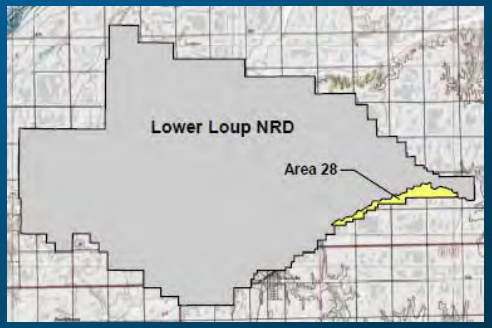
The Lower Loup Natural Resources District

Area 28 Groundwater Management Study



Karen Griffin, PG

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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.

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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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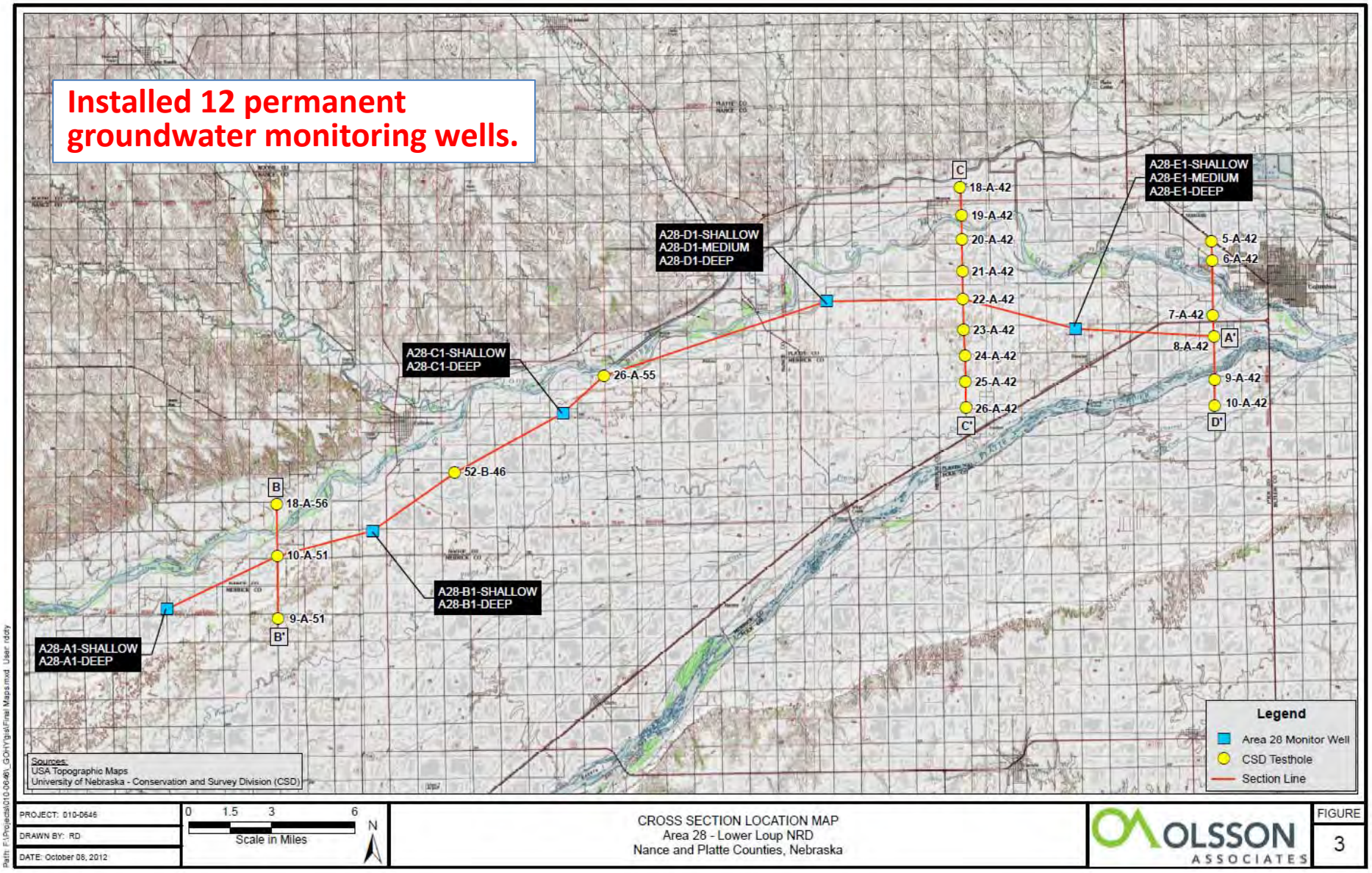
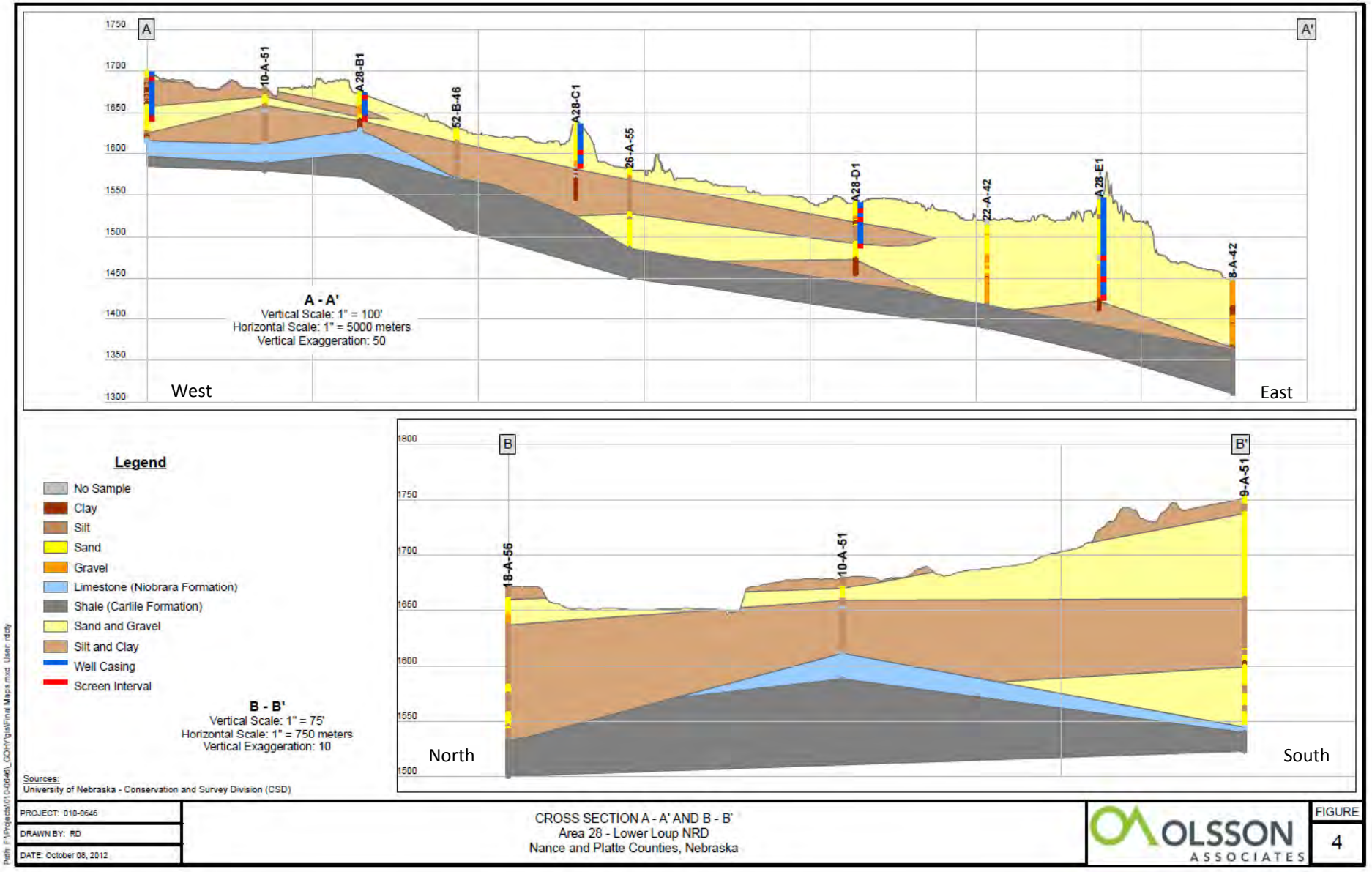
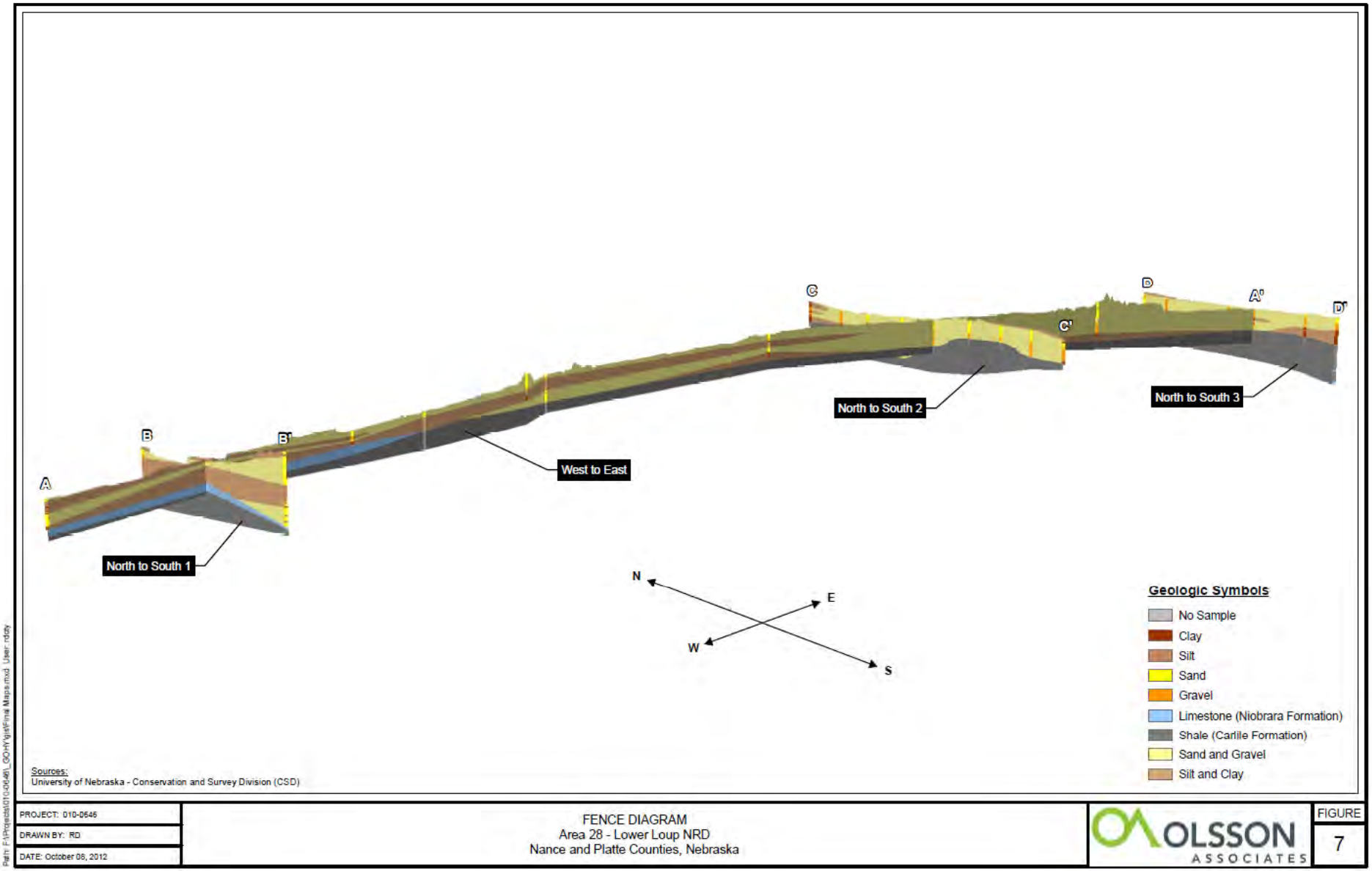
Permanent Monitoring Well Locations



