

Proposed Regional Synthesis Report

Glacial Deposit, Cambrian/Ordovician, and New England Crystalline Aquifer Systems

Proposed Title: Nutrients and pesticides in ground water supplying domestic wells within the glaciated area of the United States

Scope (NAWQA components / constituents): This study focuses on nutrients and pesticides in domestic water supplies in the glacial deposit aquifer system sampled by NAWQA from 1991 to 2004. Drinking-water use in rural agricultural areas, of which an estimated 90% is ground water from domestic supplies, is most susceptible to pesticide and nutrient contamination because of the surrounding agricultural land use. The water quality in domestic supplies will be compared to water quality in public-water supplies sampled by NAWQA in the glacial deposit aquifer system during 1991-2004. Water quality may differ as public water-supply wells produce much larger yields and usually are deeper than domestic wells. The water quality in domestic supplies also will be compared to water quality in samples from shallow monitoring wells. Water from these shallow wells is recently recharged ground water that may become the source for domestic and public supplies as ground water moves through the glacial deposit aquifer system. This tiered approach assesses the source (recently recharged ground water) and receptors (domestic and public supplies) for drinking water.

Often consumers have a choice in the glacial deposit aquifer system to obtain water from the glacial deposit aquifer system or drill deeper to other underlying principal aquifer systems, such as the Cambrian-Ordovician or New England Crystalline aquifer system. This study will compare the water quality from the entire ground-water system underlying the glaciated area of the northern United States.

Study Units: There are 18 NAWQA study units in the glaciated area that are part of this study. These study units have performed water-quality analysis of 469 domestic wells, 99 public water supplies, and 1,116 shallow monitoring wells in the glacial deposit aquifer system. Data have been retrieved for all wells sampled by NAWQA within the glacial deposit, Cambrian-Ordovician, and New England Crystalline aquifer systems of the northern United States as of June 2004.

The following is the distribution of analysis by water use within the glacial deposit aquifer system:

STUDY UNIT																			
ABBREV.	ALMN	CCYK	CNBR	CONN	COOK	DELR	EIWA	HDSN	HPGW	LERI	LINJ	LIRB	NECB	PUGT	REDN	UIRB	UMIS	WHMI	WMIC
DOMESTIC	30	21	0	28	22	12	32	1	30	48	1	54	0	32	50	50	3	31	24
PUBLIC																			
SUPPLY	0	0	0	15	9	0	0	8	15	4	0	2	29	1	1	0	0	15	0
UNUSED	0	53	31	160	0	1	88	52	0	60	0	57	29	62	107	56	95	177	88

The following is the distribution of analysis by water use within the Cambrian-Ordovician aquifer system:

Study Unit	WMIC	UMIS
Domestic	21	49
Public Supply	6	0
Unused	0	0

The following is the distribution of analysis by water use within the New England Crystalline aquifer system:

Study Unit	CONN	LINJ	NECB
Domestic	27	28	58
Public Supply	0	0	0
Unused	0	0	0

Time period: 1991- 2004

Land use(s): Not relevant although most domestic supplies are rural.

Is this an inter-regional proposal? Yes

Expected authors – Lead: Kelly Warner

Contributing: Terri Arnold

Objectives:

- 1. Determine frequency and occurrence of nutrients, pesticides, and their relations with selected chemical and physical parameters in water from domestic-supply wells.**
- 2. Determine the relation of water quality among domestic and public supply as well as recently recharged ground water.**
- 3. Determine the differences in domestic well water quality between three principal aquifer systems (glacial deposit, Cambrian/Ordovician, and New England Crystalline) within the extent of the glaciated area.**

Data interpretation approach & feasibility

Number of sites / components (eg: nutrients, pesticides): Multi-study-unit network for nutrients, pesticides, and ancillary data, from all domestic wells in glaciated areas, including bedrock wells open to the Cambrian-Ordovician and New England Crystalline aquifer systems. There are 469 domestic, 99 public water supplies, and 1,116 monitoring wells (538 recently recharged ground water) open to the glacial deposits aquifer system with nitrate data. The pesticide data (based on atrazine) are almost as ubiquitous as nitrate with 424 domestic, 94 public supply, and 1054 monitoring wells having pesticide data.

Methods (standard? new?): Standard nonparametric statistical methods as described in Helsel and Hirsch (1995) will be used to explore relations within and among aquifer systems. Geostatistical relations will be explored using ordinary and co-kriging, and cluster analysis. Geostatistical data may involve cluster analysis and kriging where needed. Results will be compared to other results obtained concerning domestic supplies (DeSimone, Focazio, Moran, etc).

