



Barr Engineering Company
4700 West 77th Street • Minneapolis, MN 55435-4803
Phone: 952-832-2600 • Fax: 952-832-2601 • www.barr.com *An EEO Employer*

Minneapolis, MN • Hibbing, MN • Duluth, MN • Ann Arbor, MI • Jefferson City, MO • Bismarck, ND

October 13, 2009

Kirk Rosenberger
Minnesota Department of Natural Resources
500 Lafayette Road
St. Paul, MN 55155-4029

**Re: 2009 Wild Rice Survey and Sulfate Monitoring
Mesabi Nugget Phase II Project**

Dear Mr. Rosenberger,

On behalf of Steel Dynamics, Inc. and Mesabi Mining, LLC, enclosed is the 2009 Wild Rice Survey and Sulfate Monitoring. This report is being submitted at the request of the MPCA to aid in the EIS and NPDES permitting.

Please address any questions and comments directly to Keith Hanson at 218-529-8222 or via email at khanson@barr.com.

Sincerely,

A handwritten signature in black ink, appearing to read "Keith E. Hanson".

Keith E. Hanson
Senior Consultant

Enclosure

c: Darin Steen, Bois Forte
Rose Berens, Bois Forte
Margaret Watkins, Grand Portage Band
Nancy Schuldt, Fond du Lac Band
Nick Axtell, 1854 Treaty *electronic only*
John Coleman, GLIFWC *electronic only*
Darren Vogt, 1854 Treaty
Esteban Chiriboga, GLIFWC
Tom Lutes, Mesabi Nugget
Jasmine Scheuring, Mesabi Nugget
Bill Johnson, MDNR *electronic only*
Jon Ahlness, USACE
Brian Timerson, MPCA
Chris Nelson, MPCA *electronic only*
Anna Miller, USEPA
Beth Nixon, EOR *electronic only*
James Walsh, MDH
Mike Berndt, MDNR
John Adams, MDNR
Mike Liljegren, MDNR
Kim Lapakko, MDNR *electronic only*
Richard Clark, MPCA *electronic only*
Vicky Raske, Grand Portage
Leroy Defoe, Fond du Lac

2009 Wild Rice Survey and Sulfate Monitoring

Lower Partridge River and St. Louis River

Mesabi Nugget Phase II Project

***Prepared for
Steel Dynamics, Inc.
Mesabi Mining, LLC***

October 2009



2009 Wild Rice Survey and Sulfate Monitoring Lower Partridge River and St. Louis River

October 2009

Table of Contents

1.0 Summary of Findings	1
2.0 Background	3
3.0 Wild Rice Survey	4
3.1 Wild Rice Survey Methodology	4
3.1.1 Methodology of Literature Review for Wild Rice in Downstream Receiving Waters from the Project	4
3.1.2 Methodology of Historic Aerial Photographic Imagery Analysis	4
3.1.3 Methodology of Ground Verification and Density/Acreage Calculations	5
3.1.4 Methodology for Analysis of 2009 Aerial Photographs	6
3.2 Wild Rice Survey Results	6
3.2.1 Results of 2009 Literature Review	6
3.2.2 Results of Historic Aerial Photographic Imagery Analysis	6
3.2.3 Results of Ground Verification and Density/Acreage Calculations	7
3.2.4 Results of 2009 Aerial Photographs	8
4.0 Sulfate Monitoring	9
4.1 Sulfate Monitoring - 2009 Data	9
4.2 Sulfate Monitoring - Baseline Data	10
5.0 Wild Rice Summary	11
References	12

List of Tables

Table 1-1	Comparison of Wild Rice Densities and Sulfate Concentrations.....	1
Table 3-1	Wild Rice Density Scale	5
Table 4-1	Comparison of Sulfate Concentrations and Water Depth at Wild Rice Stands August – September 2009	9
Table 4-2	Sulfate Monitoring Data Partridge and Second Creek.....	10

List of Figures

Figure 1	Wild Rice and Sulfate Sampling Location on the Partridge River
Figure 2	Wild Rice and Sulfate Sampling Locations for Pokegama Bay & Lower St. Louis River
Figure 3	Potential Wild Rice USGS Photo Survey Results for the Lower Partridge River
Figure 4	Potential Wild Rice USGS Photo Survey Results for Pokegama Bay and Lower St. Louis River
Figure 5	Ground Wild Rice Survey Results for Colby Lake & the Lower Partridge River
Figure 6	Ground Wild Rice Survey Results for Pokegama Bay & Lower St. Louis River
Figure 7	Grid Density Calculations Lower Partridge River
Figure 8	Grid Density Calculations Pokegama Bay (St. Louis River)
Figure 9	Photographs Depicting Range of Wild Rice Densities (1-5)
Figure 10	Sulfate Concentrations and Wild Rice Stand Density in Mesabi Nugget Phase II Project Study Area
Figure 11	Sulfate Monitoring Data Partridge River and Second Creek

List of Appendices

Appendix A	Photographs of Wild Rice for the Project Study Area
Appendix B	Wild Rice Grid Density Calculations for the Project Study Area
Appendix C	MPCA Wild Rice Information Request

1.0 Summary of Findings

The purpose of this report is to determine the location of wild rice stands downstream from the Project. The study area includes the Partridge River below Colby Lake to the confluence of the St Louis River and the St Louis River downstream from the Partridge River to the mouth of the St Louis River. In order to determine locations of wild rice, a literature review, an analysis of historic infrared USGS photographs and field verification of the historic photos were preformed.

The results from the literature review, historic aerial imagery analysis and 2009 ground surveys identified the presence of wild rice in the Lower Partridge River and the Lower St. Louis River. Several dense stands of wild rice were identified from ground surveys on the Lower Partridge River and in Pokegama Bay near the St. Louis River. A comparison of measured wild rice densities for grid locations (Stems/0.5 meters²) and sulfate concentrations (mg/l) on these water bodies is presented in Table 1-1. As noted in the table, Pokegama Bay had densities between 28 and 54 stems / 0.5 m² with sulfate levels ranging from 7.0 mg/L to 8.8 mg/L and the Lower Partridge River downstream from Colby Lake had fairly dense stands between 39 and 117 stems / 0.5 m² with sulfate data collected as part of the baseline data for the Phase II project ranging from 47mg/L to 289 mg/L.

Table 1-1 Comparison of Wild Rice Densities and Sulfate Concentrations

Site Location	Survey Grid #	Density (Stems/0.5 Meter ²)	Sulfate Concentrations (mg/L)
Partridge River	26	39.0	289 ¹
Partridge River	27	117	289 ¹
Partridge River	28	69.9	46.8 ¹
Pokegama Bay	90	28	6.95
Pokegama Bay	91	39.6	7.68
Pokegama Bay	92	53.6	7.09

¹ Sulfate samples were not collected at this site during wild rice surveying. These concentrations were measured as part of the Mesabi Nugget baseline stream monitoring.

Additional monitoring data (both for sulfate concentrations and wild rice density) would be needed in order to determine the effects of sulfate on wild rice growth and production (see Walker et al.,

submitted for publication 2009) and the relative importance of other factors affecting wild rice density (e.g. hydrologic, weather, and ecological factors).

It is difficult to determine the health and history of wild rice in these waterbodies without a multi-year combined analysis of ground surveys and aerial photographic imagery, as wild rice populations oscillate over an approximate 4 to 6 year period. Delays in plant nutrient uptake and wild rice tissue chemistry influence wild rice growth and production from year to year (Walker et al., 2006; Walker et al., submitted for publication 2009). Other factors such as water level, parasites, herbivory, and weather conditions may also play a role, but no data has been collected over multiple years and published. Given that wild rice populations fluctuate over a multiple year time period, studies carried out over a shorter time period (one year) may not provide sufficient information regarding the growth and production of wild rice.

2.0 Background

The purpose of this report is to provide information in response to the Minnesota Pollution Control Agency's (MPCA) "Wild Rice Information Request" on May 28, 2009 (Appendix C) with regard to the Steel Dynamics, Inc. and Mesabi Mining, LLC (Referred to as Mesabi Nugget) Phase II Project (Project).

The MPCA requested the following information:

- A literature review to identify water bodies which could potentially support wild rice downstream from the Project. As a result of this literature review, an analysis of historic infra-red USGS photographs for the presence of wild rice in water bodies downstream from the Project was determined to be beneficial.
- Consultation with Bands of Chippewa and the 1854 Treaty Authority.
- A ground survey of wild rice presence and density.
- Information on current sulfate concentrations in the bodies of water where wild rice was identified.

As part of consultation with the Bands of Chippewa (Bands), Mesabi Nugget contacted representatives from Bois Forte Band of Chippewa, Fond du Lac Band of Lake Superior Chippewa, Grand Portage Band of Lake Superior Chippewa, and the 1854 Treaty Authority. Following the literature review and prior to the ground survey, each representative was contacted by email and phone for comment regarding potential water bodies affected by the Project. Feedback was received from 1854 Authority's Darren Vogt on July 10, 2009 confirming that Mesabi Nugget proposed study area included waterbodies with potential for the presence of wild rice stands. Mr. Vogt mentioned the St Louis River, including several sites upstream from its confluence with the Partridge River. After a follow-up phone call, Mr. Vogt agreed that those sites were outside the scope of waters potentially affected by discharge waters. Mr. Vogt also sent Mesabi Nugget a picture of wild rice stands near Highway 110 on the Partridge River dated July 29, 2009. Three grid density calculations were made in that location. After follow up emails and phone calls to representatives of the three bands, they said that they did not have any additional input beyond what Mr. Vogt provided.

3.0 Wild Rice Survey

The purpose of the Wild Rice Survey is to determine the presence of wild rice (*Zizania palustris* L, known as *Manoomin* in Ojibwe), an annual grass, on the Lower Partridge River from Colby Lake to its confluence with the St. Louis River and the St. Louis River downstream from its confluence with the Partridge (Figures 1 and 2). Since wild rice populations oscillate over an approximate 4 to 6 year period, the following analyses and ground surveys were performed to determine past and current presence of wild rice:

- Literature review to identify water bodies which could potentially support wild rice downstream from the Project.
- Analysis of historic aerial photographic imagery of the Study Area.
- On-the-ground verification of the presence and density of select wild rice stands.
- Analysis of 2009 aerial photographic imagery to verify information obtained from the cultural data, historic aerial photography, and ground surveys.

3.1 Wild Rice Survey Methodology

The following section describes the methodologies used in obtaining information and data on wild rice.

3.1.1 Methodology of Literature Review for Wild Rice in Downstream Receiving Waters from the Project

To determine which waterbodies downstream of the Project might potentially have wild rice, a literature review of historic and cultural information was conducted. Information examined include the 2008 DNR “Natural Wild Rice in Minnesota” Report, U.S. Department of Interior Geological Survey maps (Topographic maps), and the 1854 Treaty Authority List.