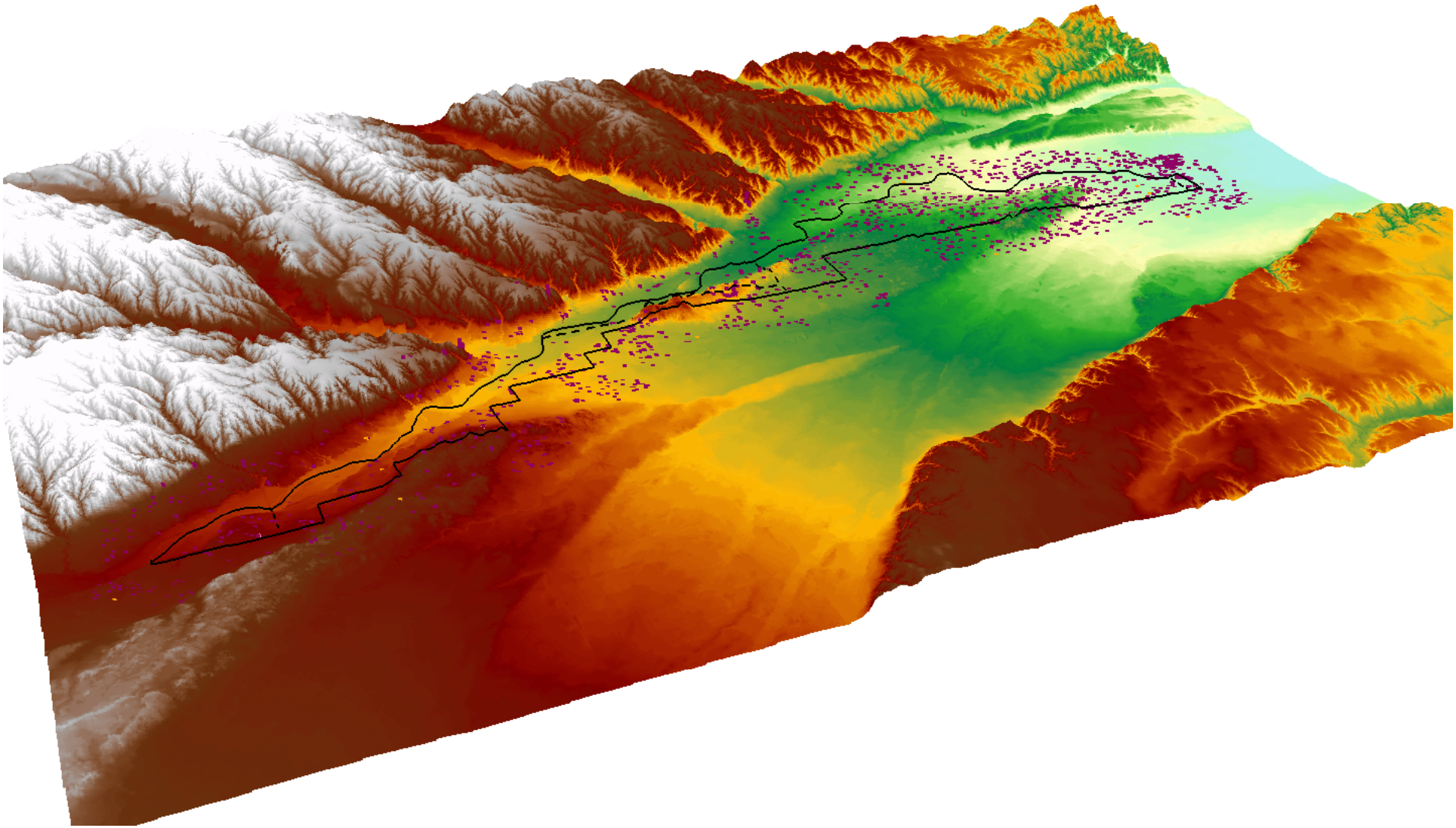
Geologic Cross Sections (A-A', B-B')



