SOURCE WATER PROGRAM

SITE ASSESSMENT RESULTS

For the

REMSEN MUNICIPAL WATER SUPPLY
MUNICIPAL WELL #8
(REMSEN MUNICIPAL UTILITIES)

REMSEN, PLYMOUTH COUNTY, IOWA

SEPTEMBER 5, 2008

IOWA DEPARTMENT OF NATURAL RESOURCES

Prepared by

Daniel Cook
Environmental Specialist Senior
IDNR Project Manager
Contaminated Sites Section

TABLE OF CONTENTS

1. Introduction 3
2. Site Description 3
   2.1 Location 3
   2.2 Site Description 3
   2.3 Operational History and Waste Characteristics 3
   2.4 Nitrates and Nitrites 4
3. Collection of Non-Sampling Data 5
4. Collection of Sampling Data 6
   4.1 Soil Samples 6
   4.2 Groundwater Samples 6
   4.3 Surface Water Samples 6
   4.4 Sample Collection Methods 6
5. Field Activities 7
6. Conclusions 7
   6.1 Modeling Results 7
   6.2 Groundwater Results 7
   6.3 Surface Water Results 8

Appendix A ..... Figures
Appendix B ..... Tables
Appendix C ..... Sample Collection Sheets

1. INTRODUCTION

At the request of the Iowa Department of Natural Resources, Source Water Program, the Iowa Department of Natural Resources, Contaminated Sites Section (IDNR), has conducted an environmental assessment in and around the municipal water well field for Remsen, Plymouth County, Iowa. The purpose of this investigation was to evaluate the sites hydrological profile and identify possible source(s) for the elevated nitrate levels found in Municipal Well Number 8.

2. SITE DESCRIPTION

2.1 Location

The Remsen well field is located in the NE ¼ of the NW ¼ of Section 6, Tier 92 North, Range 43 West, Plymouth County, Iowa. The site is found within the city limits of Remsen, Iowa on the north side of town along Deep Creek. (Figure 1).

2.2 Site Description

Remsen, Iowa is located within the land form region known as the Northwest Iowa Plains with Pleistocene Series loess, till, gravel, and sand seams found from the surface down to approximately 250 feet deep. This Quaternary Period material overlays the Cretaceous Period, Fort Benton (Lower Colorado) Group, Dakota Formation shales and sandstone locally known as the Dakota Sandstone and includes both the Woodbury Member (250 feet to 450 feet deep) followed by the Nishnabotna Member (450 feet to 640 feet deep). Galena Group dolomite of the Ordovician Period was found below the Nishnabotna Member.

The City of Remsen Municipal Well Number 8 is located in an alluvial setting just south of Deep Creek. The driller's log for Well Number 8 indicates that it's a shallow well bored to 32.5 feet deep. The screen is located from 24.5 feet to 32.5 feet deep. The log also indicated that till and sandy areas were found from the surface down to 11 feet deep followed by course sand and gravel to the bottom of the boring. Both wells Number 5 and 6 are close to Well Number 8 and have similar logs but both noted a dense gray till layer starting at 31 feet deep for well Number 5 and 30 feet deep for well Number 6. It is assumed that Well Number 8 would have found the gray till layer if it was drilled any deeper. Figure 2 shows the locations of the municipal wells in the Deep Creek alluvium.

2.3 Operational History and Waste Characteristics

For the most part the area surrounding the well field is agricultural land with the exception of the city burn pile between Well Number 6 and 9, and a former borrow pit located directly southeast of Well Number 8. The burn pile is designated as an area for burning tree limbs and brush only but there is evidence that household garbage has also been burned as well. Incomplete combustion of plastics can produce polycyclic aromatic hydrocarbons (PAHs) which if ingested can be health concern.

The borrow pit is visible in a 1930s aerial photograph but has since been filled in (Figure 3). It is unclear what was used to fill in the pit but it was thought to have been used for household trash before it was capped. Sink holes routinely open up in the area of the former borrow pit suggesting that solid waste was at one time placed in the pit then covered with soil. As the solid waste decays it leave voids that collapse and cause sink holes.

2.4 Nitrates and Nitrites

Nitrates and nitrites are nitrogen-oxygen chemical units which combines with various organic and inorganic compounds. Once taken into the body, nitrates are converted into nitrites. The greatest use of nitrates is as a fertilizer.

In 1974, Congress passed the Safe Drinking Water Act. This law requires the US Environmental Protection Agency (EPA) to determine safe levels of chemicals in drinking water which are known to or may cause health problems. These non-enforceable levels, based solely on possible health risks and exposure, are called Maximum Contaminant Level Goals. The MCLG for nitrates has been set at 10 parts per million (ppm), and for nitrites at 1 ppm, because EPA believes this level of protection would not cause any of the potential health problems described below.

Based on this MCLG, EPA has set an enforceable standard called a Maximum Contaminant Level (MCL). MCLs are set as close to the MCLGs as possible, considering the ability of public water systems to detect and remove contaminants using suitable treatment technologies. The MCL for nitrates has been set at 10 ppm, and for nitrites at 1 ppm, because EPA believes, given present technology and resources, this is the lowest level to which water systems can reasonably be required to remove this contaminant should it occur in drinking water. These drinking water standards and the regulations for ensuring these standards are met, are called National Primary Drinking Water Regulations. All public water supplies must abide by these regulations.

Short-term: Excessive levels of nitrate in drinking water have caused serious illness and sometimes death. The serious illness in infants is due to the conversion of nitrate to nitrite by the body, which can interfere with the oxygen-carrying capacity of the child's blood. This can be an acute condition in which health deteriorates rapidly over a period of days. Symptoms include shortness of breath and blueness of the skin (Blue Baby Syndrome).

Long-term: Low to moderate levels of nitrates and nitrites have the potential to cause diuresis, increased starchy deposits and hemorrhaging of the spleen from a lifetime exposure at levels above the MCL.

The regulation for nitrates and nitrites became effective in 1992. Between 1993 and 1995, EPA required your water supplier to collect water samples at least once

a year and analyze them to find out if nitrates and or nitrites are present above 50 percent of their MCLs. If it is present above this level, the system must continue to monitor this contaminant every 3 months. If contaminant levels are found to be consistently above their MCLs, your water supplier must take steps to reduce the amount of nitrates/nitrites so that they are consistently below that level. Ion exchange, Reverse Osmosis, Electro-dialysis are treatment methods that have been approved by EPA for removing nitrates/nitrites.

If the levels of nitrates/nitrites exceed their MCLs, the system must notify the public via newspaper, radio, TV and other means. Additional actions, such as providing alternative drinking water supplies, may be required to prevent serious risks to public health.

3. COLLECTION OF NON-SAMPLING DATA

The area around the well field was modeled using the three dimensional groundwater flow and transportation modeling program called Visual MODFLOW (Modflow). Modflow allows you to input values for different types of surface conditions, soil conditions, and availability of groundwater. Well logs were used to define the different soil horizons and porosity levels. Well field pumping data was used to determine drawdown conditions around the wells and how much of an influence the wells have on the aquifer. And, as with any modeling program, some of the required input data is not known and values are chosen using your best professional judgment. For instance Deep Creek is not monitored by U.S. Geological Survey and no stream flow data was available so estimated values were used.

First the model was ran with all the municipal wells turned off and the aquifer in a steady state. An area of nitrate contamination was introduced in the location suspected as the source area (Figure 4). The blue arrows show the modeled groundwater flow direction and the red arrows show the modeled flow of the nitrate contamination.

Then the model was ran using five different steady state scenarios, all wells on (Figure 5), only well No.8 on (Figure 6), only well No.5 on (Figure 7), only well No.3 on (Figure 8), and finally, wells No.3 and 5 on (Figure 9). In reviewing the different scenarios you see that well No. 8 can capture the nitrate contamination by its self but well No. 3 alone and well No. 5 alone can not. This is most likely because well No 3 and 5 are located in a narrow area of the deep Creek flood plain and the groundwater moves faster through this region. With the faster flowing groundwater it takes more pumping action to influence the groundwater flow direction as noted in Figure 9, both wells No.3 and 5 pumping.

Overall, the model indicates the following:

- Deep Creek, at normal flow levels, does not have a significant impact on the alluvium sand and gravel aquifer flow direction. The modeled

contaminant plume runs parallel to Deep Creek which is most likely a loosing stream.

- Well Number 8 is capable of capturing the majority of the contamination from the suspected source area.
- Wells Number 3 and 5 would be susceptible to increasing nitrate levels if Well Number 8 were to be shut down.

4. COLLECTION OF SAMPLING DATA

4.1 Soil Samples

No soil samples were collected during this sampling event.

4.2 Groundwater Samples

Twenty-six (26) groundwater samples were collected from thirteen (13) locations identified on Figure 10. Two (2) samples were collected from each of the thirteen (13) locations, one from the top of the aquifer (shallow) and the other from near the interface between the sand/gravel aquifer and the lower till unit (deep). Samples were analyzed for nitrates and ammonia using the HACH DR2800 Spectrophotometer serial number 1254017. HACH Sample Method 10206 was utilized for the nitrate analysis and was capable of measuring nitrate levels in water from 0.3 to 30.0 mg/L. HACH Sample Method 10205 was used to measuring nitrogen, ammonia levels in water within a range of 2 to 47 mg/L. The results for the groundwater samples are found in Table 1 and the sample collection information sheets are located in Appendix C. Nitrate sample results ranged from below the lower method detection limit to greater than the upper method detection limit. None of the samples had ammonia detections above the lower ammonia detection limit.

4.3 Surface Water Samples

Four (4) surface water samples were collected from the site, three (3) from Deep Creek and one (1) from a small feeder creek (Figure 10). The results for the surface water samples are found in Table 1 and the sample collection information sheets are located in Appendix C.

4.4 Sample Collection Method

All groundwater samples were collected in a manor utilizing the procedures in ASTM D6001-96e1, *Standard Guide for Direct-Push Water Sampling for Geo-Environmental Investigations*, for direct push groundwater sampling. All groundwater collecting equipment was decontaminated after sample collection was complete at each location in accordance with Quality Assurance Project Plan for Iowa Department of Natural Resources Land Quality Bureau Contaminated Sites Section.

The Geoprobe® samples were collected with the following SOPs and manuals;

- Geoprobe® FC4000 Field Instrument (Conductivity Probe) User's Guide; Manual No. 20777
- Geoprobe® Screen Point 15 Groundwater Sampler SOP; Technical Bulletin No. 95-1500

5. FIELD ACTIVITIES

Field personnel traveled to the site on July 29th, 30th and 31st, 2008. Field activities were performed in Level D personal protective equipment that consisted of steel-toed boots, safety glasses, hearing protection and hard hats. Iowa One Call was contacted at least 48 hours prior to the site visit in order to have all underground utilities located before the field work started. Access agreements were pre-arranged by IDNR Source Water Program staff and City of Remsen staff.

6. CONCLUSIONS

6.1 Modeling Results

Prior information collected about the City of Remsen alluvium well field indicated the parcel of land (area of concern) directly east of the well field could potentially be the source area for the elevated level of nitrates in well No.8. This parcel of land receives commercially applied fertilizer as well as manure from a nearby cattle feed lot. The surface topography for this parcel lends itself to rapid surface water infiltration in the lower elevation portion found on the north central and north eastern side. This information was used to create a nitrate source area for the Modflow software for predicting the fate and transport models. Only Municipal Wells No. 3, 5 and 8 were used in the modeling, well No.6 was disregarded. A source area was also added to the small cattle feed lot just to the north east of Municipal Well No.8 but the model predicted little if any impact on the well field.

