Volunteer Nitrate Monitoring Network: Methods and Results

Minnesota Department of Health
Environmental Health Division
Source Water Protection Unit
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Volunteer Nitrate Monitoring Network: Methods and Results Summary

Drinking water quality is a concern across southeastern Minnesota, where nitrate loading to the subsurface can be significant and hydrogeologic sensitivity varies between low and very high. Yet there are few services available for domestic supply well owners who are concerned about their drinking water quality. In 2008, the Southeast Minnesota Water Resources Board (SEMNWRB), and several partners (Minnesota Pollution Control Agency, MPCA; Minnesota Department of Agriculture, MDA; Minnesota Department of Health, MDH) began collecting data from the "volunteer nitrate monitoring network" (VNMN). This network of 675 domestic drinking water wells, representing a stratified-random distribution across nine counties (Figure 1) and several aquifers, was designed to provide nitrate concentration data to answer the question "what is the quality of water that people are drinking?"

Before data collection began, well network coordinators (county staff) enrolled volunteers (well owners) into the program by collecting detailed information about well location, well construction, and nearby nitrate sources. Volunteers collected six rounds of samples, from February 2008 to August 2011 (funding remains for a seventh and final sampling round in August 2012).

This report summarizes project results to-date, and consists of two sections: 1) a summary of the method MDH used to assess wells brought into the network, and 2) an assessment of nitrate results to-date. Some material discussed below was previously presented in the SEMNWRB report (2009).

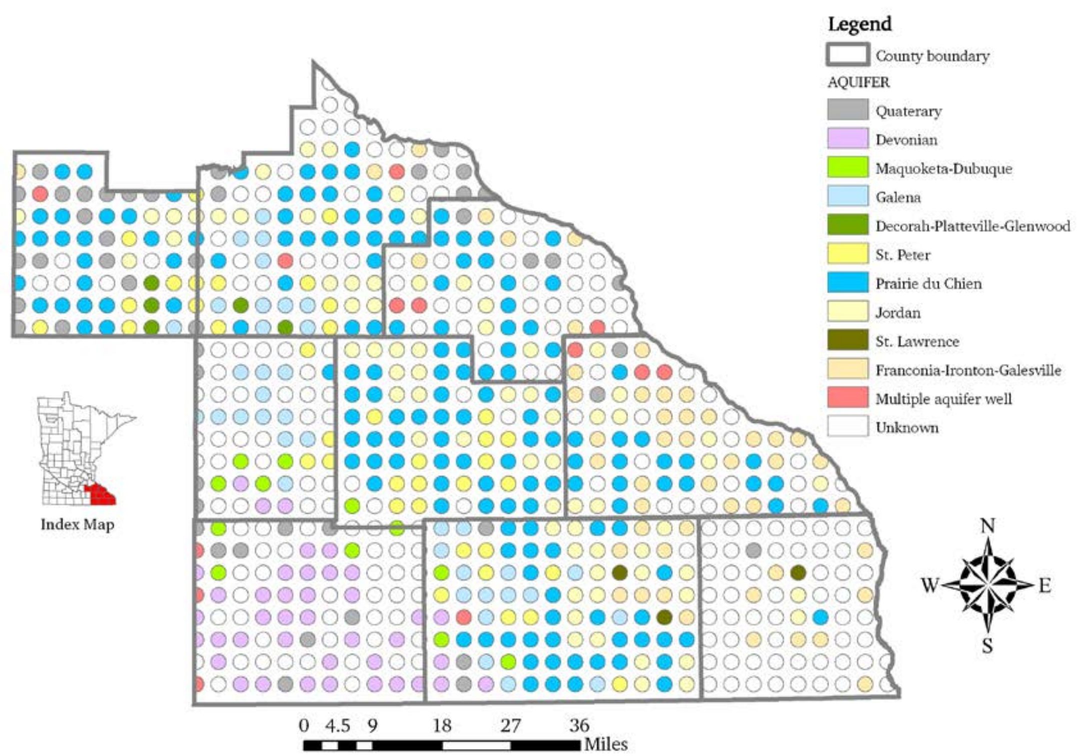
Assessing Wells Enrolled In the VNMN Network

This report section describes the supporting field information collected by the well network coordinators, and the assessment MDH performed on each well brought into the study.

Supporting Information Supplied for Well Enrollment

Nitrate data is interpreted in the context of well completion and geology; however, due to the method of well selection, this information was unavailable for 153 wells in the network. For this reason, MDH provided the well network coordinators with several documents (see Appendices) to support the collection of the greatest possible amount of information about each network well. Three of these documents were forms designed to be completed at the time of enrollment.

Figure 1: Southeast Minnesota Volunteer Nitrate Monitoring Network
Buffer Locations and Aquifers of Completion



Well Information Form

- Optimally, the Well Information Form records the unique number of a well enrolled in the VNMN. If available, the unique number of a well is the means through which the County Well Index database (CWI) provides known well construction and geologic information.
- If the unique number was unavailable, the well coordinator used the Well Information Form to record additional information in support of an interpretation of well completion (depth, aquifer). The additionally collected information included: well depth, identity of other wells present on the same property, drinking water treatment, and other unusual properties (cloudiness, odors, etc.).

Potential Nitrate Source Inventory Form

- The Potential Nitrate Source Inventory Form recorded information about potential nitrate sources within 200 feet of the well, including: source type, source direction, and distance from well.

Geographic Positioning System (GPS) Waypoint Log

- o The GPS Waypoint Log recorded waypoint numbers and unique numbers of enrolled wells. MDH received this completed form to verify transmitted GPS coordinates of enrolled wells.

MDH also provided well network coordinators the following instructions and fact sheets to guide the collection of information at the time of volunteer enrollment. Selected documents are available from MDH:

- Overview of well construction and aquifers in southeastern Minnesota
- Summary of procedures for collecting well information during a site visit
- Procedure for collecting data using a Garmin GPS 12 receiver (modified from Minnesota Department of Agriculture information)
- Instructions for downloading, processing and editing Garmin 12 GPS waypoint data
- County-specific list of known but "unlocated" wells (locations not verified)
- Maps (county highway maps for field use and backup)
- Water quality database for county (MS-Access)
- Nitrate data recording forms

MDH Assessment of Site Visit Data Received From Well Network Coordinators

Upon completion of the site visits, well network coordinators forwarded all the site visit information to MDH staff. MDH scanned these documents, returned the electronic files to the counties, and kept the originals.

