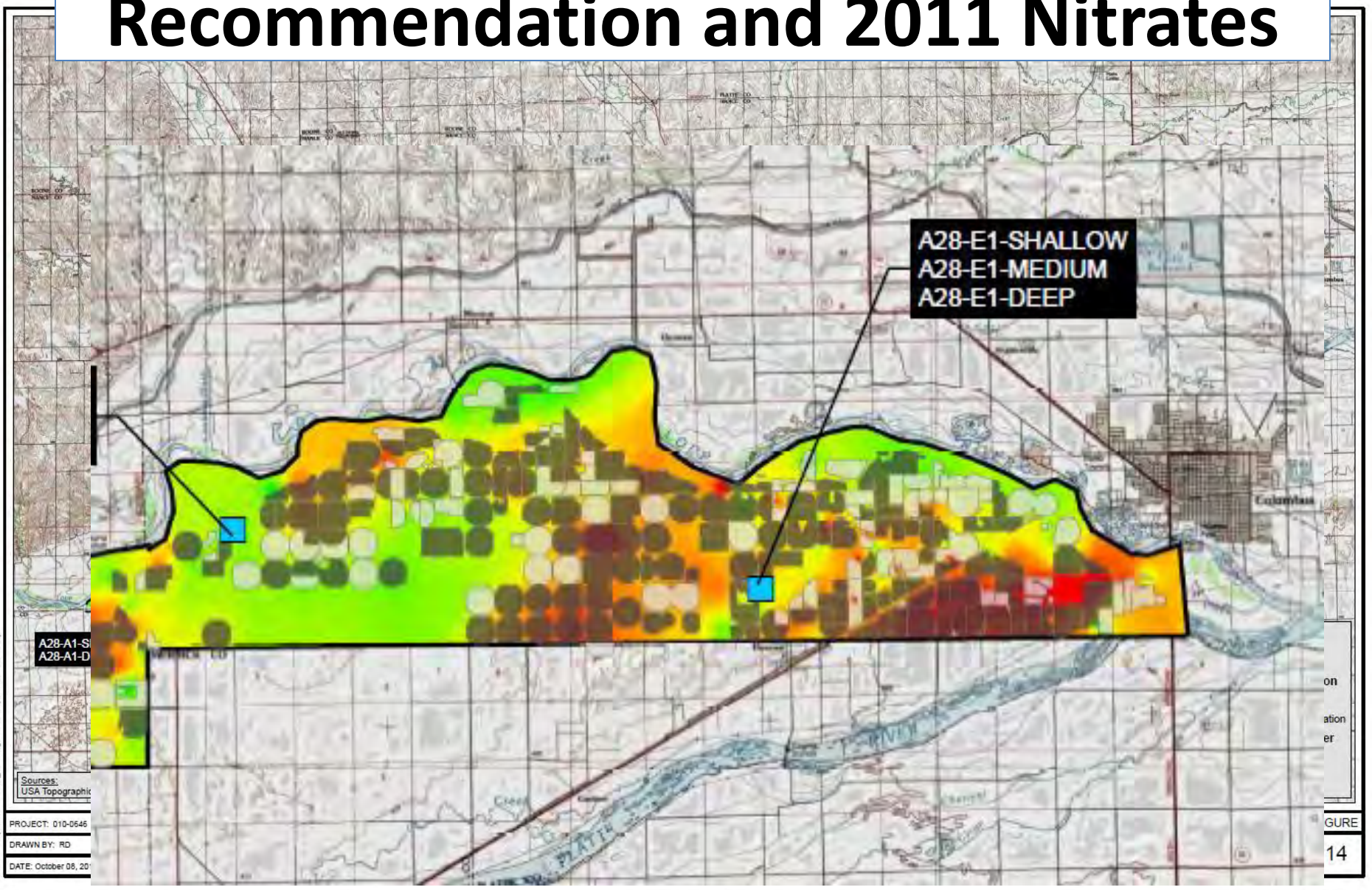
Aquifer Thickness and 2011 Nitrates



Land Use and 2011 Nitrates



Average Application Exceeding NRD Recommendation and 2011 Nitrates



Basis for Final Recommendations in Report

- GIS Mapping Findings
- UNL and other research
- Workable Solutions
  - NRD
  - Farmers
  - Crop Consultants
  - Costs / Funding

NRD Recommended N Rates

- Revise rates to match UNL Calculator
- Differences with UNL Calculator
  - Organic matter N mineralization
  - Application timing – 5% reduction for split app
  - Manure application
    - 15%, 7%, 4% of N release in subsequent years
    - Accounts for ammonia loss depending on incorporation
- Phase IV – Do not allow more than recommendation

Fertigation

- Match fertilizer application to crop need
- Reduce N loading and potential for leaching
- In-season adjustments versus forecasting
- Use in sprinkler or drip irrigation

Convert from Flood Irrigation

- Sprinkler irrigation
- Drip irrigation for small or odd-shaped fields
- Other irrigation efficiency improvements
- CPNRD research 50% of groundwater nitrate reductions from conversion from flood to sprinkler

Cover Crops

- Planted after fall harvest
- Uptake excess N
- Above ground N sink
- Growing during highest leaching potential
- Release N with decomposition in spring
- MN research reduced N losses by 11-13%

Irrigation Scheduling

- Nitrate issues combination of N and leaching
- UNL Checkbook Method
- Modified ET gauges
- Soil moisture probes
- Combination of the above
- One inch of deep percolation 5 to 25 lbs N

Other Items Evaluated
Potential Future Consideration

- Additional manure management
- Crop rotations and/or alfalfa
- Further narrow pre-plant window
- Variable rate N, N sensors, etc.
- Controlled release fertilizer
- Expected yield revisions

Recommendations Summary

1. NRD recommended N rates
2. Fertigation
3. Conversion from flood irrigation
4. Cover crops
5. Irrigation scheduling

Questions?

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