St. Peter Wellhead Protection

Nitrogen Rate Results

September 2003

A Demonstration Project Funded Through
Section 319 of the Federal Clean Water Act

You farm and/or own land within the St. Peter wellhead protection area and have likely received information in the past about what this means to your operation. Wellhead Protection is a planned approach that manages potential contaminant sources on the land area that contributes water to a city's drinking water supply. The city of St. Peter has developed a written plan that identifies objectives and defines implementation steps that will protect the aquifer. Educating farmers, homeowners, and businesses on protection measures is an important first step for protecting our groundwater resources. The fact that you are receiving this letter does not mean you are polluting the water. It does mean, however, that you may have added responsibility for keeping the water safe.

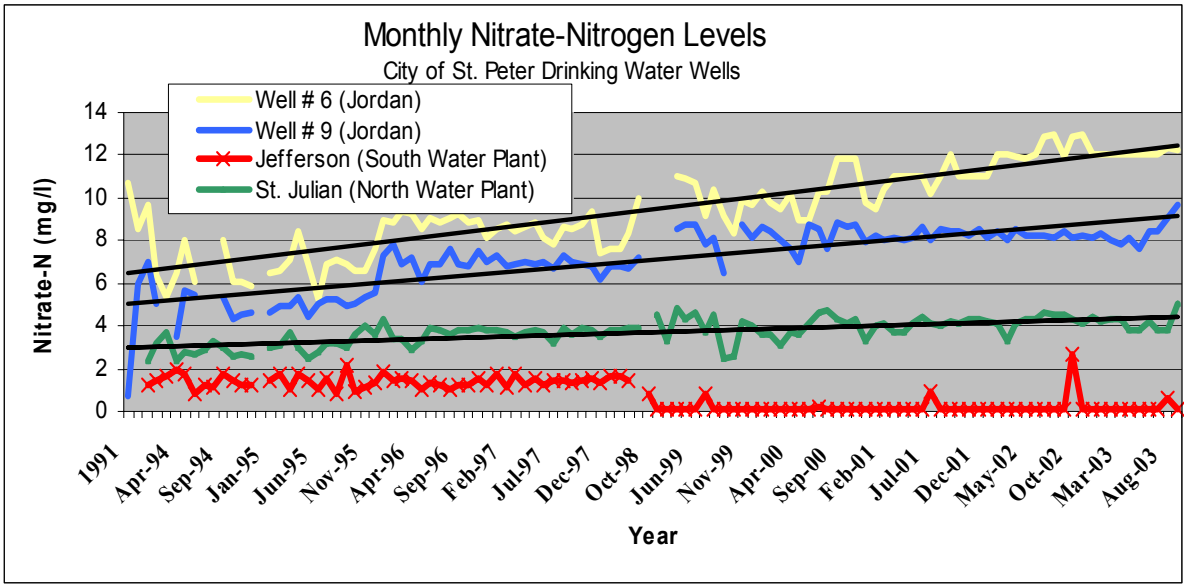
WHAT ARE SOME OF ST. PETER'S UNIQUE CHALLENGES

- The area that supplies water for St. Peter's aquifer covers over 4,600 acres. (page 5) A portion of this water is derived from tile-drained cropland on the western edge of the management area and discharged onto the sandy soils near the western city limits. The rapid movement of water through these course soils allows quick movement of contaminants into the aquifer.
- Seven supply wells, varying in depth from 130 to 670 feet, pump water from three separate aquifers. Of these, four shallow wells located in the Jordan aquifer are considered vulnerable to land use activities.
- Nitrate levels in the vulnerable wells have been steadily increasing since the 1980s. (page 3)
- City staff currently blend water from various wells to produce a finished water supply which typically contains nitrate-N levels between 4 to 5 parts per million (PPM). The federal health standard is 10 ppm.

The wellhead protection area is very unique and sensitive.
This aerial photograph is a view looking east at a portion of the area that supplies drinking water to the city of St. Peter. Tile-drained cropland on the western edge of the management area is discharged onto the sandy soils near the west city limits.

HOW DOES NITRATE GET INTO DRINKING WATER?