The first step in assessing the site visit data was to determine wells lacking unique numbers. For each such well, MDH staff used CWI and the Geographic Information System database (GIS) to search for wells with unique numbers that could be the well recorded on the site visit form. If an existing well could be verified as the well recorded during the site visit, then the correct unique number, well construction data, and geologic data were retained. If no such well could be found, MDH staff assigned a unique number from the series "268XXX."

Next, MDH staff collated available location data (Universal Transverse Mercator coordinates, UTM) for each well. If there were no pre-existing coordinates, MDH staff assigned coordinates collected during the site visit. For wells with existing coordinates, MDH and Minnesota Geological Survey (MGS) staff determined which to retain, following established procedure.

The next step in assessing information collected during the site visit was to begin populating the project database with geologic and well data. For wells lacking either geologic or construction records (or both), a special step was required prior to data entry. Using an MDH extension to ArcMap, MDH staff constructed cross-sections using the nearest CWI wells for which geologic and well construction information were available to determine the likely aquifer of completion, if a study well lacked this information. For some wells (but not all), this step yielded a reasonable estimate of the completion of the well.

MDH staff entered the geologic and well data for each well into the database as follows (bold items are the field names of the project database).

- The **INFO** field recorded the confidence level of the geologic and well construction data.
  - *INFO = 2* for wells with both geologic and construction logs.
  - *INFO = 1* for wells lacking geologic and/or construction logs, but a reasonable estimate of aquifer completion was possible using recorded data on the Well Information Form and the ArcMap cross section tool.
  - *INFO = 0* for wells where no such estimate was possible.

- The **AQUIFER** field recorded the aquifer supplying most of the water to the open interval of the well.
  - If *INFO = 2*, the AQUIFER field contained the same information as the AQUIFER field in CWI.
  - If *INFO = 1*, the AQUIFER field entry was determined through cross-section (described above).
  - If *INFO = 0*, the AQUIFER field was left blank.

- The **MATRIX** field recorded the primary matrix type of the open interval of the well.
  - *MATRIX = S* if solution-weathered bedrock (limestone or dolomite).
  - *MATRIX = C* if clastic bedrock.
  - *MATRIX = B* if both solution-weathered (S) and clastic (C) bedrock.
  - *MATRIX = Q* if clastic unconsolidated material.
  - *MATRIX = L* if low permeability material.
  - If *INFO = 0*, the *MATRIX* field was left blank.

- The **PROTECTION** field recorded whether the well was drilled in a protected geologic setting.
  - *PROTECTION = Yes* if there was at least ten continuous feet of (unmodified) clay or shale (not including the interval from ground surface to ten feet), consistent with the DNR standard* (1991).
  - *PROTECTION = Yes* if a conventionally-accepted regional bedrock confining layer was present, as per the Minnesota water well construction code.*
  - *PROTECTION = No* for all other conditions.

    * See "References."

- The **WELLCODE** field recorded whether the placement of grout in the annular space was documented, consistent with requirements of the Minnesota Water Well Construction Code.
  - *WELLCODE = Yes* if grout placement was documented.
  - *WELLCODE = No* for all other conditions.

- The **RECHARGE2WELL** field recorded whether surface drainage was toward the well casing.
  - *RECHARGE2WELL* = *Yes* if surface drainage was toward well casing.
  - *RECHARGE2WELL* = *No* for all other conditions.

Based on information recorded on the Well Information Form, MDH staff made any necessary changes to CWI entries for owner name, owner address, aquifer designation, or other fields. MDH staff also entered the project and buffer number in the "Alternate ID" window of CWI.

Collection, Transmittal and Recording of Nitrate Data

The formal collection and analysis of groundwater samples for nitrate began with the February 2008 sample (Round 1). Well network coordinators mailed sampling supplies to well owners, who collected samples from their own wells, preserved them by freezing, and returned them by U.S. mail. The well network coordinators then analyzed each sample using a Hach 4000 tabletop nitrate analysis device, and recorded results on forms transmitted to MDH. Quality assurance/quality control (QA/QC) samples were collected for laboratory analysis for nitrate at an approximate rate of ten percent (not discussed in this report). Finally, MDH staff collated and entered the transmitted nitrate data into the project database.

MDH Assessment of Nitrate Results

The following sections briefly summarize the MDH assessment of the data collected to-date (early 2012) for this project. The discussion considers only wells that were part of the randomly-selected population of "grid" wells. Results from other wells sampled during this study ("baseline" and "targeted" wells) will be reported elsewhere when available.

Volunteer Participation Rate

The initial well selection grid consisted of 675 uniformly spaced search areas; no participant was identified for some search areas. The highest sample return rate was 76.9 percent (519; Round 1, February 2008; Table 1). After Round 1, the sample return rate steadily dropped to a low of 62.2 percent (420 samples; Round 5, August 2010), before rebounding slightly to 63.0 percent (425 samples; Round 6, August 2011). Possible reasons for declining return rates include:

- Loss of interest, particularly if the nitrate concentrations were unchanging over time;
- New well ownership by disinterested citizen;
- Well replacement due to elevated initial nitrate result. (If owner sampled a different well without reporting the change, an apparent change in nitrate concentration could be the result).

Table 1: Volunteer Participation Rates, Rounds 1 - 6

	Round 1 February 2008	Round 2 August 2008	Round 3 February 2009	Round 4 August 2009	Round 5 August 2010	Round 6 August 2011
Number of Samples Returned[1]	519	510	494	471	420	425

[1] The tally only includes results from locations where no change in the well sampled was reported for any sampling round (no replacement wells during the course of the study). The same condition applies throughout this report.

Physical Controls on Nitrate Concentration

The two primary categories of physical control on nitrate concentration are hydrogeologic setting and well construction. Because variations in median nitrate concentrations over time were small, this assessment only considers February 2008 (Round 1) results, which had the greatest number of returned samples. Round 1 was a winter sampling date when vadose zone recharge and nitrate loading are assumed to have been minimal, and the results likely represent baseline conditions.

