

Appendix E

Other Groundwater Information Sources



Barr Engineering Company
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Minneapolis, MN • Hibbing, MN • Duluth, MN • Ann Arbor, MI • Jefferson City, MO

Technical Memorandum

To: File
From: Jim Eidem
Subject: Well Search, UMore Park
Date: October 1, 2008
Project: 23/19-0B05.03

This technical memorandum has been prepared to document the methods by which the well search for the above referenced project was conducted.

County Well Index Search

The well search was conducted with the use of the web-based County Well Index (CWI) data system which is maintained by the Minnesota Department of Health. The data system is available to public users for the storage and retrieval of water-well information. Output from the CWI includes a well logs with descriptions of the geologic units encountered, well construction information and approximate depth to water measurements and a map illustrating approximate well locations.

The CWI search area included the property within UMore Park and neighboring PLS sections. The search area was by Township/Range/Section and the returned well logs were catalogued. Table 1 provides a summary of the CWI records.

Additional Well Search

In addition to the CWI search, well logs and information were gathered from additional sources. These additional sources included the University of Minnesota, Dakota County, and information published from the Environmental Impact Statement prepared for the Empire Sand and Gravel Mining District located southwest of UMore Park. Data from these sources are also included in Table 1.

Technical Memorandum

To: File

From: JME

Subject: Well Search, UMore Park

Date: October 1, 2008

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Data Review and Well Selection

The resultant well logs were reviewed to determine which existing wells may provide data useful for the hydrogeologic assessment. The following screening criteria were applied to the wells identified during the well search and specific wells were not considered useable if the well was:

- sealed;
- completed across multiple aquifers;
- completed in the Jordan aquifer (or deeper);
- located greater than ½ mile off-site (with a few exceptions);
- located off-site and used for domestic water supply; or
- the well log was incomplete (e.g. missing well construction or aquifer information).

After the initial screening with the criteria above, a site reconnaissance visit was conducted to locate wells that passed the screening. A number of wells that passed the screening criteria were not located during the site visit and thus were not considered for future use. Additional wells were removed from the list (rejected as 'not needed' in Table 1) if a nearby well that was selected for future use provided comparable data (i.e., if two Prairie du Chien wells were located within a ½ mile for each other, only one would be used for monitoring).

The final screening results are summarized in Table 1. The wells that were rejected based on the screening criteria are displayed as shaded records and wells that passed are included in non-shaded records. With permission from well/property owners and pending accessibility for a water level indicator probe, the wells that passed the screening criteria will be used to collect groundwater elevation data to supplement the hydrogeologic assessment data set.

**TABLE 1 - APPENDIX E
WELL SEARCH RESULTS**
UMore Park
Dakota County, Minnesota

MN Unique Well ID Number	Alternate ID Number	Location			PLLS Location				Listed Well Use	Ground Surface Elev (ft MSL)	Well Depth (ft bgs)	Aquifer	Data Source	Rejection Criteria	Comments
		On-Site	Off-Site	unknown	Township (north)	Range (west)	Sec	subSec							
100962			x		114	19	5	DDDAAB	Domestic	955	155	PDC	CWI	OS,DW	
101068			x		115	19	25	ADCBCD	Domestic	980	152	PDC	CWI	OS,DW	
101119			x		115	19	32	DADAAC	Domestic	954	200	PDC	CWI	OS,DW	
101181			x		115	19	32	ADAAAA	Domestic	951	220	PDC	CWI	OS,DW	
121082			x		115	19	36	DDDDCC	Domestic	910	365	Jordan	CWI	OS,TD	
124315			x		114	19	10	BAABAC	Domestic	937	135	PDC	CWI	OS,DW	
136548			x		115	19	32	BCCDCD	Sealed	941	200	PDC	CWI	SL	
145827			x		115	19	36	ADDCCD	Domestic	920	320	Jordan	CWI	OS,TD	
170826			x		115	19	36	DDDACD	Domestic	912	290	Jordan	CWI	OS,TD	
174675	2		x		115	19	27	DBCCCC	Domestic	941	178	PDC	CWI	OS,DW	Across 145th St from site, E of City Hall
179702			x		114	19	5	DCDCDC	Domestic	942	145	SP	CWI	OS,DW	
185278	Well #2	x			114	19	4	BCDCBC	Irrigation	951	310	PDC	CWI		UofM ownership, well #2
198269			x		115	19	32	CCACBB	Domestic	949	200	SP-PDC	CWI	MA	
207604			x		114	19	3	CCDBDD	Domestic	935	935		CWI	TD	
207605		x			114	19	3	BBAAAD	Domestic	943	206	PDC	CWI		Ag Eng.
207606	19	x			114	19	4	BBACBB	Sealed	954	429		CWI	SL	
207607		x			114	19	4	AAACBC	Domestic	945	170	PDC	CWI	NN	Use 208402
207608		x			114	19	4	DACADD	Public	948	415	Jordan	CWI	TD	
207611					115	19	26		Com supply	937	411		CWI	TD, ID	didn't show in intial CWI search; DNR
207612			x		115	19	26	AADADB	Domestic	895	177	PDC	CWI	OS,DW	
207613			x		115	19	26	BDDDBD	Domestic	938	178		CWI	OS,DW,ID	
207614			x	x	115	19	27	ADCDDD	Domestic	935	155	PDC	CWI	NF	
207615	4	x			115	19	33	ADBACC	Domestic	955	432		CWI	TD,ID	
207616	5	x			115	19	33	ABBBBC	Irrigation	954	221	SPPDC	CWI	MA	
207617	6	x			115	19	33	CDBBAA	Domestic	950	434		CWI	TD,ID	
207618		x			115	19	35	BADBAB	Com supply	935	390	Jor/StL	CWI	MA	
207619			x		115	19	25	BDCCCC	Domestic	965	380	Jordan	CWI	TD	
208400	1	x			115	19	28	DCCCBB	Unknown	950	153	SPPDC	CWI	MA	
208402		x			115	19	33	DDDCC	Domestic	950	166	PDC	CWI		UofM Admin bld
208403		x			115	19	34	AABBC	Unknown	940	188	QBAA	CWI		owner: US Naval Facility
208404		x			115	19	34	BABBD	Domestic	940	115	QBAA	CWI		UofM ownership - north beef farm
208405		x			115	19	34	CCCCD	Domestic	953	236	PDC	CWI	NN	Use 208402
216240			x		114	19	9	ABBCAD	Domestic	955	182	PDC	CWI	OS,DW	
216473			x		115	19	25	BCCBAC	Domestic	950	169	QU	CWI	OS,DW	North of site on Blaine Ave (CR 71)
224320		X		x	115	19	34	BAA	Domestic	940	134	QBAA	CWI	NN	Use 208404
224364				x	115	19	35	CCCA	Domestic		73		CWI	NF	UofM ownership
224365				x	115	19	35	CACC	Domestic		50		CWI	NF	UofM ownership
224376				x	115	19	35	CBCD	Domestic		73		CWI	NF	UofM ownership
227460	T00019, MW21D	x			115	19	36	BCCDCC	Unknown	922	88	SPPDC ?			
232246				x	115	19	32	CDCCCB	Unknown	952	325	PDC	CWI	NF	
235758	23	x			114	19	1	BACDCA	Unknown	915			CWI	ID	boring?
239823			x		115	19	28			960	207		CWI	OS,ID	Far north of Site
243747		x		x	115	19	26	DCD	Unknown	930	156	PDC	CWI	NF	DNR Observ Well 19016
243767	T00006	x			115	19	35	CCC	Sealed	921	102	QWTA	CWI	SL	MW-9D, DNR obs well 19042
249104			x		115	19	25	DADACB	Domestic	921	560	Multiple	CWI	MA	
249519		x		x	115	19	34	AABB		938			CWI	NF	
249520		x		x	115	19	34	AABC		941			CWI	NF	
255137				x	114	19	4	CCCCCD	Scientific	954	80	Q	CWI	NF	detailed log by AET; boring?
255138				x	114	19	4		Scientific	958	85		CWI	NF	detailed log by AET; boring?
255139	22	x			114	19	2	CCCCCB	Sealed	941	78		CWI	SL	

**TABLE 1 - APPENDIX E
WELL SEARCH RESULTS**
UMore Park
Dakota County, Minnesota

MN Unique Well ID Number	Alternate ID Number	Location			PLLS Location				Listed Well Use	Ground Surface Elev (ft MSL)	Well Depth (ft bgs)	Aquifer	Data Source	Rejection Criteria	Comments
		On-Site	Off-Site	unknown	Township (north)	Range (west)	Sec	subSec							
255140				x	114	19	1	CBCB	Scientific	928	50		CWI	ID	boring?
328874		x			114	19	4	AAC	Sealed		59		CWI	SL	
407103			x		114	19	5	CBCBDD	Domestic	950	218	SP-PDC	CWI	MA	
412400			x		115	19	27	ADCCDB	Domestic	936	380	Jordan	CWI	TD	
425291	MW28	x			115	19	36	BCBCCC	Test well	930	230	PDC	CWI		10yr GW elevation data
425292	MW29	x			115	19	36	CBCBCB	Test well	926	230	PDC	CWI		10yr GW elevation data
425293	17	x			115	19	36	CBBCCC	Sealed	926	291	Jordan	CWI	SL	
429488	MW1		x	x	114	19	10		Monitor		52	SP	UofM		
429489		x			115	19	34		Sealed		68		CWI	SL	
434005	12	x			115	19	35	ACBCCB	Sealed	934	107	PDC	CWI	SL	
434006	13	x			115	19	35	BDDDBB	Sealed	934	84	QBUA	CWI	SL	
441909	3	x			115	19	27	DCDDBB	Domestic	940	380	Jordan	CWI	TD	
441911	11	x			115	19	34	BABBAD	Domestic	935	420	Jordan	CWI	TD	
441912		x			115	19	34	BA	Domestic		120?		CWI	SL	
441915			x		114	19	8	AAABBD	Domestic	938	150	SP	CWI	OS,DW	
450888				x	115	19	25		Sealed		60		CWI	SL	
450889				x	115	19	25		Sealed		94		CWI	SL	
450890				x	115	19	25		Sealed		84		CWI	SL	
457126			x	x	115	19	27	ADC	Monitor		245		CWI		
457167			x		115	19	27		Com supply	940	400	Jordan	CWI	TD	didn't show in intial CWI search; DNR
506638			x		115	19	32	DCCDBB	Domestic	952	198	PDC	CWI	OS,DW	
507991	MP1E			x	115	19	25		Monitor		78		CWI	NF	UofM ownership, WT well
507992	T00020, MW22			x	115	19	25		Sealed?		63		UofM		UofM Data available
513925	MW1		x		114	19	12	BAA	Monitor		50	Q-sp/cl	UofM	NN	Use 539518
513927	MW3		x		114	19	12	BAA	Monitor		68	Q-cl	UofM	NN	Use 539518
513928	MW4		x		114	19	12	BAA	Monitor		47	Q-cl	UofM	NN	Use 539518
539514	MW6		x		114	19	12	BAA	Monitor		68	Q-sp/ml	UofM	NN	Use 539518
539515	MW8		x		114	19	12	BAA	Monitor		68	Q-cl/sl	UofM	NN	Use 539518
539516	MW7		x		114	19	12	BAA	Monitor		51	Q	UofM	NN	Use 539518
539517	MW9		x		114	19	12	BAA	Monitor		50	Q	UofM	NN	Use 539518
539518	MW2		x		114	19	1	DCD	Monitor		68	Q	CWI		
539519	MW10		x		114	19	12	DCD	Monitor		51	Q	UofM	NN	Use 539518
540395	MW13		x		114	19	1	DCD	Monitor		99	PDC	CWI		
540396	MW12		x		114	19	12	BAA	Monitor		110	PDC	UofM	NN	Use 540395
543862	MW1	x			114	19	3	BBD	Sealed		65	Q	CWI	SL	PEER study of MPCA Leak #2529
543863	MW2	x			114	19	3	BBD	Sealed		65	Q	CWI	SL	PEER study of MPCA Leak #2529
543864	MW3	x			114	19	3	BBD	Sealed		65	Q	CWI	SL	PEER study of MPCA Leak #2529
575906	MW1	x		x	114	19	4	ADA	Monitor				Delta	NF	
585110					115	18	33	BBBCBD	Domestic	895	360	JOR-STL		TD	
585147					115	18	33	BCCABB	Domestic	899	360	JOR-STL		TD	
585160			x		115	19	36		Domestic		320		CWI	OS,DW	
590636				x	114	19	1		Industrial		320		CWI	TD	SKB well
629447			x		114	19	9	AABACB	Domestic	957	177	PDC	CWI	OS,DW	
635497	MW2	x			114	19	4	DAA	Sealed		50		CWI	SL	
635498	MW3	x			114	19	4	DAA	Sealed		50		CWI	SL	
635499	MW4	x			114	19	4	DAA	Sealed		59		CWI	SL	
642485		x			115	19	35	DCB	Domestic		340	Jordan	CWI	TD	UofM ownership
651999			x		114	19	3	CDB	Irrigation		320		CWI	TD,ID	
658488			x		114	19	5	DAA	Domestic		180		CWI	OS,DW	
672575			x		115	19	32	ACD	Irrigation		330		CWI	OS,ID	