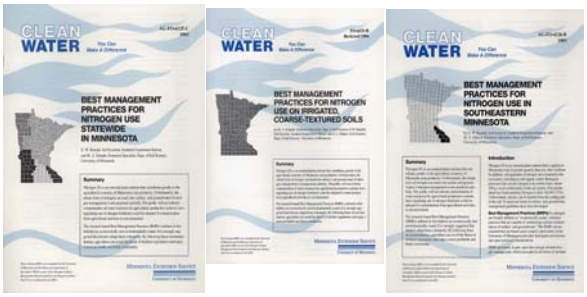
The primary contaminant concern for the city of St. Peter is nitrate. Nitrate contamination can come from many sources such as: commercial fertilizers, manure, legume crops, decaying plant and animal tissue, organic matter in the soil, septic systems, engine emissions, and even lightning. Nitrate contamination occurs when there is more nitrate in the soil than plants can use. When water moves easily through the soil and underlying rock, the excess nitrate is carried through the soil into groundwater supplies by irrigation, rain-water and snowmelt. This occurs particularly where the soil is sandy, gravelly or shallow over porous limestone bedrock. Almost one-third of the St. Peter Wellhead Protection Area soil types are classified as a sandy, course-textured material.



As shown in the graph above, nitrate concentrations have steadily increased over the past several years. The federal drinking water standard is 10 ppm. To stay within public health guidelines, the city blends high nitrate water (well # 6 and #9) with low nitrate water from deeper aquifers. Through this blending process nitrates are kept below 5 ppm (north and south water plants) . Regardless, blending will become less feasible if nitrate concentrations continue to increase.

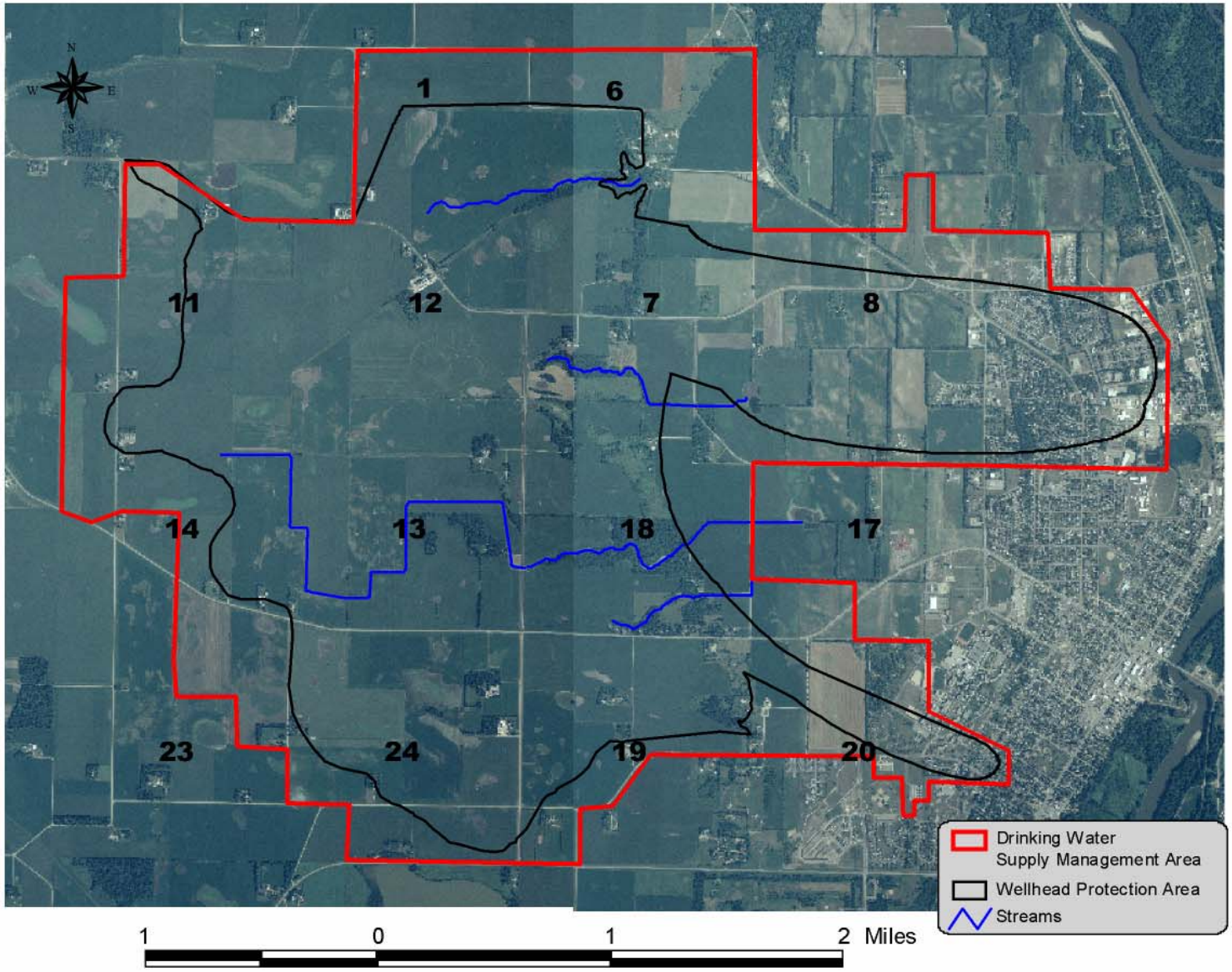
WHAT CAN I DO?

