2011 Wild Rice and Water Quality Monitoring

Second Creek, Spring Mine Creek, Trimble Creek, Unnamed Creek (PM 11), Wyman Creek, Embarrass River, Partridge River, and Pike River

Prepared for
PolyMet Mining Inc. – NorthMet Project

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1.0 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 with regard to the PolyMet Mining, Inc. (PolyMet) NorthMet Project (Project). This report comprises the third year of data collection to fulfill that request. This report does not include information considered duplicative of the *2009 Wild Rice and Sulfate Monitoring* report (2009 report) and *2010 Wild Rice and Water Quality Monitoring* report (2010 report). As in 2010, this report includes a ground survey of wild rice presence and density, plant collection data, analysis of plant growth parameters in the laboratory, and analysis of water quality parameters in addition to sulfate (SO_4^{2-}), including major cations (Mg^{2+}, Ca^{2+}, K^+, and Na^+) and major anions (HCO_3^- and Cl^-). In 2010, the latter three activities were discussed with the MPCA as useful additions to the original request, but were not communicated formally by letter or email. PolyMet chose to comply with those requests. The MPCA requested some additional explanation and clarification of data from the Embarrass and Partridge Rivers. Memoranda provided to the MPCA on 6/29/2011, 9/15/2011 and 11/4/2011 are included as appendices to this report. Several water bodies that were surveyed in 2009 and/or 2010 were not surveyed in 2011, including Pokegama Bay, Colby Lake, Esquagama Lake, sections of the St. Louis River, and the Embarrass River downstream of Esquagama Lake.

2.0 Wild Rice Survey

The purpose of the Wild Rice Survey is to determine the presence, stand density, and measurements of plant growth of wild rice (*Zizania palustris L*, known as *Manoomin* in Ojibwe), an annual grass, on Second Creek; Spring Mine Creek, Unnamed Creek (PM 11), Trimble Creek, Wyman Creek, the Embarrass River from Spring Mine Creek to Fourth Lake; the Partridge River from Longnose Creek to County Highway 110, Hay Lake (MN ID 69579), Little Rice Lake (MN ID 69578), and the Pike River (Study Area) (Figure 1). Because wild rice populations oscillate over an approximate 4- to 6-year period, the following analyses and ground surveys were performed to determine the presence of wild rice and some basic plant and water quality parameters in waters where wild rice has been observed in the Study Area. The survey and sampling consisted of:

1) On-the-ground verification of the presence and density of select wild rice stands.

2) Plant survey collection from each grid and from some select locations. Measurement and basic statistical analyses of plant growth parameters including: total plant biomass, root biomass, seed biomass and seed number.

3) In addition to sulfate (SO_4^{2-}), chemical analysis of water samples collected in or next to wild rice stands; analyses include sulfate, major cations (Mg^{2+}, Ca^{2+}, K^+, and Na^+) and major anions (HCO_3^- and Cl^-).

2.1 Wild Rice Survey Methodology

The following section describes the methodologies used in obtaining information and data on wild rice and is consistent with the 2009 and 2010 reports.

2.1.1 Methodology of Ground Verification and Density/Acreage Calculations

Surveys to estimate wild rice density and stand size were carried out in August and September 2011. Methods from PolyMet's *2009 Wild Rice Survey and Sulfate Monitoring* report were followed in 2011. Table 1 includes information regarding the wild rice density classification and percent coverage.

Table 1 Wild Rice Density Scale

Wild Rice Density Classification	Description
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

As in 2009 and 2010, stem density data were collected from nine grid locations in 2011. Table 2 includes grid numbers and location information. Grid data is also included in Figures 10 though 14, and in Appendix B.

Table 2 Wild Rice Grid Number and Locations in the Study Area

Grid Number	Coordinates of Grid Center*		Grid Location
21	549835.49796	5261317.49272	Unnamed Lake
22	549835.49796	5262467.50035	Lower Embarrass Lake
29	549835.49796	5260244.95534	Cedar Island Lake
30	549835.49796	5259368.08856	Cedar Island Lake
19	549835.49796	5268473.18967	Pike River
20	549835.49796	5268667.51108	Little Rice Lake
26	549835.49796	5263123.50420	Partridge River
27	549835.49796	5262723.49610	Partridge River
28	549835.49796	5263435.49274	Partridge River

* Coordinates are NAD 83 / UTM Zone 15N

Prior to conducting field surveys in 2009, field staff carried out an initial evaluation of the Study Area water bodies by reviewing aerial photographs. Aerial photographs were examined to obtain a preliminary understanding of stream conditions prior to the field visit, and to evaluate and document channel conditions along stream stretches that were not navigable by canoe or kayak and too difficult to access on foot. Such evaluation was separate from the historic aerial photographic imagery analysis discussed on pp. 2 and 3 of the 2009 Report. Stream conditions which limited access by canoe, kayak, or foot also tend not to favor wild rice growth. These include, but are not limited to:

- Very low water levels (less than 1 foot);
- Predominantly rocky or sandy substrate;
- Narrow channel conditions with little to no open water often due to thick vegetation growth or channel morphology;
- Algal growth; and
- Presence of shrub and tree species next to the streambed, or overhanging the stream.

2.2 Wild Rice Survey Results

The following sections include the results of the 2011 wild rice field survey for the Study Area. As in 2009 and 2010, the wild rice surveys were conducted in waters associated with three distinct water courses: Embarrass River, Partridge River, and Pike River. Waters surveyed in the Embarrass River watershed include Spring Mine Creek, Trimble Creek, Unnamed Creek, Embarrass River, Hay Lake, Sabin Lake, Wynne Lake, Embarrass Lake, Lower Embarrass Lake, Unnamed Lake, Cedar Island Lake, and Fourth Lake (Section 2.2.1). Waters surveyed in the Partridge River watershed include sections of the Partridge River, Second Creek, and Wyman Creek (Section 2.2.2). Waters surveyed in the Pike River watershed include the Pike River, Little Rice Lake, and Hay Lake (Section 2.2.3). The St. Louis River and Pokegama Bay were surveyed in 2009 and 2010. Results from the 2009 and 2010 reports are included for comparison as applicable. Photographs of wild rice in the Study Area in 2011 are included in Appendix A. Detailed density calculations from the ground surveys are included in Appendix B.

2.2.1 2.2.1 Wild Rice Survey of Embarrass River and Tributaries

Embarrass River and the Embarrass River Chain of Lakes

Prior to preparation of this report, in response to MPCA requests, Barr sent two emails with additional information regarding Embarrass River water bodies. On June 29, 2011, Barr submitted a memorandum to the MPCA regarding habitat conditions of Unnamed Creek (PM11), northwest of the former LTVSMC Tailings Basin (Appendix D). On September 15, 2011, Barr submitted information (maps, photographs, and descriptions) to the MPCA documenting three years (2009-2011) of wild rice observations for the section of the Embarrass River between Hwy 135 and the outlet of Wynne Lake, as well as the adjacent Hay Lake (MN Lake ID 69435) (Appendix E). Some wild rice stands were observed all three years, while others appeared some years and not others. Approximate stand size and density also appear to fluctuate year to year. In 2011, wild rice was observed in three distinct stands (density ratings of 1) on the upper Embarrass River between Sabin Lake and Hwy 135

(Figure 2). Along this river segment, six stands (density rating 1) were observed in 2010, and two stands (density rating 1) were observed in 2009.

The Embarrass River and its chain of lakes were surveyed in August 2011, from its confluence with Spring Mine Creek to the outlet of Fourth Lake (Figures 2 - 4). Sabin and Wynne Lakes were surveyed on August 25, 2011. A small group of wild rice plants were observed on the north end of Wynne Lake (Figure 3), in the same place wild rice was observed in 2009 and 2010; substrate was coarse sand with a water depth of 1.5 feet. Wild rice was not observed in other parts of Sabin and Wynne Lakes in 2011.

Embarrass Lake was surveyed on August 8, 2011. No wild rice was observed on Embarrass Lake in 2011 (Figure 3). Low density stands rice of wild rice were observed on Embarrass Lake during the 2009 and 2010 surveys. Field staff documented that the shoreline was rocky, with very little aquatic vegetation in the lake.

In 2011, wild rice was observed in Lower Embarrass Lake at similar locations and densities as observed during the 2009 and 2010 surveys (Figure 4). Grid 22 mean stem density was 0.45 stems / 0.5 m^2 (Figure 9, Appendix B-2). Mean density declined from 2010 (0.65 stems / 0.5 m^2) and 2009 (18.9 stems / 0.5 m^2).

Unnamed Lake (surveyed August 11, 2011) and Cedar Island Lake (surveyed August 10, 2011) had the largest populations of wild rice on the Embarrass River system, with density ratings ranging from 1 to 4 (Figure 4). Grid 21 on Unnamed Lake had a mean stem density of 1.7 stems/ 0.5 m^2 (Figure 10, Appendix B-2). Mean density declined from 2010 (5.1 stems / 0.5 m^2) and 2009 (20.0 stems / 0.5 m^2). Cedar Island Lake Grids 29 and 30 mean stem densities were 28.0 and 38.3 stems / 0.5 m^2, respectively (Figure 11, Appendix B-1). Mean densities declined from 2010 (60.0 and 60.2 stems / 0.5 m^2) and 2009 (54.0 and 56.9 stems / 0.5 m^2).

Fourth Lake was surveyed August 11, 2011 and had wild rice at densities and locations similar to previous years (Figure 4).

Hay Lake (MN Lake ID 69435)

Hay Lake's shore was surveyed on foot on September 7, 2011 (Figure 2). It was not possible to canoe or kayak due to low water levels. Hay Lake is man-made, created by an earthen berm and wooden stop-log structure at its outlet. Although the lake was mostly dry in 2010 (due to erosion of the earthen berm along the outlet structure), the berm appeared to have been repaired prior to the

2011 survey, and its basin re-flooded. Shoreline water levels were shallow (less than two feet deep). Dominant lake vegetation included bur-reeds (*Sparganium* spp.), arrowheads (*Sagittaria* spp.), sedges (*Carex* spp.), spike rushes (*Eleocharis* sp.), and bluejoint grass (*Calamagrostis canadensis*). No wild rice was observed in 2011. The survey, however, was conducted by walking the shoreline and it is possible that small stands or a few wild rice plants (density rating 1) were present in the center of the lake and not visible from shore. In 2010, low density stands (rating 1) grew amongst and near other grasses and macrophytes on the mudflat near the former shoreline. Similarly, in 2009, low density stands (rating 1) were observed near the former shoreline. Hay Lake is upstream from the Embarrass River and will not receive flow from the future Project, even under flood conditions.

Spring Mine Creek

Spring Mine Creek was surveyed on August 16, 2011 from its confluence with the Embarrass River, upstream to CR615 (Figure 2). No wild rice was observed. Most of Spring Mine Creek was unnavigable by canoe or kayak, and the survey was conducted on foot. The stream channel was between 6 to 12 feet wide with flowing water. The upstream portion cascades through rocks and boulders, and has dense forest canopy. The downstream portion flows alongside a road, where the streambed is a mix of sand, gravel, and silt. The banks are overhanging grass. Field staff observed the following macrophytes: cattails (*Typha* spp.), bulrushes (*Scirpus* spp.), joe-pye weed (*Eupatorium maculatum*), rushes (*Juncus* spp.), and bentgrasses (*Agrostis* spp.).

Trimble Creek

Sections of Trimble Creek were surveyed on foot on August 16, 2011 near County Road 358 and County Road 615 (Figure 2). No wild rice was observed. In 2010, field staff walked the entire stream channel from County Road 358 to County Road 615, and did not observe wild rice. Navigation on foot was extremely difficult, as the substrate was very soft, with sandy and fine grain sediments along portions of this stream. The upstream portion of Trimble Creek is dominated by cattails (*Typha* spp.). The downstream portion of Trimble Creek is dominated by reed canary grass (*Phalaris arundinacea*). Field staff observed several beaver dams.

Unnamed Creek (PM 11)

Unnamed Creek was surveyed on August 16, 2011 in the vicinity of the old railroad grade (Figure 2). No wild rice was observed. Upstream (east) of the railroad grade, Unnamed Creek passes through a large open wetland dominated by dense cattails (*Typha* spp.). Downstream (west) of the railroad grade, Unnamed Creek was approximately eight feet wide. In 2011, a beaver dam was documented a short distance downstream of the railroad grade. The stream bank was dense over-hanging grass.

Further downstream, thick brush covered the stream banks and prevented further survey. The streambed comprised cobble and silty sand.

2.2.2 Wild Rice Survey of Partridge River and Tributaries

Partridge River

In 2011, sections of the Partridge River were surveyed for wild rice, both upstream and downstream of Colby Lake (Figures 5 and 6). Due to safety concerns related to navigating parts of the Partridge River dominated by rocks and rapids, two sections were not surveyed in 2011: 1) the section immediately upstream of Colby Lake and downstream of County Road 565; and 2) the 1 mile long section immediately downstream of Colby Lake.

Upper Partridge River

On August 11, 2011, approximately ten miles of the Upper Partridge River was surveyed upstream of the CR65 road crossing (approximately two river miles upstream of Colby Lake) to one mile upstream of the confluence with Longnose Creek (T59 R13 S29). The Upper Partridge River between CR65 and Colby Lake was unnavigable by kayak due to rocks and rapids and by foot due to dense nearshore vegetation. Wild rice was observed in the lower segment of the Upper Partridge (within three river miles upstream of Colby Lake) at density ratings 1 and 2 (Figure 5).

During the 2010 and 2011 surveys, no wild rice was observed upstream of river mile 22.5 in the Upper Partridge River. In 2009, Barr field staff reported numerous (≈50) isolated stands of wild rice (density rating 1) between river mile 22.5 and the confluence of Longnose Creek (river mile 14). Barr staff, however, determined that field staff misobserved another grass species, northern manna grass (*Glyceria borealis*), as wild rice on the Upper Partridge River in 2009. As in the case of the Embarrass River, in response to MPCA request, Barr submitted a memorandum on November 4, 2011 that documented 2009 – 2011 Partridge River survey findings (Appendix F).

Lower Partridge River

On August 11, 2011, the Lower Partridge River was surveyed from Mile 29 to Mile 31, (Figure 6). The section of the Partridge River immediately downstream of Colby Lake was not surveyed due to rocks and rapids that make navigation difficult. Wild rice was not observed on Colby Lake in either 2009 or 2010, and therefore, was not resurveyed in 2011. Wild rice stands were observed along the Lower Partridge River, with density ratings ranging from 1 to 5 (Figure 6). Wild rice stands with a density rating of 5 were observed at the confluence with Second Creek. Wild rice stands immediately downstream and upstream of Second Creek were comparable in terms of size and

density. Grids 26 through 28 had mean stem densities of 36.0, 75.7, and 38.5 stems / 0.5 m^2 respectively (Figure 12, Appendix B-3). In 2010, stem densities were 44.0, 44.5 and 36.5 stems / 0.5 m^2 respectively, and in 2009, 39.0, 117.0 and 69.9 stems / 0.5 m^2 respectively.

Wyman Creek

Wyman Creek was surveyed on September 9, 2011. The river was surveyed on foot at river mile 1.75 (railroad crossing) and surveyed by kayak from river mile 3.25, down to the confluence with Forest Road 117 (Figure 8). No wild rice was observed. Much of the creek channel comprised thick stands of emergent vegetation and was unnavigable by canoe or kayak. The segment surveyed by kayak contained larger pools. The creek is blocked by numerous small beaver dams, and water depths ranged from 1 to 4 feet. The creek flows through flat terrain and consisted of a large complex of emergent and bog wetlands. Several sections diverge from the main channel due to beaver activity. Adjacent soils were typically organic (peat and muck), with some areas containing sandy substrate, and some areas containing large boulders. Dominant vegetation included manna grass (*Glyceria* sp.), smartweed (*Polygonum* sp.), sedges (*Carex* spp.), cinquefoil (*Potentilla* sp.), cattails (*Typha* spp.), and reed canary grass (*Phalaris arundinacea*).

Second Creek

Second Creek was surveyed in two locations in 2011: near the crossing of CR666 on September 9th, and at its confluence with the Partridge River on September 7th (Figures 2 and 8). Portions of Second Creek were unnavigable by canoe, kayak, or foot. The streambed comprised a mixture of cobble, sand, and fine grain sediments. The area surrounding the channel was flat and grassy with wetlands along portions of the stream populated mostly by cattails (*Typha* spp.) and reed canary grass (*Phalaris arundinacea*). Wild rice was observed in Second Creek within 500 feet upstream of its confluence with the Partridge River, at density ratings of 4, 2, and 1. No wild rice was observed in the section surveyed near the CR666 crossing. Previous survey events documented extensive beaver activity.

2.2.3 Wild Rice Survey of Hay Lake (MN Lake ID 69579), Little Rice Lake (MN Lake ID 69578), and Pike River

Hay Lake

Hay Lake (MN Lake ID 69579) was surveyed on August 24, 2011 and had small, low density wild rice stands (density rating of 1) scattered across the lake (Figure 7). The results of 2009 and 2010 were comparable to those of 2011. Dominant vegetation on Hay Lake included water shield

(*Brasenia schreberi*) and horsetail (*Equisetum arvense L.*). Field staff also observed that Hay Lake had low transparency due to a high concentration of dissolved organic compounds, or tannins.

Little Rice Lake and Pike River

Little Rice Lake and the Pike River were surveyed on August 9, 2011. Both water bodies contained many wild rice stands with density ratings from 3 to 5 (Figure 7). Grids 19 and 20 had mean stem densities of 19.6 to 45.8 stems / 0.5 m^2 respectively. In 2010, mean stem densities were 34.7 to 115.0 stems / 0.5 m^2 respectively. In 2009, mean stem densities were 31.5 to 110.0 stems / 0.5 m^2 respectively (Figure 13, Appendix B-4).