3D Fence Diagrams



3D Hydrogeology of Area 28



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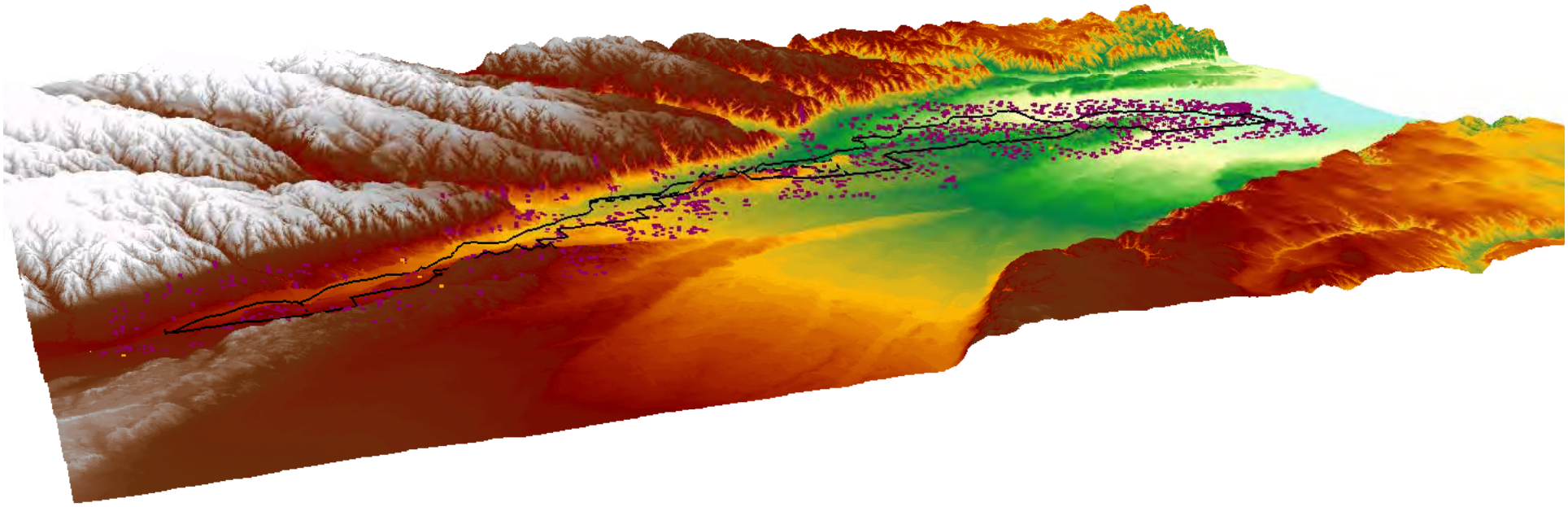

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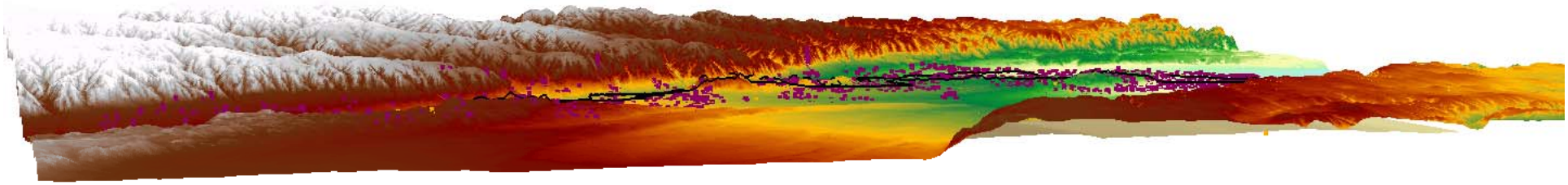

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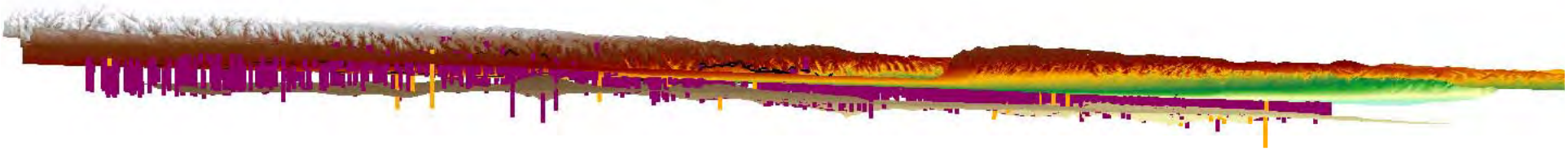

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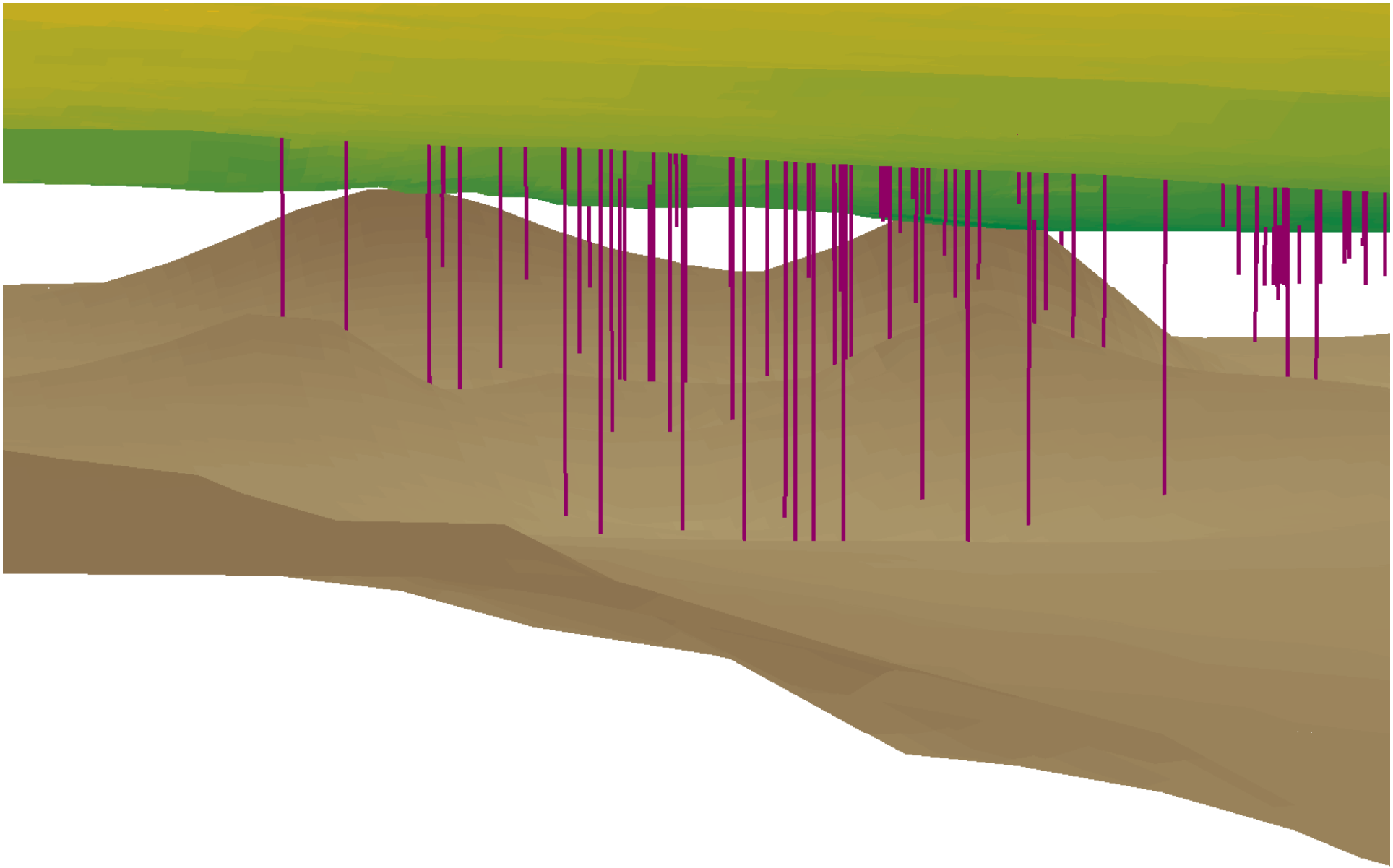

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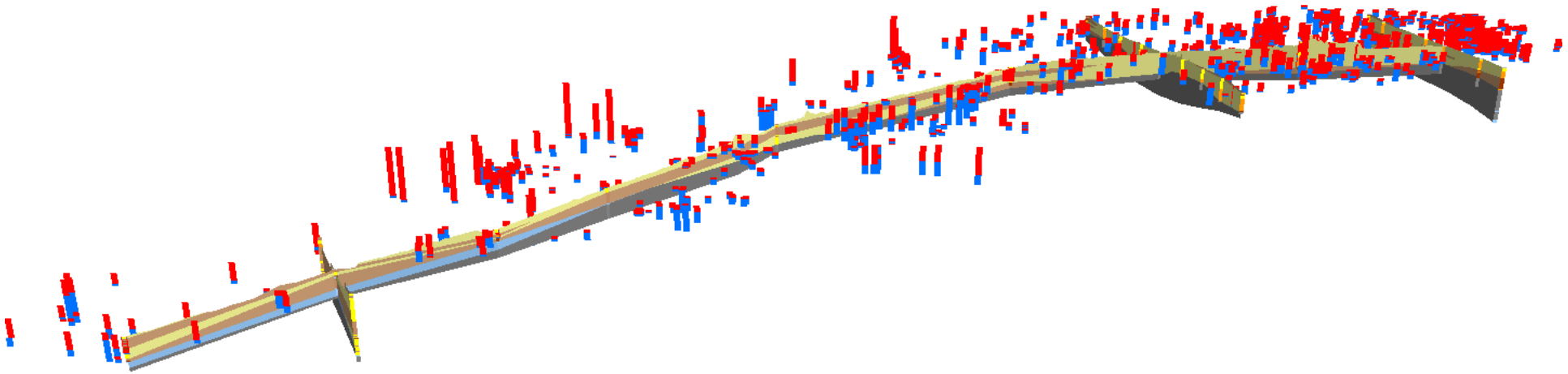