Modflow outputs were generated to predict the following conditions; all wells off (Figure 4), all wells on (Figure 5), only well No.8 (Figure 6), only well No.5 (Figure 7), only well No.3 (Figure 8), and well No.3 and 5 (Figure 9). All outputs were run at 'steady state' showing the maximum impact the contaminated source area would have on the aquifer.

Figure 5 and 6 both show that well No.8 is in a unique position to capture most of the nitrate contamination plume coming from the area of concern. With well No.8 off well No.3 or 5 alone can not capture the nitrate plume, in stead it take both 3 and 5 working together (Figure 9). If well No.8 is no longer pumping the model predicts well No.3 and 5 would see an increase in nitrate levels.

6.2 Groundwater Results

Background groundwater sample locations, GP-16, 17, and 19, were selected out side and up gradient of the area of concern. The deep nitrate sample results for GP-16, 17, and 19 (28 to 32 feet deep) ranged from non-detect at GP-16 and 19 to 4.3 mg/L at GP-17. The shallow nitrate samples (16 to 20 feet deep) for the

same locations were below method detection limits at GP-19, 6.5 mg/L at GP -17 and 27 mg/L at GP-16. Overall this is an indication that the groundwater moving into the area of concern does have low levels of nitrate but not enough to account for the high levels found in Municipal Well No.8. The higher level of nitrates found in the shallow sample from GP-16 is most likely coming from the source area.

Groundwater was collected from GP-18 located at the southwest corner of the feedlot just to the northeast of Municipal Well No.8. GP-18 was collected to see what, if any, impact the feed lot was having on the alluvium aquifer. The results of the deep and shallow samples both exceeded the maximum method detection limits of 30 mg/L for nitrate. Sample point GP-19, just up gradient of GP-18 had no detectable levels of nitrate in the deep or shallow samples. As noted above, this area was considered a source in the modeling but was predicted to have little impact to the well field. Further sampling is required to determine how much impact the feed lot has on the alluvium well field.

A series of groundwater samples were collected around Municipal Well No.8 as shown on Figure 10. Again shallow and deep samples were collected at each location as noted above. The results of the analysis were plotted to show the shallow levels of nitrate around Municipal Well No.8 on Figure 11 and the deep levels on Figure 12. As seen in Figure 11, Figure 11A, Figure 12, and Figure 12A far more nitrates are detected leaving than entering the area of concern. Also, Figure 11 and 12 implies the nitrates are for the most part being captured by the pumping action of Municipal Well No.8 corresponding with the modeled results. The parcel of land directly east of Municipal Well No.8 appears to be the main source for the high nitrate levels found in well No.8.

6.3 Surface Water Results

Surface water samples were collected a four (4) locations across the site (Figure 10). This information was collected to see if stream conditions could be a source of the nitrates found in Municipal Well No.8. SW-01 was the upper most sample collected with nitrate levels found at 4.6 mg/L, SW-02 was the mid-stream location with nitrates at 4.8mg/L, and SW-04 the down stream location with nitrate levels at 5.3mg/L. SW-03 was collected from the small feeder stream that runs past the city burn pile near Municipal Wells No.1 and 6 and had a nitrate level of 17.9 mg/L.

The levels of nitrate found in Deep Creek (SW-01, SW-02 and SW-04) may be contributing to but does not appear to be the source causing the high levels of nitrates found in Municipal Well No.8. The high levels of nitrate found in the feeder creek are to far south to be a factor in the nitrate levels for well No.8.