In response to the Minnesota Groundwater Protection Act of 1989, a plan was developed with the purpose of managing nitrogen inputs to crop production to prevent degradation of Minnesota's water resources while maintaining profitability. The central tool for achieving this goal is the voluntary adoption of Best Management Practices (BMPs) for nitrogen. BMPs are based on the concept of total nitrogen management, which accounts for all forms of on-farm nitrogen. These BMP practices are technically sound, easily adopted, and backed by University of Minnesota and other land grant university research.



- Set a realistic yield goal.
- Develop and use good records for field-specific information.
- Adjust N rate for soil organic content.
    - The top six inches of a 3% organic soil will contain about 4000 pounds of nitrogen in the organic form. Soil tests show that an average of 40-60 pounds of N per acre are released through organic matter decay and becomes available nitrate in soils each year. These values can vary from 30-100 pounds per acre.
- Use a soil nitrate test where appropriate.
- Credit second year nitrogen credits from alfalfa and manure.
- Use prudent manure management to optimize nitrogen credit.
    - Test manure for nutrient content.
    - Calibrate manure application equipment.
    - Apply manure uniformly through the field.
    - Injection of manure is preferable.
    - Avoid applying manure to sloping, frozen soils
    - Incorporate broadcast applications whenever possible.
- Plan nitrogen application timing to achieve high nitrogen-use efficiency.
    - If applying in the fall, only use anhydrous ammonia and delay applications until soil temperatures reach and remain below 50 degrees F at the top 4 to 6 inch depth. Fall application of urea is <u>not recommended.</u>
    - Use a nitrification inhibitor like N-Serve with fall applications of N, to limit de-nitrification and leaching.
    - Carefully manage N applications on soils with high leaching potential. Do not apply fertilizer N in the fall to coarse-textured (sandy) soils.
- **<u>DO NOT</u>** apply nitrogen above University of Minnesota recommended rates.

St. Peter Wellhead Protection Area



St. Peter Wellhead Protection Area--Nitrogen Rate Validation Results

2000

Participant A

N Rate	Avg. Yield
0	132
60	160
90	166
120	170
150	169

Participant B

N Rate	Avg. Yield
0	139
60	145
90	149
120	151
150	151

Participant C

N Rate	Avg. Yield
0	115
60	151
90	157
120	159
150	161

Participant D

N Rate	Avg. Yield
0	134
60	159
90	167
120	171
150	169

Participant E

N Rate	Avg. Yield
0	141
60	154
90	154
120	153
150	167

N Rate	Year Average
0	**132**
60	**154**
90	**159**
120	**161**
150	**163**

2001

Participant A

N Rate	Avg. Yield
0	123
60	137
90	138
120	134
150	138

Participant B

N Rate	Avg. Yield
0	141
60	161
90	163
120	168
150	174

Participant C

N Rate	Avg. Yield
0	138
60	148
90	152
120	147
150	150

Participant D

N Rate	Avg. Yield
0	112
60	152
90	160
120	168
150	167

N Rate	Year Average
0	**129**
60	**150**
90	**153**
120	**154**
150	**157**

2002

Participant A

N Rate	Avg. Yield
0	110
60	141
90	150
120	169
150	170

Participant B

N Rate	Avg. Yield
0	154
60	162
90	164
120	167
150	165

Participant C

N Rate	Avg. Yield
0	134
60	157
90	162
120	161
50	156

N Rate	Year Average
0	**133**
60	**153**
90	**159**
120	**166**
150	**164**

Three-Year Average

N Rate	Year Average
0	131
60	152
90	157
120	160
150	161

ARE UNIVERSITY OF MINNESOTA NITROGEN RECOMMENDATIONS RIGHT FOR MY FARM?

University of Minnesota soil scientists have conducted hundreds of field studies to find the best rate of fertilizer N for corn following soybeans since the 1960s. These studies have also evaluated uncontrollable factors like precipitation and temperature. Finding the right amount of fertilizer N to add for a crop is based on the previous crops N contribution, organic matter content in the soil, and a realistic yield goal. The right N rate allows for maximum yields at the most economical price.