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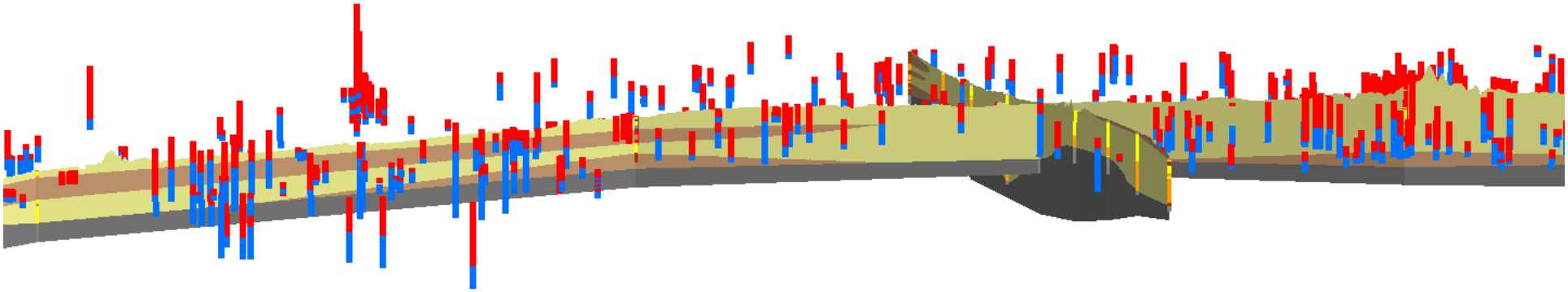

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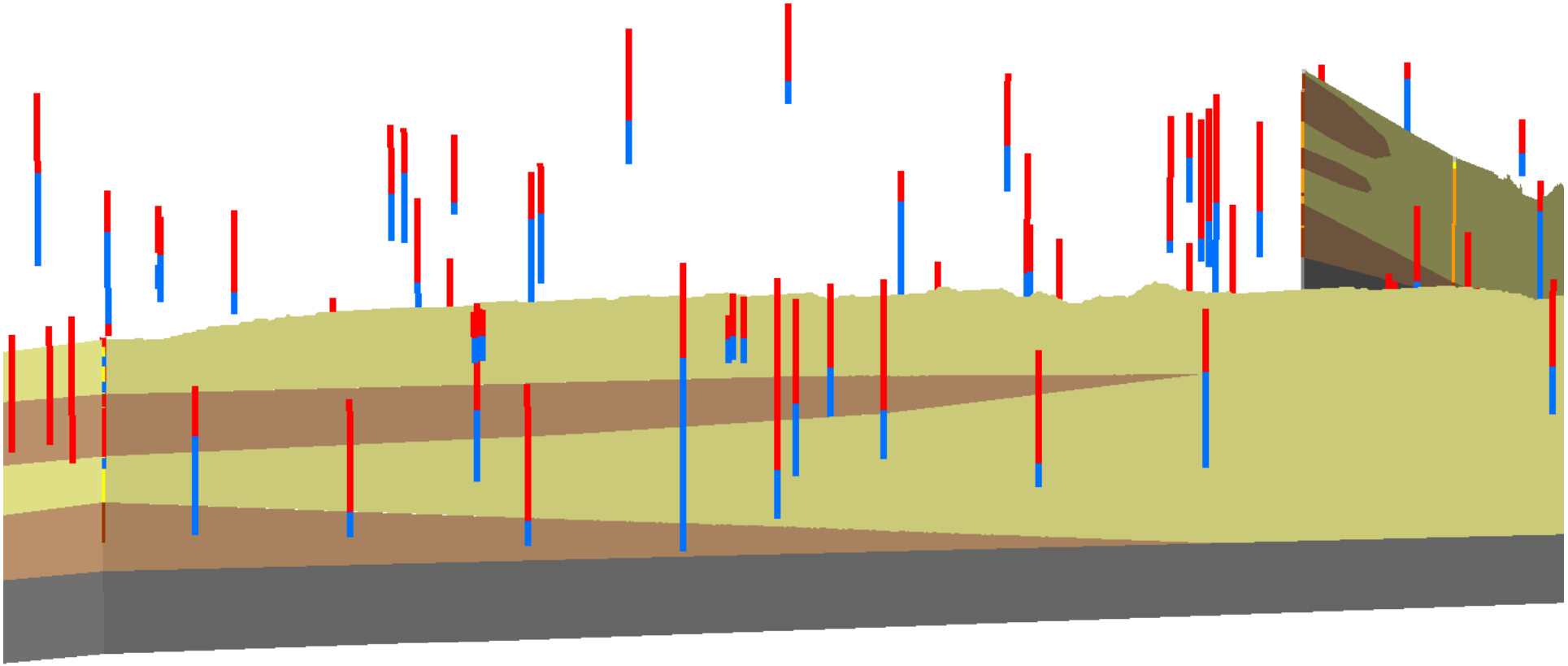
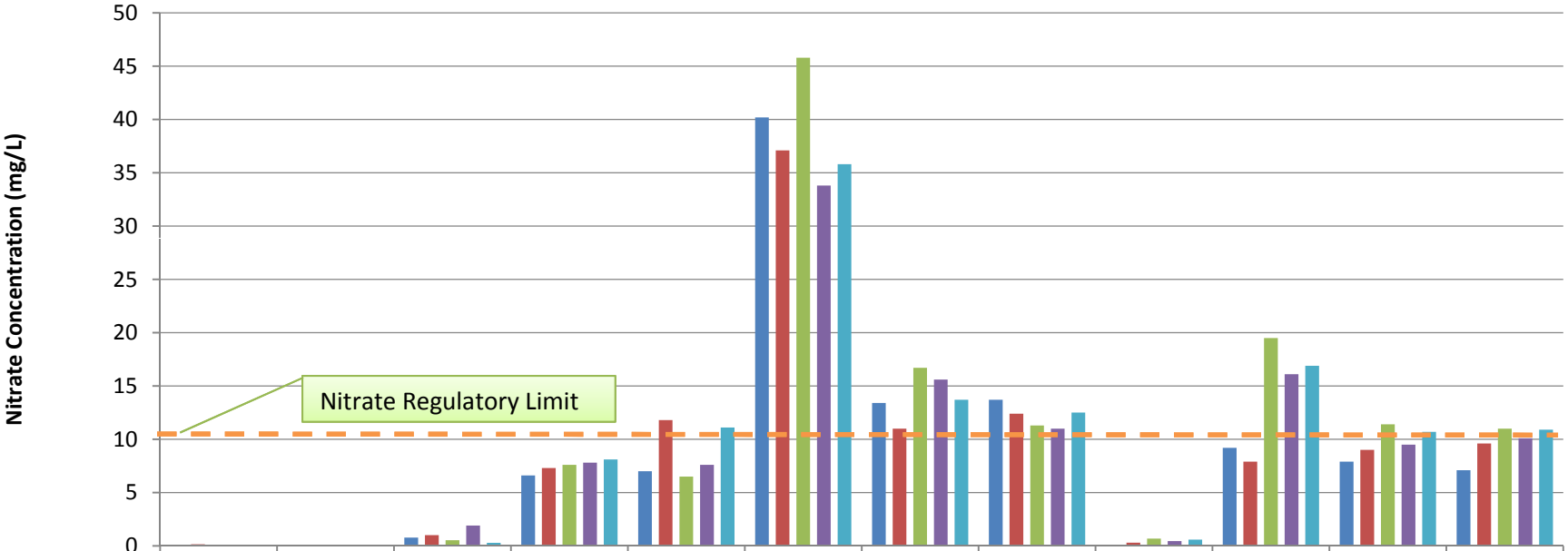