**TABLE 1 - APPENDIX E
WELL SEARCH RESULTS**
UMore Park
Dakota County, Minnesota

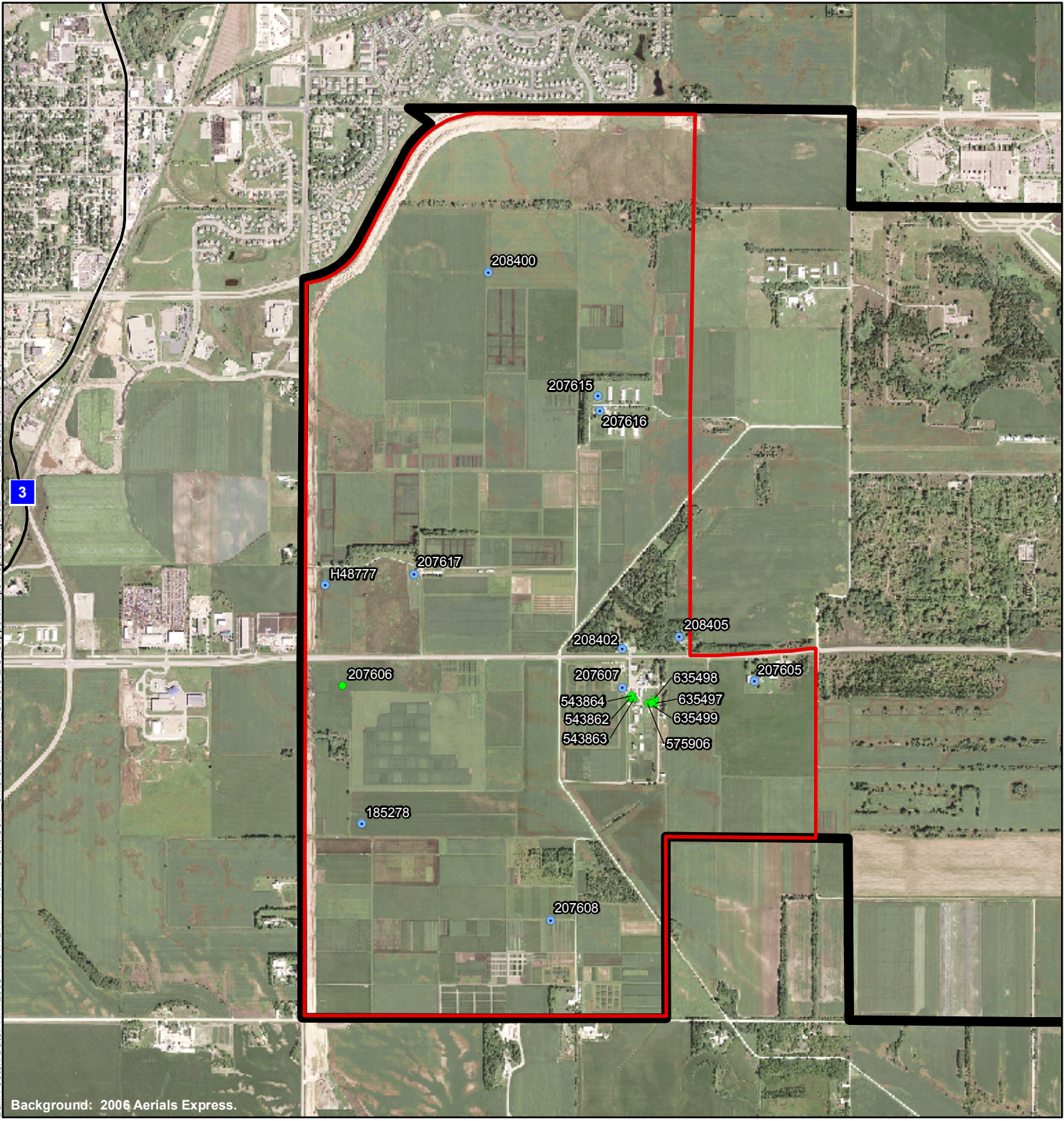
MN Unique Well ID Number	Alternate ID Number	Location			PLLS Location				Listed Well Use	Ground Surface Elev (ft MSL)	Well Depth (ft bgs)	Aquifer	Data Source	Rejection Criteria	Comments
		On-Site	Off-Site	unknown	Township (north)	Range (west)	Sec	subSec							
678244			x		115	19	32	ABCDDDB	Test well	965	467	Jordan	CWI	TD,OS	
683049			x		114	19	1	DDC	Domestic		275		CWI	OS,DW	
698456			x		114	19	16	AAA	Monitor		19	Q	CWI		Empire S&G MW
698459			x		114	19	8	AAD	Monitor		50.5	Q	CWI		Empire S&G MW
698460			x		114	19	6	DBD	Monitor		80.5	Q	CWI		Empire S&G MW
698461			x		114	19	6	BBB	Monitor		56	Q	CWI		Empire S&G MW
698462	MW4			x	114	19	5	CCC	Monitor		64.4		CWI		Empire S&G MW
706804			x		115	19	32	ABCDAD	Com supply	965	475	Jordan	CWI	TD,OS	
712760			x		115	19	36	DDD	Domestic		320		CWI	OS,DW	
745851		x			115	19	26	DAA	Domestic		420		CWI	TD, ID	
19W0000043			x		115	19	36	DA	Domestic	928	130		CWI	OS,DW	
19W0000103			x		115	19	27	AC	Domestic				CWI	OS,DW,ID	
19W0000282			x		115	19	36	DD	Domestic				CWI	OS,DW	
19W0000424			x		115	19	26	A	Domestic				CWI	OS,DW,ID	
19W0000641			x		114	19	5	CB	Domestic				CWI	OS,DW	
19W0000842	T00022, MW23D		x		115	19	25	DA	Monitor				UofM		UofM Data available
19W0020005				x	114	19	1	DCDCCD	Unknown	928			CWI	NF	
	T000023, MW5		x		115	19	13		Monitor				Delta	OS,ID	UofM monitoring well

Notes:

Shading indicates well is not considered for data collection
Domestic - indicates well is used for domestic water supply
Sealed - indicates well has been sealed/decommissioned
Irrigation - well used for crop irrigation water supply
Com supply - well used for community water supply
Monitor - well used for monitoring purposes
SP - St. Peter Formation
PDC - Prairie du Chien Group
Jordan - Jordan Formation
STL - St. Lawrence Formation
Q - quaternary deposits
CWI - County Well Index
UofM - University of Minnesota

Rejection Criteria

OS - Off-site to far to be of use
SL - Decommissioned (sealed)
DW - Domestic well
TD - Total depth, well is constructed too deep to be of use
NF - Not found
NN - not needed
MA - Multiple aquifers intercepted



Background: 2006 Aerials Express.

- Active Well
- Sealed Well
- Umore Mining Area (UMA)
- Umore Park Boundary

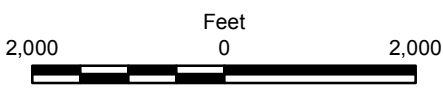


Figure E-1

EXISTING AND SEALED WELLS

Umore Mining Area
Groundwater Assessment
Dakota County, MN

Source: Dakota County, SEH, Barr, HKGi.
Well data is from the Dakota County Well and Water Management System (WELLMAN)



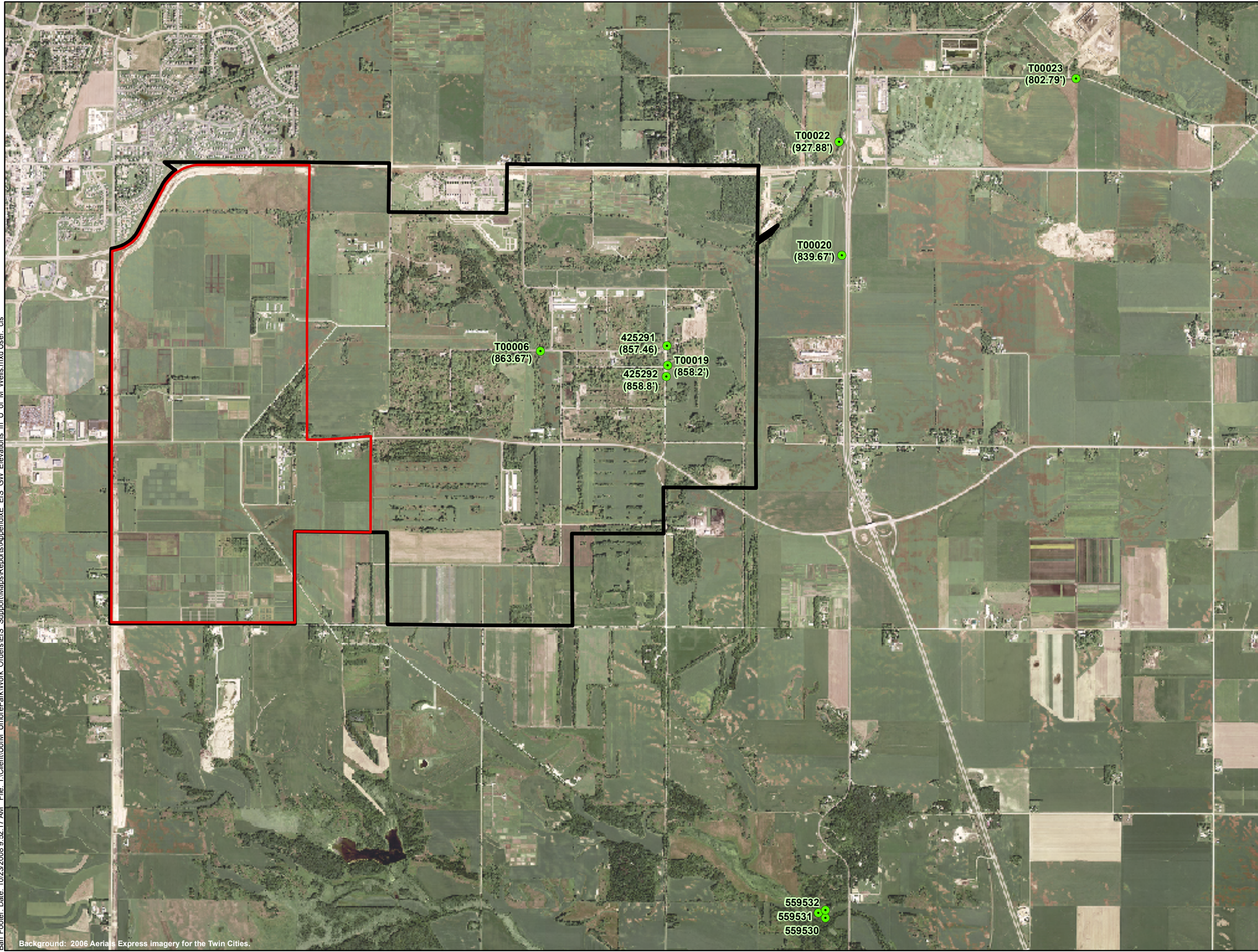
GROUNDWATER ELEVATIONS IN UNIVERSITY OF MINNESOTA MONITORING WELLS

UMore Park
Rosemount, Minnesota

Unique No.	Unique Well ID	Well Depth	Casing Depth	Static	Aquifer	Date Drilled	Riser Elevation	GW ELEV 6/18/2004	7/17/2006	9/27/2006	5/14/2007	3/18/2008	General Location Description
425291	MW28	230	95	80	OPDC	1986	927.38	864.57	881.36		859.28	857.46	Former pumping well; east of intersection of
425292	MW29	230	105	85	OPDC	1986	930.16	866.01	861.7		860.56	858.8	In clump of trees, E of Blaine Rd & ~1000' S
559530*	MW3	19	9	7	Q	1995	UK	12.42*		14.76*	14.6*		In brush west of Clayton Road and next to former Practice Pistol Range and tributary to Vermillion River.
559531*	MW1	16.5	6.5	7	Q	1995	UK	12.56*		14.44*	14.28*	14.60*	
559532*	MW2	16.5	6.5	9	Q	1995	UK	12.85*		12.75*	12.9*	12.72*	
T00006	MW9d	142			OPDC		932.98	869.7		866.4	865.49	863.67	East of old rail grade and south of 155 th St.
T00019	MW21d	161			OSTP		931.9	865.53	865.15		860.2	858.2	East of intersection of 156 th St and Blaine
T00020	MW22	135			OPDC		925.37	847.95	843.19		842.16	839.67	Next to farm road and US 52; about 50 feet
T00022	MW23d	137			OPDC		965.46	835.31		831.18	830.55	927.88	West of exit ramp in NW quadrant of
T00023	MW25	166			OPDC		849.51	811.58		806.41	806.05	802.79	West of power lines near turn on Ehlers Rd

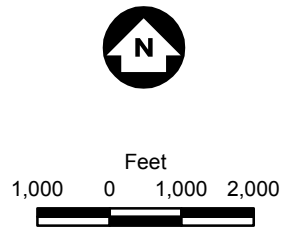
* Well elvevation is actually depth to water from TOC

Barr Footer: Date: 10/23/2008 9:52:17 AM File: I:\Client\UofM_UmorePark\Work_Orders\EIS_Support\Maps\Reports\AppendixE_EIS_GW_Elevations_in_U_of_M_Wells.mxd User: cjs



- Dakota County Wells
- Umore Park Boundary
- Umore Mining Area (UMA)

Source: SEH, Barr, HKGI, Dakota County.



Appendix E
 GW ELEVATIONS AT UNIVERSITY
 OF MINNESOTA WELLS

Umore Mining Area
 Groundwater Assessment
 Dakota County, MN





2770 Cleveland Avenue
Roseville, MN 55113-1127
U.S.A.
651/639-9449
FAX: 651/639-9473

April 25, 2000

Mr. Dave Douglas
Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, MN 55155

Subject: 2000 Ground Water Monitoring Results and
Monitoring Well Abandonment
University of Minnesota Rosemount Research Center
Rosemount, Minnesota
Delta Project No. A086-054

Dear Dave:

The purpose of this letter is to present, on behalf of the University of Minnesota (University), the results of the 2000 ground water monitoring activities at the above-referenced site. The monitoring activities were performed in accordance with a request by the Minnesota Pollution Control Agency (MPCA) in a February 6, 1998, letter to the University. In addition, documentation of the monitoring well abandonment is included.

Ground Water Monitoring

On March 23, 2000, five monitoring wells were gauged by Delta Environmental Consultants, Inc. (Delta). The well locations are depicted on Figure 1. Ground water elevation data are summarized in Table 1. Ground water elevation as measured in these wells has decreased less than a foot since May 1999. A ground water contour map (Figure 2) was constructed using ground water elevation data collected during the 2000 sampling event. Ground water flow is toward the northeast, which is similar to historical ground water flow patterns observed at the site.

Monitoring well MW-28 is located approximately 1 mile downgradient from the source area. This area has historically exhibited the highest level of impacts to ground water. MW-28 was sampled by Matrix Technologies, Inc. on March 21, 2000. The ground water sample was analyzed by Pace Analytical Services, Inc. for volatile organic compounds (VOCs) using Minnesota Department of Health (MDH) method 465E. The laboratory report is contained in Appendix A. The results of the analysis indicate that chloroform (6.7 micrograms per liter { $\mu\text{g/l}$ }) and carbon tetrachloride (2.3 $\mu\text{g/l}$) were detected in MW-28. Methylene chloride was also detected in the sample; however, a footnote on the laboratory report identifies this compound as a common laboratory contaminant.

The additivity factor, Cumulative Hazard Index (CHI), was calculated using the recent analytical data obtained from MW-28 and compared to historical CHI results (Table 2). MW-28 currently has a CHI of 0.878. This represents a slight increase from the 1999 CHI result (0.810), but is still less than 1, the level indicating an excessive cancer risk due to multiple VOCs.

Mr. Dave Douglas
April 21, 2000
Page 2

Monitoring Well Abandonment

Abandonment activities in 1998 and early 1999 resulted in the sealing of 33 monitoring wells. In December 1999, five additional monitoring wells (429489, 429490, MW-6, MW-8, and MW-17) and two farmstead wells were abandoned (Table 1).

Eleven wells remain active, including five wells (4252291 {MW-28}, T00019 {MW-21D}, T00020 {MW-22}, T00022 {MW-23D} and T00023 {MW-25}) used by the University to monitor this investigation, four wells (559530, 559531, 559532, and 575906) used for monitoring a separate investigation, and two wells (425292 and T00006) which will likely be abandoned in the future. Two additional wells (MW-24 and MW-26) are buried and Delta is in the process of locating, uncovering, and sealing them.

If you have any questions or comments, please contact Mr. Paul Lucas of Delta at (651) 697-5192, or me at (651) 697-5203.

Sincerely,

DELTA ENVIRONMENTAL CONSULTANTS, INC.

Lina Overacker

for Karen J. Thole
Hydrogeologist

Reviewed by:


Paul L. Lucas
Industrial Unit Manager

KJT/gdo

cc: ✓ Dr. Fay Thompson - University of Minnesota
City Administrator - City of Rosemount
Mr. Steve Scott - Dakota County

TABLE 1

Ground Water Elevation Data
University of Minnesota Rosemount Research Center
Rosemount, Minnesota
Delta Project No. A086-054

Well ID	Date	Casing Elevation	Depth to Ground Water	Ground Water Elevation
MW-21D	10/26/95	931.90	68.62	863.28
	05/06/99	931.90	64.23	867.67
	03/23/00	931.90	64.51	867.39
MW-22	10/25/95	925.37	80.20	845.17
	05/06/99	925.37	75.35	850.02
	03/23/00	925.37	75.83	849.54
MW-23D	10/25/95	865.46	32.67	832.79
	05/06/99	865.46	28.49	836.97
	03/23/00	865.46	29.24	836.22
MW-25	10/24/95	849.51	40.84	808.67
	05/06/99	849.51	36.04	813.47
	03/23/00	849.51	36.68	812.83
MW-28	10/26/95	927.38	121.53	805.85
	05/06/99	927.38	60.68	866.70
	03/23/00	927.38	60.99	866.39

All elevations expressed in feet.