SOURCE WATER PROGRAM

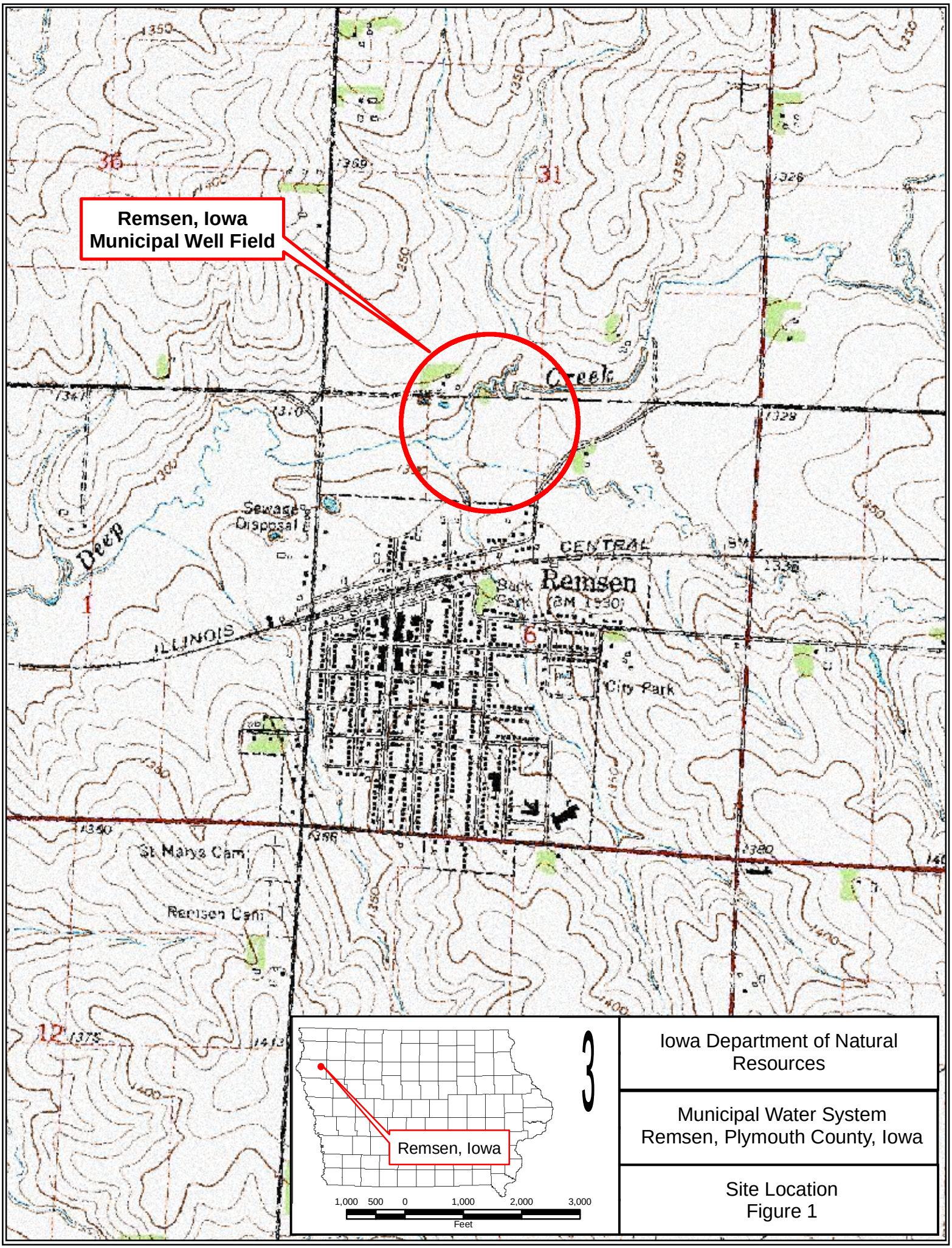
SITE ASSESSMENT RESULTS

For the

REMSEN MUNICIPAL WATER SUPPLY
MUNICIPAL WELL #8

APPENDIX A

FIGURES

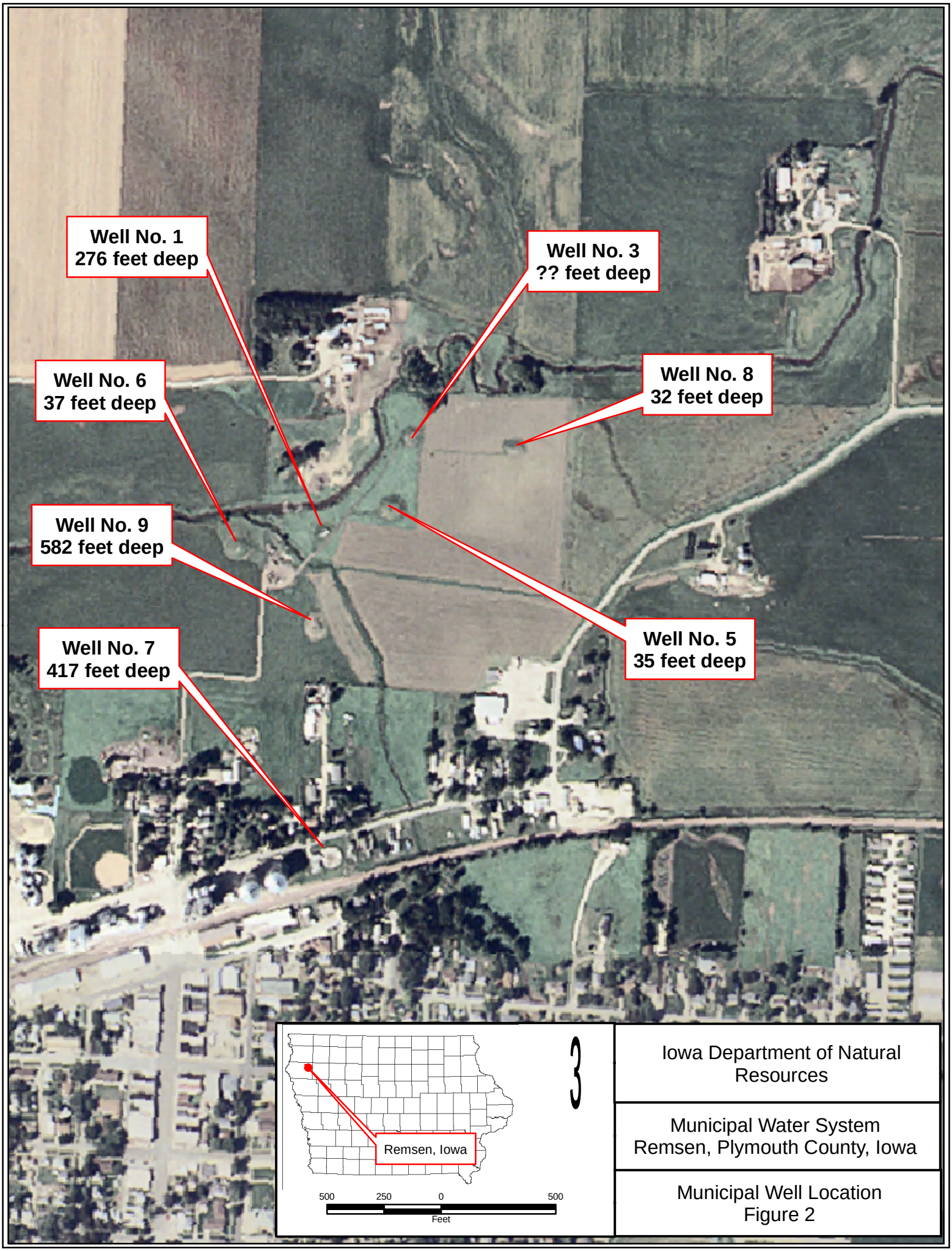


3

Iowa Department of Natural Resources

Municipal Water System
Remsen, Plymouth County, Iowa

Site Location
Figure 1

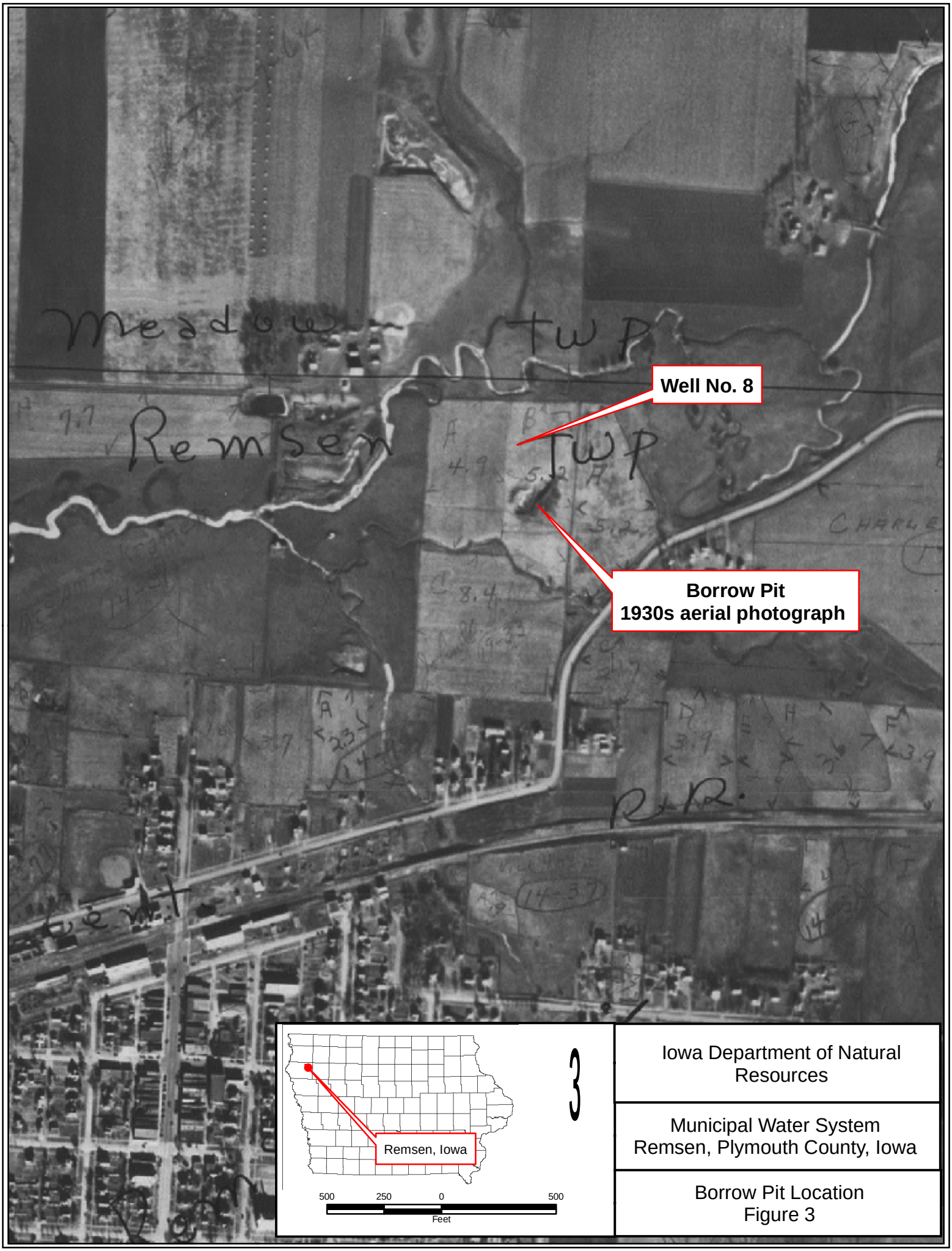


3

Iowa Department of Natural Resources

Municipal Water System
Remsen, Plymouth County, Iowa

Municipal Well Location
Figure 2



3

Iowa Department of Natural Resources

Municipal Water System
Remsen, Plymouth County, Iowa

Borrow Pit Location
Figure 3

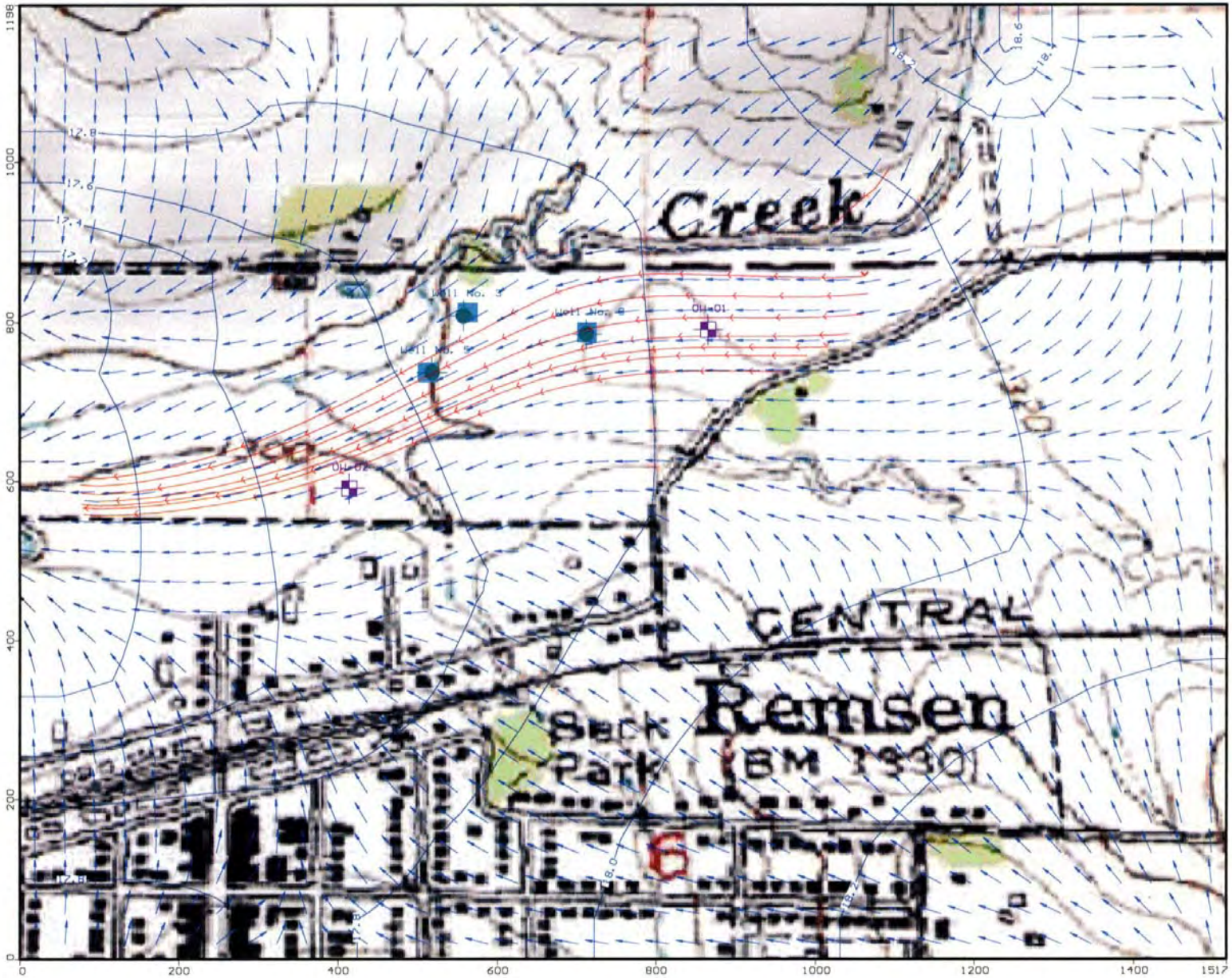


Figure 4
All Wells Off (Steady State)

Modeled Groundwater Flow Direction
Modeled Contaminant Flow Direction

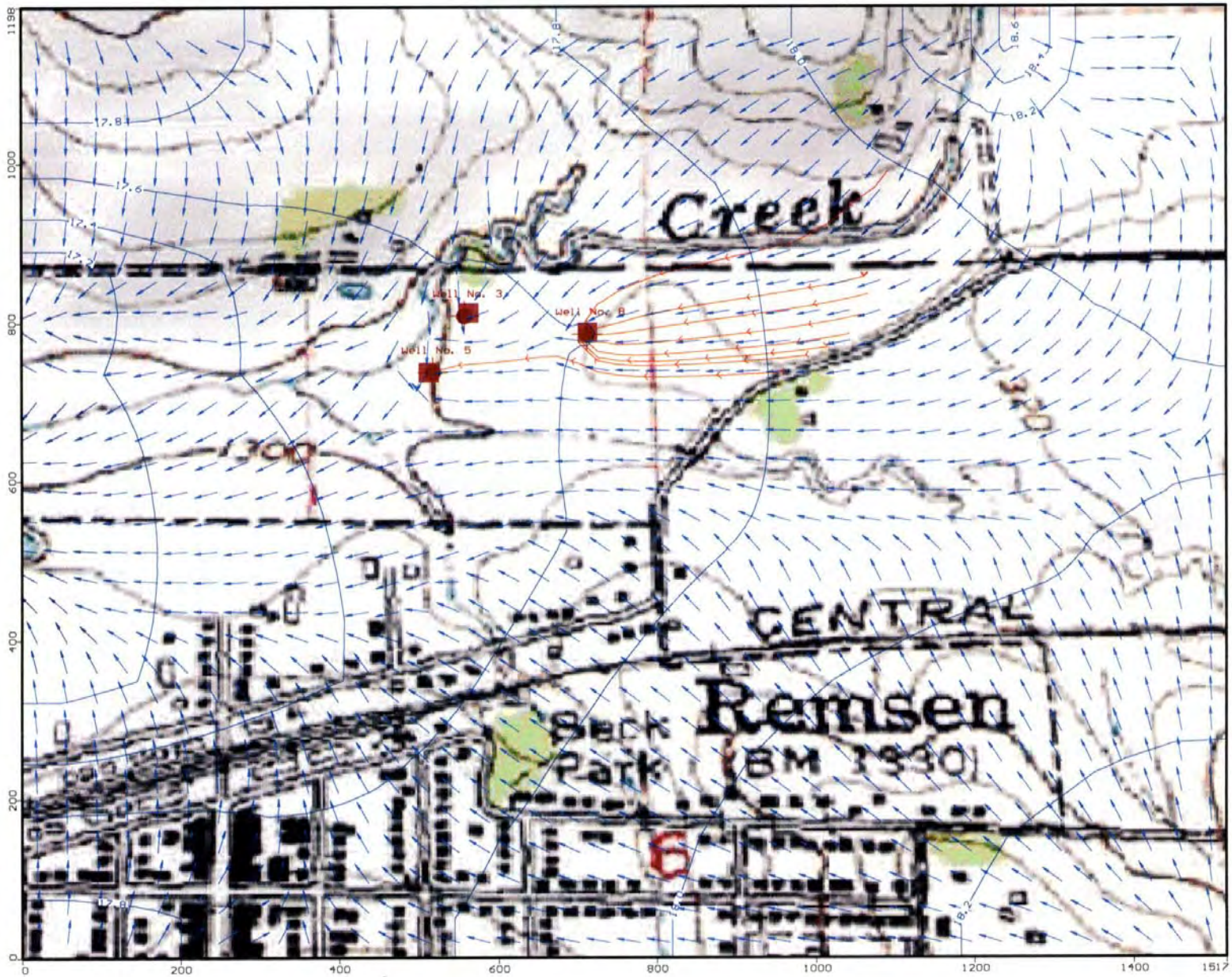


Figure 5
All Wells On (Steady State)

