

2008 Douglas County Nitrate Study

Lessons Learned

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Tri-County Health Department

Overview



- Nitrate and Health
- Study Purpose
- Background
- Study Design
- Potential Factors
- Limitations
- Methods
- Results
- Conclusions

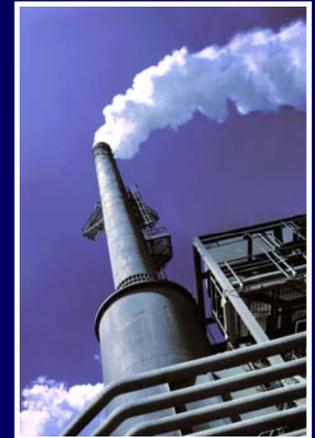
“Water quality impacts are occurring from onsite wastewater systems in a number of specific areas in Colorado. However, the presence and nature of these problems often has not been verified or rigorously documented.

In fact, few well-documented studies have been done in Colorado that directly link water quality or health risks with onsite wastewater systems.”

From Summary Characterization of Onsite Wastewater System Impacts of the ISDS Steering Committee Report

Nitrate and Health

- Sources of nitrate
- Methemoglobinemia
 - Sensitive infants and fetuses
 - Inhibits ability of blood to carry oxygen
- Drinking water standard (MCL)
 - 10 mg/L nitrate



Evaluating Nitrate Impacts

- **Modeling**
 - Proper model selection
 - Requires good input data
 - Good Data = Good Predictions
 - Poor Data = Poor Predictions
- **Groundwater Monitoring**
 - Dedicated wells preferred
 - Drinking water wells available



Study Purpose

- Impacts of Individual Sewage Disposal Systems (ISDS) on groundwater
- Determine factors to “pre-dispose” a well to contamination from ISDS