3.1.2 Methodology of Historic Aerial Photographic Imagery Analysis

Staff from the Geospatial Sciences and Technologies Branch USGS-BRD-Upper Midwest Environmental Sciences Center in La Crosse, WI analyzed 2004 and 2008 one meter resolution NAIP (National Agricultural Imagery Program) natural color and color infrared aerial photographic imagery for the presence of wild rice on the Lower Partridge River and the St. Louis River. These photos are the best publicly available aerial images from which to identify areas with the potential for the presence of wild rice. The USGS staff has over a decade of experience analyzing NAIP aerial images for the presence of wild rice, mostly along the backwaters and bays of the Mississippi River

in southeastern Minnesota and southwestern Wisconsin. The quality of the analysis is influenced by several factors, including the date of acquisition, weather conditions, light conditions, and the quality of the “wild rice photographic signature.” While the wild rice signature is considered distinct at the end of the growing season, it can be difficult to distinguish it from the signature of other emergent plants at other stages.

3.1.3 Methodology of Ground Verification and Density/Acreage Calculations

Surveys to estimate wild rice density and crop acreage were carried out in August and September of 2009. Qualitative estimates of wild rice coverage were carried out by canoeing or kayaking along the perimeter of wild rice beds, recording bed locations using a Trimble® GPS Pathfinder® ProXH™ receiver, and recording approximate stand density using a density factor with a scale of one (low density) to five (high density). A similar method was used by 1854 Treaty Authority, “Wild Rice Monitoring and Abundance in the 1854 Ceded Territory (1998- 2008) (See Figure 9 for example photographs). Quantitative estimates of wild rice coverage were determined from representative sampling grids of 10 meters x 10 meters. Table 3-1 provides information regarding the wild rice density classification and percent coverage.

Table 3-1 Wild Rice Density Scale

Wild Rice Density Classification	Description
1	<10% Wild Rice Coverage
2	10 – 25 % Wild Rive Coverage
3	25 – 50 % Wild Rice Coverage
4	50 – 75% Wild Rice Coverage
5	>75% Wild Rice Coverage

Grid sampling was carried out in areas with a density factor between three and five. Three grids were sampled in the Lower Partridge River near Highway 110. Three grids were sampled in Pokegama Bay upstream in the Lower St. Louis River estuary.

Within each grid, 20 one meter by one meter plots were randomly selected using a computer random number generator. Each randomly selected plot was sampled using a 0.5 m² sampling square made

from PVC piping (0.71 m on each side). The square was placed on the water surface at each randomly selected plot and the rice stems within the 0.5 m² square were counted. Stem height above the water surface was measured for one to five plants within each 0.5 m² plot. Height was measured at the plant's highest point (seed head or flag leaf depending on stage of plant growth). Stem count sum, mean, median, and standard deviation were calculated based on the stem count for 20 plots. The total stem count for each grid comprises 10 percent of the grid area. The total area sampled for each grid was 10 m² (20 plots x 0.5 m² each). UTM coordinates for each plot in each grid were recorded.

3.1.4 Methodology for Analysis of 2009 Aerial Photographs

Aerial photographic images of the Study Area were acquired the first week of September 2009; rectification and analysis is currently underway, and the corresponding results will be presented at a later date. The aerial photographs are color digital imagery with a 1.9 feet/pixel resolution. The sun angle was 30 degrees but the sky conditions were somewhat hazy.

3.2 Wild Rice Survey Results

The following sections present the results of the wild rice survey for the Study Area. Surveying and grid sampling were carried out between August 13 and September 8, 2009.

3.2.1 Results of 2009 Literature Review

The Lower Partridge River and the Lower St. Louis River were identified as waterbodies which could potentially support wild rice downstream from the Project. Pokegama Bay flows into the St. Louis River and could serve as a control site (Figure 2).

3.2.2 Results of Historic Aerial Photographic Imagery Analysis

Several sources of photography were considered to perform the historic photographic imagery analysis. Those sources included:

- 2003/2004 NAIP aerial imagery for the Study Area acquired during the period of June 15-20, 2003
- Imagery for the Lower St. Louis River taken on August 18, 2003
- 2008 NAIP aerial imagery for the Partridge River and Lower St. Louis River taken on August 17, 2008
- Imagery for the Lower St. Louis River at Brookston taken on August 18, 2008
- Imagery for the Lower St. Louis River taken on August 29, 2008

Only photographs taken in late summer provide insight into potential locations for wild rice presence. Wild rice does not emerge from the floating leaf stage until late June/ July; its signature is not identifiable until later in the summer. Only the 2008 NAIP images and the 2003/2004 images for the Lower St. Louis River taken in late summer are therefore suitable for identifying wild rice. The potential presence of wild rice identified from the historic aerial photographic imagery analysis is marked with green squares (2008 photos) and yellow squares (2004 photos) (Figures 3 and 4). This method of identification did not include any estimates for bed size, overall acreage, or density.

No rice was identified along the main stem of the St. Louis River from its confluence with the Partridge to Brookston. After discussion with the USGS staff who carried out the analysis, they concluded that it was unlikely wild rice grew along that portion of the St. Louis River.

3.2.3 Results of Ground Verification and Density/Acreage Calculations

Wild rice was identified from ground surveys performed on the Partridge River from Colby Lake to the Highway 110 crossing, and the Lower St. Louis River from Brookston to Lake Superior (Figures 5 through 8, Figure 10, Appendices A and B).

Partridge River

No wild rice was identified on Colby Lake or the first mile of the Partridge River downstream of Colby Lake (Figure 5). Several stands of wild rice with a density factor between three to four were identified several hundred yards upstream of the Partridge River's confluence with Second Creek. Beginning several hundred yards upstream of the confluence with Second Creek, wild rice was observed growing nearly continuously along the shorelines of the Partridge River down to the Highway 110 crossing. At times, wild rice was observed growing across the entire width of the Partridge River (Figures 5, 7, A-1, A-2, and Table B-1). Wild rice was observed growing along the banks of the Partridge River for a short distance downstream of Highway 110 before the river entered a long series of rapids. It became very difficult to navigate the last three miles of the Partridge River by canoe or kayak due to long stretches of rapids and limited access; this section was not surveyed or sampled. Wild rice was also observed growing in Second Creek at the confluence with the Partridge River.

Lower St. Louis River

No rice was found along the river near Brookston, an area identified as potentially having wild rice from historic photographs (NAIP 2008). Sparse stands of wild rice were found along short stretches of the lower St. Louis River near its outlet into Lake Superior (Figures 6, A-3, A-4). A large, dense stand

(approximately 30 acres) was identified in Pokegama Bay, a bay that flows into the St. Louis River (Figure 8, Table B-2). From discussion with Professor Anthony Kern, Northland College, Ashland WI who carries out research on wild rice in Pokegama Bay, wild rice is present in dense stands and covers a large acreage most years (personal communication, August 2009). According to Minnesota Rules Chapter 7050.0470, sections of the St Louis River upstream of the Project Area are classified as wild rice waters.

3.2.4 Results of 2009 Aerial Photographs

Rectification and analysis of aerial photographic imagery acquired in September 2009 is ongoing. Results will be included in a future report.

4.0 Sulfate Monitoring

Sulfate monitoring was carried out during the wild rice surveying in August and September of 2009. Additional monitoring as part of the Mesabi Nugget Phase II surface water monitoring program has been underway since May 2008. Results of measurements collected to date are presented in this report.

4.1 Sulfate Monitoring - 2009 Data

Results of sulfate analyses performed on water samples collected during wild rice surveys are presented in Table 4-1 and shown in Figures 1, 2, and 10.

Table 4-1 Comparison of Sulfate Concentrations and Water Depth at Wild Rice Stands August – September 2009

Water Body	# Samples	Sulfate Concentration (mg/L)			Water Depth (in)
		Mean	Std. Dev.	Range	Mean
Pokegama Bay	4	7.6	0.8	7.0 - 8.8	23
St. Louis River	6	17.7	7.4	8.0 - 27.4	15

All water samples were analyzed for sulfate using an ion chromatography method (EPA 300.0). A total of 10 water samples were taken from 2 different water bodies. Observed sulfate concentrations ranged from a minimum of 7.0 mg/L (Pokegama Bay, St. Louis River) to a maximum of 27.4 mg/L (St. Louis River mainstem). Six samples collected on the St. Louis River downstream of Brookston averaged 17.7 mg/L and ranged from 8.0 mg/L to 27.4 mg/L. Sulfate concentrations in Pokegama Bay near the mouth of the St. Louis River ranged from 7.0 mg/L to 8.8 mg/L and averaged 7.6 mg/L for the four samples collected. The data for these sampling locations is presented graphically in Figure 10.

Sulfate samples were not collected during wild rice surveys on the Lower Partridge River (downstream of Colby Lake). However, water quality samples were collected as part of the Mesabi Nugget Phase II surface water monitoring program at two surface water monitoring stations on August 19, 2009, one day before the wild rice survey was performed on this river segment. Measured sulfate levels were 46.8 mg/L just downstream of the Colby Lake outlet (MNSW14) and 289 mg/L at the Highway 110 crossing (MNSW12). The full record of Mesabi Nugget's sulfate data on these water bodies is discussed below and shown in Figure 11.

4.2 Sulfate Monitoring - Baseline Data

Sulfate concentrations have been measured at one location along the Partridge River at the Highway 110 bridge crossing (MNSW12) and one location on Second Creek just before its confluence with the Partridge River (MNSW8) since 2008 as part of an ongoing water quality monitoring program for the Mesabi Nugget Phase II Project (Figure 1). An additional water quality monitoring station on the Partridge River just downstream of the Colby Lake outlet (MNSW14) was established in June 2009. These data are summarized in Table 4-2 and the time series of all observations is shown in Figure 11.

Table 4-2 Sulfate Monitoring Data Partridge and Second Creek

Monitoring Station	Water Body	Location	Monitoring Period	Average (mg/L)	Std. Dev. (mg/L)	Min. (mg/L)	Max. (mg/L)
MNSW14	Partridge River	Below Colby Lake outlet	June - August 2009	36.4	7.9	28.7	46.8
MNSW12	Partridge River	At Highway 110	May 2008 - August 2009	164	103	43.0	302
MNSW8	Second Creek	Near outlet to Partridge River	May 2008 - August 2009	474	111	269	624

Measured concentrations of sulfate in the Partridge River were greatest at the most downstream monitoring location (MNSW12), averaging 164 mg/L and ranging from 43.0 mg/L to 302 mg/L. As shown in Figure 11, sulfate concentrations in the Partridge River at MNSW12 appear to be strongly controlled by sulfate loading from Second Creek, which joins the Partridge River approximately 1,000 feet upstream of MNSW12. For the same period of record (May 2008 to August 2009), sulfate concentrations in Second Creek averaged 474 mg/L and ranged from 269 mg/L to 624 mg/L.