In the Pike River, directly adjacent to Little Rice Lake, wild rice grows continuously across the entire width of the river channel. Upstream of Little Rice Lake, wild rice was observed near the banks of the Pike River but not in the center of the channel. No wild rice was observed in the Pike River near Hay Lake. These results are similar to those observed during the 2009 and 2010 surveys.

2.3 Plant Density and Seed Calculations Results

Total plant, shoot, root, and seed weight (dry weight) and total seed number were calculated for plants collected from the Embarrass River (including the chain of lakes), the Pike River (including Little Rice Lake), and the Partridge River. (Figures 14 to 18). Mean, median and standard deviation of each parameter was also calculated. To assure accuracy of plant weight calculations, total plant biomass of intact plants were compared to the sum of individual roots, shoots, and seed biomass calculations; these values were very similar (Appendix C).

Mean plant weight in the four river systems ranged from 0.96 g in the Partridge River (lowest) to 2.71 g in the Pike River (highest). Mean root weight ranged from 0.10 g in the Partridge River to 0.34 g in the Pike River. Mean shoot weight ranged from 0.79 to 2.24 g in the Partridge and Pike Rivers respectively. Mean seed weight ranged from 0.07 to 0.13 g in the Embarrass and Partridge Rivers (both were 0.07 g) and Pike River respectively. Mean seed number ranged from 16 to 35 in the Embarrass and Pike Rivers, respectively. Standard deviations, however, were very large for each parameter in each water body. If future sampling is carried out, a larger plant sample may assist in reducing the standard deviation.

2.4 Wild Rice Survey Discussion

Results from 2011 ground surveys observed the presence of wild rice in many of the same locations where wild rice was observed in 2009 and 2010. Three areas had fairly dense (density rating ≥ 3)

stands of wild rice: Cedar Island Lake in the Embarrass River watershed; Little Rice Lake (MN ID 69578) in the Pike River watershed; and the Lower Partridge River. Figures 9 to 13 include stem counts for all grids. Figures 19 and 20 present grid mean wild rice stem densities from 2009 to 2011.

It is difficult to determine the health and history of wild rice in these water bodies without a multi-year combined analysis of ground surveys 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. Other factors such as water level and water level fluctuations (precipitation events and beaver activity to name a few), parasites, herbivory, competition from other plants and weather conditions may also play a role, but no data has been collected over multiple years and published. Studies carried out over too short a time period also make it difficult to determine the relative importance of sulfate compared to other factors on wild rice growth and production.

Additional monitoring data (not limited to sulfate concentrations and wild rice density) would be needed in order to begin assessing the effects of sulfate on wild rice growth and production. Such monitoring data should include analysis of sediment characteristics such as percent water and organic content, total sulfur, total iron and manganese anion. It could also include analysis of plant nutrient content. These data will assist in determining the effects of sulfate relative to other factors on the growth and production of wild rice. Section 3.0 comprises analysis of major water anion and cation concentrations from samples collected near wild rice populations.

3.0 Water Quality Monitoring

Water quality samples were collected during the wild rice field surveys in August and September of 2011. Results of major cation and anion analyses, including sulfate concentrations, are presented in this section.

3.1 Concentrations of Major Cations and Anions

Figures 21 & 22 include the results of sulfate analyses performed on water samples collected during 2011 surveys. All water samples were analyzed for sulfate using an ion chromatography method (EPA 300.0). A total of 16 water samples were collected from the Study Area water bodies. Sulfate concentrations ranged from a minimum of 2.24 mg/L (Little Rice Lake, off of the Pike River) to a maximum of 167 mg/L (Partridge River).

Table 3 includes the results of sulfate analyses performed on water samples collected duirng 2011 surveys in the Embarrass River watershed. Concentrations ranged from 6.0 mg/L to 151 mg/L.

Table 4 includes the results of sulfate analyses performed on water samples collected during 2011 surveys on the Partridge River. Concentrations ranged from 9.65 mg/L to 167 mg/L. In the Partridge River, sulfate concentrations increase at the confluence with Second Creek due to the higher concentrations of sulfate in Second Creek.

Table 5 includes the results of sulfate analyses performed on water samples collected duirng 2011 surveys on the Pike River (including Hay Lake and Little Rice Lake). Concentrations ranged from 2.24 mg/L to 3.62 mg/L.

Table 3 Concentrations of Major Cations and Anions At Wild Rice Stands On the Embarrass River

Sample ID	Sample Date	Sulfate (mg/L)	Alkalinity, bicarbonate (mg/L CaCO3)	Chloride (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)
PM-CIL-KJN-01	8/10/2011	14.2	58.6	4.56	15.3	8.85	1.45	6.26
PM-CIL-KJN-02	8/10/2011	13.5	58.6	4.49	15.6	8.86	1.52	6.31
PM-LEM-LAD-01	8/11/2011	15.9	60.3	4.85	16.3	9.3	1.41	6.47
PM-LEM-UNL-01	8/11/2011	17.3	52.9	4.78	23.4	12.2	2.62	7.09
MN-POLY-KMS2-1	8/18/2011	151	174	1.69	31.3	49.6	9.81	21.7
MN-POLY-KMS2-2	8/19/2011	11.7	177	4.40	28.9	21.2	2.05	18.4
MN-POLY-KMS2-3	8/19/2011	11.2	169	4.04	28.5	20.2	1.95	17.3
MN-POLY-KMS2-4	8/19/2011	6.00	103	2.67	23	11.8	1.11	7.93
Minimum	--	6.00	52.9	1.69	15.3	8.85	1.11	6.26
Maximum	--	151	177	4.85	31.3	49.6	9.81	21.7

Table 4 Concentrations of Major Cations and Anions At Wild Rice Stands On the Partridge River

Sample ID	Sample Date	Sulfate (mg/L)	Alkalinity, bicarbonate (mg/L CaCO3)	Chloride (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)
PM-PAR-KDM-01	8/10/2011	9.65	54.2	11.5	13.3	8.26	1.31	9.85
PM-PAR-KDM-02	8/11/2011	31.4	55.7	5.32	21.1	9.81	1.2	6.14
PM-PAR-KJN-01	8/12/2011	104	86.8	5.63	24.5	33.5	2.37	9.3
PM-PAR-KJN-02	8/12/2011	167	108	5.9	28	50.2	3.39	11.8
PM-PAR-LAD-01	8/12/2011	29.4	57.2	5.37	21	9.76	1.24	6.09
Minimum	--	9.65	54.2	5.32	13.3	8.26	1.2	6.09
Maximum	--	167	108	11.5	28	50.2	3.39	11.8

Table 5 Concentrations of Major Cations and Anions At Wild Rice Stands In the Pike River Watershed

Sample ID	Sample Date	Sulfate (mg/L)	Alkalinity, bicarbonate (mg/L CaCO3)	Chloride (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)
PM-LRI-KJN-01	8/9/2011	2.24	37.6	3.16	12.1	4.36	<0.25	3.51
PM-PIK-KJN-01	8/9/2011	3.62	66.3	7.36	19.2	7.37	0.58	6.36
PM-PIK-KJN-02	8/9/2011	3.60	66	7.41	19.2	7.48	0.55	6.47
Minimum	--	2.24	37.6	3.16	12.1	4.36	<0.25	3.51
Maximum	--	3.62	66.3	7.41	19.2	7.48	0.58	6.47

3.2 Additional Water Quality Monitoring Activities

Additional water quality monitoring activities were conducted at multiple locations in 2011 for other environmental studies for the Project (Polymet 2011a and Polymet 2011b). Water quality data, including sulfate concentrations, were measured in the Embarrass River and several of its tributaries. Sulfate concentrations observed during these additional monitoring activities are included in Table 6, and are summarized below.

Sulfate concentrations were measured in the Embarrass River and associated lakes at monitoring locations PM-12, PM-12.2, PM-12.3, PM-12.4, PM-13, PM-21, PM-22, PM-23, PM-24, EL-1, and EL-2. Sulfate was also measured in Spring Mine Creek (PM-12.1), Trimble Creek (PM-19), and Unnamed Creek (PM-11). Sulfate concentrations at monitoring location PM-12 in the Embarrass River upstream of Spring Mine Creek ranged from < 1 mg/L to 26.5 mg/L. Sulfate concentrations were higher (53.8 – 91.8 mg/L) at monitoring location PM-12.2 in the Embarrass River, immediately downstream of Spring Mine Creek. Further downstream on the Embarrass River at monitoring locations PM-12.3, PM-12.4, and PM-13, sulfate concentrations ranged from 5.64 to 11.2 mg/L.

Table 6 Concentrations of Sulfate in Water Samples Collected for Other 2011 Water Quality Monitoring Activities

Location	Waterbody	Jun-11	Jul-11	Aug-11	Sep-11	Min	Max
PM-12	**Embarrass River**	< 1	< 1	26.5	19.8	< 1	26.5
PM-12.2	**Embarrass River**	---	53.8	91.8	71.0	53.8	91.8
PM-12.3	**Embarrass River**	---	7.94	5.64	5.86	5.64	7.94
PM-12.4	**Embarrass River**	---	7.73	11.2	5.67	5.67	11.2
PM-13	**Embarrass River**	---	8.62	10.5	7.56	7.56	10.5
EL-1	**Upper Embarrass Lake**	---	14.0	14.0	---	14.0	14.0
EL-2	**Upper Embarrass Lake**	---	15.6	15.5	---	15.5	15.6
PM-21	**Sabin Lake**	---	11.9	10.2	---	10.2	11.9
PM-23	**Sabin Lake**	---	7.94	7.03	---	7.03	7.94
PM-22	**Wynne Lake**	---	14.1	14.2	---	14.1	14.2
PM-24	**Wynne Lake**	---	11.6	10.5	---	10.5	11.6
PM-12.1	**Spring Mine Creek**	235	186	224	81.6	81.6	235
PM-19	**Trimble Creek**	22.0	< 1	< 1	3.47	< 1	22.0
PM-11	**Unnamed Creek**	92.5	68.8	64.6	---	64.6	92.5

4.0 References

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PolyMet Mining. 2011b. NorthMet Project Water Modeling Data Package Volume 2 – Plant Site, Version 4.

Figures

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Partridge River
Colvin Creek
MCKINLEY
Lower Embarrass Lake
HOYT LAKES
Unnamed Lake
Partridge River
Whitewater Lake
Cedar Island Lake
Saint Louis River
Laird Creek
GILBERT
Saint Louis River
Fourth Lake
Saint Louis River

- Stream Segments Surveyed in 2011
- Lake Shoreline Surveyed in 2011
- Other Lakes
- City Boundaries
- Embarrass River Watershed
- Pike River Watershed
- Colby-Whitewater Watershed
- Partridge River Watershed
- Second Creek Watershed
- Wyman Creek Watershed

N

0 0.875 1.75 3.5

Miles

DRAFT

Figure 1

EXTENTS OF 2011 WILD RICE SURVEYS IN THE EMBARRASS RIVER, PARTRIDGE RIVER AND PIKE RIVER WATERSHEDS

NorthMet Project

PolyMet Mining, Inc.

Hoyt Lakes, Minnesota

Barr Footer: ArcGIS 10.0, 2012-01-20 11:04 File: I:\Client\PolyMet_Mining\Work_Orders\Wild_Rice\Maps\Reports\Figure 2 Ground Wild Rice Survey Results for Hay Lake Upper Embarrass River.mxd User: amz

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Figure 2
GROUND WILD RICE SURVEY RESULTS FOR HAY LAKE
(MNID 69435) & THE UPPER EMBARRASS RIVER
NorthMet Project
PolyMet Mining, Inc.
Hoyt Lakes, Minnesota

Entire shoreline of Wynne Lake was surveyed. Wild rice was encountered in one isolated location on shore of Wynne Lake.

Entire shoreline of Embarrass Lake was surveyed. No wild rice was encountered.

21 Mi
Sabin Lake
20.5 Mi
20 Mi
Wynne Lake
19.5 Mi
19 Mi
18.5 Mi
18 Mi
17.5 Mi
17 Mi
16.5 Mi
Embarrass Lake
16 Mi
Lower Embarrass Lake
138
135
100
110
130
4
Second Creek
First Creek

Imagery Source: FSA, 2010.

Barr Footer: ArcGIS 10.0, 2012-01-20 11:05 File: I:\Client\PolyMet_Mining\Work_Orders\Wild_Rice\Maps\Reports\Figure 3 Ground Wild Rice Survey Results for Wynne Lake and Embarrass Lake.mxd User: emn2

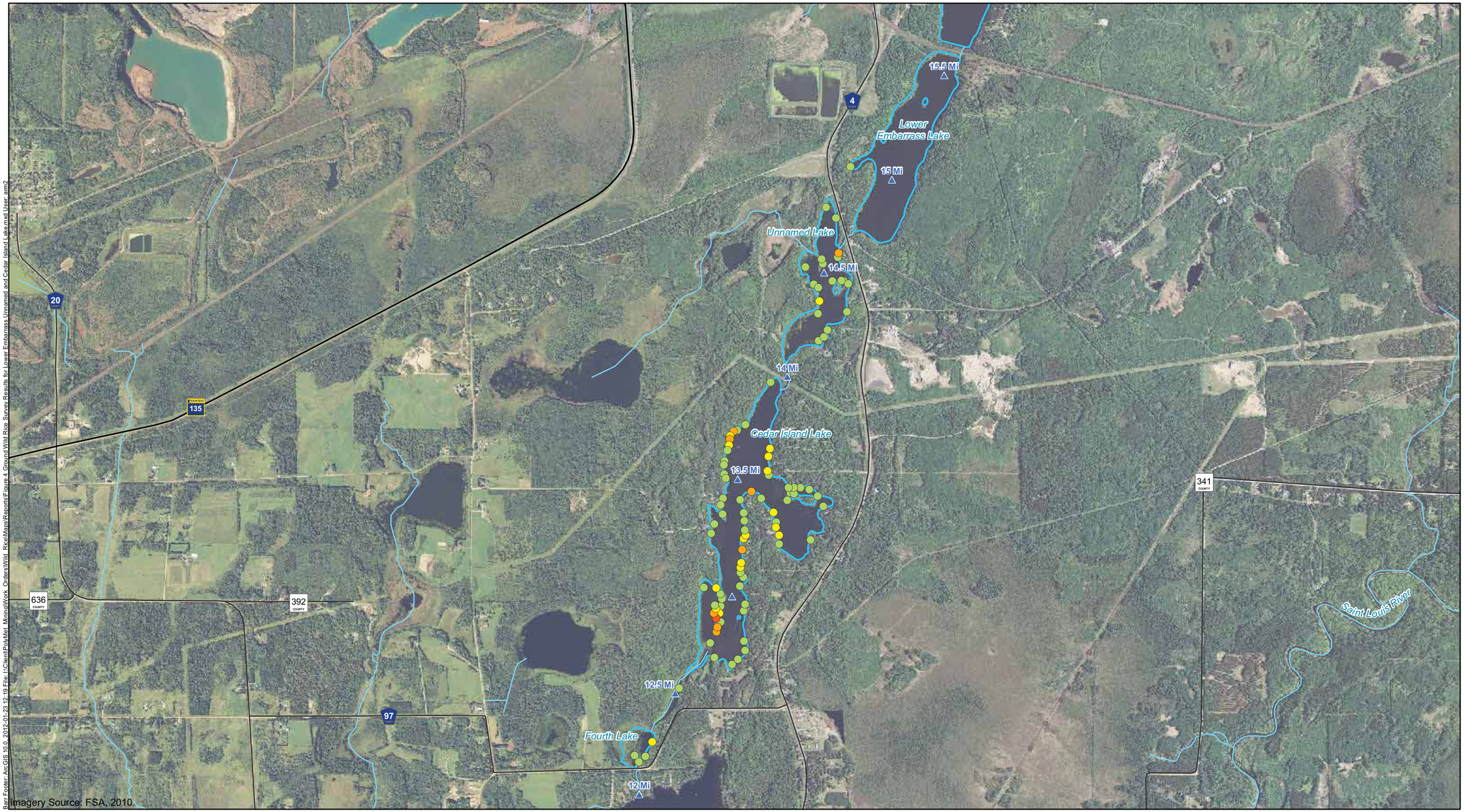
Wild Rice Density in 2011
- 1 <10% Wild Rice Coverage
- 2 10-25%
- 3 25-50%
- 4 50-75%
- 5 >75% Wild Rice Coverage

- Embarrass River Mile Markers
- Rivers and Streams
- Stream Segments Surveyed in 2011
- Lake Shoreline Surveyed in 2011

0 1,500 3,000 6,000
Feet

DRAFT
Figure 3
GROUND WILD RICE SURVEY RESULTS FOR
WYNNE & EMBARRASS LAKES (EMBARRASS RIVER)
NorthMet Project
PolyMet Mining, Inc.
Hoyt Lakes, Minnesota

Barr Footer: ArcGIS 10.0, 2012-01-23 12:19 File: I:\Client\PolyMet_Mining\Work_Orders\Wild_Rice\Maps\Reports\Figure 4 Ground Wild Rice Survey Results for Lower Embarrass Unnamed and Cedar Island Lake.mxd User: amz



Imagery Source: FSA, 2010.