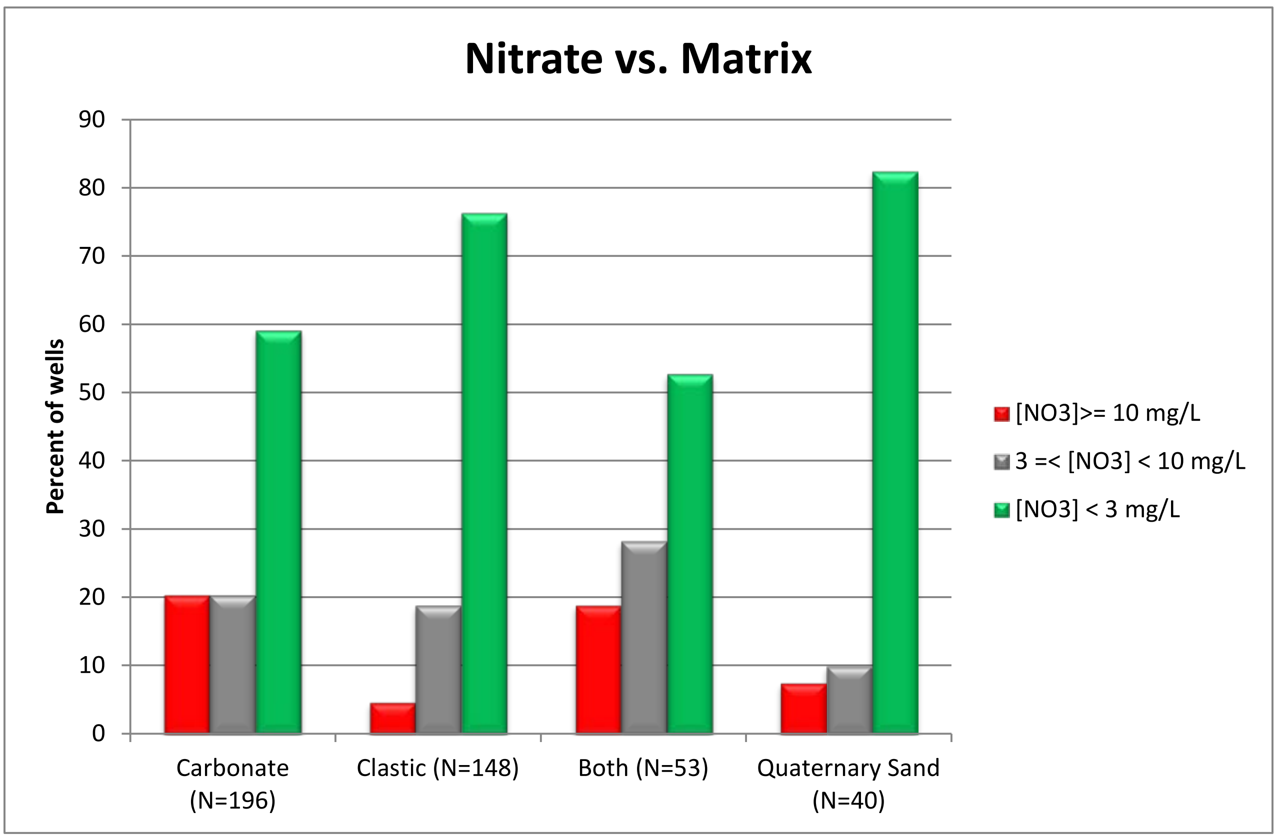


Figure 2 - Chart compares the percentage of wells completed in each matrix type that have high (red), medium (gray), or low (green) nitrate concentrations. Nitrate concentrations for wells completed in low permeability aquifers (N=6) are not shown.

Nitrate and Matrix

In Figure 2, Round 1 nitrate concentrations are shown in comparison to aquifer matrix type: carbonate bedrock (limestone or dolomite); clastic bedrock (sandstone); both carbonate and clastic bedrock; or quaternary sand (few wells were completed in a fifth category, low-permeability aquifers). The bars represent the percentage of wells of each matrix type that fell into each of three concentration categories: high (nitrate concentration greater than or equal to 10 mg/L); moderate (nitrate concentration greater than or equal to 3 mg/L but less than 10 mg/L); and low (nitrate concentration less than 3 mg/L). For all matrix types, low nitrate concentrations were measured for a high percentage of the wells (52.8 - 82.5 percent). However the greatest percentages of moderate-to-high nitrate concentrations were measured in wells completed in carbonate aquifers, or combined carbonate-clastic aquifers (e.g., Prairie du Chien-Jordan Aquifer). In addition, the percentages of wells completed in clastic bedrock (only) or unconsolidated Quaternary sand aquifers that produced low nitrate concentrations were similar (76.4 and 82.5 percent, respectively). The results suggest that wells completed in carbonate bedrock (or combined carbonate-clastic bedrock) aquifers are likely to produce more moderate to high nitrate concentrations than wells completed in other types of aquifers.

Nitrate and Overlying Geologic Protection

Figure 3 depicts the relationship between Round 1 nitrate concentration and the presence or absence of overlying geologically-protective layers, such as shale or clay-rich glacial till. The bars over the label "Yes" indicate the percentage of the wells with geologic protection in each of the three nitrate concentration categories, and the bars over the label "No" show the same for wells lacking geologic protection. A majority (85.3 percent) of the wells with geologic protection had nitrate concentrations less than 3 mg/L. For wells lacking geologic protection, the proportion of wells with moderate or high nitrate concentrations nearly equaled the number of wells with low nitrate concentrations. This finding is evidence that the presence or absence of an overlying geologically-protective layer can strongly influence nitrate concentration in a drinking water well.