More recent data from upstream of the Second Creek confluence (MNSW14, from June to August 2009) confirm that sulfate concentrations in the Partridge River above Second Creek are relatively low. For this period of record, sulfate concentrations downstream of the Colby Lake outlet averaged 36.4 mg/L and ranged from 28.7 mg/L to 46.8 mg/L.

5.0 Wild Rice Summary

Results from the historic aerial imagery analysis and 2009 ground surveys identified the presence of wild rice the Lower Partridge River and the Lower St. Louis River. It is possible that the historic aerial imagery analysis resulted in mistaking other emergent vegetation for wild rice or in identifying the presence of stands of wild rice in 2003/2004 (only photographs taken in late summer, but not early in the season) and 2008. Several dense stands of wild rice were identified from ground surveys on the Lower Partridge River and in Pokegama Bay near the St. Louis River. While historic photography provides evidence of some presence on those waterbodies, the locations on the photographs often did not match the locations of wild rice identified on the ground.

It is difficult to determine the health and history of wild rice in these waterbodies without a multi-year combined analysis of ground surveys and aerial photographic imagery, as wild rice populations oscillate over an approximate 4 to 6 year period. Delays in plant nutrient uptake and wild rice tissue chemistry influence wild rice growth and production from year to year (Walker et al., 2006; Walker et al., submitted for publication 2009). Other factors such as water level, parasites, herbivory, and weather conditions may also play a role, but no data has been collected over multiple years and published. Given that wild rice populations fluctuate over a multiple year time period, studies carried out over a shorter time period (one year) may not provide sufficient information regarding the growth and production of wild rice.

Two areas had fairly dense stands of wild rice: Pokegama Bay, in the St. Louis River watershed and the Lower Partridge River near Highway 110. A comparison of measured wild rice densities for grid locations on these water bodies is presented in Figure 10, and sulfate data collected as part of this study is presented in Section 4 (Figures 7, 8 and 10). Pokegama Bay had densities between 28 and 54 stems / 0.5 m² with sulfate levels ranging from 7.0 mg/L to 8.8 mg/L. The Lower Partridge River downstream from Colby Lake had fairly dense stands between 39 and 117 stems / 0.5 m². Sulfate samples were not collected at this site during wild rice surveying, but concentrations measured by Mesabi Nugget baseline stream monitoring ranged from 46.8 mg/L below Colby Lake to 289 mg/L at the Highway 110 bridge the day prior to the wild rice survey. Additional monitoring data (both for sulfate concentrations and wild rice density) would be needed in order to determine the effects of sulfate on wild rice growth and production and the relative importance of other factors affecting wild rice density (e.g. hydrologic, weather, and ecological factors).

References

1854 Treaty Authority (2008) Wild Rice Monitoring and Abundance in the 1854 Ceded Territory (1998 - 2008)

Minnesota Department of Natural Resources. 2008. *Natural Wild Rice In Minnesota: A Wild Rice Study* document submitted to the Minnesota Legislature by the Minnesota Department of Natural Resources February 15, 2008

Personal Communication, August 19, 2009, with Dr. Anthony Kern, Northland College, Ashland, WI at the Wild Rice Symposium: People Protecting Manoomin, Manoomin Protecting People, Mahnomen, MN.

Walker, R.D., Pastor, J., Dewey, B.W. 2006. "Effects of wild rice (*Zizania Palustris* L.) straw on biomass and seed production in northern Minnesota." *Canadian Journal of Botany*, 84, (1): 1019-1024.

Walker, R.D., Pastor, J., Dewey, B.W. Submitted for publication 2009. "Litter Quantity and Nitrogen Immobilization Cause Oscillations in Productivity of Wild Rice (*Zizania palustris* L.) in Northern Minnesota." (MS# ECO-09-0211)

Figures



- Surface Water Monitoring Locations with Sulfate Listed in mg/L
- Wild Rice Locations (see Figure 5)
- Rivers and Streams
- - - City Boundaries

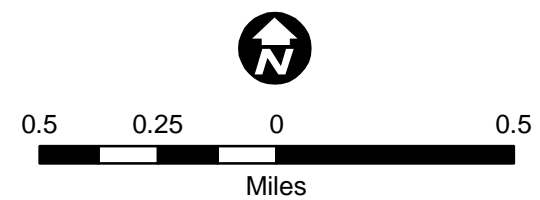


Figure 1
WILD RICE AND SULFATE SAMPLING LOCATIONS
ON THE PARTRIDGE RIVER
Mesabi Nugget Phase II
Hoyt Lakes, Minnesota



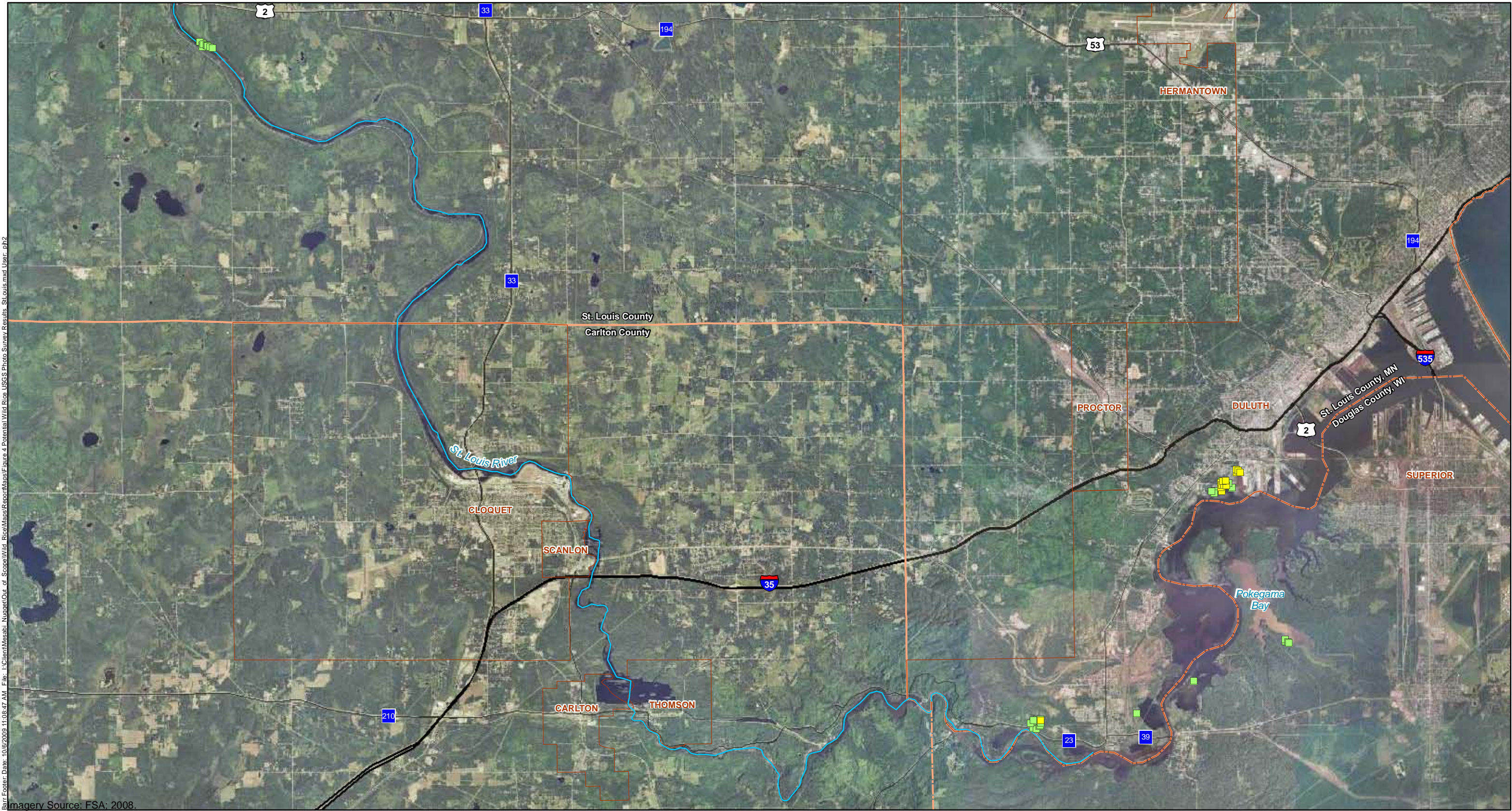


Bar Footer Date: 10/13/2009 4:32:20 PM File: I:\Client\Mesabi Nugget\Out of Scope\Wild Rice\Map\Report\Map\Figure 3 Potential Wild Rice USGS Photo Survey Results Partidoe.mxd User: am2

Imagery Source: FSA, 2008.



Figure 3
 POTENTIAL WILD RICE
 USGS PHOTOGRAPHIC SURVEY RESULTS
 FOR THE LOWER PARTRIDGE RIVER
 Mesabi Nugget Phase II
 Hoyt Lakes, Minnesota



imagery Source: FSA; 2008.

- Potential Wild Rice Location - 2004
- Potential Wild Rice Location - 2008
- Rivers and Streams
- City Boundaries
- - - County Boundary