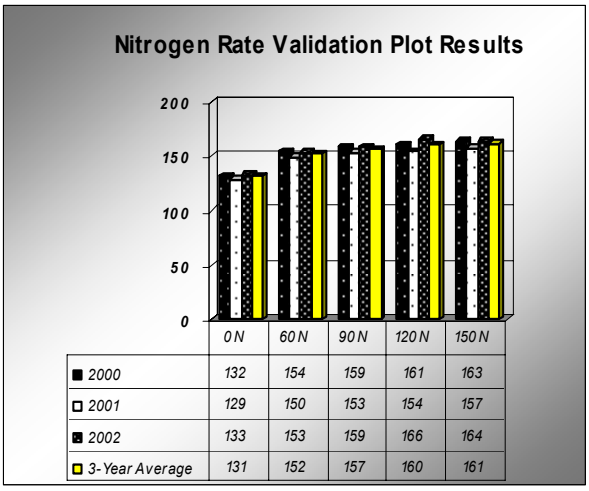
From 2000-2003, 15 corn farmers have participated in a nitrogen validation project within the St. Peter Wellhead Protection area. Nitrogen application rates (0, 60, 90, 120, and 150 pounds per acre) were replicated three times at each site. Average size of the treatment sites were approximately 2.5 acres with soil types and plot boundaries geo-referenced. Yield data was then collected with a GPS equipped yield monitor, with calibration verified by a participating advisor. The special project was funded by the Federal 319 funds administrated by the MPCA and Brown Nicollet Cottonwood Water Quality Board.

GOALS OF THE ST. PETER NITROGEN VALIDATION DEMONSTRATION:

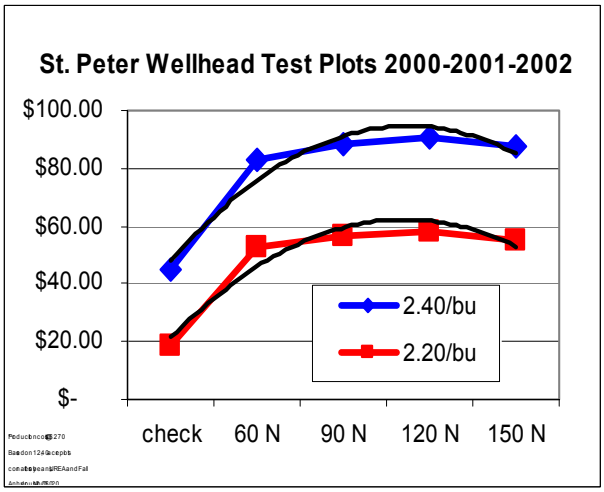
- Evaluate crop response to various rates of N in corn-soybean rotations on soils specific to the wellhead protection area.
- Increase producers' confidence in UM Nitrogen recommendations *(120-140 lbs./acre)* .

RESULTS

- ✓ On average, with 0 applied N, 130 bu./acre of corn was produced.
- ✓ In all three years the Economically Optimum Nitrogen Rate (EONR) was proven at 90-120 lbs. of nitrogen per acre.
- ✓ Results validate UM Extension Recommendations of 120 lbs./acre will produce 150 to 175 bu./acre corn.
- ✓ Some producers are over applying N by 30 lbs./acre. An estimated 38.1 tons of N would have the potential of being leached away into the drinking water supply for St. Peter every year. If the rate was cut back from 150 lbs./acre to 120 lbs acre, producers could save an average of $6-$10/acre or more on their fertilizer costs.



