Lac qui Parle Major Watershed Project - Phase 2 Budget							
Cost Category	Unit Cost (per hour, per mile, etc)	# of Units (hours, mileage, etc.)	Total Budget	Expended Previous Period	Expended Jan. - June 2020	Total Expended	Balance
Objective 1: Community Outreach							
Task A: TEAM Coordination							
LqPYBWD	$ 40.00	270	$ 10,800.00	$ 6,360.00	$ 3,560.00	$ 9,920.00	$ 880.00
County/SWCD Staff	$ 40.00	548	$ 21,920.00	$ 3,930.00	$ 720.00	$ 4,650.00	$ 17,270.00
Mileage	Commissioner's Plan Rate		$ 3,750.00	$ 511.60	$ 99.94	$ 611.54	$ 3,138.46
Subtotal Task A			*$ 36,470.00*	*$ 10,801.60*	*$ 4,379.94*	*$ 15,181.54*	*$ 21,288.46*
Task B: Public Participation and Education							
LqPYBWD	$ 40.00	671	$ 26,840.00	$ 14,870.00	$ 4,530.00	$ 19,400.00	$ 7,440.00
County/SWCD Staff	$ 40.00	488	$ 19,520.00	$ 3,710.00		$ 3,710.00	$ 15,810.00
Mileage	Commissioner's Plan Rate		$ 1,677.58	$ 807.70	$ 115.40	$ 923.10	$ 754.48
Meeting Supplies			$ 2,700.00	$ 1,032.73	$ 37.01	$ 1,069.74	$ 1,630.26
Radio Program	$ 20.00	16	$ 320.00	$ 117.50	$ 22.50	$ 140.00	$ 180.00
Retractable Banners			$ 1,250.00	$ 435.00	$ 320.58	$ 755.58	$ 494.42
Park Display			$ 9,600.00	$ -	$ 9,996.21	$ 9,996.21	$ (396.21)
Advertising	$ 50.00	32	$ 1,600.00	$ 901.24		$ 901.24	$ 698.76
Meal	$ 7.50	100	$ 750.00	$ -		$ -	$ 750.00
Bus Rental	$ 900.00	3	$ 2,700.00	$ -		$ -	$ 2,700.00
Canoe Trips	$ 105.00	4	$ 420.00	$ 247.19		$ 247.19	$ 172.81
Informational Pamphlets			$ 450.00	$ 26.98		$ 26.98	$ 423.02
Room Reservation			$ 240.00	$ -		$ -	$ 240.00
Subtotal Task B			*$ 68,067.58*	*$ 22,148.34*	*$ 15,021.70*	*$ 37,170.04*	*$ 30,897.54*
Objective 1 Subtotal			**$ 104,537.58**	**$ 32,949.94**	**$ 19,401.64**	**$ 52,351.58**	**$ 52,186.00**
Objective 2: Data Collection and Analysis							
Task A: Watershed Inventories							
LqPYBWD	$ 40.00	220	$ 8,800.00	$ 1,920.00		$ 1,920.00	$ 6,880.00
LqPYBWD Intern	$ 25.00	526	$ 13,150.00	$ -		$ -	$ 13,150.00
County/SWCD Staff	$ 40.00	0	$ -	$ -		$ -	$ -
Mileage	Commissioner's Plan Rate		$ 950.00	$ 311.58		$ 311.58	$ 638.42
Subtotal Task A			*$ 22,900.00*	*$ 2,231.58*	*$ -*	*$ 2,231.58*	*$ 20,668.42*
Task B: Stressor Identification							
LqPYBWD	$ 40.00	117	$ 4,680.00	$ 4,290.00		$ 4,290.00	$ 390.00
Mileage	Commissioner's Plan Rate		$ 389.48	$ 389.48		$ 389.48	$ -
Shipping	$ 40.00	9	$ 92.05	$ 92.05		$ 92.05	$ -
Shipping Supplies			$ 60.89	$ 60.89		$ 60.89	$ -
Subtotal Task B			*$ 5,222.42*	*$ 4,832.42*	*$ -*	*$ 4,832.42*	*$ 390.00*
Objective 2 Subtotal			**$ 28,122.42**	**$ 7,064.00**	**$ -**	**$ 7,064.00**	**$ 21,058.42**
Objective 3: Project Coordination							
Task A: Project Management							
LqPYBWD	$ 40.00	560	$ 22,400.00	$ 6,170.00	$ 2,210.00	$ 8,380.00	$ 14,020.00
Subtotal Task A			*$ 22,400.00*	*$ 6,170.00*	*$ 2,210.00*	*$ 8,380.00*	*$ 14,020.00*
Objective 3 Subtotal			**$ 22,400.00**	**$ 6,170.00**	**$ 2,210.00**	**$ 8,380.00**	**$ 14,020.00**
Totals			**$ 155,060.00**	**$ 46,183.94**	**$ 21,611.64**	**$ 67,795.58**	**$ 87,264.42**

Attachments

Figure 1: Rain Barrel Decoration, Saint Peter's Catholic Church, 2018 (Objective 1, Task B, Subtask 5)

Figure 2: 2018 Canoe Trip (Objective 1, Task B, Subtask 6)

Figure 3: Hendricks, MN students figuring out rain barrel decorations (Objective 1, Task B, Subtask 5)

Figure 4: Stressor Identification Water Sampling in Summer 2018 (Objective 2, Task B, Subtask 1)

Figure 5: Program Coordinator's sister Kellie - start of 2017 canoe trip on the West Branch of the Lac qui Parle River (Objective 1, Task B, Subtask 6)

Figure 6: Landowner Workshop - February 2018 (Objective 1, Task B, Subtask 3)

Figure 7: Water Sampling Demonstration Day with Dawson – Boyd high school sophomore biology students on a beautiful fall morning with MPCA biologists , October 9, 2019 (Objective 1, Task B, Subtask 4)

Figure 8: First-hand look at fish shocking and sampling. Big thank you to MPCA staff biologists who came out to demonstrate, very neat and fun for the students! (Objective 1, Task B, Subtask 4)

Figure 9: Rhyan from the Lac qui Parle Soil and Water Conservation District giving aquatic invasive species and macroinvertebrate lessons to eager learners! (Objective 1, Task B, Subtask 4)

Figure 10: Minnesota Pollution Control Agency biologists sharing preserved fish samples with sophomore biology students. (Objective 1, Task B, Subtask 4)

Figure 11: Coming in hot at the 2019 canoe trip landing! (Objective 1, Task B, Subtask 6)

Figure 12: One of four interpretive signs installed describing WRAPS and how it relates to the watershed. This sign was installed near the rock rapids in Dawson, MN. (Objective 1, Task B, Subtask 10)

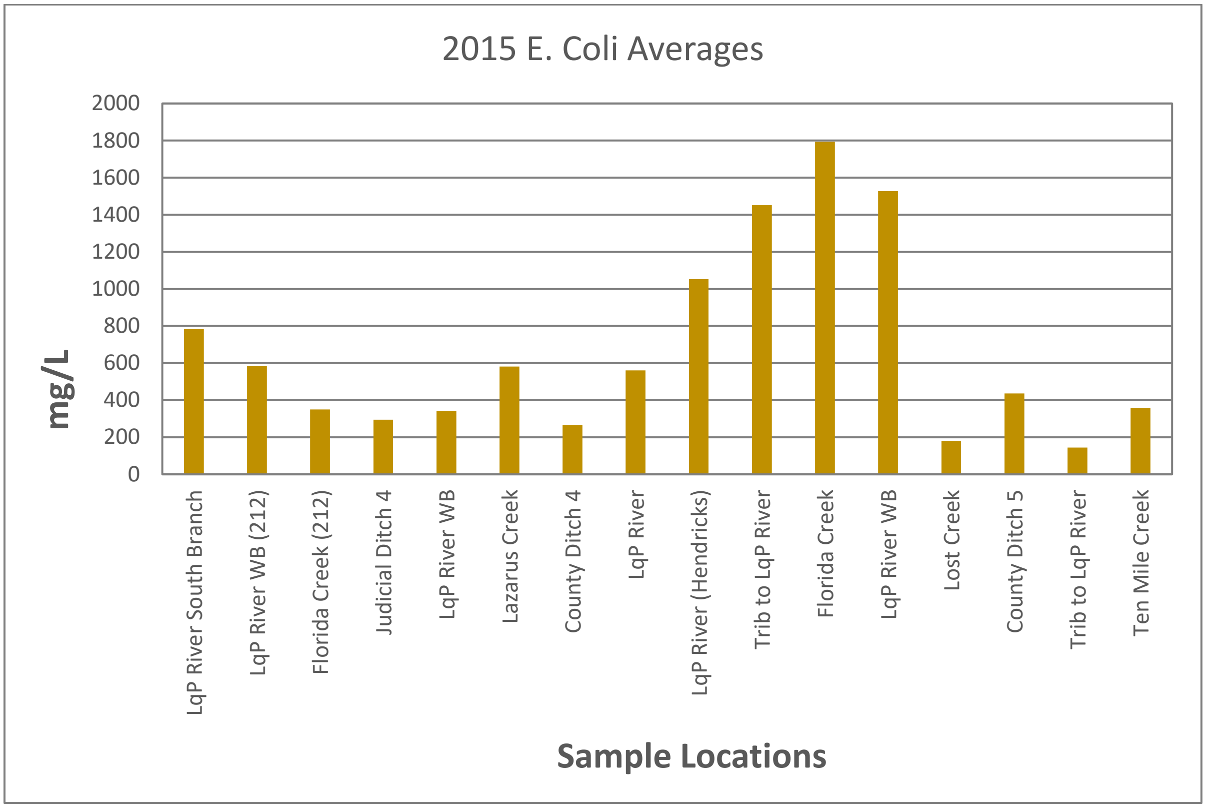
Figure 13: One of four interpretive signs installed describing WRAPS and how it relates to the watershed. This sign was installed at the headwaters of the Lac qui Parle River in Hendricks, MN. (Objective 1, Task B, Subtask 10)

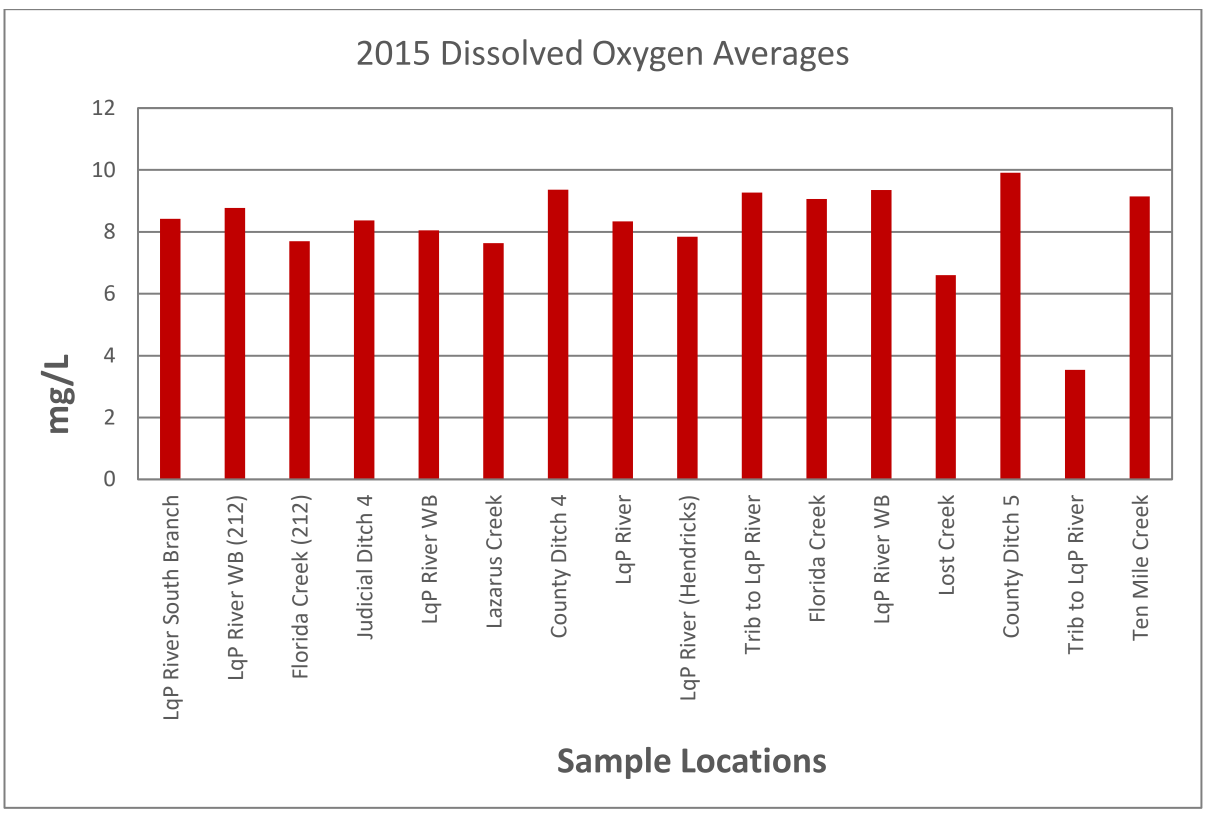
Figure 14: Water pollution demonstration table at the Family Fun Evening at Stonehill Park. Demonstration courtesy of partner SWCD staff. (Objective 1, Task B, Subtask 5)

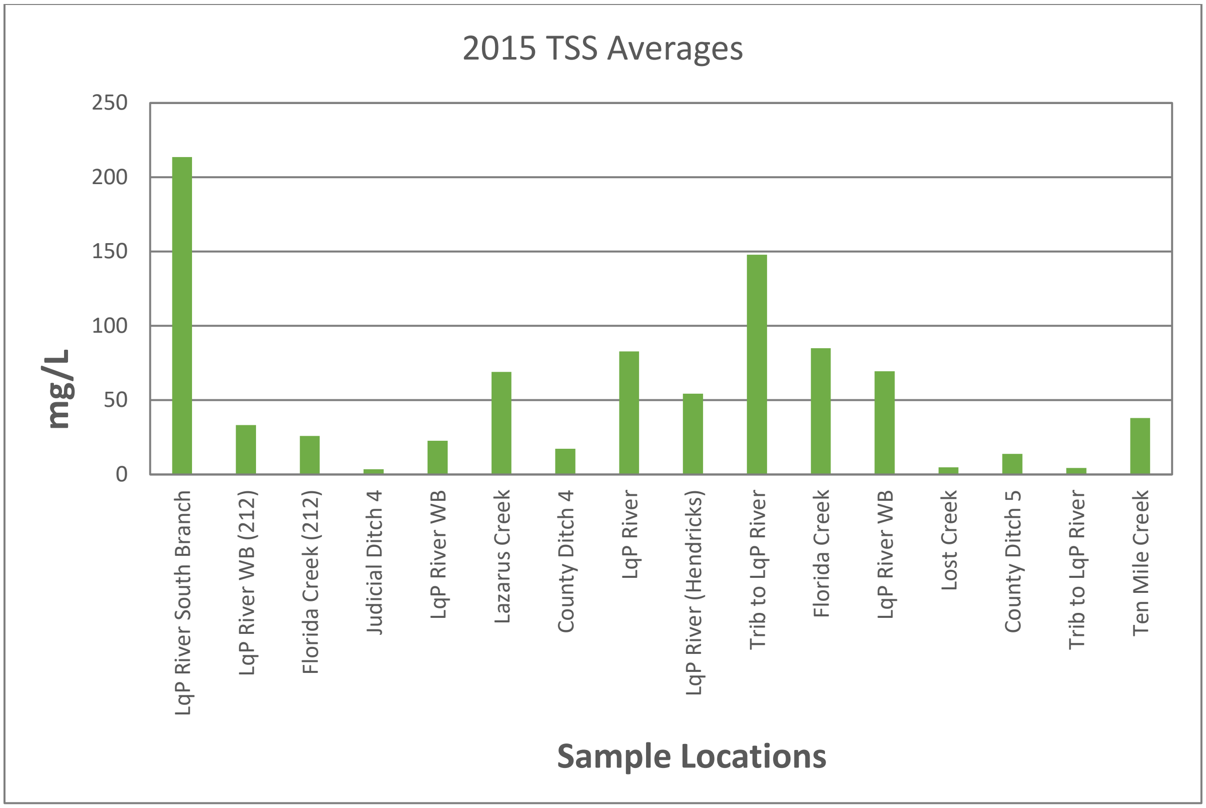
Figure 15: Check in and education station at the Family Fun Evening. (Objective 1, Task B, Subtask 5)

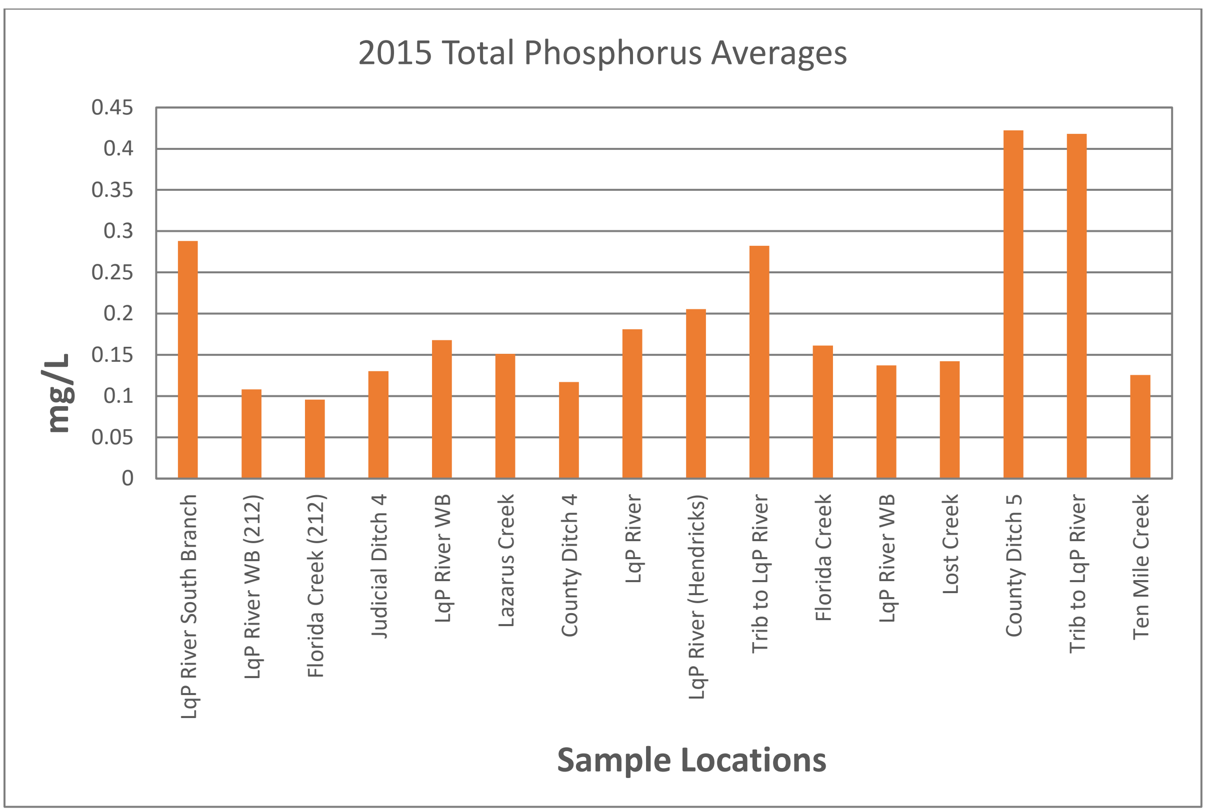
Figure 16: Retractable Banners (Objective 1, Task B, Subtask 9)

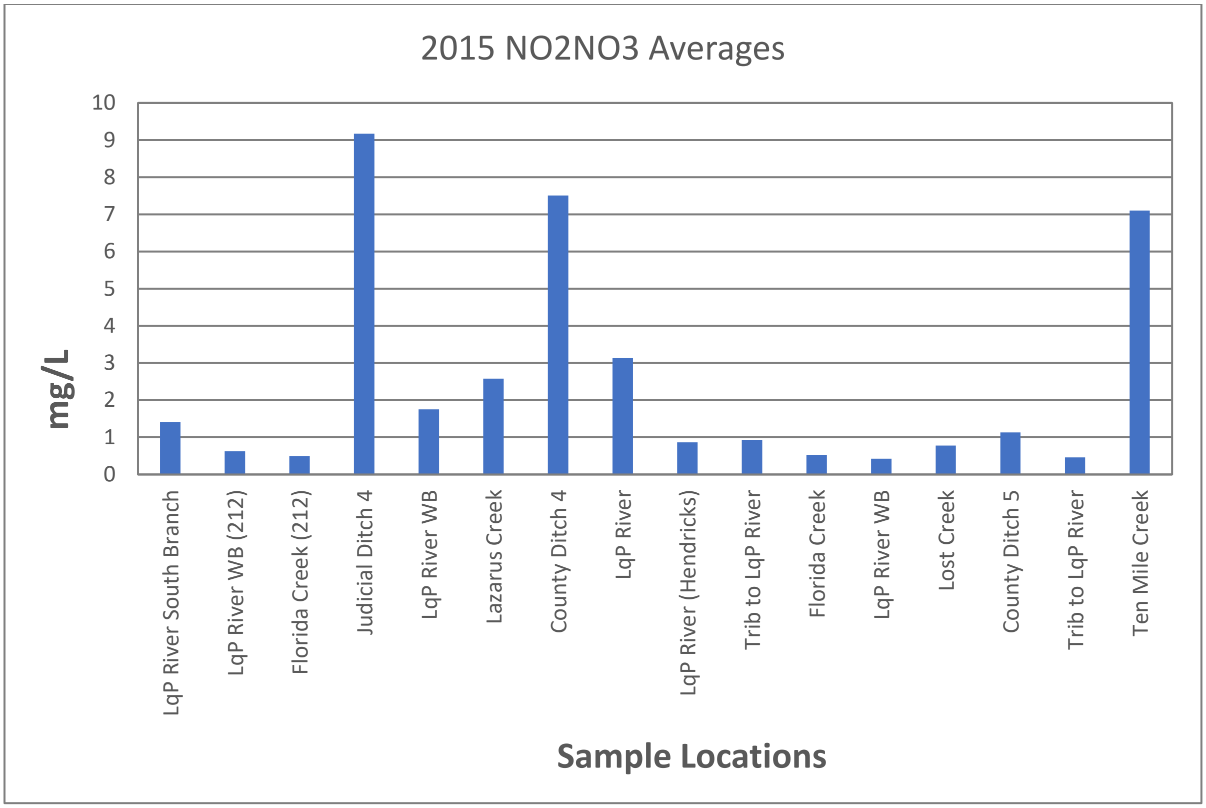
2015 Averages





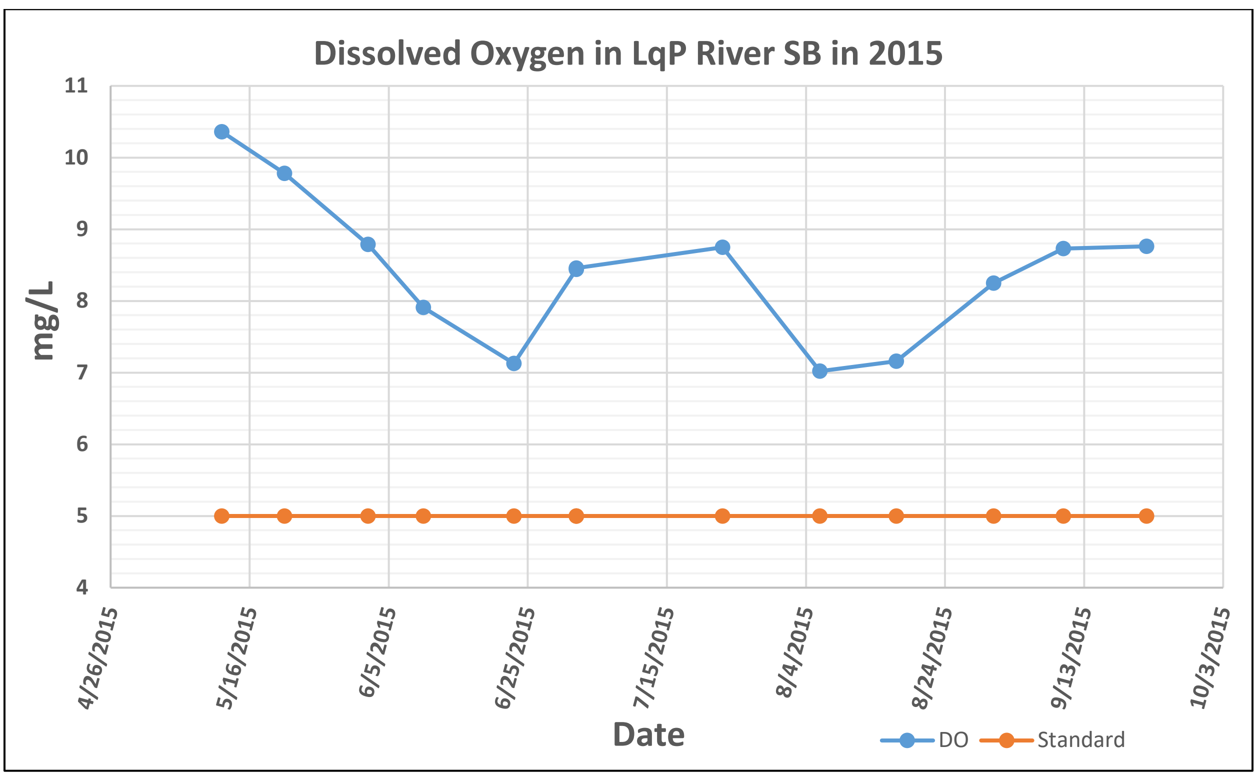

2015 TSS Averages
250
200
150
100
50
0
mg/L
LqP River South Branch
LqP River WB (212)
Florida Creek (212)
Judicial Ditch 4
LqP River WB
Lazarus Creek
County Ditch 4
LqP River
LqP River (Hendricks)
Trib to LqP River
Florida Creek
LqP River WB
Lost Creek
County Ditch 5
Trib to LqP River
Ten Mile Creek
Sample Locations


2015 Total Phosphorus Averages
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
mg/L
LqP River South Branch
LqP River WB (212)
Florida Creek (212)
Judicial Ditch 4
LqP River WB
Lazarus Creek
County Ditch 4
LqP River
LqP River (Hendricks)
Trib to LqP River
Florida Creek
LqP River WB
Lost Creek
County Ditch 5
Trib to LqP River
Ten Mile Creek
Sample Locations

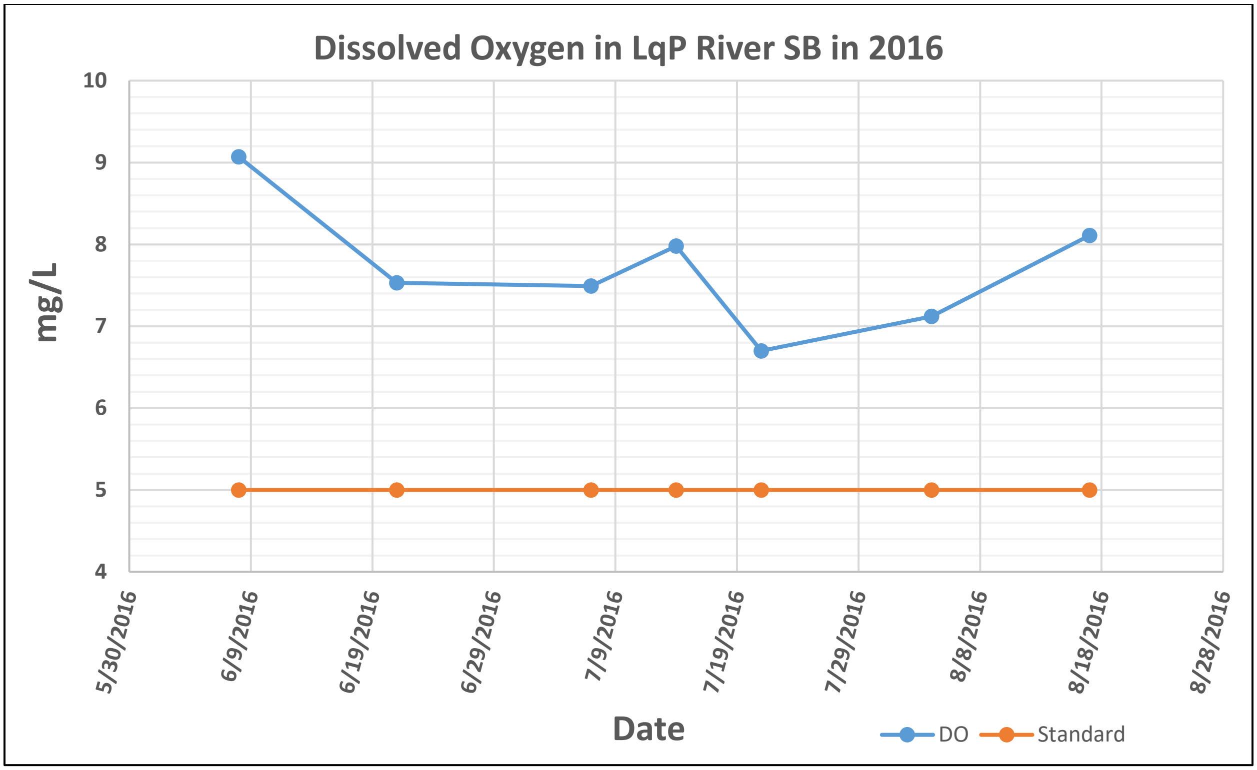


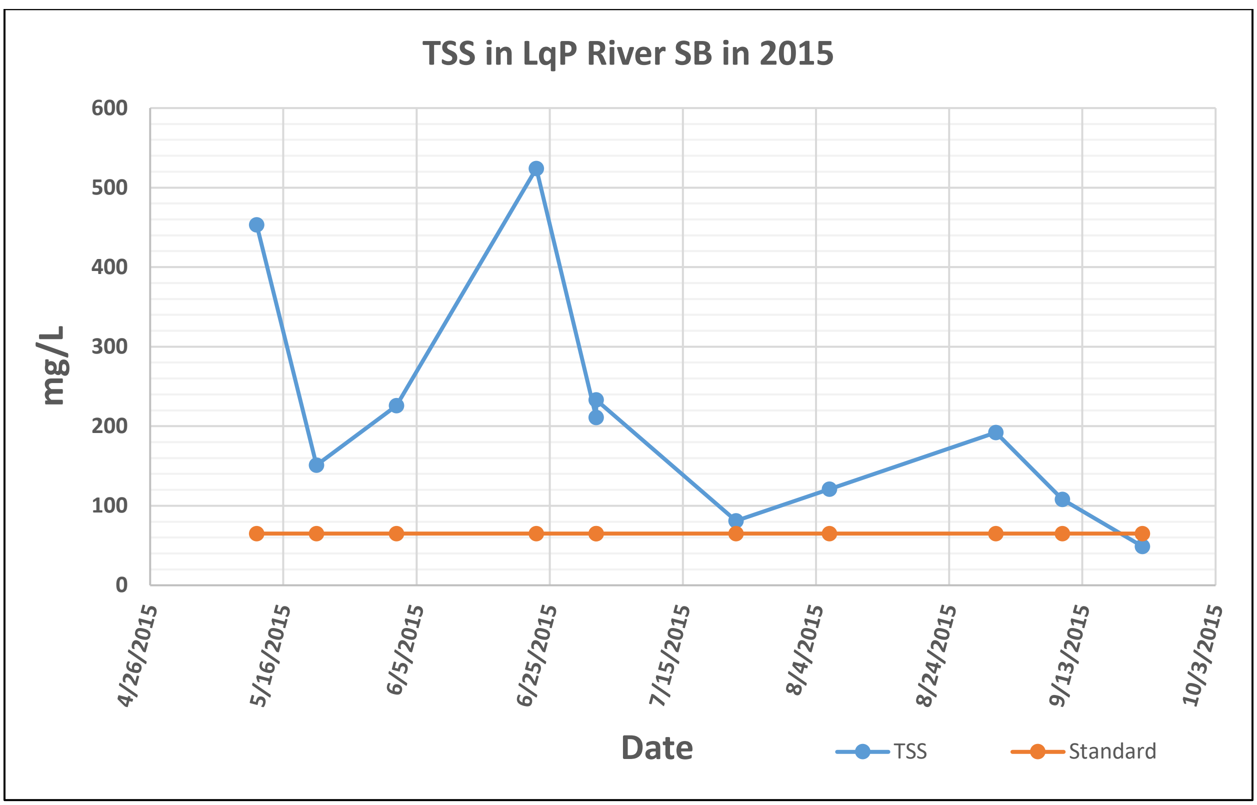
2015 NO2NO3 Averages
mg/L
10
9
8
7
6
5
4
3
2
1
0
LqP River South Branch
LqP River WB (212)
Florida Creek (212)
Judicial Ditch 4
LqP River WB
Lazarus Creek
County Ditch 4
LqP River
LqP River (Hendricks)
Trib to LqP River
Florida Creek
LqP River WB
Lost Creek
County Ditch 5
Trib to LqP River
Ten Mile Creek
Sample Locations

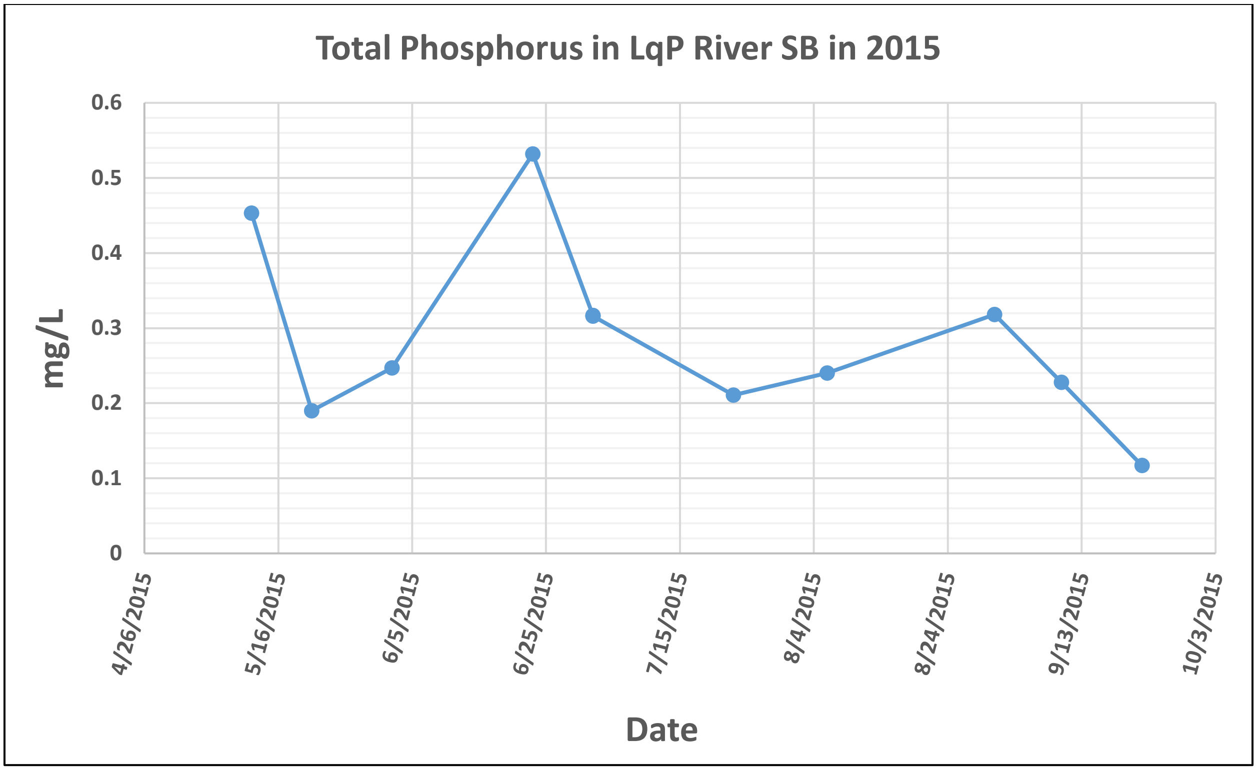
S003-085

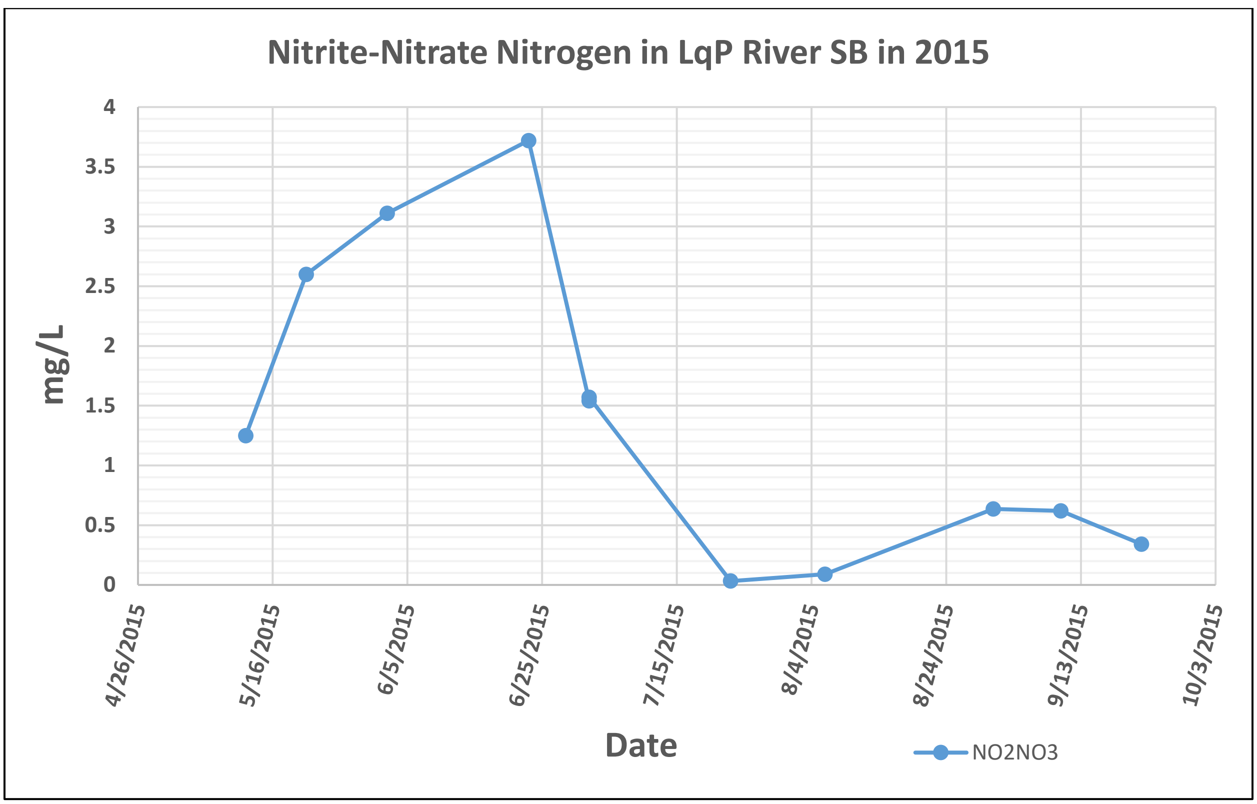


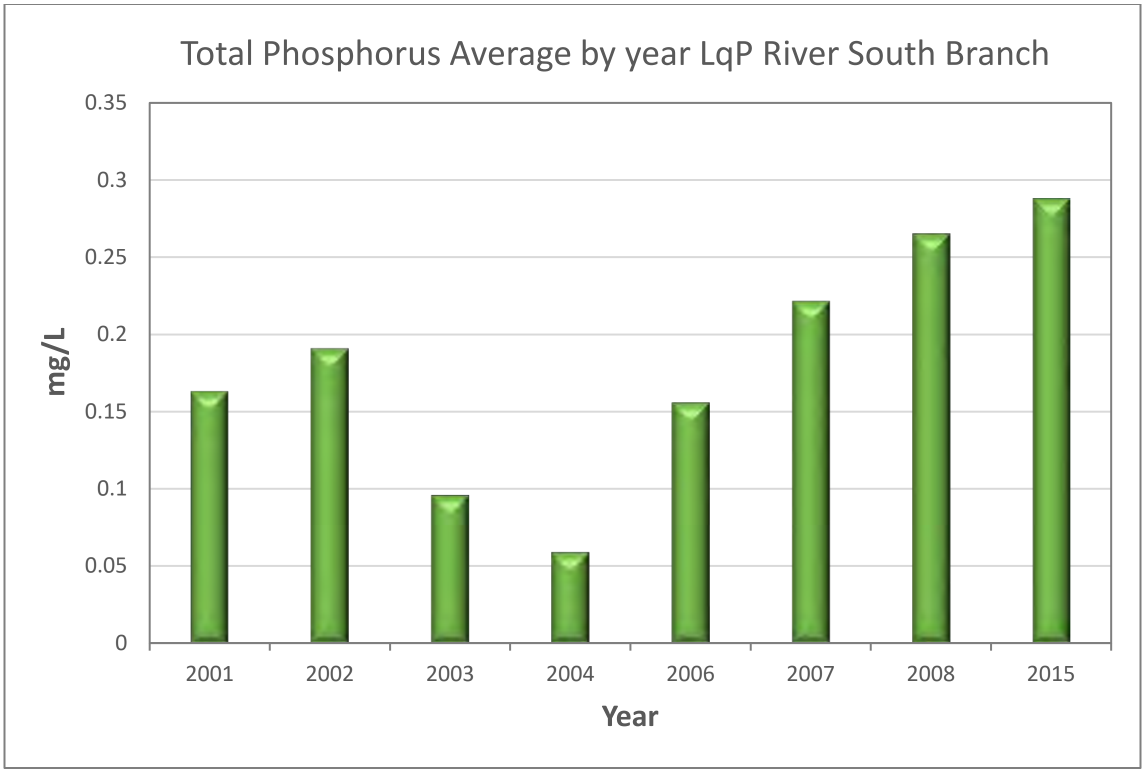
Dissolved Oxygen in LqP River SB in 2015
mg/L
11
10
9
8
7
6
5
4
4/26/2015
5/16/2015
6/5/2015
6/25/2015
7/15/2015
8/4/2015
8/24/2015
9/13/2015
10/3/2015
Date
DO
Standard

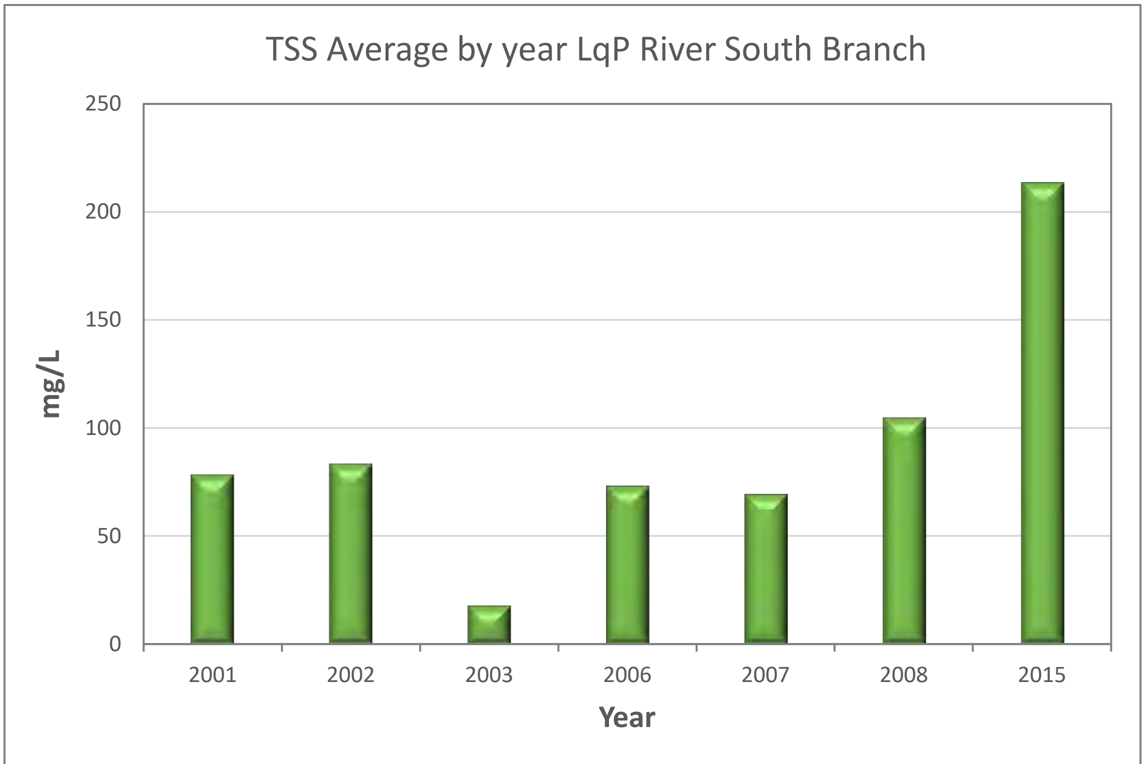

Dissolved Oxygen in LqP River SB in 2016
mg/L
10
9
8
7
6
5
4
5/30/2016
6/9/2016
6/19/2016
6/29/2016
7/9/2016
7/19/2016
7/29/2016
8/8/2016
8/18/2016
8/28/2016
Date
DO
Standard


TSS in LqP River SB in 2015
mg/L
600
500
400
300
200
100
0
4/26/2015
5/16/2015
6/5/2015
6/25/2015
7/15/2015
8/4/2015
8/24/2015
9/13/2015
10/3/2015
Date
TSS
Standard

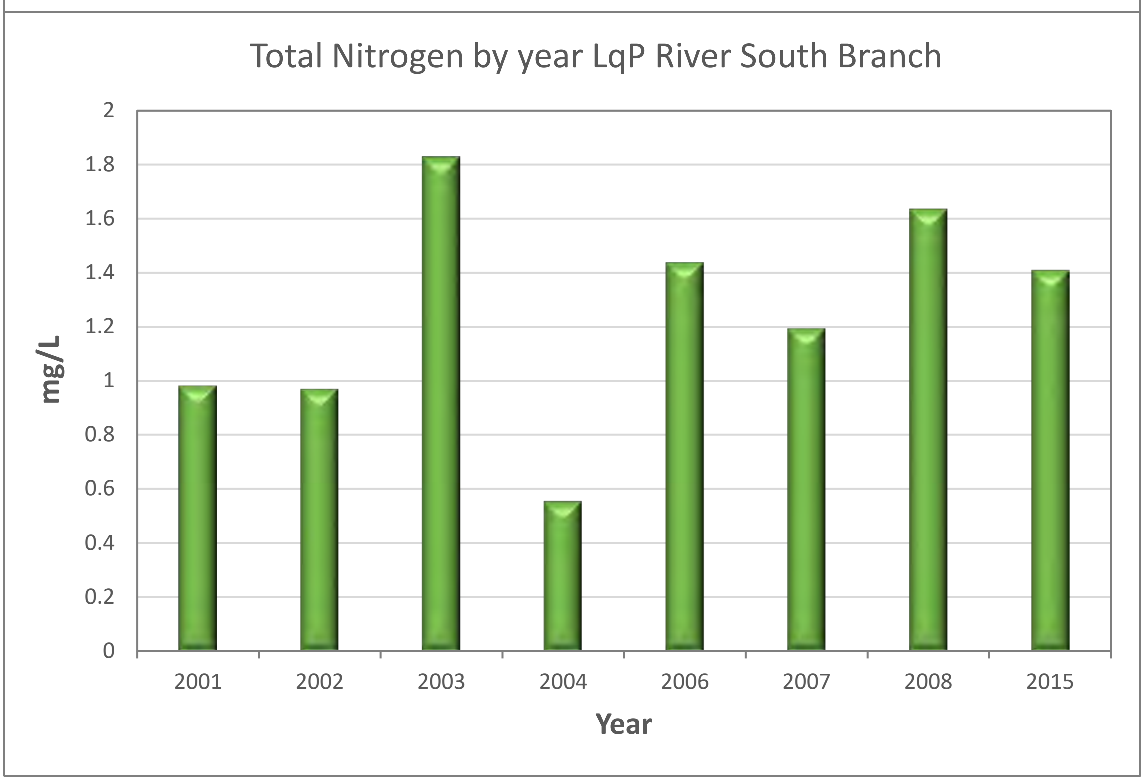

Total Phosphorus in LqP River SB in 2015
0.6
0.5
0.4
0.3
0.2
0.1
0
mg/L
4/26/2015
5/16/2015
6/5/2015
6/25/2015
7/15/2015
8/4/2015
8/24/2015
9/13/2015
10/3/2015
Date


Nitrite-Nitrate Nitrogen in LqP River SB in 2015
4
3.5
3
2.5
2
1.5
1
0.5
0
mg/L
4/26/2015
5/16/2015
6/5/2015
6/25/2015
7/15/2015
8/4/2015
8/24/2015
9/13/2015
10/3/2015
Date
NO2NO3

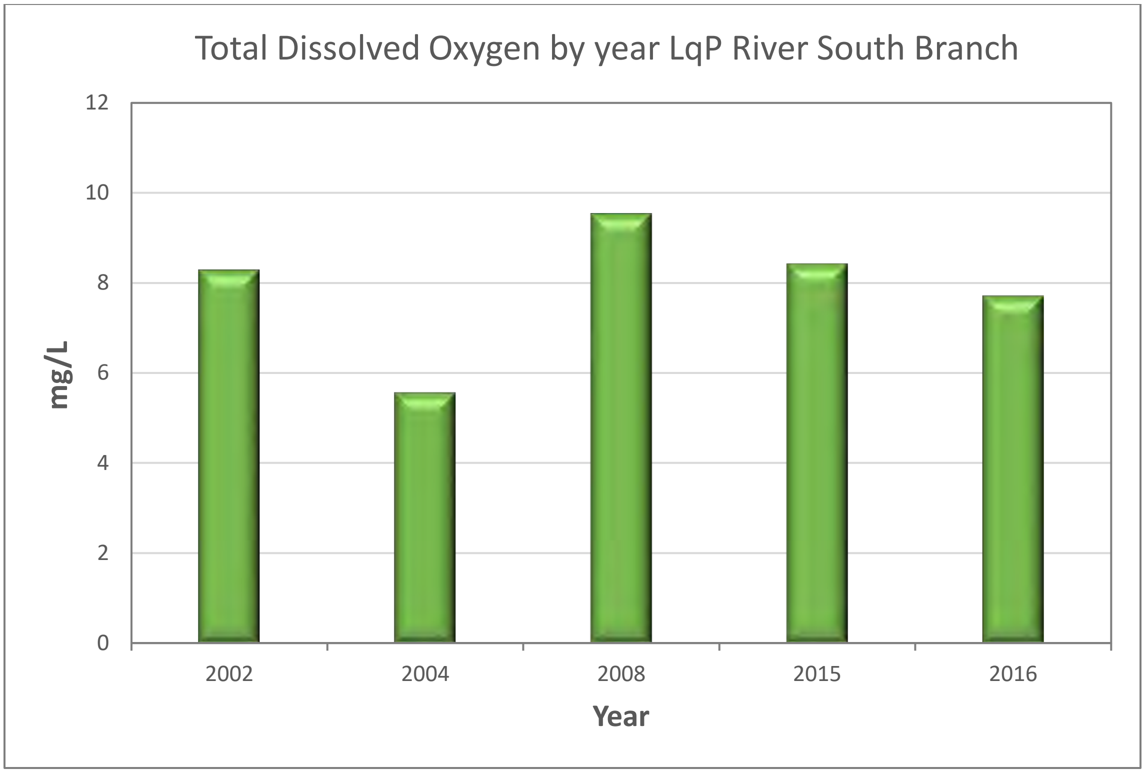

Total Phosphorus Average by year LqP River South Branch
mg/L
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
2001
2002
2003
2004
2006
2007
2008
2015
Year

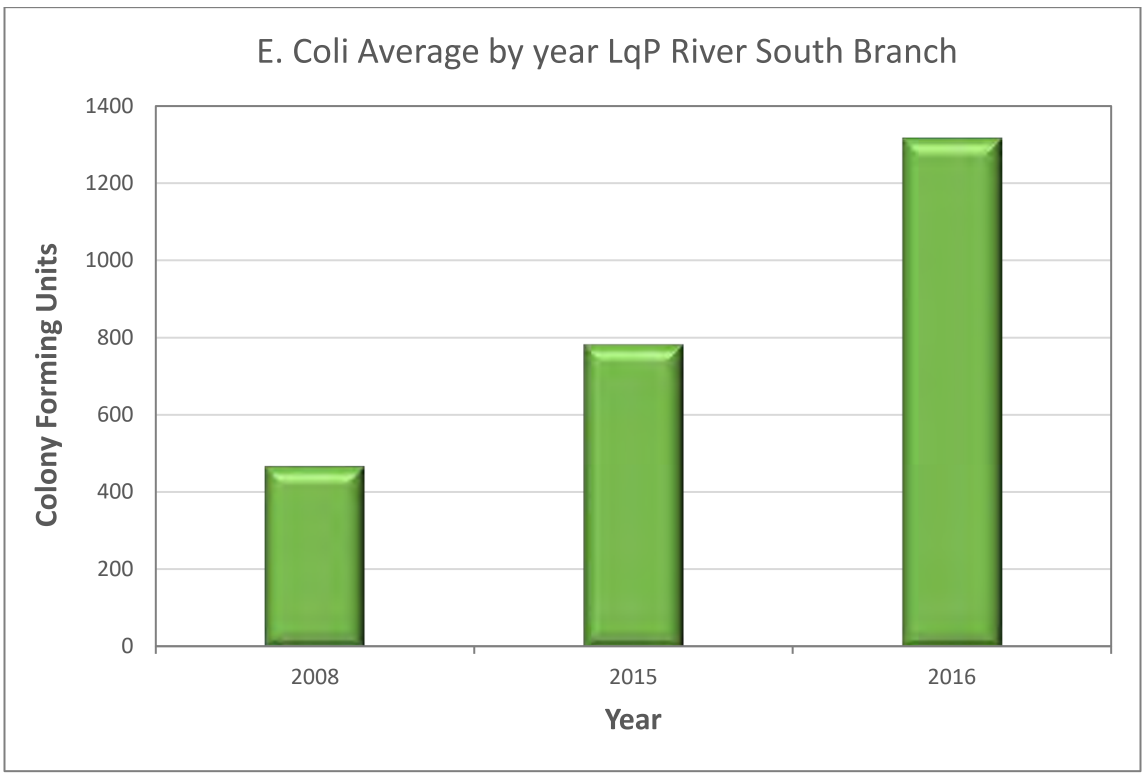


TSS Average by year LqP River South Branch
mg/L
250
200
150
100
50
0
2001
2002
2003
2006
2007
2008
2015
Year

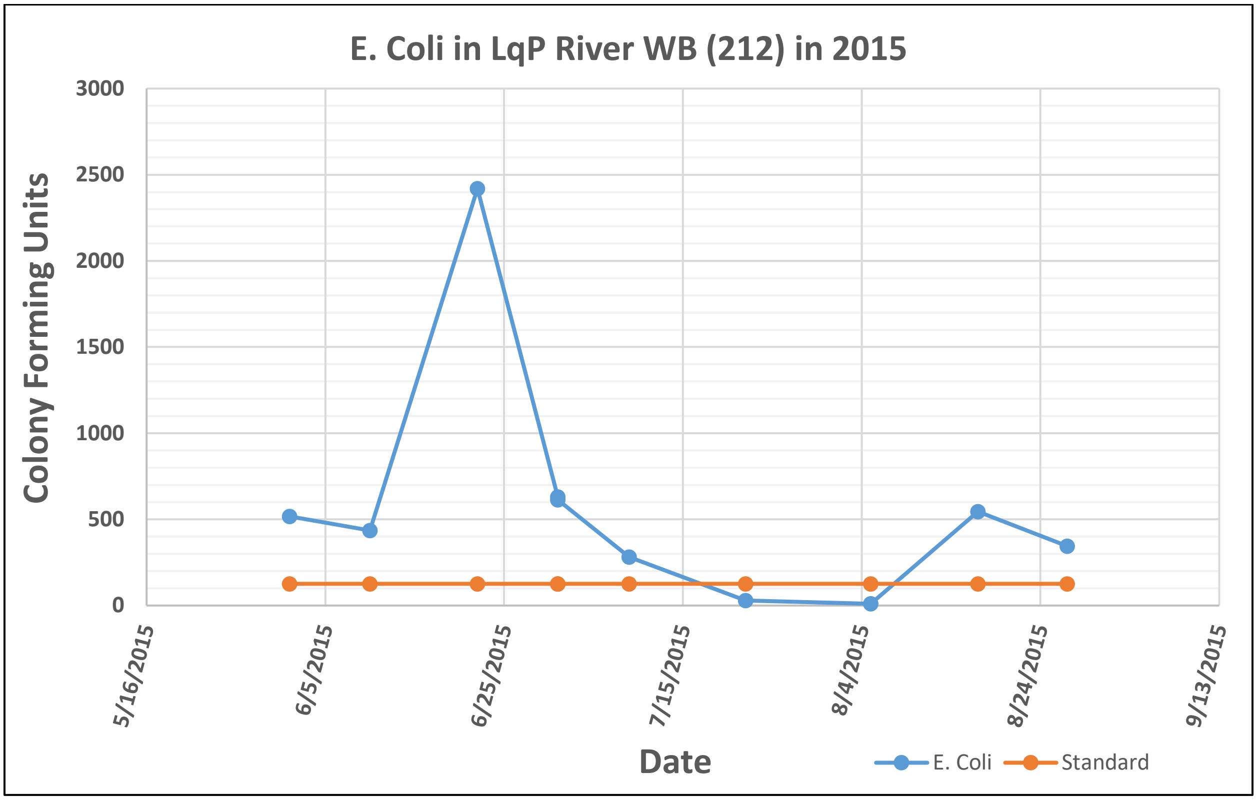


Total Nitrogen by year LqP River South Branch
mg/L
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
2001
2002
2003
2004
2006
2007
2008
2015
Year

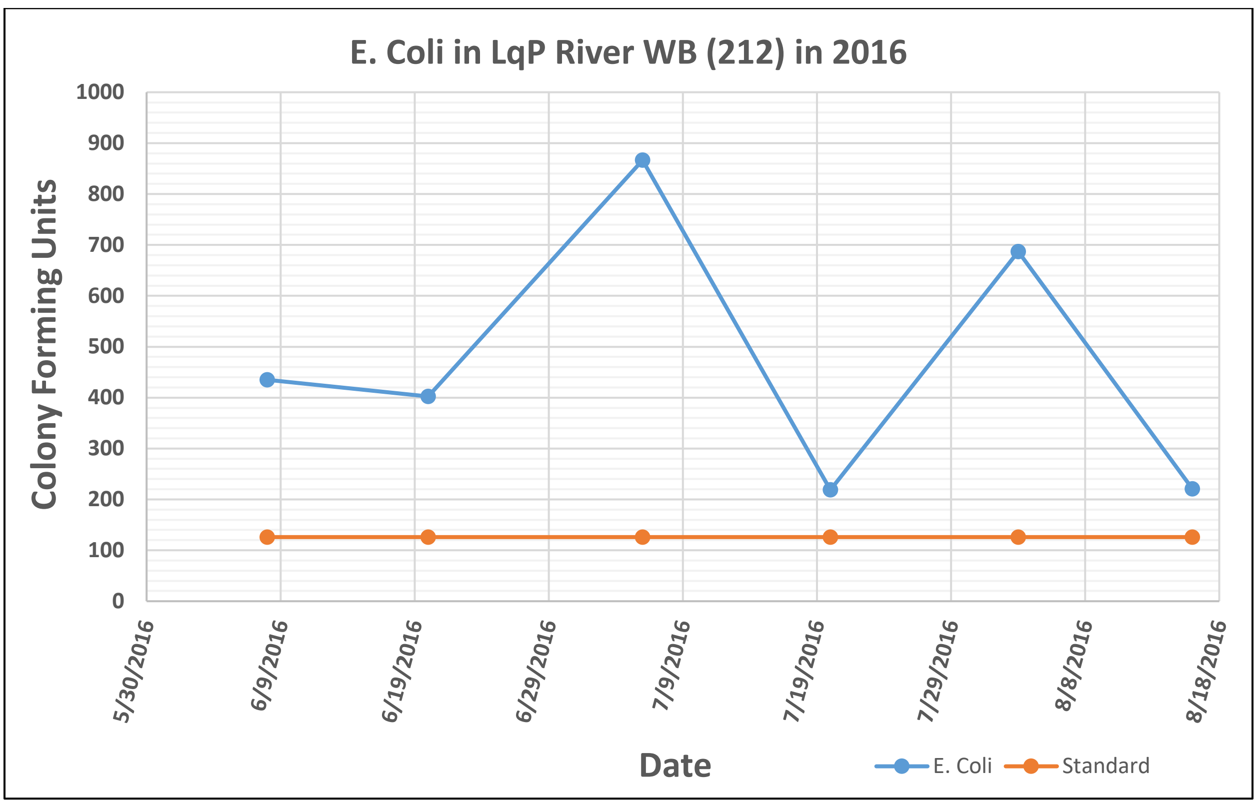

Total Dissolved Oxygen by year LqP River South Branch
12
10
8
6
4
2
0
mg/L
2002
2004
2008
2015
2016
Year


E. Coli Average by year LqP River South Branch
1400
1200
1000
800
600
400
200
0
Colony Forming Units
2008
2015
2016
Year

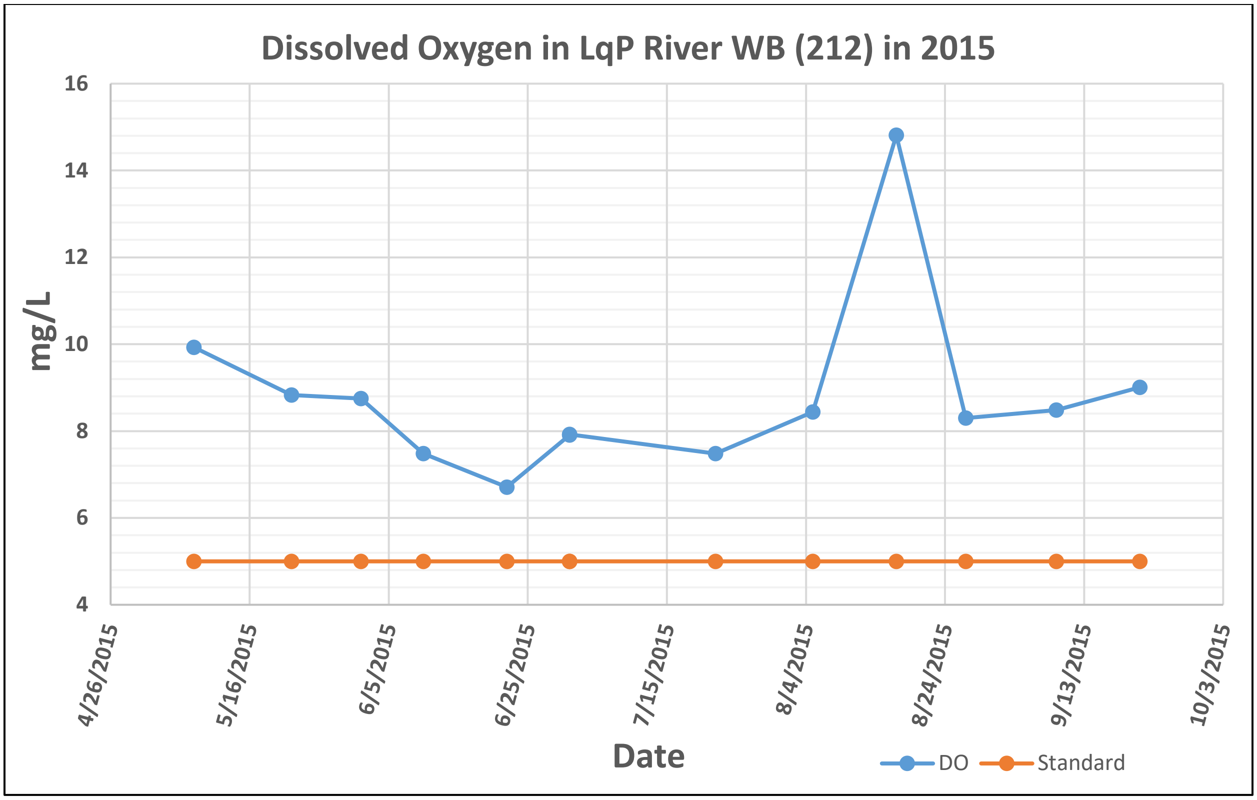
S003-086

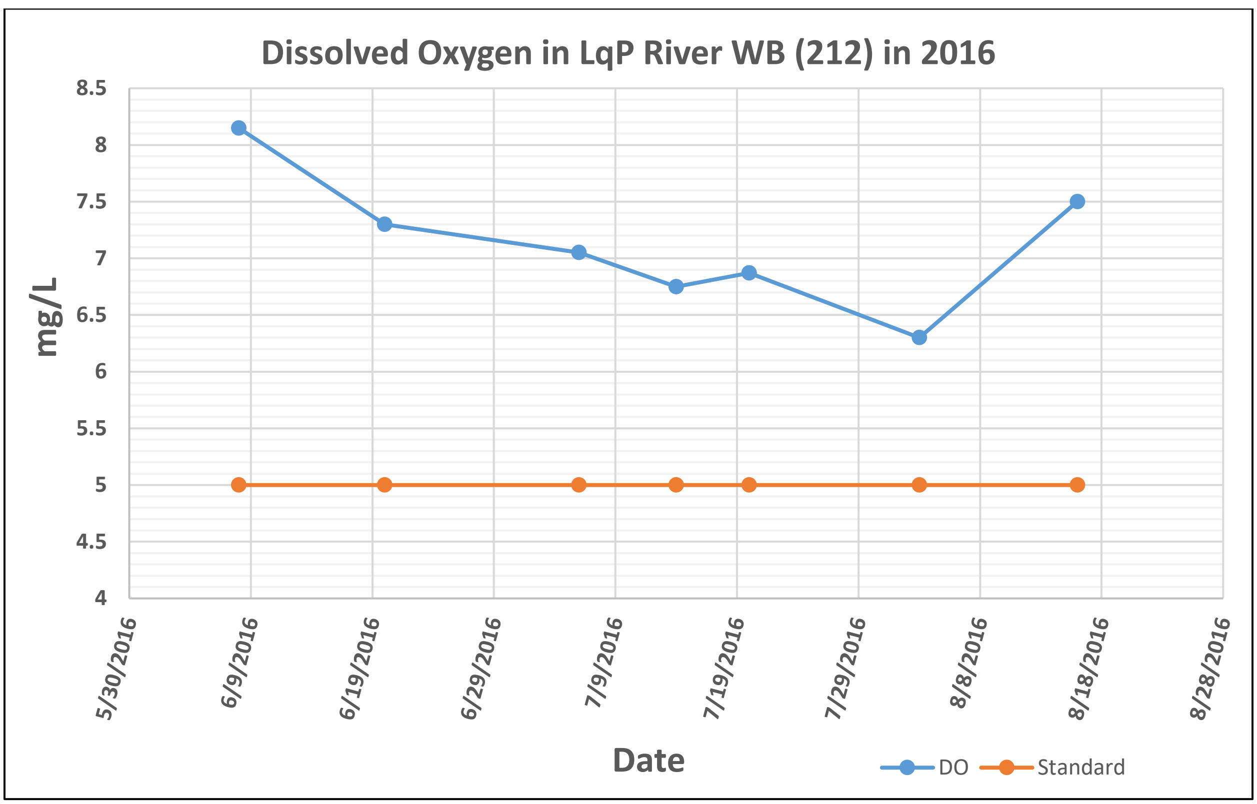


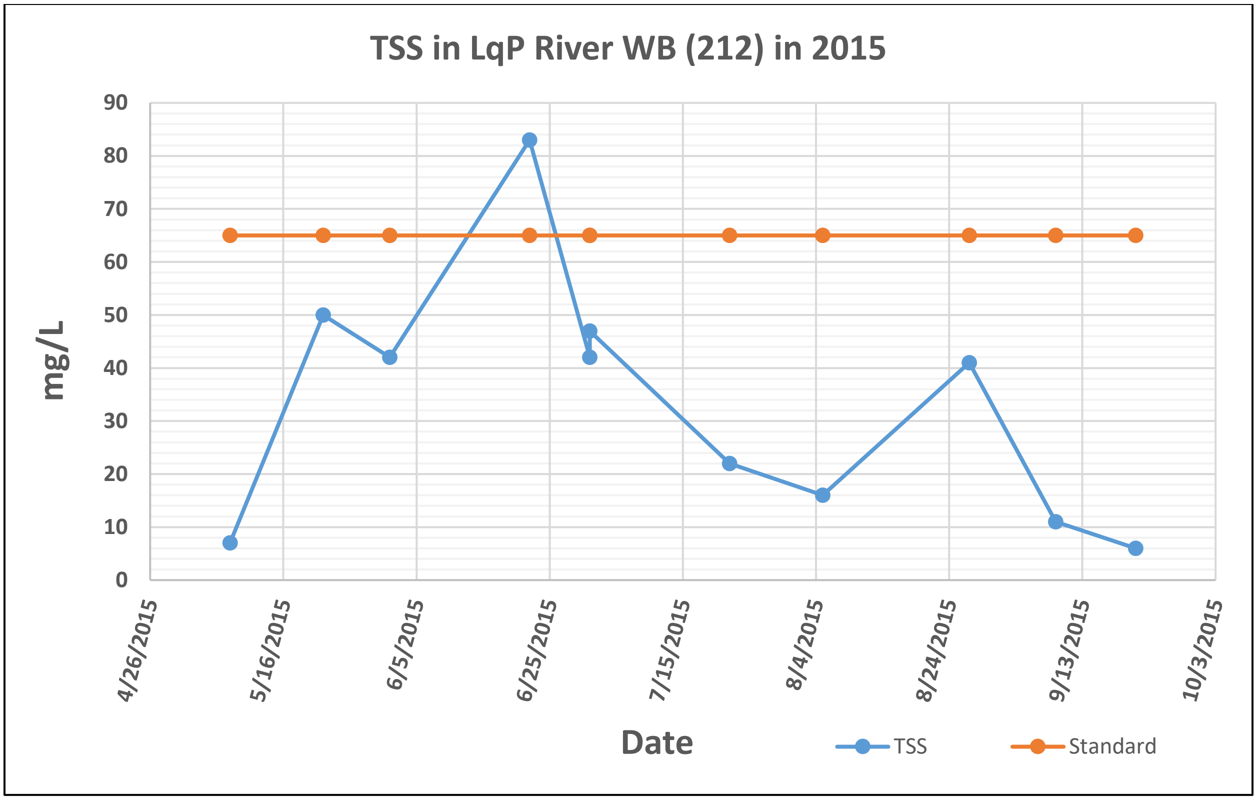
E. Coli in LqP River WB (212) in 2015
Colony Forming Units
3000
2500
2000
1500
1000
500
0
5/16/2015
6/5/2015
6/25/2015
7/15/2015
8/4/2015
8/24/2015
9/13/2015
Date
E. Coli
Standard

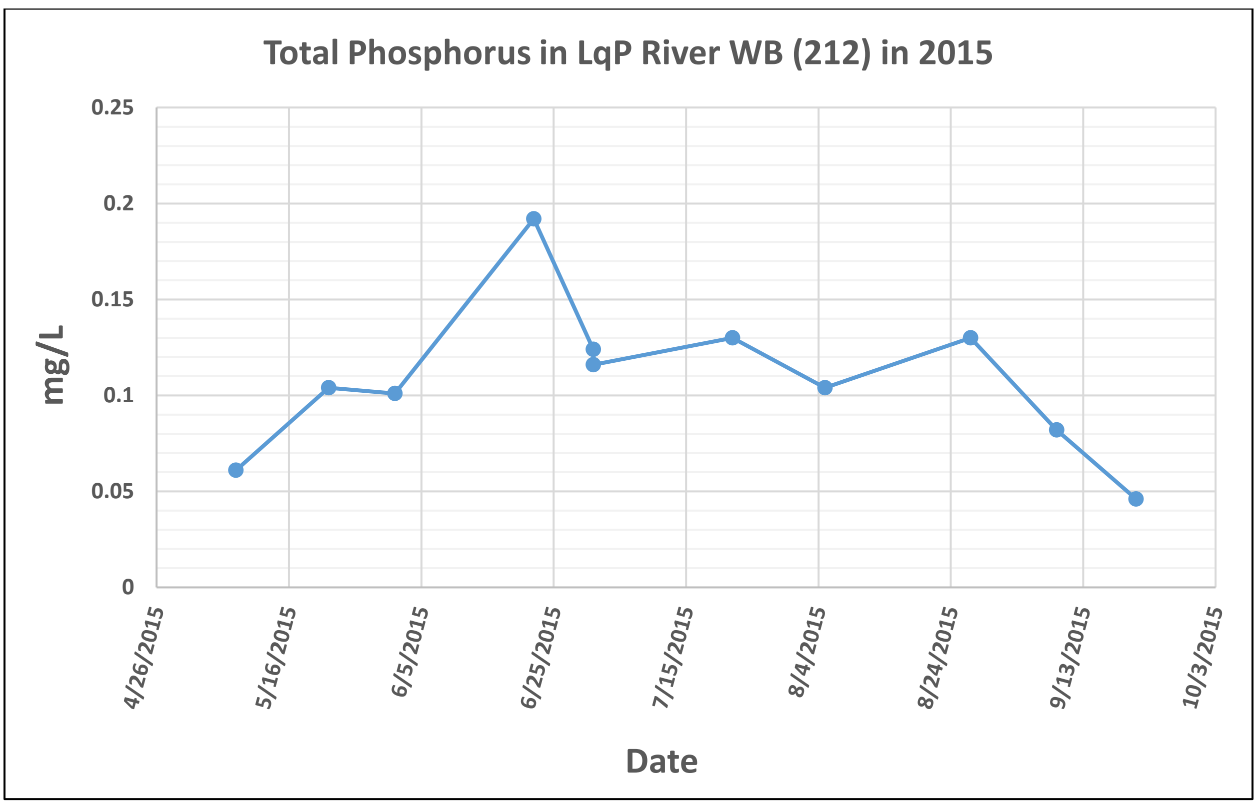


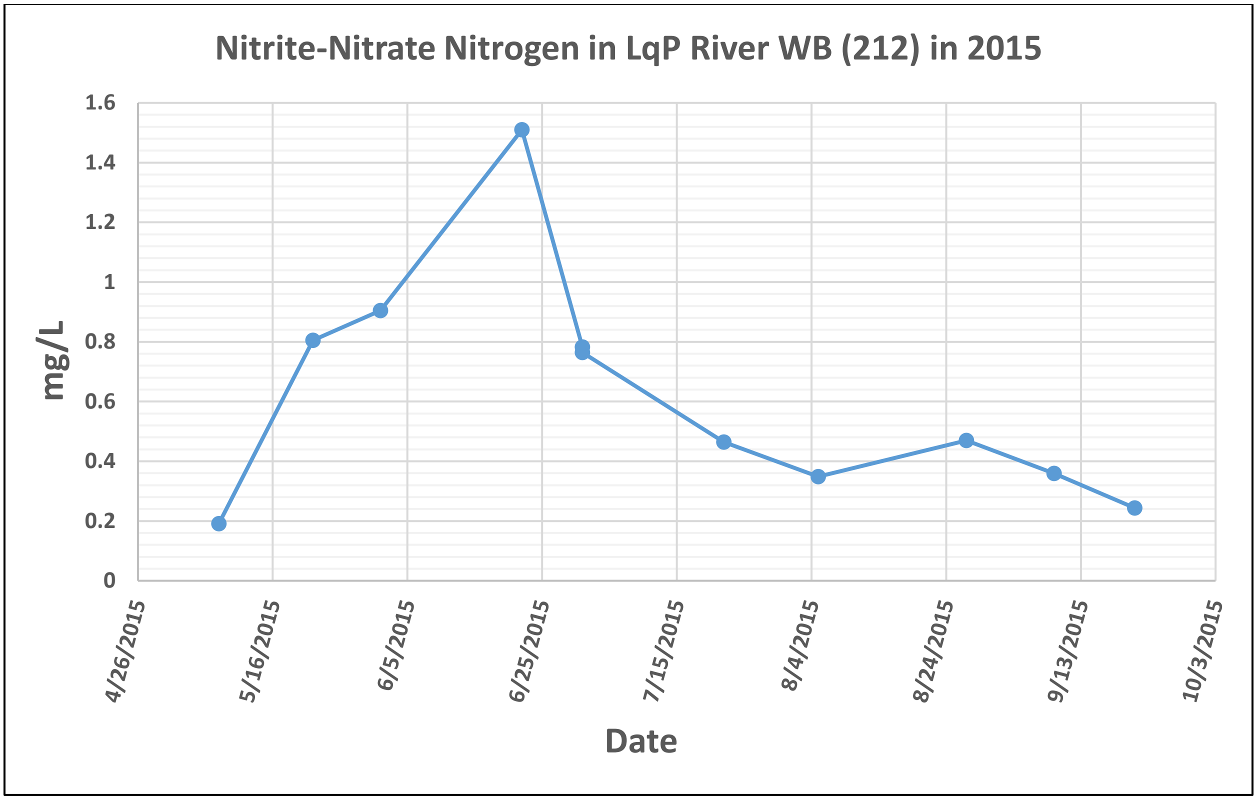
E. Coli in LqP River WB (212) in 2016
Colony Forming Units
1000
900
800
700
600
500
400
300
200
100
0
5/30/2016
6/9/2016
6/19/2016
6/29/2016
7/9/2016
7/19/2016
7/29/2016
8/8/2016
8/18/2016
Date
E. Coli
Standard

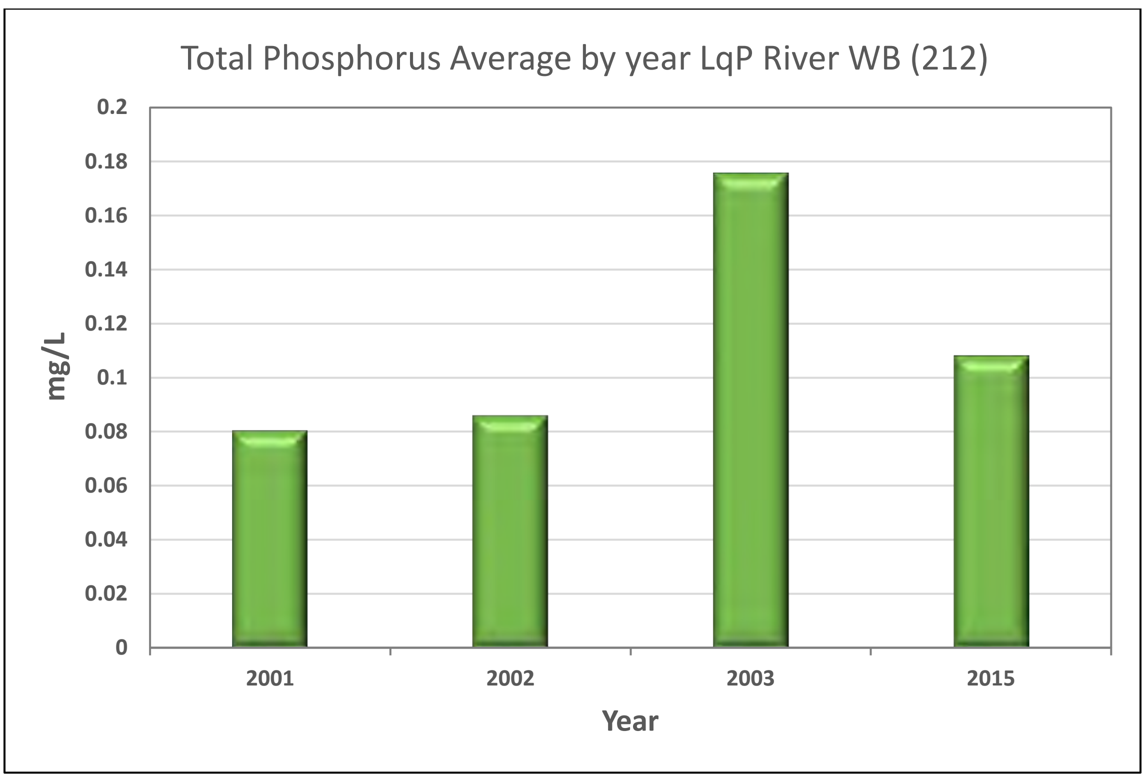

Dissolved Oxygen in LqP River WB (212) in 2015
mg/L
16
14
12
10
8
6
4
4/26/2015
5/16/2015
6/5/2015
6/25/2015
7/15/2015
8/4/2015
8/24/2015
9/13/2015
10/3/2015
Date
DO
Standard

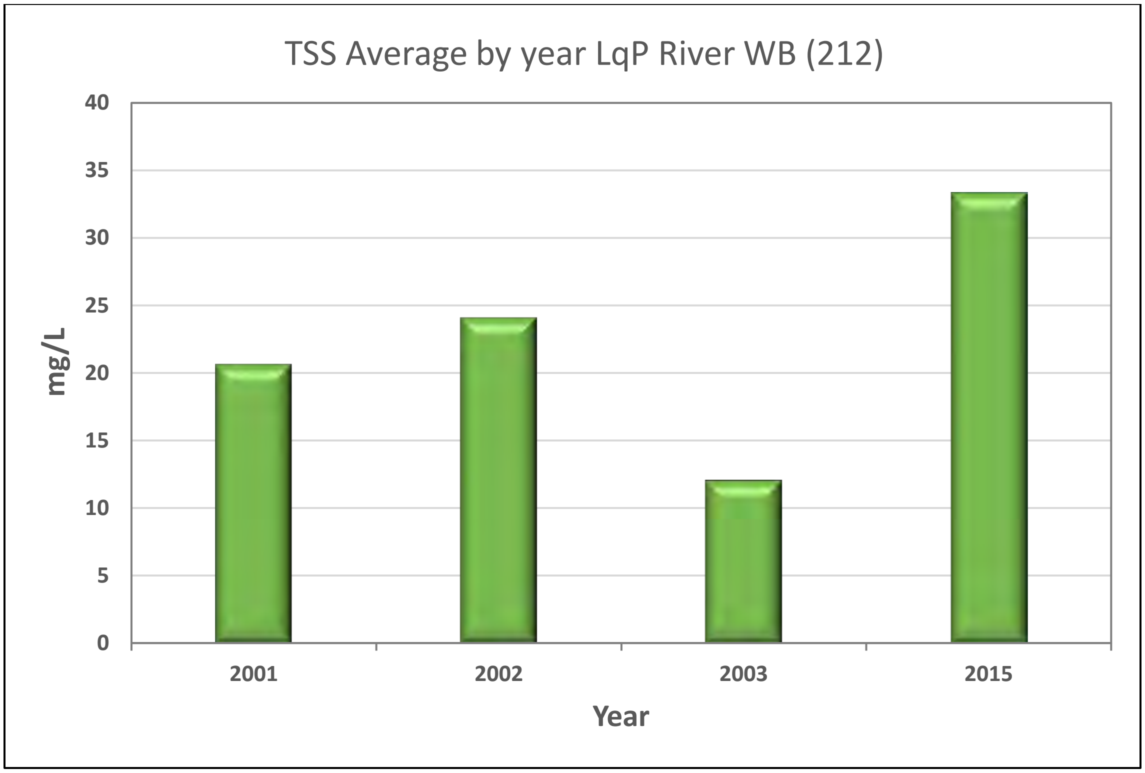

Dissolved Oxygen in LqP River WB (212) in 2016
mg/L
8.5
8
7.5
7
6.5
6
5.5
5
4.5
4
5/30/2016
6/9/2016
6/19/2016
6/29/2016
7/9/2016
7/19/2016
7/29/2016
8/8/2016
8/18/2016
8/28/2016
Date
DO
Standard

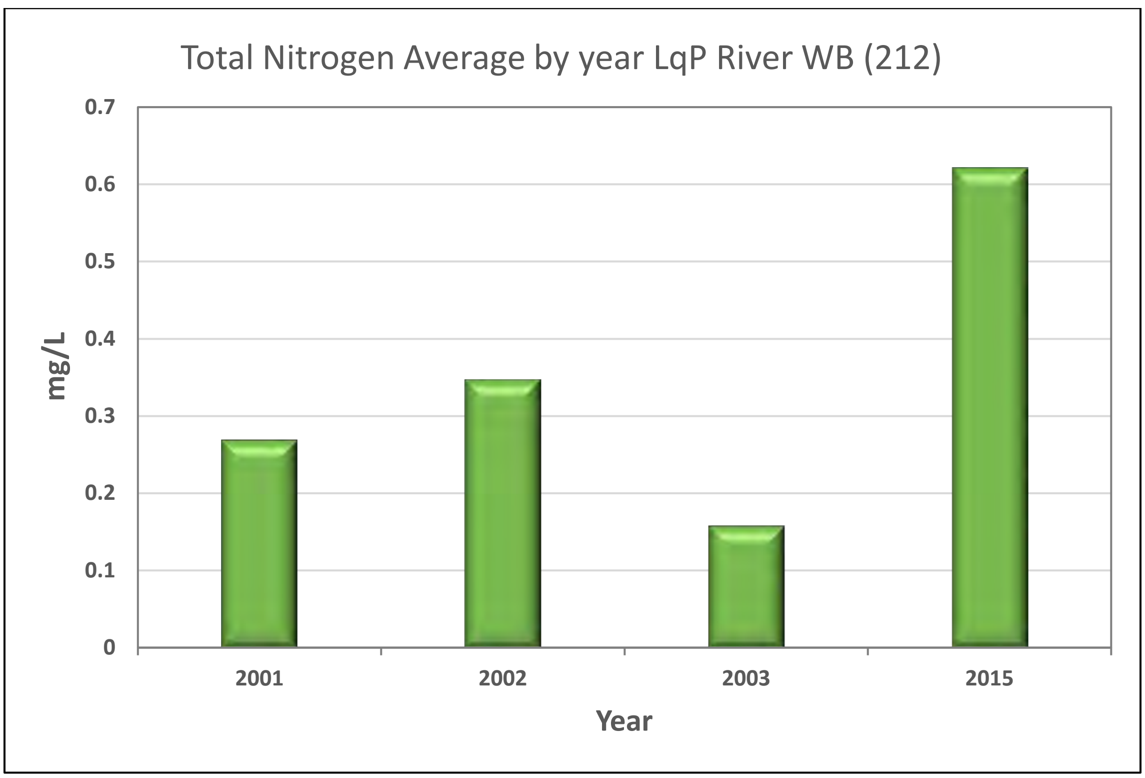

TSS in LqP River WB (212) in 2015
mg/L
0
10
20
30
40
50
60
70
80
90
4/26/2015
5/16/2015
6/5/2015
6/25/2015
7/15/2015
8/4/2015
8/24/2015
9/13/2015
10/3/2015
Date
TSS
Standard

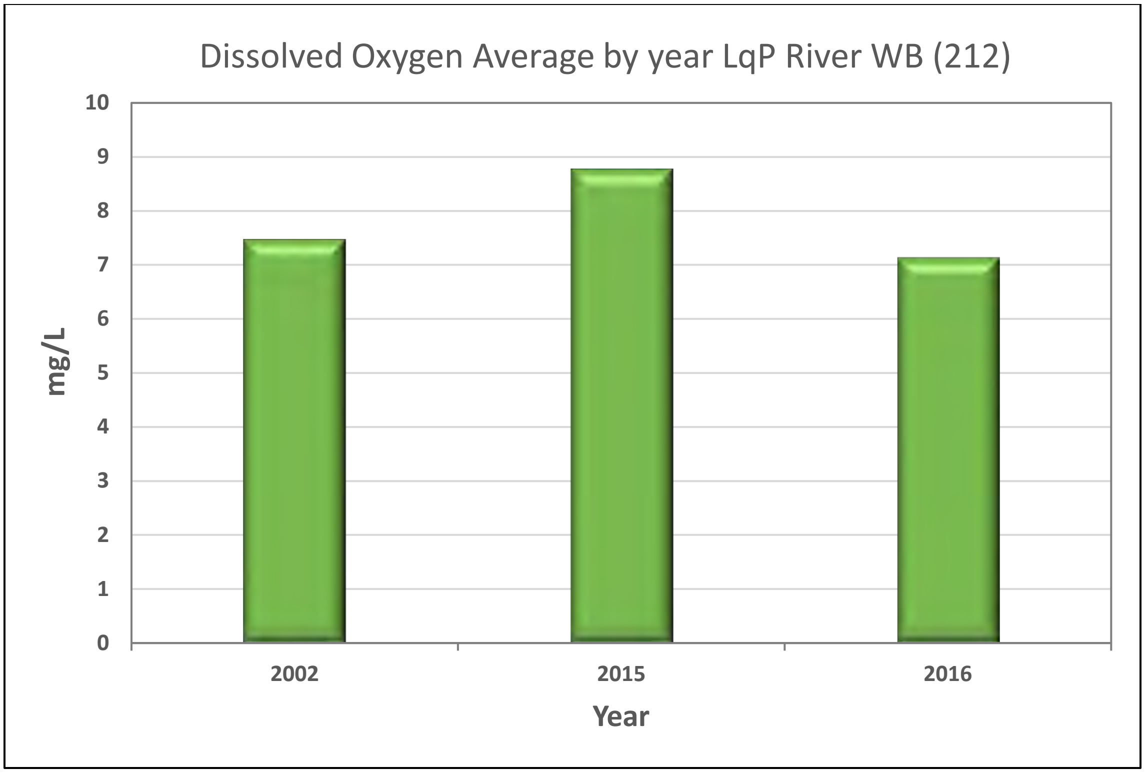

Total Phosphorus in LqP River WB (212) in 2015
mg/L
0
0.05
0.1
0.15
0.2
0.25
4/26/2015
5/16/2015
6/5/2015
6/25/2015
7/15/2015
8/4/2015
8/24/2015
9/13/2015
10/3/2015
Date


Nitrite-Nitrate Nitrogen in LqP River WB (212) in 2015
mg/L
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
4/26/2015
5/16/2015
6/5/2015
6/25/2015
7/15/2015
8/4/2015
8/24/2015
9/13/2015
10/3/2015
Date

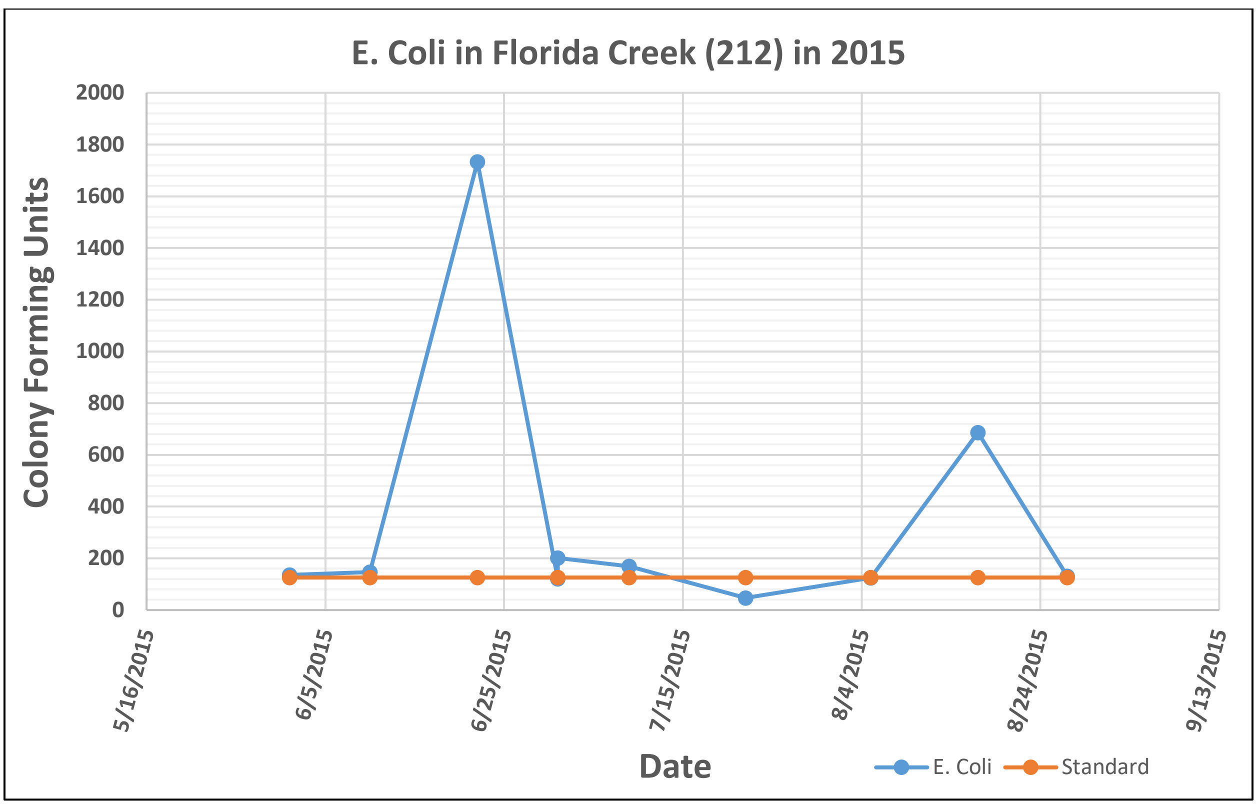

Total Phosphorus Average by year LqP River WB (212)
mg/L
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
2001
2002
2003
2015
Year

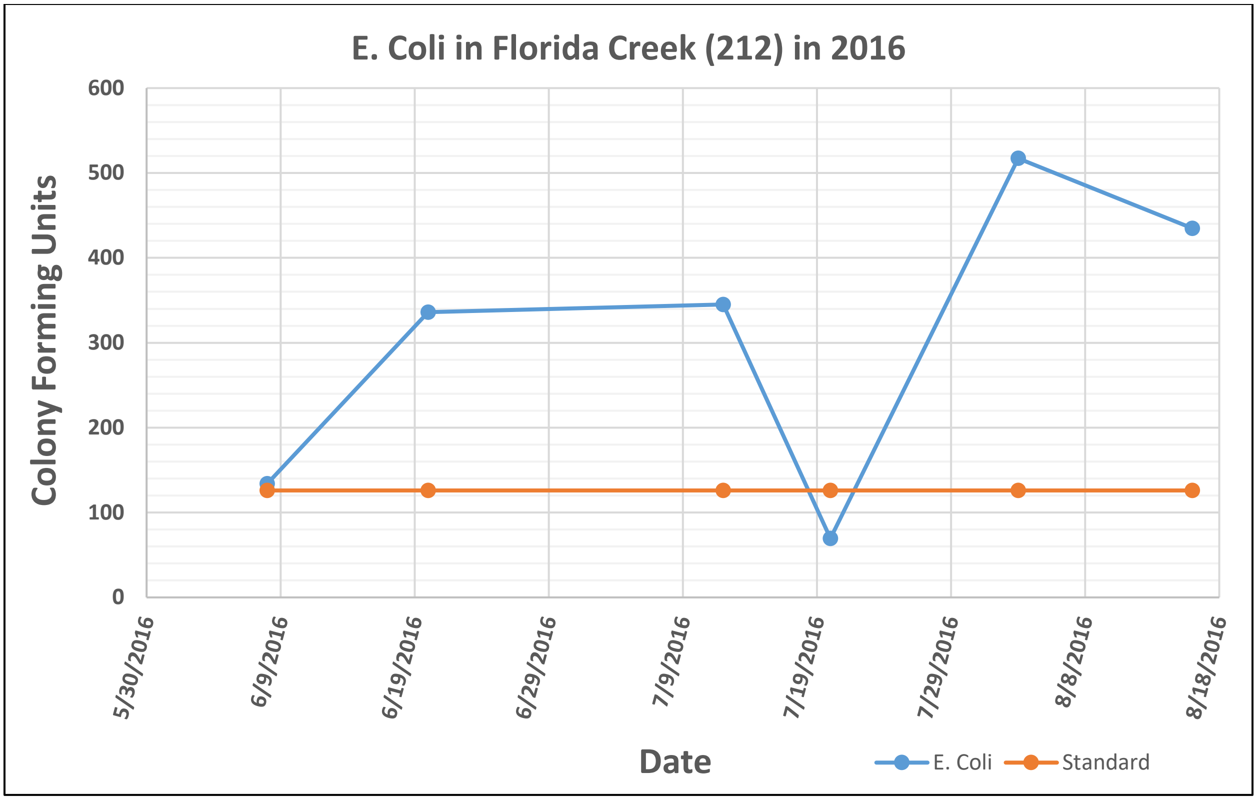

TSS Average by year LqP River WB (212)
mg/L
0
5
10
15
20
25
30
35
40
2001
2002
2003
2015
Year

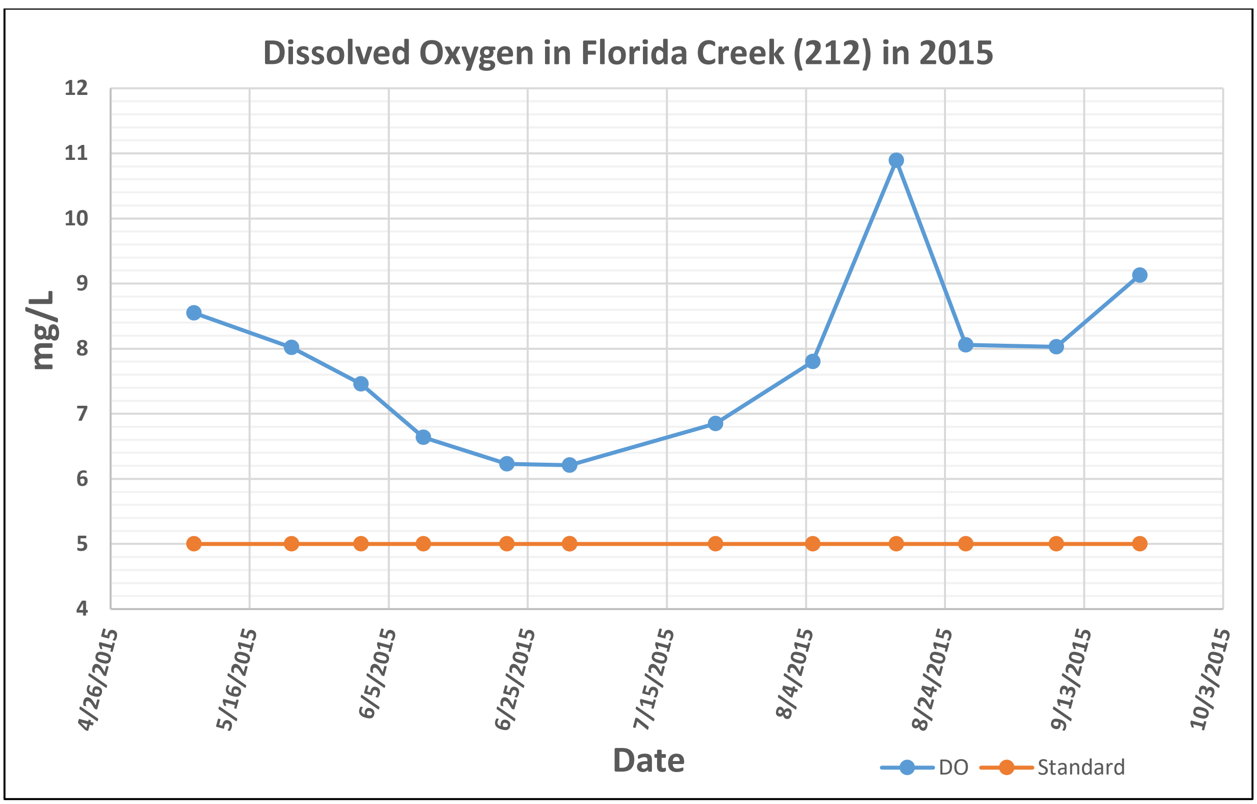

Total Nitrogen Average by year LqP River WB (212)
mg/L
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
2001
2002
2003
2015
Year

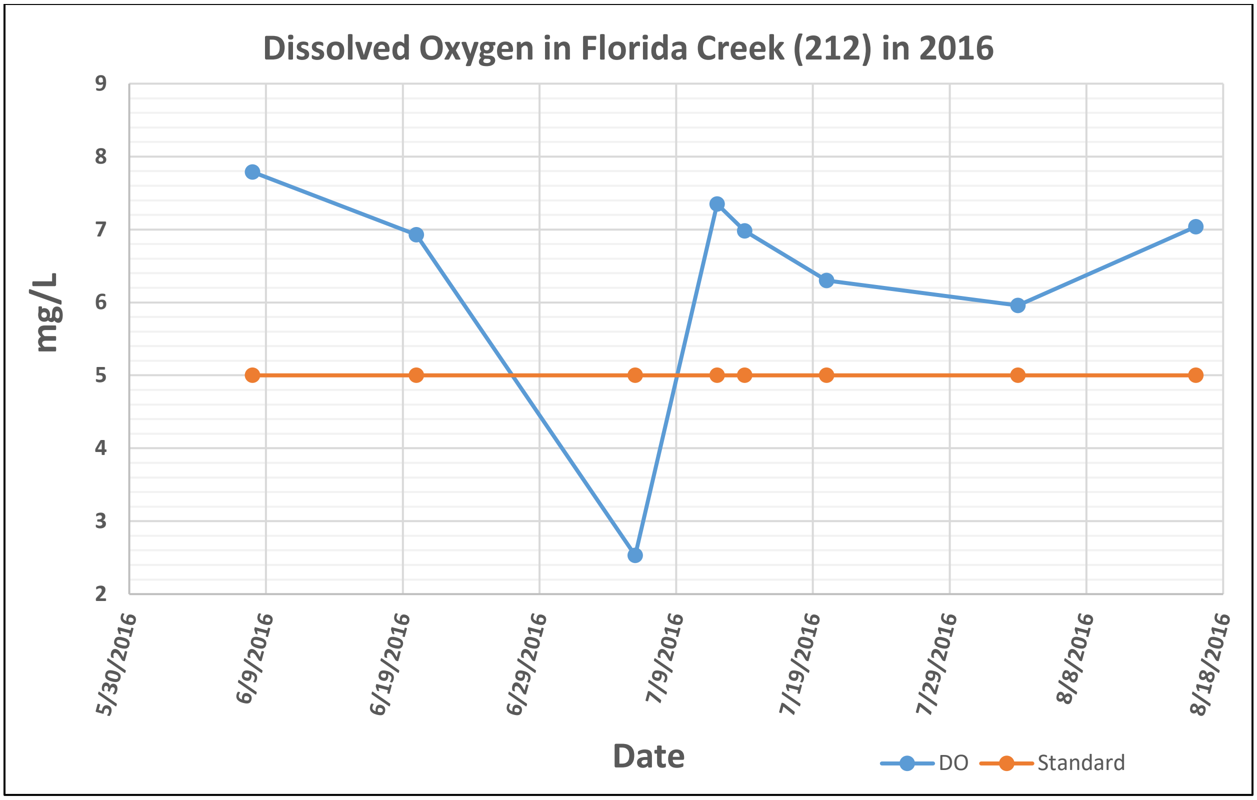

Dissolved Oxygen Average by year LqP River WB (212)
mg/L
10
9
8
7
6
5
4
3
2
1
0
2002
2015
2016
Year

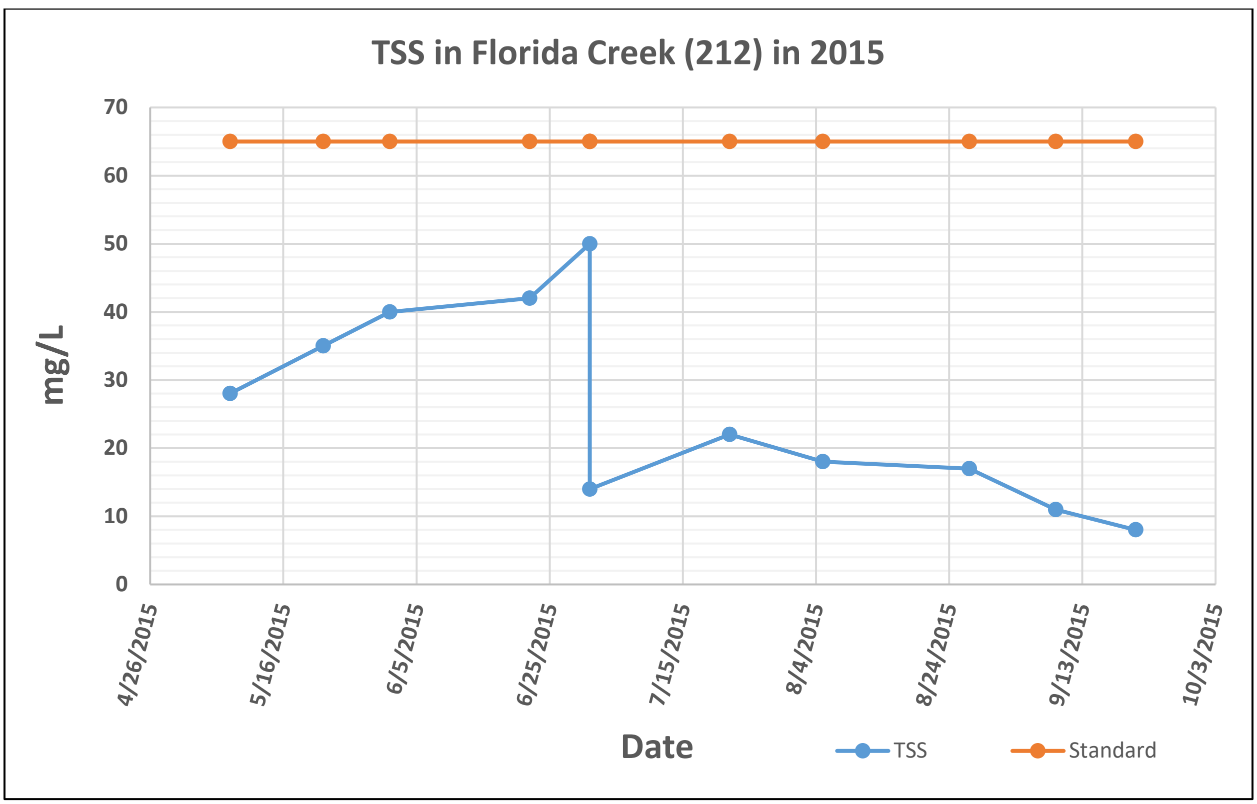
S003-088

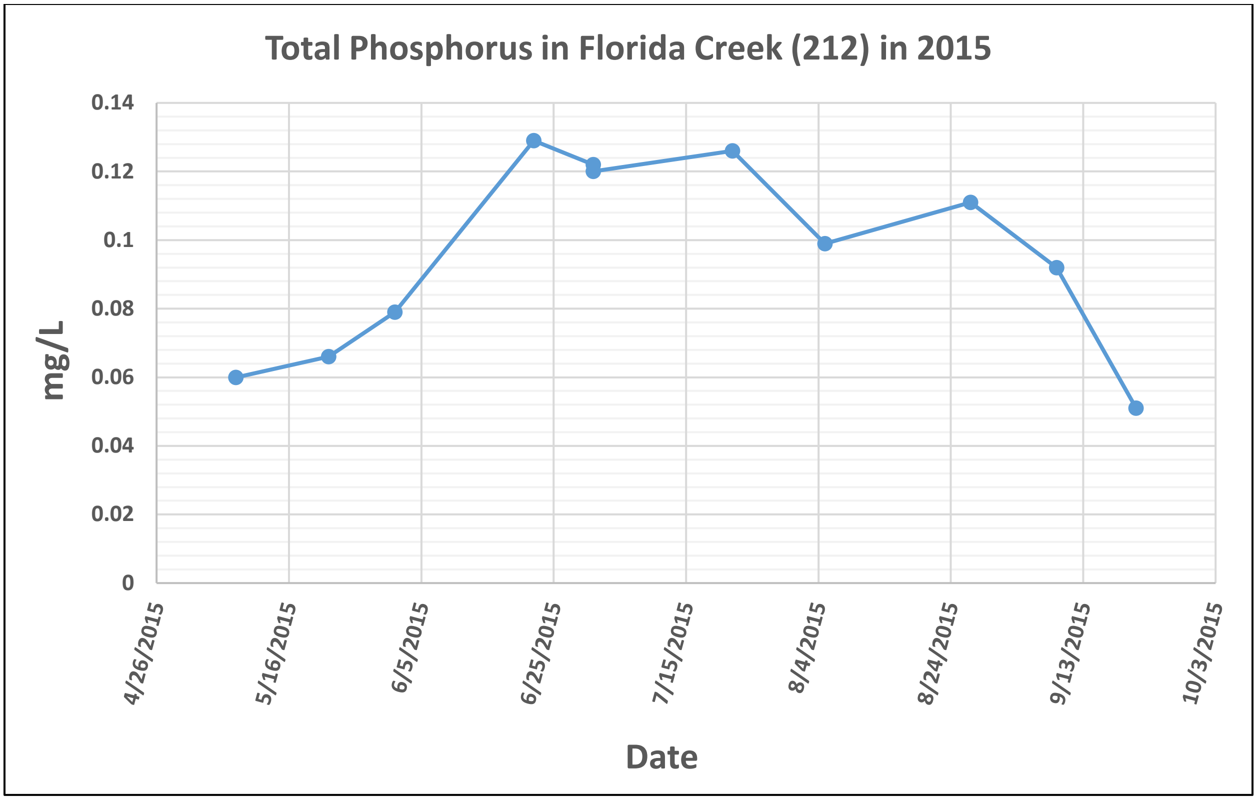

E. Coli in Florida Creek (212) in 2015
Colony Forming Units
2000
1800
1600
1400
1200
1000
800
600
400
200
0
5/16/2015
6/5/2015
6/25/2015
7/15/2015
8/4/2015
8/24/2015
9/13/2015
Date
E. Coli
Standard

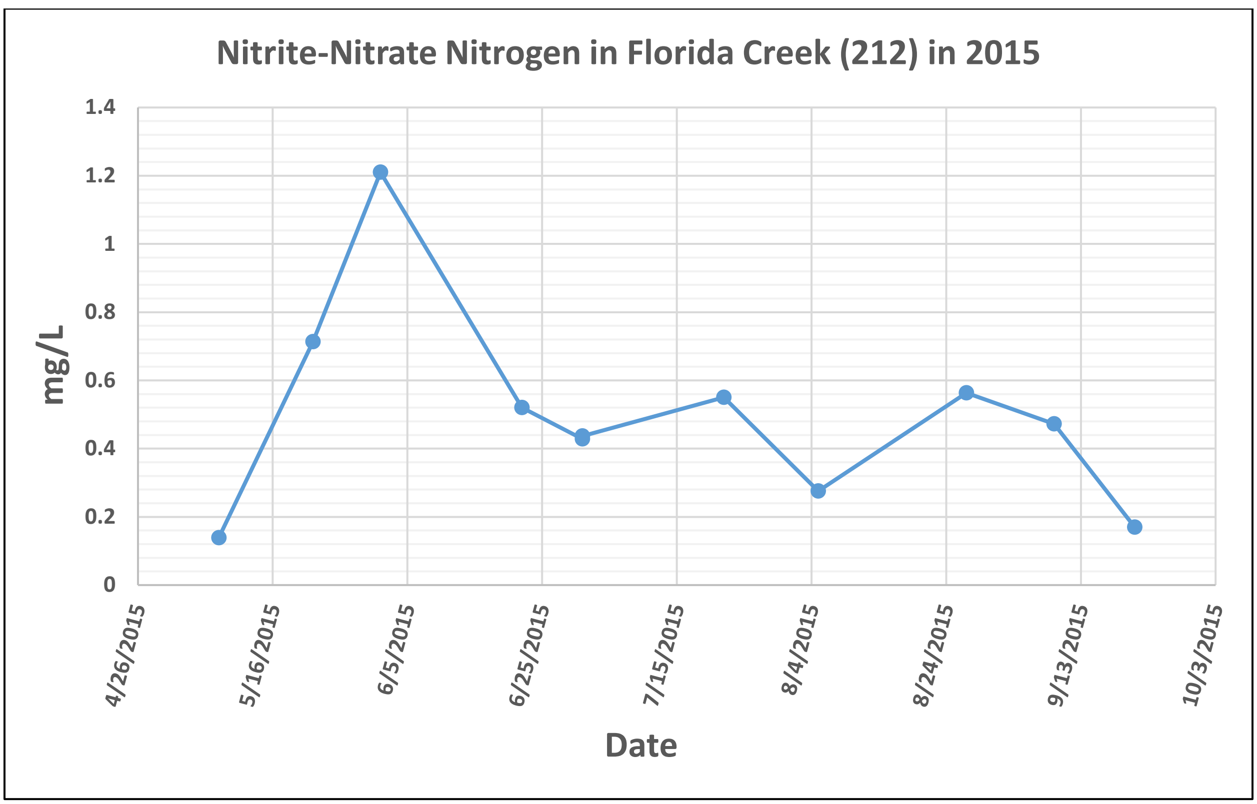

E. Coli in Florida Creek (212) in 2016
Colony Forming Units
600
500
400
300
200
100
0
5/30/2016
6/9/2016
6/19/2016
6/29/2016
7/9/2016
7/19/2016
7/29/2016
8/8/2016
8/18/2016
Date
E. Coli
Standard

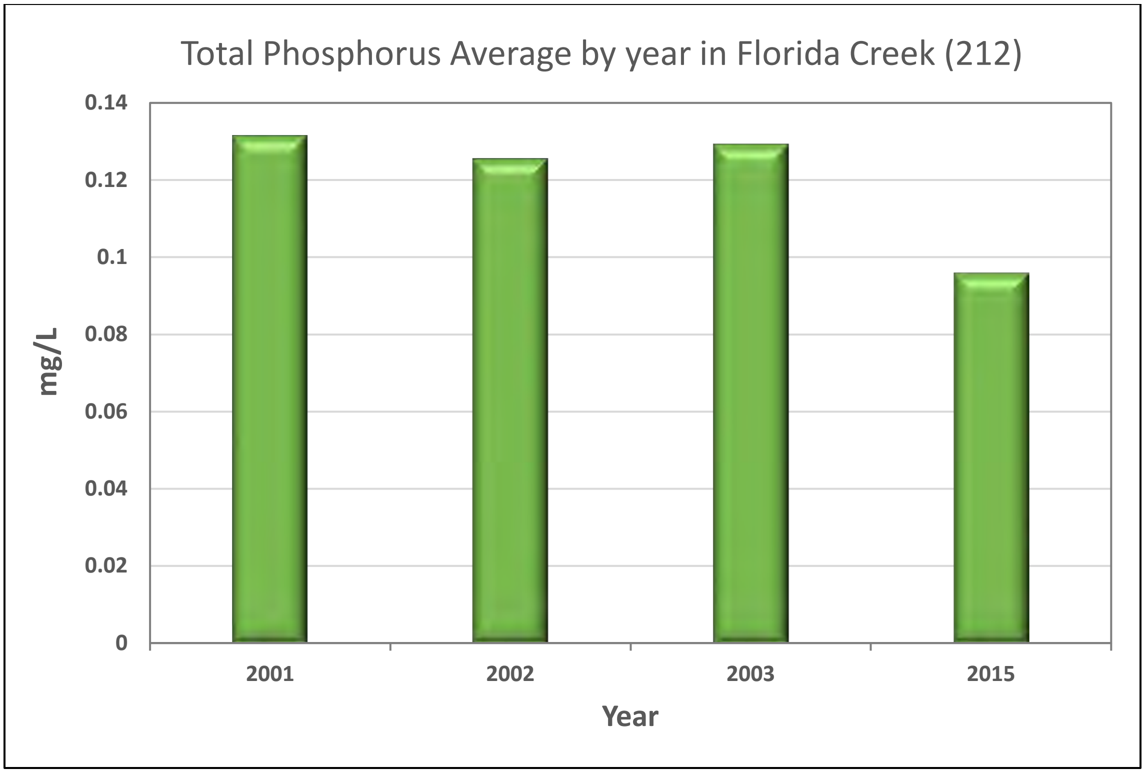

Dissolved Oxygen in Florida Creek (212) in 2015
mg/L
12
11
10
9
8
7
6
5
4
4/26/2015
5/16/2015
6/5/2015
6/25/2015
7/15/2015
8/4/2015
8/24/2015
9/13/2015
10/3/2015
Date
DO
Standard

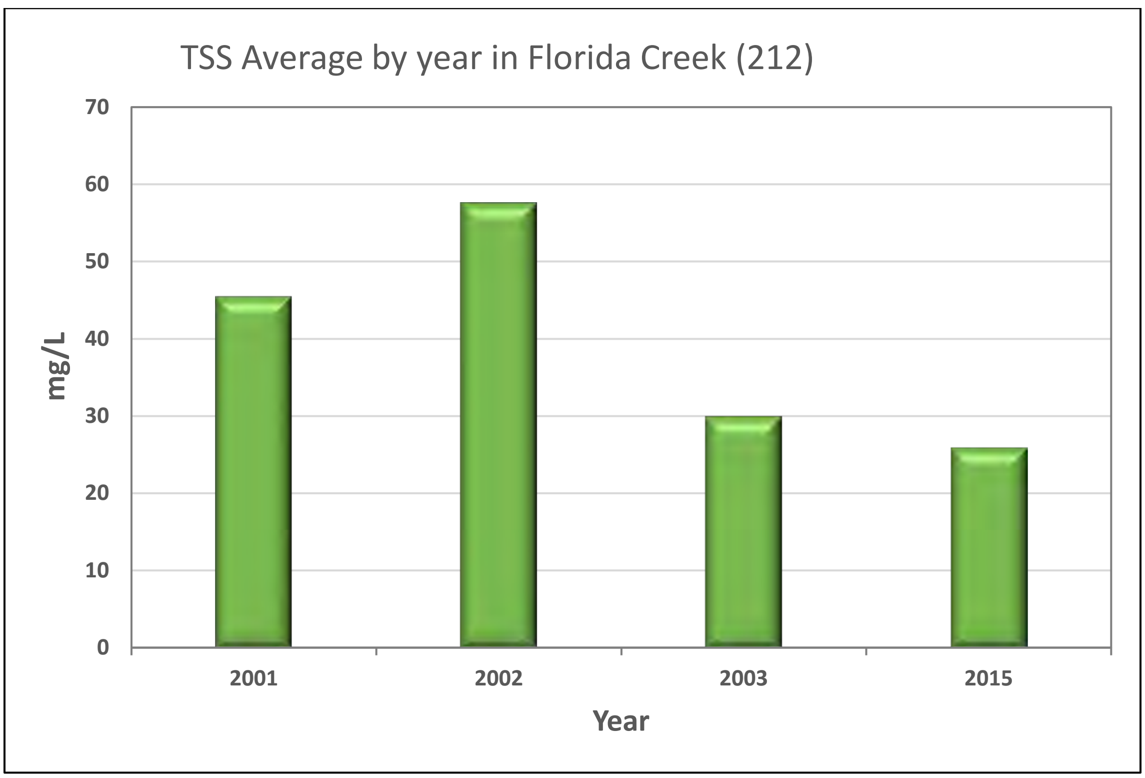

Dissolved Oxygen in Florida Creek (212) in 2016
mg/L
9
8
7
6
5
4
3
2
5/30/2016
6/9/2016
6/19/2016
6/29/2016
7/9/2016
7/19/2016
7/29/2016
8/8/2016
8/18/2016
Date
DO
Standard

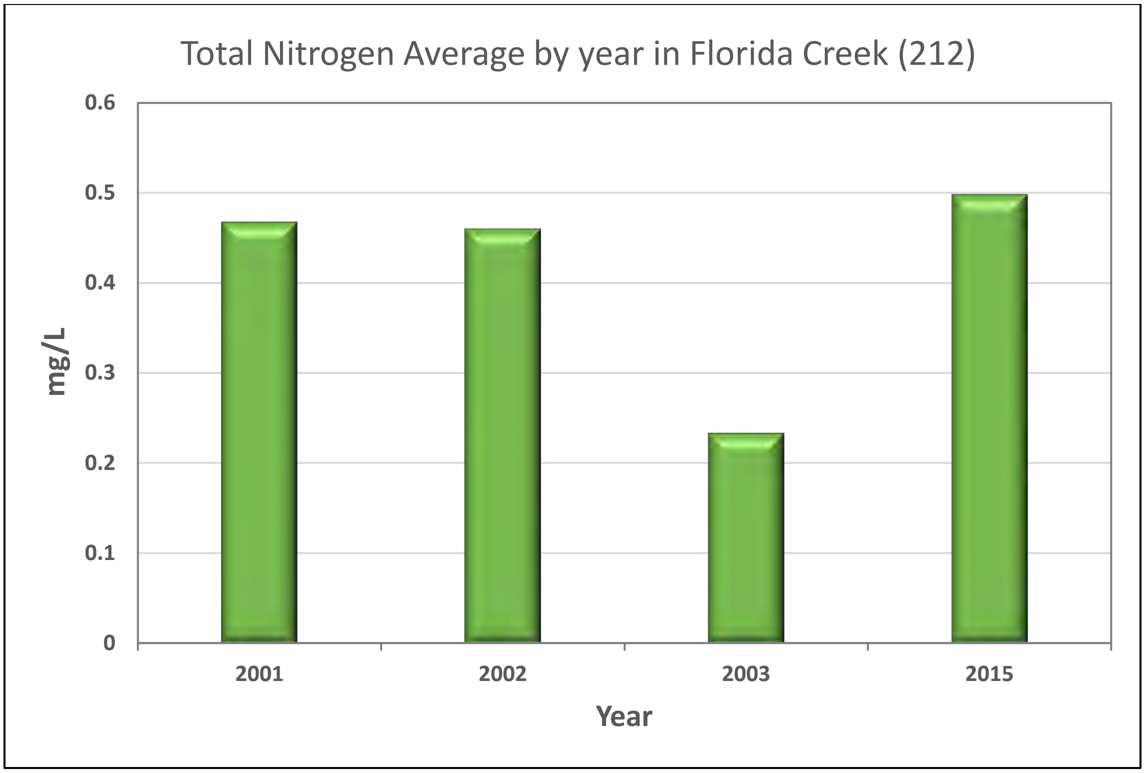

TSS in Florida Creek (212) in 2015
mg/L
70
60
50
40
30
20
10
0
4/26/2015
5/16/2015
6/5/2015
6/25/2015
7/15/2015
8/4/2015
8/24/2015
9/13/2015
10/3/2015
Date
TSS
Standard

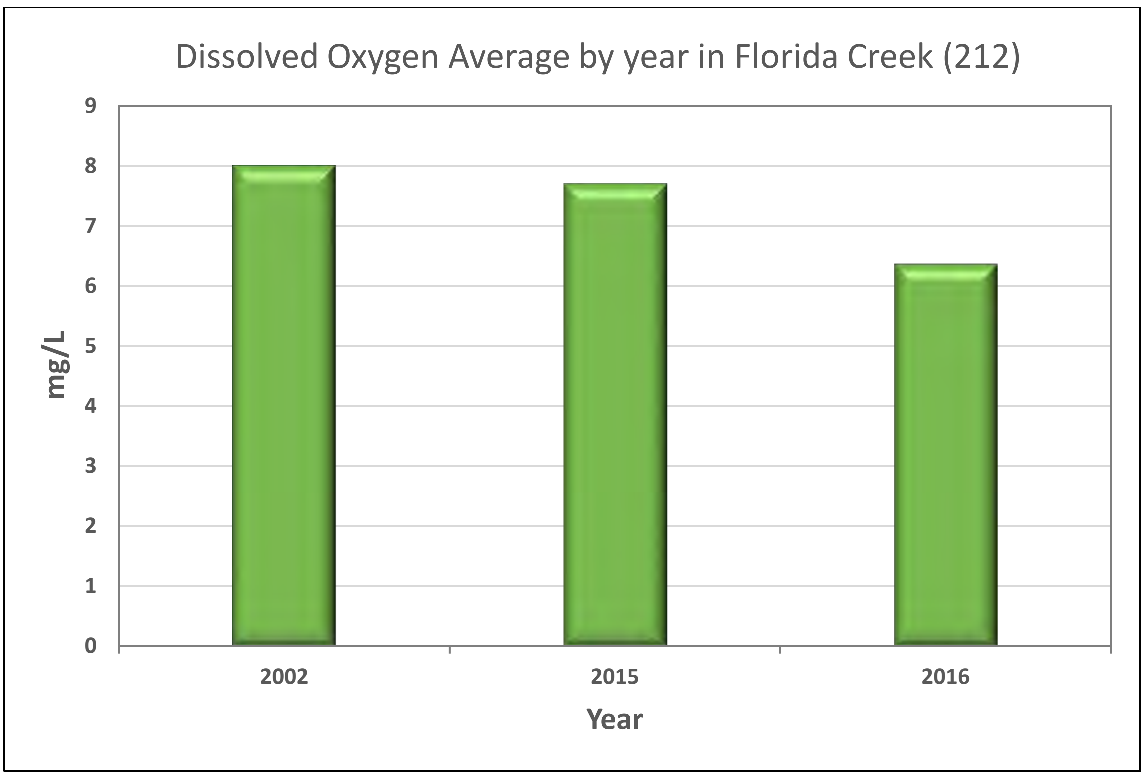

Total Phosphorus in Florida Creek (212) in 2015
mg/L
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
4/26/2015
5/16/2015
6/5/2015
6/25/2015
7/15/2015
8/4/2015
8/24/2015
9/13/2015
10/3/2015
Date


Nitrite-Nitrate Nitrogen in Florida Creek (212) in 2015
mg/L
1.4
1.2
1
0.8
0.6
0.4
0.2
0
4/26/2015
5/16/2015
6/5/2015
6/25/2015
7/15/2015
8/4/2015
8/24/2015
9/13/2015
10/3/2015
Date

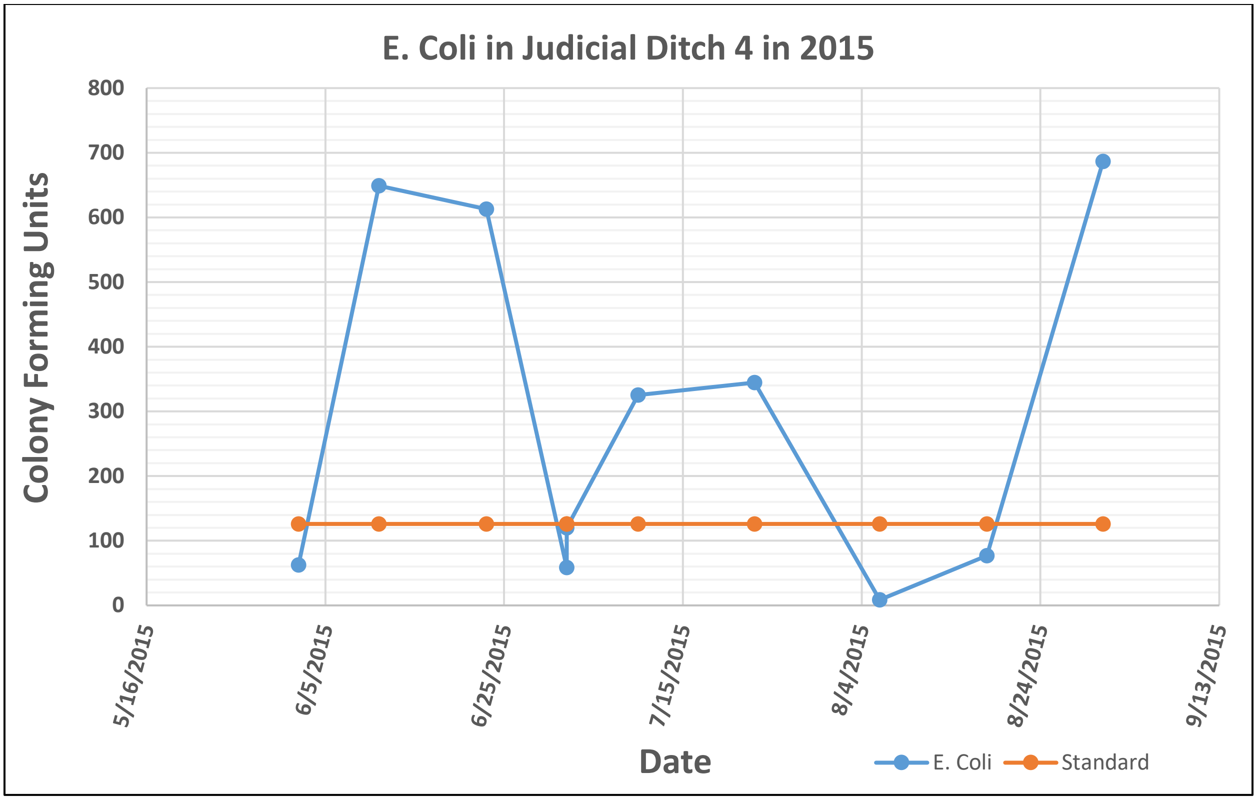

Total Phosphorus Average by year in Florida Creek (212)
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
mg/L
2001
2002
2003
2015
Year