Modeled Groundwater Flow Direction
Modeled Contaminant Flow Direction

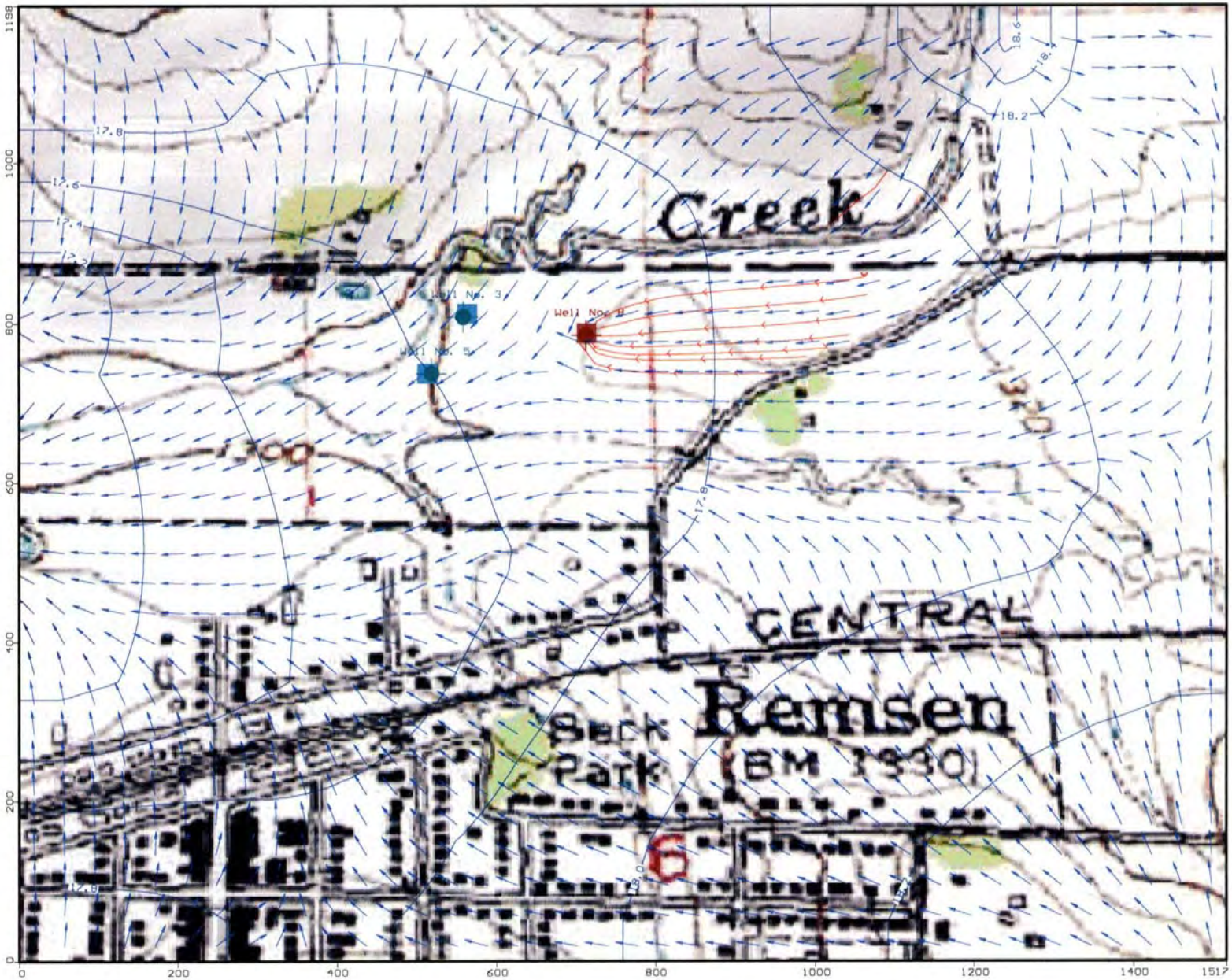


Figure 6
Well 8 On (Steady State)

Modeled Groundwater Flow Direction
Modeled Contaminant Flow Direction

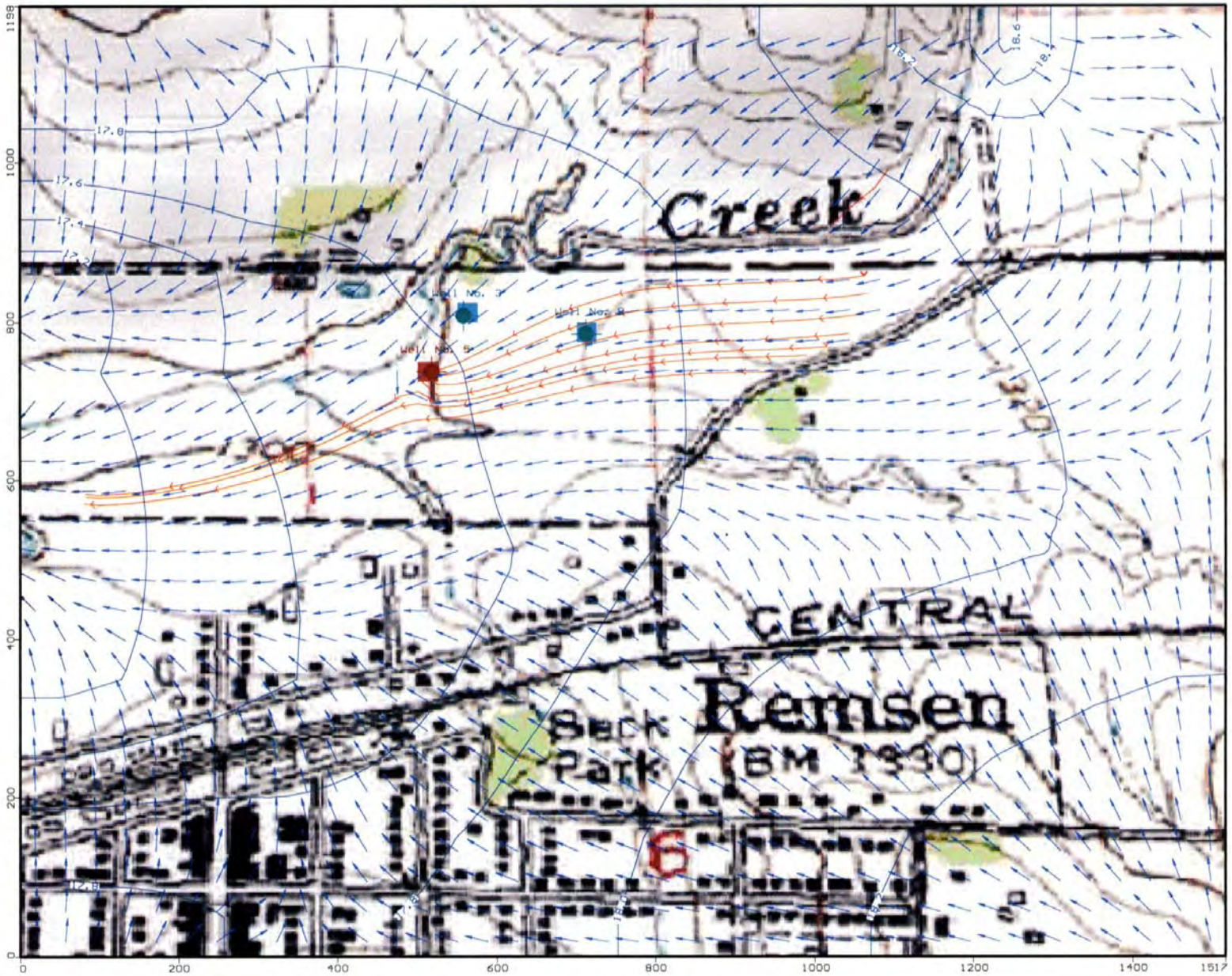


Figure 7
Well 5 On (Steady State)

Modeled Groundwater Flow Direction
Modeled Contaminant Flow Direction

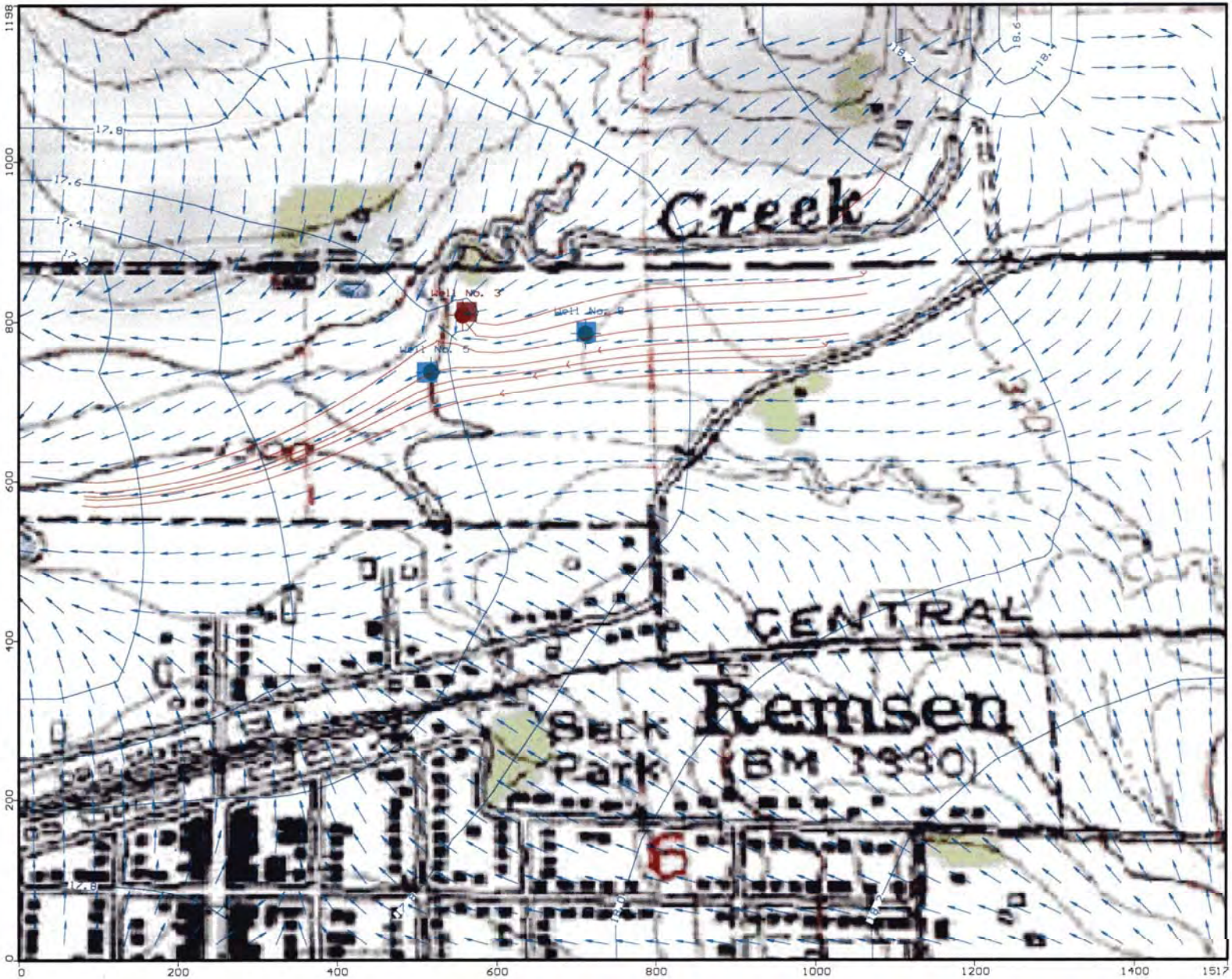


Figure 8
Well 3 On (Steady State)