TABLE 2

Additivity Evaluation for Ground Water Chemistry - MW-28
University of Minnesota Rosemount Research Center
Rosemount, Minnesota
Delta Project No. A086-054

MW-28 (1990)

Organic Chemical	Drinking Water Criteria	Basis	Well Concentration (ug/L)	Ratio
Carbon Tetrachloride	3	HRL	1.4	0.467
Chloroform	60	HRL	29.0	0.483
1,2-Dichloroethane	4	HRL	ND	0.000
1,1,1-Trichloroethane (TCA)	600	HRL	0.6	0.001
1,1,2 Trichloroethylene (TCE)	30	HRL	2.0	0.067

Cumulative Hazard Index = 1.018

MW-28 (1992)

Organic Chemical	Drinking Water Criteria	Basis	Well Concentration (ug/L)	Ratio
Carbon Tetrachloride	3	HRL	1.2	0.400
Chloroform	60	HRL	31.0	0.517
1,2-Dichloroethane	4	HRL	1.8	0.450
1,1,1-Trichloroethane (TCA)	600	HRL	ND	0.000
1,1,2 Trichloroethylene (TCE)	30	HRL	0.7	0.023

Cumulative Hazard Index = 1.390

MW-28 (1993)

Organic Chemical	Drinking Water Criteria	Basis	Well Concentration (ug/L)	Ratio
Carbon Tetrachloride	3	HRL	1.7	0.567
Chloroform	60	HRL	36.0	0.600
1,2-Dichloroethane	4	HRL	1.6	0.400
1,1,1-Trichloroethane (TCA)	600	HRL	0.9	0.002
1,1,2 Trichloroethylene (TCE)	30	HRL	2.1	0.070

Cumulative Hazard Index = 1.638

TABLE 2

Additivity Evaluation for Ground Water Chemistry - MW-28
 University of Minnesota Rosemount Research Center
 Rosemount, Minnesota
 Delta Project No. A086-054

MW-28 (1995)

Organic Chemical	Drinking Water Criteria	Basis	Well Concentration (ug/L)	Ratio
Carbon Tetrachloride	3	HRL	1.4	0.467
Chloroform	60	HRL	23.0	0.383
1,2-Dichloroethane	4	HRL	1.2	0.300
1,1,1-Trichloroethane (TCA)	600	HRL	0.9	0.002
1,1,2 Trichloroethylene (TCE)	30	HRL	2.4	0.080

Cumulative Hazard Index = 1.232

MW-28 (1999)

Organic Chemical	Drinking Water Criteria	Basis	Well Concentration (ug/L)	Ratio
Carbon Tetrachloride	3	HRL	1.1	0.367
Chloroform	60	HRL	23.0	0.383
1,2-Dichloroethane	4	HRL	ND	0.000
1,1,1-Trichloroethane (TCA)	600	HRL	ND	0.000
1,1,2 Trichloroethylene (TCE)	30	HRL	1.8	0.060

Cumulative Hazard Index = 0.810

MW-28 (2000)

Organic Chemical	Drinking Water Criteria	Basis	Well Concentration (ug/L)	Ratio
Carbon Tetrachloride	3	HRL	2.3	0.767
Chloroform	60	HRL	6.7	0.112
1,2-Dichloroethane	4	HRL	ND	0.000
1,1,1-Trichloroethane (TCA)	600	HRL	ND	0.000
1,1,2 Trichloroethylene (TCE)	30	HRL	ND	0.000

Cumulative Hazard Index = 0.878

TABLE 3

Monitoring Well Abandonment Summary
University of Minnesota Rosemount Research Center
Rosemount, Minnesota
Delta Project No. A086-054

Sealing No.	Unique No.	Local ID	Location	Depth	Diameter
H-146279	429489	MW-2	115/19/34-NWNWSW	67	2
H-146277	429490	MW-3	115/19/36-SWNWNW	72	2
H-146281		MW-6	115/19/35-SWSWSW	82	6
H-146282	243767	MW-8	115/19/35-SWSWSW	60	1¼
H-146280		MW-17	114/19/12-NENENW	74	2
H-146299		Old Well #1	114/19/10-NENENE	64	6
H-146300		Old Well #2	114/19/12-NWNWSW	72	6

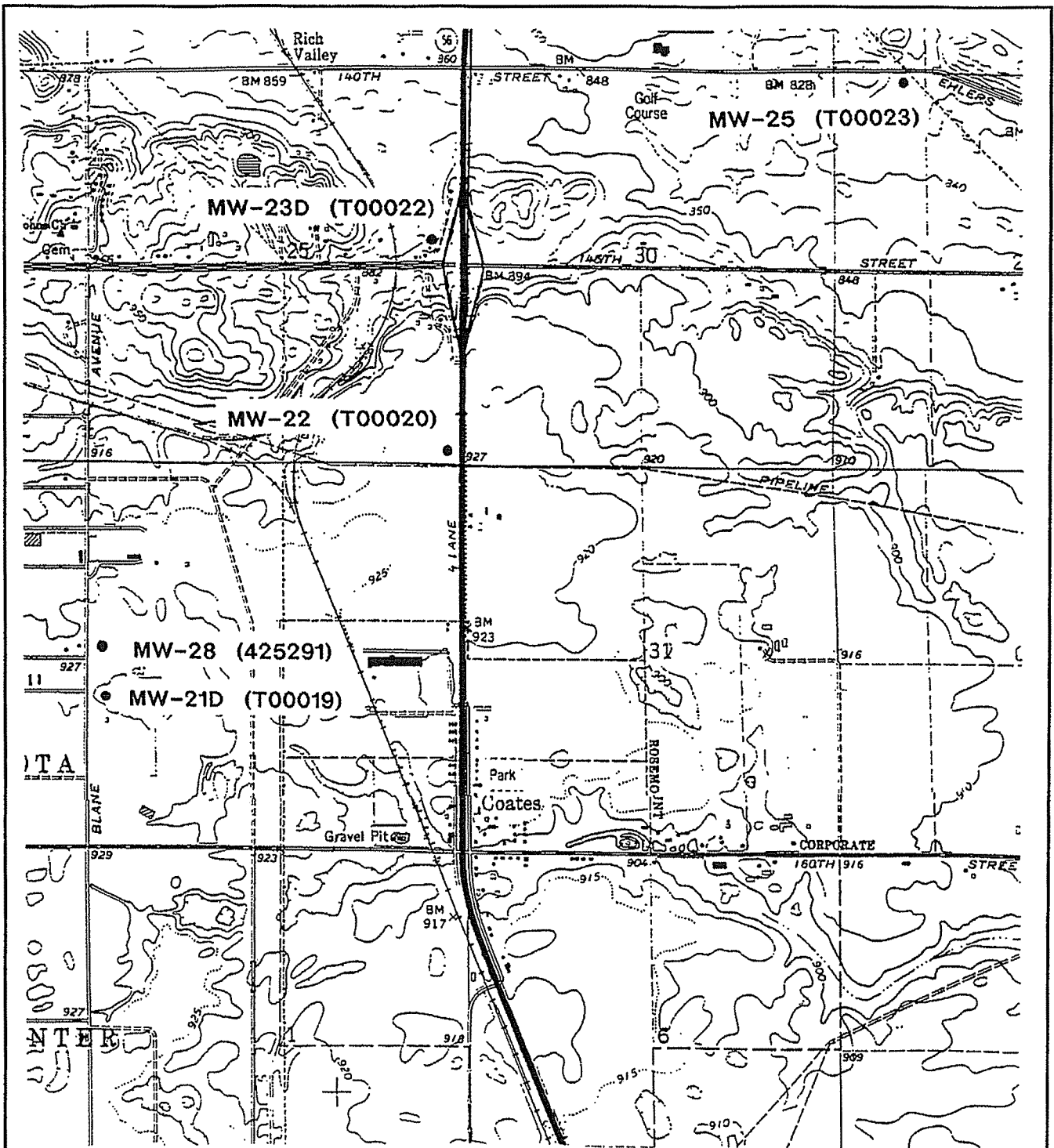
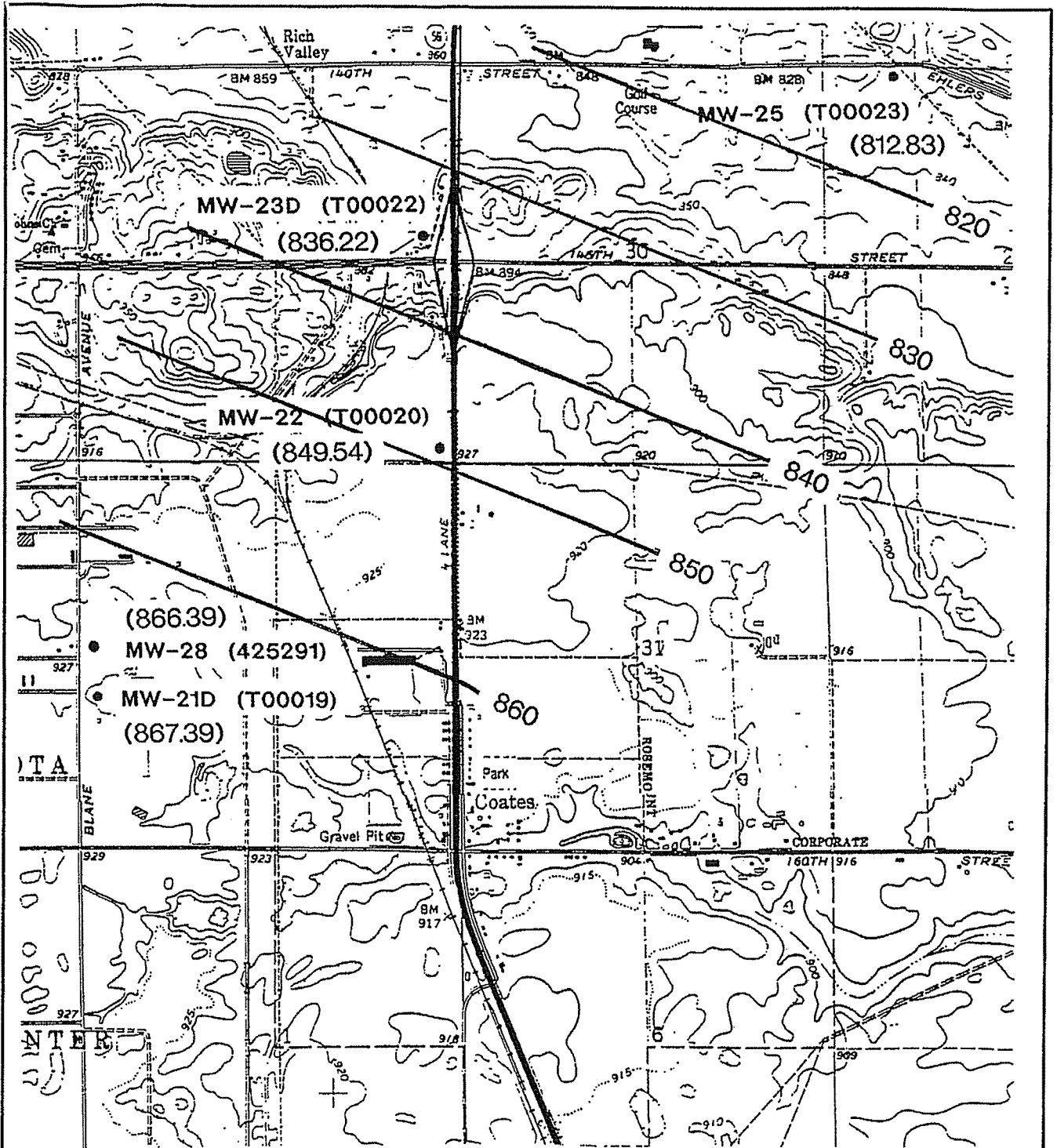


FIGURE 1
MONITORING WELL LOCATION MAP
UNIVERSITY OF MINNESOTA
ROSEMOUNT RESEARCH CENTER
ROSEMOUNT, MINNESOTA

PROJECT NO. A085-054	PREPARED BY KJT
DATE 6/15/99	REVIEWED BY





LEGEND

- (850.00) GROUND WATER ELEVATION DATA
- 850 — GROUND WATER CONTOUR LINE

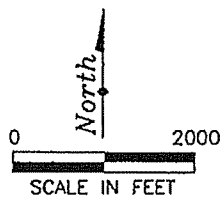


FIGURE 2
GROUND WATER FLOW MAP
 March 23, 2000
 UNIVERSITY OF MINNESOTA
 ROSEMOUNT RESEARCH CENTER
 ROSEMOUNT, MINNESOTA

PROJECT NO. A085-054	PREPARED BY KJT
DATE	REVIEWED BY



Vermillion River Monitoring Network 2007 Report

Prepared for:
Vermillion River Watershed Joint Powers Organization

April 2008

Prepared by:
Dakota County Soil and Water Conservation District



Acknowledgments:

The results presented in this report would not be complete without contributions made by the following persons:

Andrea Bergman-Minnesota Department of Natural Resources

Melissa Bokman-Scott County

Cassandra Champion-Metropolitan Council Environmental Services

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Curt Coudron-Dakota County Soil and Water Conservation District

Dave Holmen-Dakota County Soil and Water Conservation District

Karen Jensen-Metropolitan Council

Laura Jester-Dakota County Soil and Water Conservation District

Greg Kruse-Minnesota Department of Natural Resources

Ann Messerschmidt-City of Lakeville, MN

Paul Nelson-Scott County and Vermillion River Watershed Joint Powers Organization Scott County Administrator

Brian Nerbonne-Minnesota Department of Natural Resources

Lisa Pearson-Minnesota Department of Natural Resources

Jaime Rockney-Scott Soil and Water Conservation District

Laurie Sovell-Minnesota Pollution Control Agency

Justin Watkins-Minnesota Pollution Control Agency

Overview:

The Vermillion River Watershed is the largest watershed located within the Minneapolis/St. Paul metropolitan area. More importantly, the Vermillion River watershed is home to a robust and thriving trout population. As a result, numerous water quality monitoring programs are actively assessing the health of this watershed. The purpose of this report is to concisely summarize the results of the surface water quality monitoring activities sponsored by the Vermillion River Watershed Joint Powers Organization (VRWJPO) and completed by the Dakota County Soil and Water Conservation District (DCSWCD) and the Scott Soil and Water Conservation District (SSWCD).

In addition to describing results from 2007, this report includes historical water quality monitoring results from as early as 2000. The historical results presented here are intended to describe preliminary long-term water quality trends apparent in the watershed. The level of statistical analysis completed here is limited due to a relatively brief water quality record, and results should be considered preliminary.

Vermillion River Monitoring Network:

The Vermillion River Monitoring Network (VRMN) was created in the early 1990's to obtain water quality data from the Vermillion River Watershed and initially consisted of six monitoring stations located in Dakota County. Since then, the network has grown to include a total of eight permanent monitoring stations (Figure 1).