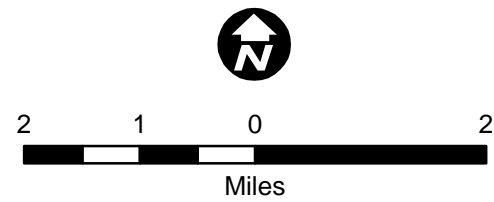
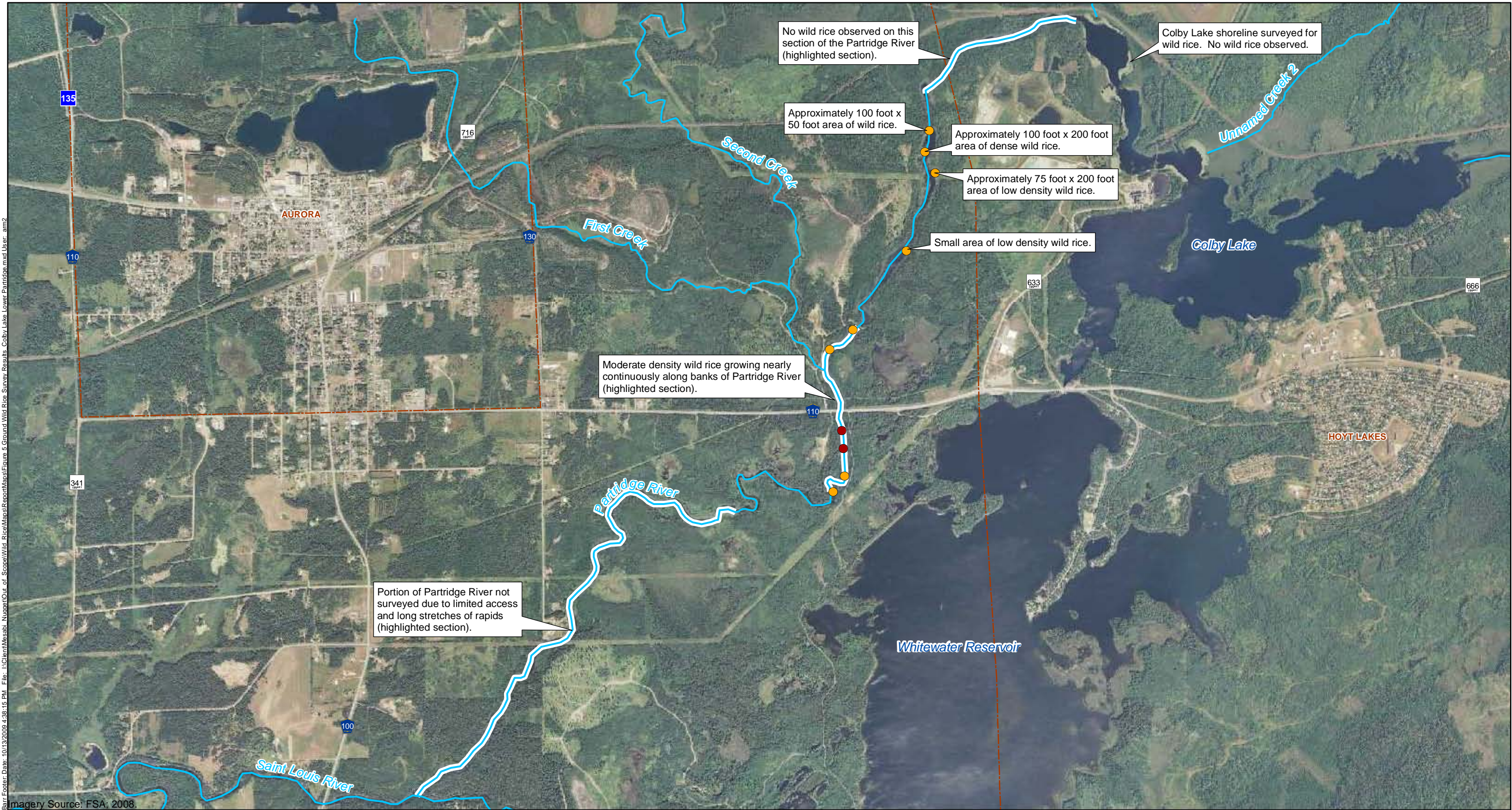


Figure 4
POTENTIAL WILD RICE
USGS PHOTOGRAPHIC SURVEY RESULTS FOR
POKEGAMA BAY & LOWER ST. LOUIS RIVER
Mesabi Nugget Phase II
Hoyt Lakes, Minnesota



Wild Rice Density

- 1 <10% Wild Rice Coverage
- 2 10 - 25% Wild Rice Coverage
- 3 25 - 50% Wild Rice Coverage
- 4 50 - 75% Wild Rice Coverage
- 5 >75% Wild Rice Coverage
- Rivers and Streams
- City Boundaries