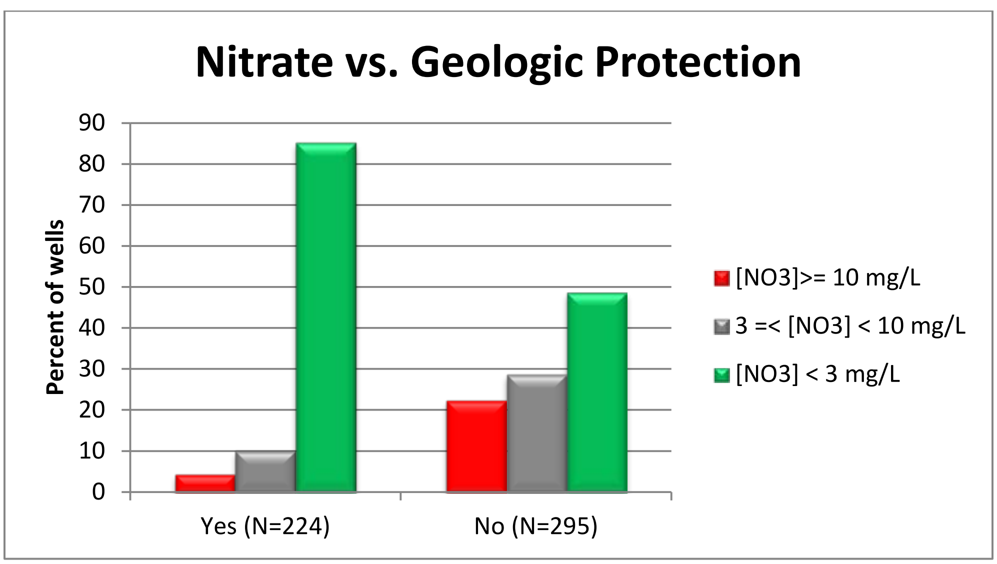


Figure 3. Chart compares the percentage of wells with and without geologic protection (see text) that have high (red), medium (gray), or low (green) nitrate concentrations.

Nitrate and Well Construction

The Minnesota Water Well Construction Code requires a grout seal within the annular space to prevent movement of water and contaminants down the casing and into a drinking water supply. However, improperly constructed wells and wells drilled before the well code was in effect (approximately 1974) may lack casing grout.

Figure 4 shows the relationship between Round 1 nitrate concentrations and the documented presence of casing grout. For properly constructed wells with casing grout, 92.9 percent of the wells had low nitrate concentrations, and none had high nitrate concentrations. Approximately 50 percent of the wells lacking grout (including wells where the placement of a grout seal could not be confirmed) had low nitrate concentrations, and the remainder had even proportions of moderate or high nitrate concentrations. Figure 4 is strong evidence that proper well construction excludes surface contaminants from groundwater.

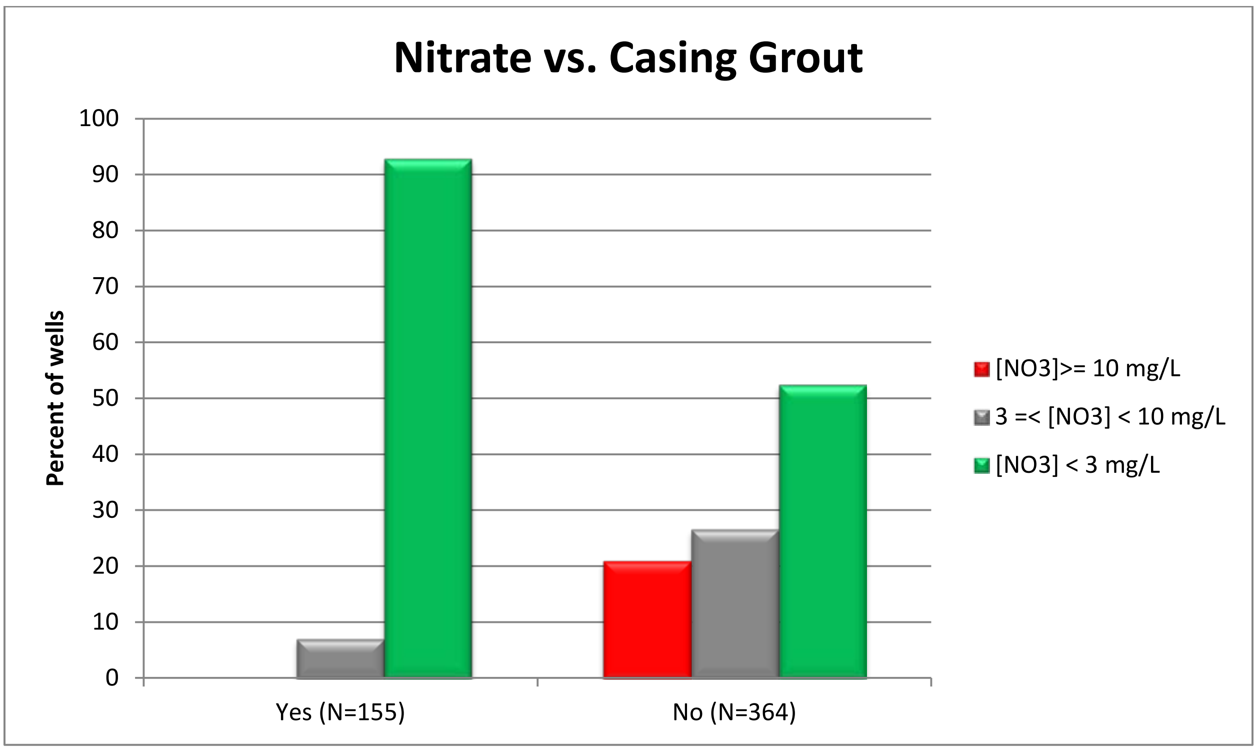


Figure 4. Chart compares the percentage of wells with and without casing grout (see text) that have high (red), medium (gray), or low (green) nitrate concentrations.

Nitrate and Surface Drainage Direction

Surface slope near the well is another physical factor accounted for in this study. If drainage is toward the well casing, surface contaminants may travel freely down the borehole and enter the well screen; the phenomenon is especially important if the well lacks casing grout. Figure 5 compares nitrate concentration and surface drainage direction. Low nitrate concentrations were measured in 51.6 percent of wells where surface drainage was towards the well, and in 67.5 percent of wells where surface drainage was away from the well. This result suggests that surface drainage affects groundwater quality, however it is a less important factor than casing grout or geologic protection.