Wild Rice Density in 2011
- 1 <10% Wild Rice Coverage
- 2 10-25%
- 3 25-50%
- 4 50-75%
- 5 >75% Wild Rice Coverage

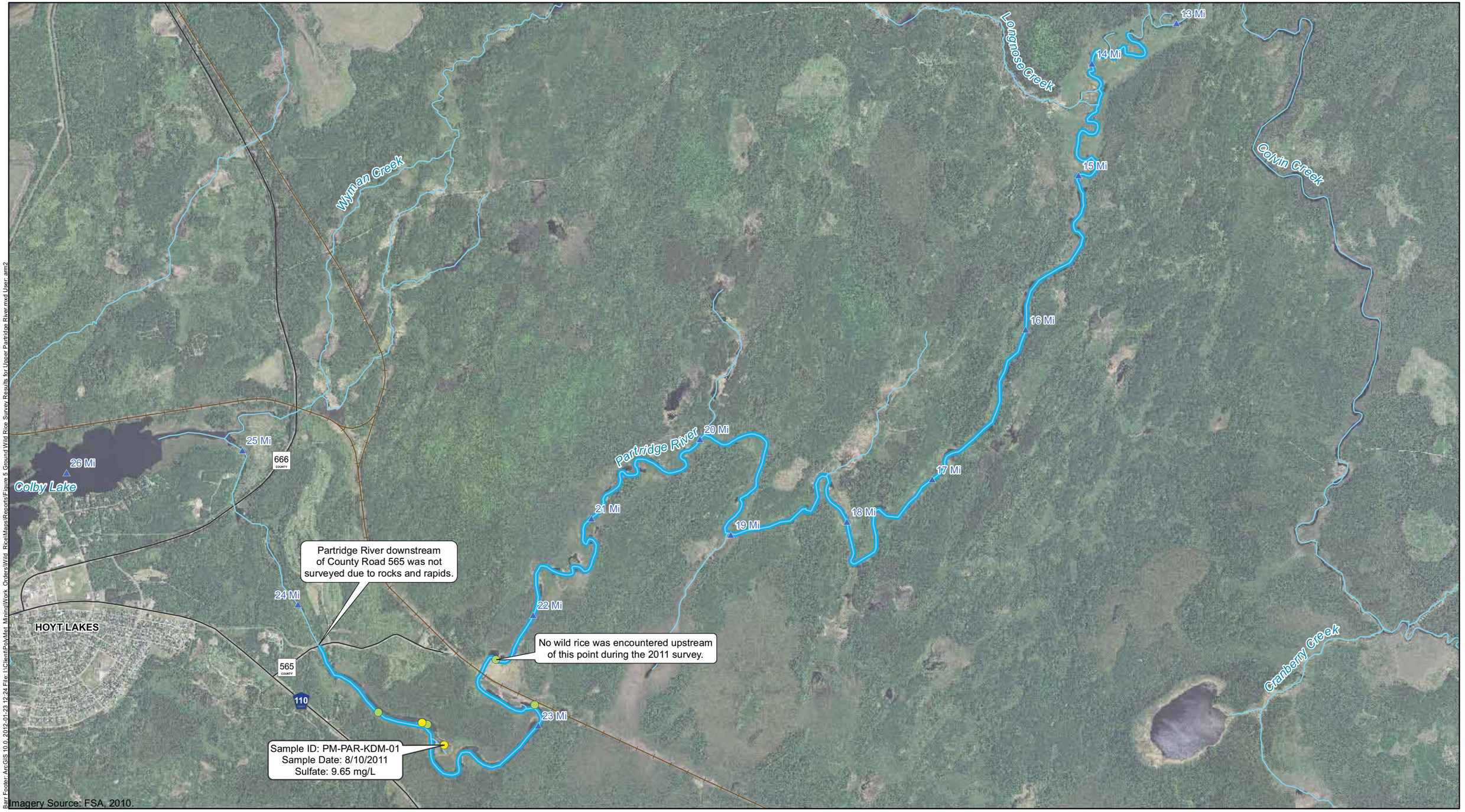
Embarrass River Mile Markers
Rivers and Streams
Stream Segments Surveyed in 2011
Lake Shorelines Surveyed in 2011

N

0 1,000 2,000 4,000
Feet

DRAFT

Figure 4
GROUND WILD RICE SURVEY RESULTS FOR LOWER EMBARRASS LAKE, UNNAMED LAKE, CEDAR ISLAND LAKE & FOURTH LAKE
NorthMet Project
PolyMet Mining, Inc.
Hoyt Lakes, Minnesota



Barr Footer: ArcGIS 10.0, 2012-01-23 12:24 File: I:\Client\PolyMet_Mining\Work_Orders\Wild_Rice\Maps\Reports\Figure 5 Ground Wild Rice Survey Results for Upper Partridge River.mxd User: emz

Wild Rice Density in 2011
- 1 <10% Wild Rice Coverage
- 2 10-25%
- 3 25-50%
- 4 50-75%
- 5 >75% Wild Rice Coverage

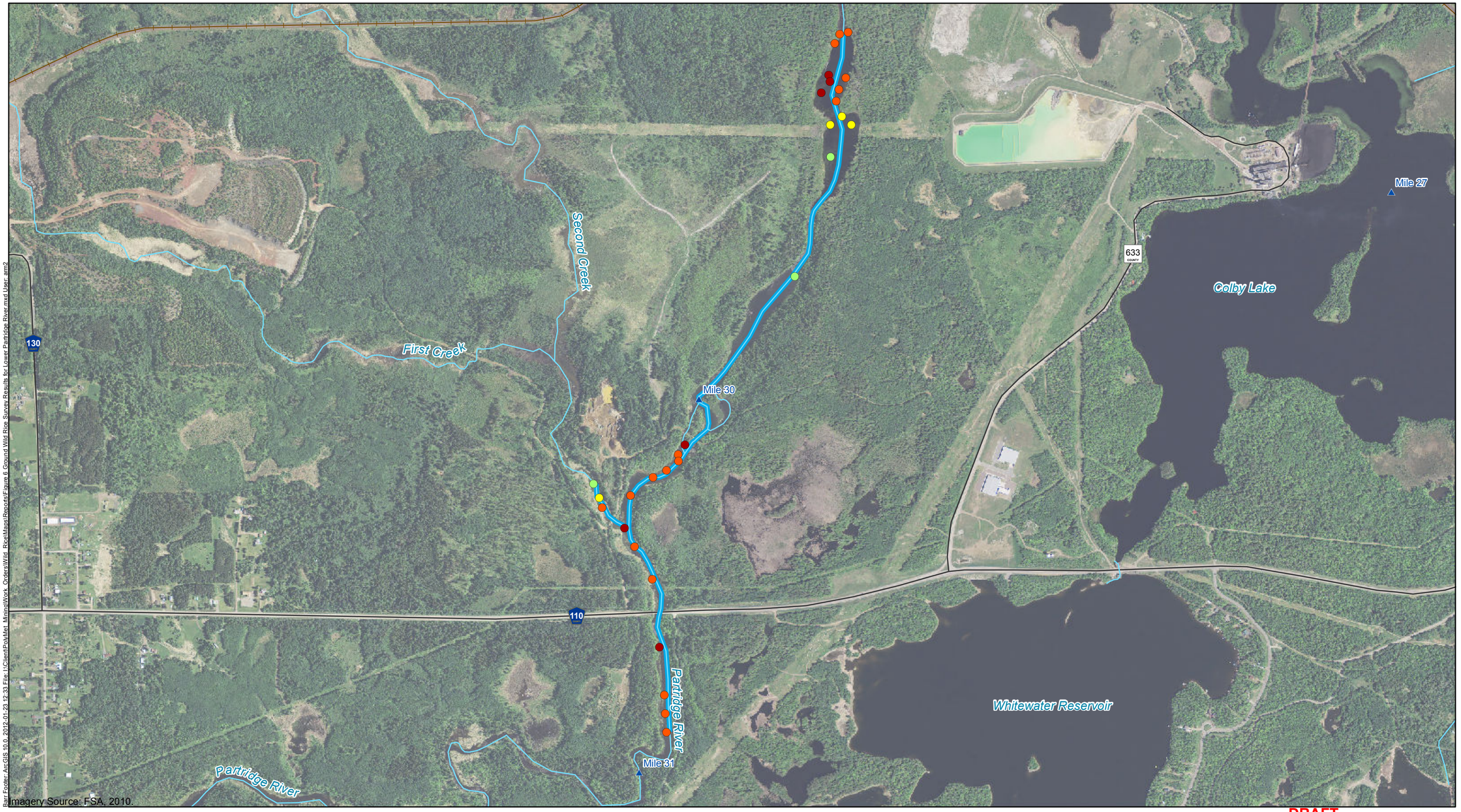
- Partridge River Mile Markers
- Other Rivers and Streams
- Stream Segments Surveyed in 2011
- Railroads

N

0 1,250 2,500 5,000
Feet

DRAFT

Figure 5
GROUND WILD RICE SURVEY RESULTS
FOR THE UPPER PARTRIDGE RIVER
NorthMet Project
PolyMet Mining, Inc.
Hoyt Lakes, Minnesota



Barr Footer: ArcGIS 10.0, 2012-01-23 12:33 File: I:\Client\PolyMet Mining\Work Orders\Wild Rice\Maps\Reports\Figure 6 Ground Wild Rice Survey Results for Lower Partridge River.mxd User: amz

Wild Rice Density in 2011
- 1 <10% Wild Rice Coverage
- 2 10-25%
- 3 25-50%
- 4 50-75%
- 5 >75% Wild Rice Coverage

- Partridge River Miles
- Other Rivers and Streams
- Stream Segments Surveyed in 2011
- Railroads

N

0 500 1,000 2,000
Feet

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Figure 6
GROUND WILD RICE SURVEY RESULTS
FOR THE LOWER PARTRIDGE RIVER
AND A PORTION OF SECOND CREEK
NorthMet Project
PolyMet Mining, Inc.
Hoyt Lakes, Minnesota

Wild rice with a density rating of "1" scattered across large area of Hay Lake.

Stands of wild rice with varying density continuous across Little Rice Lake and adjacent Pike River.

Hay Lake

Pike River

Little Rice Lake

Hay Lake Outlet

715 COUNTY

Imagery Source: ProWest, 2009.

Wild Rice Density in 2011

- 1 <10% Wild Rice Coverage
- 2 10-25%
- 3 25-50%
- 4 50-75%
- 5 >75% Wild Rice Coverage

Other Rivers and Streams

Stream Segments Surveyed in 2011

Lake Shorelines Surveyed in 2011

N

0 300 600 1,200

Feet

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Figure 7

GROUND WILD RICE SURVEY RESULTS FOR HAY LAKE (MN ID 690579), LITTLE RICE LAKE (MN ID 690578) AND THE PIKE RIVER

NorthMet Project

PolyMet Mining, Inc.

Hoyt Lakes, Minnesota

Barr Footer: ArcGIS 10.0, 2012-01-23 12:51 File:I:\Client\PolyMet_Mining\Work_Orders\Wild_Rice\Maps\Reports\Figure 7_Ground

Wild Rice Survey Results for Hay and Rice Lakes Pike River.mxd User: amz

No wild rice identified on portion of Second Creek surveyed in 2011.

No wild rice identified on upstream portion of Wyman Creek surveyed in 2011.

No wild rice identified on downstream portion of Wyman Creek surveyed in 2011.

Second Creek

Unnamed Creek

Partridge River

Wyman Creek

Longnose Creek

666
COUNTY

2 Mi
2.5 Mi
3 Mi
3.5 Mi
4 Mi
4.5 Mi
5 Mi
5.5 Mi
6 Mi
6.5 Mi
7 Mi
7.5 Mi
8 Mi

Imagery Source: FSA, 2010.

Ban Foster; ArcGIS 10.0, 2012-01-24 11:23; File: I:\Client\PolyMet Mining\Work Orders\Wild Rice\Maps\Reports\Figure 8 Ground Wild Rice Survey Results for Second and Wyman Creeks.mxd User: amn2

Wild Rice Density in 2011
- 1 <10% Wild Rice Coverage
- 2 10-25%
- 3 25-50%
- 4 50-75%
- 5 >75% Wild Rice Coverage

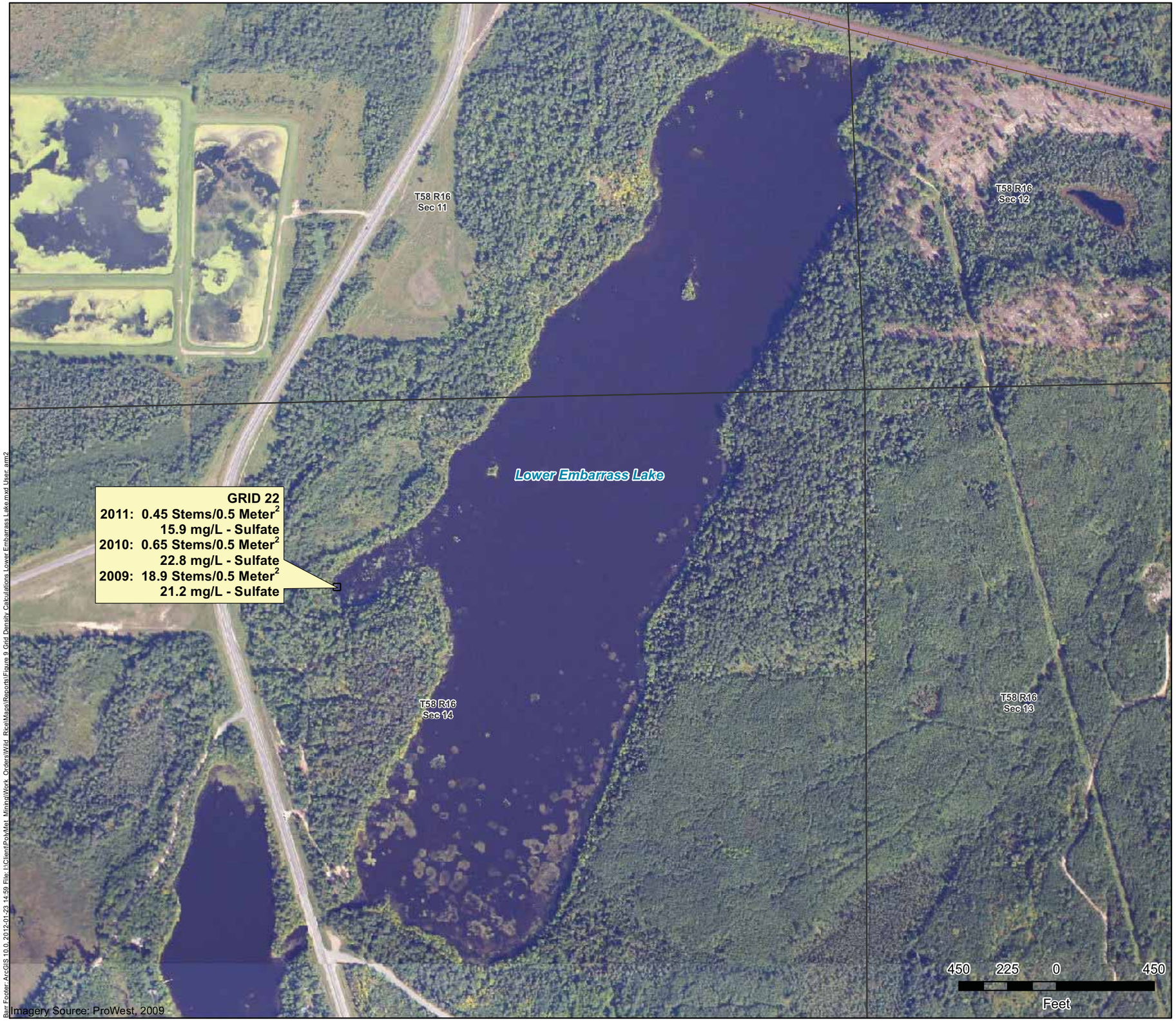
- Wyman Creek Mile Markers
- Stream Segments Surveyed in 2011
- Rivers and Streams

N

0 1,100 2,200 4,400
Feet

DRAFT

Figure 8
GROUND WILD RICE SURVEY RESULTS FOR A PORTION OF SECOND CREEK AND WYMAN CREEK
NorthMet Project
PolyMet Mining, Inc.
Hoyt Lakes, Minnesota