Modeled Groundwater Flow Direction
Modeled Contaminant Flow Direction

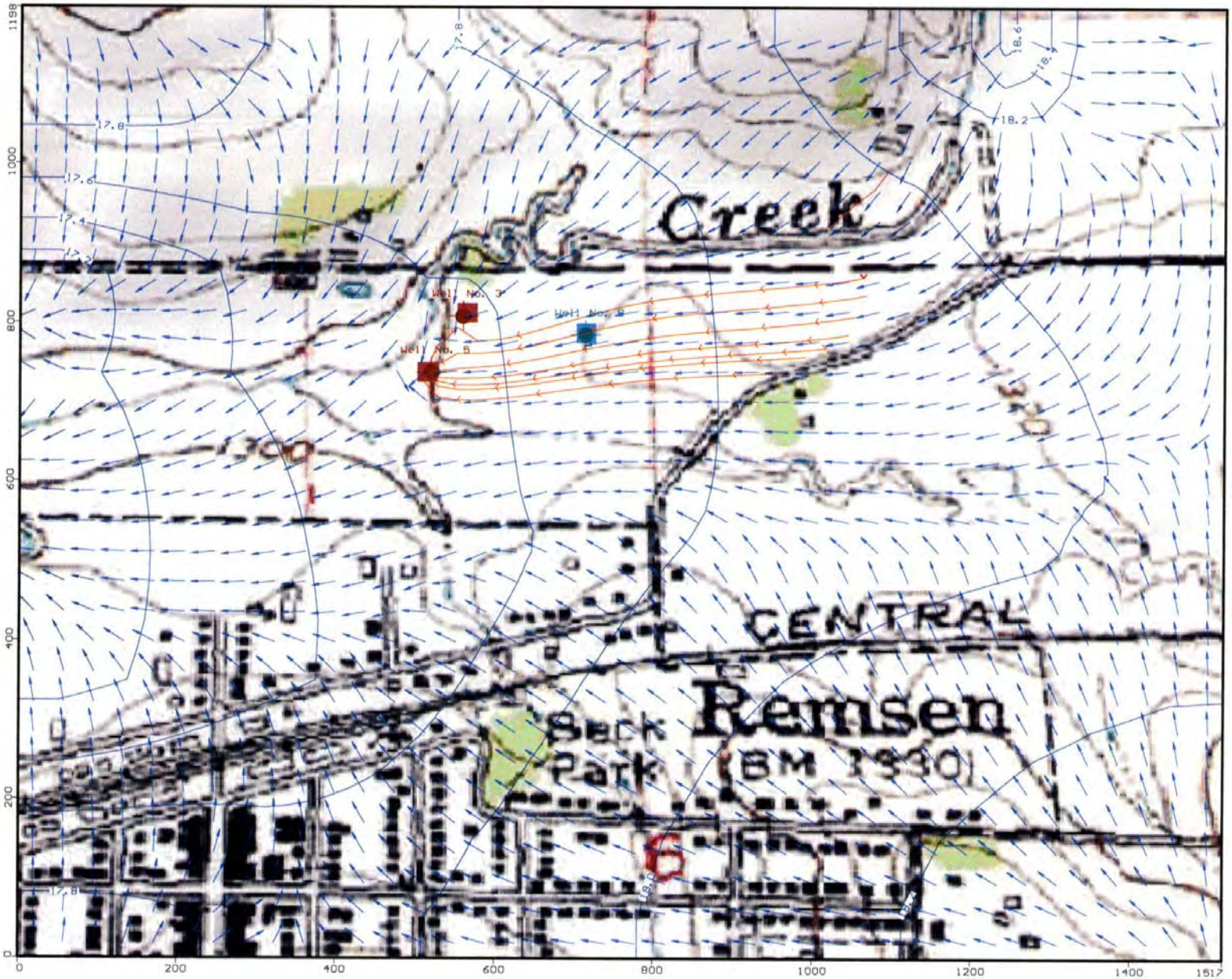
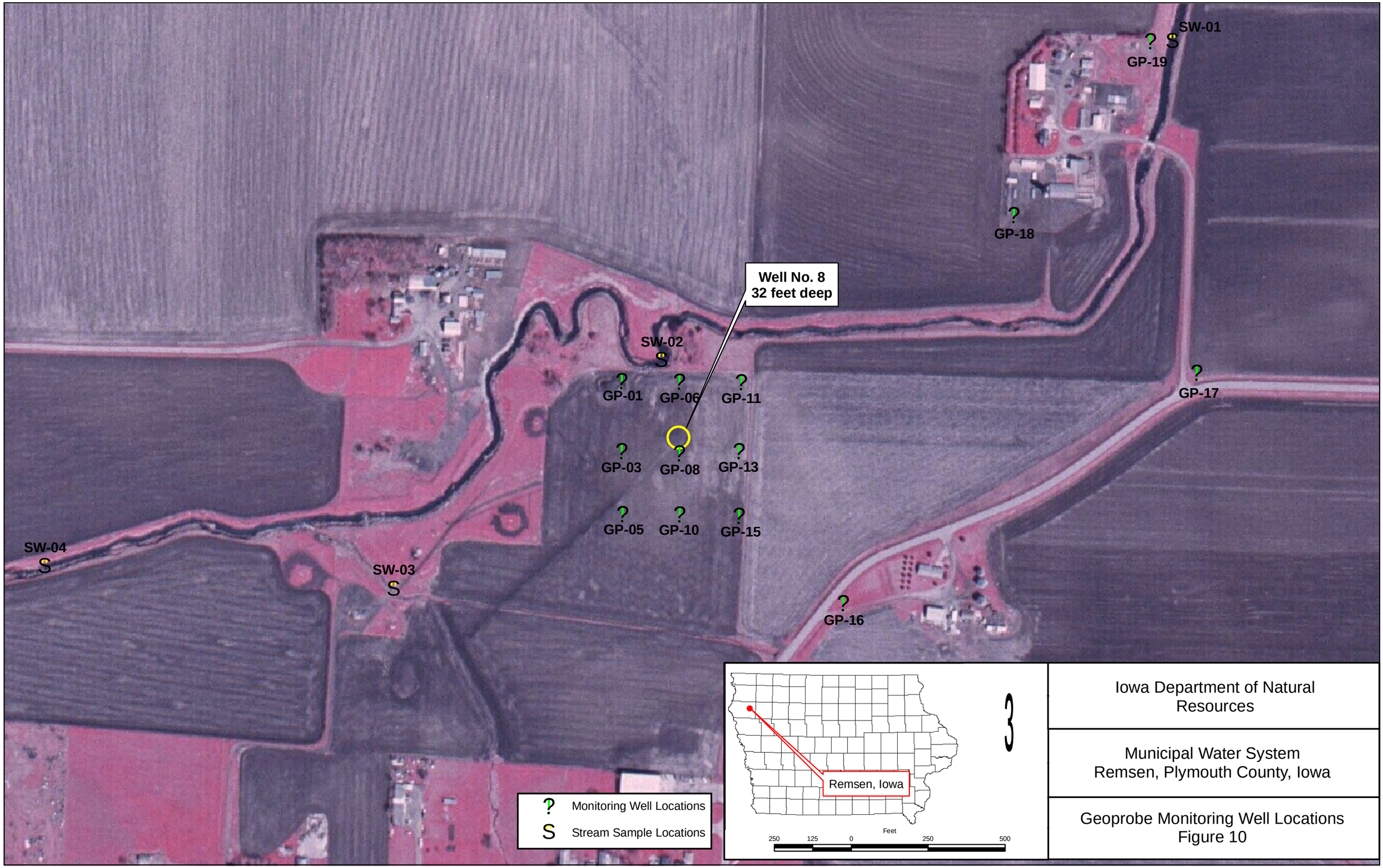


Figure 9
Wells 3 And 5 On (Steady State)

Modeled Groundwater Flow Direction
Modeled Contaminant Flow Direction



3

Iowa Department of Natural Resources

Municipal Water System
Remsen, Plymouth County, Iowa

Geoprobe Monitoring Well Locations
Figure 10

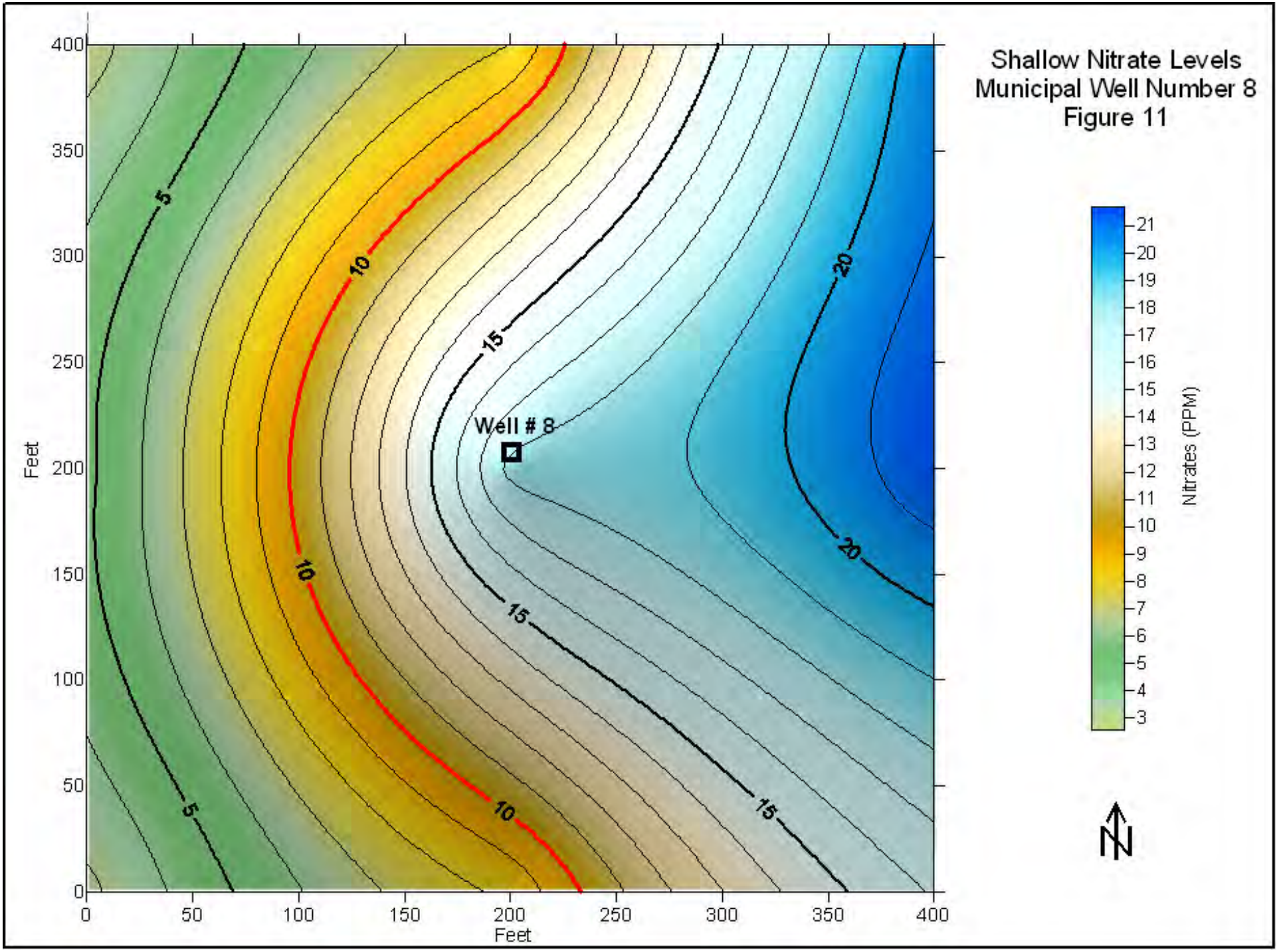
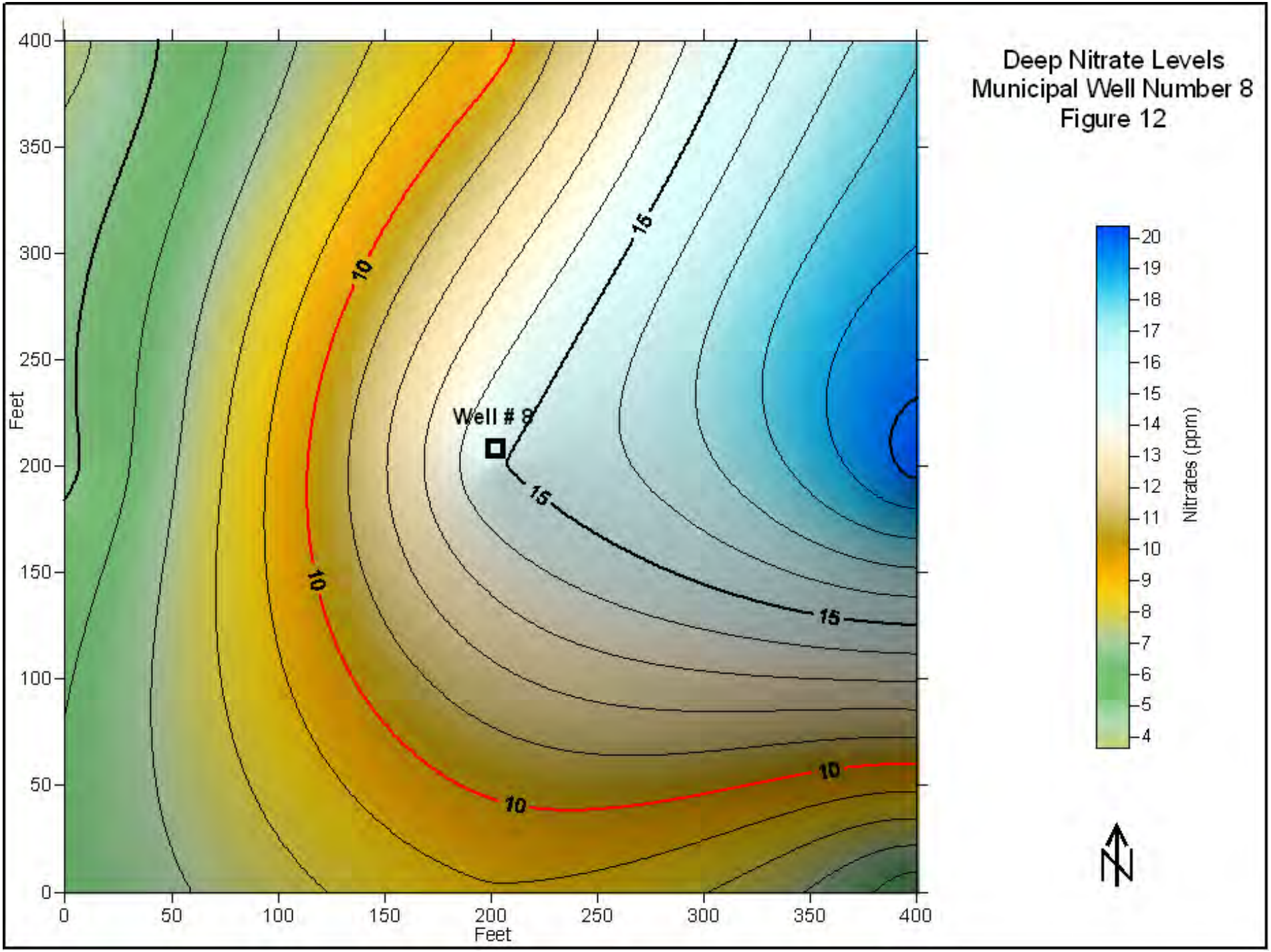