Data availability & processing: The data were retrieved from the NAWQA internal data warehouse in May and June 2004 by Terri Arnold. This is a static data set. The dataset and metadata will be available on the internal glacial deposits aquifer system Web page. The principal aquifer variable in the data warehouse was not sufficient for selecting wells to include in the glacial deposits aquifer system. Wells with any discrepancy in lithology, depth, or aquifer were verified with the study unit collecting the samples.

Staff availability: Yes.

Complexity: Low to medium. Statistical analysis should be straightforward, although new methods described in Helsel's book "Nondetects and Data Analysis" may be used for pesticide data. Geostatistical work may involve complex GIS methods such as Geostatistical Analyst.

Risks / contingencies: The risk is that the environmental characteristics that help determine the variability in pesticide and nutrient concentration may change so rapidly within glacial deposits that

without the 3-dimensional information on the geology over the entire glacial area there will be less explanatory power or extrapolation. The contingency would be to use site specific studies (flow path, TANC, or other) to fill in the gaps in knowledge of chemical transport with depth and geologic variability.

Other Program contacts: Leslie DeSimone (for her knowledge of the domestic water quality across the country), Mike Focazio (for his background and expertise in domestic and public drinking-water quality data from NWIS), Mike Moran (for his knowledge of public and domestic water-quality data collected by NAWQA), Norm Granneman (for his interest in the Great Lakes area), and many others. There are 40 people on the glacial deposits aquifer system contact list.

Outside USGS may include the Great Lakes Coalition, County Health Departments, National Groundwater Association, National Cancer Institute, and State and local agencies.

Expected Outcome: Pesticide and nutrient concentration and frequency are expected to vary in relation to chemical factors, physical factors, and regional area for domestic wells. The domestic wells open to the glacial deposits aquifer system are expected to be more susceptible to contamination from the land surface than public-supply wells because the wells are generally shallow and land-use practices surrounding domestic wells are less regulated. The degree of confinement in the glacial deposits aquifer system is expected to affect the detection frequency of pesticides, and differences in concentrations of ammonia and nitrate. It is expected that the glaciated deposit aquifer system data will differ in water quality compared to Cambrian-Ordovician and New England Crystalline aquifer systems data.

Why is this topic important to report on? No other agency reports on pesticides in drinking water for domestic supplies, although some State health departments require sampling for nutrients.

Further continued development and population growth in the glaciated areas will necessitate the need for water-use decisions based on water quality. The water-quality data need to be regionally evaluated to determine the potential availability of future use.

In this study area, there is often more than one productive aquifer from which to draw water for domestic supply. The question a private homeowner may have is "For water-quality purposes am I better off drilling my private well into the glacial deposits or the deeper bedrock aquifers?" Or "If I can only afford to drill in the glacial material then is the ground-water quality better if I drill deeper?" Because pesticides and nutrients are often the biggest issues in the rural domestic water supplies, a comparison of these constituents may help address this question.

Why does this topic need to be addressed now? A regional evaluation of the ground-water quality is necessary because of the increasing use of ground water by private domestic well supplies. Understanding the effect of pesticides and nutrients on drinking water for domestic supplies will help answer the question of "source-transport-receptor" by looking at the water quality in the receptor (domestic drinking water), and then addressing potential causal relations that may help explain the water quality.

Why is it appropriate for this topic to be addressed by USGS? NAWQA? This Regional Team? This is the one population (domestic users) that has no national or regional monitoring program to address water-quality issues. This is the gap that NAWQA fills. NAWQA now has the data available in a large regional scale at similar low-level reporting levels to help address some of the domestic drinking-water quality issues. Because much of the area overlying the glacial deposits aquifer system is agricultural, it makes sense that this principal aquifer team would address the constituents (nitrates and pesticides) of highest concern for the population most affected by these constituents.

Who cares and why?

Private citizens and Congress

Private citizens--The common sampling approach used by NAWQA and the unbiased interpretation of the data would help private consumers assess the overall effect of pesticides and nutrients in domestic water supplies. Consumer confidence in drinking water is decreasing because of unsubstantiated claims of contamination. An article from the Nebraska Water Center says that about 65 million reported not drinking tap water at all, some 24 percent of those surveyed. Reasons the survey found that people are more reluctant to rely on tap water is because of taste and smell (69 percent) and stories about pollution in the news (49 percent) http://watercenter.unl.edu/water_information/drinking/card.html

The use of mixing waters from different depths and/or from different aquifers to obtain drinking-water standards is becoming increasingly common. Knowing what pesticides, nutrients, and other compounds to expect under varying hydrologic conditions will become of increasing importance to water-suppliers.

Congress--This study will set the baseline for pesticides and nutrients in domestic supplies in these three principal aquifer systems based on all of Cycle I data. This baseline can be compared over time to help address the question of whether our Nation's water-quality is improving.