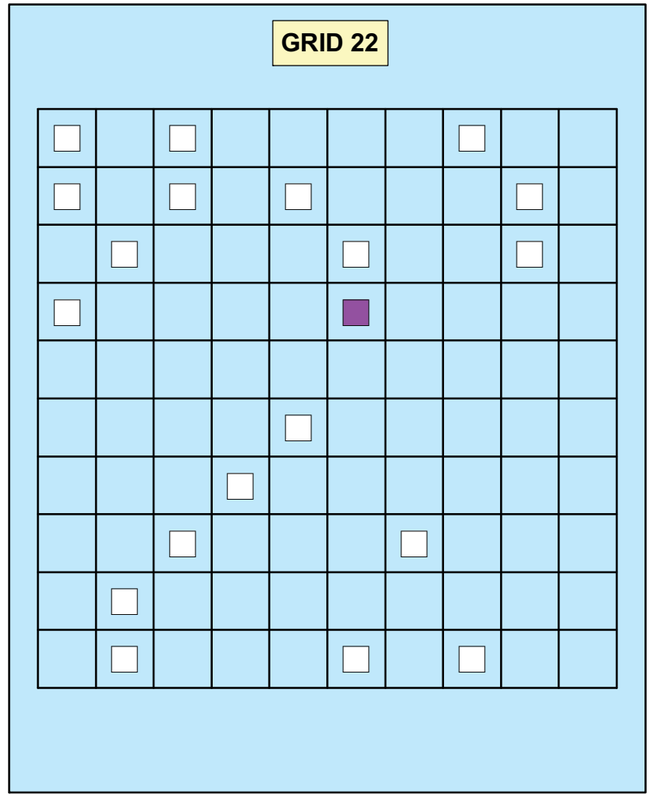


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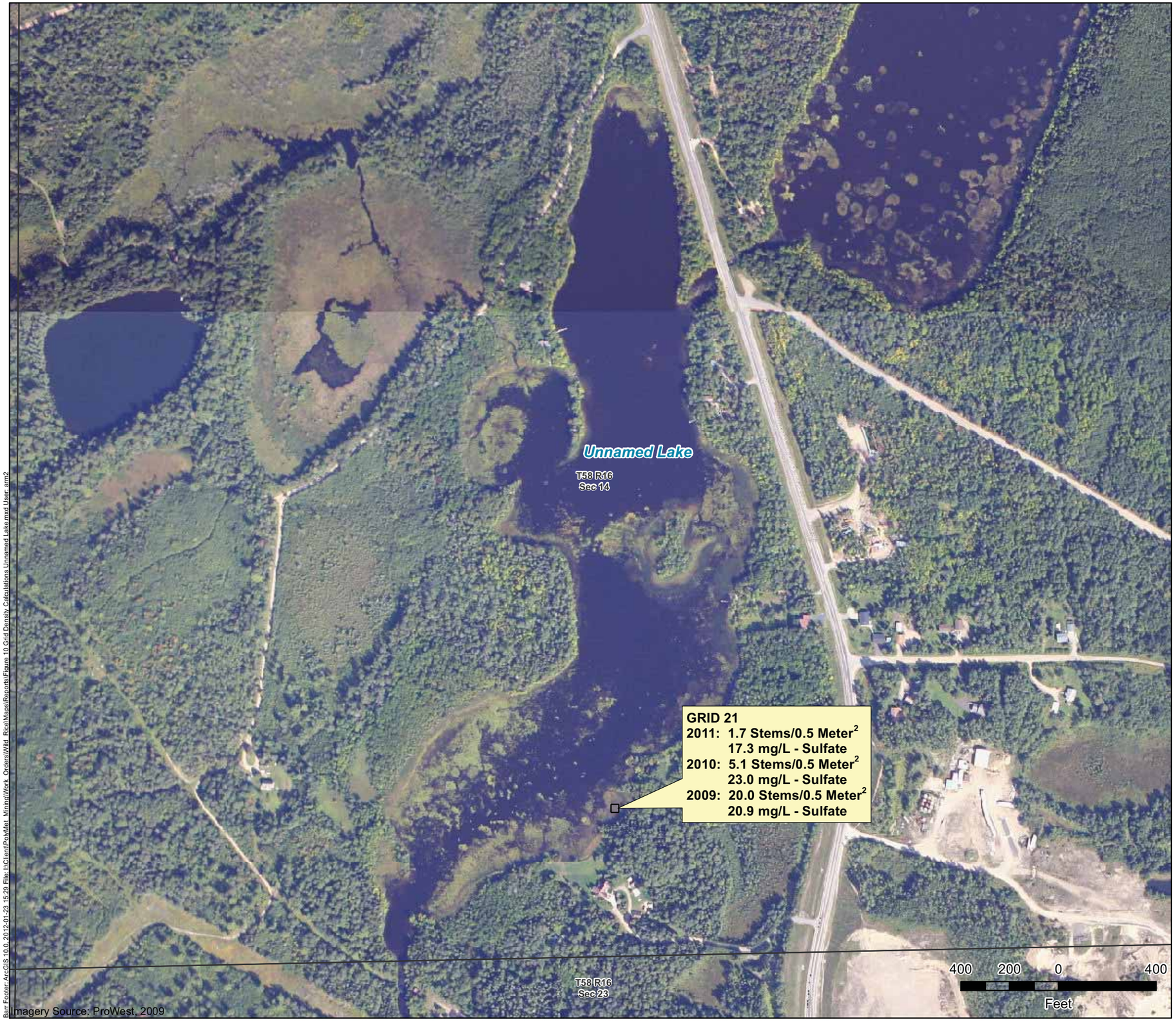
Figure 9
GRID DENSITY
LOWER EMBARRASS LAKE
(EMBARRASS RIVER)
NorthMet Project
PolyMet Mining, Inc.
Hoyt Lakes, Minnesota

Stem Density/0.5m²

- 0
- 1 - 25
- 10x10 Meter Grid

2 1 0 2
Meters



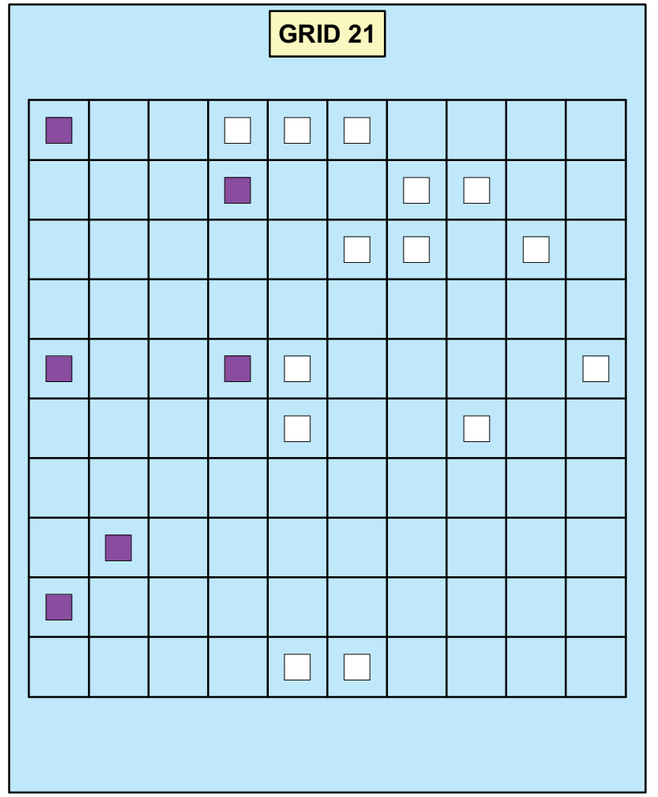


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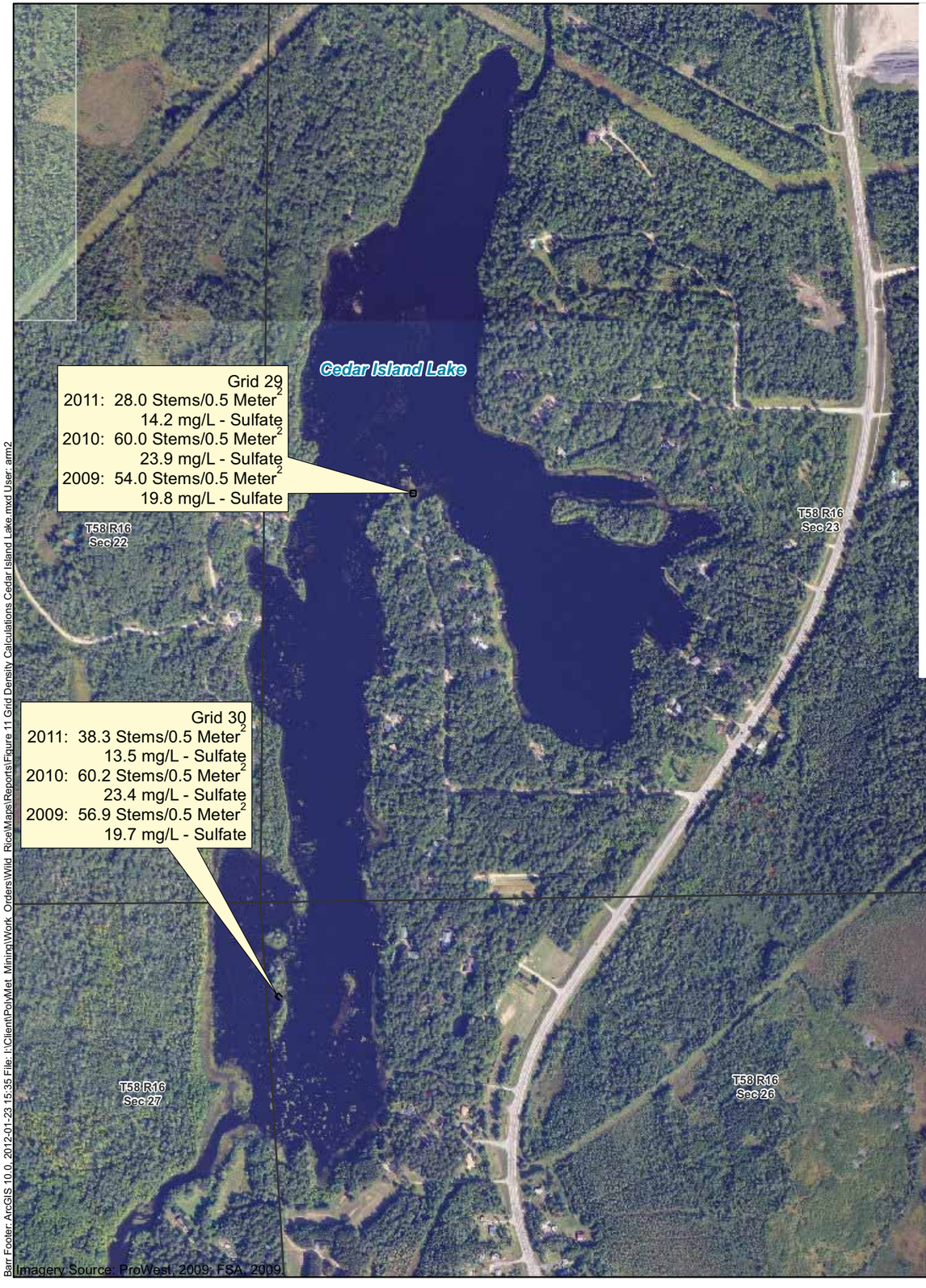
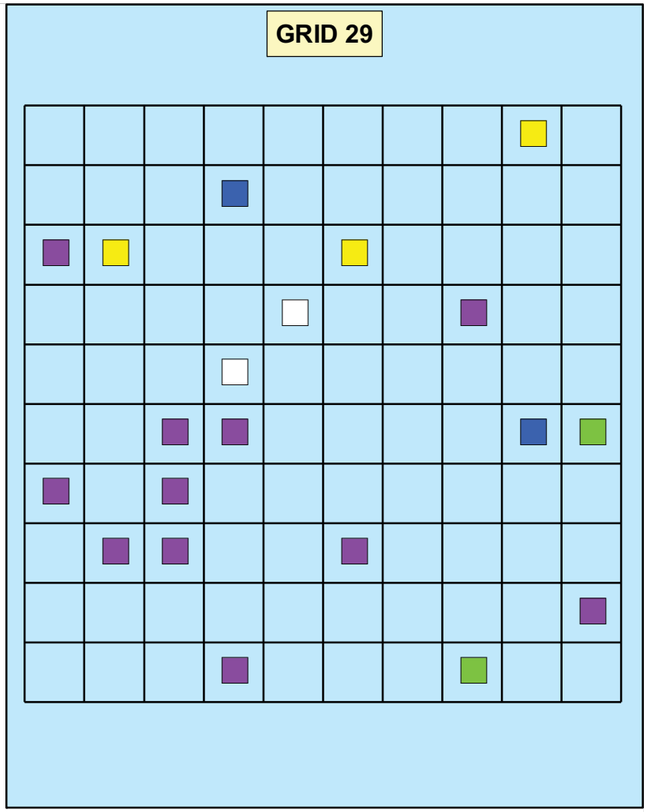
Figure 10
GRID DENSITY
UNNAMED LAKE
(EMBARRASS RIVER)
NorthMet Project
PolyMet Mining, Inc.
Hoyt Lakes, Minnesota

Stem Density/0.5m²

- 0
- 1 - 25
- 10x10 Meter Grid

2 1 0 2
Meters





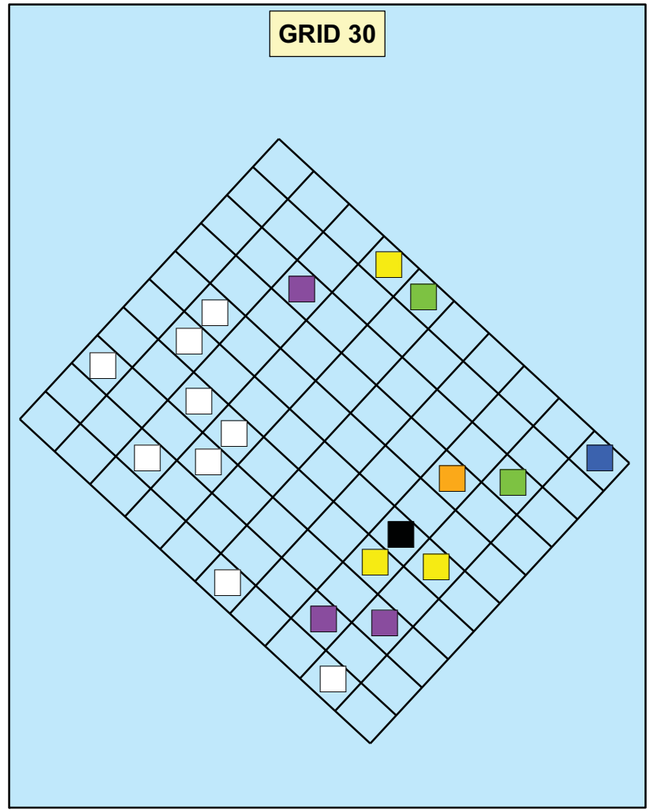


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Figure 11
GRID DENSITIES
CEDAR ISLAND LAKE
(EMBARRASS RIVER)
NorthMet Project
PolyMet Mining, Inc.
Hoyt Lakes, Minnesota

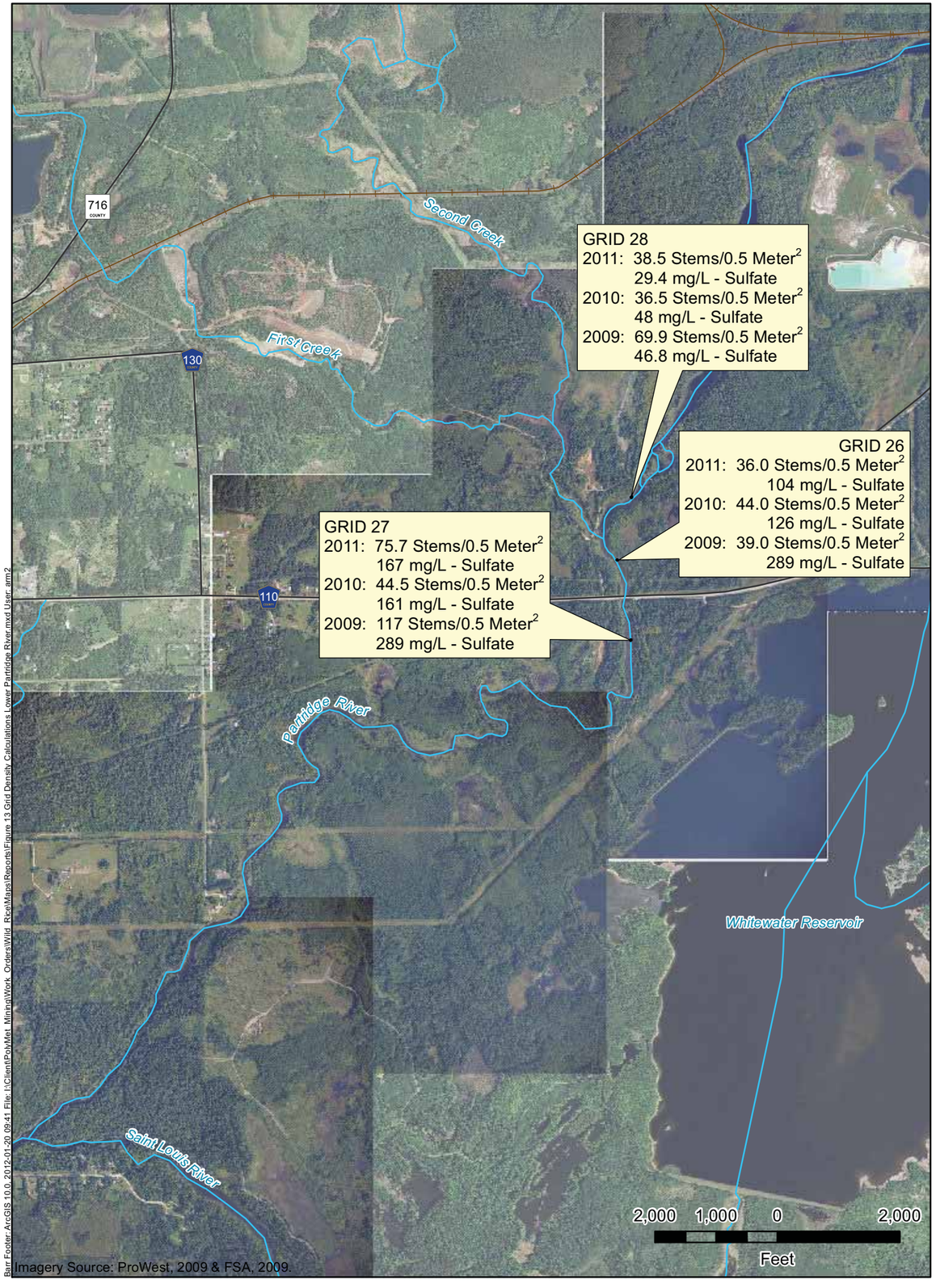
Stem Density/0.5m²

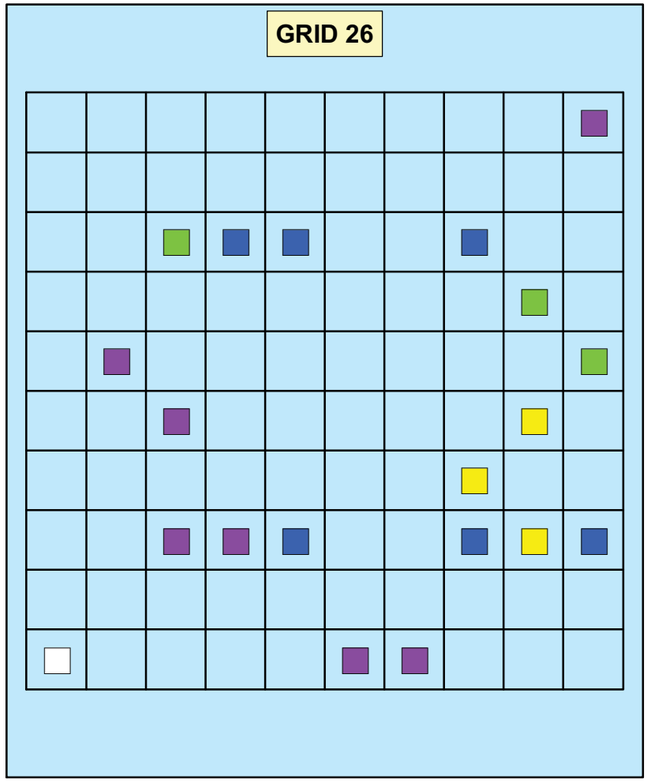
0	101 - 125
1 - 25	126 - 150
26 - 50	151 - 175
51 - 75	176 - 190
76 - 100	10x10 Meter Grid