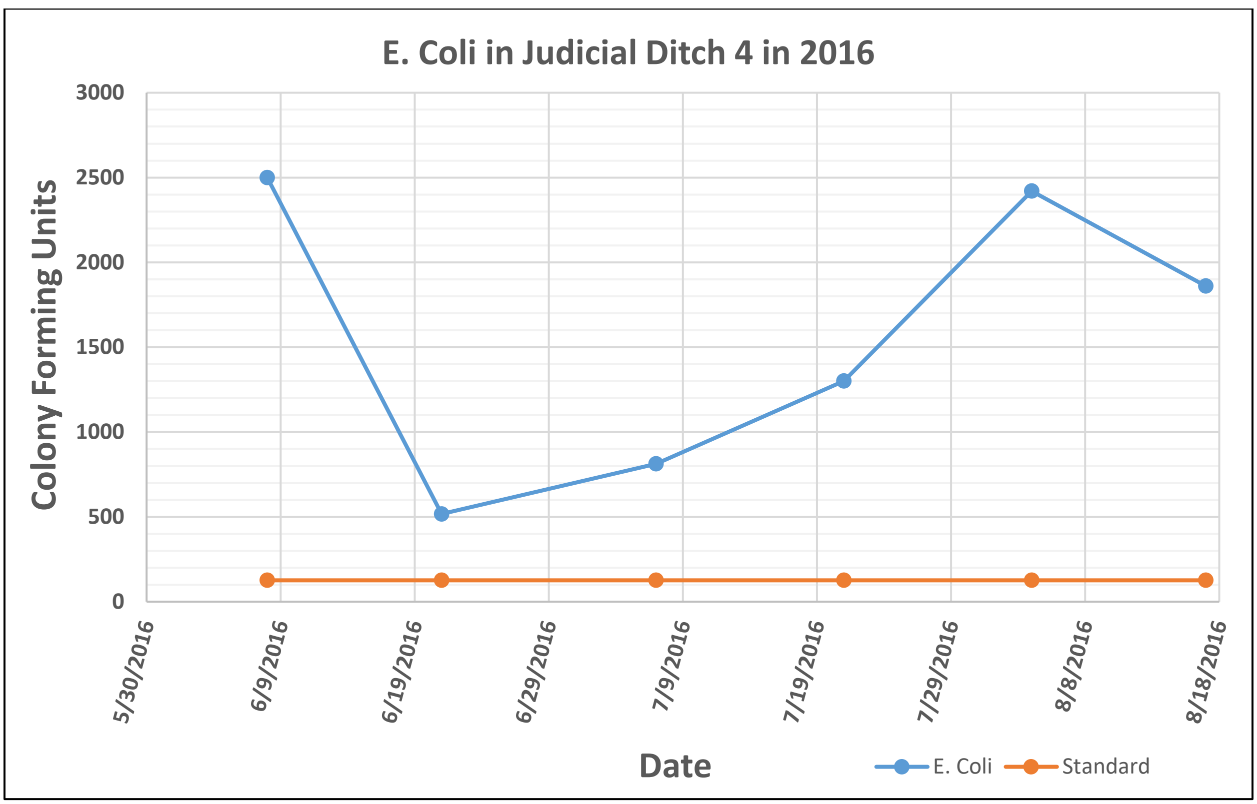

TSS Average by year in Florida Creek (212)
70
60
50
40
30
20
10
0
mg/L
2001
2002
2003
2015
Year

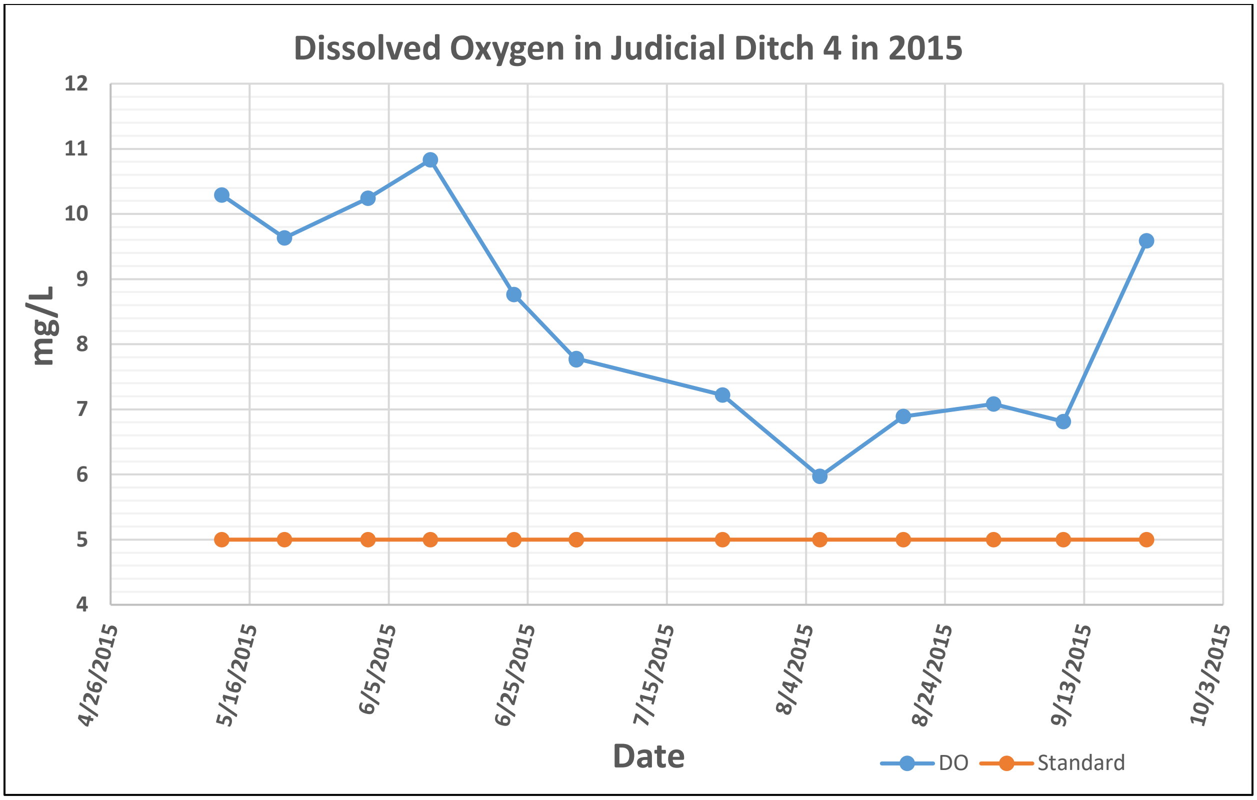

Total Nitrogen Average by year in Florida Creek (212)
mg/L
0.6
0.5
0.4
0.3
0.2
0.1
0
2001
2002
2003
2015
Year

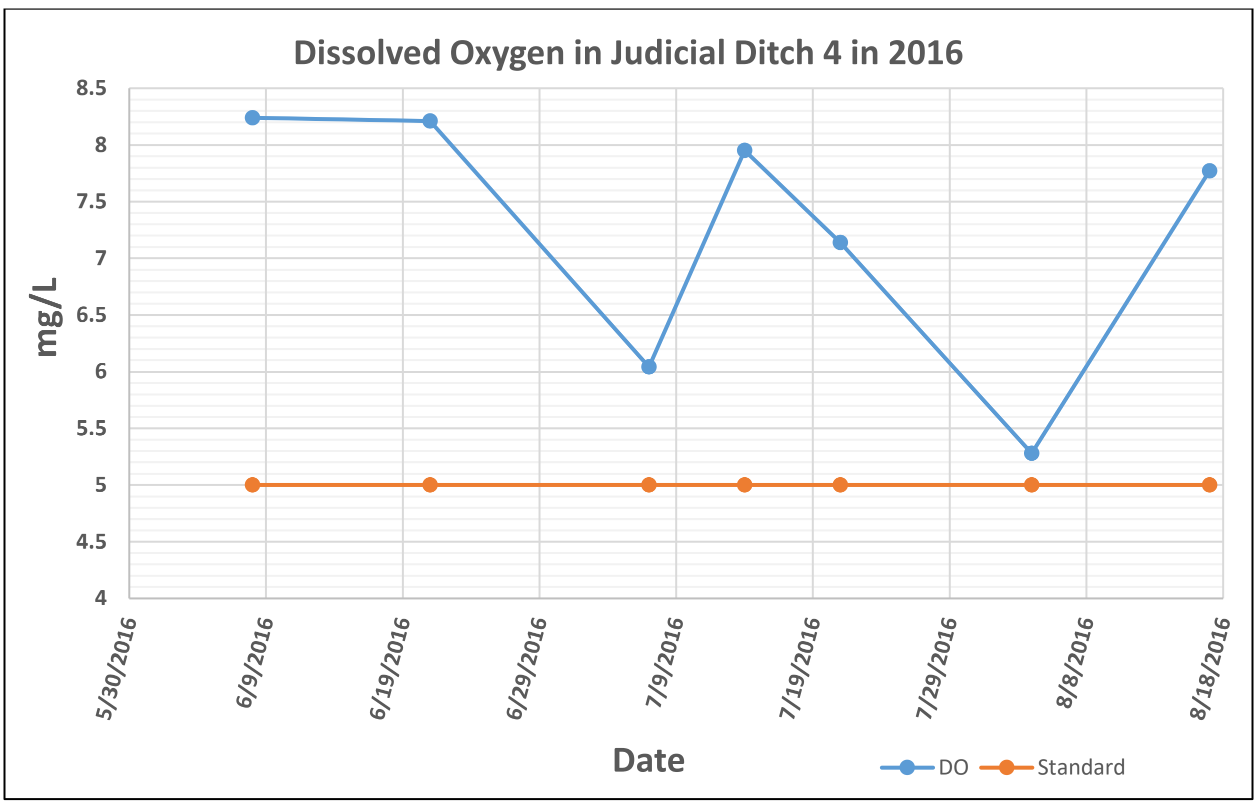

Dissolved Oxygen Average by year in Florida Creek (212)
mg/L
9
8
7
6
5
4
3
2
1
0
2002
2015
2016
Year

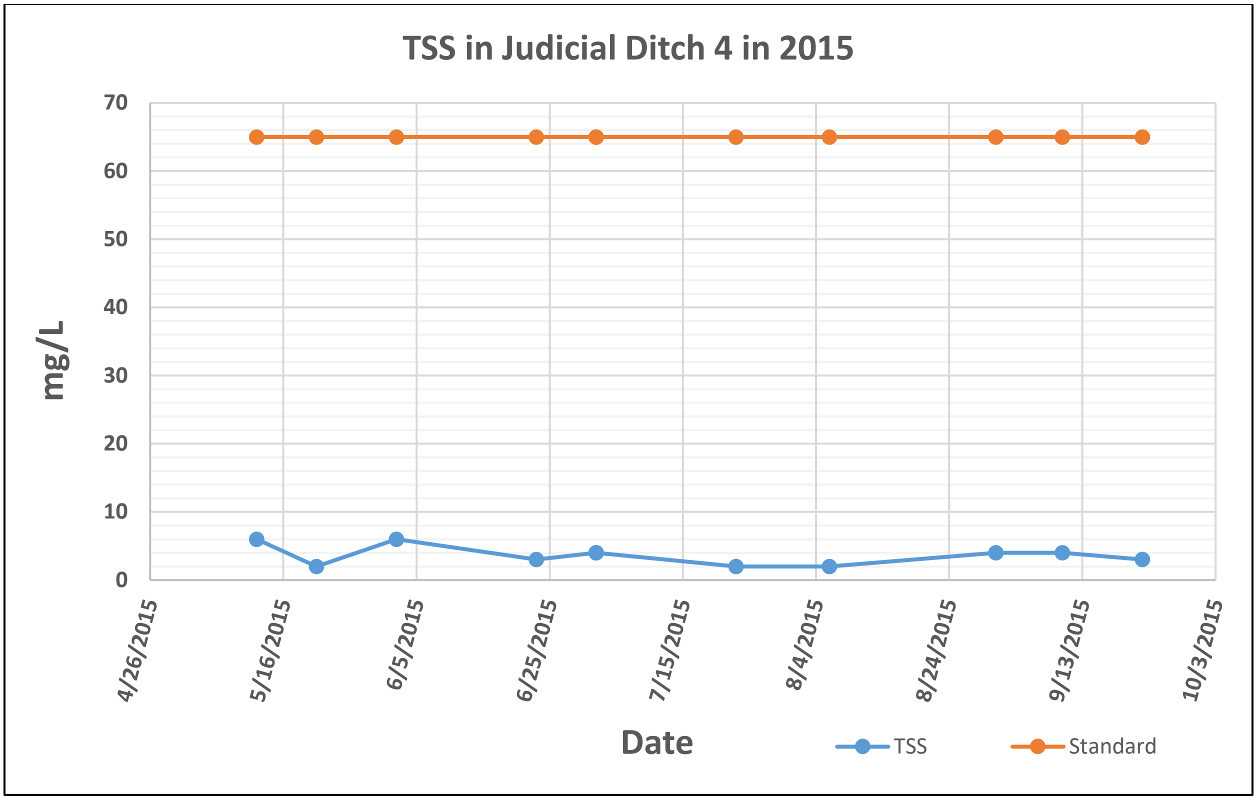
S003-381

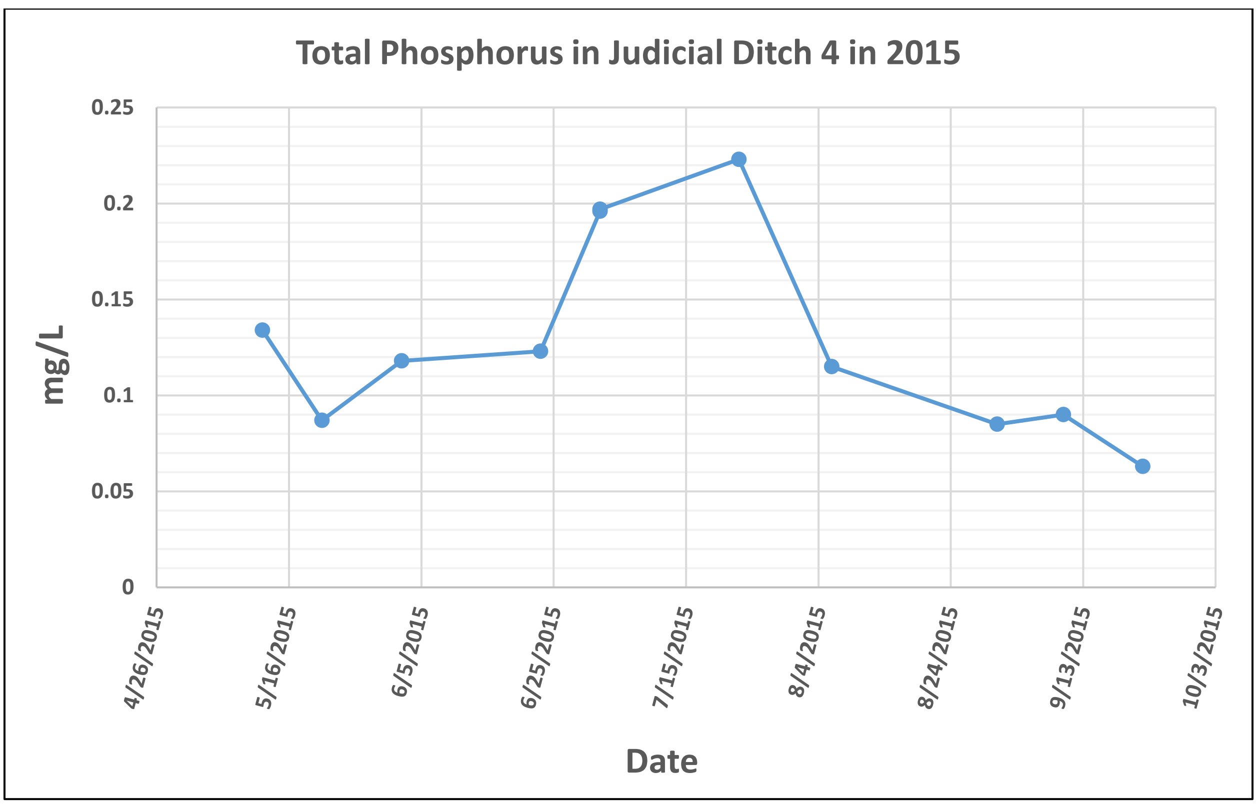

E. Coli in Judicial Ditch 4 in 2015
Colony Forming Units
800
700
600
500
400
300
200
100
0
5/16/2015
6/5/2015
6/25/2015
7/15/2015
8/4/2015
8/24/2015
9/13/2015
Date
E. Coli
Standard

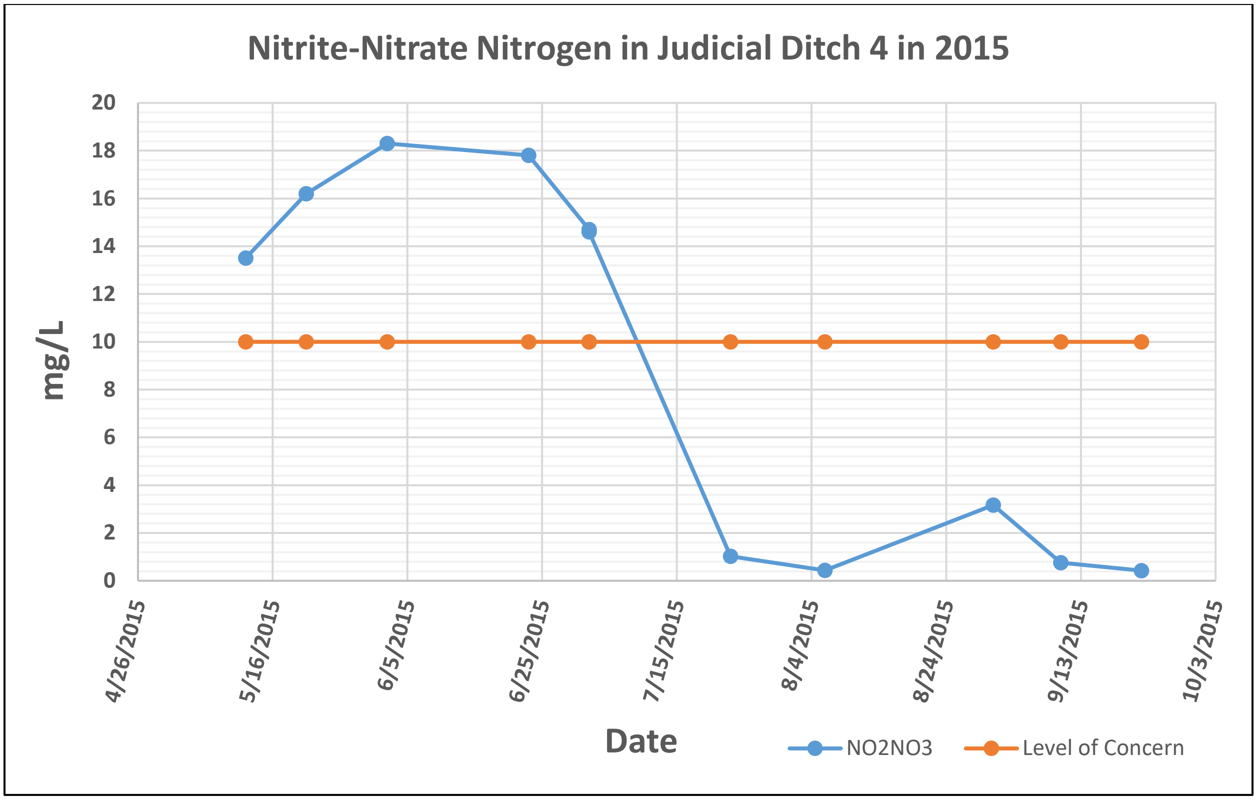

E. Coli in Judicial Ditch 4 in 2016
Colony Forming Units
3000
2500
2000
1500
1000
500
0
5/30/2016
6/9/2016
6/19/2016
6/29/2016
7/9/2016
7/19/2016
7/29/2016
8/8/2016
8/18/2016
Date
E. Coli
Standard


Dissolved Oxygen in Judicial Ditch 4 in 2015
mg/L
12
11
10
9
8
7
6
5
4
4/26/2015
5/16/2015
6/5/2015
6/25/2015
7/15/2015
8/4/2015
8/24/2015
9/13/2015
10/3/2015
Date
DO
Standard

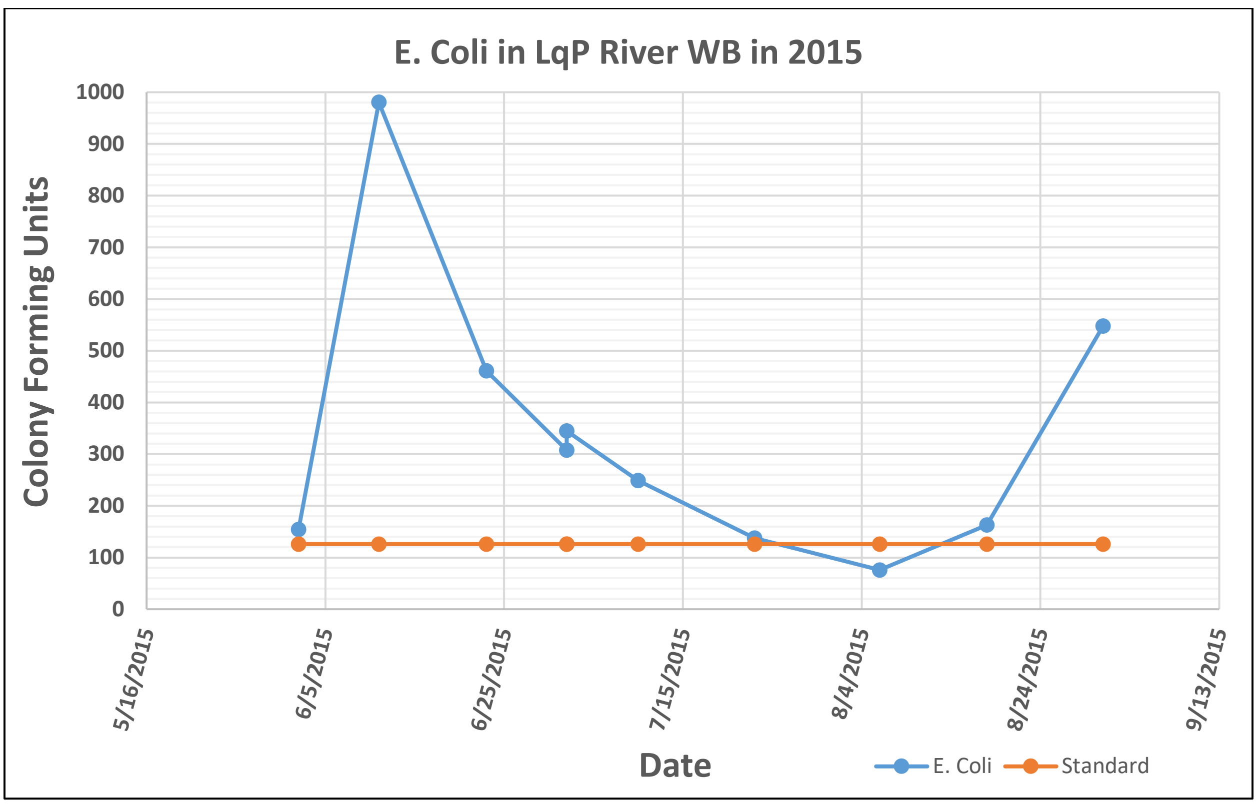

Dissolved Oxygen in Judicial Ditch 4 in 2016
mg/L
8.5
8
7.5
7
6.5
6
5.5
5
4.5
4
5/30/2016
6/9/2016
6/19/2016
6/29/2016
7/9/2016
7/19/2016
7/29/2016
8/8/2016
8/18/2016
Date
DO
Standard

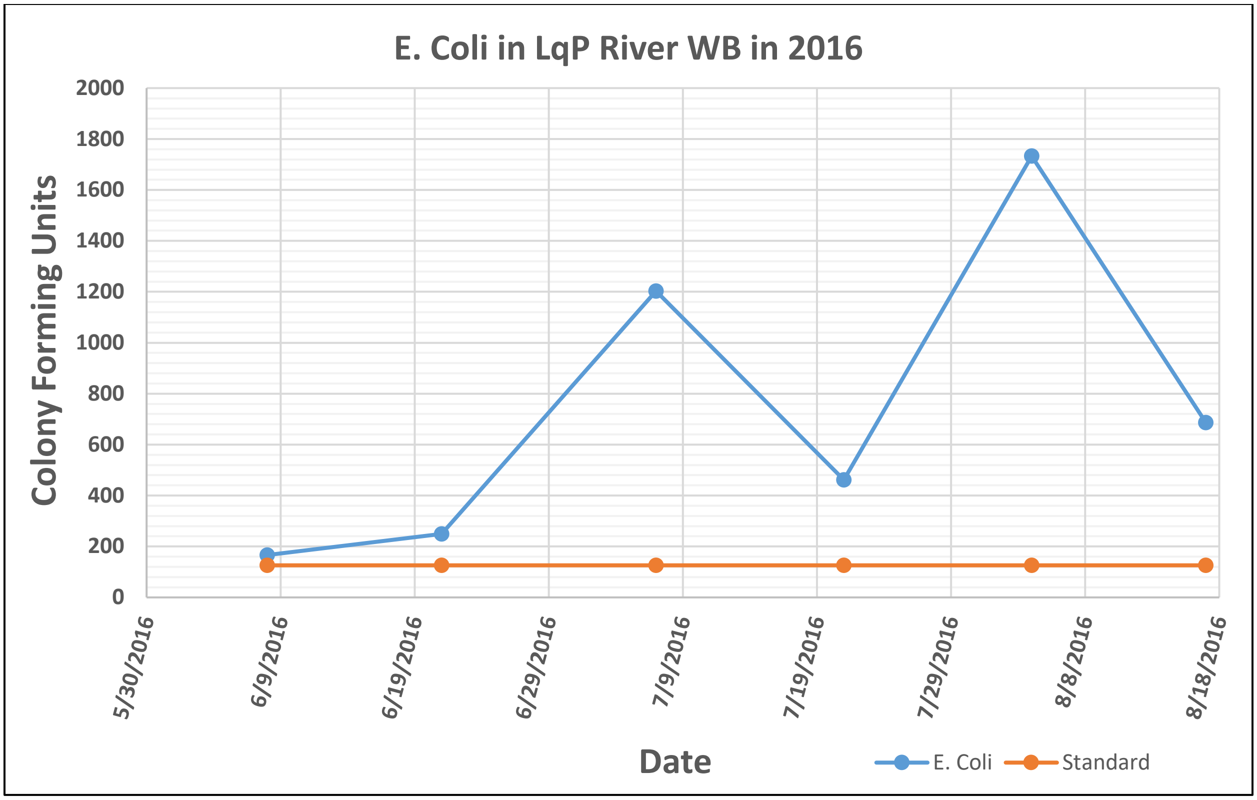

TSS in Judicial Ditch 4 in 2015
70
60
50
40
30
20
10
0
mg/L
4/26/2015
5/16/2015
6/5/2015
6/25/2015
7/15/2015
8/4/2015
8/24/2015
9/13/2015
10/3/2015
Date
TSS
Standard

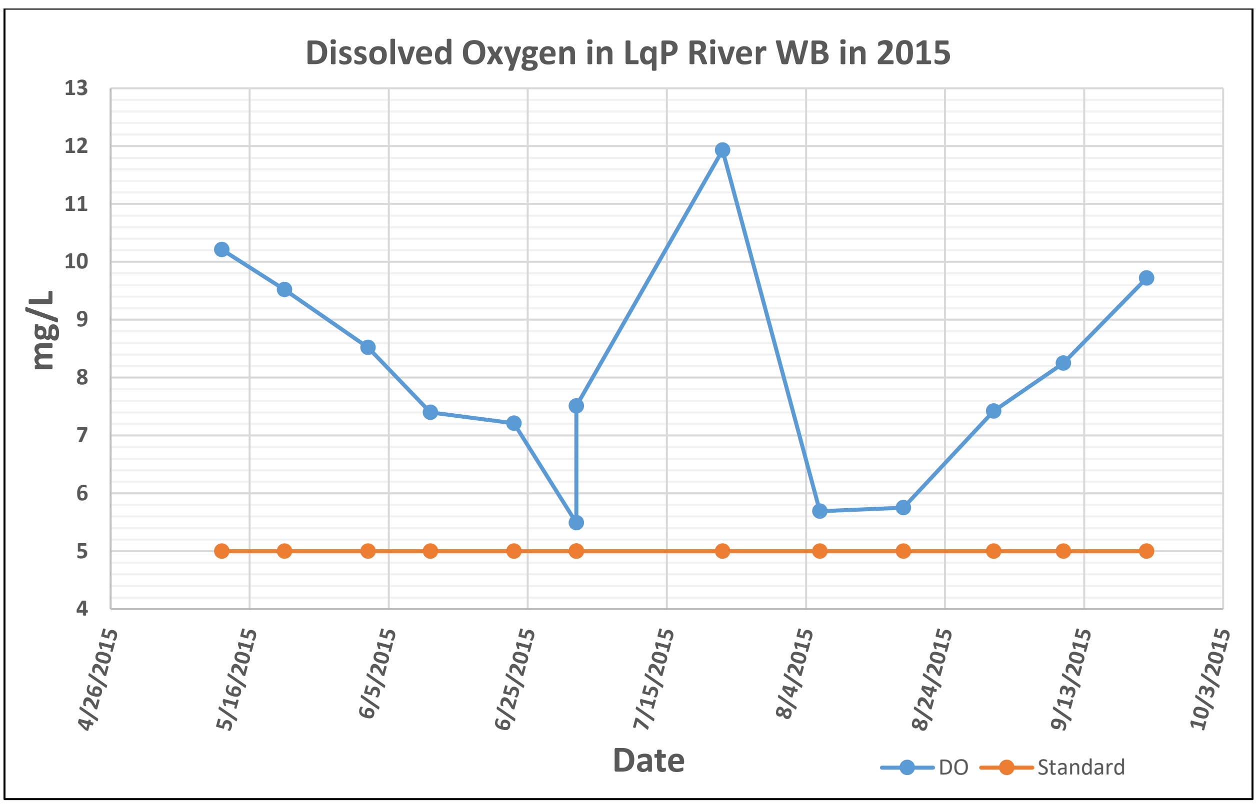

Total Phosphorus in Judicial Ditch 4 in 2015
0.25
0.2
0.15
0.1
0.05
0
mg/L
4/26/2015
5/16/2015
6/5/2015
6/25/2015
7/15/2015
8/4/2015
8/24/2015
9/13/2015
10/3/2015
Date

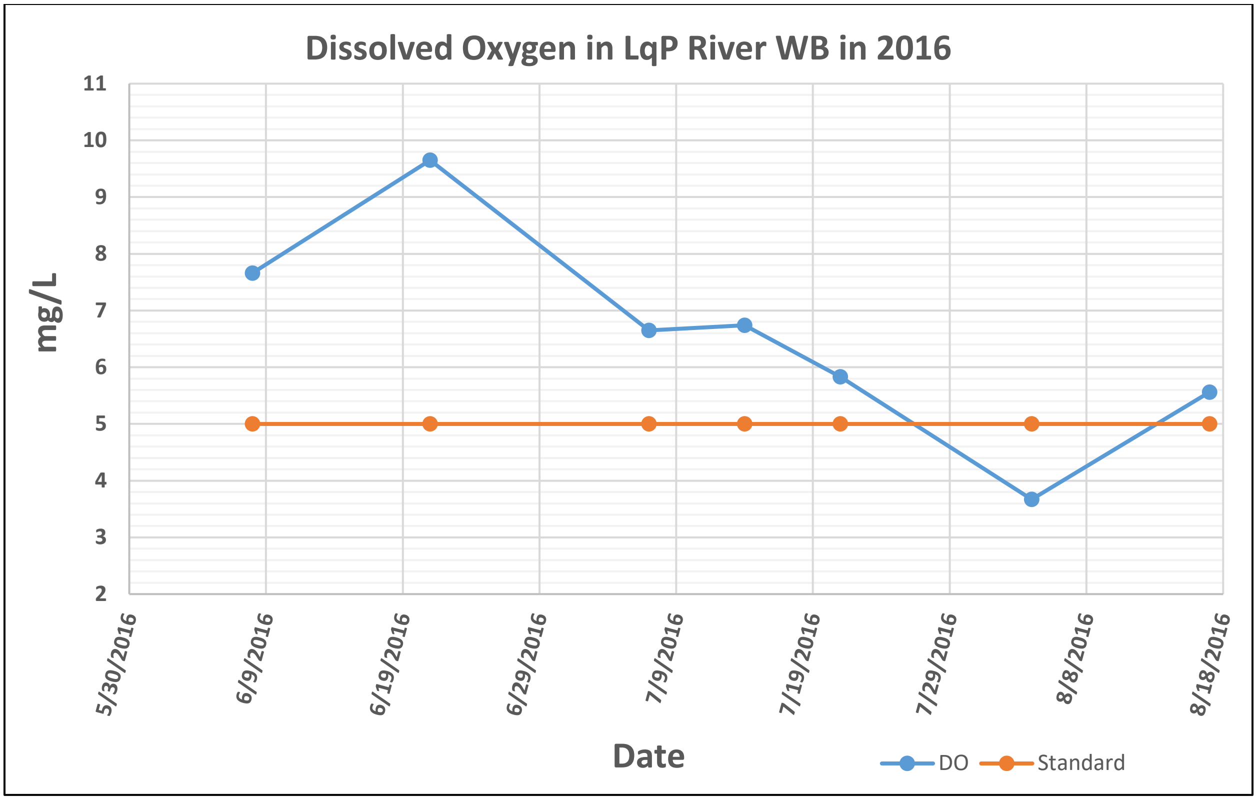

Nitrite-Nitrate Nitrogen in Judicial Ditch 4 in 2015
mg/L
20
18
16
14
12
10
8
6
4
2
0
4/26/2015
5/16/2015
6/5/2015
6/25/2015
7/15/2015
8/4/2015
8/24/2015
9/13/2015
10/3/2015
Date
NO2NO3
Level of Concern

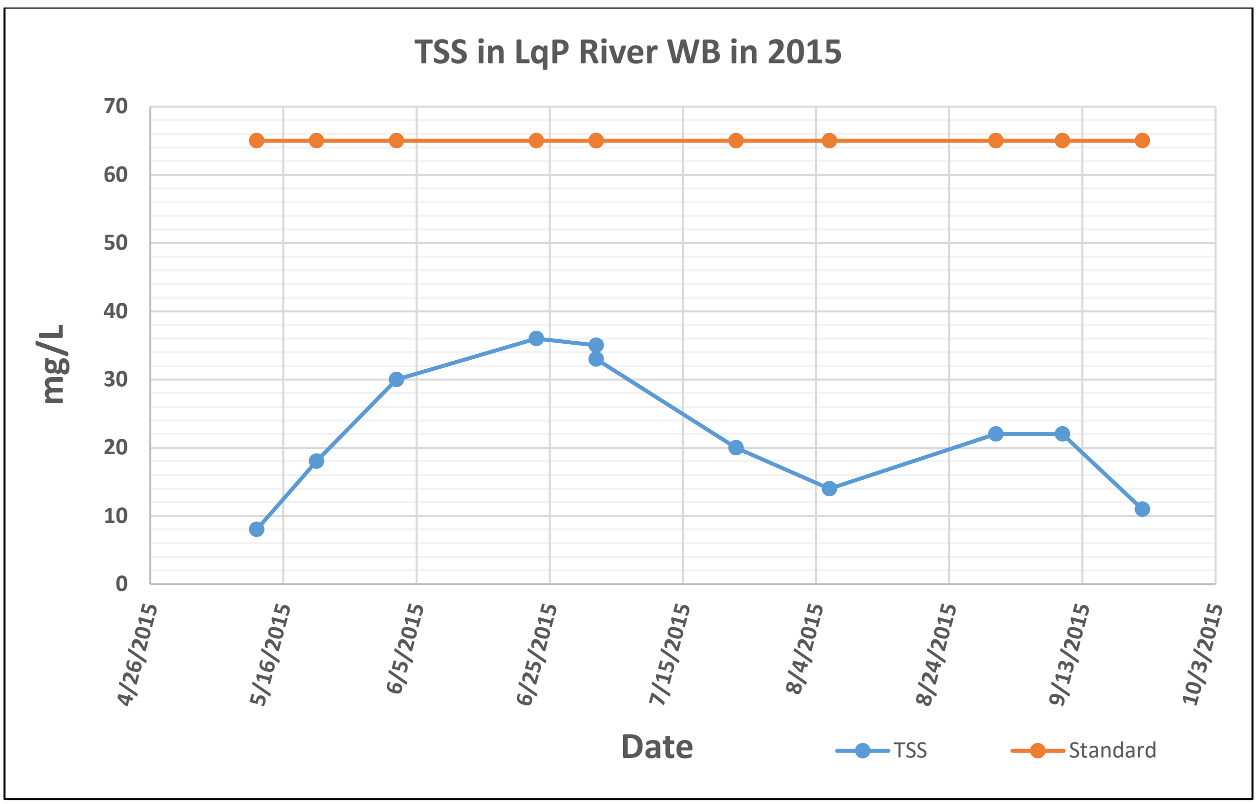
S004-554

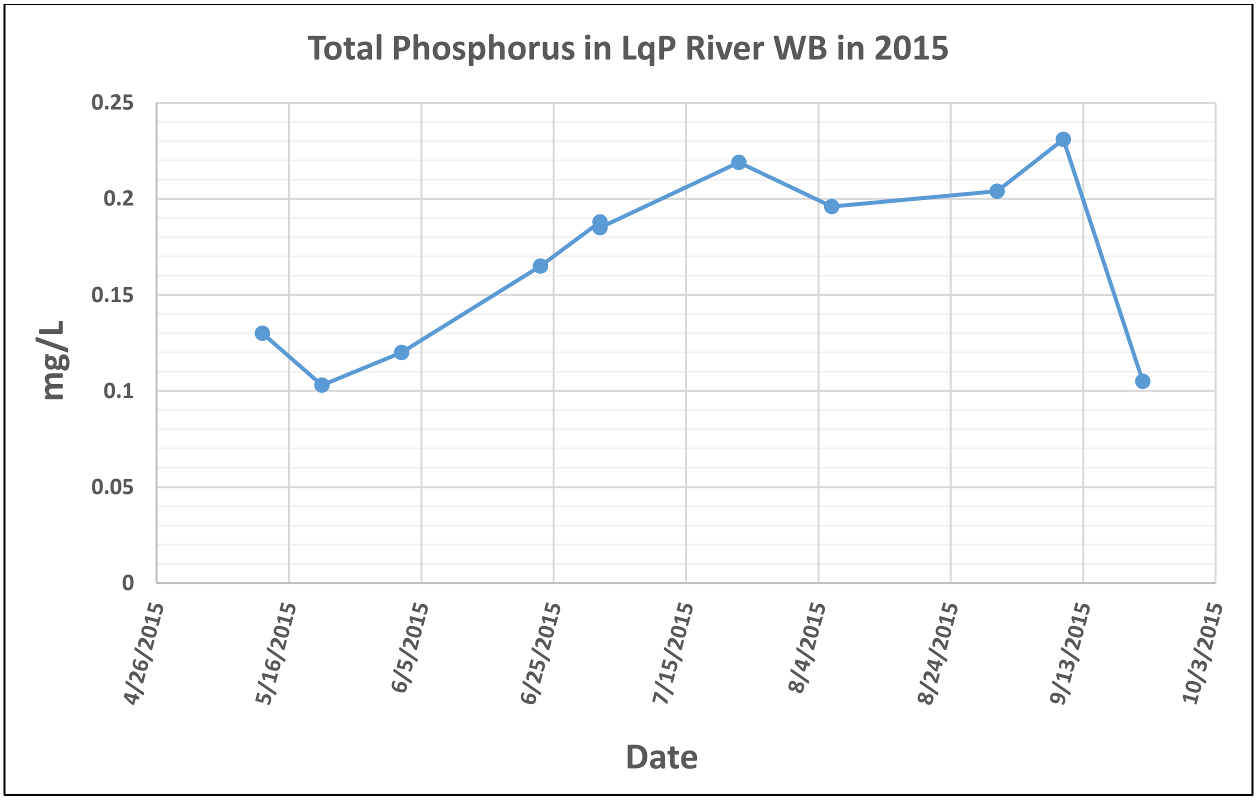

E. Coli in LqP River WB in 2015
Colony Forming Units
1000
900
800
700
600
500
400
300
200
100
0
5/16/2015
6/5/2015
6/25/2015
7/15/2015
8/4/2015
8/24/2015
9/13/2015
Date
E. Coli
Standard

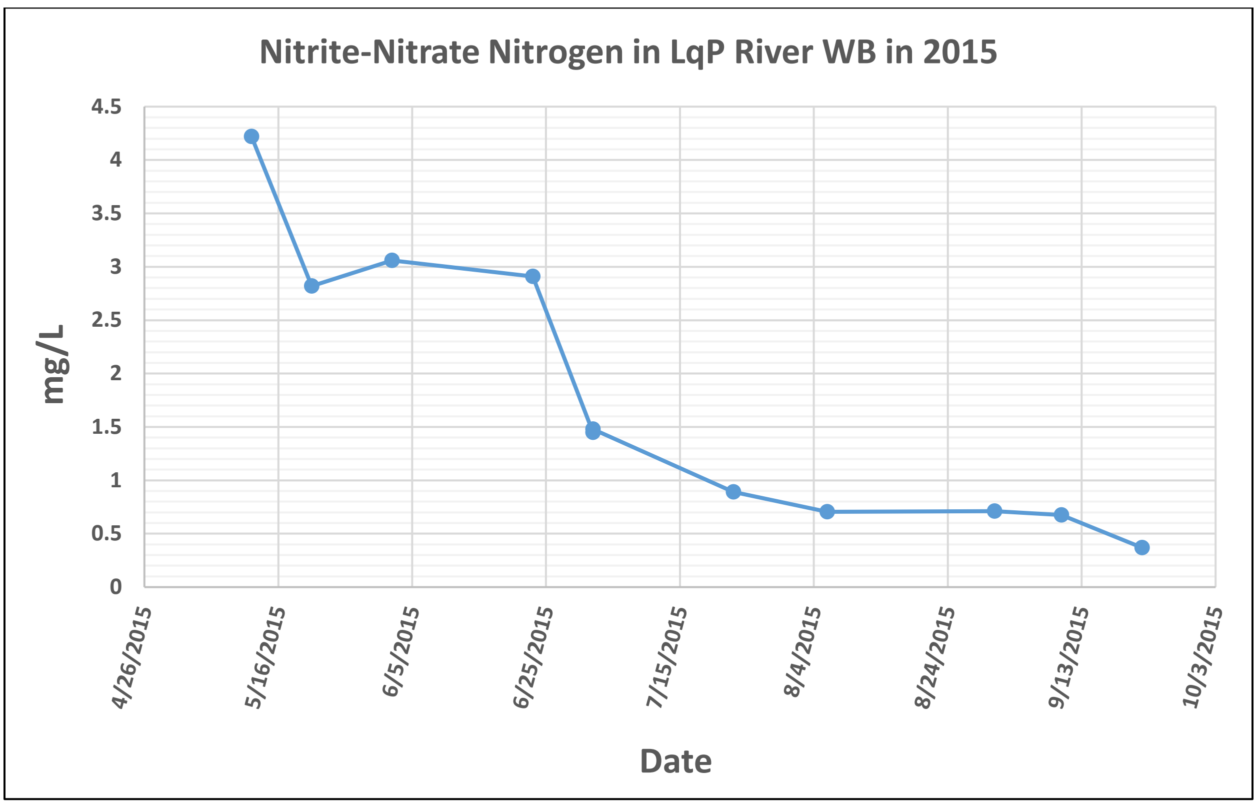

E. Coli in LqP River WB in 2016
Colony Forming Units
2000
1800
1600
1400
1200
1000
800
600
400
200
0
5/30/2016
6/9/2016
6/19/2016
6/29/2016
7/9/2016
7/19/2016
7/29/2016
8/8/2016
8/18/2016
Date
E. Coli
Standard


Dissolved Oxygen in LqP River WB in 2015
mg/L
13
12
11
10
9
8
7
6
5
4
4/26/2015
5/16/2015
6/5/2015
6/25/2015
7/15/2015
8/4/2015
8/24/2015
9/13/2015
10/3/2015
Date
DO
Standard

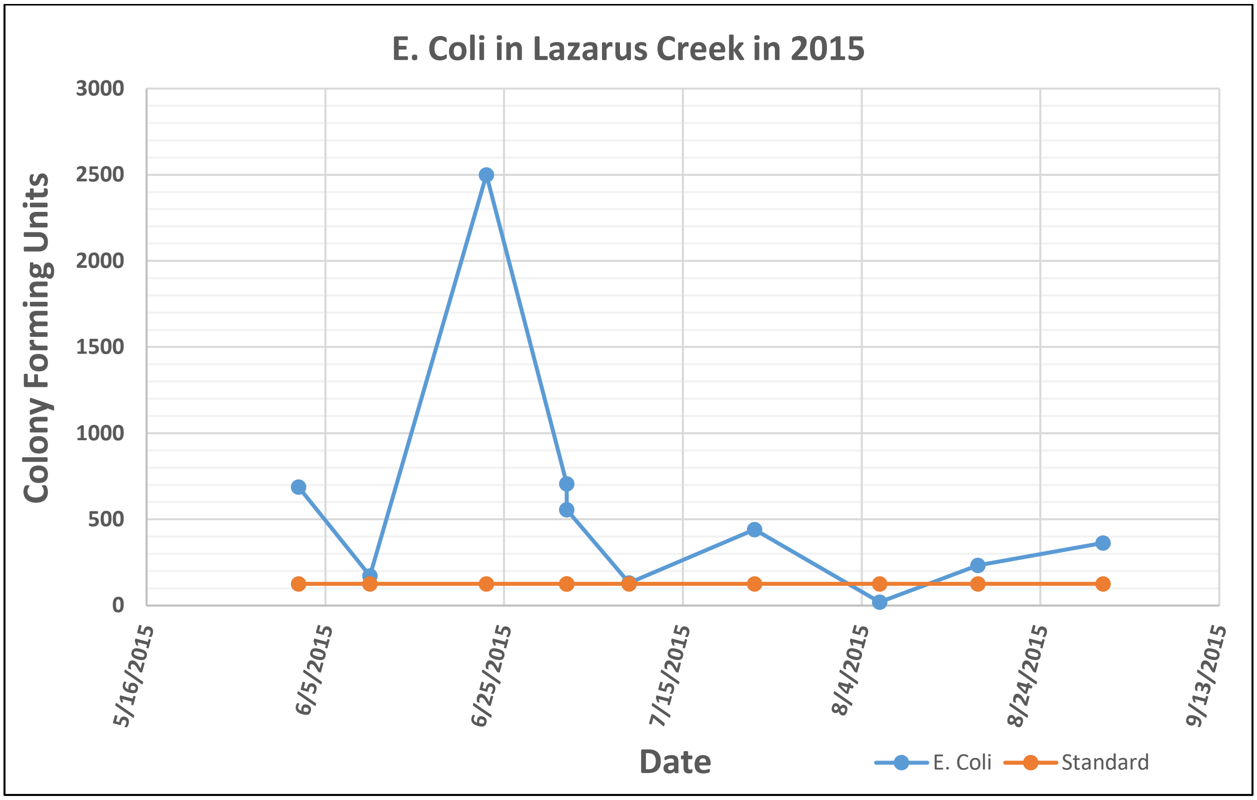

Dissolved Oxygen in LqP River WB in 2016
mg/L
11
10
9
8
7
6
5
4
3
2
5/30/2016
6/9/2016
6/19/2016
6/29/2016
7/9/2016
7/19/2016
7/29/2016
8/8/2016
8/18/2016
Date
DO
Standard

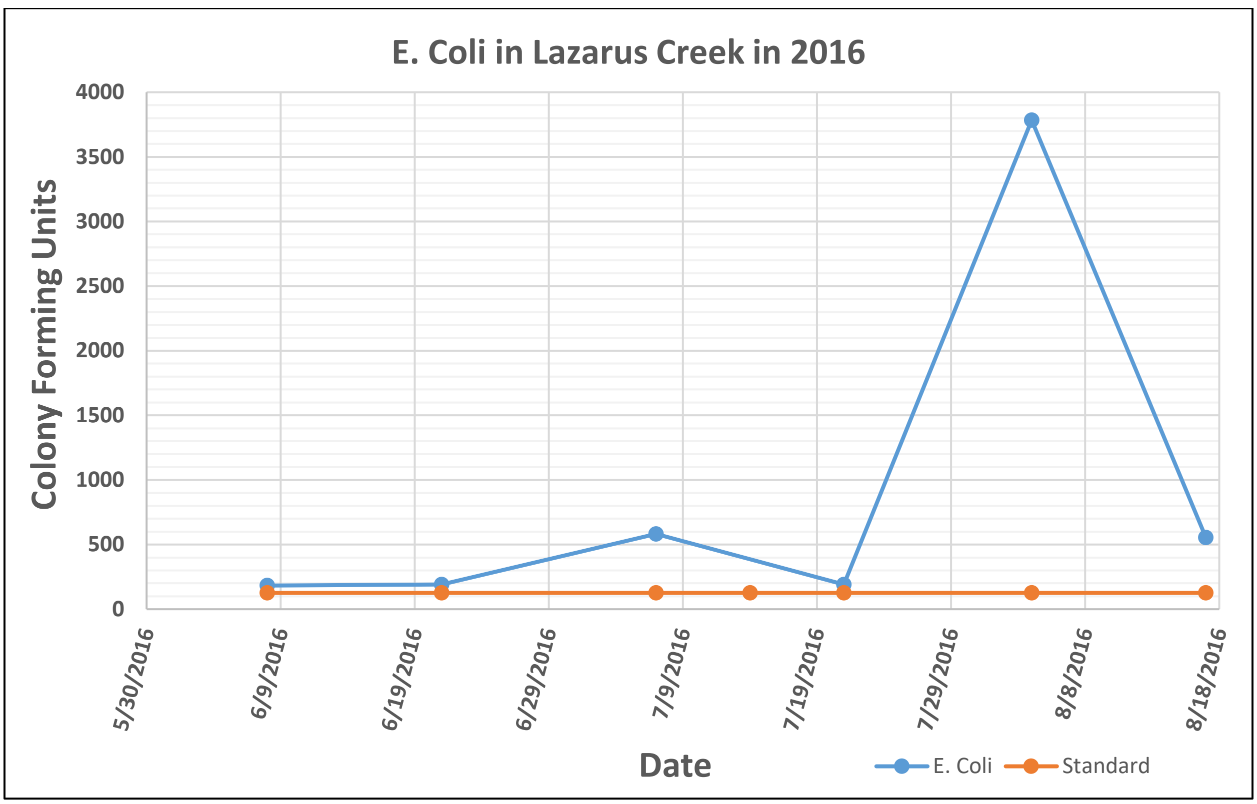

TSS in LqP River WB in 2015
mg/L
70
60
50
40
30
20
10
0
4/26/2015
5/16/2015
6/5/2015
6/25/2015
7/15/2015
8/4/2015
8/24/2015
9/13/2015
10/3/2015
Date
TSS
Standard

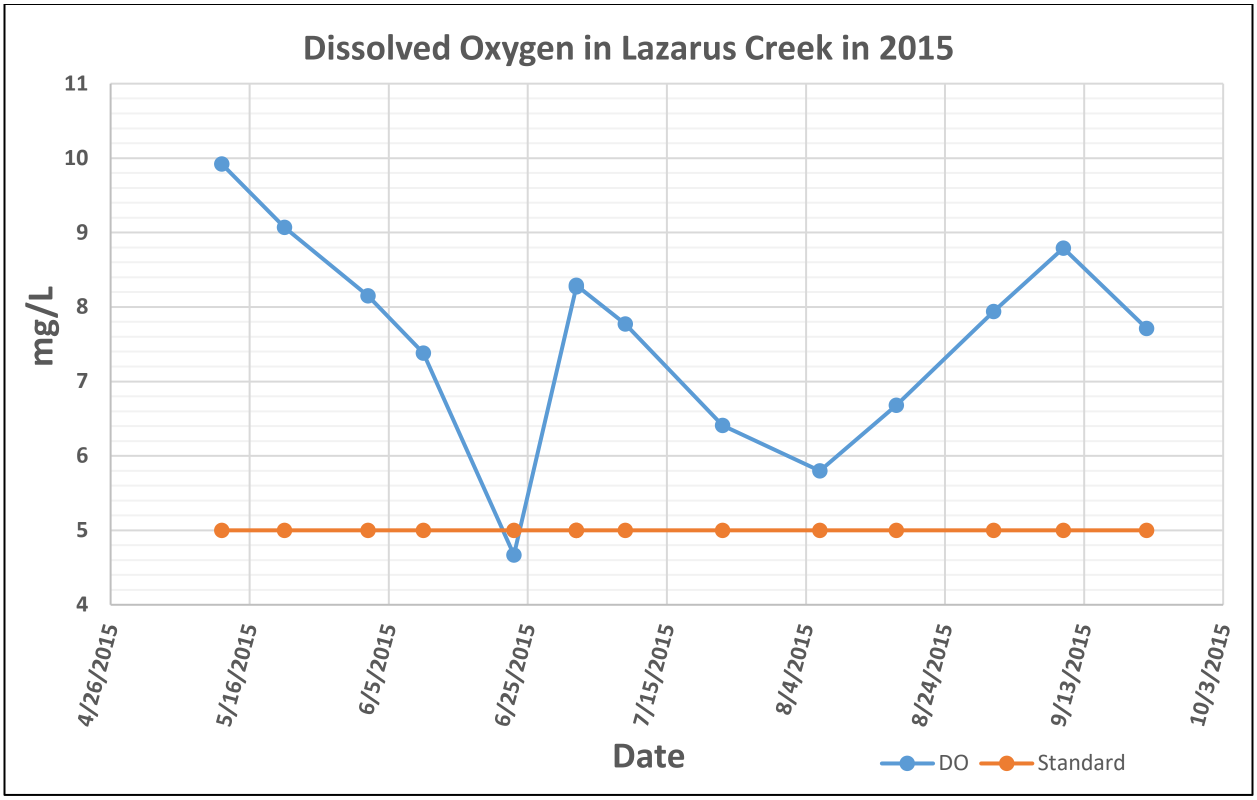

Total Phosphorus in LqP River WB in 2015
mg/L
0.25
0.2
0.15
0.1
0.05
0
4/26/2015
5/16/2015
6/5/2015
6/25/2015
7/15/2015
8/4/2015
8/24/2015
9/13/2015
10/3/2015
Date

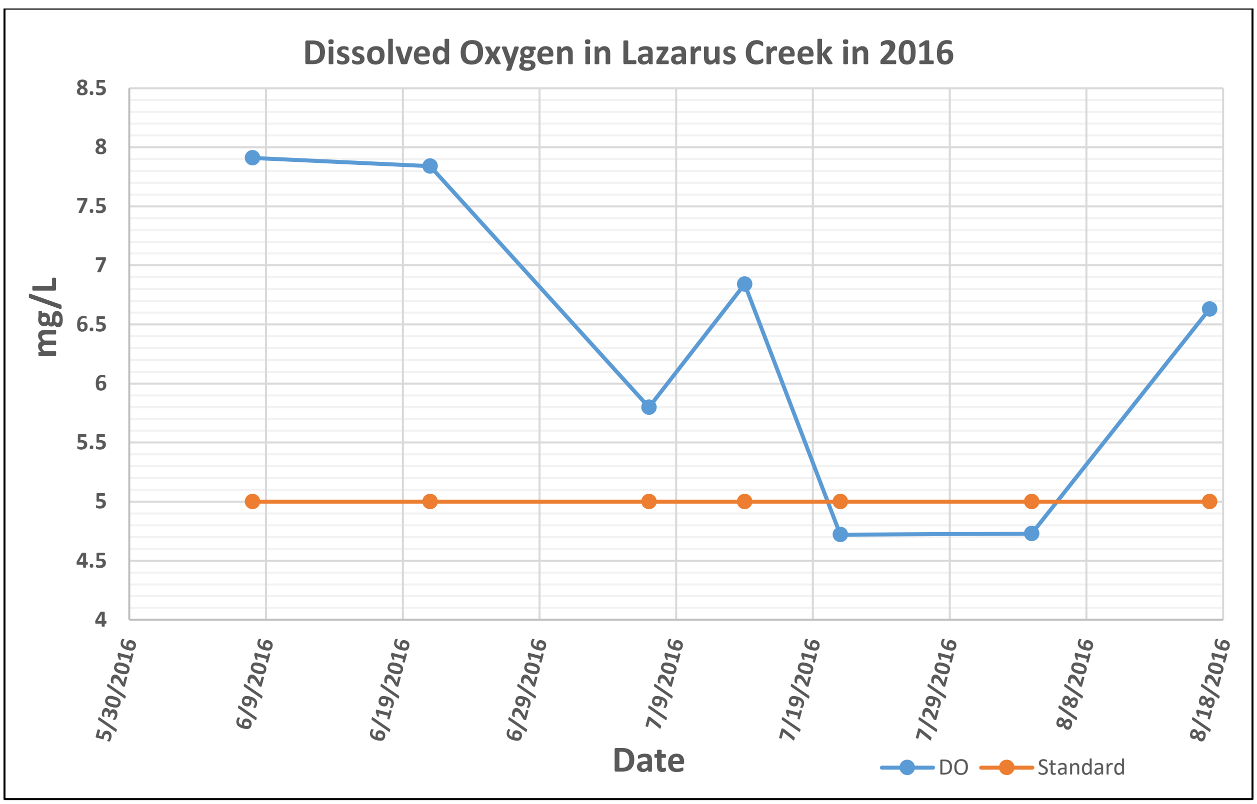

Nitrite-Nitrate Nitrogen in LqP River WB in 2015
mg/L
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
4/26/2015
5/16/2015
6/5/2015
6/25/2015
7/15/2015
8/4/2015
8/24/2015
9/13/2015
10/3/2015
Date

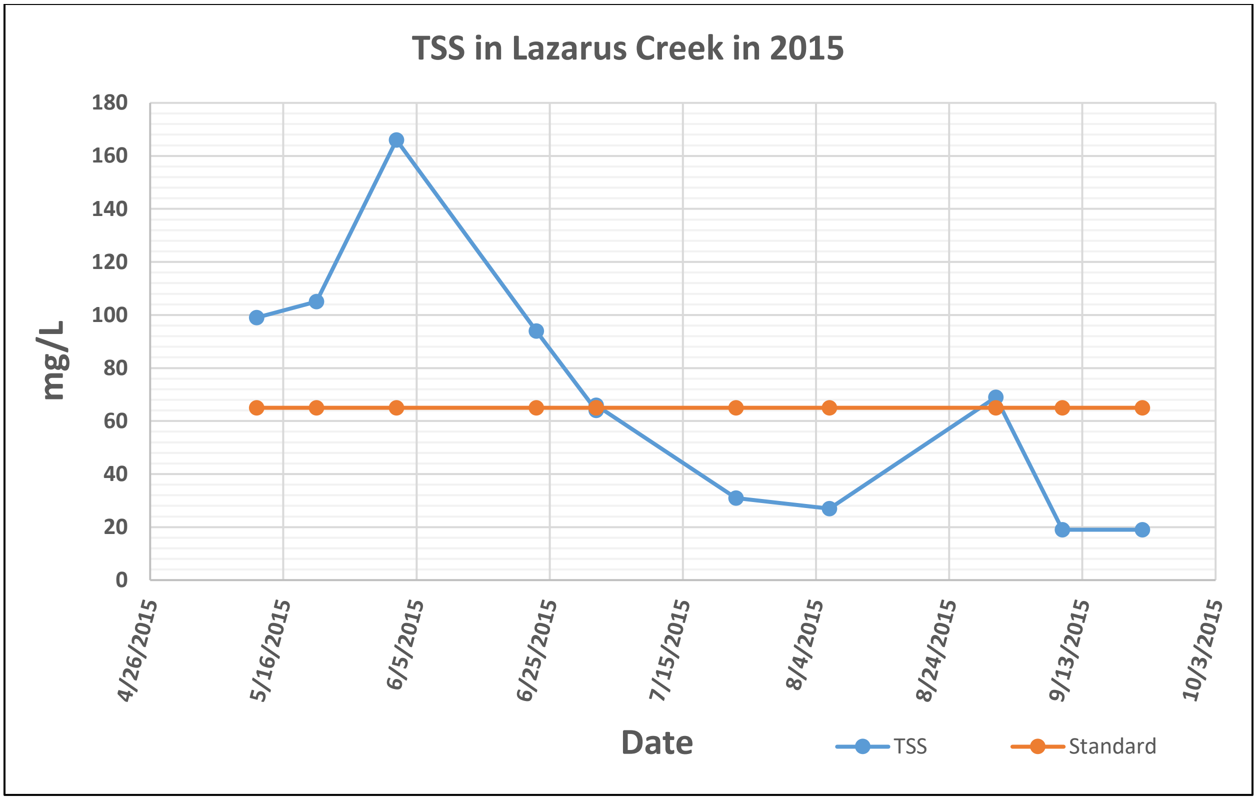
S004-552

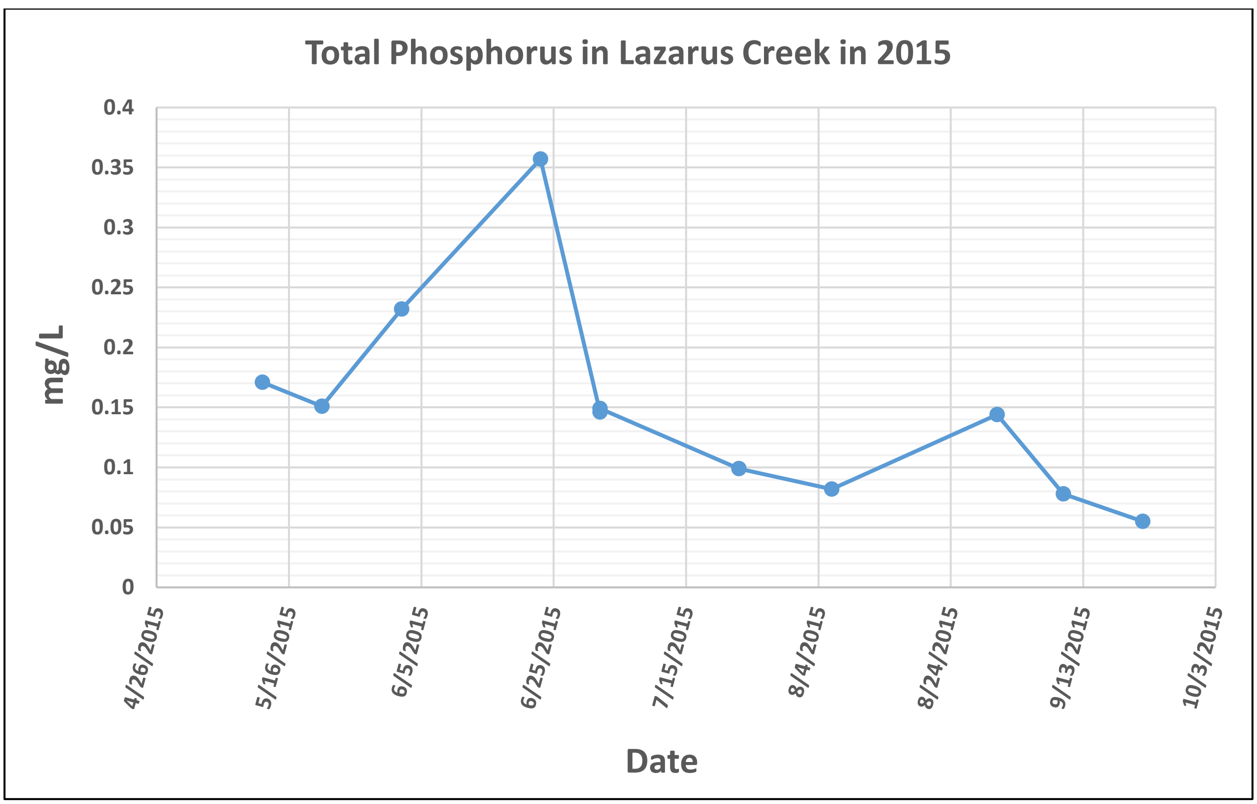

E. Coli in Lazarus Creek in 2015
Colony Forming Units
3000
2500
2000
1500
1000
500
0
5/16/2015
6/5/2015
6/25/2015
7/15/2015
8/4/2015
8/24/2015
9/13/2015
Date
E. Coli
Standard

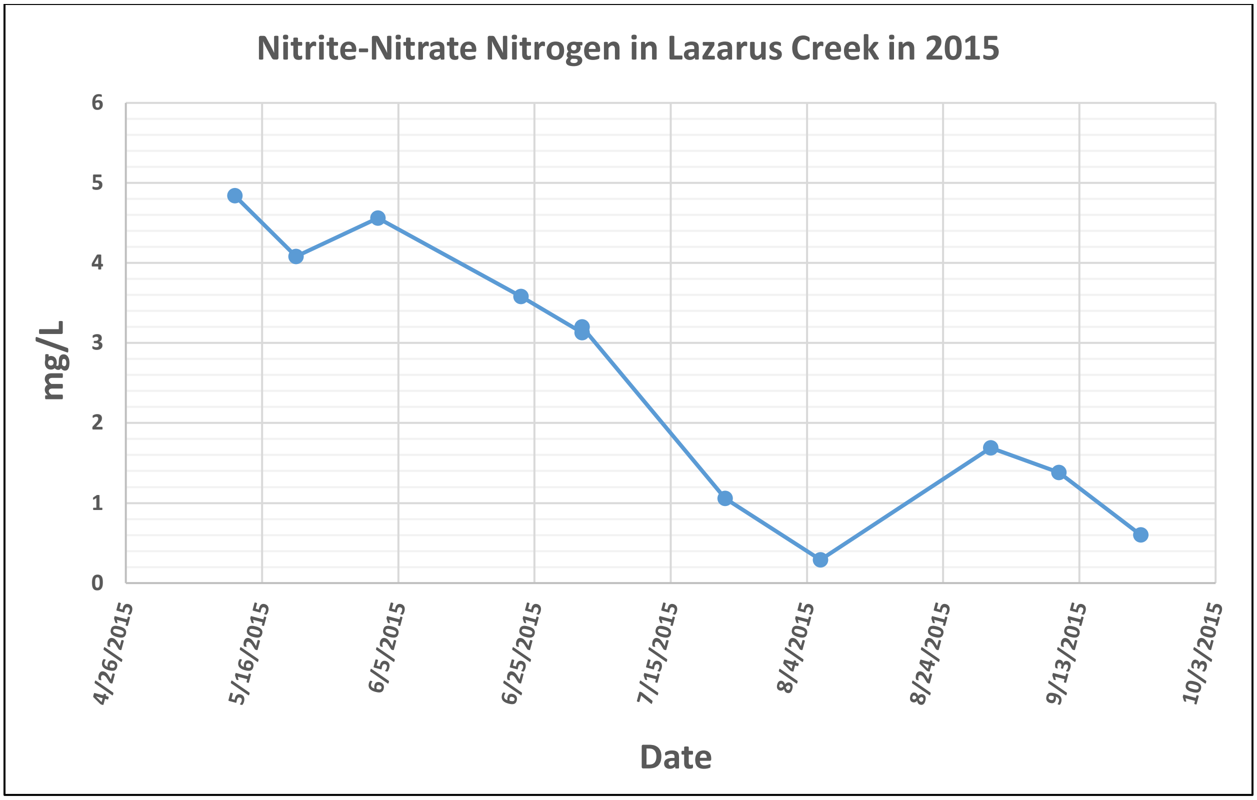

E. Coli in Lazarus Creek in 2016
Colony Forming Units
4000
3500
3000
2500
2000
1500
1000
500
0
5/30/2016
6/9/2016
6/19/2016
6/29/2016
7/9/2016
7/19/2016
7/29/2016
8/8/2016
8/18/2016
Date
E. Coli
Standard


Dissolved Oxygen in Lazarus Creek in 2015
mg/L
11
10
9
8
7
6
5
4
4/26/2015
5/16/2015
6/5/2015
6/25/2015
7/15/2015
8/4/2015
8/24/2015
9/13/2015
10/3/2015
Date
DO
Standard

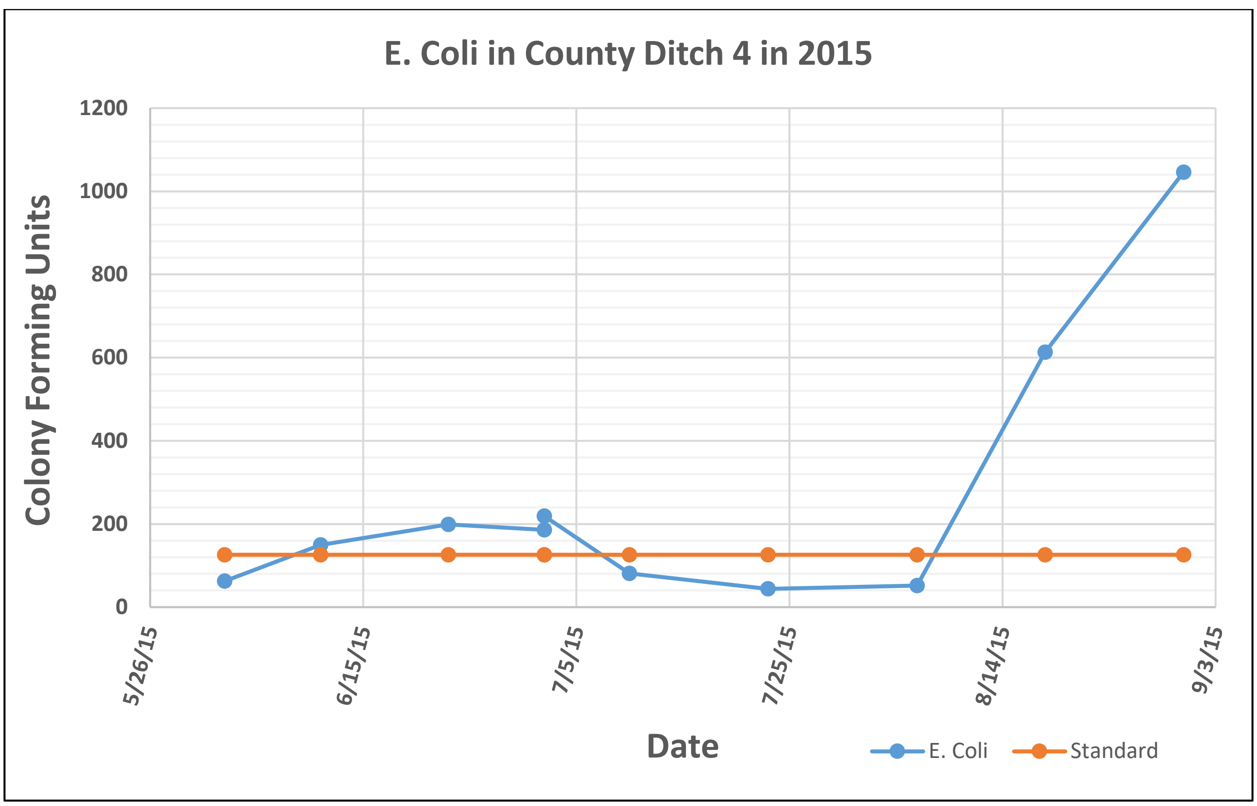

Dissolved Oxygen in Lazarus Creek in 2016
mg/L
8.5
8
7.5
7
6.5
6
5.5
5
4.5
4
5/30/2016
6/9/2016
6/19/2016
6/29/2016
7/9/2016
7/19/2016
7/29/2016
8/8/2016
8/18/2016
Date
DO
Standard

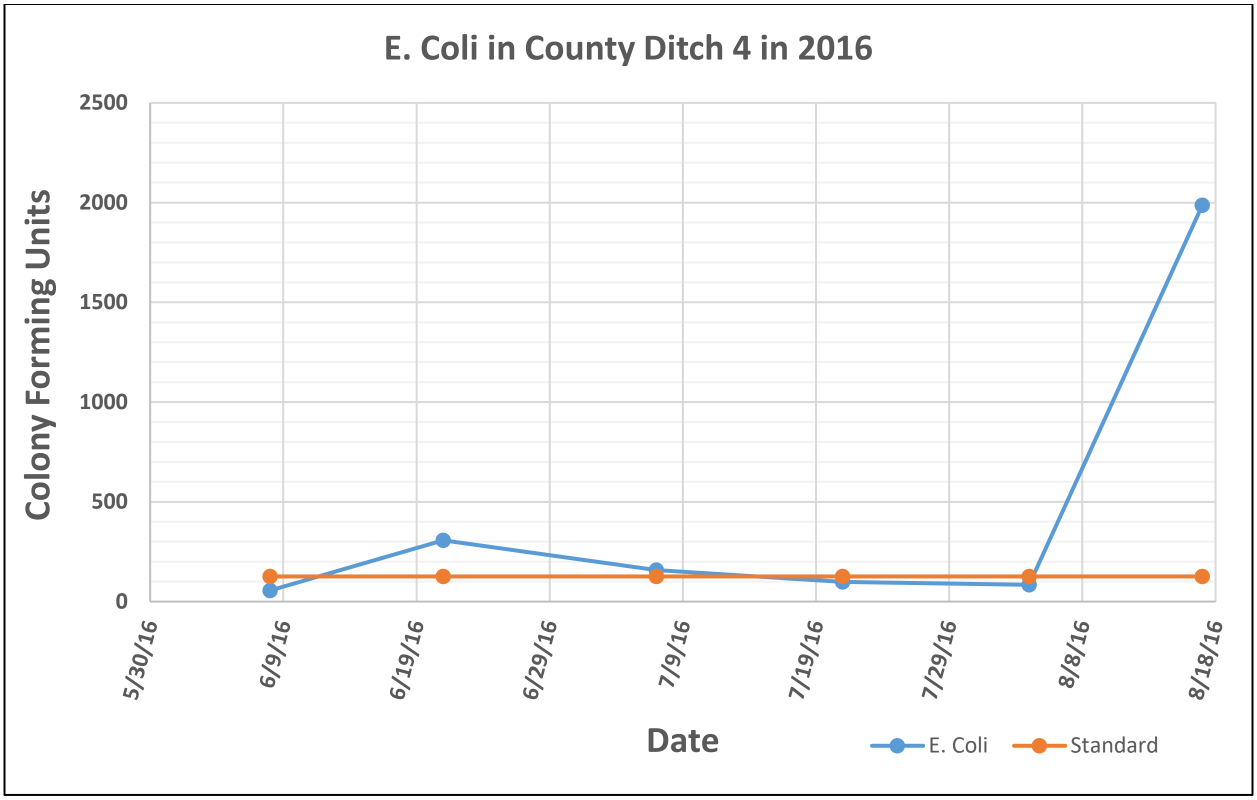

TSS in Lazarus Creek in 2015
180
160
140
120
100
80
60
40
20
0
mg/L
4/26/2015
5/16/2015
6/5/2015
6/25/2015
7/15/2015
8/4/2015
8/24/2015
9/13/2015
10/3/2015
Date
TSS
Standard

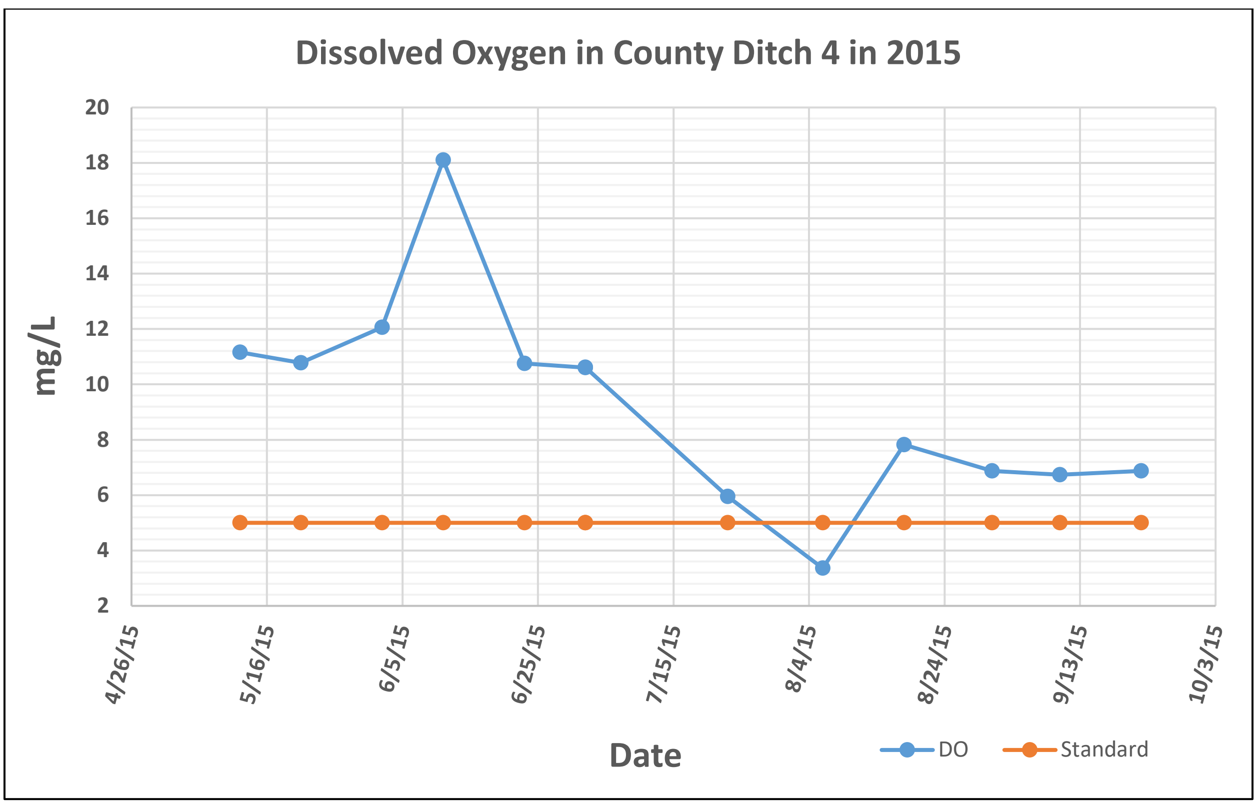

Total Phosphorus in Lazarus Creek in 2015
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
mg/L
4/26/2015
5/16/2015
6/5/2015
6/25/2015
7/15/2015
8/4/2015
8/24/2015
9/13/2015
10/3/2015
Date

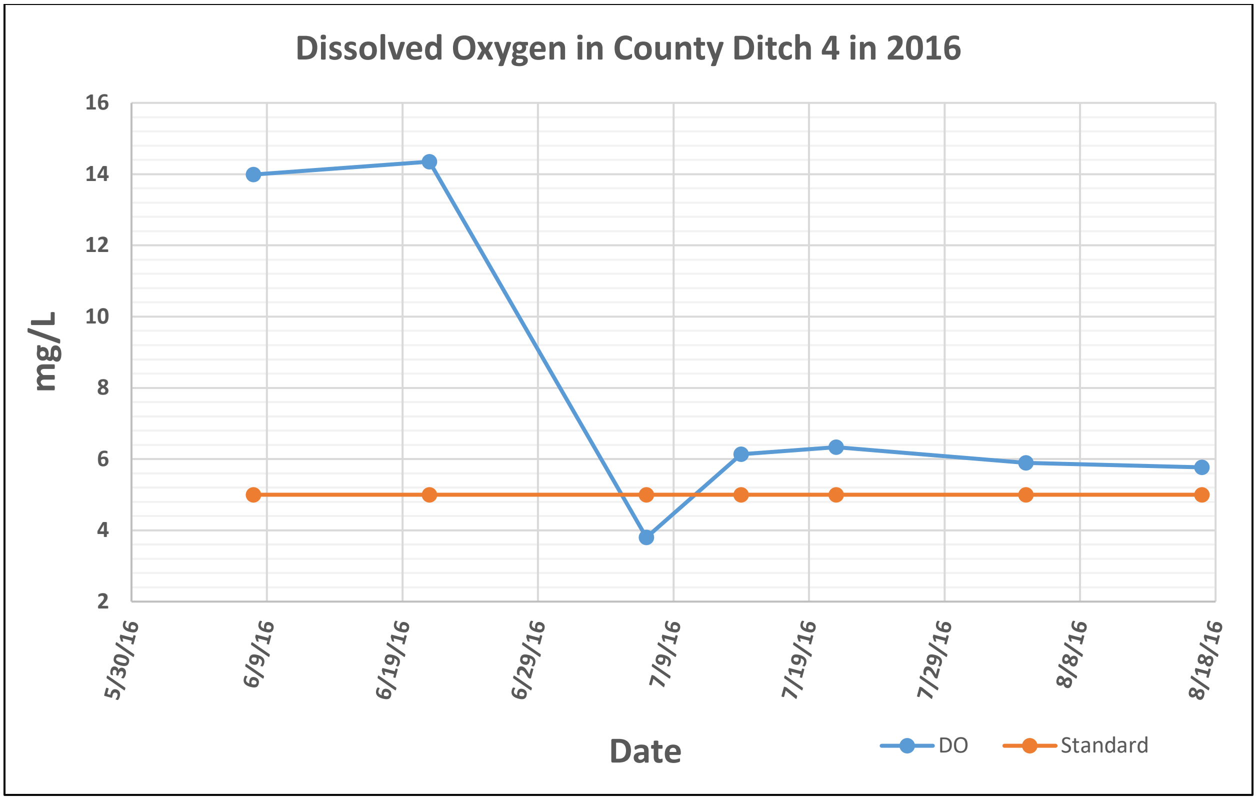

Nitrite-Nitrate Nitrogen in Lazarus Creek in 2015
mg/L
0
1
2
3
4
5
6
4/26/2015
5/16/2015
6/5/2015
6/25/2015
7/15/2015
8/4/2015
8/24/2015
9/13/2015
10/3/2015
Date

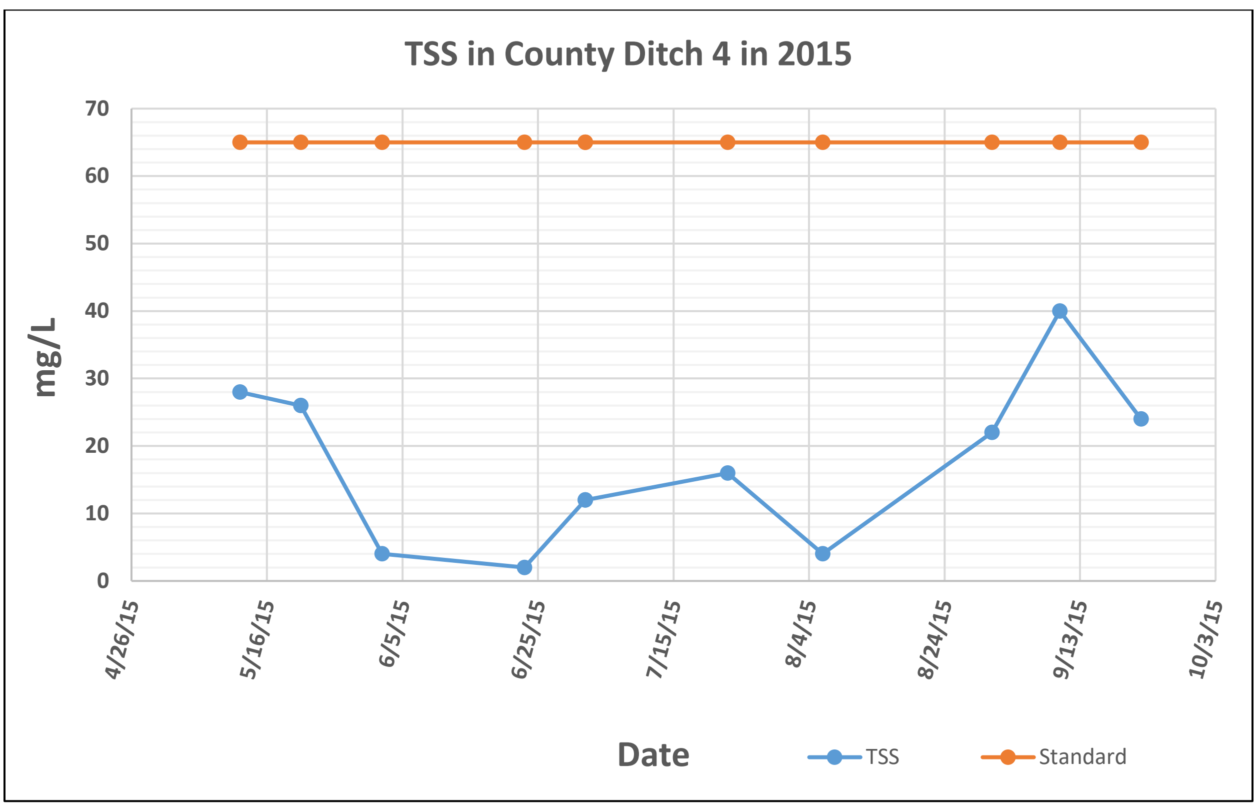
S001-841

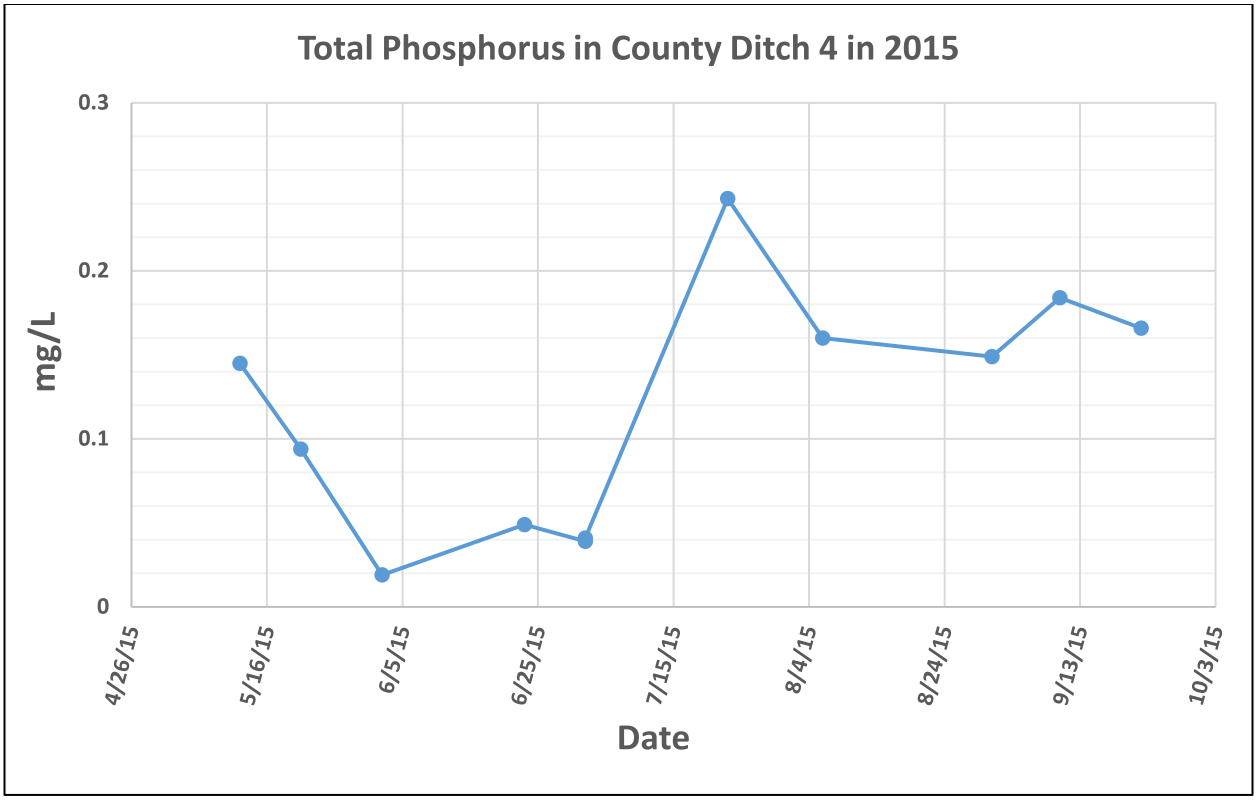

E. Coli in County Ditch 4 in 2015
Colony Forming Units
0
200
400
600
800
1000
1200
5/26/15
6/15/15
7/5/15
7/25/15
8/14/15
9/3/15
Date
E. Coli
Standard

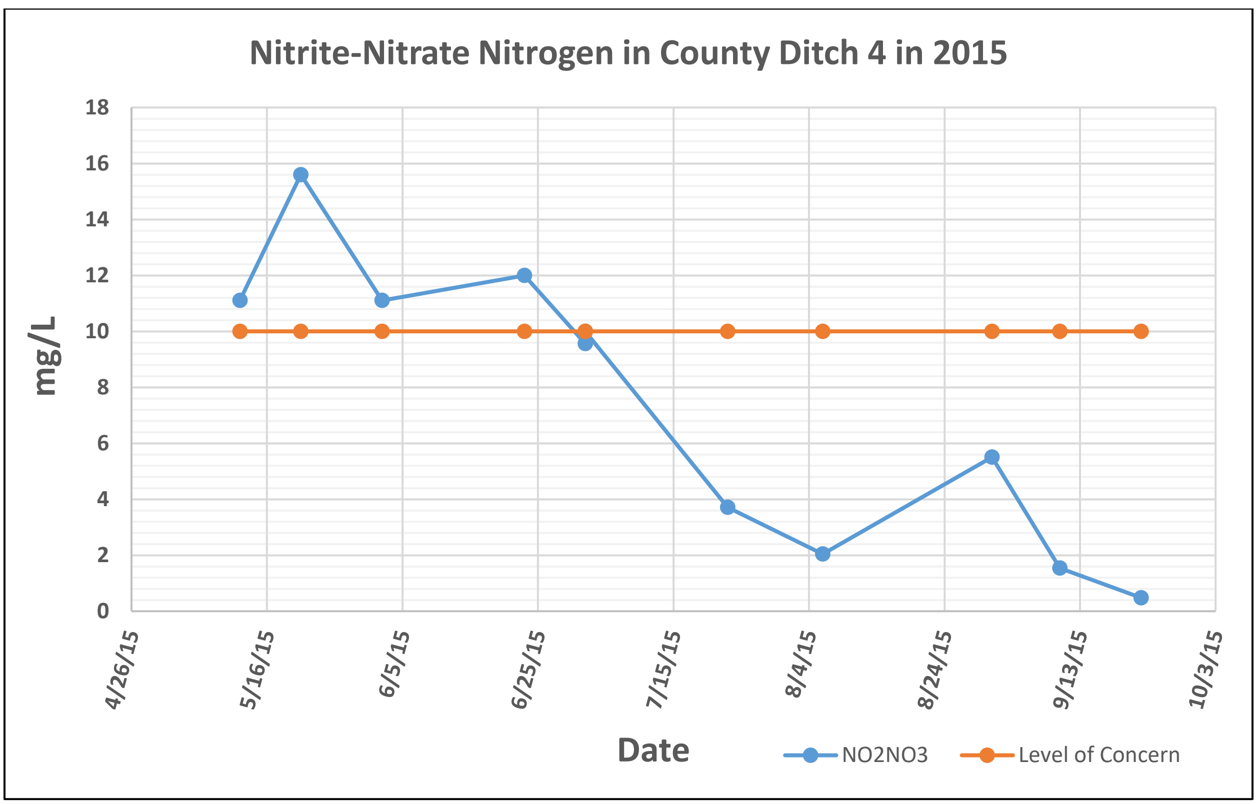

E. Coli in County Ditch 4 in 2016
Colony Forming Units
2500
2000
1500
1000
500
0
5/30/16
6/9/16
6/19/16
6/29/16
7/9/16
7/19/16
7/29/16
8/8/16
8/18/16
Date
E. Coli
Standard


Dissolved Oxygen in County Ditch 4 in 2015
mg/L
20
18
16
14
12
10
8
6
4
2
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date
DO
Standard

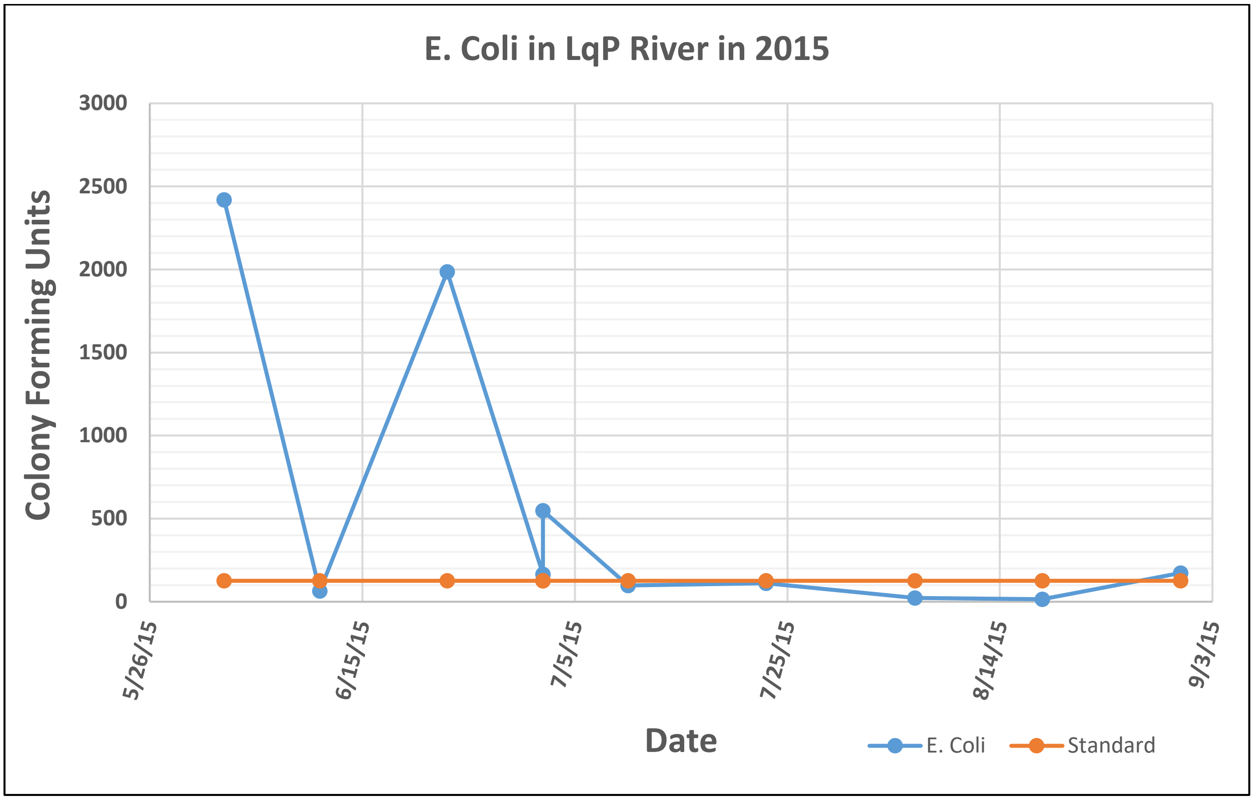

Dissolved Oxygen in County Ditch 4 in 2016
mg/L
16
14
12
10
8
6
4
2
5/30/16
6/9/16
6/19/16
6/29/16
7/9/16
7/19/16
7/29/16
8/8/16
8/18/16
Date
DO
Standard


TSS in County Ditch 4 in 2015
mg/L
70
60
50
40
30
20
10
0
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date
TSS
Standard

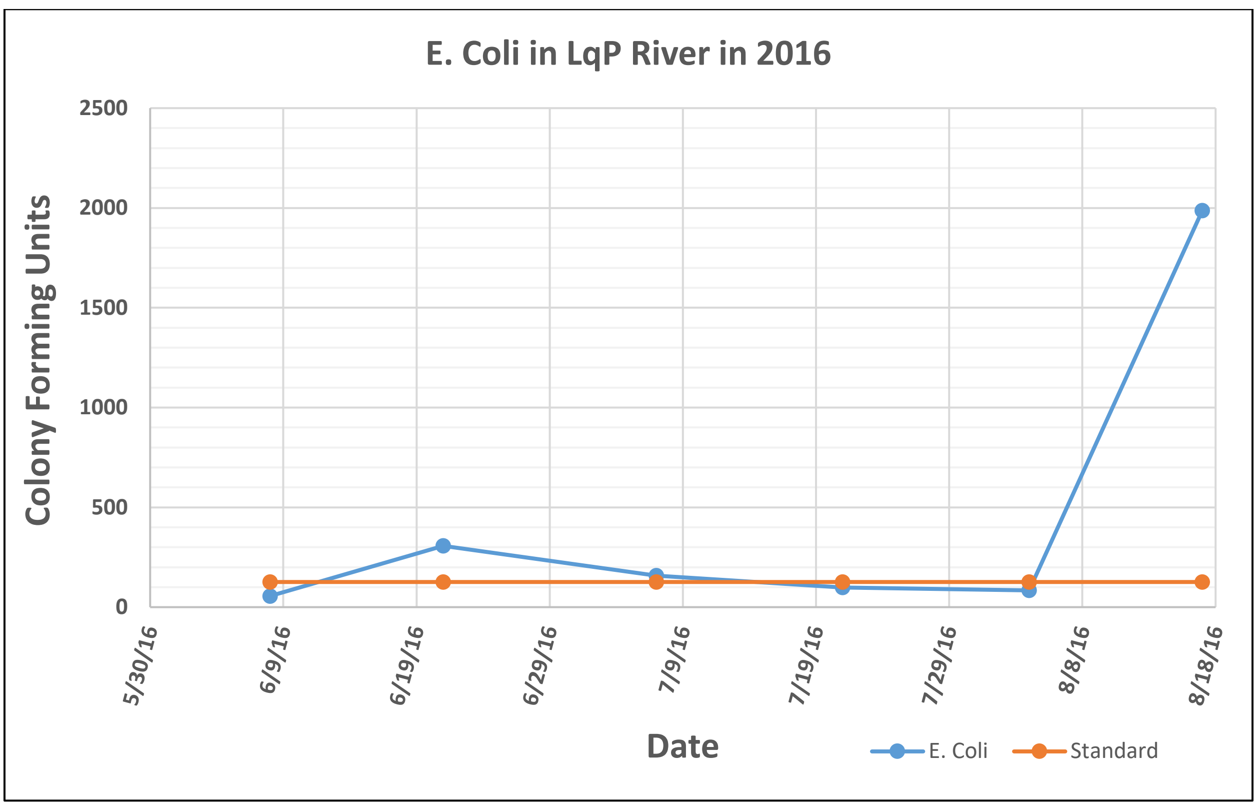

Total Phosphorus in County Ditch 4 in 2015
0.3
0.2
0.1
0
mg/L
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date


Nitrite-Nitrate Nitrogen in County Ditch 4 in 2015
18
16
14
12
10
8
6
4
2
0
mg/L
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date
NO2NO3
Level of Concern

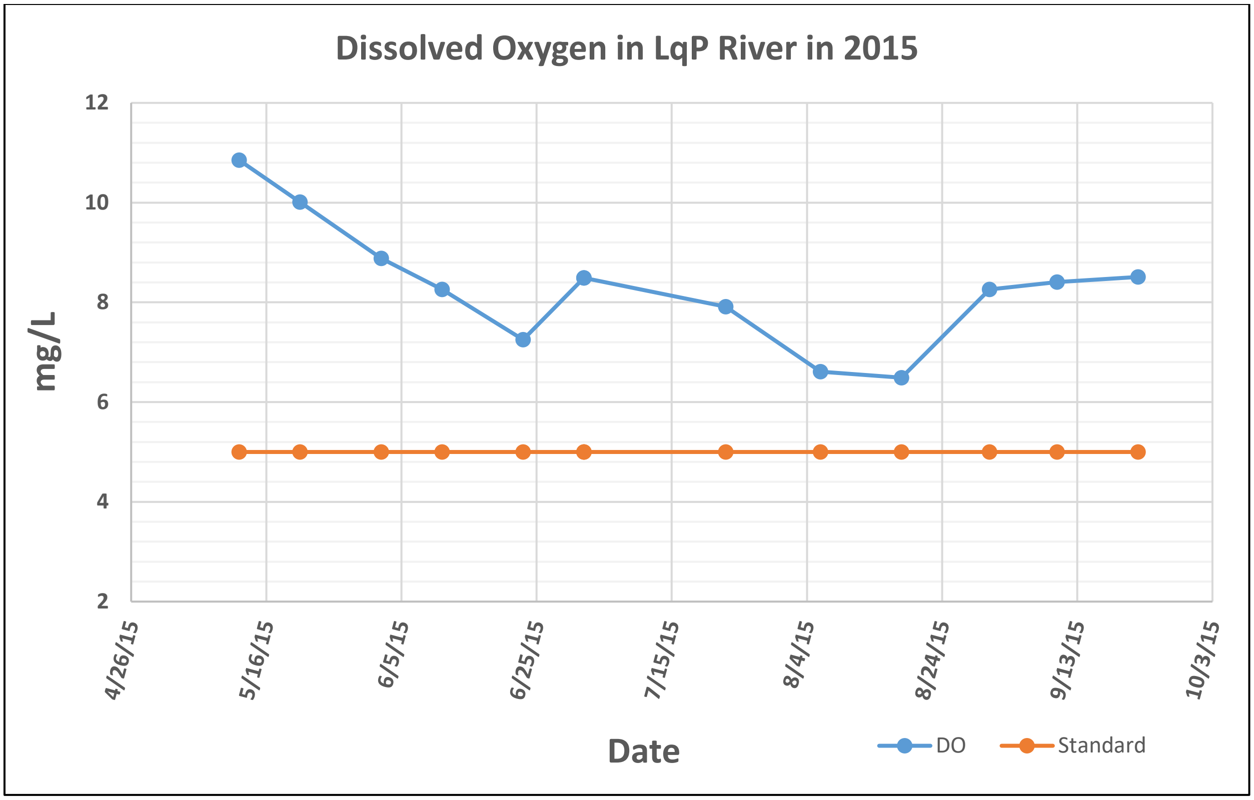
S000-143

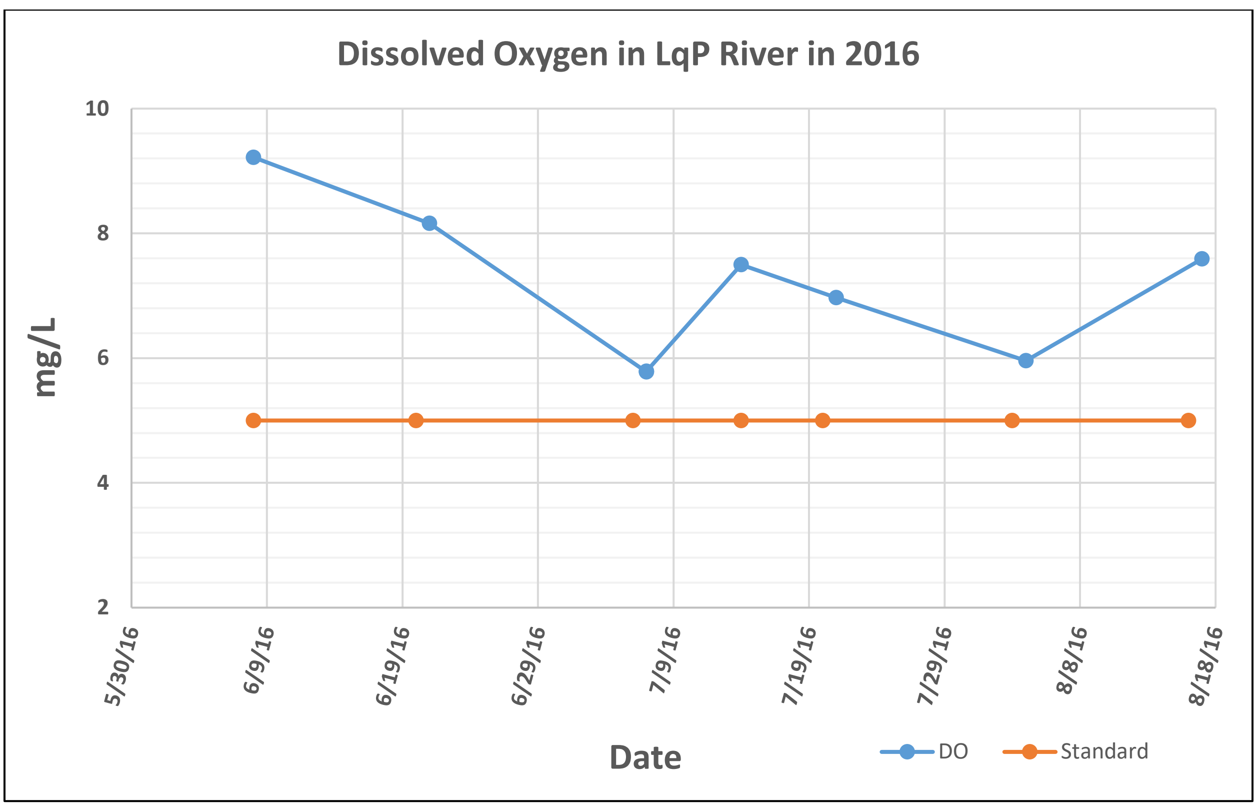


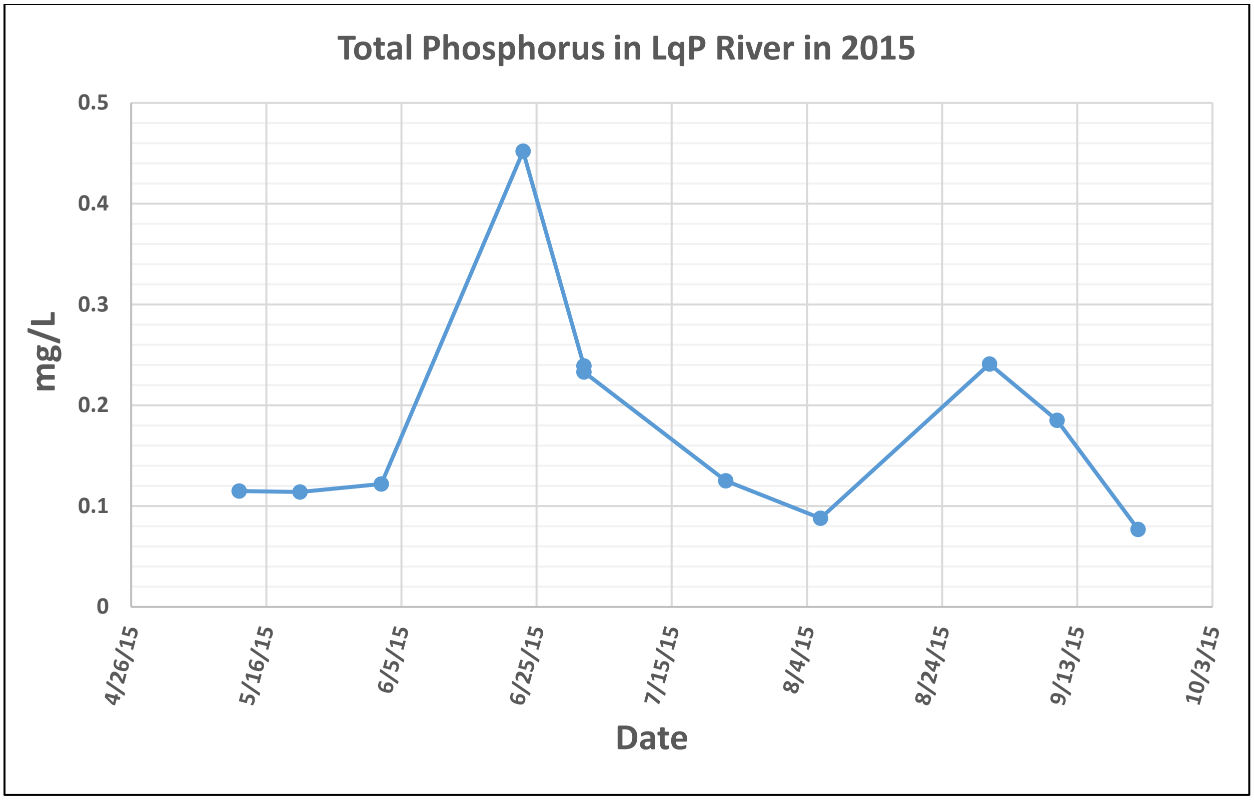
E. Coli in LqP River in 2015
Colony Forming Units
3000
2500
2000
1500
1000
500
0
5/26/15
6/15/15
7/5/15
7/25/15
8/14/15
9/3/15
Date
E. Coli
Standard

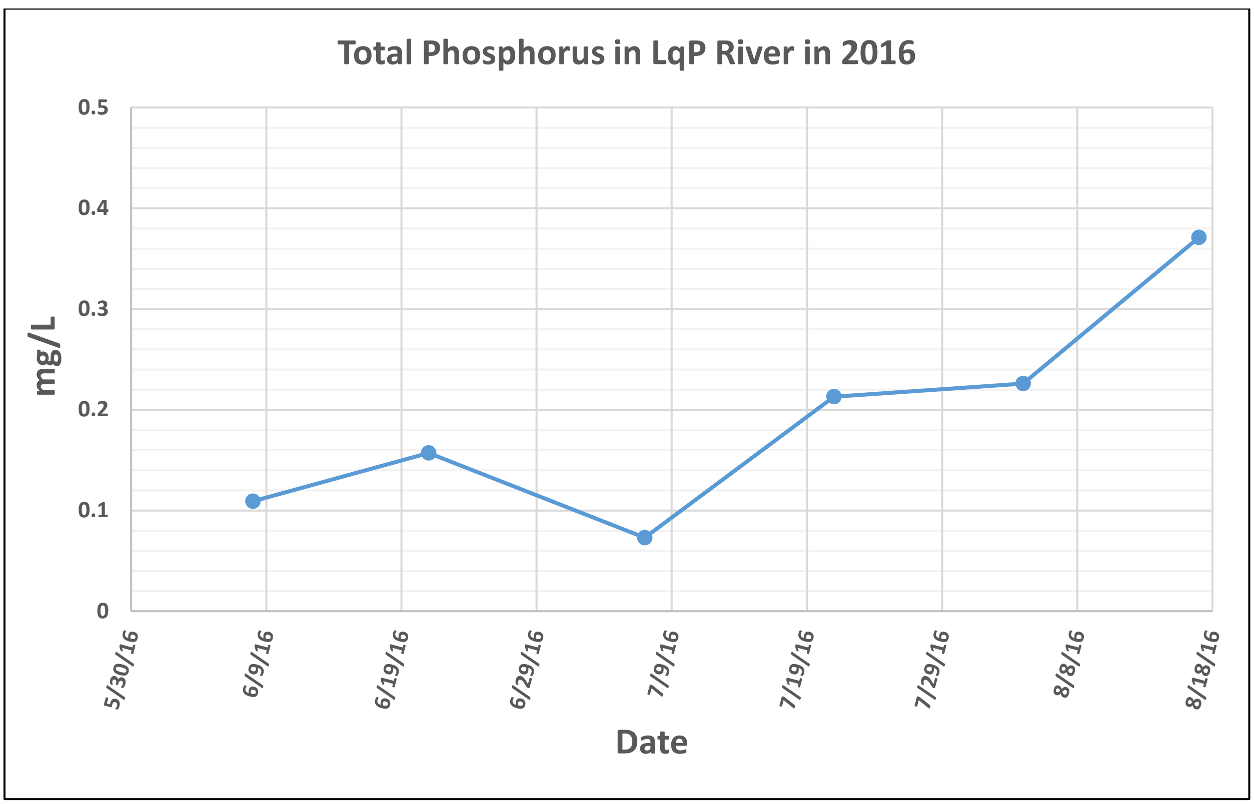


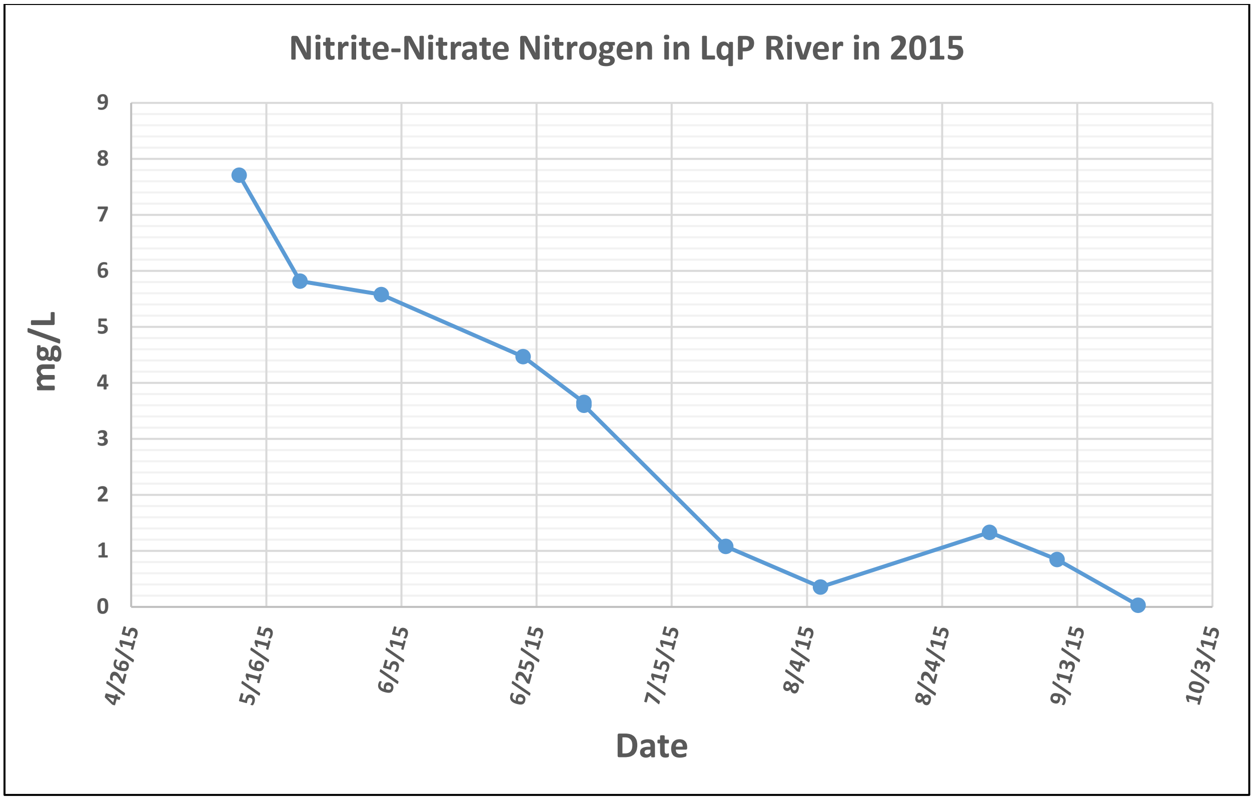
E. Coli in LqP River in 2016
Colony Forming Units
2500
2000
1500
1000
500
0
5/30/16
6/9/16
6/19/16
6/29/16
7/9/16
7/19/16
7/29/16
8/8/16
8/18/16
Date
E. Coli
Standard

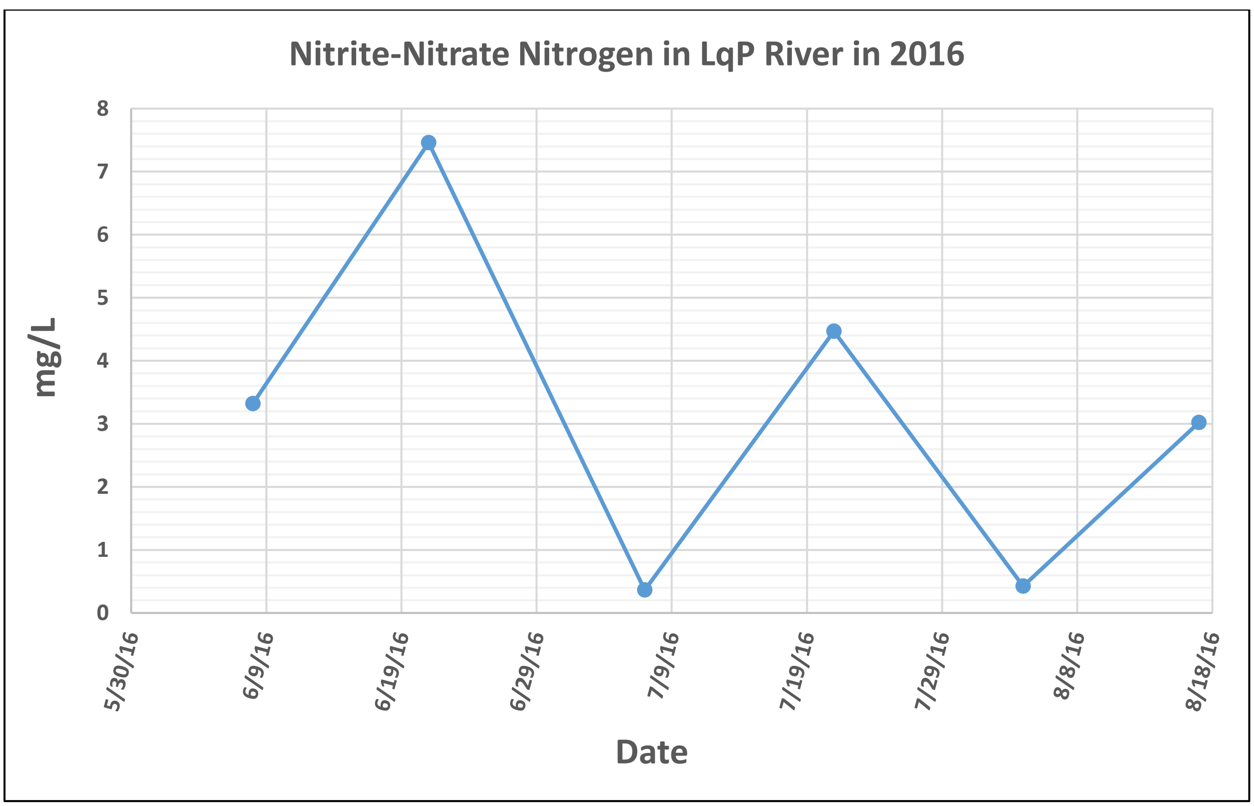

Dissolved Oxygen in LqP River in 2015
mg/L
12
10
8
6
4
2
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date
DO
Standard

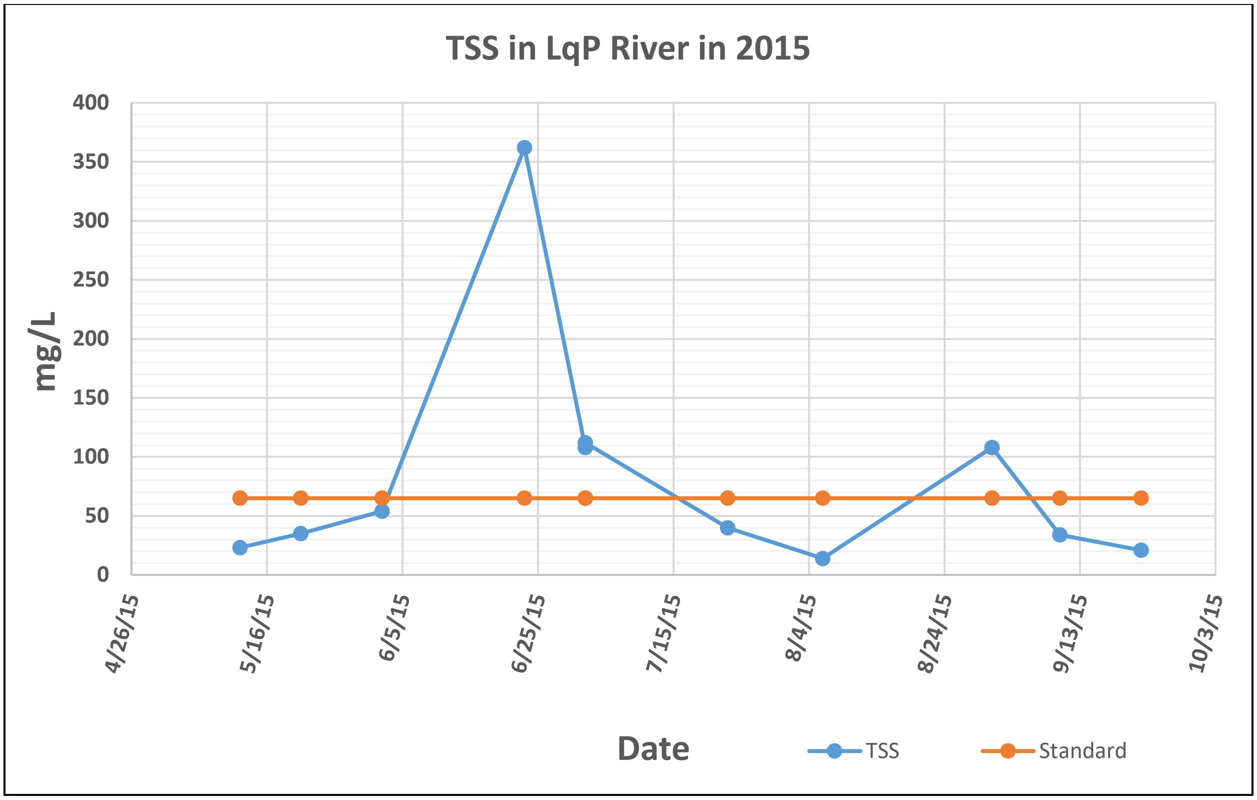

Dissolved Oxygen in LqP River in 2016
mg/L
10
8
6
4
2
5/30/16
6/9/16
6/19/16
6/29/16
7/9/16
7/19/16
7/29/16
8/8/16
8/18/16
Date
DO
Standard


Total Phosphorus in LqP River in 2015
mg/L
0.5
0.4
0.3
0.2
0.1
0
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date


Total Phosphorus in LqP River in 2016
mg/L
0.5
0.4
0.3
0.2
0.1
0
5/30/16
6/9/16
6/19/16
6/29/16
7/9/16
7/19/16
7/29/16
8/8/16
8/18/16
Date


Nitrite-Nitrate Nitrogen in LqP River in 2015
mg/L
0
1
2
3
4
5
6
7
8
9
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date


Nitrite-Nitrate Nitrogen in LqP River in 2016
mg/L
0
1
2
3
4
5
6
7
8
5/30/16
6/9/16
6/19/16
6/29/16
7/9/16
7/19/16
7/29/16
8/8/16
8/18/16
Date


TSS in LqP River in 2015
mg/L
400
350
300
250
200
150
100
50
0
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date
TSS
Standard

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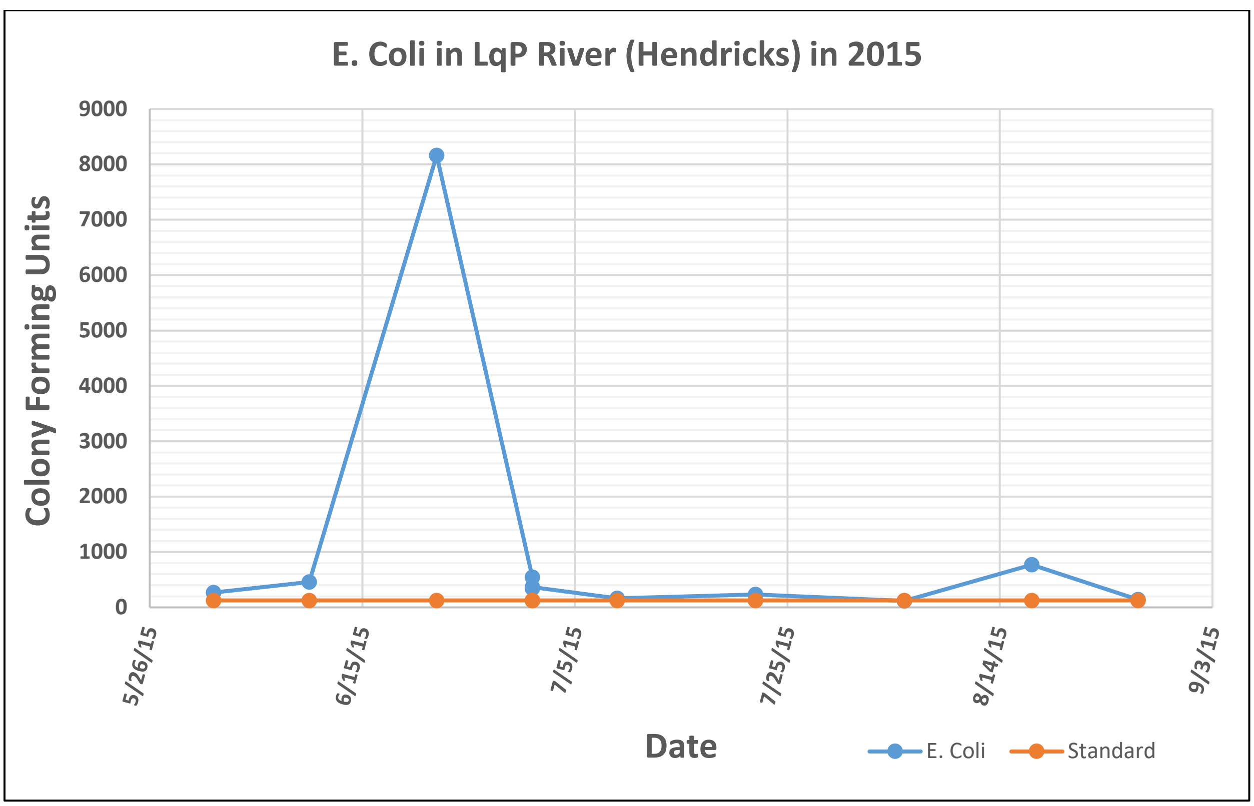
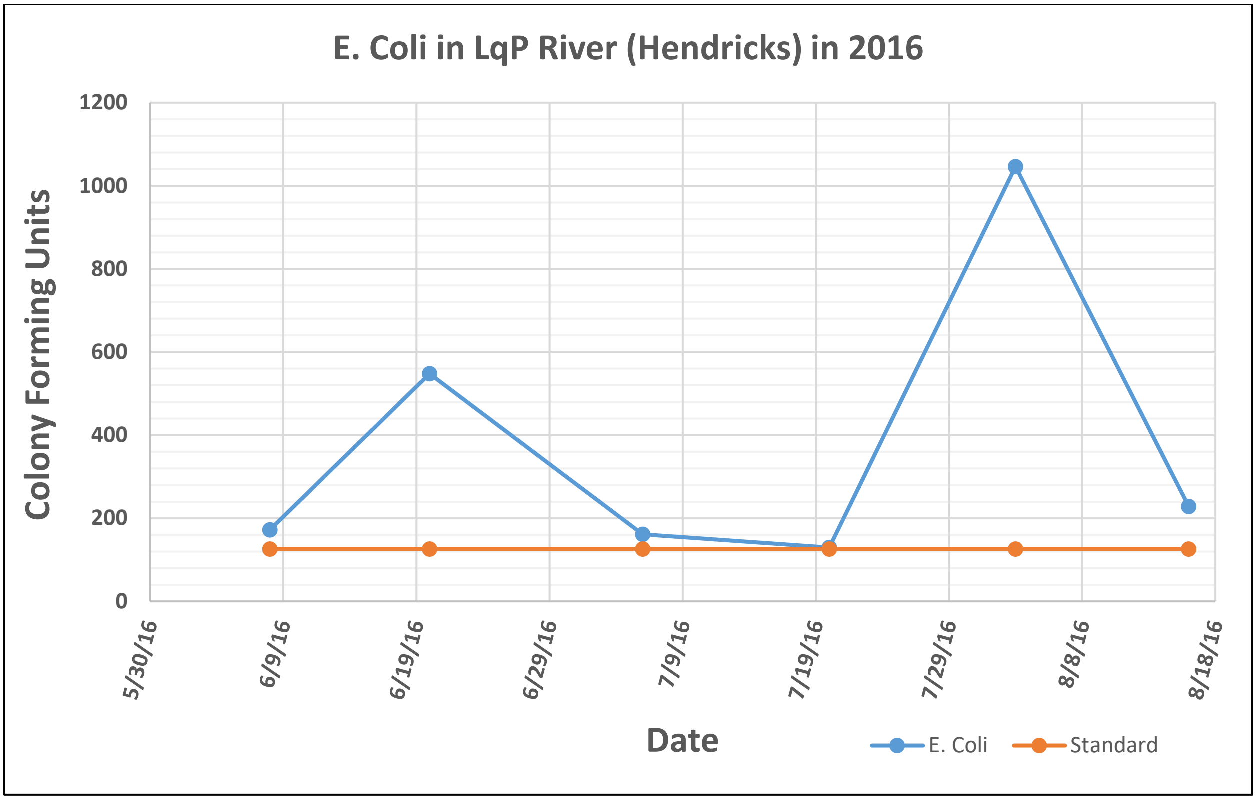
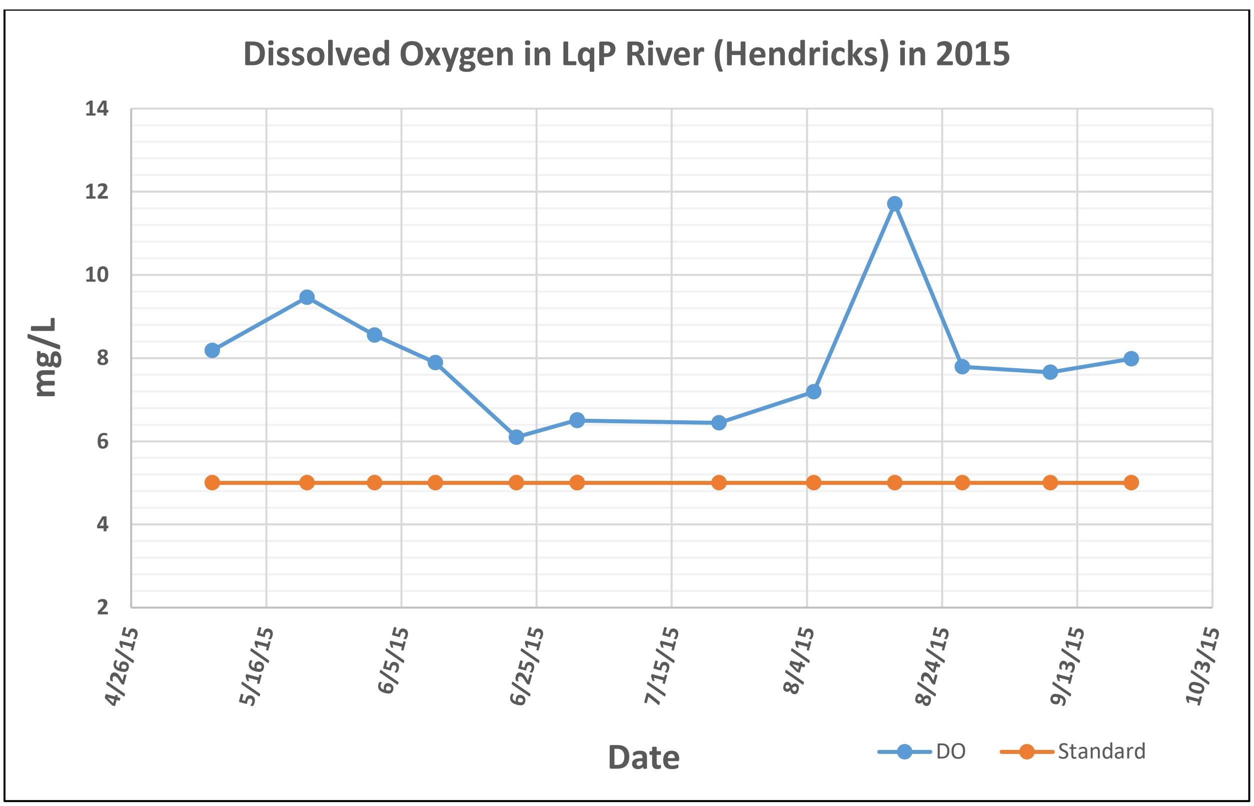
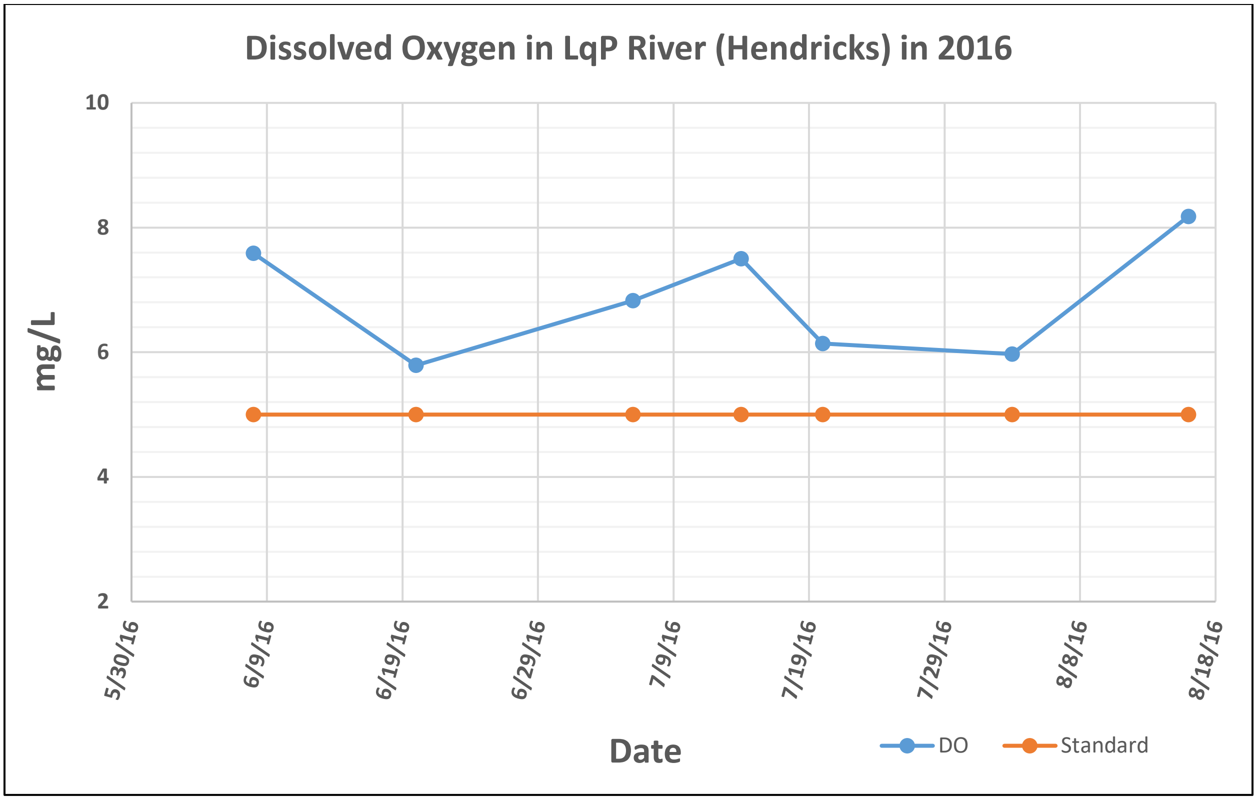
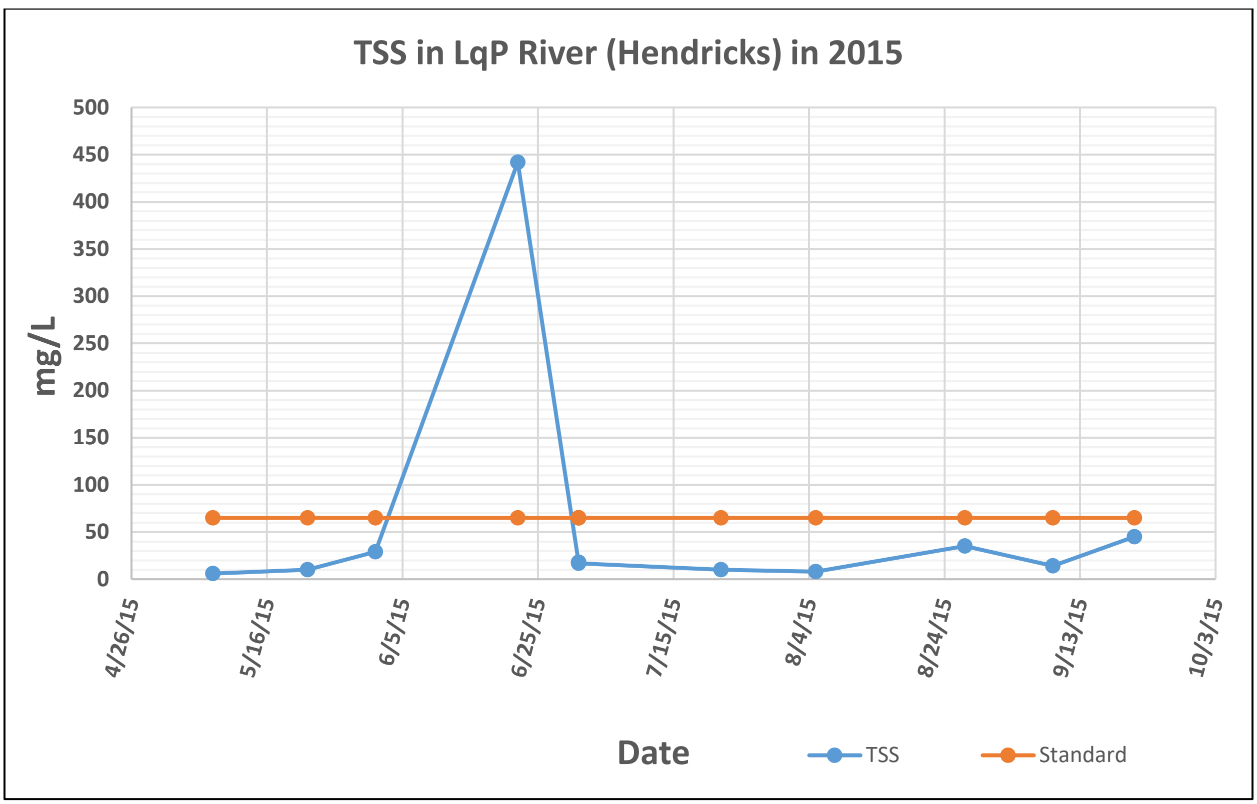