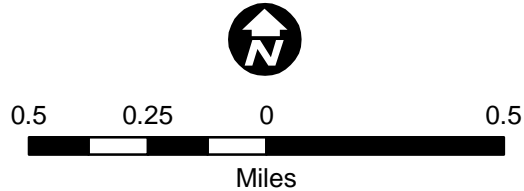
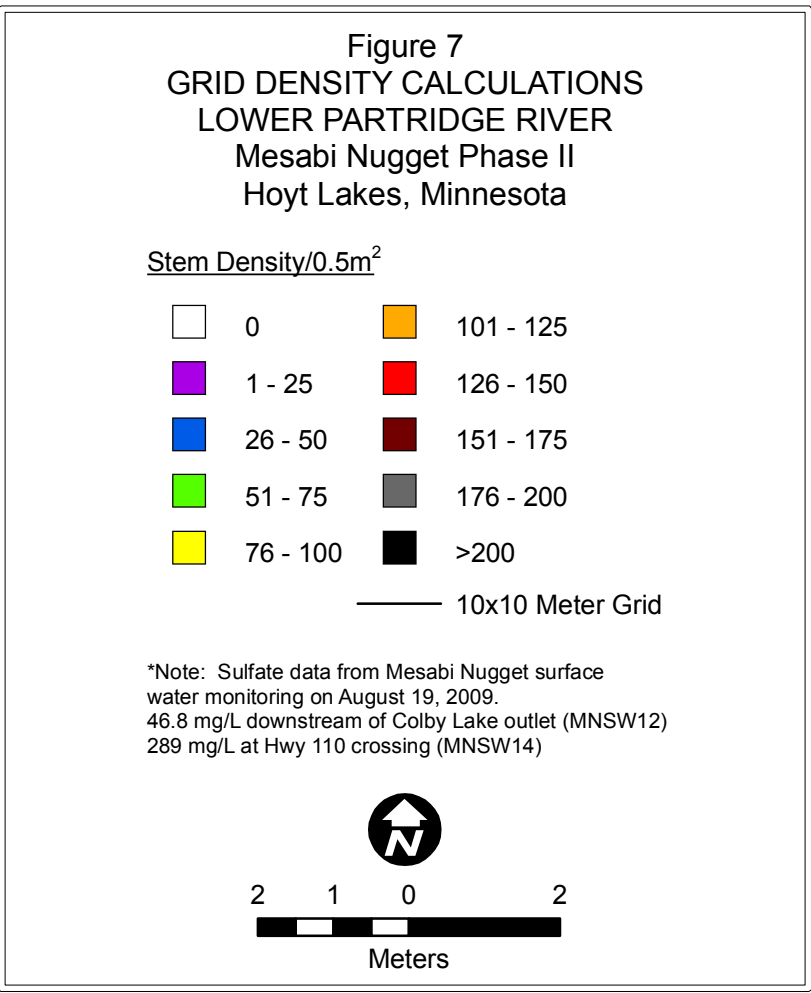
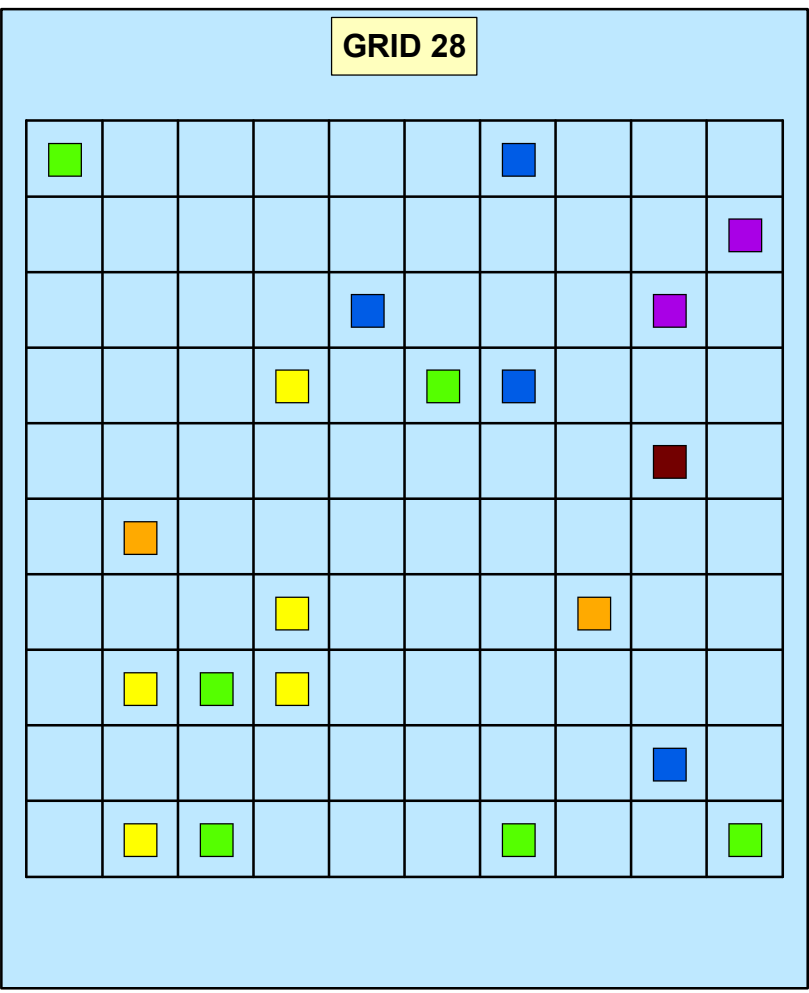
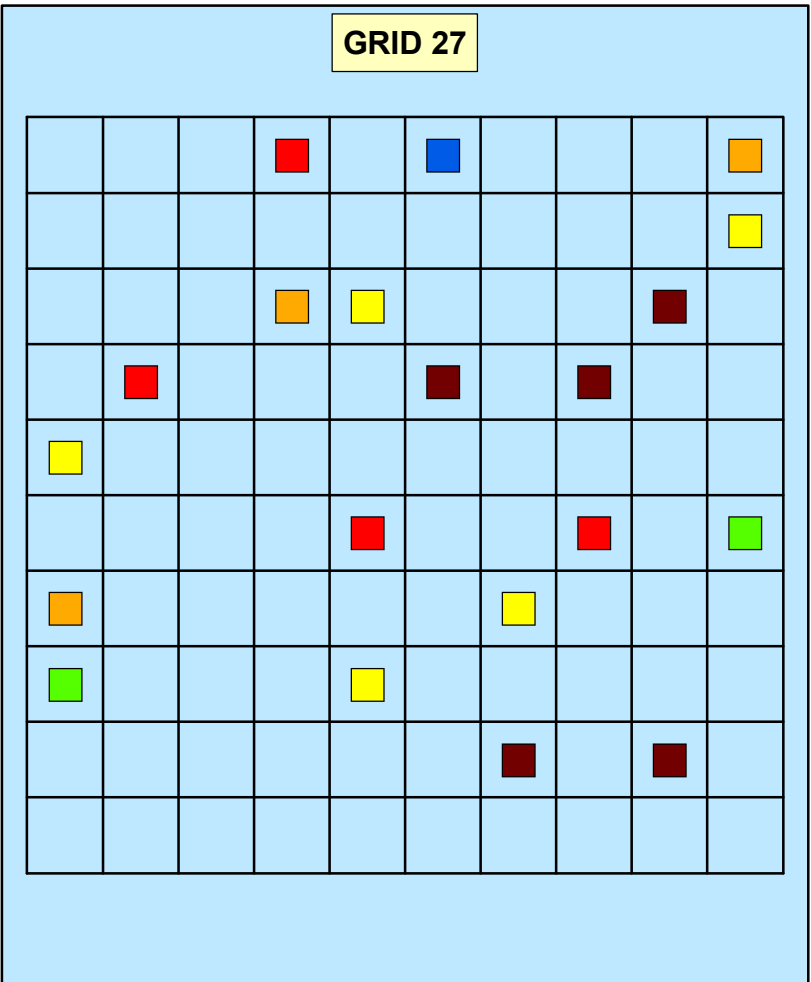
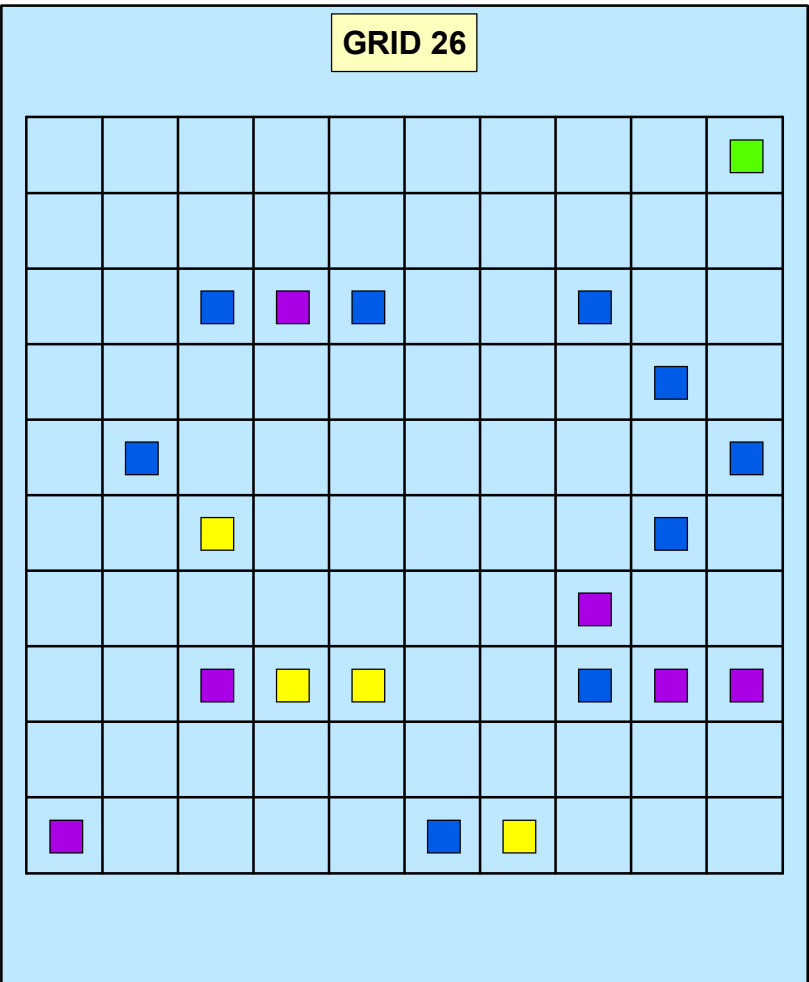
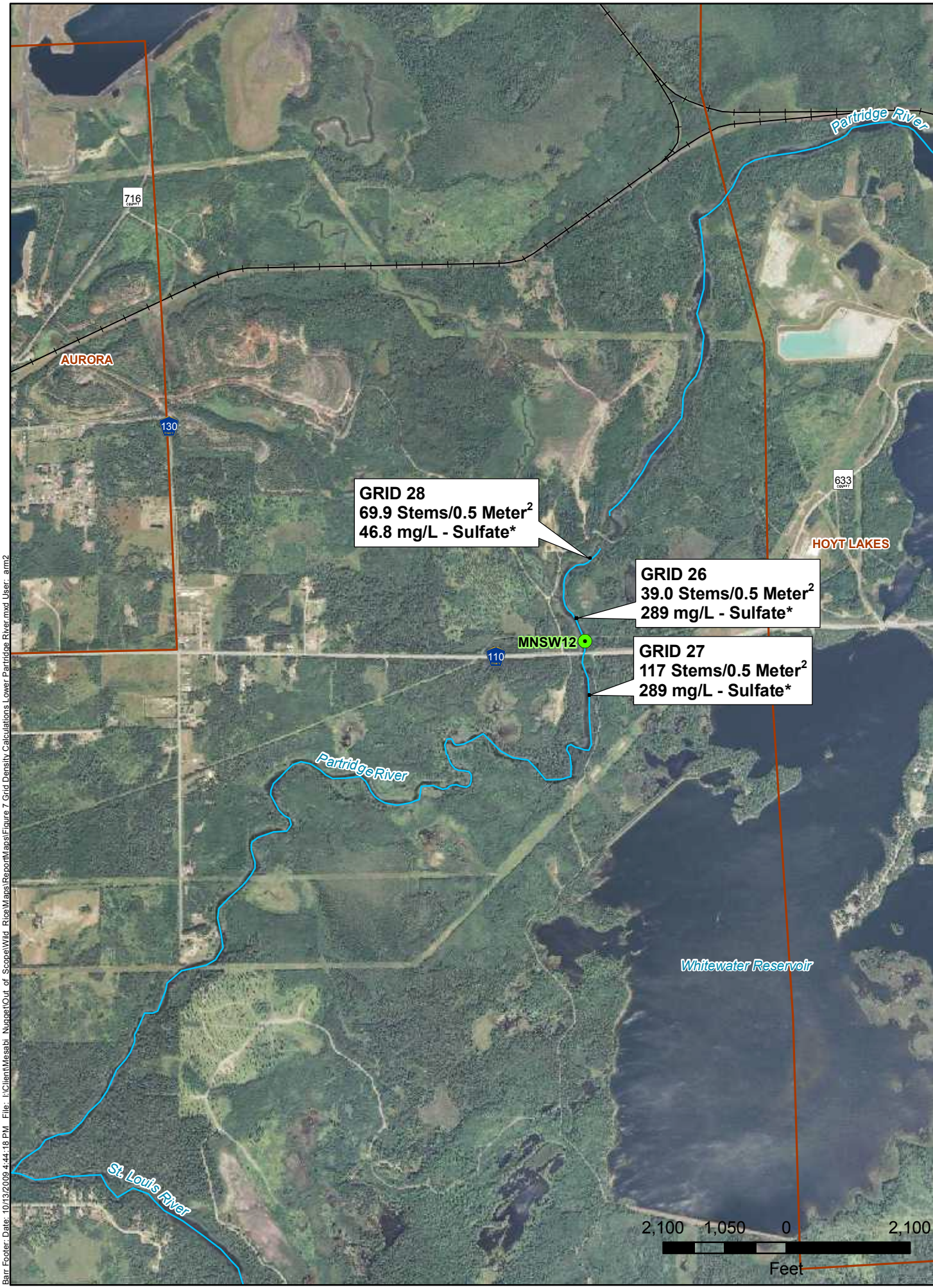