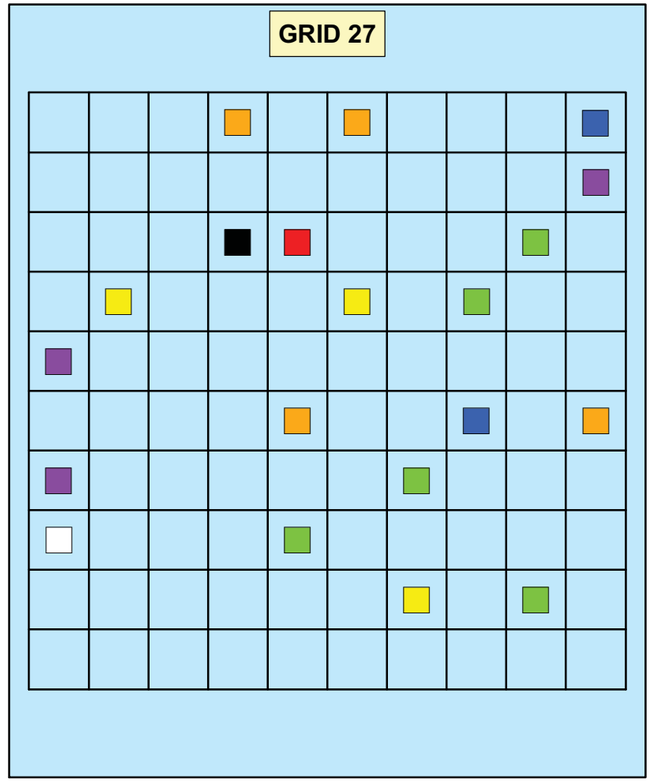
2.5 1.25 0 2.5
Meters

Imagery Source: ProWest, 2009; FSA, 2009

Barr Footer: ArcGIS 10.0, 2012-01-23 15:35 File: I:\Client\PolyMet_Mining\Work_Orders\Wild_Rice\Maps\Reports\Figure 11 Grid Density Calculations Cedar Island Lake.mxd User: arm2







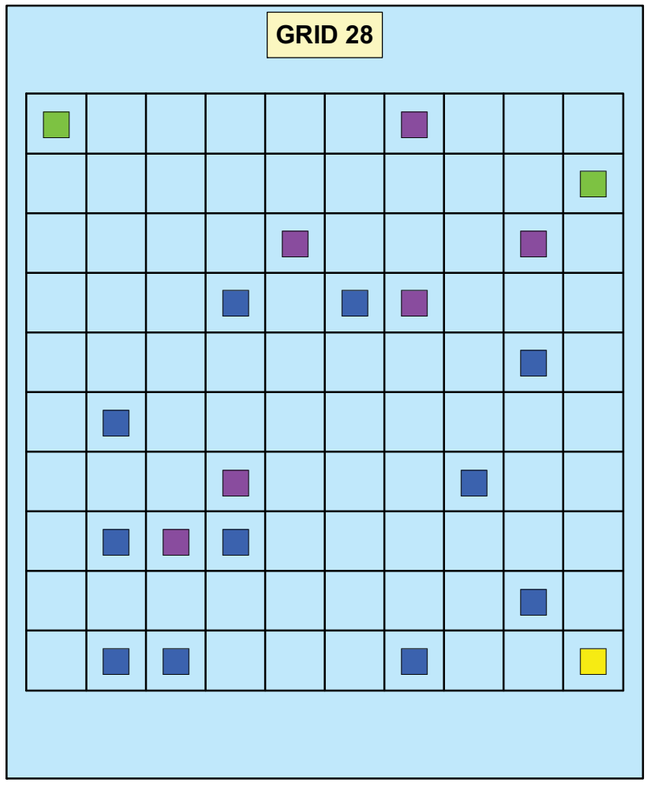


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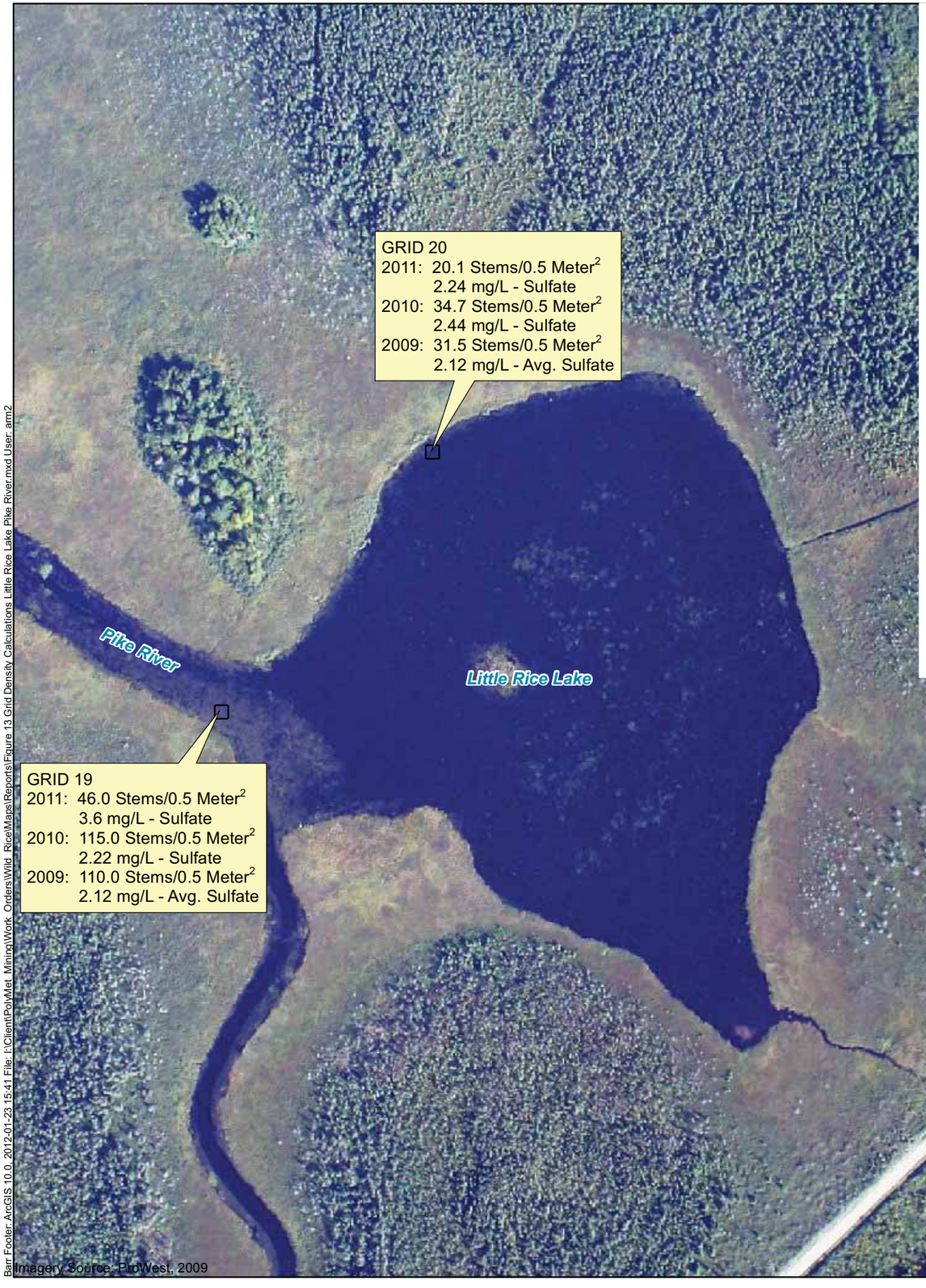
Figure 12
GRID DENSITIES
LOWER PARTRIDGE RIVER
NorthMet Project
PolyMet Mining, Inc.
Hoyt Lakes, Minnesota

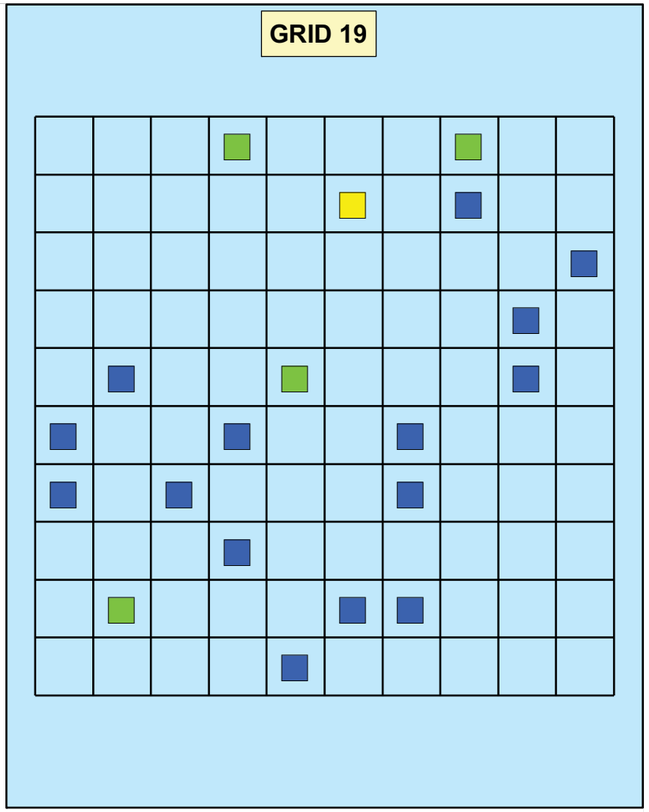
Stem Density/0.5m^2

0	101 - 125
1 - 25	126 - 150
26 - 50	151 - 175
51 - 75	>175
76 - 100	10 x 10 Meter Grid

N

0 1 2 4
Meters





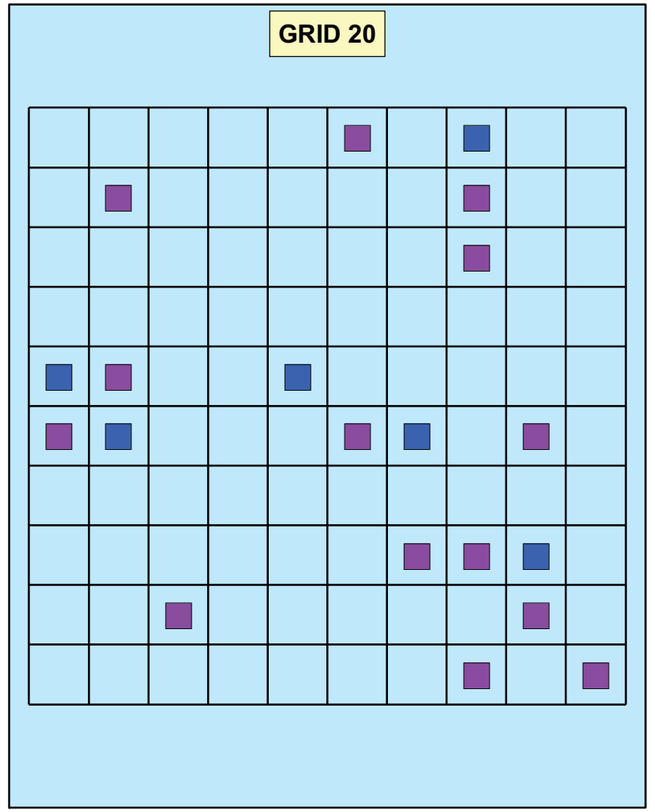


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Figure 13
GRID DENSITIES
LITTLE RICE LAKE
(PIKE RIVER)
NorthMet Project
PolyMet Mining, Inc.
Hoyt Lakes, Minnesota

Stem Density/0.5m²

- 1 - 25
- 26 - 50
- 51 - 75
- 76 - 100
- 10x10 Meter Grid

0 1 2 4
Meters

Figure 14 Median, Mean, and Standard Deviation of
Total Calculated Wild Rice Plant Weight (g) in Partridge River, Embarrass River Chain of Lakes, and Pike River in 2011

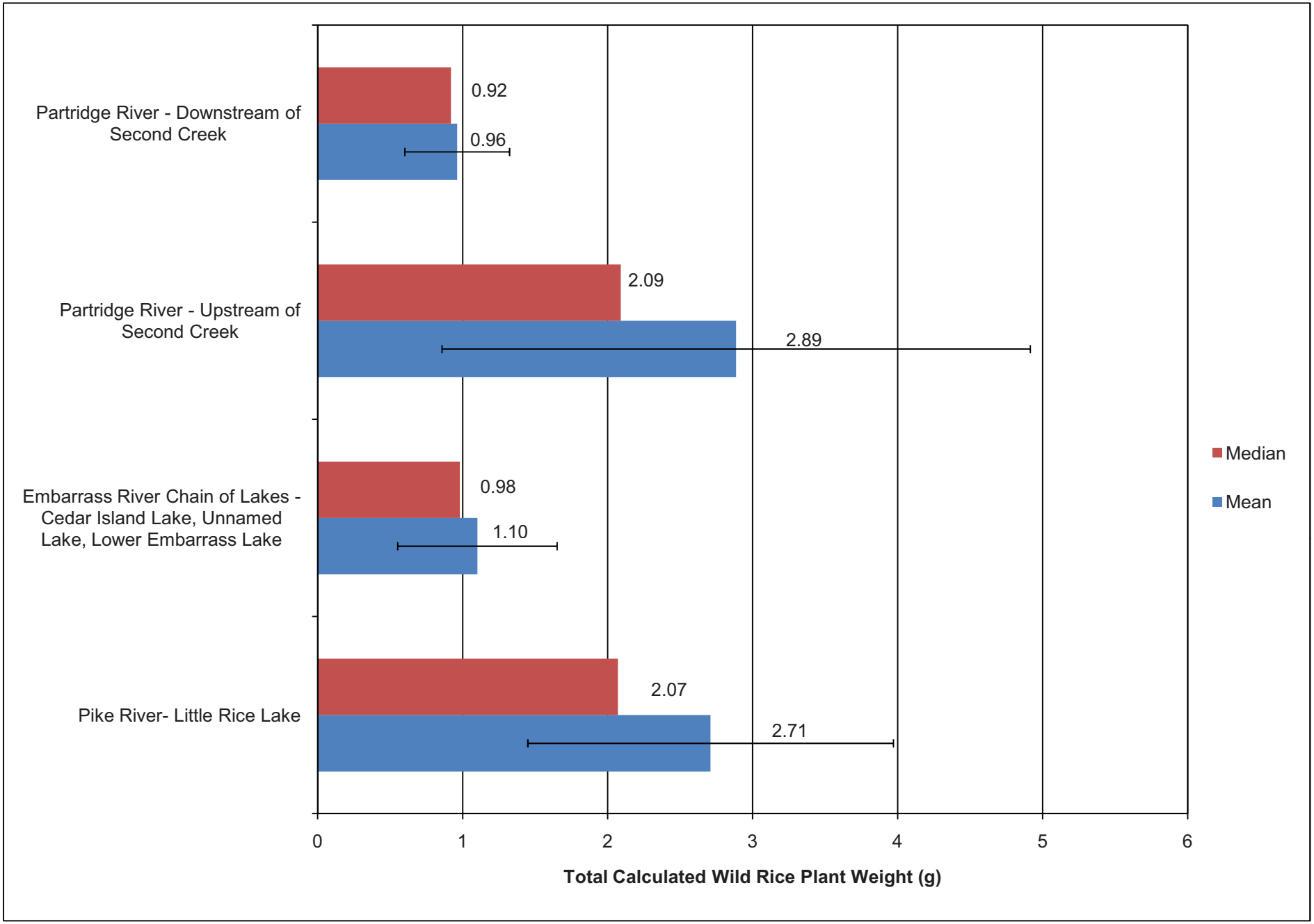


Figure 15 Median, Mean, and Standard Deviation of
Total Calculated Wild Rice Root Weight (g) in Partridge River, Embarrass River Chain of Lakes, and Pike River in 2011