E. Coli in LqP River (Hendricks) in 2015
Colony Forming Units
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
5/26/15
6/15/15
7/5/15
7/25/15
8/14/15
9/3/15
Date
E. Coli
Standard


E. Coli in LqP River (Hendricks) in 2016
Colony Forming Units
1200
1000
800
600
400
200
0
5/30/16
6/9/16
6/19/16
6/29/16
7/9/16
7/19/16
7/29/16
8/8/16
8/18/16
Date
E. Coli
Standard

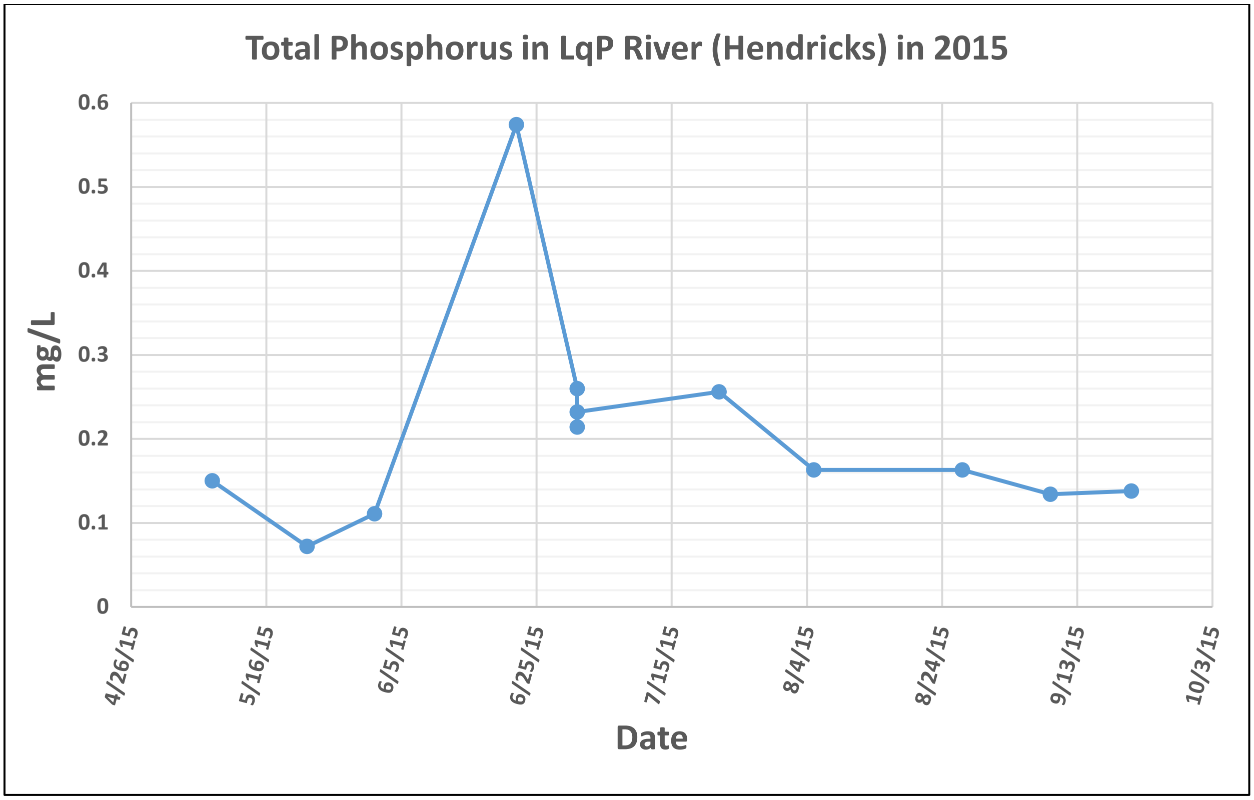

Dissolved Oxygen in LqP River (Hendricks) in 2015
mg/L
14
12
10
8
6
4
2
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date
DO
Standard



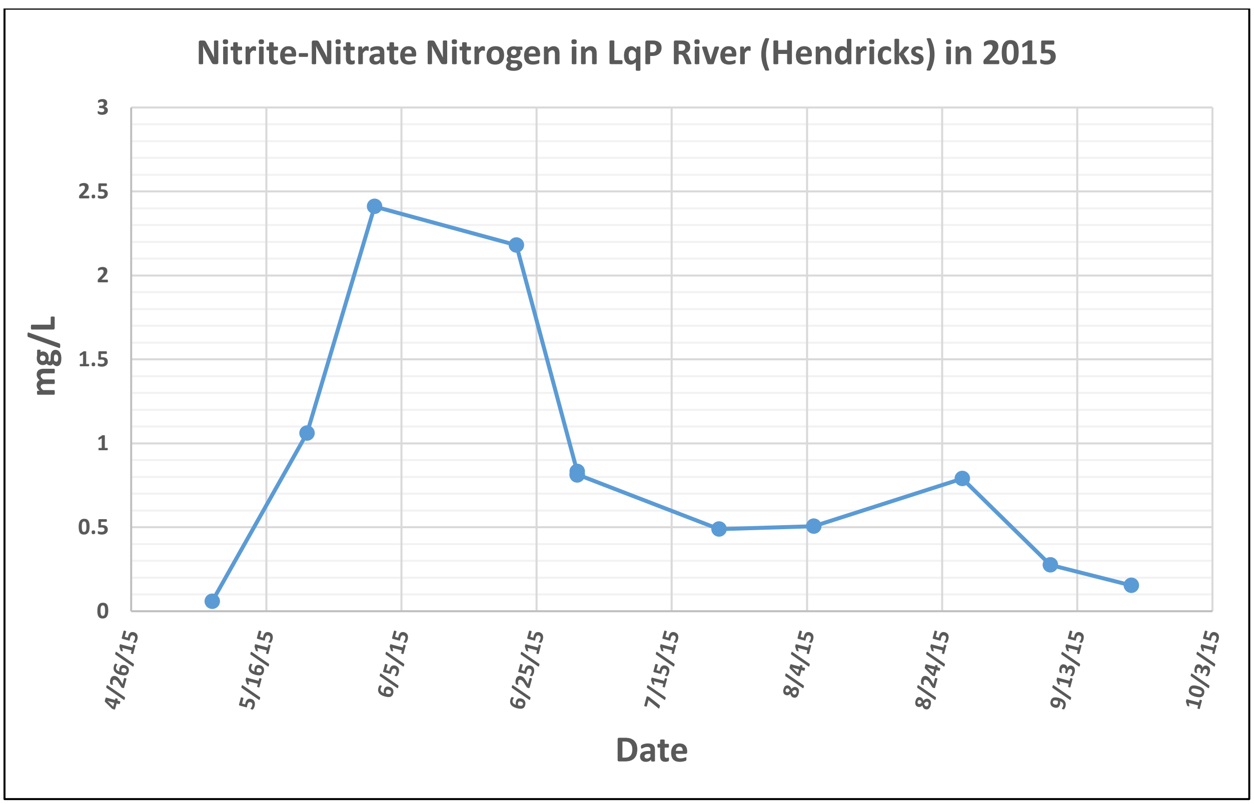
Dissolved Oxygen in LqP River (Hendricks) in 2016
10
8
6
4
2
mg/L
5/30/16
6/9/16
6/19/16
6/29/16
7/9/16
7/19/16
7/29/16
8/8/16
8/18/16
Date
DO
Standard



TSS in LqP River (Hendricks) in 2015
500
450
400
350
300
250
200
150
100
50
0
mg/L
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date
TSS
Standard



Total Phosphorus in LqP River (Hendricks) in 2015
mg/L
0.6
0.5
0.4
0.3
0.2
0.1
0
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date



Nitrite-Nitrate Nitrogen in LqP River (Hendricks) in 2015
mg/L
3
2.5
2
1.5
1
0.5
0
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date

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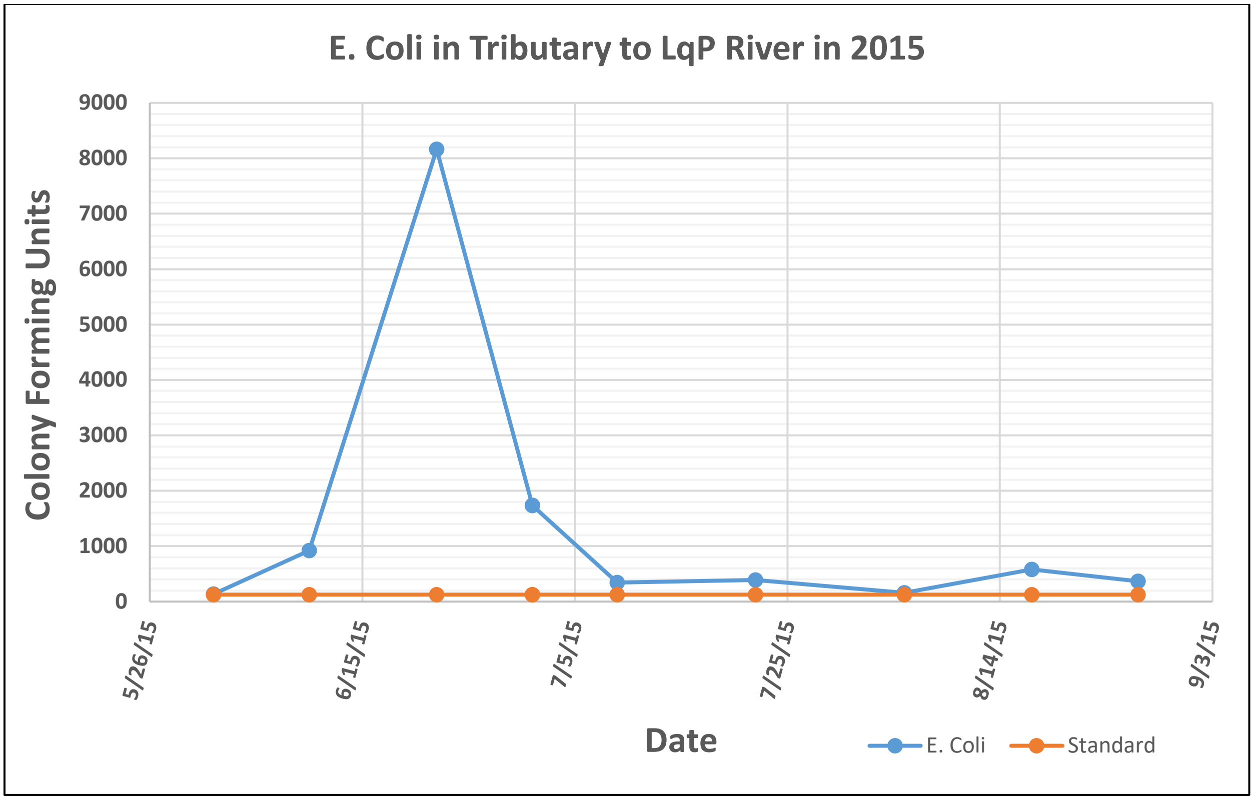
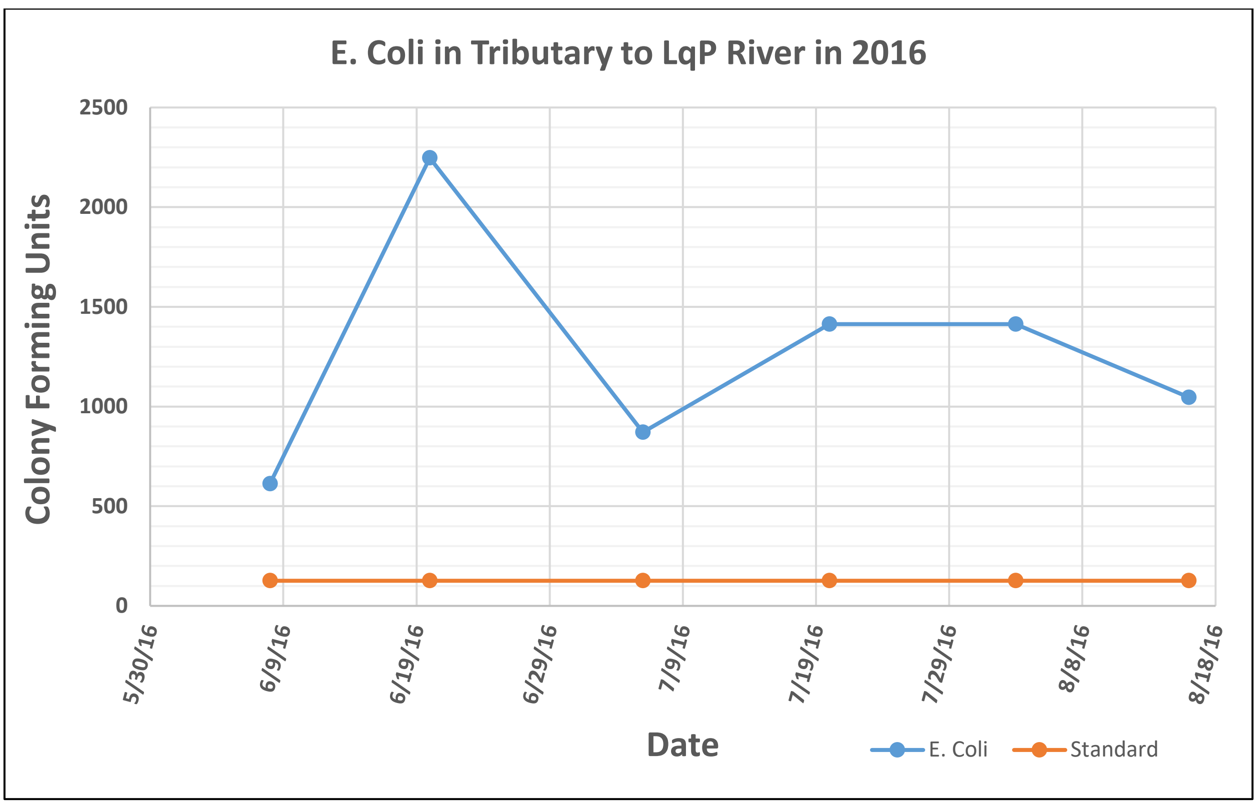
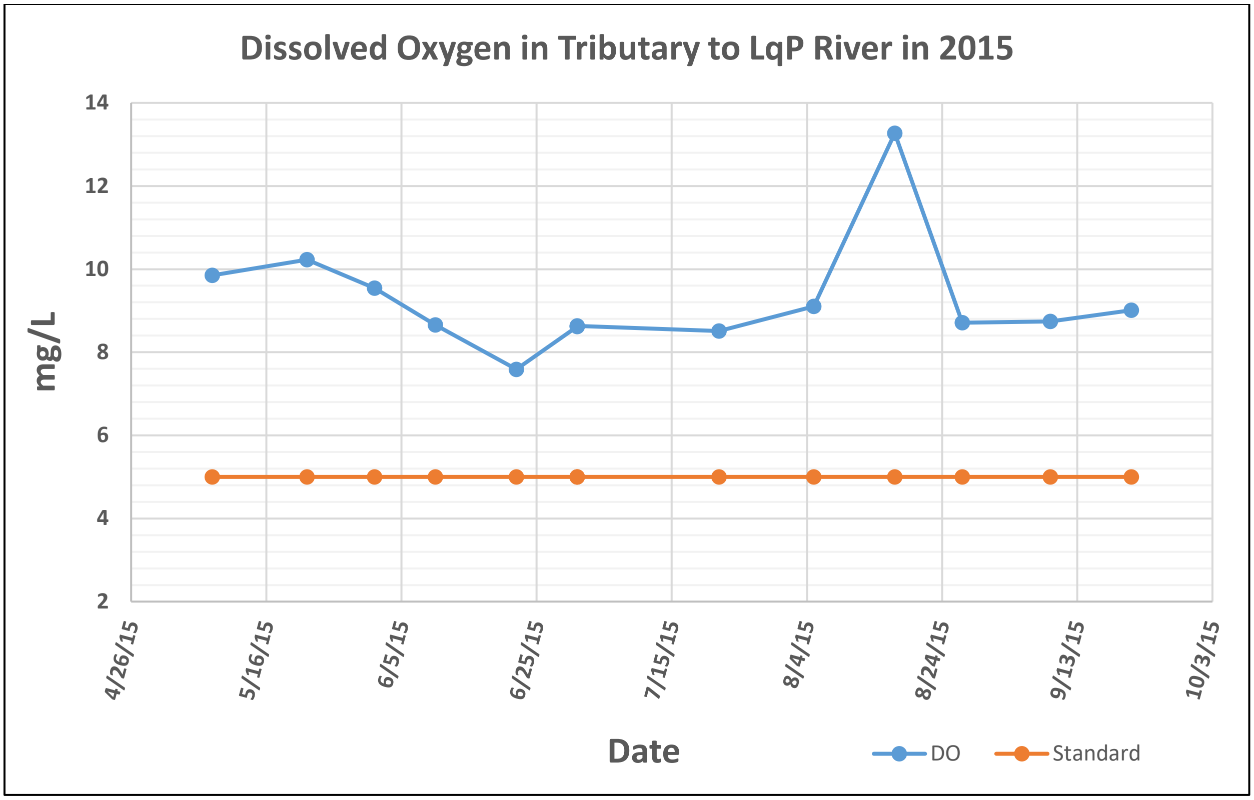
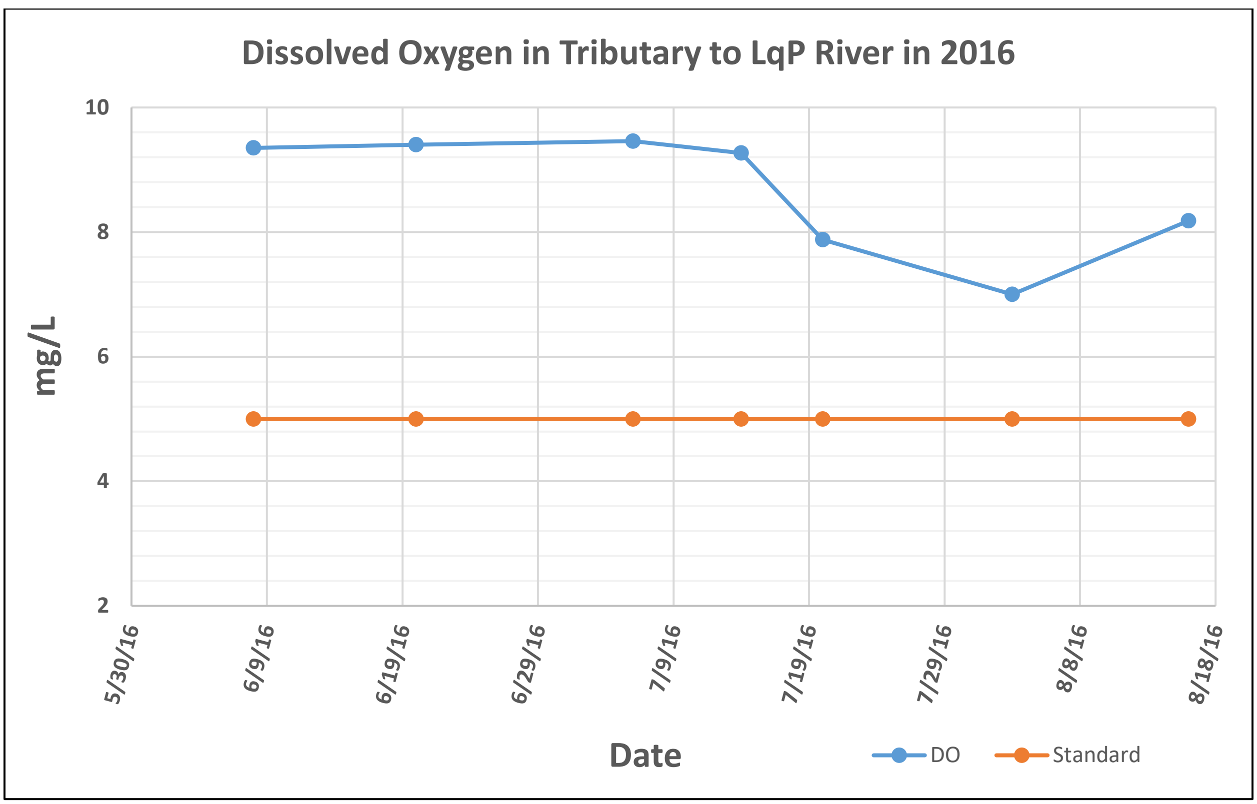

E. Coli in Tributary to LqP River in 2015
Colony Forming Units
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
5/26/15
6/15/15
7/5/15
7/25/15
8/14/15
9/3/15
Date
E. Coli
Standard

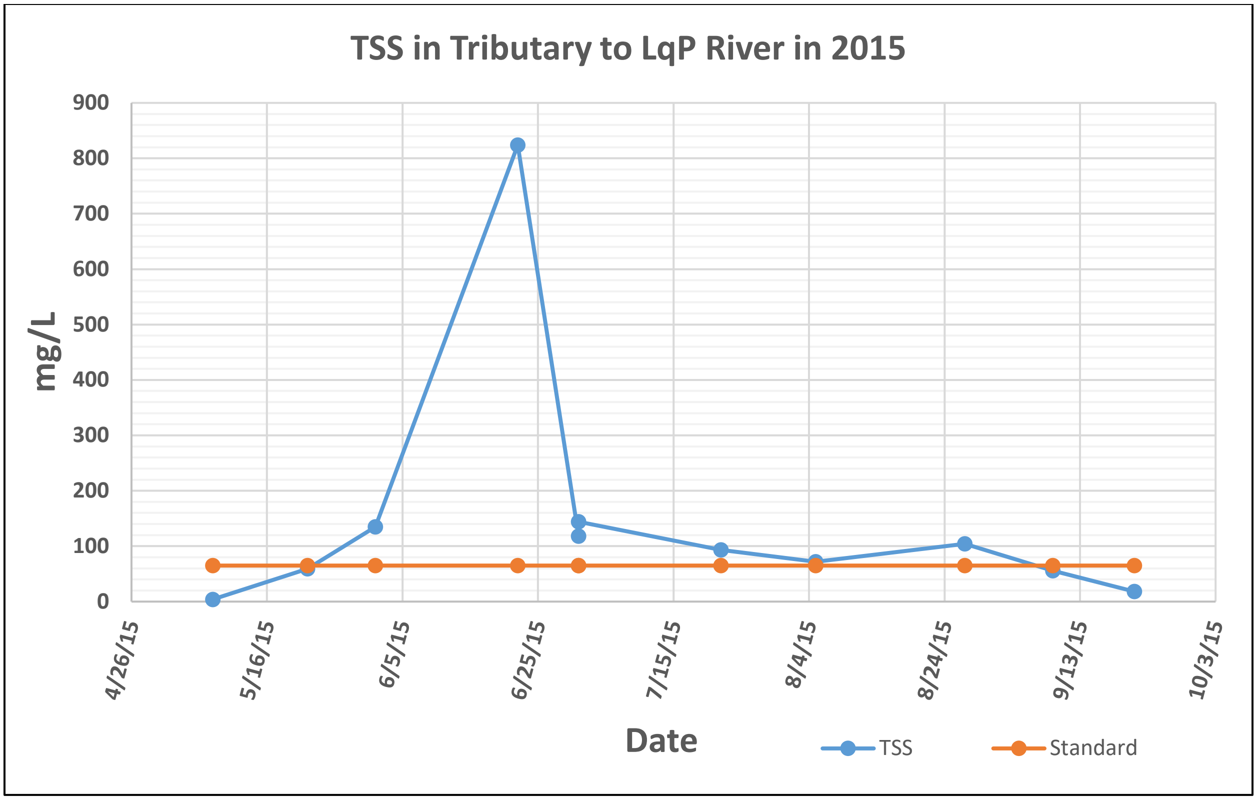

E. Coli in Tributary to LqP River in 2016
Colony Forming Units
2500
2000
1500
1000
500
0
5/30/16
6/9/16
6/19/16
6/29/16
7/9/16
7/19/16
7/29/16
8/8/16
8/18/16
Date
E. Coli
Standard

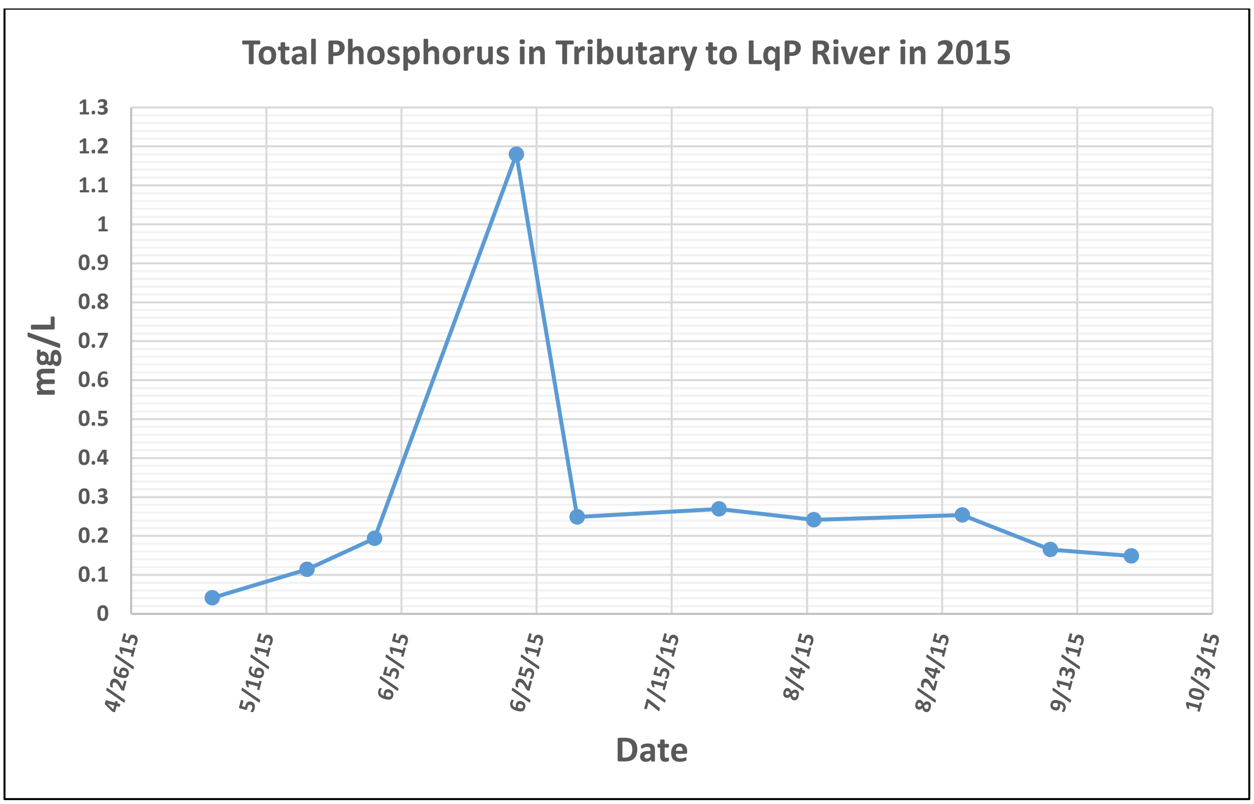


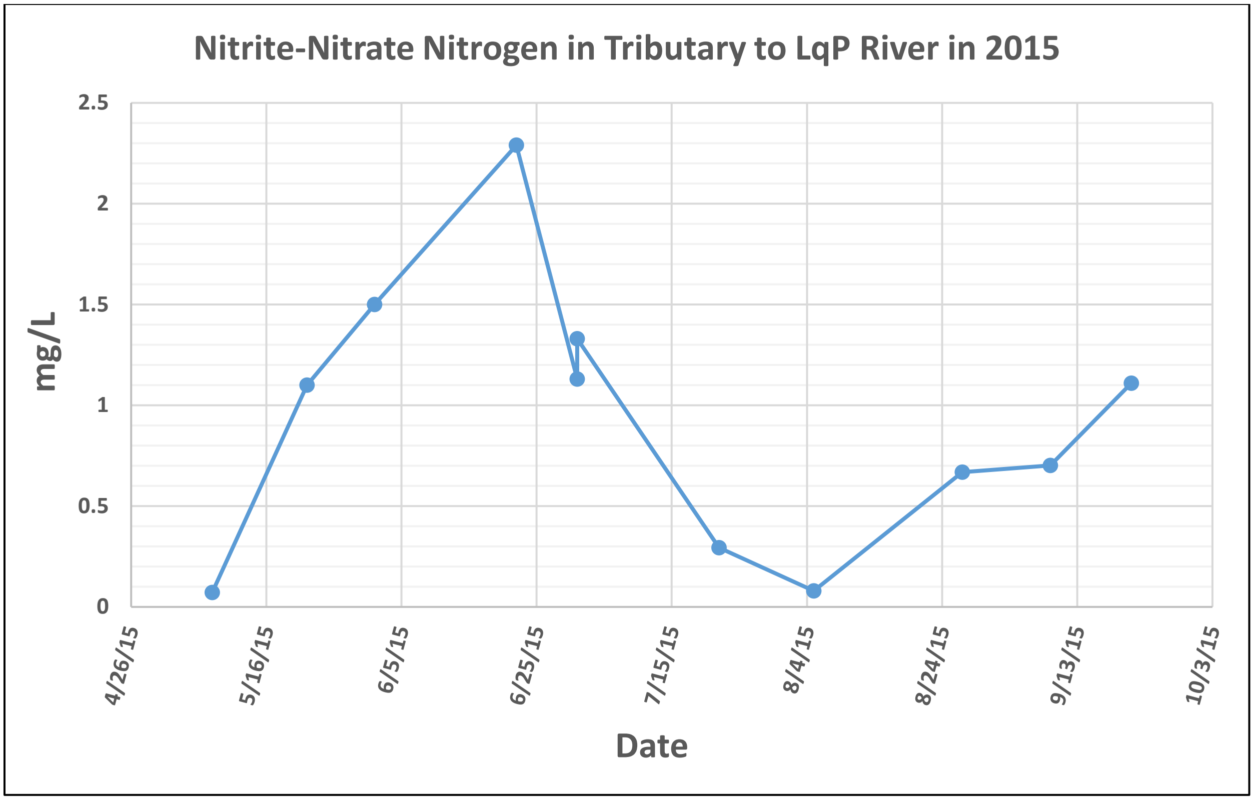
Dissolved Oxygen in Tributary to LqP River in 2015
mg/L
14
12
10
8
6
4
2
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date
DO
Standard



Dissolved Oxygen in Tributary to LqP River in 2016
mg/L
10
8
6
4
2
5/30/16
6/9/16
6/19/16
6/29/16
7/9/16
7/19/16
7/29/16
8/8/16
8/18/16
Date
DO
Standard


TSS in Tributary to LqP River in 2015
900
800
700
600
500
400
300
200
100
0
mg/L
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date
TSS
Standard


Total Phosphorus in Tributary to LqP River in 2015
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
mg/L
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date


Nitrite-Nitrate Nitrogen in Tributary to LqP River in 2015
mg/L
2.5
2
1.5
1
0.5
0
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date

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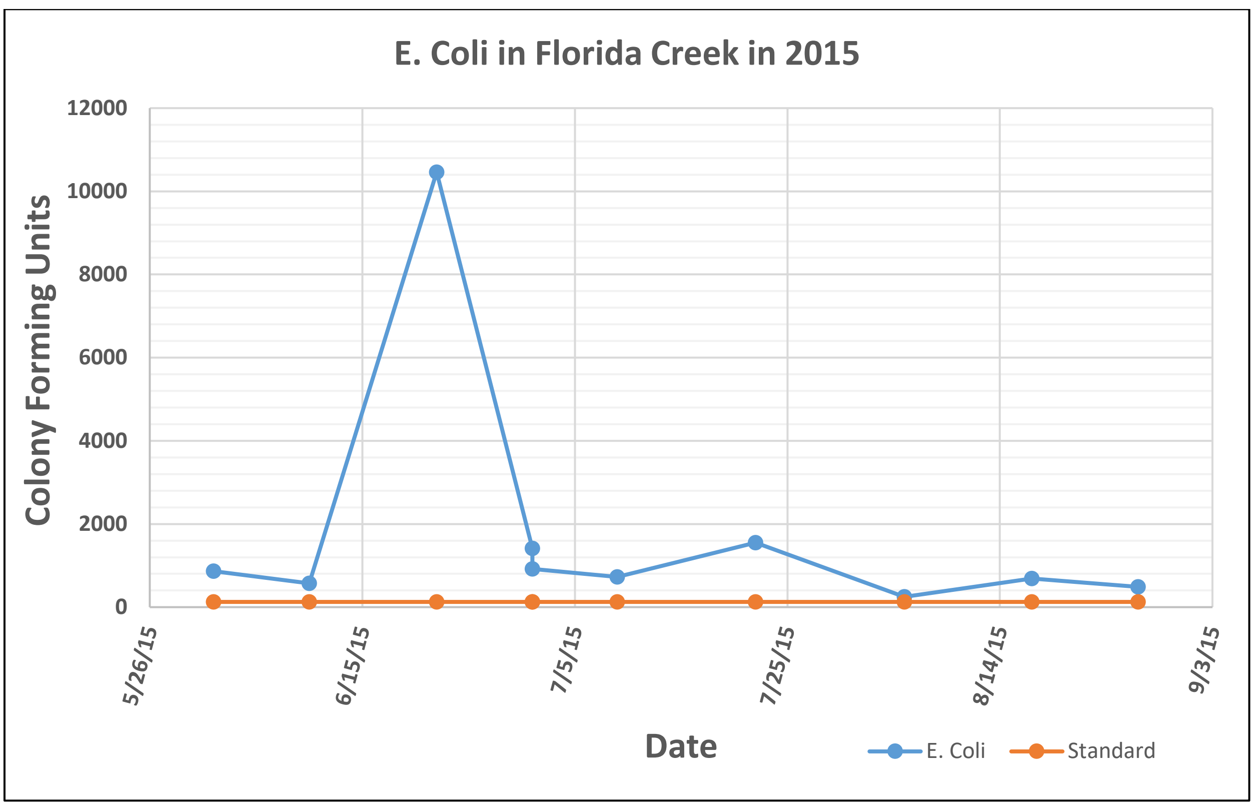
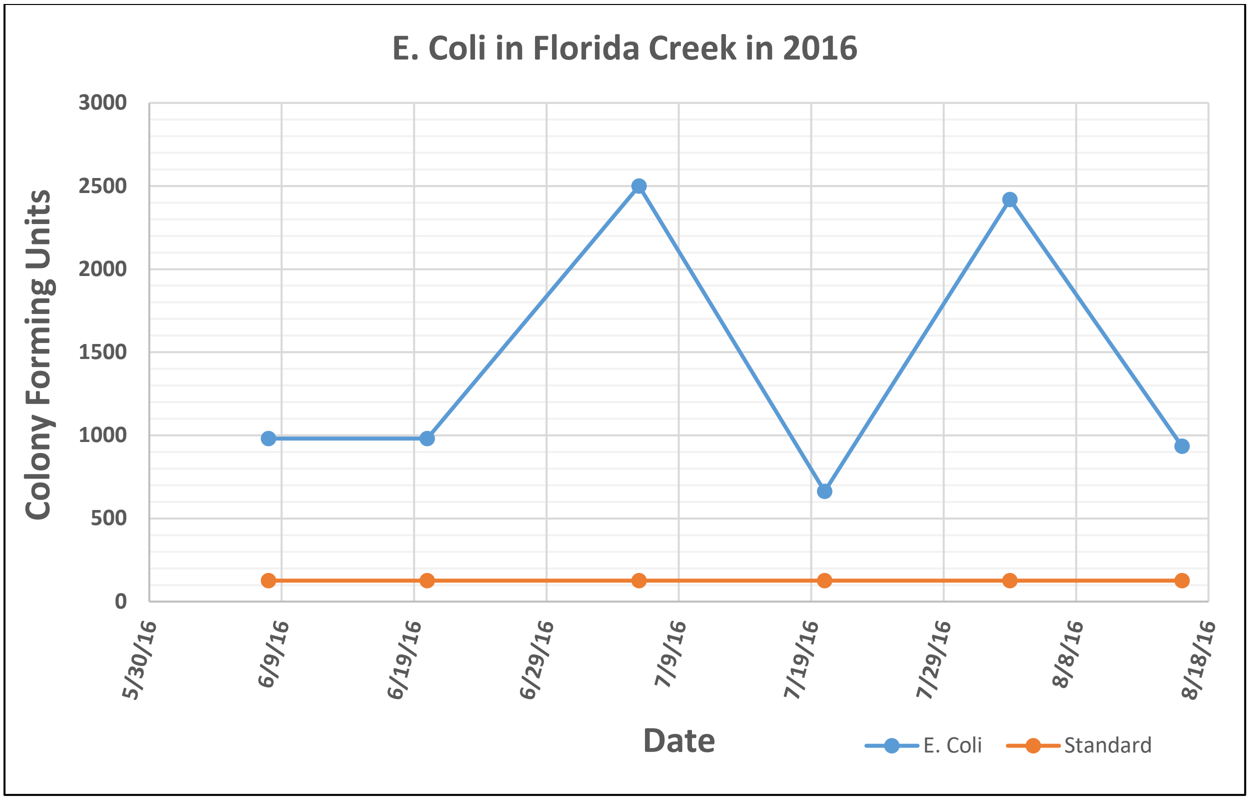
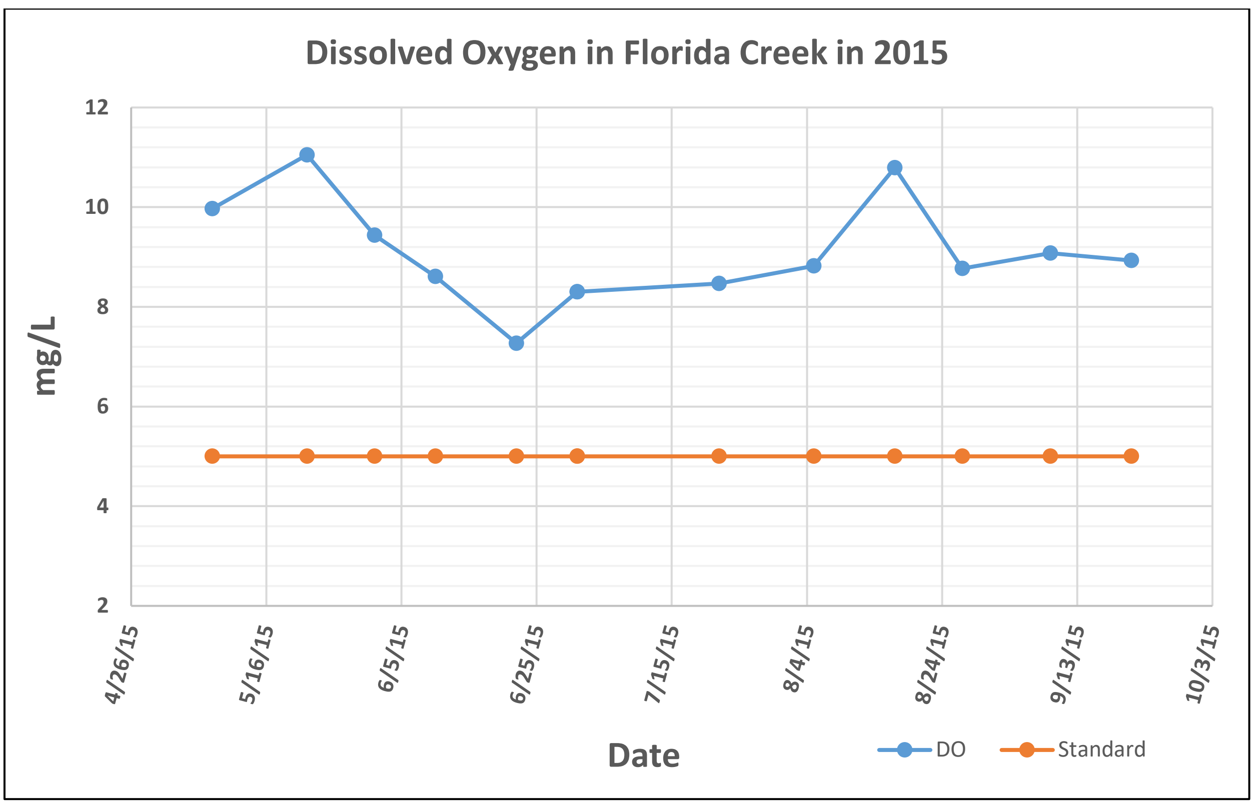
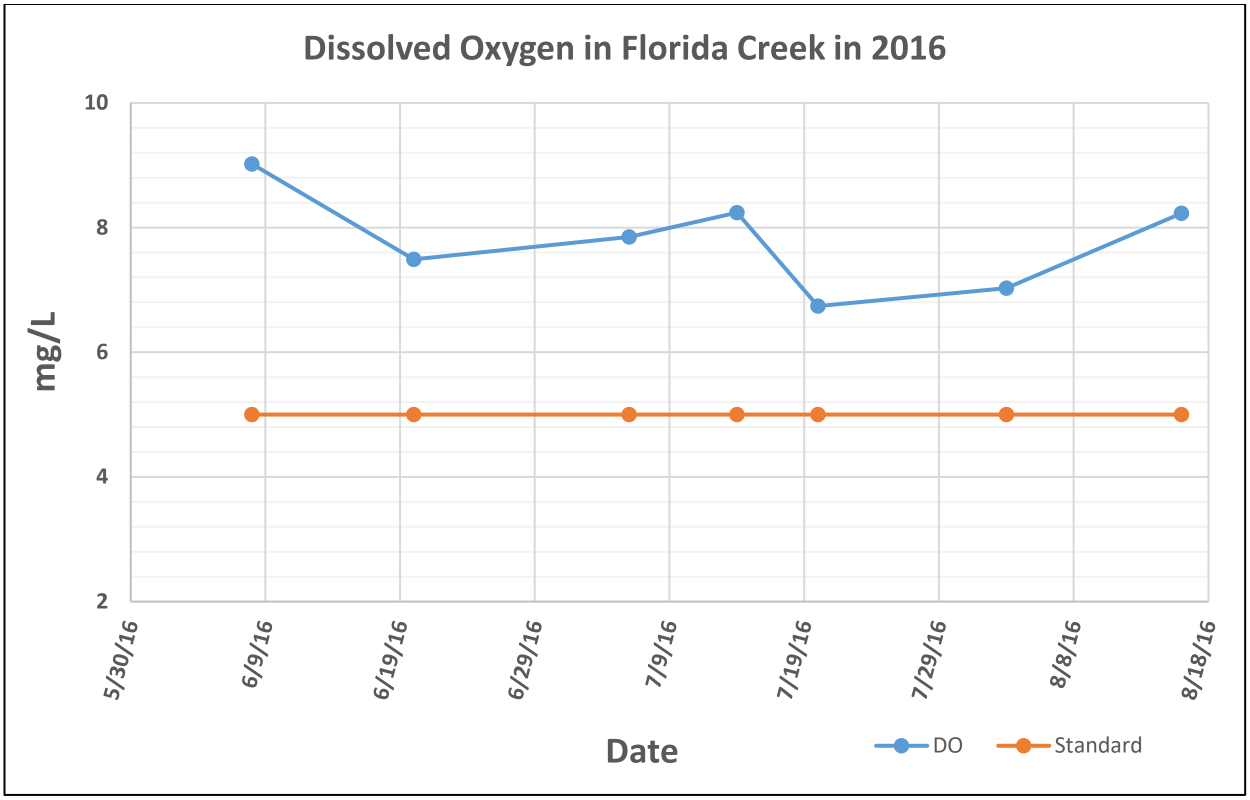
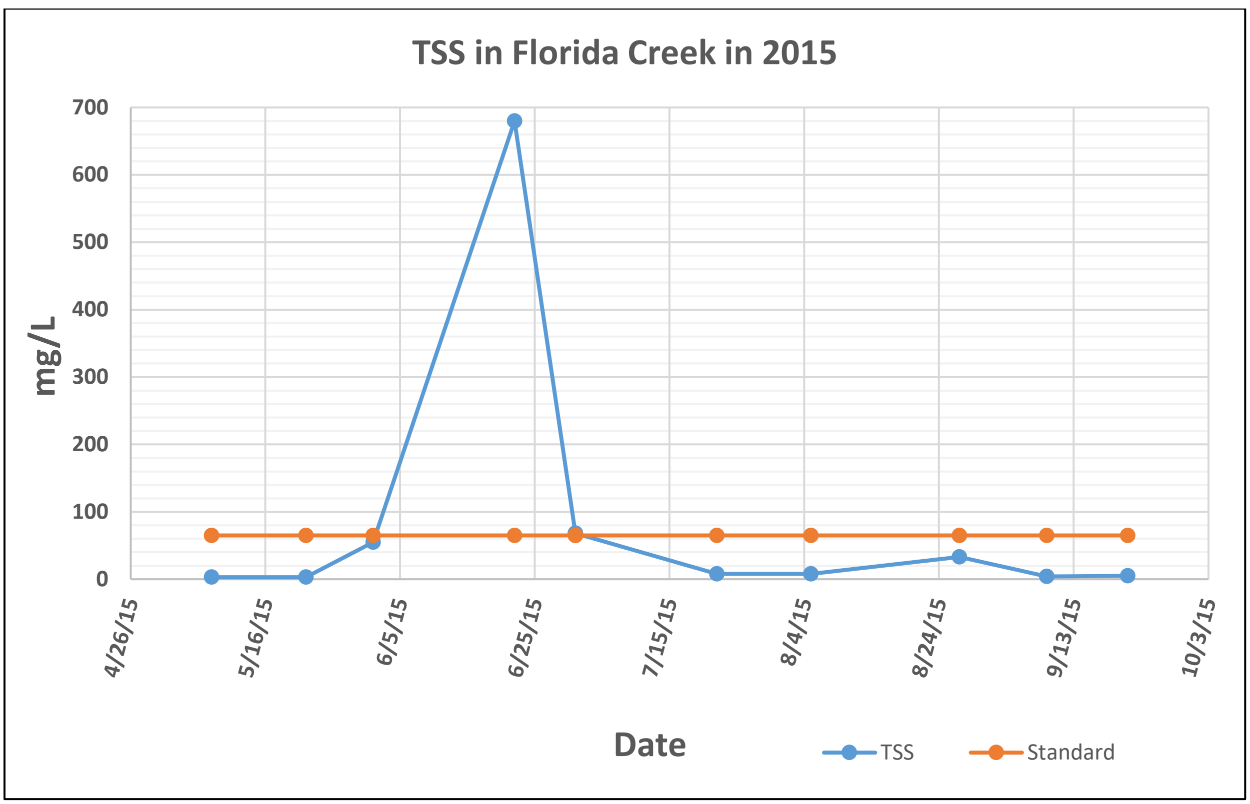

E. Coli in Florida Creek in 2015
Colony Forming Units
12000
10000
8000
6000
4000
2000
0
5/26/15
6/15/15
7/5/15
7/25/15
8/14/15
9/3/15
Date
E. Coli
Standard


E. Coli in Florida Creek in 2016
Colony Forming Units
3000
2500
2000
1500
1000
500
0
5/30/16
6/9/16
6/19/16
6/29/16
7/9/16
7/19/16
7/29/16
8/8/16
8/18/16
Date
E. Coli
Standard

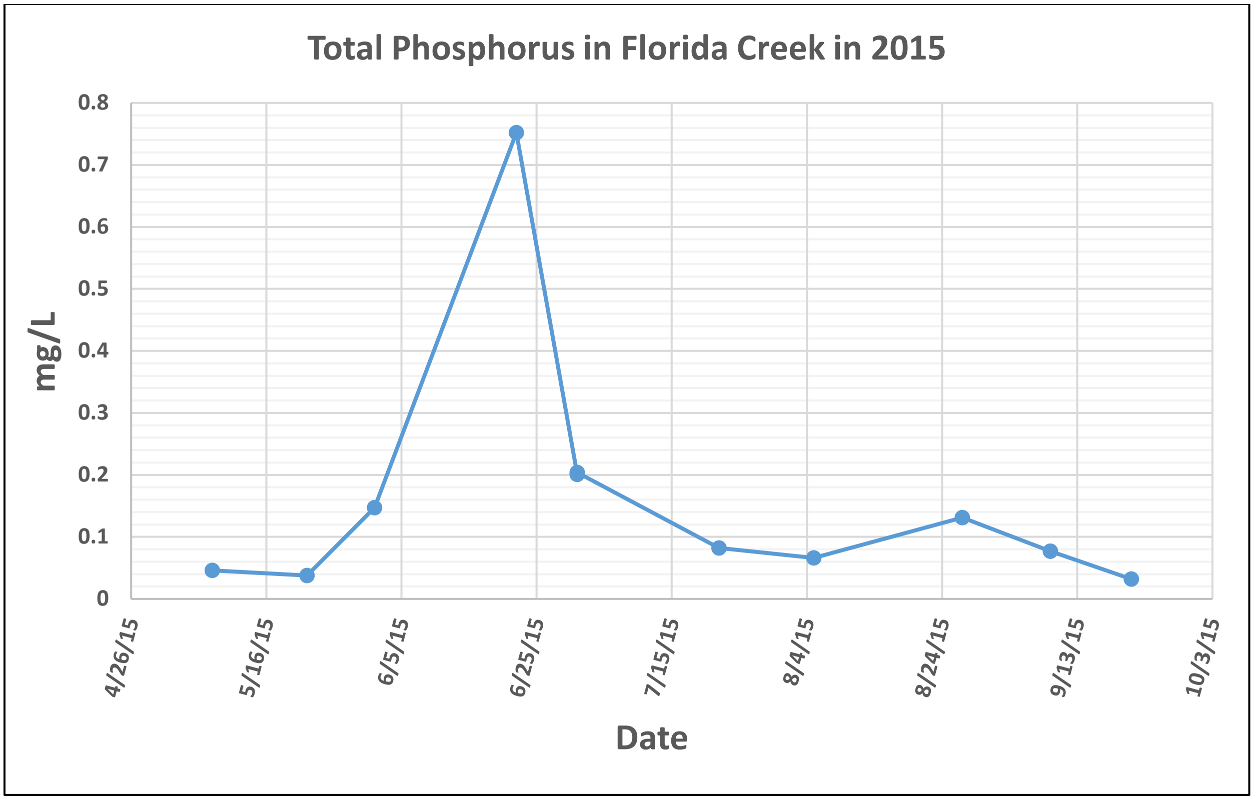

Dissolved Oxygen in Florida Creek in 2015
mg/L
12
10
8
6
4
2
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date
DO
Standard



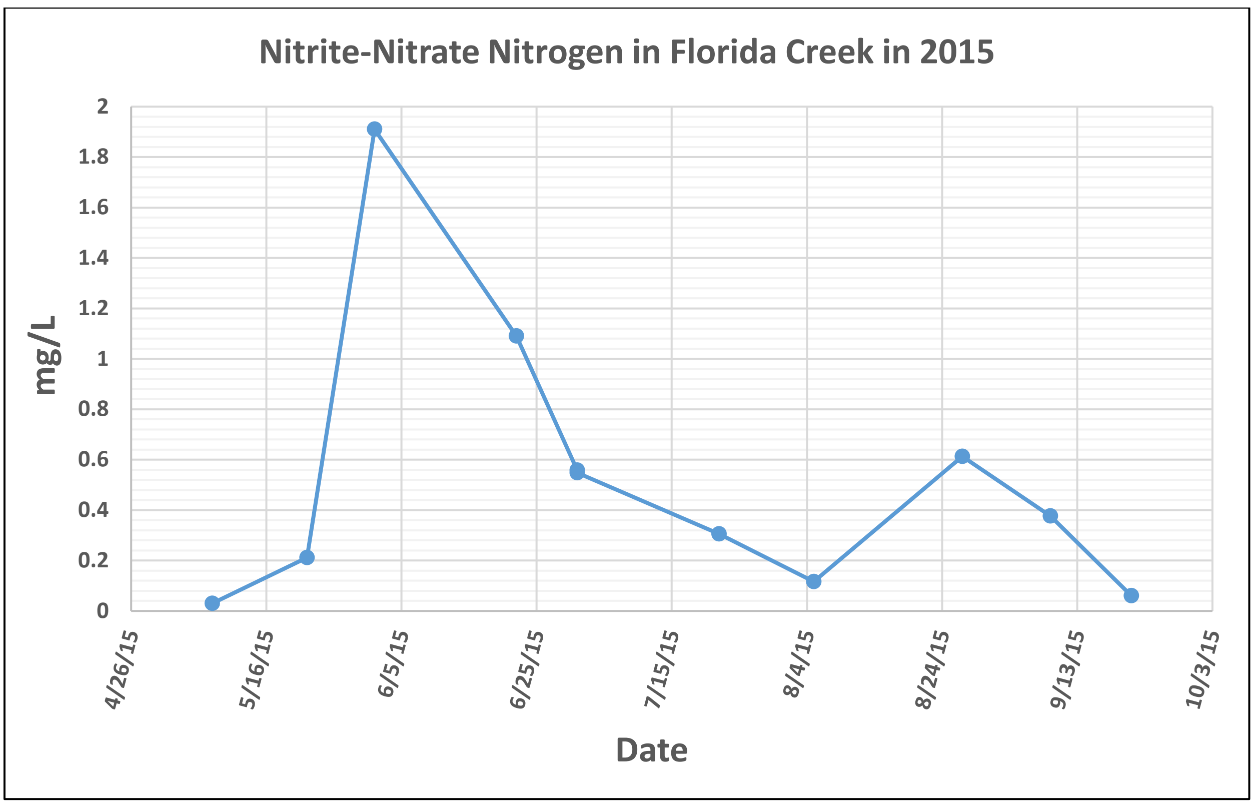
Dissolved Oxygen in Florida Creek in 2016
mg/L
10
8
6
4
2
5/30/16
6/9/16
6/19/16
6/29/16
7/9/16
7/19/16
7/29/16
8/8/16
8/18/16
Date
DO
Standard



TSS in Florida Creek in 2015
mg/L
700
600
500
400
300
200
100
0
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date
TSS
Standard



Total Phosphorus in Florida Creek in 2015
mg/L
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date



Nitrite-Nitrate Nitrogen in Florida Creek in 2015
mg/L
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date

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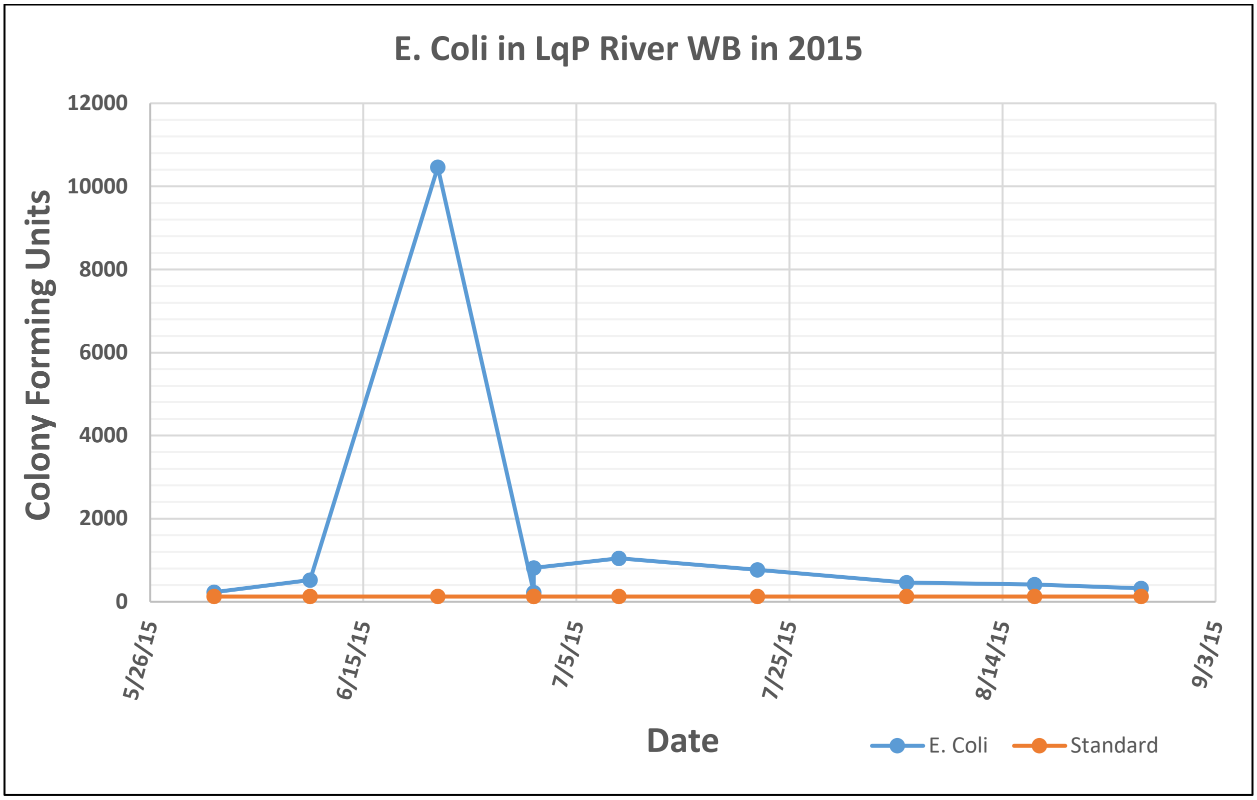
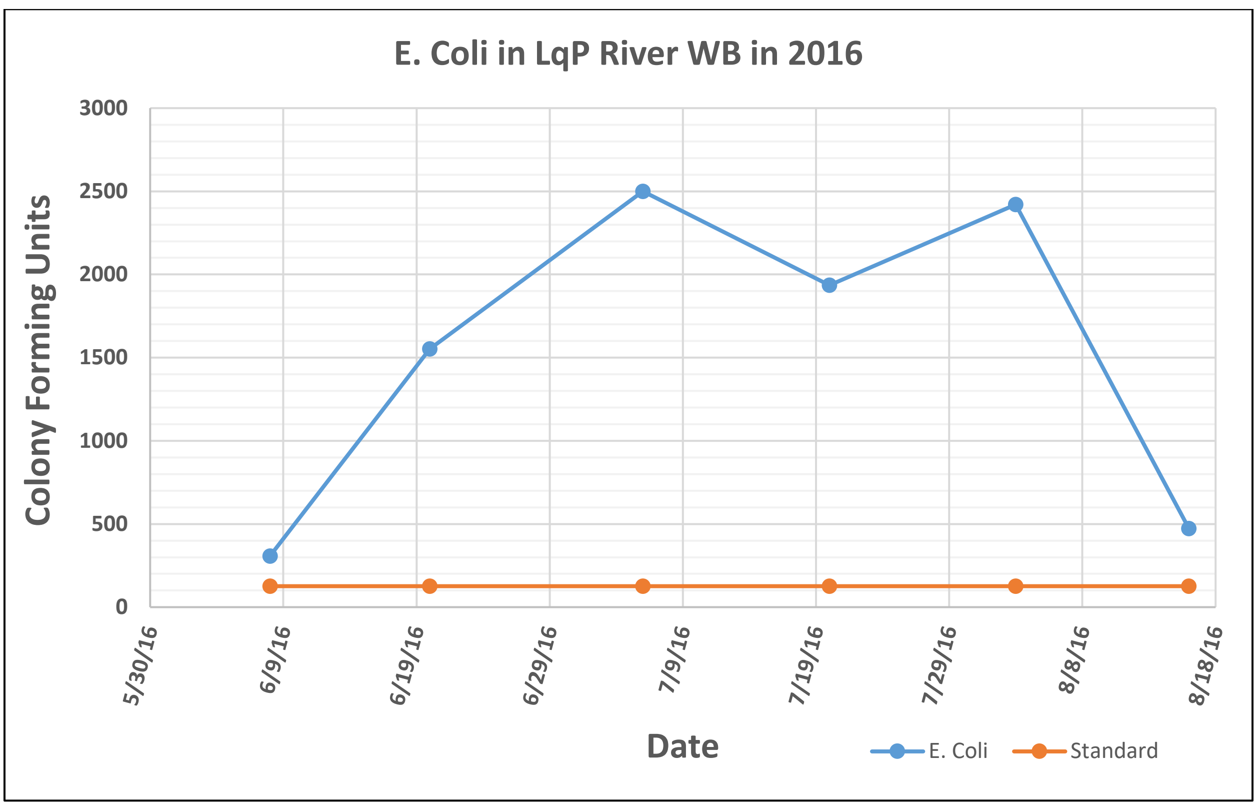
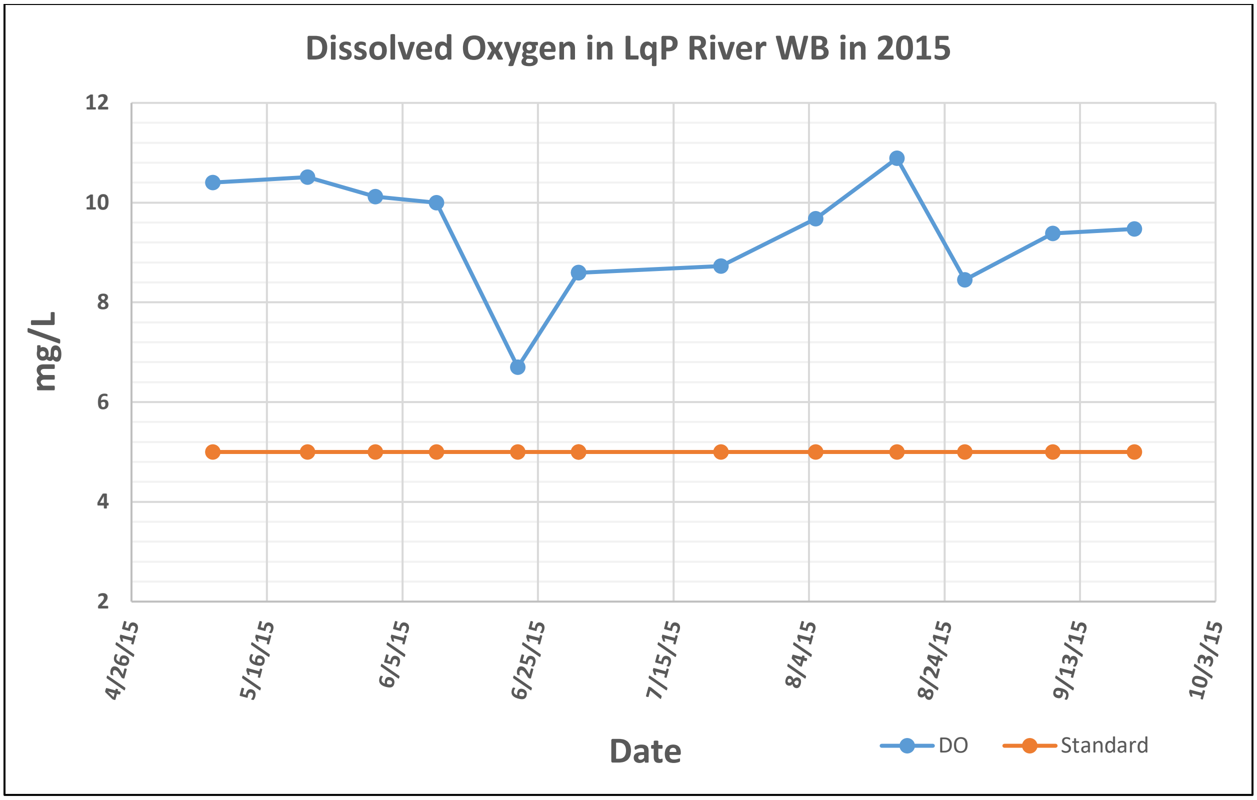
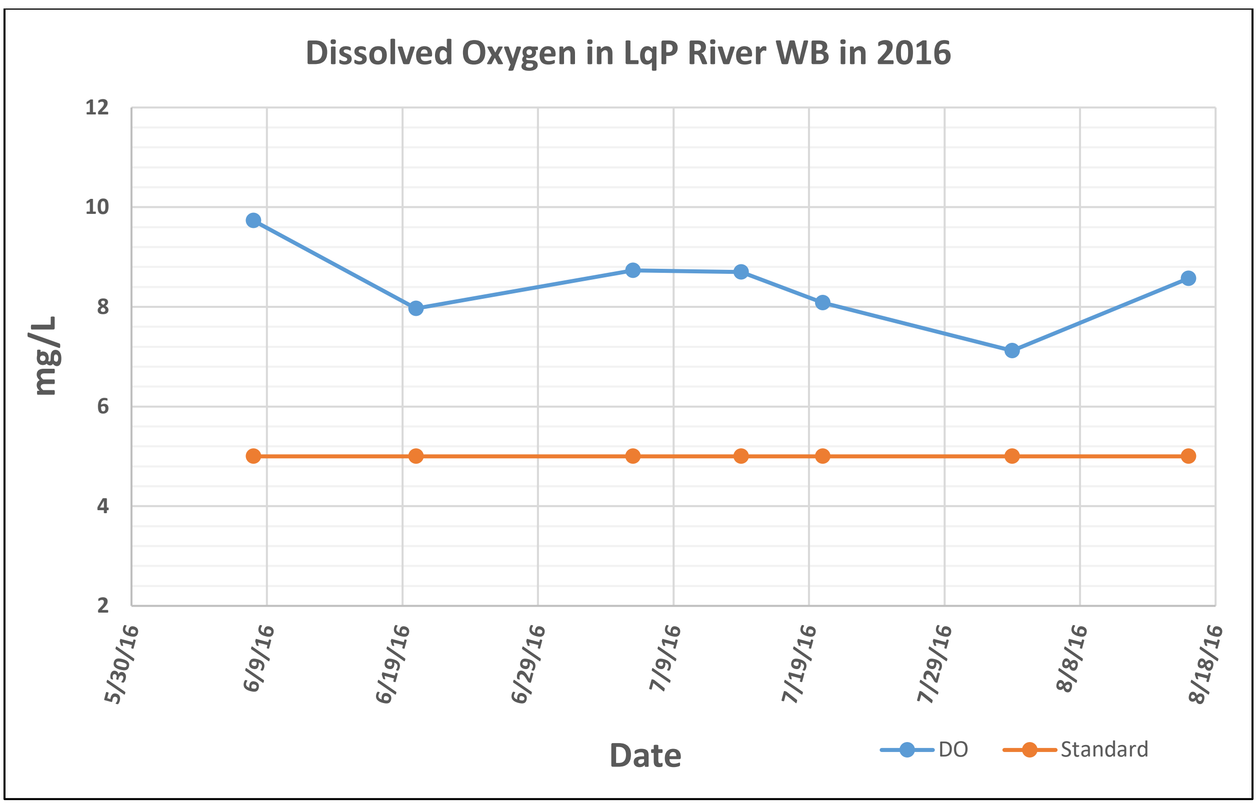
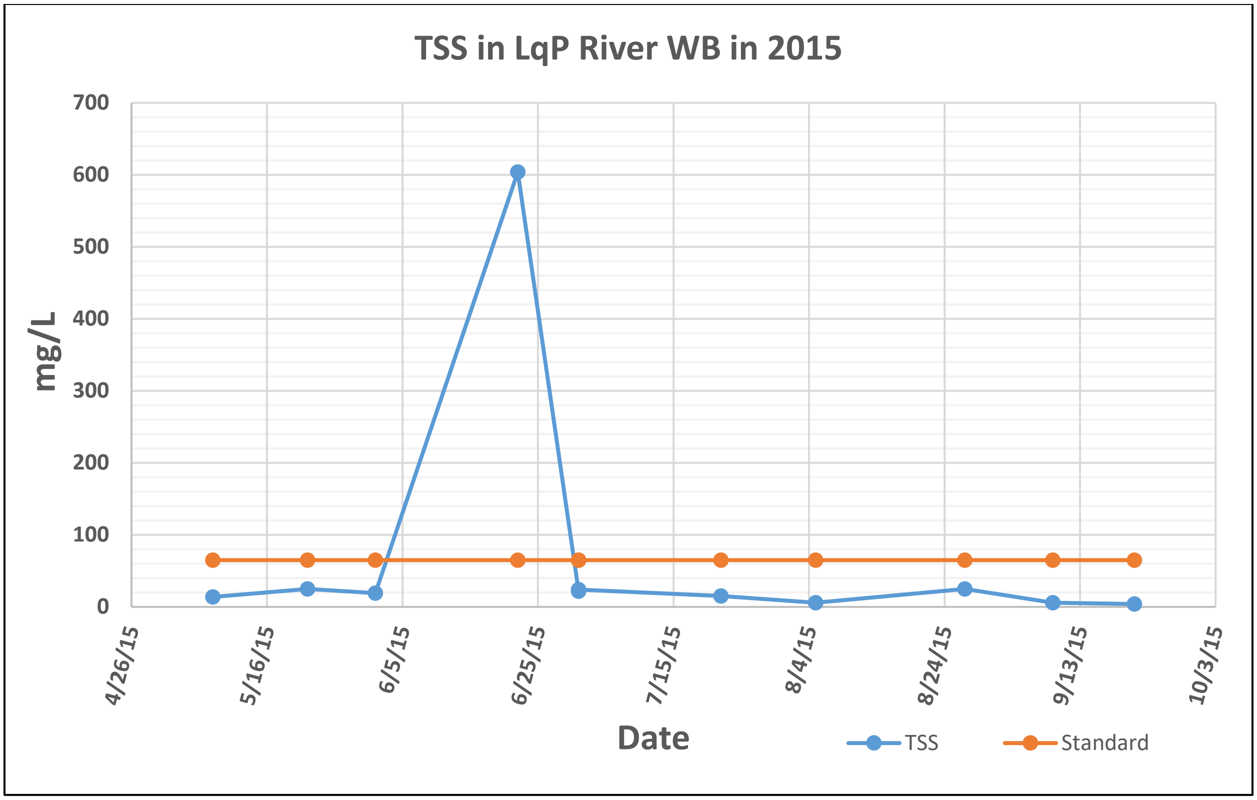
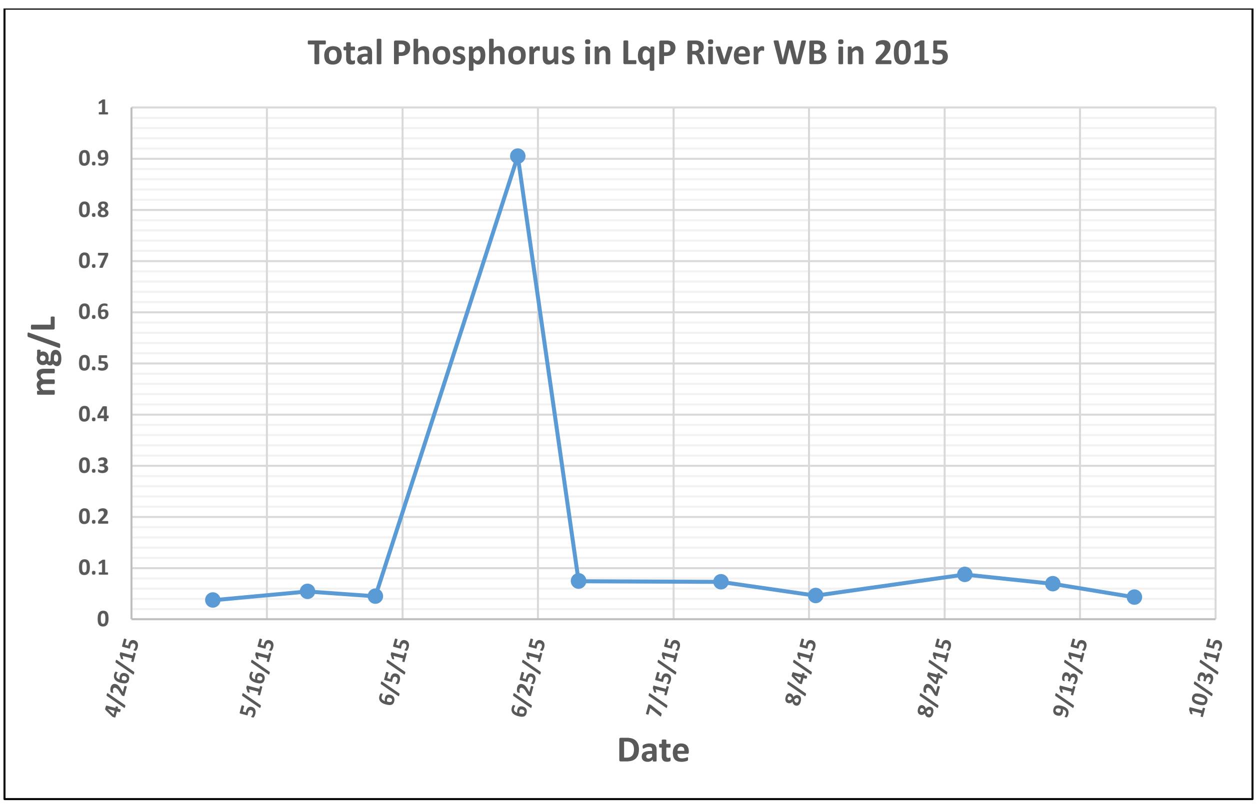

E. Coli in LqP River WB in 2015
Colony Forming Units
12000
10000
8000
6000
4000
2000
0
5/26/15
6/15/15
7/5/15
7/25/15
8/14/15
9/3/15
Date
E. Coli
Standard

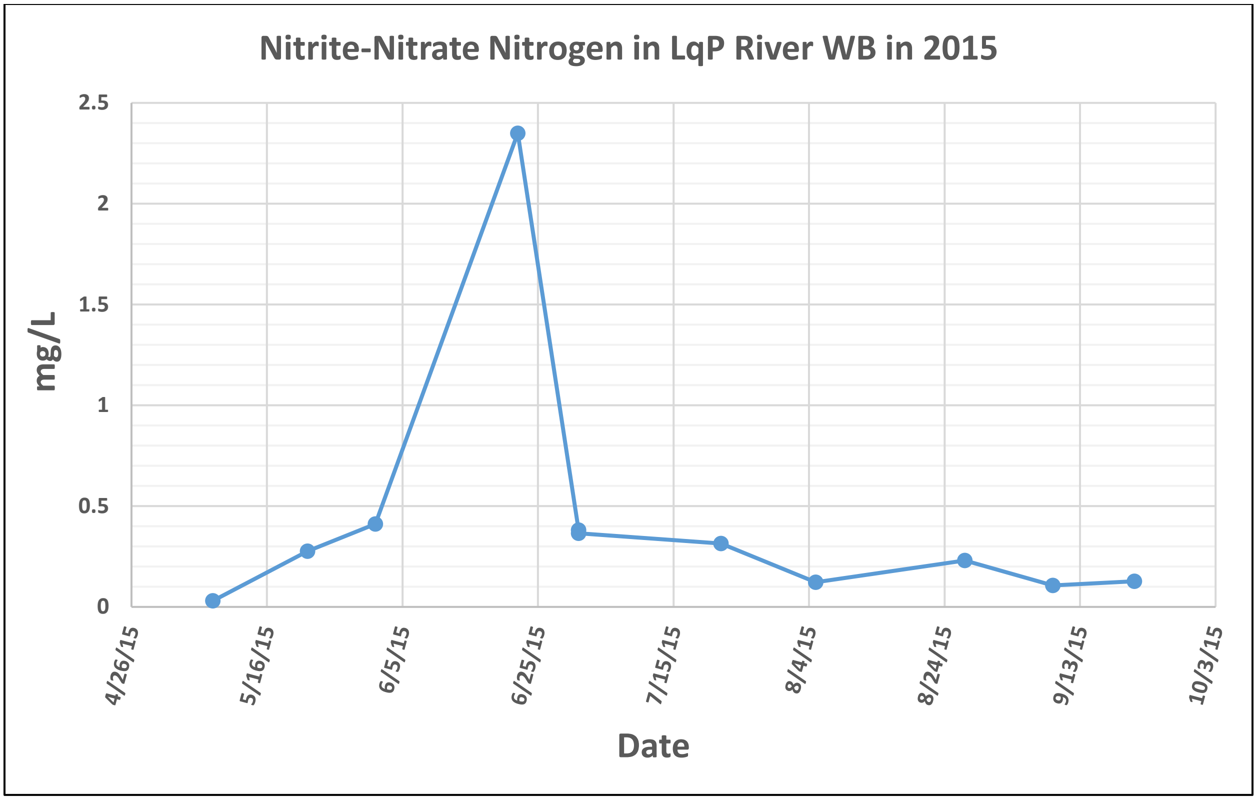

E. Coli in LqP River WB in 2016
Colony Forming Units
3000
2500
2000
1500
1000
500
0
5/30/16
6/9/16
6/19/16
6/29/16
7/9/16
7/19/16
7/29/16
8/8/16
8/18/16
Date
E. Coli
Standard


Dissolved Oxygen in LqP River WB in 2015
12
10
8
6
4
2
mg/L
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date
DO
Standard


Dissolved Oxygen in LqP River WB in 2016
12
10
8
6
4
2
mg/L
5/30/16
6/9/16
6/19/16
6/29/16
7/9/16
7/19/16
7/29/16
8/8/16
8/18/16
Date
DO
Standard


TSS in LqP River WB in 2015
mg/L
700
600
500
400
300
200
100
0
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date
TSS
Standard


Total Phosphorus in LqP River WB in 2015
mg/L
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date


Nitrite-Nitrate Nitrogen in LqP River WB in 2015
mg/L
2.5
2
1.5
1
0.5
0
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date

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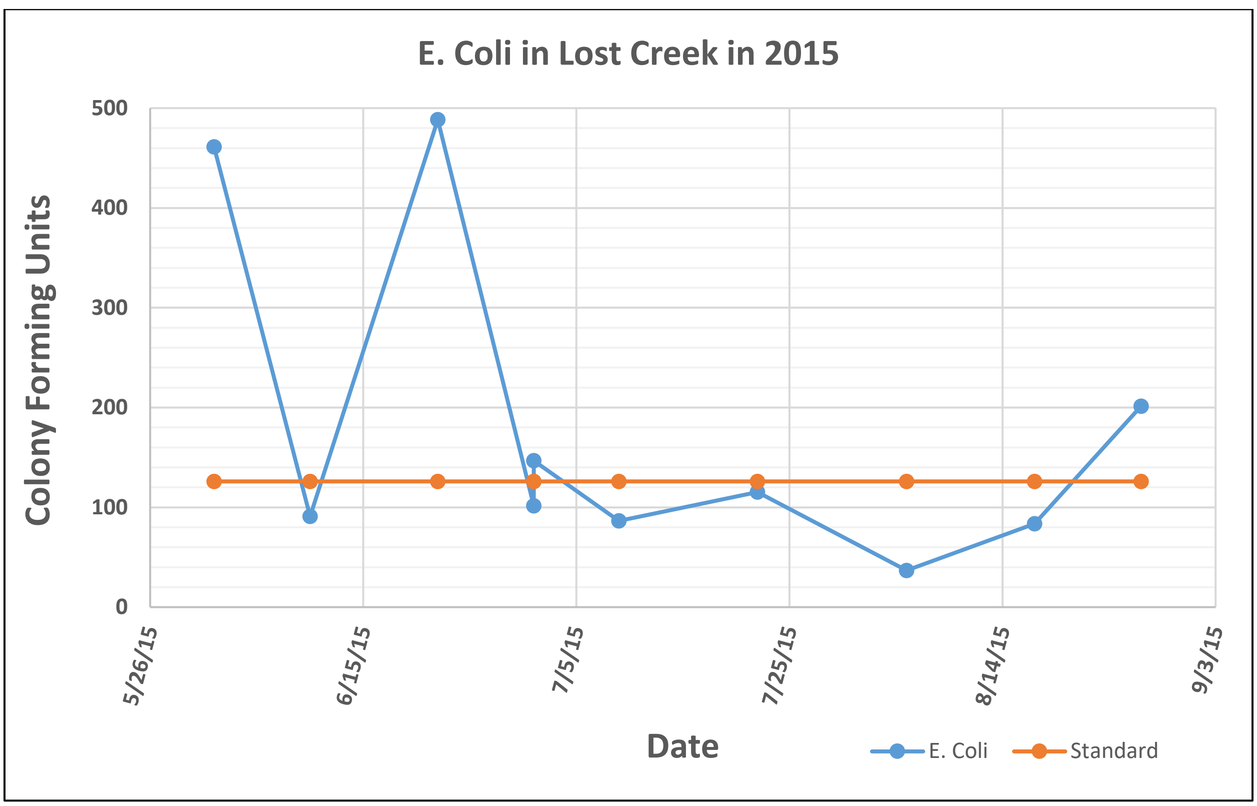
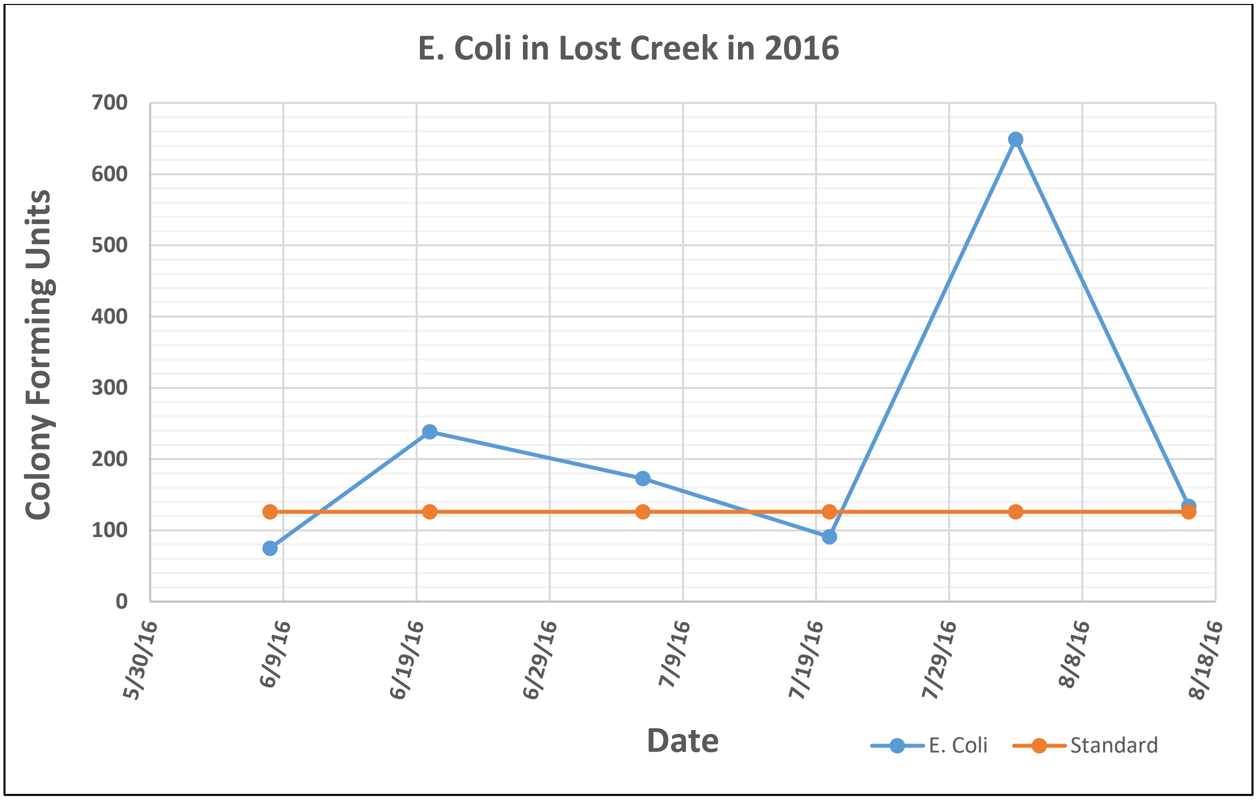
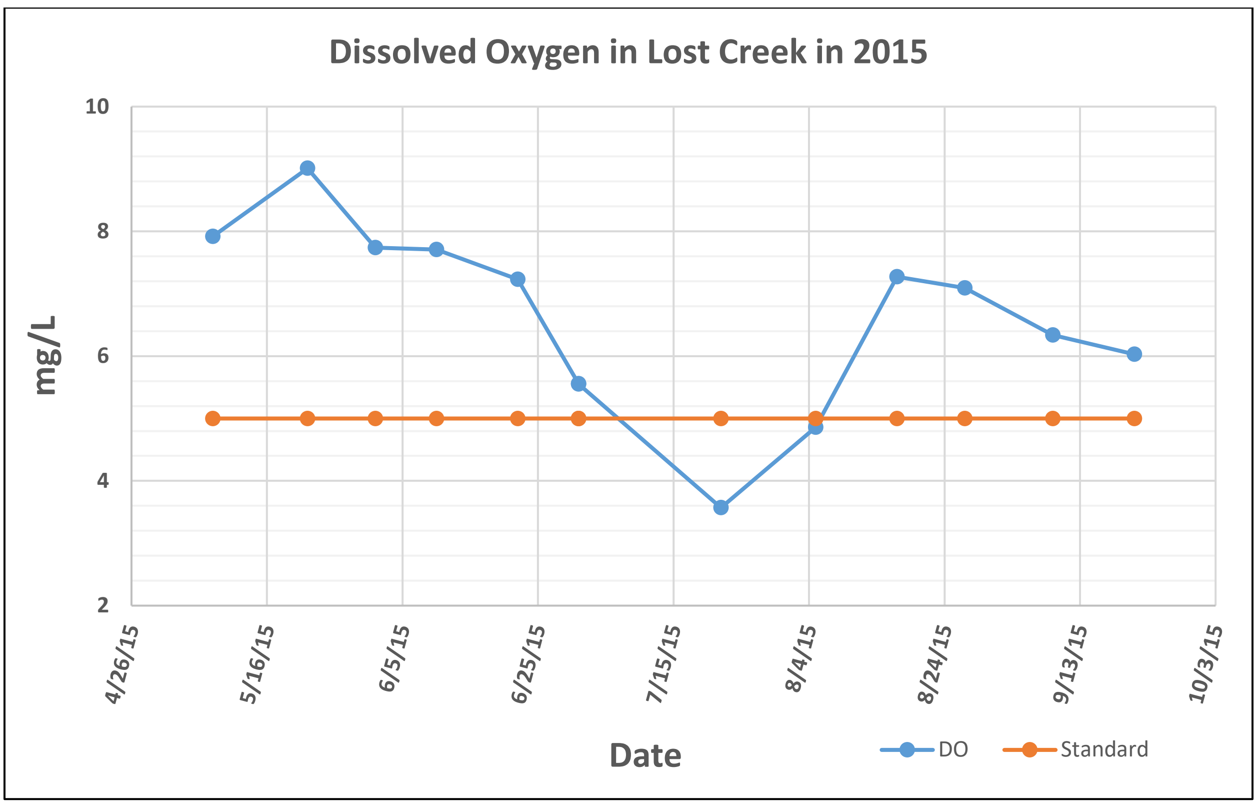
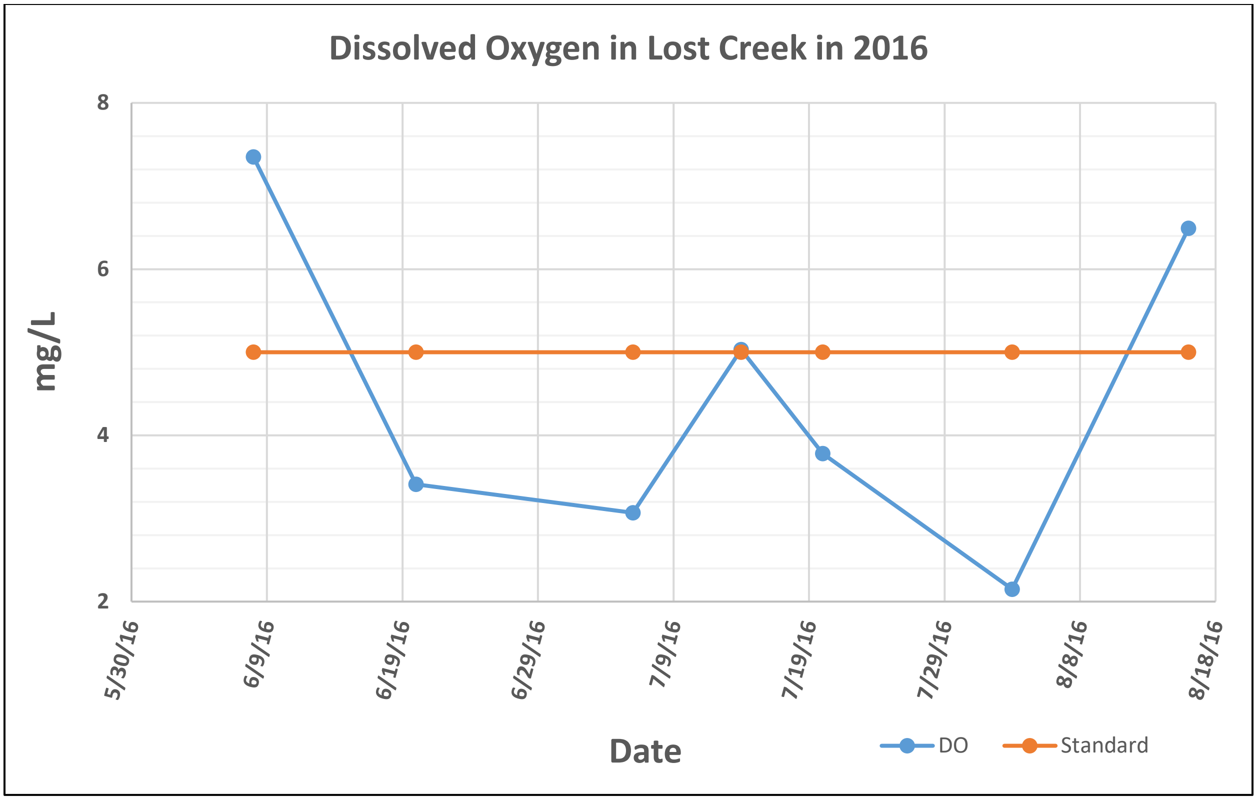
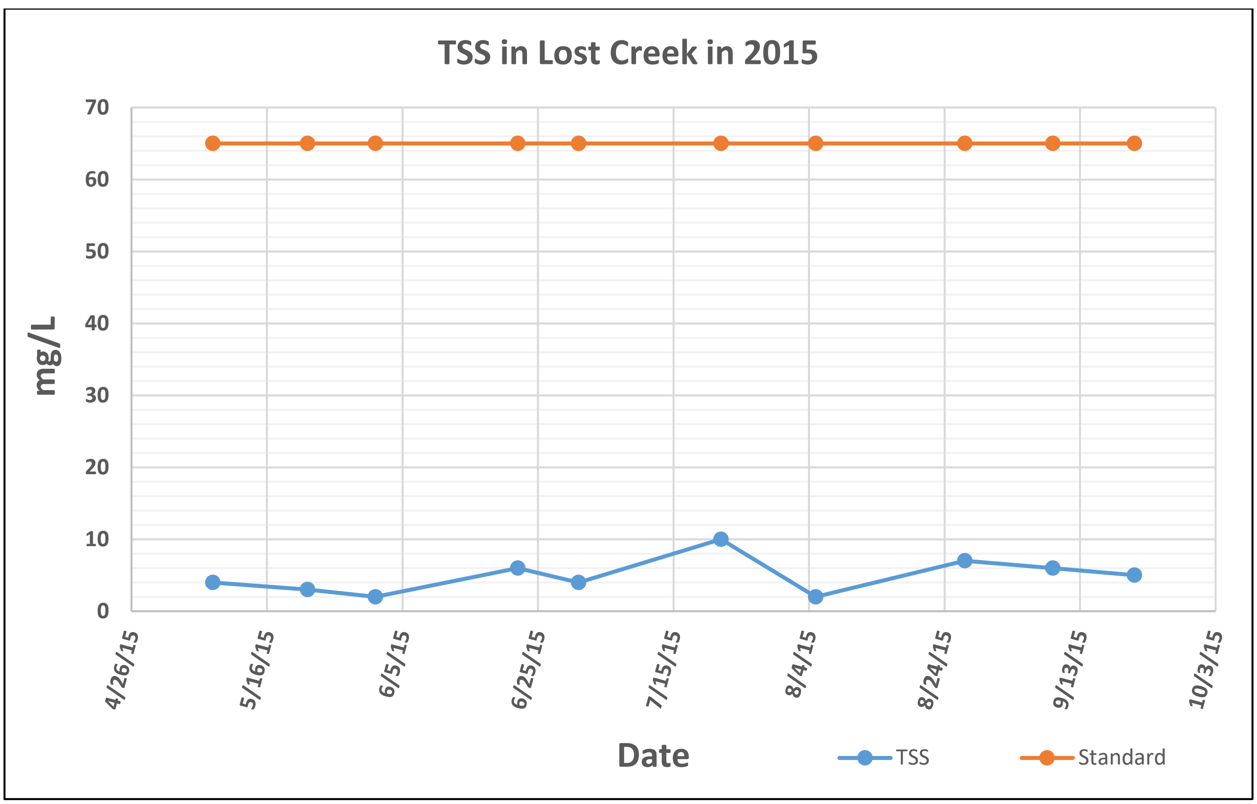
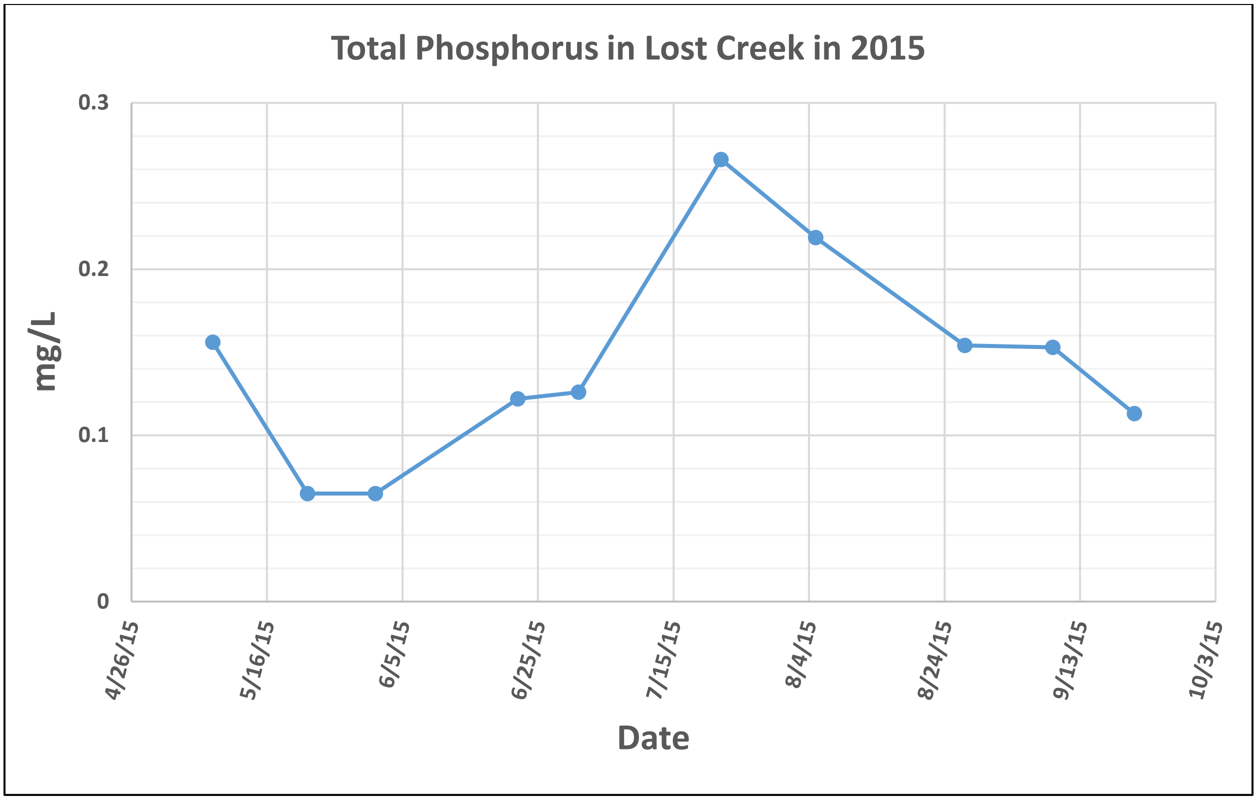

E. Coli in Lost Creek in 2015
Colony Forming Units
500
400
300
200
100
0
5/26/15
6/15/15
7/5/15
7/25/15
8/14/15
9/3/15
Date
E. Coli
Standard


E. Coli in Lost Creek in 2016
700
600
500
400
300
200
100
0
Colony Forming Units
5/30/16
6/9/16
6/19/16
6/29/16
7/9/16
7/19/16
7/29/16
8/8/16
8/18/16
Date
E. Coli
Standard

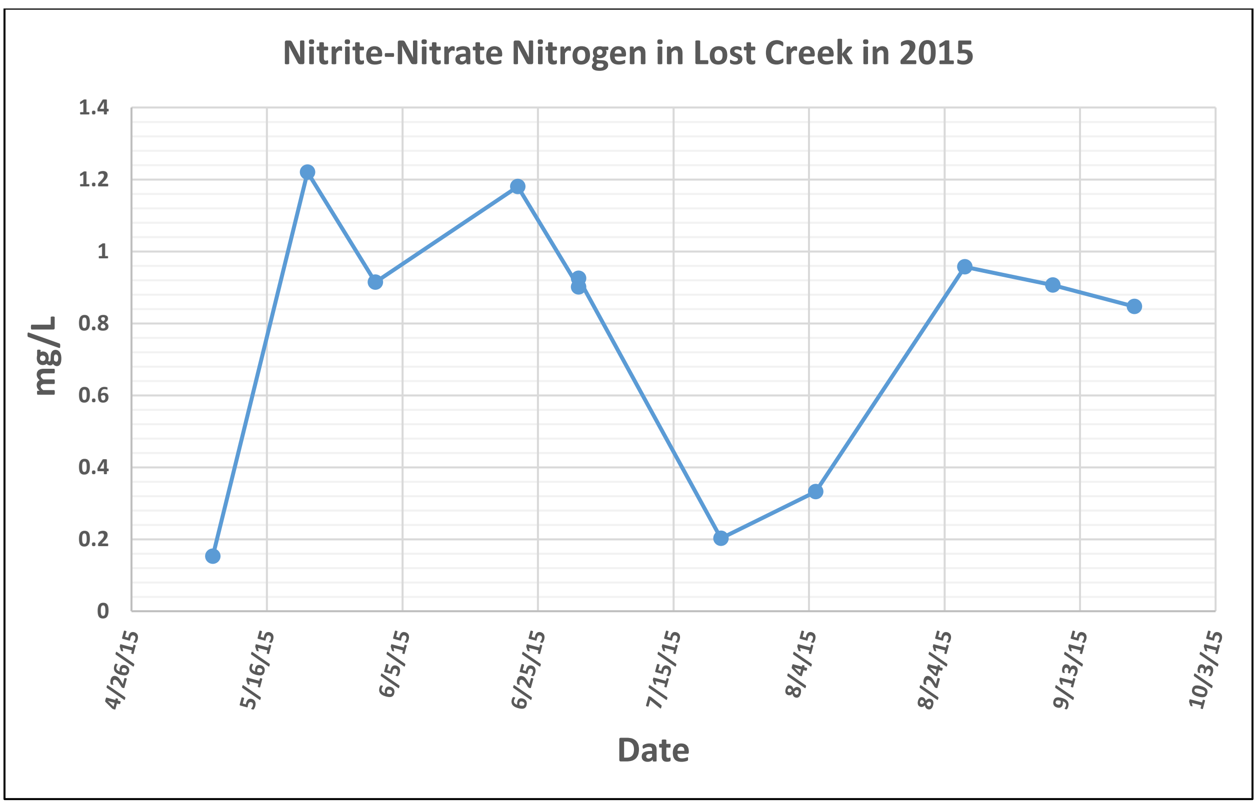

Dissolved Oxygen in Lost Creek in 2015
10
8
6
4
2
mg/L
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date
DO
Standard


Dissolved Oxygen in Lost Creek in 2016
mg/L
8
6
4
2
5/30/16
6/9/16
6/19/16
6/29/16
7/9/16
7/19/16
7/29/16
8/8/16
8/18/16
Date
DO
Standard


TSS in Lost Creek in 2015
mg/L
70
60
50
40
30
20
10
0
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date
TSS
Standard

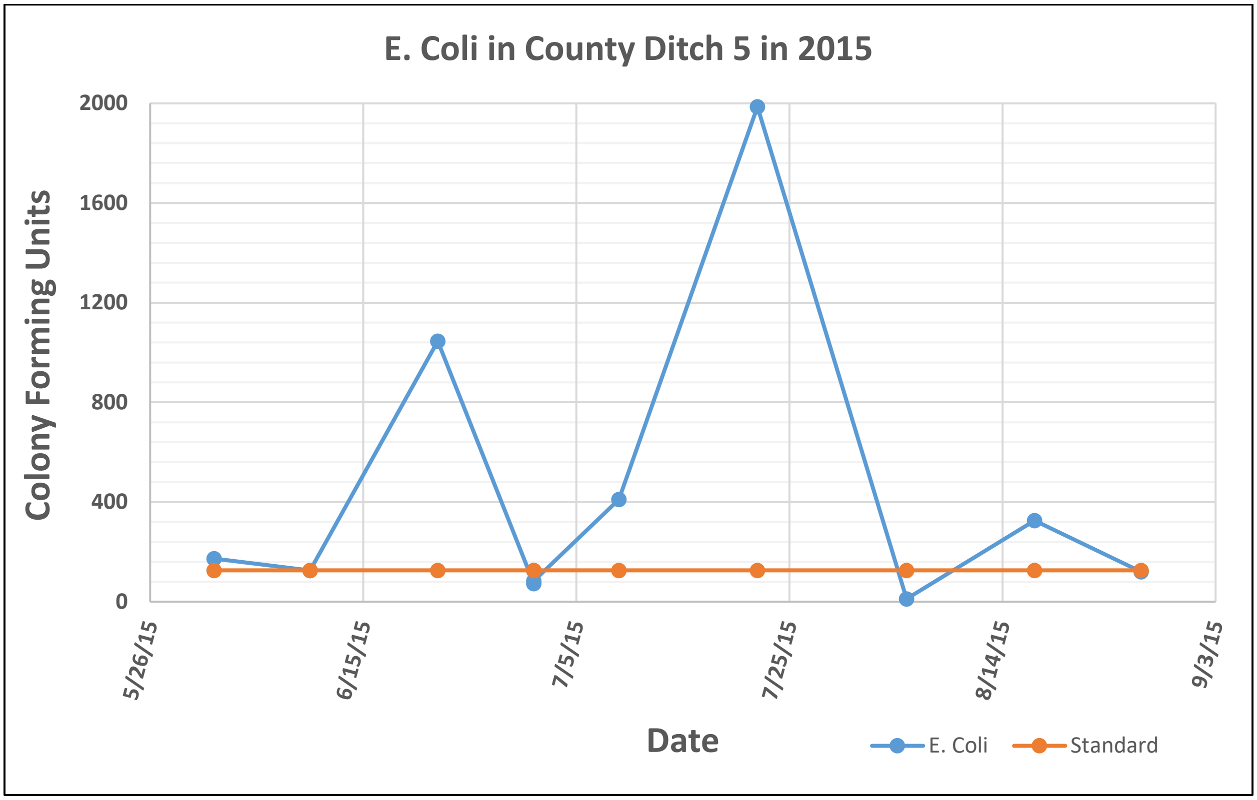


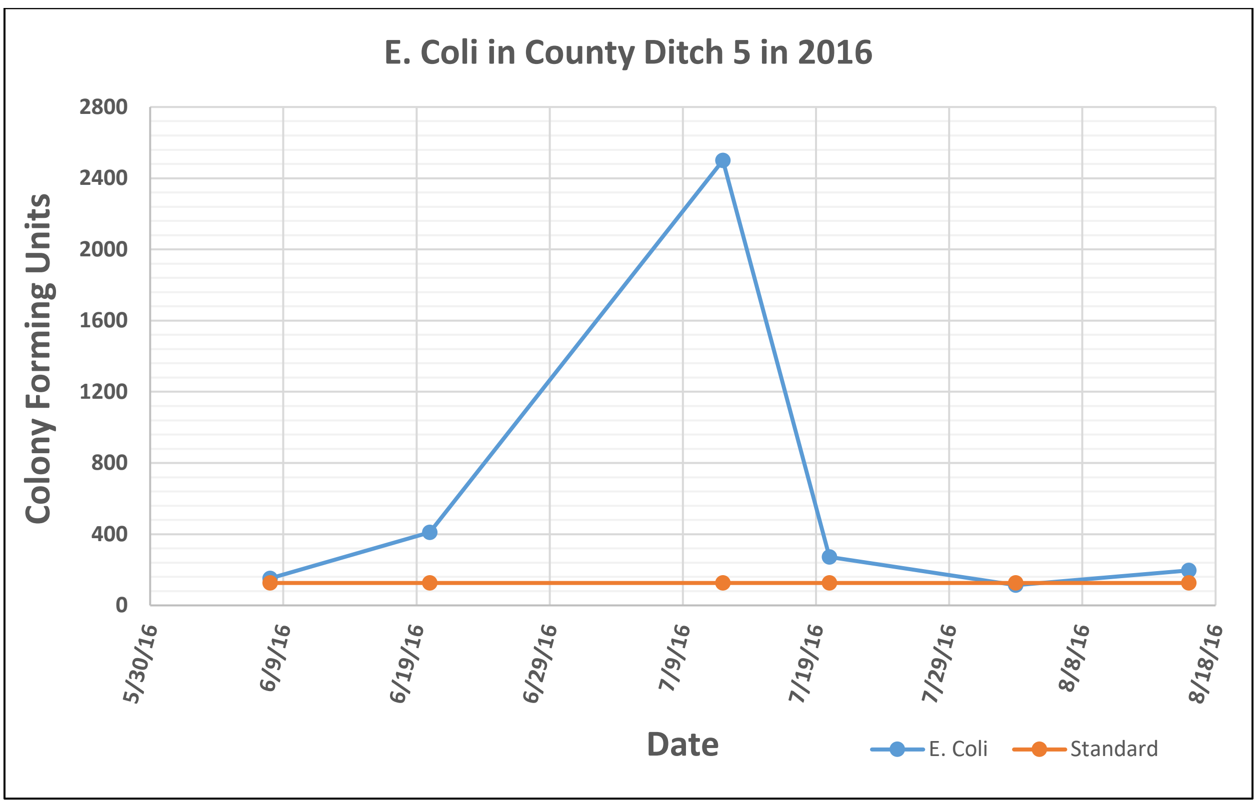
Total Phosphorus in Lost Creek in 2015
0.3
0.2
0.1
0
mg/L
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date

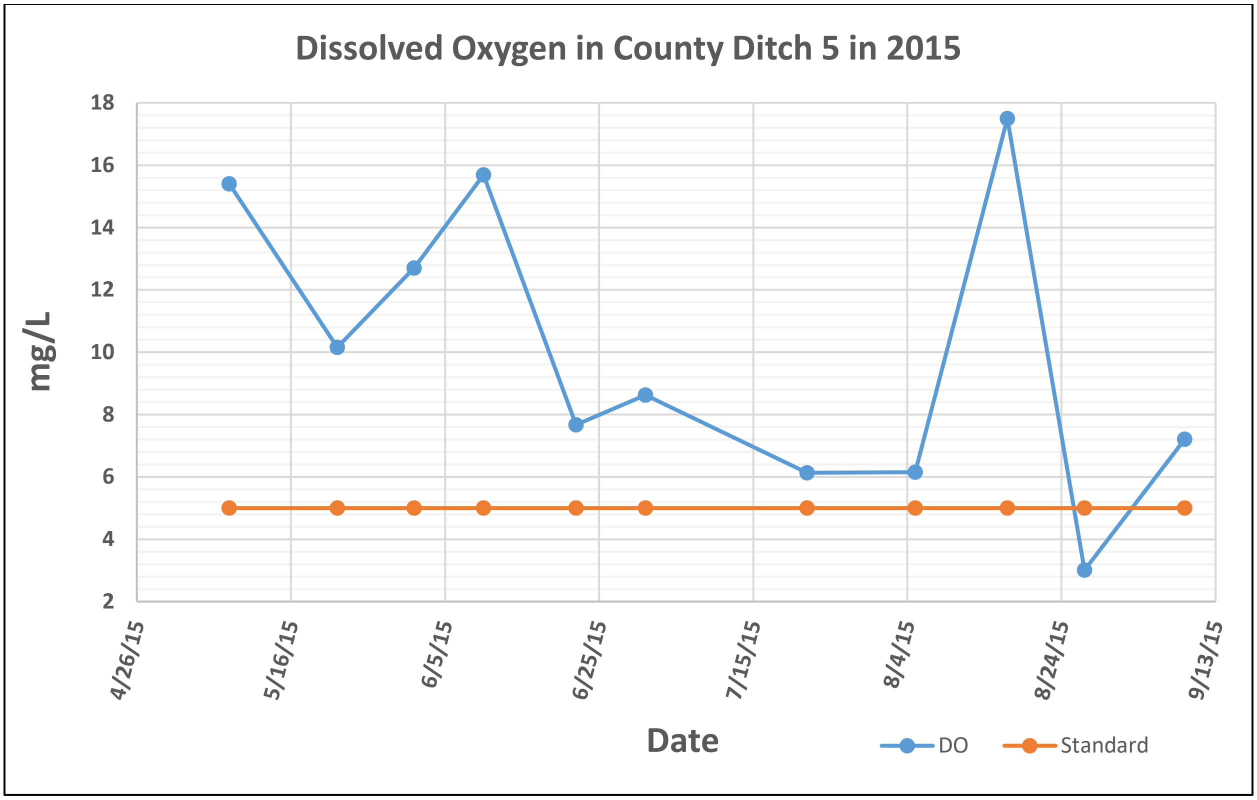


Nitrite-Nitrate Nitrogen in Lost Creek in 2015
1.4
1.2
1
0.8
0.6
0.4
0.2
0
mg/L
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date

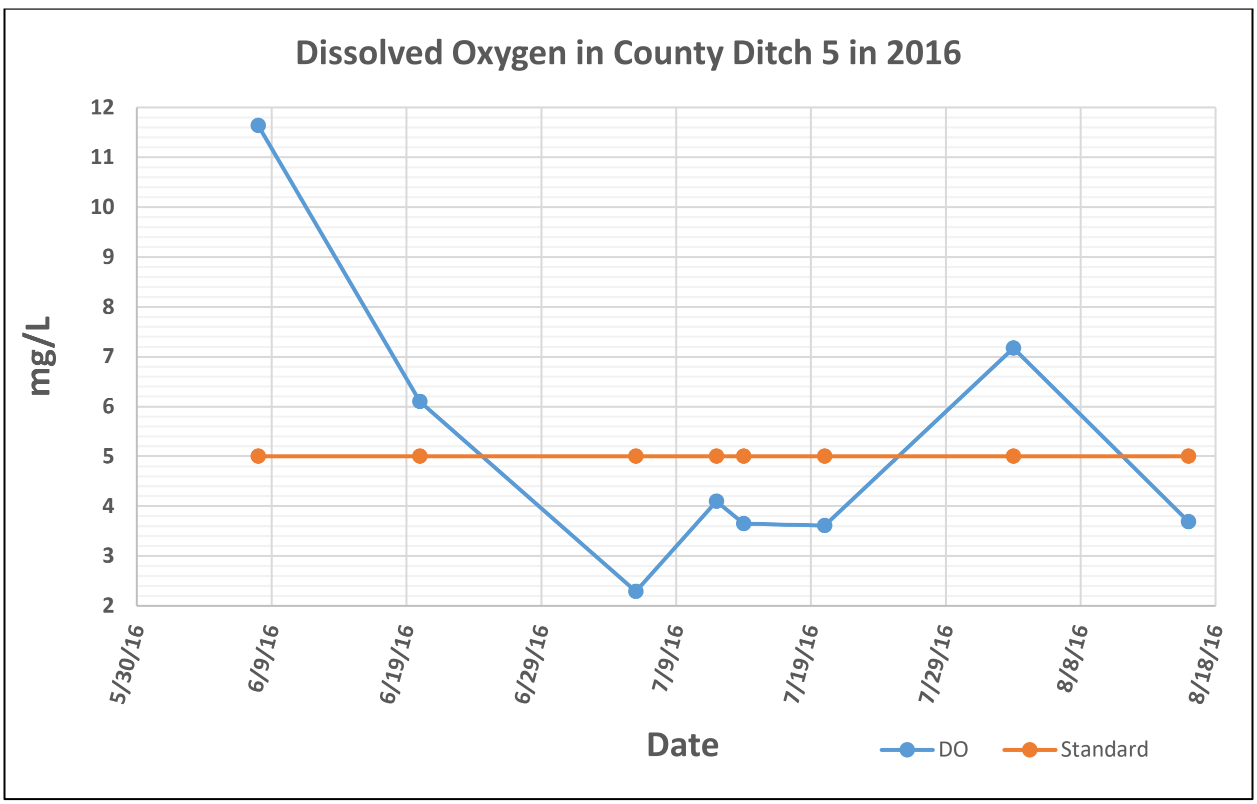
S008-467


E. Coli in County Ditch 5 in 2015
Colony Forming Units
2000
1600
1200
800
400
0
5/26/15
6/15/15
7/5/15
7/25/15
8/14/15
9/3/15
Date
E. Coli
Standard

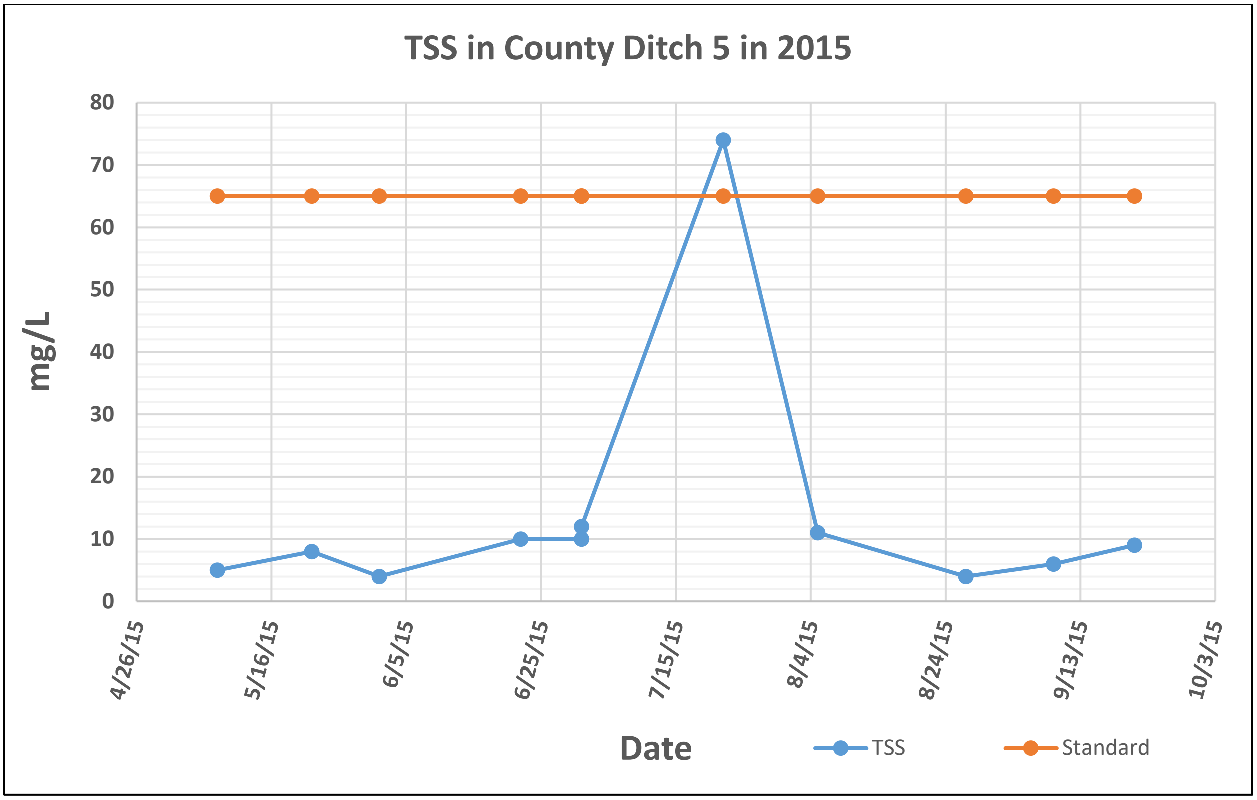

E. Coli in County Ditch 5 in 2016
Colony Forming Units
2800
2400
2000
1600
1200
800
400
0
5/30/16
6/9/16
6/19/16
6/29/16
7/9/16
7/19/16
7/29/16
8/8/16
8/18/16
Date
E. Coli
Standard

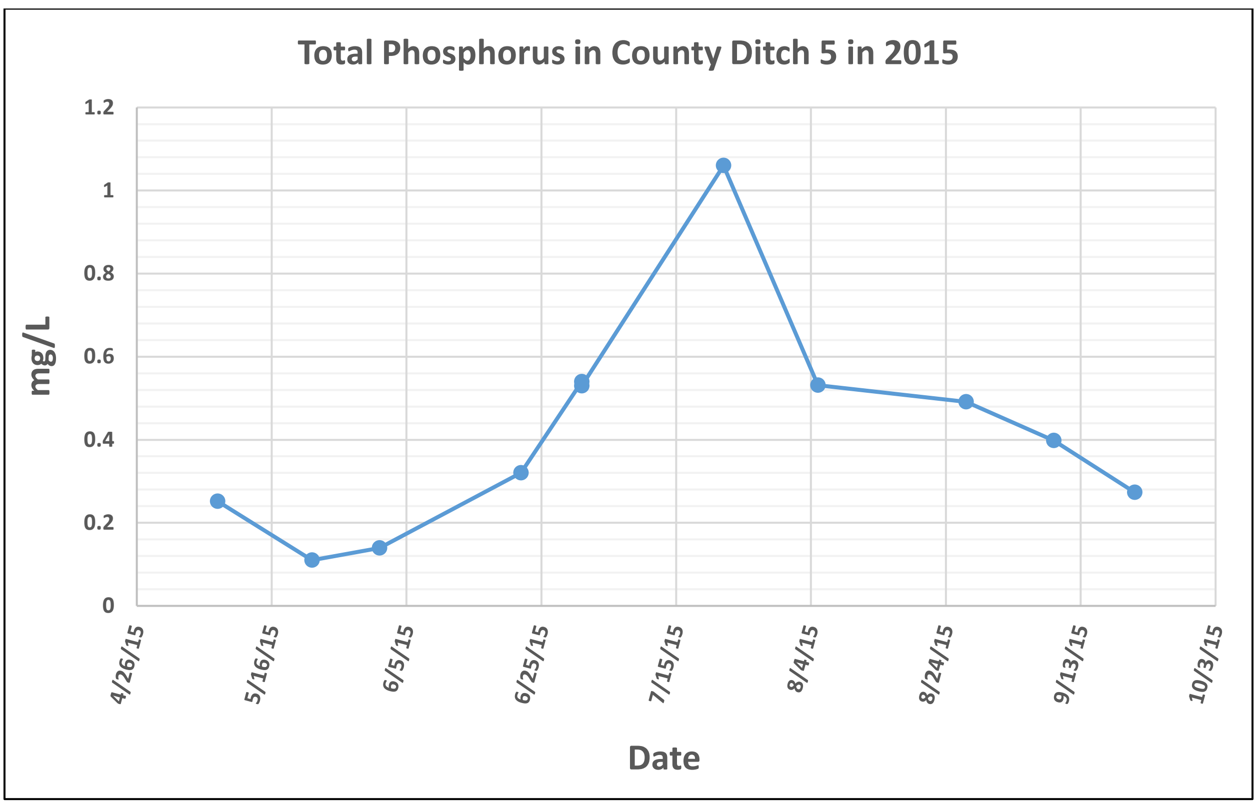


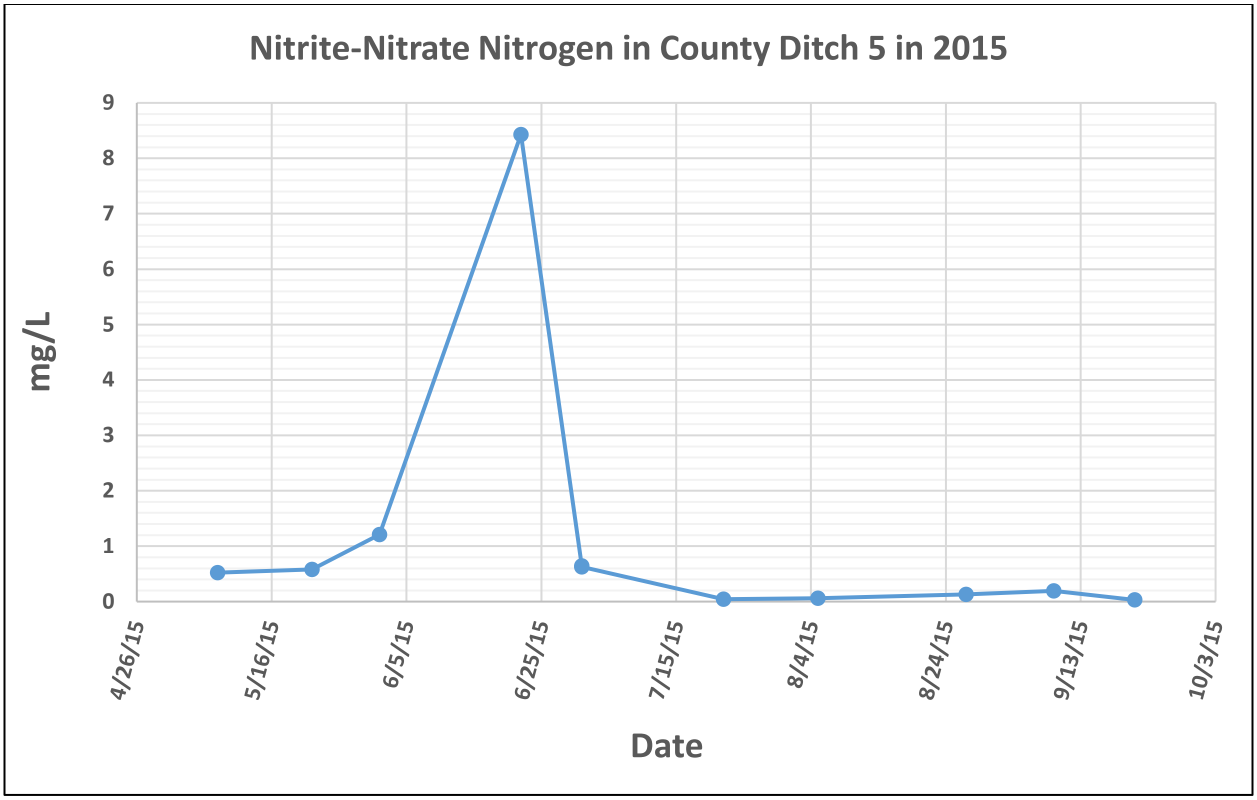
Dissolved Oxygen in County Ditch 5 in 2015
mg/L
18
16
14
12
10
8
6
4
2
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
Date
DO
Standard