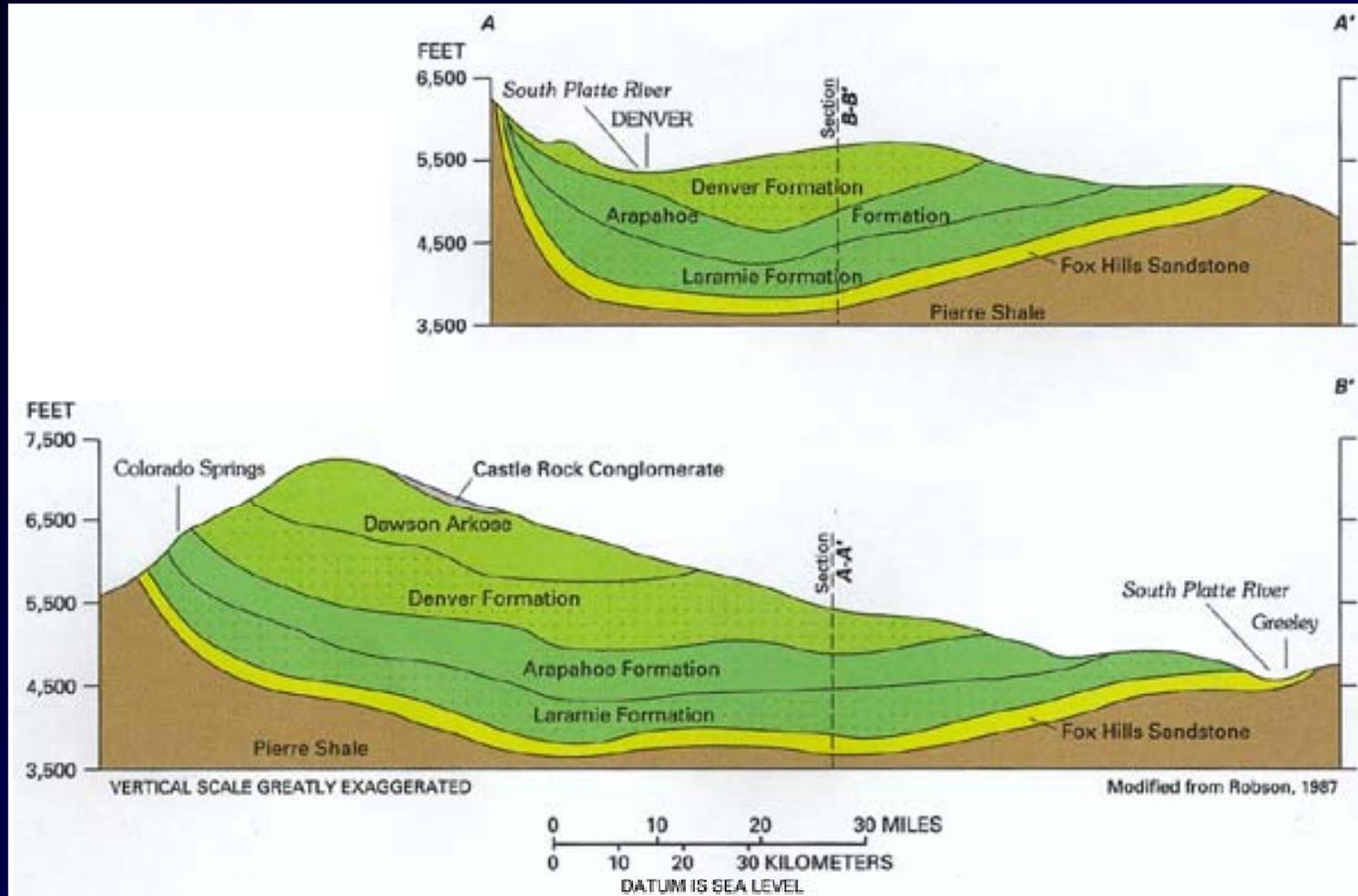


Background



- Most wells in the Dawson Aquifer
- Mean depth of wells is 366 ft

Denver Basin Aquifers



Taken from the USGS Groundwater Atlas

Typical ISDS

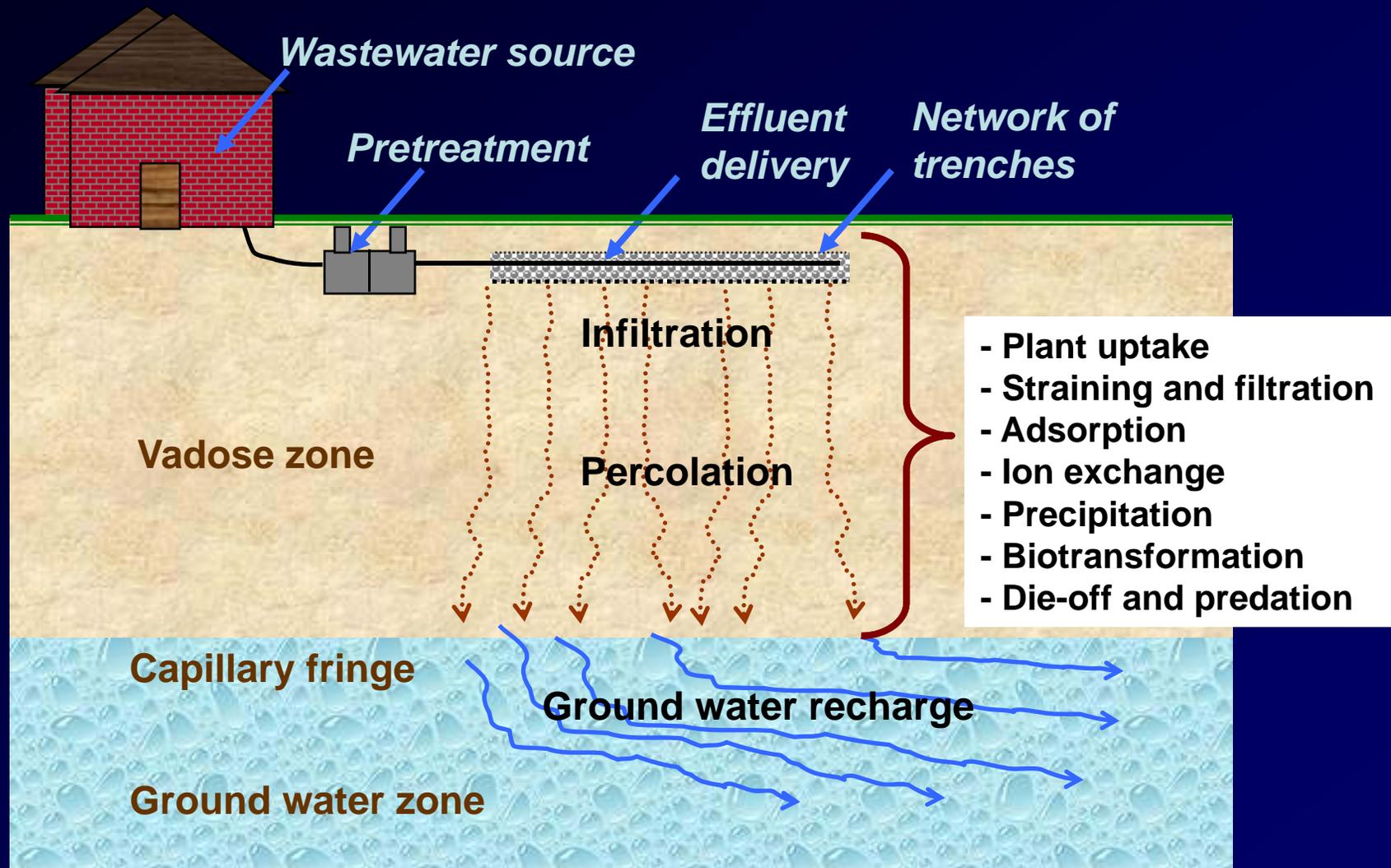
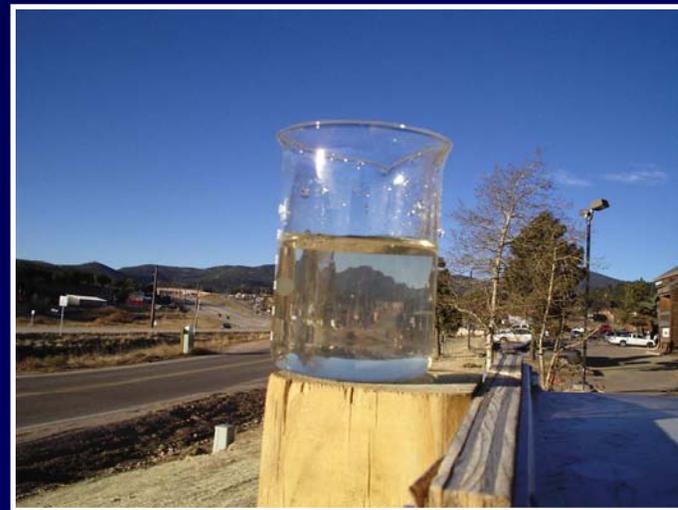


Illustration created by Colorado School of Mines

Colorado School of Mines (CSM) Study

- CSM Study
 - Assess possible impacts from proposed development
- Modeling
 - Nitrate selected as principal contaminant
 - Screening models
 - Complex model
 - Hydrus 1D



Aspen Park Effluent sample

CSM Study (cont'd)

- **Modeling Study Outcomes**
 - Model highly sensitive to denitrification rate
 - Denitrification rates have large “range of values”
 - Nitrate standard may or may not be exceeded
 - Monitoring recommended
 - Simplified models

Tri-County Nitrate Study Design

- Models predict many decades to see nitrate impacts
- Pre-1973 homes selected
- Most wells constructed in uppermost aquifer



Pre-dispositional Factors

- Distance from leachfield to well
- Elevation of leachfield in relation to well
- Age of ISDS
- Soil type for leachfield
- Frequency of septic tank pumping
- Depth of well