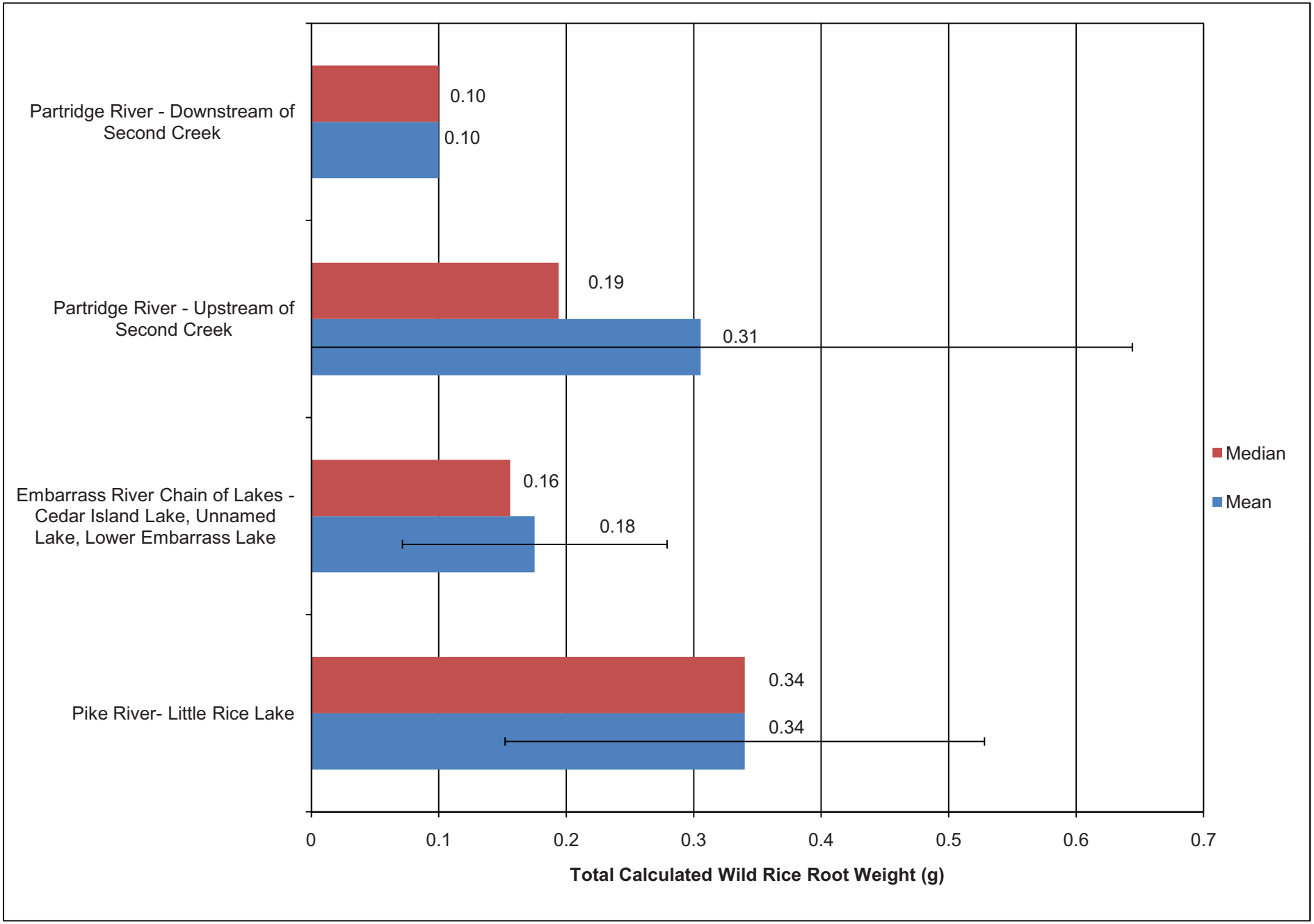


Figure 16 Median, Mean, and Standard Deviation of
Total Calculated Wild Rice Shoot Weight (g) in Partridge River, Embarrass River Chain of Lakes, and Pike River in 2011

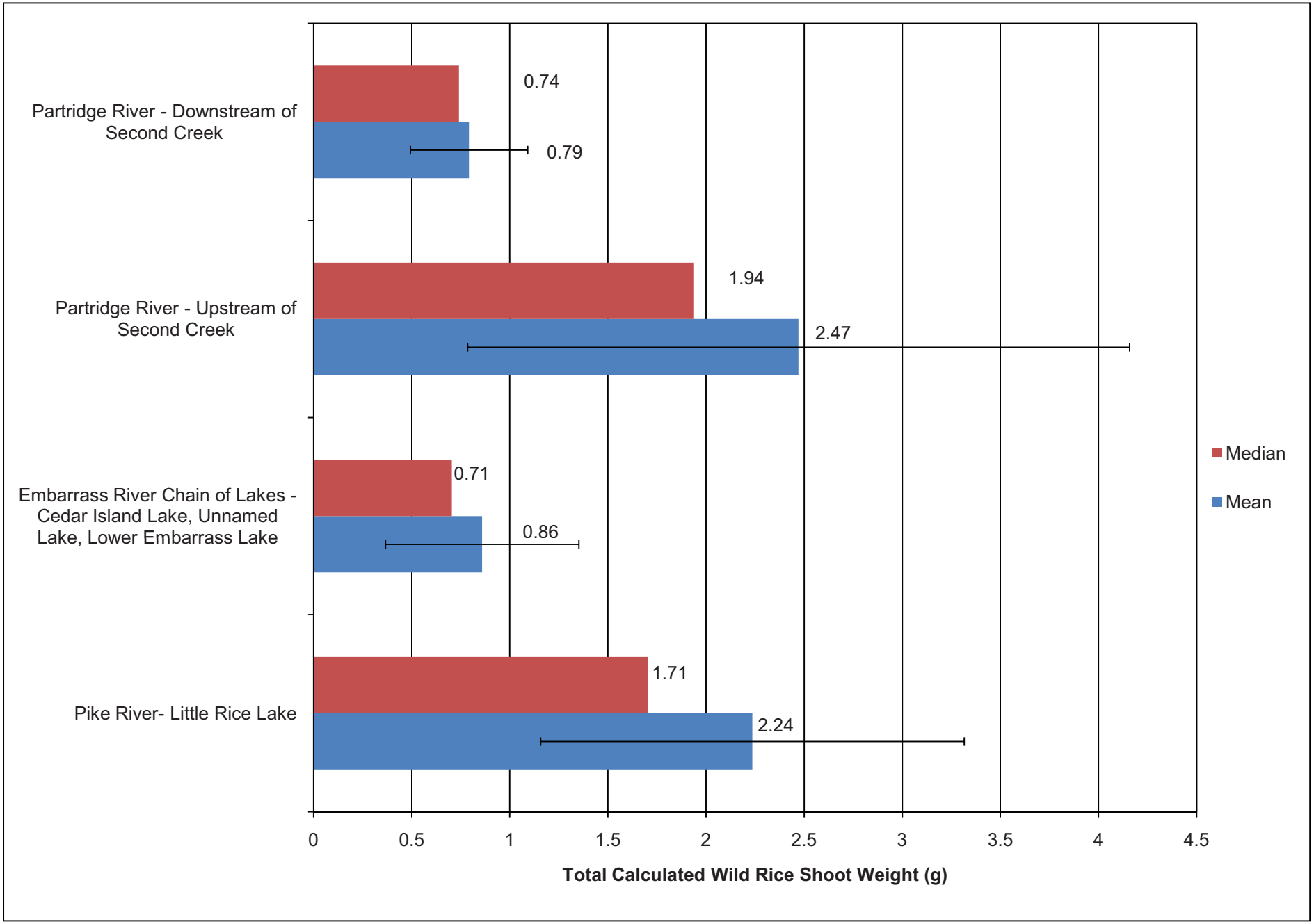


Figure 17 Median, Mean, and Standard Deviation of
Total Calculated Wild Rice Seed Weight (g) in Partridge River, Embarrass River Chain of Lakes, and Pike River in 2011

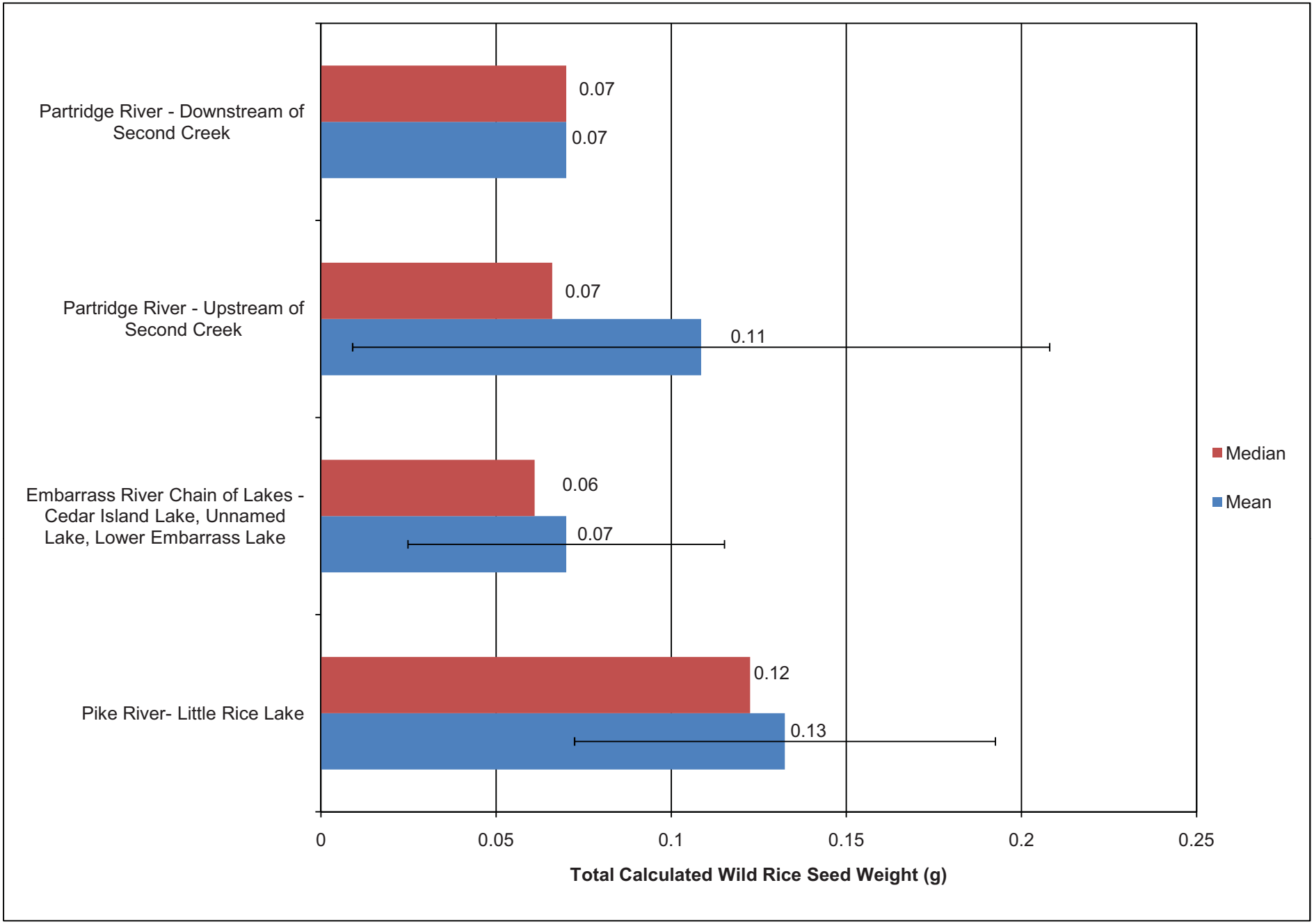


Figure 18 Median, Mean, and Standard Deviation of
Total Calculated Wild Rice Seed Count (#) in Partridge River, Embarrass River Chain of Lakes, and Pike River in 2011

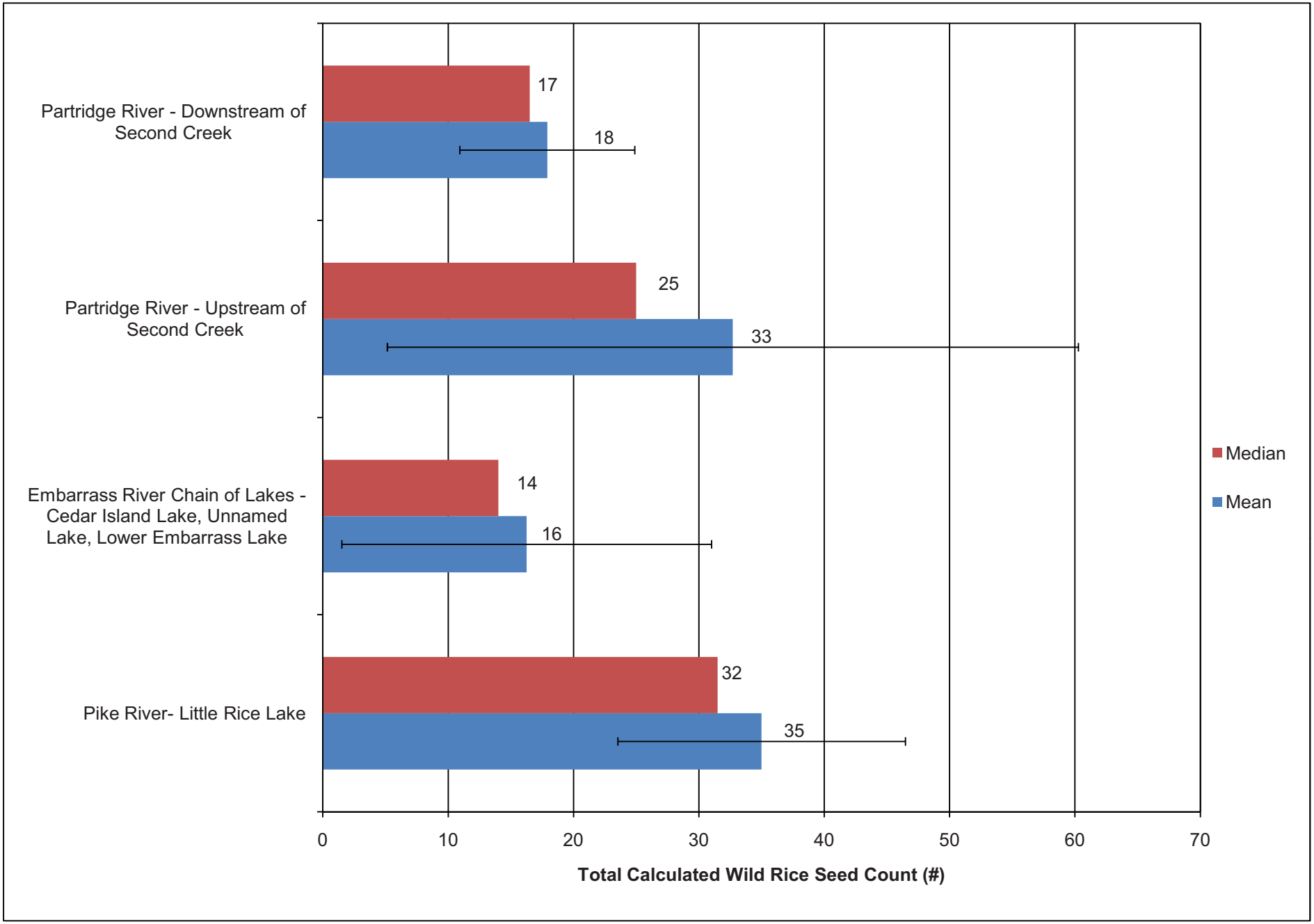


Figure 19 Mean Stem Densities (stems/ 0.5m^2) by Grid According to Year
for Lower Embarrass Lake, Unnamed Lake, and Cedar Island Lake, 2009 to 2011

