



Impact of Long-Term Land Application of Poultry Litter on Groundwater Quality at Several Sites in Wilkes County, North Carolina

Shuying Wang, Don Geddes, and Ray Milosh

NC Division of Water Quality, Aquifer Protection Section
Piedmont and Mountains
Groundwater Resource Evaluation Program

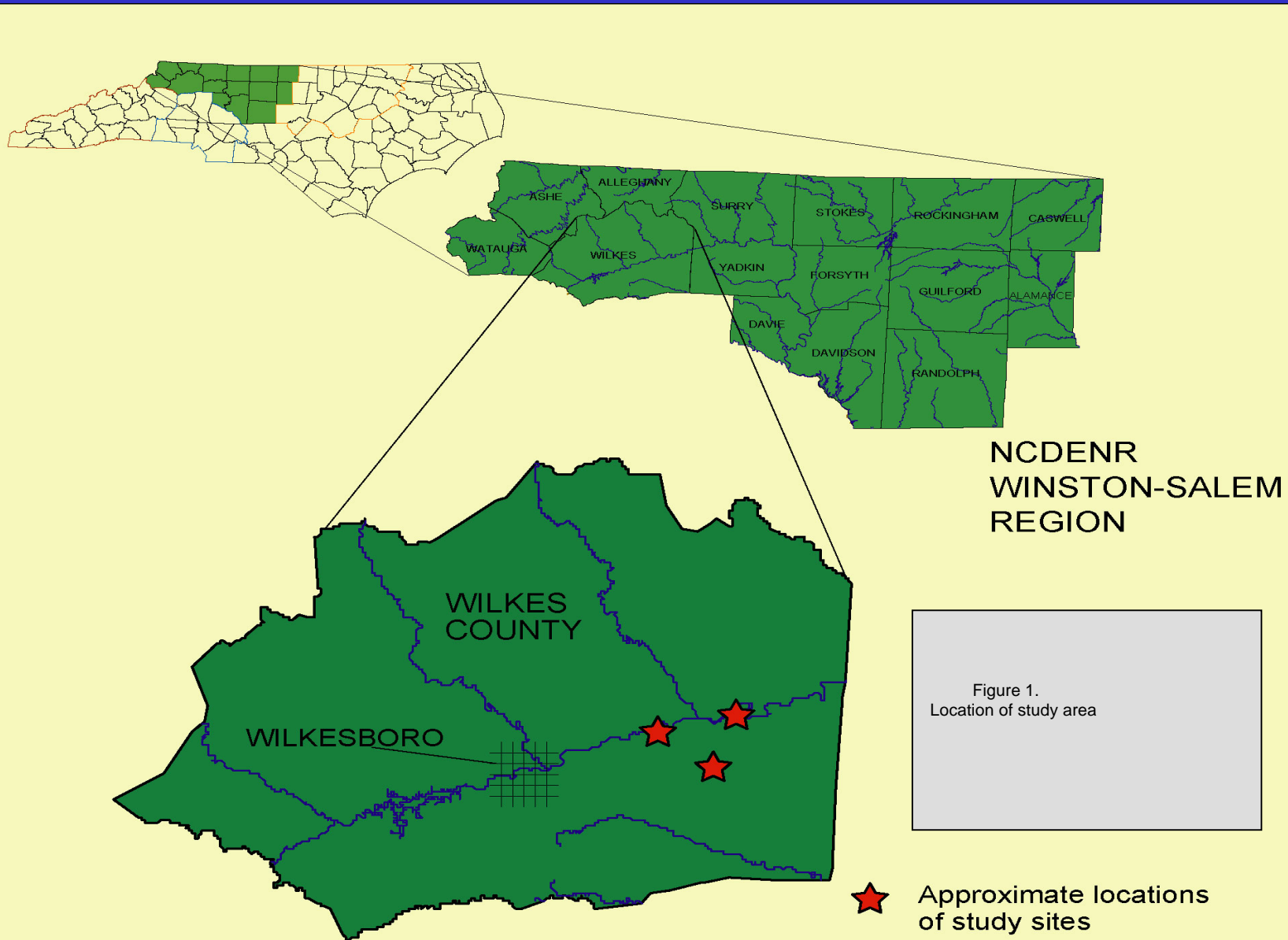
Poultry Litter and Disposal?

- The waste product composed of bedding material, manure, and uneaten feed from poultry houses is commonly referred to as poultry litter.
- It is typically disposed of through a land application process that takes advantage of the litter's nutrients to fertilize agricultural fields.