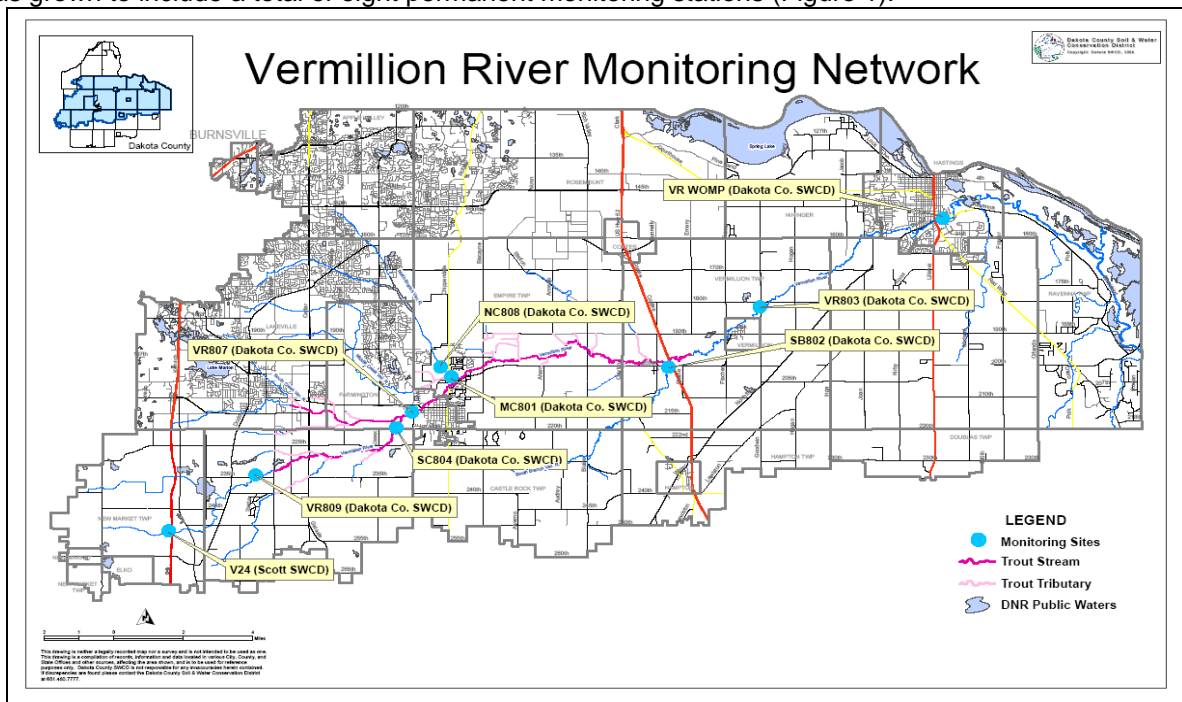


Figure 1. Vermillion River Monitoring Network and WOMP Station Locations

Several improvements were made to the Vermillion River Monitoring Network in 2007. The monitoring network was expanded to include an automated weather station, located near the center of the watershed. This station was added to the network to assist with water quality analysis in the Vermillion River Watershed (Figure 2).

The Vermillion River Joint Powers Board also contracted with the Department of Natural Resources in 2007 to assist in refining flow measurements and the data analysis necessary to convert 15-minute stage data into 15-min flow data, which is used by various water resource management organizations throughout the watershed.



Figure 2. Vermillion River Monitoring Network Weather Station

Methods:

Monthly base flow and event flow samples were collected from the Vermillion River Monitoring Network utilizing standardized procedures outlined by the Metropolitan Council Environmental Services (Metropolitan Council, 2003). At each station, automated equipment records stage every fifteen minutes, which is then converted to flow values through the use of MNDNR developed rating tables.

In addition to results from the Vermillion River Monitoring Network, data from the Metropolitan Council's Watershed Outlet Monitoring Program (WOMP) site, located on the Vermillion River in Hastings, are included to provide water quality data from the extreme eastern portion of the watershed. This site is labeled as VR WOMP in Figure 1. DCSWCD staff collect monthly low flow samples, event grab samples, and event composite samples from this location.

All samples are transported to the Metropolitan Council's Water Quality Lab and are analyzed according to EPA specified protocols for various endpoints. These endpoints include standard bacterial and chemical parameters. At the end of every sampling season, these data are entered into the MPCA's Environmental Data Access system and the EPA's STORET database.

Results and Discussion:

Results presented in the following graphs extend from the western-most site, located in Scott County, to the Metropolitan Council's Watershed Outlet Monitoring Program site, located in Hastings. Results include flow, precipitation, nutrient, turbidity, temperature, and *E. coli* (bacteria) data.

Results are typically presented as an arithmetic or geometric mean and are compared against mean values for minimally impacted streams of the Western Corn Belt Plains ecoregion, published by the Minnesota Pollution Control Agency (MPCA) (McCollor and Heiskary, 1993). The Western Corn Belt Plains ecoregion was selected since most of the Vermillion River Watershed is located within this ecoregion. Results are also compared against State Water Quality Standards (Minnesota Statute 7050) where appropriate. Stream temperature data are compared against optimal temperatures for adult brown trout (Bell, 2006).

Comparisons with ecoregion mean data and state standards are simple and are only intended to be used as a method to identify water quality exceedances. These analyses are not intended to be a definitive determination of water quality impairment. Assessment of impairment is completed bi-annually by the MPCA using a more comprehensive process and assessment methods.

Flow and Precipitation

Mean daily flows and precipitation data for the 2007 sampling season are presented in Figure 3.

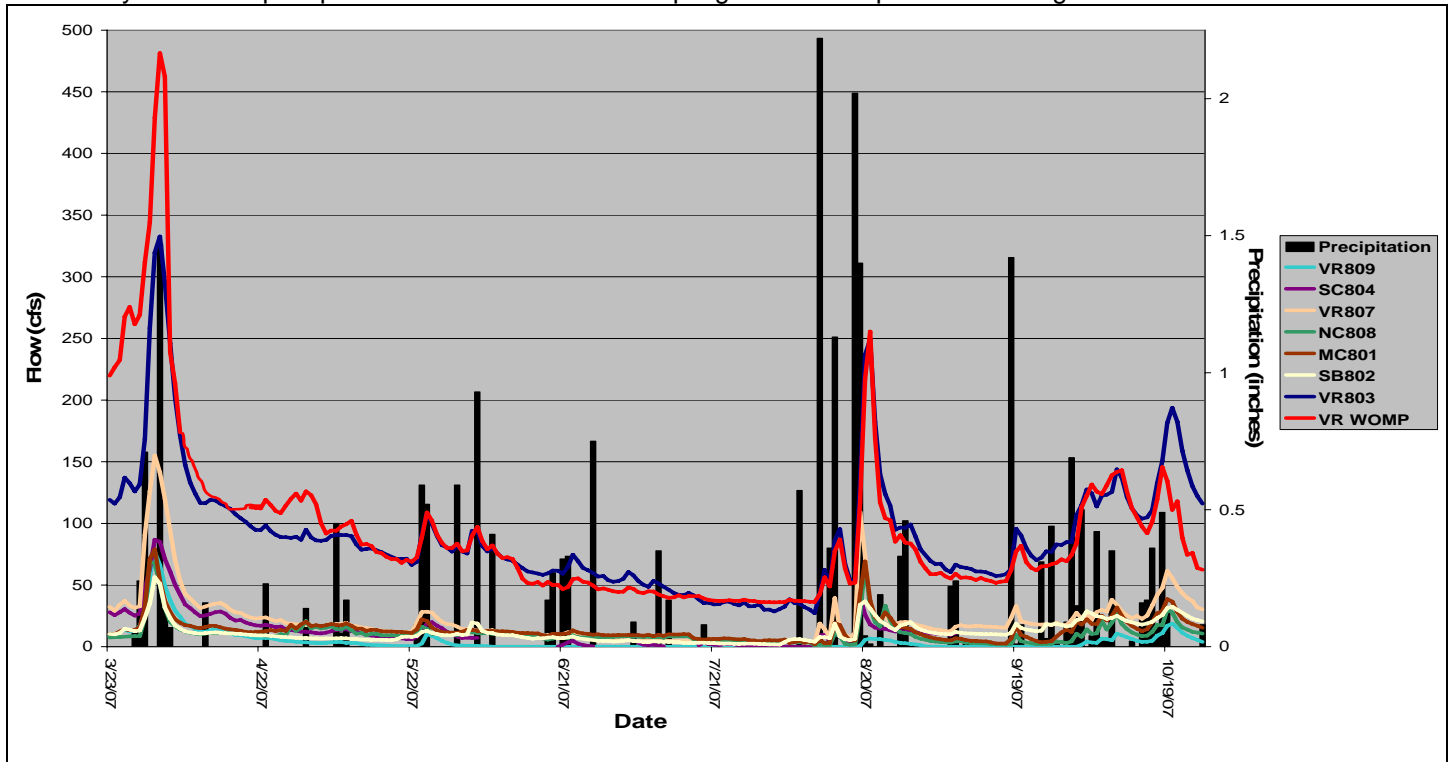


Figure 3. 2007 Vermillion River Monitoring Network and WOMP Flow and Precipitation Results

Total Phosphorus

Total phosphorus concentrations in 2007 were generally below the Western Corn Belt plains minimally impacted stream eco-region mean. Site V24 is located just downstream from the Elko/New Market Wastewater Treatment Plant, which likely accounts for the elevated event flow total phosphorus concentrations at this site. The VR WOMP site is located downstream from predominately agricultural lands which may be releasing a considerable amount of phosphorus rich agricultural runoff. In addition, sites VR803 and VR WOMP are downstream from several wastewater treatment facilities, which are possible sources of additional phosphorus.

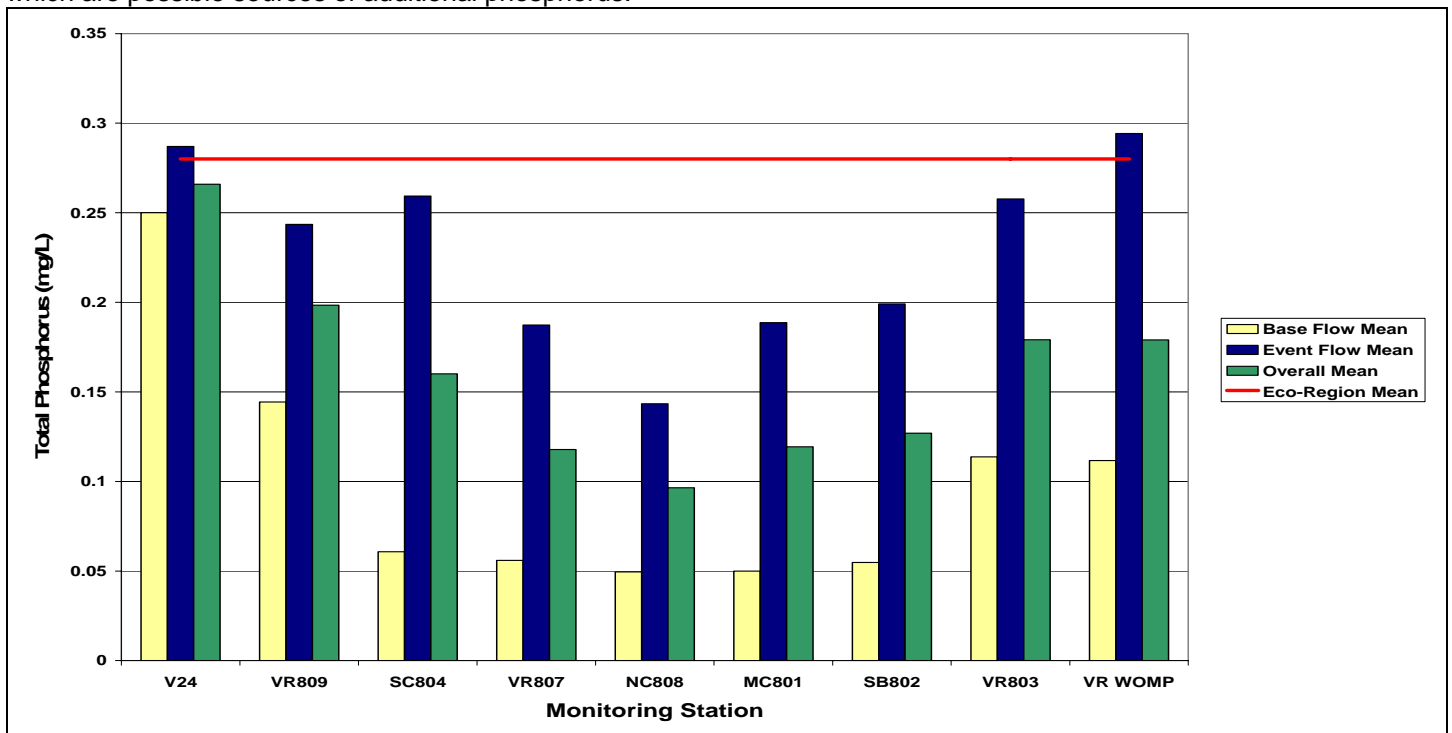


Figure 4. 2007 Mean Total Phosphorus Concentrations

Historical total phosphorus results are presented in Figure 5. Lower total phosphorus concentrations in 2006-2007 are likely the result of reduced rainfall over this period. Total phosphorus loading rates are often driven by precipitation. With fewer large rain events in 2006-2007, it is not surprising that total phosphorus concentrations appear to have decreased. In addition, the Metropolitan Council upgraded the Empire wastewater treatment plant in early 2006, which may account for a portion of the apparent decrease in phosphorus concentrations observed in recent years.

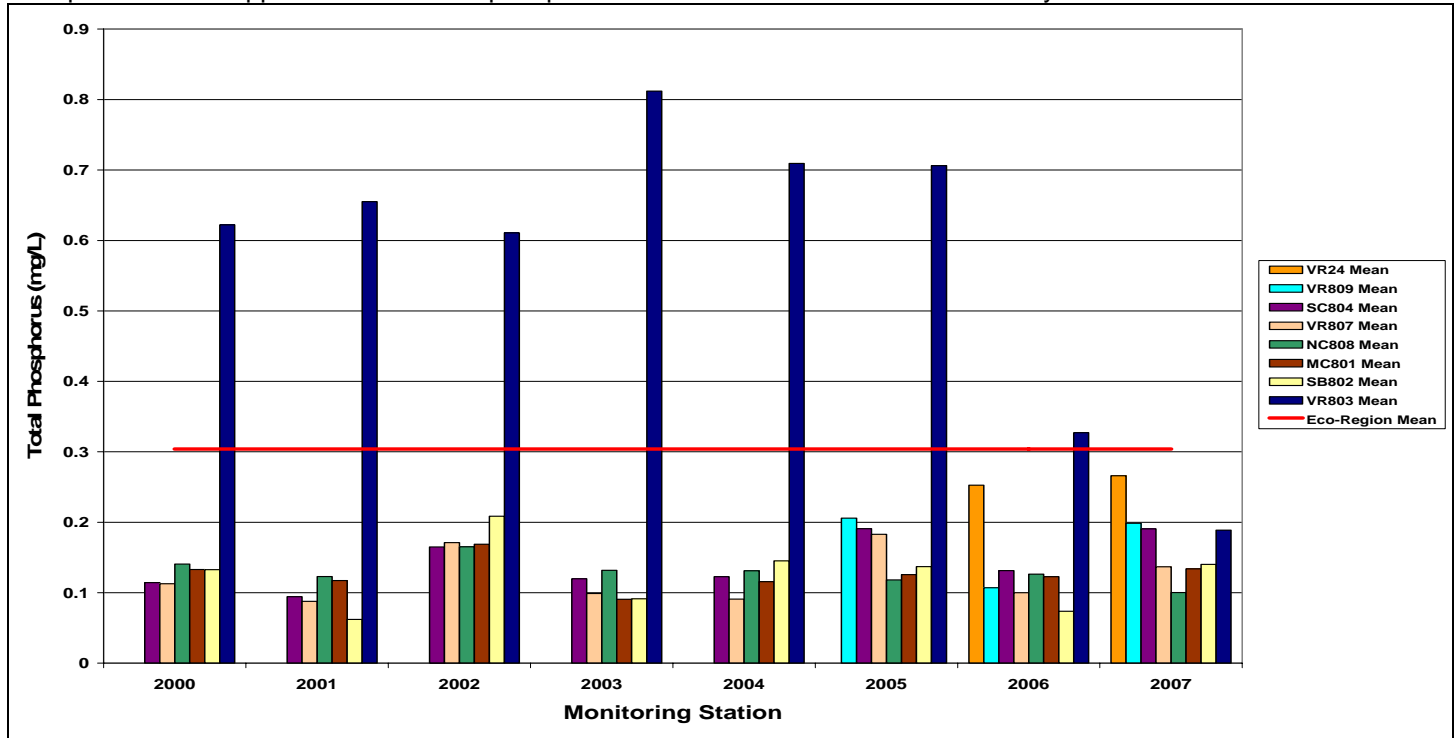


Figure 5. Annual Mean Total Phosphorus Concentrations

Nitrates

Nitrate concentrations were also below the minimally impacted stream eco-region mean, with the exception of sites SB802, VR803, and VR WOMP (Figure 6). This may be the result of a combination of nitrate sources including agricultural runoff, groundwater inputs, and discharge from the Empire and Vermillion wastewater treatment plants. However, it should be noted that nitrate concentrations at site SB802 were the highest in the watershed, and the source of these elevated results remains unknown.