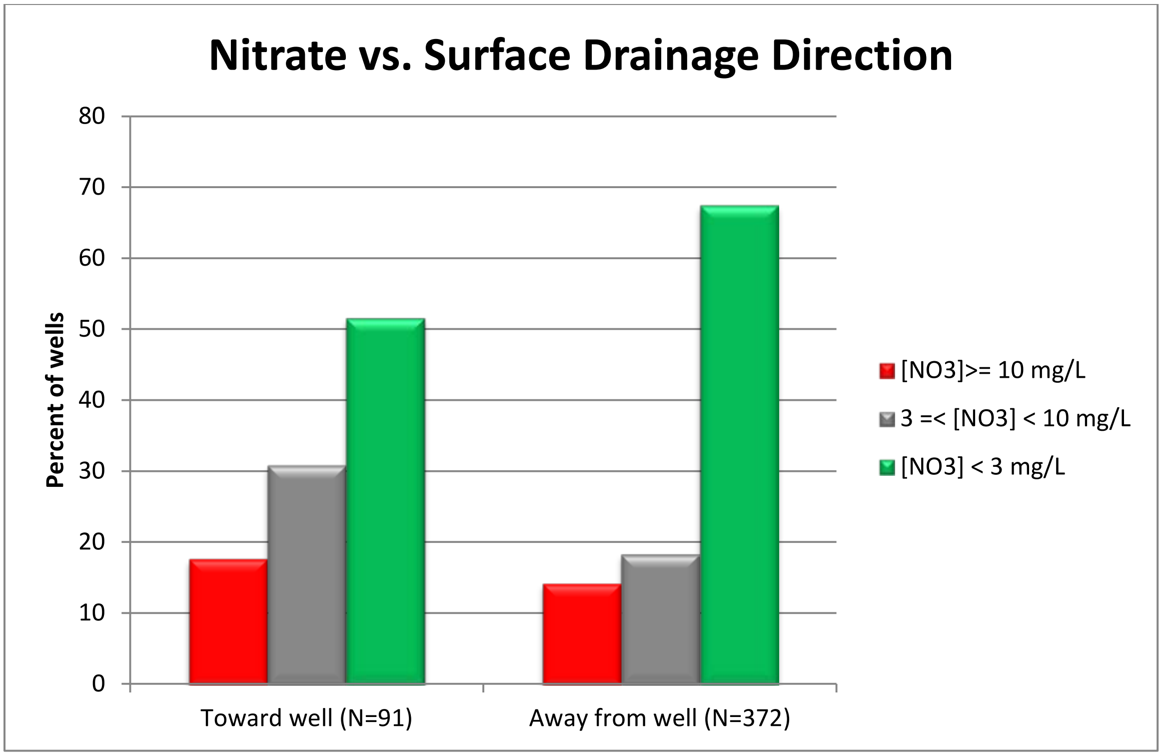


Figure 5. Chart compares the percentage of wells with surface drainage toward or away from well that have high (red), medium (gray), or low (green) nitrate concentrations.

Nitrate, Geologic Protection, and Well Construction

Figures 2-5 illustrate factors that affect water quality, as documented in this study. The two most clearly important factors were proper well construction (presence or absence of casing grout) and geologic protection. Figure 6 combines these two factors in comparison to Round 1 nitrate concentrations. Figure 6 shows that low nitrate concentrations occurred in 97.4 percent of the wells with both geologic protection and proper well construction, and there were no wells with high concentrations. Low nitrate concentrations occurred in 74.1 - 80.5 percent of the wells with only one of these two factors; high nitrate concentrations occurred in less than 10 percent of these wells. In wells lacking both casing grout and geologic protection (neither factor present), the three nitrate concentration categories (high, moderate, low) were approximately evenly distributed. Figure 6 is strong evidence that the best protection against unacceptably high nitrate concentrations in drinking water is proper well construction combined with a completion depth that benefits from overlying geologic protection.