Reason for Investigation

- The impact of land application of poultry litter on ground water in North Carolina is a growing environmental concern.
- To address the public concern and to provide scientific data for policy makers to develop guidance for poultry litter land application.

Locations of Sites

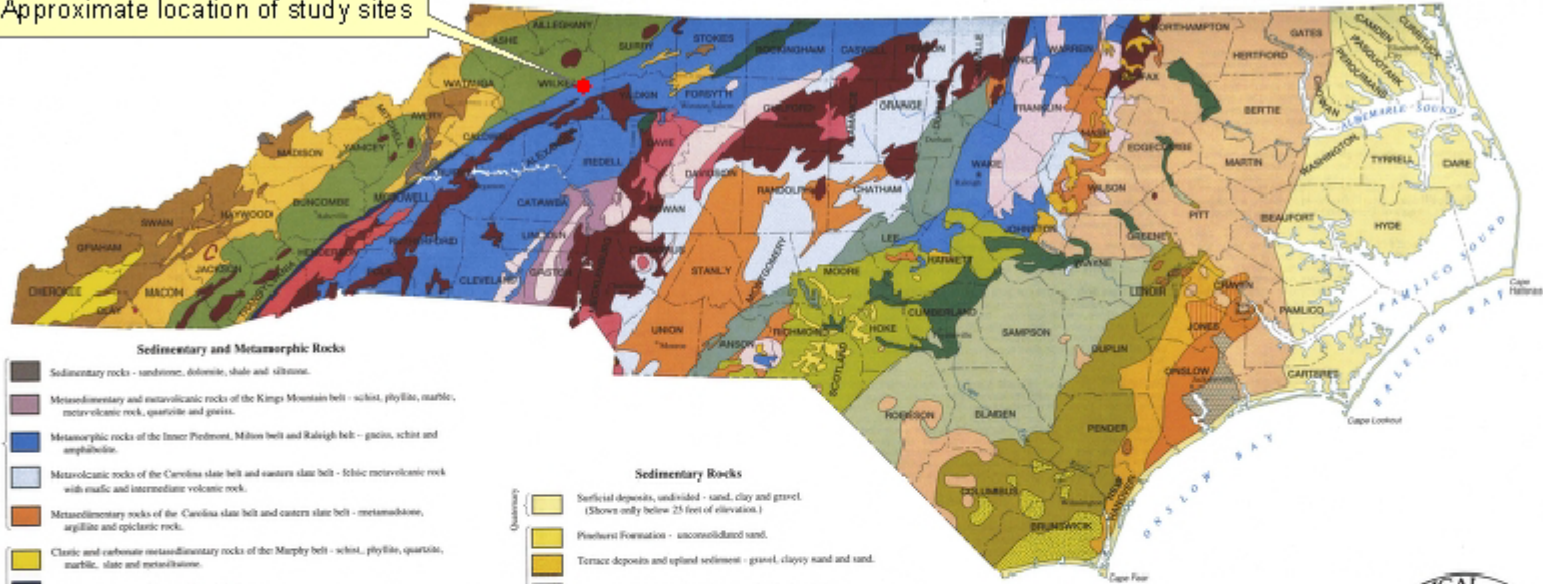


Description of Sites

- Located in the eastern part of Wilkes Co., NC
- Corn and/or small grains are cropped
- Pasture fields
- Chicken houses and other farm buildings
- Land application of poultry litter has been conducted at the sites for 20 - 30 years, at most - twice a year, with application rates of 2 – 6 tons per acre per application or per year.
- Physiographical setting varies: floodplain, low to mid terraces, and uplands
- Soil types include: Toccoa, State, Pacolet, Masada and Dogue series.
- Geologically located within Inner Piedmont belt separated by the Brevard Fault zone from the Blue Ridge

GENERALIZED GEOLOGIC MAP OF NORTH CAROLINA

Approximate location of study sites



Sedimentary and Metamorphic Rocks

- Quaternary**
 - Sedimentary rocks - sandstone, dolomite, shale and siltstone.
 - Metasedimentary and metavolcanic rocks of the Kings Mountain belt - schist, phyllite, marble, metavolcanic rock, quartzite and gneiss.
 - Metamorphic rocks of the Inner Piedmont, Milnes belt and Raleigh belt - gneiss, schist and amphibolite.
 - Metavolcanic rocks of the Carolina slate belt and eastern slate belt - felsic metavolcanic rock with mafic and intermediate volcanic rock.
 - Metasedimentary rocks of the Carolina slate belt and eastern slate belt - metabasalt, argillite and ophiolite rock.