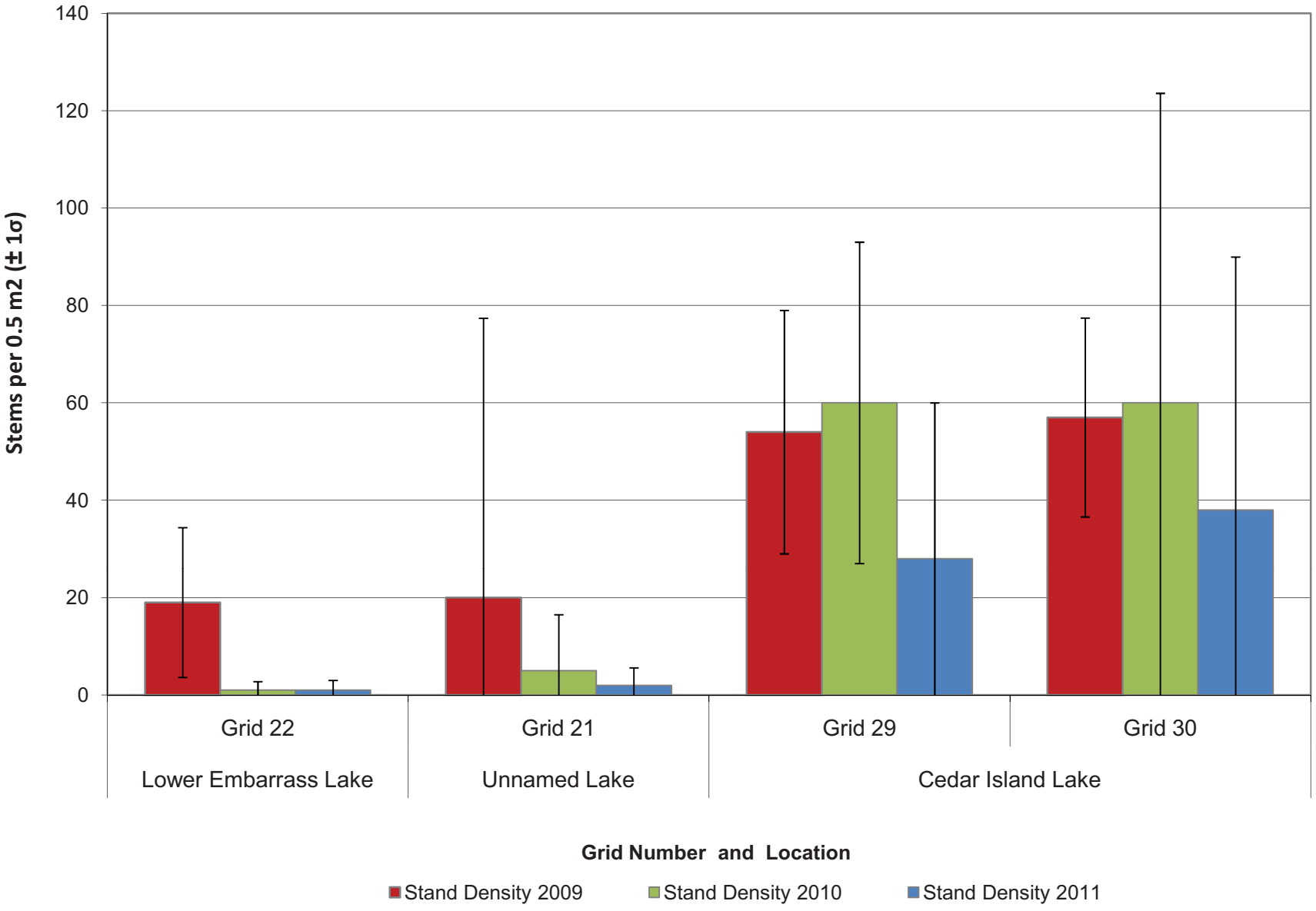
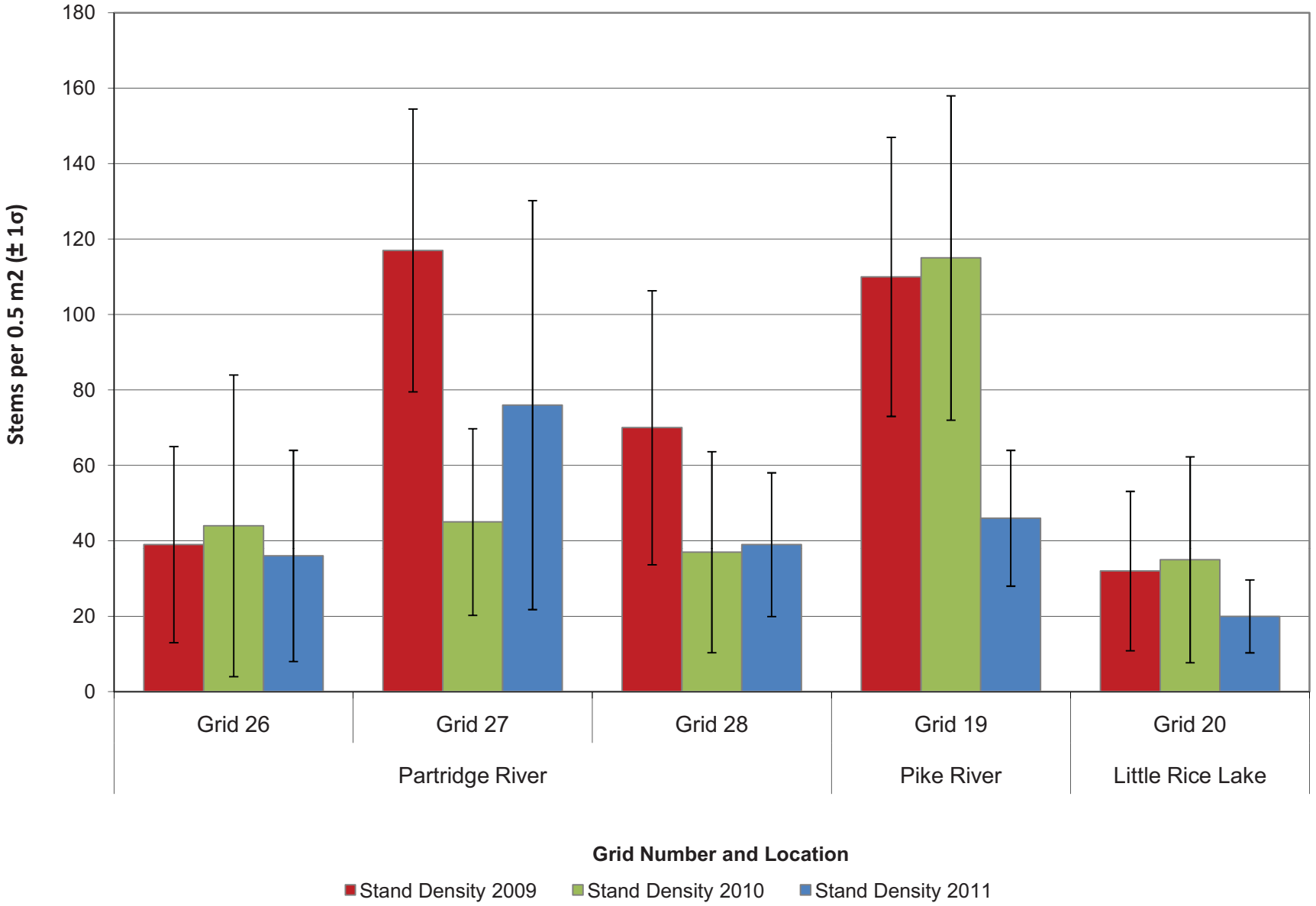
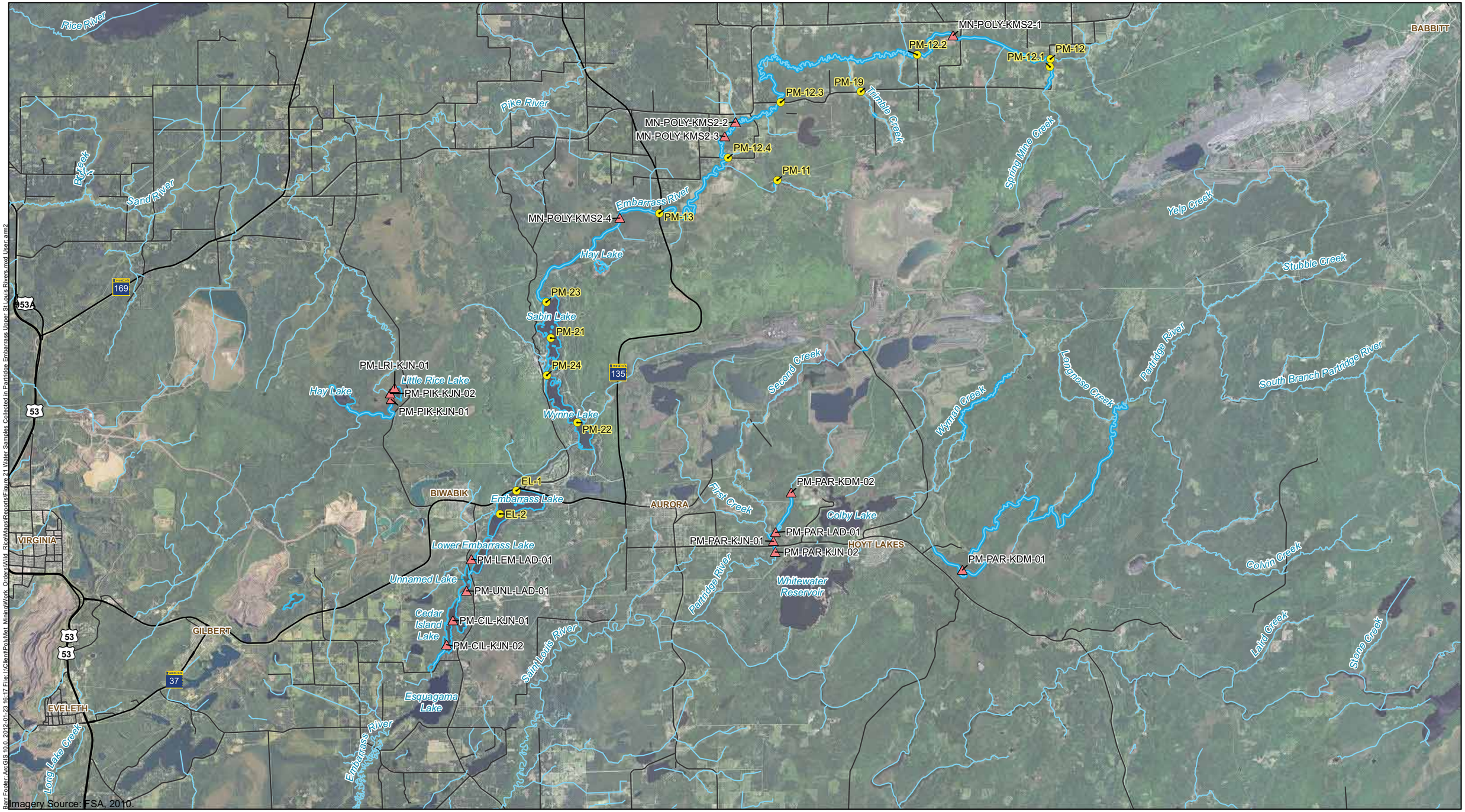


Figure 20 Mean Stem Densities (stems/ 0.5m^2) by Grid According to Year for Partridge River, Little Rice Lake, and Pike River, 2009 to 2011



\\barr.com\projects\Mpls\23 MN\69\2369862\WorkFiles\WO 006 Env Impact Statement\Wild Rice\2011 Report\1stDraft\Figures\Excel Versions\Polymet Density Charts 2011.xlsx



Imagery Source: FSA, 2010.

Surface Water Monitoring Locations
Wild Rice Survey Water Sampling Location
Rivers and Streams
Stream Segments Surveyed in 2011
Lake Shorelines Surveyed in 2011

0 1.25 2.5 5
Miles

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Figure 21
WATER SAMPLES COLLECTED IN THE PARTRIDGE RIVER & EMBARRASS RIVER
NorthMet Project
PolyMet Mining, Inc.
Hoyt Lakes, Minnesota

Barr Footer: ArcGIS 10.0, 2012-01-23 16:25 File: I:\Client\PolyMet_Mining\Work_Orders\Wild_Rice\Mxd\Reports\Figure 22 Sulfate Concentrations in Partridge Embarrass Upper St Louis.mxd User: amn2

Wild Rice Survey Water Sampling Location
Sulfate Values in mg/L
Rivers and Streams
Stream Segments Surveyed in 2011
Lake Shorelines Surveyed in 2011

0 1.25 2.5 5
Miles

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Figure 22
SULFATE CONCENTRATIONS
MEASURED AT WILD RICE STANDS IN 2011
NorthMet Project
PolyMet Mining, Inc.
Hoyt Lakes, Minnesota

Appendices

Appendix A

Photographs of Wild Rice for the Project Study Area

Figure A1: Cedar Island Lake (moderate rice) – August 10, 2011

Figure A2: Cedar Island Lake (sparse rice) – August 10, 2011

Figure A3: Little Rice Lake (moderate wild rice) – August 9, 2011

Figure A4: Pike River (moderate wild rice) – August 9, 2011

Figure A5: Lower Partridge River (moderate rice) – August 11, 2011

Figure A6: Lower Partridge River (moderate rice) – August 11, 2011

Figure A7: Upper Partridge River (no wild rice) – August 10, 2011

Figure A8: Second Creek (sparse wild rice) – September 7, 2011

Figure A9: Upper Embarrass River (sparse wild rice), August 18, 2011

Figure A10: Hay Lake near Embarrass River (no wild rice) – September 7, 2011

Appendix B

Wild Rice Grid Density Calculations for the Project Study Area

B-1 Cedar Island Lake (Embarrass River)

B-2 Unnamed Lake and Lower Embarrass Lake (Embarrass River)

B-3 Lower Partridge River

B-4 Little Rice Lake (Pike River)

Appendix B-1

Cedar Island Lake (Embarrass River)

Cedar Island Lake, Embarrass River

8/10/2011				8/10/2011			
Grid 29				**Grid 30**			
Plots	**Water Depth (in)**	**Stems**	**Height (in)**	**Plots**	**Water Depth (in)**	**Stems**	**Height (in)**
Plot 90	17	3	11	**Plot 71**	24	0	
Plot 60		71	16	**Plot 99**	21	0	
			26				
			27				
			32				
			26				
Plot 98	21	66	35	**Plot 83**	27	0	
			24				
			29				
			22				
			24				
Plot 59	23	34	24	**Plot 88**	20	7	18
			29				13
			16				9
			24				11
			20				17
Plot 94	20	8	22	**Plot 79**	16	15	15
			18				15
			12				19
			8				14
			19				12
Plot 38	23	5	19	**Plot 74**	25	0	
			14				
			24				
			15				
			18				
Plot 76	22	3	24	**Plot 64**	23	0	
			20				
			15				
Plot 9	22	83	32	**Plot 68**	17	85	32
			31				35
			21				17
			19				20
			27				24
Plot 73	21	13	31	**Plot 58**	20	190	34
			21				30
			16				25
			22				28
			14				18

8/10/2011				8/10/2011			
Grid 29				**Grid 30**			
Plots	**Water Depth (in)**	**Stems**	**Height (in)**	**Plots**	**Water Depth (in)**	**Stems**	**Height (in)**
Plot 14	22	40	25	**Plot 63**	24	0	
			27				
			30				
			23				
			20				
Plot 72	22	11	22	**Plot 59**	12	84	23
			29				30
			11				24
			18				23
			13				28
Plot 22	22	77	23	**Plot 52**	23	0	
			23				
			26				
			29				
			28				
Plot 26	21	95	21	**Plot 38**	16	104	23
			21				31
			23				30
			22				24
			27				26
Plot 21	24	21	19	**Plot 42**	22	0	
			15				
			21				
			17				
			10				
Plot 35	22	0		**Plot 29**	17	67	30
							26
							16
							18
							32
Plot 44	22	0		**Plot 23**	20	22	17
							16
							21
							15
							11
Plot 53	20	6	11	**Plot 10**	8	32	29
			13				43
			15				18
			13				25
			19				19
Plot 61	22	6	14	**Plot 4**	16	93	18
			14				23
			16				28
			8				23
			7				21

Cedar Island Lake, Embarrass River

8/10/2011				8/10/2011			
Grid 29				**Grid 30**			
Plots	**Water Depth (in)**	**Stems**	**Height (in)**	**Plots**	**Water Depth (in)**	**Stems**	**Height (in)**
Plot 63	23	21	21	**Plot 96**	26	0	
			14				
			11				
			25				
			17				
Plot 54	21	1		**Plot 5**	19	67	23
							15
							21
							25
							31

	Water Depth (in)	**Stems**	**Height (in)**		**Water Depth (in)**	**Stems**	**Height (in)**
Total		564	1608	**Total**		766	1232
Mean	21.58	28	20.35	**Mean**	19.8	38.3	22.40
Median		12	21	**Median**		11	23
S.D.		32	6.42	**S.D.**		51.95	7.07

S.D. is Standard Deviation

Appendix B-2

Unnamed Lake and Lower Embarrass Lake (Embarrass River)

Unnamed Lake, Lower Embarrass Lake

8/11/2011				8/11/2011			
Grid 21 (Unnamed Lake)				**Grid 22 (Lower Embarrass Lake)**			
Plots	**Water Depth (in)**	**Stems**	**Height (in)**	**Plots**	**Water Depth (in)**	**Stems**	**Height (in)**
Plot 81	20	11	12	**Plot 1**	13	0	
5261322 N				**5262472 N**			
549831 E				**550001 E**			
Plot 41	15	3	9	**Plot 11**	13	0	
5261318 N				**5262471 N**			
549831 E				**550001 E**			
Plot 72	7	12	18	**Plot 22**	12	0	
5261315 N			9	**5262470 N**			
549832 E			13	**550002 E**			
Plot 1	16	2	17	**Plot 31**	13	0	
5261314 N				**5262469 N**			
549831 E				**550001 E**			
Plot 4	13	0		**Plot 82**	12	0	
5261322 N				**5262464 N**			
549834 E				**550002 E**			
Plot 5	13	0		**Plot 92**	11	0	
5261322 N				**5262463 N**			
549835 E				**550002 E**			
Plot 14	14	5		**Plot 15**	19	0	
5261321 N				**5262471 N**			
549834 E				**550005 E**			
Plot 45	12	0		**Plot 55**	15	0	
5261318 N				**5262467 N**			
549835 E				**550005 E**			
Plot 55	13	0		**Plot 64**	12	0	
5261317 N				**5262466 N**			
549835 E				**550004 E**			
Plot 95	13	0		**Plot 73**	11	0	
5261313 N				**5262465 N**			
549835 E				**550003 E**			

Unnamed Lake, Lower Embarrass Lake

8/11/2011				8/11/2011			
Grid 21 (Unnamed Lake)				**Grid 22 (Lower Embarrass Lake)**			
Plots	**Water Depth (in)**	**Stems**	**Height (in)**	**Plots**	**Water Depth (in)**	**Stems**	**Height (in)**
Plot 6	11	0		**Plot 3**	15	0	
5261322 N				**5262472 N**			
549836 E				**550003 E**			
Plot 17	12	0		**Plot 13**	16	0	
5261321 N				**5262471 N**			
549837 E				**550003 E**			
Plot 27	13	0		**Plot 26**	19	0	
5261320 N				**5262470 N**			
549837 E				**550006 E**			
Plot 26	11	0		**Plot 36**	23	9	29
5261320 N				**5262469 N**			
549836 E				**550006 E**			
Plot 96	9	0		**Plot 77**	20	0	
5261313 N				**5262465 N**			
549836 E				**550007 E**			
Plot 18	11	0		**Plot 98**	24	0	
5261321 N				**5262463 N**			
549838 E				**550008 E**			
Plot 29	9	0		**Plot 96**	15	0	
5261320 N				**5262463 N**			
549839 E				**550006 E**			
Plot 58	11	0		**Plot 8**	27	0	
5261317 N				**5262472 N**			
549838 E				**550008 E**			
Plot 50	9	0		**Plot 19**	34	0	
5261318 N				**5262471 N**			
549840 E				**550009 E**			
Plot 44	11	1	14	**Plot 29**	27	0	
				5262470 N			
				550009 E			