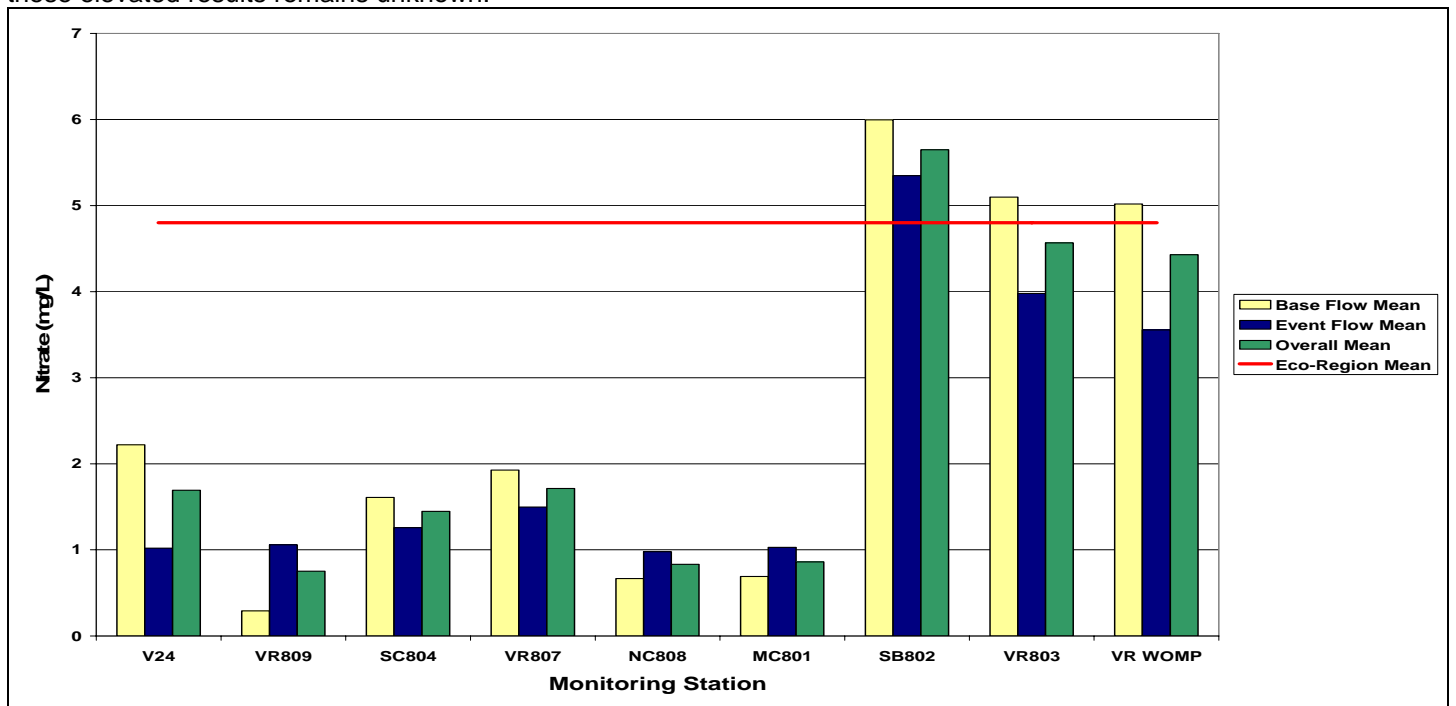


Figure 6. 2007 Mean Nitrate (NO₃) Concentrations

When 2007 nitrate concentrations are plotted against historical annual means, there appears little difference among the various years, despite lower 2007 precipitation results (Figure 7). However, for the second consecutive year, nitrate concentrations at the SB802 site continue to exceed those of the downstream VR803 site.

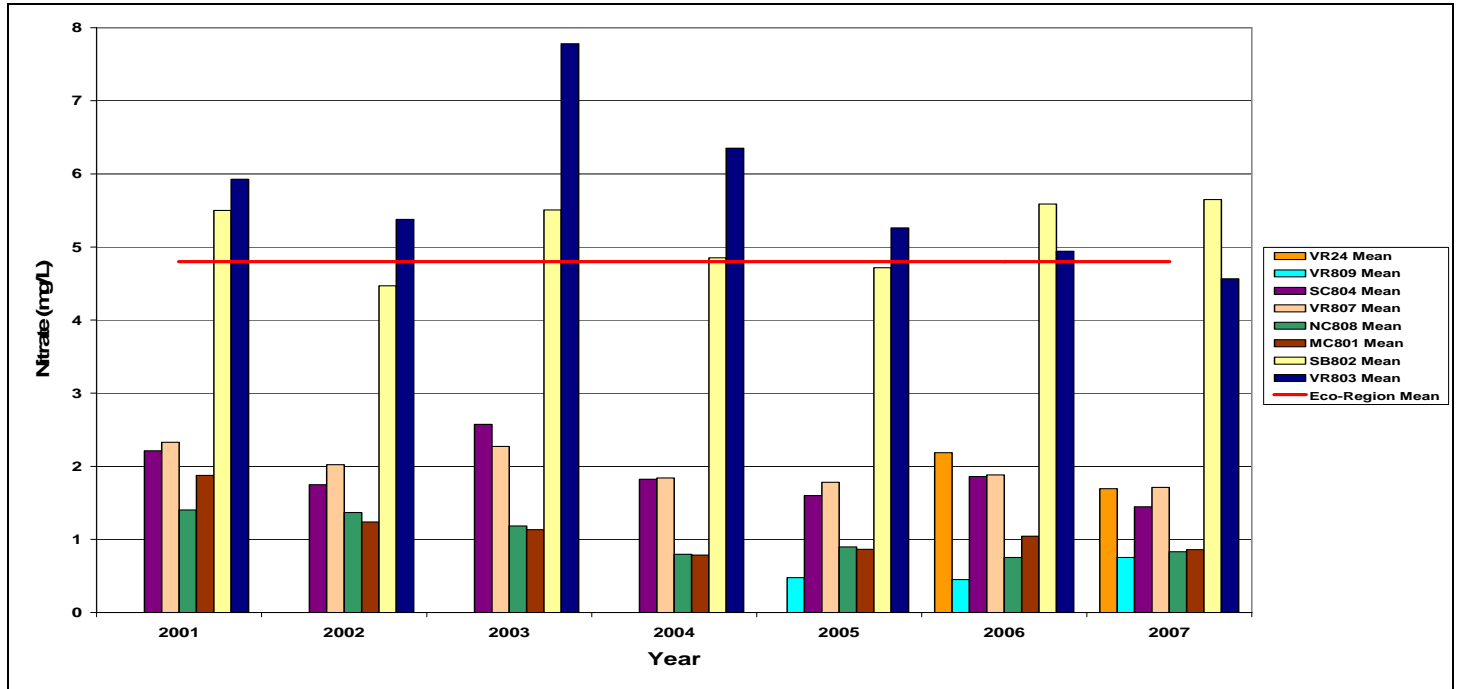


Figure 7. Annual Mean Nitrate (NO3) Concentrations

Pollutant Loads

Pollutant loads for 2007 were calculated using the FLUX stream load computation tool (Walker, 1988). A pollutant load is the mass of a particular pollutant that flows through a monitoring station over a given period of time. This is a new analysis applied to VRMN results and can be useful when comparing pollutant contributions to the Vermillion River among sub-watersheds. Calculated loads were divided by the area of the associated sub-watershed for each monitoring station (Figure 8). Loads for some tributaries were estimated by subtraction.

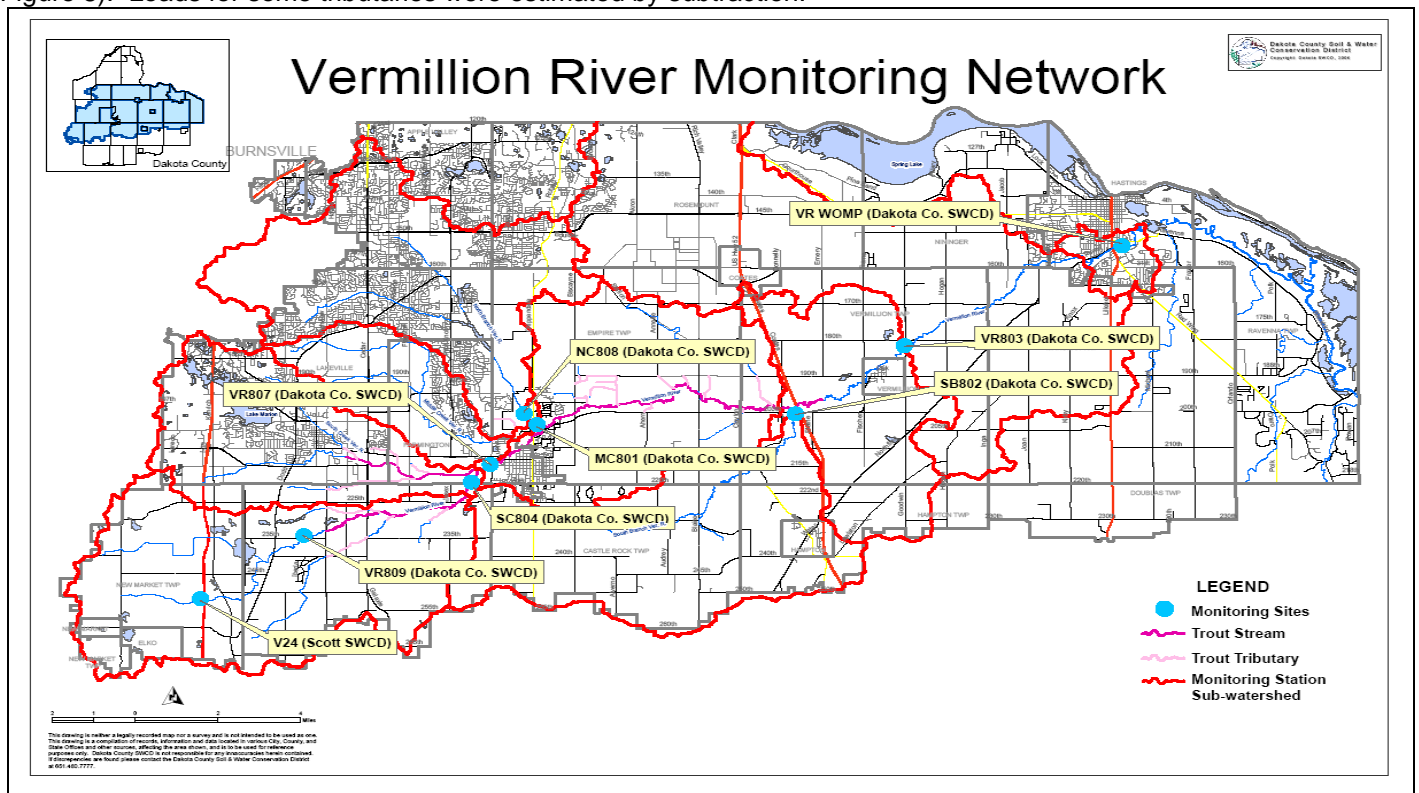


Figure 8. Monitoring Station Sub-watersheds

Total phosphorus loads per acre were relatively similar among monitoring stations and tributaries, with the exception of Goodwin Ave. sub-watershed (Figure 9). This watershed drains lands that include two wastewater treatment plants, which are likely major contributors to total phosphorus loads within this watershed.

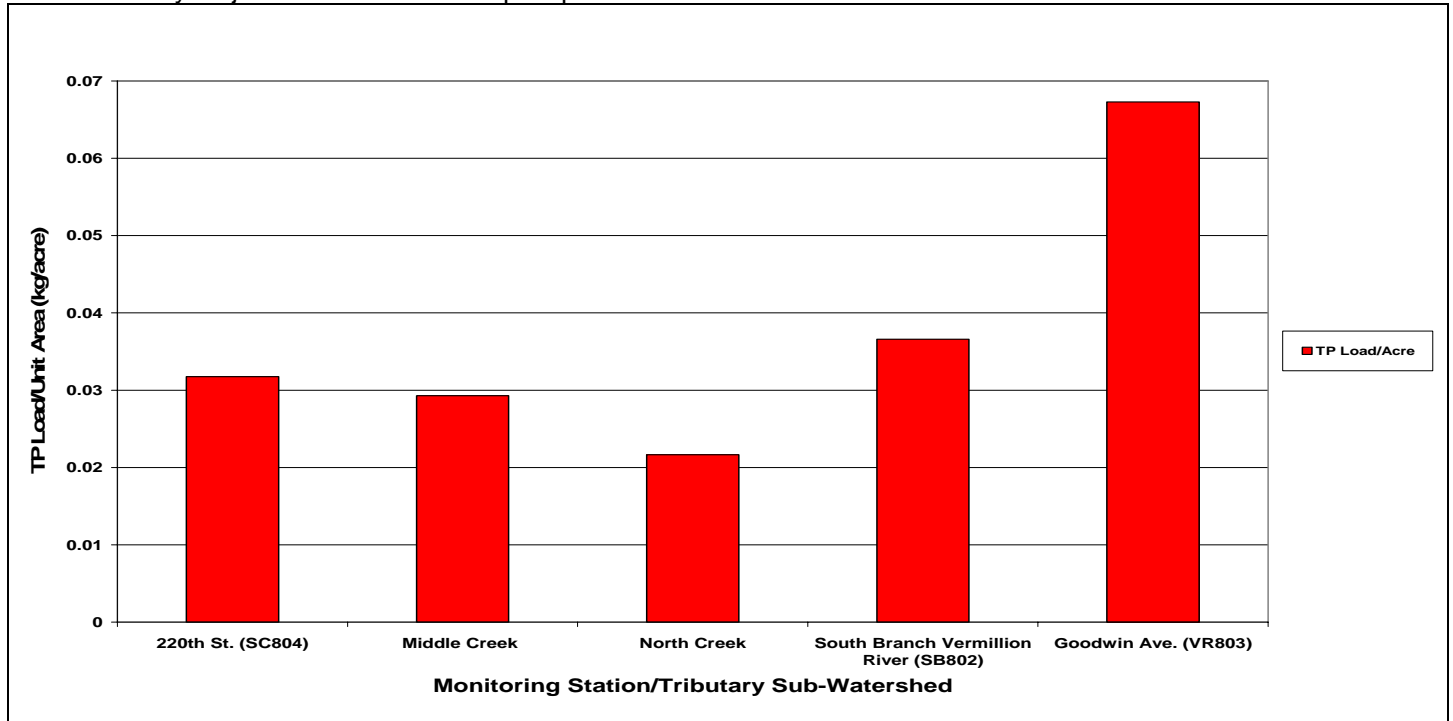


Figure 9. 2007 Total Phosphorus Load/Acre

Nitrate loads per acre were highest for the South Branch Vermillion River sub-watershed (Figure 10). The nitrate loads even exceeded the Goodwin Ave. watershed, which is downstream from several wastewater treatment plants. Additional monitoring may be needed to aid in determining the source of nitrates in the South Branch watershed.