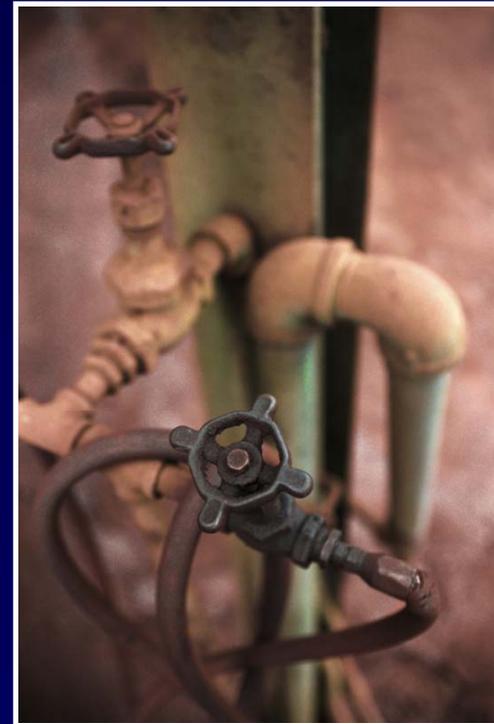
Limitations of Study

- Random vs. convenience samples
- State engineer's office (SEO) database matching
- Residential vs. monitoring wells



Field Methods-Work Plan

- GPS
- Data Sheet
- Field Tap
- Garden hose
- Sample Containers
 - Nitrate
 - Hardness & Conductivity



GIS Methods

- Geographic Information Systems (GIS)
 - [Live map tool](#)
 - Data Sources
 - US Geological Survey digital elevation models
 - Natural Resources Conservation Service Soil Data Mart database
 - State Engineer's Office database of well permits

Interactive Mapping Tool

Address <http://www.tchdgis.org/googlemaps/pointeditor.html>



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Show Parcels: Click SHOW for the range of numbers that includes your Address_ID

1-75: SHOW HIDE	76-120: SHOW HIDE	121-150: SHOW HIDE	151-225: SHOW HIDE	226-260: SHOW HIDE
261-290: SHOW HIDE	291-308: SHOW HIDE	309-314: SHOW HIDE	Note: Not all sites will have Parcel boundaries	

Location Type (W for Well, L for Leachfield):

Address_ID Lat:

Your Initials Lon:

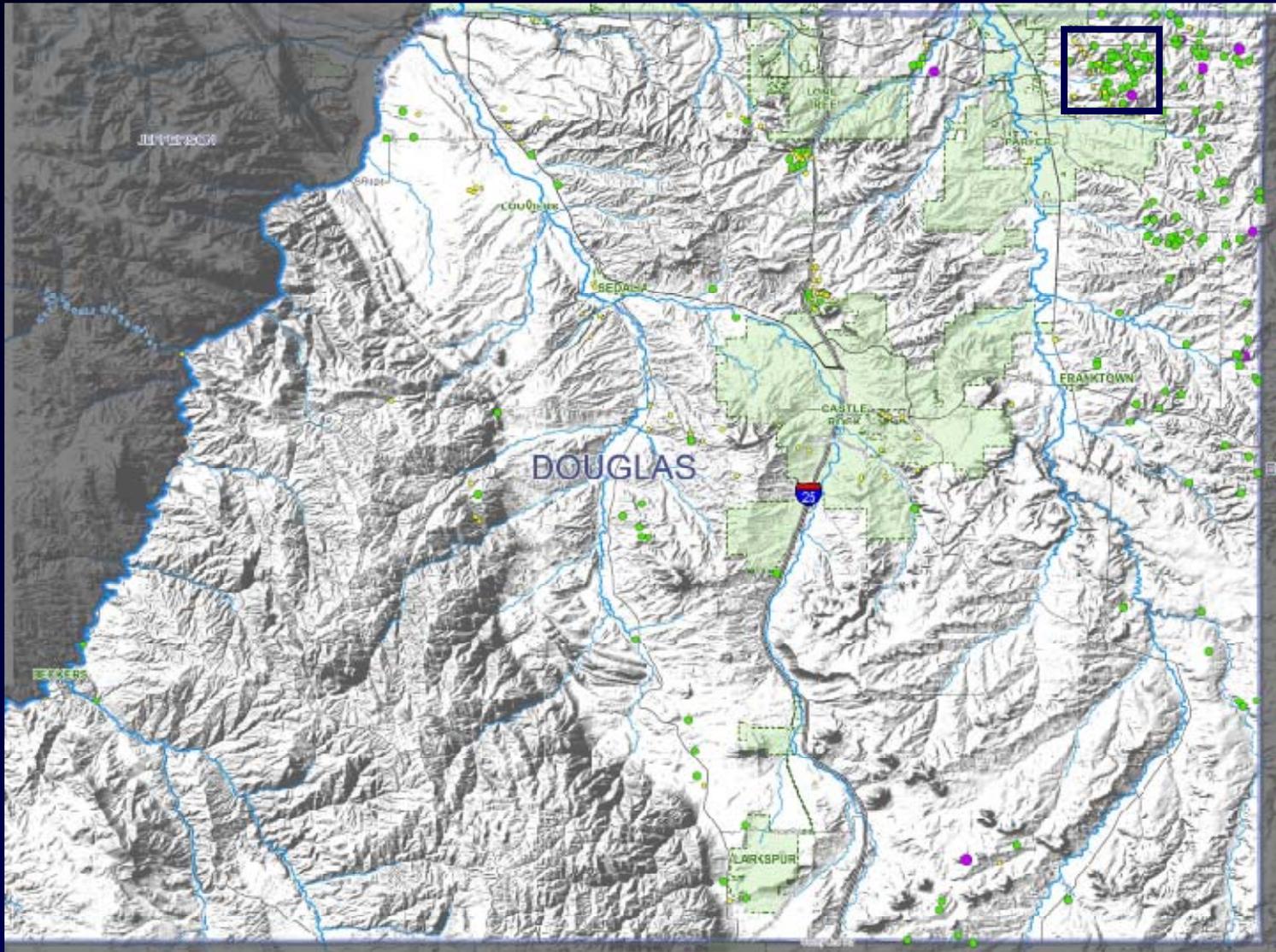
Notes:

Lab and Statistical Methods

- Lab
 - Hardness and conductivity
 - EPA 300.1 for nitrate
- Statistics
 - Excel 2003 and SAS 9.1
 - Single-variant and multi-variant

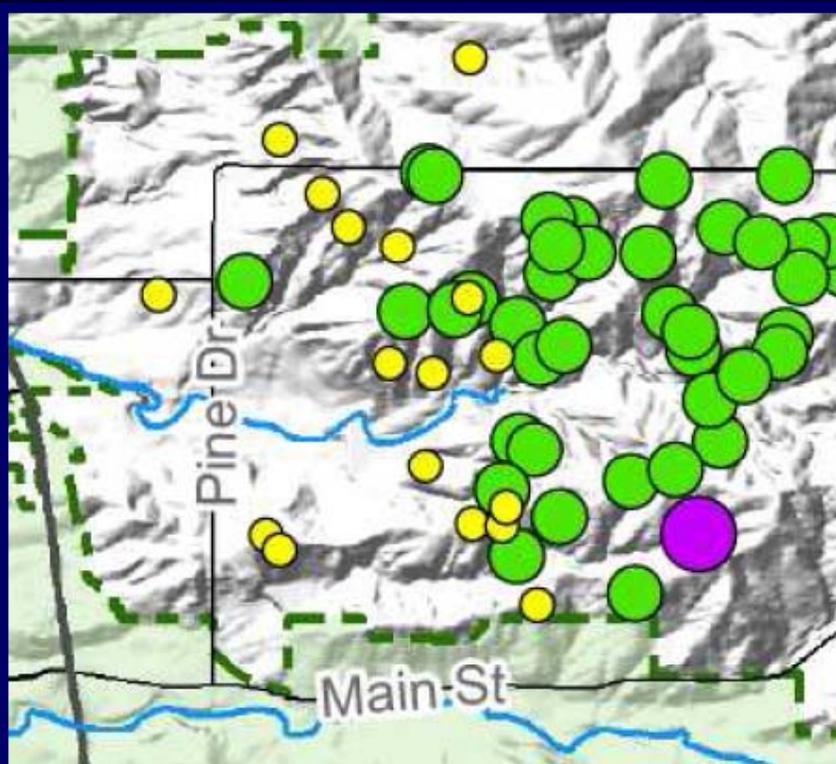


Results



Map created by Tri-County Health Department

Sample Map



LEGEND

-  Above Health Standard ($\geq 10\text{mg/L}$)
-  Detectable ($0.3 \leq N < 10\text{mg/L}$)
-  Not Detectable ($< 0.3\text{mg/L}$)