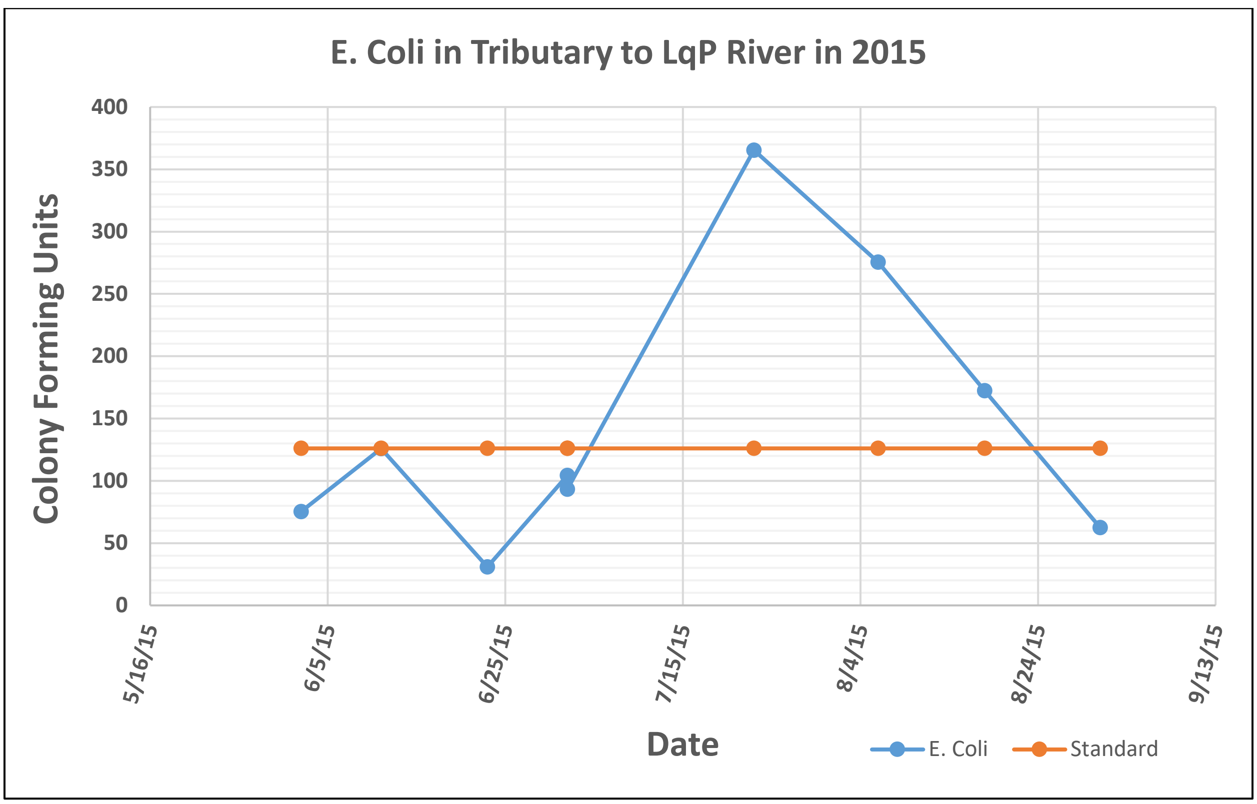
Dissolved Oxygen in County Ditch 5 in 2016
mg/L
12
11
10
9
8
7
6
5
4
3
2
5/30/16
6/9/16
6/19/16
6/29/16
7/9/16
7/19/16
7/29/16
8/8/16
8/18/16
Date
DO
Standard

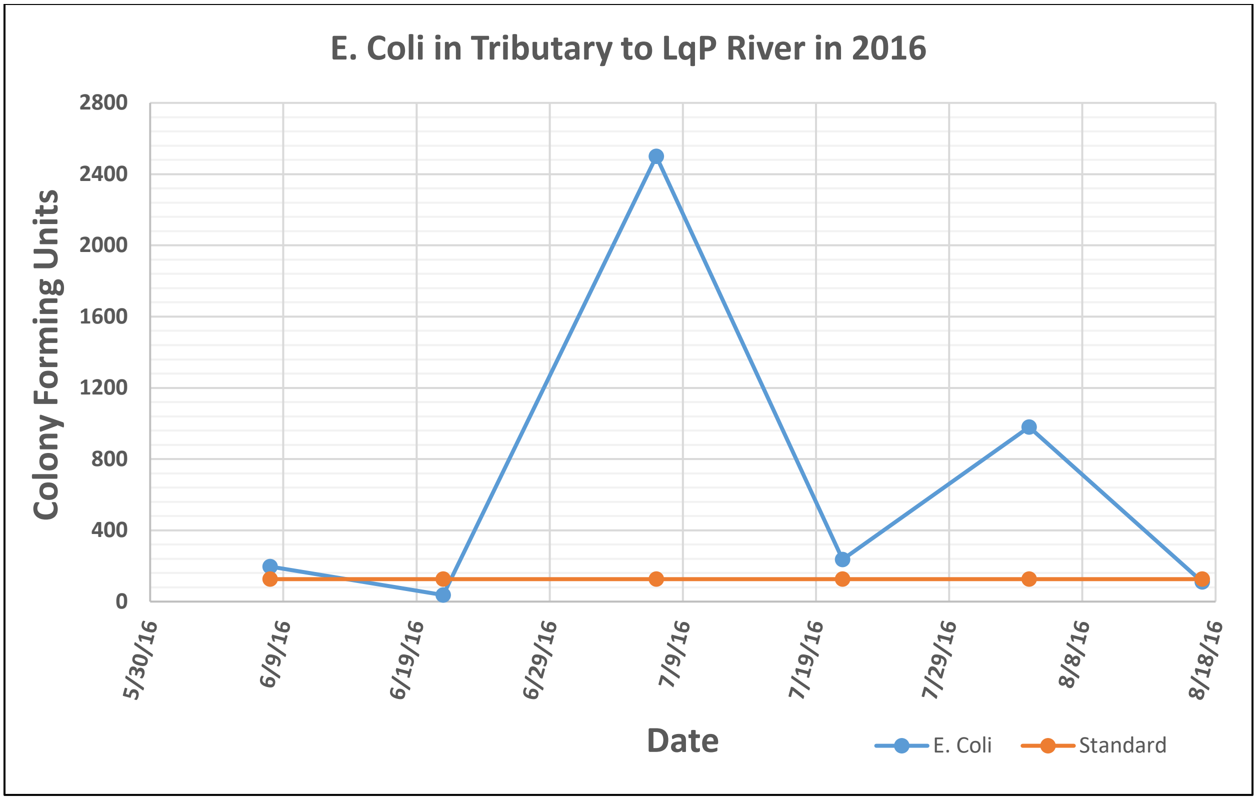

TSS in County Ditch 5 in 2015
80
70
60
50
40
30
20
10
0
mg/L
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date
TSS
Standard

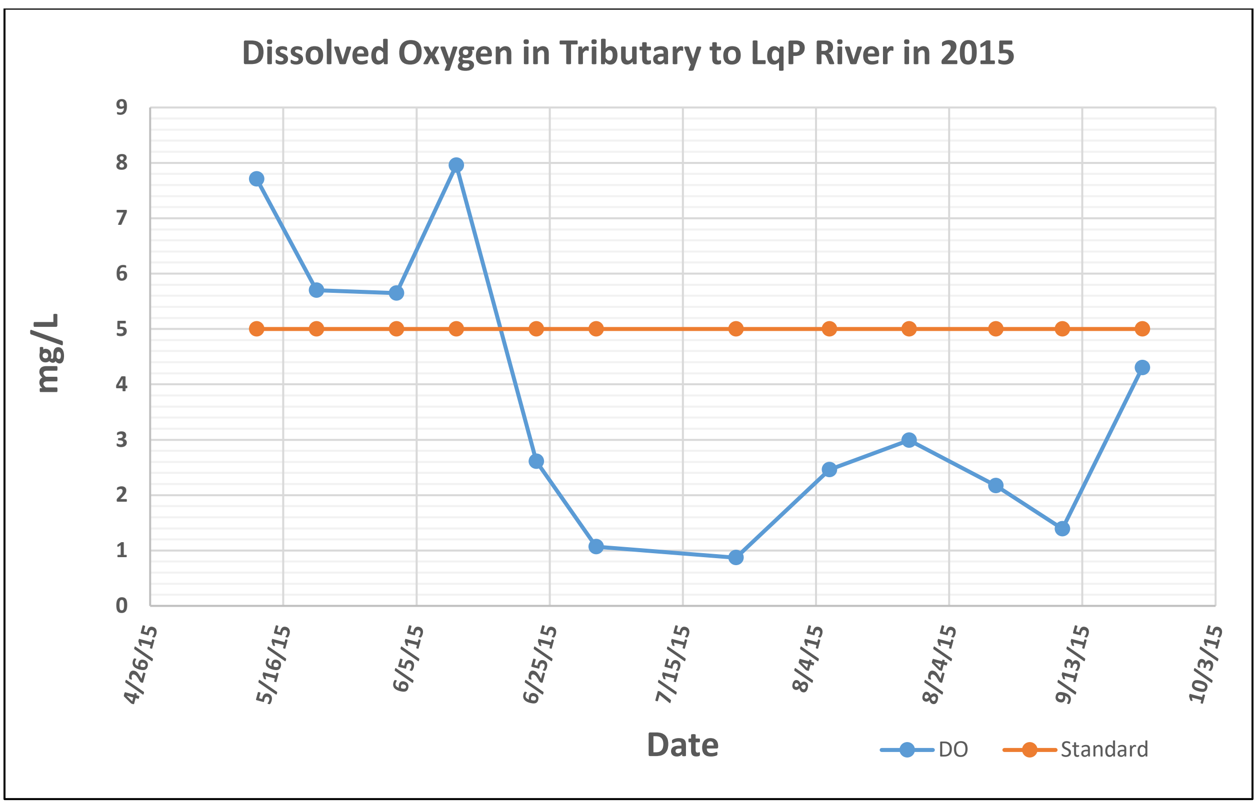

Total Phosphorus in County Ditch 5 in 2015
1.2
1
0.8
0.6
0.4
0.2
0
mg/L
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date

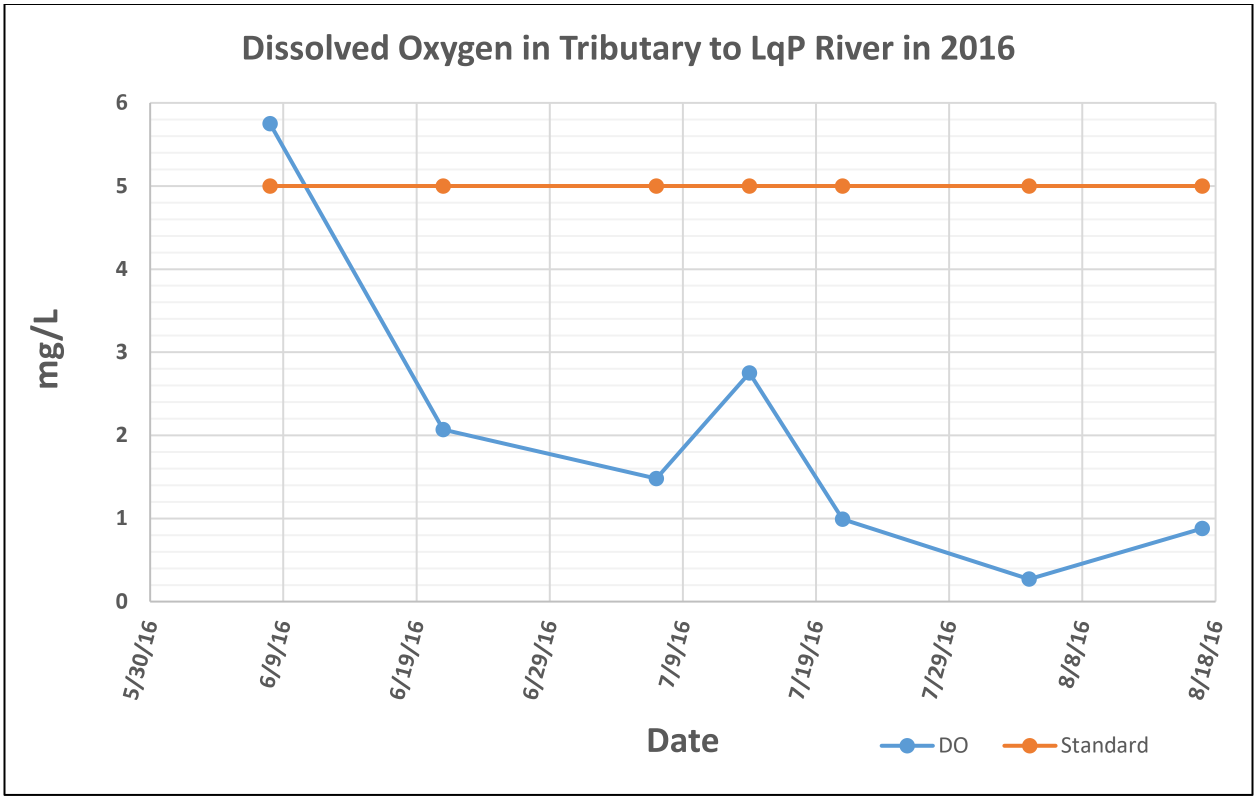

Nitrite-Nitrate Nitrogen in County Ditch 5 in 2015
mg/L
9
8
7
6
5
4
3
2
1
0
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date

S008-465

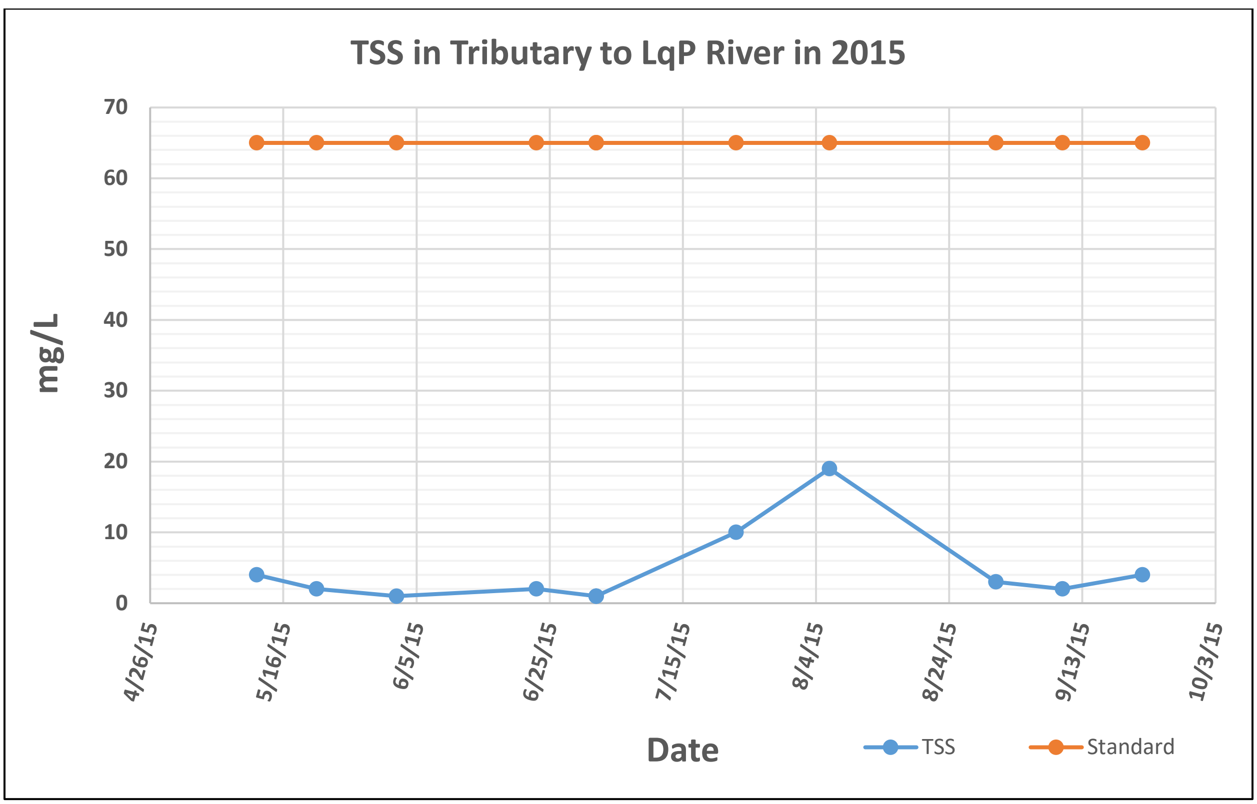

E. Coli in Tributary to LqP River in 2015
Colony Forming Units
400
350
300
250
200
150
100
50
0
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
Date
E. Coli
Standard


E. Coli in Tributary to LqP River in 2016
Colony Forming Units
2800
2400
2000
1600
1200
800
400
0
5/30/16
6/9/16
6/19/16
6/29/16
7/9/16
7/19/16
7/29/16
8/8/16
8/18/16
Date
E. Coli
Standard

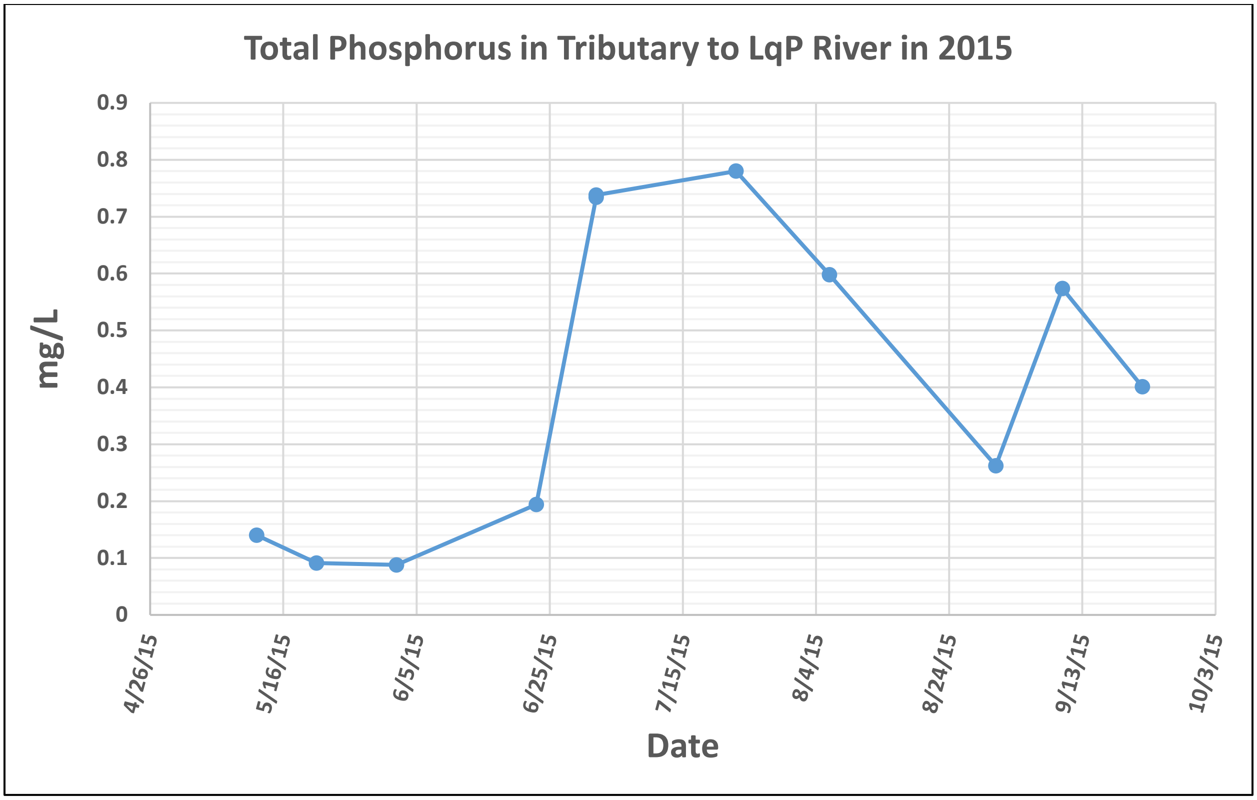

Dissolved Oxygen in Tributary to LqP River in 2015
mg/L
9
8
7
6
5
4
3
2
1
0
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date
DO
Standard

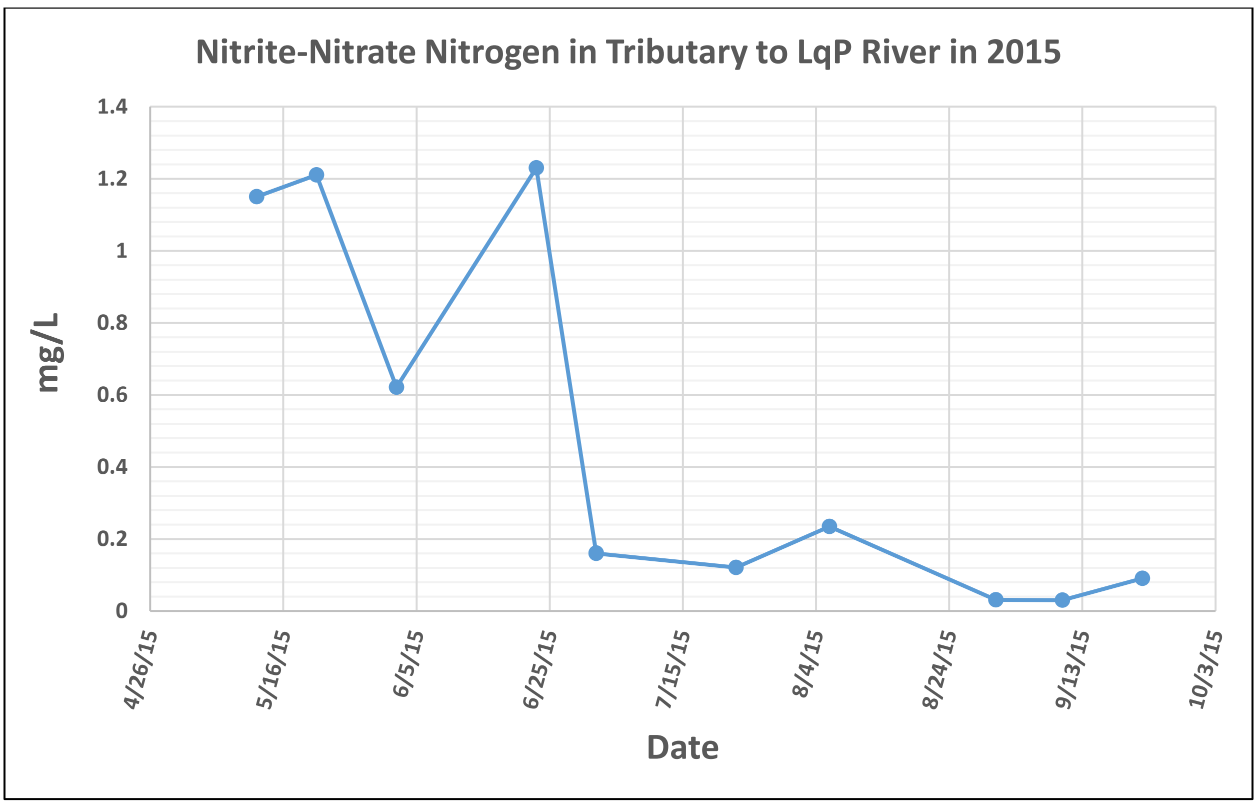


Dissolved Oxygen in Tributary to LqP River in 2016
mg/L
0
1
2
3
4
5
6
5/30/16
6/9/16
6/19/16
6/29/16
7/9/16
7/19/16
7/29/16
8/8/16
8/18/16
Date
DO
Standard

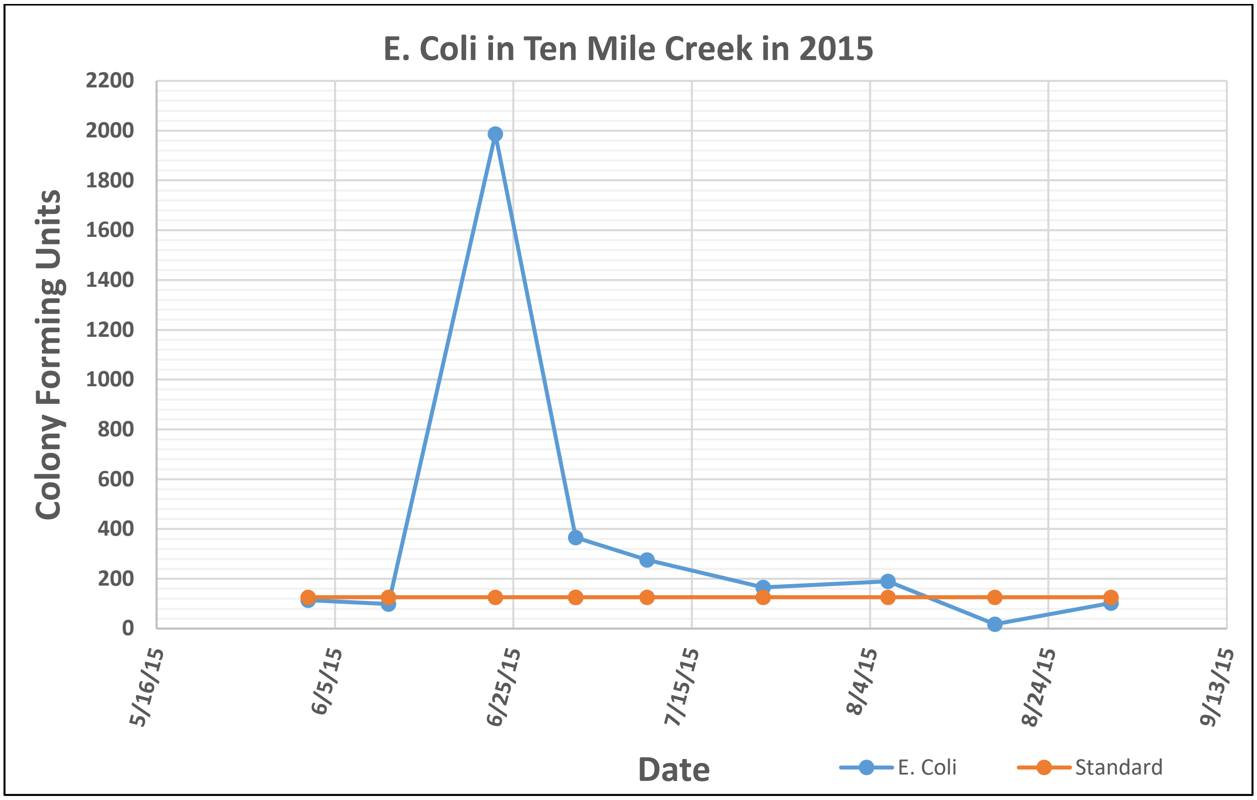


TSS in Tributary to LqP River in 2015
mg/L
0
10
20
30
40
50
60
70
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date
TSS
Standard

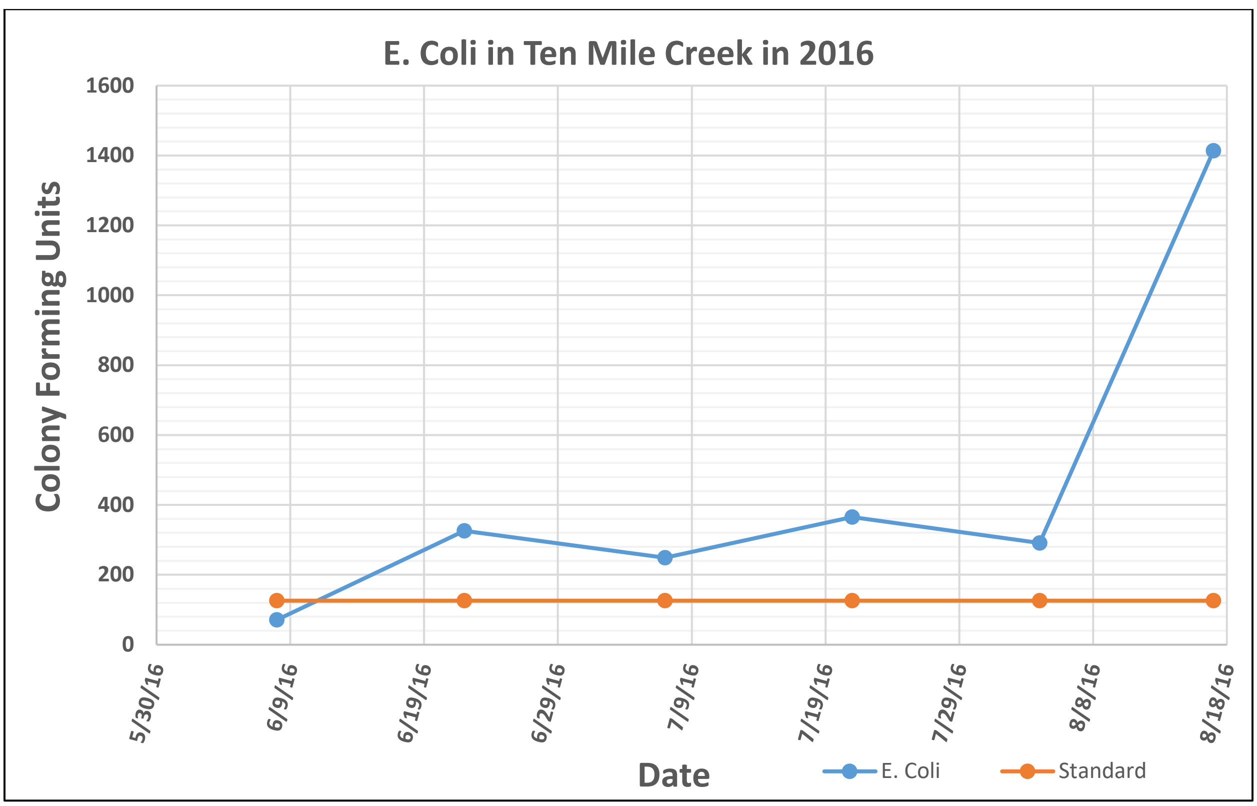

Total Phosphorus in Tributary to LqP River in 2015
mg/L
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date


Nitrite-Nitrate Nitrogen in Tributary to LqP River in 2015
mg/L
0
0.2
0.4
0.6
0.8
1
1.2
1.4
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date

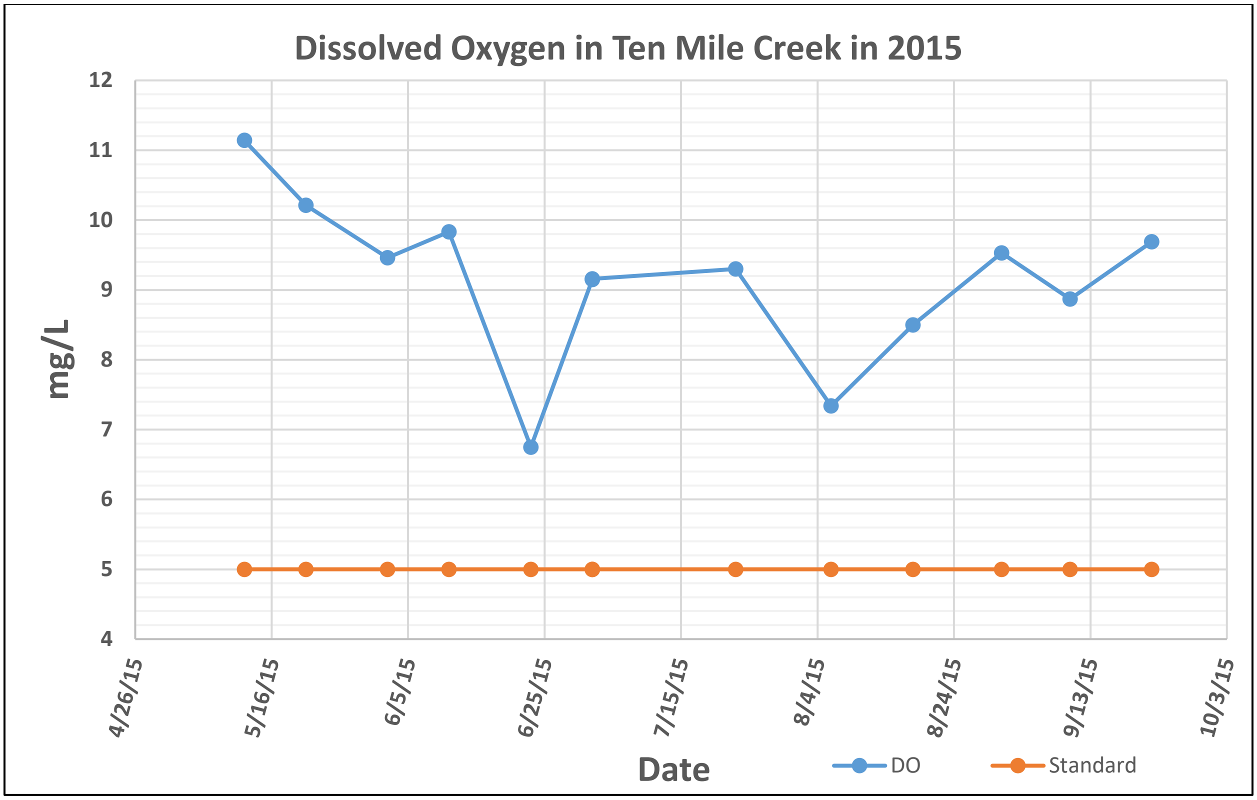
S008-466

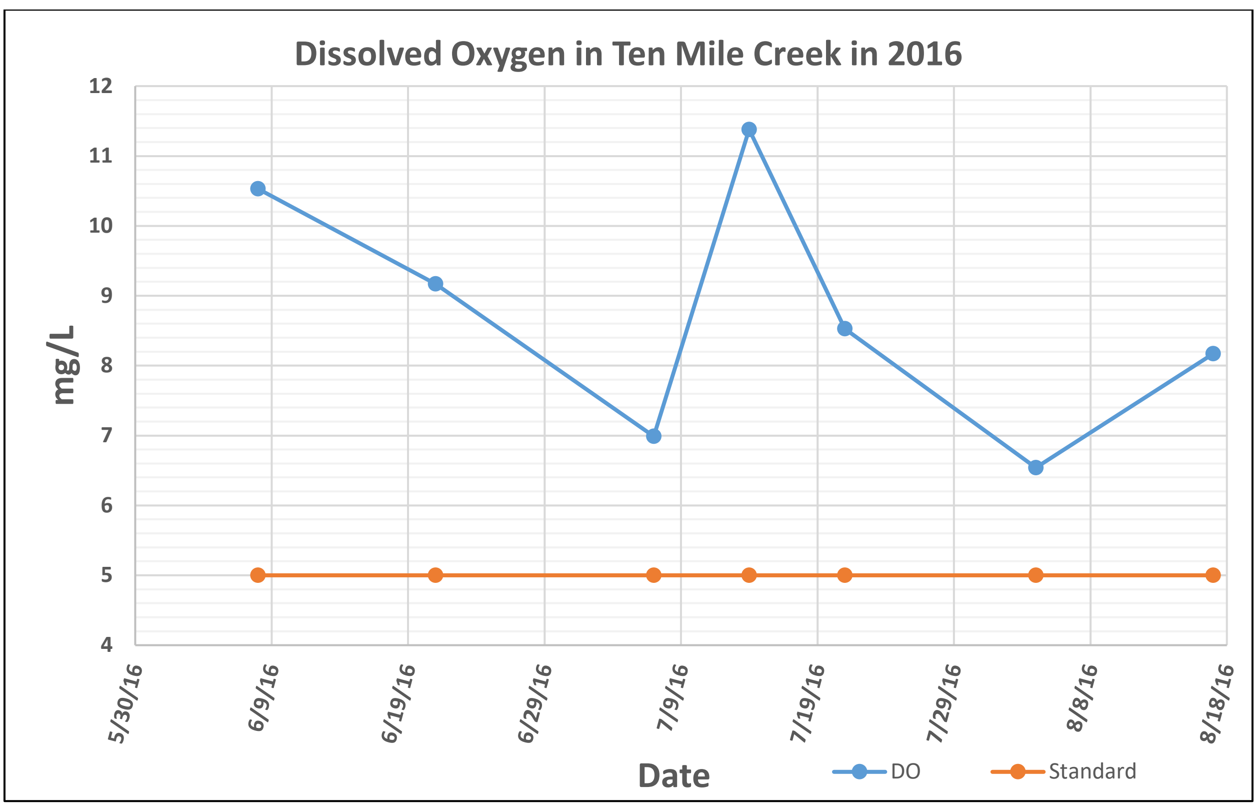


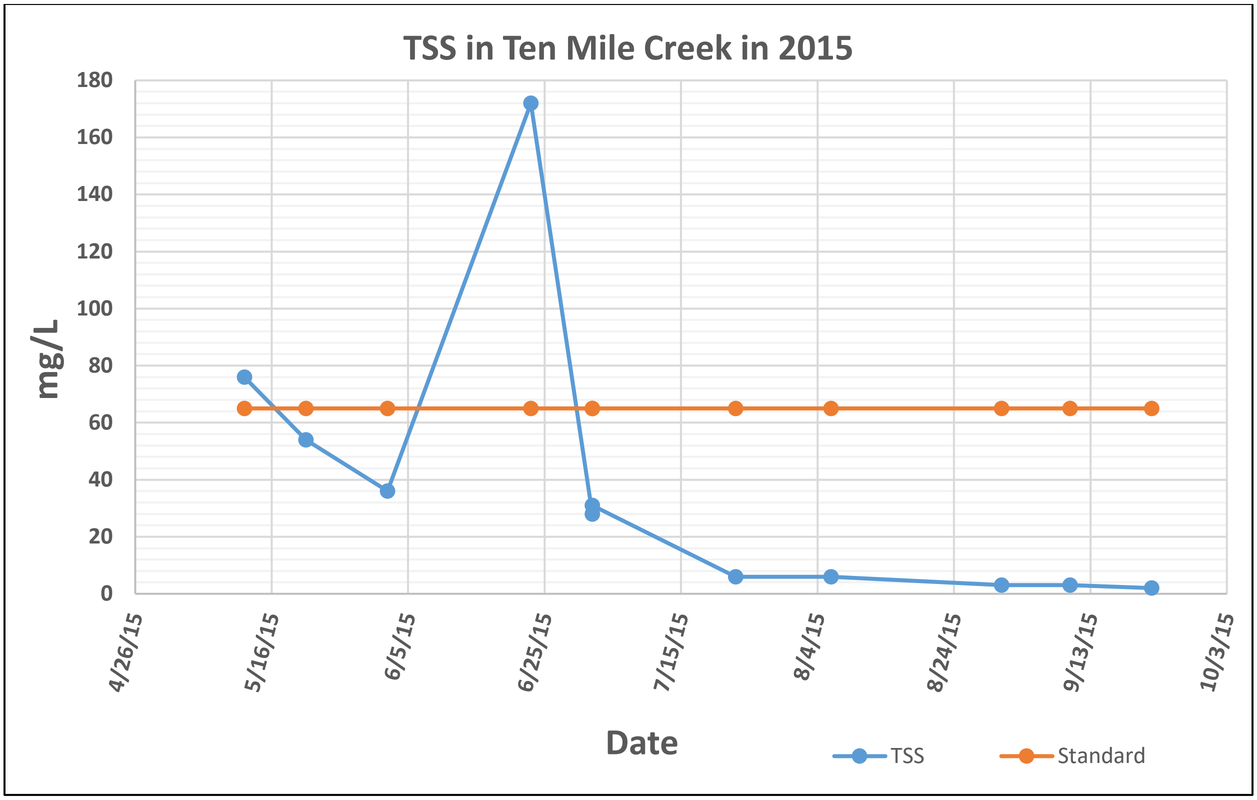
E. Coli in Ten Mile Creek in 2015
Colony Forming Units
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
Date
E. Coli
Standard

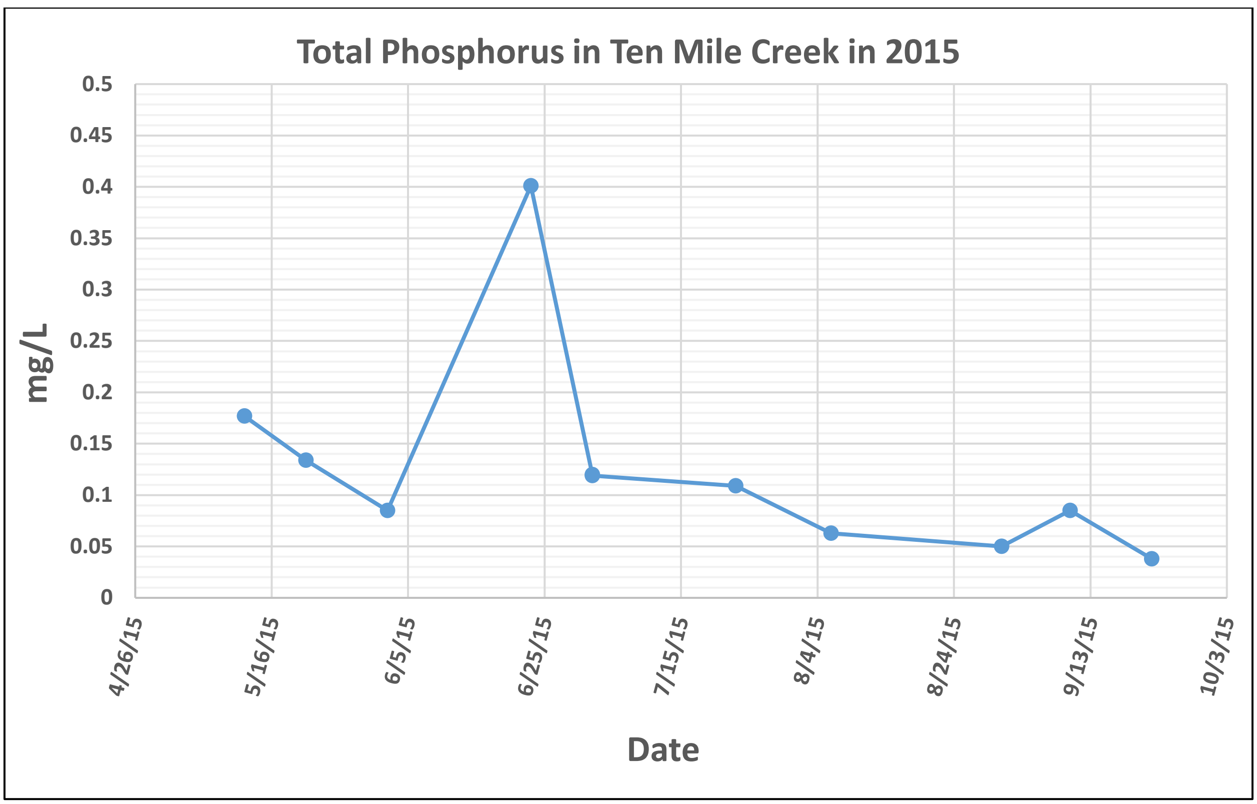


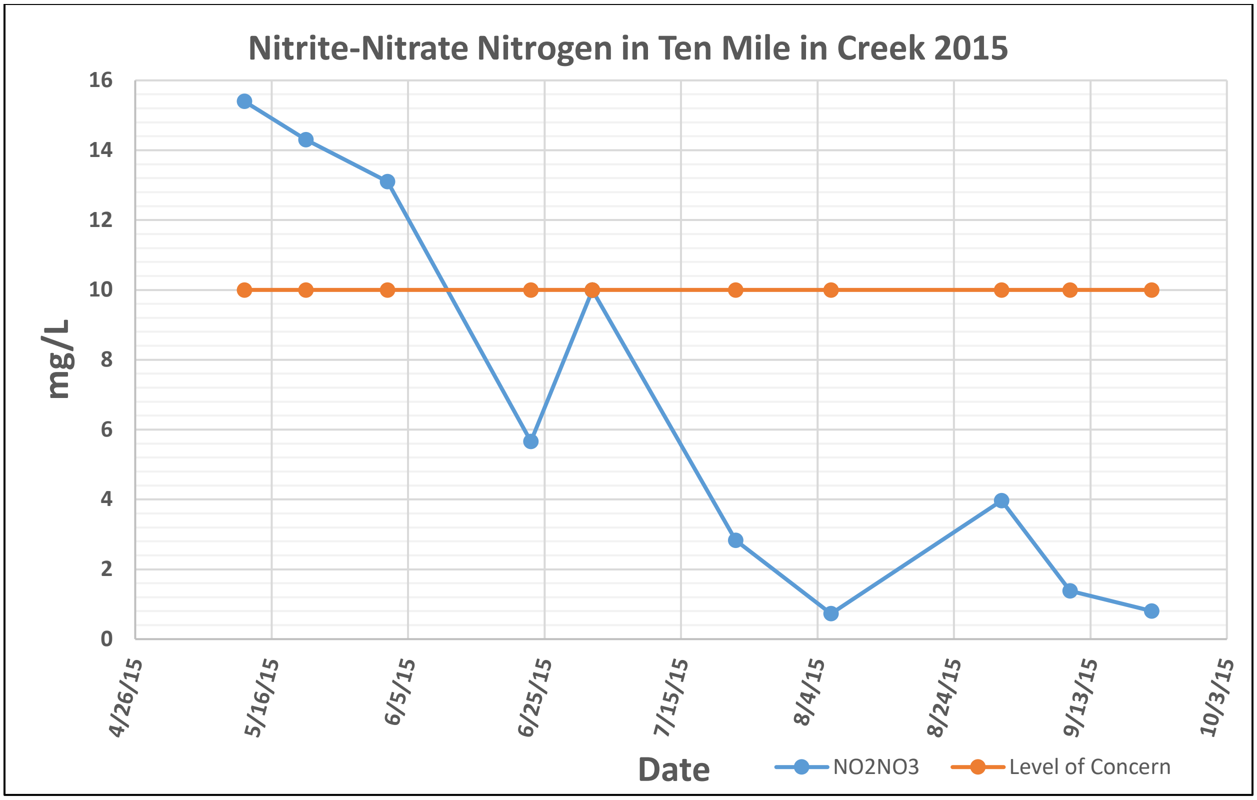
E. Coli in Ten Mile Creek in 2016
Colony Forming Units
1600
1400
1200
1000
800
600
400
200
0
5/30/16
6/9/16
6/19/16
6/29/16
7/9/16
7/19/16
7/29/16
8/8/16
8/18/16
Date
E. Coli
Standard


Dissolved Oxygen in Ten Mile Creek in 2015
mg/L
12
11
10
9
8
7
6
5
4
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date
DO
Standard


Dissolved Oxygen in Ten Mile Creek in 2016
mg/L
12
11
10
9
8
7
6
5
4
5/30/16
6/9/16
6/19/16
6/29/16
7/9/16
7/19/16
7/29/16
8/8/16
8/18/16
Date
DO
Standard


TSS in Ten Mile Creek in 2015
180
160
140
120
100
80
60
40
20
0
mg/L
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date
TSS
Standard


Total Phosphorus in Ten Mile Creek in 2015
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
mg/L
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date


Nitrite-Nitrate Nitrogen in Ten Mile in Creek 2015
mg/L
16
14
12
10
8
6
4
2
0
4/26/15
5/16/15
6/5/15
6/25/15
7/15/15
8/4/15
8/24/15
9/13/15
10/3/15
Date
NO2NO3
Level of Concern

Lac qui Parle River Watershed Survey

The Lac qui Parle-Yellow Bank Watershed District invites you to participate in this survey. This survey will collect baseline information on perceptions about the Lac qui Parle River and tributaries and will take less than 5 minutes to complete. There will be additional surveys in the future as we collect and assess water quality data throughout the watershed.

1. Please check all that apply.

   City resident   Rural resident   Business Owner   Ag Producer

   Lac qui Parle   Lincoln   Yellow Medicine   Other______________

   Age group   16-30   31-50   51-70   71 and older

2. Please rate these water resources in order of importance, in your opinion.
   1 being most important and 4 being least important

   _____Lakes ______Streams ______Wetlands ______Groundwater

   Comments

3. In your opinion, how polluted is the Lac qui Parle River and its tributaries.

   Very polluted   Somewhat polluted   Not very polluted
   Not polluted   Don't know

   Comments

4. Who is responsible for water quality? Check all that apply.

   Landowners   State Government   Federal Government
   Industry   Individuals   Local Government   Other________

   Comments

5. Water quality in the Lac qui Parle and its tributaries is most influenced by which of the following?

   Land-use practices adjacent to the river   Mother Nature
   Agricultural practices   South Dakota
   City Activities   Industrial Activities
   All of the above   Not sure
   Comments

(Over)

6. How concerned are you about the Lac qui Parle River and its tributaries?
   Very Concerned   Somewhat concerned   Not very concerned
   Not at all concerned   Don't know
   Comment

7. Do you think something should be done to clean up the Lac qui Parle River and tributaries?   Yes   No

8. Who do think should be most responsible for making decision about clean up the Lac qui Parle River and its tributaries?

   Local residents
   Local Government
   State Government
   Federal Government
   Other Please specify____
   Comments

9. Are you aware of efforts to improve water quality in the Lac qui Parle River and its tributaries?   Yes   No   Not sure
   Comments

10. If you are interested in receiving electronic updates about the Lac qui Parle River and its tributaries, please fill out your contact information below. Thank you.
    Name____
    Email____

1. (Check all that apply)

   City Resident:l
   Rural Resident: lllllllllllllllllllllllll
   Business Owner:lll
   Ag Producer:lllllllllll
   Government Employee:lllll
   Lac qui Parle:llllllllllllll
   Yellow Medicine:lllllll
   Lincoln:ll
   Other:
   Age: 16-30:ll 31-50:llllll 51-70:lllllllllllllllllllll 71+:l

2. Please rate by importance 1-4 (4 least important)
   Lakes: 1-ll 2-llllllllllll 3-llllllll 4-llllllll
   Streams:1-ll 2-llllllllllll 3-llllllllllllll 4-ll
   Wetlands:1-llll 2-llll 3-lll 4-lllllllllllllllllll
   Groundwater: 1-lllllllllllllllllllllll 2-ll 3-lll 4-l

3. In your opinion, how polluted is the Lac qui Parle River and its tributaries
   Very:l
   Somewhat:llllllllllllllllll
   Not very:llll
   Not:l
   Don't know:lllll

4. Who is responsible for water quality? (check all that apply)
   Landowners:lllllllllllllllllllll
   State government:llllllllllll
   Federal government:llllllllll
   Local government:llllllllll
   Industry:llllllllllll
   Individuals:lllllllllllllllllll
   Other:lllll

5. Water quality in the Lac qui Parle and its tributaries is most influenced by which of the following?
   Land use practices adjacent to streams:lllll
   Agricultural practices:llllllll
   City Activities:llll
   Mother Nature:llll
   South Dakota:l
   Industrial Activities:l
   All of above:llllllllllllllllllll

6. How concerned are you about the Lac qui Parle River and its tributaries?
Very concerned:llllllllll
Somewhat concerned:llllllllllllllll
Not very concerned:l
Not at all concerned:ll
Don’t know:ll

7. Do you think something should be done to clean up the Lac qui Parle River and tributaries?
Yes:llllllllllllllllllllllll No:llll

8. Who should be most responsible for making decision about clean up the Lac qui Parle River and its tributaries?
Local residents:lllllllllllllllllllllll
Local government:llllllllllllllll
State government:lll
Federal government:l
Other:lll

9. Are you aware of efforts to improve water quality in the Lac qui Parle River and tributaries?
Yes:llllllllllllllllllllllllll No:l Not sure:l

Steps in Watershed Approach

Step 1 - Monitor Lakes/Rivers and Collect Data (2015-2016)
The cycle begins with a two-year intensive monitoring program of lakes and streams by local staff and MPCA staff to help determine the overall health and identify impaired waters. Additional information is collected on watershed's physical characteristics, including land use, topography, soils, and pollution sources.

Step 2 - Assess the Data (2017-2018)
Based on results of monitoring in Step 1, MPCA water quality specialists evaluate the data to determine if water quality standards and designated uses are being met, identify the impaired waters and waters that should be protected, and identify various stressors affecting the aquatic life in our streams.

Step 3 - Develop Strategies to Restore and Protect LqP Lakes and Rivers (2018-2019)
Based on the watershed assessment, a WRAPS Report is developed. The report will provide details on water quality issues and identify what needs to be done to restore impaired streams and lakes and protect those that are at risk of becoming impaired.

Step 4 - Implement Strategies (2019-2024)
Included in this step is to implement the restoration and protection projects in the Lac qui Parle River watershed.

Mary Homan, Project Coordinator
Lac qui Parle-Yellow Bank
Watershed District
LqP County Courthouse
600 6th Street, Suite 7
Madison, MN 56256
mary.homan@lqpco.com
Phone: 320-598-3319
FAX: 320-598-3125
www.lqpybwatershed.org

Project Partners

Lac qui Parle, Yellow Medicine and Lincoln County Environmental Offices

Lac qui Parle, Yellow Medicine and Lincoln County Soil and Water Conservation Districts

Minnesota Pollution Control Agency

Department of Natural Resources

Board of Soil and Water Resources

CLEAN WATER LAND & LEGACY AMENDMENT

This Project is funded by the Clean Water Fund through the MPCA.

Lac qui Parle River Watershed Restoration And Protection Strategies (WRAPS)

About the Watershed Project

The Lac qui Parle River (LqP) headwaters is Lake Hendricks in Lincoln County. The LqP River flows northeasterly through Yellow Medicine and Lac qui Parle Counties where it merges with the Minnesota River. The western border of the watershed is formed by the Coteau des Prairie which creates a dramatic elevation change.

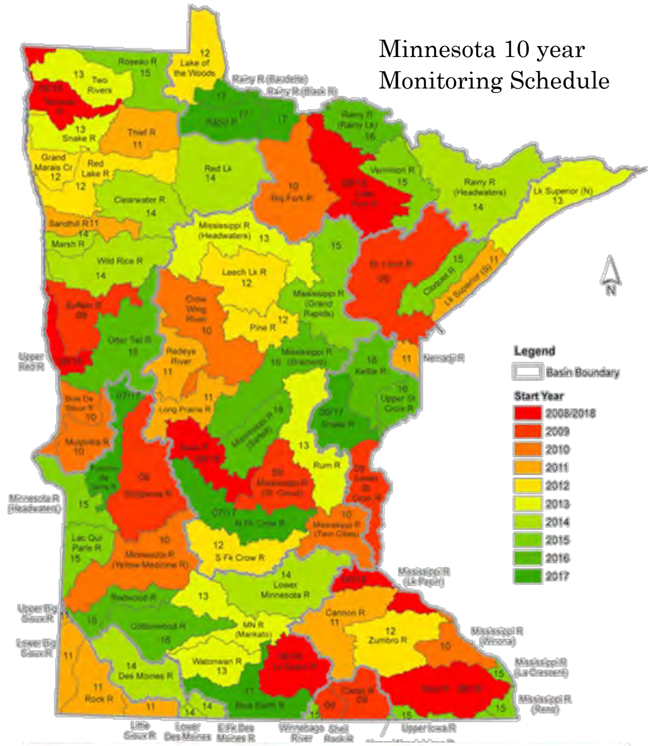
Intensive watershed monitoring will be conducted in 2015 and 2016. Monitoring will include looking at fish and macro invertebrate communities along with water quality samples. Major lakes in the watershed will be also be sampled.

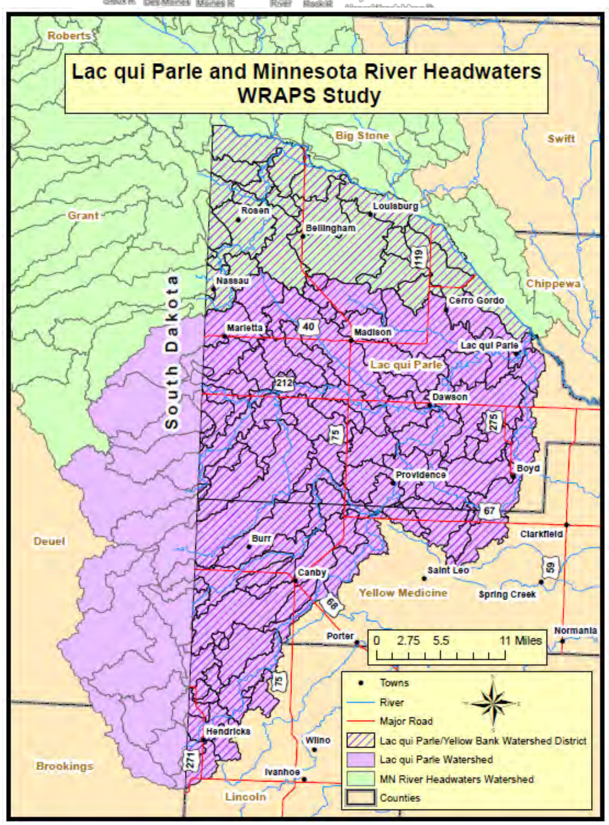
While the Yellow Bank River is part of the Lac qui Parle-Yellow Bank Watershed District it is being studied as part of the Minnesota River Headwaters Restoration and Protection Project.

What are Watersheds

A watershed is an area of land where all of the water that is under it or drains off of it goes into the same place. Watersheds come in all shapes and sizes. They cross county, state and national boundaries. The Lac qui Parle River watershed begins in South Dakota and flows into Minnesota and across Lincoln, Yellow Medicine and Lac qui Parle counties.

Minnesota 10 year Monitoring Schedule





Benefits of Minnesota's 10-Year Watershed Approach

- A predictable cycle for water quality management and evaluation.
- Integrating watershed protection and restoration needs into a single management plan.
- A more efficient approach to addressing water quality impairments.
- A common framework for monitoring and implementing strategies for restoration and protection.
- Improved collaboration and innovation of partnering agencies.
- Future plans will be developed on a watershed scale versus political boundaries that will prioritize restoration and protection of our local water resources.

How Can You be Involved?

- Become a citizen monitor on your favorite lake or nearby stream to provide additional data for this project.
- Sign up for email updates about WRAPS.
- Contact me anytime with your ideas for restoration and protection.

Survey of Implementation Strategies in the Lac qui Parle River Watershed

Houston Engineering, Inc (HEI) wants to make sure the information in the TMDL and WRAPS is useful to the local partners and incorporates current and future local plans into the documents. The following are questions will help develop various sections in the TMDL and WRAPS documents, including **Reasonable Assurances** and **Implementation Strategy Summary** in the TMDL and **Prioritizing and implementing restoration and protection** in the WRAPS document.

1) Local knowledge of the watershed is invaluable to understanding what is happening in the watershed. To make sure important factors are not overlooked, in your opinion, what are the possible causes of the impairments in the watershed. Are there any known issues or local areas of concern (hot spots) as related to the impaired reaches or watershed-wide (e.g. areas where cattle are not restricted in **E. coli** impaired reaches)?

4) Table 1 (below) shows a lists of potential management practices that can be implemented to address water quality/biological impairments. Are there practices not included in Table 1 that are used in the watershed that should be included or you feel are missing? Are there any practices that are included in Table 1 that should not be included? What practices are already used in the watershed (at any level)? Are there preferred practices commonly implemented in the watershed? Practices not preferred?

Instructions for Tables:

1. **Rank parameters 1 – 7 with 7 being the most important to focus on and 1 the least.**

2. **Assign a value from 1 to 4 in each box in the Description column containing related BMPs as it relates to the Parameter with the following scale:**
   4 – Very High Priority 3 – High Priority 2 – Medium Priority 1 – Low Priority

3. **Assign a value to each box in the Example BMP/action column as it relates to the associated Parameter with the following scale:**

   4 – Very High Priority 3 – High Priority 2 – Medium Priority 1 – Low Priority

Survey of Implementation Strategies in the Lac qui Parle River Watershed

Table 1. Potential Management Practices

Parameter (include non-pollutant stressors)	Strategy key	
	Description	**Example BMPs/actions**
Total Suspended Solids (TSS)	**Improve upland/field surface runoff controls:** Soil and water conservation practices that reduce soil erosion and field runoff, or otherwise minimize sediment from leaving farmland.	Cover crops
		Water and sediment basins, terraces
		Rotations including perennials
		Conservation cover easements
		Grassed waterways
		Strategies to reduce flow – some of flow reduction strategies should be targeted to ravine subwatersheds
		Residue management – conservation tillage
		Forage and biomass planting
		Open tile inlet controls – riser pipes, french drains
		Contour farming
		Field edge buffers, borders, windbreaks and/or filter strips
		Stripcropping
	Protect/stabilize banks/bluffs: Reduce collapse of bluffs and erosion of streambank by reducing peak river flows and using vegetation to stabilize these areas.	Strategies for altered hydrology (reducing peak flow)
		Streambank stabilization
		Riparian forest buffer
		Livestock exclusion – controlled stream crossings
	Stabilize ravines: Reducing erosion of ravines by dispersing and infiltrating field runoff and increasing vegetative cover near ravines. Also may include earthwork/regrading and revegetation of ravine.	Field edge buffers, borders, windbreaks and/or filter strips
		Contour farming and contour buffer strips
		Diversions
		Water and sediment control basin
		Terrace

Survey of Implementation Strategies in the Lac qui Parle River Watershed

Parameter (include non-pollutant stressors)	Strategy key	
	Description	**Example BMPs/actions**
		Conservation crop rotation
		Cover crop
		Residue management – conservation tillage
	Stream channel restoration	Addressing road crossings (direct erosion) and floodplain cut-offs
		Clear water discharge: urban areas, ag tiling etc. – direct energy dissipation
		Two-stage ditches
		Large-scale restoration – channel dimensions match current hydrology and sediment loads, connect the floodplain, stable pattern, (natural channel design principals)
		Stream channel restoration using vertical energy dissipation: step pool morphology
Nitrogen (TN) or Nitrate	**Increase fertilizer and manure efficiency:** Adding fertilizer and manure additions at rates and ways that maximize crop uptake while minimizing leaching losses to waters	Nitrogen rates at maximum return to nitrogen (U of MN rec's)
		Timing of application closer to crop use (spring or split applications)
		Nitrification inhibitors
		Manure application based on nutrient testing, calibrated equipment, recommended rates, etc.
	Store and treat tile drainage waters: Managing tile drainage waters so that nitrate can be denitrified or so that water volumes and loads from tile drains are reduced	Saturated buffers
		Restored or constructed wetlands
		Controlled drainage
		Woodchip bioreactors
		Two-stage ditch
	Increase vegetative cover/root duration: Planting crops and vegetation that maximize vegetative cover and capturing of soil nitrate by roots during the spring, summer and fall.	Conservation cover (easements/buffers of native grass and trees, pollinator habitat)
		Perennials grown on marginal lands and riparian lands
		Cover crops
		Rotations that include perennials
		Crop conversion to low nutrient-demanding crops (e.g., hay).

Survey of Implementation Strategies in the Lac qui Parle River Watershed

Parameter (include non-pollutant stressors)	Strategy key	
	Description	**Example BMPs/actions**
Phosphorus (TP)	**Improve upland/field surface runoff controls:** Soil and water conservation practices that reduce soil erosion and field runoff, or otherwise minimize sediment from leaving farmland	Strategies to reduce sediment from fields (see above - upland field surface runoff)
		Constructed wetlands
		Pasture management
	Reduce bank/bluff/ravine erosion	Strategies to reduce TSS from banks/bluffs/ravines (see above for sediment)
	Increase vegetative cover/root duration: Planting crops and vegetation that maximize vegetative cover and minimize erosion and soil losses to waters, especially during the spring and fall.	Conservation cover (easements/buffers of native grass and trees, pollinator habitat)
		Perennials grown on marginal lands and riparian lands
		Cover crops
		Rotations that include perennials
	Preventing feedlot runoff: Using manure storage, water diversions, reduced lot sizes and vegetative filter strips to reduce open lot phosphorus losses	Open lot runoff management to meet Minn. R. 7020 rules
		Manure storage in ways that prevent runoff
	Improve fertilizer and manure application management: Applying phosphorus fertilizer and manure onto soils where it is most needed using techniques that limit exposure of phosphorus to rainfall and runoff.	Soil P testing and applying nutrients on fields needing phosphorus
		Incorporating/injecting nutrients below the soil
		Manure application meeting all 7020 rule setback requirements
	Address failing septic systems: Fixing septic systems so that on-site sewage is not released to surface waters. Includes straight pipes.	Eliminating straight pipes, surface seepages
	Reduce Industrial/Municipal wastewater TP	Municipal and industrial treatment of wastewater P
		Upgrades/expansion. Address inflow/infiltration.
	Treat tile drainage waters: Treating tile drainage waters to reduce phosphorus entering water by running water through a medium which captures phosphorus	Phosphorus-removing treatment systems, including bioreactors
E. coli	**Reducing livestock bacteria in surface runoff:** Preventing	Strategies to reduce field TSS (applied to manured fields, see above)

Survey of Implementation Strategies in the Lac qui Parle River Watershed

Parameter (include non-pollutant stressors)	**Strategy key**	
	Description	**Example BMPs/actions**
	manure from entering streams by keeping it in storage or below the soil surface and by limiting access of animals to waters.	Improved field manure (nutrient) management
		Adhere/increase application setbacks
		Improve feedlot runoff control
		Animal mortality facility
		Manure spreading setbacks and incorporation near wells and sinkholes
		Rotational grazing and livestock exclusion (pasture management)
	Address failing septic systems: Fixing septic systems so that on-site sewage is not released to surface waters. Includes straight pipes.	Replace failing septic (SSTS) systems
		Maintain septic (SSTS) systems
Dissolved Oxygen	**Reduce phosphorus**	See strategies above for reducing phosphorus
	Increase river flow during low flow years	See strategies above for altered hydrology
	In-channel restoration: Actions to address altered portions of streams.	Goal of channel stability: transporting the water and sediment of a watershed without aggrading or degrading.
		Restore riffle substrate
Altered hydrology; peak flow and/or low base flow (Fish/Macroinvertebrate IBI)	**Increase living cover:** Planting crops and vegetation that maximize vegetative cover and evapotranspiration especially during the high flow spring months.	Grassed waterways
		Cover crops
		Conservation cover (easements and buffers of native grass and trees, pollinator habitat)
		Rotations including perennials
	Improve drainage management: Managing drainage waters to store tile drainage waters in fields or at constructed collection points and releasing stored waters after peak flow periods.	Treatment wetlands
		Restored wetlands
	Reduce rural runoff by increasing infiltration: Decrease surface runoff contributions to peak flow through soil and water conservation practices.	Conservation tillage (no-till or strip till w/ high residue)
		Water and sediment basins, terraces

Survey of Implementation Strategies in the Lac qui Parle River Watershed

Parameter (include non-pollutant stressors)	Strategy key	
	Description	**Example BMPs/actions**
	Improve irrigation water management: Increase groundwater contributions to surface waters by withdrawing less water for irrigation or other purposes.	Groundwater pumping reductions and irrigation management
Poor habitat (Fish/Macroinvertebrate IBI)	**Improve riparian vegetation:** Planting and improving perennial vegetation in riparian areas to stabilize soil, filter pollutants and increase biodiversity	50' vegetated buffer on waterways
		One rod ditch buffers
		Lake shoreland buffers
		Increase conservation cover: in/near water bodies, to create corridors
		Improve/increase natural habitat in riparian, control invasive species
		Tree planting to increase shading
		Streambank and shoreline protection/stabilization
		Wetland restoration
		Accurately size bridges and culverts to improve stream stability
	Restore/enhance channel: Various restoration efforts largely aimed at providing substrate and natural stream morphology.	Retrofit dams with multi-level intakes
		Restore riffle substrate
		Two-stage ditch
		Dam operation to mimic natural conditions
		Restore natural meander and complexity
	Improve riparian vegetation: Actions primarily to increase shading, but also some infiltration of surface runoff.	Riparian vegetative buffers
		Tree planting to increase shading

LAC QUI PARLE YELLOW BANK
WATERSHED DISTRICT

Family Fun Event At Stonehill Park

* Join in on a fun day full of water based games and activities at Stonehill Park on Del Clark Lake. Kayaking, water balloon toss, cannonballing, water relay, and an education station (including aquatic robots!) are a few of the fun times, and don't forget the large swimming beach! Prizes and refreshments available.

August 19th, 2019, 3 to 7 p.m.

Stonehill Park on Del Clark Lake
1801 Co Rd 30, Canby, MN 56220

Contact Mitch Enderson with questions
mitch.enderson@lqpco.com
320-598-3319

CLEAN WATER LAND & LEGACY AMENDMENT

Family Fun Evening Directions

- Enjoy all the activities, including:
  - Get your strip in your folder stamped at the Water Relay, Balloon Toss, and the Education Station and redeem for a prize!
  - Water Relay:
    - Find someone to race against
    - Soak your sponge and race to the bucket on the opposite end
    - Drain your sponge into the bucket and race back to soak again
    - Repeat until your bucket is filled up, first one done wins!
  - Water Balloon Distance Toss
    - Find a partner
    - One person stands at the starting flag
    - The other person will continue to back up to the next flag until the balloon pops.
  - Education Station
    - Complete the short quiz in your folder to earn your stamp
    - Don't forget to check out the aquatic robot!
  - Kayak Rides
    - Wear a lifejacket!
  - Cannonballs off the pier
  - Swimming at the beach
  - Have a hotdog and beverage!

Education Station Quiz

1. What does WRAPS stand for?

____

2. Does the DNR stock trout anywhere in the Lac qui Parle Watershed?

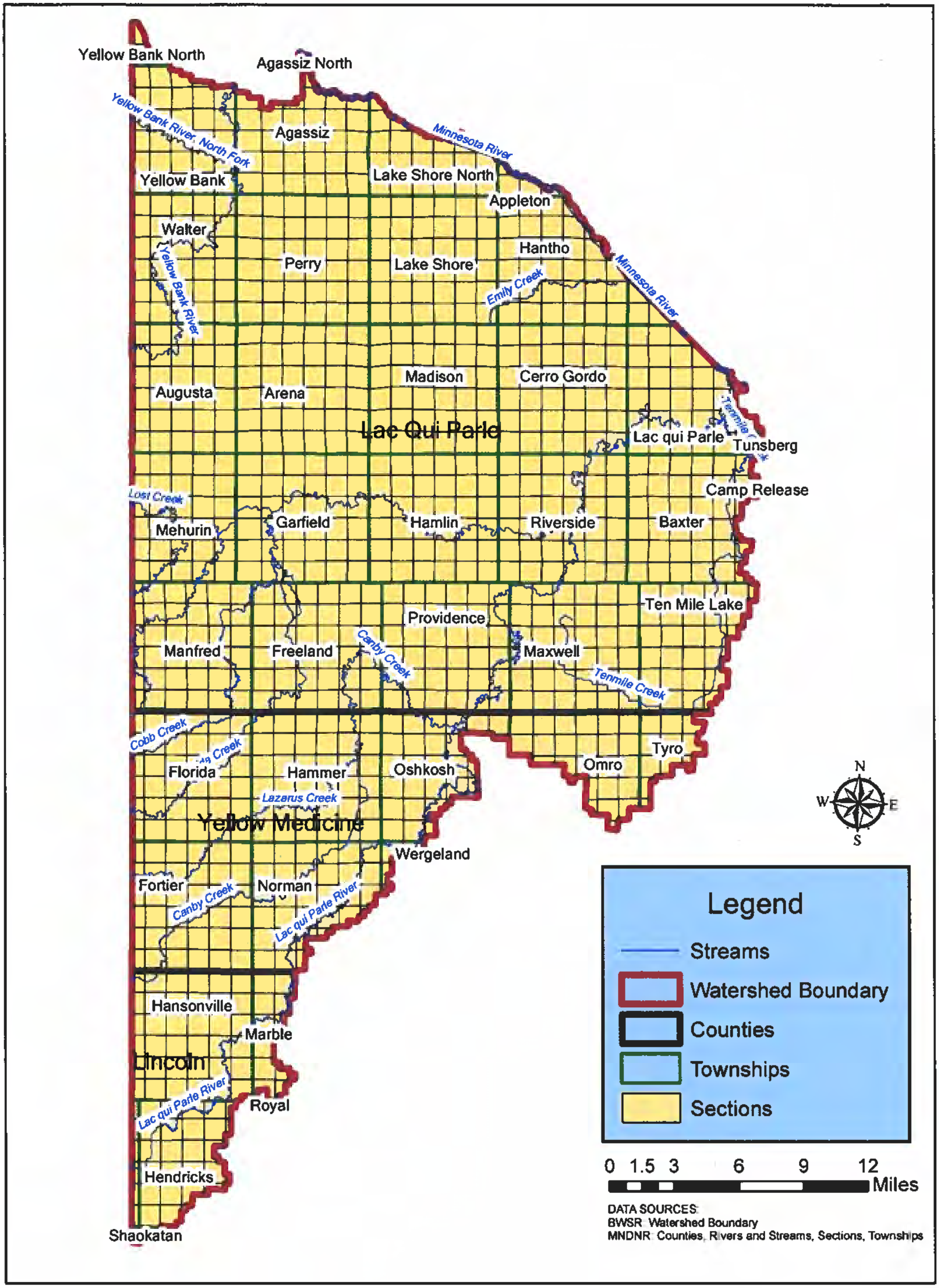
   Yes   No

3. What is the only current waterbody in the Lac qui Parle Watershed that is in Full Support of Aquatic Recreation?

A. Canby Creek
B. Lake Hendricks
C. Del Clark Lake
D. Lac qui Parle River

4. What are zebra mussels? (choose all that apply)

A. Strong parts of the body that help zebras run
B. Small, clam-like animals that have striped shells
C. Horses that live around the lake
D. An aquatic invasive species in Minnesota


Yellow Bank North
Agassiz North
Yellow Bank River, North Fork
Agassiz
Minnesota River
Lake Shore North
Yellow Bank
Appleton
Walter
Hantho
Yellow Bank River
Perry
Lake Shore
Emily Creek
Minnesota River
Madison
Cerro Gordo
Augusta
Arena
Lac Qui Parle
Lac qui Parle
Tunsberg
Camp Release
Lost Creek
Mehurin
Garfield
Hamlin
Riverside
Baxter
Ten Mile Lake
Providence
Canby Creek
Manfred
Freeland
Maxwell
Tenmile Creek
Cobb Creek
Tyro
Florida
Hammer
Oshkosh
Omro
Lazarus Creek
Yellow Medicine
Wergeland
Fortier
Canby Creek
Norman
Lac qui Parle River
Hansonville
Marble
Lincoln
Lac qui Parle River
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Counties
Townships
Sections
0 1.5 3 6 9 12
Miles
DATA SOURCES:
BWSR: Watershed Boundary
MNDNR: Counties, Rivers and Streams, Sections, Townships

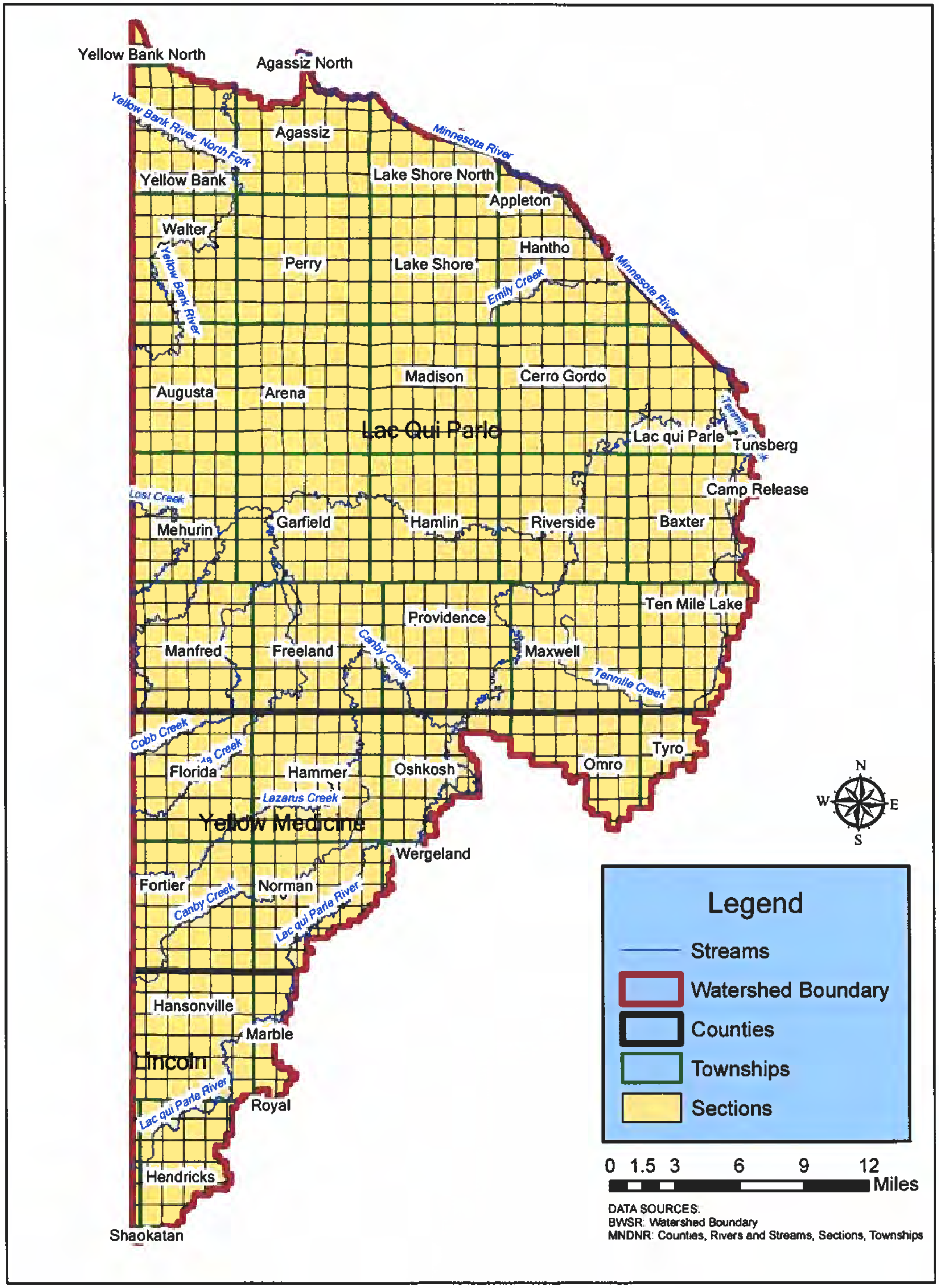
Lac qui Parle Yellow Bank
Watershed District

Lac qui Parle Yellow Bank
Watershed District

- The Watershed District was formed in 1972 to assist with issues caused by flooding
- There is approximately 1,708 square miles in the watershed, with 719 square miles located in South Dakota
- The Lac qui Parle River originates as the outlet for Lake Hendricks in Hendricks, MN and flows northeast until it reaches the MN River
- The Yellow Bank River originates near Southshore, SD
- The Watershed's mission is to: Serve as a partner in water planning and management with the state agencies, counties, cities, and Soil and Water Conservation Districts, and assist with the management of water quality and quantity within Lac qui Parle—Yellow Bank Watershed boundaries.
- The Watershed lies within portions of three counties: Lac qui Parle - 74%, Yellow Medicine - 19%, and Lincoln - 7%
- The Lac qui Parle river is part of the MN River basin

Lac qui Parle Yellow Bank
Watershed District

Lac qui Parle Yellow Bank
Watershed District


Yellow Bank North
Agassiz North
Yellow Bank River, North Fork
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Minnesota River
Yellow Bank
Lake Shore North
Appleton
Walter
Hantho
Perry
Lake Shore
Yellow Bank River
Emily Creek
Minnesota River
Madison
Cerro Gordo
Augusta
Arena
Lac Qui Parle
Lac qui Parle
Tunsberg
Lost Creek
Camp Release
Mehurin
Garfield
Hamlin
Riverside
Baxter
Ten Mile Lake
Providence
Manfred
Freeland
Canby Creek
Maxwell
Tenmile Creek
Cobb Creek
Tyro
Florida
Hammer
Oshkosh
Omro
Lazarus Creek
Yellow Medicine
Wergeland
Fortier
Norman
Canby Creek
Lac qui Parle River
Hansonville
Marble
Lincoln
Lac qui Parle River
Royal
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LAC QUI PARLE YELLOW BANK
WATERSHED DISTRICT

LAC QUI PARLE YELLOW BANK
WATERSHED DISTRICT

Watershed Restoration And Protection Strategies (WRAPS)

WRAPS is a four step, 10 year cycle to assess the health of the Watershed and develop strategies that will help restore impaired waters and protect unimpaired waters

Step 1: Intensive water monitoring and assessment to see if major rivers and lakes meet water quality standards

Step 2: Identify conditions that stress fish and bugs as well as healthy conditions that foster them

Step 3: Develop restoration and protection strategies (Scheduled completion June 2020 for LqP River)

Step 4: Implement changes to restore and protect waters through local water plans

As part of involving and gaining public input in the development of WRAPS, the Watershed hosts an assortment of public engagement events, including today's demonstrations.

Secchi Tube Instructions

*Do not wear sunglasses while taking a measurement, as this affects the accuracy of your reading. If you wear photo gradient prescription sunglasses, please prevent them from darkening by wearing a hat or visor with a wide rim.

1. Collect your water sample in a clean bucket or bottle at mid-stream and depth. A clean paint bucket from your local hardware store works well. Here are the two most common methods for water collection.
    a. Wading or from streambank: Always sample safely - do not wade into fastmoving water or areas of unknown depth. If you cannot sample safely, record visual observations only (Appearance, Recreational suitability, Estimated Stream stage). If a sample from mid-stream and depth is not possible, avoid stagnant water and sample as far from the shoreline as is safe.
        - Try not to stir up the bottom
        - Face upstream as you fill your bucket
        - Avoid collecting sediment from the stream bottom and materials floating on the water surface

    b. From atop a bridge or culvert:
        - With a rope tied to its handle, lower a bucket to the stream to collect water
        - Pull the bucket back up, taking care not to bounce the rope or bucket on the side of the bridge / culvert
2. Take your tube readings in open conditions (not shady). Avoid direct sunlight by turning your back to the sun if necessary. Do not wear sunglasses.
3. Pull up the inside string to remove the black and white Secchi disk from the tube.
4. Fill the tube with water from your bucket. Let the water level drain to the zero mark on the tape measure.
5. While looking down into your tube from the top, slowly lower the Secchi disk down into it until the disk disappears from sight. When it does, stop lowering.
6. While continuing to look down the top of the tube, slowly pull the string to raise the disk until it reappears. Lower and raise the disk until you have found the midpoint between disappearance and reappearance of the disk.
7. Pinch the string against the side of the tube to hold the disk at the midpoint depth. Look at the side of the tube, across the top of the disk, to see the closest centimeter mark on the tape.

Getting signed up with Citizen Monitoring:

https://www.pca.state.mn.us/water/citizen-water-monitoring

https://www.pca.state.mn.us/sites/default/files/wq-csm1-05.pdf

Can anyone be a citizen water monitor?

Yes! No prior experience or training is needed. Lake monitors need access to a boat, canoe or kayak; stream monitors access their sites from a streambank or bridge crossing.

What do citizen water monitors do?

Volunteers conduct water clarity tests at least twice a month each summer at designated locations on lakes or streams. To determine water clarity, volunteers find the disappearance/reappearance point of a Secchi disk as it descends into a lake or a specially designed stream collection tube. Volunteers submit their readings at the end of each monitoring season.

Why monitor water clarity?

Water clarity is an important indicator of lake and stream health. It signifies the amount of algae or sediment in the water, which can affect plant, insect, and fish communities and impact recreational opportunities. Long-term monitoring by volunteers can detect declines or improvement in quality of a lake or stream.

Are the data volunteers collect useful?

Yes! Volunteer-collected data help government agencies and municipalities make decisions on protecting and restoring lakes and streams across the state.

The MPCA uses volunteer-collected data in two important ways:

- To detect trends in water clarity over time. Increases or decreases in water clarity may indicate changes in water quality on a lake or stream.
- To formally assess the health of lakes and streams by comparing them to state water quality standards. Lakes and streams that fail to meet water quality standards are categorized as impaired and require restoration to improve their overall health.
    - For lakes, volunteer water clarity readings help determine if swimming standards are being met by combining them with phosphorus and chlorophyll-a (algae) data.

- For streams, volunteer water clarity readings help determine if sediment standards are being met.

What do you get out of the program?

You will be part of a community of citizen scientists from across the state that is passionate about water quality and focused on protecting our state's water resources. You will also receive:

- First-hand knowledge of your lake or stream's condition
- Annual online monitoring site reports detailing the data you collect
- Program newsletters
- Notification of local watershed efforts that may affect your lake or stream
- Access to experts working on water quality issues in the state

Program goals

- Help determine the condition of Minnesota lakes and streams by expanding the state water-quality monitoring network.
- Provide the opportunity to any Minnesota resident interested in water quality to participate in a basic, centrally administered water monitoring program.
- Support existing volunteer monitoring programs.
- Facilitate understanding of water-quality issues, and promote shared responsibility for protection of Minnesota's water resources.

Contact mitch.enderson@lqpco.com if interested in becoming a Citizen Monitor.

Athericidae

Common Name: Aquatic Snipe Flies
Feeding Group: Predators
Tolerance Value: 2 (Low)
Habitat: Athericid larvae are most commonly found under rocks in the riffles of streams.


Figure 13.66: Athericidae larva, Lateral View.

Size: Medium (10-18 mm)
Characteristics: Body elongate; head reduced and withdrawn into the thorax although some parts may be visible; mandibles moving parallel to each other on a vertical plane; a pair of prolegs present on abdominal segments 1-7 and a single proleg on abdominal segment 8; abdomen terminates in two pointed tails fringed with hairs.
Notes: Athericid larvae are piercer predators that prey on aquatic insects such as chironomids and Ephemeroptera. Egg-laying in this family is curious. The female finds a twig over-hanging a stream and lays an egg mass. She then stays with the eggs until she dies. Other females are attracted to the same spot and a clump of dead flies and egg masses eventually accumulates. When the larvae hatch they must crawl through the mass of fly carcasses in order to drop into the stream below.

Baetidae

Common Name: Small Minnow Mayflies
Feeding Group: Collector/Gatherers, Scrapers
Tolerance Value: 4 (Moderate)
Habitat: These mayfly larvae are found in a variety of habitats and are widespread in the Upper Midwest. Some are found in streams of moderate current or in areas of slack water. Other species are primarily restricted to lakes and ponds.
Size: Small to Medium (3-12 mm)
Characteristics: Antennae in most genera 2-3x longer than the width of the head; gills present on abdominal segments 1 or 2 through 7; gill shape variable; 2-3 caudal filaments present.
Notes: These mayflies are often very small and sometimes very abundant when conditions permit. Most baetid mayflies are good swimmers, hence the name minnow mayfly. Some species can be very common in polluted streams.

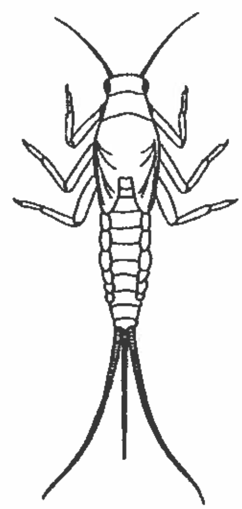
Figure 4.41: Generalized Baetidae larva, Dorsal View.

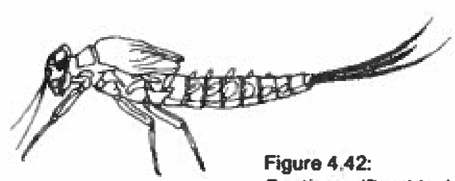
Figure 4.42: *Baetis* sp. (Baetidae) larva, Lateral View.

Caenidae

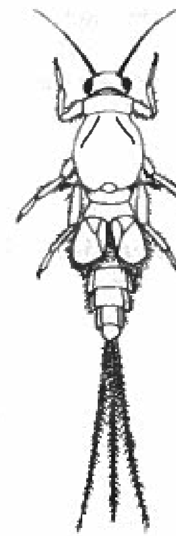

Figure 4.44:
Caenis sp. (Caenidae) larva, Dorsal View.

Common Name: Small Square-Gill Mayflies

Feeding Group: Collector/Gatherers, Scrapers

Tolerance Value: 7 (High)

Habitat: Caenid mayfly larvae occur in streams in areas of slow current, at the edges of lakes, and in wetlands.

Size: Small (2-8 mm)

Characteristics: Gills on abdominal segment 1 vestigial (small and finger-like); gills on abdominal segment 2 square operculate (plate-like) and covering succeeding gills; operculate gills touch or overlap at midline; fringed gills present on abdominal segments 3-6; setae on caudal filaments restricted to apex of each annulation.

Notes: The operculate gills do not take up dissolved oxygen, but instead are used to cover and protect the other gills, which absorb dissolved oxygen from the water. Since these mayflies occur in areas where the current is slow, sediment can rapidly settle on the gills and prevent dissolved oxygen uptake. In order to keep their gills free of sediment, caenid mayflies wave their operculate gills.

Chironomidae

Common Name: Non-Biting Midges
Feeding Group: Collector/Gatherers (also Scrapers, Filter/Collectors, Predators)
Tolerance Value: 6 (Moderate) - pale forms; 8 (High) - blood red
Habitat: Chironomids are found in every aquatic habitat from small seeps to large rivers and from temporary pools to deep lakes. They occur in soft sediment, on rocks, in and around vegetation, in snags, and just about any other habitat.
Size: Small to large (2-30 mm)
Characteristics: Head sclerotized, rounded, and clearly separate from the thorax; body elongate and worm-like; mandibles moving against each other on a horizontal plane; two pairs of ventral prolegs (one on prothorax and one at the terminal end); prolegs terminate in a series of hooks.
Notes: Chironomids are the most abundant and diverse group of aquatic insects. They are found in almost any water body and it is common for chironomids to comprise more than 50% of the species richness. Some kinds of chironomids are blood red (this color is lost when the specimen is preserved). The red coloration comes from hemoglobin that allows the larvae to store oxygen and survive in situations with low dissolved oxygen. Chironomids are an important food source for insects, fishes, and birds.

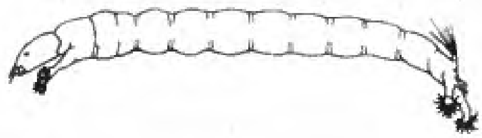

Figure 13.72: ***Ablabesmyia* sp. (Chironomidae) larva, Lateral View.**

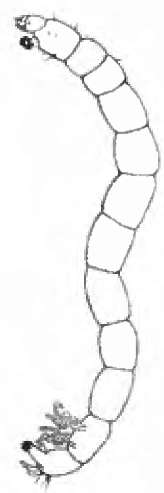

Figure 13.73: ***Chironomus tentans* (Chironomidae) larva, Lateral View.**

Common Name: Riffle Beetles
Feeding Group: Scrapers
Tolerance Value: 5 (Moderate)
Habitat: Elmid beetles occur in the swift areas of streams (most commonly in cool waters) generally under rocks or logs. They are also sometimes found along the wave washed shores of lakes.
Size: **Larvae:** Small (3-8 mm). **Adults:** Small (1-8 mm)
Characteristics: **Larvae:** Legs with four segments and terminating in a single claw; 9 abdominal segments; abdominal segment with cavity containing gills that is protected by hinged lid. **Adults:** Hard bodied; antennae usually slender (sometimes clubbed); elytra with rows of indentations; legs are long compared to body.
Notes: Riffle beetles are one of the few beetle groups that live completely underwater in all life stages. They are sometimes difficult to see in the field due to their small size and slow movements. After emerging, the adults generally fly for a short period of time before returning to the water. Once the adults enter the water they do not fly again and over time their wings waste away. Because elmids do not breathe atmospheric oxygen, many species require waters with high oxygen contents. These species are usually limited to fast-flowing streams with cool waters.

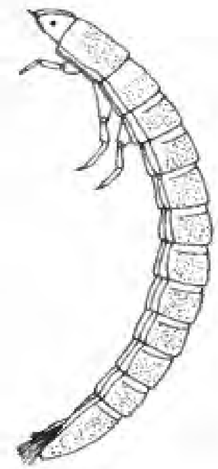

Figure 12.30: Elmidae larva, Lateral View.

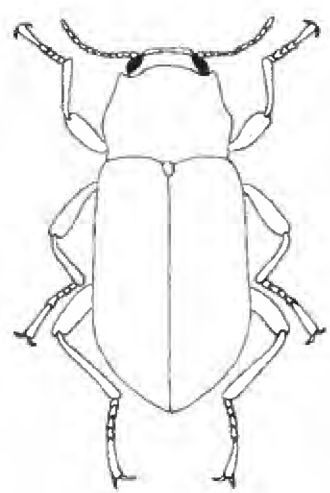

Figure 12.31: *Ordobrevia* sp. (Elmidae) adult, Dorsal View.

Ephemeridae

Common Name: Common Burrowing Mayflies
Feeding Group: Collector/Gatherers
Tolerance Value: 4 (Moderate)
Habitat: Ephemerid mayflies are found in the soft silt or sand of streams and lakes.
Size: Medium to Large (10-32 mm)
Characteristics: Upturned mandibular tusks present; frontal process between antennae; fore legs modified (widened) for burrowing; gills present on segments 1-7; gills on segment 1 are small (vestigial) and simple; gills on segments 2-7 forked with fringed margins (feathered) and held over the abdomen.
Notes: Ephemerid mayflies make U-shaped burrows in soft sediments. Within this burrow these mayflies generate flow through the burrow by moving their gills. This current brings dissolved oxygen and food particles into the burrow. When the adults emerge on warm summer evenings they can cause problems as they can cover bridges, buildings, and vehicles near lakes and streams where they occur. In some cases, there are so many mayflies that driving can be slick and snowplows may be used to move piles of dead mayflies from bridges.

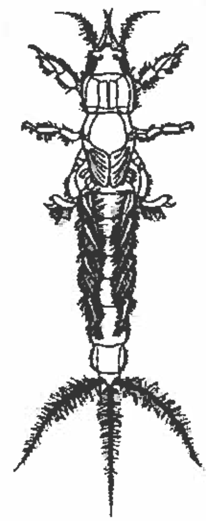

Figure 4.46: *Hexagenia limbata* (Ephemeridae) larva, Dorsal View.

Heptageniidae

Common Name: Flathead Mayflies
Feeding Group: Scrapers
Tolerance Value: 4 (Moderate)
Habitat: Flathead mayflies are most common in slow to fast flowing streams where they occur on the surface of rocks, logs, vegetation, and leaves.
Size: Small to large (5-20 mm)
Characteristics: Body, head, and legs (femora) flattened; mouthparts not visible from dorsal view; gills present on abdominal segments 1-7; only short setae present on caudal filaments.
Notes: Flathead mayflies are very common in streams in the Upper Midwest. They are well adapted for swift flowing waters. Their bodies, head, and legs are flattened which reduces drag by forcing water over the organism. Most of these mayflies feed on algae and microorganisms growing on rocks. One genus of heptageniid mayfly has only two tails, but can be separated from stoneflies by the presence of a single tarsal claw at the end of each leg.

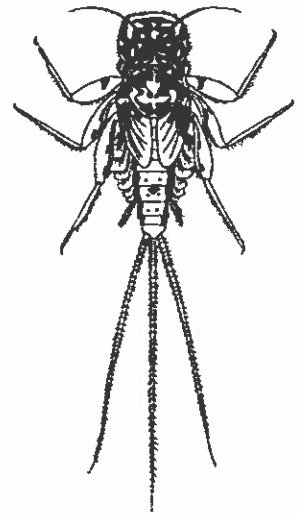

Figure 4.47: *Stenonema exiguum* (Heptageniidae) larva, Dorsal View.

Hydropsychidae

Common Name: Common Net-Spinner Caddisflies
Feeding Group: Collector/Filterers
Tolerance Value: 4 (Moderate)
Habitat: Hydropsychid caddisflies are restricted to flowing waters, from small spring streams to large rivers. They are most commonly collected from areas with cobble or bedrock substrate where solid structures are available on which to attach their nets. They can also be common on large woody debris and submerged vegetation.
Size: Medium to Large (9-30 mm)
Characteristics: The nota (tops) of all thoracic segments with sclerotized plates; most abdominal segments with tufts of finely branched gills; anal prolegs terminating in a brush of long setae.
Notes: These caddisflies build tubular retreats and spin silk nets nearby which are used to collect detritus from the water. From time to time they extend their heads from their retreats and glean material that has collected in the net. Hydropsychid caddisflies defend their retreats. In some situations, such as below pond outflows and downstream of sewage treatment plants, they can reach large densities.

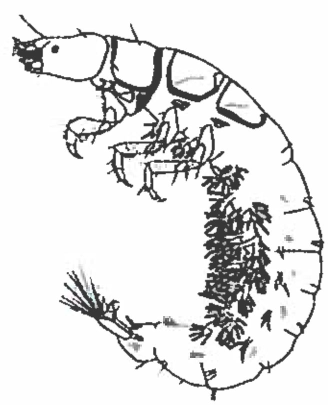

Figure 10.51: *Cheumatopsyche pettiti* (Hydropsychidae) larva, Lateral View.

Leptoceridae

Common Name: Long-Horned Case-Maker Caddisflies
Feeding Group: Collector/Gatherers, Shredders
Tolerance Value: 4 (Moderate)
Habitat: Leptocerid caddisfly larvae are common in all types of freshwaters, but they are most common in standing waters such as marshes, ponds, and lakes.
Size: Small to Medium (7-15 mm)
Characteristics: Antennae relatively long and prominent (length at least 6x width) in most species (*exception*: in the genus *Ceraclea* the antennae are short but a pair of dark lines on the posterior of the mesonotum separate this taxon from other caddisflies); pronotum and mesonotum sclerotized (lightly sclerotized on mesonotum); metanotum mostly membranous usually with small sclerites; hind legs longer than fore and middle legs; abdominal gills variable (usually simple).
Notes: These caddisflies build cases from a variety of materials including sand, rock particles, silk, plant fragments, and freshwater sponge spicules. The shapes and sizes of these cases also vary considerably. Some species are free-swimming and use their long, setose legs to propel them and their lightweight case.

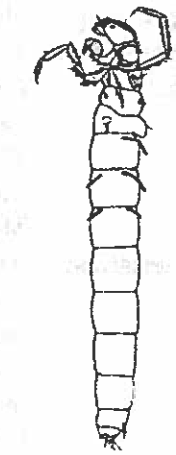

Figure 10.54: *Nectopsyche intervena* (Leptoceridae) larva, Lateral View.

Leptophlebiidae

Common Name: Prong-Gilled Mayflies
Feeding Group: Collector/Gatherers
Tolerance Value: 2 (Low)
Habitat: The larvae of prong-gilled mayflies occur in a variety of habitats including lakes, ponds, and swift and slow flowing streams. They are found on rocks and gravel, leaf packs, and submerged roots.
Size: Small to medium (4-15 mm)
Characteristics: Gills on first abdominal segment usually slender and finger-like; gills on abdominal segments 2-7 forked with variable shape (consisting of slender filaments, or broad and ending in slender filaments); setae on caudal filaments present at apex of each segment.
Notes: A common distinguishing characteristic of leptophlebiid mayflies is the presence of forked gills. Unfortunately, these gills are commonly broken off making identification difficult.

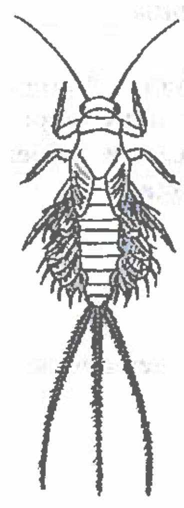

Figure 4.49: *Leptophlebia* sp. (Leptophlebiidae) larva, Dorsal View.

Limnephilidae

Common Name: Northern Case-Maker Caddisflies
Feeding Group: Shredders
Tolerance Value: 4 (Moderate)
Habitat: Limnephilid larvae occur in a wide range of habitats including small springs, large rivers, lakes, and marshes. They can be found just about anywhere in these habitats such as in snags, on rocks, and in vegetation.
Size: Medium to large (8-35 mm)
Characteristics: Antennae located midway between eye and mandible; prosternal horn present; pronotum and mesonotum heavily sclerotized; metanotum mostly membranous usually with small sclerites; anterior margin of mesonotum not notched at midline; dorsal and lateral humps present on abdominal segment 1; abdominal gills variable; a sclerotized plate present top of abdominal segment nine.
Notes: Limnephilid caddisflies use a variety of materials including sand grains, sticks, and plant fragments to build their cases. The habitat influences the species present and the materials used in case construction. For example, species inhabiting cool flowing waters generally construct cases from mineral materials, whereas species in slow-moving warm waters often construct cases from vegetative material.

Figure 10.55: *Hesperophylax designatus* (Limnephilidae) larva, Lateral View.

Perlidae

Common Name: Common Stoneflies
Feeding Group: Predators
Tolerance Value: 1 (Low)
Habitat: The larvae of this family are found in streams and rivers of all sizes. They are commonly found under logs and stones and in snags where an abundance of prey can be found.
Size: Large (20-50 mm)
Characteristics: These relatively large larvae are usually strikingly patterned; finely branched gills are present on all 3 thoracic segments (absent from abdominal segments 1-2); labium with deep notch and paraglossa extending beyond glossa; labial palps slender.
Notes: Common stonefly larvae require 1-3 years to mature depending on their geographic location.

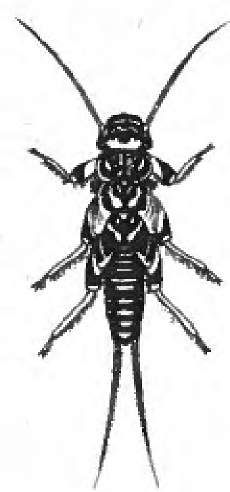

Figure 6.35: *Acroneuria carolinensis* (Perlidae) larva, Dorsal View.

Potamanthidae

Common Name: Hacklegill Mayflies
Feeding Group: Collector/Filterers
Tolerance Value: 4 (Moderate)
Habitat: Potamanthids generally occur in moderate to fast flowing streams and rivers.
Size: Medium (8-15 mm)
Characteristics: Mandibular tusks present; fore legs slender (not modified for burrowing); gills held laterally; feathery gills present on segments 1-7; gills on segment 1 are small (vestigial) and simple; gills on segments 2-7 forked with fringed margins and held laterally; caudal filaments fringed with hairs.
Notes: The young larvae of potamanthids are burrowers in soft silt, but as the larvae mature they move to erosional habitats with cobble and gravel where they can be found on rocks. The potamanthid mayflies are closely related to other burrowing mayflies (Ephemeridae and Polymitarcyidae), but their fore legs are not adapted for burrowing.

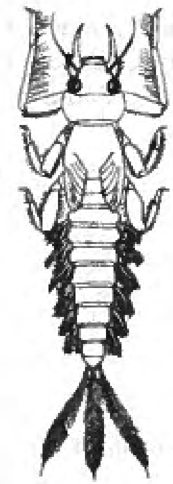

Figure 4.52: ***Potamanthus* sp. (Potamanthidae) larva, Dorsal View.**

Simuliidae

Common Name: Black Flies, Buffalo Gnats
Feeding Group: Collector/Filterers
Tolerance Value: 6 (Moderate)
Habitat: Black fly larvae occur in streams and rivers in areas of moderate to fast current. They are found attached to rocks, logs, vegetation, or any other solid substrate in the current.

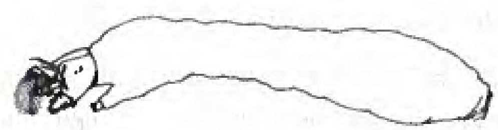

Figure 13.86: ***Simulium venustum* (Simuliidae) larva, Lateral View.**

Size: Small to medium (3-15 mm)
Characteristics: Head sclerotized, rounded, and clearly separate from thorax; pair of labral fans ("mouthbrushes") usually present; mandibles moving against each other on a horizontal plane; proleg present ventrally on prothorax; posterior 1/3 of abdomen swollen; abdomen terminates in a ring of hooks.
Notes: Black flies have a ring of hooks at the terminal end of the abdomen, which enables them to adhere to the substrate and avoid being swept away in the current. At a glance these hooks resemble a suction disc. The hooks are used to cling to a patch of silk, which the larva attaches to the substrate. Black flies use a brush-like structure to filter fine organic matter from the water. These larvae are common in streams of the Upper Midwest and in some situations can reach huge numbers, covering rocks and other substrate in flowing waters. Most adult females are blood feeders on mammals and can be a nuisance in regions where they are extremely abundant.

Tabanidae

Common Name: Horse Flies, Deer Flies
Feeding Group: Predators
Tolerance Value: 6 (Moderate)
Habitat: Tabanid larvae commonly occur in ponds, marshes, and streams. They are usually found burrowing in sediment in areas of standing or slow flow, but some species occur in sand or gravel in the swift portions of streams.

Figure 13.89: *Tabanus reinwardtii* (Tabanidae) larva, Lateral View.

Size: Medium to large (15-60 mm)
Characteristics: Body spindle-shaped with both ends tapering; integument is tough with longitudinal striations; head reduced and withdrawn into the thorax; mandibles moving parallel to each other on a vertical plane; prolegs absent; creeping welts with small hooks present on abdominal segments 1-7 (3-4 welts present on each segment).
Notes: Adult female tabanids are blood sucking and can be a nuisance to humans because of their painful bite. The larvae attack their prey using their hook-like mandibles. Tabanid larvae can give a painful bite when handled carelessly.

Talitridae (Beach Hoppers)

Live near or above the high water mark. During the day they mostly shelter in burrows in the sand or under seaweed washed ashore but at night they hop around in search of detritus.

Tipulidae

Common Name: Crane Flies

Feeding Group: Shredders (also Predators and Collector/Gatherers)

Tolerance Value: 3 (Low)

Habitat: Tipulid larvae can be found in a variety of habitats such as streams, ponds, and marshes. They can be found under rocks, in sand, snags, leaf packs, and algal mats.

Figure 13.90: *Tipula abdominalis* (Tipulidae) larva, Lateral View.

Size: Small to large (3-60 mm)

Characteristics: Much of rounded head capsule present or reduced to only a few rods; head capsule completely or partially retracted into thorax; mandibles moving against each other on a horizontal plane; usually with ventral welts; terminal segment usually with two spiracles; spiracular disc usually surrounded by lobes or projections of varying numbers or shapes.

Notes: Some of the large larvae are very common in leaf packs and are sometimes called "leatherjackets" because of their thick integument. These larvae are very important contributors to stream ecosystems because they break leaves into smaller pieces and make them accessible to other organisms. Adult crane flies look like large mosquitoes, but these insects do not bite.

LAC QUI PARLE-YELLOW BANK WATERSHED TERRAIN ANALYSIS

TECHNICAL DOCUMENT

2015

For targeting conservation and practices within the Lac qui Parle-Yellow Bank Watershed District

CLEAN WATER LAND & LEGACY AMENDMENT

LAC QUI PARLE YELLOW BANK WATERSHED DISTRICT

WRC
WATER RESOURCES CENTER
MINNESOTA STATE UNIVERSITY MANKATO

Contents

Introduction

The Water Resources Center, Minnesota State University, Mankato, completed a terrain analysis of the area encompassed by the Lac qui Parle-Yellow Bank Watershed District. During this analysis, only the portions of the watersheds lying in Minnesota were evaluated. This technical document describes the terrain analysis process and the role the resulting dataset provides to identify opportunity areas for best management practices (BMPs) that help us achieve watershed reduction goals. These focus sites are areas that may be suitable for BMPs such as grassed waterways in critical runoff risk areas and nutrient removal wetlands for water quality and quantity improvements.

A "terrain analysis" uses Geographic Information Systems (GIS) and high resolution topographic data collected using Light Detection and Ranging (LiDAR) technology combined with soil and land use information to identify critical areas across the watershed where nutrient loading, erosion, and sedimentation are greatest due to surface water runoff. This is done through hydromodification of Digital Elevation Model (DEMs) derived from the LiDAR dataset.

Methods

Study Area

The Lac qui Parle–Yellow Bank Watershed District is located in western Minnesota, bordering South Dakota. Due to funding, variations in available data and jurisdictions, only the portions of the watersheds within Minnesota were analyzed. The District manages approximately 988 square miles of area in Minnesota draining to the two rivers, the Lac qui Parle River and the Yellow Bank River. The majority of land use in the District is agricultural with 61% crop land, 10% pasture and range land, as well as forested areas, public wildlife, land, and urban land. The analysis was performed across the District, while a more in-depth analysis was completed within HUC 12 JD19-Lac qui Parle River (070200030102) in the South Branch of the Lac qui Parle River and the HUC 10 Ten Mile Creek Watershed on the eastern edge of the District (Figure 1). Ten Mile Creek is made up of three HUC 12's: 070200030601 (Headwaters), 070200030602 (County Ditch 34), and 070200030603 (Judicial Ditch 8 or Ten Mile Creek). The watershed boundaries referenced during this study were provided by the Minnesota Department of Natural Resources (MnDNR) dataset. These three subwatersheds were selected for a deeper analysis based on local priorities of partnering agencies and citizens in the watershed.

Datasets

As a part of the analysis, GIS datasets were compiled and produced in order to model surface flows across the landscape. When conducting a terrain analysis, it is important to evaluate flow patterns, precipitation intensity, land uses, soil types, proximity to surface water, stream gradient, bluffs and ravines, and slope. The processes and datasets used to conduct the analysis include:

Topographic Data: This project used the 2012 State of Minnesota's Elevation Mapping Project's Light Detection and Ranging (LiDAR) elevation data collected in 1 and 3 meter resolution. This LiDAR data is used to determine a Digital Elevation Model (DEM) that has the spatial resolution of 3 by 3 meters. In this study, a 3 meter LiDAR dataset was used to reduce processing time and file sizes, while still producing a high level of elevation data (Galzki et al. 2011). Elevation data was downloaded from Minnesota Department of Natural Resources (MnDNR) MnTOPO website: http://arcgis.dnr.state.mn.us/maps/mntopo/.

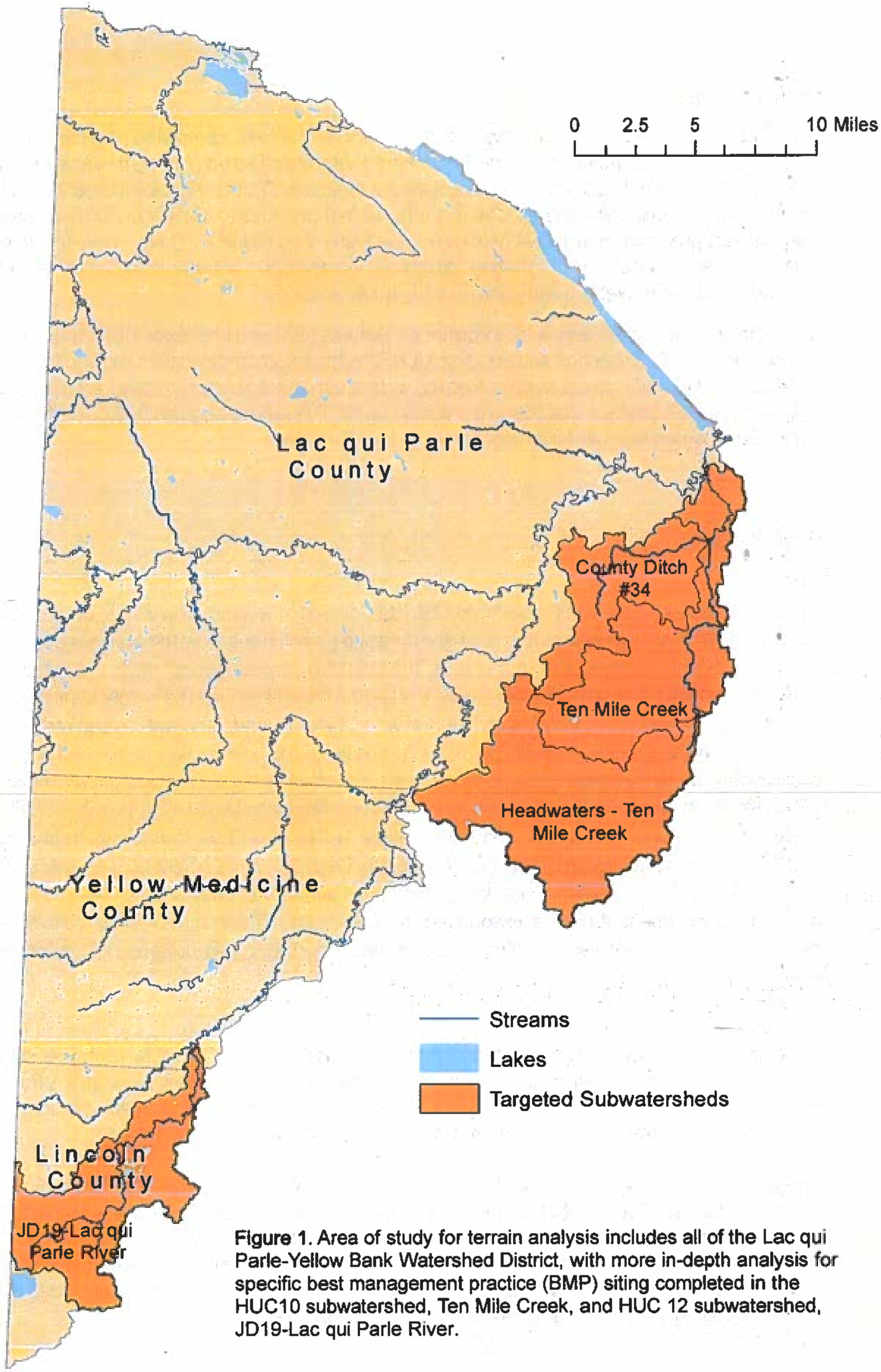

Figure 1. Area of study for terrain analysis includes all of the Lac qui Parle-Yellow Bank Watershed District, with more in-depth analysis for specific best management practice (BMP) siting completed in the HUC10 subwatershed, Ten Mile Creek, and HUC 12 subwatershed, JD19-Lac qui Parle River.

Aerial Orthophotos: Using orthorectified and georeferenced aerial imagery, features manually created and outputs automatically generated can be visually assessed for accuracy. The MNGEO's web map service was accessed through a GIS server in order to use aerial orthophotos. http://www.mngeo.state.mn.us/chouse/wms/wms_image_server_arcgis_instructions.html.

Surface Waters: Stream data identifying both perennial and intermittent networks was used to compare modeled flow patterns from hydromodified DEM and evaluate hydrologic connection to secondary attributes. The files were downloaded from the MnDNR Data Deli: http://deli.dnr.state.mn.us/.

Watershed Boundaries: While conducting the terrain analysis, watershed data at various HUC-levels were used as a reference and output extent when clipping files to area of interest. The watershed district boundary was provided by Lac qui Parle-Yellow Bank Watershed District and subwatersheds collected from the MnDNR Data Deli: http://deli.dnr.state.mn.us/.

Administrative Boundaries: The boundaries of cities and political zones are used for spatial orientation while performing the terrain analysis and when illustrating the outputs. Boundaries can be collected from the Minnesota Geospatial Commons: https://gisdata.mn.gov/group/boundaries.

Precipitation Data: The Non-Contributing analysis uses rainfall data that simulates a 10-year 24-hour rain event. This data is from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 (NOAA, 2013). Precipitation data were used for the rainfall depths for the 10-year, 24-hour event to generate runoff volume estimates used to identify areas that contribute runoff downstream to Ten Mile Creek. This tool was developed by Houston Engineering Inc. (HEI).

Land Use and Soils Data: Recent land use, field boundary, and soil survey information for individual HUC12 watersheds was downloaded from the Agricultural Conservation Planning Framework (ACPF) website for the study area in order to identify areas to target for BMP implementation: http://northcentralwater.org/acpf/.

Analyses Performed

Hydromodification

This project utilized the high resolution of LiDAR imagery DEM dataset clipped to the watershed district boundary with a 1000 meter buffer. The DEM was then hydromodified before performing primary and secondary attribute analysis. LiDAR is high resolution data that is derived from high precision lasers collecting information on terrain. A limitation of LiDAR is that it is not sensitive to presence of "digital dams," such as culverts, bridges, dams (Figure 2). In order to model surface water flow for more accurate outputs, the DEM was manually "conditioned" or "modified" (Figure 3). Hydrologic conditioning is the process of modifying the topographic data represented as the raw or "bare earth" DEM through a series of GIS processing steps to more accurately represent the movement of water on the landscape. Several iterations are generally needed to achieve the final conditioned DEM. The modification process typically involves lowering elevation values where a digital dam is located, whereas walls can be applied to rise elevation in areas where local knowledge determines water drains away from the watershed. The quality of the final conditioned products and their usability is completely dependent upon the number and placement of burnlines used to condition the DEM. The burnline inventory allows us to conservatively model surface water flow compared to an unmodified DEM dataset because it generates flow paths more true to natural flow paths across the landscape.

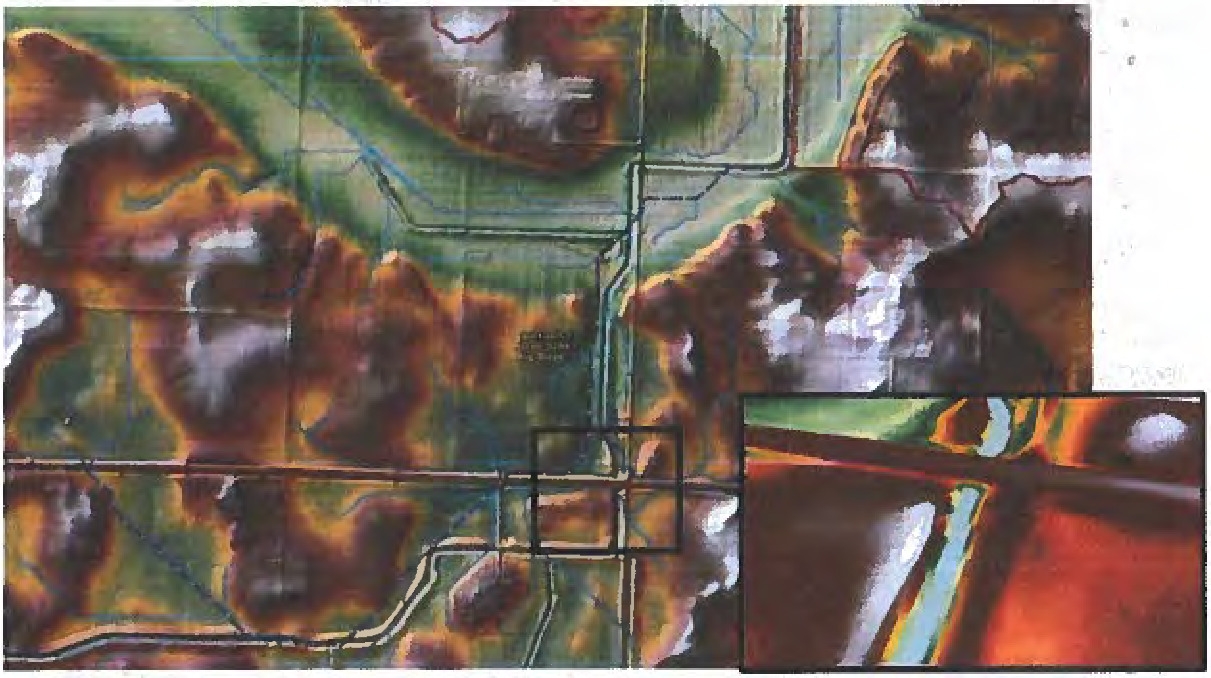

Figure 2. Example of "digital dams" existing in LiDAR datasets that impede flow paths through water conveyance infrastructure.

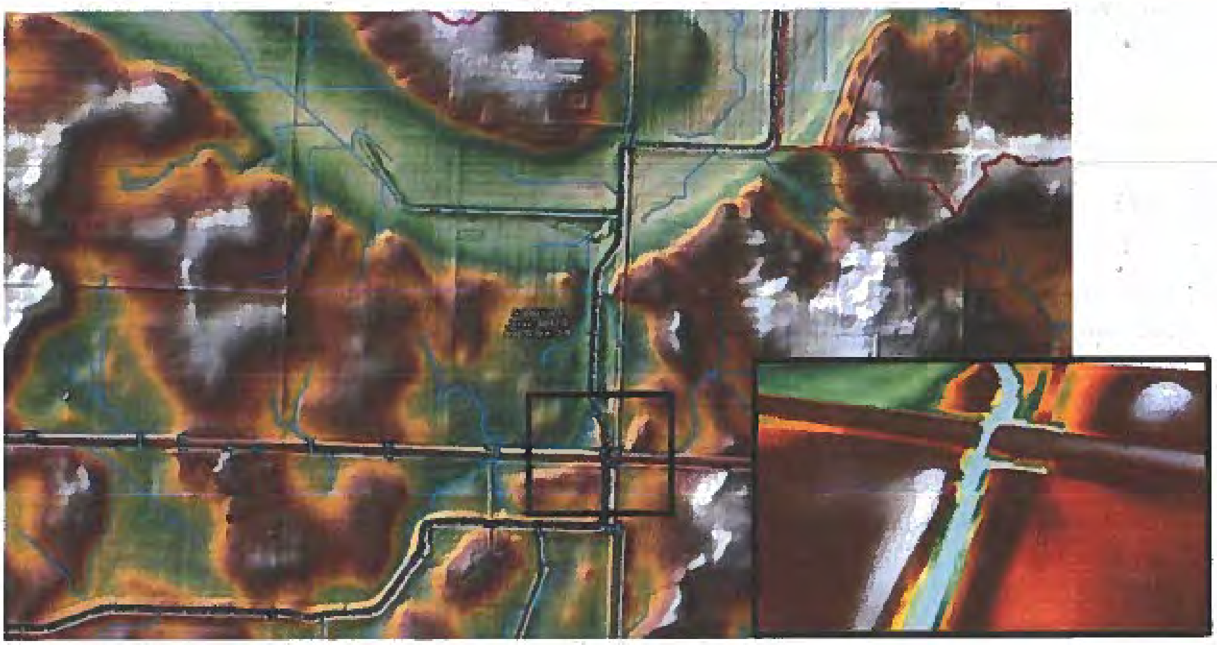

Figure 3. Flow path adjusted to model surface water flow through water conveyance infrastructure.

Calculating Primary Terrain Attributes

The hydromodified DEM is used to generate a raster file demonstrating flow direction, flow accumulation and slope which are later used to calculate secondary attributes to identify critical source areas and predicting potential locations for best management practices.

Non-Contributing Analysis

This analysis uses precipitation data to simulate the non-contributing areas within a watershed during a certain rainfall event. For this study, non-contributing areas were defined as areas that contain the runoff volume corresponding to the 10-year, 24-hour precipitation event. Depression areas (e.g., sinks, wetlands, potholes) are a naturally-occurring feature in many landscapes. During rain events, the runoff volume reaching a depression area is not contributed downstream until the runoff volume exceeds the depressional area volume. If the runoff volume does not exceed the depression area volume, the area was categorized as "non-contributing". This determination is dependent on the size of the runoff event analyzed. For the study area, this event was 3.83 inches of precipitation, as defined by the National Oceanic and Atmospheric Administration (NOAA) in the Atlas 14 Precipitation-Frequency Atlas of the United States (NOAA, 2013). The non-contributing determination was performed using a series of iterative GIS processes in which the available storage of a depression area was compared to the runoff volume generated from the contributing watershed of the depression area. This is an iterative "fill and spill" process in which the excess runoff of contributing areas is routed through subsequent downstream depression areas until no excess runoff was produced. All depression areas determined to be contributing were "filled" by adjusting their elevation values to equal the surface spill out elevation to create a continuous flow path that traverses the depression area. Flow paths terminate at the minimum elevation cell within each non-contributing depression area.

Calculating Secondary Attributes

Since terrains are complex, terrain analysis requires a comprehensive evaluation of slope and flow paths. Secondary attributes incorporating these factors are calculated as Stream Power Index (SPI) and Compound Topographic Index (CTI). SPI is used to help identify areas with high probability for gully erosion because it accounts for physical characteristics of a landscape to estimate the potential of overland and concentrated surface water flow to cause erosion. Values are calculated as the product of the natural log of flow accumulation and slope (Figure 4).

$$SPI = \ln\{(\text{flow accumulation}) * (\text{slope})\}$$

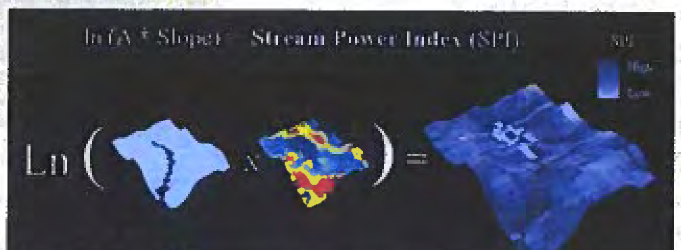

Figure 4. Flow accumulation and slope datasets used to calculate Stream Power Index (SPI).

High SPI values identify areas on the landscape where steep slopes and flow accumulation exists, thus indicating likelihood of high erosive power across the landscape. SPI is a simple analysis, not accounting for land cover, land use, soil type or other factors that impact surface water erosion. For this reason, it is best to compare SPI values across areas with similar land management practices, land covers, and soils.

In Figure 5a, the SPI output is shown within Ten Mile Creek. The primary focus of the SPI analysis was to locate areas with high potential for erosion and subsequently gully formation, shows areas of erosion based on SPI values. SPI helps show locations with a high probability of erosion or gullies. These highly erodible areas, are sites where appropriate BMPs could significantly reduce the movement of sediment and nutrients across the landscape to surface waters. CTI evaluates the quotient of slope and flow accumulation to identify areas where ponding is likely to occur on the terrain (Figure 5b). These sitings are ideal for surface impoundment BMPs for storing water, such as wetland restorations and sediment basins.

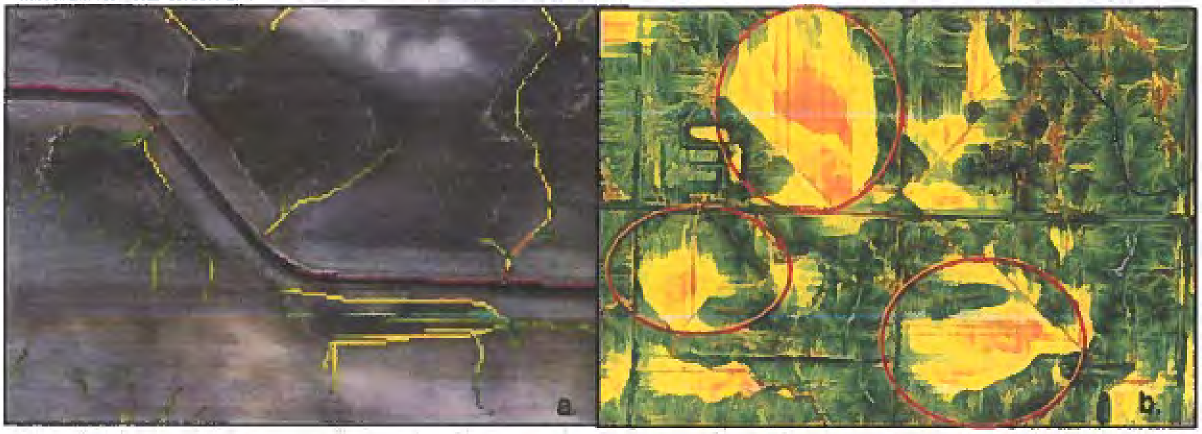

Figure 5. (a) SPI calculation illustrating flow intensity across a field and draining to a nearby ditch. (b) CTI calculation identifying flow accumulation in depressional areas where ponding is expected to occur.

Conservation and BMP Opportunity Siting

Calculating secondary terrain attributes is useful to understand how water flows across the landscape with current management practices, and where Critical Source Areas (CSA) are with high erosion. A tool that complements these terrain attributes is the Agricultural Conservation Planning Framework (ACPF; Tomer et al. 2015). The Framework's foundation is building soil health (Figure 6). The ArcGIS program identifies potential structural BMPs to manage sensitive areas and critical source areas. Conservation practices, such as fertilizer management and cover crops, should be incorporated to create a well-rounded watershed management plan with local landowners and operators. ACPF tool draws from information collected into a geodatabase by the members of the U.S. Department of Agriculture, Agricultural Research Services (USDA-ARS) National Laboratory for Agriculture and the Environment (NLAE), in Ames, IA. This tool uses the input data to identify locations that are suitable for BMP implementation based on criteria set forth by the USDA.

Figure 6. Agricultural Conservation Planning Framework (ACPF) foundation for conservation management and meeting watershed reduction goals.

Results

A terrain analysis results in many files and data that cannot feasibly be packaged into a map. Data products are provided as file geodatabases for future conservation planning based off of local knowledge and priorities. The data can be summed up into three categories:

1. Original dataset unmodified by terrain analysis and used as inputs for calculating primary terrain attributes;
2. Hydrologically conditioned DEM dataset and subsequent primary and secondary terrain attributes calculated for each HUC10-level subwatershed in the District; and
3. Conservation management and BMP siting geodatabases for the Ten Mile Creek HUC10 subwatershed generated from the ACPF GIS tools developed to facilitate customized watershed planning to meet over-arching watershed reduction goals (Example watershed management strategy in the HUC12 Ten Mile Creek subwatershed illustrated in Figure 7).

These geodatabases can be used to visualize terrain attributes by a natural resource planner to understand the differences and management options for specific landscapes. Layers can overlay each other to gain a better understanding of the complex terrain attributes contributing to transport of sediment in nutrients via water flow paths. A listing of layers is provided in the file geodatabases products (See Appendix).