The nitrate loads per acre for South Creek sub-watershed were also surprisingly high, considering that a similar, adjacent watershed (North Creek) had much lower nitrate loads.

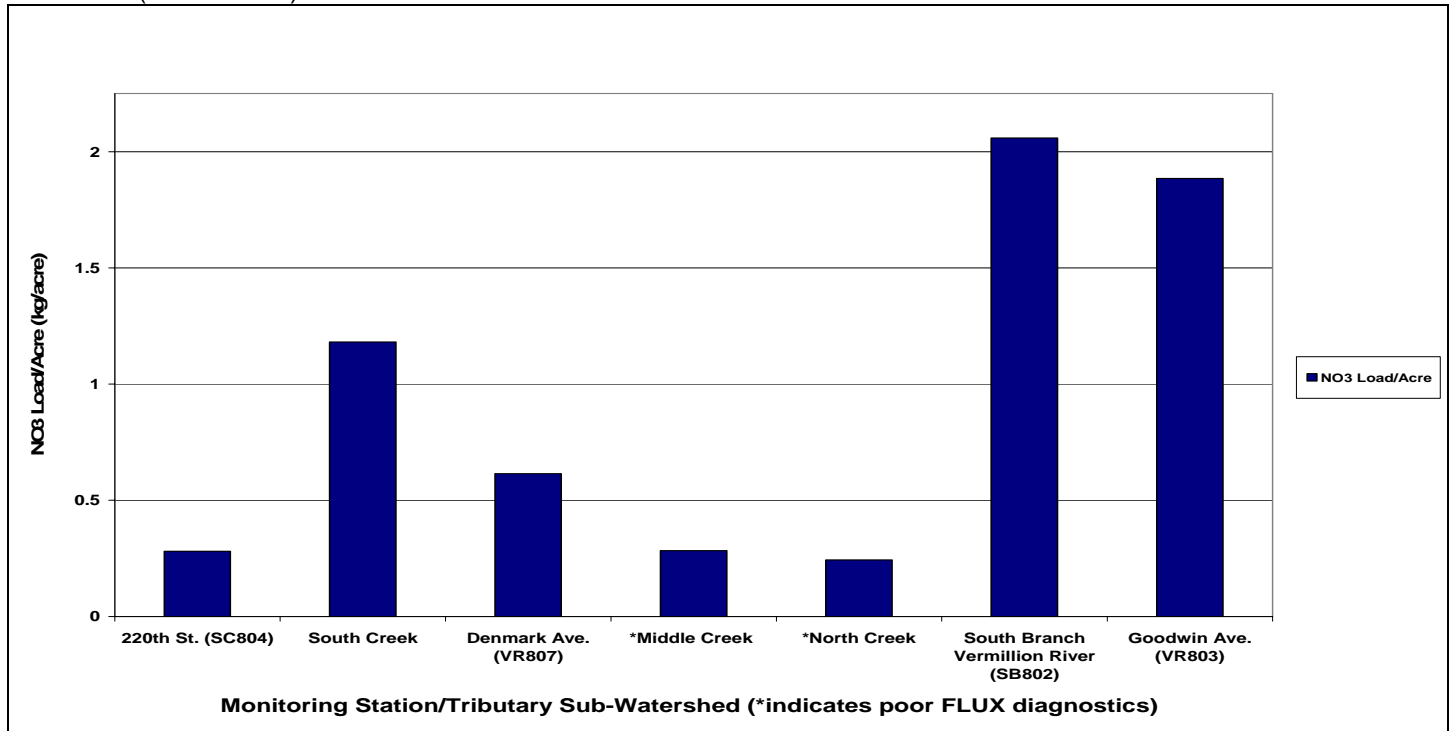


Figure 10. 2007 Nitrate Load/Acre Results

Turbidity

Turbidity results for 2007 were mixed (Figure 11). Turbidity during base flow conditions remained well below the state standards for all sites. However, during larger precipitation events turbidity was substantially elevated, often exceeding the state standard. The dramatic increase observed at the SC804 site is a consequence of a single, elevated May storm event sample.

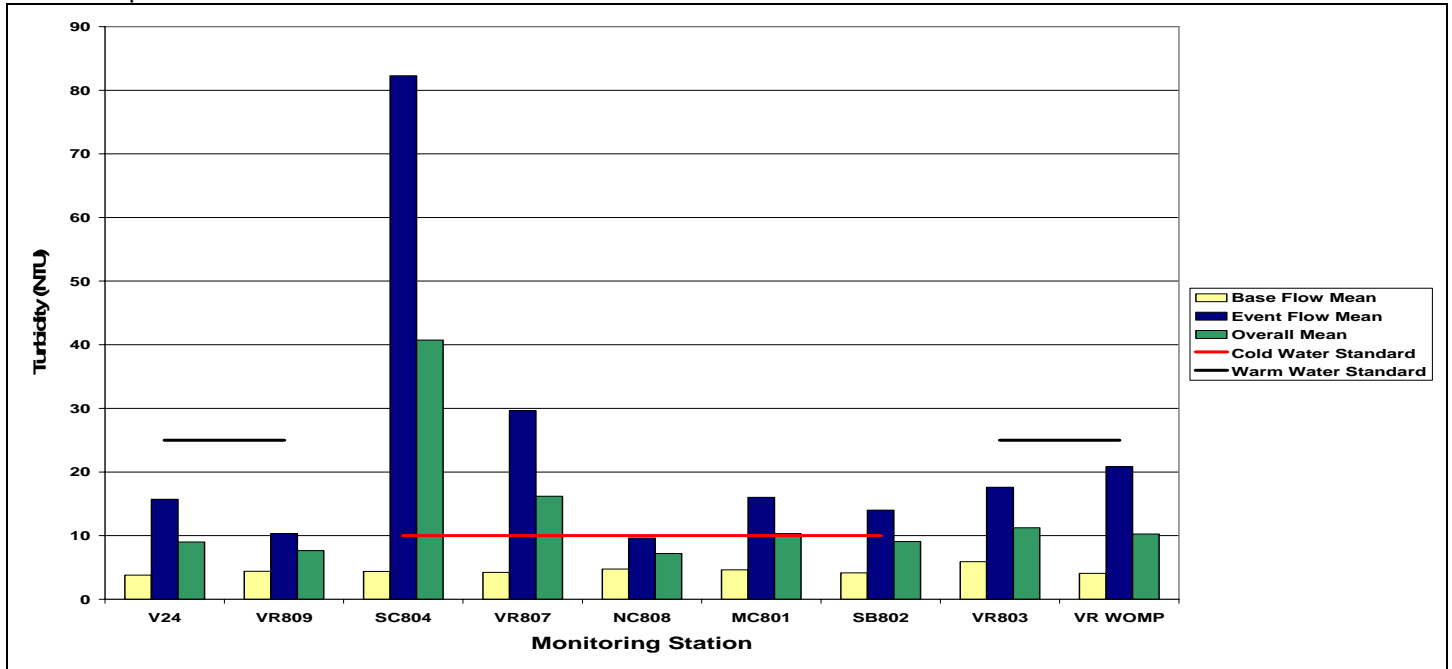


Figure 11. 2007 Mean Turbidity Results

Turbidity results are highly variable over the period of record (Figure 12). Results from 2007 are within the range of previous years, with the exception of the SC804 monitoring station. Again, the elevated concentration at this station is the result of a single sample collected during a storm event. It should also be mentioned that the MPCA has proposed including a reach of the Vermillion River near monitoring stations SC804 and VR807 for a turbidity impairment in the draft 2008 303d list. The most recent historical data for these sites appears to corroborate the proposed listing.

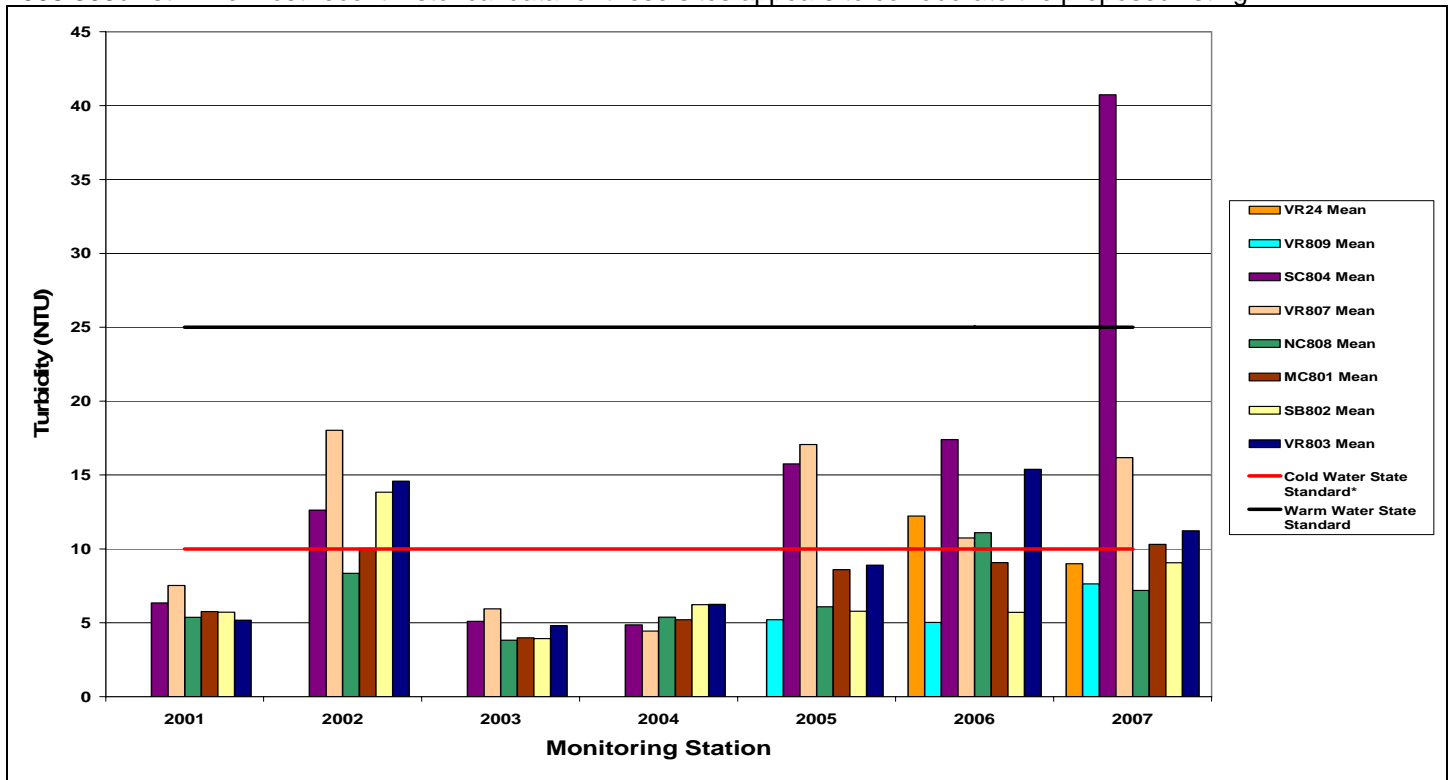


Figure 12. Annual Mean Turbidity Results

* Cold water standards apply only to trout stream portion of the Vermillion River (SC804, VR807, NC808, MC801, SB802).

Temperature

The Minnesota Department of Natural Resources (MNDNR) has been very active in monitoring stream temperatures in the Vermillion River Watershed. Since 2005, the DCSWCD has been assisting the MNDNR with temperature monitoring. In addition, the VRWJPO was awarded an EPA Targeted Watershed Grant in 2005. Identifying and describing the way in which groundwater inputs are influencing the temperatures of the Vermillion River, was among one of several goals specified in this grant. Stream temperature results presented here are a compilation of data resulting from both MNDNR and the EPA Targeted Watershed Grant efforts.

Automated temperature loggers were placed at each of the Vermillion River Monitoring Network stations, and water temperature was recorded at 15-minute intervals. Mean temperatures for the period of 6/2-9/2 were then plotted and are shown in Figure 13. Results from 2007 were also plotted adjacent to 2005, 2006 temperatures for the same reference period. According to a recent literature review, the adult brown trout chronic (long-term) exposure temperature limit is approximately 64° F (Bell, 2006). Average temperatures at most monitoring stations, especially those in the trout stream portion of the Vermillion River (SC804, VR807, NC808, MC801, SB802) were near the 64° F threshold.

It appears that temperatures were generally higher in 2006 than in 2005 or 2007. Possible explanations include slightly higher ambient air temperatures and large construction de-watering projects in the Middle and North Creek area in 2005 and 2007. De-watering projects remove cool groundwater and discharge those waters to area streams. It should also be noted that the temperature logger at site VR809 was out of the water for much of the 2006-2007 summer months, and as a result the reported mean temperature is based on a smaller record than other sites.

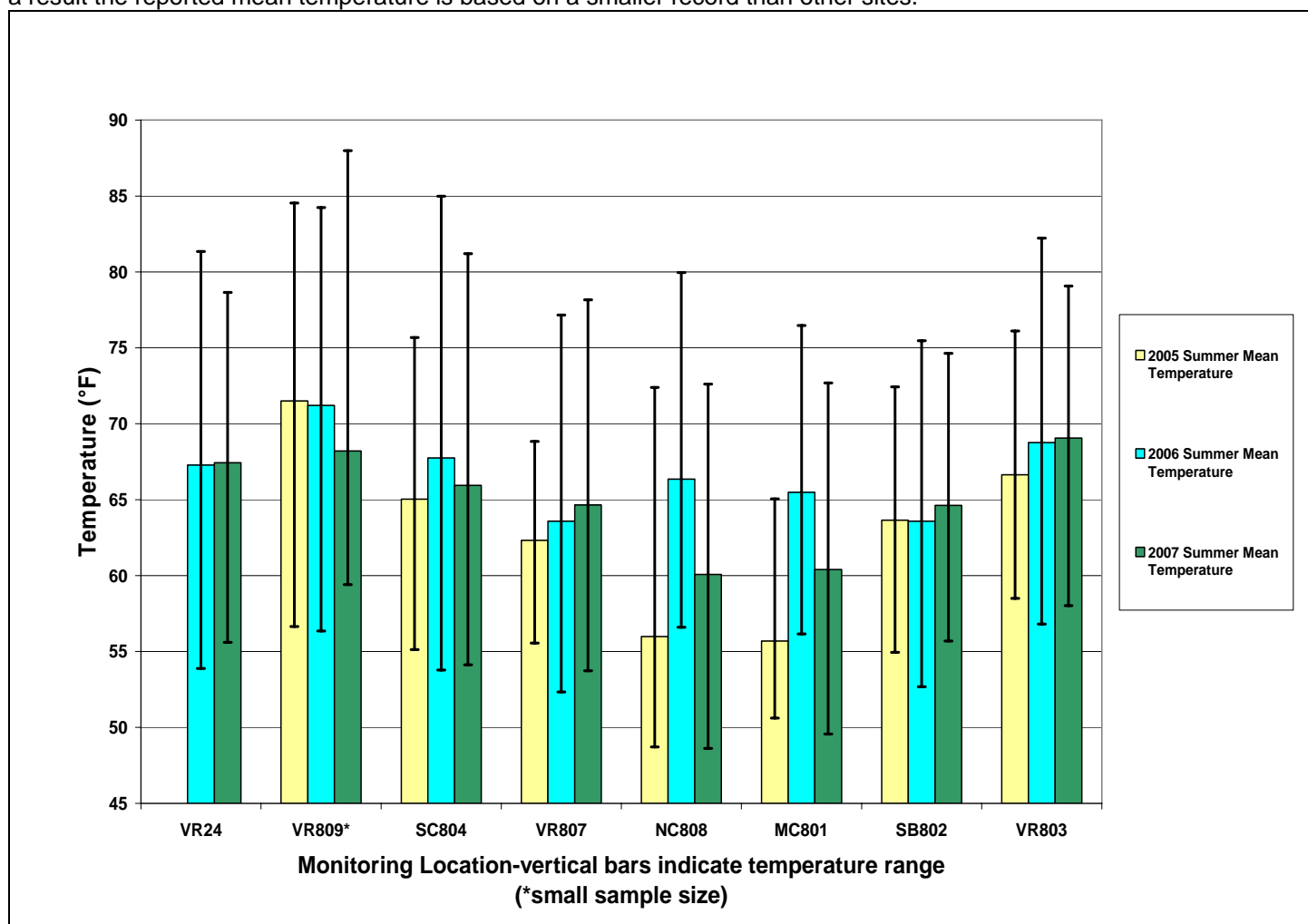


Figure 13. 2005-2007 Mean Temperature Results

Escherichia coli

E. coli concentrations within the Vermillion River continue to exceed the proposed state standard (Figure 14). Precipitation event samples produced the most elevated results. Possible explanations for base flow results include septic system discharge, agricultural runoff, livestock in streams, urban runoff, and re-suspension of sediment bacteria.