Shallow Nitrate Levels
Municipal Well Number 8
Figure 11
Well # 8
Feet
Feet
Nitrates (PPM)
0
50
100
150
200
250
300
350
400
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
N

Figure 11A
Shallow Nitrate Levels
(From Figure 11)


Deep Nitrate Levels
Municipal Well Number 8
Figure 12
Well # 8
10
15
Feet
Feet
0
50
100
150
200
250
300
350
400
Nitrates (ppm)
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
N

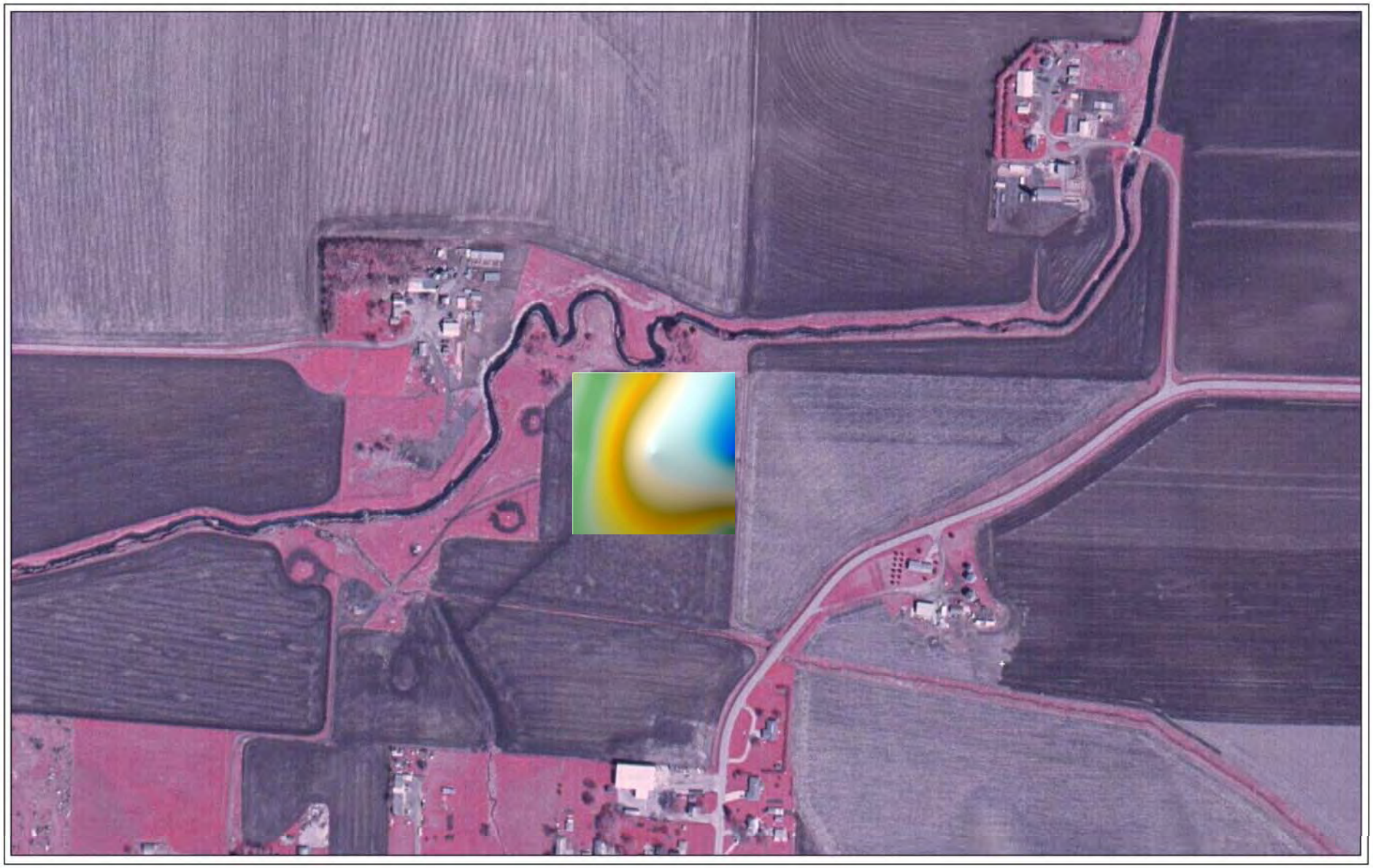


Figure 12A
Deep Nitrate Levels
(From Figure 12)

SOURCE WATER PROGRAM

SITE ASSESSMENT RESULTS

For the

REMSEN MUNICIPAL WATER SUPPLY
MUNICIPAL WELL #8

APPENDIX B

TABLES

Iowa Department of Natural Resources

Source Water Program

Remsen Municipal Water Supply

Groundwater/Surface Water Sample Results

All results in mg/L

Table 1

Sample	Nitrate	Ammonia
GP-01S	2.6	ND
GP-01D	3.6	ND
GP-03S	4.8	ND
GP-03D	4.7	ND
GP-05S	2.8	ND
GP-05D	6.1	ND
GP-06S	8.0	ND
GP-06D	9.4	ND
GP-08S	18.3	ND
GP-08D	14.9	ND
GP-10S	8.2	ND
GP-10D	8.9	ND
GP-11S	20.7	ND
GP-11D	17.9	ND
GP-13S	21.7	ND
GP-13D	20.4	ND
GP-15S	16.1	ND
GP-15D	5.3	ND
GP-16S	27.0	ND
GP-16D	ND	ND
GP-17S	6.5	ND
GP-17D	4.3	ND
GP-18S*	30+	ND
GP-18D*	30+	ND
GP-19S	ND	ND
GP-19D	ND	ND
SW-01	4.6	ND
SW-02	4.8	ND
SW-03	17.9	ND
SW-04	5.3	ND

* Samples exceeded method detection limit

ND - Not detected, analyte below method detection limit.

S - Shallow sample

D - Deep sample

Samples analyzed with a HACH DR 2800 Spectrophotometer

SOURCE WATER PROGRAM

SITE ASSESSMENT RESULTS

For the

REMSEN MUNICIPAL WATER SUPPLY
MUNICIPAL WELL #8

APPENDIX C

SAMPLE COLLECTION SHEETS

Sample Collection Field Sheet
Iowa Department of Natural Resources
Des Moines, Iowa

Project Name:	Remsen Municipal Water Supply	Project Manager:	Dan Cook
Address:	Municipal Well Field	Program:	SWP Site Assessment
City, State:	Remsen, Iowa		

Sample Number	GP-18D & 18S	Sample Matrix:	Groundwater
Latitude:	95° 57' 50.56" N	Collection Date:	July 29, 2008
Longitude:	42° 49' 27.34" W	Collection Time:	1:30 pm

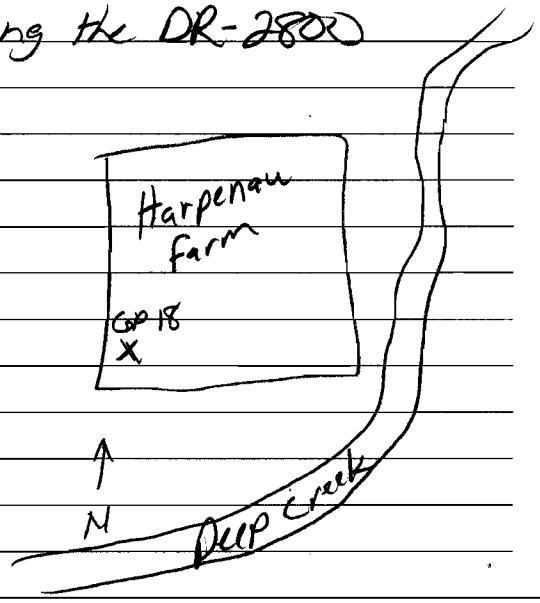
Container:	40 ml Vial	Analysis:	Nitrogen, Ammonia HACH Method 10205
			Nitrates, HACH Method 8039

Collection Notes:

Started GP-18 and pushed to 32 feet deep with the screenpoint 15. Purged 3 gallons of water then collected the deep sample. Pulled up the screen-point so the screen was 16-20 feet deep then purged 3 gallons of water and collected the shallow sample. Pulled up all the equipment and decon it.