Map created by Tri-County Health Department

Nitrate Results

	Number	Percentage of Whole (%)
Above Health Standard (≥ 10 mg/L)	9	3.1
Detectable ($0.3 \leq N < 10$ mg/L)	185	62.7
Not detectable (< 0.3 mg/L)	101	34.2

Nitrate Range and Mean

Total Number of Samples	295
Minimum Value	< 0.30 mg/L
Maximum Value	75 mg/L
Mean	2.0 mg/L
Median	0.72 mg/L

Well Drill Depth Results

$n=104$

	Depth (ft)
Minimum	75
Maximum	925
Mean	366

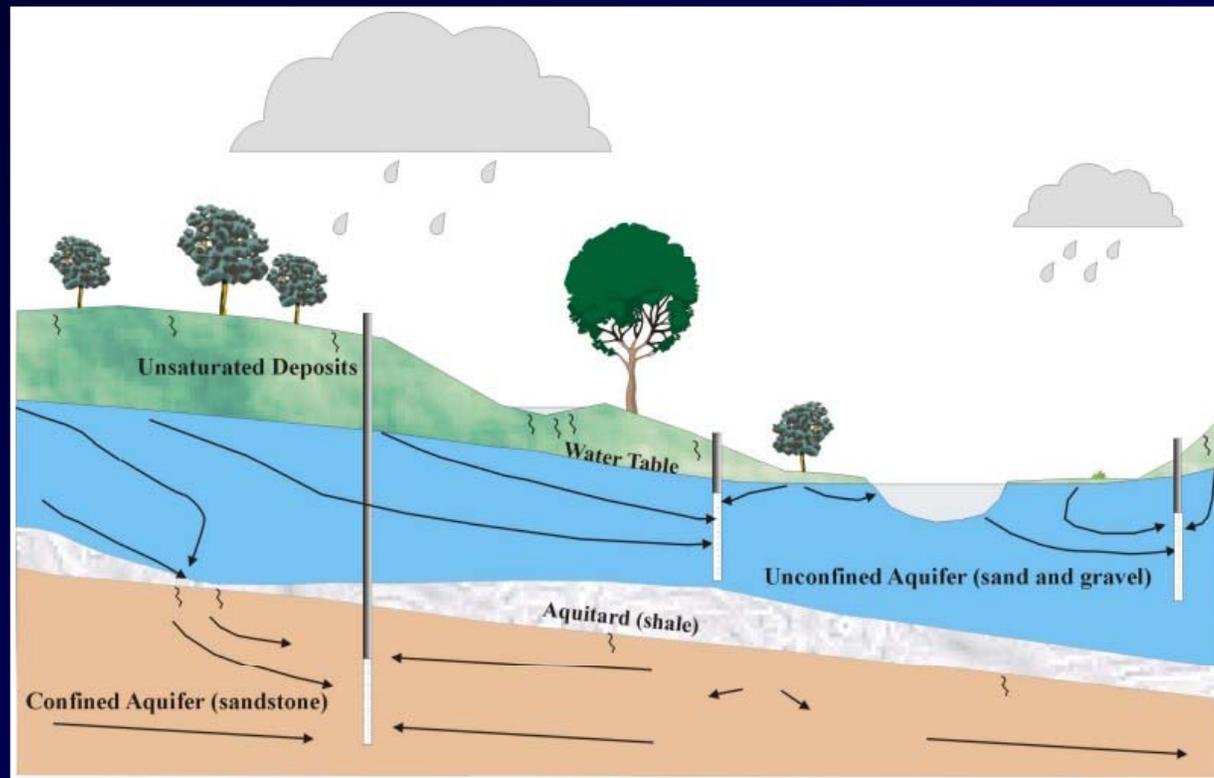
Well logs available for 104 of 295 wells

Non-significant Factors

- Well distance to leachfield
- Elevation of leachfield in relation to well
- System age
- Soil saturated hydraulic conductivity