In 2007, the MPCA recommended that DCSWCD/SSWCD staff discontinue using fecal coliform as a bacterial endpoint. This was suggested in anticipation of a change in Minnesota water quality Rules 7050. Since no fecal coliform samples were collected in 2007, no historical comparison is possible.

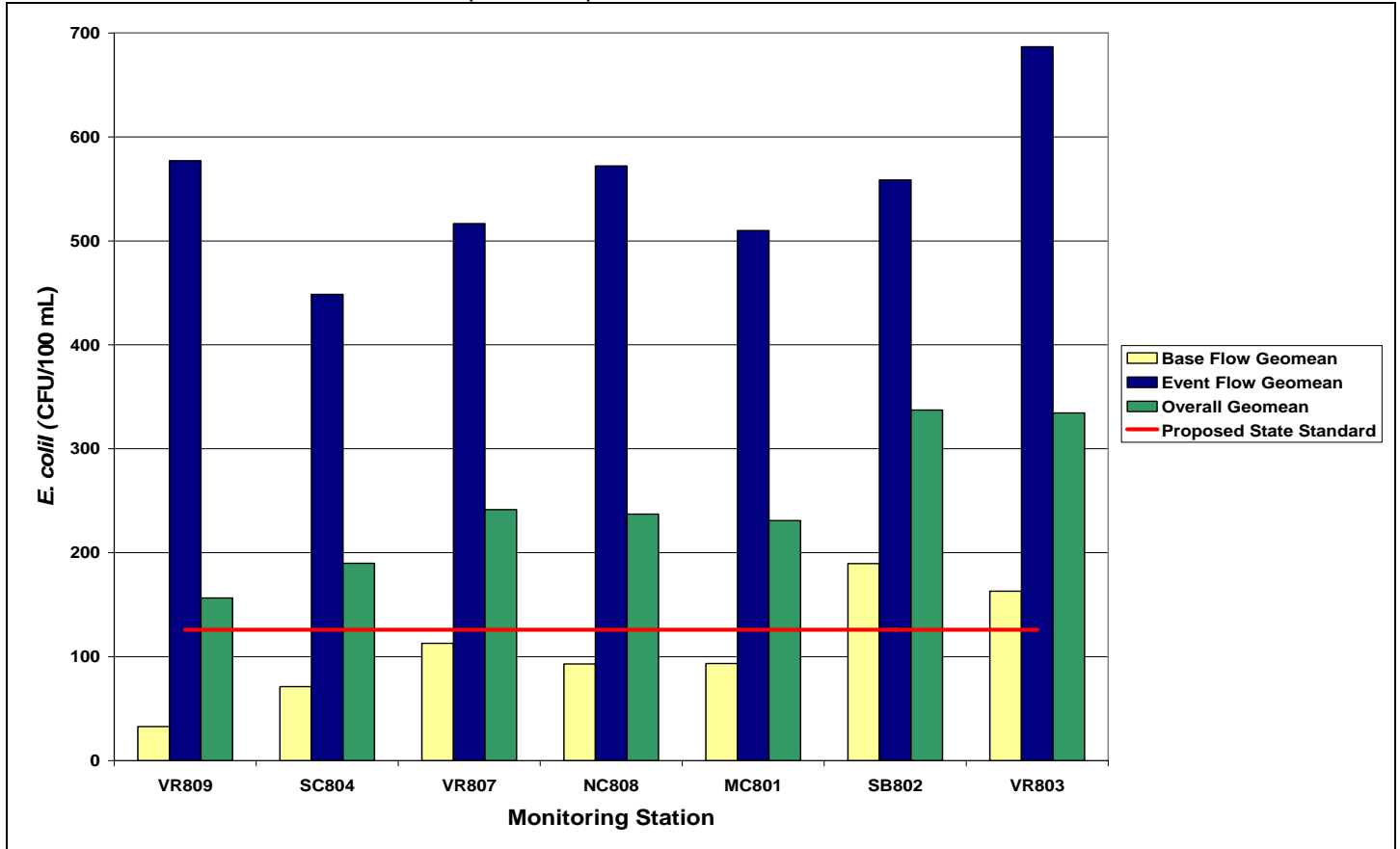


Figure 14. 2007 *Escherichia coli* Geometric Means

2007 Middle and North Creek Bacteria Study:

The Vermillion River was officially listed on the Federal Clean Water Act 303 (d) list in 1998 for elevated fecal coliform concentrations. In response to region wide fecal coliform impairments, the MPCA has developed and finalized a Lower Mississippi River Basin TMDL project, which includes the Vermillion River. An additional study was completed in 2004 to supplement the region wide TMDL, focusing specifically on the Vermillion River fecal coliform impairment. This study identified two sub-watersheds, Middle Creek and North Creek, as contributing unusually high levels of bacteria to the Vermillion. In 2006, the Middle and North Creek Bacteria Study was initiated to further identify sources in these sub-watersheds.

Thirteen bacteria monitoring sites were selected throughout the Middle and North Creek sub-watersheds (Figure 15). Samples were collected five times a month, from April to October. Samples were immediately placed on ice and transported to Minnesota Valley Testing Laboratories, Inc. for analysis. Approximately 10% of all samples were collected as QA/QC samples, which included blanks and field duplicates. Fecal coliform and *E. coli* analyses were completed using EPA approved methodology.

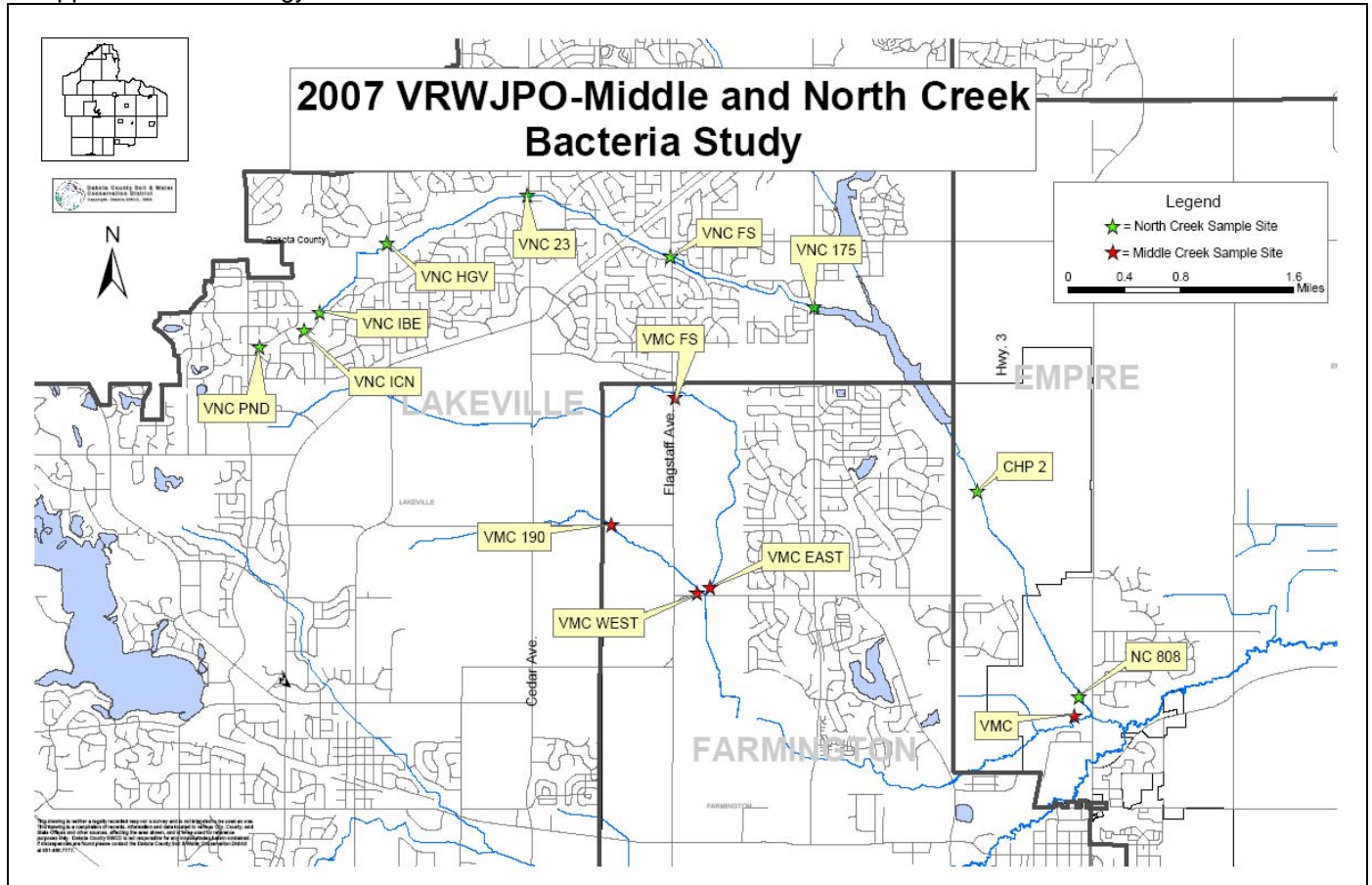


Figure 15. 2007 Middle and North Creek Bacteria Monitoring Locations

Results and Discussion:

In 2006, the MPCA recommended that the VRWJPO discontinue collecting fecal coliform samples in anticipation of the state bacteria standard changing from fecal coliform to *Escherichia coli*. In 2007, the VRWJPO funded water quality monitoring programs discontinued using the fecal coliform endpoint in exchange for the *E. coli* endpoint, including those samples collected for the Middle and North Creek Bacteria Study.

Escherichia coli concentrations were well in excess of the state standard throughout the sampling season, across all sites, and under nearly all flow conditions (Figure 16). Sampling locations in 2007 were expanded to include several sites very near to the headwaters of North Creek, within the Andersons Century Farms/Dakota Heights Eight Addition neighborhoods in northern Lakeville. Bacteria concentrations in these areas were well above the proposed state standard, even though very few potential sources could be identified. The 2007 *E. coli* results were similar to those observed in 2006, where fecal coliform was the endpoint utilized.

The source of these bacteria in the Middle and North Creek Watersheds continues to remain elusive. No obvious source was identified, in either watershed, during the course of the study. Possible sources may include wildlife, domesticated animals, and impervious surface, as supported by recent research (Whitlock 2002, Young 1999). Bacteria, including *E. coli*, have been shown to survive and grow within soils and sediment, which may be yet another source within the Middle and North Creek Watersheds (Whitman 2003, Anderson 2005). Finally, in the highly urbanized setting of North Creek, septic sewer and storm sewer cross connections may exist between the two sewer systems in this area, possibly leading to the observed bacteria concentrations in this area.

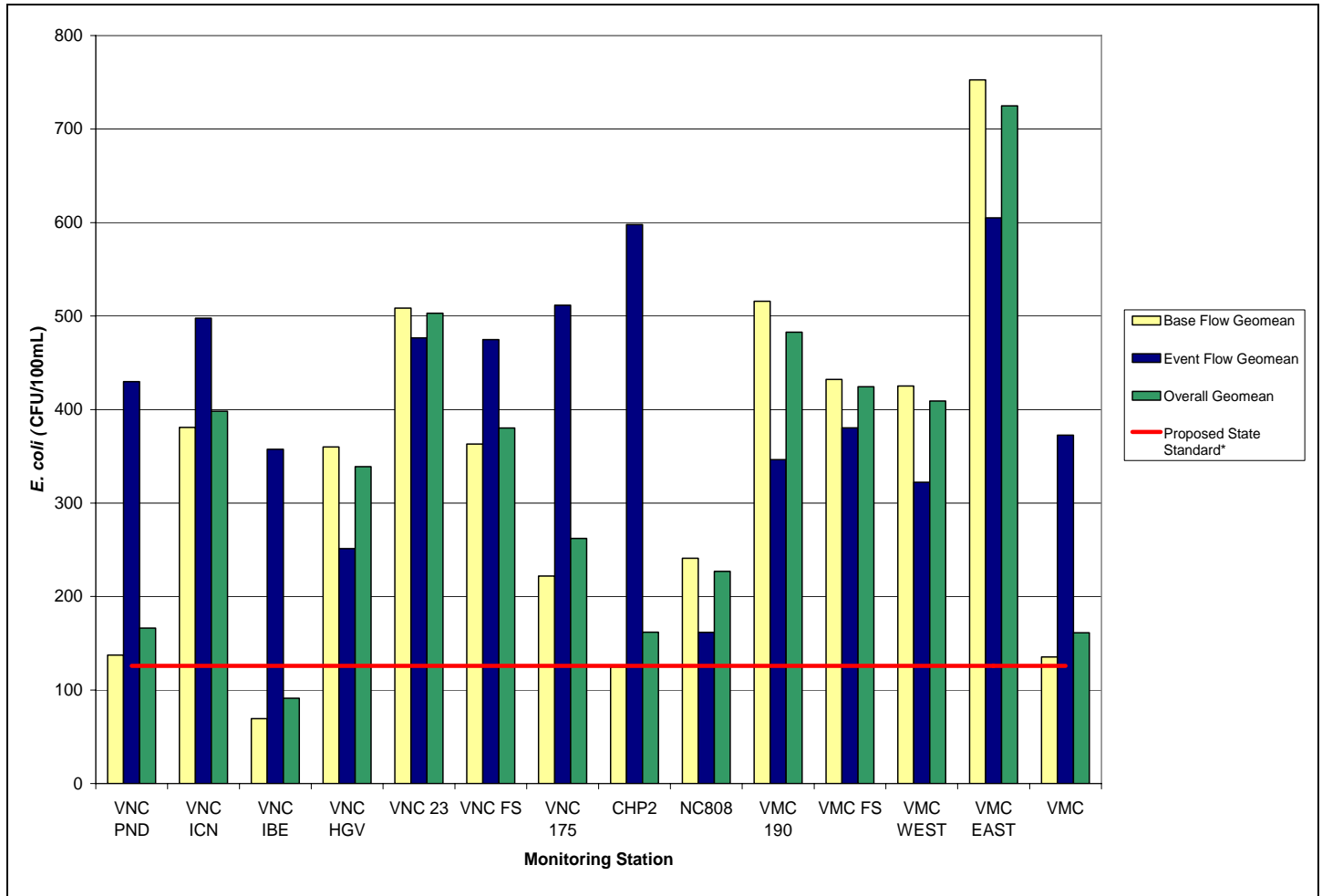


Figure 16. 2007 Middle and North Creek *E. coli* Geometric Means

*The proposed state standard applies to the monthly geometric mean of at least five samples. It should be noted that data presented in Figure 16 are annual (2007) rather than monthly geometric means.