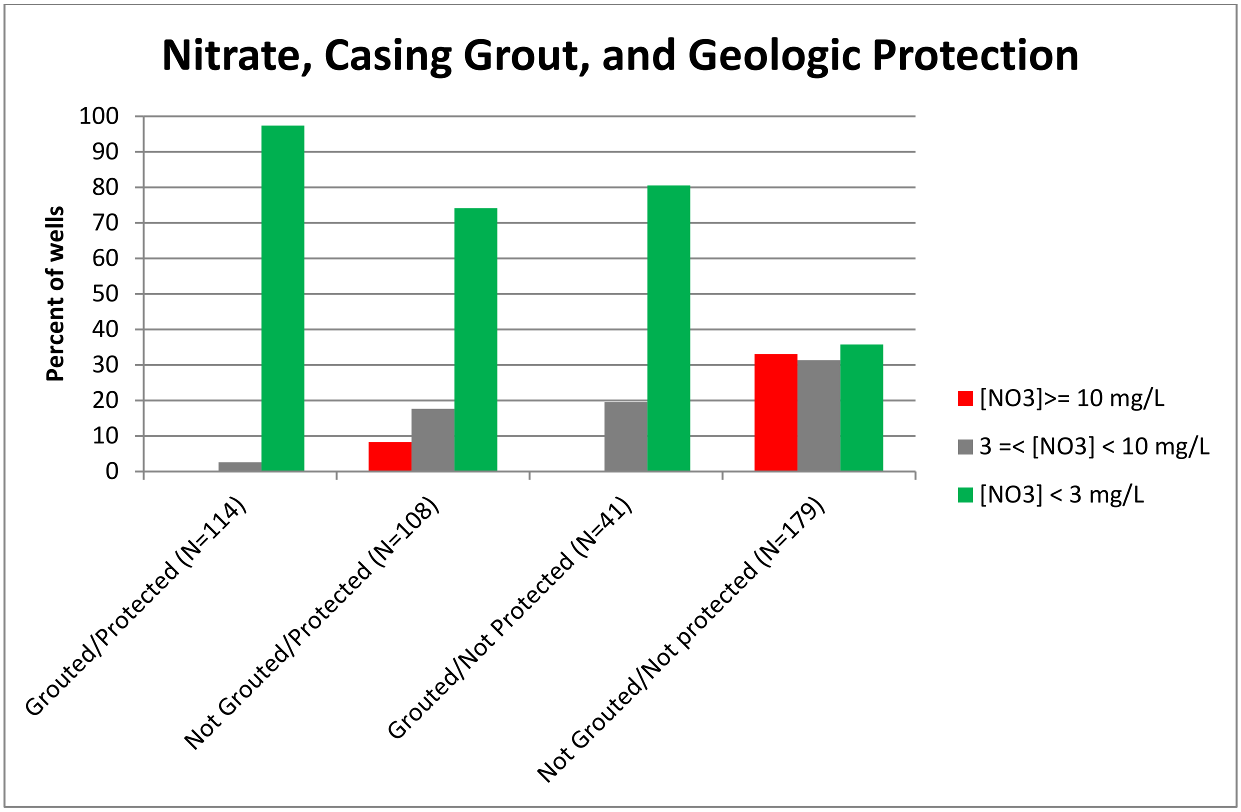


Figure 6. Chart compares percentages of wells with high (red), medium (gray), or low (green) nitrate concentrations for four well categories: both grouted and protected; protected but not grouted; grouted but not protected; and neither grouted nor protected.

The above assessment suggests how to bracket a description of the most and least desirable wells, based on factors evaluated above: aquifer matrix, the presence or absence of casing grout, the presence or absence of overlying geologic protection, and surface drainage direction. Table 2 accounts for these factors, showing median nitrate concentrations and percentages of wells in each of the three nitrate concentration categories. In this study, low nitrate concentrations were virtually assured in the most desirable wells (97.7 percent). Moderate to high nitrate concentrations were measured in 87.5 percent of the least-desirable wells. In addition, the median nitrate concentration for the least-desirable wells was two orders of magnitude greater than that for the most-desirable wells.

Table 2: Round 1 Nitrate Results for Most-Desirable and Least-Desirable Wells

Well	Matrix	Geologic Protection	Casing Grout	Surface Drainage	N	% Low	% Moderate	% High	Median $[NO_3]$ mg/L
Most-Desirable	C or Q	Yes	Yes	Away	43	97.7	2.3	0	0.1
Least-Desirable	S or B	No	No	Toward	24	12.5	37.5	50.0	10.4

Nitrate Concentration and Time

Table 3 shows that the percentage of wells exceeding the maximum contaminant level (MCL) for each sampling round decreased across a range of 14.6 - 9.3 percent, with a small increase in August 2011 (10.4 percent). Table 3 also shows round-by-round median nitrate concentration and the number and percent of samples exceeding the MCL of 10 mg/L. Median nitrate concentrations for all wells sampled were low, but increased slightly between February 2008 (0.3 mg/L) and August 2011 (0.5 mg/L). Winter median nitrate concentrations (February 2008 and February 2009) were stable (0.2 - 0.3 mg/L). Summer median nitrate (August 2008, 2009, 2010, and 2011) increased slightly from 0.3 mg/L to 0.5 mg/L. The analysis of median nitrate in Table 3 does not account for the effects of well construction and geology.

TABLE 3: Median Nitrate (mg/L) and Wells Exceeding MCL

	Round 1 February 2008	Round 2 August 2008	Round 3 February 2009	Round 4 August 2009	Round 5 August 2010	Round 6 August 2011
Median [NO_3]	0.3	0.3	0.2	0.3	0.7	0.5
Exceed MCL (Number)	76	58	55	52	39	44
Exceed MCL (Percent)	14.6	11.4	11.1	11.0	9.3	10.4

Table 4 shows changes in nitrate concentration with respect to time, casing grout, and geologic protection. The following bullet items summarize the data presented in Table 4.

- In grouted wells where geologic protection was present, median nitrate concentrations were low (0.0 mg/L to 0.1 mg/L) and lacked any trend over time.
- In wells lacking casing grout but possessing geologic protection, median nitrate concentrations were low (0.1 mg/L to 0.4 mg/L), with a slightly increasing trend over time.
- In wells with casing grout but lacking geologic protection, median nitrate concentrations were low (0.0 mg/L to 0.4 mg/L) and lacked any trend over time.
- In wells lacking both casing grout and geologic protection, median nitrate concentrations were moderate (4.3 mg/L to 5.2 mg/L), with a slightly increasing trend over time.
- In wells possessing either casing grout or geologic protection, or both, there was little difference between winter median nitrate (Rounds 1 and 3) and summer median nitrate (Rounds 2, 4, 5, and 6).
- However, in wells lacking both casing grout and geologic protection, there was a difference between winter median nitrate (4.3 mg/L to 4.4 mg/L) and summer median nitrate (5.0 mg/L to 5.2 mg/L).

Table 4: Median Nitrate Concentrations Grouped by Well Construction and Geologic Protection

Grout/ Protection	Round 1 Feb. 2008	Round 2 Aug. 2008	Round 3 Feb. 2009	Round 4 Aug. 2009	Round 5 Aug. 2010	Round 6 Aug. 2011
Yes/Yes (80)	0.1	0.0	0.0	0.0	0.1	0.0
No/Yes (74)	0.1	0.2	0.1	0.2	0.4	0.3
Yes/No (28)	0.2	0.0	0.1	0.0	0.4	0.0
No/No (143)	4.4	5.1	4.3	5.0	5.0	5.2

The difference between winter and summer median nitrate concentrations would be expected if the nitrate source was overabundant and seasonal (e.g., springtime over-application of manure). In addition, recharge during the growing season is greater and flashier than during the winter. This study did not control the timing of sampling with respect to large precipitation events, with the result that some nitrate sample results could strongly reflect storm-related recharge, while others do not.

Conclusions

- Well network coordinators used a series of MDH forms to collect field data to support the network. Using the field data, MDH generated (if necessary) and archived geologic and hydrogeologic data for each well in the study.
- The number of samples provided by volunteers decreased by nearly 100 over the first six sampling rounds.
- The study evaluated several factors related to well construction and hydrogeology, and found them to influence groundwater quality. The factors considered were aquifer matrix, well construction, overlying geologic protection, and surface drainage. Well construction (the documented presence or absence of casing grout) and overlying geologic protection (shale or at least ten feet of clay above the open interval of the well) had the strongest influence on groundwater quality.
- Low nitrate concentrations were measured in 97.7 percent of wells with the most-desirable construction and hydrogeologic characteristics.
- The median nitrate concentration in the most-desirable wells was two orders of magnitude less than the median nitrate concentration in the least-desirable wells.
- Median nitrate concentration for all study wells was stable over time.
- Median nitrate concentrations were low (less than 1 mg/L) and stable over time for wells with overlying geologic protection, casing grout, or both.
- Wells lacking both overlying geologic protection and casing grout had higher median nitrate concentrations in summer (August) than winter (February).
- The study does not account for storm-related aquifer recharge.