Significant Factor

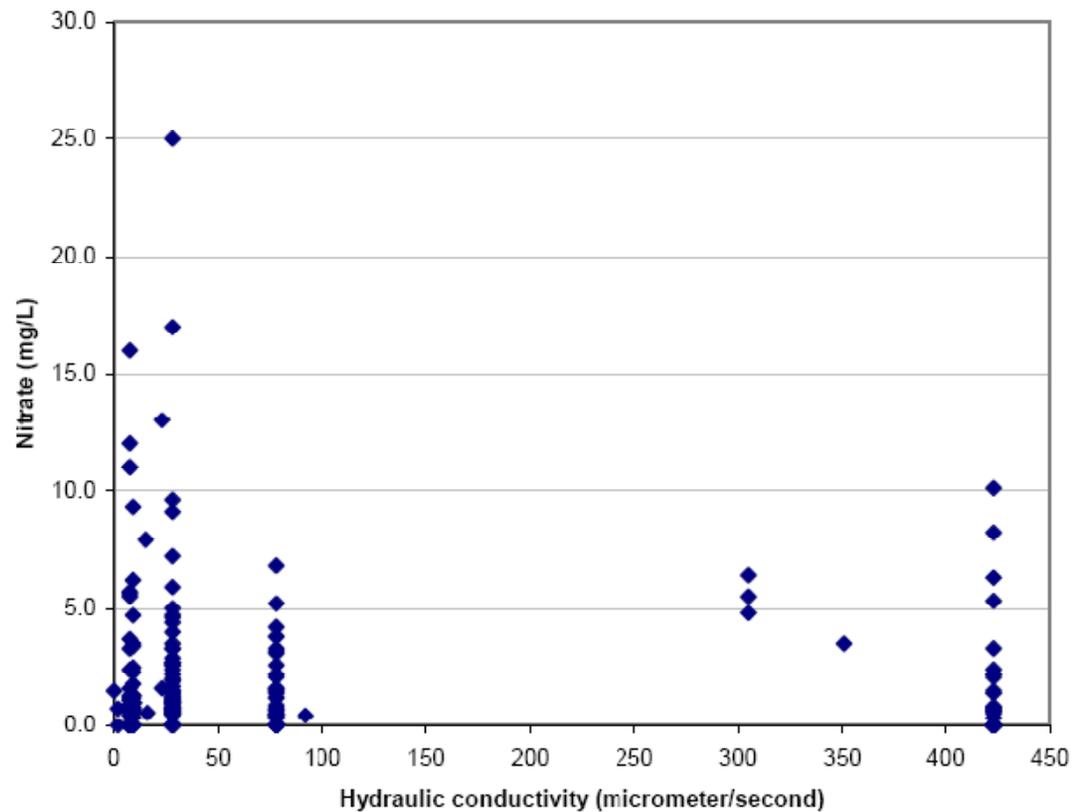
- Well depth



Hydraulic Conductivity

Saturated hydraulic conductivity of leachfield and nitrate level of water

n=221



Lessons Learned

- **Scheduling**
 - Dedicated staff
 - Open-ended vs. appointment with homeowner
- **Homeowner's knowledge**
 - May be limited or inaccurate
- **Consistency of data**
 - Field vs. GIS
- **Correlation of data with SEO database**

Report Conclusion

- ISDS have impacted groundwater
- Few wells above the health standard
- Model inputs need improvement
- Additional research beneficial



Further Research

- **Background levels of nitrate**
 - Prior to residential use of land
- **Field studies needed to refine model input parameters**
 - Aquifer characteristics
 - Denitrification rates in vadose zone
- **Monitoring**
 - Properly constructed monitoring wells
 - Ongoing monitoring

Summary/Review

- Study provided useful results
- Significant nitrate reduction occurring in vadose zone
- Increased level of confidence in water quality



Summary



- Factors not as significant as expected
- SEO well database needs to be updated
- More research & studies will improve understanding of ISDS impacts

Acknowledgements

- Adams County Commissioners
- Douglas County Commissioners
- Douglas County GIS Staff
- Colorado School of Mines
- Lara Juliusson, TCHD GIS Specialist
- TCHD Environmental Health Sampling Team
- TCHD Epidemiology, Planning, and Communications Staff
- Richard L. Vogt, MD, TCHD Executive Director
- Technical Staff at USGS, NRCS, and SEO

Thank You!

Questions?

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303-846-2013