Task 5 – GW Well Sampling

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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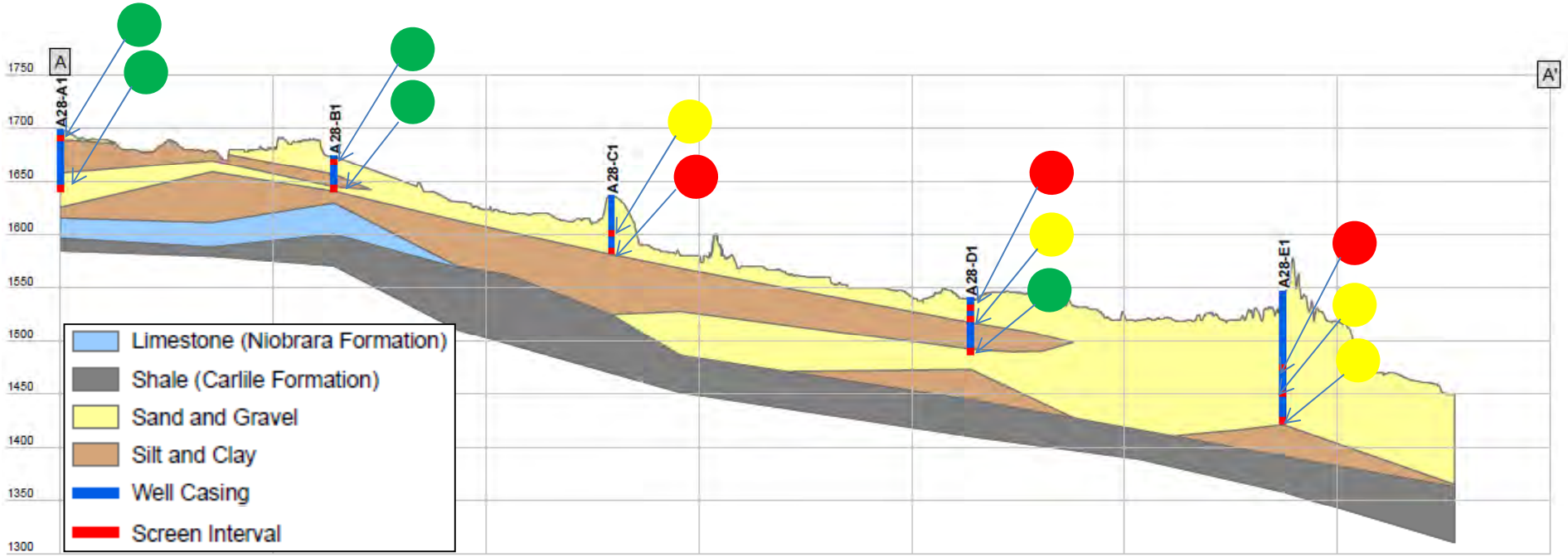
Average Groundwater Sample Results



- 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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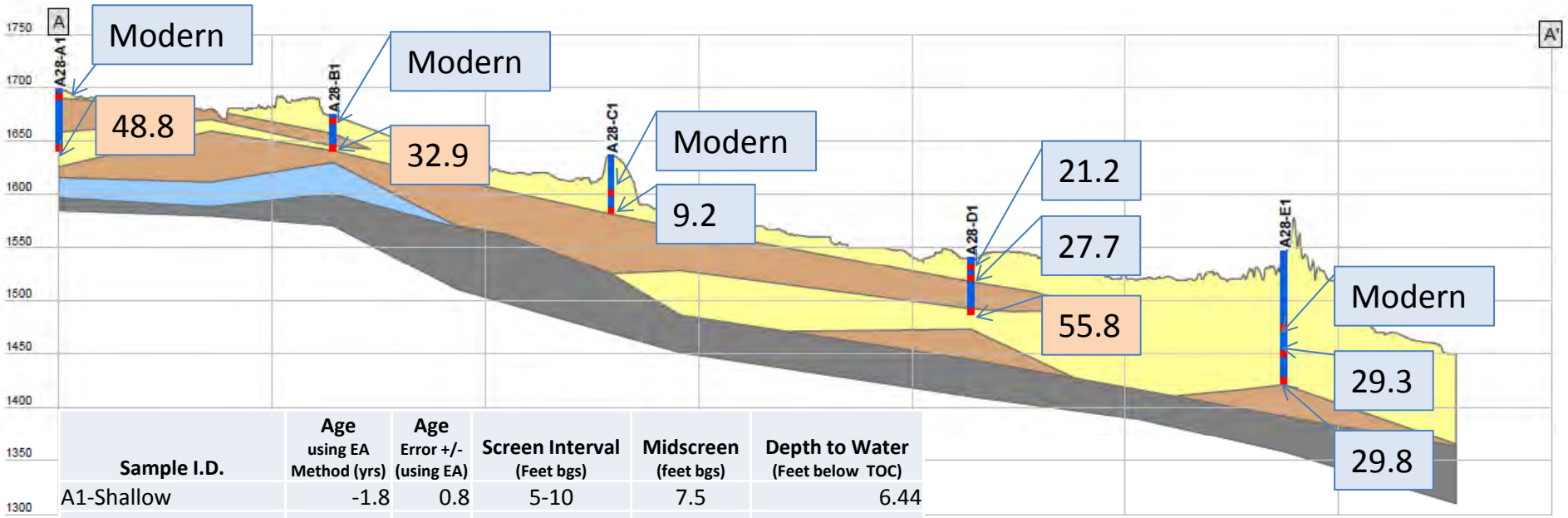
Task 6 - Groundwater Age Dating



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	-1.8	0.8	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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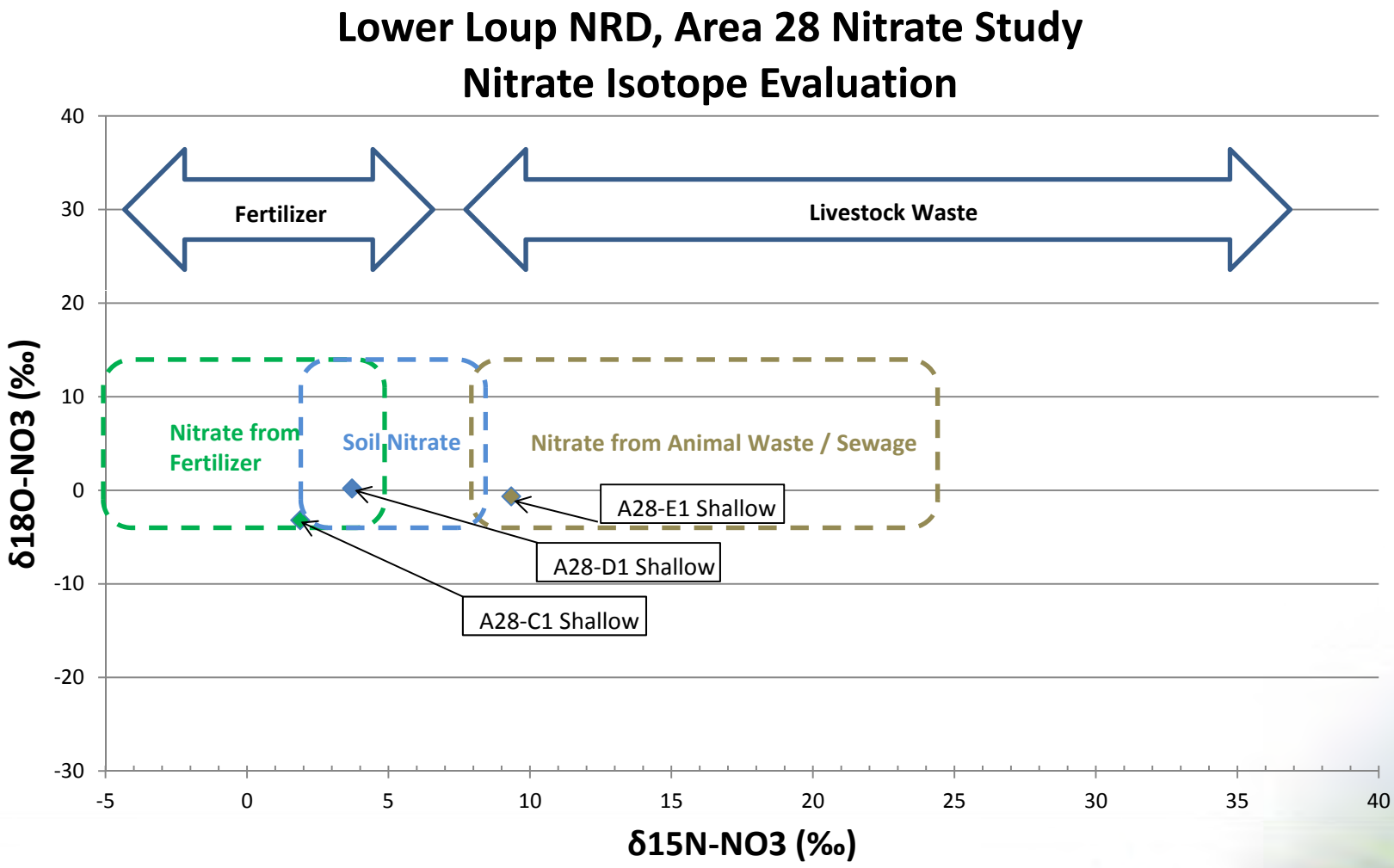
Task 7 - Nitrogen Isotope Analyses