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Young K.D., and Edward L. Thackston, 1999. Housing Density and Bacterial Loading in Urban Streams. *Journal of Environmental Engineering*. 125, 1177-1180.

Vermillion River Monitoring Network 2007 Report: Executive Summary

Prepared for:
Vermillion River Watershed Joint Powers Organization

The Vermillion River Monitoring Network (Figure 1) was created to collect water quality and quantity data throughout the Vermillion River Watershed. Samples are analyzed for a variety of parameters including nutrients, bacteria, and sediment. These results are used to establish long-term water quality and quantity data, provide trend analysis and pollutant loading values.

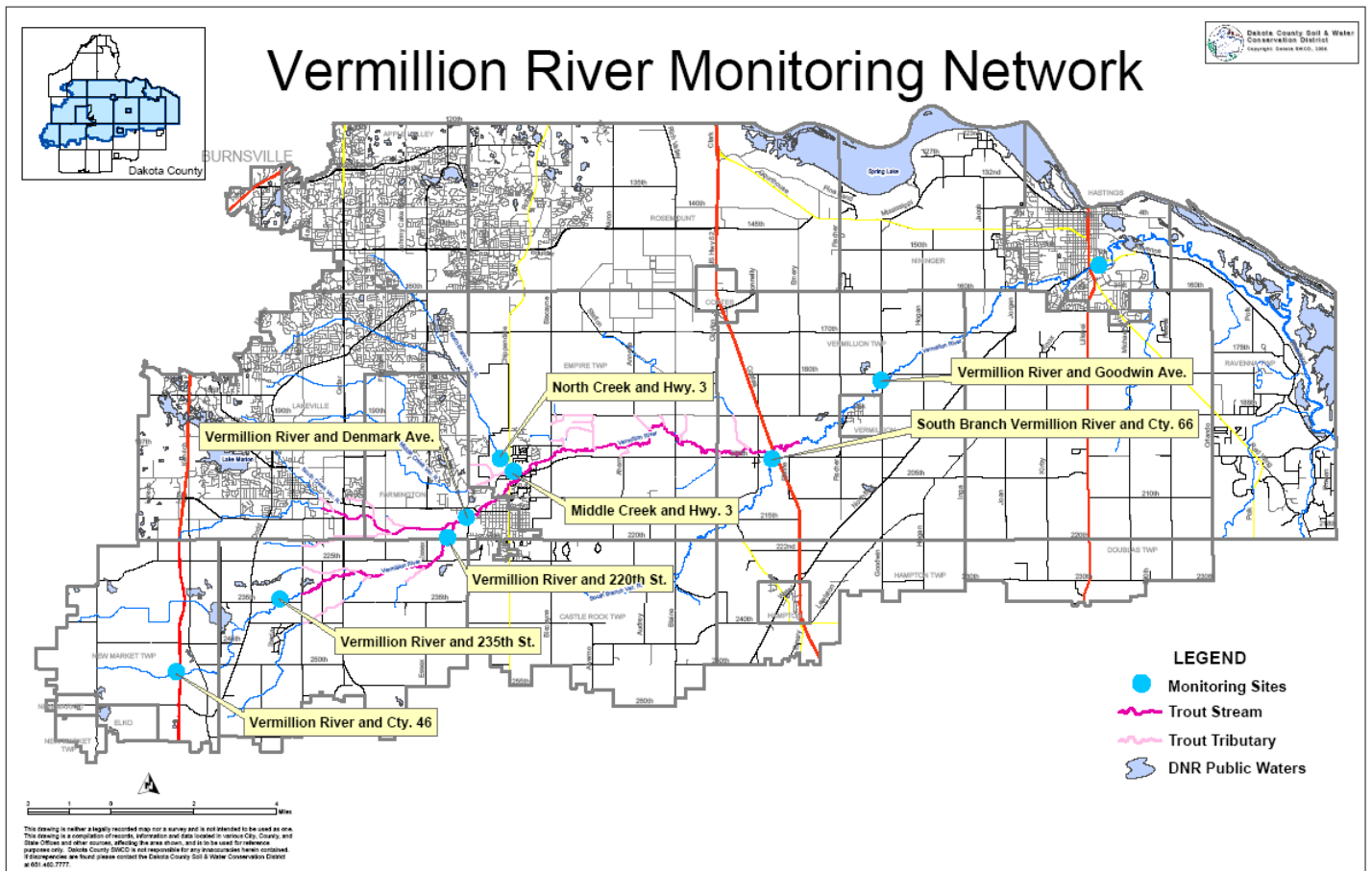


Figure 1. Vermillion River Monitoring Network and WOMP Station Locations

Results for the 2007 monitoring season are listed below and are compared against state water quality standards or minimally impacted stream eco-region means, developed by the Minnesota Pollution Control Agency. Results in red text are exceeding state water quality standards or eco-region means.

Wastewater treatment plant discharge can contribute to elevated conductivity levels which may explain the conductivity results for those sites downstream from nearby wastewater treatment plants (Elko/New Market and Empire/Vermillion). Since the Vermillion River has been listed as impaired for bacteria, it is not surprising that 2007 *E. coli* results exceeded the state standard at all locations. A region-wide effort is currently underway to address elevated bacteria concentrations. Nitrate results were unusually high at the South Branch site, and may warrant further investigation in view of nitrate groundwater contamination in the eastern portion of the watershed. The turbidity (cloudiness) results at sites located in the center of the watershed confirm concerns that turbidity in these locations frequently exceeds the state standard. The Minnesota Pollution Control Agency has proposed listing this reach as impaired for turbidity in 2008.

Monitoring Sites										
Parameters	Vermillion River and Cty. 46 (Scott Co.)	Vermillion River and 235 th St.	Vermillion River and 220 th St.	Vermillion River and Denmark Ave.	Middle Creek and Hwy. 3	North Creek and Hwy. 3	South Branch Vermillion River and Cty. 66	Vermillion River and Goodwin Ave.	2007 Notes	
	Alkalinity	271 mg/L	222 mg/L	211 mg/L	207 mg/L	195 mg/L	188 mg/L	173 mg/L	207 mg/L	Typical for freshwater
	Chloride	199 mg/L	79 mg/L	34 mg/L	41 mg/L	51 mg/L	52 mg/L	18 mg/L	90 mg/L	In compliance with state standard
	Conductivity (field)	1051 mMHOS	727 mMHOS	563 mMHOS	589 mMHOS	648 mMHOS	669 mMHOS	524 mMHOS	816 mMHOS	Above eco-region mean downstream from wastewater treatment plants
	Dissolved Oxygen	8.72 mg/L	8.38 mg/L	9.03 mg/L	8.33 mg/L	7.62 mg/L	8.16 mg/L	8.77 mg/L	9.15 mg/L	Adequate for trout fishery
	<i>E. coli</i>	na	156 CFU/100mL	190 CFU/100mL	242 CFU/100mL	231 CFU/100mL	237 CFU/100mL	337 CFU/100mL	335 CFU/100mL	Exceeding state standard at all sites
	Nitrate (NO ₃)	1.70 mg/L	0.75 mg/L	1.45 mg/L	1.71 mg/L	0.86 mg/L	0.83 mg/L	5.65 mg/L	4.57 mg/L	Exceeding eco-region mean at S. Branch and Cty. 66
	Nitrogen Ammonia	0.09 ug/L	0.27 ug/L	0.08 ug/L	0.08 ug/L	0.22 ug/L	0.18 ug/L	0.15 ug/L	0.10 ug/L	Below eco-region mean
	Total Phosphorus	0.27 mg/L	0.20 mg/L	0.16 mg/L	0.12 mg/L	0.12 mg/L	0.10 mg/L	0.13 mg/L	0.18 mg/L	Below eco-region mean
	pH (field)	8.11	7.86	7.94	7.90	7.77	7.72	7.95	8.08	In compliance with state standard
	Suspended Solids	17.3 mg/L	10.2 mg/L	33.6 mg/L	23.0 mg/L	13.2 mg/L	15.1 mg/L	13.6 mg/L	25.9 mg/L	Below eco-region mean
	Average Summer Temperature	67.4 °F	68.2 °F	65.9 °F	64.7 °F	60.4 °F	60.1 °F	64.6 °F	69.1 °F	Slightly elevated for trout fishery at 220 th St.
Turbidity	9.0 NTU	7.6 NTU	40.7 NTU	16.2 NTU	10.3 NTU	7.2 NTU	9.1 NTU	11.2 NTU	Exceeding state standard near center of watershed	
mg/L = milligrams per liter or parts per million (ppm) CFU = colony forming units ug/L = micrograms per liter or parts per billion (ppb) NTU = nephelometric turbidity units mMHO = micromhos or microseimens °F = degrees Fahrenheit										

Recommendations for 2008 monitoring:

- Continue water quality/quantity monitoring utilizing the Vermillion River Monitoring Network
- Continue collaborating with MNDNR to further refine flow measurements and subsequent data analysis
- Further investigate turbidity issues in the center of the watershed

Summary of Wellhead and Source Water Protection Plan City of Rosemount, Minnesota

The City of Rosemount has developed a Wellhead and Source Water Protection Plan (the Plan) for their municipal water supply wells. At the time the Plan was prepared the Rosemount municipal water supply system consisted of six wells: Wells 3, 7, 8, 9, RR-1, and RR-2. The source water aquifer for these wells is the Jordan Sandstone. The Plan was prepared in accordance with the applicable portions of the State of Minnesota Wellhead Protection Rules (Minnesota Rules 4720.5100 through 4720.5590).

In Part 1 of the Plan (Barr, 2002), Wellhead Protection Areas (WHPAs) and Drinking Water Supply Management Areas (DWSMAs) were delineated. In accordance with Minnesota Rules 4720.5550, the municipal wells were identified as vulnerable due to the presence of tritium in groundwater samples previously collected from the City's municipal wells by the Minnesota Department of Health. In the Part 1 report, the source water aquifer within the DWSMAs was also identified as vulnerable to contamination. The delineated WHPAs and DWSMAs as well as the source water aquifer vulnerability within the DWSMAs are shown on the attached Figure.

In Part 2 of the Plan (Barr, 2003), management strategies for protecting the source water aquifer are presented. Per the Wellhead Protection Rules, the Plan will need to be amended as new municipal water supply wells are put into service and updated at least every 10 years regardless of wells being added to the water supply system.

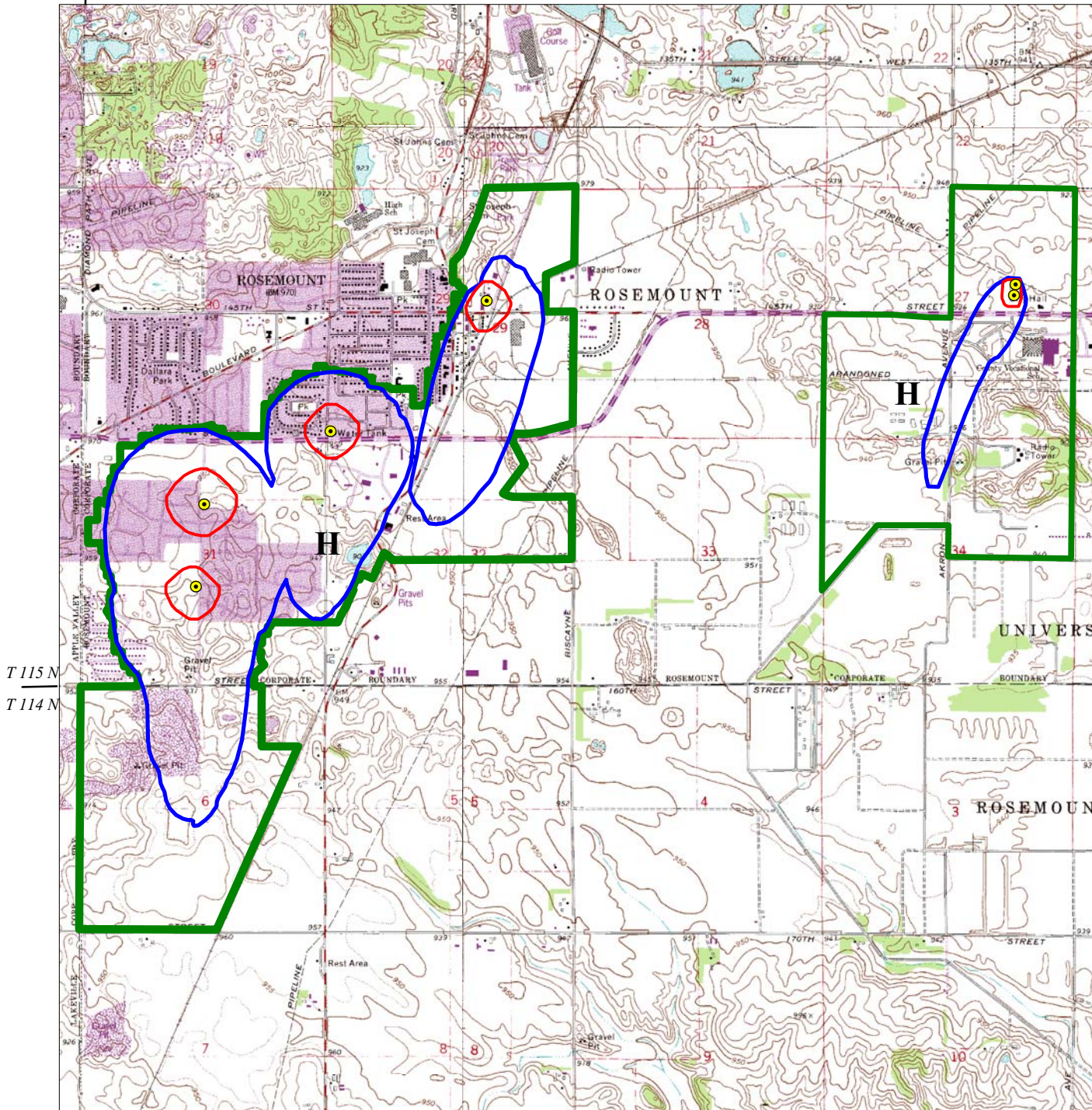
References:





Barr Engineering Company (Barr), 2002. *Wellhead Protection Area Delineations for the City of Rosemount, Minnesota, prepared for the City of Rosemount, April 2002.*

Barr Engineering Company (Barr), 2003. *Wellhead and Source Water Protection – Part 2: Wellhead Protection Plan, prepared for the City of Rosemount, October 2003.*

City of Rosemount

Drinking Water Supply Management Area (DWSMA) 20 year Time of Travel



-  Public Water Supply Well
-  Emergency Management Zone
-  Wellhead Protection Area (WHPA)
-  DWSMA

H = High Vulnerability