- Tertiary**
 - Clastic and carbonate metasedimentary rocks of the Murphy belt - schist, phyllite, quartzite, marble, slate and metabasalt.
 - Brevard fault zone - schist, exarble and phyllonite.
 - Clastic metasedimentary and metavolcanic rocks of the Ocoee Supergroup, Grandfather Mountain Formation, Mount Rogers Formation and quartzite of the Sawtooth Mountains anticlinorium - slate, metabasalt, schist, metagraywacke, calc-silicate gneiss, quartzite and felsic metavolcanic rock.

- Triassic**
 - Clastic metasedimentary rock, and mafic and felsic metavolcanic rock of the Ashe Metamorphic Suite, Tallulah Falls Formation and Alligator Back Formation - gneiss, schist, metagraywacke, amphibolite and calc-silicate gneiss.

- Jurassic**
 - Felsic gneiss derived from sedimentary and igneous rocks in the northern outcrop area; biotite gneiss in the southern outcrop area; locally migmatite and mylonite. Locally and variably interlayered with amphibolite, calc-silicate granulite and rare marble, intruded by Late Proterozoic mafic and felsic phases.

- Crinoid**
 - Intrusive Rocks**
 - Gneissic rocks - foliated to weakly foliated.
 - Syenite - Concord ring dikes.
 - Metamorphosed gabbro and diorite - foliated to weakly foliated.
 - Metamorphosed granitic rocks - foliated to weakly foliated; locally migmatite.
 - Henderson Gneiss - uneven-grained monzonitic to granodioritic.
 - Meta-ultramafic rocks.

Sedimentary Rocks

- Quaternary**
 - Sedifical deposits, undivided - sand, clay and gravel. (Shows only below 25 feet of elevation.)
 - Pinehurs Formation - unconsolidated sand.
 - Terrace deposits and upland sediments - gravel, clayey sand and sand.
 - Waccamaw Formation - fossiliferous sand with silt and clay.
 - Yorktown Formation and Duplin Formation, undivided - Yorktown Formation - fossiliferous clay and sand. Duplin Formation - shelly sand, sandy marl and limestone.
 - Belgrade Formation, undivided - Pollockville Member - oyster-shell mounds in sand, marl. Haywood Landing Member - fossiliferous clayey sand.
 - River Bend Formation - sandy, molluscan-mold limestone.
 - Castle Hayne Formation - Spring Garden Member - molluscan-mold limestone.
 - Confort Member and New Hanover Member, undivided - Confort Member - limestone with bryozoan and radiolarian skeletons. New Hanover Member - phosphate-pebble conglomerate.
 - Beaufort Formation, undivided - Unnamed upper member - glauconitic, fossiliferous sand and silty clay. Jericho Run Member - siliceous mudstone with sandstone lenses.

- Tertiary**
 - Proctor Formation - marine sand, clayey sand and clay.
 - Black Creek Formation - lignitic sand and clay.
 - Middlewell Formation - sand, sandstone and clay.
 - Cape Fear Formation - sandstone and sandy mudstone.

- Triassic**
 - Dan River Group, undivided - Snowville Formation - conglomerate, sandstone and mudstone. Crow Branch Formation - mudstone. Pine Bluff Formation - sandstone, mudstone and conglomerate.
 - Chatham Group, undivided - Sanford Formation - conglomerate, sandstone and mudstone. Curmeck Formation - sandstone and mudstone. Polk Formation - conglomerate, sandstone and mudstone.



1991
Reprinted, 1996

Methods of Investigation

- Soil Boring/Coring and Monitoring Well Installation
- Soil and Water Quality Sampling
- Slug Tests and Water Level Measurements
- Soil Description and Soil Saturated Hydraulic Conductivity Tests
- Questionnaire