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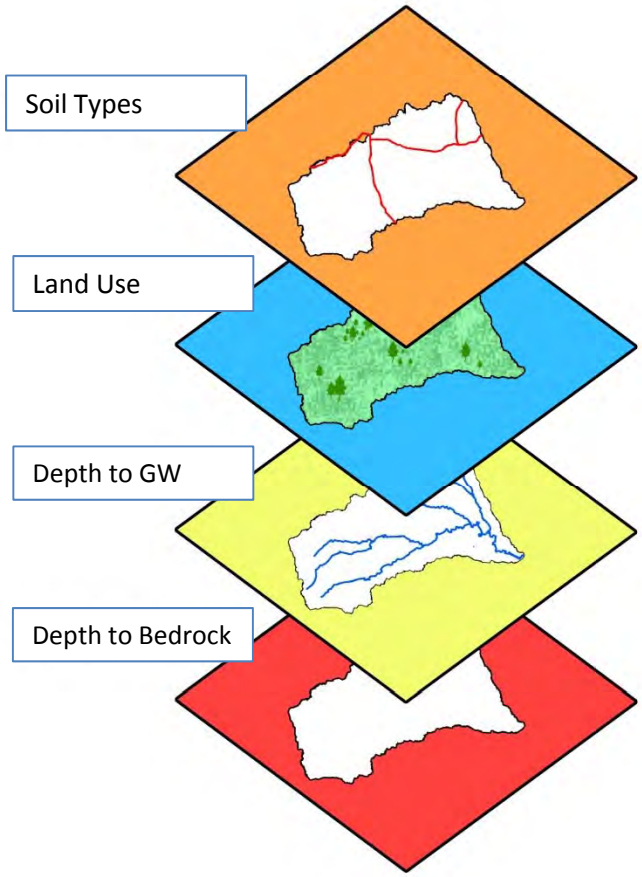
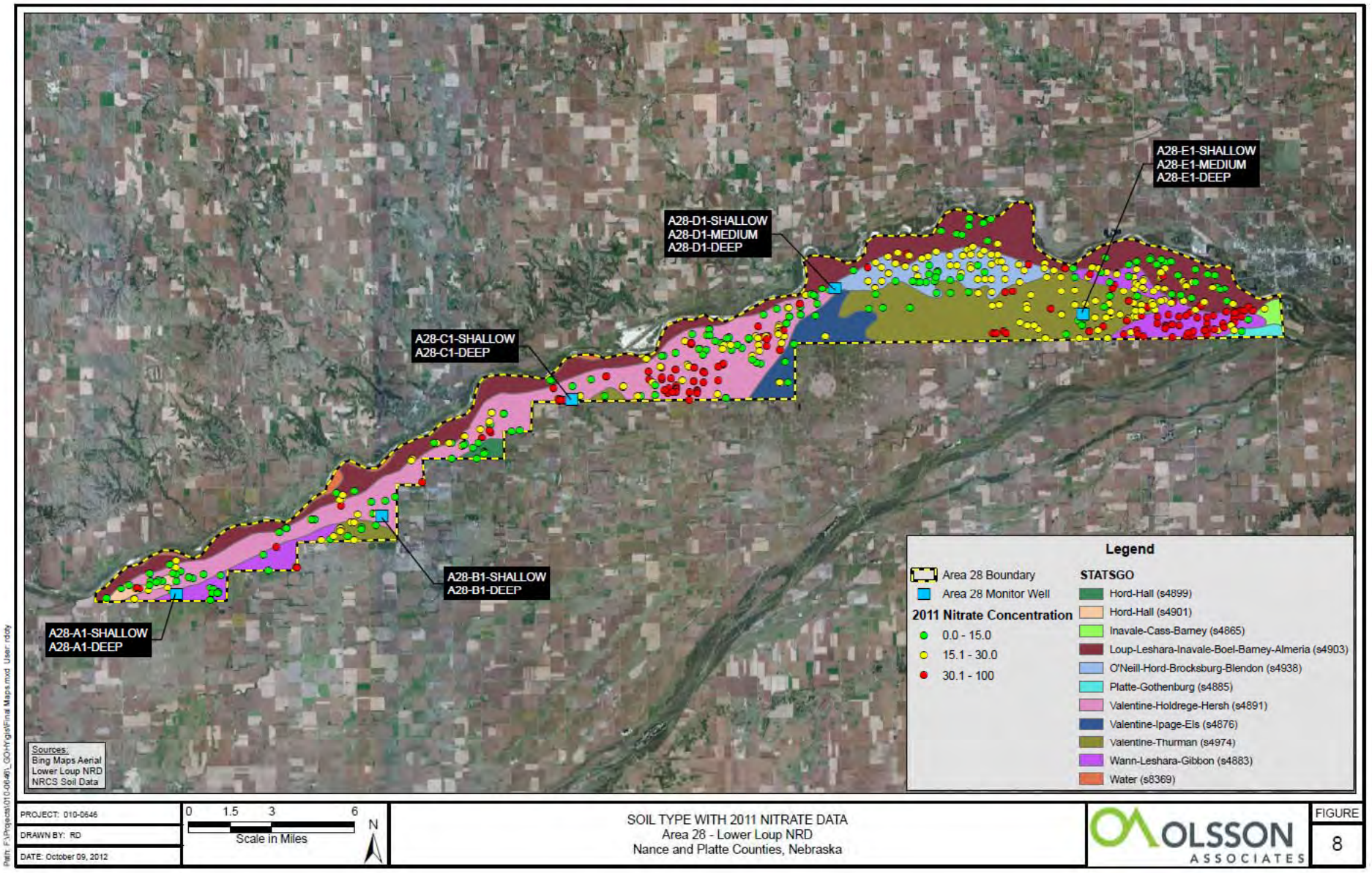
Task 3 – GIS Mapping Interpretation

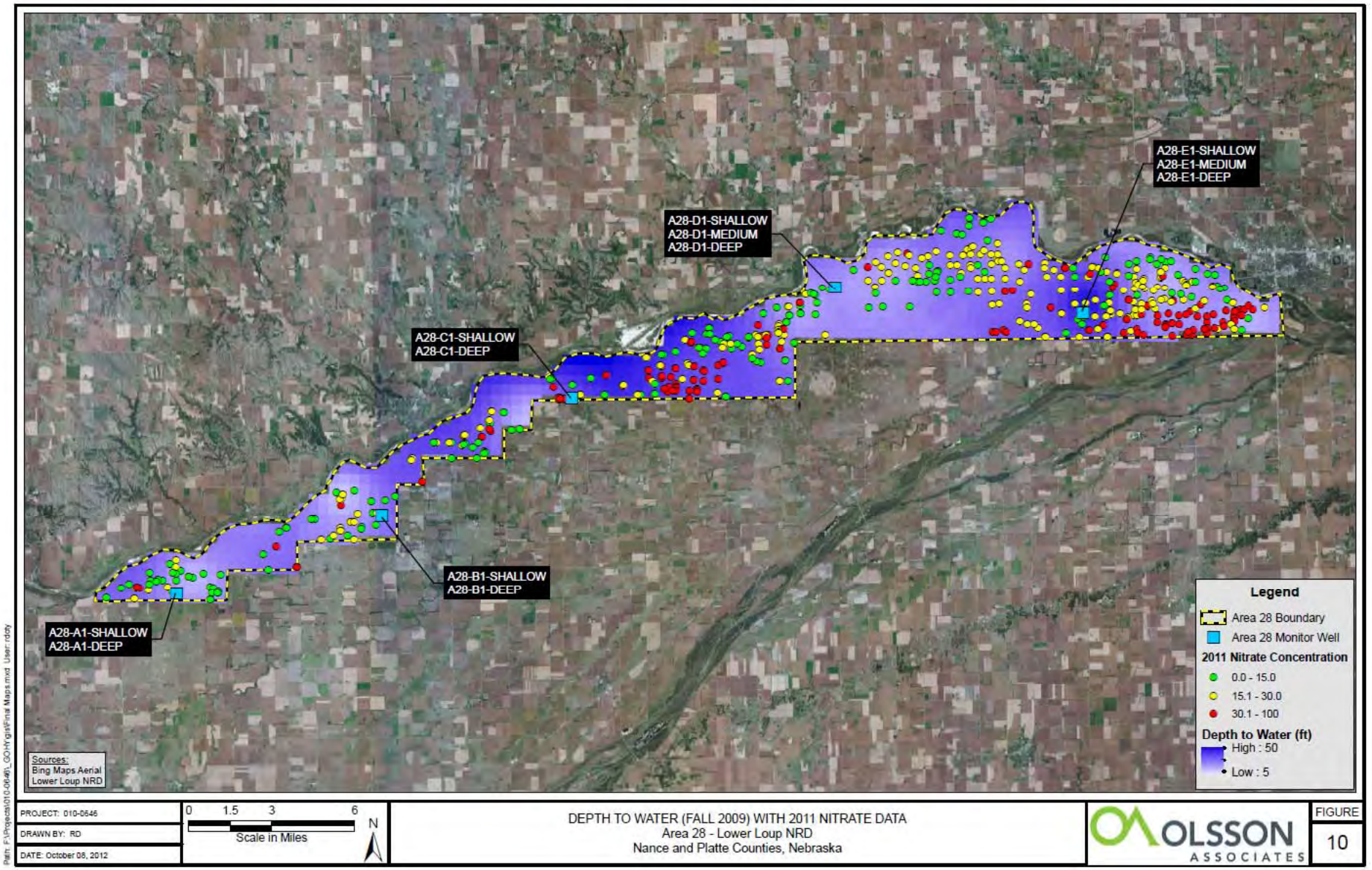
- Prepare GIS maps and datasets illustrating the hydrogeology and nitrate contamination
  - Why? to see if there is any correlation between the distribution of nitrates and mapped datasets.