St. Peter Nitrogen Rate Results



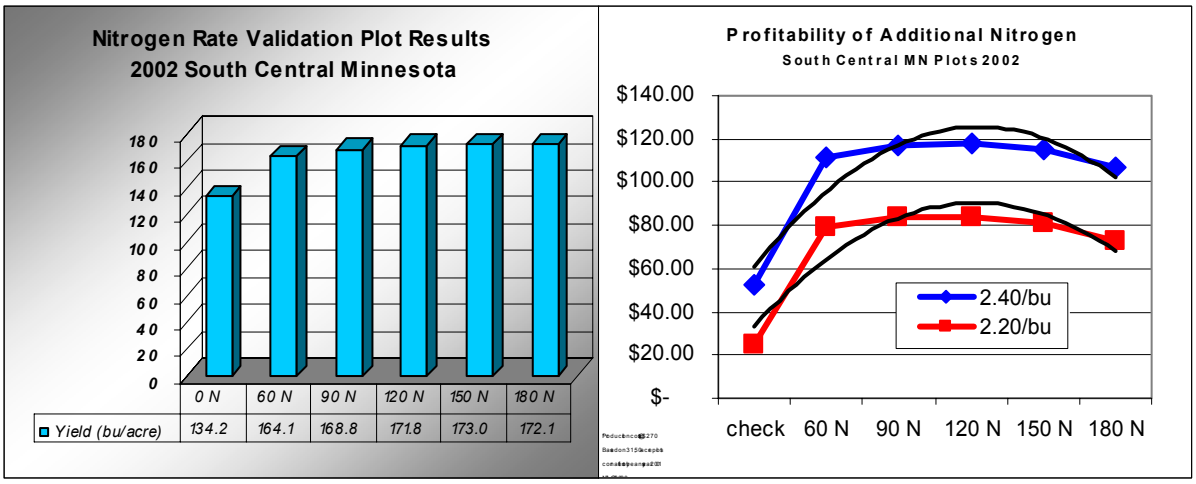
St. Peter Profitability

2002 SOUTH CENTRAL MINNESOTA NITROGEN VALIDATION TRIALS

As a result of the work done within the St. Peter area, nitrogen validation work expanded into south central Minnesota in 2002. The majority of sites were located in Nicollet and Blue Earth counties with 34 farmers participating. The results once again confirmed that U of M recommendations are more than adequate for a corn-soybean rotation.

RESULTS

- ✓ Results showed higher than average yields in 2002.
- ✓ Corn yields of 185 bu./acre were typical in fertilized strips.
- ✓ Corn yields of 137 bu./acre were typical in unfertilized strips.
- ✓ On the average, the maximum profit occurred with nitrogen application of 105 lb./acre of N.
- ✓ If farmers are applying 150 lb./acre N, (average amount applied) this study shows rates can be safely reduced by 10-30 lbs./acre without risking loss of profit.
- ✓ The optimum N rate to apply is very sensitive to the price of nitrogen fertilizer. For every $0.10/lb increase in N price, the optimum rate of N to apply decreases about 10 lb/acre.
- ✓ Due to natural gas prices, increases in the price of nitrogen fertilizer are expected for this coming crop year.
- ✓ Similar to St. Peter Wellhead findings, 2002 results show that it does not pay to over apply nitrogen.



South Central MN Nitrogen Rate Results

South Central MN Profitability

SUMMARY

Nitrogen is an essential plant nutrient and comes from many different sources. The key to preventing large nitrogen losses to groundwater is to minimize the amount of nitrate in soils that will not be used by crops. Nitrogen rate demonstrations on soils specific to the St. Peter Wellhead Protection Area, show that farmers can maximize profits with nitrogen applications between 90-120 lbs. N/acre. Managing nitrogen applications now can prevent costly regulations in the future.

Thank you for your cooperation and continued desire to help protect drinking water now and for future generations, and a special thanks to all those farmers who participated in the N rate demonstrations over the past several years.

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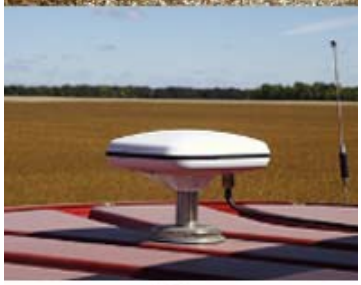

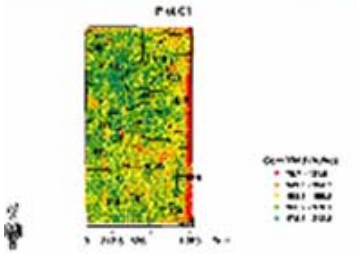

2000-2001-2002 Summary

- On the 12 participating farms within the St. Peter Wellhead Protection Area the Economically Optimum Nitrogen Rate (EONR) ranged from 60 lbs./acre to 138 lbs./acre with an average EONR of 99 lbs. N /acre across all farms.

- Corn yields ranged from 136-170 bu./acre with an average yield of 157 bu./acre across all farms.

- The three year independent study concludes that the UM Nitrogen Recommendations of 120 lbs.N /acre are valid for a yield goal of 150-174 bu./acre, soil organic matter level medium to high, and soybeans as a previous crop.

- Rates above 120 lbs./acre may decrease profit potential and increase the potential for nitrate leaching to rural and city drinking water supplies.

2000

	Yield	EONR
A	170	105
B	152	86
C	160	108
D	161	100
E	143	90

2001

	Yield	EONR
A	136	68
B	161	138
C	147	60
D	152	117

2002

	Yield	EONR
A	170	125
B	166	100
C	162	89

	Yield	**EONR**
Average	**157**	**99**
Min	**136**	**60**
Max	**170**	**138**