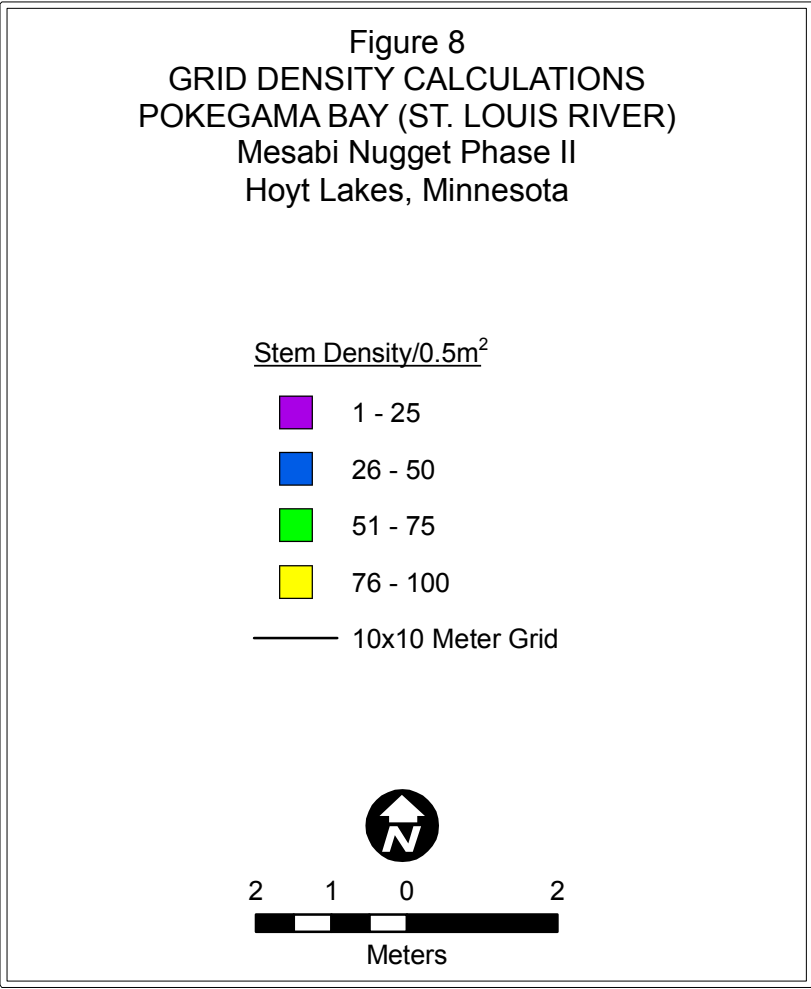
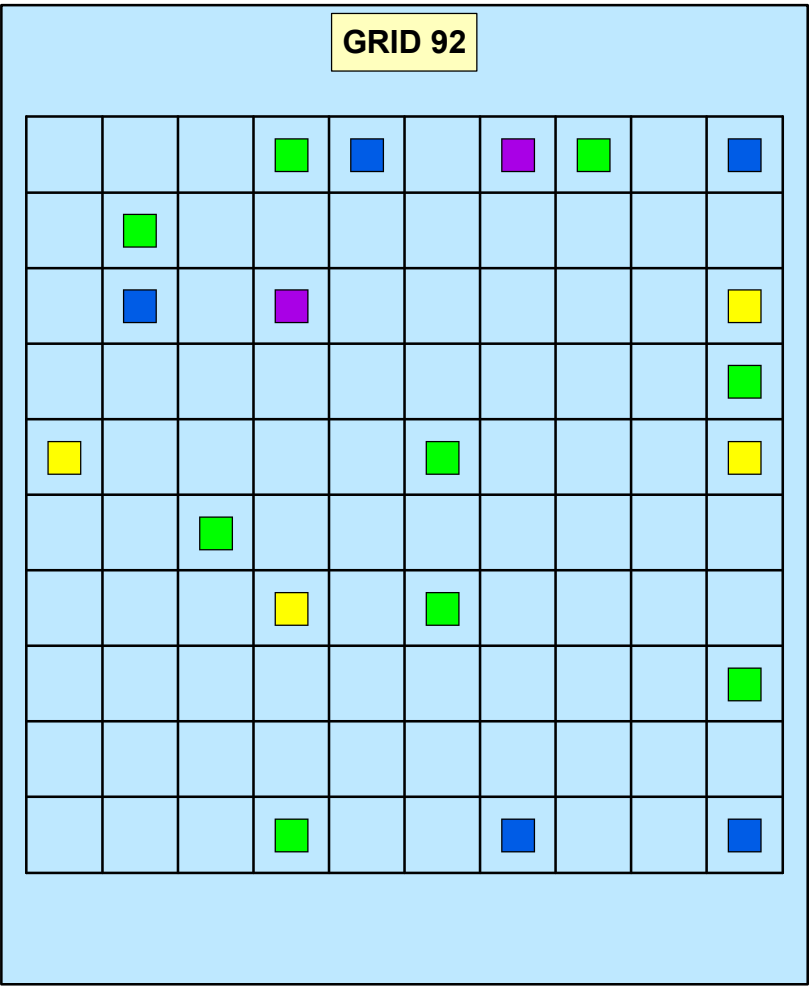
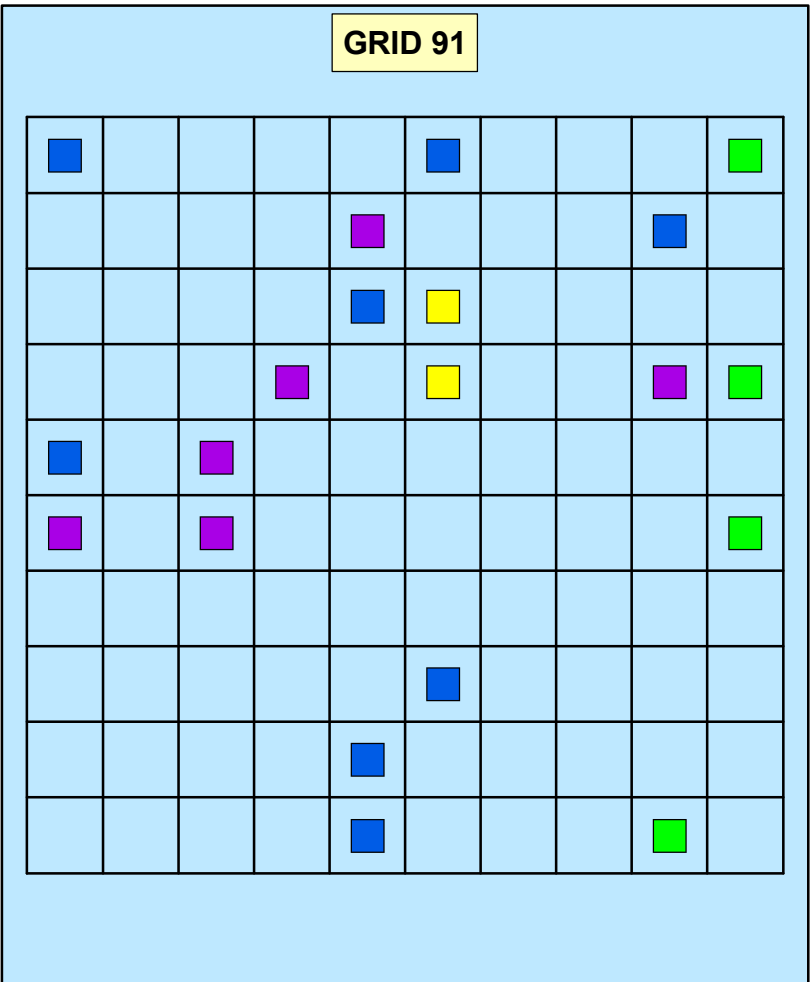
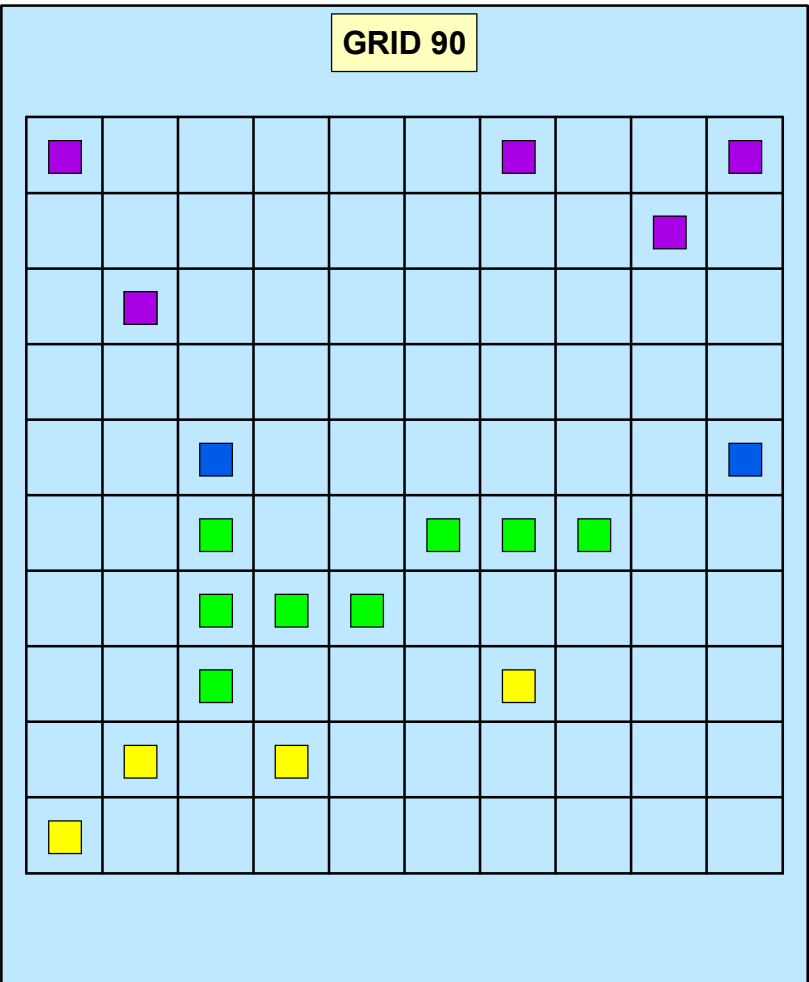
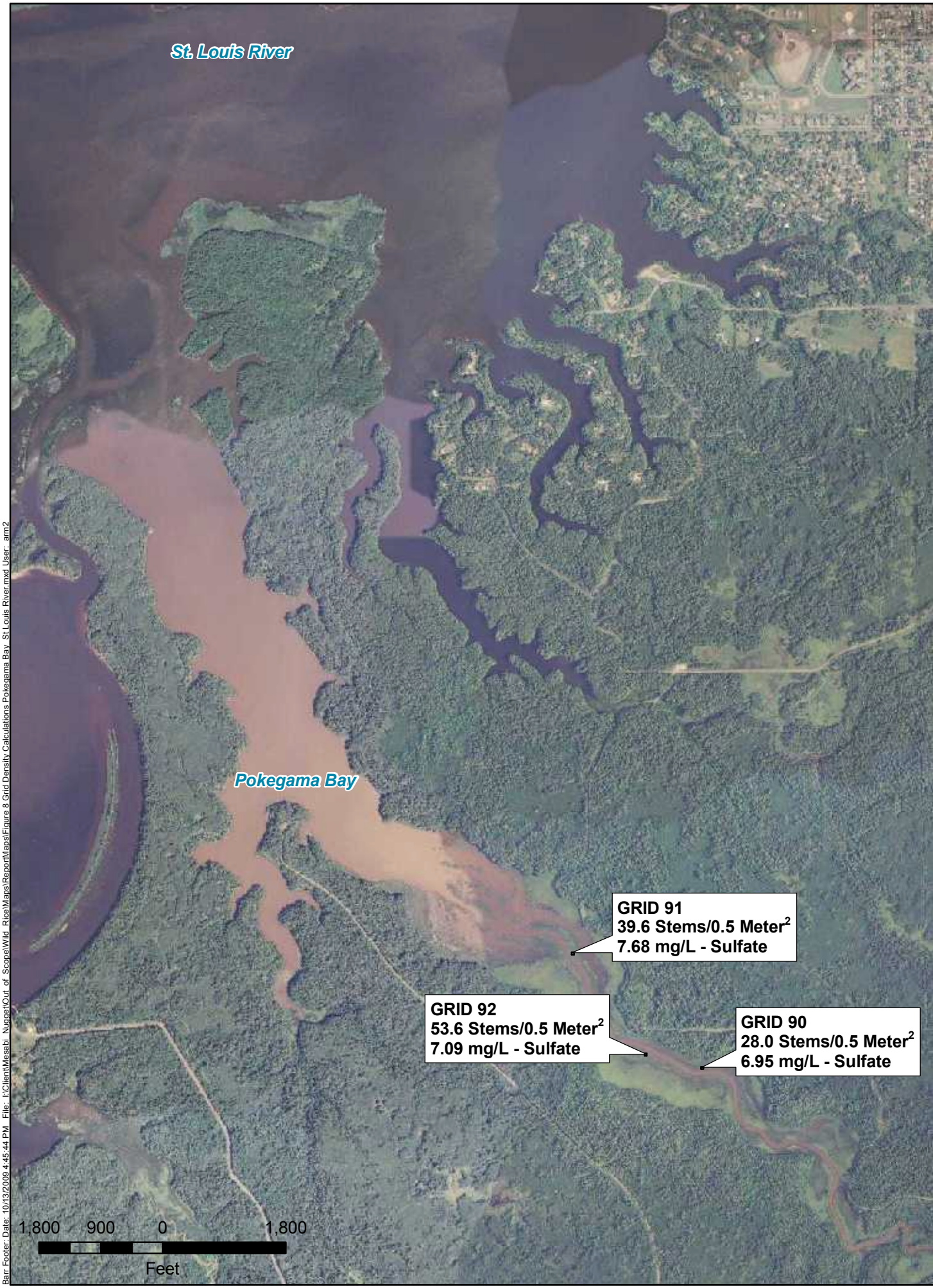