Recommendations

- Information recorded on the field data forms was key to the interpretation of nitrate data. The form templates were retained for use in future projects with similar goals (e.g., the Minnesota Department of Agriculture Central Sands Private Well Network).
- The initial sampling interval of six months (February and August; modified after Round 4 to annually in August) was not optimal for evaluating changes in nitrate concentration over time. The sampling design did not account for nitrogen application or storm events, factors that may unevenly influence the measured concentrations. Future studies should follow a sampling frequency that does account for these factors, for instance combining infrequent sampling rounds during winter (when nitrate application and recharge are negligible) with more frequent sampling rounds at specific locations during the growing season (when both nitrate application and storm-related recharge occur).
- There was a significant up-front investment in assembling the VNMN network. Though it is currently at risk of deterioration, it deserves support and should be maintained if possible. It can support studies of other pollutants and not only of nitrate. Naturally-occurring analytes of interest could include arsenic, radium and gross alpha, trace metals, major cations and anions, stable isotopes, and field measurements.

References

Minnesota Department of Natural Resources, 1991, *Criteria and Guidelines for Assessing Geologic Sensitivity of Ground Water Resources in Minnesota*, developed by the Geologic Sensitivity Project Workgroup, June 1991, 122 pp.

Southeast Minnesota Water Resources Board, 2009, Section 319 *Nonpoint Source Pollution Program Volunteer Nitrate Monitoring Network Final Report*, grant contract CFMS #B05788, Attachment 8b, MDH Contribution to final report.

Minnesota Administrative Rules, Chapter 4725, Wells and Borings, revised 2008.

Appendices

*** Potential Nitrate Source Inventory Form**

*** Well Information Form**

*** Geographic Positioning System (GPS) Waypoint Log**

Potential Nitrate Source Inventory Form
For Use In
"Volunteer Nitrate Monitoring Network in Targeted Areas - A Pilot Project"

General Information

Unique Number (6 digits): ______________________________

Owner Name: ______________________________

Owner Phone: ______________________________

Owner Address: ______________________________

____

Inspector Name: ______________________________

Inspector Phone: ______________________________

Date of Visit: ______________________________

Grid Node ID: ______________________________

County: ______________________________

Well Construction Information

Information From (Circle One): a) Well Log (Attach) b) Verbal (Indicate Person): ____________________

Well Construction Date: ______________ Well Depth (Feet): ____________________

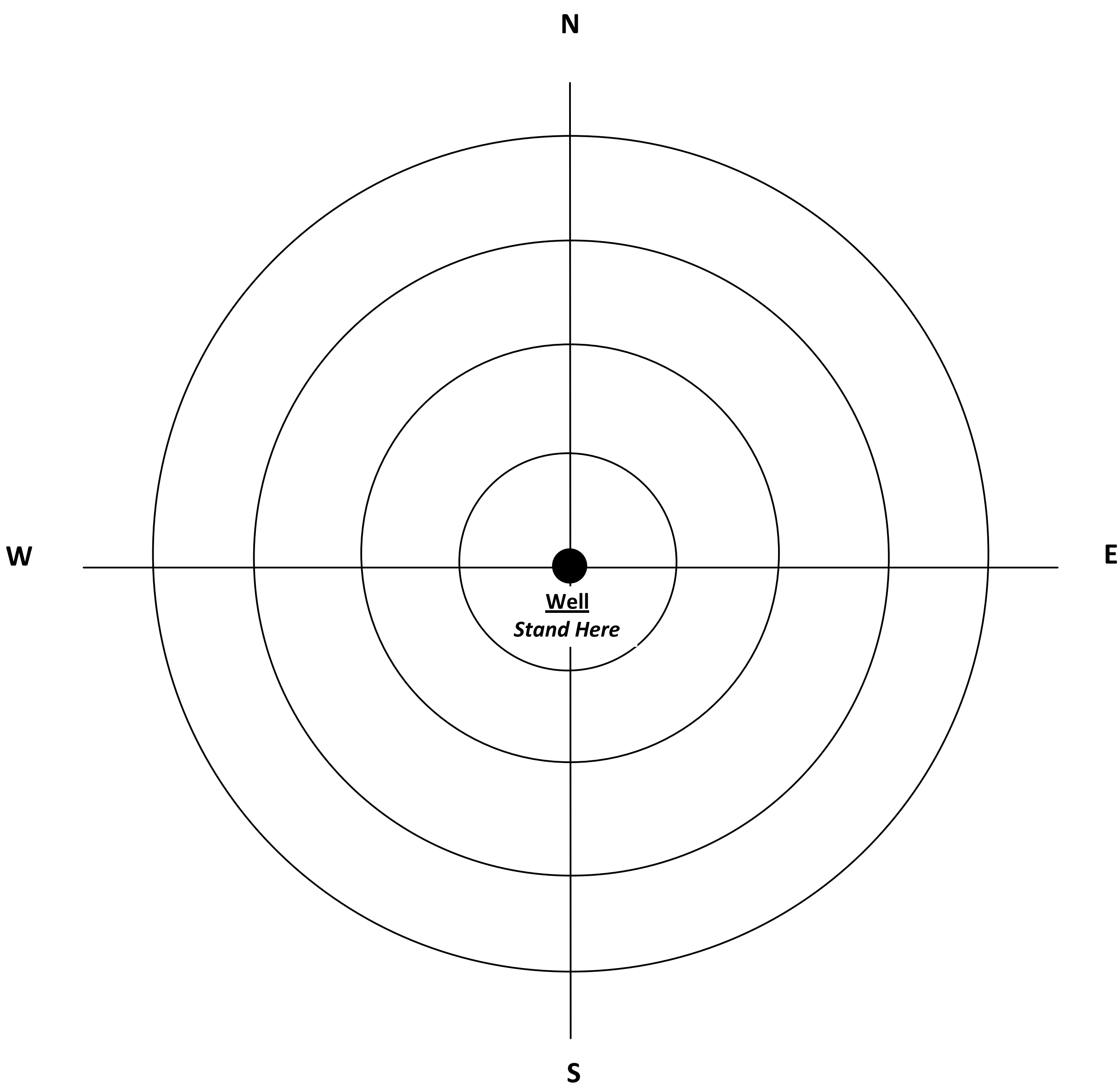
Well Diameter (Inches): ______________ Pump Installer (Sticker): ____________________