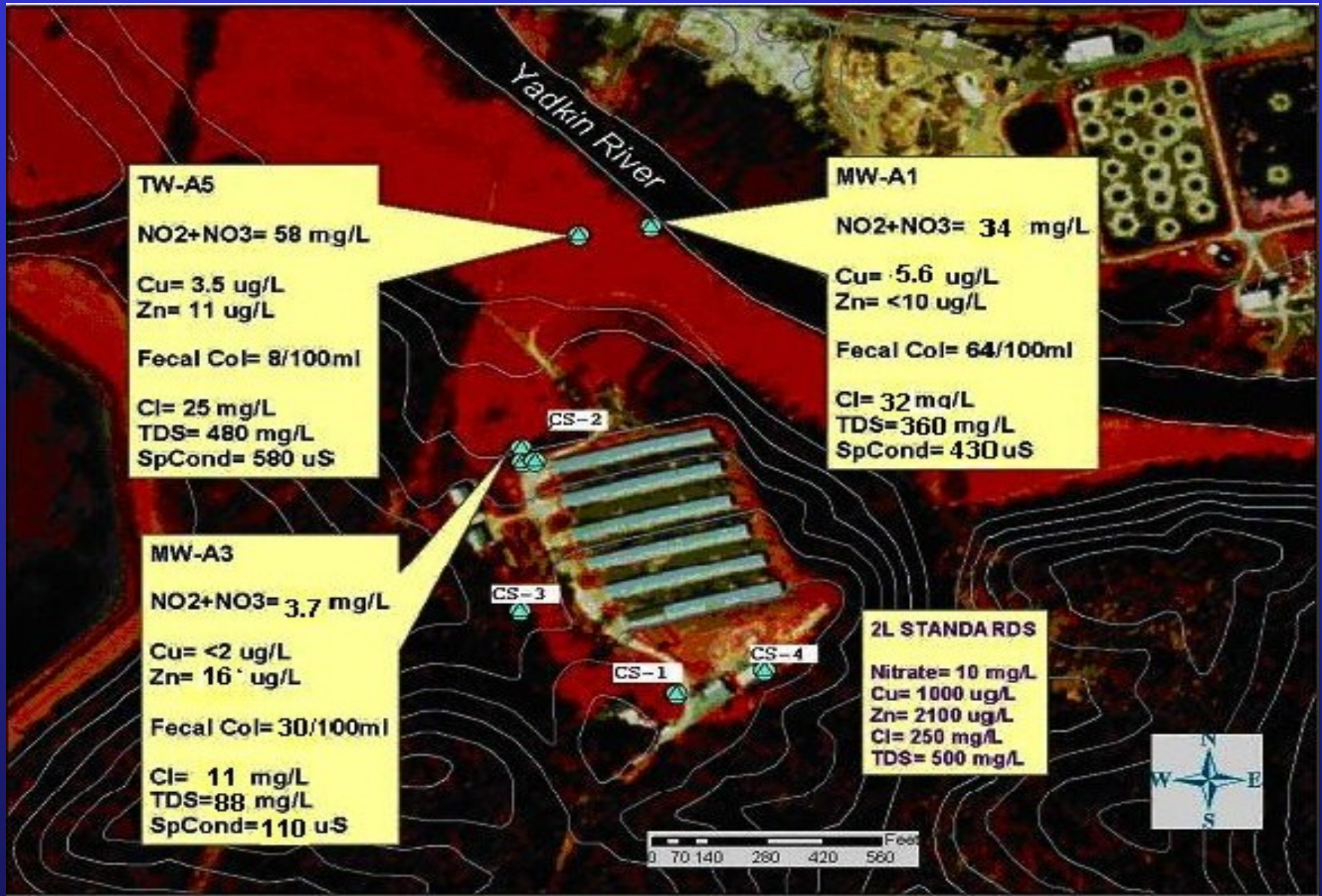
Results and Discussion

- Accumulations of P, K, Cu, and Zn in soil above the NCDA Alert Levels were detected. The accumulations occurred within 1-2 feet of the surface. Only one sample showed Cu concentration above its Critical Toxic Level, 3000 Cu-I or 60 ppm.
- Zn is only element that was detected in the surface water above North Carolina surface water quality standard; high level of fecal coliform (up to 2600 colonies/100 ml) and low levels (but above national background in stream) of nutrients, NH_3 , TKN + NO_2 + NO_3 , Total P, were also detected in the creeks.