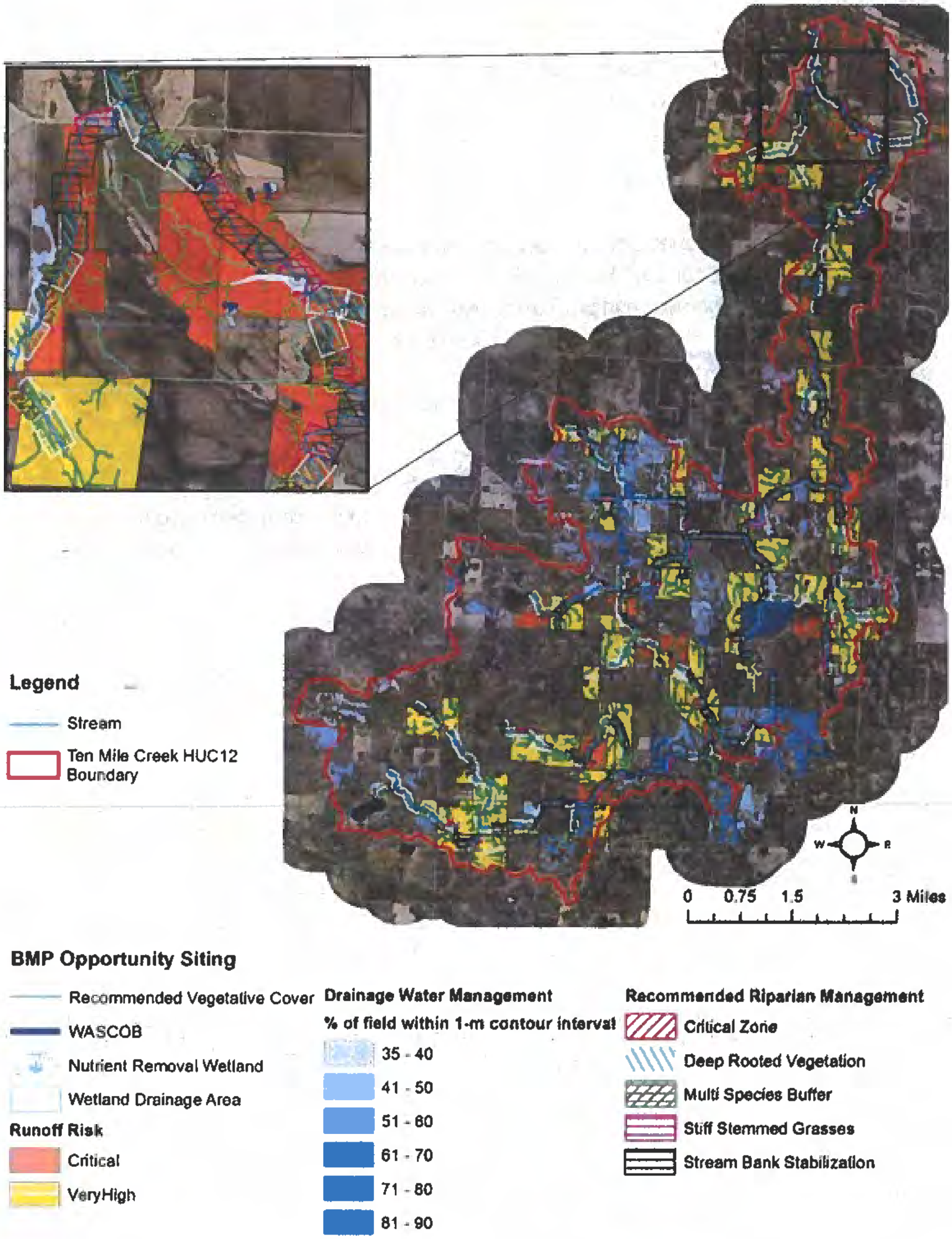

Figure 7. Example of what a watershed management could look like at a HUC12 scale in Ten Creek Mile watershed. BMP Opportunity areas for practices such as Water and Sediment Control Basins (WASCOBs), nutrient removal wetlands and riparian management, as well as areas with critical and very high risk of surface runoff with intense erosive power.

References

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Appendix

GIS Dataset Input

DEM Conditioning Inputs		
Name	Type	Description
DEM	Raster	Raw DEM with 3 meter resolution and elevation values in meters.
Burnlines	Polyline	Polyline file use to remove digital dams impeding flow patterns across the landscape through water conveyance structures.

Agricultural Conservation Planning Framework (ACPF) Base Layers For more information about layers visit http://northcentralwater.org/acpf/		
Name	Type	Description
bnd+inHUC	Polygon	Watershed boundary (USGS WBD derived from NHD)
buf+inHUC	Polygon	Watershed boundary buffered out by 1000 meters – base data is clipped to buffered extent to ensure coverage for all fields that may lie partly within watershed
FB + inHUC	Polygon	Agricultural field boundaries that have been manually updated from 2005 USDA/FSA Common Land Unit (CLU) dataset. The field boundary feature class contains an "isAG" field in the attribute table. Possible "isAG" values include: 0 = Non-agricultural (Forest, Water/Wetland, Urban, LT 15ac, and Unassigned) 1 = Agricultural (Corn/Soybeans, Continuous Corn, C/S with Continuous Corn, Conservation Rotation, Extended Rotation, Mixed Agriculture, and Flood-prone Cropland 2 = Pasture Note: The "isAG" field can be used for simple land use queries rather than performing a join with the land use table.
Soils DATA: gSSURGO SurfHrz + inHUC SurfTex + inHUC soilVALU + inHUC	Thematic Raster Table Table Table	USDA/NRCS 10-meter soils raster that can be joined to soil tables through mapunit or cokey field Surface horizon table Surface texture table Value added table
LU6_ + inHUC	Table	Land use table derived from the most recent 6 years of the NASS CDL; can be joined to field boundary layer by a unique FBndID. Contains information on majority crop found among the pixels (from original remote sensing data) in each field within the classified NASS data, % majority crop (indicates confidence in the crop cover assigned by year), 6–yr land cover strings (Tomer et al., 2015a), and a generalized land use classification for each field.
CH_ + inHUC	Table	Crop history table derived from all available years of the NASS CDL; can be joined to field boundary layer by a unique FBndID. Contains information on crop rotation, majority crop and % majority crop for each year in the dataset.
wsCDL2009 wsCDL2010 wsCDL2011	Thematic Raster	USDA NASS Cropland Data Layers for the most recent 6 years. The filename ends with the 4-digit year that it represents.

wsCDL2012 wsCDL2013 wsCDL2014		
DEM + inHUC	Continuous Raster	A LiDAR-derived DEM of meter horizontal resolution must be generated by the user and added to the fgdb. This should be an unfilled DEM, meaning that sinks still exist.

GIS Dataset Products

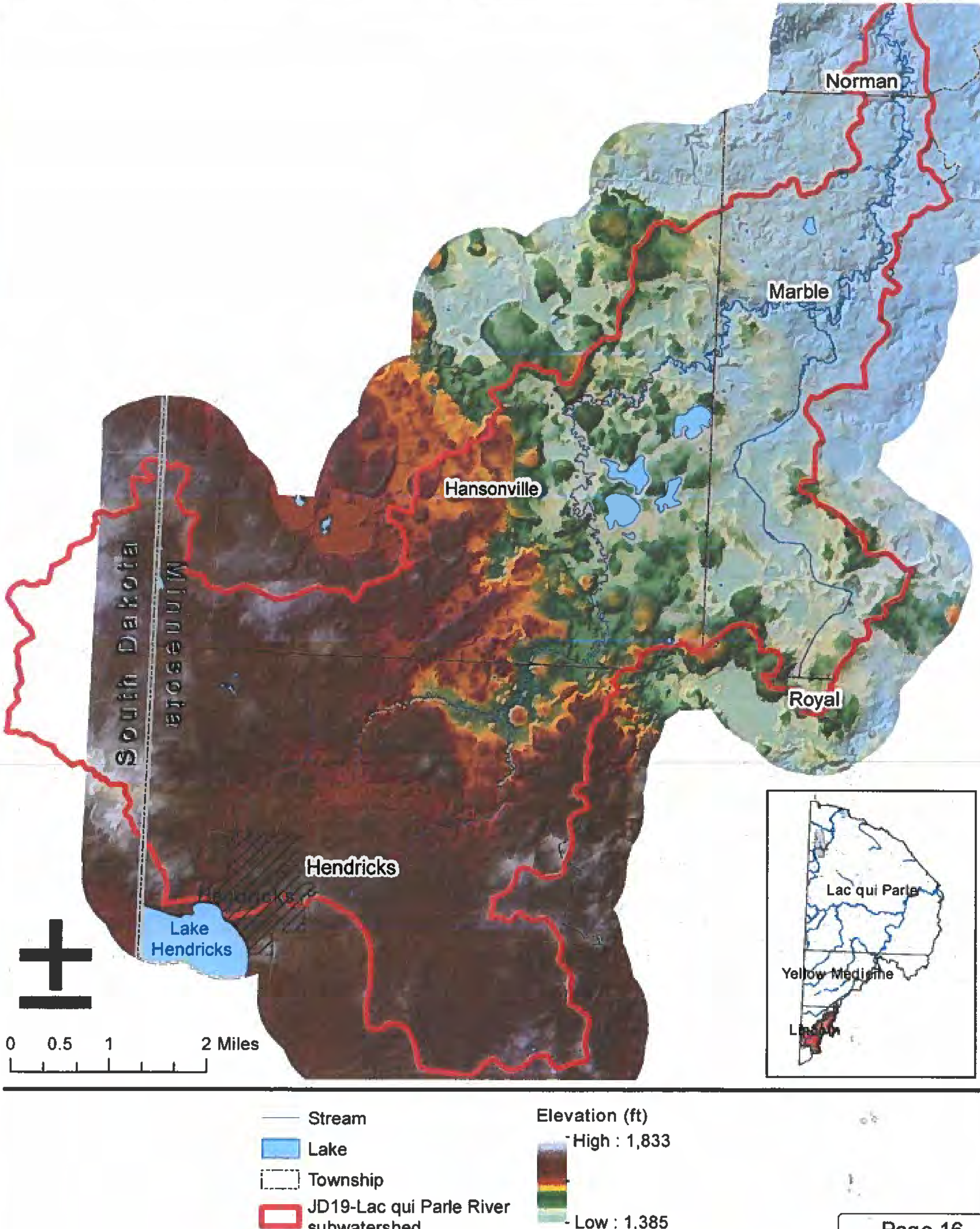
Primary Terrain Attributes Calculated using NRCS Engineering Tools		
Name	Type	Description
HydroDEM	Raster	Hydroconditioned DEM based on burnline inventory
Fill_hydroDEM	Raster	Sinks in DEM dataset filled
flowDirection	Raster	Illustrates tabulated direction of flow for each cell within the raster dataset
flowAccumulation	Raster	Number of cells upstream where accumulation occurs
Non-Contributing Analysis For more information on the tool please contact Houston Engineering Inc.		
Name	Type	Description
Agree_TotalWatershed	Raster	DEM with reconditioning applied not considering noncontributing areas and tile inlet as extractions
Agree_ContribSurfaceOnly	Raster	DEM with reconditioning applied considering noncontributing during the 10-year and 24-hour rainfall event and tile inlet as extractions
Fill_TotalWatershed	Raster	Sinks are filled within the entire watershed
Fill_ContribSurfaceOnly	Raster	Sinks are filled within the contributing drainage area during the 10-year 24-hour rainfall event.
FDR_TotalWatershed	Raster	Indicates the direction of flow from each cell within the entire watershed.
FDR_ContribSurfaceOnly	Raster	Indicates the direction of flow from each cell within the contributing drainage area during the 10-year 24-hour rainfall event.
FAC_TotalWatershed	Raster	The accumulated number of cells upstream of each cell within the entire watershed.
FAC_ContribSurfaceOnly	Raster	The accumulated number of cells upstream of each cell within the contributing drainage area during the X10-year 24-hour rainfall event.
Hydrodem	Raster	Hydrologically reconditioned DEM.
Flowpaths_ContribSurfaceOnly	Polyline	LiDAR derived flowpaths produced from the Fill_ContribSurfaceOnly raster for areas with > 5 acres of drainage area.
Flowpaths_TotalWaterhsed	Polyline	LiDAR derived flowpaths produced from the Fill_TotalWatershed raster for areas with > 5 acres of drainage area. This flowpath linework represents runoff patterns if all the depressions on the landscape are filled and surface run out from the depressions occur.
Contributing_Watershed_SurfaceDA	Polygon	Dataset of LiDAR derived surface contributing subwatershed boundaries.

Contributing_Subwatersheds_SurfaceDA	Polygon	Dataset of LiDAR derived from surface contributing subwatershed boundaries, based on MnDNR HU Level 8 "DNR Catchments".
Subwatershed_Outlets	Point	Outlet locations based on MnDNR HU Level 8 "DNR Catchments".
NonContrib_Basin_10yr24hr	Polygon	Footprint of non-contributing basins at the spill out elevation for the depressed area.
NonContrib_DrainageArea_10yr24hr	Polygon	Drainage area to non-contributing basins.
Depression_Points	Point	Created at minimum elevation location in non-contributing Basins and is used to create ContribSurfaceOnly products.
CN	Raster	The curve number values were determined using methods presented in Technical Release 55 (Urban Hydrology for Small Watersheds) based on the combination of the hydrologic soil type (Soil Survey Geographic (SSURGO) Database) and the landuse (National Land Cover).
Flowlength	Raster	Upstream flow length in meters
TotalWatershed_Subwatersheds	Polygon	Subwatersheds of project area based on Total Watershed conditioned DEM, with outlet points based on MnDNR HUC Level 8 "DNR Catchments".
TotalWatershed	Polygon	Project area based on Total Watershed conditioned DEM
Secondary Terrain Attributes **Calculated using NRCS Engineering Tools**		
Name	**Type**	**Description**
CTI	Raster	Evaluates the quotient of slope and flow accumulation to identify areas where ponding is likely to occur on the terrain
SPI	Raster	Used to help identify areas with high probability for gully erosion because it accounts for physical characteristics of a landscape to estimate the potential of overland and concentrated surface water flow to cause erosion.
Agricultural Conservation Planning Framework (ACPF) Output Products For more information about layers visit http://northcentralwater.org/acpf/		
Name	**Type**	**Description**
D8FlowDir + inHUC	Thematic Raster	Raster of flow direction from each cell to its steepest downslope neighbor, using ArcGIS D8 flow direction values.
D8FlowAcc + inHUC	Continuous Raster	Raster of accumulated flow. Cell values equal the count of the number of upstream cells flowing into each target cell in the output raster.
DEMFill + inHUC	Continuous Raster	DEM that has been processed so that all sinks have been filled.
Hshd + inHUC	Continuous Raster	Shaded relief. Derived from unfilled DEM.
AreaFlowNet + inHUC	Polyline	Flow network polyline derived from the Flow Network Definition – Area Threshold tool.
PDFlowNet + inHUC	Polyline	Flow network polyline derived from the Flow Network Definition - Peuker Douglas tool.
DepthGrid + inHUC	Continuous Raster	Depth grid, in which each cell represents the elevation difference between the filled and unfilled DEM.

NewDEM + inHUC	Continuous Raster	Unfilled DEM containing altered elevation values along user-provided cut and/or dam lines.
StreamReach + inHUC	Polyline	Polyline feature class representing each reach in a stream network.
Catchments + inHUC	Thematic Raster	Polygon feature class representing each sub watershed. The "gridcode" value of each polygon will equal the "LINKNO" of its corresponding reach in the StreamReach feature class.
Slope + inHUC	Continuous Raster	Slope raster derived from LIDAR DEM (in percent rise).
SlopeTable + inHUC	Table	Table that contains slope information on a field by field basis. Can be linked to the field boundary feature class through the FBndID.
DrainageTable + inHUC	Table	Table that, based on a user selected query of by-field slope and soils information, classifies agricultural fields (including pasture) as tile-drained or non tile-drained. Can be linked to the field boundary feature class through the FBndID.
DistToStrm + inHUC	Continuous Raster	The distance to stream raster calculates the horizontal distance (in meters) to the channel for each grid cell, moving downslope according to the D8 flow model, until a stream grid cell is encountered.
RunoffRisk + inHUC	Table	Table that contains runoff risk information on a field by field basis. Can be linked to the field boundary feature class through the FBndID. The runoff risk table contains information on agricultural fields only (including pasture), as identified by the 6-year generalized land use classification. As a result, the # of rows in the attribute table of the runoff risk table will usually be less than that of the input field boundary feature class.
Depressions + inHUC	Polygon	Polygon layer created as an output of the Depression Identification tool. Will contain a unique "Depress_ID".
Depress_Wsheds + inHUC	Polygon	Polygon layer created as an output of the Depression Watersheds tool. Will contain a unique "Depress_ID".
DrainageMgmt + inHUC	Polygon	Polygon layer created as an output of the Drainage Water Management tool. Polygons will represent discrete areas (larger than a user-specified % of field) where all elevation values are within a user-specified contour interval that can be chosen between .3 and 1.5 meters (default is 1.0 m).
GrassWaterway + inHUC	Polyline	Polyline layer created as an output of the Grassed Waterway tool.
CBS + inHUC	Polygon	Polygon layer created as an output of the Contour Buffer Strip tool.
NRW + inHUC	Polygon	Output Nutrient Removal Wetland feature class (polygon). Each suitable site will contain 2 rows in the output attribute table - one for each wetland polygon (pooled area - permanent storage) and one for the buffer polygon (vegetated area - variable storage) polygon. Attributes will be the same for each of the 2 rows. Each polygon will have a unique "SiteID".
NRWDrainageAreas + inHUC	Polygon	Output Nutrient Removal Wetland Drainage Area feature class (polygon). Each polygon will have a unique "SiteID".
WASCOBs + inHUC	Polyline	Output WASCOB polyline feature class. Each polyline will represent a transect line of 100 m length, and will contain site-specific information as attributes.

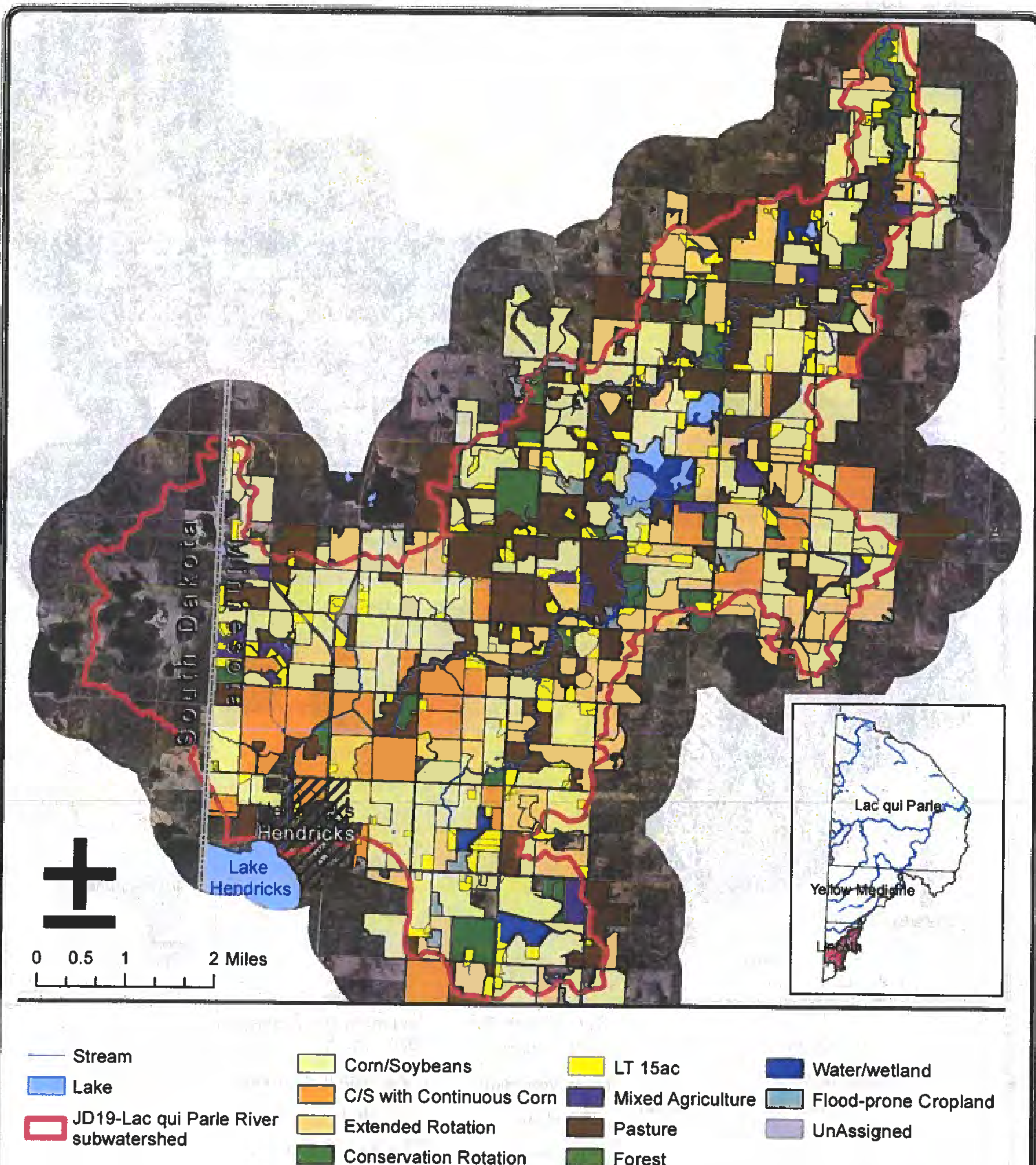
WASCOBbasin + inHUC	Polygon	Polygon layer representing the basin, or area which would pond water upstream of each WASCOB, for all input WASCOBS
AdjFlowDir + inHUC	Thematic Raster	D8 flow direction raster. Flow directions have been modified to force flow from adjacent bank cells directly into channel.
WaterTableDepth + inHUC	Thematic Raster	Thematic raster representing a classification of an estimated depth to water table, used to identify riparian zone management opportunities.
RAP + inHUC	Polygon	Feature class containing riparian assessment polygons (RAPs). RAPs are generated along the stream network and are split by stream side. Each RAP is 250 meters long and 180 meters wide (90 meters on each side of stream). The feature class contains site-specific information for each riparian assessment polygon (RAP).

Supplementary Maps Illustrating Uses of Outputs from Terrain Analysis



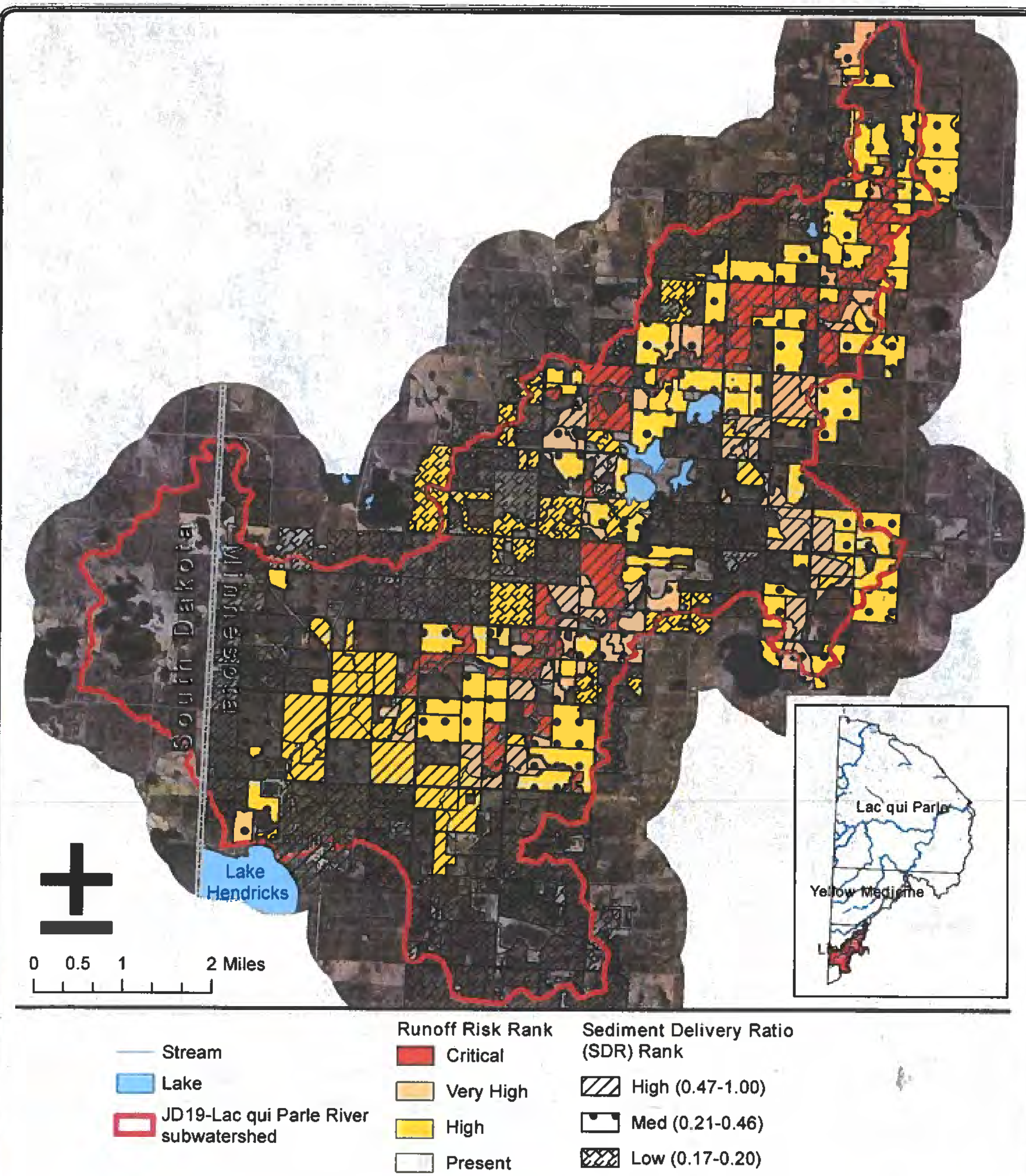
Map 1. JD19-Lac qui Parle River Subwatershed

JD19-Lac qui Parle River watershed is located in the southern portion of the Lac qui Parle River Watershed District. The watershed drains north from Lake Hendricks and drains approximately 24852 acres.



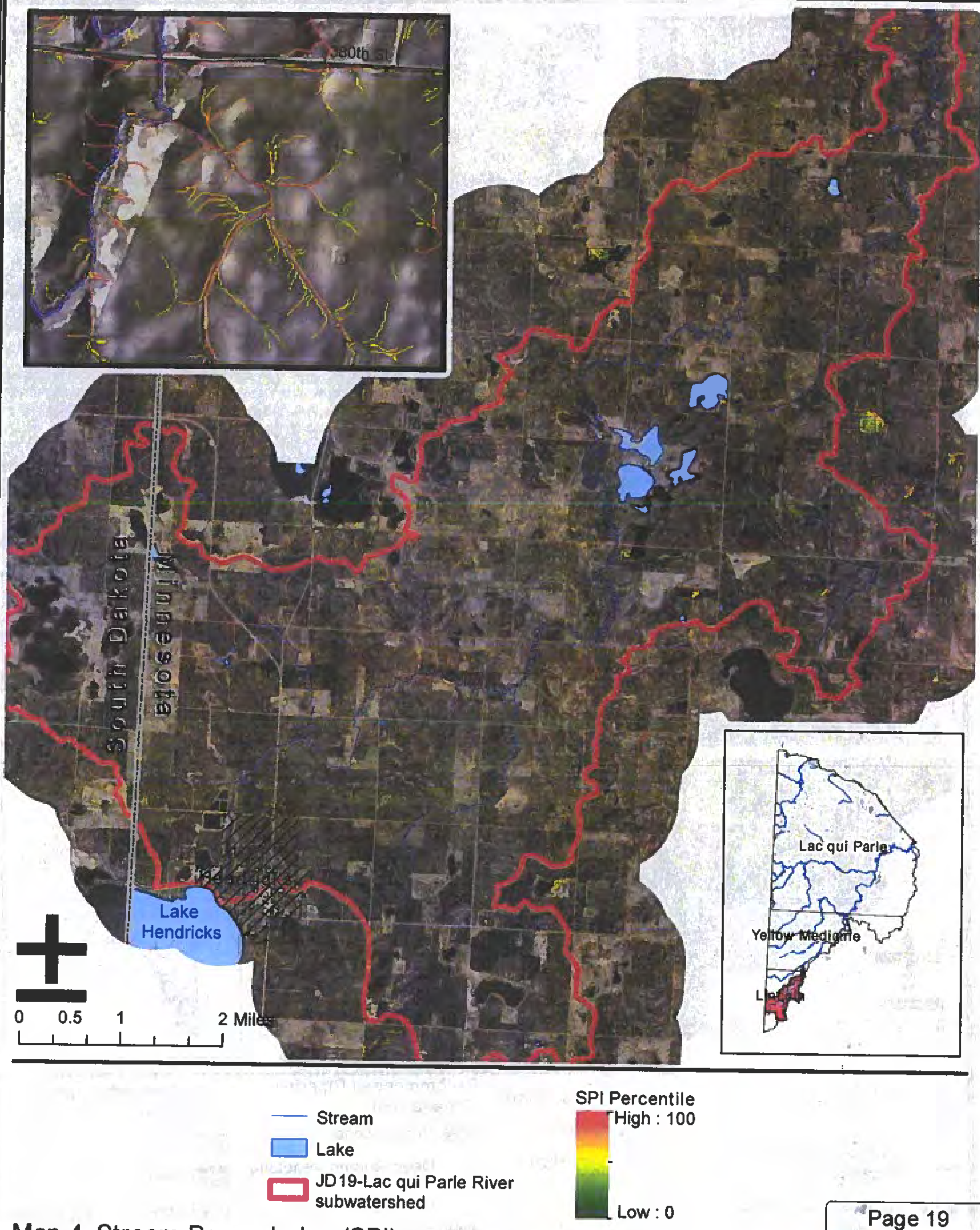
Map 2. General land use

Mapped representation of general land use in Judicial Ditch 19-Lac qui Parle River subwatershed (HUC: 070200030102; Source: 2007-2012 NASS CDL). The majority of the watershed is in a row crop rotation (74%) and pasture (22%).



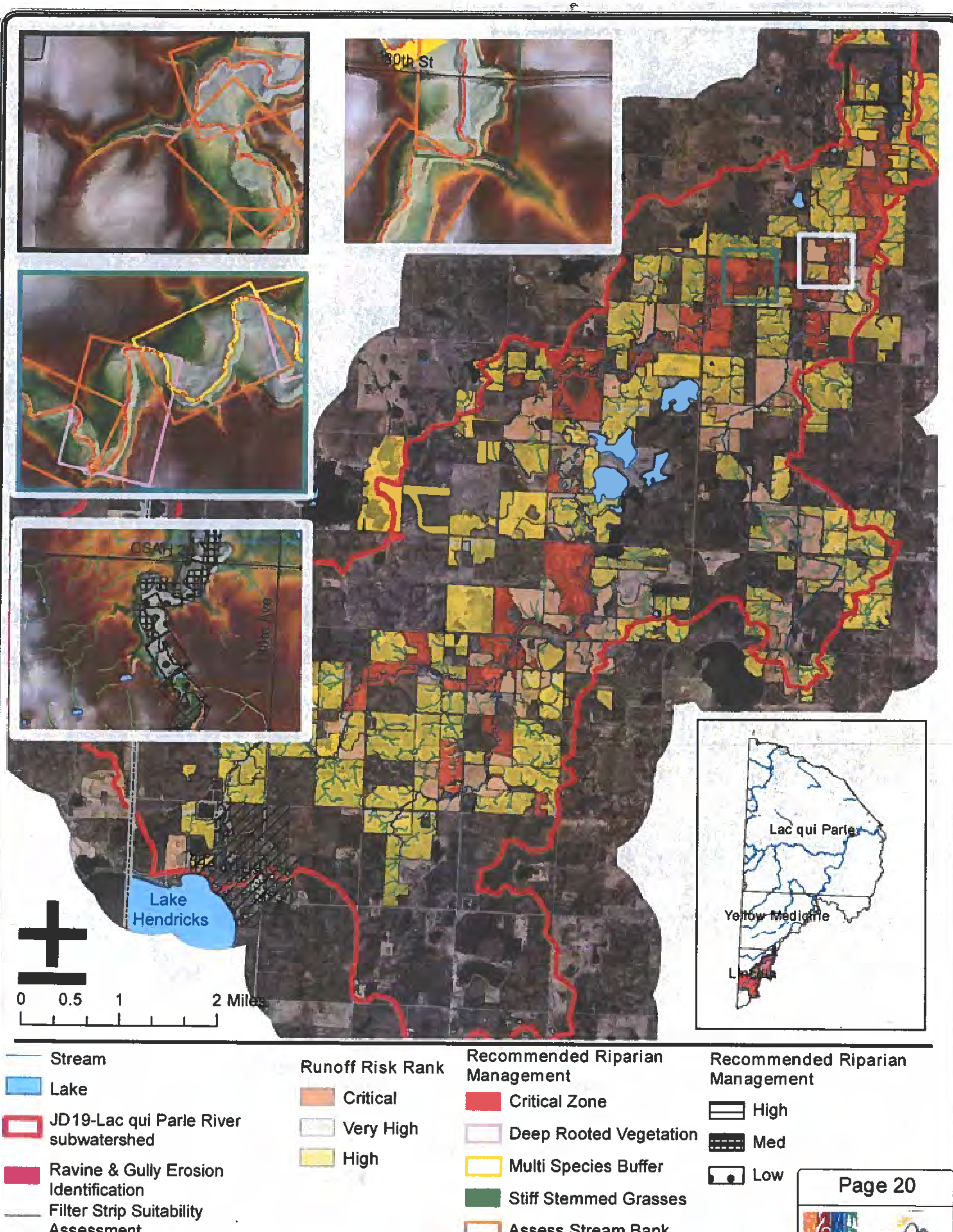
Map 3. Prioritized fields based on erosion vulnerability

Fields prioritized based on the ACPF runoff risk analysis, with only agricultural land use fields assessed and classified for risk of direct runoff contribution to the adjacent stream reach based on the slope and distance to stream. Placing conservation practices on fields ranked as "Critical", "Very High" and "High" would have greater potential impact in total sediment and phosphorus delivery reductions. Sediment Delivery Ratio (SDR) accounts for deposition that occurs from the sediment source to the outlet. The value is determined based on the distance to surface water body and estimated landscape trapping. The thresholds applied in this study was a 20-40-40 breakdown. The steepest and nearest 20% of fields are "High", the next 40% of fields are classified as "Medium" and the lowest 40% of fields are classified as "Low." As more data becomes available, another iteration can be ran to adjust the distribution of SDR values and prioritizing of fields. Analysis completed with ACPF: http://northcentralwater.org/acpf/



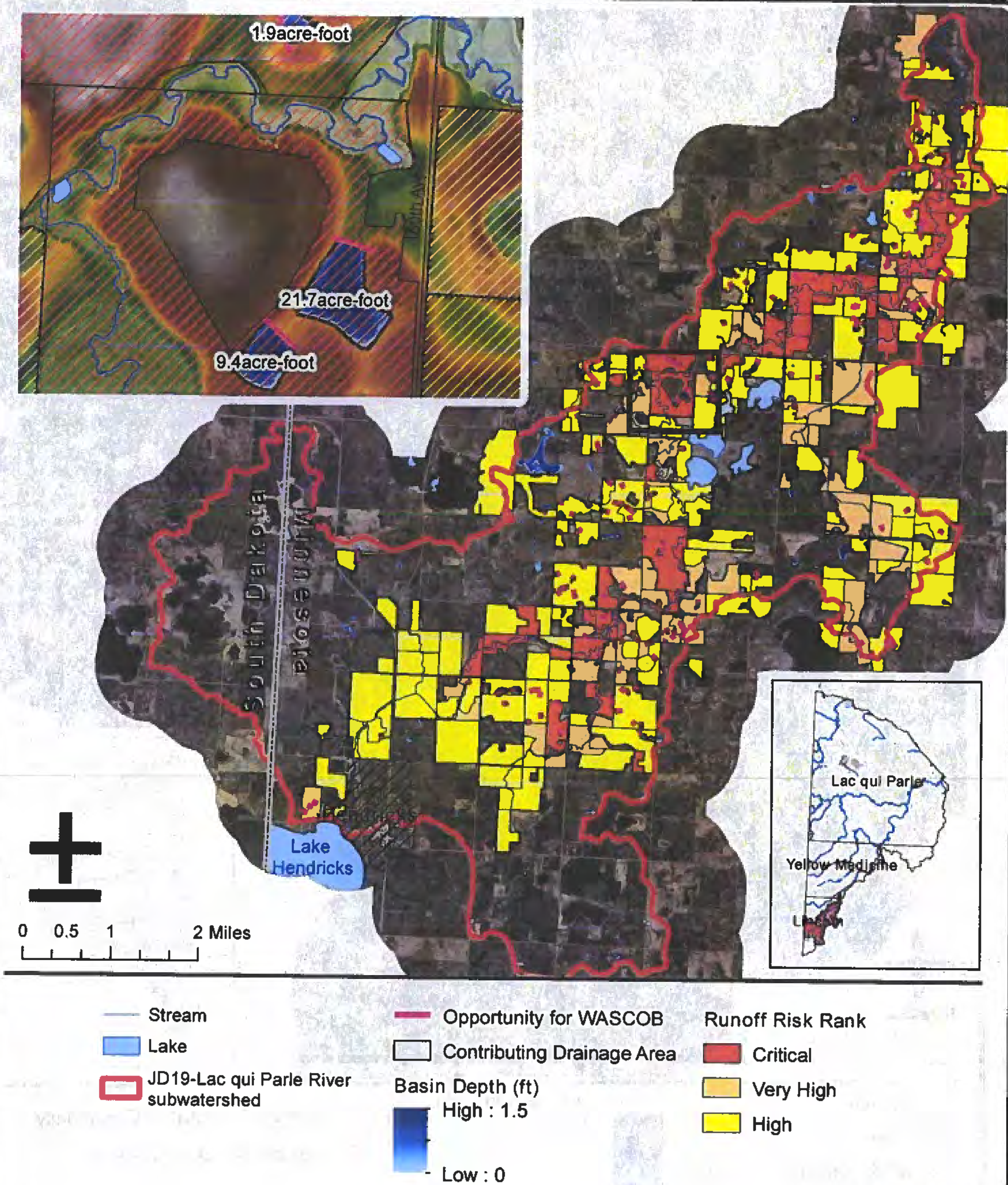
Map 4. Stream Power Index (SPI)

Stream Power Index (SPI) was calculated to determine areas within the watershed that are estimated to have concentrated overland flow. This information can help identify probable areas for gully erosion, rapidly down-cutting ravines, and bluffs, A percentile analysis was completed on the SPI to compare values relatively and help prioritize areas within the watershed that are more sensitive to erosion.



Map 5. Erosion control best management practices (BMPs) suitability analysis on prioritized fields and stream corridor

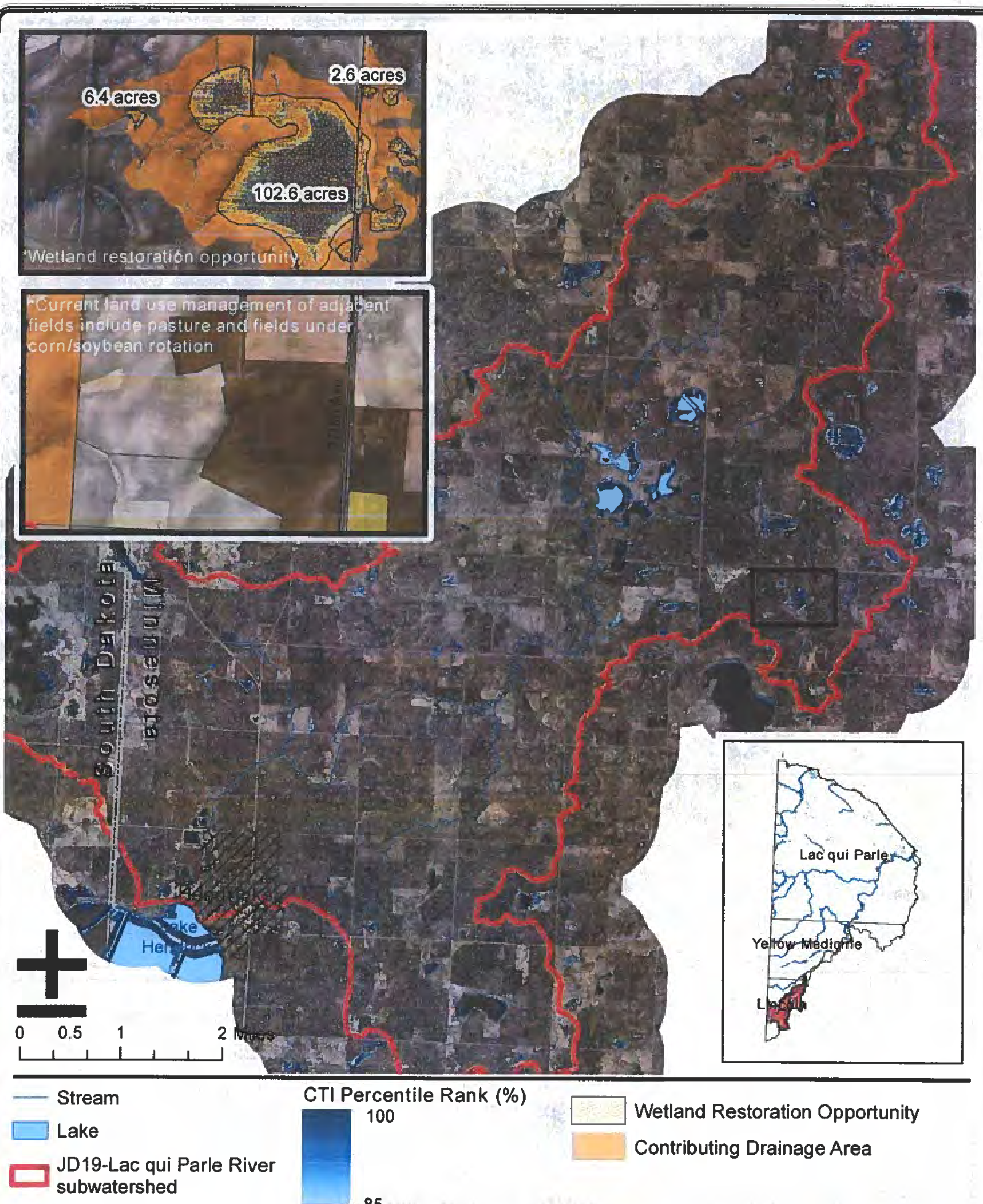
Analysis completed with ACPF: http://northcentralwater.org/acpf/



Map 6. Water and Sediment Control Basins (WASCOBs)

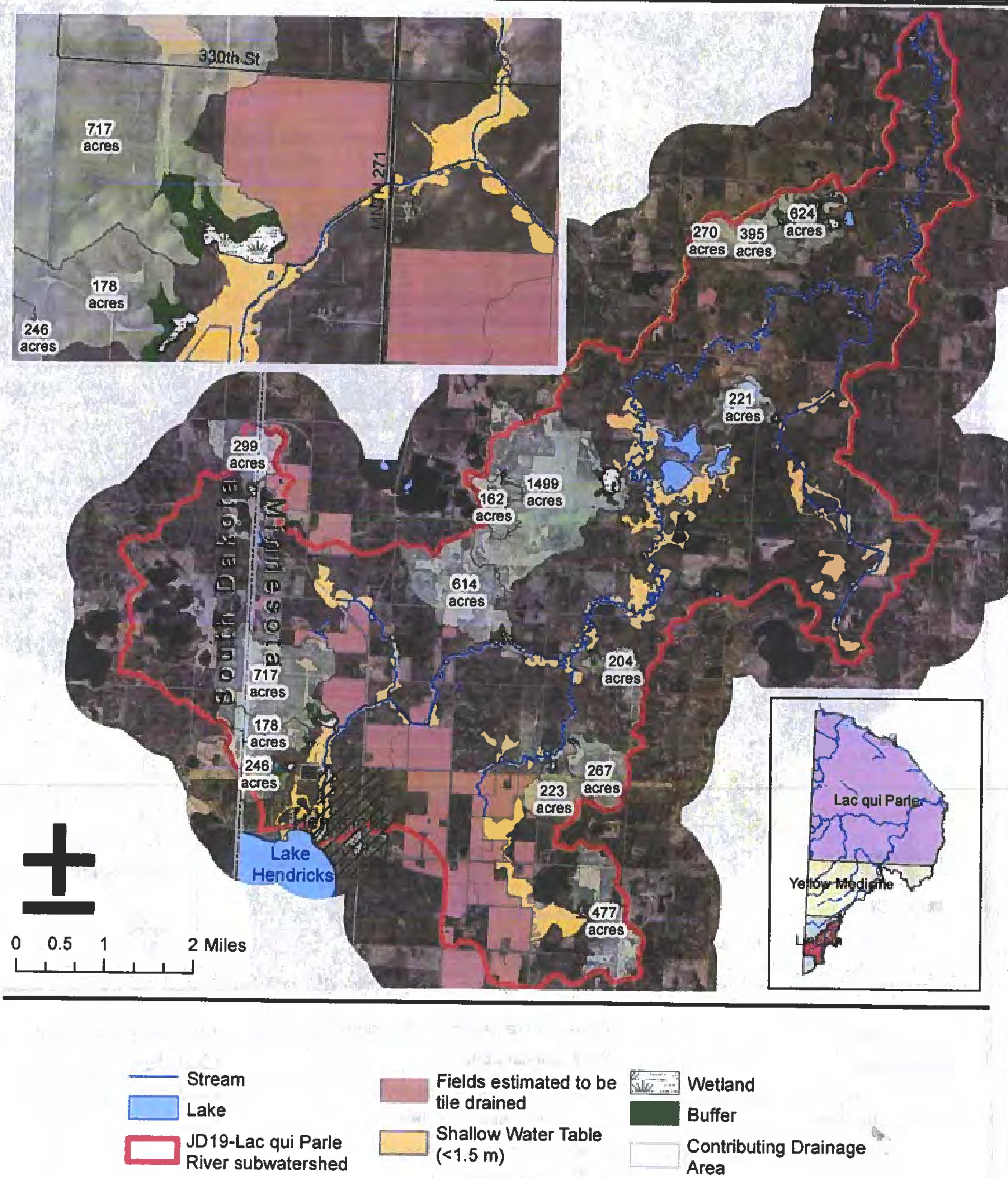
Distribution of Water and Sediment Control Basins (WASCOBs) in fields identified as having a runoff risk of "Critical", "Very High" and "High" ranking. These represent opportunity areas for a WASCOB structure and estimated basin depth in order to estimate water storage benefits. Suitable areas are determined based on the following criteria: 1.5-meter embankment height and 100-meter spacing. Selection criteria can be modified in future iterations of ACPF, if desired.

Analysis completed with ACPF: http://northcentralwater.org/acpf/



Map 7. Water storage and wetland restoration opportunities

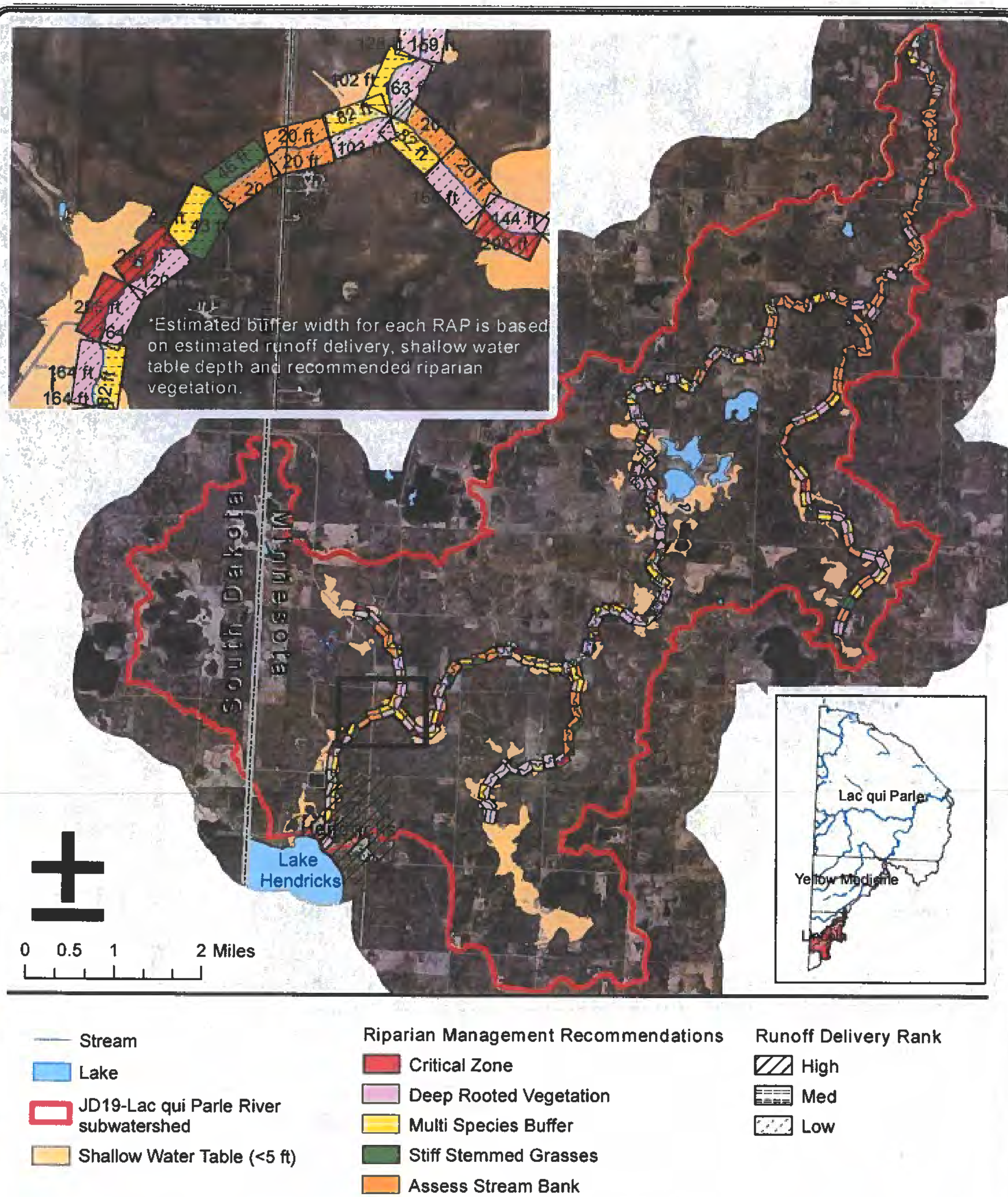
Distribution of where water is likely accumulate based on the top 85% of the secondary terrain analysis attribute, Compound Topographic Index (CTI), for JD19-Lac qui Parle River watershed. CTI illustrates estimates ponding sites based of the modeled overland surface flow. These areas can be overlaied with outputs from the ACPF toolset, such as "Depressions" for a further analysis on BMP suitabiliy and estimated drainage area contriubuting to the site.



Map 8. Nutrient removal wetland suitability sitings

Areas suited for nutrient removal wetlands as an edge-of-field practice. Locations for wetlands were evaluated based on on sampling along flow paths every 100 m using the following user specifications: 0.9 m wetland impoundment height and 1.5 m buffer height. These values can be changed based off desired wetland embankment criteria. Nutrient removal wetlands are effective in reducint nutrients in nonpoint source runoff. Fields estimated to be tiled drained are based on the terrain analysis and can be updated as tiling records within the watershed district become available.

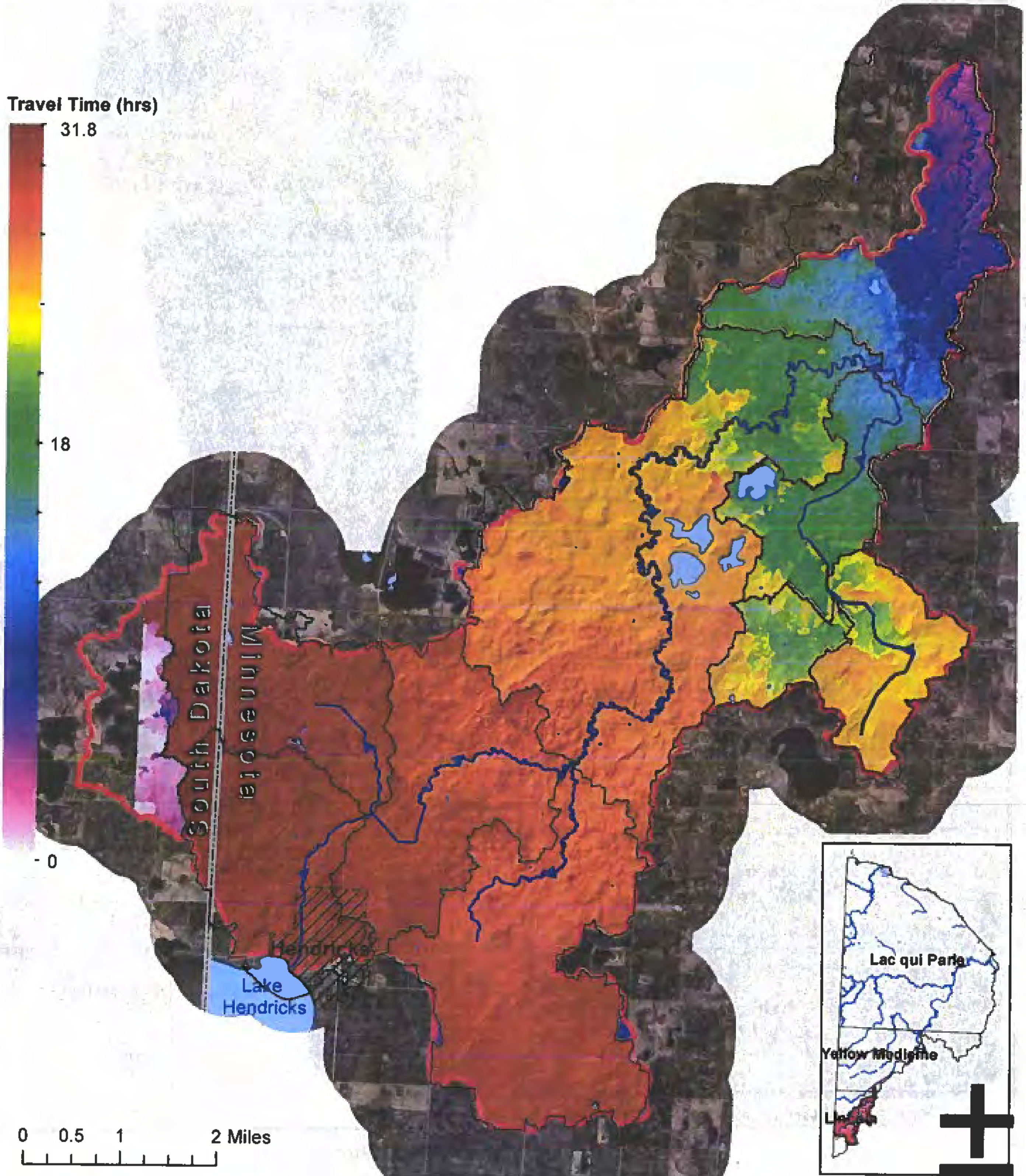
Analysis completed using ACPF toolset: http://northcentralwater.org/acpf/



Map 9. Streambank management and prioritization

Recommended riparian zone management based off of an analysis using ACPF toolset on soil type, runoff and morphological features within a 250 meter by approximately 90 meter riparian area polygon (RAP). Those areas are identified as critical zones; multispecies buffer for water uptake, nutrient and sediment trapping; stiff-stemmed grasses for trapping runoff and sediment; deep rooted vegetation tolerant of saturated soils; and areas where stream bank stability should be evaluated. Each RAP was analyzed using ACPF for runoff delivery rank based on local runoff delivery where a significant potential runoff contribution exists.

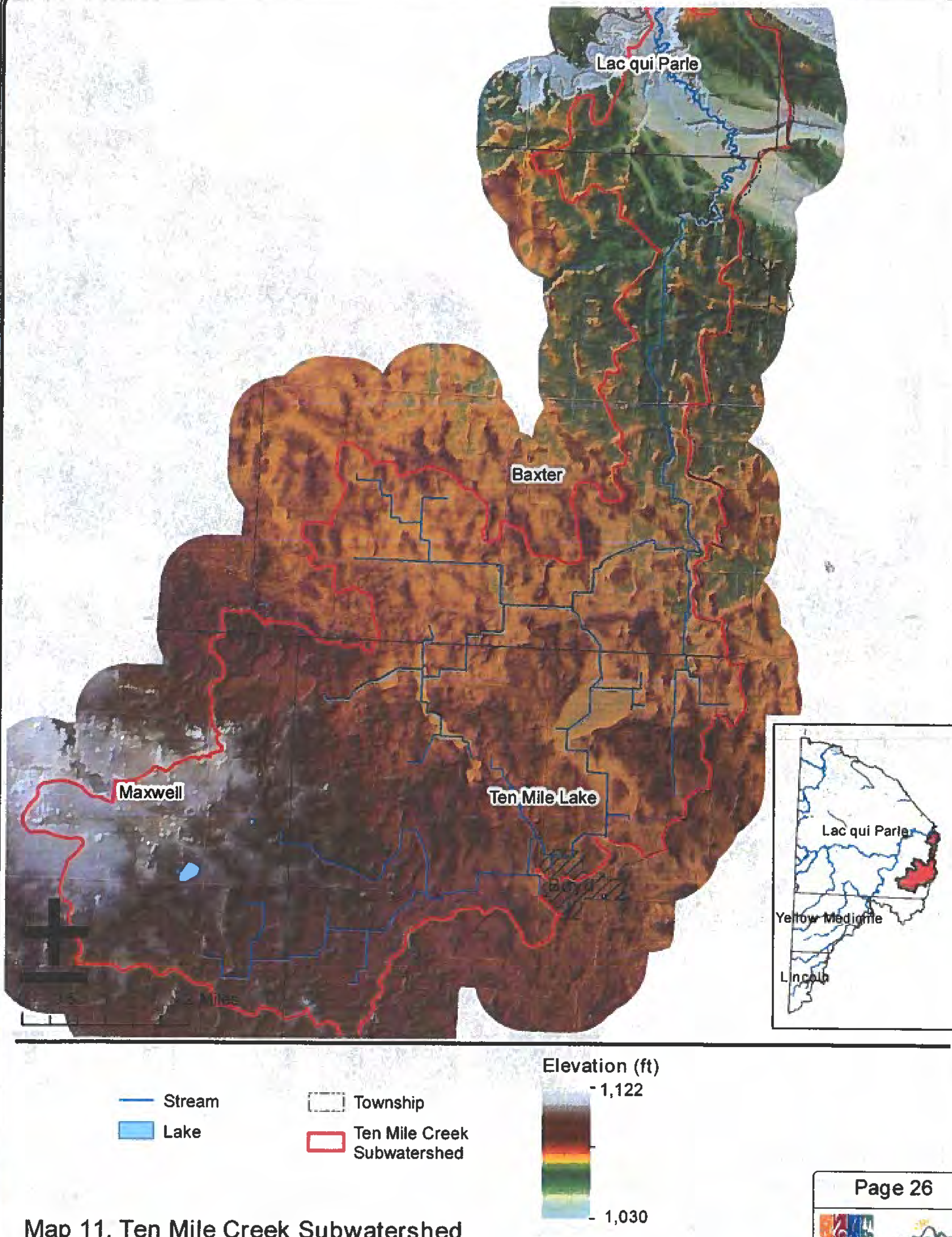
Analysis completed using ACPF toolset: http://northcentralwater.org/acpf/



Stream | Lake | Stream Catchments | JD19-Lac qui Parle River subwatershed

Map 10. Travel time of overland flow

Each cell within the raster dataset has travel time calculated in hours per meter to the outlet of the watershed. The map illustrates the calculated time it takes water to flow across the surface to the outlet of the watershed. The analysis determines water velocity bas ed on the hydraulic radius (R), Man n in g's N (N), also known as surface roughness, and slope. The longest travel time calculated for JD19-Lac qui Parle River subwatershed is 31.8 hours from the headwaters to the outlet. Analysis completed with MnDNR Hydro Tool:(http://www.dnr.state.mn.us/mis/gis/tools/arcgis/index.html)



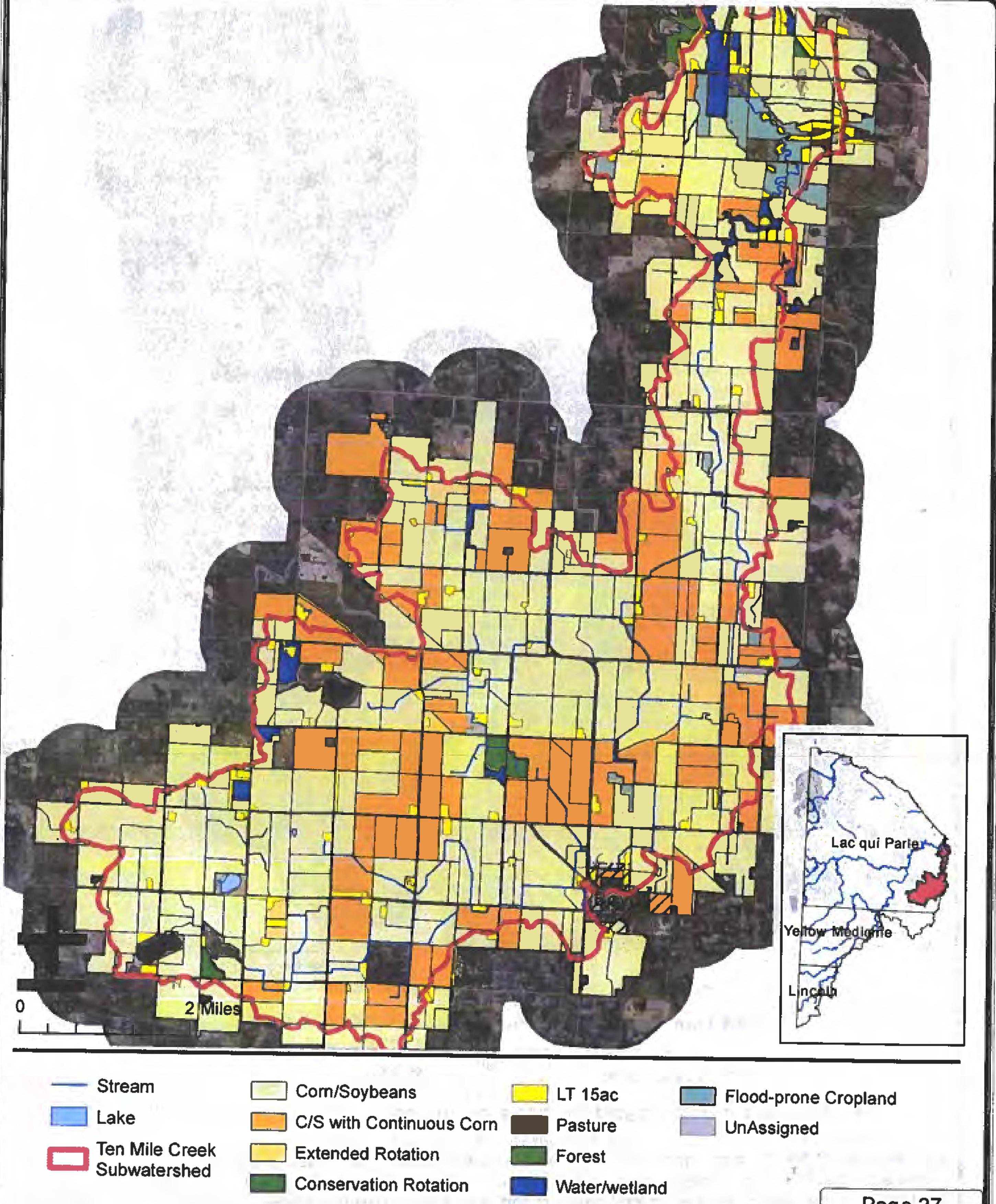
Map 11. Ten Mile Creek Subwatershed

Ten Mile Creek Subwatershed is located in the east-central portion of the Lac qui Parle River Watershed District. The watershed drains north starting near the City of Boyd and drains approximately 26,824 acres.

CLEAN WATER LAND & LEGACY AMENDMENT

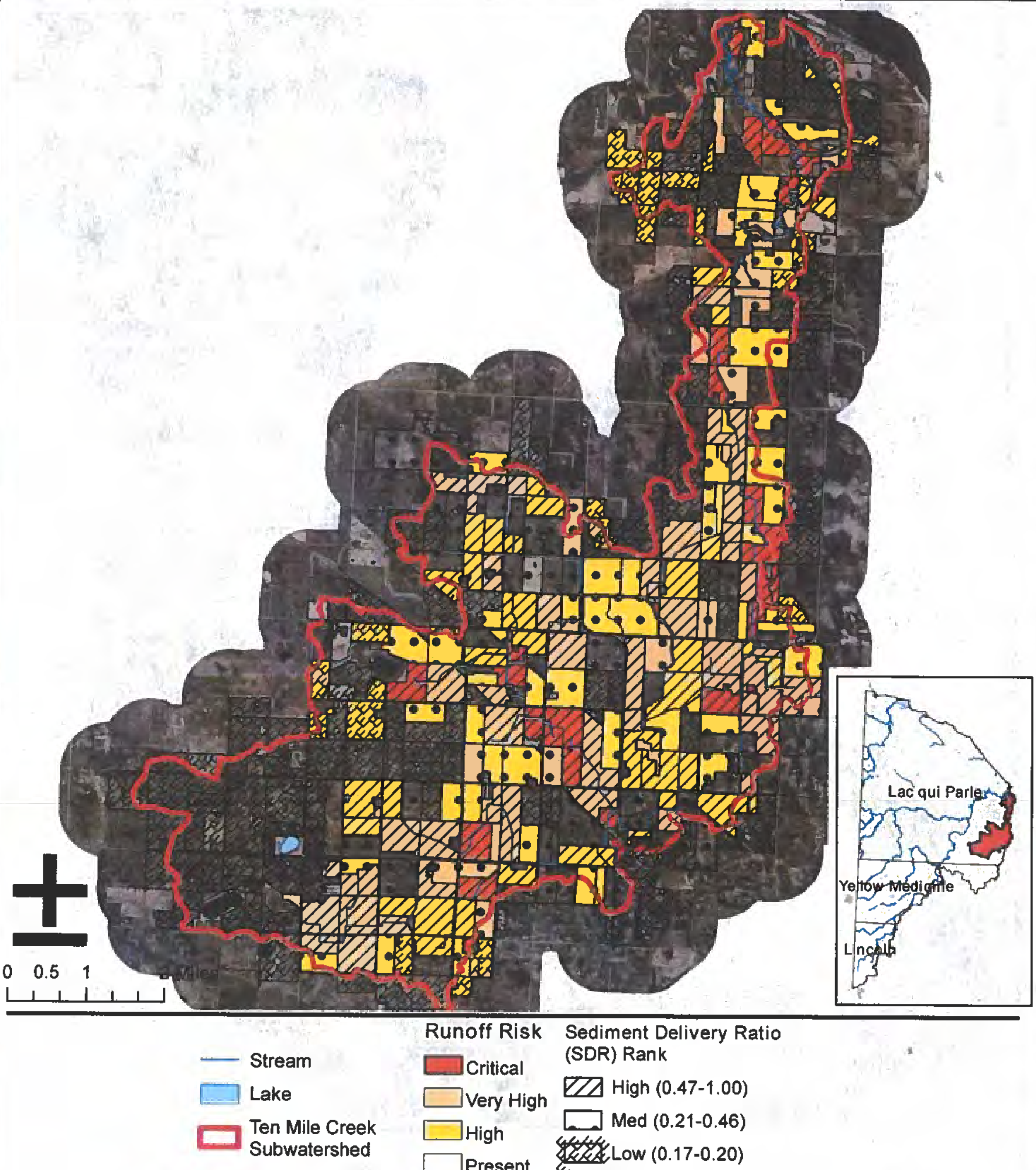
Lac qui Parle Yellow Bank Watershed District

WRC



Map 12. General land use

Mapped representation of general land use in Ten Mile Creek subwatershed (HUC: 070200030603; Source: 2007-2012 NASS CDL). The majority of the watershed is in a row crop rotation (94%).



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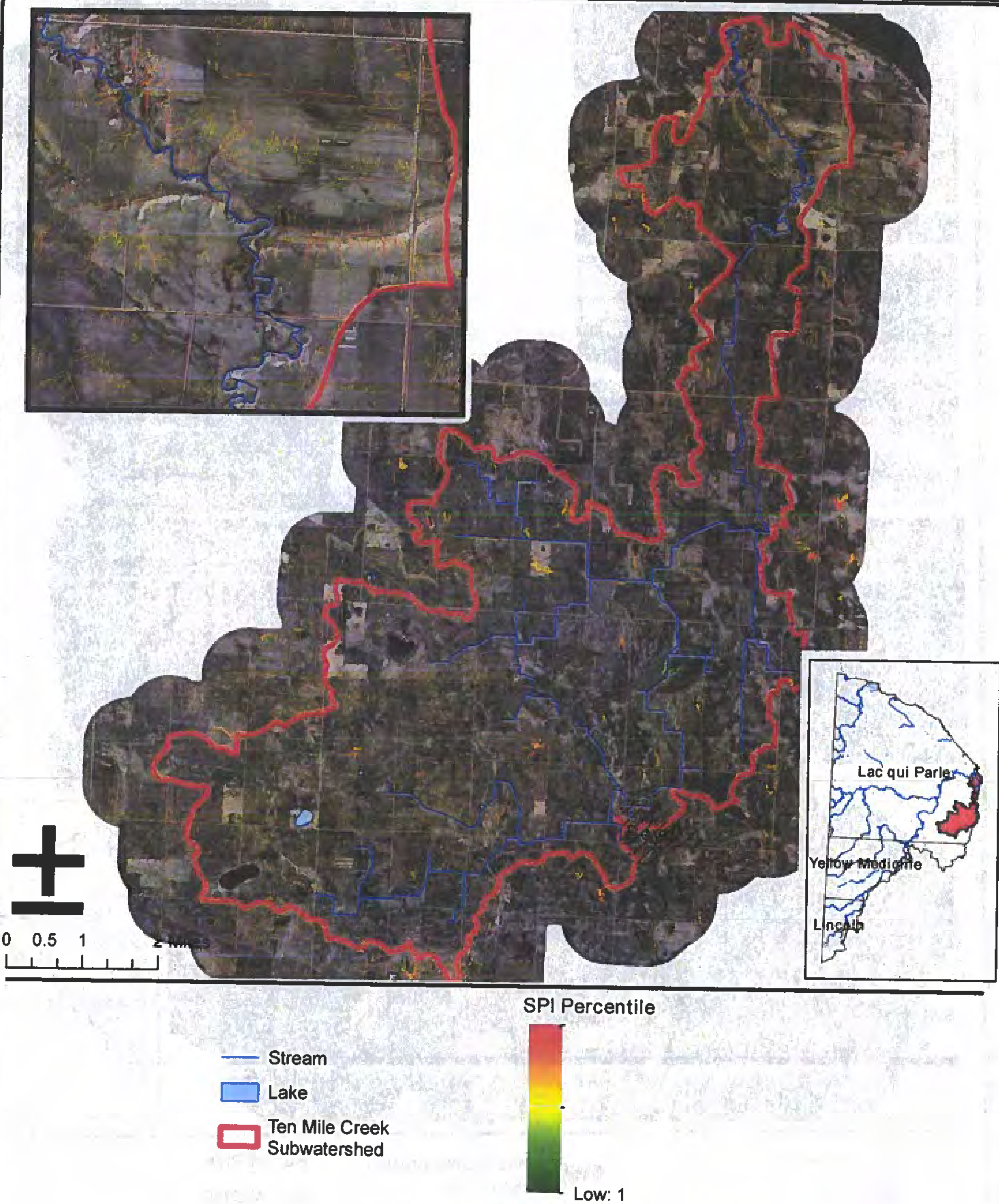
Fields prioritized based on the ACPF runoff risk analysis, with only agricultural land use fields assessed and classified for risk of direct runoff contribution to the adjacent stream reach based on the slope and distance to stream. Placing conservation practices on fields ranked as ³Critical´, ³Very High´ and ³High´ would have greater potential impact in total sediment and phosphorus delivery reductions. Sediment Delivery Ratio (SDR) accounts for deposition that occurs from the sediment source to the outlet. The value is determined based on the distance to surface waterbody and estimated landscape trapping. Thresholds applied in this study was a 20-40-40 breakdown . The steepest and nearest 20% of fields are ³High´, the next 40% o fields are classified as ³Medium´ and the lowest 40% of fields are classified as ³Low.´ As more data becomes available, more iterations can be ran to adjust the distribution of SDR values and prioritization of fields.



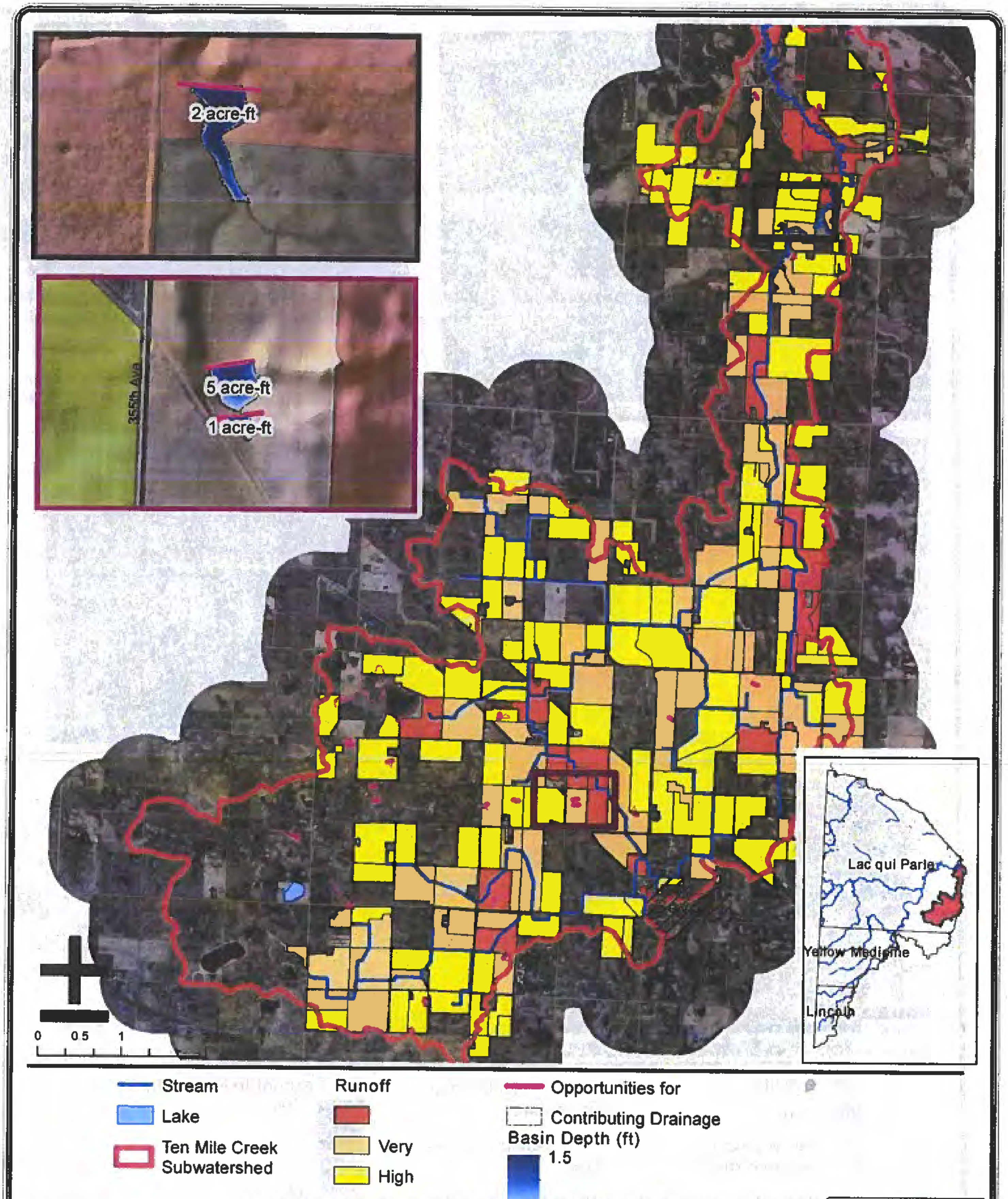
Map 14. Stream Power Index (SPI)

Stream Power Index (SPI) was calculated to determine areas within the watershed that are estimated to have concentrated overland flow. This information can help identify probable areas for gully erosion, rapidly down-cutting ravines, and bluffs, A percentile analysis was completed on the SPI to compare values relatively and help prioritize areas within the watershed that are more sensitive to erosion.

Stream
Lake
Ten Mile Creek Subwatershed
Ravine & Gully Erosion Sensitive Area
Filter Strip Suitability Assessment
Runoff Risk
Critical
Very High
High

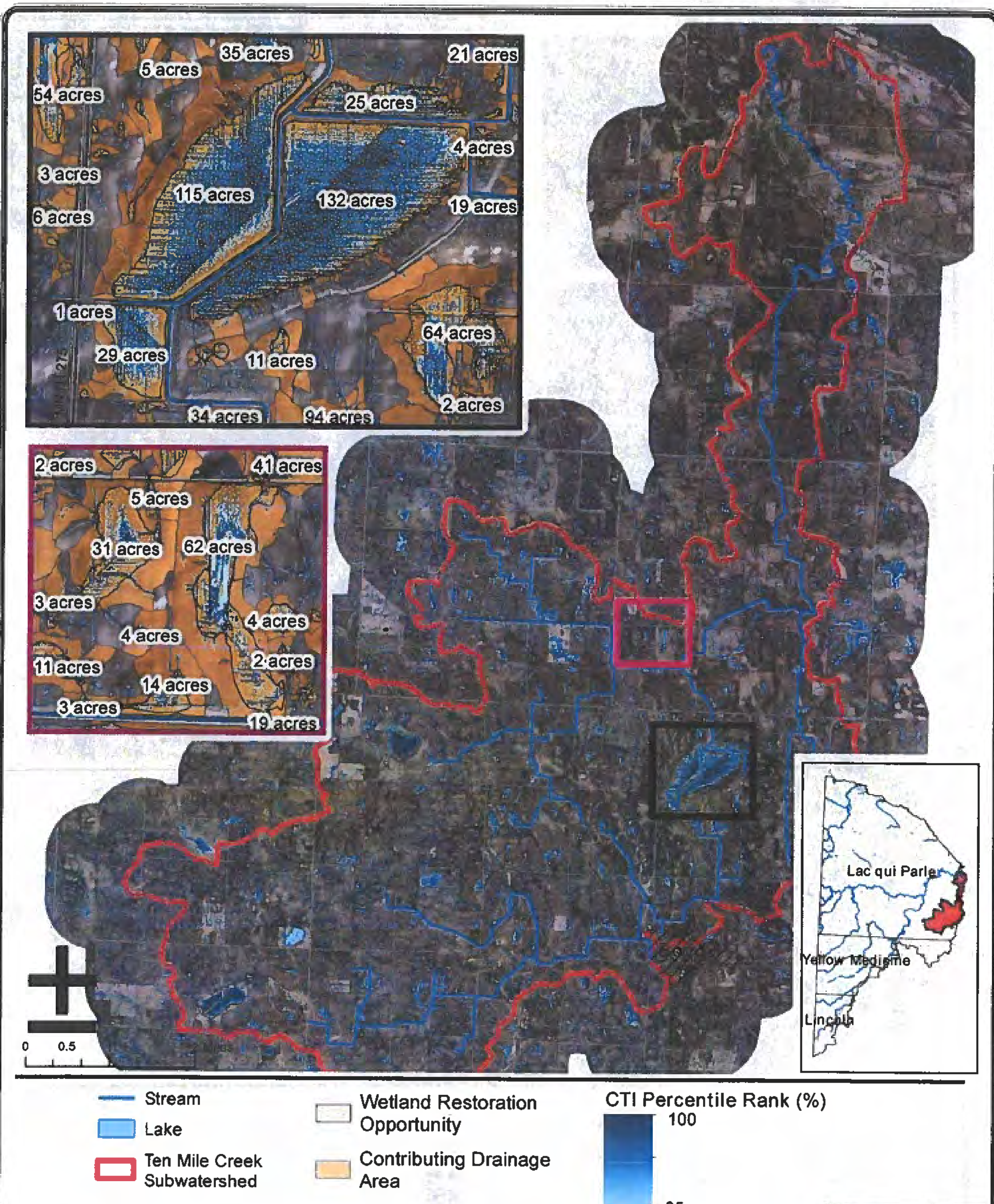
Map 15. Erosion control site identification and BMPs suitability analysis for prioritized fields and stream corridor

Analysis completed with ACPF: http://northcentralwater.org/acpf/



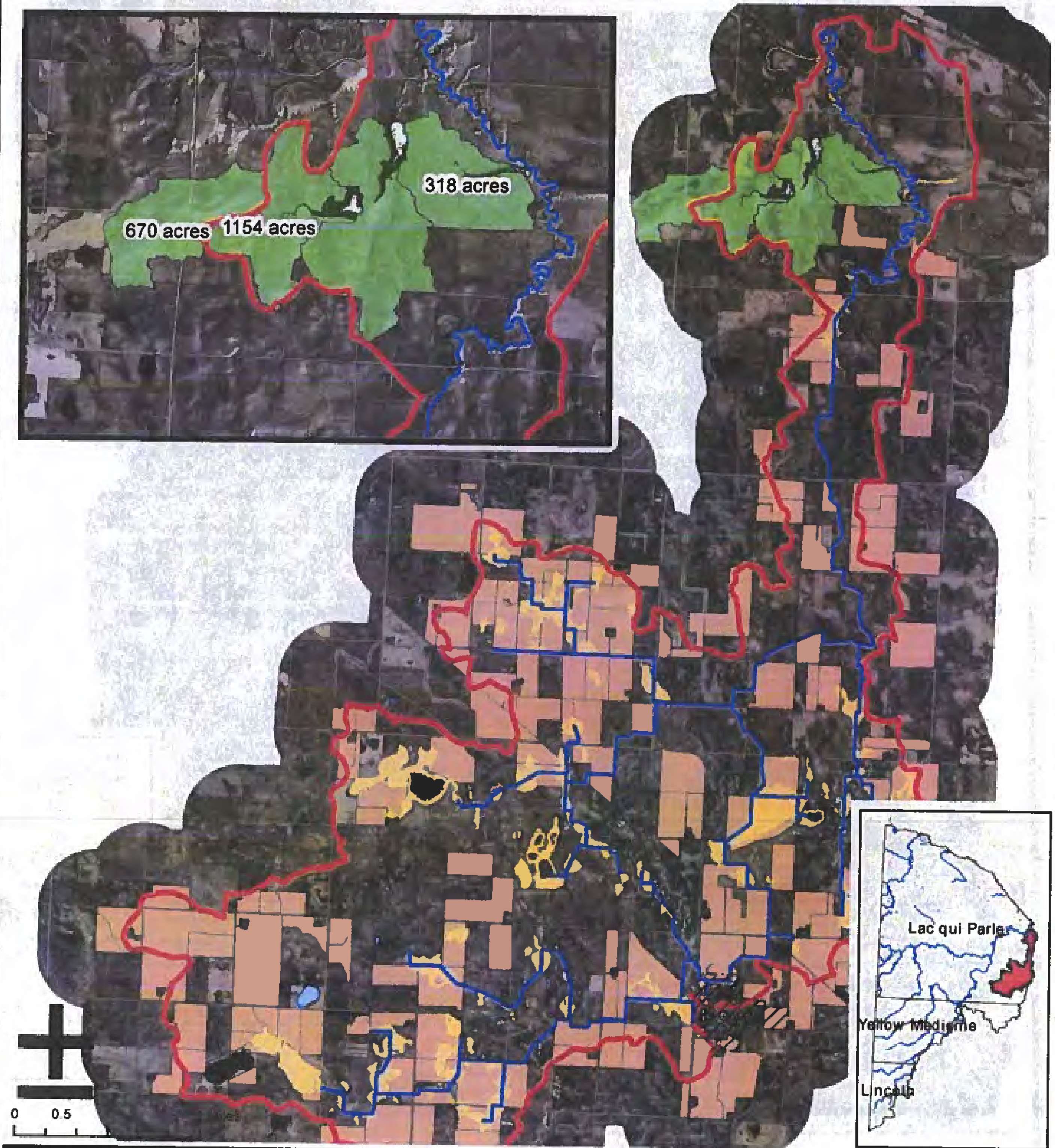
Map 16. Water and Sediment Control Basins (WASCOBs)

Distribution of Water and Sediment Control Basins (WASCOBs) in fields identified as having a runoff risk of "Critical", "Very High" and "High" ranking. These represent opportunity areas for a WASCOB structure and estimated basin depth and water storage benefits. Suitable areas are determined based on the following criteria: 1.5-meter embankment height and 100-meter spacing. Selection criteria can be modified in future iterations of ACPF, if desired. (www.northcentralwater.org/acpf/)



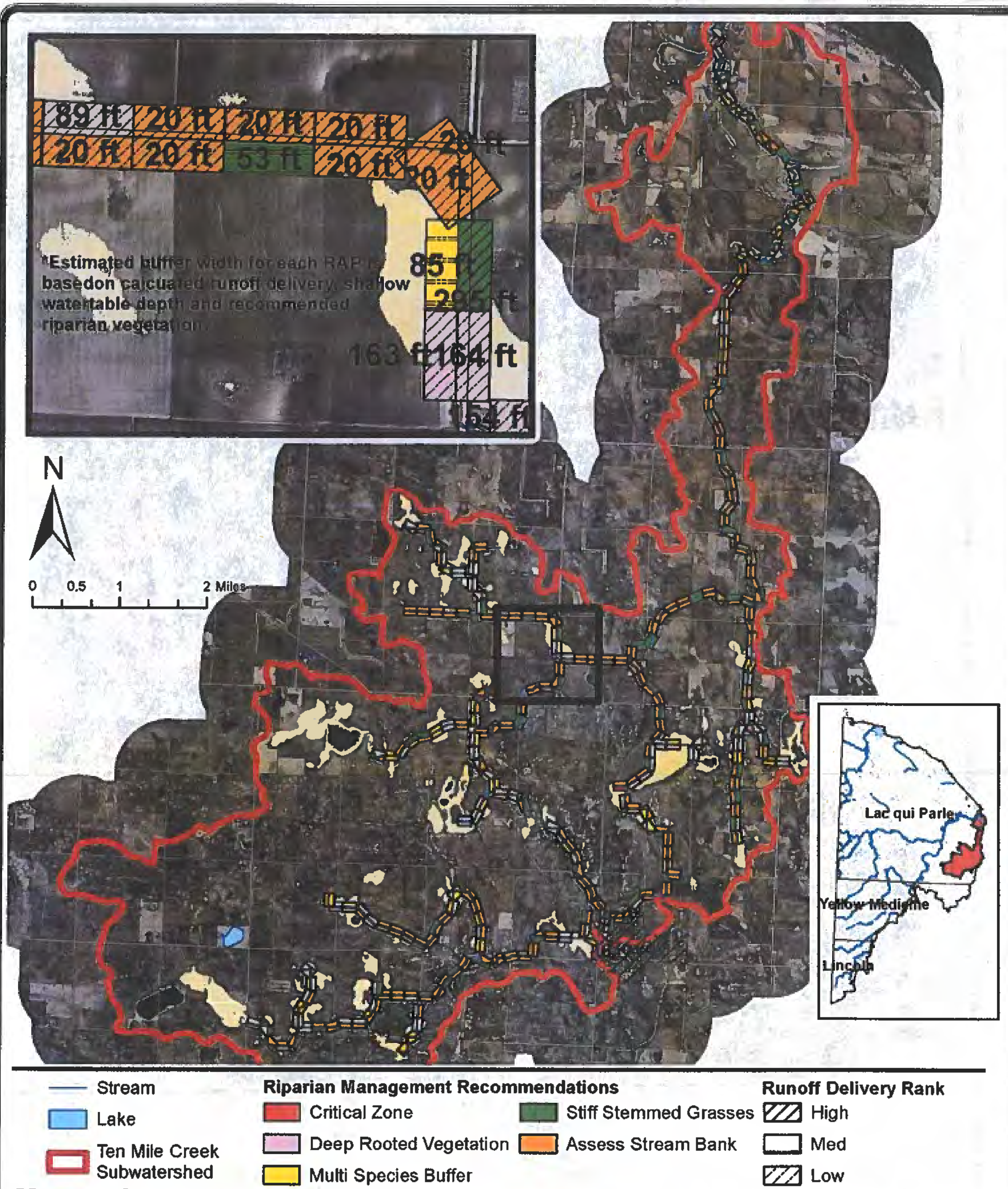
Map 17. Water storage and wetland restoration opportunities

Distribution of areas water is likely accumulate based on the top 85% of the secondary terrain analysis attribute, Compound Topographic Index (CTI), for Ten Mile Creek subwatershed. CTI estimates areas where ponding is probably to occur based of the modeled overland surface flow. These areas can be overlayed with outputs from the ACPF toolset, such as "Depressions" for a further analysis on BMP suitability and estimated drainage area contributing to the site.
Analysis completed with ACPF: http://northcentralwater.org/acpf/



Map 18. Nutrient removal wetland suitability sitings

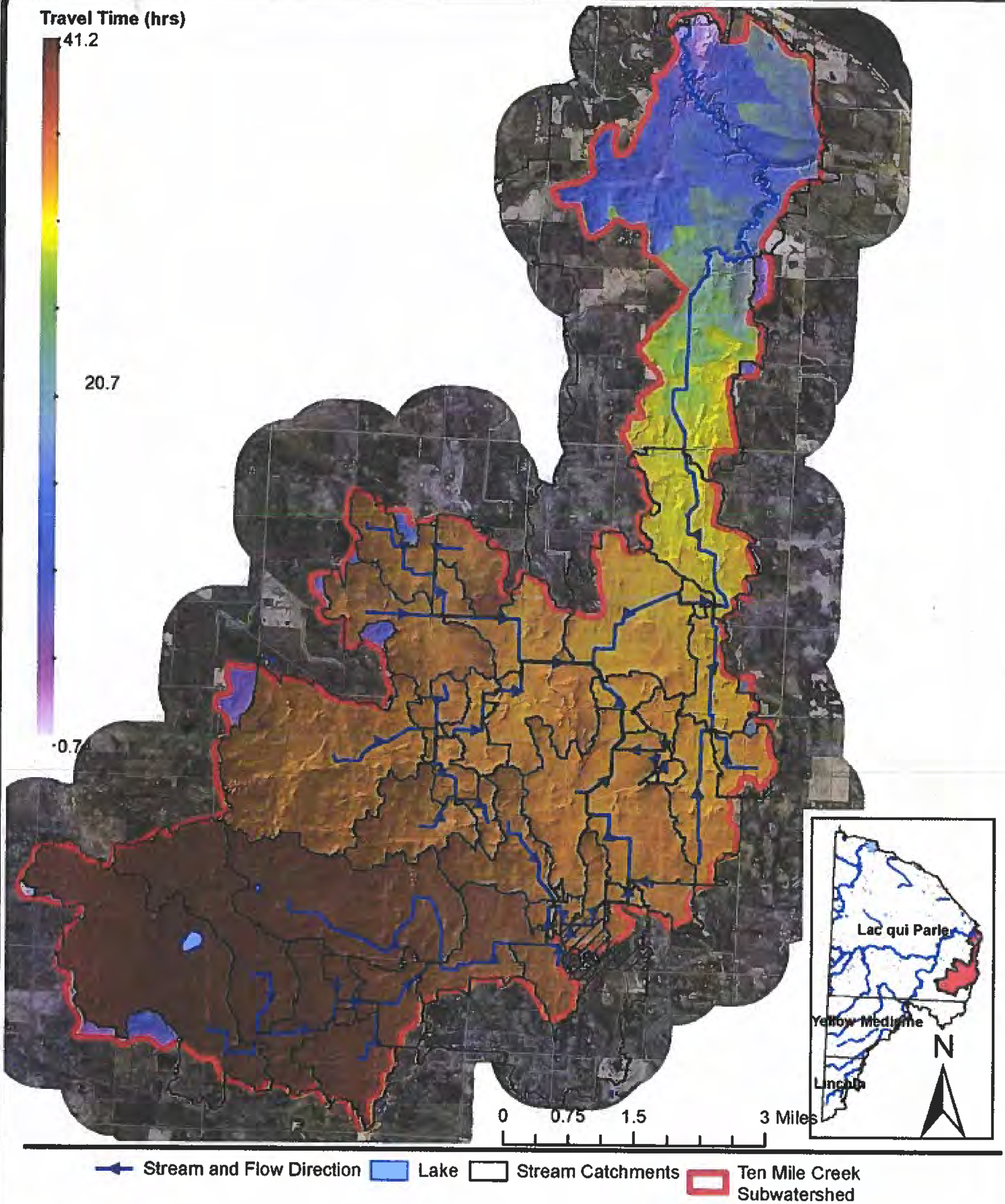
Areas suited for nutrient removal wetlands as an edge-of-field practice. Locations for wetlands were evaluated based on on sampling along flow paths every 100 m using the following user specifications: 0.9 m wetland impoundment height and 1.5 m buffer height. These values can be changed based off desired wetland embankment criteria. Nutrient removal wetlands are effective in reducint nutrients in nonpoint source runoff. Fields estimated to be tiled drained are based on the terrain analysis and can be updated as tiling records within the watershed district become available. Analysis completed using ACPF: northcentralwater.org/acpf/



Map 19. Streambank management and prioritization

Recommended riparian zone management based off of an analysis using ACPF toolset on soil type, runoff and morphological features within a 250 meter by approximately 90 meter riparian area polygon (RAP). Those areas are identified as critical zones; multispecies buffer for water uptake, nutrient and sediment trapping; stiff-stemmed grasses for trapping runoff and sediment; deep rooted vegetation tolerant of saturated soils; and areas where stream bank stability should be evaluated. Each RAP was analyzed using ACPF for runoff delivery rank based on local runoff delivery where a significant potential runoff contribution exists.

Analysis completed with ACPF toolset: http://northcentralwater.org/acpf/



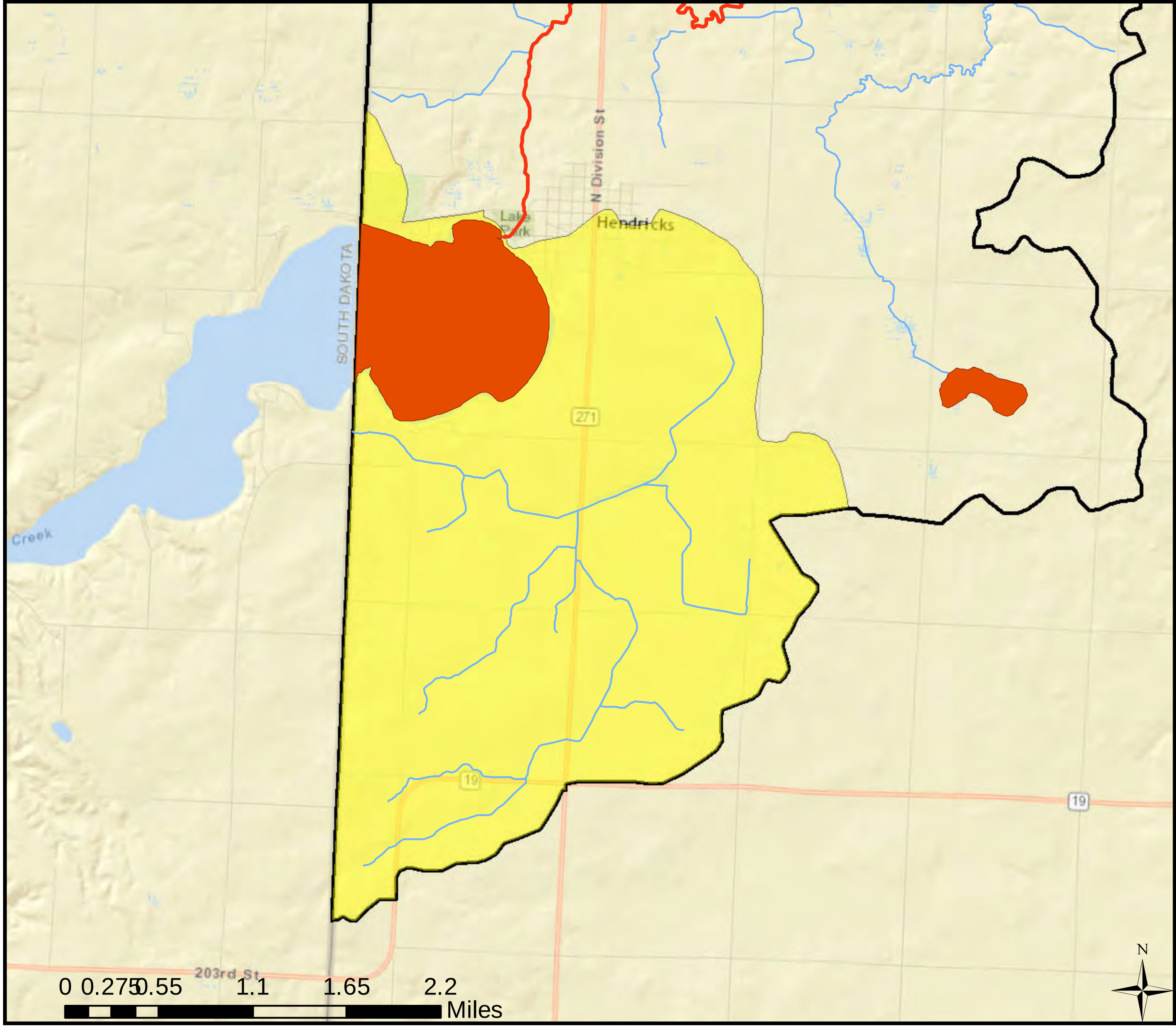
Map 20. Travel time of overland flow

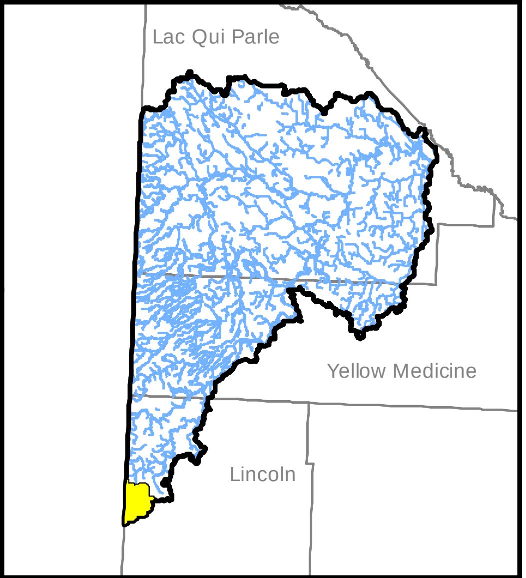
Each cell within the raster dataset has travel time calculated in hours per meter to the outlet of the watershed. The map illustrates the calculated time it takes water to flow across the surface to the outlet of the watershed. The analysis determines water velocity based on the hydraulic radius (R), Manning's N (N), also known as surface roughness, and slope. The longest travel time calculated for JD19-Lac qui Parle River subwatershed is 31.8 hours from the headwaters to the outlet. Analysis completed with MnDNR Hydro Tool:(http://www.dnr.state.mn.us/mis/gis/tools/

2017 Preliminary Watershed Assessment Lac qui Parle River 07020003

Lake Hendricks

070200030101





Aquatice Life:

Aquatic Recreation:

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

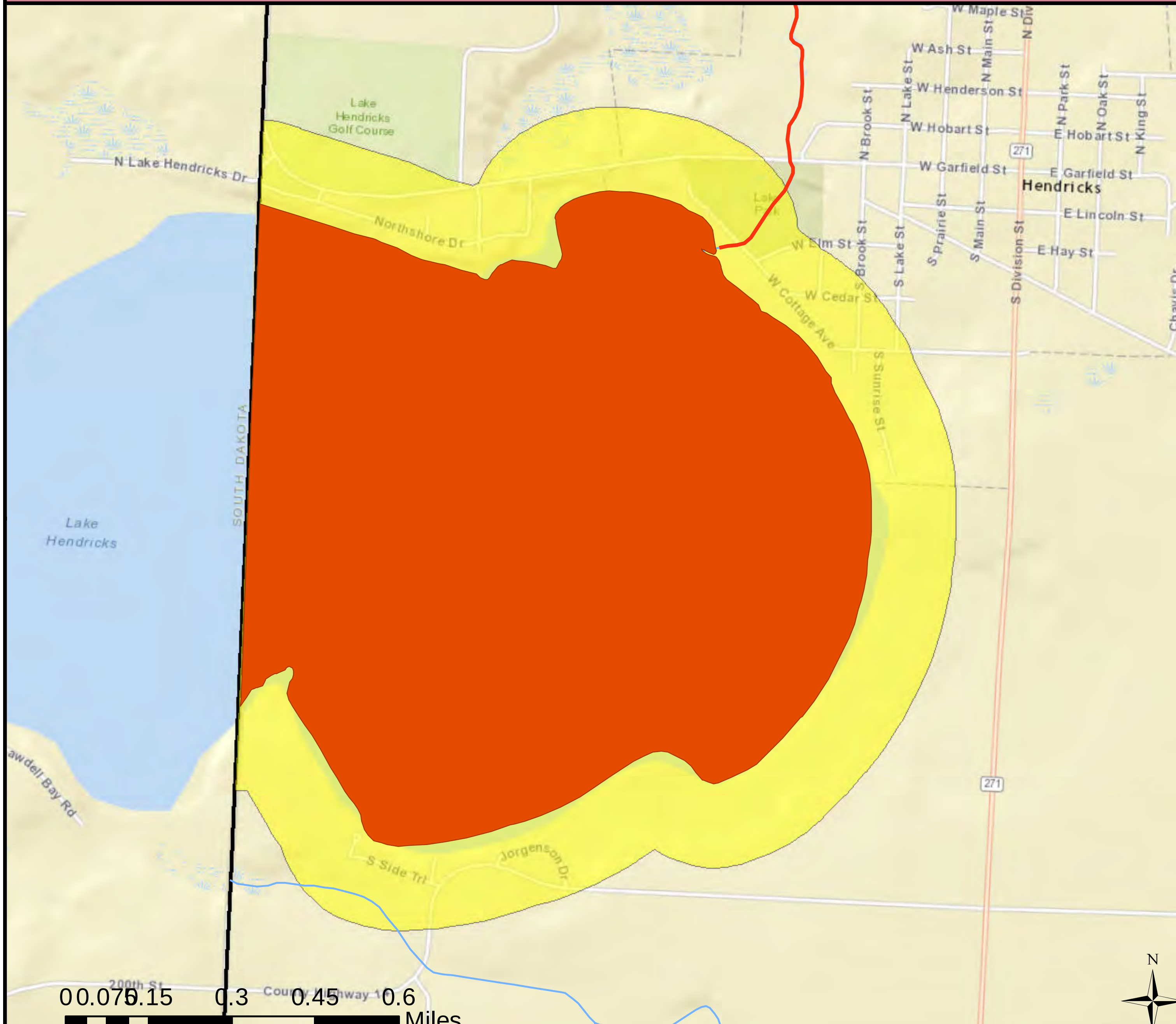
Assessed Streams

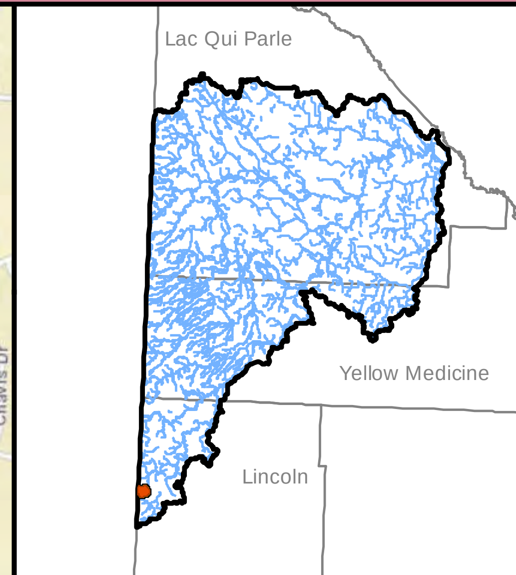
Minnesota Pollution Control Agency

1601 E Hwy 12, Suite 1
Willmar, MN 56201

Hendricks

41-0110-00





Aquatice Life:
Not Supporting
Aquatic Recreation:
Not Supporting
Limited Resource:

New Impairment:
Fish

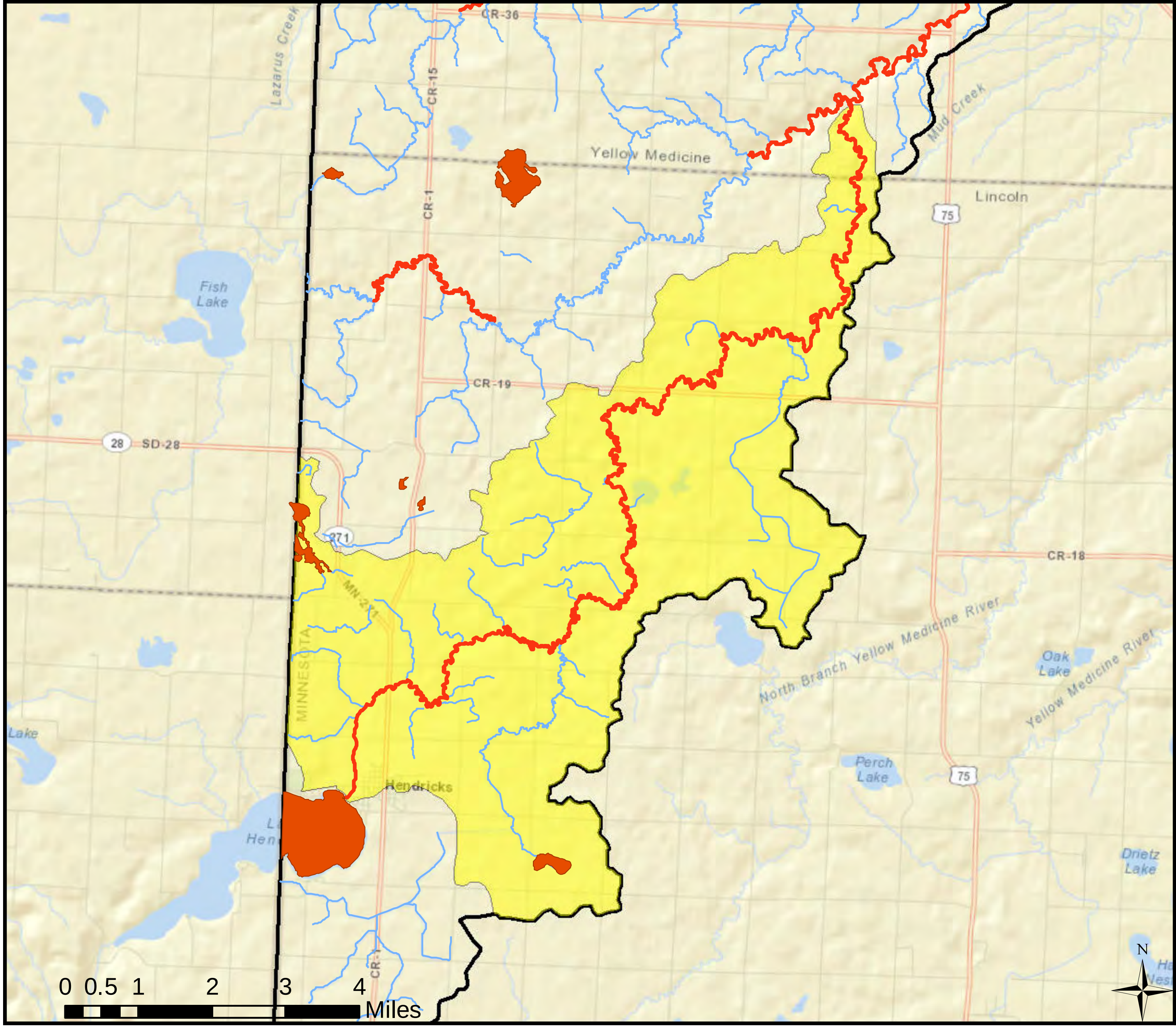
Existing Impairment:
Nutrients

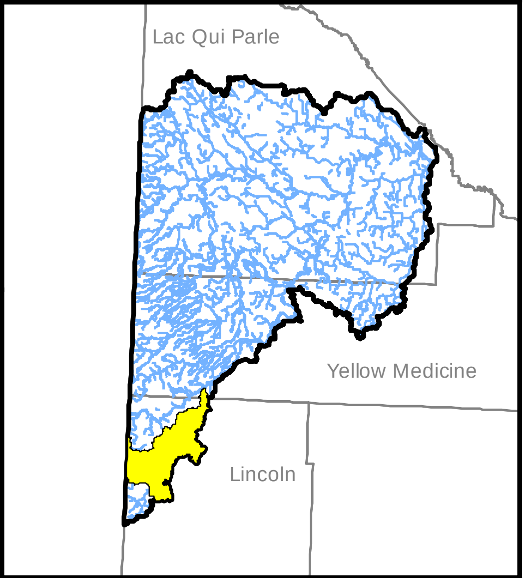
Assessed Lakes
Assessed Streams

Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Judicial Ditch No 19-Lac Qui Parle River

070200030102





Aquatice Life:

Aquatic Recreation:

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

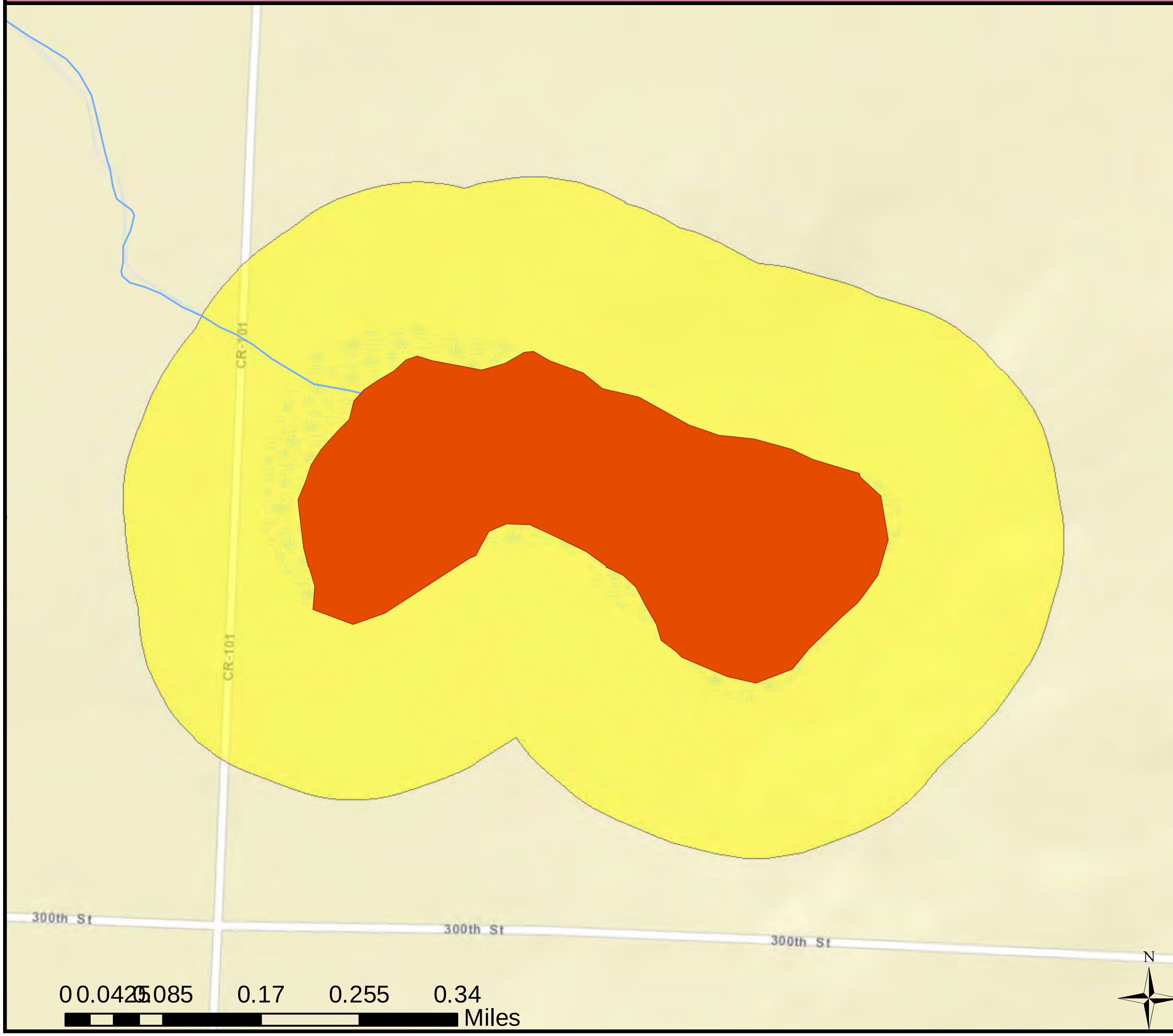
Assessed Streams

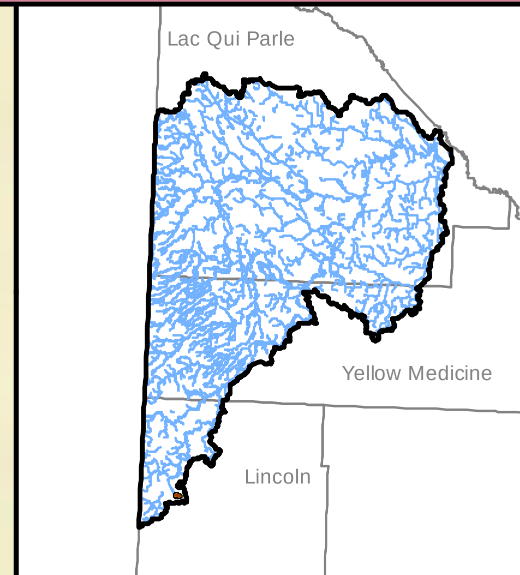
Minnesota Pollution Control Agency

1601 E Hwy 12, Suite 1
Willmar, MN 56201

Kvernmo Marsh

41-0095-00





Aquatice Life:

Aquatic Recreation:
Insufficient Information

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

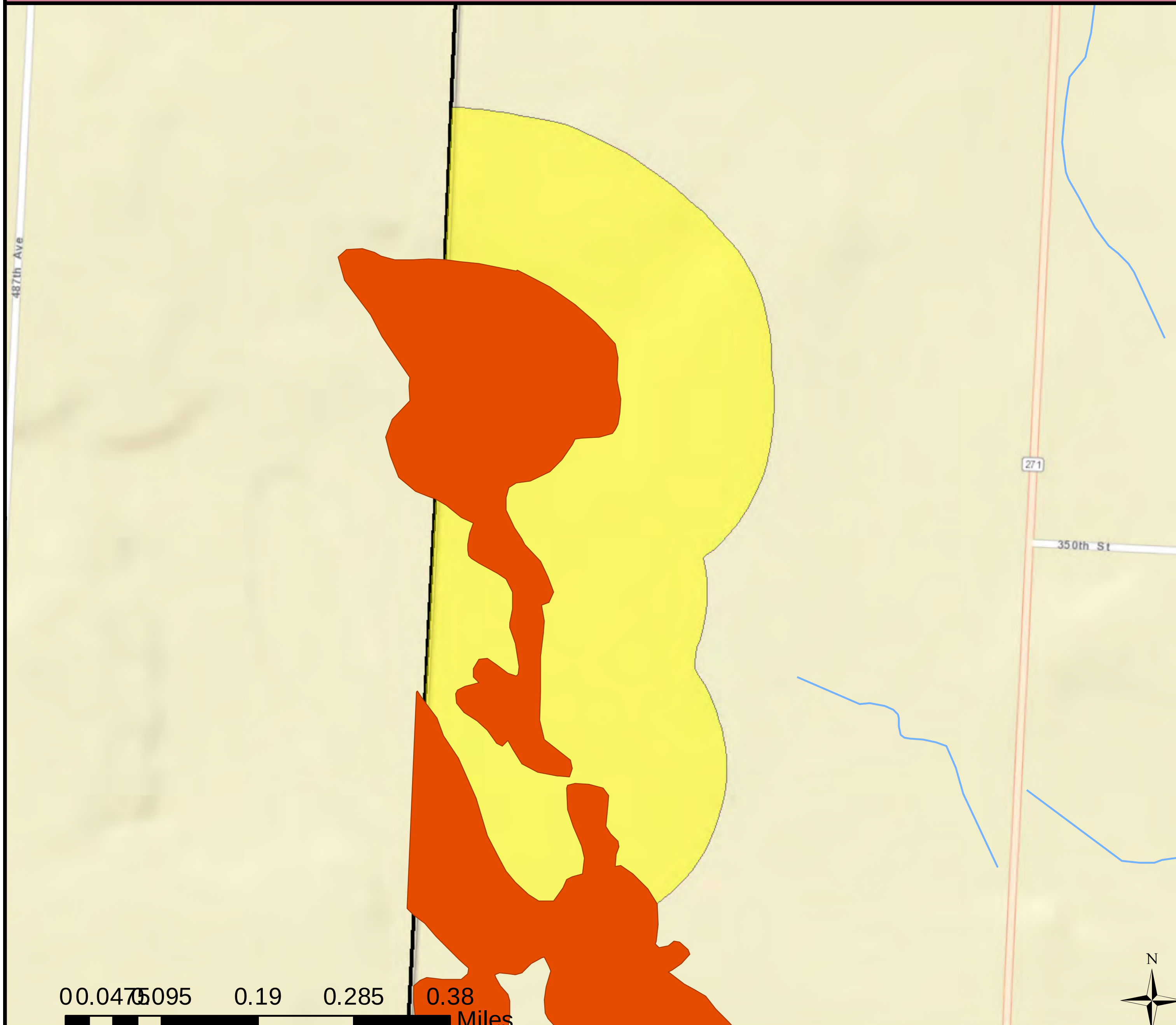
Assessed Streams

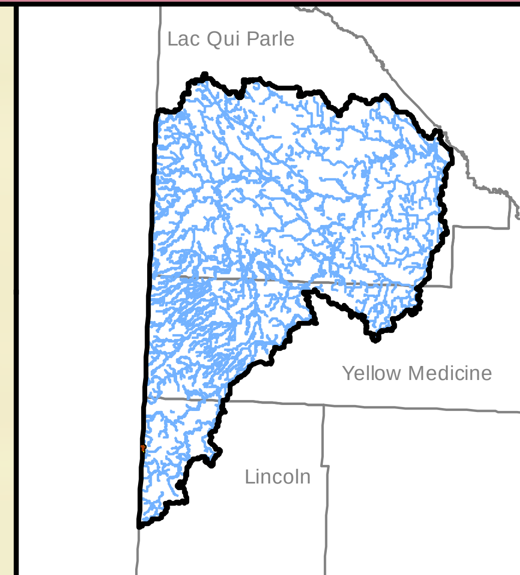
Minnesota Pollution Control Agency

1601 E Hwy 12, Suite 1
Willmar, MN 56201

Unnamed

41-0115-00





Aquatice Life:

Aquatic Recreation:
Insufficient Information

Limited Resource:

New Impairment:

Existing Impairment:

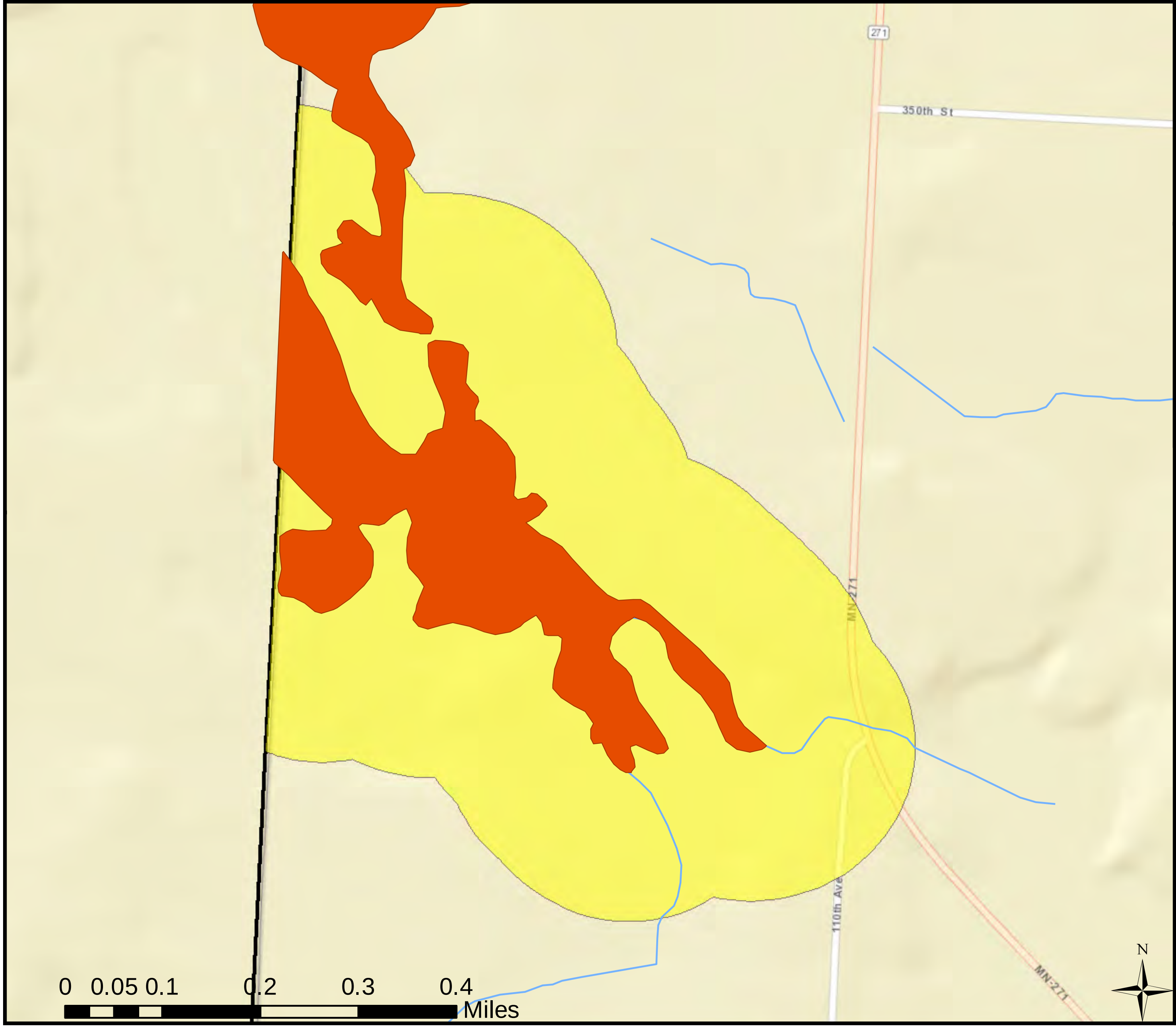
Assessed Lakes

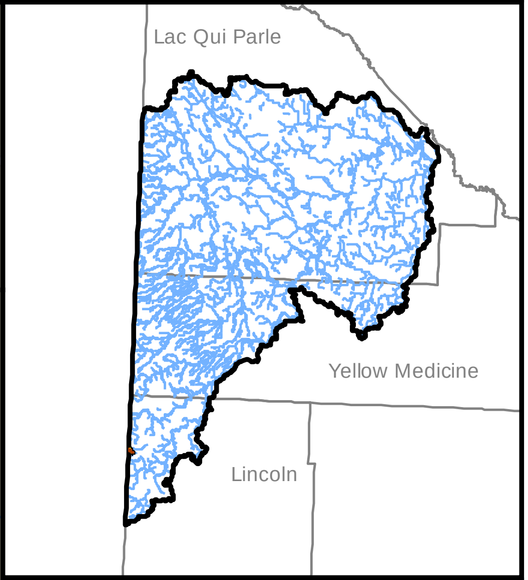
Assessed Streams

Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Unnamed

41-0116-00





Aquatice Life:

Aquatic Recreation:
Insufficient Information

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

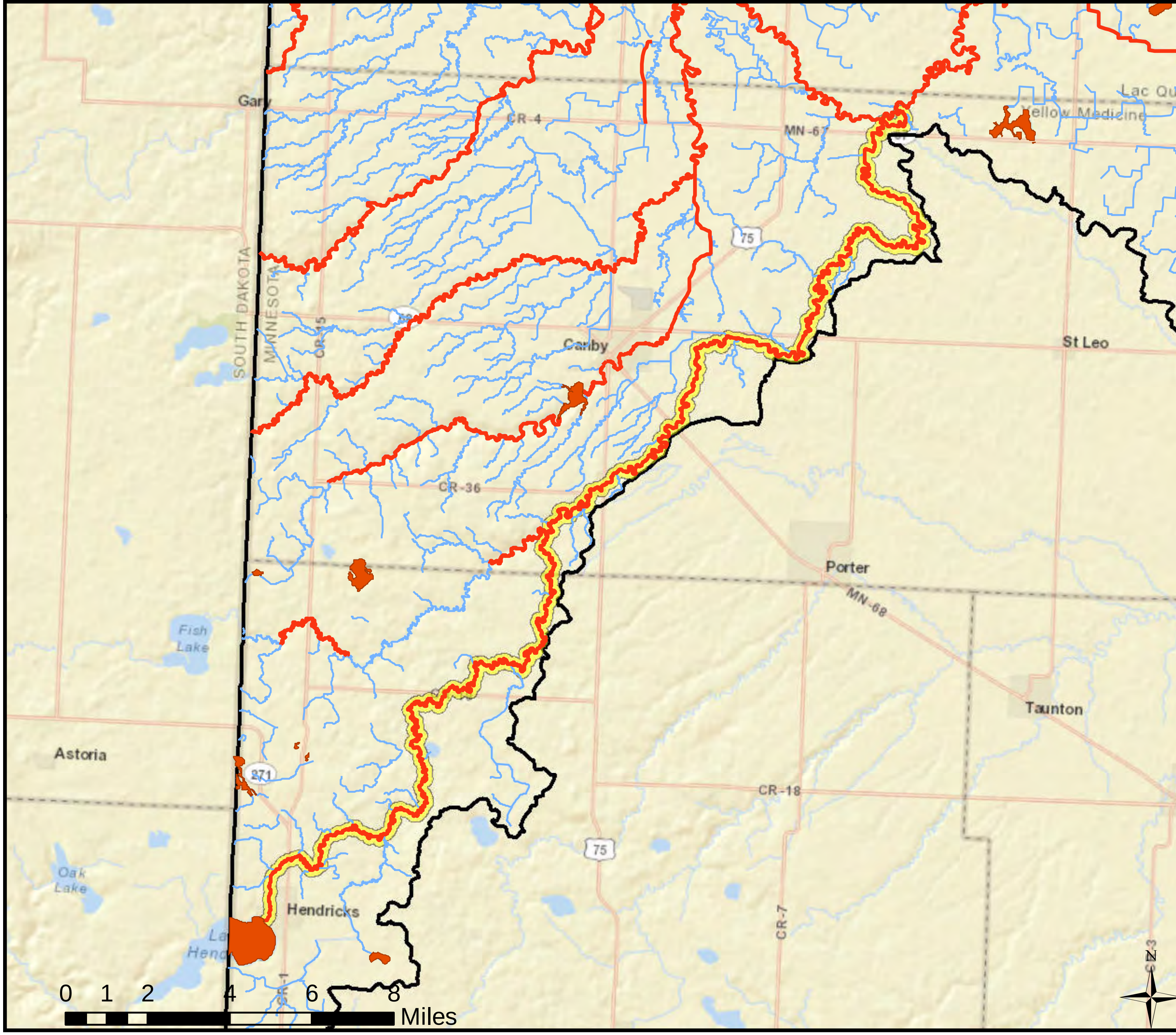
Assessed Streams

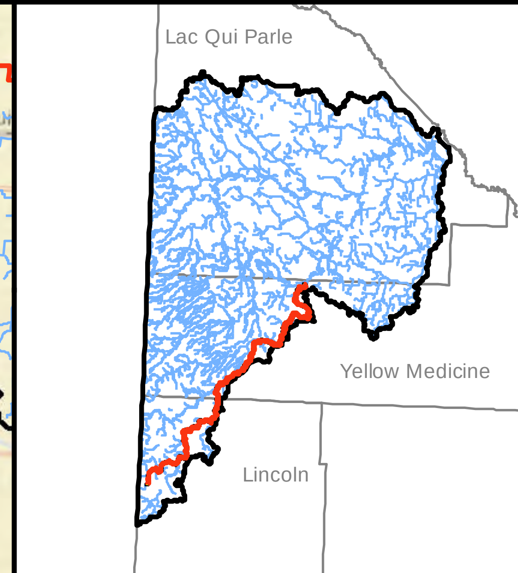
Minnesota Pollution Control Agency

1601 E Hwy 12, Suite 1
Willmar, MN 56201

Lac qui Parle River

07020003-505 Headwaters (Lk Hendricks 41-0110-00) to Lazarus Cr (Canby Cr)





Aquatice Life:
Not Supporting
Aquatic Recreation:
Not Supporting
Limited Resource:

New Impairment:
Macroinvertebrate

Existing Impairment:
Mercury, Fecal Coliform, Fish, Turbidity

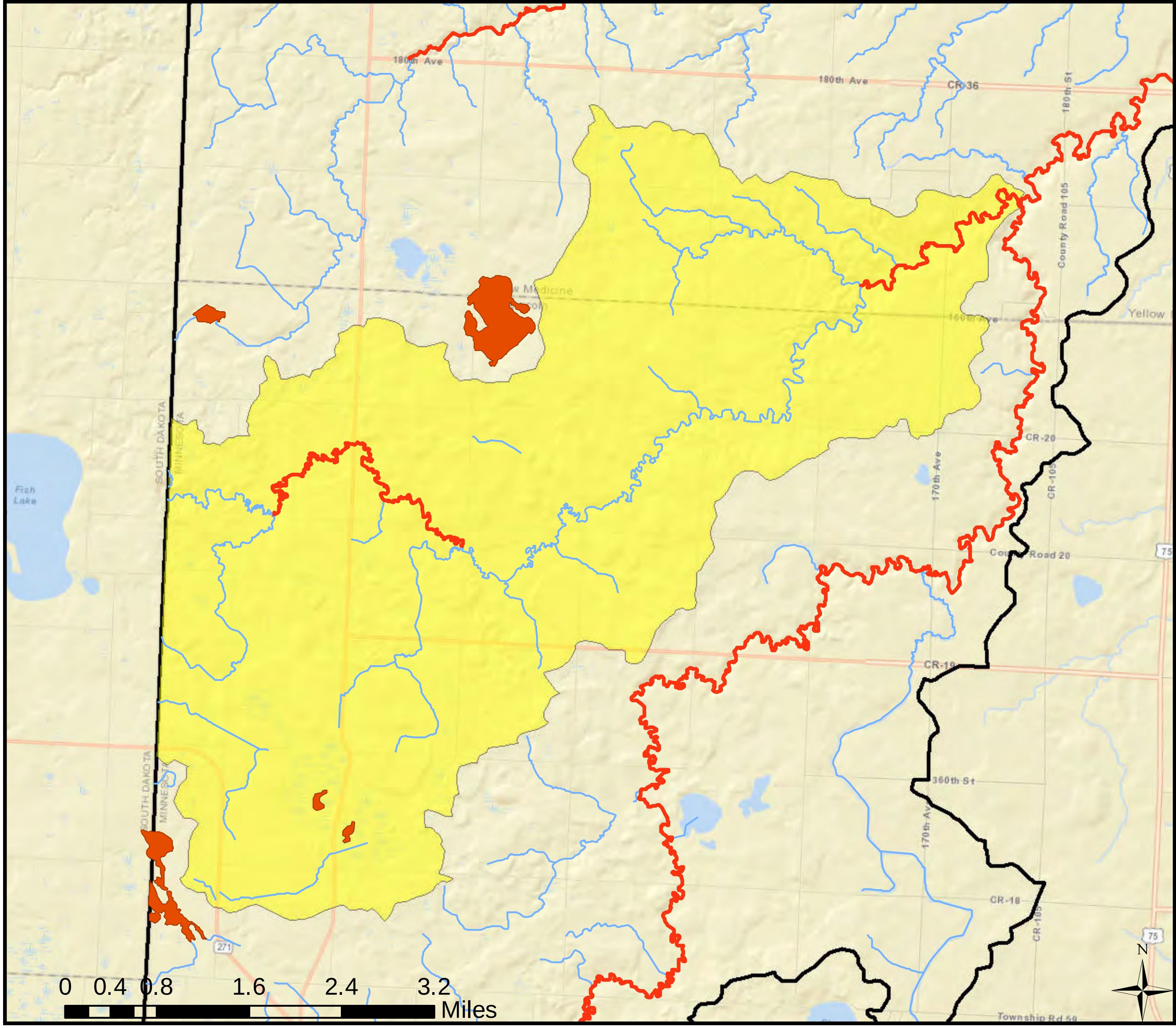
Assessed Lakes

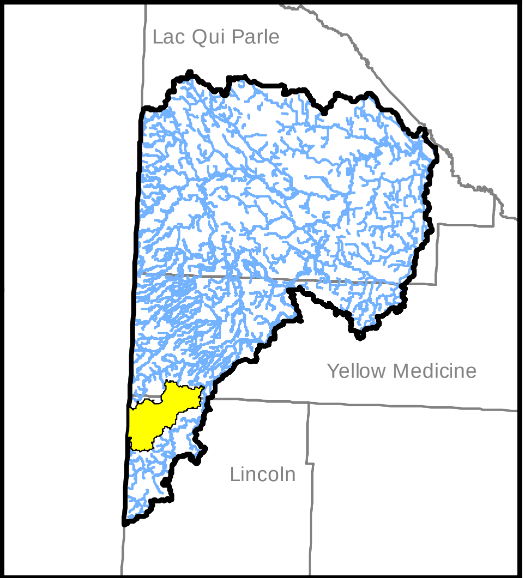
Assessed Streams

Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Twin Lake

070200030105





Aquatice Life:

Aquatic Recreation:

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

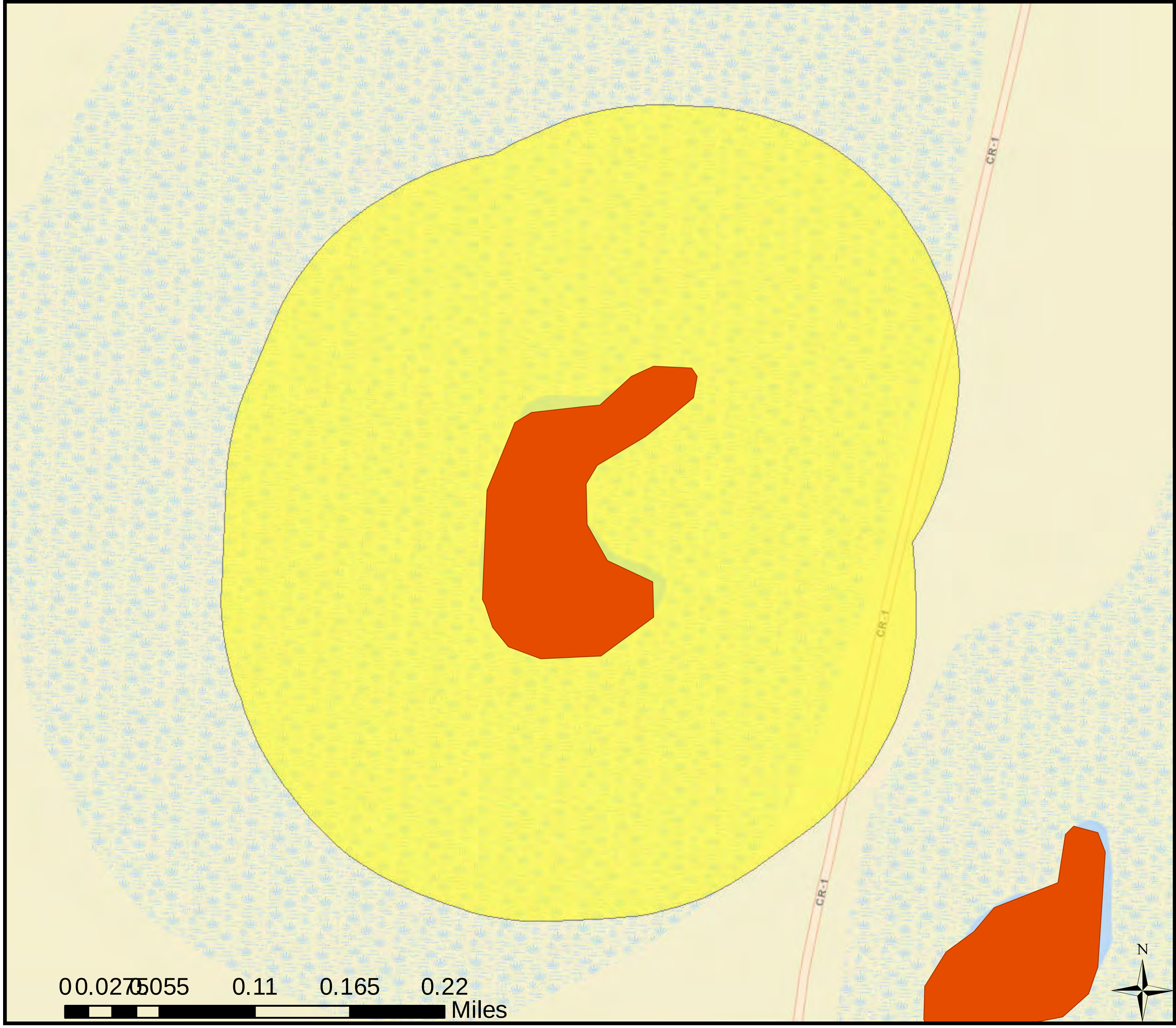
Assessed Streams

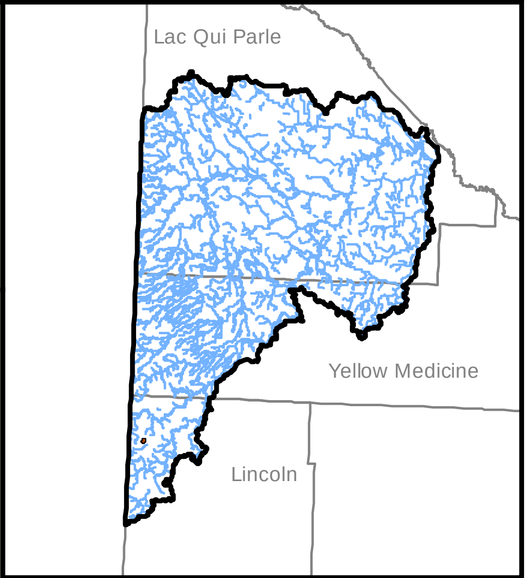
Minnesota Pollution Control Agency

1601 E Hwy 12, Suite 1
Willmar, MN 56201

West Twin

41-0102-00





Aquatice Life:

Aquatic Recreation:
Insufficient Information

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

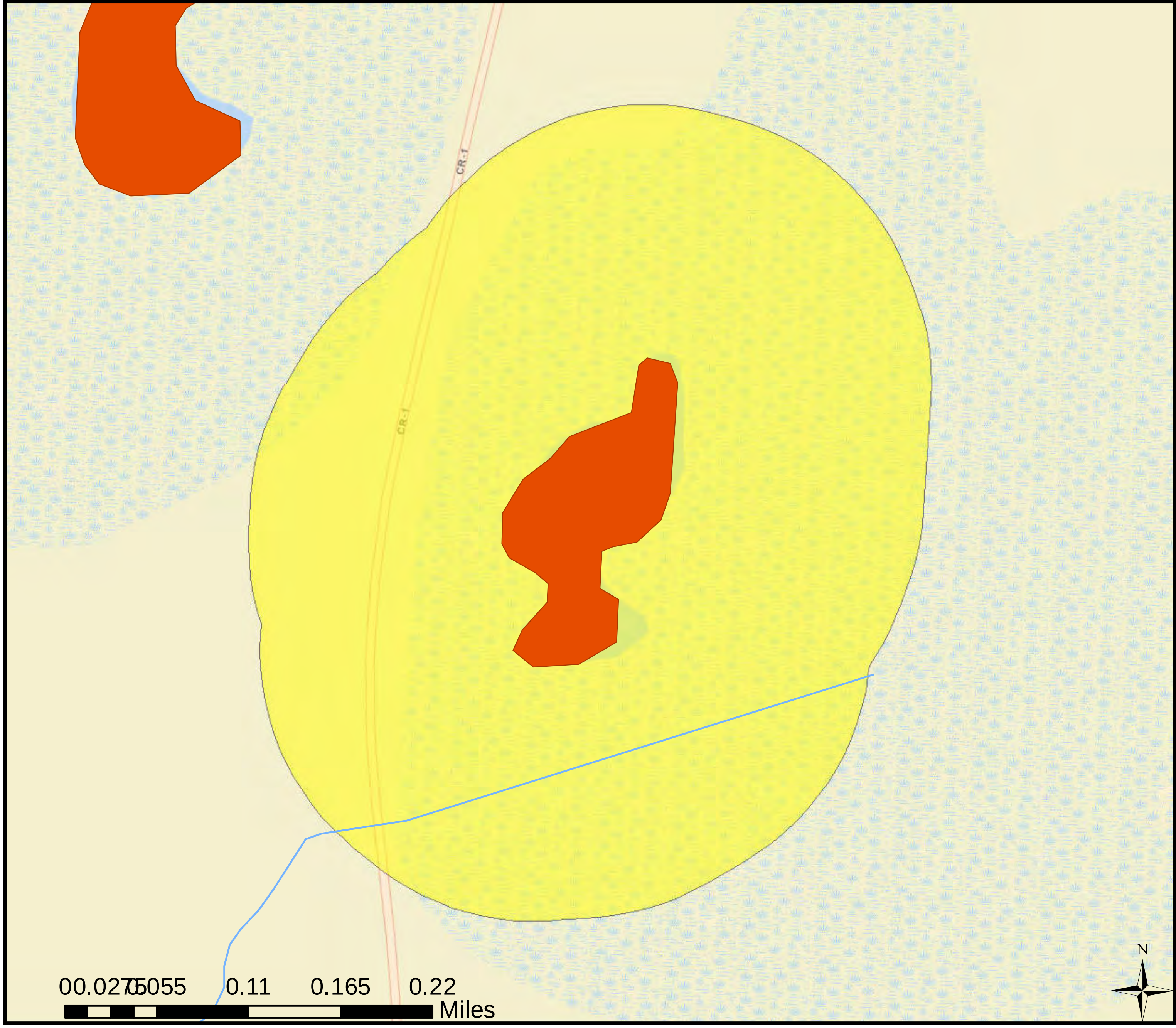
Assessed Streams

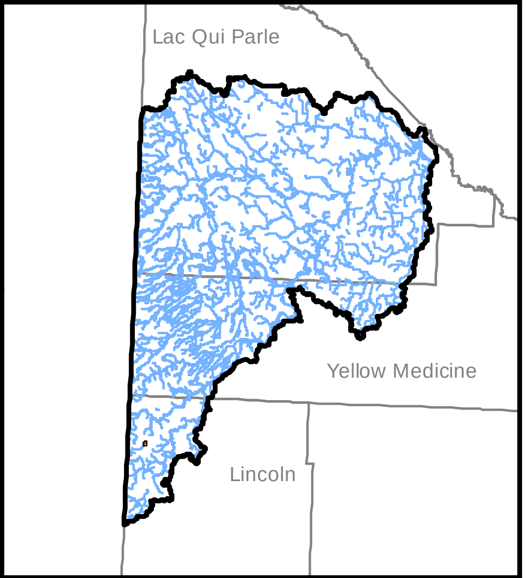
Minnesota Pollution Control Agency

1601 E Hwy 12, Suite 1
Willmar, MN 56201

East Twin

41-0108-00





Aquatice Life:

Aquatic Recreation:
Insufficient Information

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

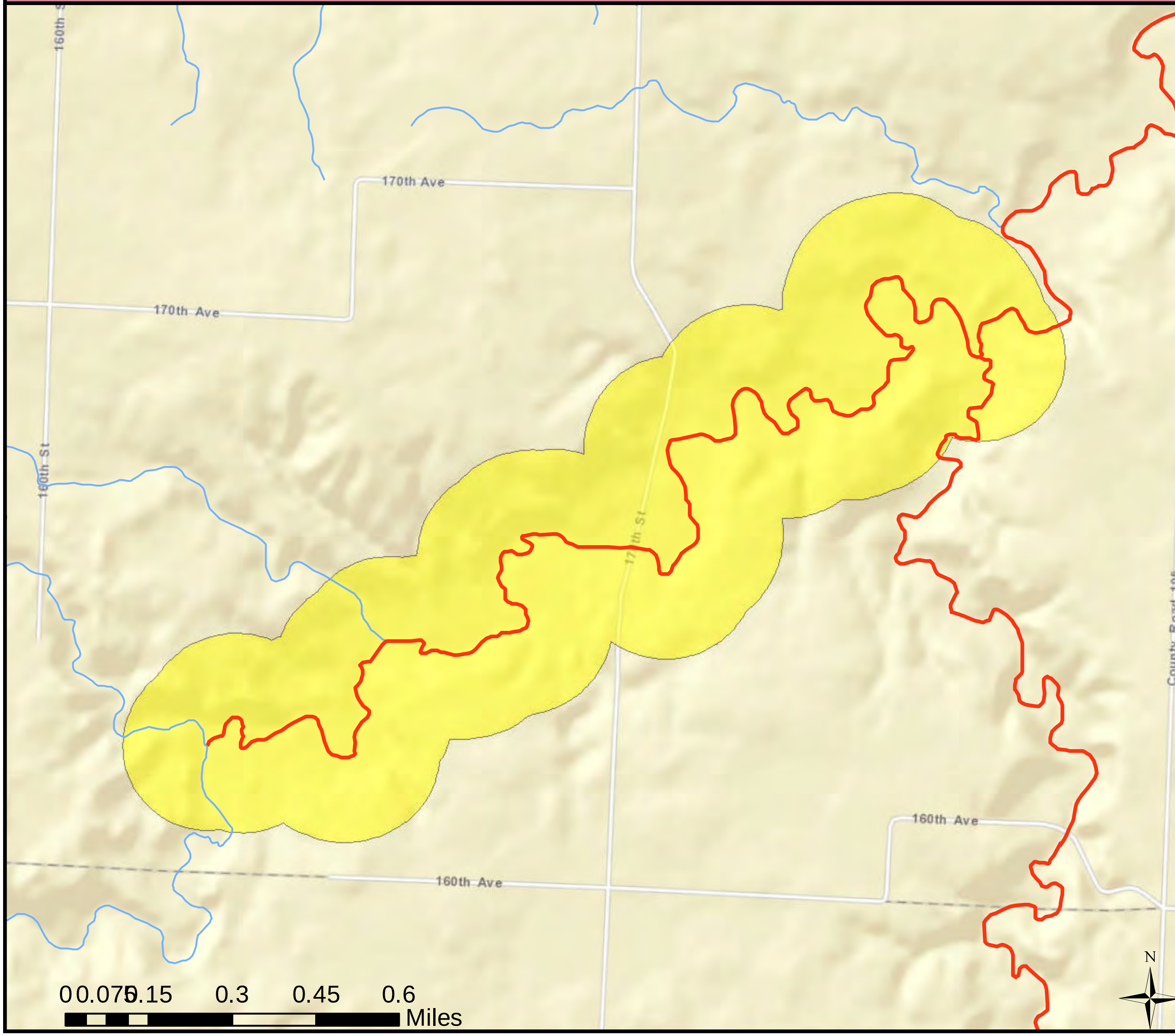
Assessed Streams

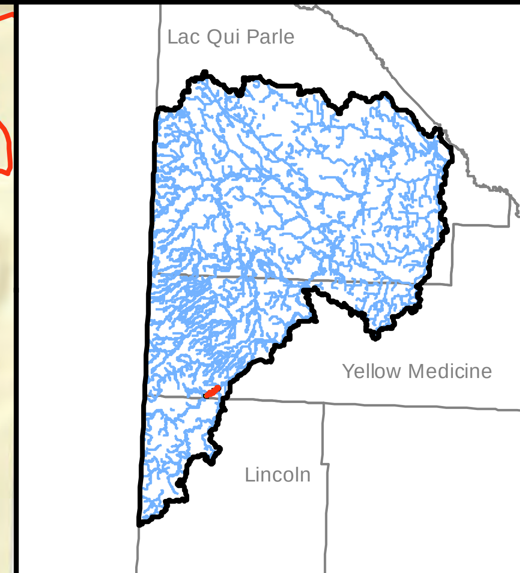
Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Unnamed creek

07020003-530

Unnamed cr to Lac Qui Parle R





Aquatice Life:
Not Supporting
Aquatic Recreation:
Not Supporting
Limited Resource:

New Impairment:
Macroinvertebrate, E. coli, Fish, TSS
Existing Impairment:

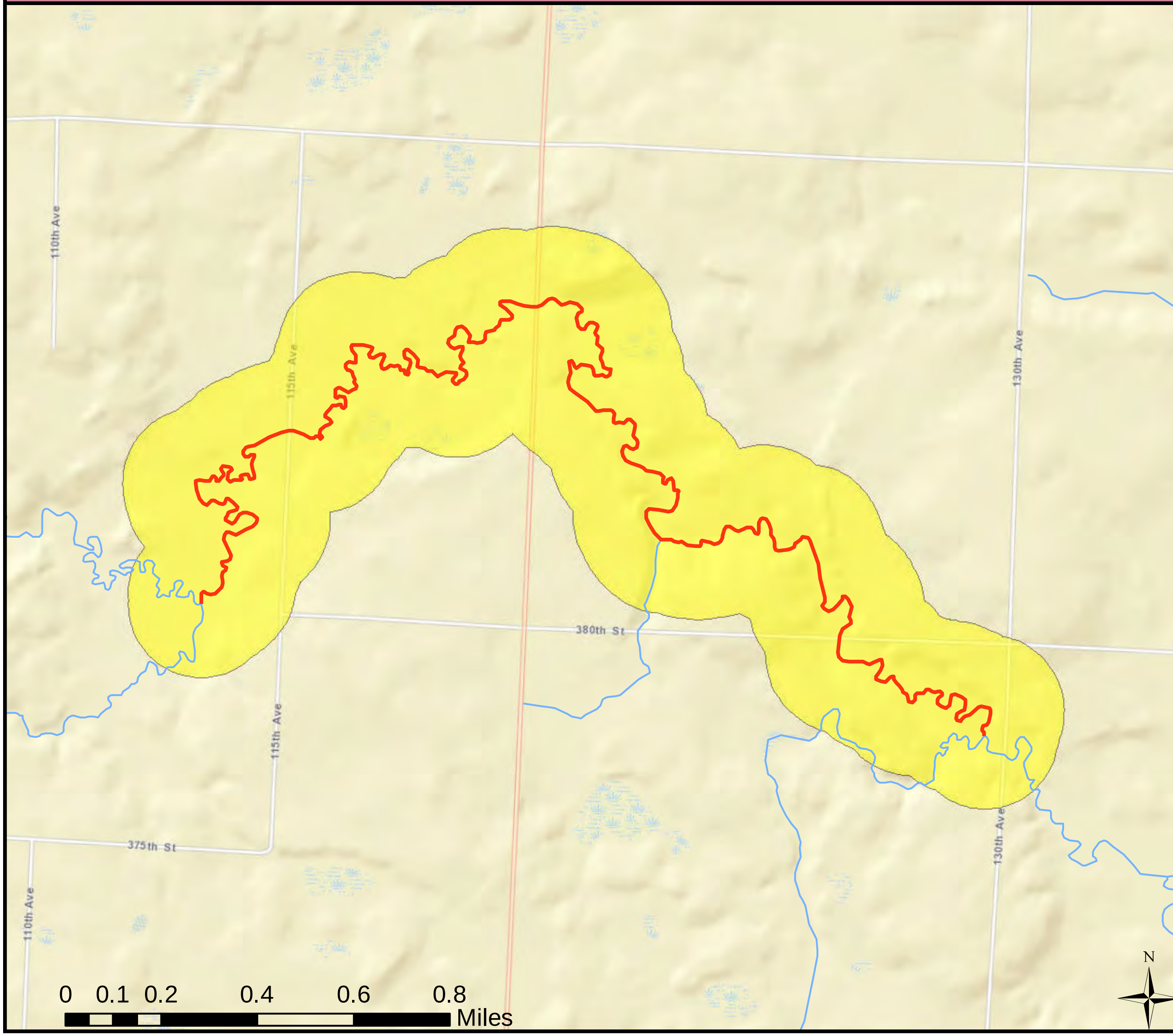
Assessed Lakes
Assessed Streams

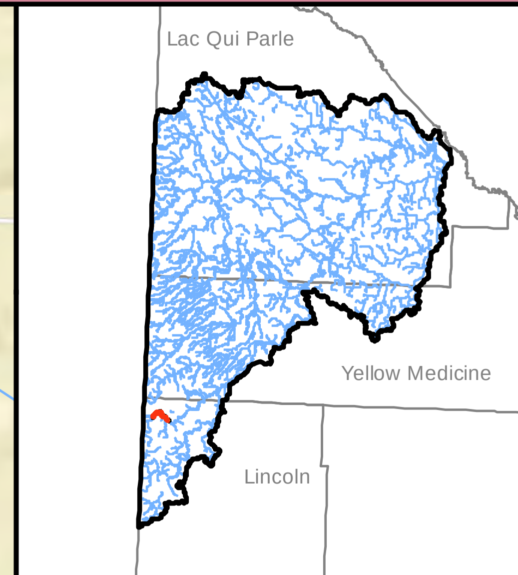
Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Unnamed creek

07020003-569

Unnamed cr to Unnamed cr





Aquatice Life:
Not Supporting

Aquatic Recreation:

Limited Resource:

New Impairment:
Fish

Existing Impairment:

Assessed Lakes

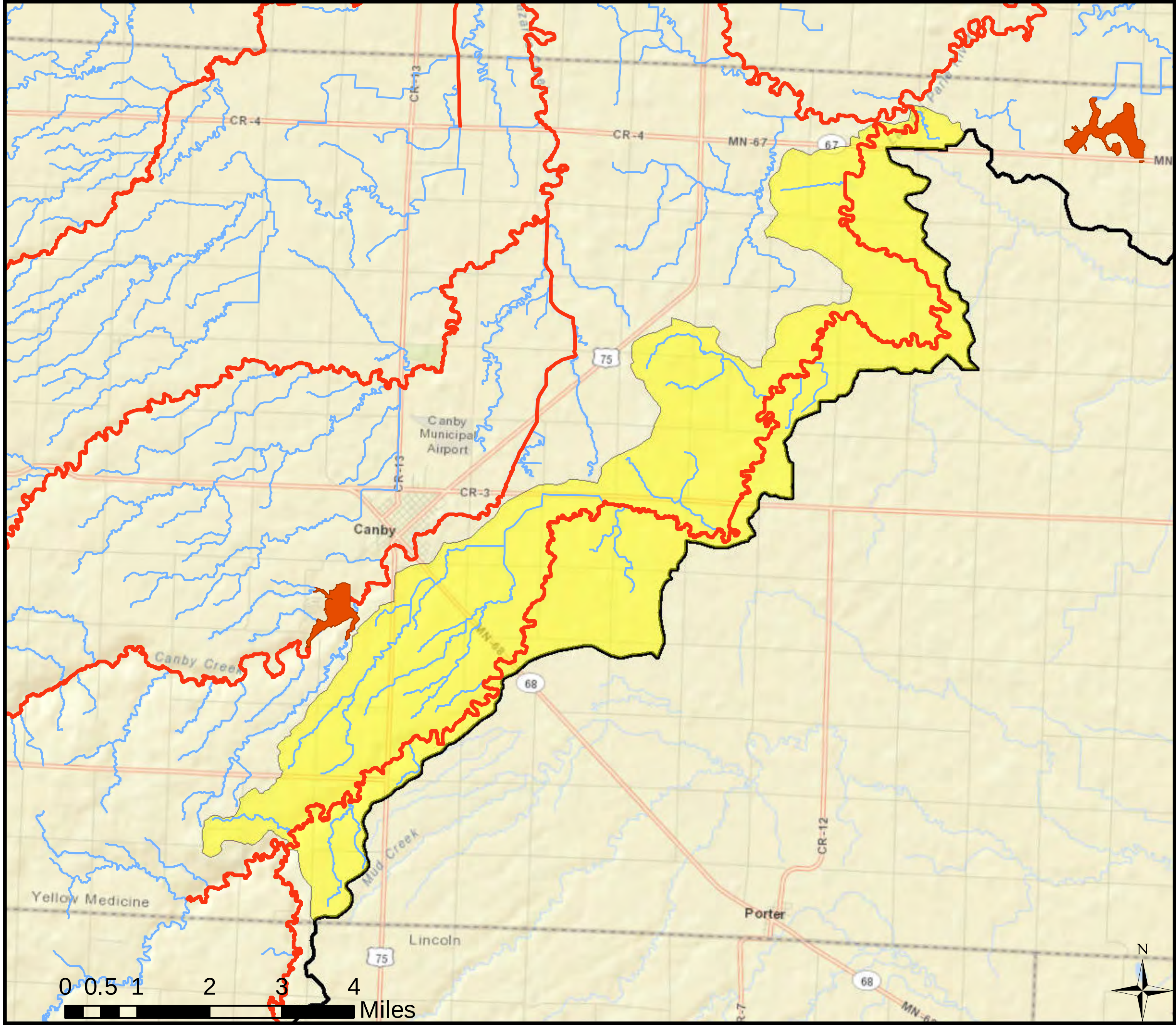
Assessed Streams

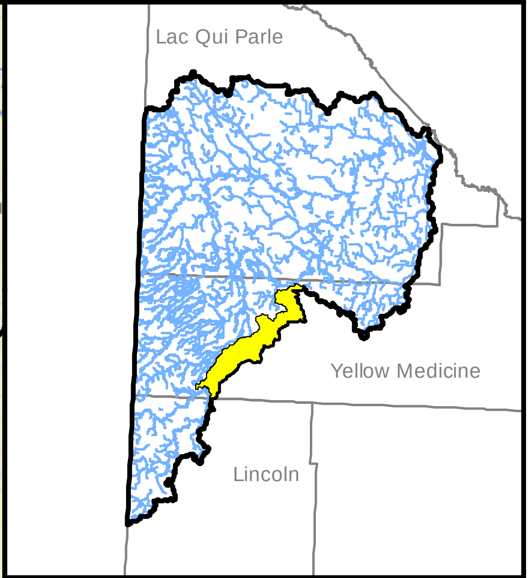
Minnesota Pollution Control Agency

1601 E Hwy 12, Suite 1
Willmar, MN 56201

Saint Stephens Cemetery-Lac Qui Parle River

070200030106





Aquatice Life:

Aquatic Recreation:

Limited Resource:

New Impairment:

Existing Impairment:

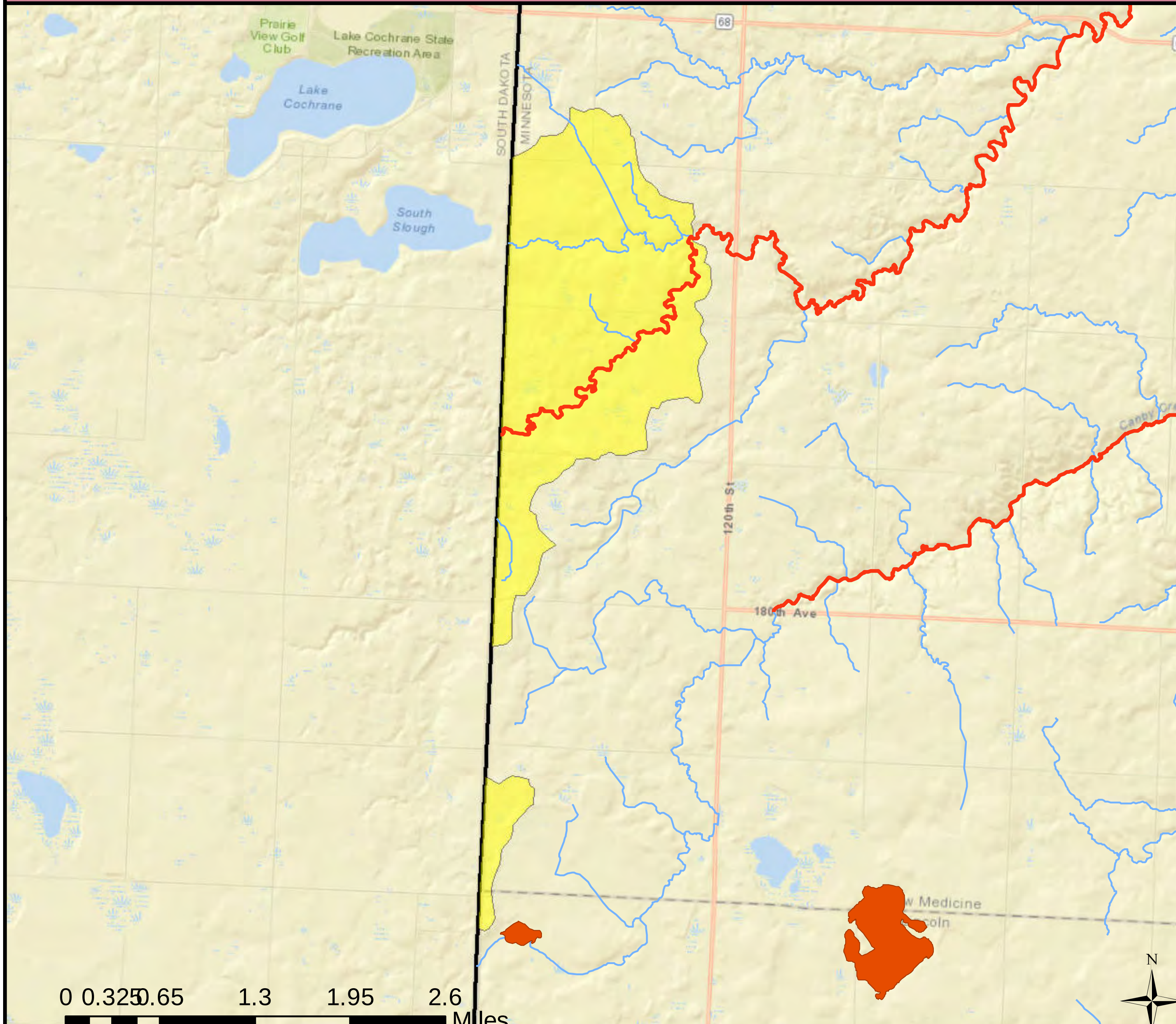
Assessed Lakes

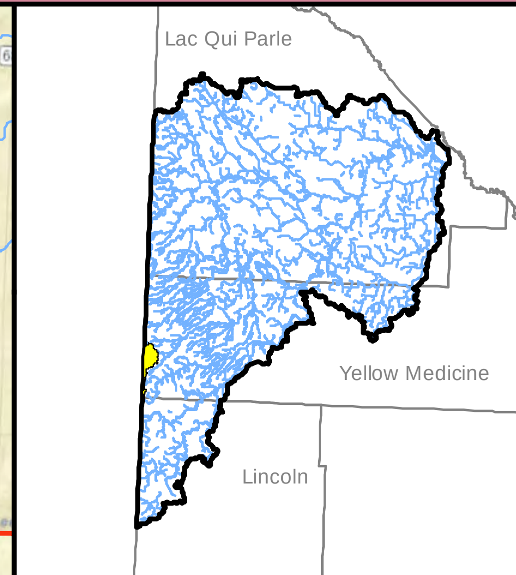
Assessed Streams

Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

South Slough

070200030201





Aquatice Life:

Aquatic Recreation:

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

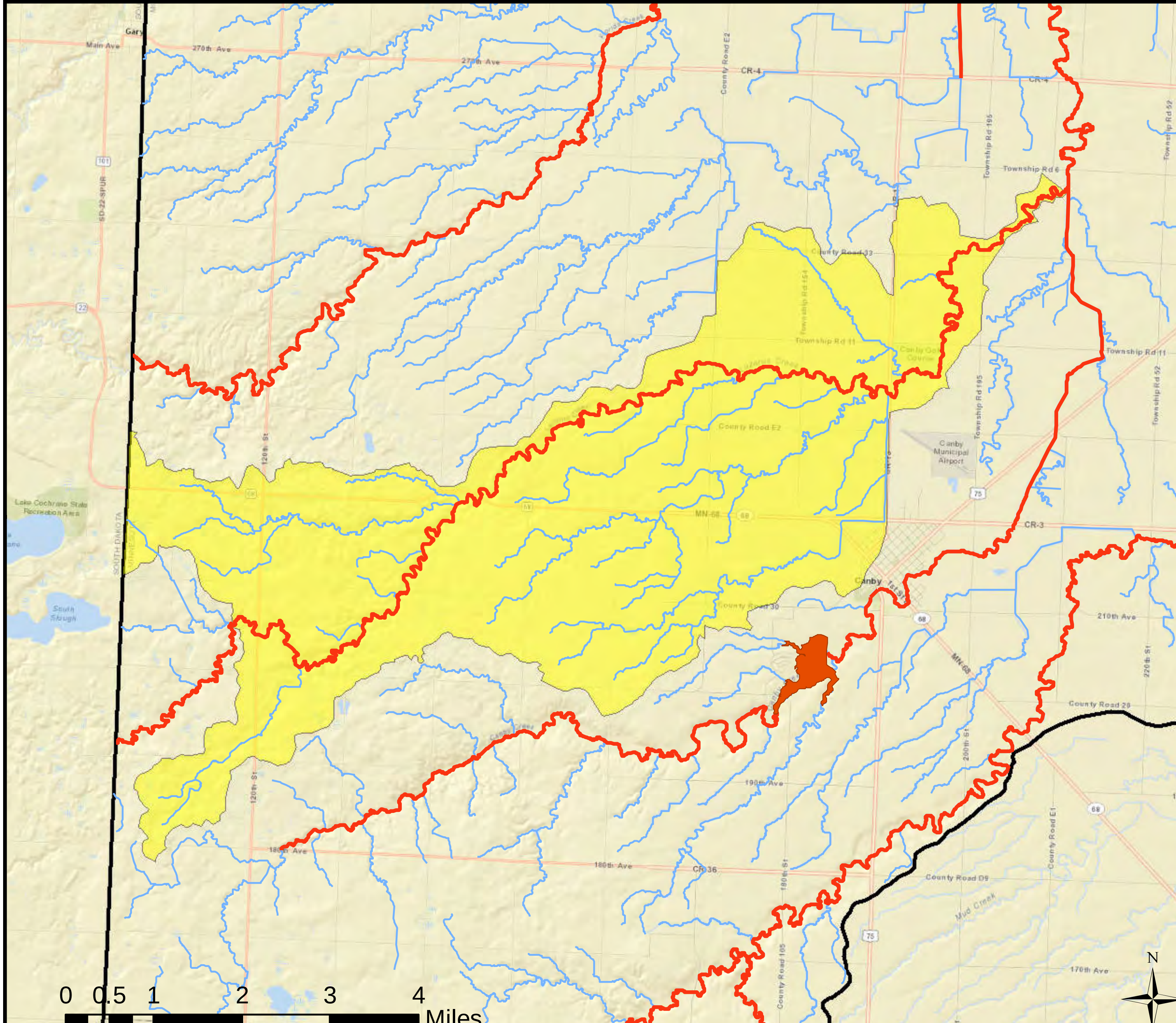
Assessed Streams

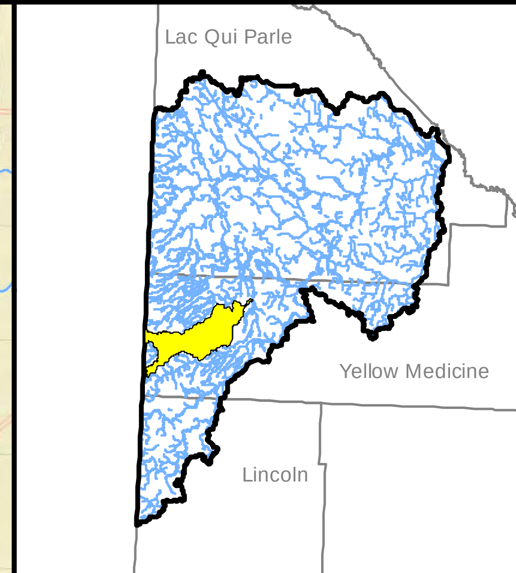
Minnesota Pollution Control Agency

1601 E Hwy 12, Suite 1
Willmar, MN 56201

Upper Lazarus Creek

070200030202





Aquatice Life:

Aquatic Recreation:

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

Assessed Streams

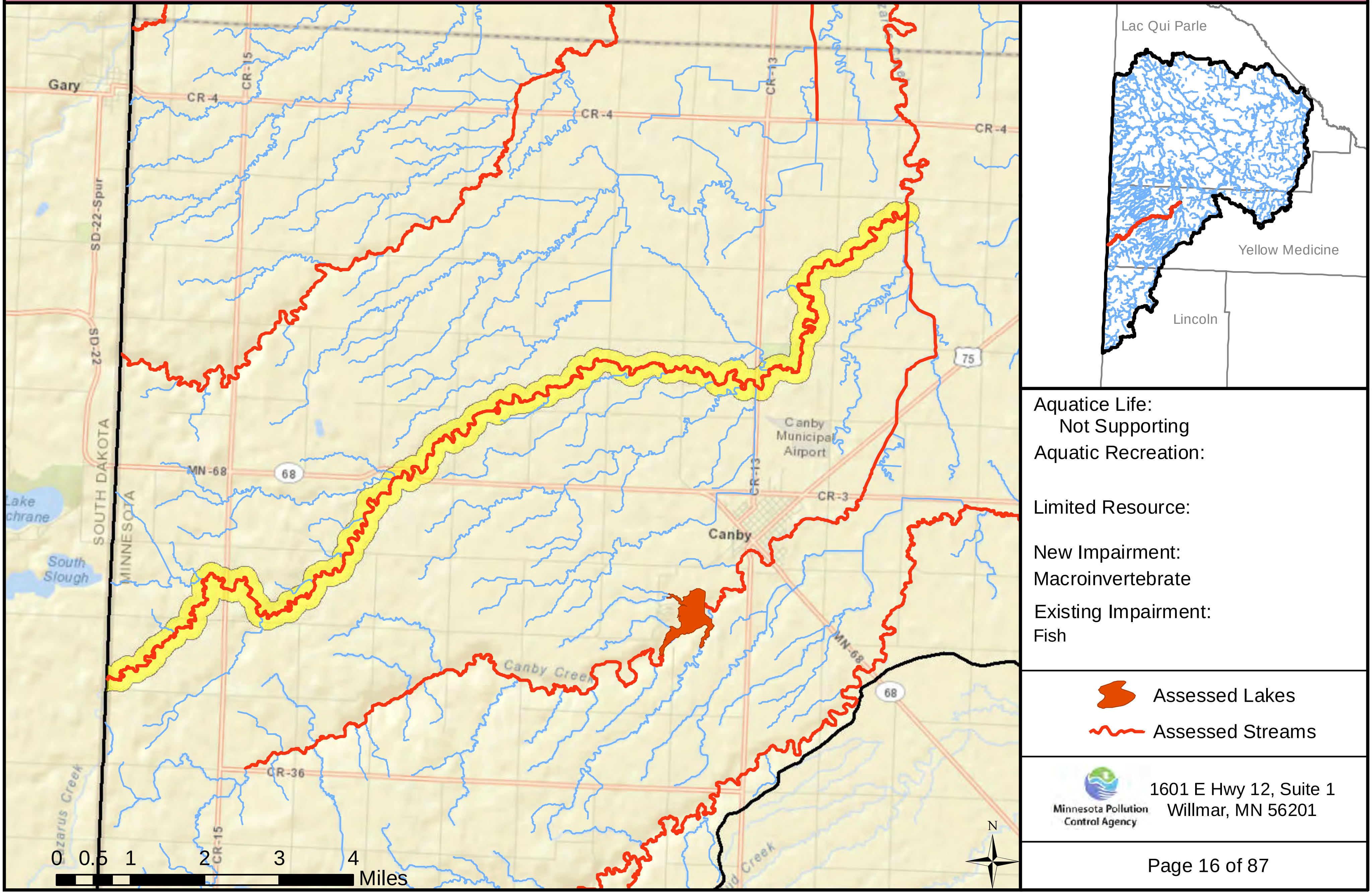
Minnesota Pollution Control Agency

1601 E Hwy 12, Suite 1
Willmar, MN 56201

Lazarus Creek

07020003-509

MN/SD border to Canby Cr



Aquatice Life:
Not Supporting
Aquatic Recreation:

Limited Resource:

New Impairment:
Macroinvertebrate

Existing Impairment:
Fish

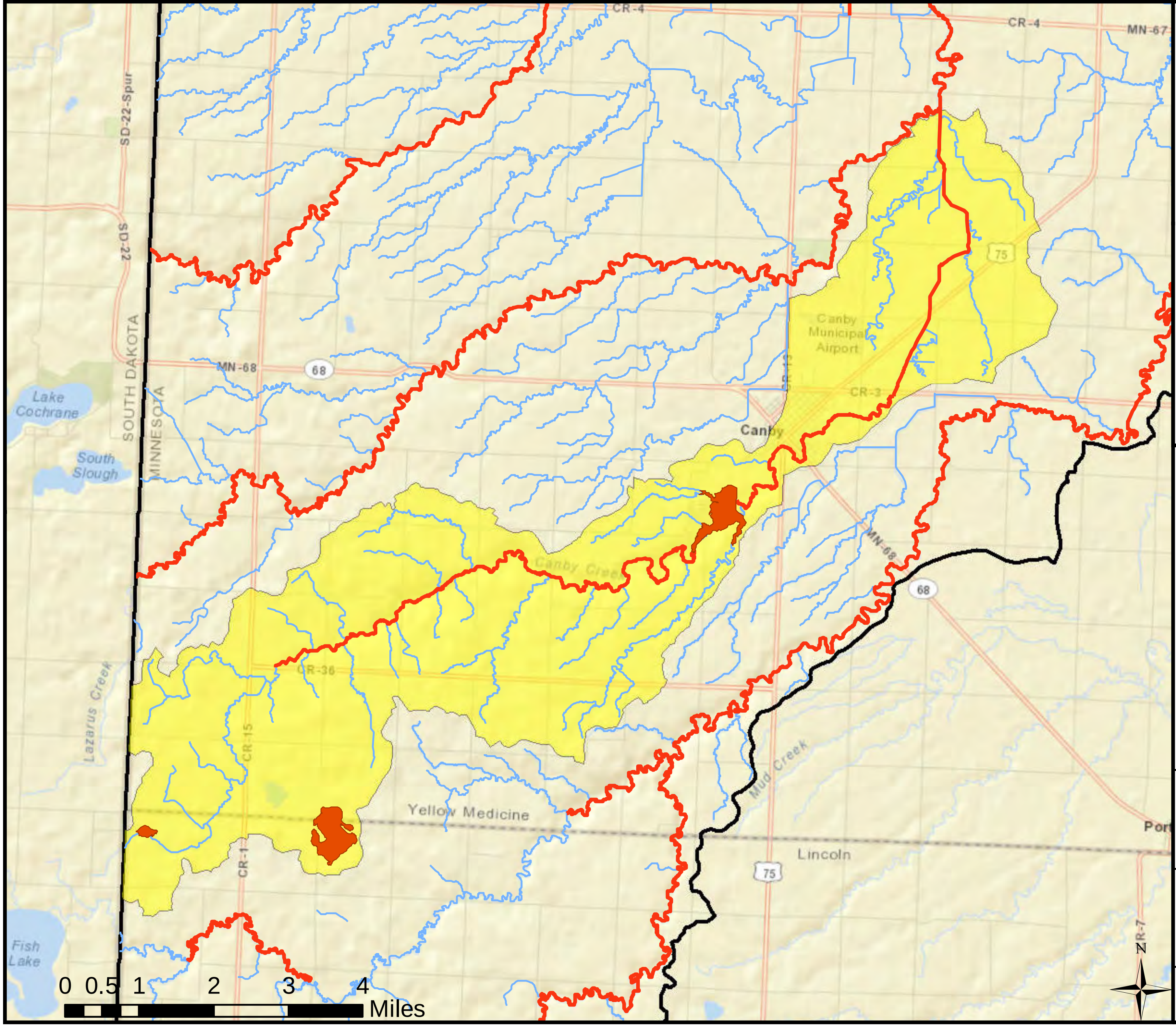
Assessed Lakes

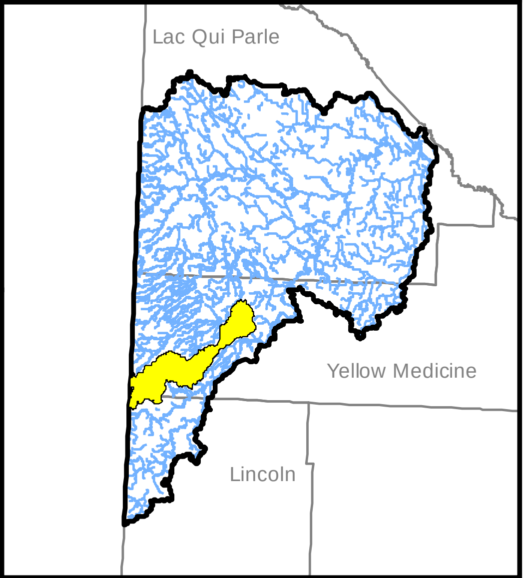
Assessed Streams

Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Canby Creek

070200030203





Aquatice Life:

Aquatic Recreation:

Limited Resource:

New Impairment:

Existing Impairment:

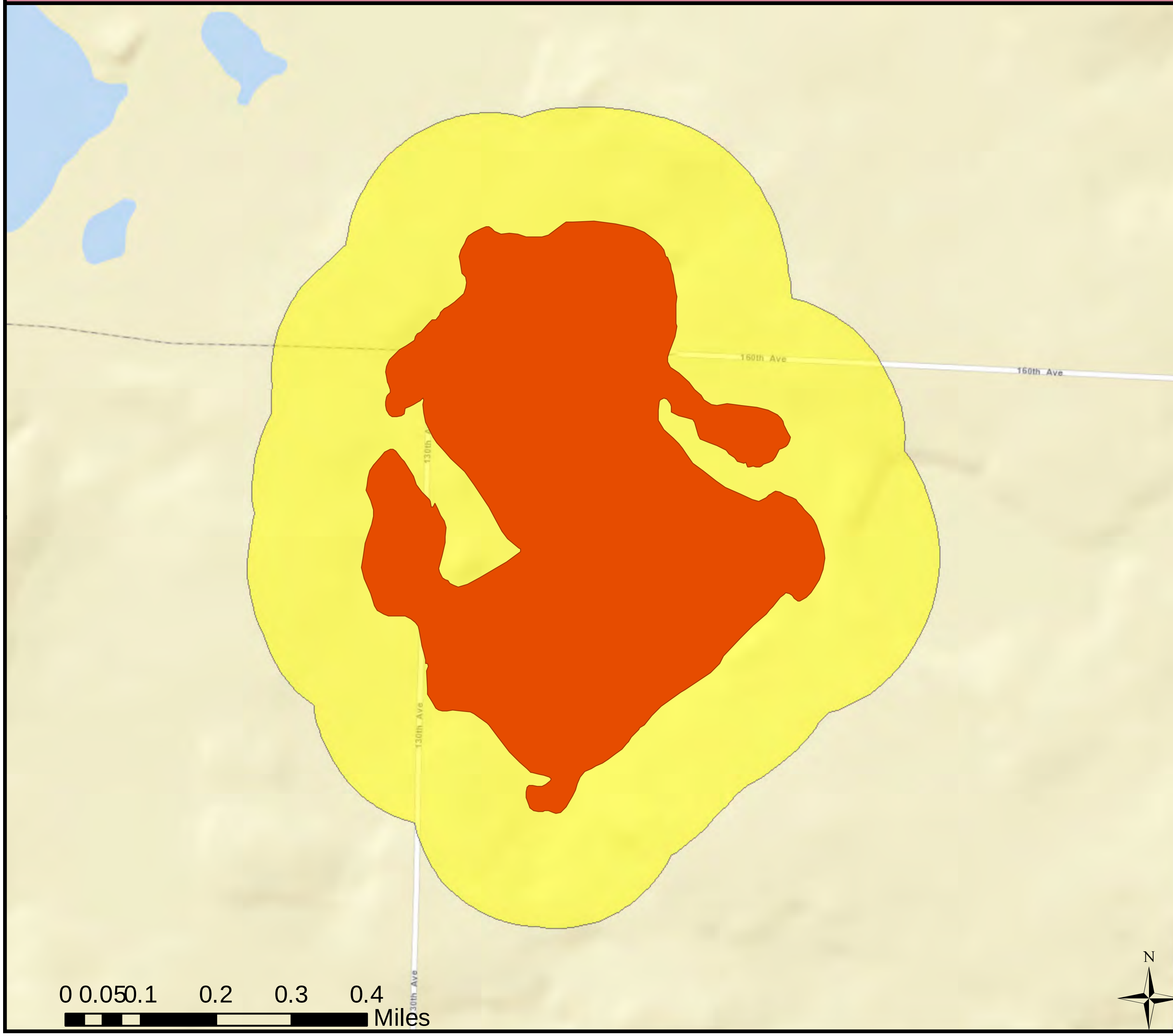
Assessed Lakes

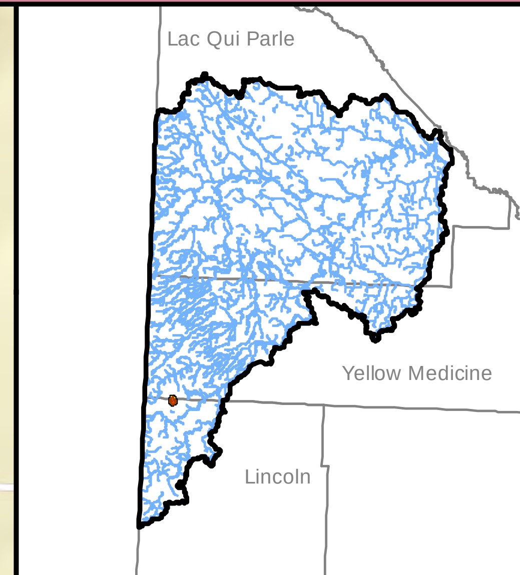
Assessed Streams

Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Unnamed (Bohemian)

41-0109-00





Aquatice Life:

Aquatic Recreation:
Insufficient Information

Limited Resource:

New Impairment:

Existing Impairment:

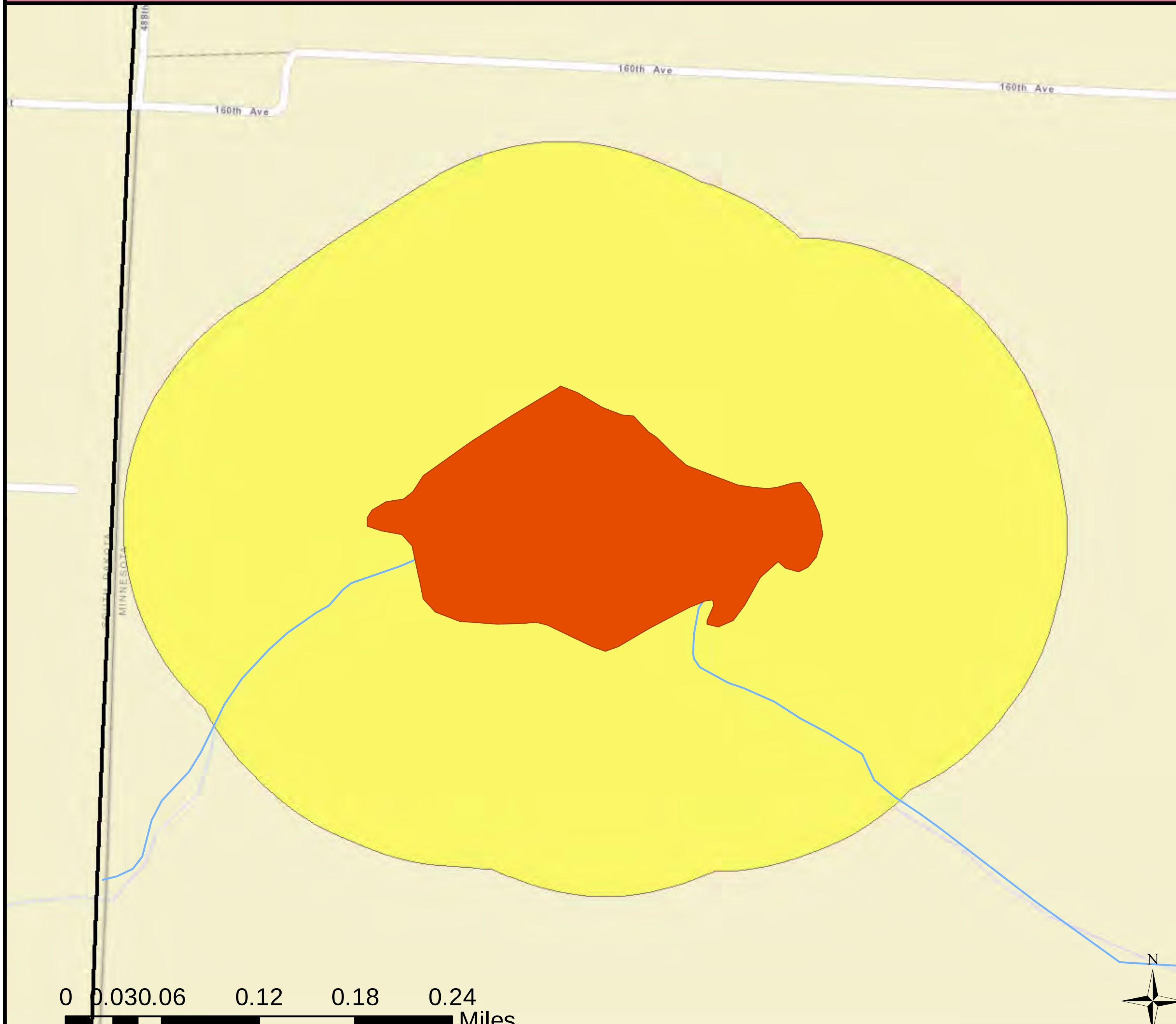
Assessed Lakes

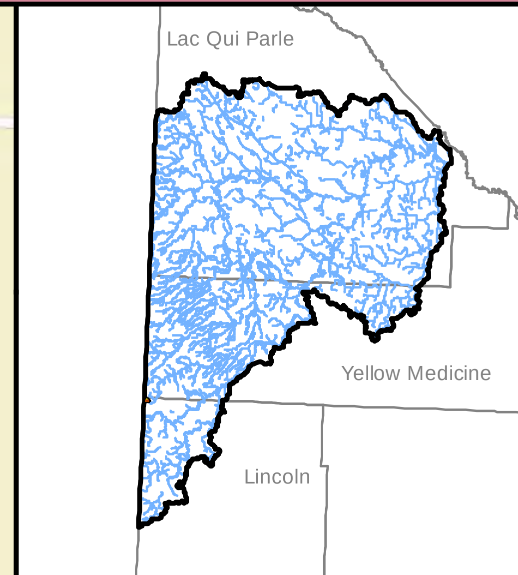
Assessed Streams

Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Unnamed

41-0142-00





Aquatice Life:

Aquatic Recreation:
Insufficient Information

Limited Resource:

New Impairment:

Existing Impairment:

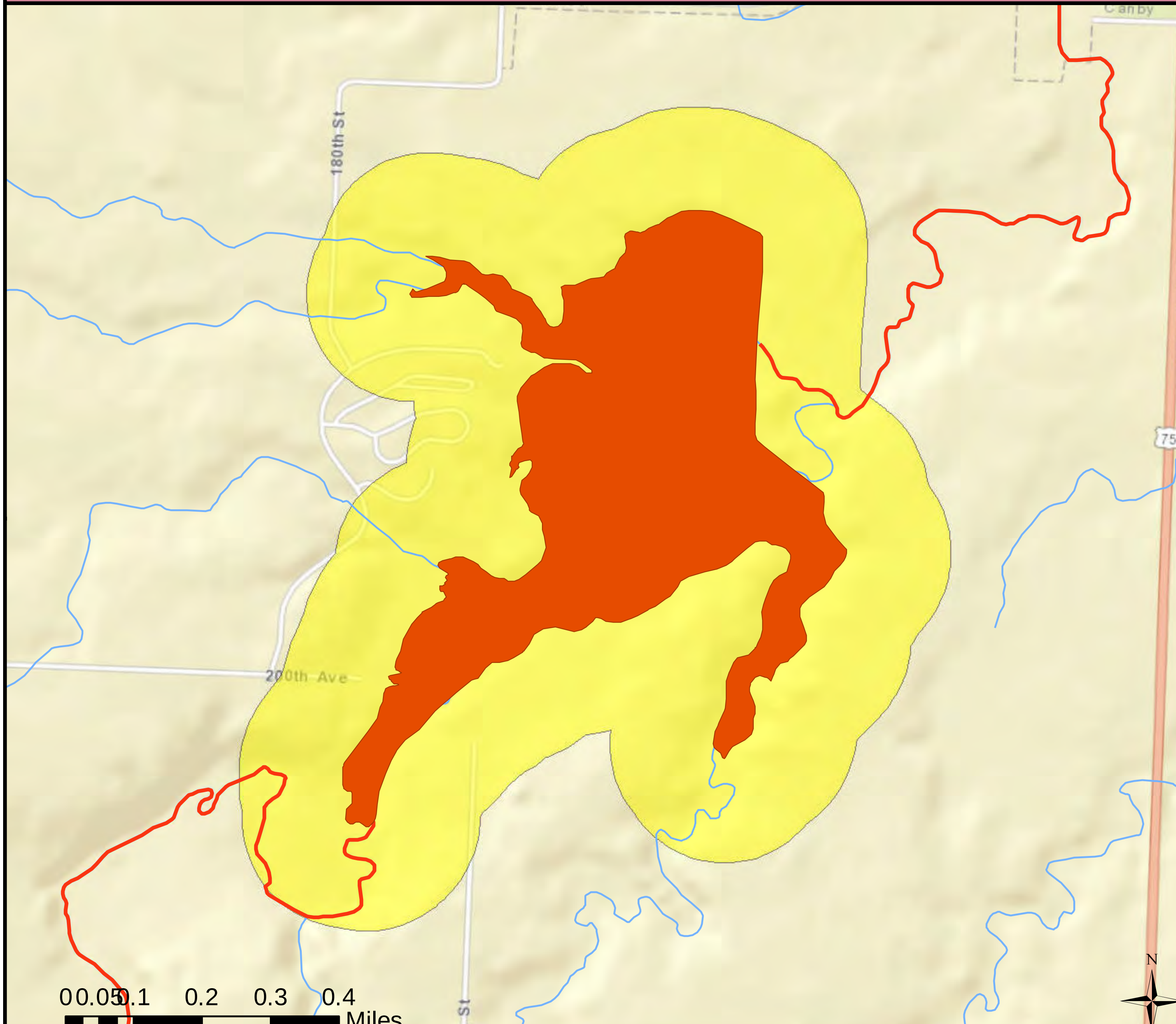
Assessed Lakes

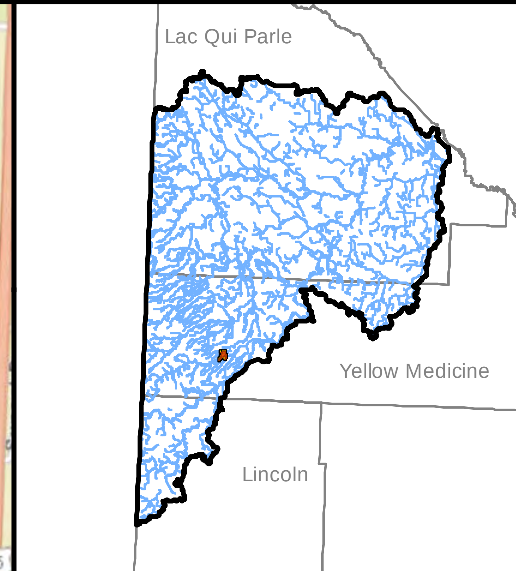
Assessed Streams

Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Del Clark

87-0180-00





Aquatice Life:

Aquatic Recreation:
Fully Supporting

Limited Resource:

New Impairment:

Existing Impairment:

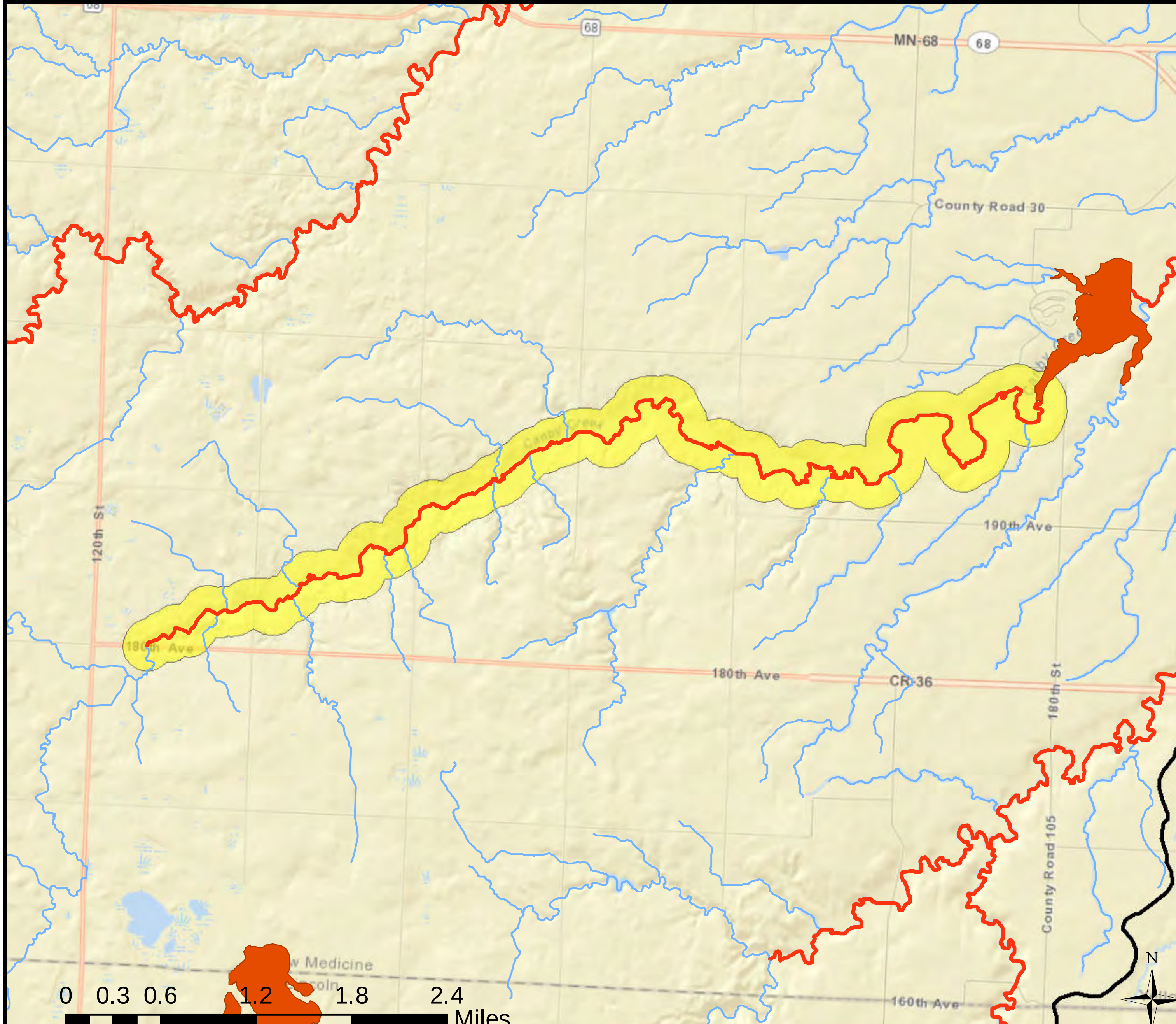
Assessed Lakes

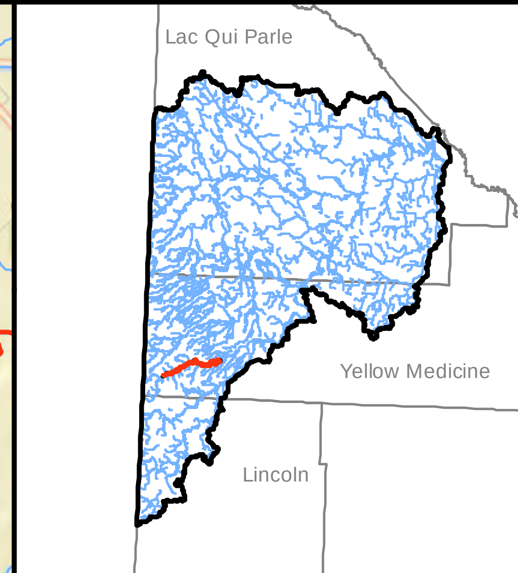
Assessed Streams

Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Canby Creek

07020003-557 T114 R46W S21, south line to Del Clark Lk





Aquatice Life:
Not Supporting

Aquatic Recreation:

Limited Resource:

New Impairment:
Macroinvertebrate, Fish

Existing Impairment:

Assessed Lakes

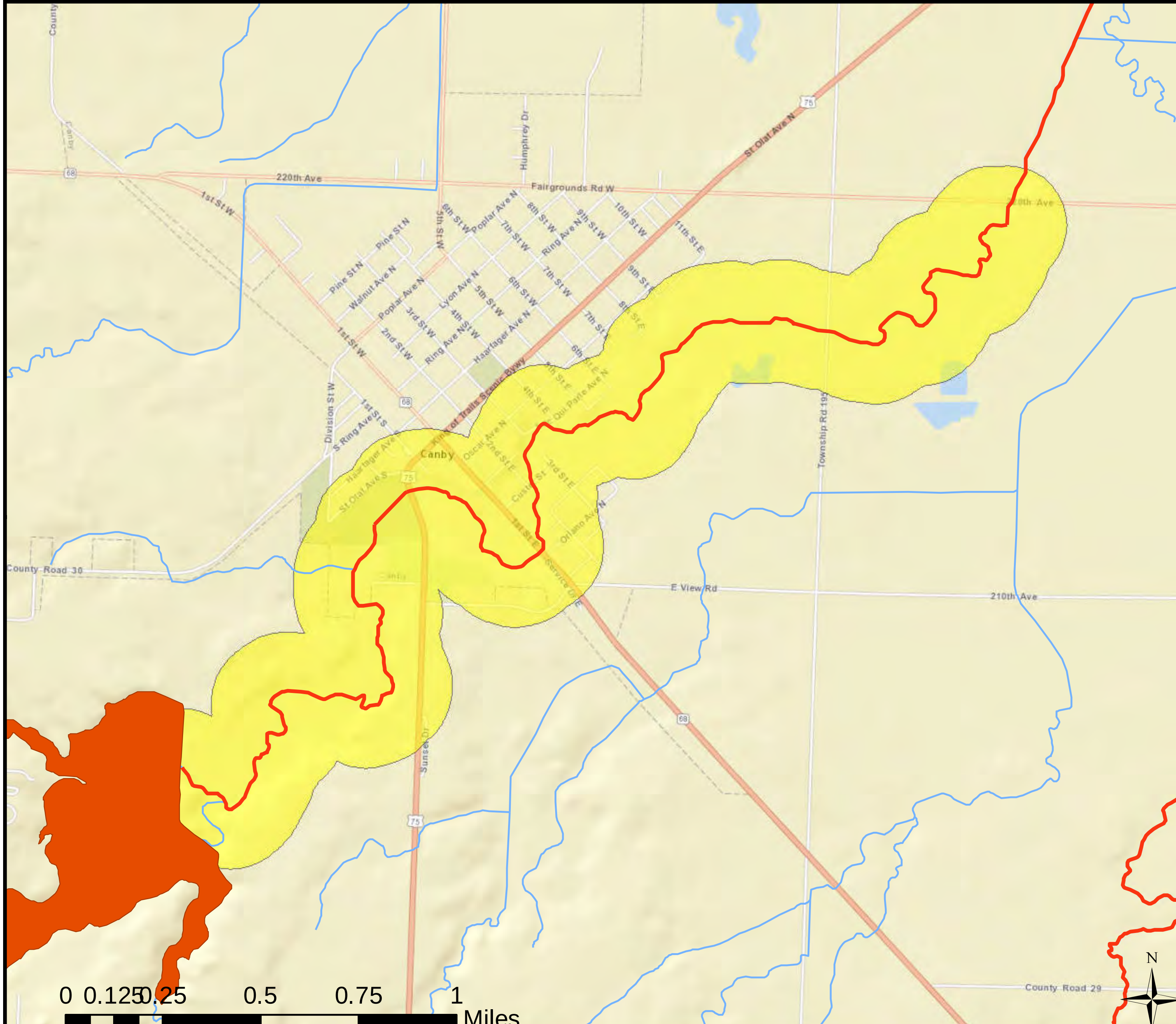
Assessed Streams

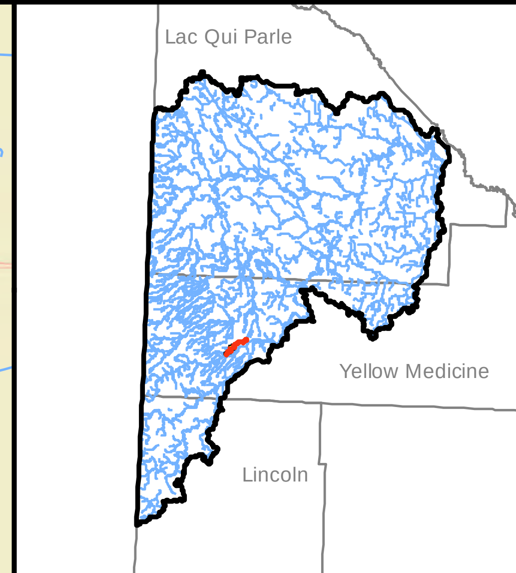
Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Canby Creek

07020003-585

Del Clark Lk to CSAH 3





Aquatice Life:

Insufficient Information

Aquatic Recreation:

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

Assessed Streams

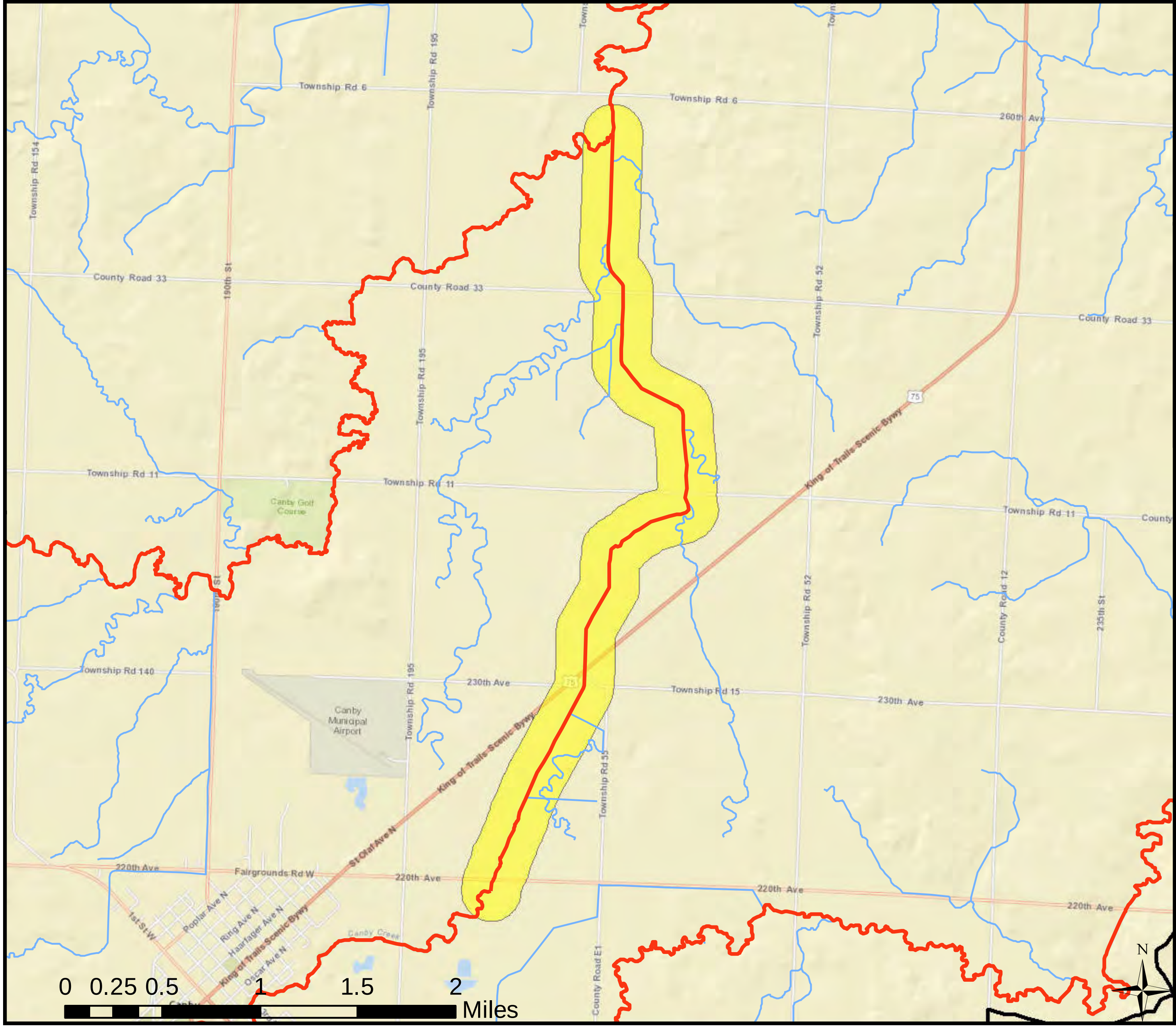
Minnesota Pollution Control Agency

1601 E Hwy 12, Suite 1
Willmar, MN 56201

Service Layer Credits: Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2013

Canby Creek

07020003-586 CSAH 3 to Lazarus Cr



Aquatice Life:
Not Supporting
Aquatic Recreation:

Limited Resource:

New Impairment:
Fish

Existing Impairment:

Assessed Lakes

Assessed Streams

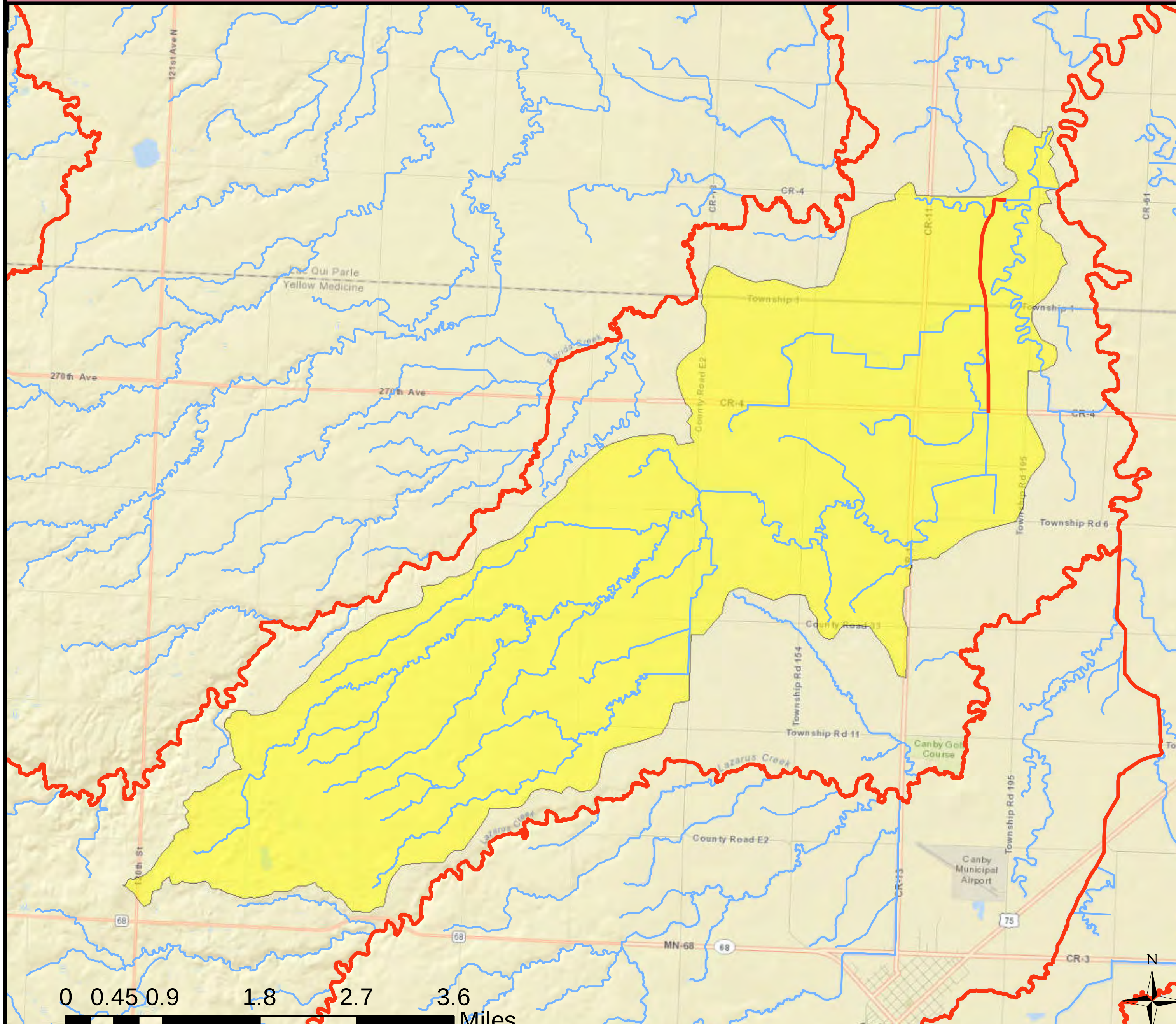
Minnesota Pollution Control Agency

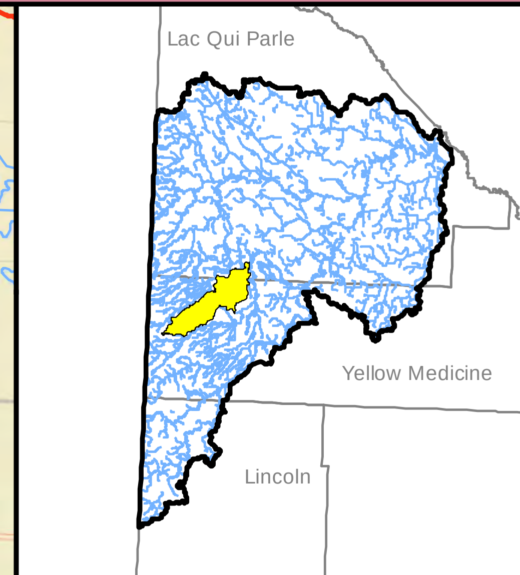
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Service Layer Credits: Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2013

Judicial Ditch No 1

070200030204





Aquatice Life:

Aquatic Recreation:

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

Assessed Streams

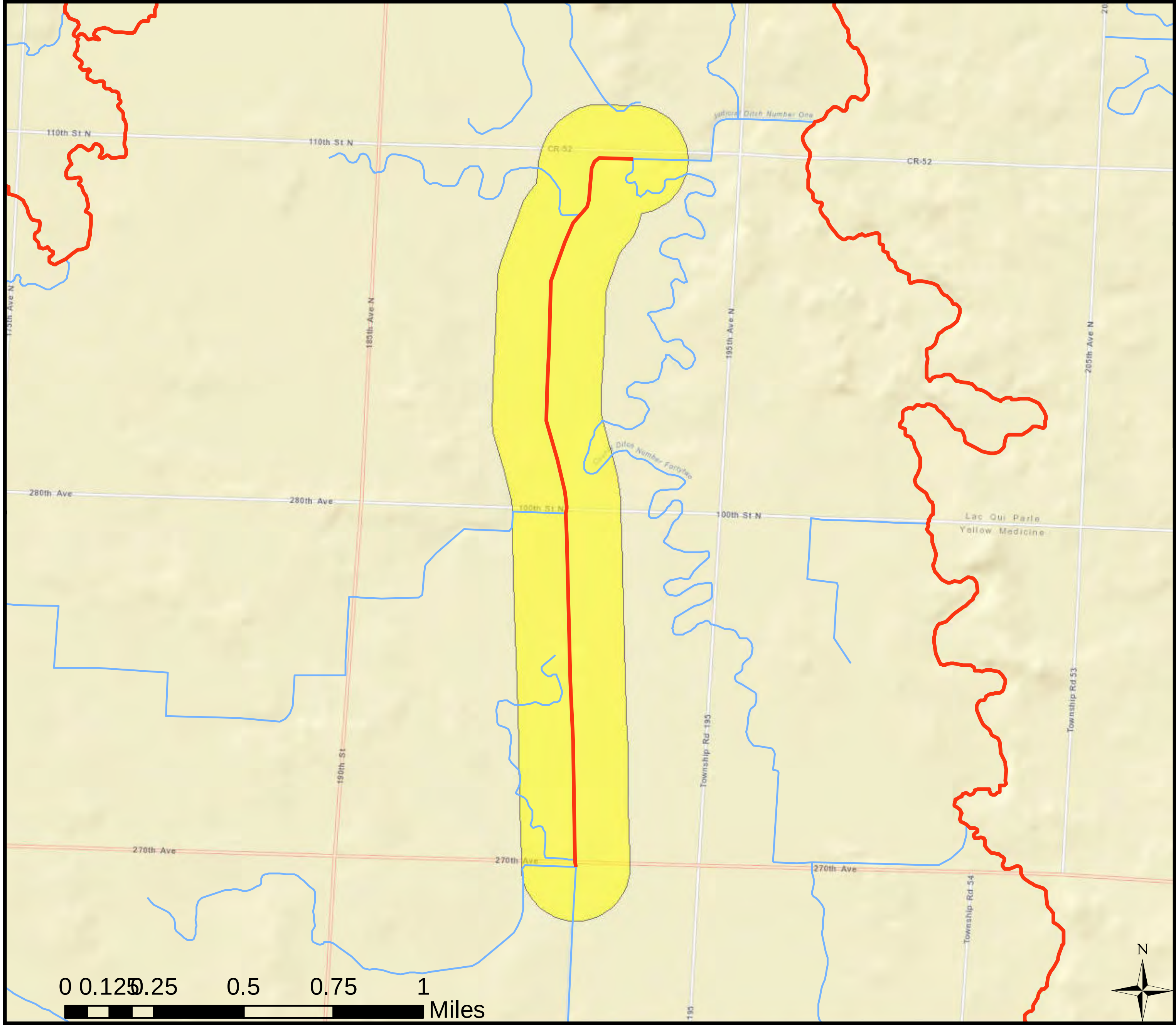
Minnesota Pollution Control Agency

1601 E Hwy 12, Suite 1
Willmar, MN 56201

Judicial Ditch 1

07020003-560

Unnamed ditch to CD 42



Aquatice Life:
Fully Supporting

Aquatic Recreation:

Limited Resource:

New Impairment:

Existing Impairment:

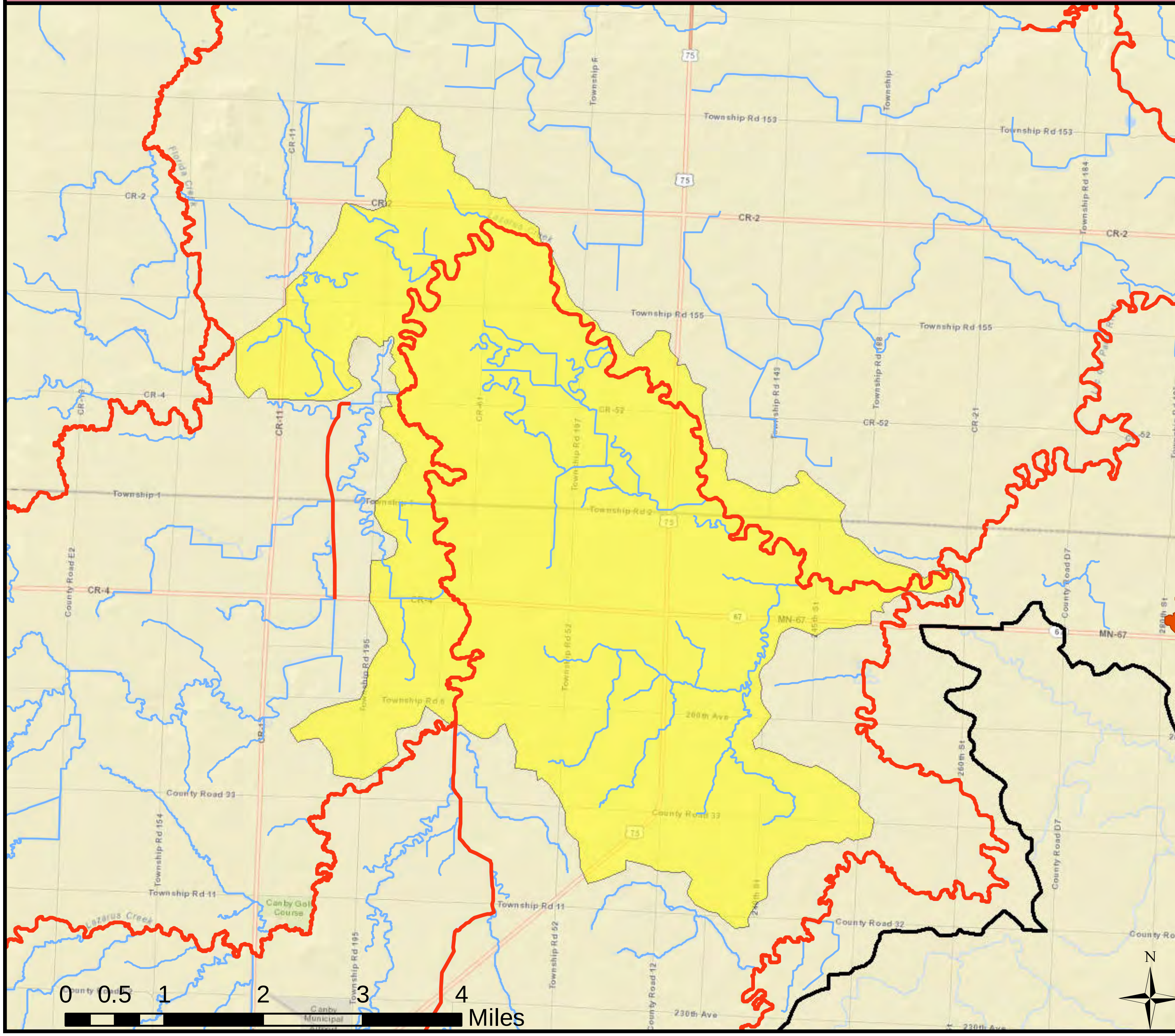
Assessed Lakes

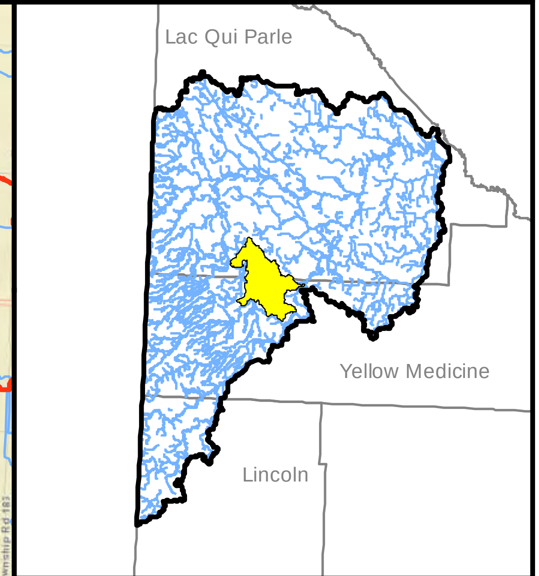
Assessed Streams

Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Lower Lazarus Creek

070200030205





Aquatice Life:

Aquatic Recreation:

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

Assessed Streams

Minnesota Pollution Control Agency

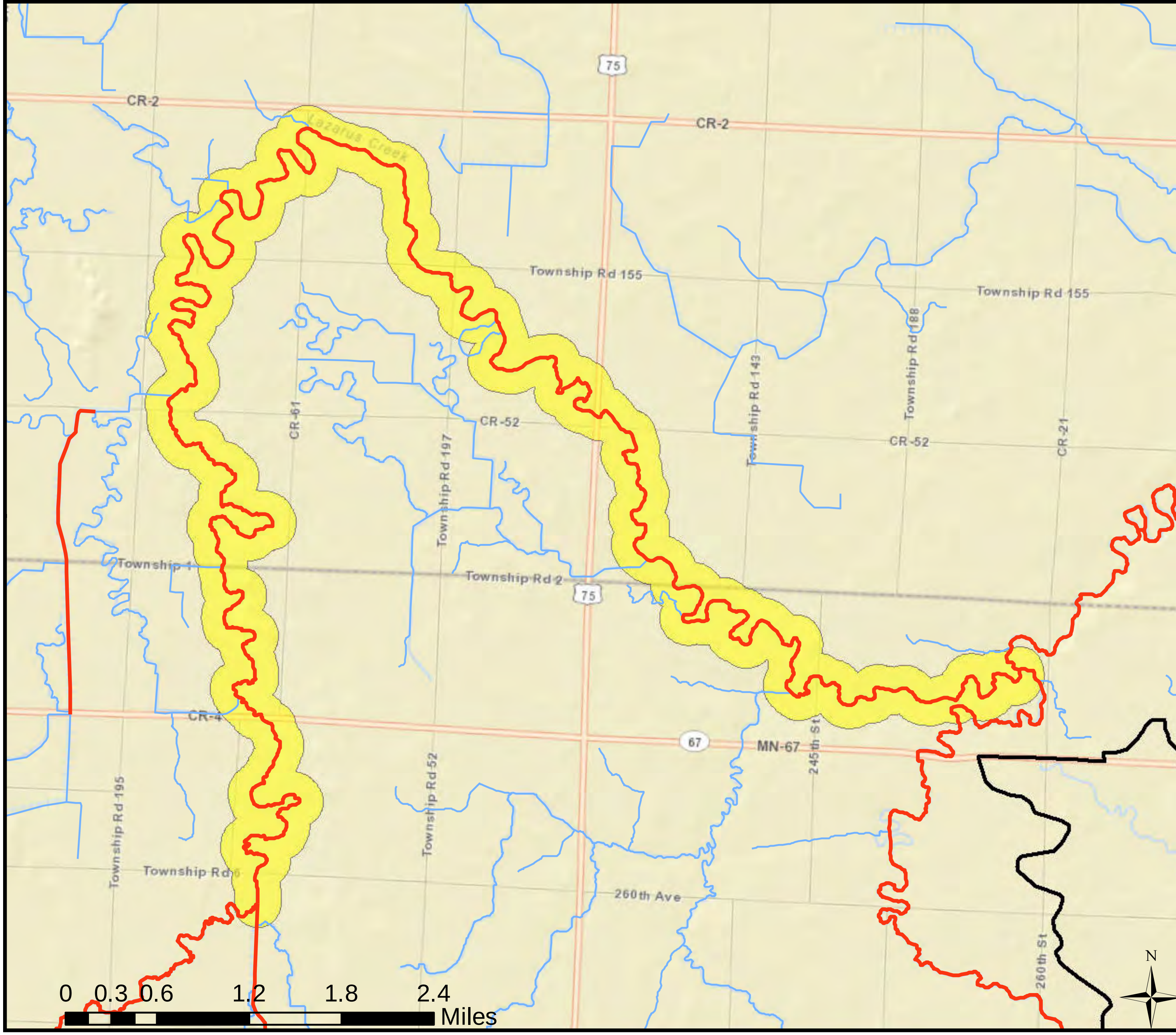
1601 E Hwy 12, Suite 1
Willmar, MN 56201

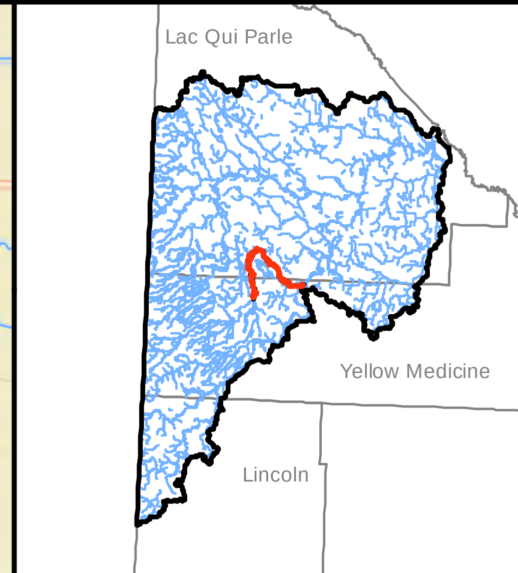
Service Layer Credits: Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2013

Lazarus Creek (Canby Creek)

07020003-508

Canby Cr to Lac Qui Parle R





Aquatice Life:
Not Supporting
Aquatic Recreation:
Not Supporting
Limited Resource:

New Impairment:
Macroinvertebrate, Fish

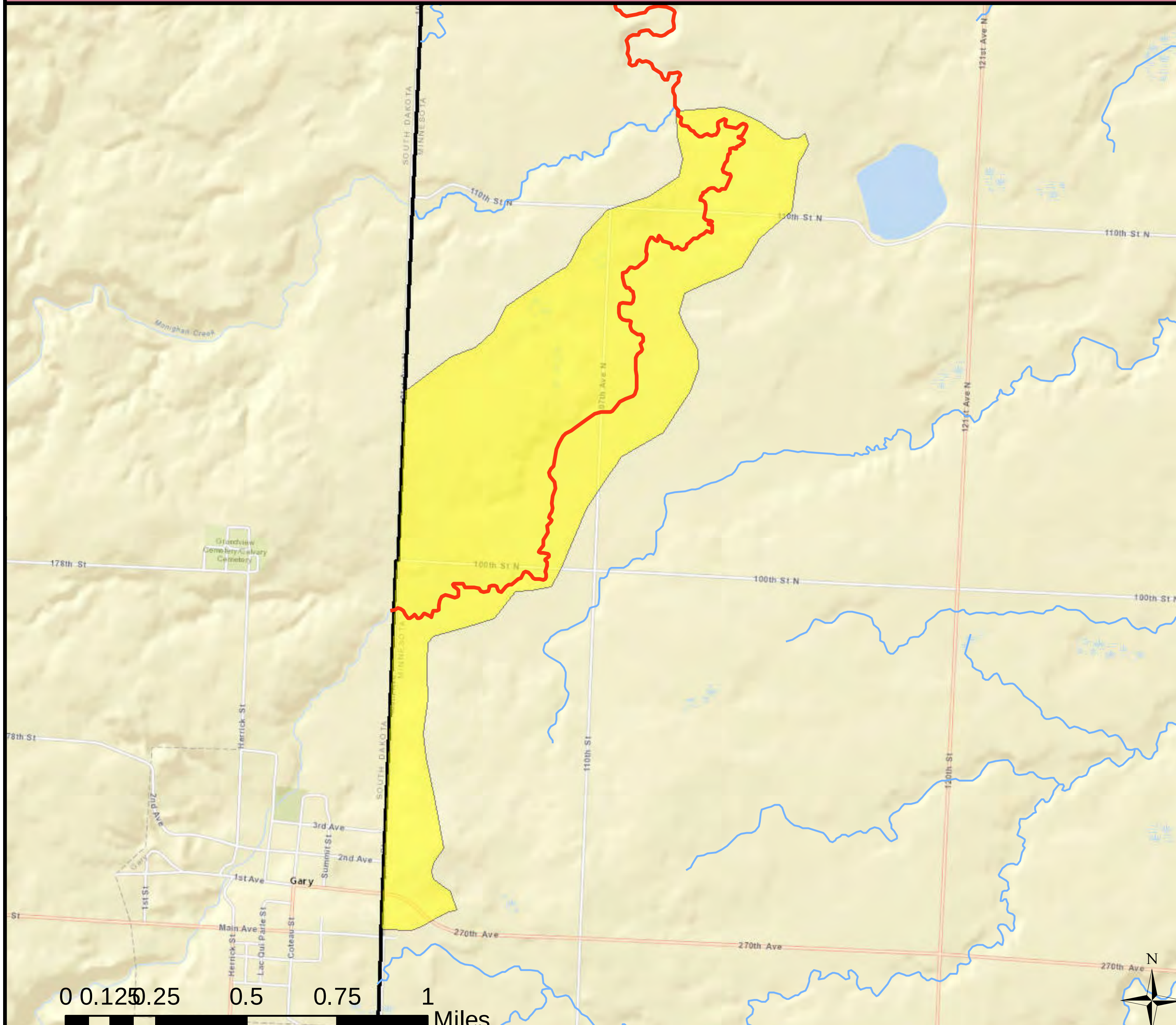
Existing Impairment:
Fecal Coliform, Turbidity

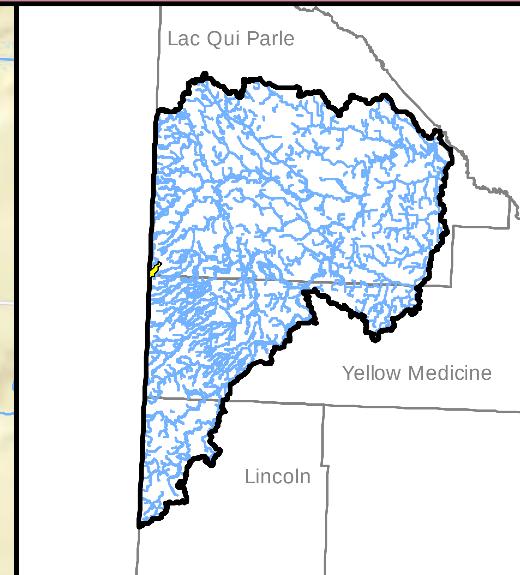
Assessed Lakes
Assessed Streams

Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Headwaters West Branch Lac Qui Parle River

070200030301





Aquatice Life:

Aquatic Recreation:

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

Assessed Streams

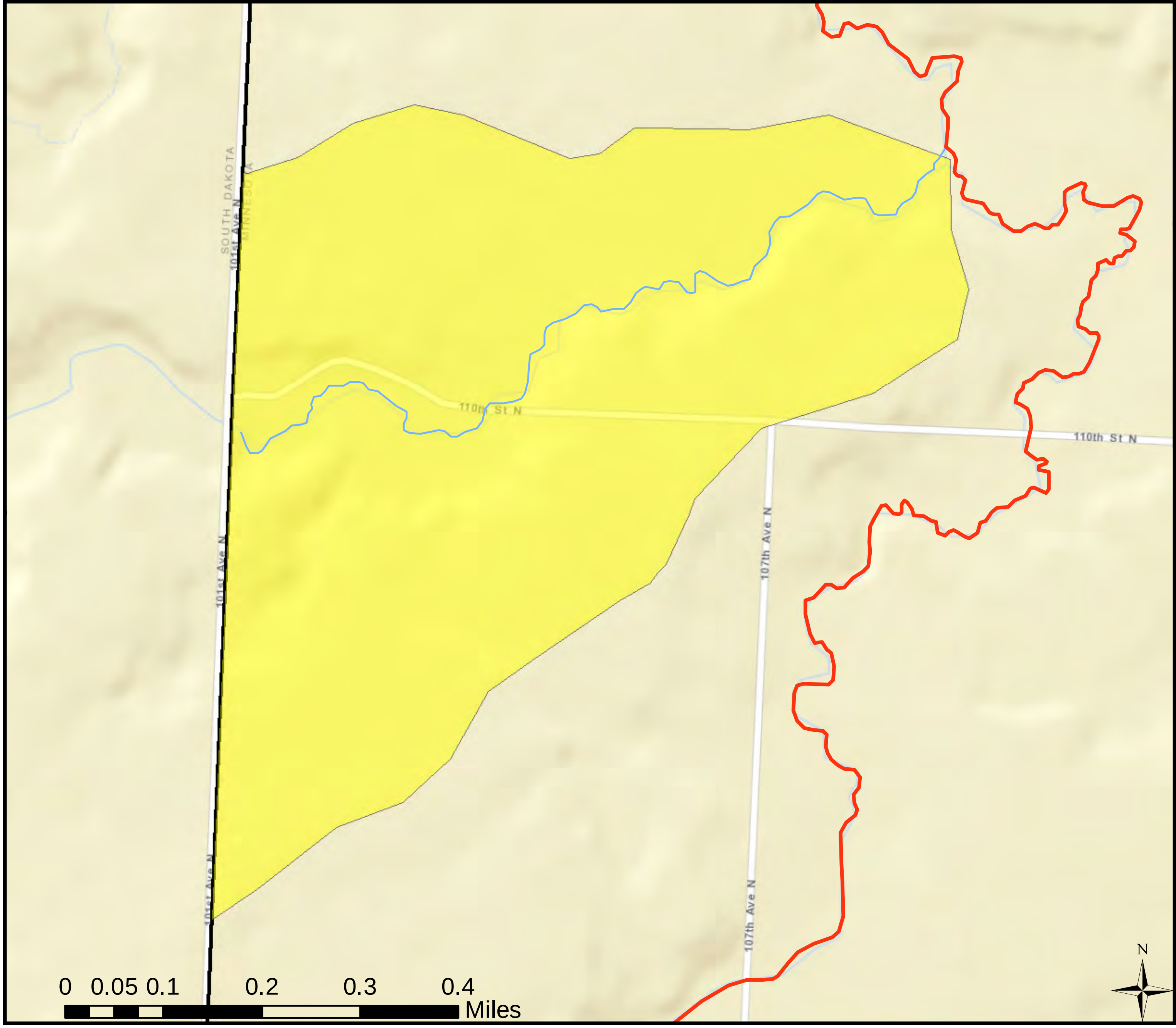
Minnesota Pollution Control Agency

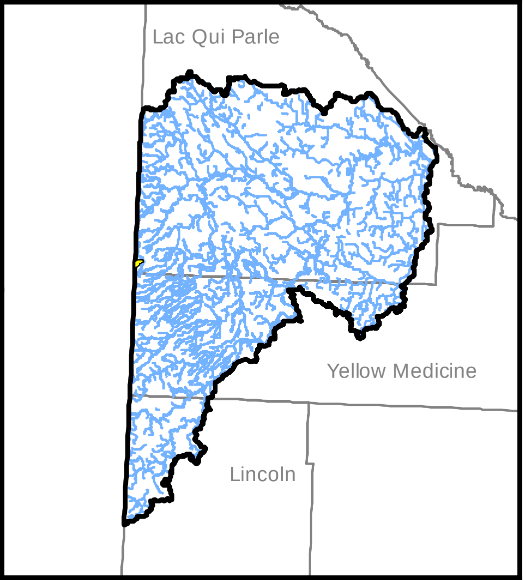
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Service Layer Credits: Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2013

Monighan Creek

070200030302





Aquatice Life:

Aquatic Recreation:

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

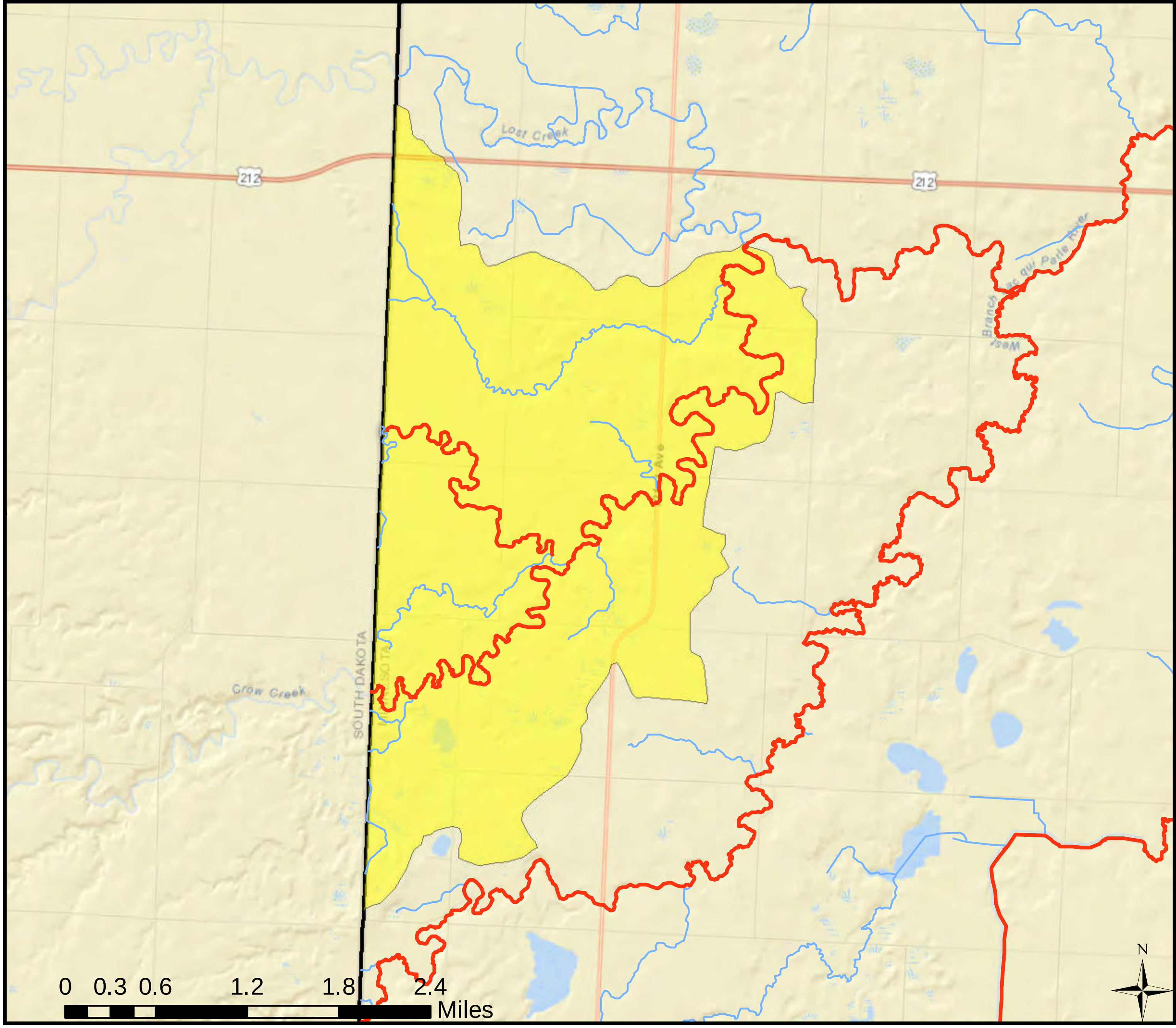
Assessed Streams

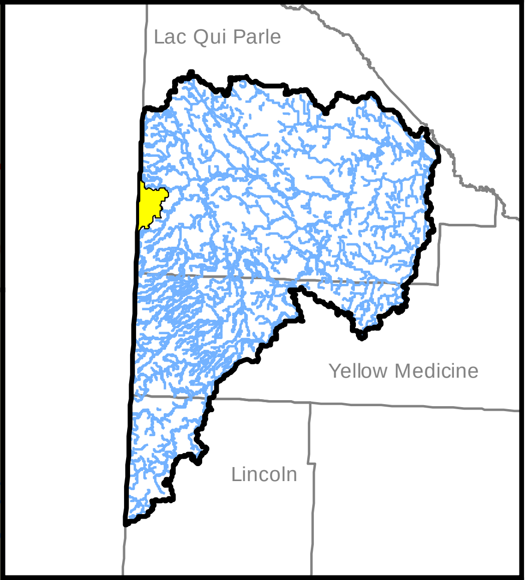
Minnesota Pollution Control Agency

1601 E Hwy 12, Suite 1
Willmar, MN 56201

Crow Creek

070200030303





Aquatice Life:

Aquatic Recreation:

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

Assessed Streams

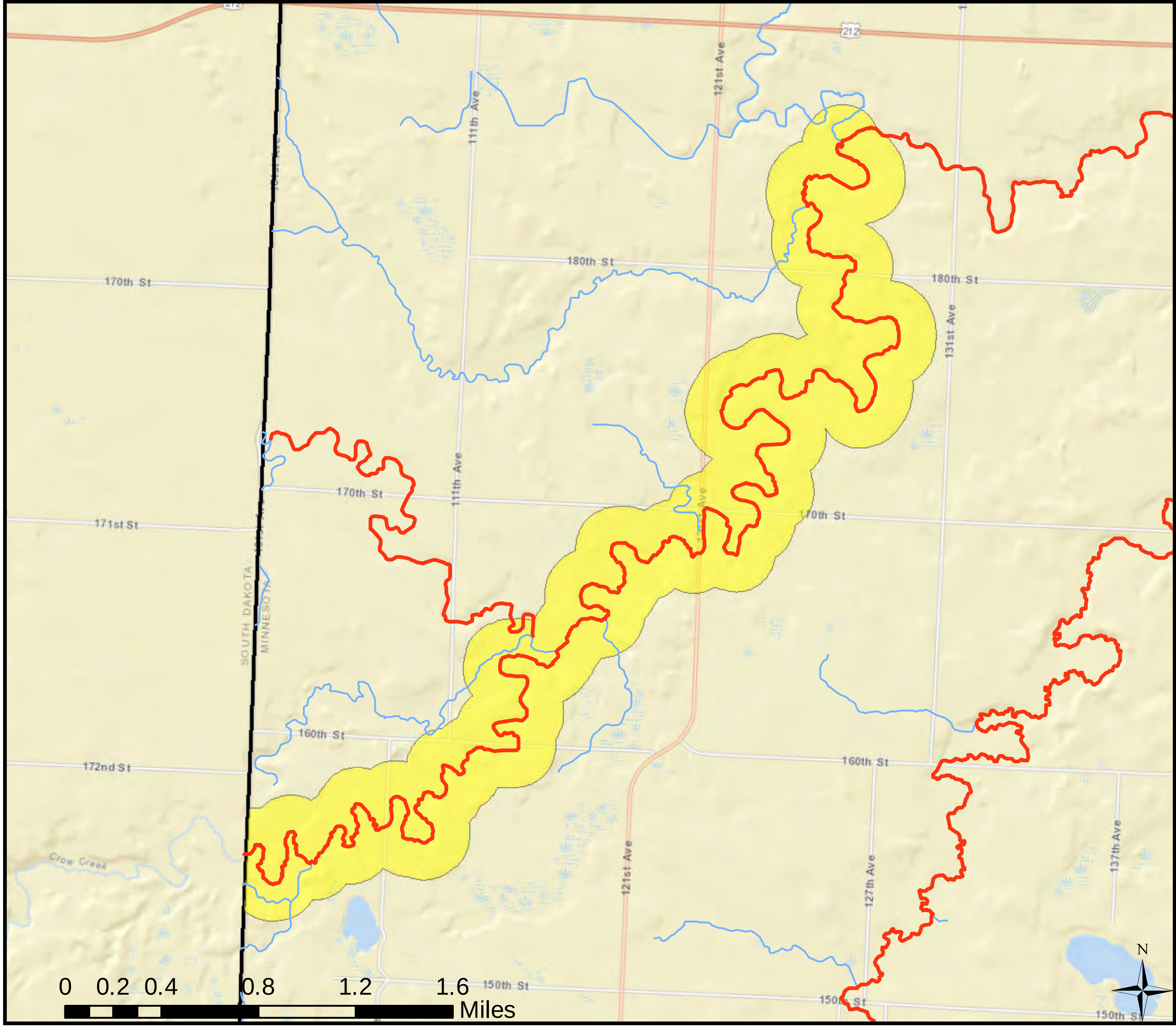
Minnesota Pollution Control Agency

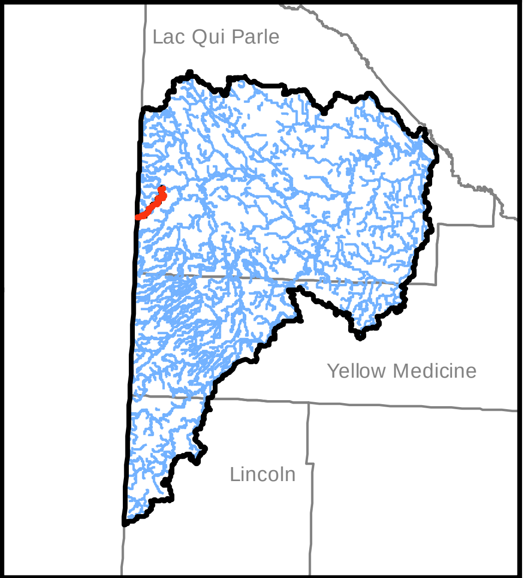
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Crow Timber Creek

07020003-520

MN/SD border to Lost Cr





Aquatice Life:
Not Supporting

Aquatic Recreation:

Limited Resource:

New Impairment:
Macroinvertebrate

Existing Impairment:

Assessed Lakes

Assessed Streams

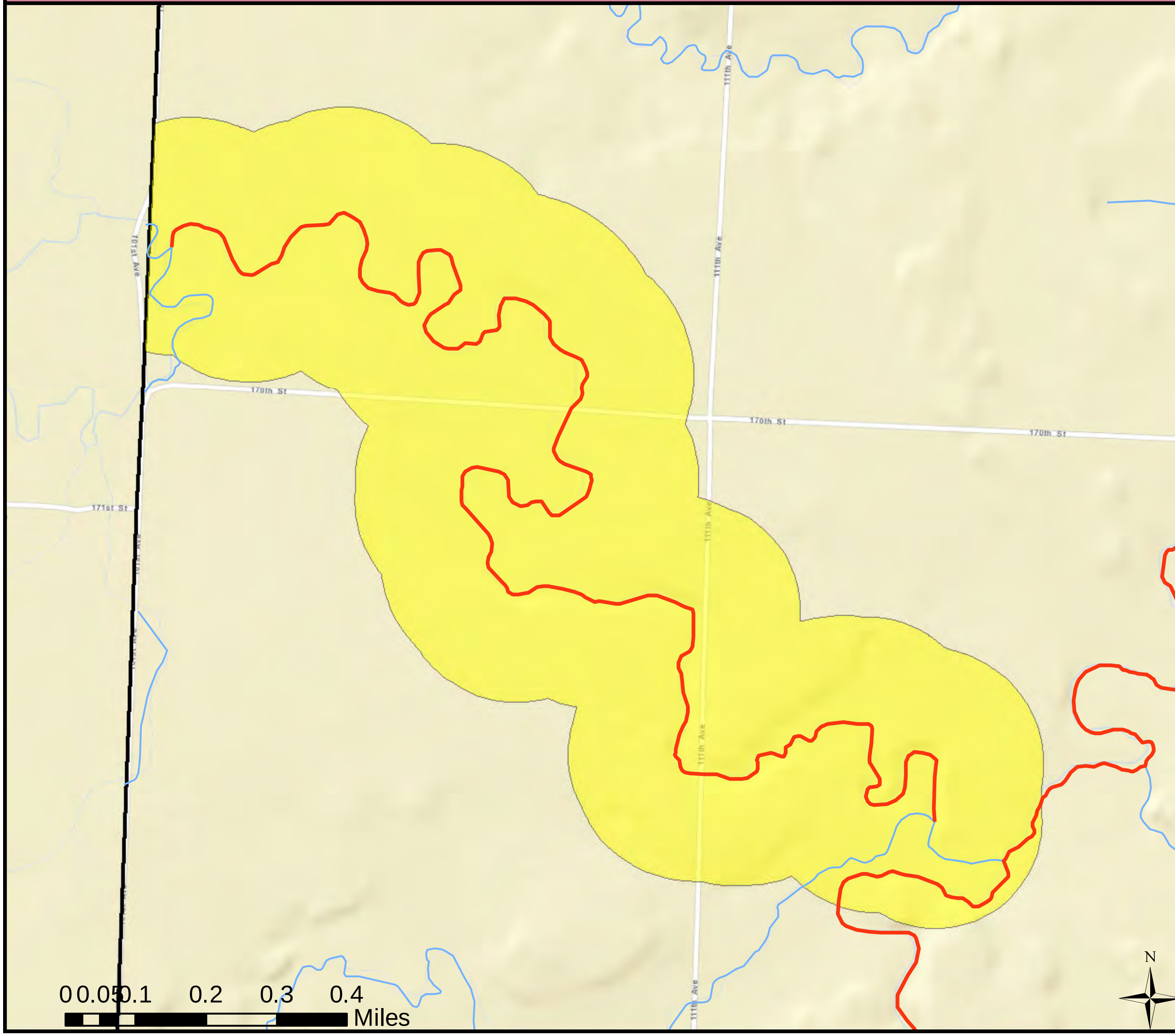
Minnesota Pollution Control Agency

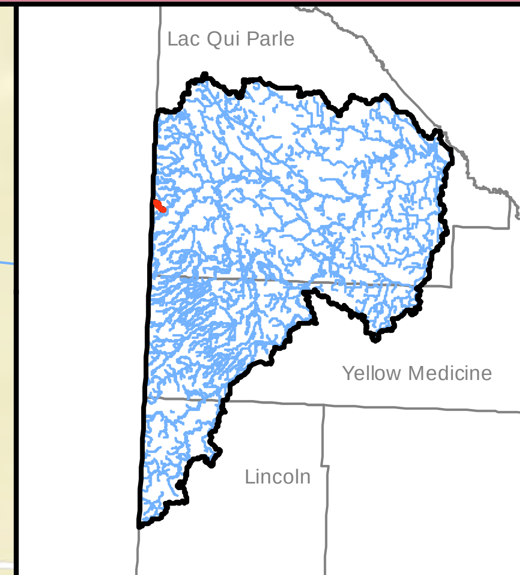
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Unnamed creek

07020003-567

Unnamed cr to Unnamed cr





Aquatice Life:
Not Supporting

Aquatic Recreation:

Limited Resource:

New Impairment:
Macroinvertebrate

Existing Impairment:

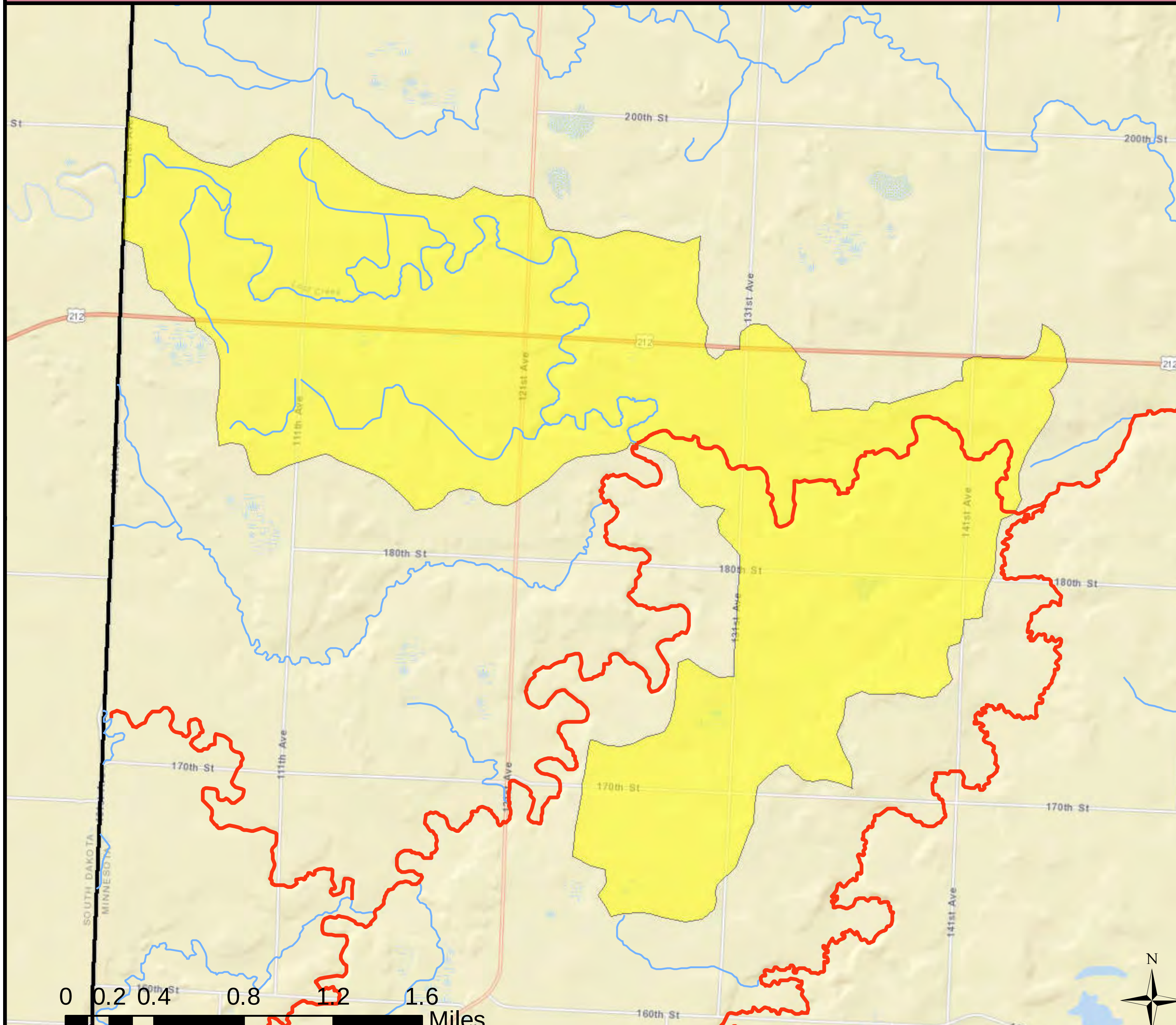
Assessed Lakes

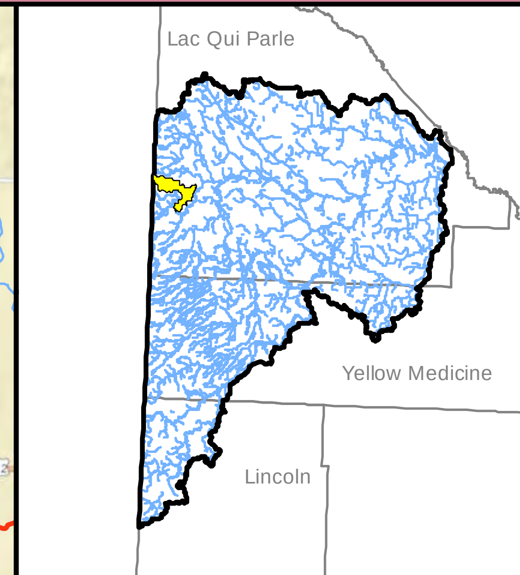
Assessed Streams

Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Lost Creek

070200030304





Aquatice Life:

Aquatic Recreation:

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

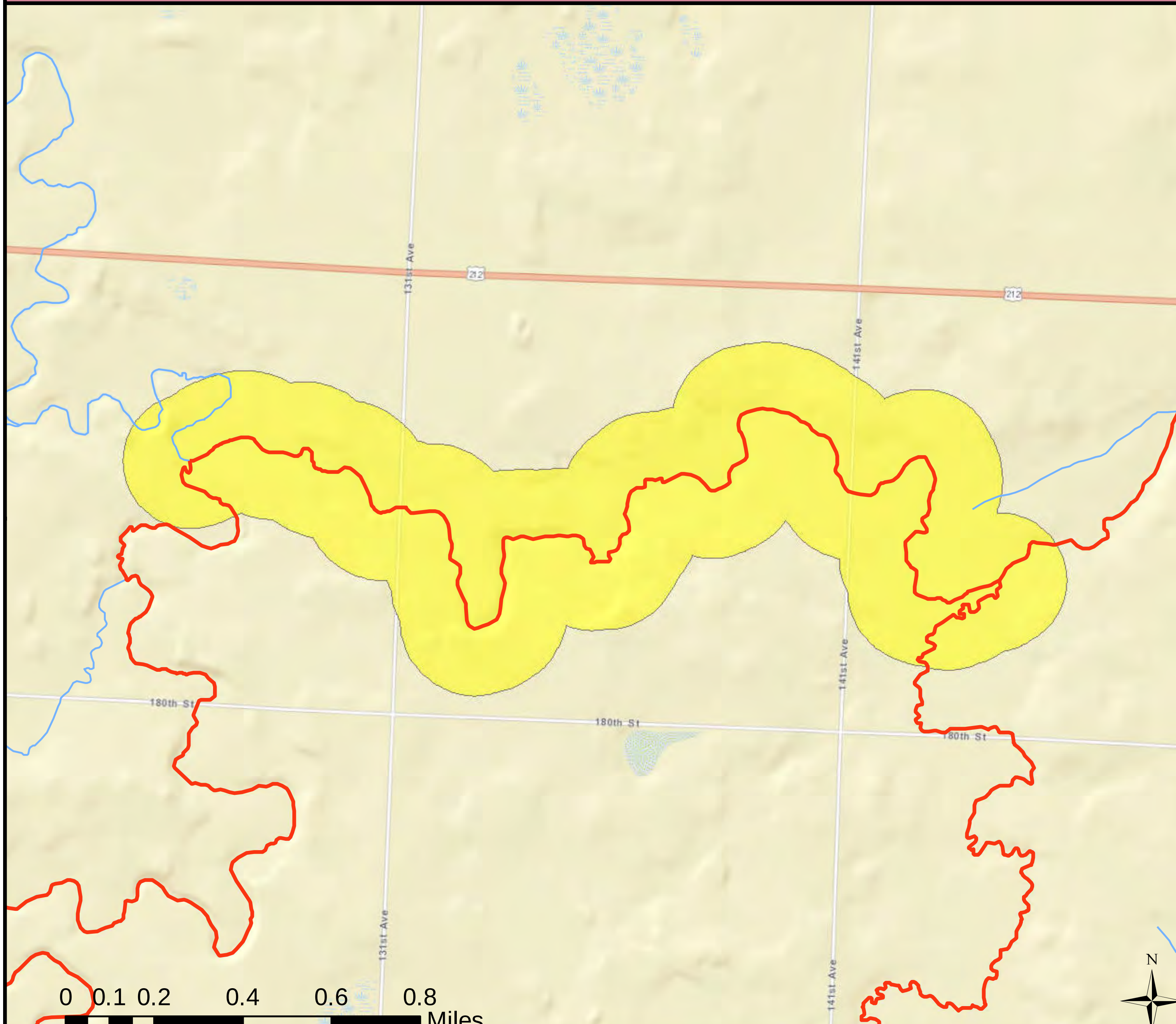
Assessed Streams

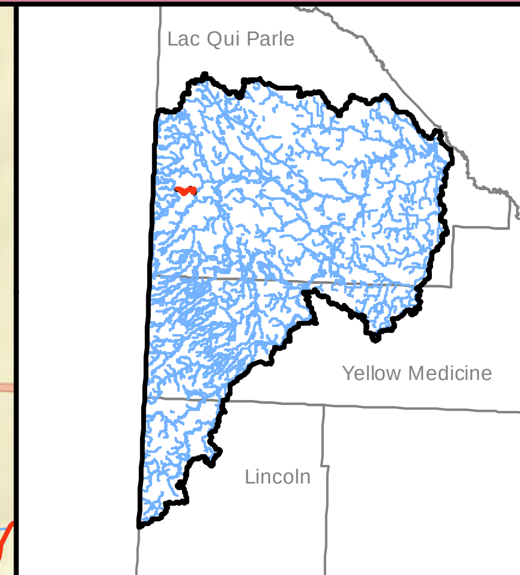
Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Lost Creek

07020003-517

Crow Timber Cr to W Br Lac Qui Parle R





Aquatice Life:
Not Supporting
Aquatic Recreation:
Not Supporting
Limited Resource:

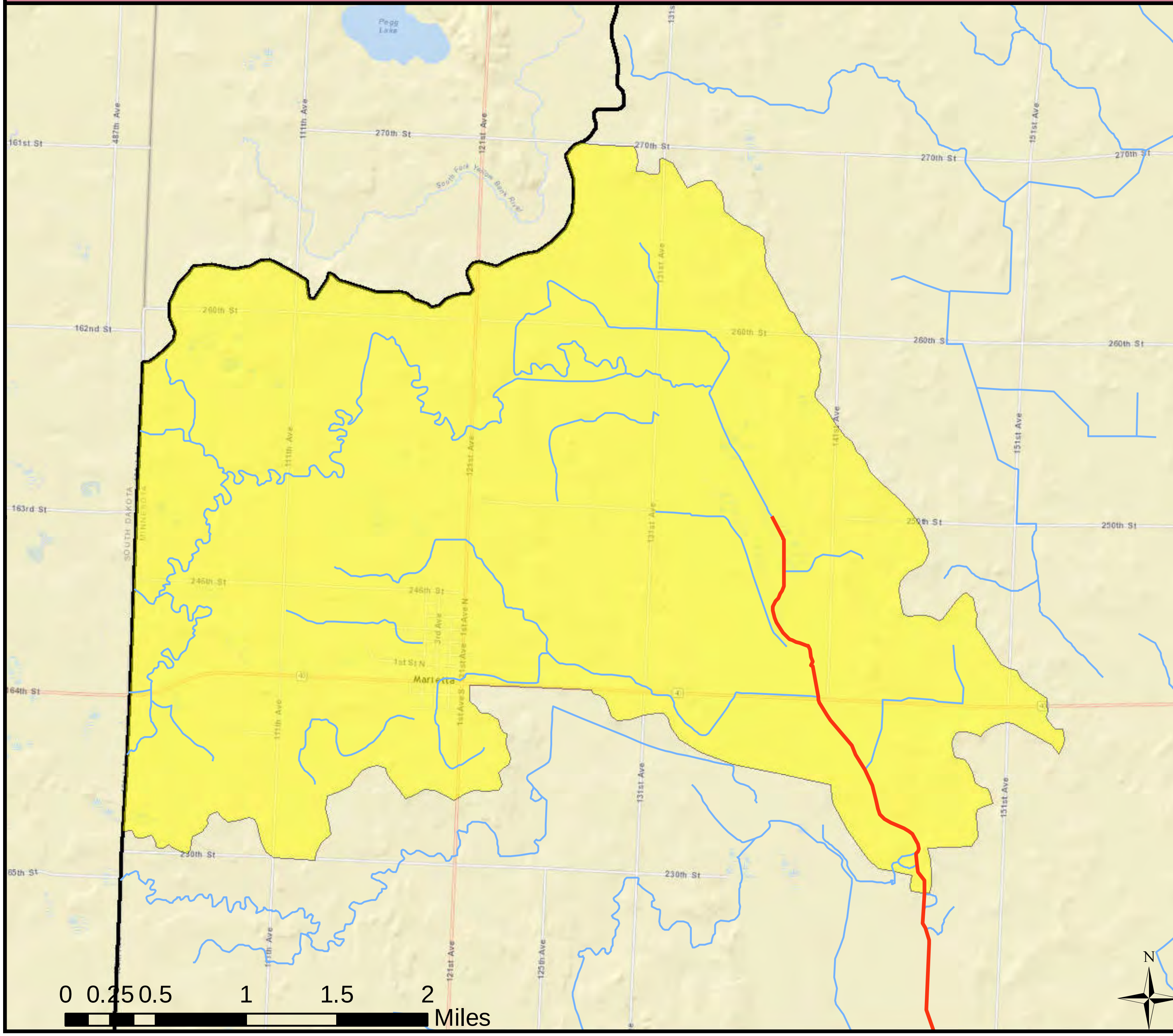
New Impairment:
Macroinvertebrate, DO, E. coli, Fish
Existing Impairment:

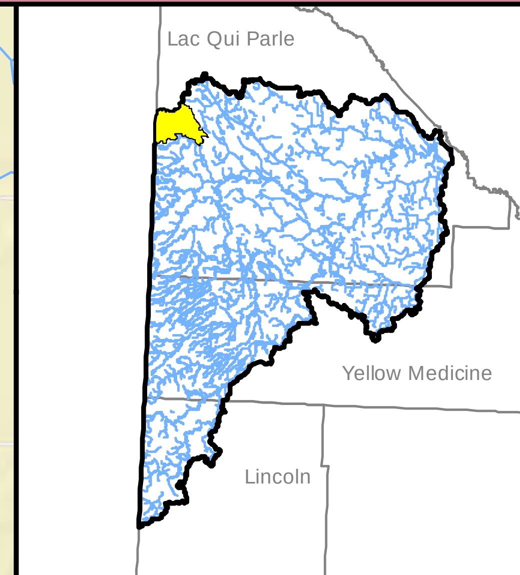
Assessed Lakes
Assessed Streams

Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Upper County Ditch No 5

070200030305





Aquatice Life:

Aquatic Recreation:

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

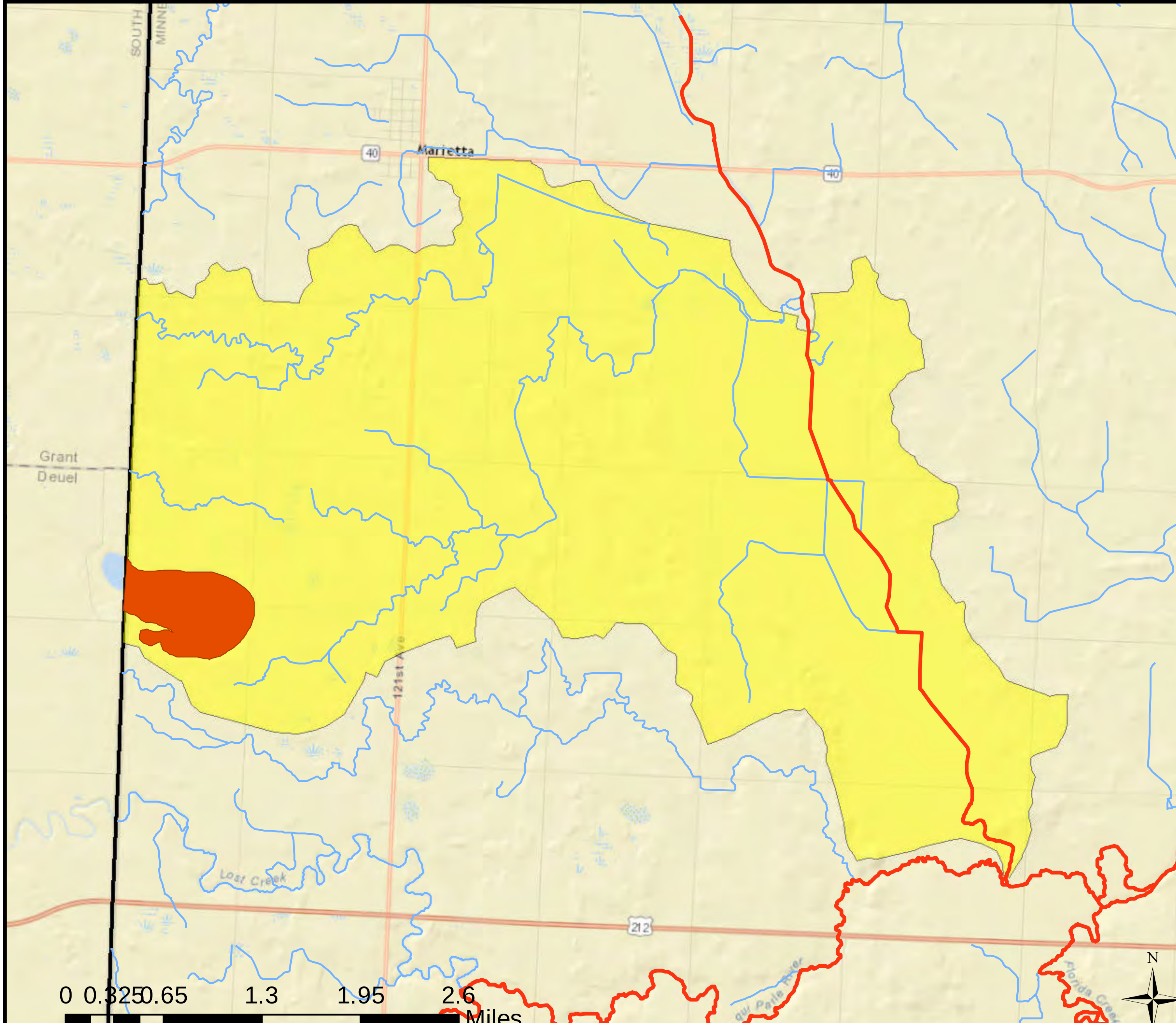
Assessed Streams

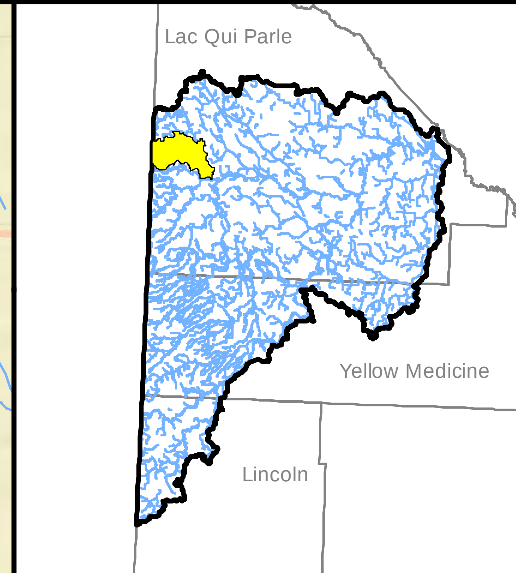
Minnesota Pollution Control Agency

1601 E Hwy 12, Suite 1
Willmar, MN 56201

Lower County Ditch No 5

070200030306





Aquatice Life:

Aquatic Recreation:

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

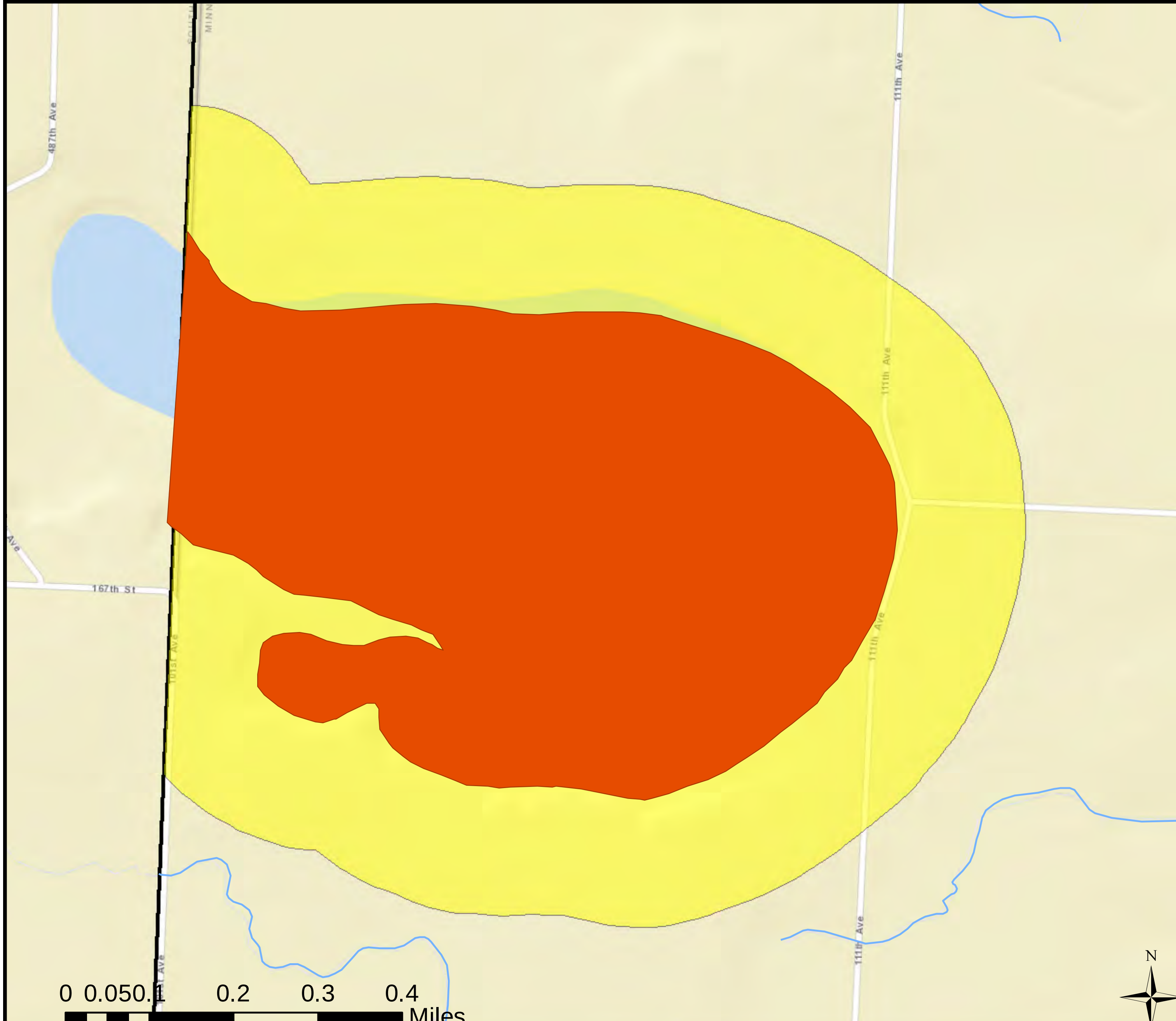
Assessed Streams

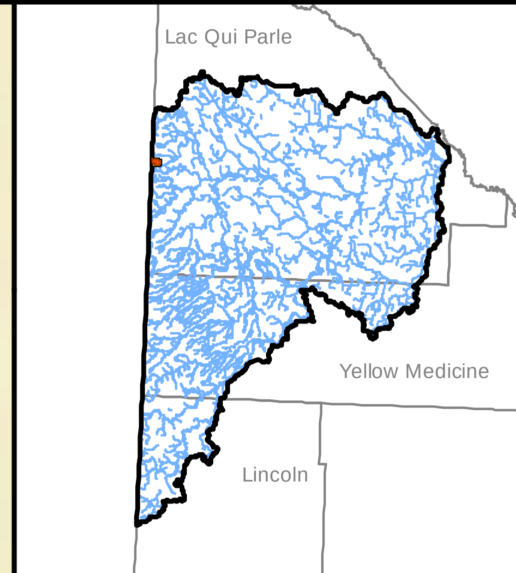
Minnesota Pollution Control Agency

1601 E Hwy 12, Suite 1
Willmar, MN 56201

Salt

37-0229-00





Aquatice Life:

Aquatic Recreation:
Insufficient Information

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

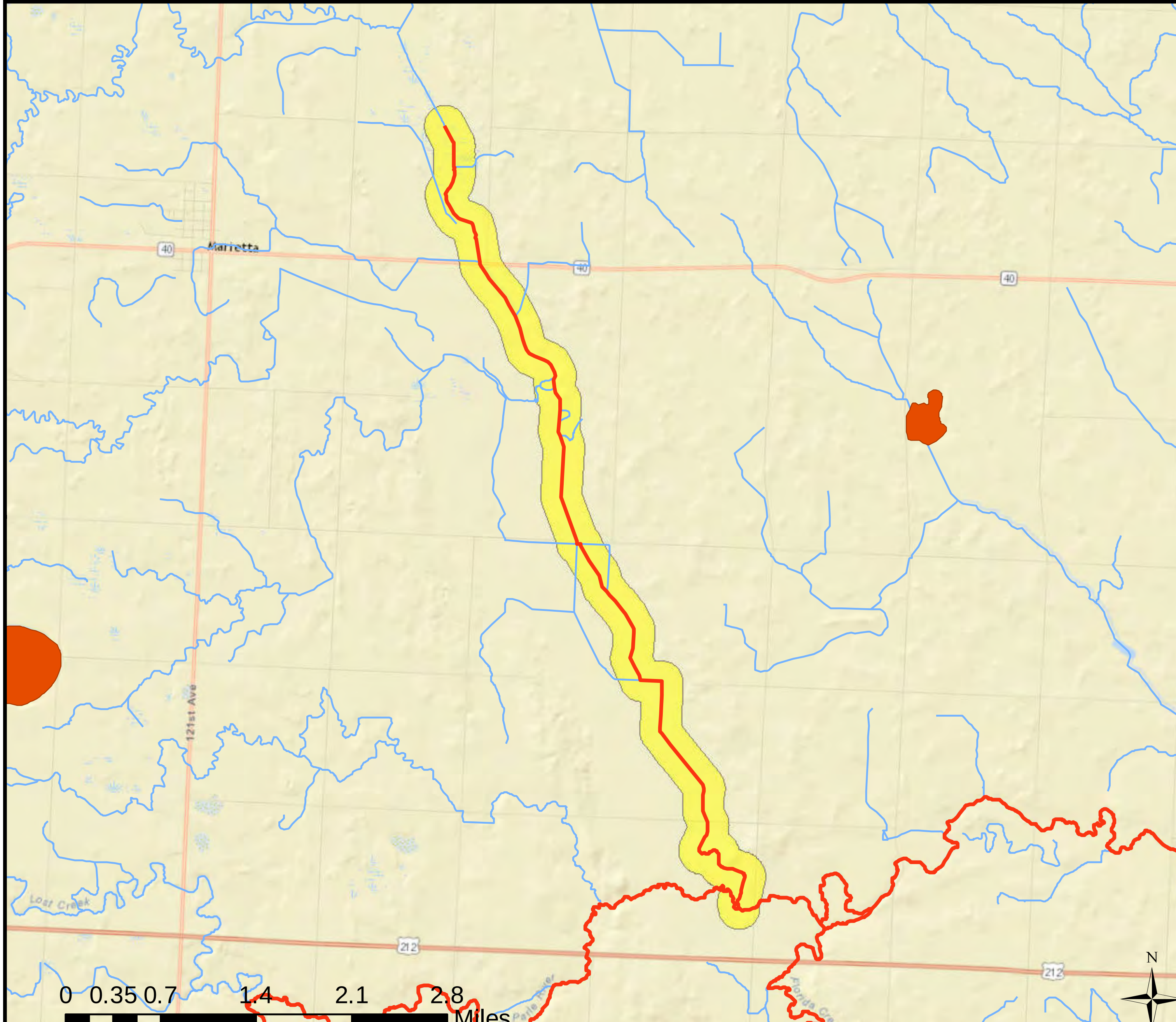
Assessed Streams

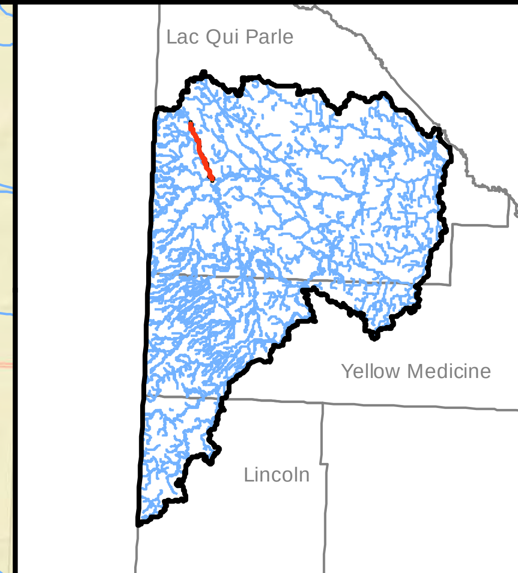
Minnesota Pollution Control Agency

1601 E Hwy 12, Suite 1
Willmar, MN 56201

County Ditch 5

07020003-523 T118 R46W S23, north line to W Br Lac Qui Parle R





Aquatice Life:

Aquatic Recreation:

Limited Resource:
Not Supporting
New Impairment:
E. coli

Existing Impairment:

Assessed Lakes

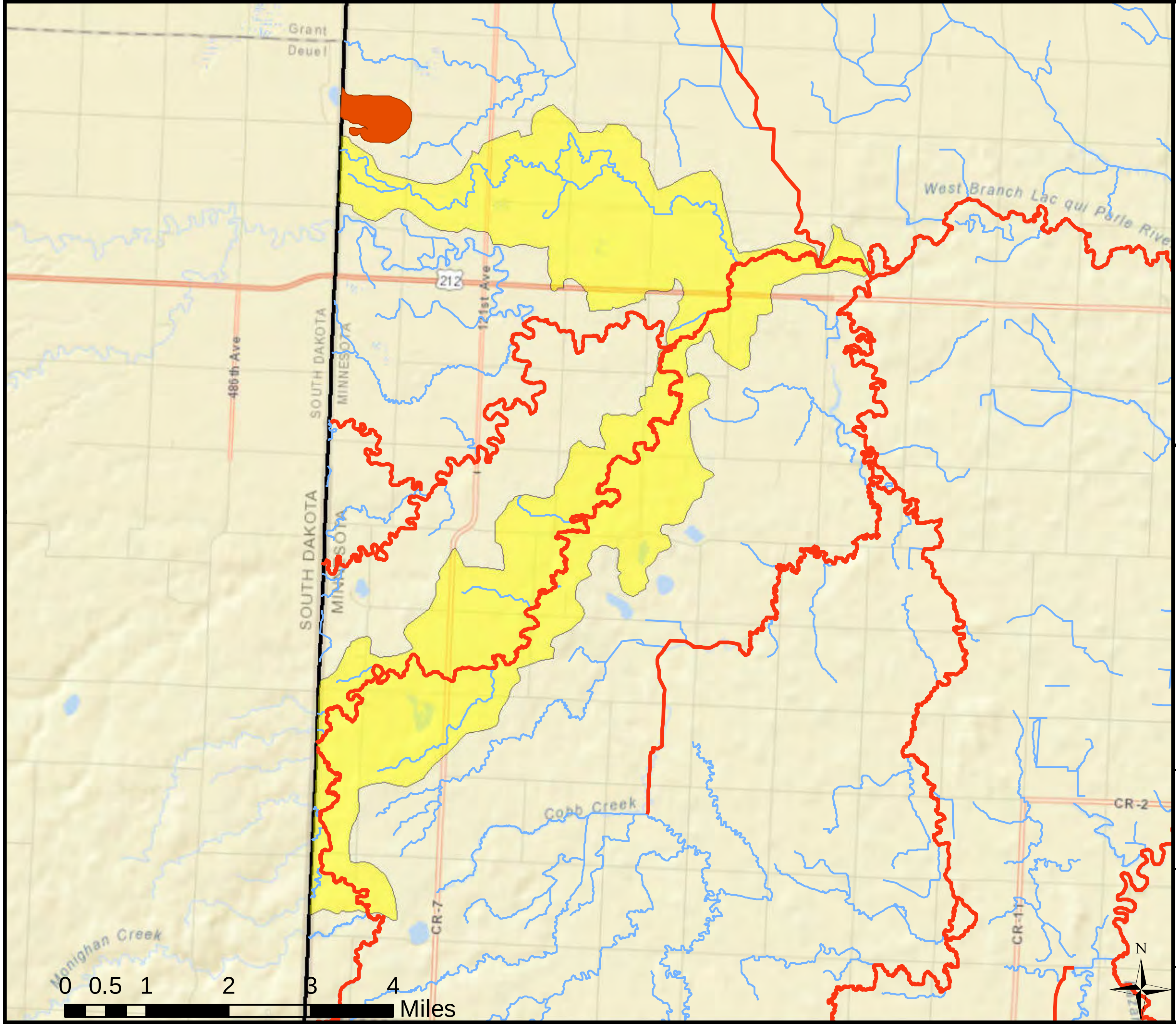
Assessed Streams

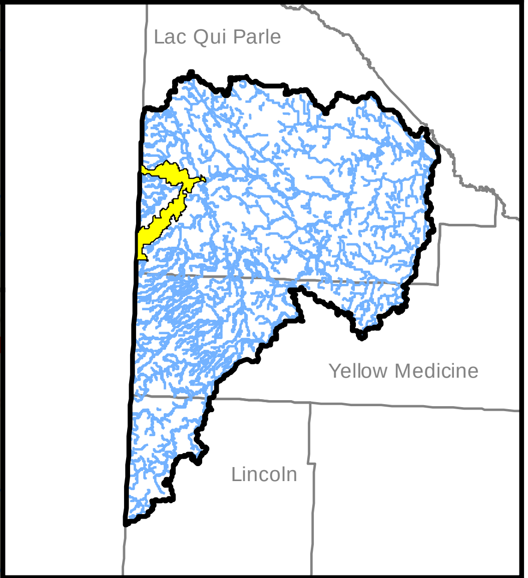
Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Service Layer Credits: Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2013

Bolland Slough-West Branch Lac Qui Parle River

070200030307





Aquatice Life:

Aquatic Recreation:

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

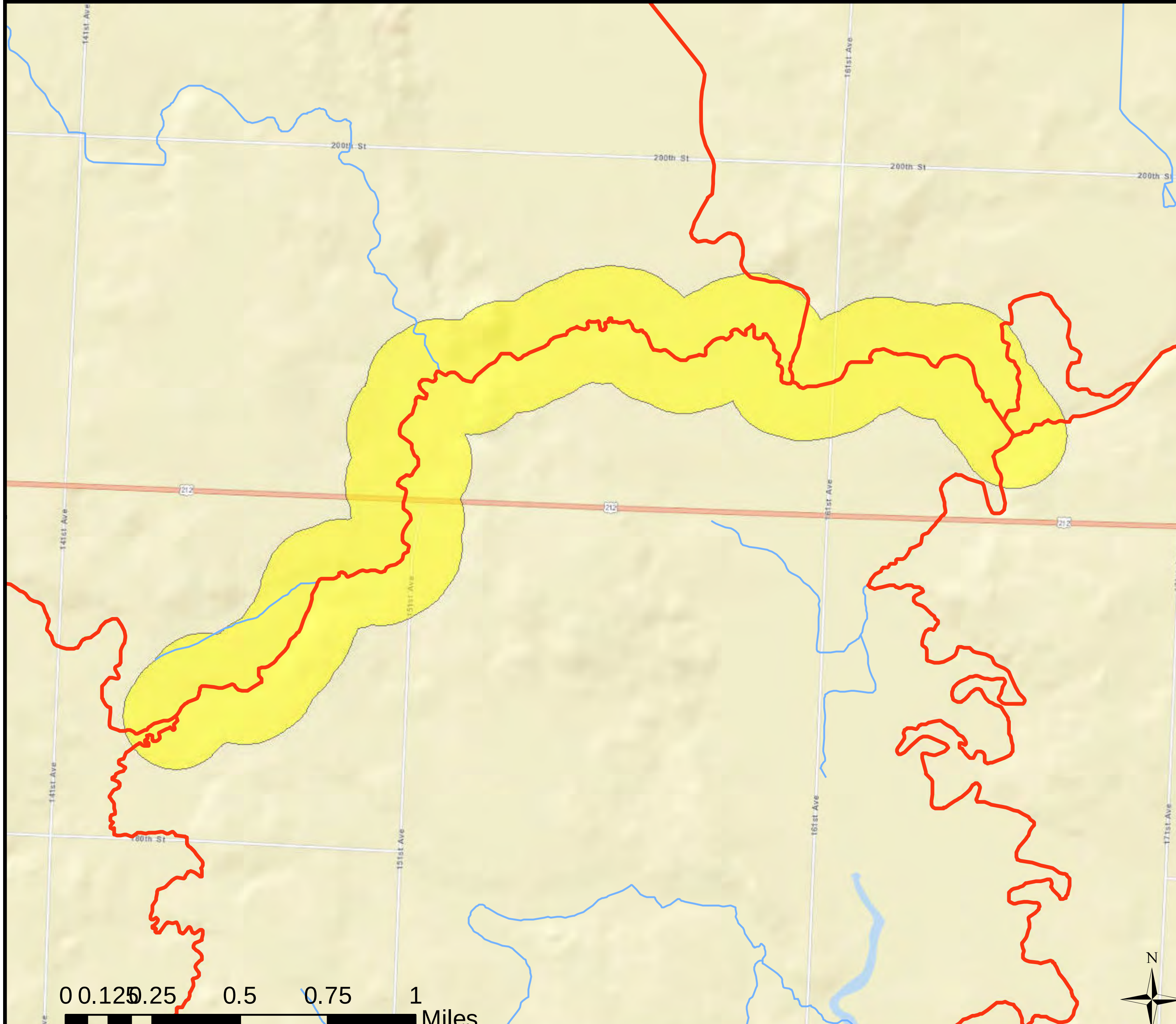
Assessed Streams

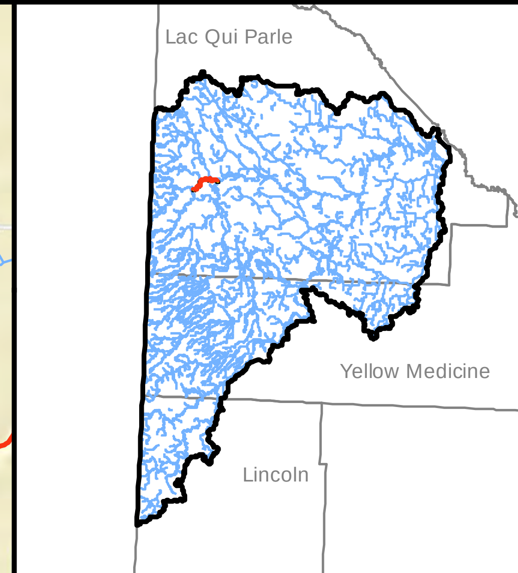
Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Lac qui Parle River, West Branch

07020003-516

Lost Cr to Florida Cr





Aquatice Life:
Not Supporting

Aquatic Recreation:
Not Supporting

Limited Resource:

New Impairment:
Macroinvertebrate, E. coli, Fish

Existing Impairment:
Mercury, Turbidity, Fecal Coliform

Assessed Lakes

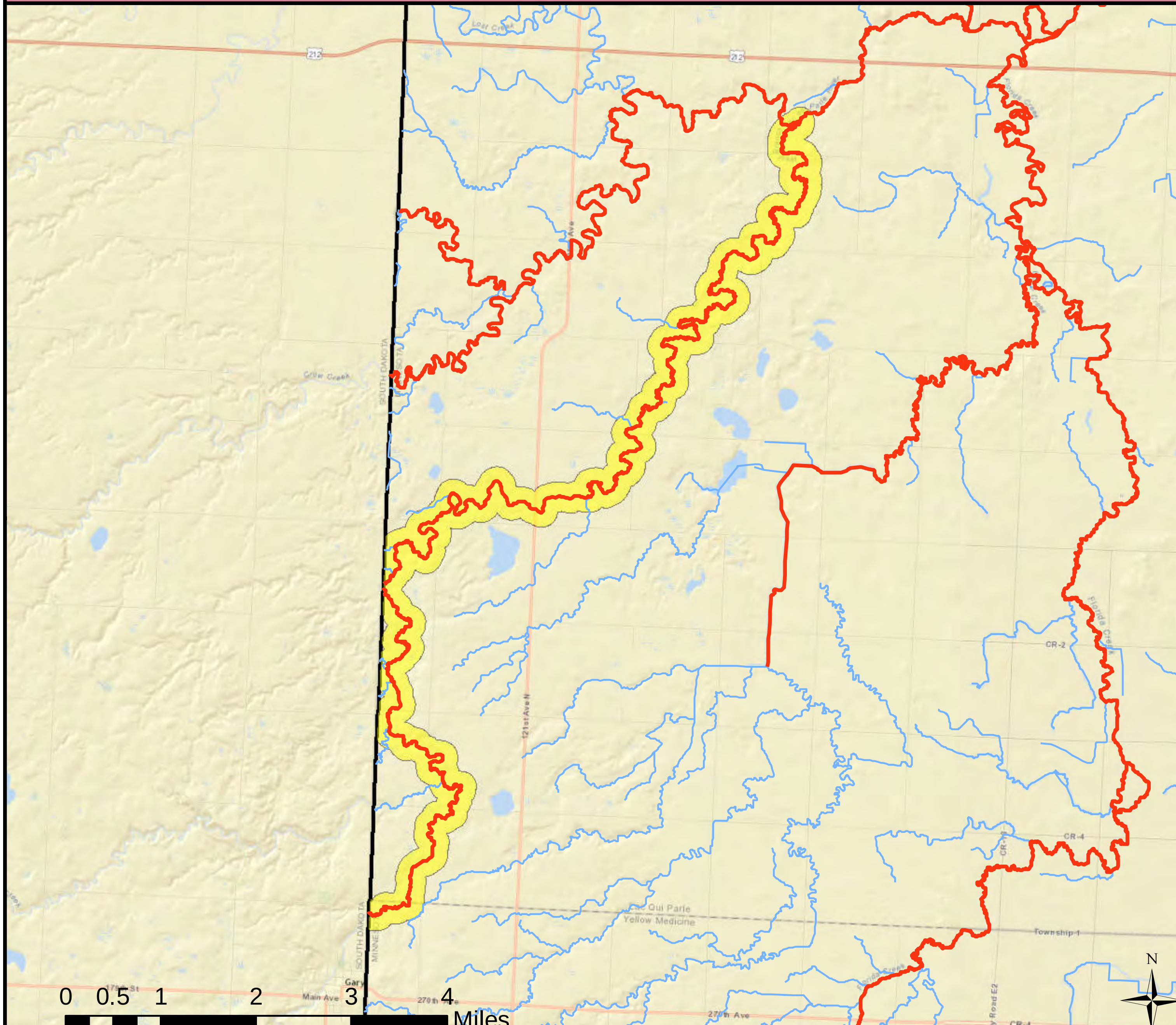
Assessed Streams

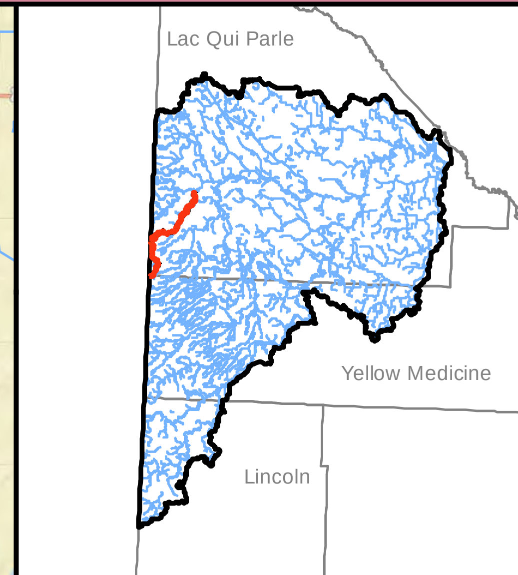
Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Lac qui Parle River, West Branch

07020003-519

MN/SD border to Lost Cr





Aquatice Life:
Not Supporting

Aquatic Recreation:
Not Supporting

Limited Resource:

New Impairment:
E. coli, Fish

Existing Impairment:
Mercury

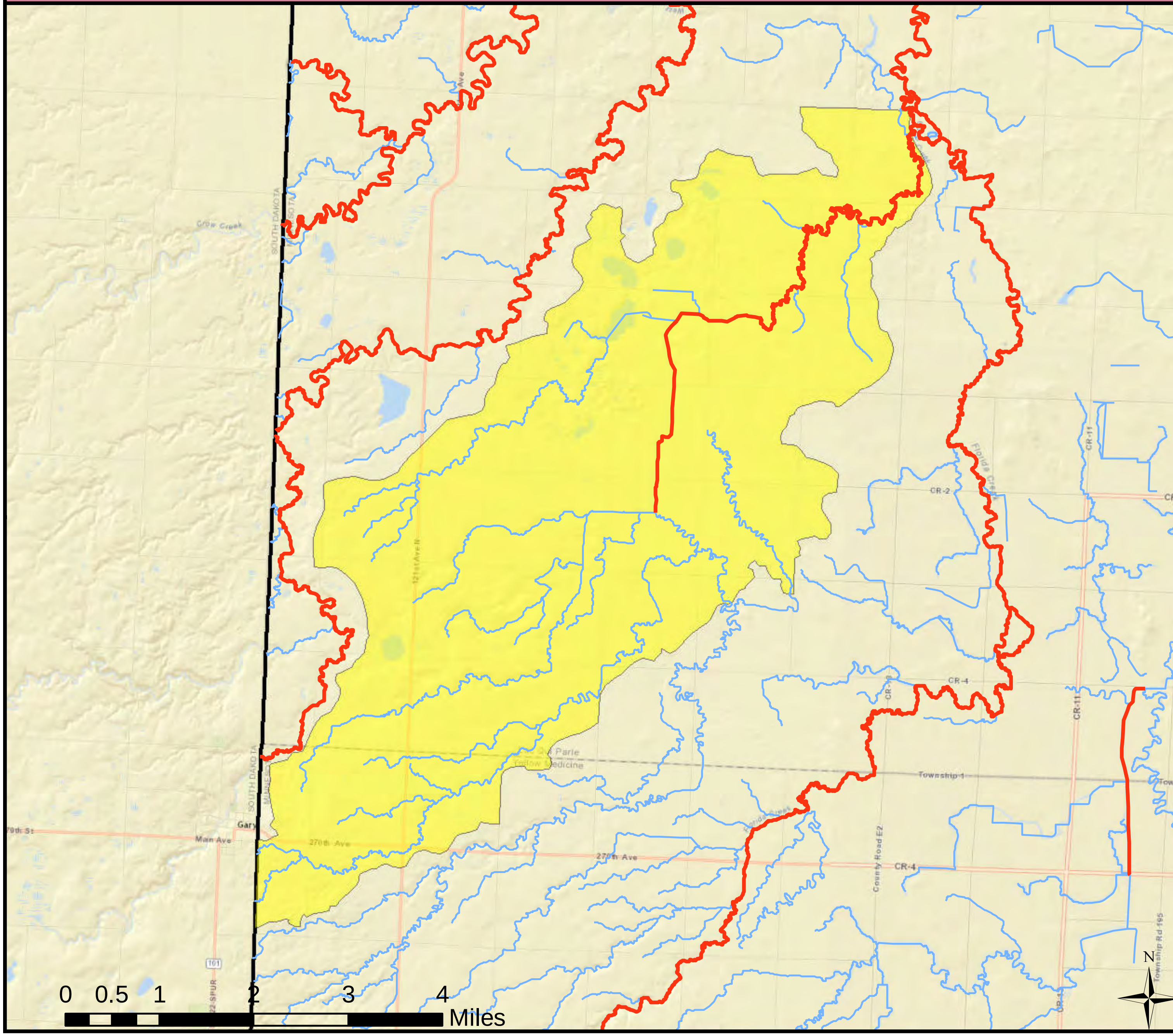
Assessed Lakes

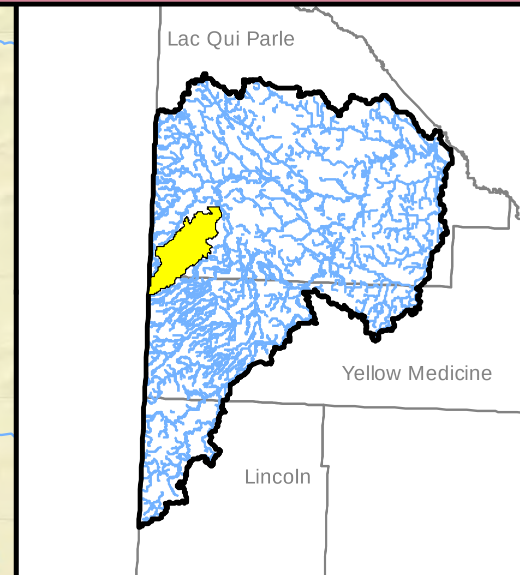
Assessed Streams

Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Sweetwater State Wildlife Management Area-Cobb Creek

070200030403





Aquatice Life:

Aquatic Recreation:

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

Assessed Streams

Minnesota Pollution Control Agency

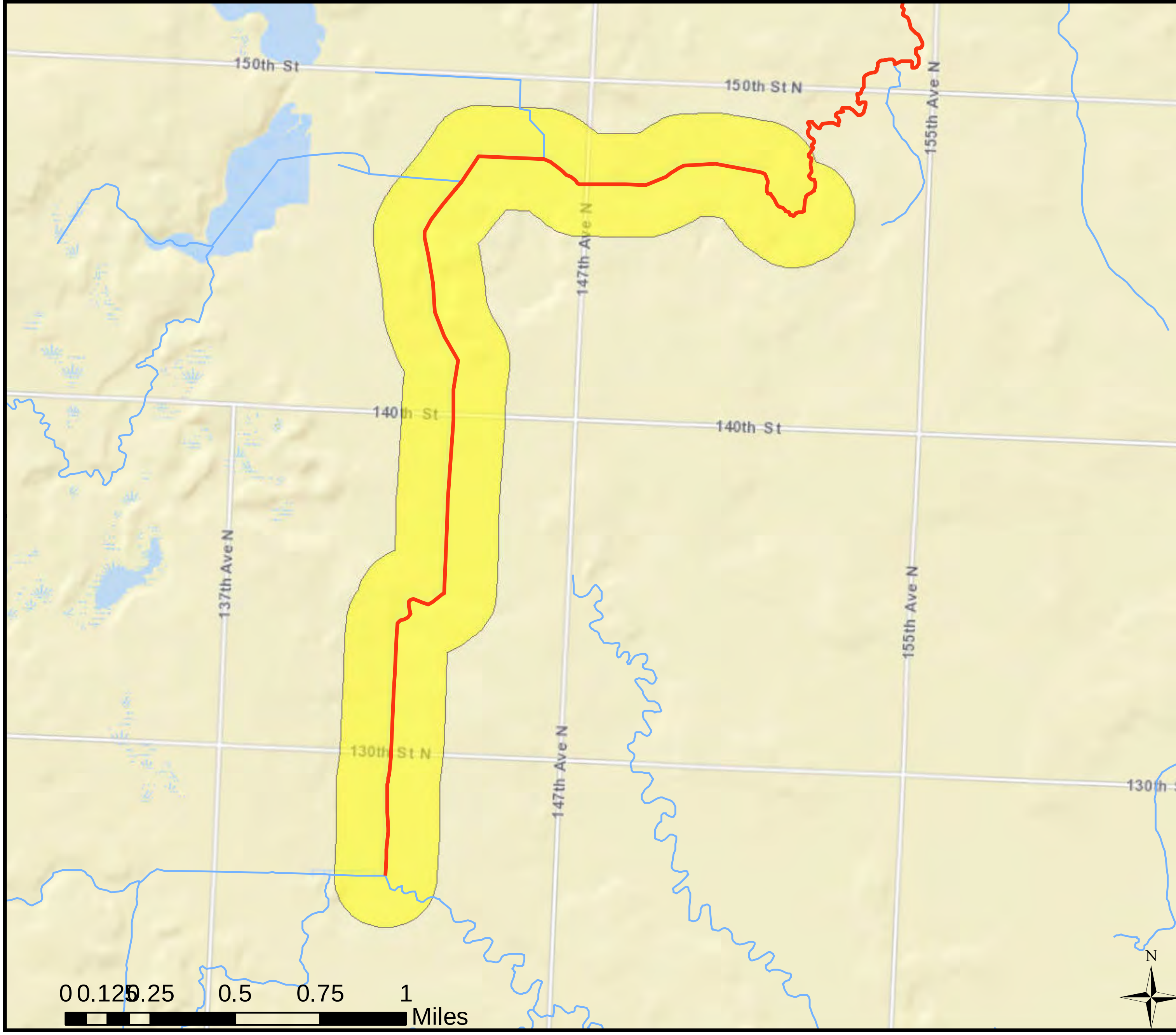
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Service Layer Credits: Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2013

Cobb Creek

07020003-583

Unnamed cr to -96.3457, 44.8724



Aquatice Life:
Not Supporting

Aquatic Recreation:

Limited Resource:

New Impairment:
Macroinvertebrate

Existing Impairment:

Assessed Lakes

Assessed Streams

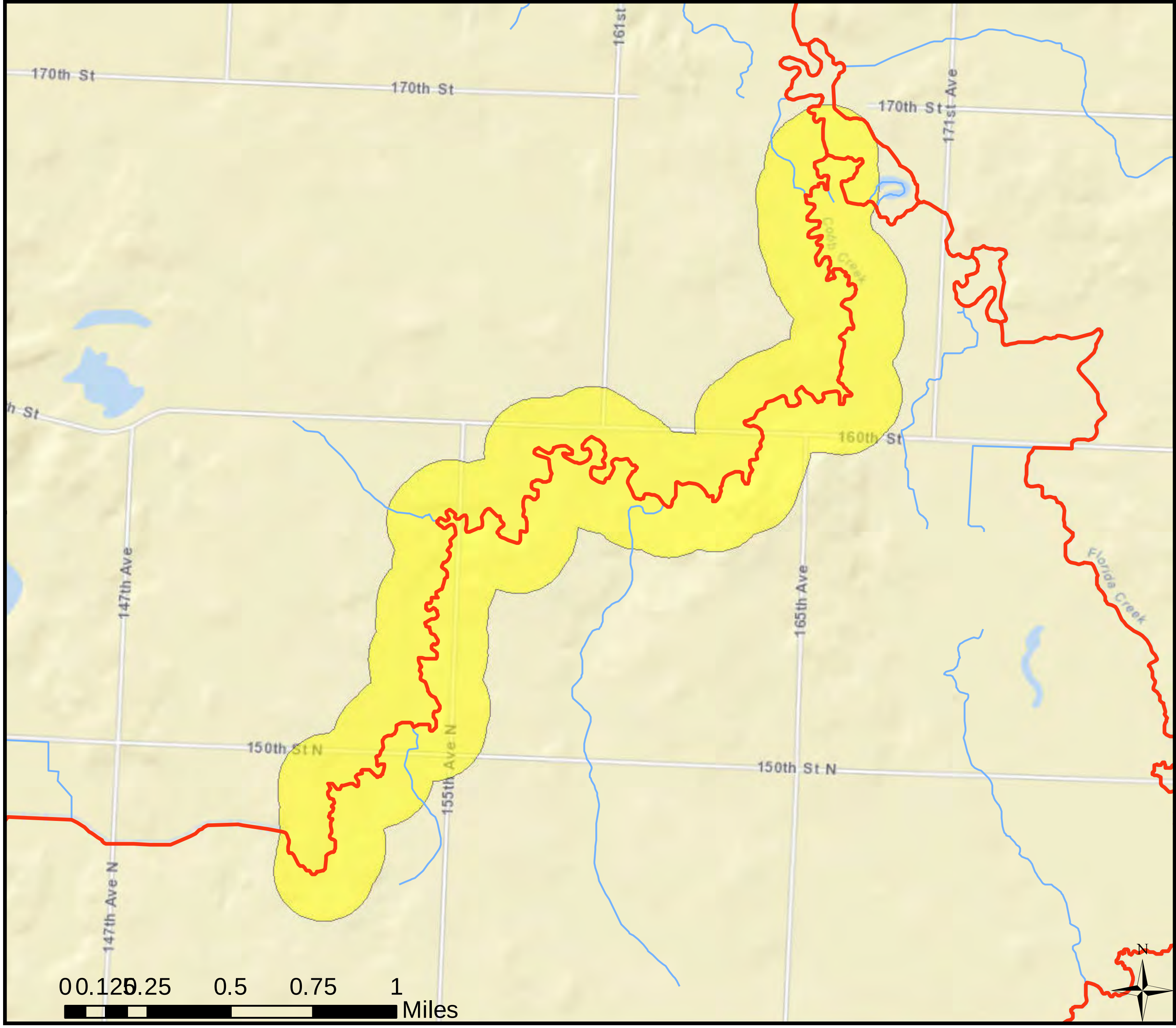
Minnesota Pollution Control Agency

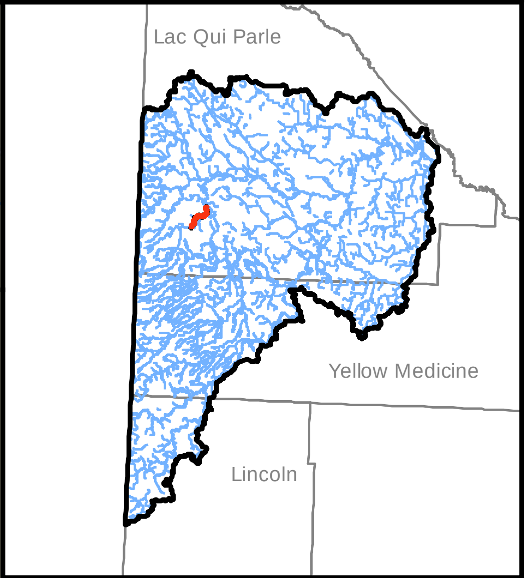
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Cobb Creek

07020003-584

-96.3457, 44.8724 to Florida Cr





Aquatice Life:
Insufficient Information

Aquatic Recreation:

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

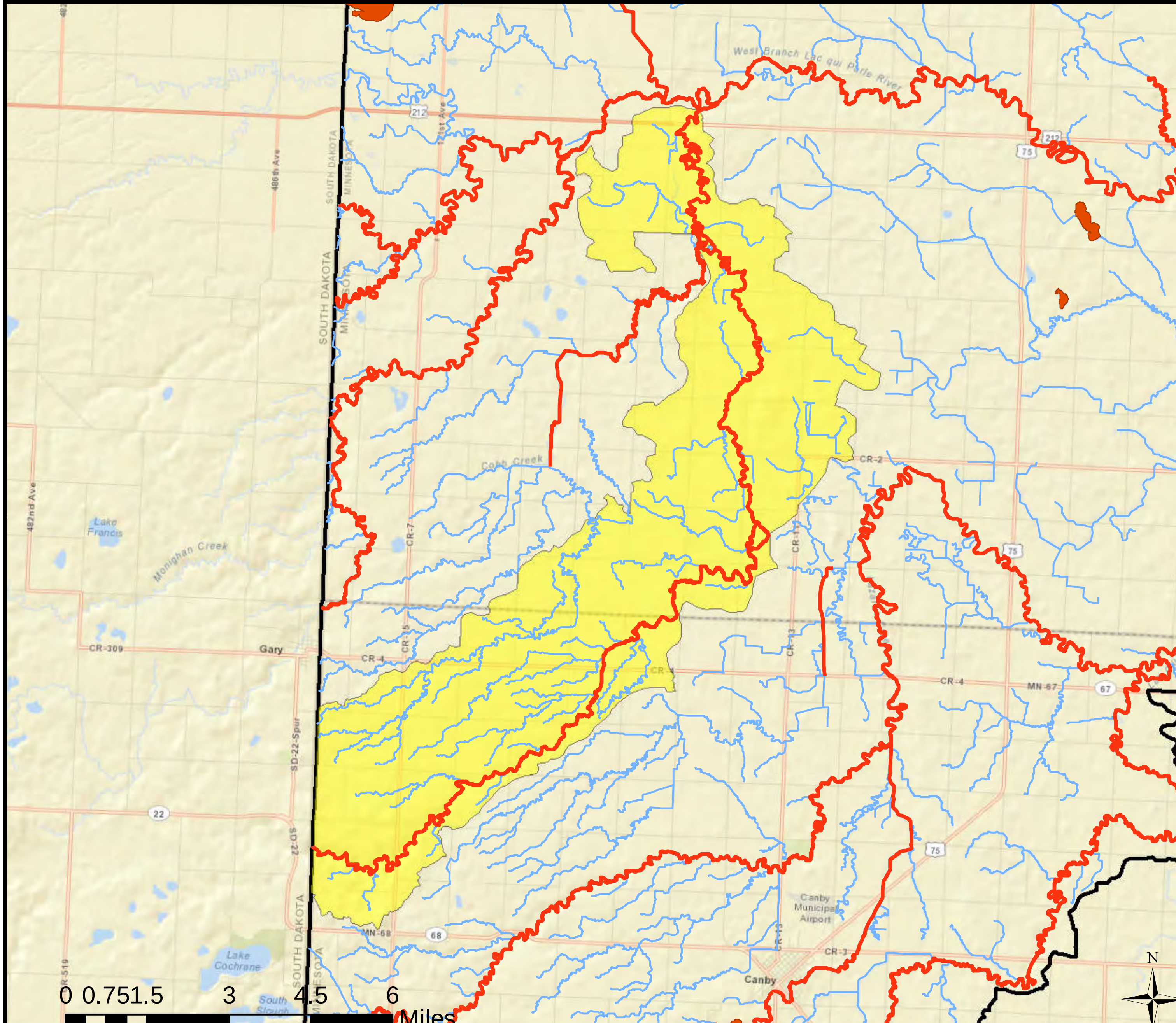
Assessed Streams

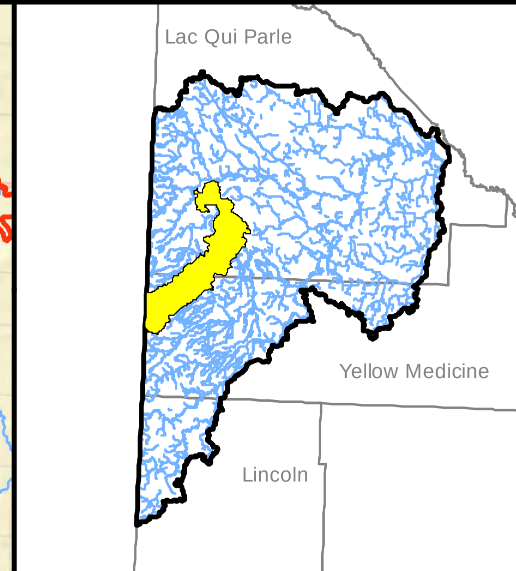
Minnesota Pollution Control Agency

1601 E Hwy 12, Suite 1
Willmar, MN 56201

Florida Creek

070200030404





Aquatice Life:

Aquatic Recreation:

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

Assessed Streams

Minnesota Pollution Control Agency

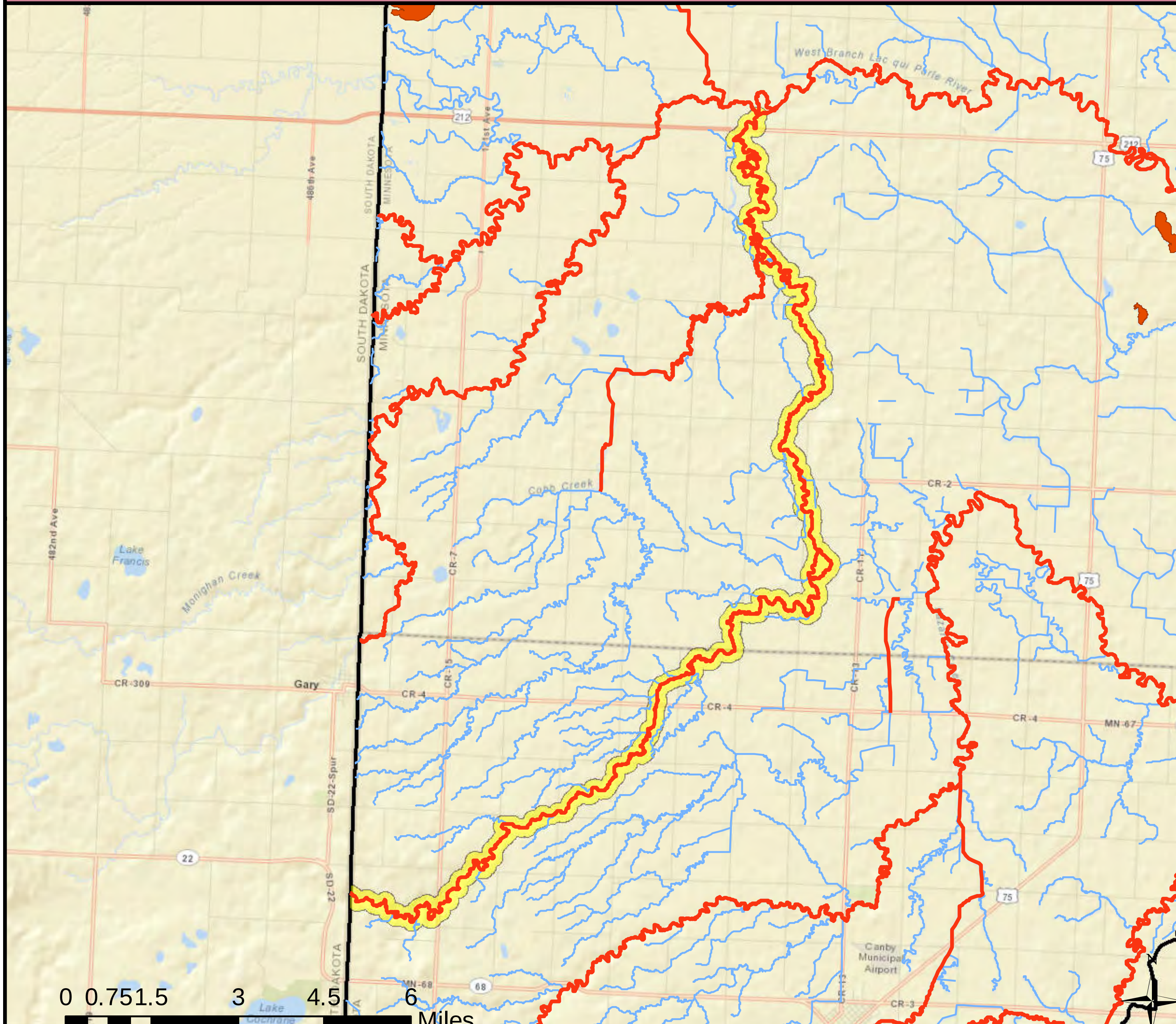
1601 E Hwy 12, Suite 1
Willmar, MN 56201

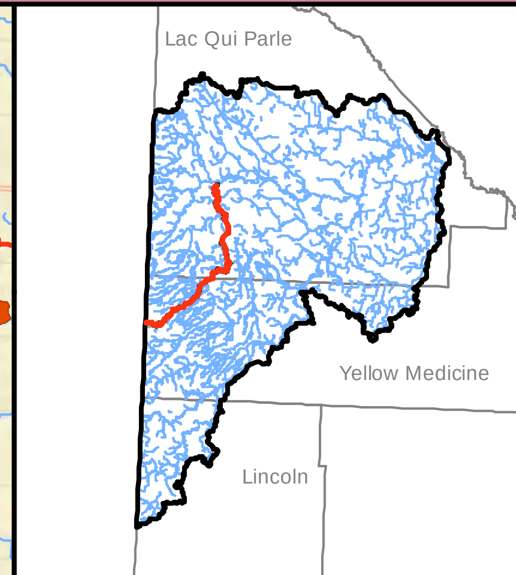
Service Layer Credits: Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2013

Florida Creek

07020003-521

MN/SD border to W Br Lac Qui Parle R





Aquatice Life:
Not Supporting

Aquatic Recreation:
Not Supporting

Limited Resource:

New Impairment:
Macroinvertebrate

Existing Impairment:
Fecal Coliform, Fish, Turbidity

Assessed Lakes

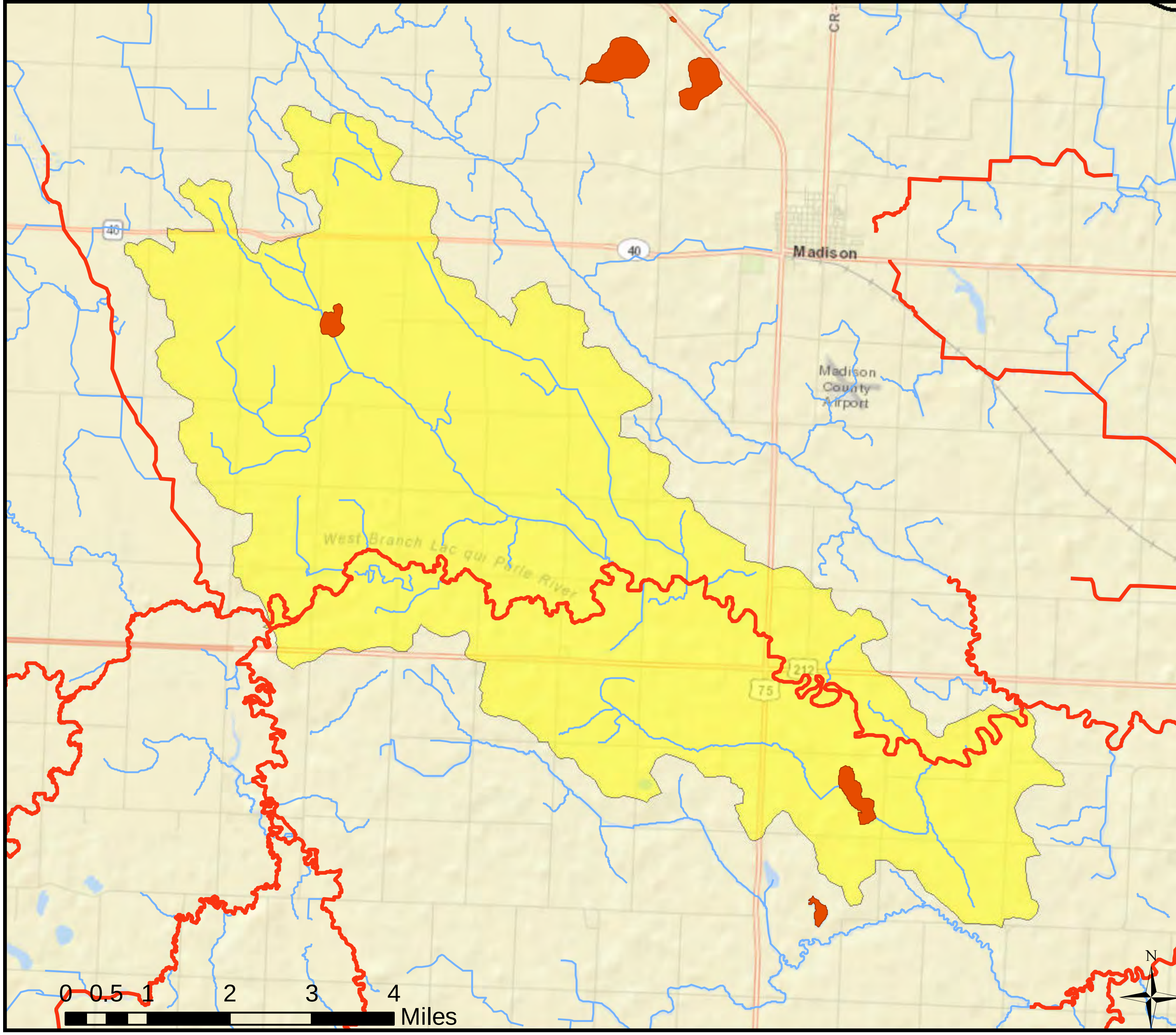
Assessed Streams

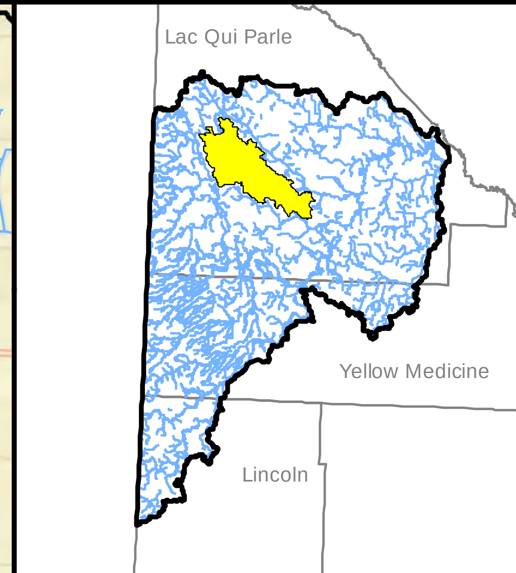
Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Service Layer Credits: Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2013

County Ditch No 17-West Branch Lac Qui Parle River

070200030501





Aquatice Life:

Aquatic Recreation:

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

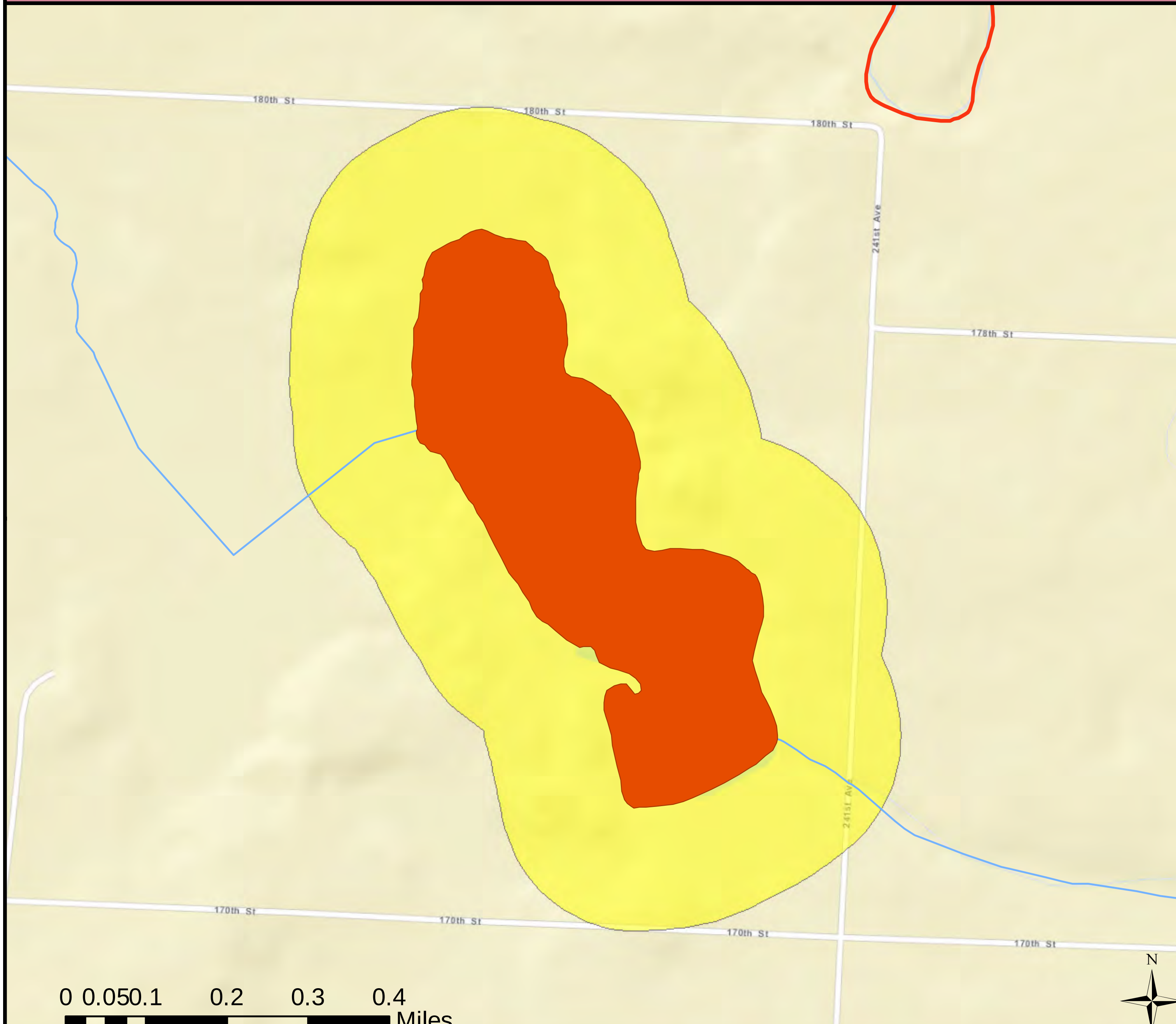
Assessed Streams

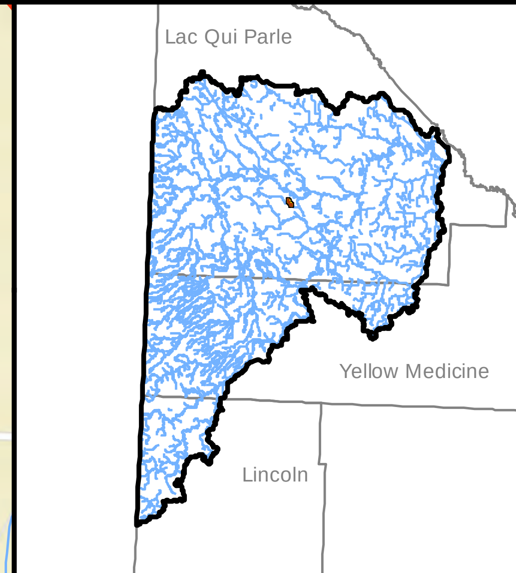
Minnesota Pollution Control Agency

1601 E Hwy 12, Suite 1
Willmar, MN 56201

Cory

37-0103-00





Aquatice Life:

Aquatic Recreation:
Insufficient Information

Limited Resource:

New Impairment:

Existing Impairment:

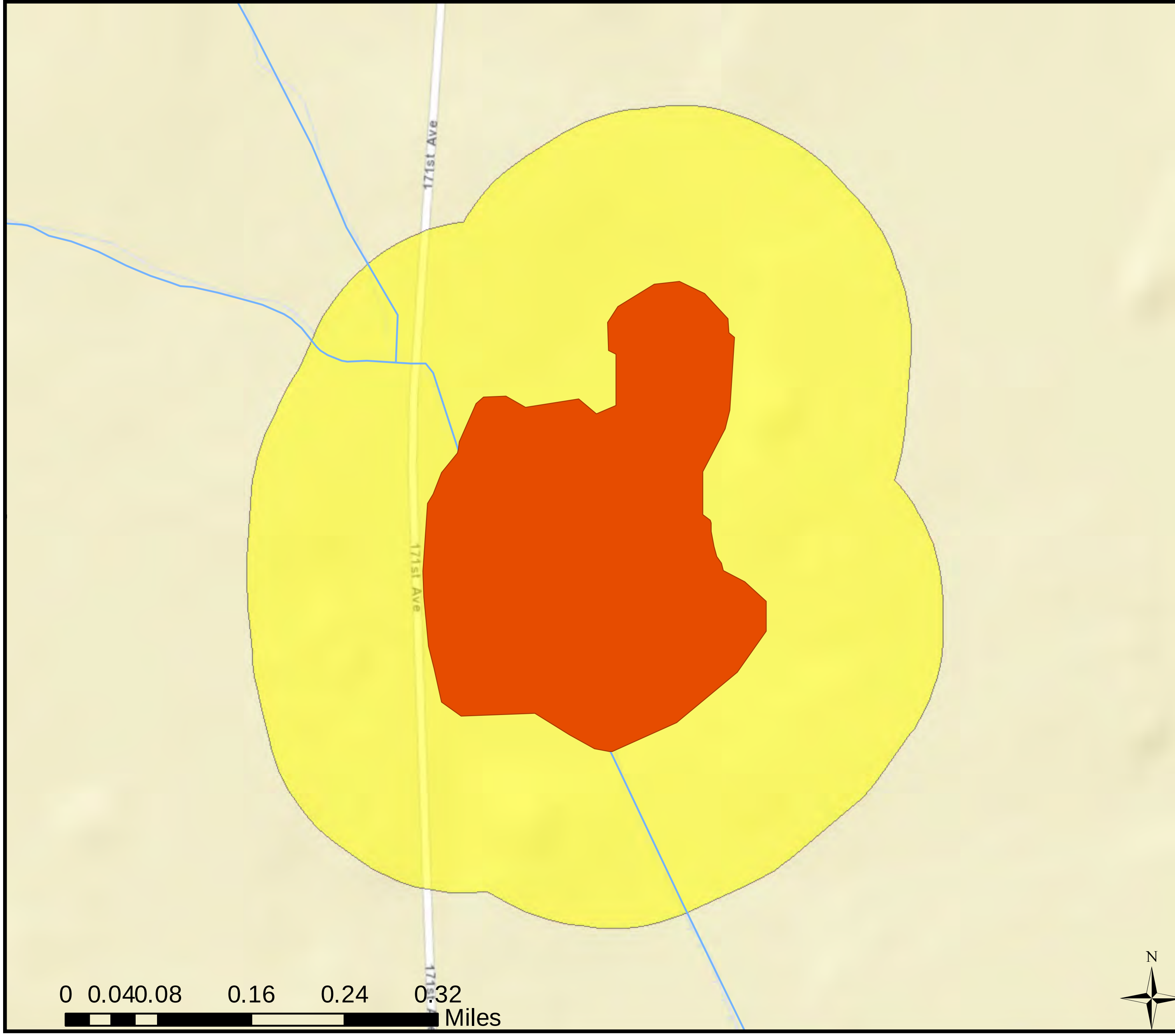
Assessed Lakes

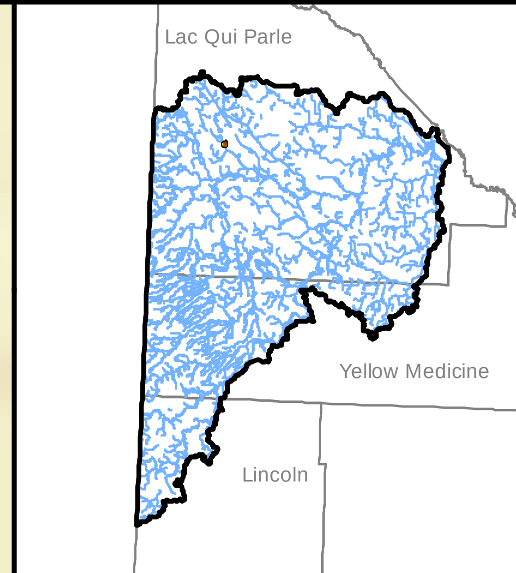
Assessed Streams

Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Unnamed

37-0154-00





Aquatice Life:

Aquatic Recreation:
Insufficient Information

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

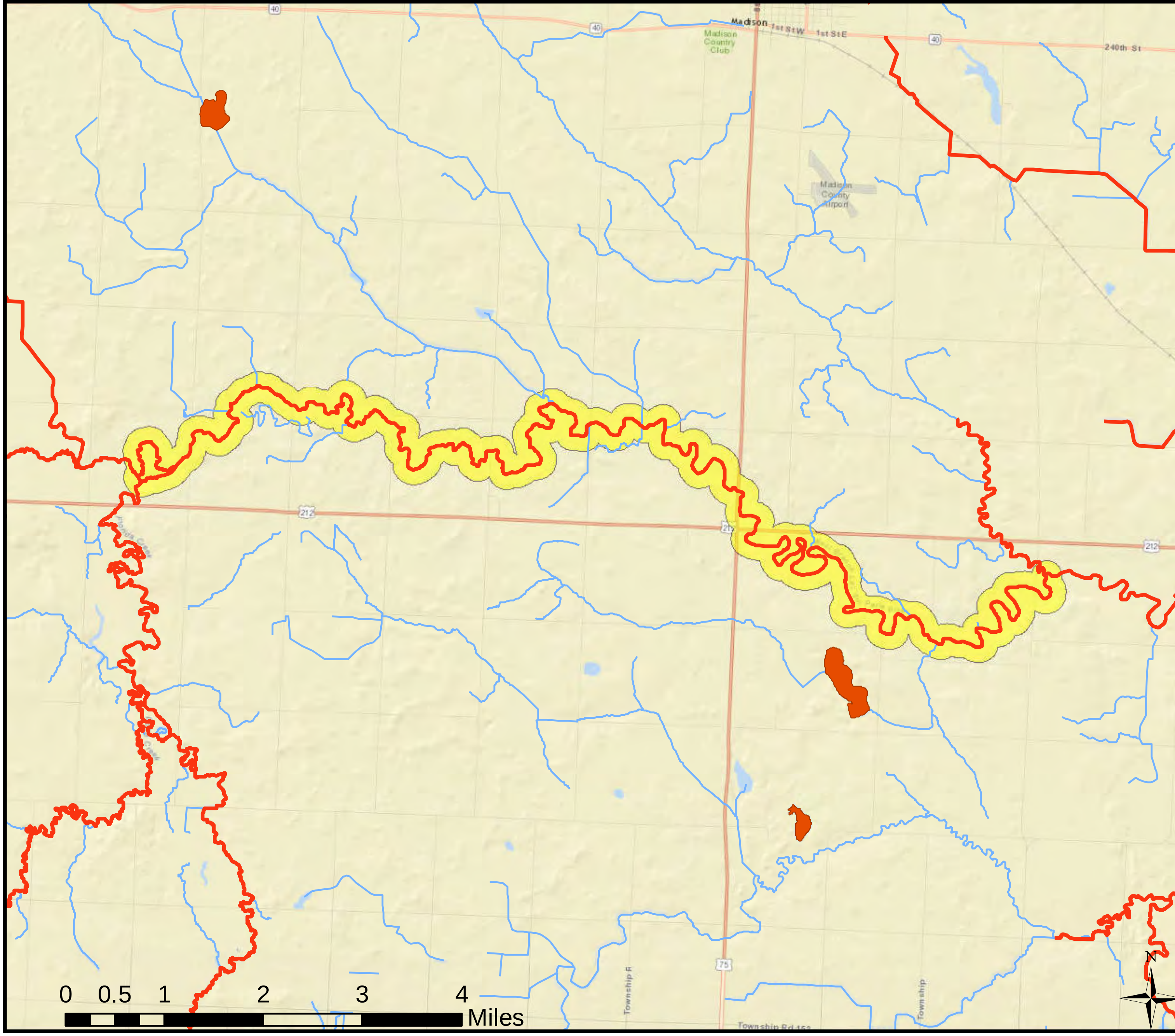
Assessed Streams

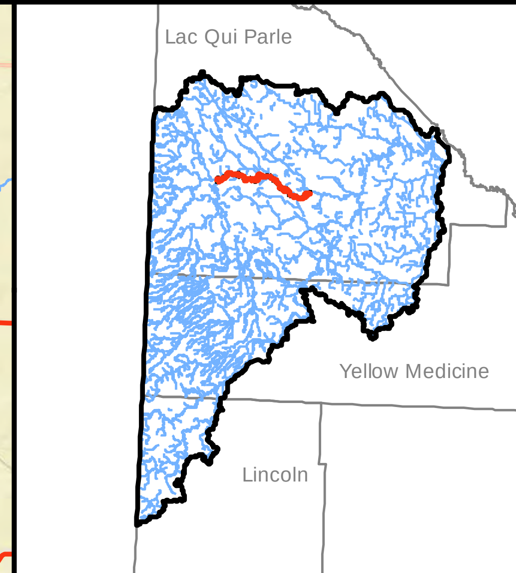
Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Lac qui Parle River, West Branch

07020003-515

Florida Cr to Unnamed cr





Aquatice Life:
Not Supporting

Aquatic Recreation:

Limited Resource:

New Impairment:
Fish

Existing Impairment:
Mercury

Assessed Lakes

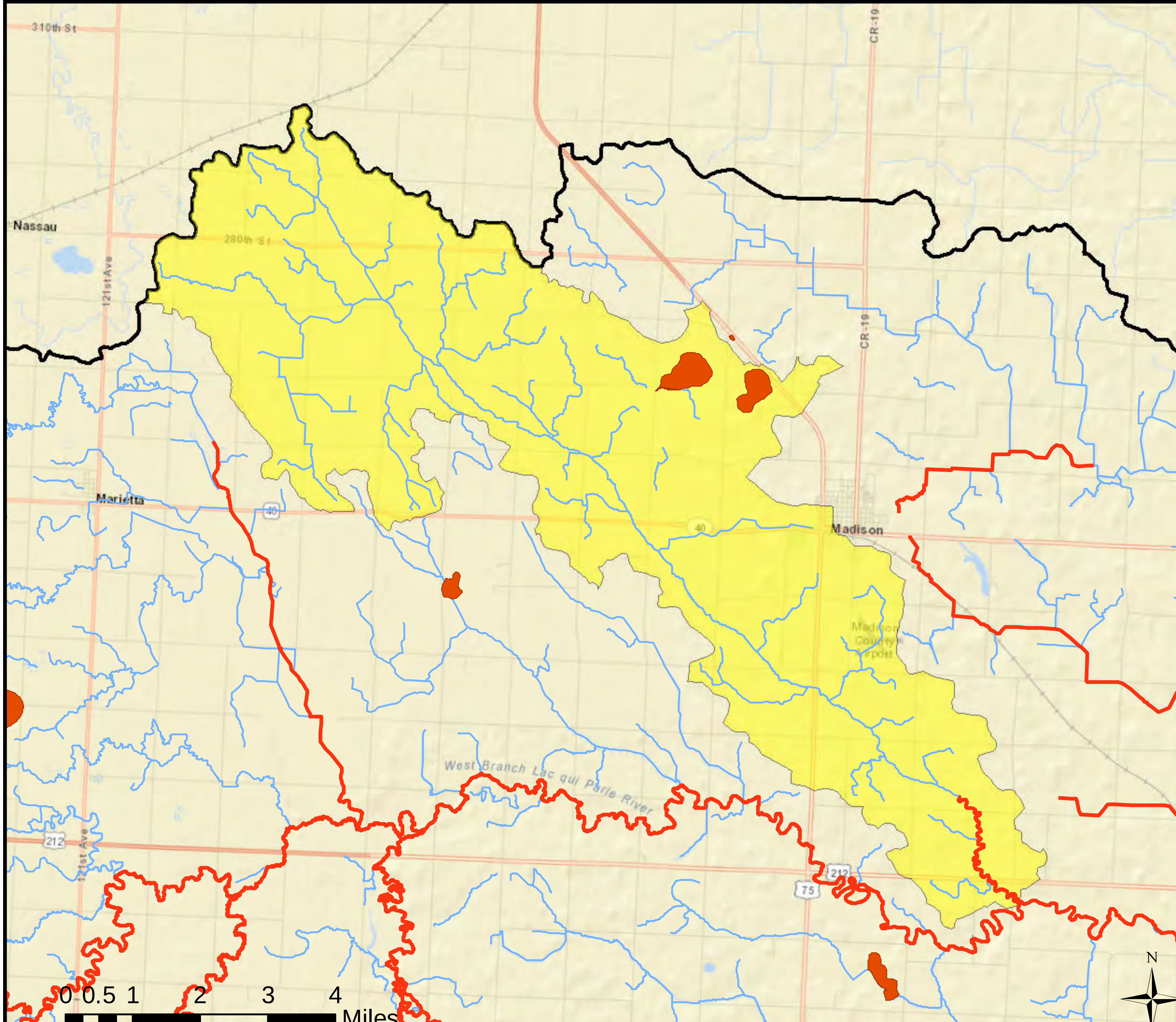
Assessed Streams

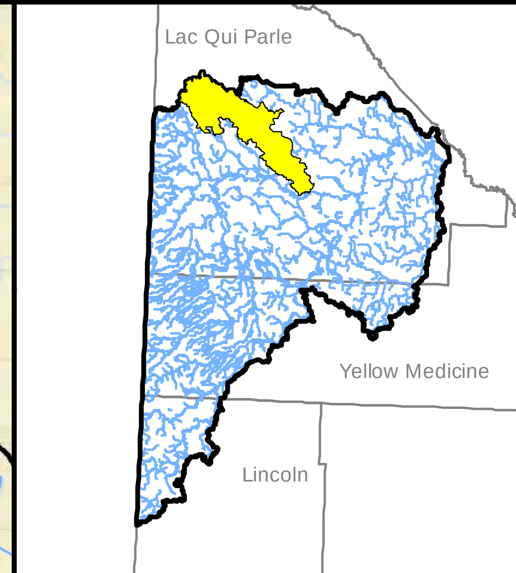
Minnesota Pollution Control Agency

1601 E Hwy 12, Suite 1
Willmar, MN 56201

Madison Municipal Airport

070200030502





Aquatice Life:

Aquatic Recreation:

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

Assessed Streams

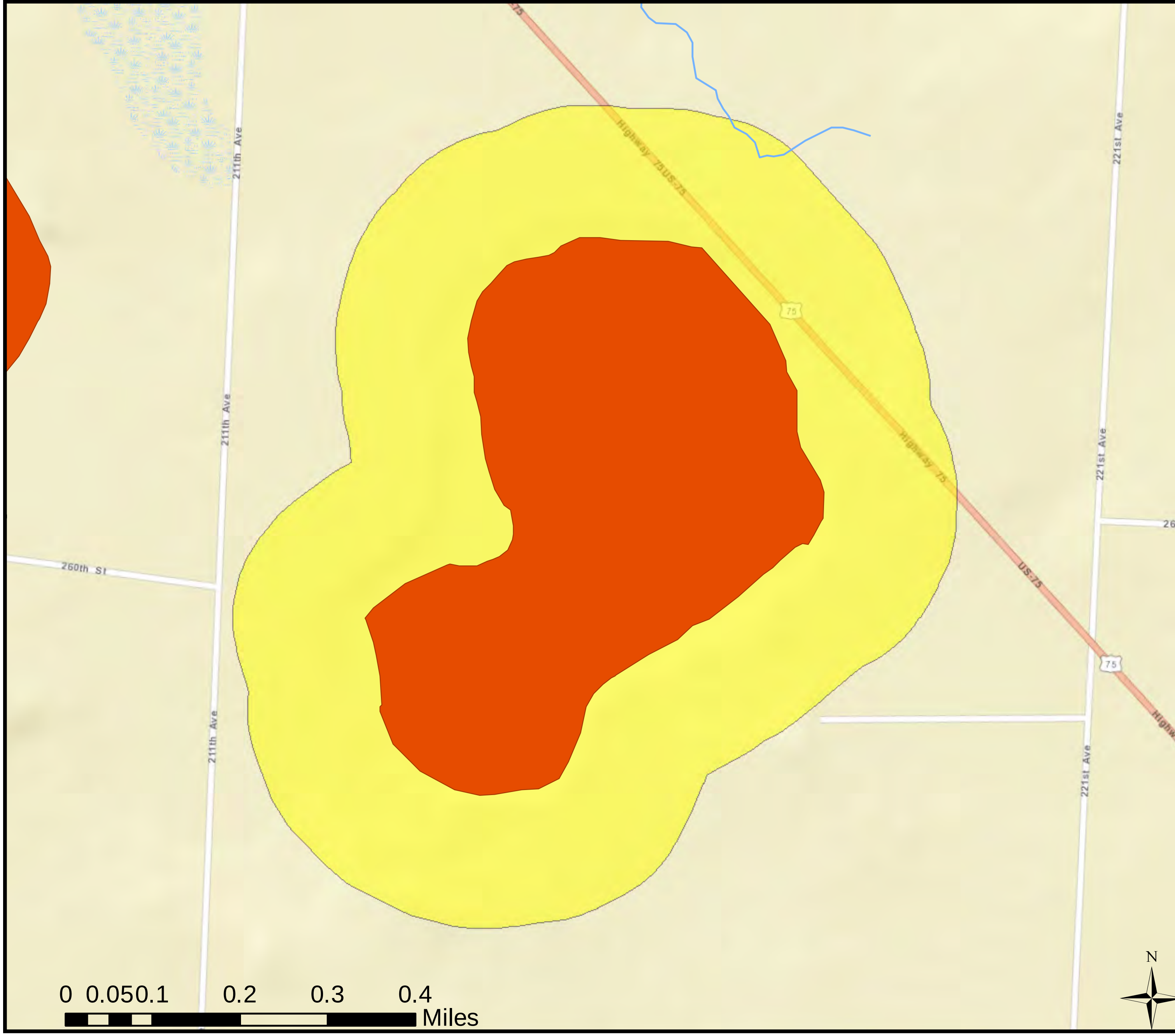
Minnesota Pollution Control Agency

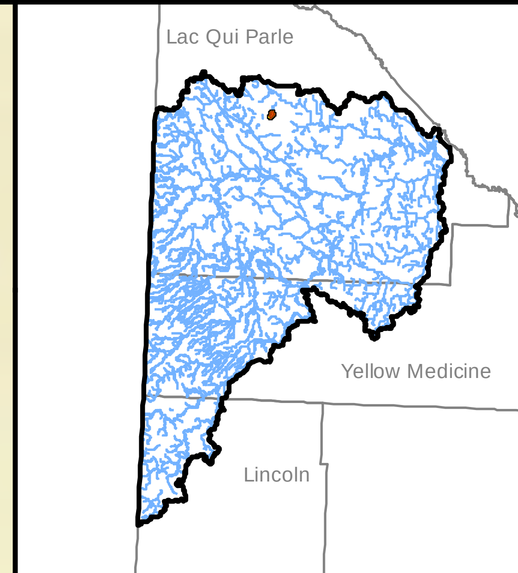
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Service Layer Credits: Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2013

Unnamed (Madison WMA)

37-0107-00





Aquatice Life:

Aquatic Recreation:
Insufficient Information

Limited Resource:

New Impairment:

Existing Impairment:

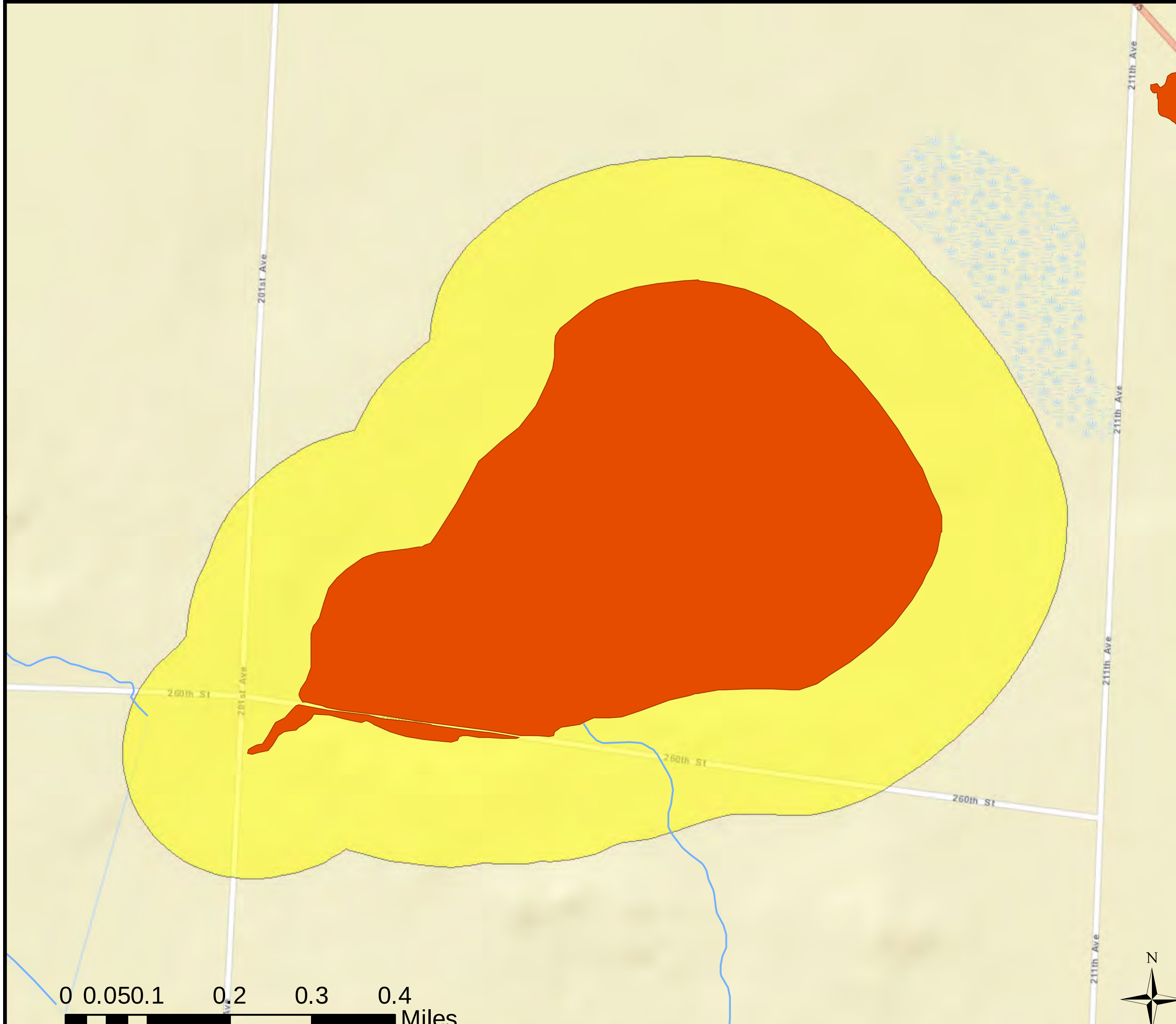
Assessed Lakes

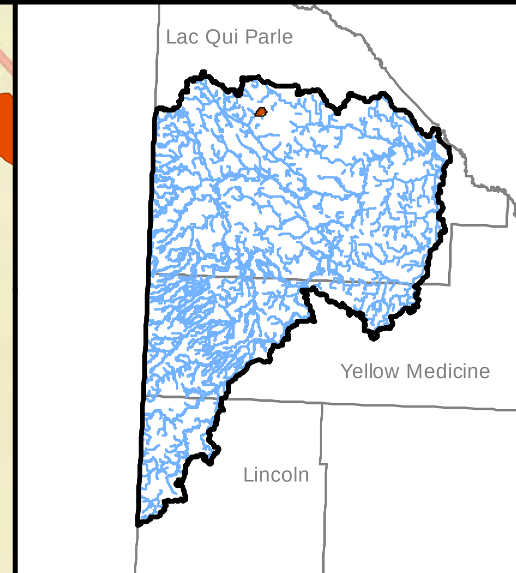
Assessed Streams

Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Unnamed (Arena)

37-0148-00





Aquatice Life:

Aquatic Recreation:
Insufficient Information

Limited Resource:

New Impairment:

Existing Impairment:

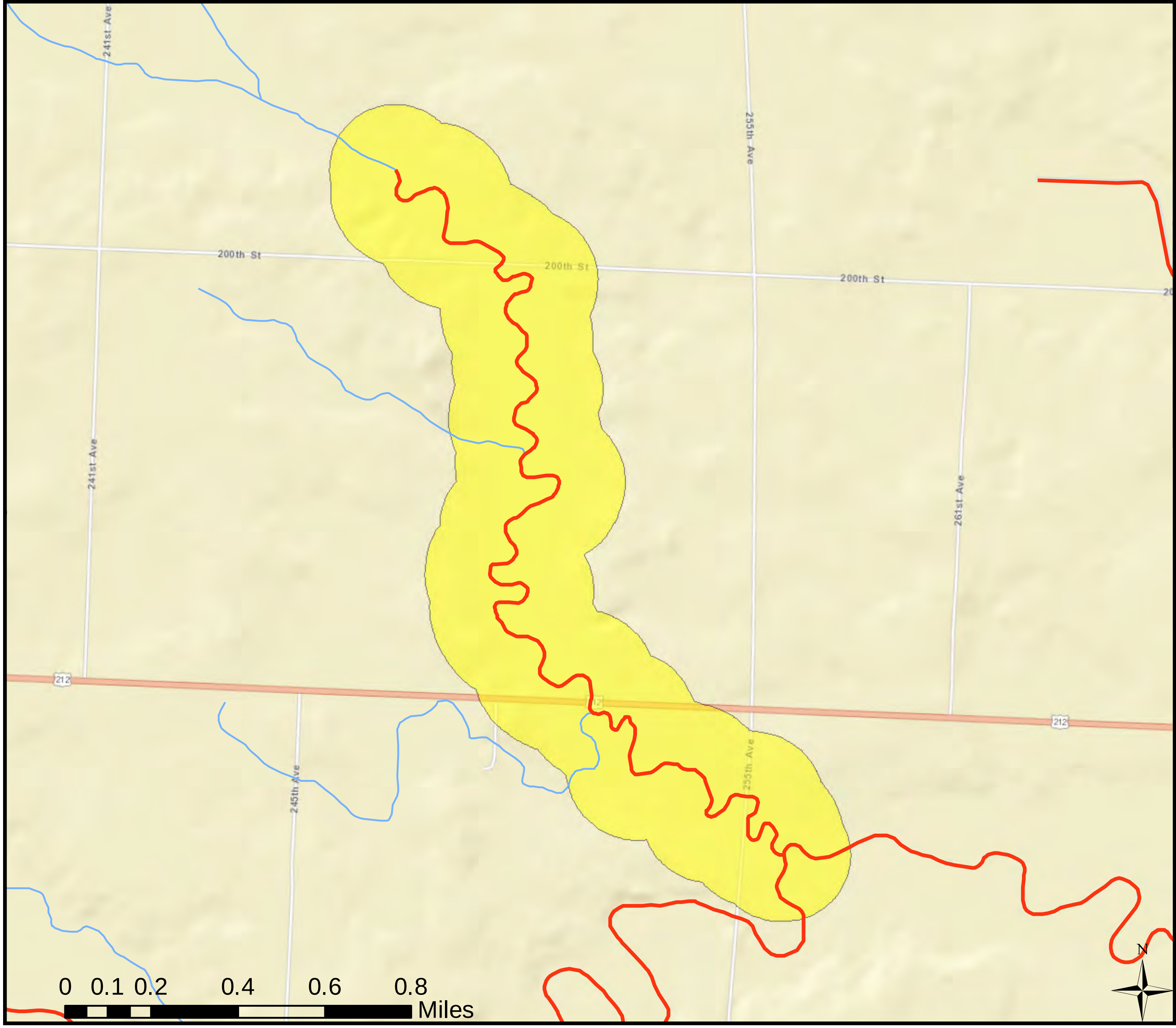
Assessed Lakes

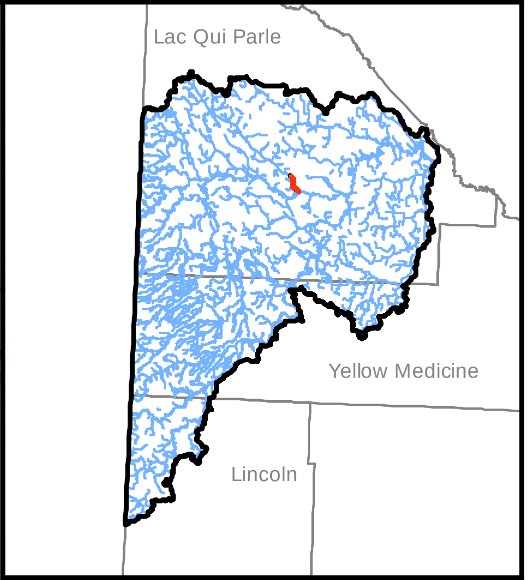
Assessed Streams

Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Unnamed creek

07020003-580 -96.1517, 44.9533 to W Br Lac Qui Parle R





Aquatice Life:
Not Supporting
Aquatic Recreation:
Not Supporting
Limited Resource:

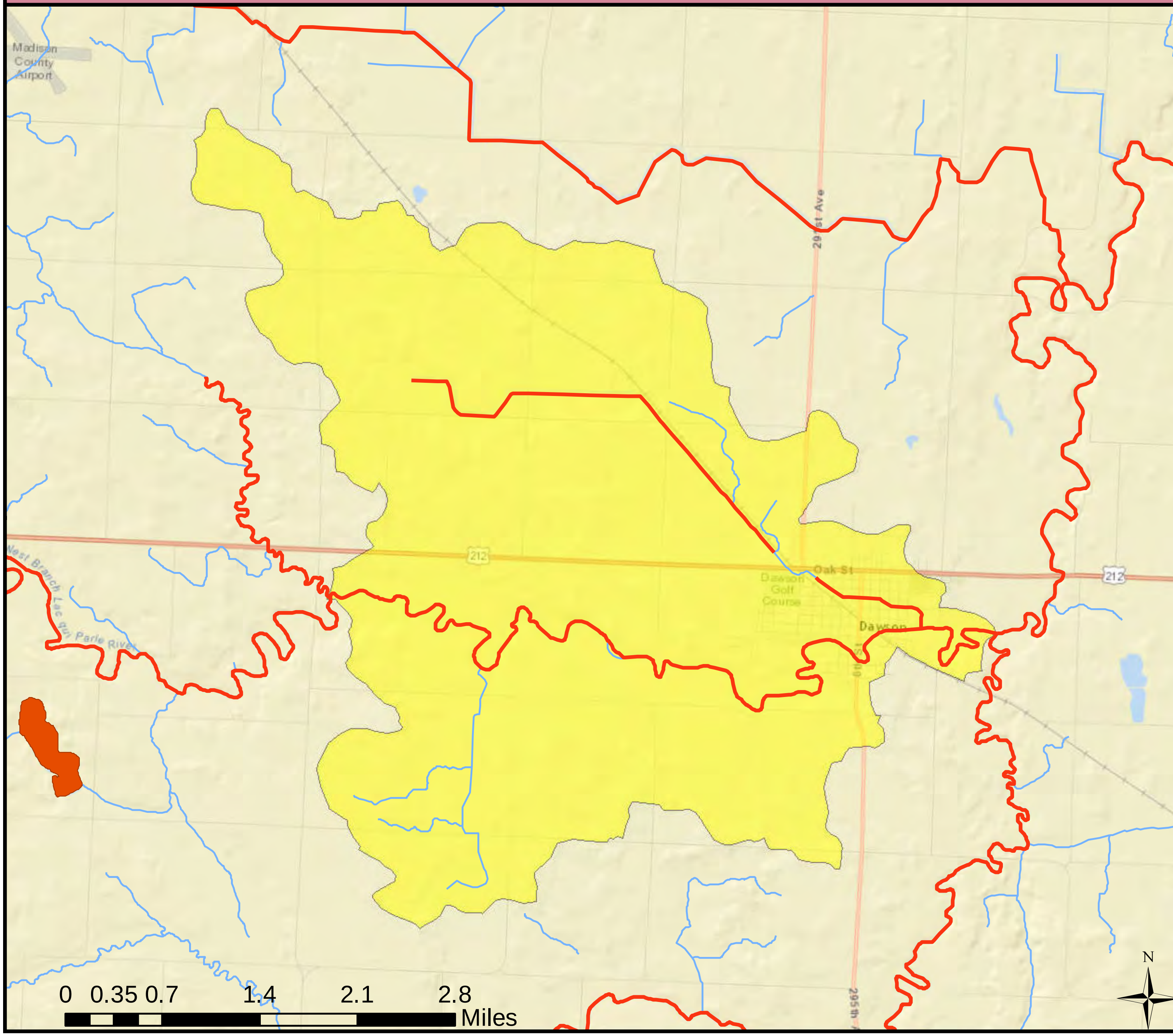
New Impairment:
Macroinvertebrate, E. coli, Fish
Existing Impairment:

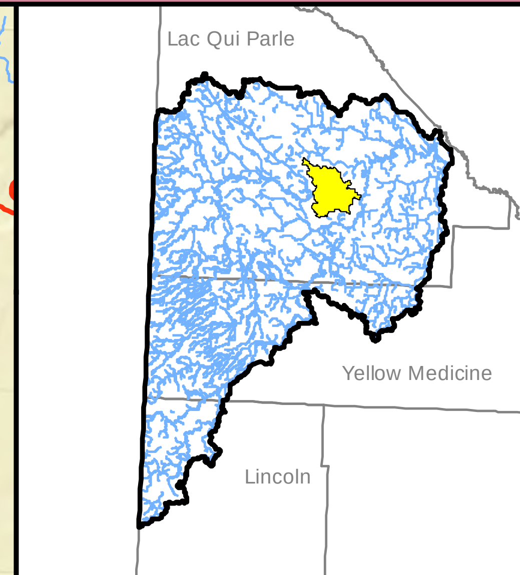
Assessed Lakes
Assessed Streams

Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

West Branch Lac Qui Parle River

070200030503





Aquatice Life:

Aquatic Recreation:

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

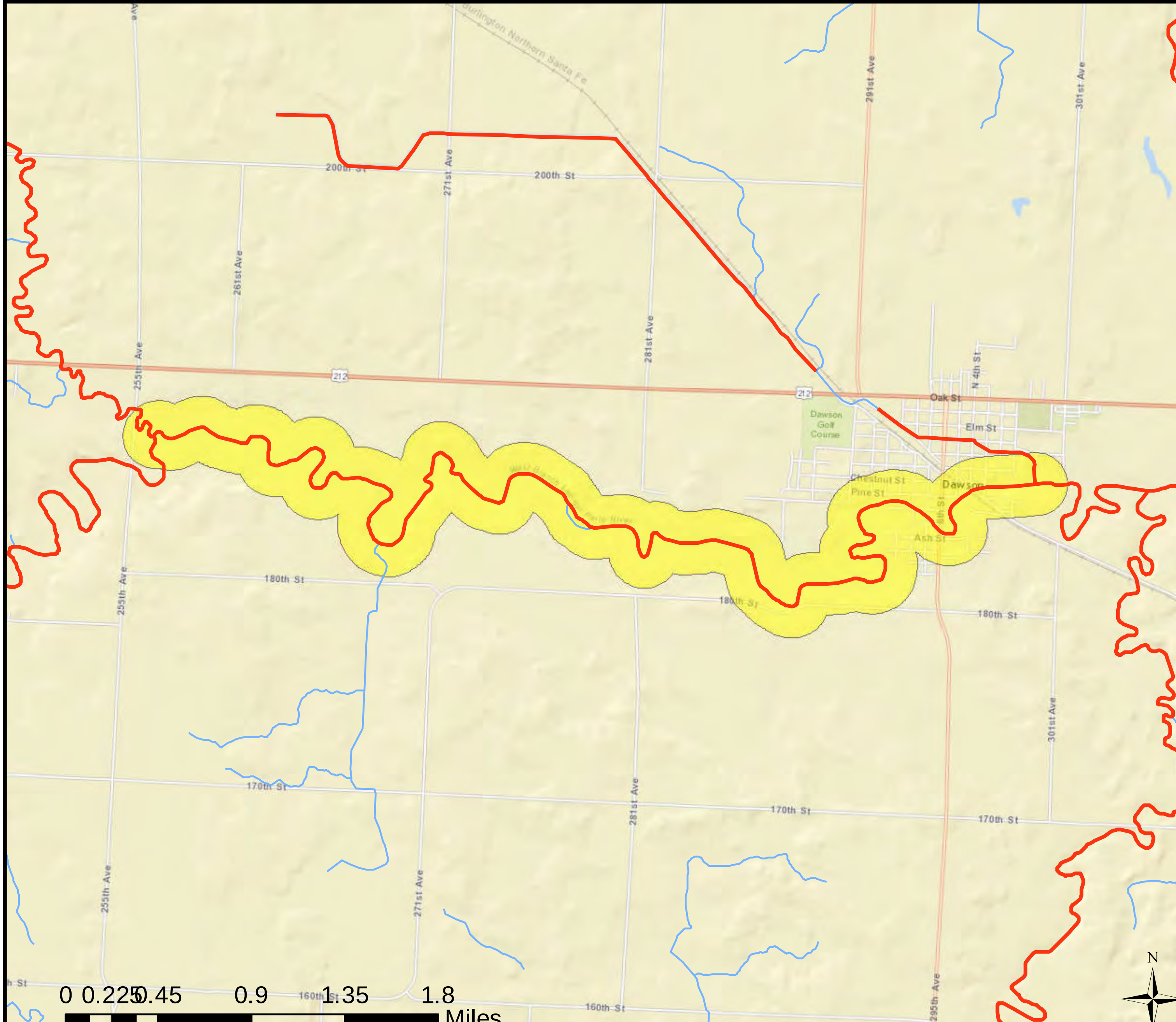
Assessed Streams

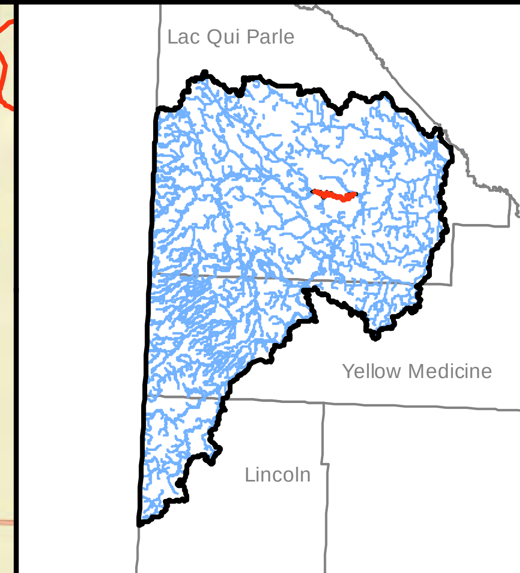
Minnesota Pollution Control Agency

1601 E Hwy 12, Suite 1
Willmar, MN 56201

Lac qui Parle River, West Branch

07020003-512 Unnamed cr to Unnamed ditch





Aquatice Life:
Insufficient Information

Aquatic Recreation:
Not Supporting

Limited Resource:

New Impairment:

Existing Impairment:
Mercury, Fecal Coliform

Assessed Lakes

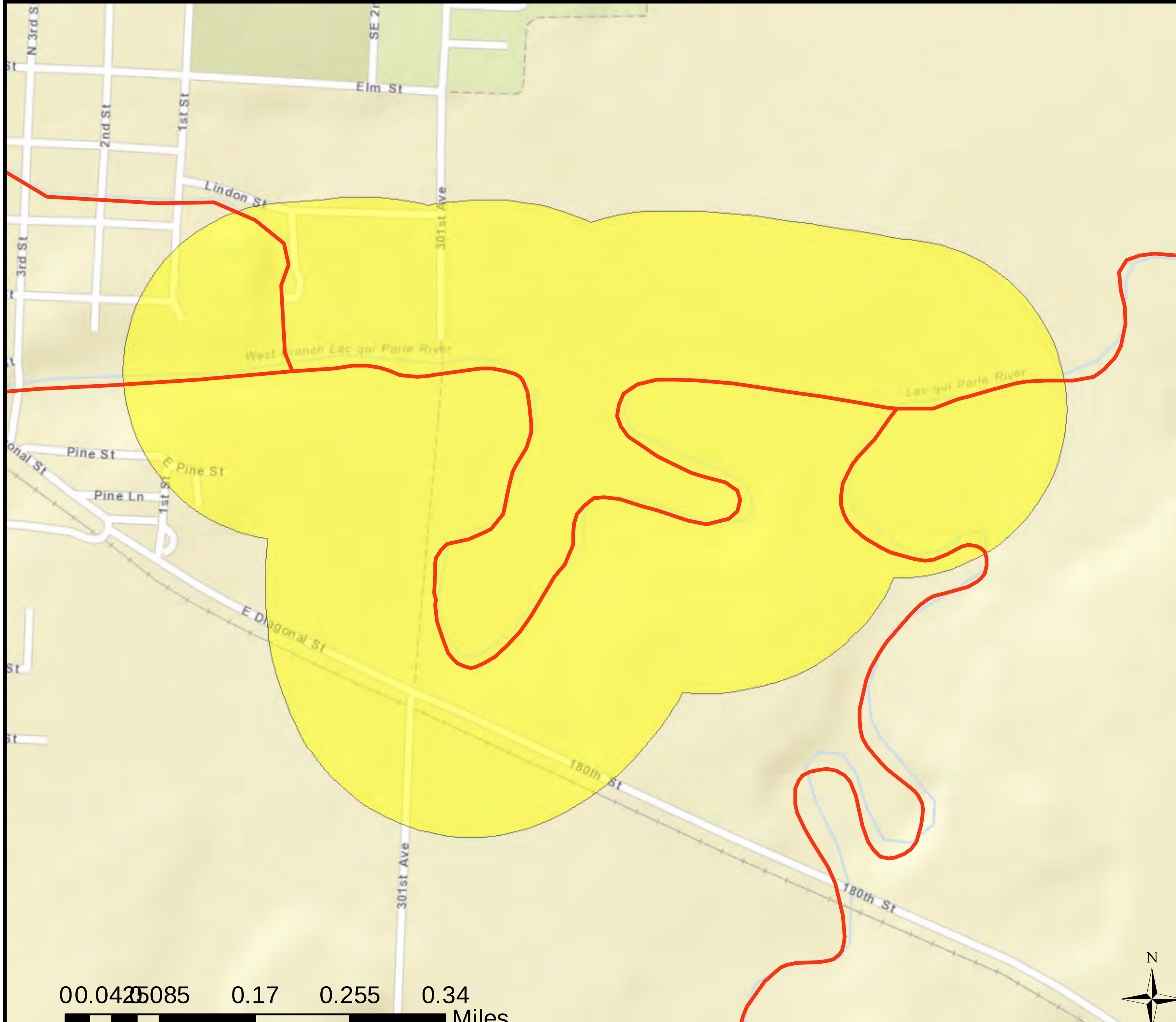
Assessed Streams

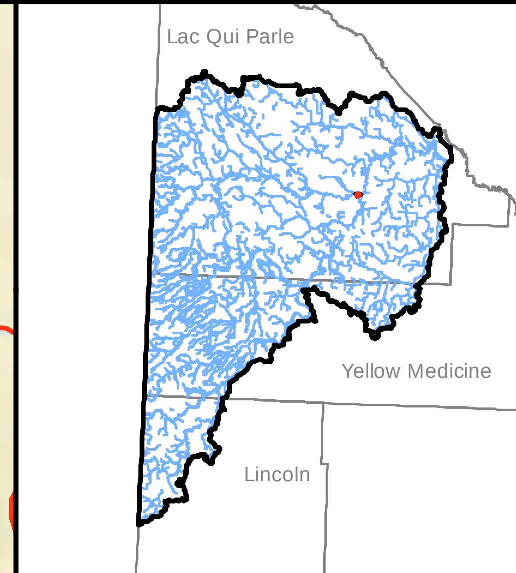
Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Lac qui Parle River, West Branch

07020003-513

Unnamed ditch to Lac Qui Parle R





Aquatice Life:
Not Supporting

Aquatic Recreation:
Not Supporting

Limited Resource:

New Impairment:
Macroinvertebrate, E. coli

Existing Impairment:

Assessed Lakes

Assessed Streams

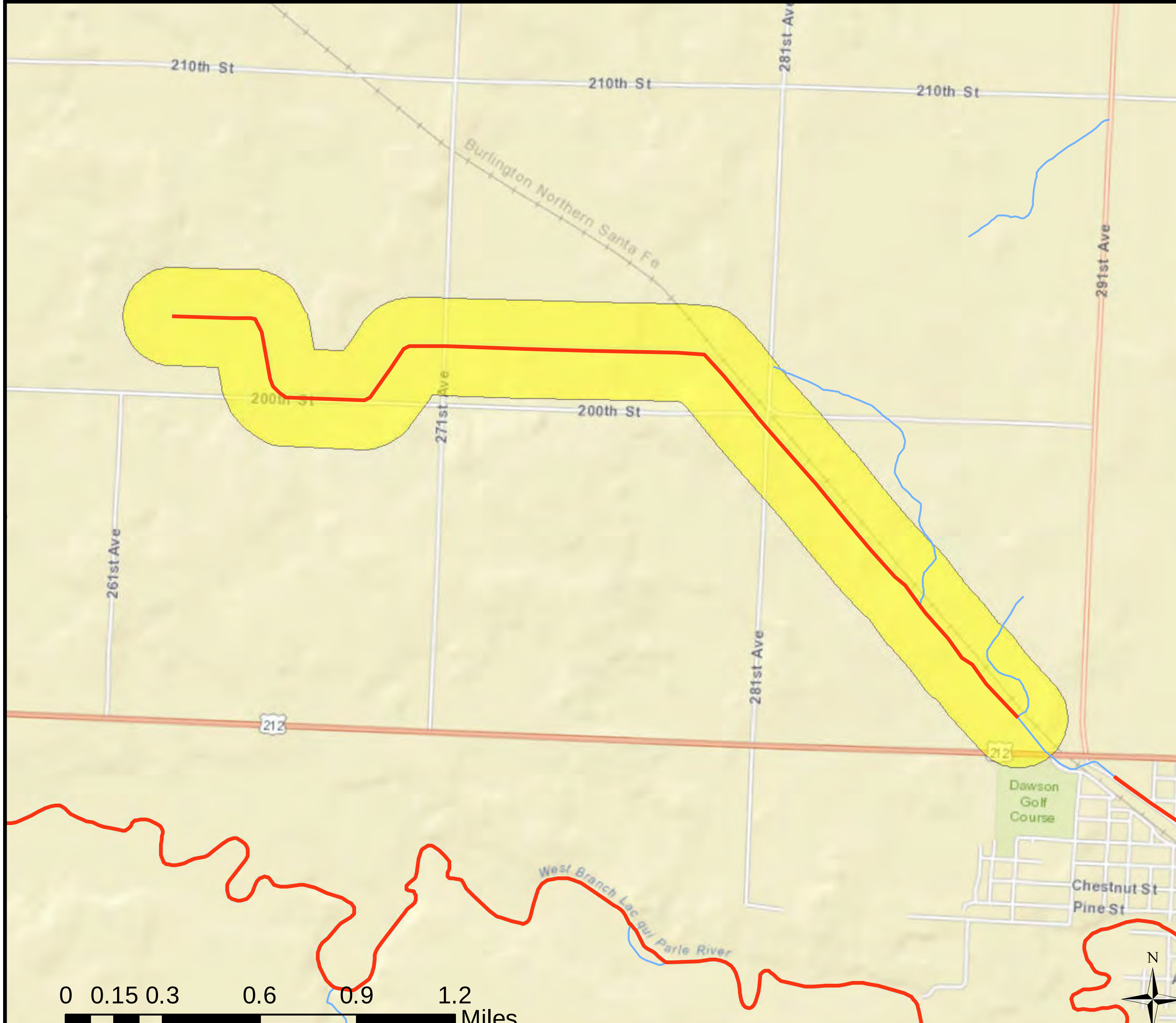
Minnesota Pollution Control Agency

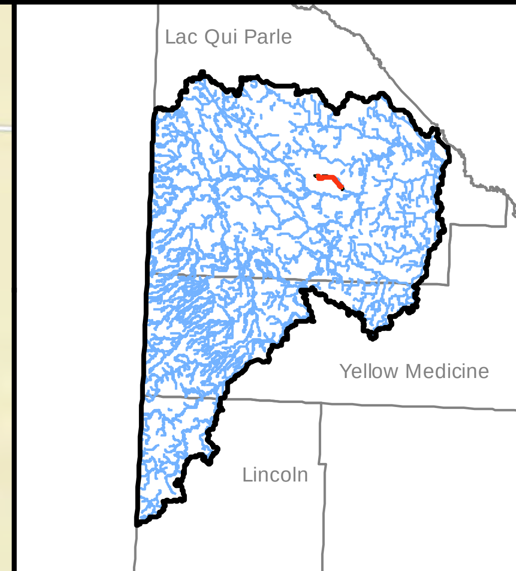
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Judicial Ditch 4

07020003-555

Headwaters to Unnamed cr





Aquatice Life:

Aquatic Recreation:

Limited Resource:
Insufficient Information

New Impairment:

Existing Impairment:

Assessed Lakes

Assessed Streams

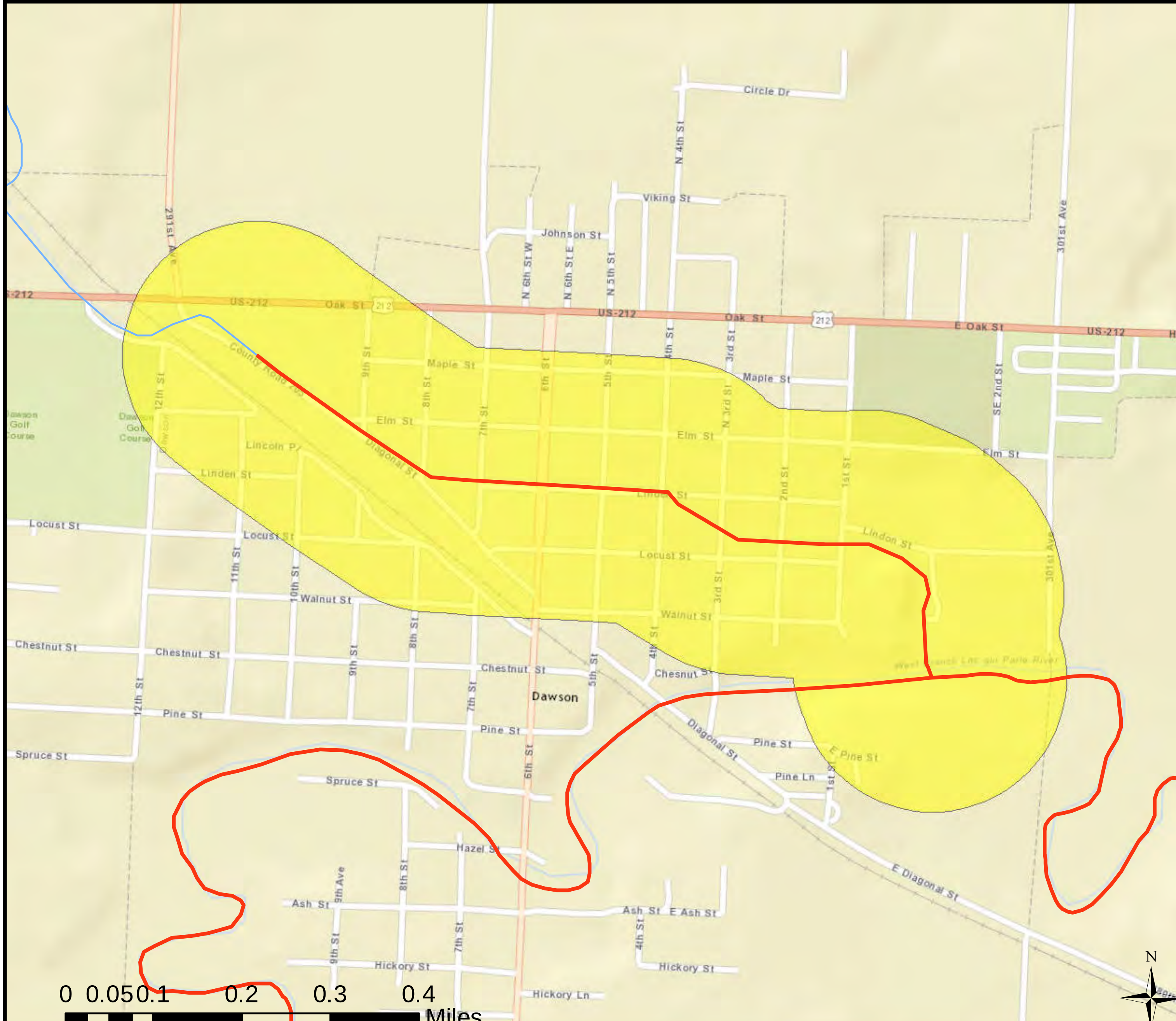
Minnesota Pollution Control Agency

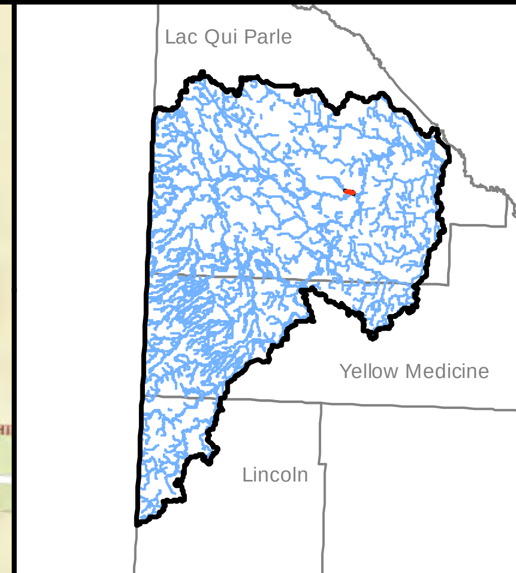
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Judicial Ditch 4

07020003-563

Underground portion





Aquatice Life:
Not Assessed

Aquatic Recreation:
Not Assessed

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

Assessed Streams

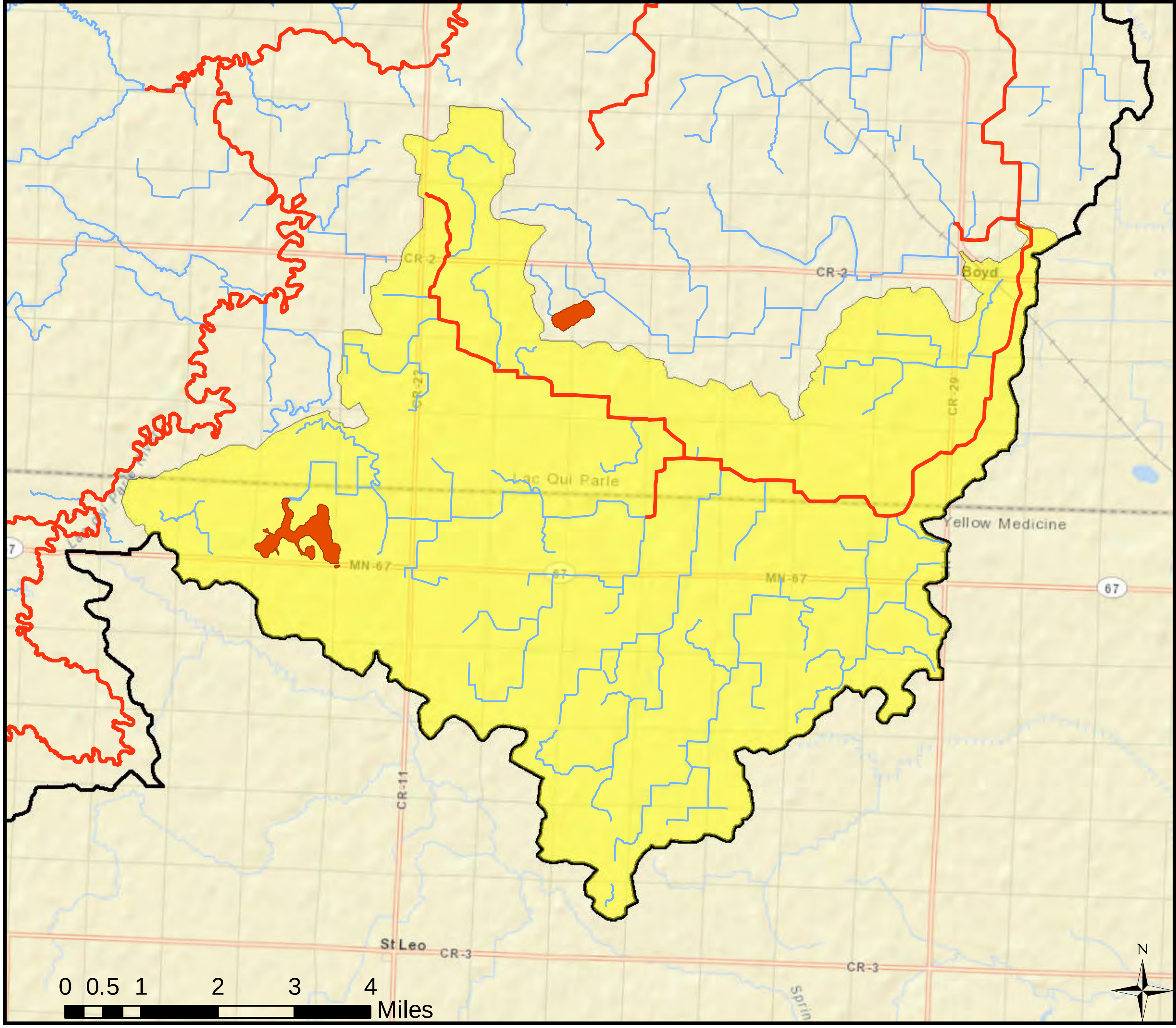
Minnesota Pollution Control Agency

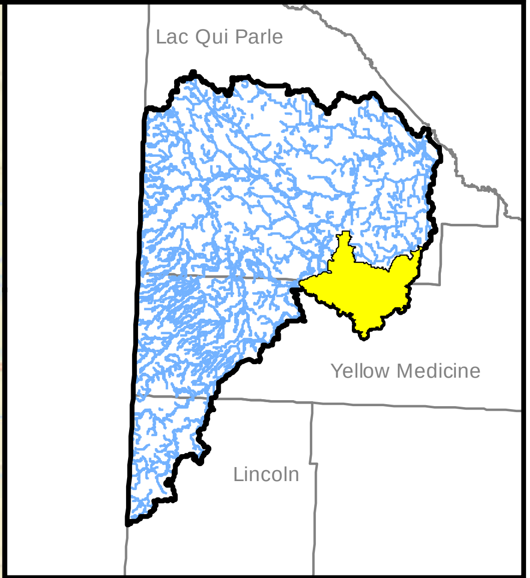
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Service Layer Credits: Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2013

Headwaters Tenmile Creek

070200030601





Aquatice Life:

Aquatic Recreation:

Limited Resource:

New Impairment:

Existing Impairment:

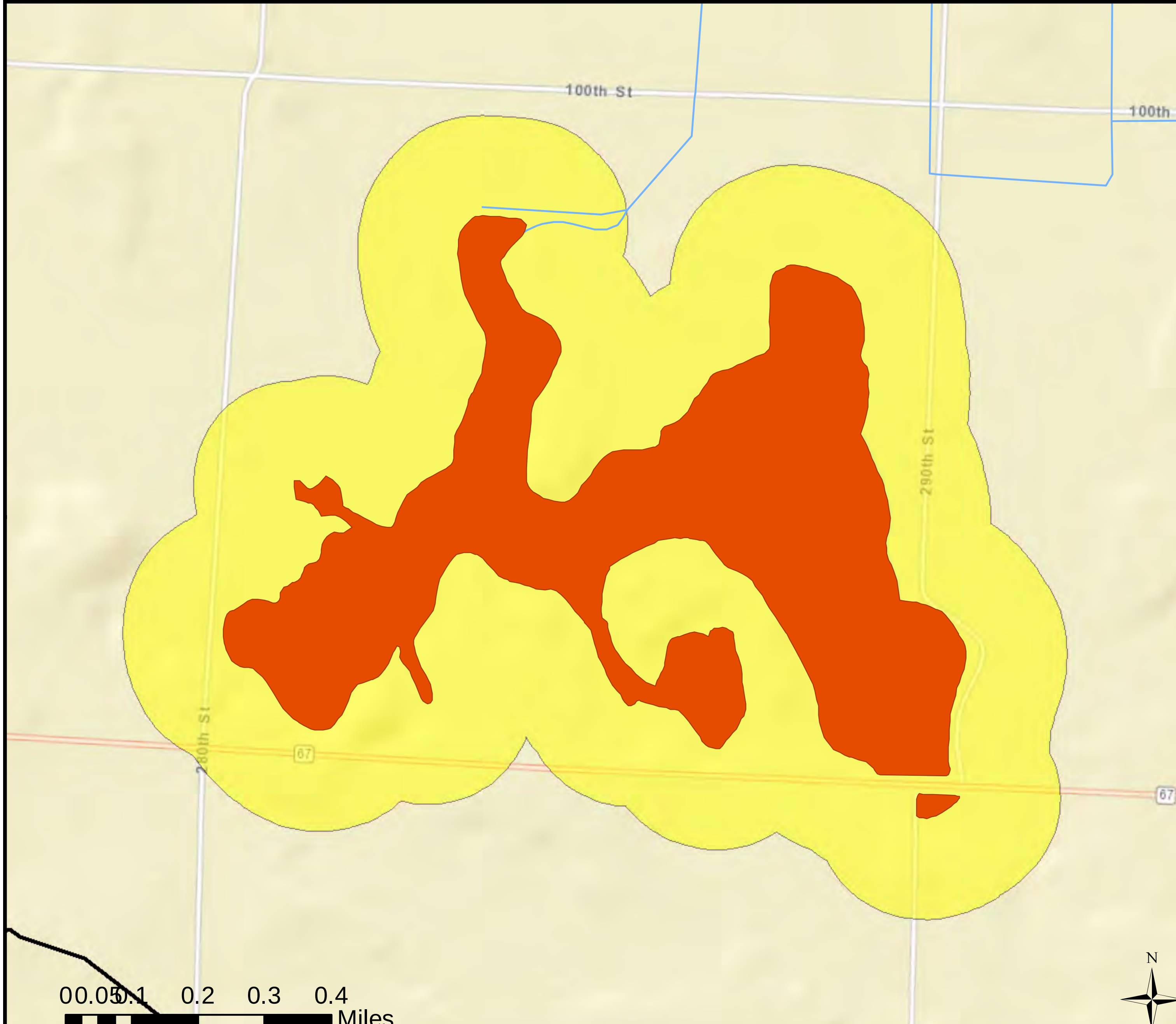
Assessed Lakes

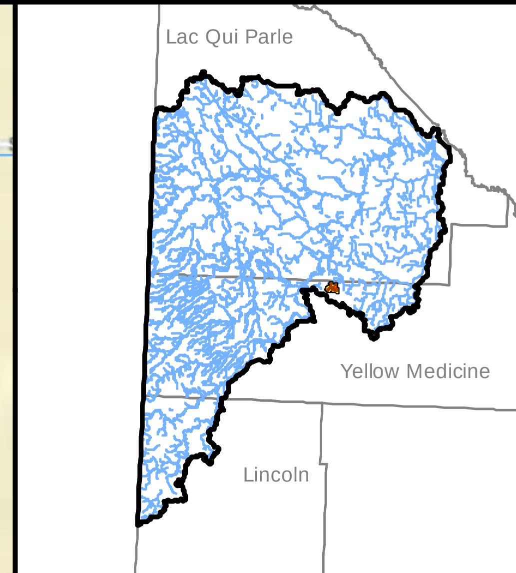
Assessed Streams

Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Miller

87-0102-00





Aquatice Life:

Aquatic Recreation:
Insufficient Information

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

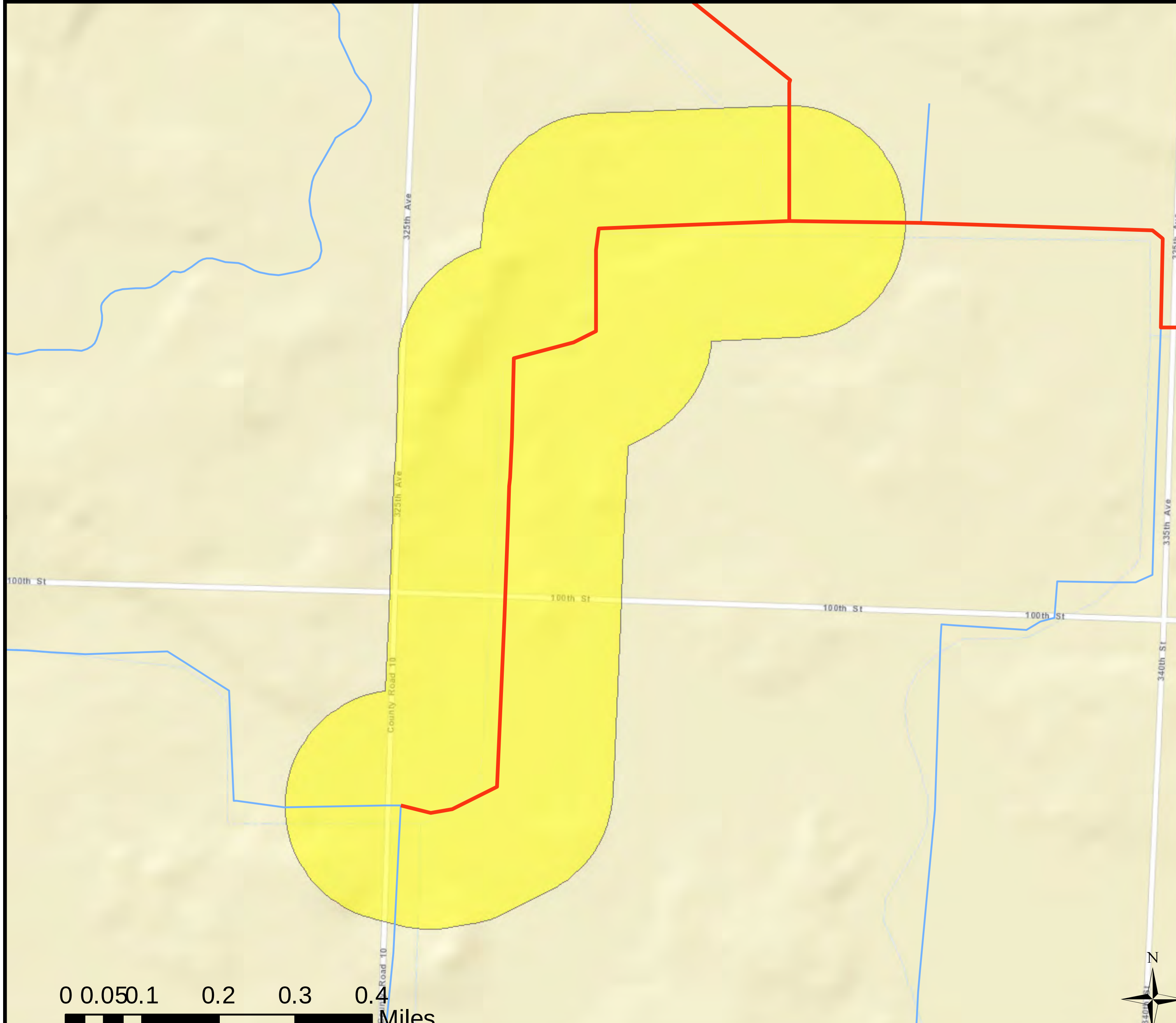
Assessed Streams

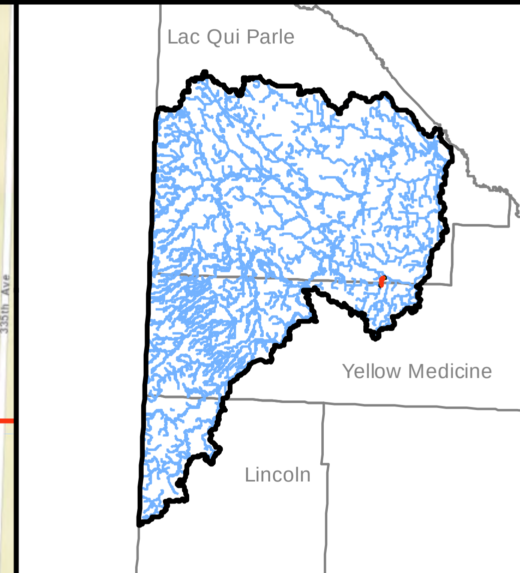
Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Unnamed ditch

07020003-570

Unnamed ditch to Tenmile Cr





Aquatice Life:
Not Supporting

Aquatic Recreation:

Limited Resource:

New Impairment:
Macroinvertebrate

Existing Impairment:

Assessed Lakes

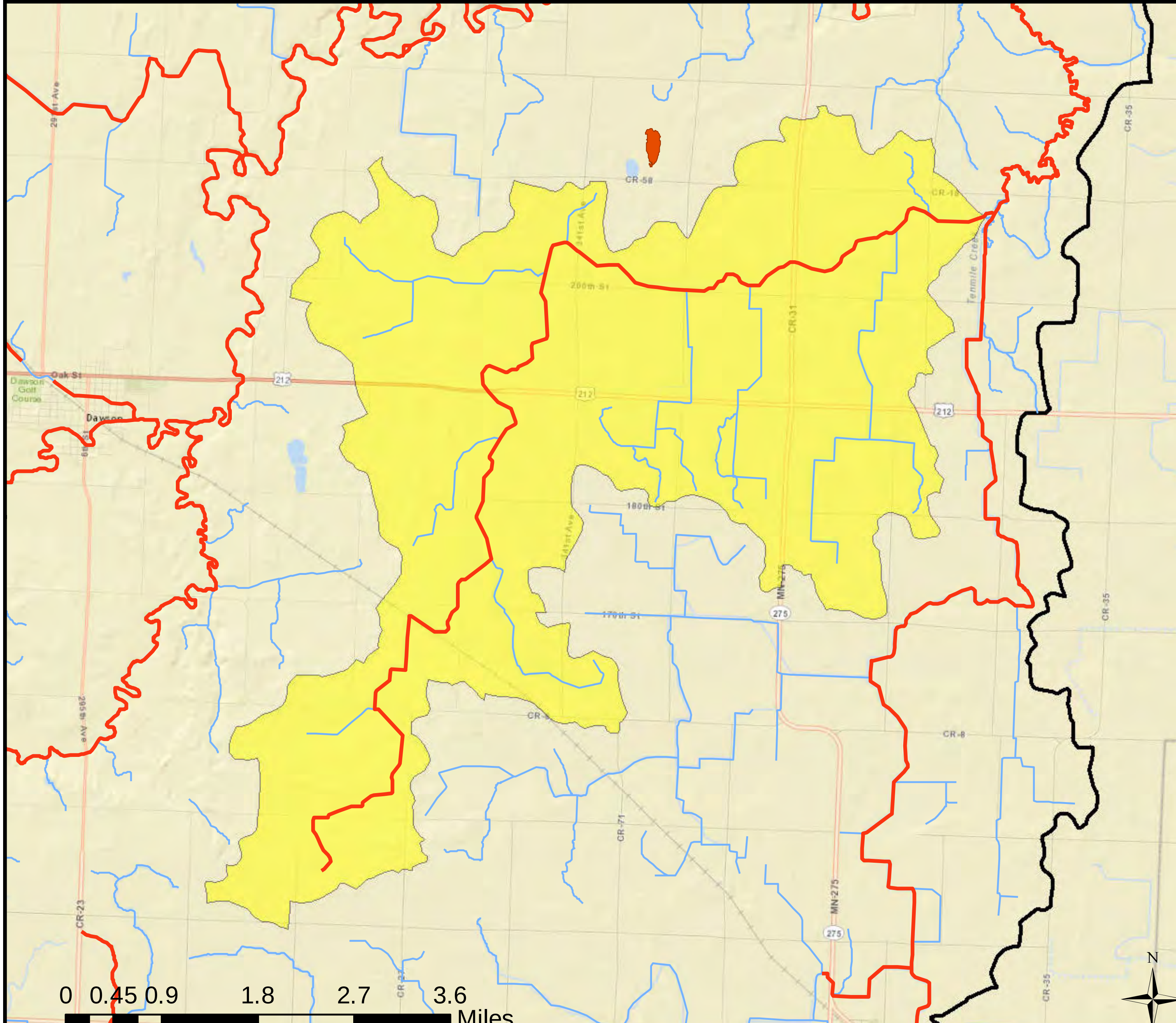
Assessed Streams

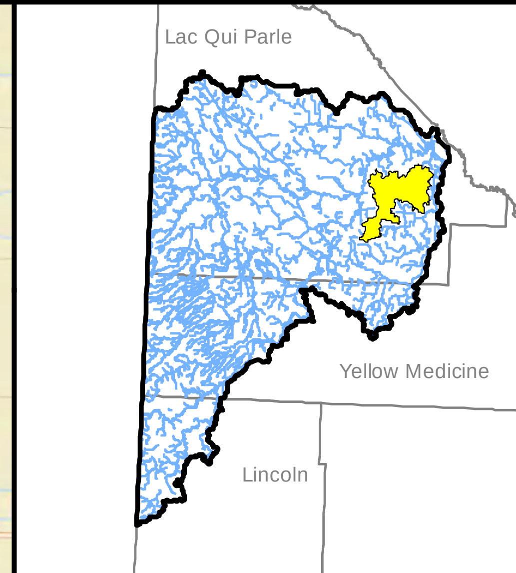
Minnesota Pollution Control Agency

1601 E Hwy 12, Suite 1
Willmar, MN 56201

County Ditch No 34

070200030602





Aquatice Life:

Aquatic Recreation:

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

Assessed Streams

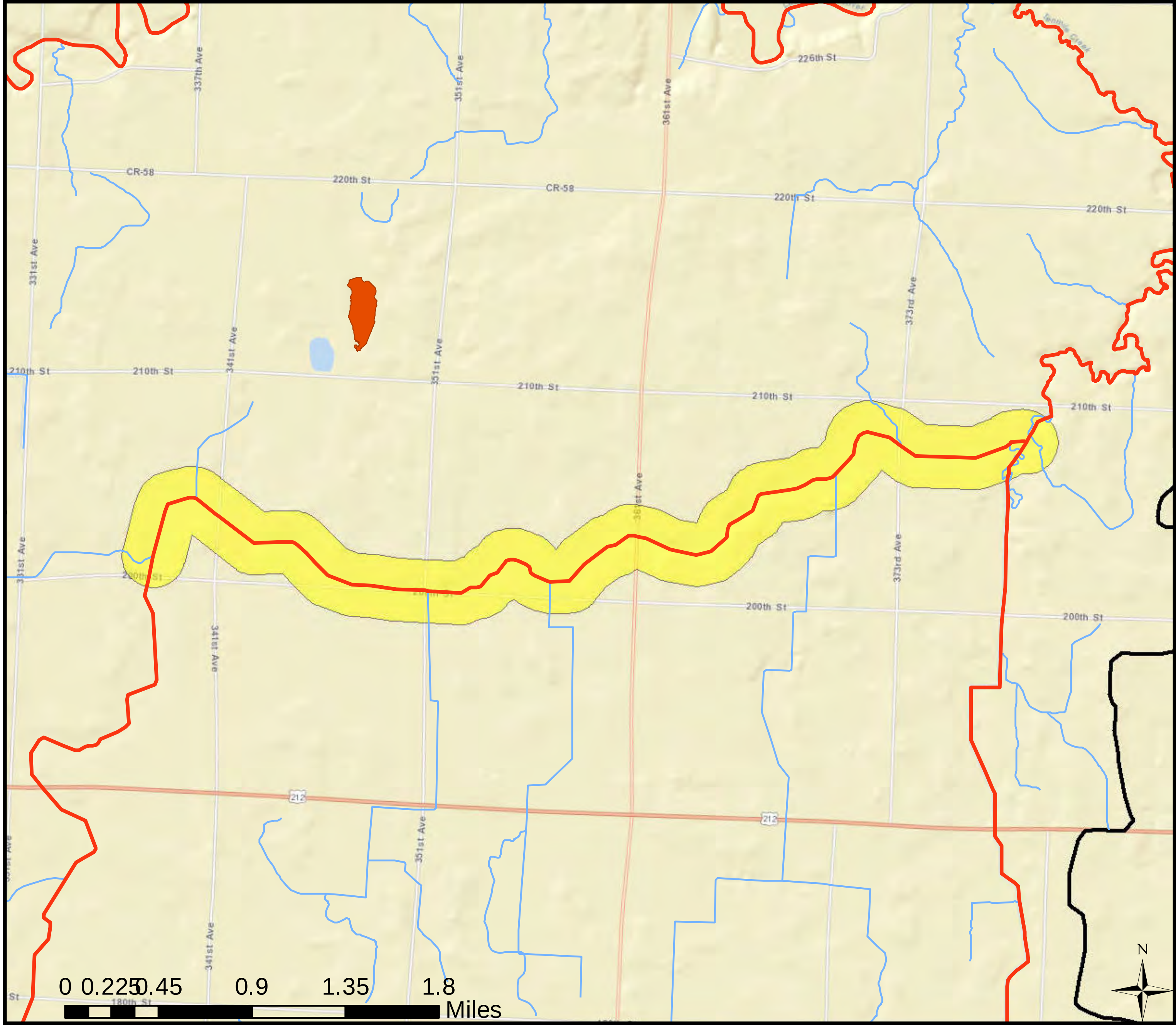
Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

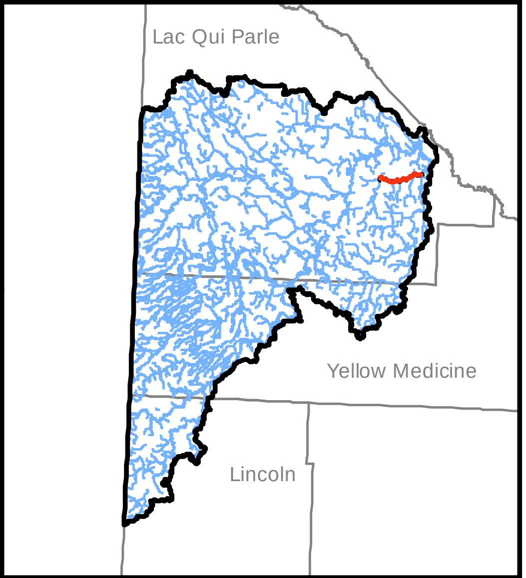
Service Layer Credits: Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2013

County Ditch 34

07020003-526

Unnamed ditch to Tenmile Cr





Aquatice Life:
Not Supporting

Aquatic Recreation:

Limited Resource:

New Impairment:
Macroinvertebrate

Existing Impairment:

Assessed Lakes

Assessed Streams

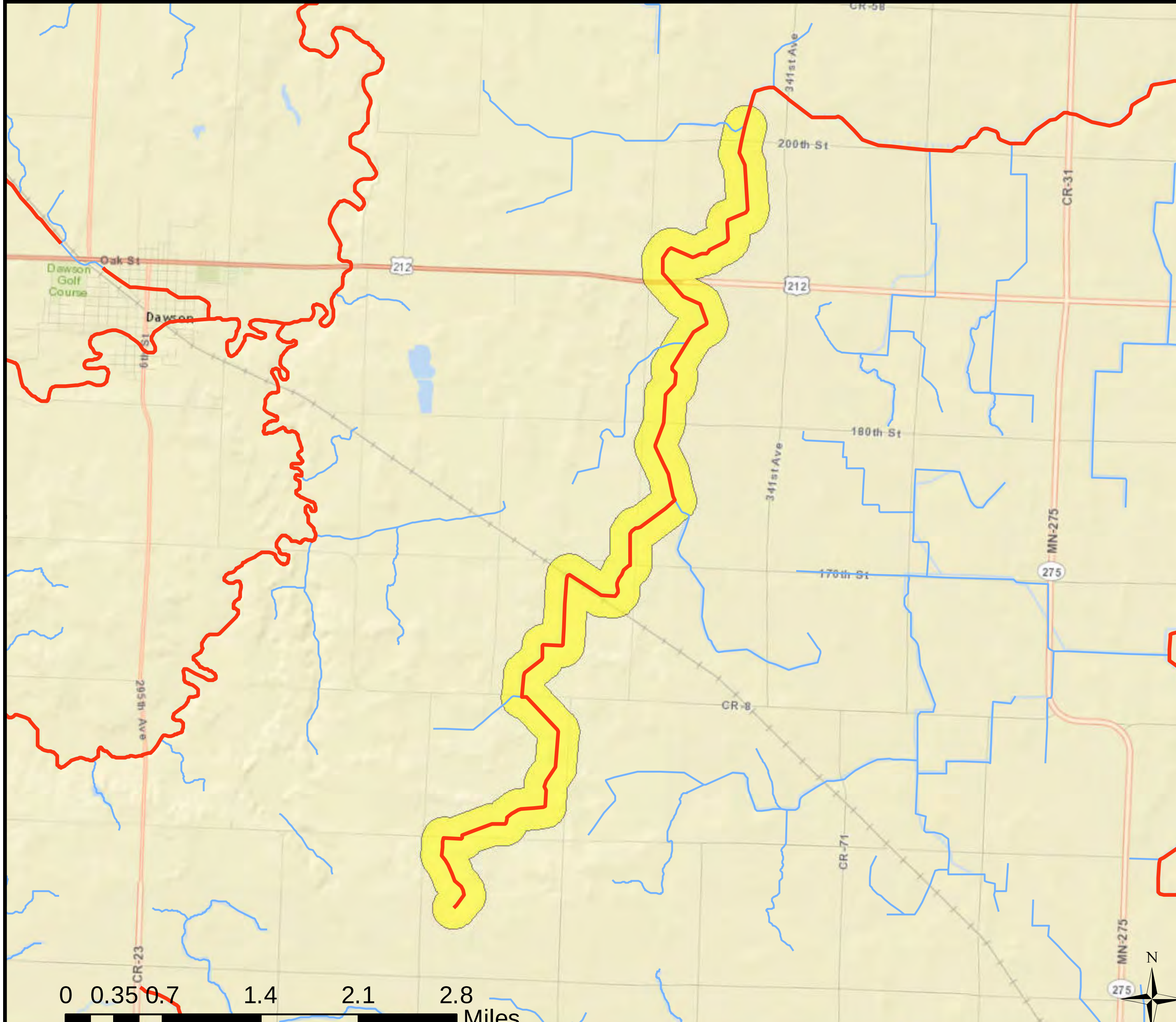
Minnesota Pollution Control Agency

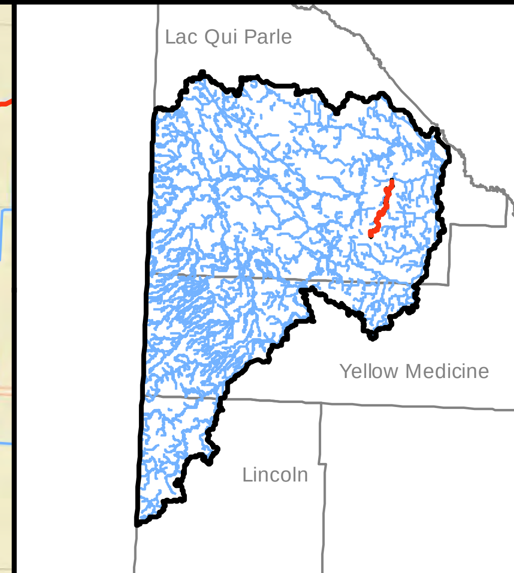
1601 E Hwy 12, Suite 1
Willmar, MN 56201

County Ditch 34

07020003-532

Headwaters to Unnamed ditch





Aquatice Life:
Insufficient Information

Aquatic Recreation:

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

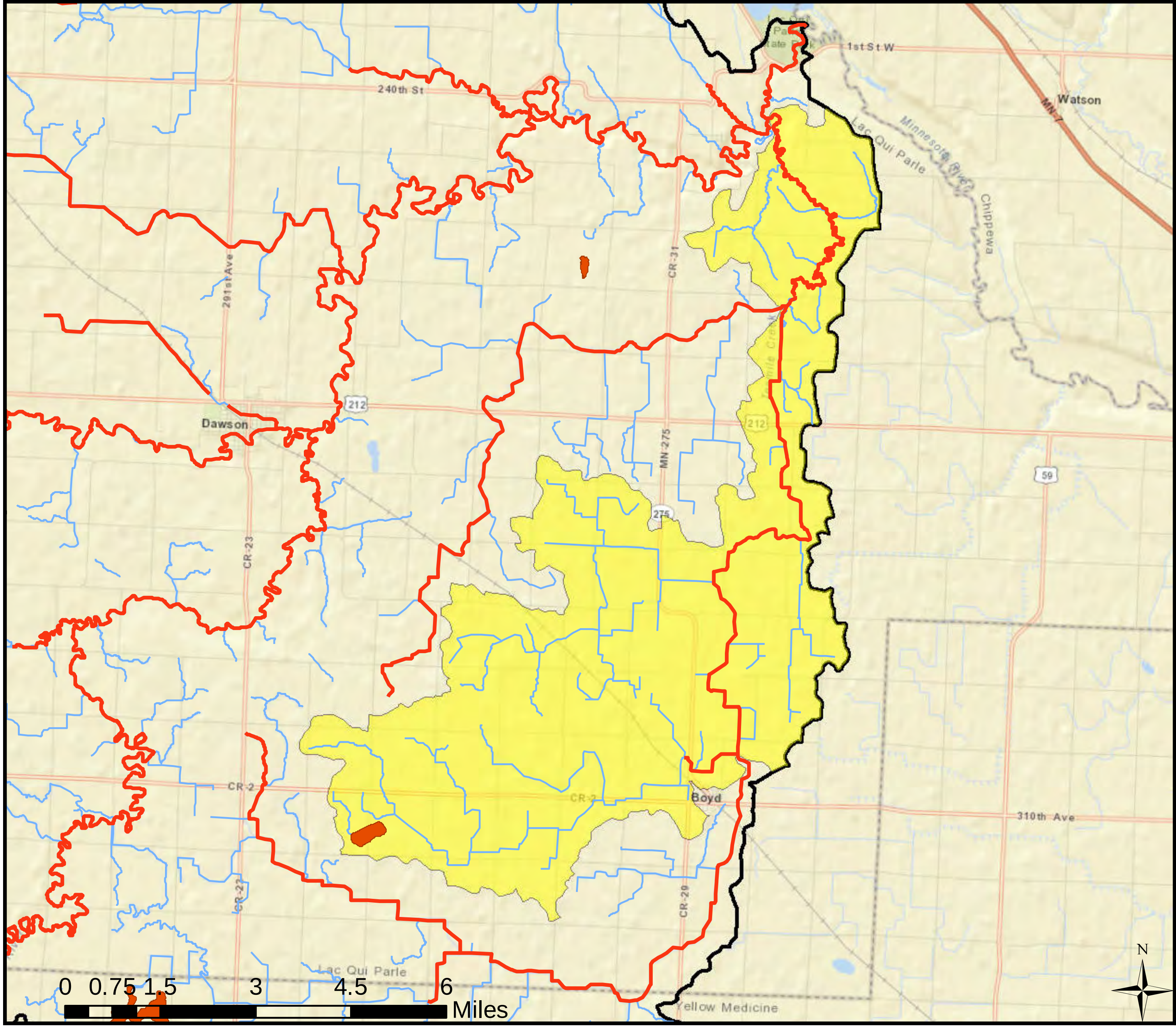
Assessed Streams

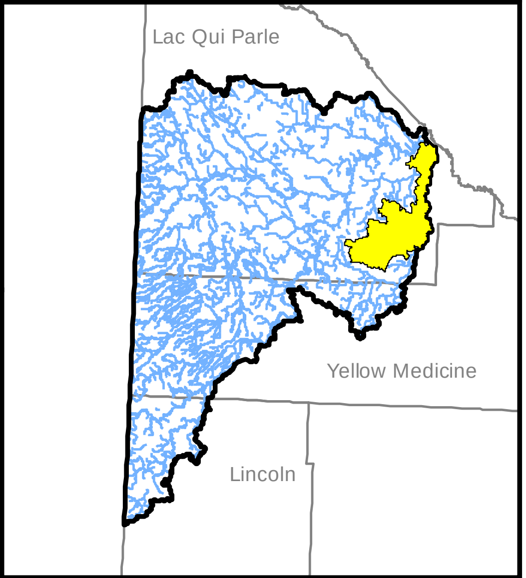
Minnesota Pollution Control Agency

1601 E Hwy 12, Suite 1
Willmar, MN 56201

Tenmile Creek

070200030603





Aquatice Life:

Aquatic Recreation:

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

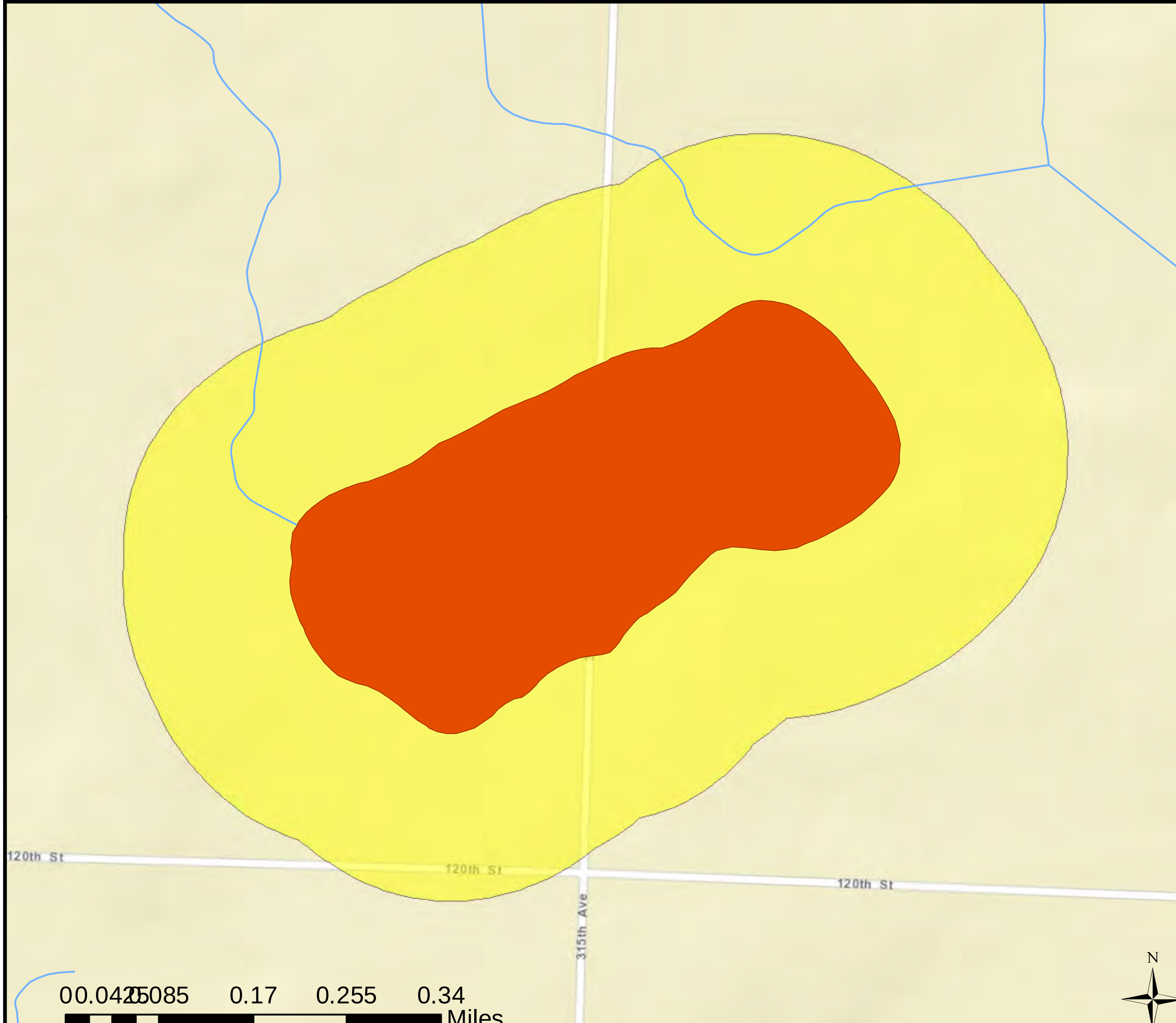
Assessed Streams

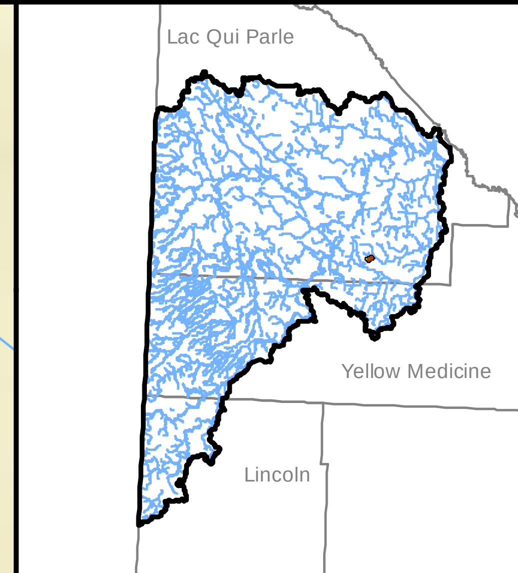
Minnesota Pollution Control Agency

1601 E Hwy 12, Suite 1
Willmar, MN 56201

Unnamed (Wild Wings WMA)

37-0056-00





Aquatice Life:

Aquatic Recreation:
Insufficient Information

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

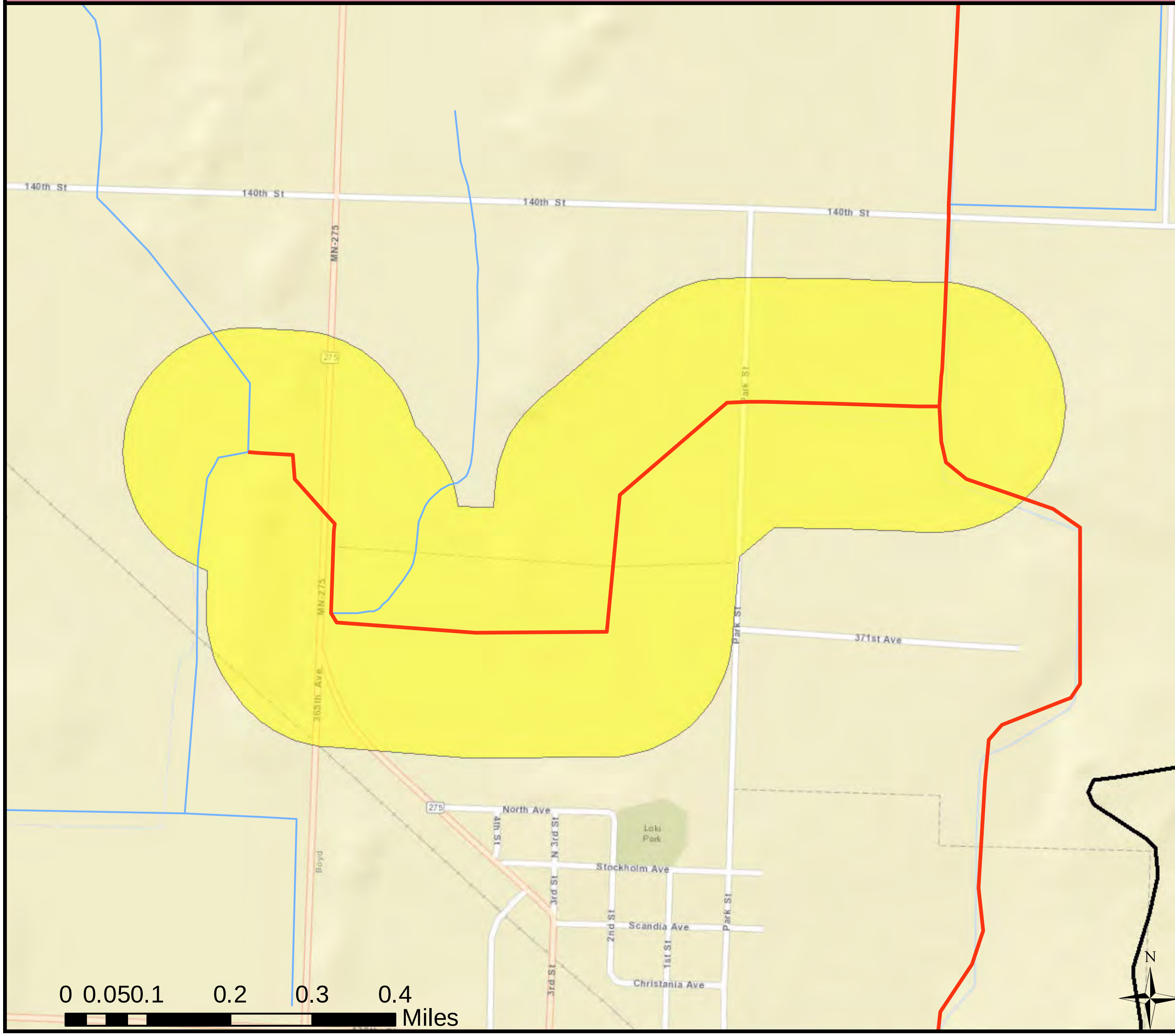
Assessed Streams

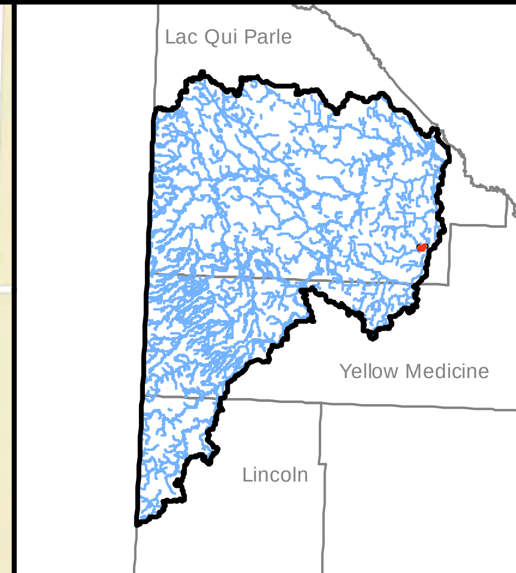
Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Unnamed ditch

07020003-571

Unnamed ditch to Tenmeil Cr





Aquatice Life:
Not Supporting

Aquatic Recreation:

Limited Resource:

New Impairment:
Macroinvertebrate

Existing Impairment:

Assessed Lakes

Assessed Streams

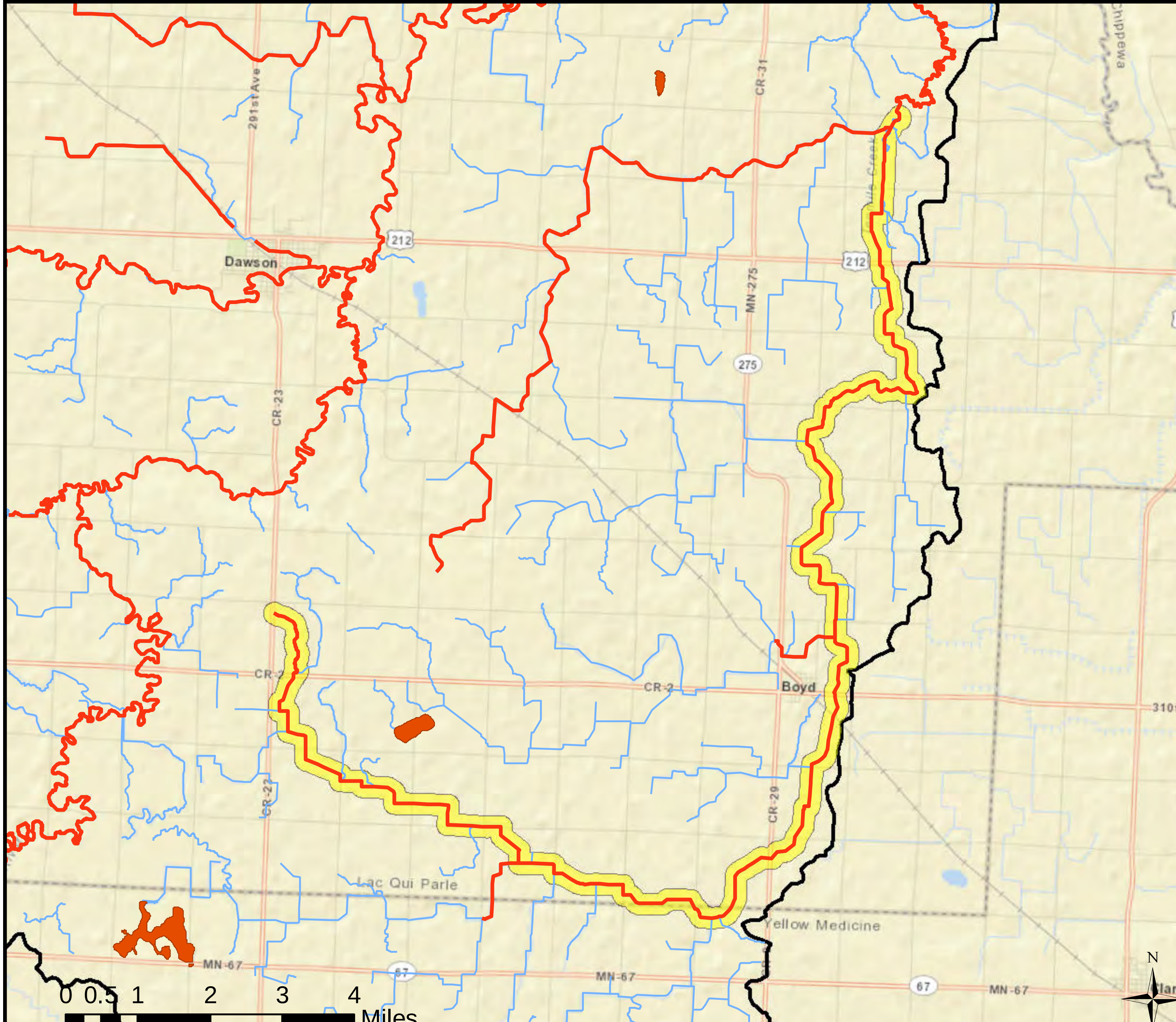
Minnesota Pollution Control Agency

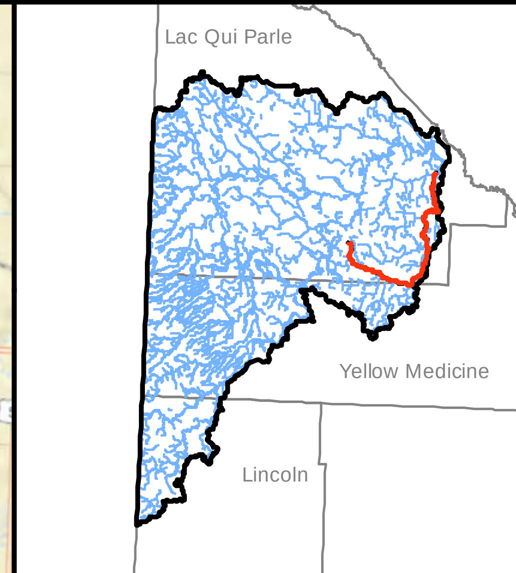
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Tenmile Creek

07020003-577

Headwaters to CSAH 18





Aquatice Life:
Not Supporting

Aquatic Recreation:
Not Supporting

Limited Resource:

New Impairment:
Macroinvertebrate

Existing Impairment:
Fecal Coliform, Fish

Assessed Lakes

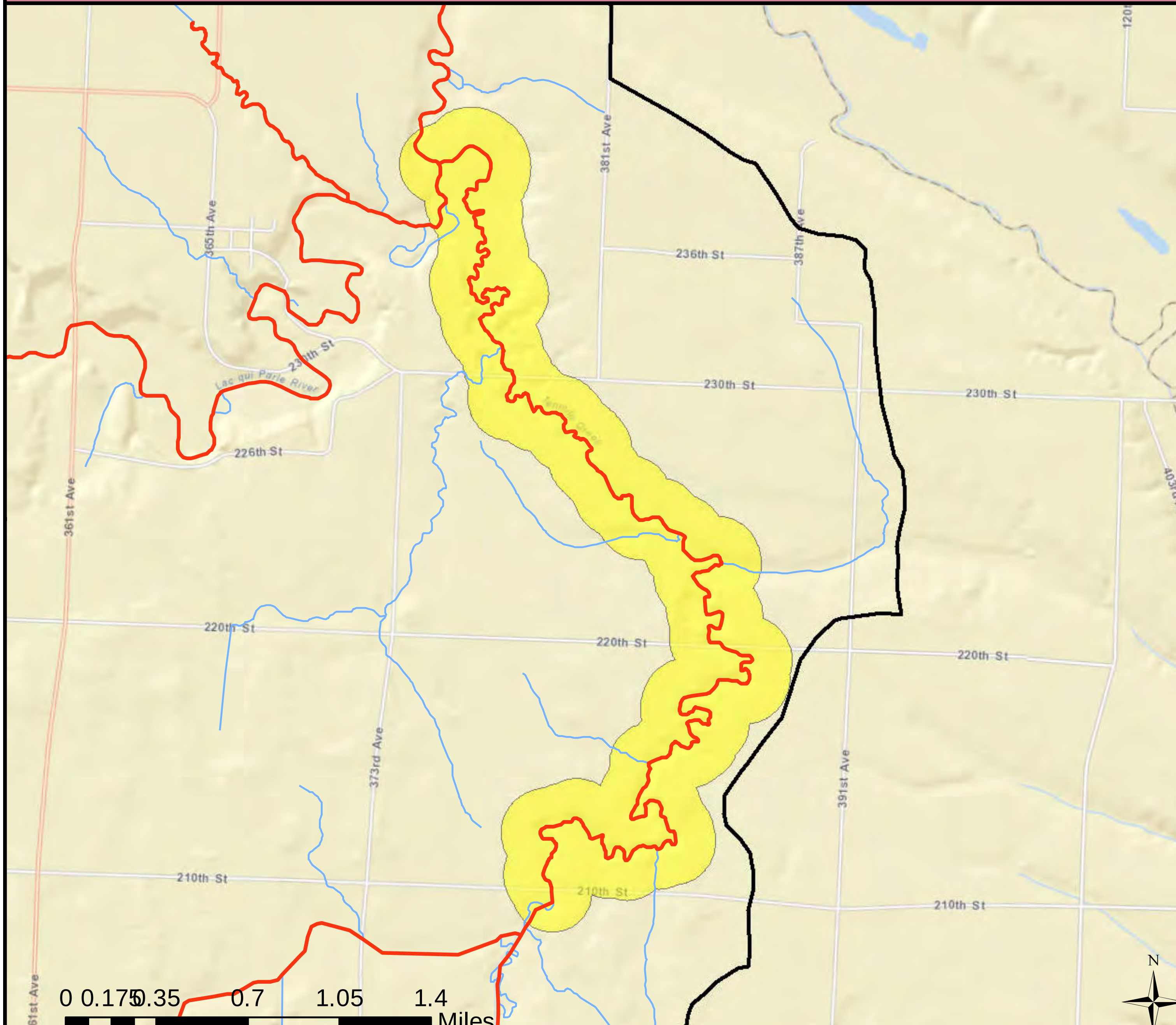
Assessed Streams

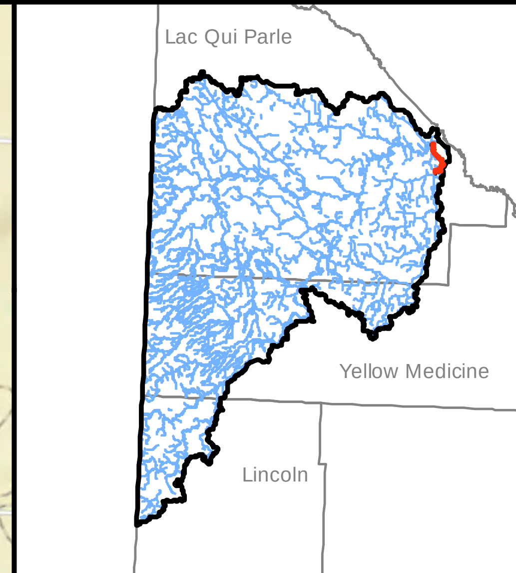
Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Service Layer Credits: Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2013

Tenmile Creek

07020003-578 CSAH 18 to Lac Qui Parle R





Aquatice Life:
Not Supporting

Aquatic Recreation:
Not Supporting

Limited Resource:

New Impairment:
Macroinvertebrate, Fish

Existing Impairment:
Fecal Coliform

Assessed Lakes

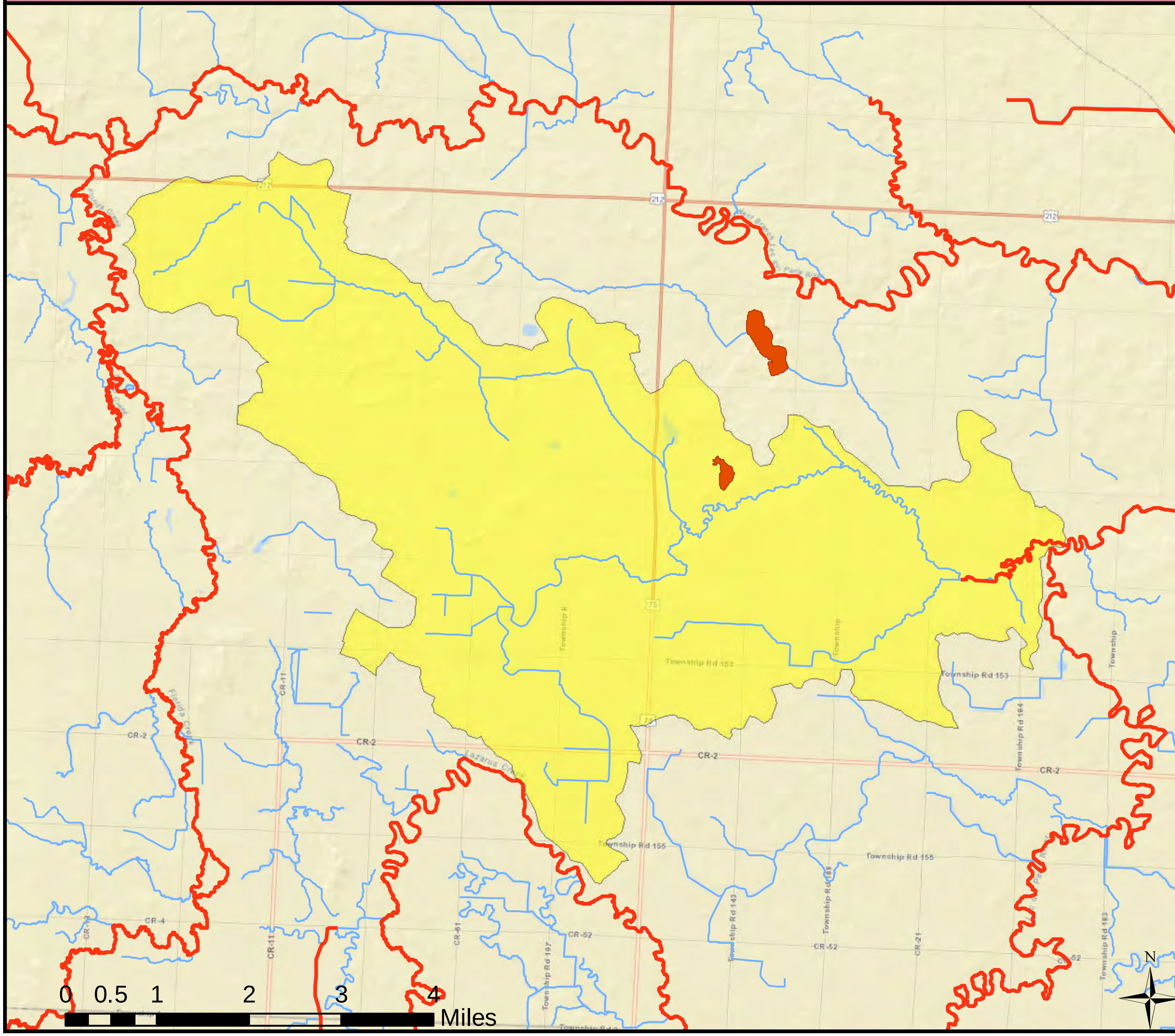
Assessed Streams

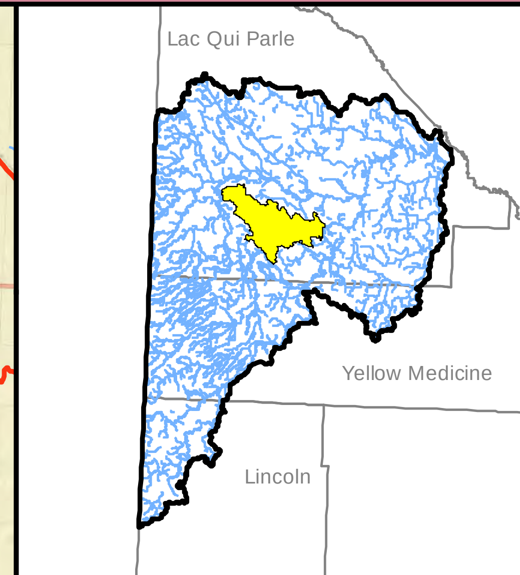
Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Service Layer Credits: Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2013

County Ditch No 29A

070200030701





Aquatice Life:

Aquatic Recreation:

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

Assessed Streams

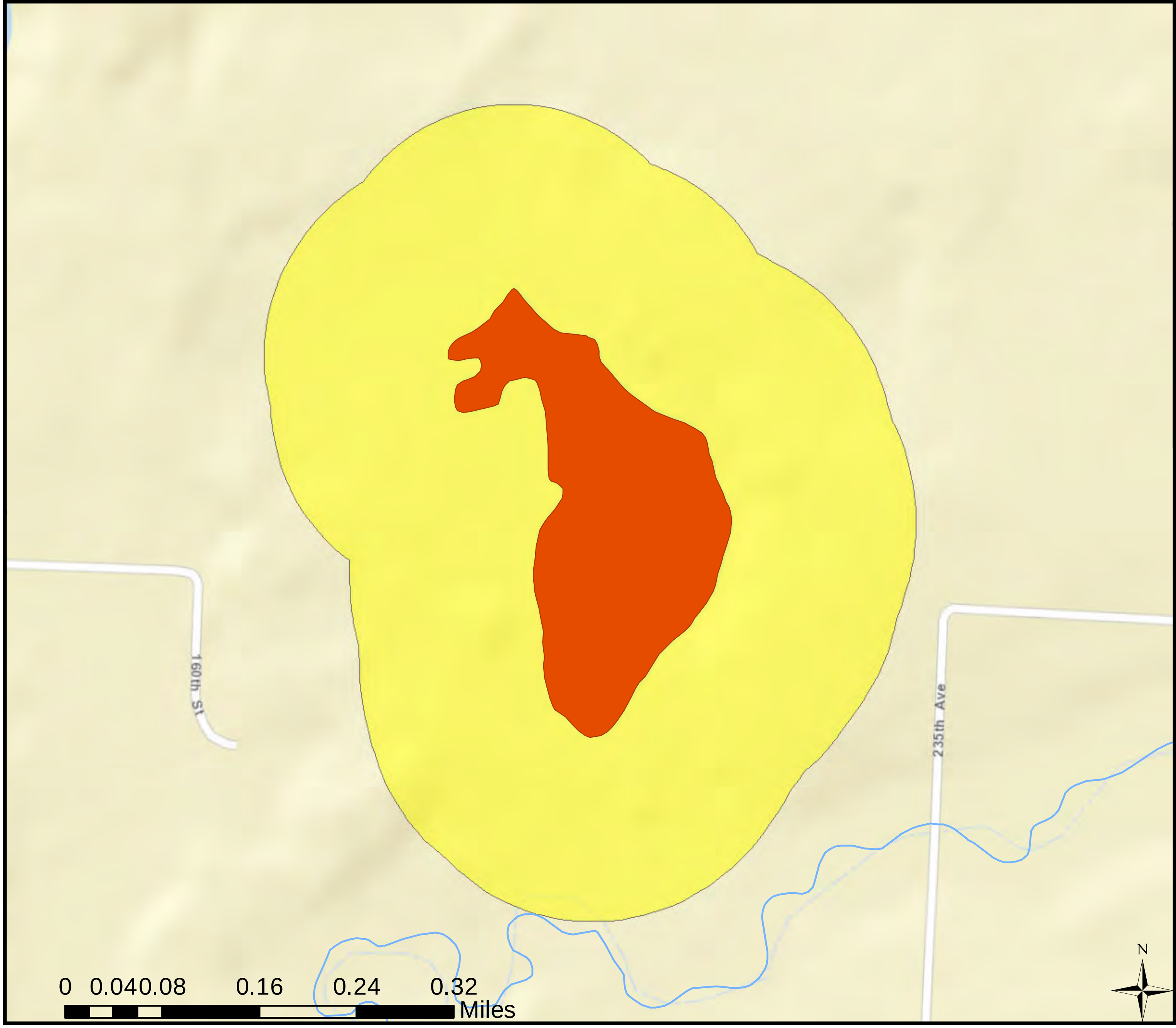
Minnesota Pollution Control Agency

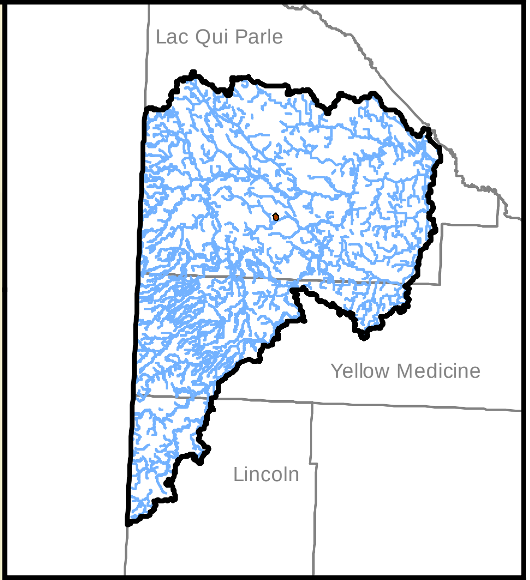
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Service Layer Credits: Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2013

Unnamed

37-0100-00





Aquatice Life:
Insufficient Information

Aquatic Recreation:
Insufficient Information

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

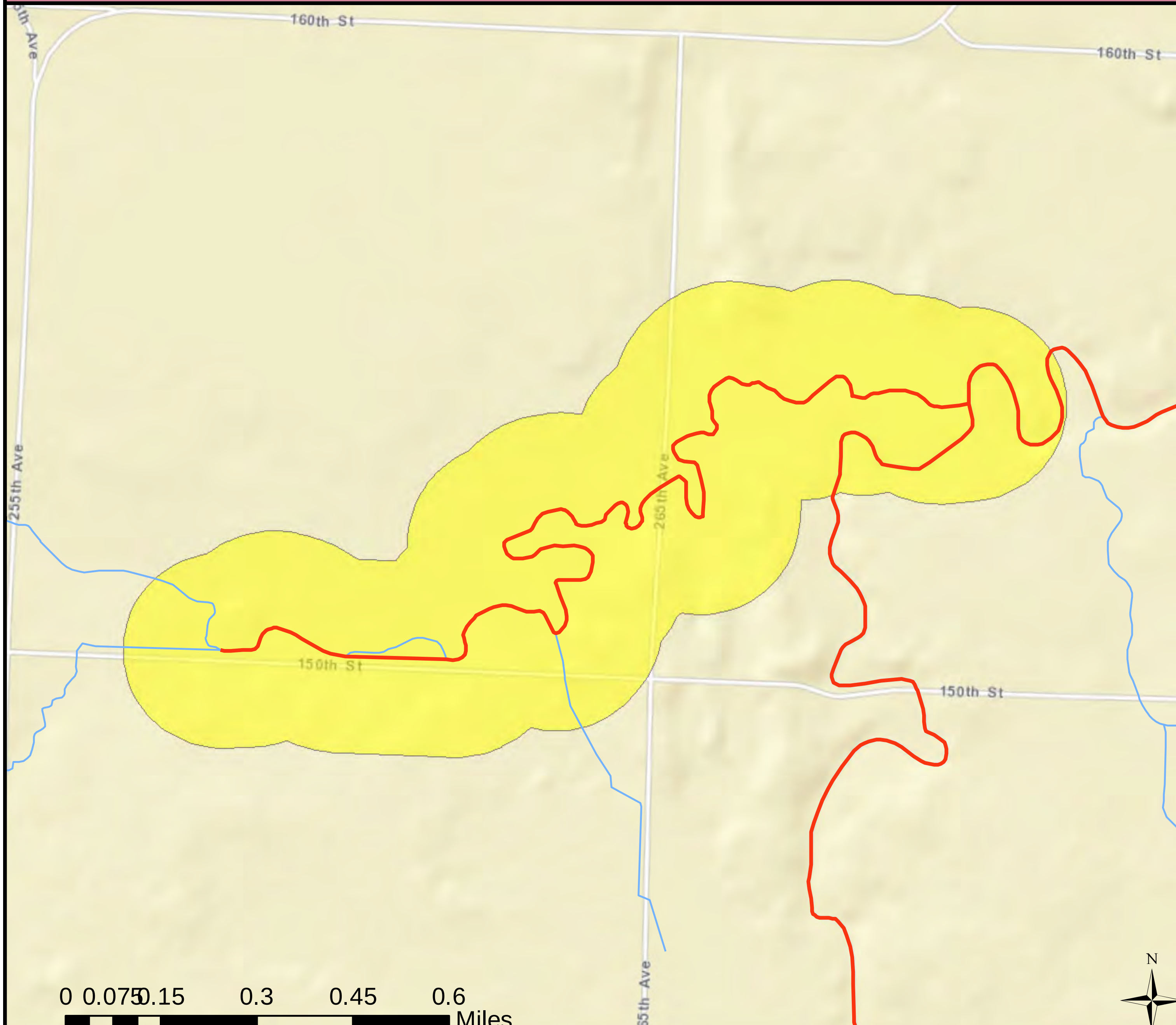
Assessed Streams

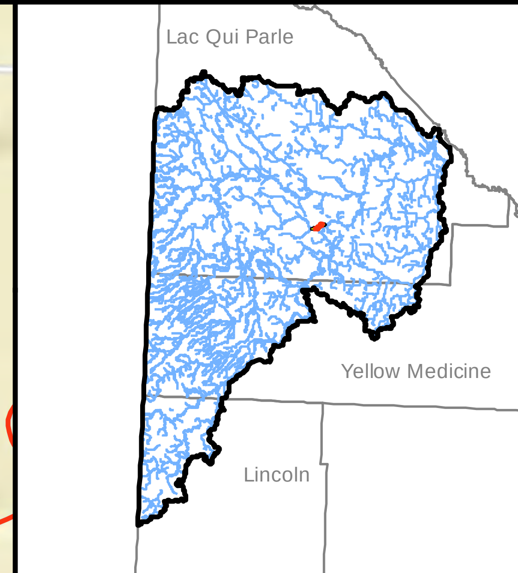
Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Unnamed creek

07020003-534

CD 29A to Lac Qui Parle R





Aquatic Life:
Not Supporting
Aquatic Recreation:

Limited Resource:

New Impairment:
Fish

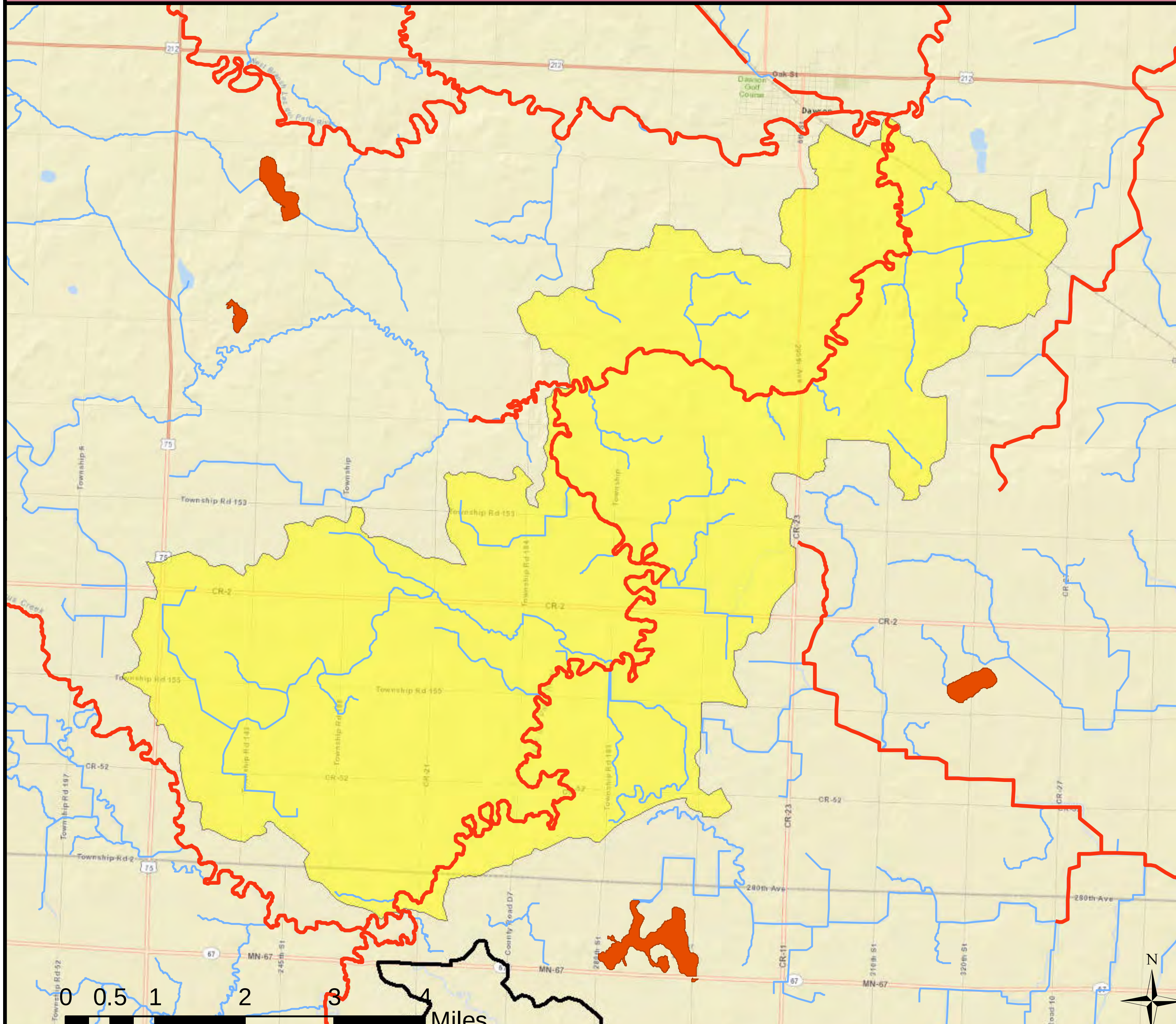
Existing Impairment:

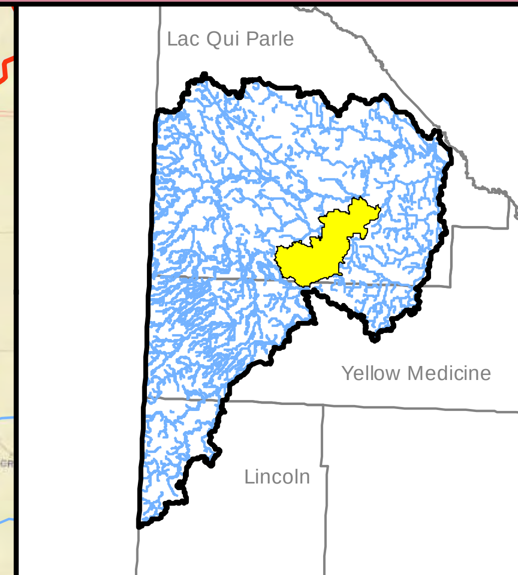
Assessed Lakes
Assessed Streams

Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

County Ditch No 79-Lac Qui Parle River

070200030702





Aquatice Life:

Aquatic Recreation:

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

Assessed Streams

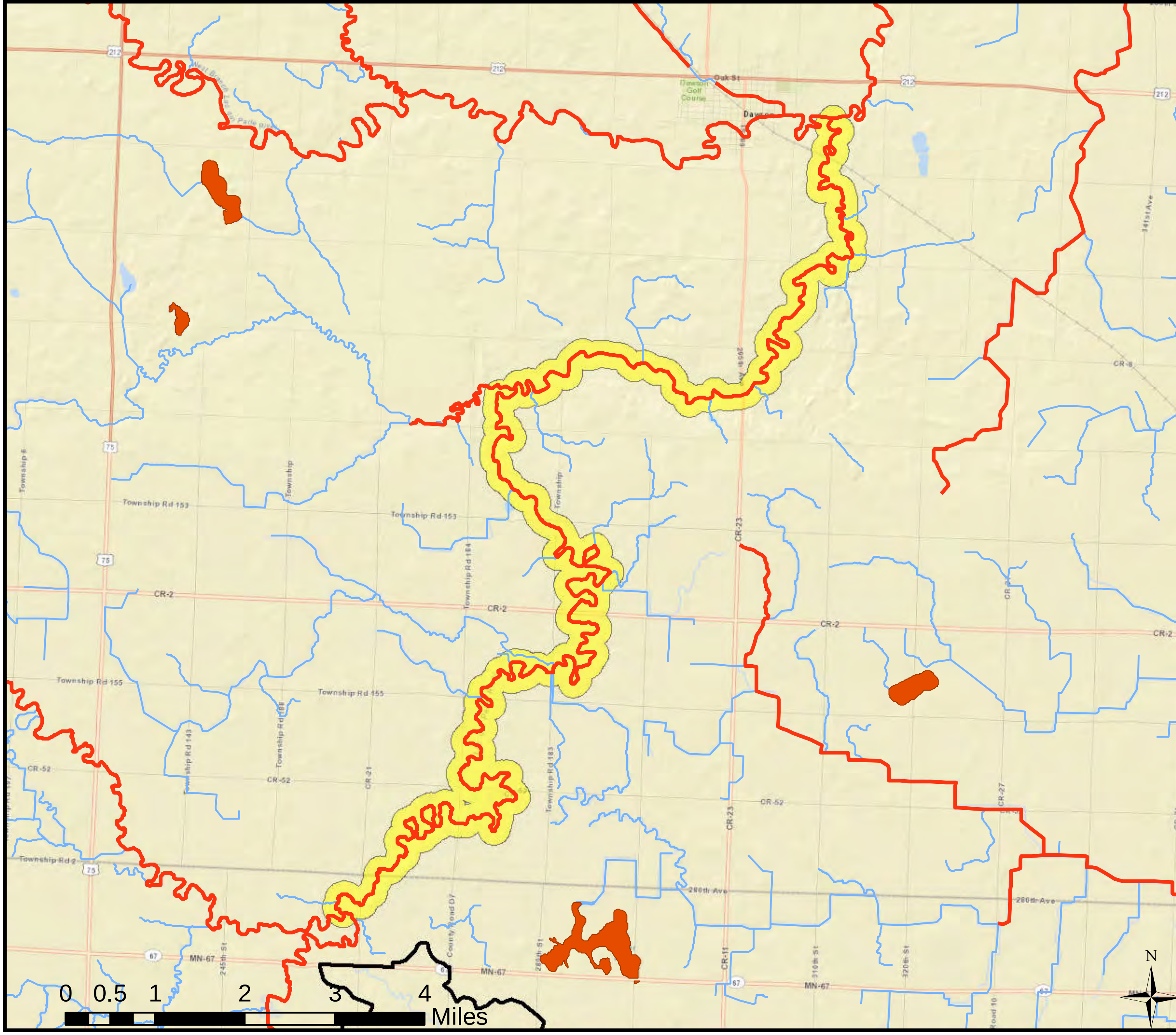
Minnesota Pollution Control Agency

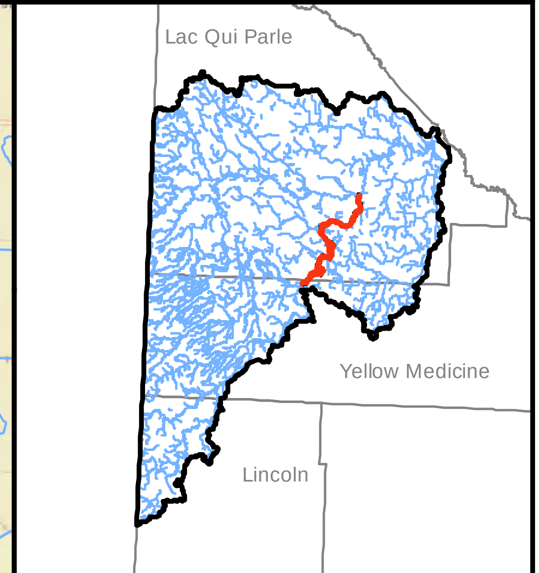
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Service Layer Credits: Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2013

Lac qui Parle River

07020003-506 Lazarus Cr (Canby Cr) to W Br Lac Qui Parle R





Aquatice Life:
Not Supporting

Aquatic Recreation:
Not Supporting

Limited Resource:

New Impairment:

Existing Impairment:
Mercury, Fecal Coliform, Turbidity

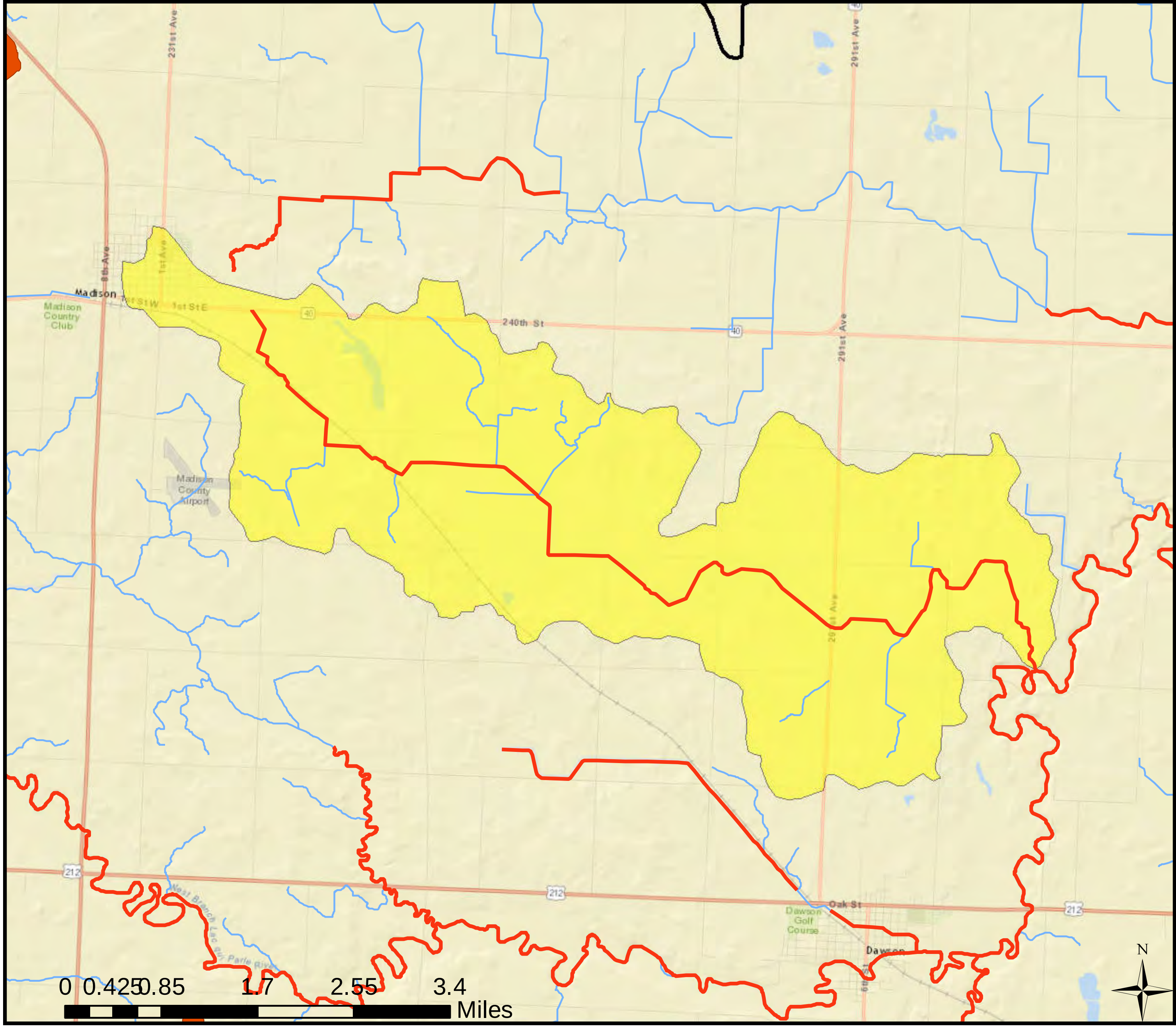
Assessed Lakes

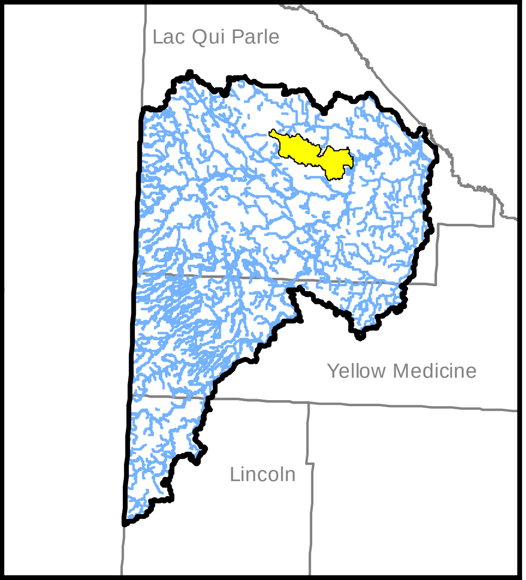
Assessed Streams

Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

County Ditch No 27

070200030703





Aquatice Life:

Aquatic Recreation:

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

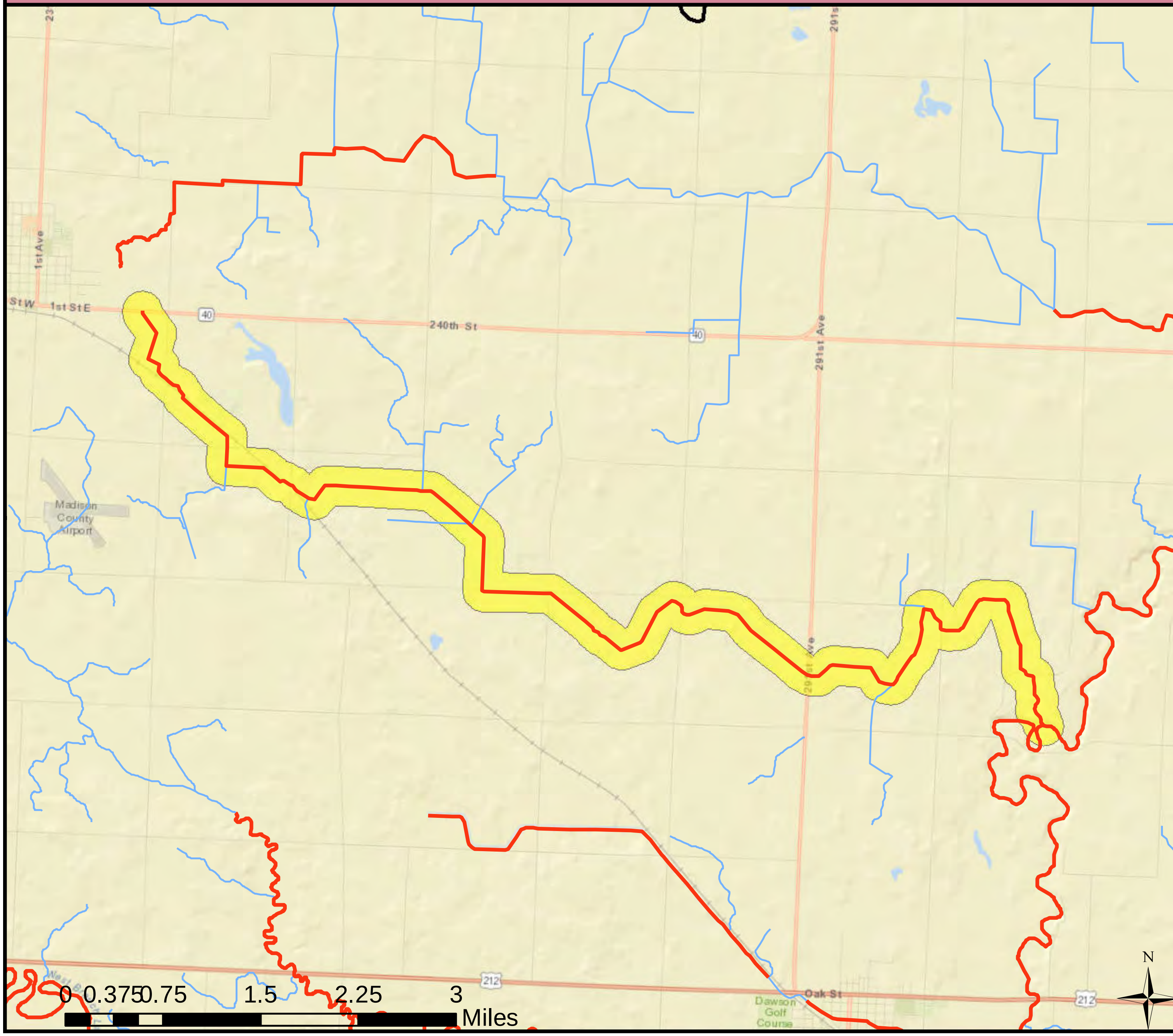
Assessed Streams

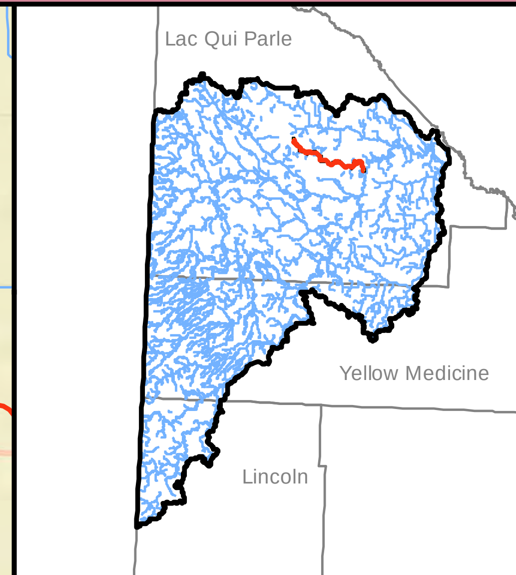
Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

County Ditch 27

07020003-522

Headwaters to Lac Qui Parle R





Aquatice Life:

Aquatic Recreation:

Limited Resource:
Insufficient Information

New Impairment:

Existing Impairment:

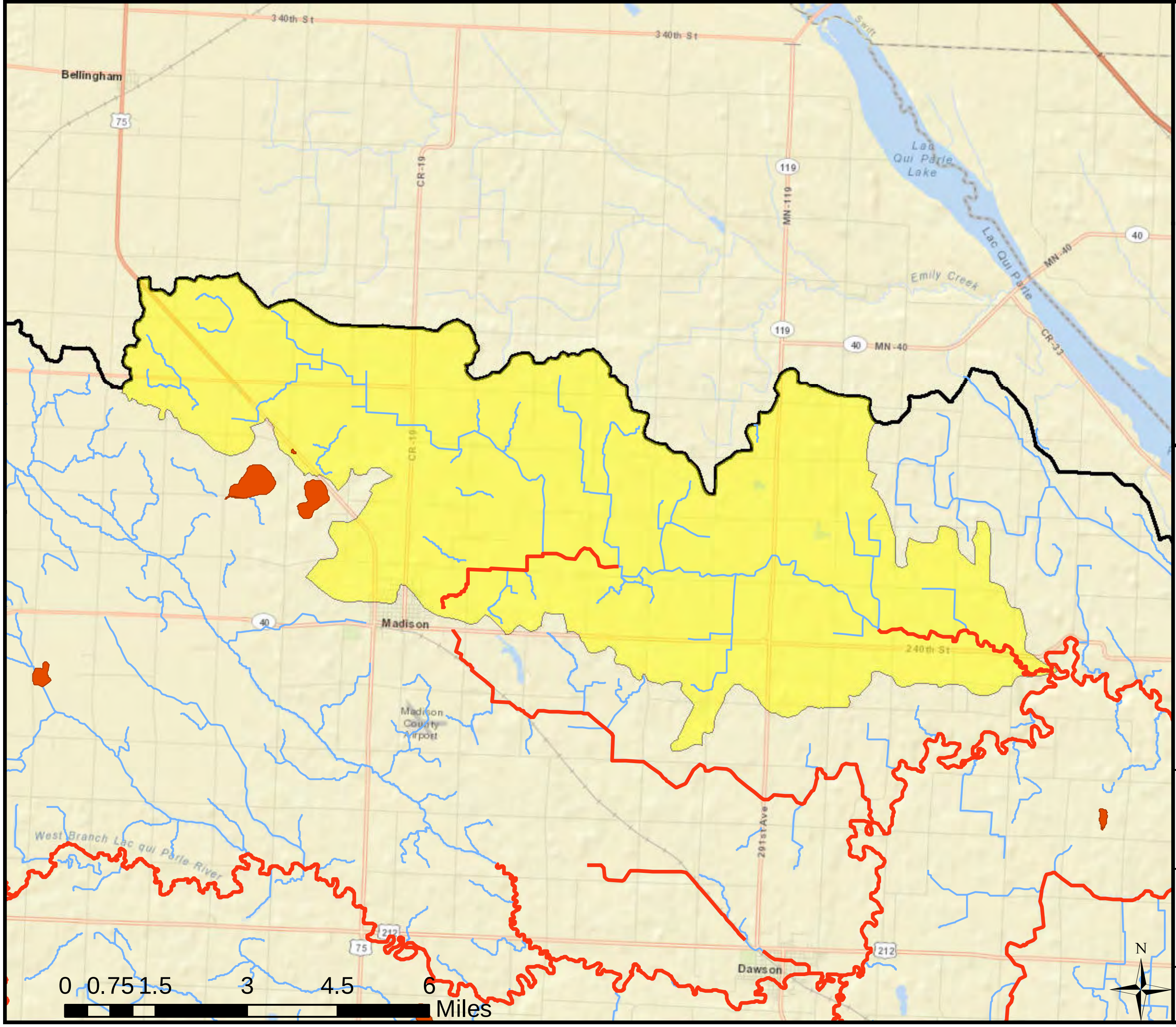
Assessed Lakes

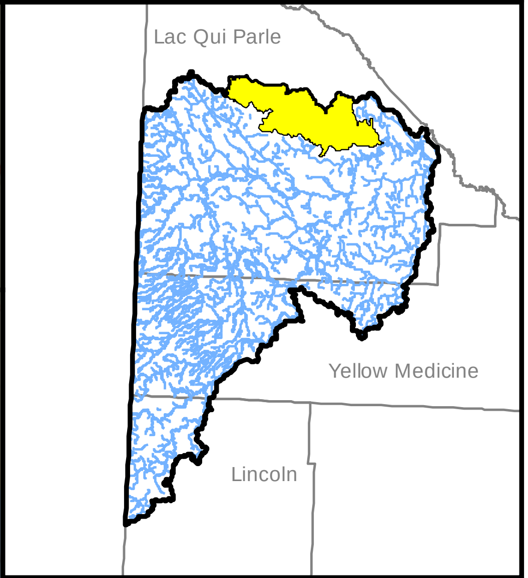
Assessed Streams

Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

County Ditch No 4

070200030704





Aquatice Life:

Aquatic Recreation:

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

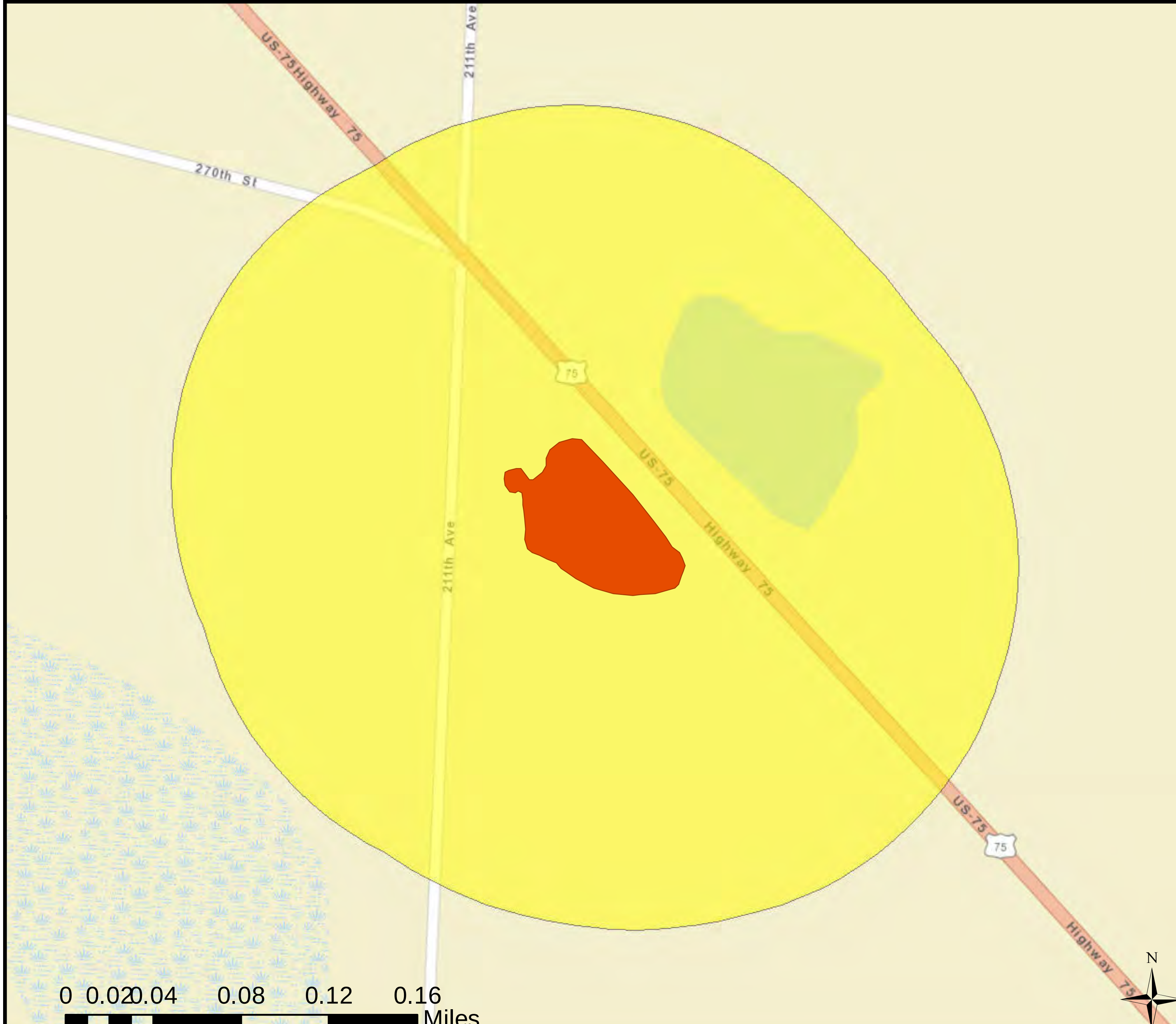
Assessed Streams

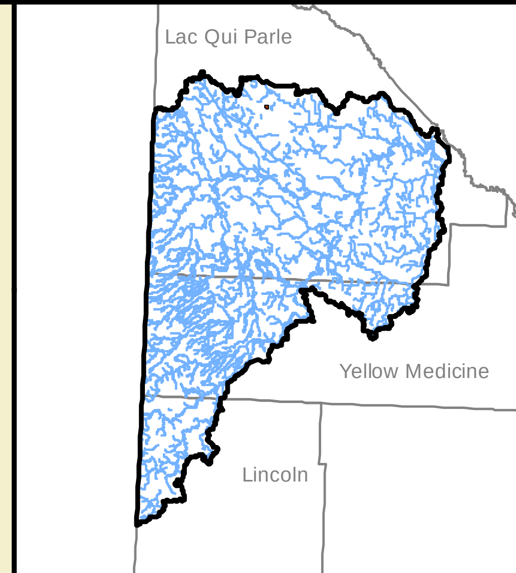
Minnesota Pollution Control Agency

1601 E Hwy 12, Suite 1
Willmar, MN 56201

Unnamed-Southwest Portion

37-0134-02





Aquatice Life:
Insufficient Information

Aquatic Recreation:
Insufficient Information

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

Assessed Streams

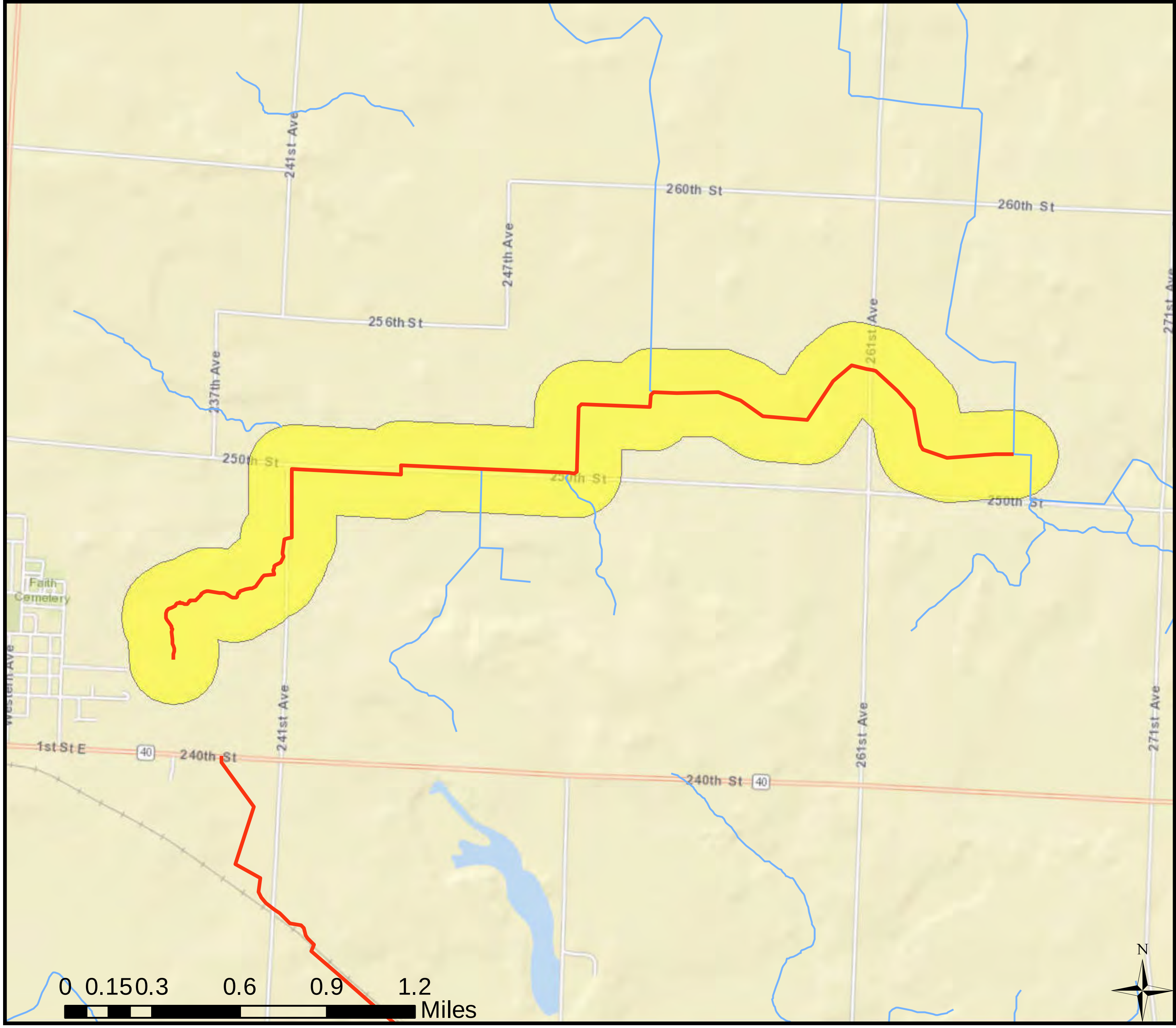
Minnesota Pollution Control Agency

1601 E Hwy 12, Suite 1
Willmar, MN 56201

Unnamed ditch

07020003-575

Headwaters to Unnamed ditch



Aquatice Life:
Not Supporting
Aquatic Recreation:

Limited Resource:

New Impairment:
Macroinvertebrate, Fish
Existing Impairment:

Assessed Lakes
Assessed Streams

Minnesota Pollution Control Agency
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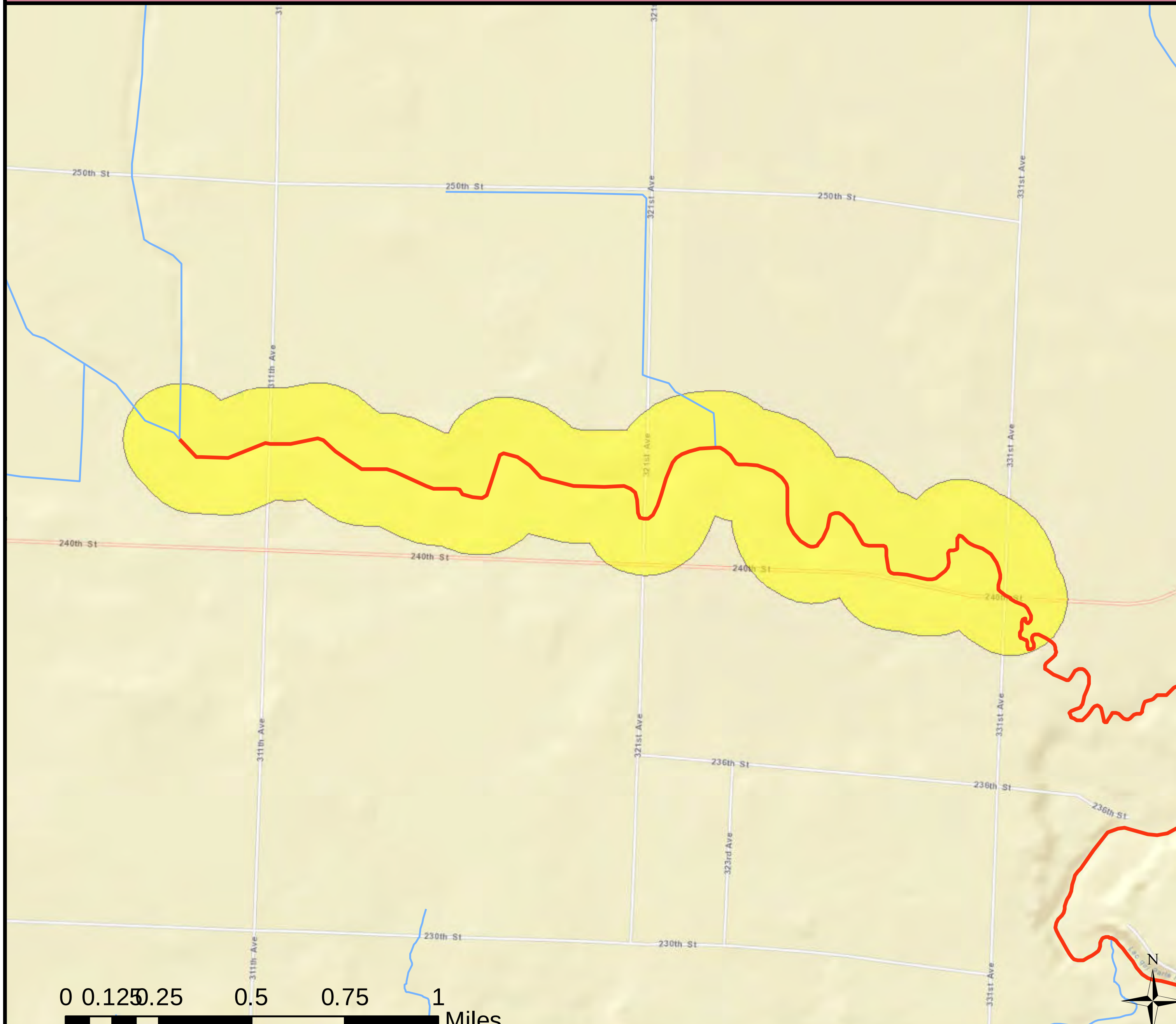
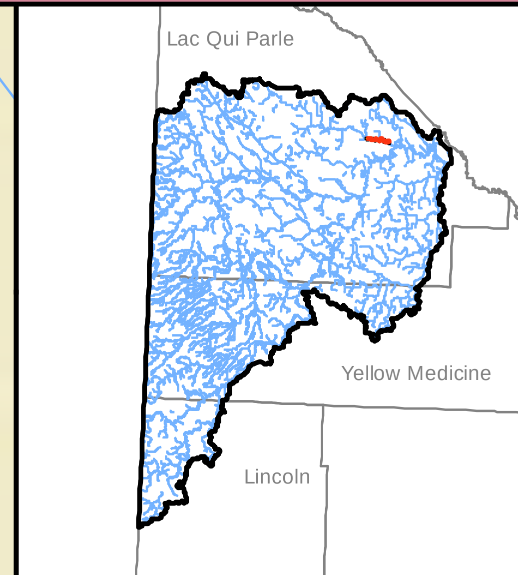
Unnamed ditch (County Ditch 4)

07020003-581

Unnamed ditch to CSAH 20





Aquatice Life:
Insufficient Information

Aquatic Recreation:
Not Supporting

Limited Resource:

New Impairment:
E. coli

Existing Impairment:

Assessed Lakes

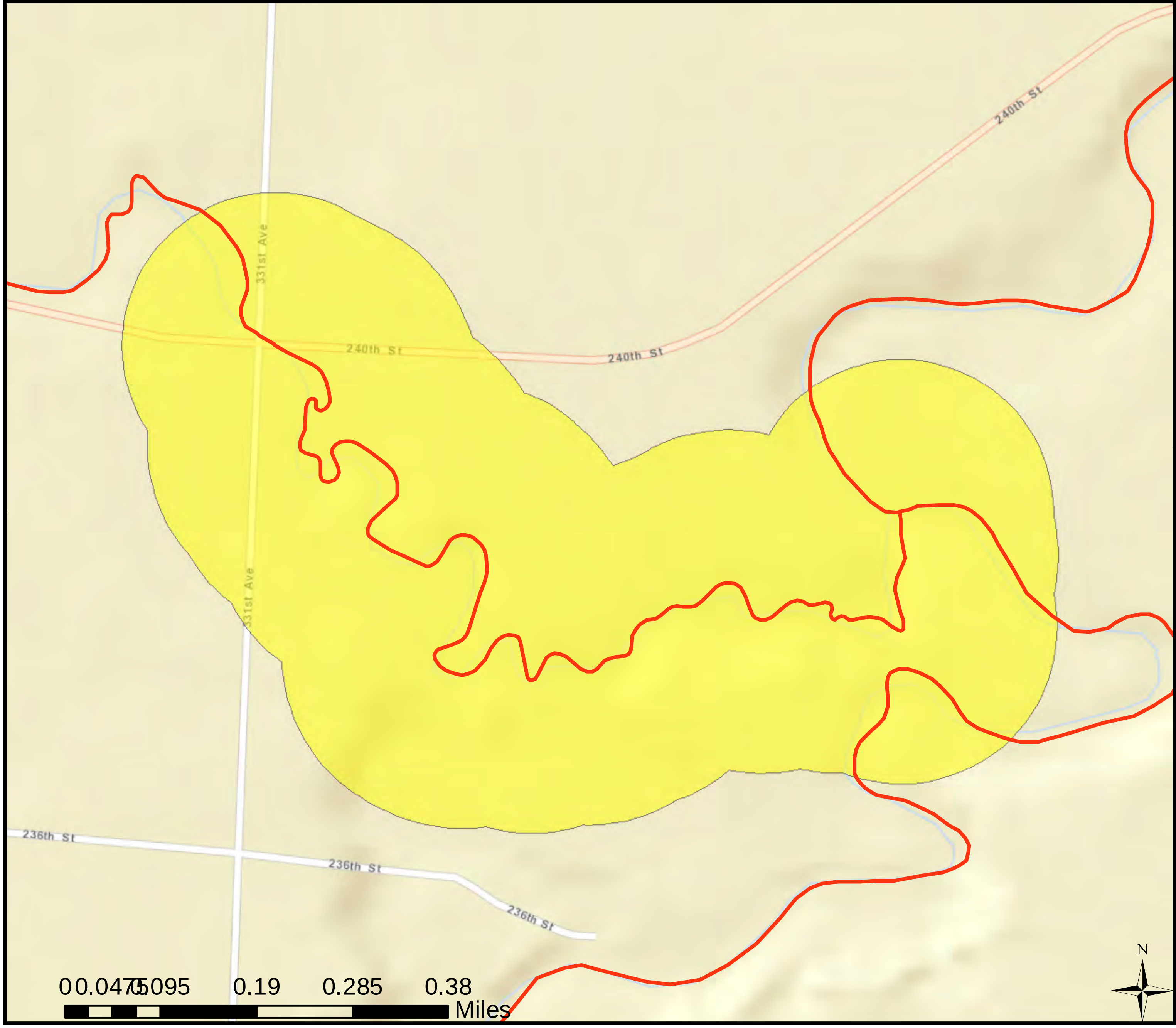
Assessed Streams

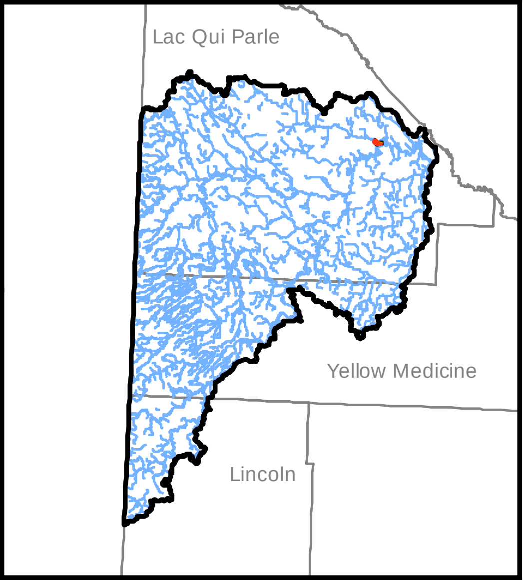
Minnesota Pollution Control Agency

1601 E Hwy 12, Suite 1
Willmar, MN 56201

Unnamed ditch (County Ditch 4)

07020003-582 CSAH 20 to Lac Qui Parle R





Aquatice Life:
Not Supporting
Aquatic Recreation:

Limited Resource:

New Impairment:
Macroinvertebrate, Fish

Existing Impairment:

Assessed Lakes
Assessed Streams

Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
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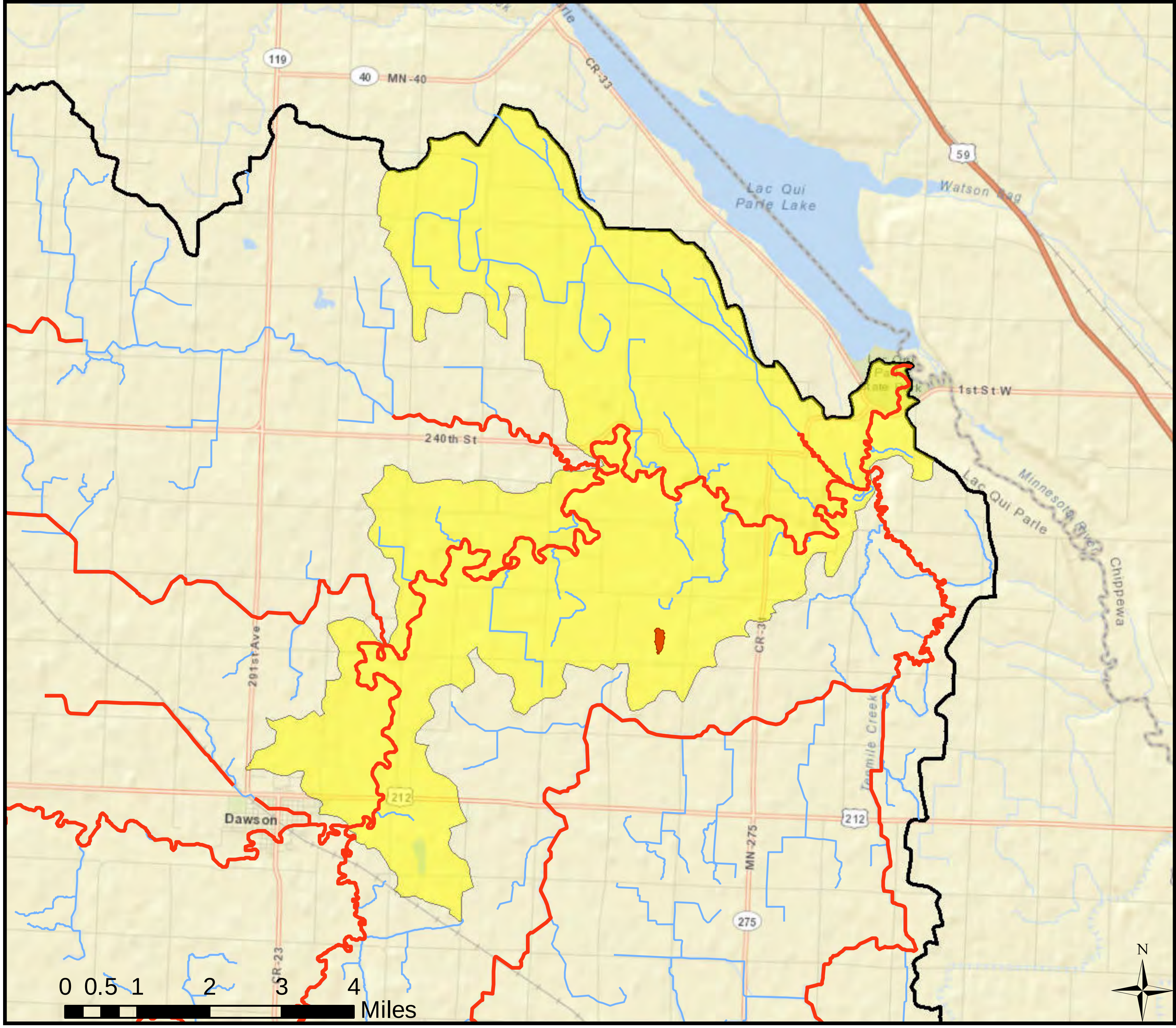
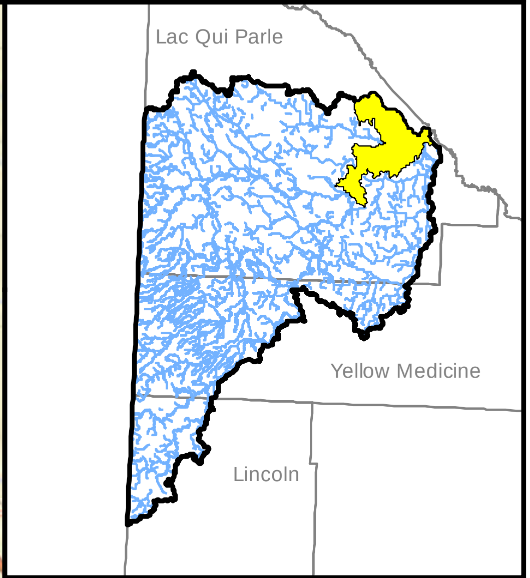
Lac Qui Parle River

070200030705





Aquatice Life:

Aquatic Recreation:

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

Assessed Streams

Minnesota Pollution Control Agency

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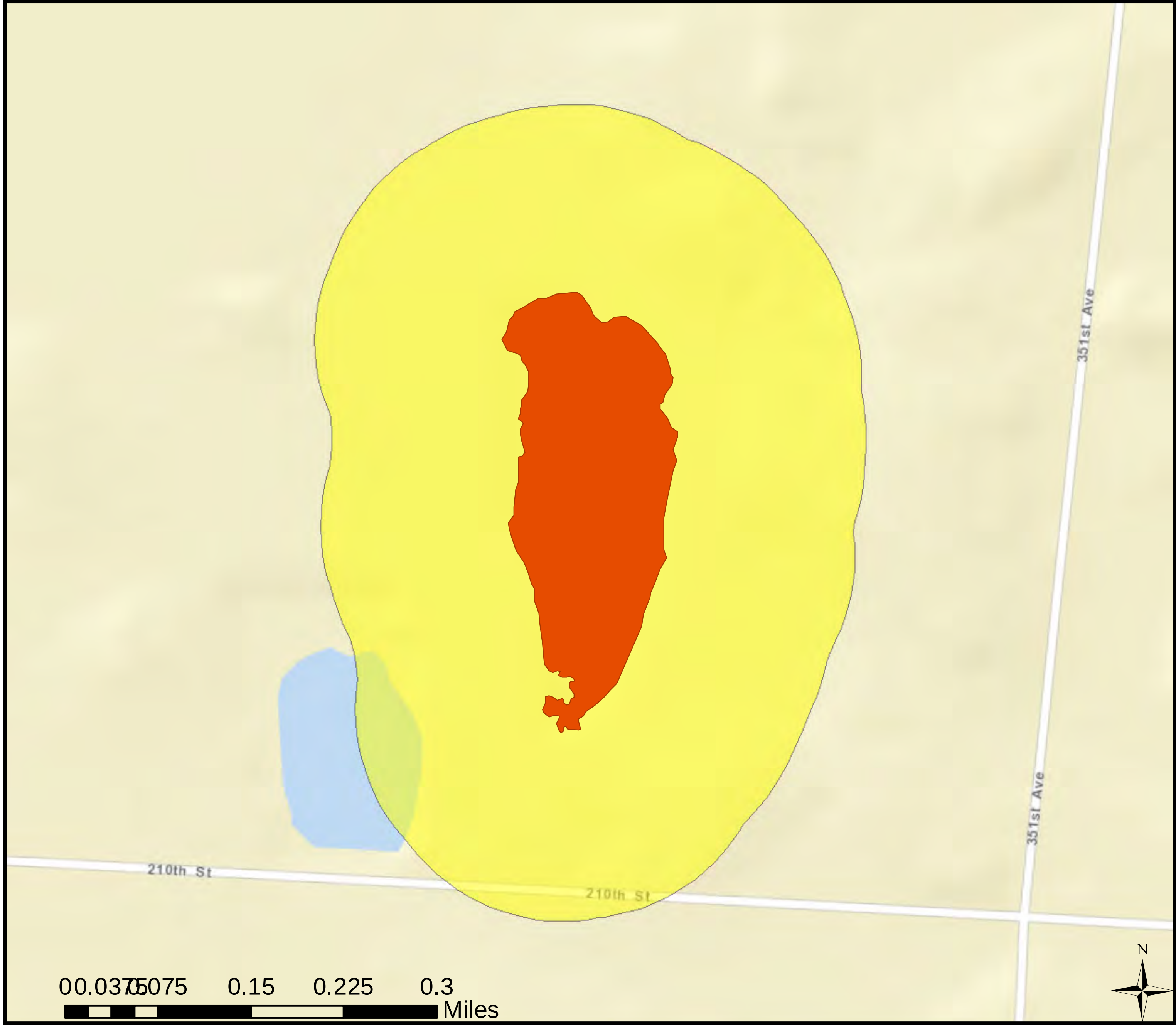
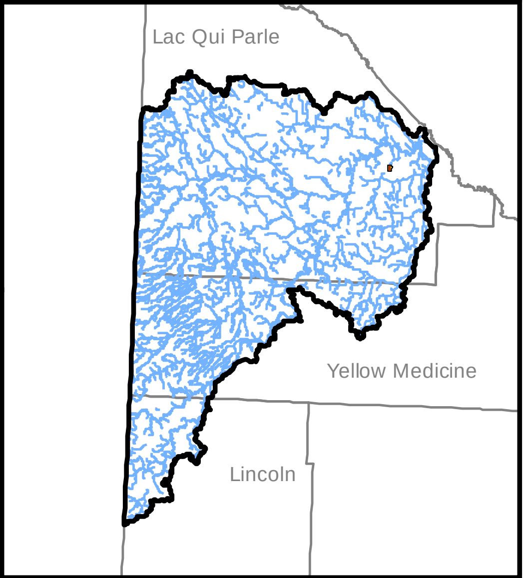
Willmar, MN 56201

Service Layer Credits: Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2013

Andrew

37-0026-01





Aquatice Life:
Insufficient Information

Aquatic Recreation:
Insufficient Information

Limited Resource:

New Impairment:

Existing Impairment:

Assessed Lakes

Assessed Streams

Minnesota Pollution Control Agency
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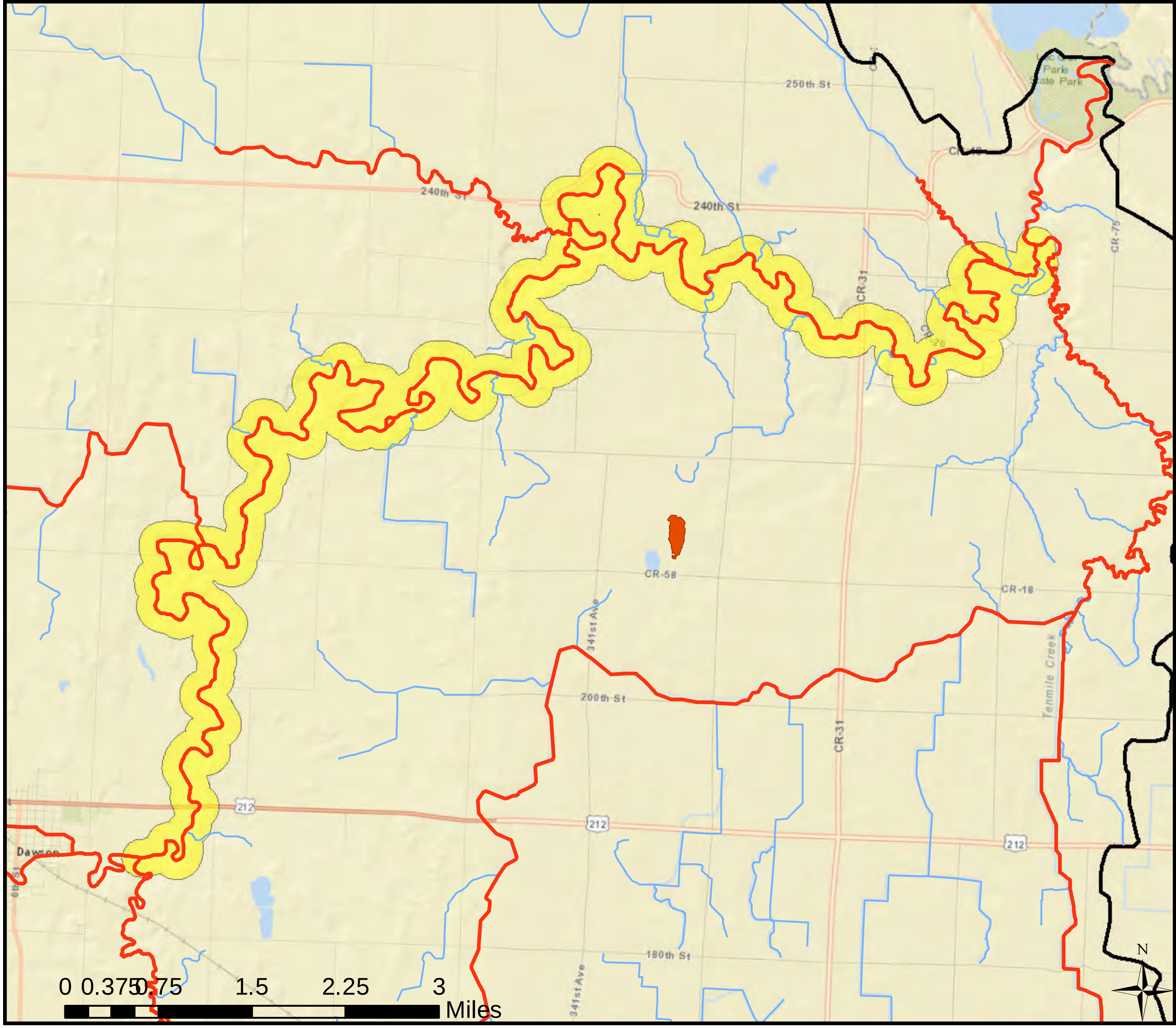
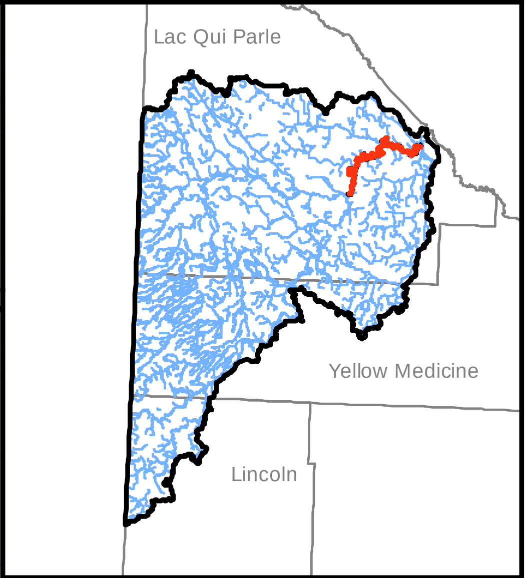
Lac qui Parle River

07020003-501

W Br Lac Qui Parle R to Tenmile Cr





Aquatice Life:
Not Supporting
Aquatic Recreation:
Not Supporting
Limited Resource:

New Impairment:
Macroinvertebrate, Chlorpyrifos
Existing Impairment:
DO, Mercury, Fecal Coliform, Turbidity

Assessed Lakes
Assessed Streams

Minnesota Pollution Control Agency
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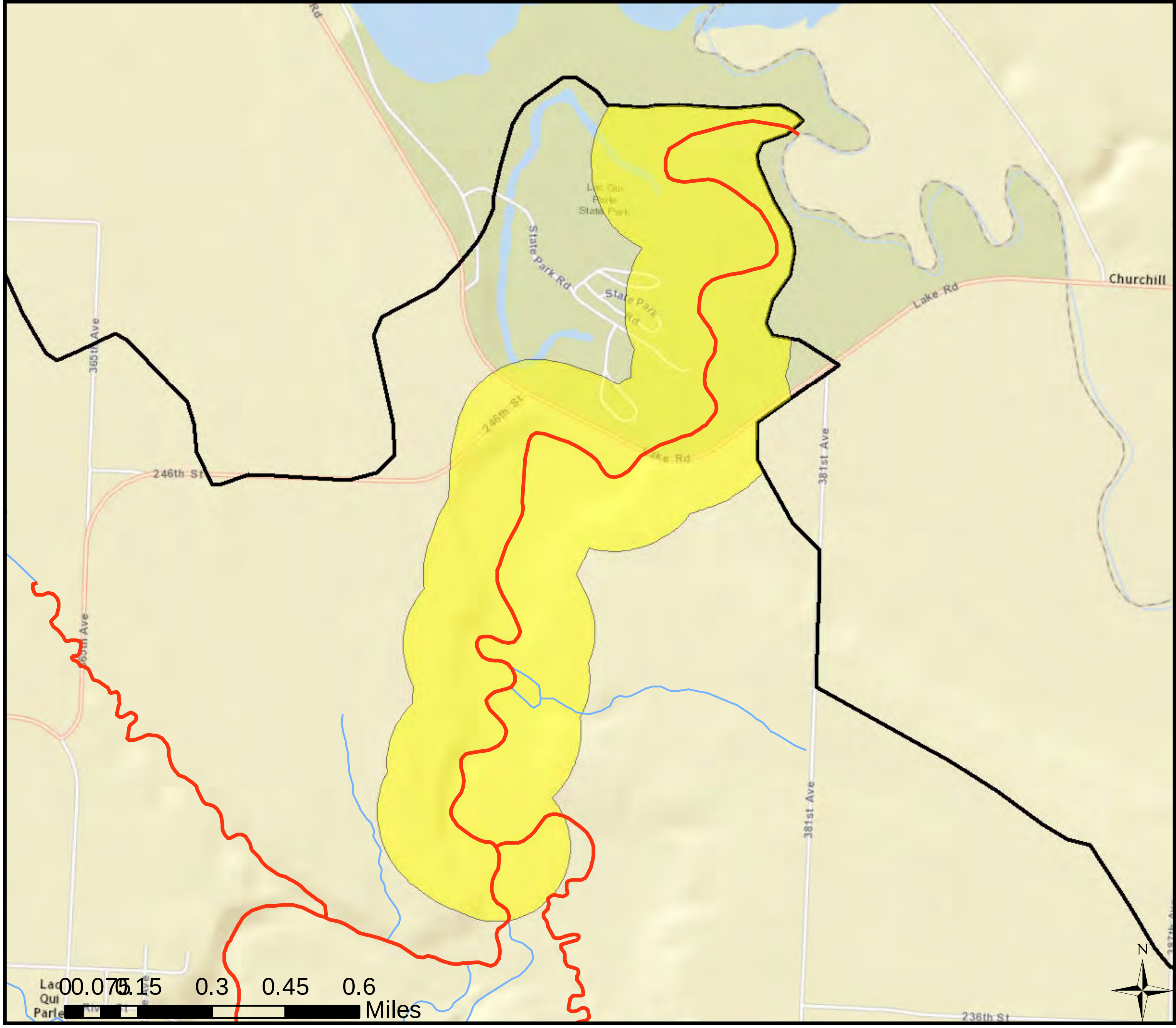
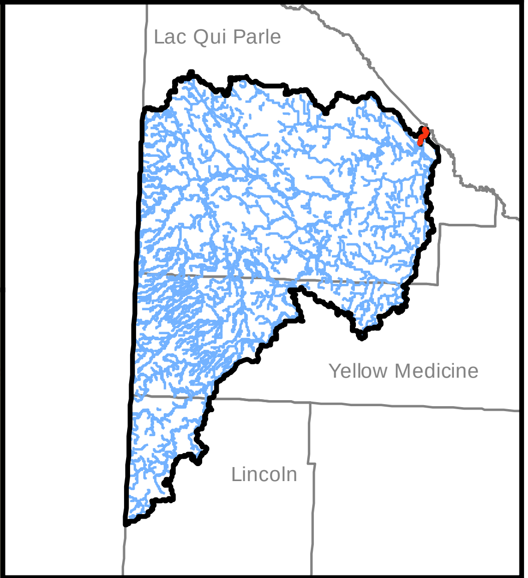
Lac qui Parle River

07020003-502

Tenmile Cr to Minnesota R





Aquatice Life:
Insufficient Information

Aquatic Recreation:
Not Supporting

Limited Resource:

New Impairment:
E. coli

Existing Impairment:
Mercury

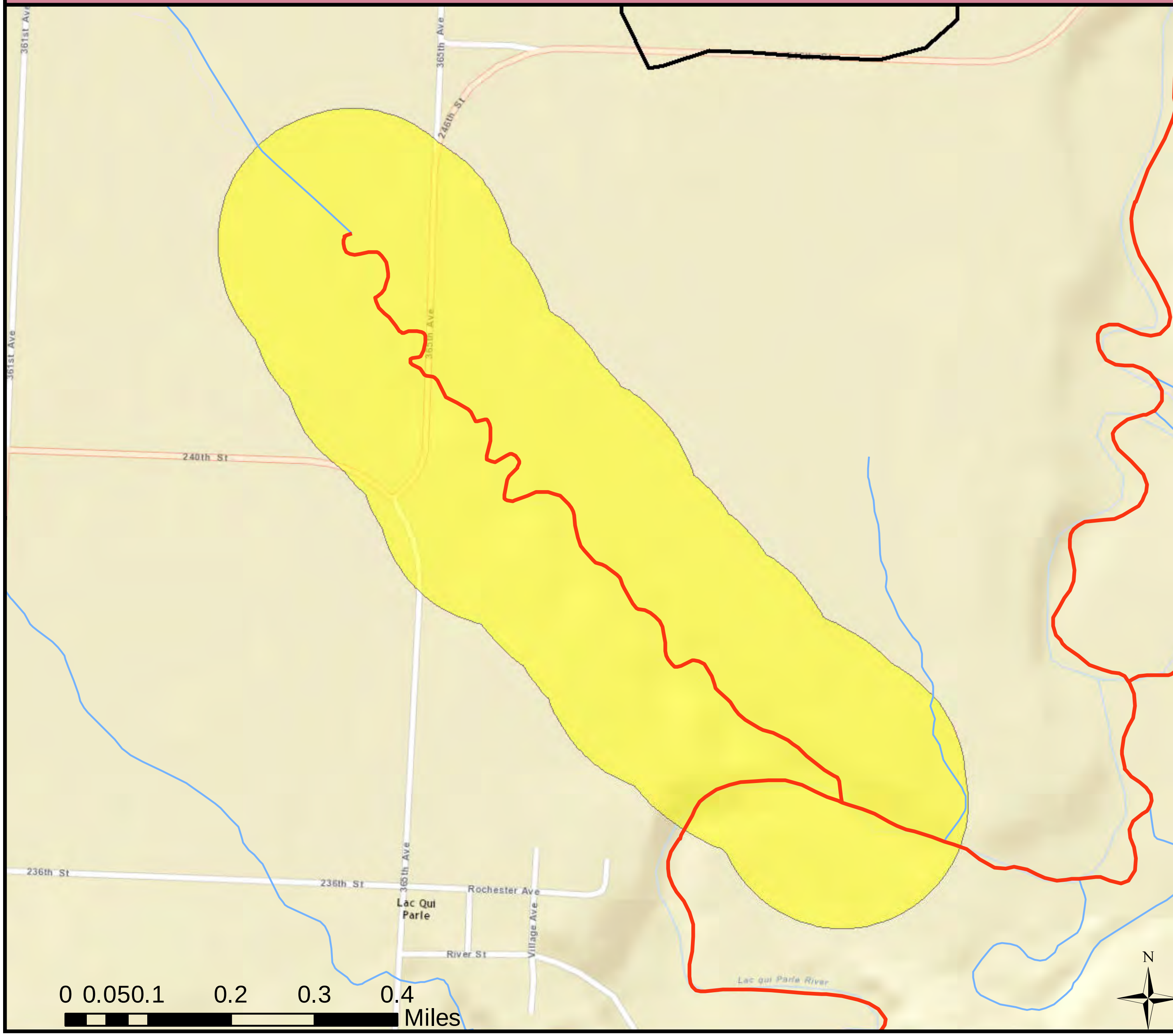
Assessed Lakes

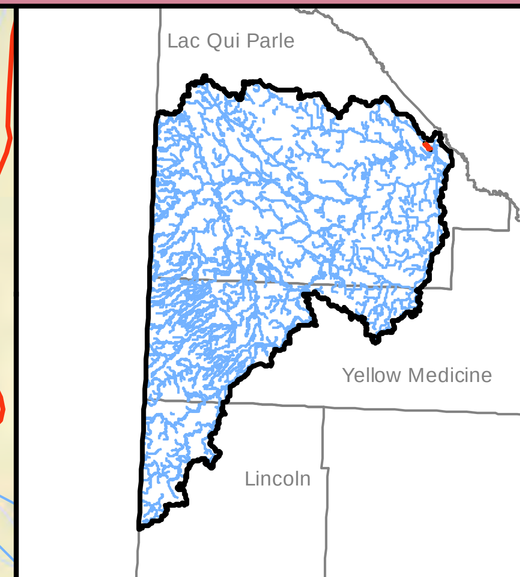
Assessed Streams

Minnesota Pollution Control Agency
1601 E Hwy 12, Suite 1
Willmar, MN 56201

Unnamed creek

07020003-588 -95.9114, 45.012 to Lac qui Parle R





Aquatice Life:
Not Supporting

Aquatic Recreation:

Limited Resource:

New Impairment:
Macroinvertebrate, Fish

Existing Impairment:

Assessed Lakes

Assessed Streams

Minnesota Pollution Control Agency
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Willmar, MN 56201