Potential Nitrate Source Inventory Codes

AFL:	Animal Feedlot
APB:	Animal/Poultry Building
MSA:	Manure Storage Area
LAP:	Land Application of Manure, Septage, Sewage Sludge, Waste
FWP:	Feeding or Watering Area
DRA:	Drainfield - Above or Below Grade
PRV:	Privy (Old Outhouse)
SET:	Septic Tank
AGG:	Dry Well, Leaching Pit, Seepage Pit, Injection Well, Agricultural Drainage Well

UNIQUE No.:	

DIRECTIONS
Directions: *Put a dot where nitrate source is relative to the well. *Label the dot with the appropriate code. (Codes on reverse side.) *Label the distance. **Does water drain to the well? Yes / No (Circle One)** **Which direction does the landscape slope? (Draw arrow across bull's eye, through well, and label.)** **Is the slope: a) Steep or b) Shallow (Circle One)**



Potential Nitrate Source Inventory Codes—Definitions

Use the following definitions for the “Potential Nitrate Source Inventory Codes” on page one of the form:

AFL-Animal Feedlot

A lot or building or combination of lots and buildings intended for the confined feeding, breeding, raising, or holding of animals and specifically designed as a confinement area in which manure may accumulate, or where the concentration of animals is such that a vegetative cover cannot be maintained within the enclosure.

APB-Animal/Poultry Building

A building used for housing farm animals.

MSA-Manure Storage Area

An area where animal manure or process wastewaters are stored or processed.

LAP-Land Application of Manure, Septage, Sewage Sludge, Waste

Addition of a material to a site by leaking, pumping, pouring, emitting, emptying, dumping, escaping, seeping, leaching or other means.

FWP-Feeding or Watering Area

An open area where animals are fed or watered.

DRA-Drainfield

A subsurface system that recycles wastewater by releasing it into the soil for adsorption and filtration.

PRV-Privy (old outhouse)

An aboveground structure with an underground cavity that is used for the storage or treatment and disposal of toilet wastes.

SET-Septic Tank

A watertight, covered receptacle that receives discharge of sewage from a building sewer, separates solids from liquid, digests organic matter, stores liquids through a period of detention, and allows the effluent to discharge to a treatment system.

AGG-Dry Well, Leaching Pit, Seepage Pit, Injection Well, Agricultural Drainage Well

An underground pit into which a sewage tank discharges effluent and from which liquid seeps into the surrounding soil through the bottom and openings in the side of the pit.

Well Information Form

WNC Name:					Date:	
Well Address:					**Grid Node #:**	
Selection Round:					**County:**	
Well Owner Name	**Number**	**Dir.**	**Street/Avenue**	**Type**	**City**	**Zip**
Example	*757*	*W.*	*Broadway*	*St.*	*Winona*	*55987*

☐ **Well Successfully Identified**

Well Unique # or W-series # (6 or 8 characters):

Well ID # Verified By (check all that apply):

☐ Tag on well ☐ Address ☐ Name on mailbox ☐ Owner ☐ Neighbor ☐ Other________

☐ **Well Unique Number or W-series Number Unavailable**

- Well Depth (feet) _____ Well Diameter (inches) _____ Year Drilled _____
- Who Services the Well? ____
- Source of well construction information:

  ☐ Owner

  ☐ Original well driller (Name: __________________; phone: _____________)

  ☐ Well repair company (Name: _________________; phone: _____________)

Other wells on the property? ☐ Yes ☐ No

If yes, please write the Well ID # or the above information for each additional well on the back of this form.

Well Location (GPS):

GPS waypoint recorded: Y/N

Waypoint form complete: Y/N

Well Location (County Map):

Marked on map: Y/N

Township: ____ Section: ____

Additional Questions:

Treated well water? ☐ Yes ☐ No

☐ Water Softener ☐ Chlorinator ☐ Iron Removal ☐ Reverse Osmosis

☐ Carbon Filter ☐ (Other): _____________________________________

Does the well water become cloudy? ☐ Yes ☐ No

Do you ever hear water running into the well? ☐ Yes ☐ No

Does the well suck or blow air in response to air pressure? ☐ Yes ☐ No

Does the well water ever have a “rotten egg” smell? ☐ Yes ☐ No

GPS Waypoint Log

*** Reader / Observer(s): ________________** *** Agency Code: __________** ***Program Code: __________** **Reading Date(s): ____/____/____ to ____/____/____**

Waypoint File Name: ________________.TXT **GPS Unit Serial Number: ________________** **Sheet #: ____ of ____**
(from download procedure)

Waypoint	County	* Unique Well #	Alternate ID (PWSID[1])	* Unique Well # Verification	Location Name / Remarks	Twp/Rng/Sec/Subsec[2] (49 - 18 - W - 28 DDCA)

Program Codes: **WMCDC** = MDH for Center for Disease Control **DM** = Dump Monitoring **HRA** = Health Risk Assessment **PWS** = Public Water Supply **RAD** = Radiation Control **SAC** = Site Assessment & Consultation **WHP** = Wellhead Protection **WM** = Well Management

Unique Well # Verification: Specifies how accurately the well's identity (**Unique Number**) was determined. Verifies that the location matches the correct well (Unique Number).

1 = Address verification **2** = Name on mailbox **3** = Lot-block **4** = plat book **5** = Info from owner
6 = Info from neighbor **7** = Other, note in *remarks* **E** = Emergency services number **T** = Tag on well **S** = Site Plan **X** = Tax Records

***- REQUIRED**

[1] – For a Public Water Supply, INCLUDE the Sample Number (e.g. S01) if known.

[2] – Record a minimum of FOUR subsections, if possible.