Analyzed the samples using the DR-2800

	Nitrate	Ammonia
GP-18S	30+ ppm	ND
GP-18D	30+ ppm	ND



Sample Collection Field Sheet
Iowa Department of Natural Resources
Des Moines, Iowa

Project Name:	Remsen Municipal Water Supply	Project Manager:	Dan Cook
Address:	Municipal Well Field	Program:	SWP Site Assessment
City, State:	Remsen, Iowa		

Sample Number	GP-19S & 19D	Sample Matrix:	Groundwater
Latitude:	95° 57' 44.87" N	Collection Date:	July 29, 2008
Longitude:	42° 49' 33.04" W	Collection Time:	2:30pm

Container:	40 ml Vial	Analysis:	Nitrogen, Ammonia HACH Method 10205
			Nitrates, HACH Method 8039

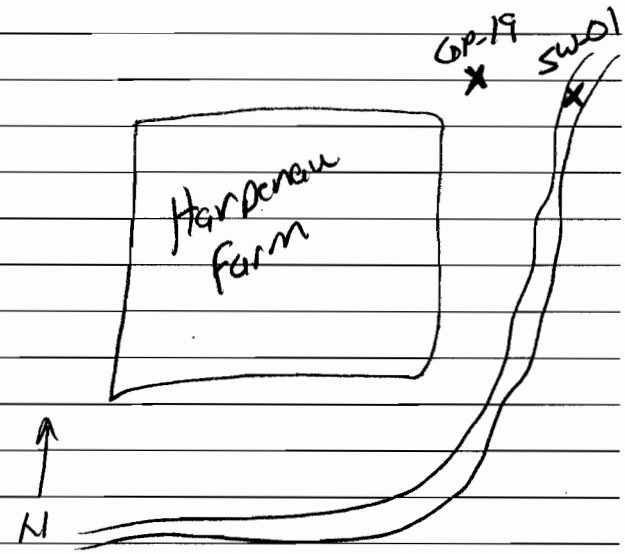
Collection Notes:

Started GP-19 by pushing to 40 feet but hit refusal at 37 feed deep - was going deeper because this location is elevated. Dry hole at 37 feet so came up 9 feet and found water at 28 feet deep. Collected the deep sample then pulled up 8 feet so the screen was 16-20 feet deep and collected the shallow sample. Pulled up all equipment and decon-ed.

DR-2800 Results

	Nitrate	Ammonia
GP-19S	ND	ND
GP-19D	ND	ND
SW-01	4.6ppm	ND

Collected SW-01 at this location



Sample Collection Field Sheet
Iowa Department of Natural Resources
Des Moines, Iowa

Project Name:	Remsen Municipal Water Supply	Project Manager:	Dan Cook
Address:	Municipal Well Field	Program:	SWP Site Assessment
City, State:	Remsen, Iowa		

Sample Number	GP-17S & 17D	Sample Matrix:	Groundwater
Latitude:	42° 49' 22.45" N	Collection Date:	July 29, 2008
Longitude:	95° 57' 42.33" W	Collection Time:	3:45pm

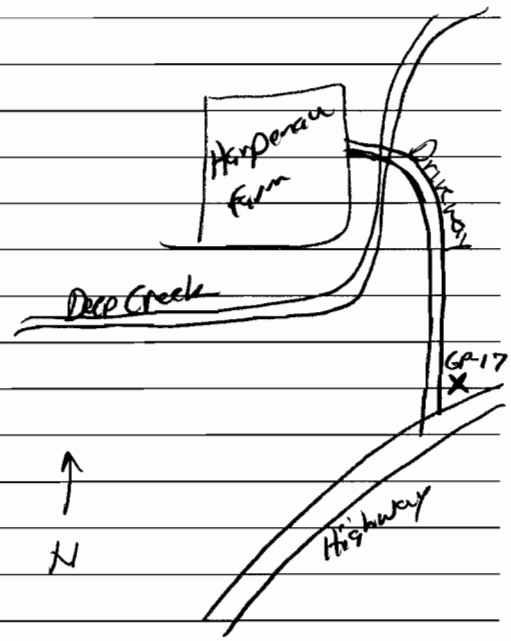
Container:	40 ml Vial	Analysis:	Nitrogen, Ammonia HACH Method 10205
			Nitrates, HACH Method 8039

Collection Notes:

Pushed GP-17 to 36 feet deep and collected the deep sample. Pull up the rods to place the screen 16-20 feet deep and collected the shallow sample. Pulled up all the equipment and decon-ed.

DR-2800 Sample Results

	Nitrate	Ammonia
GP-17S	6.5ppm	ND
GP-17D	4.3ppm	ND



Sample Collection Field Sheet
Iowa Department of Natural Resources
Des Moines, Iowa

Project Name:	Remsen Municipal Water Supply	Project Manager:	Dan Cook
Address:	Municipal Well Field	Program:	SWP Site Assessment
City, State:	Remsen, Iowa		

Sample Number	GP-16S & 16D	Sample Matrix:	Groundwater
Latitude:	42 ° 49 ' 14.7 " N	Collection Date:	July 29, 2008
Longitude:	95 ° 57 ' 57.35 " W	Collection Time:	5:10 pm

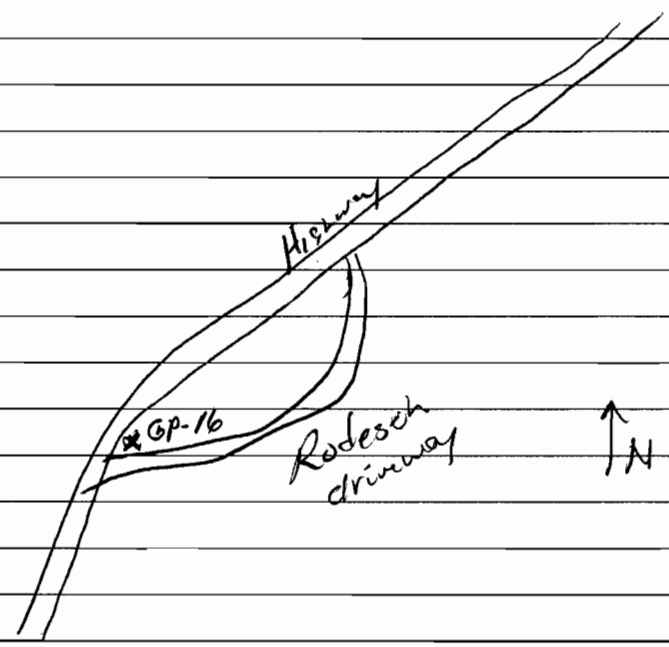
Container:	40 ml Vial	Analysis:	Nitrogen, Ammonia HACH Method 10205
			Nitrates, HACH Method 8039

Collection Notes:

Pushed GP-16 down to refusal at 33 feet deep and collected the Deep sample. Then pulled up to place the screen at 16 to 20 Feet deep and collected the shallow sample. Pulled up all equipment and decon-ed.

DR-2800 Sample Results

	Nitrate	Ammonia
GP-16S	27ppm	ND
GP-16D	ND	ND



Sample Collection Field Sheet
Iowa Department of Natural Resources
Des Moines, Iowa

Project Name:	Remsen Municipal Water Supply	Project Manager:	Dan Cook
Address:	Municipal Well Field	Program:	SWP Site Assessment
City, State:	Remsen, Iowa		

Sample Number	GP-11S & 11D	Sample Matrix:	Groundwater
Latitude:	42° 49' 21.81" N	Collection Date:	July 30, 2008
Longitude:	95° 58' 2.03" W	Collection Time:	7:30am

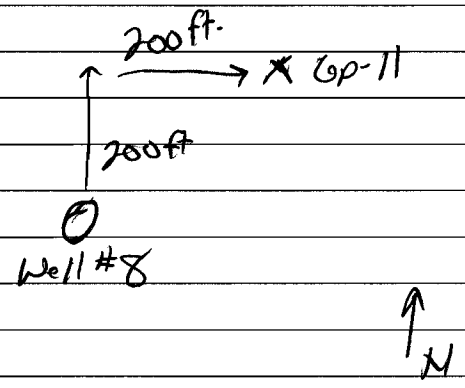
Container:	40 ml Vial	Analysis:	Nitrogen, Ammonia HACH Method 10205
			Nitrates, HACH Method 8039

Collection Notes:

Push GP-11 to 32 feet but found dry hole - pulled up 4 feet and found water the collected deep sample. Pulled up to place the screen at 16 to 20 feet deep and collected shallow sample. Pulled up all equipment and decon'd.

DR-2800 sample results

	Nitrate	Ammonia
GP-11S	20.7ppm	ND
GP-11D	17.9ppm	ND



Sample Collection Field Sheet
Iowa Department of Natural Resources
Des Moines, Iowa

Project Name:	Remsen Municipal Water Supply	Project Manager:	Dan Cook
Address:	Municipal Well Field	Program:	SWP Site Assessment
City, State:	Remsen, Iowa		

Sample Number	GP-13S & 13D	Sample Matrix:	Groundwater
Latitude:	42° 49' 19.46" N	Collection Date:	July 30, 2008
Longitude:	95° 58' 2.0" W	Collection Time:	8:40am

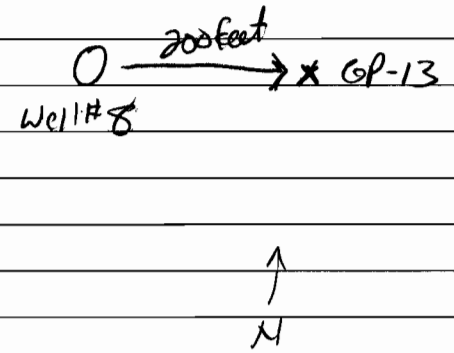
Container:	40 ml Vial	Analysis:	Nitrogen, Ammonia HACH Method 10205
			Nitrates, HACH Method 8039

Collection Notes:

Pushed GP-13 to 36 feet deep because it was up on a rise then collected deep sample after a 3 gallon purge. Pulled up rods so the screen was 16 to 20 feet deep then collected the shallow sample after a 3 gallon purge. Pulled up all equipment and deconed.

DR-2800 Sample Results

	Nitrate	Ammonia
GP-13S	21.7ppm	ND
GP-13D	20.4ppm	ND



Sample Collection Field Sheet
Iowa Department of Natural Resources
Des Moines, Iowa

Project Name:	Remsen Municipal Water Supply	Project Manager:	Dan Cook
Address:	Municipal Well Field	Program:	SWP Site Assessment
City, State:	Remsen, Iowa		

Sample Number	GP-15S + 15D	Sample Matrix:	Groundwater
Latitude:	42° 49' 17.41" N	Collection Date:	July 30, 2008
Longitude:	95° 58' 1.9" W	Collection Time:	9:45pm

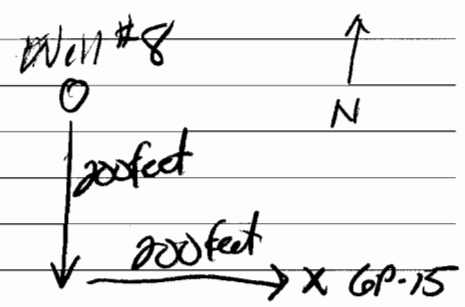
Container:	40 ml Vial	Analysis:	Nitrogen, Ammonia HACH Method 10205
			Nitrates, HACH Method 8039

Collection Notes:

Pushed GP-15 down to 32 feet deep and purged 3 gallons of water then collected the deep sample. Pulled up to place the screen at 16 to 20 feet deep, purged 3 gallons and collected the shallow sample. Pulled up all equipment and deconed.