Figure 5
GROUND WILD RICE SURVEY RESULTS FOR
COLBY LAKE & THE LOWER PARTRIDGE RIVER
Mesabi Nugget Phase II
Hoyt Lakes, Minnesota





Density Level 1



Density Level 2



Density Level 3



Density Level 4

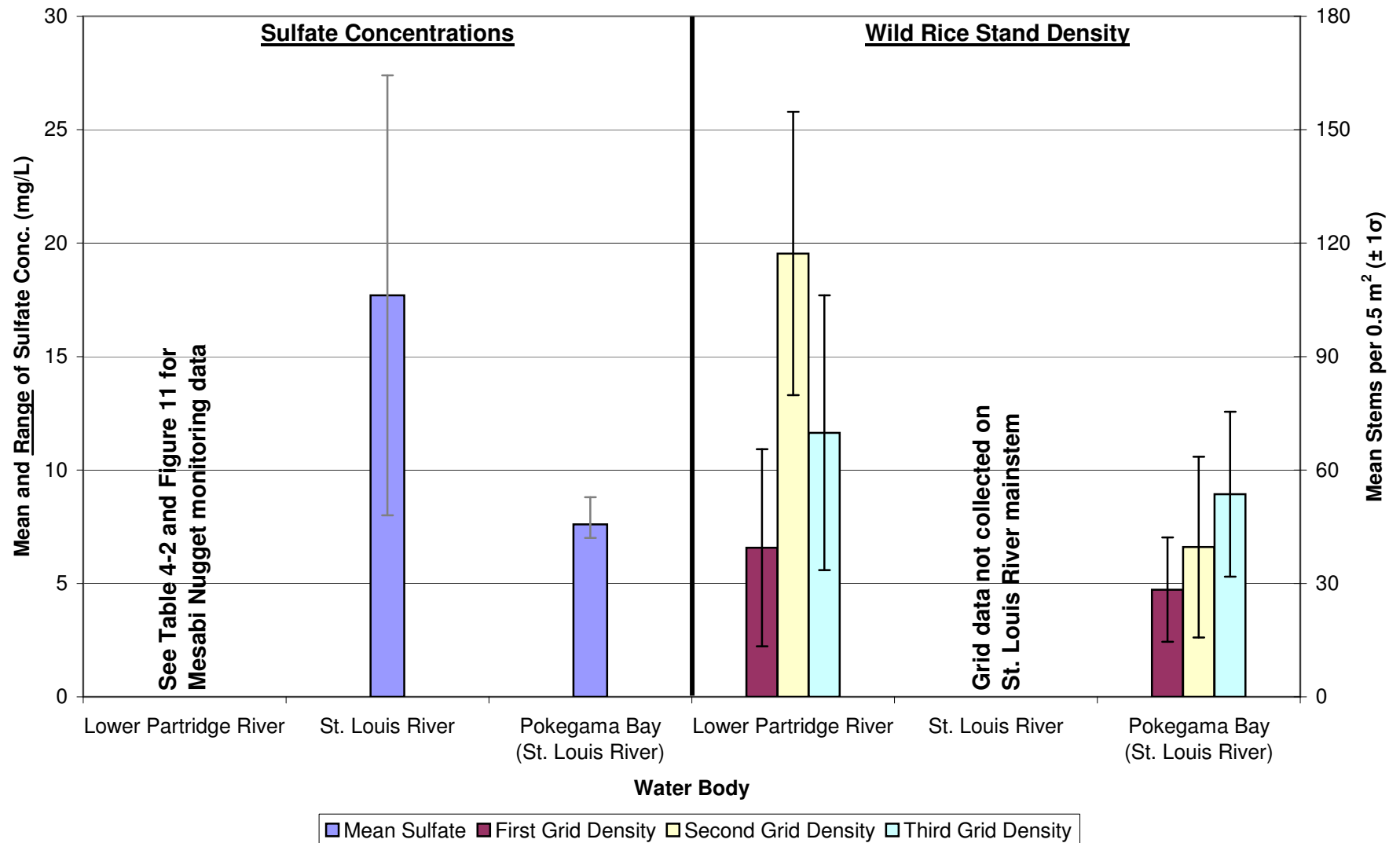


Density Level 5

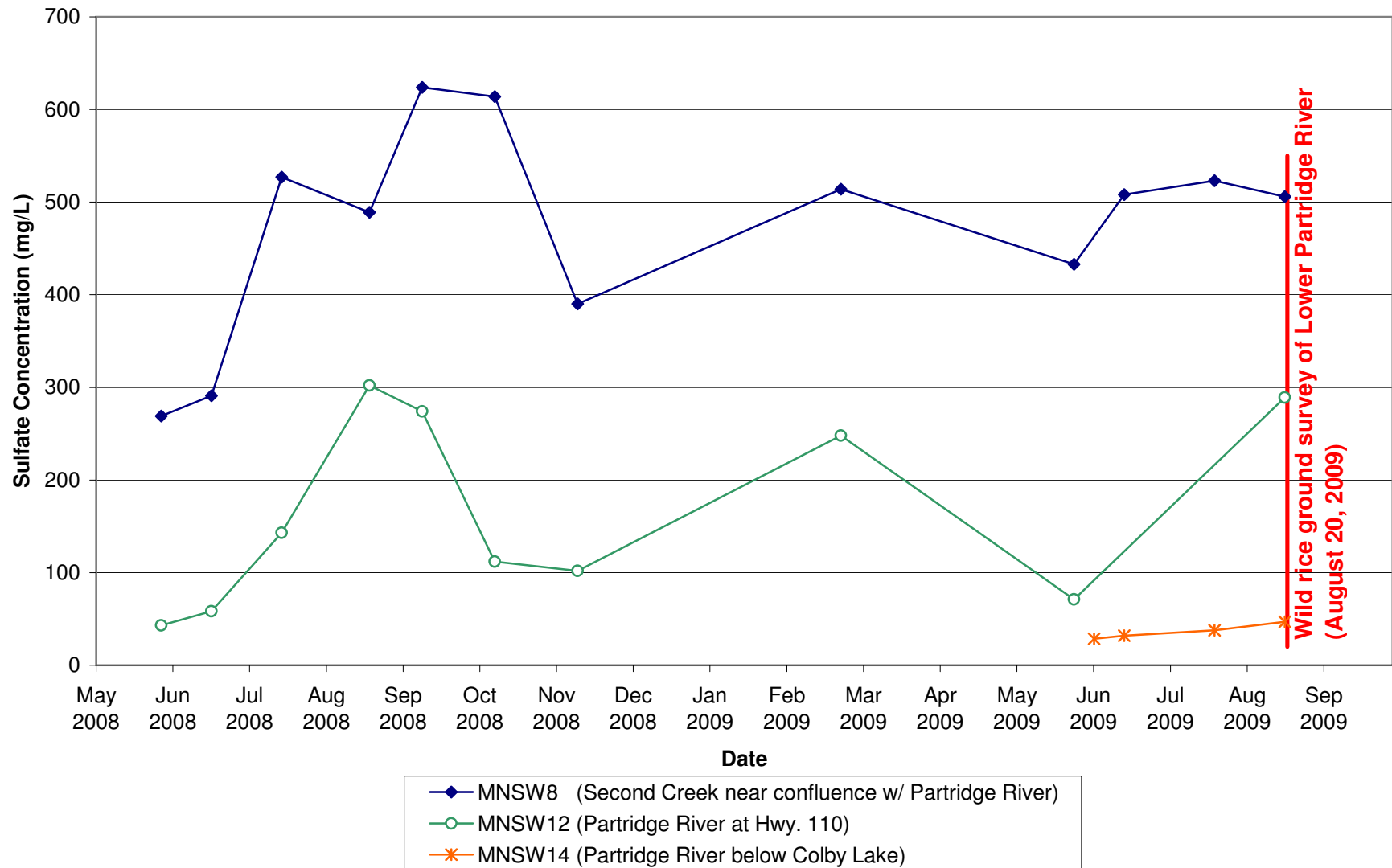


Figure 9:
Photographs Depicting Range of Wild
Rice Densities (1-5)

**Figure 10: Sulfate Concentrations and Wild Rice Stand Density in Mesabi Nugget Phase II
Project Study Area, August to September 2009**



**Figure 11: Mesabi Nugget Phase II Sulfate Monitoring Data
Partridge River and Second Creek, May 2008 through August 2009**



Appendices

Appendix A

Photographs of Wild Rice for the Project Study Area



Figure A-1 Lower Partridge River, August 20, 2009



Figure A-2 Lower Partridge River, August 20, 2009



Figure A-3 Lower St. Louis River, August 17, 2009



Figure A-4 Pokegama Bay, August 17, 2009

Appendix B

Wild Rice Grid Density Calculations for the Project Study Area

***Lower Partridge River
Pokegama Bay (St. Louis River)***

8/21/2009

Grid 26				Grid 27				Grid 28			
Plots	Water Depth (in)	Stems	Height	Plots	Water Depth (in)	Stems	Height	Plots	Water Depth (in)	Stems	Height
Plot 91	45	2	25	Plot 48	14	167	26	Plot 1	14.5	71	18
5263119 N				5262725 N			26	5263440 N			26
560961 E				561035 E			25	561032 E			24
							22				19
							20				26
Plot 42	29	30	24	Plot 39	12.5	169	29	Plot 52	13	113	24
5263124 N			17	5262726 N			22	5263435 N			22
560962 E			20	561036 E			23	561033 E			20
			25				25				26
							32				20
Plot 23	29	33	25	Plot 99	12	161	24	Plot 72	13	94	25
5263126 N			8	5262720 N			22	5263433 N			27
560963 E			26	561036 E			23	561033 E			19
			25				23				21
			24				29				17
Plot 53	29	80	28	Plot 70	14	63	22	Plot 73	12.5	72	23
5263123 N			23	5262723 N			26	5263433 N			25
560963 E			22	561037 E			24	561034 E			24
			23				24				26
			23				19				25

8/21/2009

Grid 26				Grid 27				Grid 28			
Plots	Water Depth (in)	Stems	Height	Plots	Water Depth (in)	Stems	Height	Plots	Water Depth (in)	Stems	Height
Plot 73	34	21	25	Plot 30	10	97	22	Plot 74	11.5	77	24
5263121 N			16	5262727 N			21	5263433 N			24
560963 E			28	561037 E			24	561035 E			25
			30				23				19
			36				21				24
Plot 74	34	88	29	Plot 20	9	108	25	Plot 64	14	80	14
5263121 N			25	5262728 N			24	5263434 N			19
560964 E			34	561037 E			21	561035 E			21
			28				20				25
			27				18				21
Plot 75	29	78	22	Plot 51	23	99	23	Plot 93	13	56	23
5263121 N			27	5262724 N			24	5263431 N			22
560965 E			31	561028 E			24	561034 E			20
			30				24				25
			32				28				27
Plot 24	28	20	27	Plot 42	21	145	22	Plot 92	12	88	20
5263126 N			22	5262725 N			20	5263431 N			24
560964 E			15	561029 E			24	561033 E			22
			23				25				26
			24				25				33