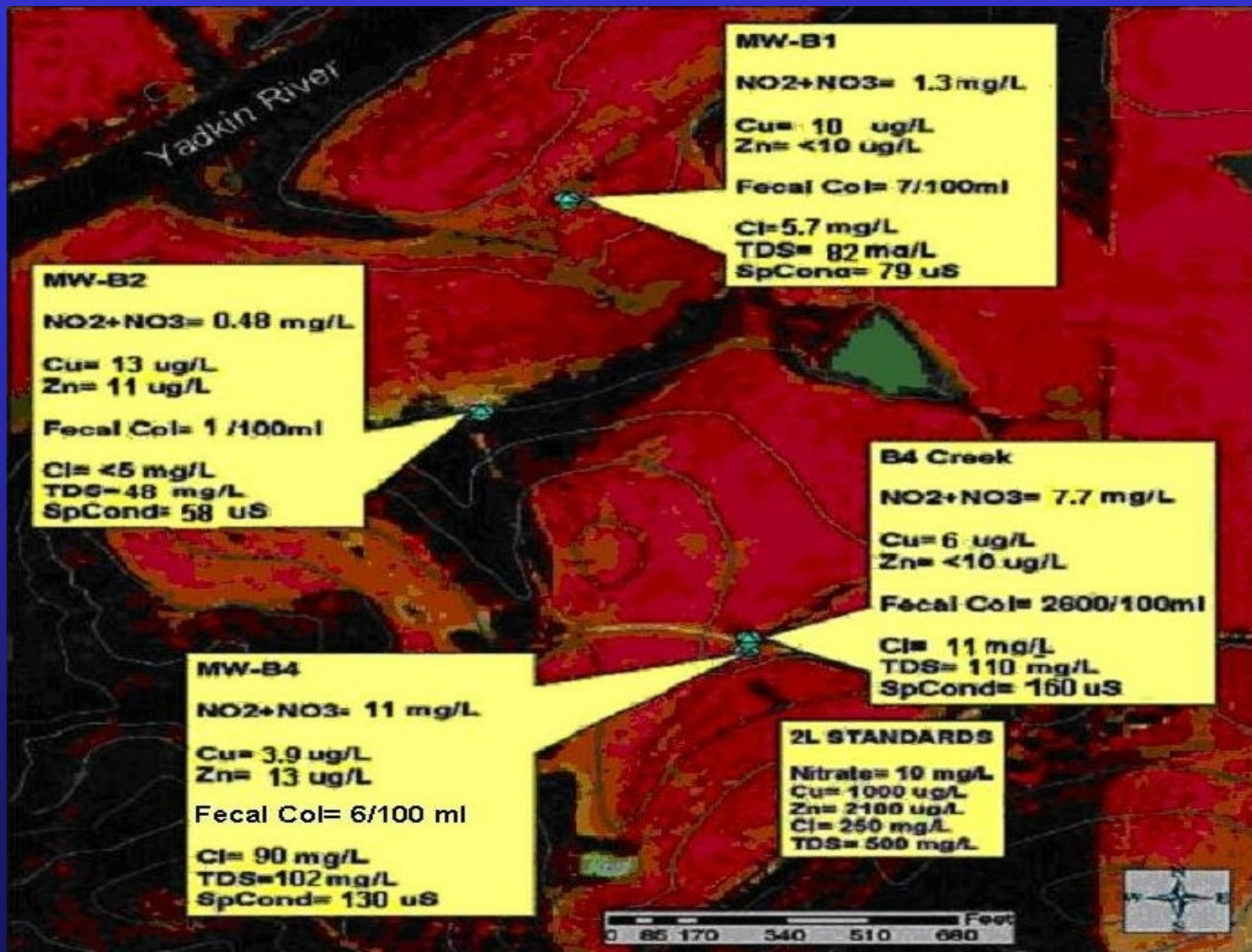
Results and Discussion (continued)

- Concentrations of $\text{NO}_2 + \text{NO}_3$ as N and fecal coliform exceeding 15A NCAC Subchapter 2L, Classification and Water Quality Standards Applicable to the Groundwaters of North Carolina were detected in the ground water.
- No heavy metals were detected above 2L standards in the ground water.

Site A



Site B



Site C

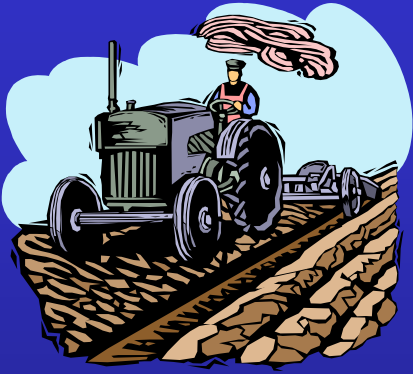


Conclusion

- The groundwater quality data at the three study sites suggest that there may have been nitrogen and fecal coliform impacts due to long-term land application of poultry litter.
- Metals from poultry litter appear to have little or no impact on the groundwater quality at the three study sites.
- Concentration of N appears to have a positive correlation with TDS and SC.

Conclusion (continued)

- Application rates may not be conservative enough to protect the ground water from impacts due to poultry litter application.
- Applications rates should be monitored. Closer attention should be paid to crop's nutrient uptake capabilities when determining the proper application rates.



THE END

Thank You!