DR-2800 Sample Results

	Nitrate	Ammonia
GP-15S	16.1ppm	ND
GP-15D	5.3ppm	ND



Sample Collection Field Sheet
Iowa Department of Natural Resources
Des Moines, Iowa

Project Name:	Remsen Municipal Water Supply	Project Manager:	Dan Cook
Address:	Municipal Well Field	Program:	SWP Site Assessment
City, State:	Remsen, Iowa		

Sample Number	GP-10S & 10D	Sample Matrix:	Groundwater
Latitude:	42° 49' 17.36" N	Collection Date:	July 30, 2008
Longitude:	95° 58' 4.6" W	Collection Time:	10:30am

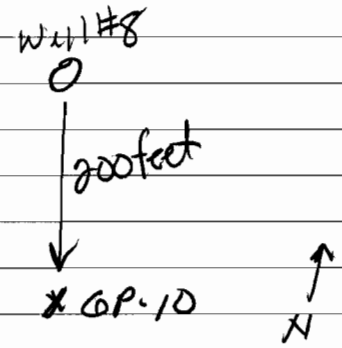
Container:	40 ml Vial	Analysis:	Nitrogen, Ammonia HACH Method 10205
			Nitrates, HACH Method 8039

Collection Notes:

Pushed GP-10 down to 32 feet, purged 3 gallons the collected the deep sample. Pulled up the rod to place the screen at 16 to 20 feet deep and purged 3 gallons the collected the shallow sample. Pull up all the equipment and decond.

DR-2800 Sample Results

	Nitrate	Ammonia
GP-10S	8.2ppm	ND
GP-10D	8.9ppm	ND



Sample Collection Field Sheet
Iowa Department of Natural Resources
Des Moines, Iowa

Project Name:	Remsen Municipal Water Supply	Project Manager:	Dan Cook
Address:	Municipal Well Field	Program:	SWP Site Assessment
City, State:	Remsen, Iowa		

Sample Number	GP-06S & 06D	Sample Matrix:	Groundwater
Latitude:	42° 49' 21.82" N	Collection Date:	July 30, 2008
Longitude:	95° 58' 4.83" W	Collection Time:	12:30pm

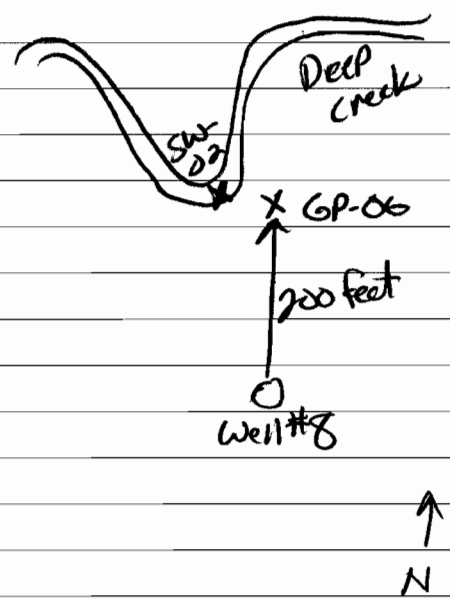
Container:	40 ml Vial	Analysis:	Nitrogen, Ammonia HACH Method 10205
			Nitrates, HACH Method 8039

Collection Notes:

Pushed GP-06 down to 32 feet deep, purged 3 gallons of water and collected the Deep sample. Pulled up the rods to place the screen at 16-20 feet deep. Purged 3 gallons then collected the shallow sample. Pulled up all equipment then deconed. Also collected the mid-stream sample SW-02

DR-2800 Sample Results

	Nitrate	Ammonia
GP-06S	8.0ppm	ND
GP-06D	9.4ppm	ND
SW-02	4.8ppm	ND



Sample Collection Field Sheet
Iowa Department of Natural Resources
Des Moines, Iowa

Project Name:	Remsen Municipal Water Supply	Project Manager:	Dan Cook
Address:	Municipal Well Field	Program:	SWP Site Assessment
City, State:	Remsen, Iowa		

Sample Number	GP-01S & 01D	Sample Matrix:	Groundwater
Latitude:	42° 49' 21.77" N	Collection Date:	July 30, 2008
Longitude:	95° 58' 7.35" W	Collection Time:	1:35pm

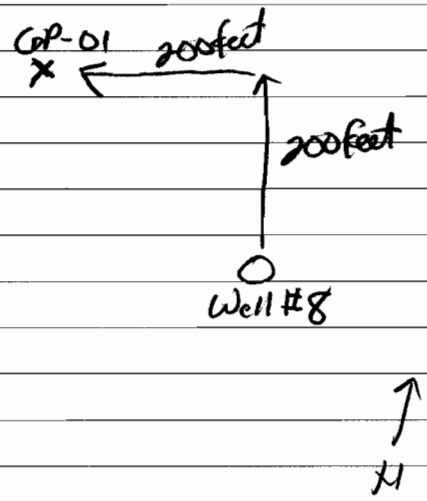
Container:	40 ml Vial	Analysis:	Nitrogen, Ammonia HACH Method 10205
			Nitrates, HACH Method 8039

Collection Notes:

Pushed GP-01 down to 32 feet deep and purged 3 gallons of water then collected the deep sample. Pulled up the rods to place the screen at 16 to 20 feet deep. Purged 3 gallons then collected the shallow sample. Pulled up all the rods and decorced.

DR-2800 Sample Results

	Nitrate	Ammonia
GP-01S	2.6ppm	ND
GP-01D	3.6ppm	ND



Sample Collection Field Sheet
Iowa Department of Natural Resources
Des Moines, Iowa

Project Name:	Remsen Municipal Water Supply	Project Manager:	Dan Cook
Address:	Municipal Well Field	Program:	SWP Site Assessment
City, State:	Remsen, Iowa		

Sample Number	GP-03S & 03D	Sample Matrix:	Groundwater
Latitude:	42° 49' 19.32" N	Collection Date:	July 30, 2008
Longitude:	95° 58' 7.23" W	Collection Time:	2:15pm

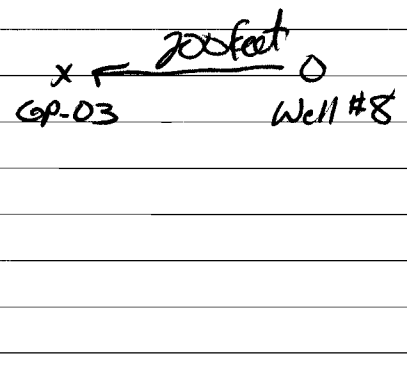
Container:	40 ml Vial	Analysis:	Nitrogen, Ammonia HACH Method 10205
			Nitrates, HACH Method 8039

Collection Notes:

Pushed GP-03 down to 32 feet purged 3 gallons of water then collected the deep sample. Pulled up the rod to place the screen at 16 to 20 feet deep. Purged 3 gallons then collected the shallow sample. Pulled up all the rods and decon'd.

DR-2800 Sample Results

	Nitrate	Ammonia
GP-03S	4.8ppm	ND
GP-03D	4.7ppm	ND



Sample Collection Field Sheet
Iowa Department of Natural Resources
Des Moines, Iowa

Project Name:	Remsen Municipal Water Supply	Project Manager:	Dan Cook
Address:	Municipal Well Field	Program:	SWP Site Assessment
City, State:	Remsen, Iowa		

Sample Number	GP-08S & 08D	Sample Matrix:	Groundwater
Latitude:	42° 49' 19.44" N	Collection Date:	July 30, 2008
Longitude:	95° 58' 4.75" W	Collection Time:	3:00pm

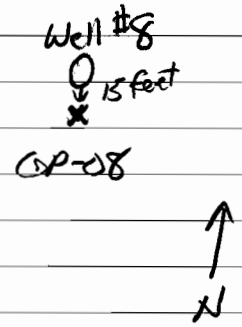
Container:	40 ml Vial	Analysis:	Nitrogen, Ammonia HACH Method 10205
			Nitrates, HACH Method 8039

Collection Notes:

Pushed GP-08 down to 38 feet deep (up on a rise), purged 3 gallons of water, then collected the deep sample. Pulled up the rods to place the screen at 16 to 20 feet deep, purged 3 gallons of water and collected the shallow sample. Pulled up all rods and deconed.

DR-2800 Sample Results

	Nitrate	Ammonia
GP-08S	18.3 ppm	ND
GP-08D	14.9 ppm	ND



Sample Collection Field Sheet
Iowa Department of Natural Resources
Des Moines, Iowa

Project Name:	Remsen Municipal Water Supply	Project Manager:	Dan Cook
Address:	Municipal Well Field	Program:	SWP Site Assessment
City, State:	Remsen, Iowa		

Sample Number	GP-05S & 05	Sample Matrix:	Groundwater
Latitude:	42° 49' 17.26" N	Collection Date:	July 30, 2008
Longitude:	95° 58' 7.12" W	Collection Time:	3:45 pm

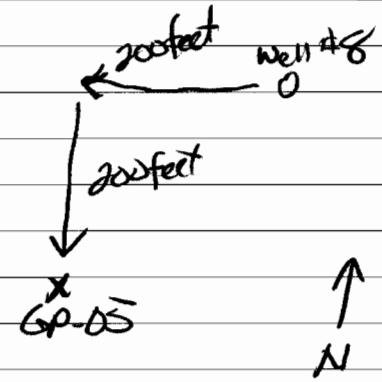
Container:	40 ml Vial	Analysis:	Nitrogen, Ammonia HACH Method 10205
			Nitrates, HACH Method 8039

Collection Notes:

Pushed GP-05 down to 32 feet deep, purged 3 gallons of water and collected the deep sample. Pulled up the rods until the screen was 16 to 20 feet deep. Purged 3 gallons of water the colleted the shallow sample. Pulled up all the equipment and deconed.

DR-2800 Sample Results

	Nitrate	Ammonia
GP-05S	2.8 ppm	ND
GP-05D	6.1 ppm	ND



Sample Collection Field Sheet
Iowa Department of Natural Resources
Des Moines, Iowa

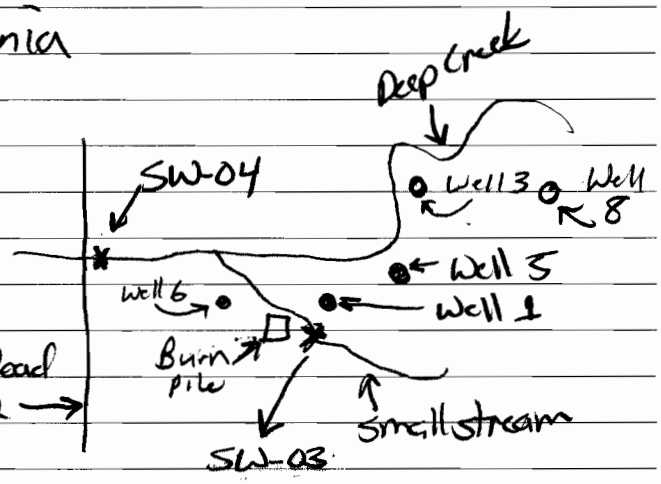
Project Name:	Remsen Municipal Water Supply	Project Manager:	Dan Cook
Address:	Municipal Well Field	Program:	SWP Site Assessment
City, State:	Remsen, Iowa		

Sample Number	SW-03 and SW-04	Sample Matrix:	Surface Water ~~Groundwater~~
Latitude:	___ ° ___ ' ___ " N	Collection Date:	July 30, 2008
Longitude:	___ ° ___ ' ___ " W	Collection Time:	4:30pm

Container:	40 ml Vial	Analysis:	Nitrogen, Ammonia HACH Method 10205
			Nitrates, HACH Method 8039

Collection Notes:

Collected surface water SW-03 from the little creek running by the burn pile near Municipal Well #1. Then went to the highway on the west side of the well field and collected surface water sample SW-04 from the Deep Creek bridge.

DR-2800 Sample Results

	Nitrate	Ammonia
SW-03	17.9 ppm	ND
SW-04	5.3 ppm	ND