8/21/2009

Grid 26				Grid 27				Grid 28			
Plots	Water Depth (in)	Stems	Height	Plots	Water Depth (in)	Stems	Height	Plots	Water Depth (in)	Stems	Height
Plot 25	27	31	24	Plot 71	39	109	19	Plot 34	13	87	23
5263126 N			25	5262722 N			19	5263437 N			23
560965 E			16	561028 E			20	561035 E			18
			18				26				21
			20				25				28
Plot 96	31	29	16	Plot 81	37	65	24	Plot 25	13	42	31
5263119 N			23	5262721 N			19	5263438 N			24
560966 E			21	561028 E			26	561036 E			22
			24				17				19
			22				21				24
Plot 97	26	80	29	Plot 14	15	126	22	Plot 36	16	57	15
5263119 N			25	5262728 N			28	5263437 N			18
560967 E			25	561031 E			23	561037 E			18
			26				27				24
			27				29				22
Plot 78	32	33	22	Plot 34	20	114	25	Plot 37	17	34	23
5263121 N			25	5262726 N			24	5263437 N			21
560968 E			21	561031 E			24	561038 E			33
			18				30				23
			21				30				22

8/21/2009

Grid 26				Grid 27				Grid 28			
Plots	Water Depth (in)	Stems	Height	Plots	Water Depth (in)	Stems	Height	Plots	Water Depth (in)	Stems	Height
Plot 79	32	18	19	Plot 35	19	100	25	Plot 7	13.5	45	20
5263121 N			13	5262726 N			28	5263440 N			19
560969 E			19	561032 E			24	561038 E			17
			24				24				22
			19				29				28
Plot 80	28	18	25	Plot 65	19	131	26	Plot 20	20	10	22
5263121 N			25	5262723 N			22	5263439 N			18
560970 E			23	561032 E			24	561041 E			25
			23				25				25
			25				23				19
Plot 68	30.5	4	24	Plot 85	19	89	21	Plot 29	16.5	10	28
5263122 N			20	5262721 N			23	5263438 N			23
560968 E				561032 E			21	561040 E			19
							24				21
							27				20
Plot 59	21.5	39	19	Plot 16	14	49	24	Plot 49	14	168	26
5263123 N			20	5262728 N			22	5263436 N			23
560969 E			31	561033 E			24	561040 E			25
			20				29				22
			22				26				28

8/21/2009

Grid 26				Grid 27				Grid 28			
Plots	Water Depth (in)	Stems	Height	Plots	Water Depth (in)	Stems	Height	Plots	Water Depth (in)	Stems	Height
Plot 50	17.5	40	23	Plot 46	16	158	25	Plot 68	15	107	26
5263124 N			13	5262725 N			28	5263434 N			20
560970 E			18	561033 E			26	561039 E			21
			22				34				27
			25				23				27
Plot 39	19.5	32	19	Plot 77	14.5	81	21	Plot 89	18	45	24
5263125 N			27	5262722 N			23	5263432 N			19
560969 E			21	561034 E			26	561040 E			19
			22				22				27
			20				29				17
Plot 28	20.5	41	17	Plot 97	13.5	164	24	Plot 97	17	72	26
5263126 N			18	5262720 N			27	5263431 N			24
560968 E			20	561034 E			26	561038 E			24
			19				29				26
			26				26				22
Plot 10	10	72	32	Plot 68	14	150	25	Plot 100	20	69	22
5263128 N			28	5262723 N			24	5263431 N			35
560970 E			21	561035 E			22	561041 E			31
			27				23				29
			23				23				24

Table B-1: Lower Partridge River (Below Colby Lake)

8/20/2009

8/20/2009

8/21/2009

Grid 26				Grid 27				Grid 28			
Water Depth (in)				Water Depth (in)				Water Depth (in)			
Plots	Stems	Height		Plots	Stems	Height		Plots	Stems	Height	
	Stems	Height			Stems	Height			Stems	Height	
Total		789	2129	Total		2345	2419	Total		1397	2307
Mean		39	23.14	Mean		117.25	24.19	Mean		69.85	23.07
Median		33	23	Median		111.5	24	Median		71.5	23
S.D.		26	4.72	S.D.		37.4656	3.05	S.D.		36.32	3.84

9/8/2009

Grid 90				Grid 91				Grid 92			
Plots	Water Depth (cm)	Stems	Height (cm)	Plots	Water Depth (cm)	Stems	Height	Plots	Water Depth (cm)	Stems	Height
Plot 1	57	33	142	Plot 1	62	45	168	Plot 12	60	56	138
5169514 N			128	5170023 N			145	5169572 N			139
565561 E			134	564985 E			171	565311 E			166
			112				158				138
			102				113				133
Plot 22	56	26	134	Plot 41	64	26	155	Plot 22	51	26	114
5169512 N			133	5170019 N			119	5169571 N			158
565562 E			109	564985 E			144	565311 E			119
			103				125				118
			106				107				122
Plot 91	60	31	96	Plot 51	64	12	105	Plot 41	58	86	89
5169505 N			97	5170018 N			144	5169569 N			133
565561 E			127	564985 E			139	565310 E			125
			147				109				95
			96				73				140
Plot 82	61	32	115	Plot 53	63	22	88	Plot 64	52	85	146
5169506 N			79	5170018 N			130	5169567 N			147
565562 E			98	564987 E			126	565313 E			132
			119				119				151
			82				82				108

9/8/2009

[illegible]

9/8/2009

Grid 90				Grid 91				Grid 92			
Plots	Water Depth (cm)	Stems	Height (cm)	Plots	Water Depth (cm)	Stems	Height	Plots	Water Depth (cm)	Stems	Height
Plot 53	62	39	115	Plot 76	57	28	151	Plot 5	55	40	103
5169509 N			151	5170016 N			136	5169573 N			130
565563 E			88	564990 E			103	565314 E			112
			92				112				121
			90				102				100
Plot 43	60	12	115	Plot 36	59	78	152	Plot 46	57	51	117
5169510 N			83	5170020 N			97	5169569 N			124
565563 E			87	564990 E			117	565315 E			146
			93				115				104
			92				142				128
Plot 22	62	15	114	Plot 25	57	45	138	Plot 66	55	53	120
5169512 N			124	5170021 N			136	5169567 N			121
565562 E			120	564989 E			124	565315 E			162
			121				131				126
			133				90				150
Plot 77	61	29	141	Plot 26	61	99	153	Plot 97	60	33	134
5169507 N			90	5170021 N			151	5169564 N			135
565567 E			111	564990 E			105	565316 E			104
			164				134				144
			153				106				131

9/8/2009

Grid 90				Grid 91				Grid 92			
Plots	Water Depth (cm)	Stems	Height (cm)	Plots	Water Depth (cm)	Stems	Height	Plots	Water Depth (cm)	Stems	Height
Plot 56	58	43	140	Plot 6	60	28	132	Plot 8	55	58	98
5169509 N			102	5170023 N			110	5169573 N			124
565566 E			113	564990 E			100	565317 E			132
			118				89				136
			136				107				112
Plot 57	58	50	129	Plot 15	68	7	100	Plot 7	61	21	109
5169509 N			105	5170022 N			100	5169573 N			123
565567 E			91	564989 E			120	565316 E			102
			112				64				107
			113				86				114
Plot 65	62	13	140	Plot 10	59	53	139	Plot 10	62	32	88
5169508 N			117	5170023 N			122	5169573 N			108
565565 E			135	564994 E			125	565319 E			128
			79				86				125
			86				100				111
Plot 7	63	11	62	Plot 19	57	35	109	Plot 30	56	83	128
5169514 N			99	5170022 N			108	5169571 N			131
565567 E			75	564993 E			134	565319 E			137
			84				112				129
			83				112				78

9/8/2009

[illegible]

Table B-2: Pokegama Bay (St. Louis River)

9/8/2009

9/8/2009

9/8/2009

Grid 90				Grid 91				Grid 92			
Plots	Water Depth (cm)	Stems	Height (cm)	Plots	Water Depth (cm)	Stems	Height	Plots	Water Depth (cm)	Stems	Height
		Stems	Height			Stems	Height			Stems	Height
Total		567	10850	Total		792	12151	Total		1072	12221
Mean		28	108.50	Mean		39.6	121.51	Mean		53.6	122.21
Median		30	110	Median		35.5	119.5	Median		54.5	123
S.D.		14	23.52	S.D.		23.913	23.46	S.D.		21.81	18.72

Appendix C

***MPCA Wild Rice Information Request
May 28, 2009***

Memorandum

From: Clark, Richard
Sent: Thursday, May 28, 2009 11:03 AM
To: 'Tom Lutes'; 'Jasmine Scheuring'
cc: 'Bill Johnson'; 'Steve Colvin'; Brian Timerson; Nelson, Christopher; 'Kirk Rosenberger'
Subject: MPCA Wild Rice Information Request

Tom and Jasmine,

The purpose of this email is to transmit to you the type of information that the MPCA is requesting from a mining project proposer/permittee of a facility that may affect waters that contain, or have the potential to contain wild rice - this applies to the Mesabi Nugget Phase II project. It would be helpful if this information was collected as soon as practical this spring/early summer so that it can be available to the environmental review and permitting processes. If you have questions please feel free to contact me or Brian Timerson.

Richard

651-757-2280

1. Conduct a literature search for wild rice in the downstream receiving waters impacted by the proposed project. Some data sources that may be used to determine the potential for wild rice impacts includes Appendix A of the 2008 DNR Wild Rice Report, the most recent DNR Wild Rice Harvester Survey, and the 1854 Treaty Authority List. For waters listed in the DNR Wild Rice Report, contact Gary Drotts at 218-833-8620 and Ann Geisen at 218-833-8625 to gather all the available DNR data on those sites. Information on any active or proposed DNR management activities designed to establish, protect, or enhance the wild rice resources of these waters should be included. In addition, Darren Vogt of the 1854 Treaty Authority should be contacted at 218-722-8907 for any further data he may have related to sites listed on one of the above lists.

2. Undertake a cooperative information gathering/exchange process with the tribes in the project area to evaluate the past, current and future wild rice status or management objectives on the sites identified above as potential wild rice waters. Informational items to be addressed include:

- A description of the historical/cultural importance of the wild rice resources at these sites.

- An estimate of the historic size (acres) of wild rice stands at these sites with an estimate of the year in which the observation was made.
- Any information the tribe may have on if/how wild rice stands at each site may have changed over time.
- Any data the tribes may have concerning whether anything in particular has contributed to the change in the size of wild rice stands at these sites.
- A description of the current use of the sites for ricing, if any.
- Information on any active or proposed management activities designed to establish, protect, or enhance the wild rice resources of these waters.

3. Conduct a field survey to observe whether wild rice is actually present in all waters in the project area that were determined to have the potential for wild rice, either based on the literature search above or those that have characteristics which may encourage wild rice production. The field surveys should be conducted by a qualified professional and should take into account the cyclic nature of the growth of this aquatic plant.

4. Determine the current sulfate levels, as determined by known historical data or additional sampling as required, for those waters where wild rice was observed during the field survey. Sampling should be conducted at a minimum of six separate locations within discernible wild rice areas of each applicable water body or stream reach.

5. Submit any other information or data that the project proposer/permittee believes may be useful to the Agency's evaluation.