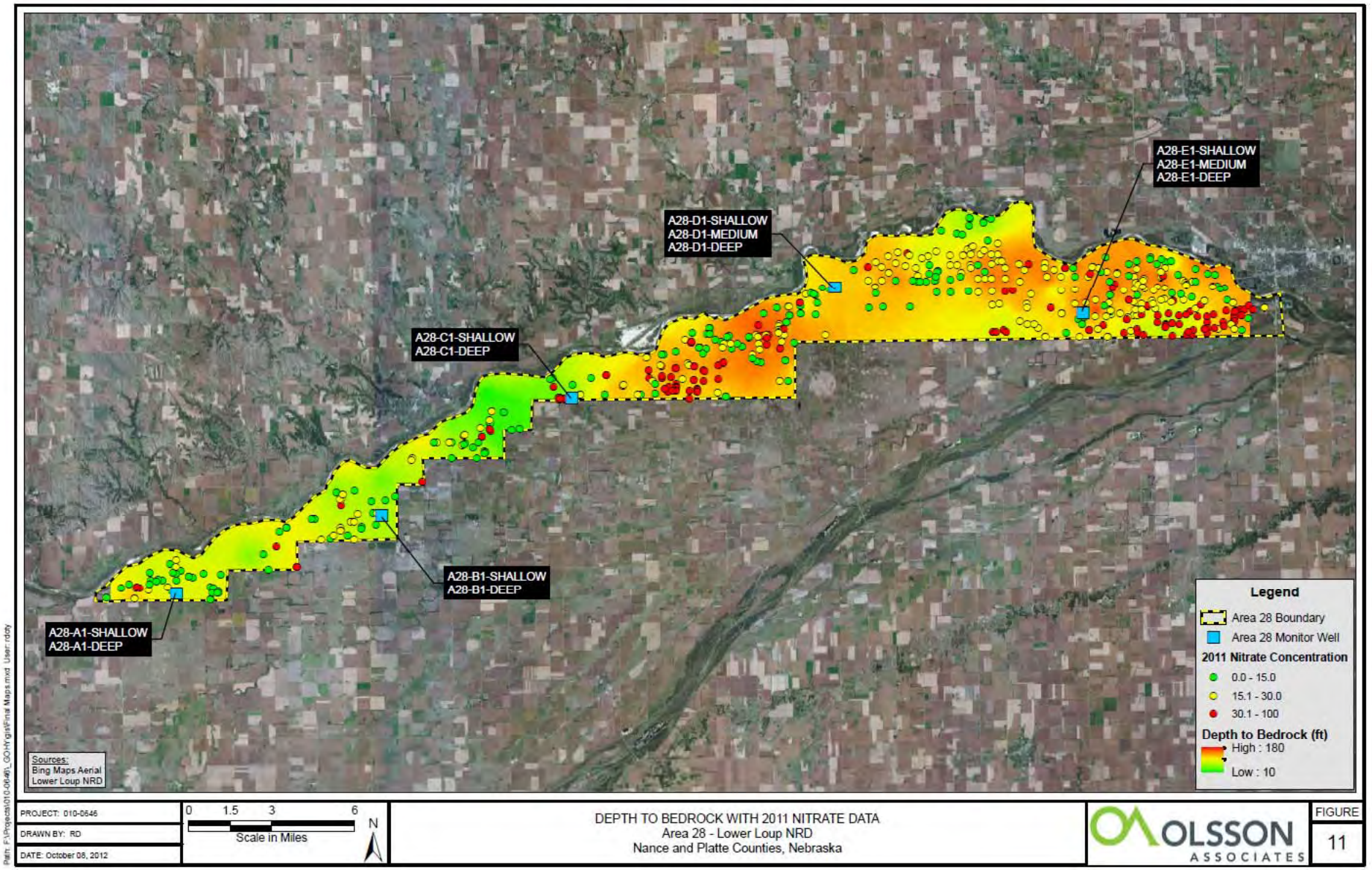
STATSGO Soils and 2011 Nitrates



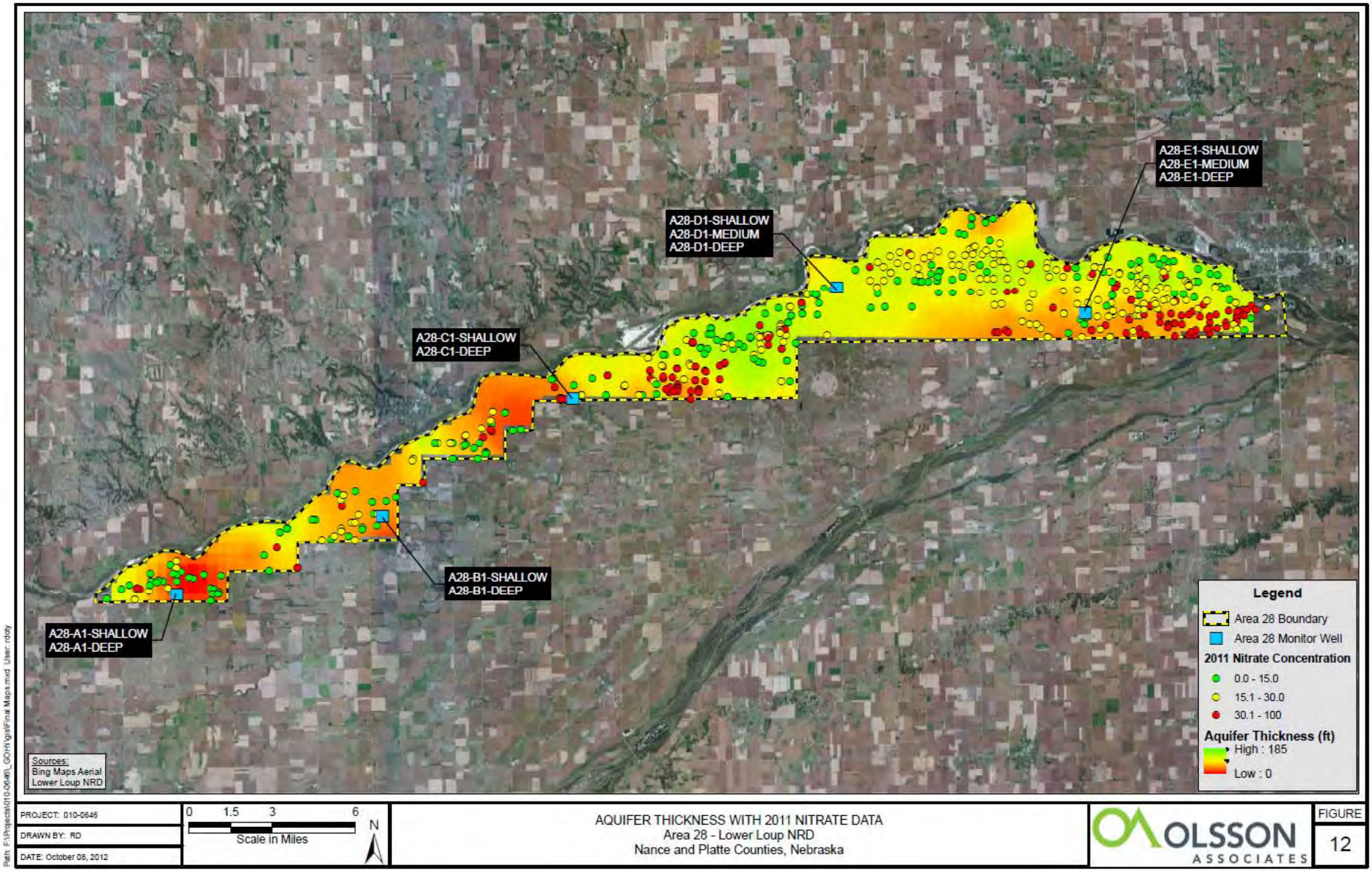
Depth to Water and 2011 Nitrates



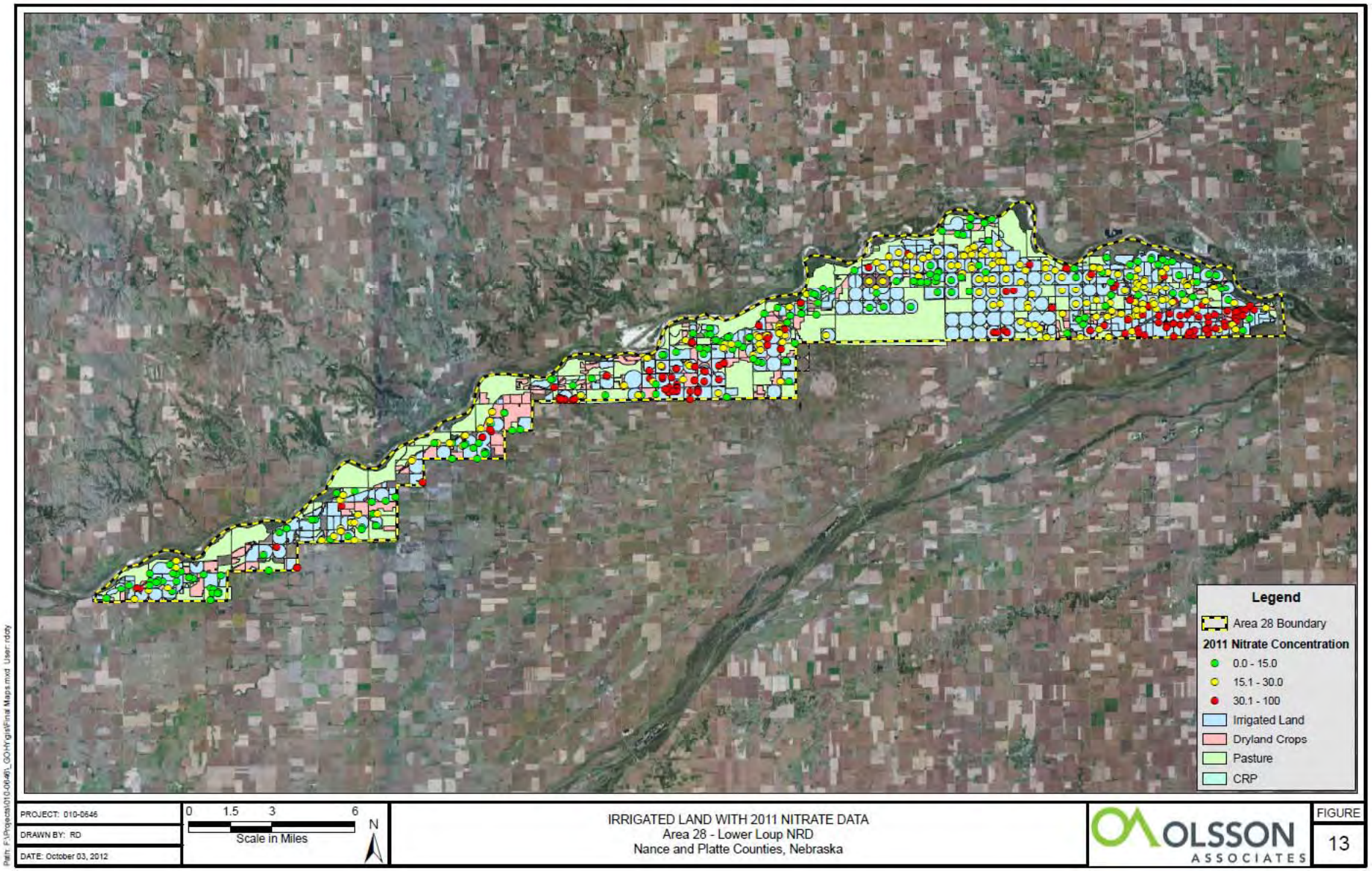
Depth to Bedrock and 2011 Nitrates



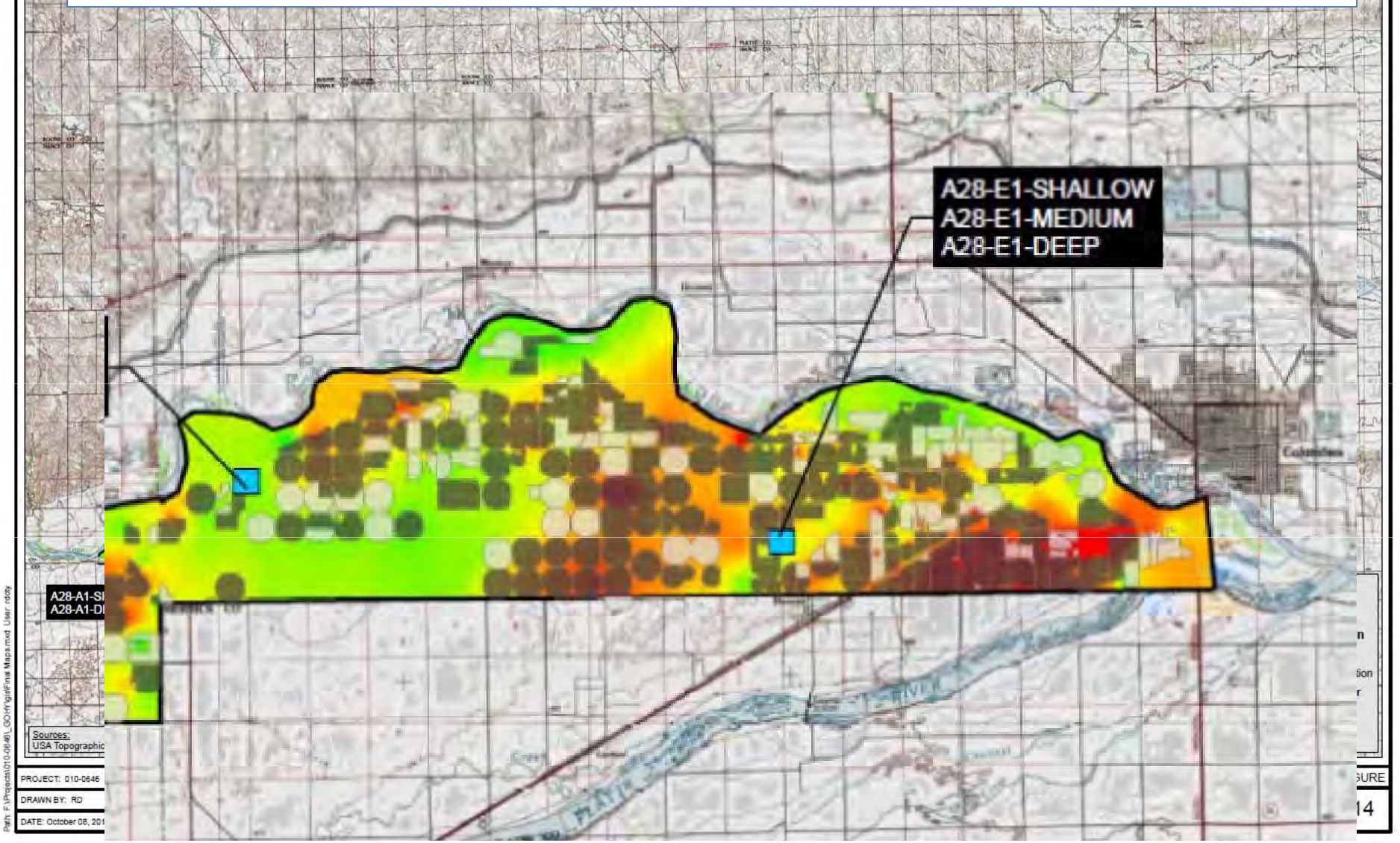
Aquifer Thickness and 2011 Nitrates



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
  - Manure application
- **Phase IV – Do not allow more than recommendation**

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**

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

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

Recommendations Summary

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

Questions?

Jeff McPeak, PE – jmcpeak@olssonassociates.com

Karen Griffin, PG – kgriffin@olssonassociates.com

1111 Lincoln Mall, Suite 111

Lincoln, NE 68508

402-474-6311

Tylr Napstek - tnaprstek@llnrd.org

Lower Loup NRD

Ord, NE

(308) 728-3221

OLSSON ASSOCIATES