	Water Depth (in)	**Stems**	**Height (in)**		**Water Depth (in)**	**Stems**	**Height (in)**
Total		34	92	**Total**		9	29
Mean	12.15	1.7	13.14	**Mean**	17.55	0.45	29.00
Median		0	13	**Median**		0	29
S.D.		3.60	3.53	**S.D.**		2.01	-

Appendix B-3

Lower Partridge River

Lower Partrige River
(Below Colby Lake)

8/12/2011				8/12/2011				8/12/2011			
Grid 26				Grid 27				Grid 28			
Plots	**Water Depth (in)**	**Stems**	**Height (in)**	**Plots**	**Water Depth (in)**	**Stems**	**Height (in)**	**Plots**	**Water Depth (in)**	**Stems**	**Height (in)**
Plot 91	43	0		**Plot 32**	25	82	12	**Plot 1**	13	61	23
5263119 N							18	**5263440 N**			26
560961 E							19	**561032 E**			22
							21				12
							22				11
Plot 42	36	10	23	**Plot 41**	38	7	17	**Plot 52**	14	36	22
5263124 N			25				14	**5263435 N**			16
560962 E			19				15	**561033 E**			23
			23				15				16
			14				12				26
Plot 23	33	51	17	**Plot 61**	46	3	12	**Plot 72**	14	42	20
5263126 N			15				6	**5263433 N**			23
560963 E			25				14	**561033 E**			22
			28								21
			25								11
Plot 53	33	10	27	**Plot 71**	47	0		**Plot 73**	13	9	11
5263123 N			28					**5263433 N**			8
560963 E			30					**561034 E**			15
			24								12
			22								14
Plot 73	30	11	12	**Plot 4**	19	116	16	**Plot 74**	13	30	5
5263121 N			19				28	**5263433 N**			12
560963 E			6				29	**561035 E**			29
			17				21				22
			20				26				12
Plot 74	35	12	24	**Plot 24**	17	233	17	**Plot 64**	14	18	15
5263121 N			17				17	**5263434 N**			14
560964 E			11				27	**561035 E**			16
			12				19				13
			14				18				22
Plot 75	30	26	17	**Plot 25**	14	137	29	**Plot 93**	11	39	24
5263121 N			16				25	**5263431 N**			22
560965 E			16				22	**561034 E**			25
			14				21				16
			17				19				22
Plot 24	29	46	23	**Plot 55**	15	121	24	**Plot 92**	12	47	20
5263126 N			24				26	**5263431 N**			21
560964 E			16				17	**561033 E**			14
			19				17				18
			17				22				15
Plot 25	27	41	16	**Plot 75**	14	64	24	**Plot 34**	14	30	16
5263126 N			22				19	**5263437 N**			21
560965 E			16				25	**561035 E**			18
			21				28				22
			9				35				19

Lower Partrige River
(Below Colby Lake)

8/12/2011				8/12/2011				8/12/2011			
Grid 26				Grid 27				Grid 28			
Plots	Water Depth (in)	Stems	Height (in)	Plots	Water Depth (in)	Stems	Height (in)	Plots	Water Depth (in)	Stems	Height (in)
Plot 96	33	11	27	**Plot 87**	15	94	17	**Plot 25**	13	19	22
5263119 N			15				23	**5263438 N**			17
560966 E			8				21	**561036 E**			25
			16				16				16
			18				15				9
Plot 97	32	16	11	**Plot 67**	13	64	17	**Plot 36**	15	41	18
5263119 N			21				11	**5263437 N**			15
560967 E			20				16	**561037 E**			21
			18				13				19
			28				16				23
Plot 78	31	27	30	**Plot 58**	12	49	19	**Plot 37**	18	23	21
5263121 N			18				22	**5263437 N**			30
560968 E			17				22	**561038 E**			21
			18				24				17
			11				24				23
Plot 79	30	78	19	**Plot 38**	11	65	17	**Plot 7**	17	23	19
5263121 N			16				10	**5263440 N**			13
560969 E			10				15	**561038 E**			12
			21				7				15
			14				21				14
Plot 80	31	31	21	**Plot 29**	8	52	25	**Plot 20**	19	56	29
5263121 N			21				15	**5263439 N**			12
560970 E			9				23	**561041 E**			17
			11				17				20
			22				13				17
Plot 68	27	93	26	**Plot 10**	11	38	24	**Plot 29**	18	23	18
5263122 N			21				12	**5263438 N**			24
560968 E			18				20	**561040 E**			21
			17				26				19
			23				18				23
Plot 59	28	86	25	**Plot 20**	7	23	22	**Plot 49**	15	45	20
5263123 N			25				16	**5263436 N**			29
560969 E			24				22	**561040 E**			22
			21				15				20
			20				12				30
Plot 50	21	60	23	**Plot 60**	9	105	34	**Plot 68**	15	42	17
5263124 N			26				25	**5263434 N**			15
560970 E			4				23	**561039 E**			23
			25				16				25
			10				16				22
Plot 39	21	71	10	**Plot 89**	10	72	27	**Plot 89**	21	46	25
5263125 N			22				20	**5263432 N**			21
560969 E			22				16	**561040 E**			24
			30				21				16
			21				13				19

Lower Partrige River
(Below Colby Lake)

8/12/2011				8/12/2011				8/12/2011			
Grid 26				**Grid 27**				**Grid 28**			
Plots	**Water Depth (in)**	**Stems**	**Height (in)**	**Plots**	**Water Depth (in)**	**Stems**	**Height (in)**	**Plots**	**Water Depth (in)**	**Stems**	**Height (in)**
Plot 28	25	34	17	**Plot 36**	15	86	11	**Plot 97**	18	47	20
5263126 N			14				20	**5263431 N**			17
560968 E			20				24	**561038 E**			26
			18				16				8
			21				10				16
Plot 10	17	15	18	**Plot 6**	12	103	20	**Plot 100**	20	92	23
5263128 N			13				21	**5263431 N**			25
560970 E			10				28	**561041 E**			26
			18				24				17
			11				16				21

	Water Depth (in)	**Stems**	**Height (in)**		**Water Depth (in)**	**Stems**	**Height (in)**		**Water Depth (in)**	**Stems**	**Height (in)**
Total		729	1773	**Total**		1514	1795	**Total**		769	1904
Mean	29.6	36	18.66	**Mean**	17.9	75.7	19.30	**Mean**	**15.35**	38.45	19.04
Median		29	18	**Median**		68.5	19	**Median**		40	20
S.D.		28	5.70	**S.D.**		54.23	5.60	**S.D.**		18.48	5.18

S.D. is Standard Deviation

Appendix B-4

Little Rice Lake (Pike River)

Pike River at Little Rice Lake, Little Rice Lake

8/9/2011				8/9/2011			
Grid 19 (Pike River at Little Rice Lake)				**Grid 20 (Little Rice Lake)**			
Plots	**Water Depth (in)**	**Stems**	**Height (in)**	**Plots**	**Water Depth (in)**	**Stems**	**Height (in)**
Plot 42	16	37	26	**Plot 12**	25	11	23
5268482 N			28	**5268671 N**			16
547970 E			29	**547222 E**			15
			24				35
			38				21
Plot 51	15	45	19	**Plot 42**	23	16	16
5268481 N			25	**5268668 N**			33
547969 E			20	**547222 E**			27
			19				24
			17				23
Plot 61	17	42	16	**Plot 41**	23	27	11
5268480 N			29	**5268668 N**			22
547969 E			21	**547221 E**			27
			29				28
			20				31
Plot 82	18	73	29	**Plot 51**	23	13	29
5268478 N			43	**5268667 N**			25
547970 E			35	**547221 E**			11
			29				19
			30				21
Plot 74	21	33	35	**Plot 52**	22	42	10
5268479 N			15	**5268667 N**			9
547972 E			25	**547222 E**			24
			32				25
			21				19
Plot 63	20	26	41	**Plot 83**	25	14	27
5268480 N			25	**5268664 N**			15
547971 E			23	**547223 E**			23
			32				28
			50				37
Plot 54	21	49	32	**Plot 6**		18	37
5268481 N			35	**5268672 N**			16
547972 E			25	**547226 E**			29
			28				15
			29				21
Plot 4	17	67	17	**Plot 45**	26	35	20
5268486 N			30	**5268668 N**			29
547972 E			41	**547225 E**			30
			27				26
			24				32
Plot 16	18	92	39	**Plot 56**	23	22	9
5268485 N			40	**5268667 N**			18
547974 E			37	**547226 E**			19
			38				29
			30				33
Plot 57	14	44	31	**Plot 8**		26	32
5268481 N			20	**5268672 N**			31

Pike River at Little Rice Lake, Little Rice Lake

8/9/2011				8/9/2011			
Grid 19 (Pike River at Little Rice Lake)				**Grid 20 (Little Rice Lake)**			
Plots	**Water Depth (in)**	**Stems**	**Height (in)**	**Plots**	**Water Depth (in)**	**Stems**	**Height (in)**
547975 E			18	**547228 E**			32
			15				27
			14				16
Plot 67	12	31	26	**Plot 18**	23	15	19
5268480 N			37	**5268671 N**			21
547975 E			30	**547228 E**			17
			33				20
			37				33
Plot 87	16	26	16	**Plot 28**	22	18	24
5268478 N			22	**5268670 N**			18
547975 E			26	**547228 E**			30
			24				26
			30				25
Plot 86	14	30	53	**Plot 57**	24	28	21
5268478 N			41	**5268667 N**			38
547974 E			31	**547227 E**			41
			29				28
			23				25
Plot 49	28	35	19	**Plot 78**	25	10	31
5268482 N			26	**5268665 N**			30
547977 E			30	**547228 E**			14
			28				27
			22				27
Plot 39	21	30	41	**Plot 77**	25	16	11
5268483 N			48	**5268665 N**			19
547977 E			28	**547227 E**			33
			33				18
			31				15
Plot 18	17	47	16	**Plot 93**	24	21	30
5268485 N			17				29
547976 E			28				41
			30				35
			25				39
Plot 8	21	51	26	**Plot 100**	24	7	26
5268486 N			34	**5268663 N**			17
547976 E			32	**547230 E**			18
			21				24
			22				11
Plot 30	19	39	30	**Plot 89**	24	20	26
5268484 N			22	**5268664 N**			11
547978 E			33	**547229 E**			19
			39				15
			35				16
Plot 45	16	73	21	**Plot 79**	22	39	27
5268482 N			40	**5268665 N**			32
547973 E			37	**547229 E**			39
			19				29

Pike River at Little Rice Lake, Little Rice Lake

8/9/2011				8/9/2011			
Grid 19 (Pike River at Little Rice Lake)				**Grid 20 (Little Rice Lake)**			
Plots	**Water Depth (in)**	**Stems**	**Height (in)**	**Plots**	**Water Depth (in)**	**Stems**	**Height (in)**
			39				20
Plot 95	12	47	25	**Plot 59**	25	15	17
5268477 N			29	**5268667 N**			20
547973 E			35	**547229 E**			27
			32				18
			25				28
				Plot 98	24	9	12
							19
							21
							32
							13

	Water Depth (in)	**Stems**	**Height (in)**		**Water Depth (in)**	**Stems**	**Height (in)**
Total		917	2871	**Total**		422	2497
Mean	17.65	46	28.71	**Mean**	23.79	20.10	23.78
Median		43	29	**Median**		18	24
S.D.		18	8.11	**S.D.**		9.67	7.75

Appendix C

Plant Data (Total, stem, root, and seed biomass, seed number)

Appendix C
Pike River and Little Rice Lake
Plant Data 2011

Sample ID	Seed Count (#)	Seed Weight (g)	Root Weight (g)	Shoot Weight (g)	Actual Total Plant Weight (g)	Calculated Total Plant Weight (g)	Difference (g)
PM-LRL-LAD-WR01	21	0.07	0.09	1.17	1.33	1.33	0.00
PM-LRL-LAD-WR02	38	0.15	0.26	1.62	2.03	2.04	-0.01
PM-LRL-LAD-WR03	30	0.15	0.64	4.29	5.08	5.08	0.00
PM-LRL-LAD-WR04	31	0.07	0.36	2.45	2.88	2.88	0.00
PM-LRL-LAD-WR05	36	0.15	0.47	3.75	4.37	4.37	0.00
PM-LRL-LAD-WR06	35	0.10	0.19	1.79	2.09	2.08	0.01
PM-LRL-LAD-WR07	24	0.09	0.71	2.60	3.39	3.40	-0.01
PM-LRL-LAD-WR08	29	0.13	0.10	2.34	2.57	2.57	0.00
PM-LRL-LAD-WR09	35	0.12	0.51	2.60	3.21	3.23	-0.02
PM-LRL-LAD-WR10	20	0.08	0.27	1.58	1.93	1.93	0.00
PM-PIK-LAD-WR01	55	0.21	0.58	3.58	4.45	4.37	0.08
PM-PIK-LAD-WR02	35	0.12	0.36	1.43	1.91	1.90	0.01
PM-PIK-LAD-WR03	30	0.15	0.32	1.56	2.03	2.03	0.00
PM-PIK-LAD-WR04	46	0.17	0.11	1.39	1.68	1.68	0.00
PM-PIK-LAD-WR05	32	0.12	0.35	1.59	2.05	2.06	-0.01
PM-PIK-LAD-WR06	31	0.33	0.41	3.45	4.18	4.19	-0.01
PM-PIK-LAD-WR07	62	0.16	0.55	4.15	4.85	4.86	-0.01
PM-PIK-LAD-WR08	27	0.08	0.17	1.39	1.65	1.65	0.00
PM-PIK-LAD-WR09	27	0.08	0.13	0.71	0.91	0.91	0.00
PM-PIK-LAD-WR10	56	0.14	0.23	1.28	1.64	1.64	0.00
Mean	35	0.13	0.34	2.24	2.71	2.71	0.00
Median	32	0.12	0.34	1.71	2.07	2.07	0.00
Standard Deviation	11	0.06	0.19	1.08	1.26	1.26	0.02

Appendix C
Embarrass River
Plant Data 2011

Sample ID	Seed Count (#)	Seed Weight (g)	Root Weight (g)	Shoot Weight (g)	Actual Total Plant Weight (g)	Calculated Total Plant Weight (g)	Difference (g)
PM-CIL-LAD-WR01	20	0.04	0.40	0.85	1.28	1.29	-0.01
PM-CIL-LAD-WR02	6	0.08	0.22	1.05	1.35	1.35	0.00
PM-CIL-LAD-WR03	13	0.07	0.07	0.46	0.59	0.59	0.00
PM-CIL-LAD-WR04	14	0.06	0.05	0.51	0.62	0.62	0.00
PM-CIL-LAD-WR05	13	0.06	0.04	0.70	0.80	0.81	-0.01
PM-CIL-LAD-WR06	9	0.05	0.15	0.65	0.84	0.85	-0.01
PM-CIL-LAD-WR07	16	0.07	0.23	1.37	1.67	1.67	0.00
PM-CIL-LAD-WR08	24	0.10	0.16	1.06	1.32	1.32	0.00
PM-CIL-LAD-WR09	7	0.08	0.08	0.63	0.79	0.79	0.00
PM-CIL-LAD-WR10	8	0.07	0.07	0.63	0.75	0.76	-0.01
PM-CIL-LAD-WR11	11	0.04	0.10	0.71	0.86	0.85	0.01
PM-CIL-LAD-WR12	10	0.20	0.20	0.77	1.16	1.16	0.00
PM-CIL-LAD-WR13	19	0.05	0.39	0.58	1.02	1.02	0.00
PM-CIL-LAD-WR14	18	0.13	0.07	0.78	0.98	0.98	0.00
PM-CIL-LAD-WR15	17	0.03	0.21	0.57	0.80	0.80	0.00
PM-CIL-LAD-WR16	4	0.01	0.16	1.25	1.41	1.41	0.00
PM-CIL-LAD-WR17	17	0.05	0.14	0.64	0.83	0.83	0.00
PM-CIL-LAD-WR18	18	0.05	0.20	0.78	1.01	1.02	-0.01
PM-CIL-LAD-WR19	12	0.10	0.28	1.19	1.56	1.56	0.00
PM-CIL-LAD-WR20	14	0.04	0.09	0.88	1.00	1.00	0.00
PM-UNL-KJN-01	9	0.02	0.16	0.34	0.50	0.51	-0.01
PM-LEM-KJN-WR01	80	0.15	0.26	2.78	3.19	3.19	0.00
PM-LEM-KJN-WR02	15	0.02	0.33	0.60	0.94	0.95	-0.01
Mean	16	0.07	0.18	0.86	1.10	1.10	0.00
Median	14	0.06	0.16	0.71	0.98	0.98	0.00
Standard Deviation	15	0.05	0.10	0.49	0.55	0.55	0.01

Appendix C
Partridge River Downstream of Second Creek
Plant Data 2011

Sample ID	Seed Count (#)	Seed Weight (g)	Root Weight (g)	Shoot Weight (g)	Actual Total Plant Weight (g)	Calculated Total Plant Weight (g)	Difference (g)
PM-PR-LAD-WR01	14	0.05	0.19	0.85	1.10	1.09	0.01
PM-PR-LAD-WR02	18	0.05	0.02	0.49	0.56	0.56	0.00
PM-PR-LAD-WR03	24	0.09	0.14	1.20	1.43	1.43	0.00
PM-PR-LAD-WR04	29	0.11	0.19	1.42	1.71	1.72	-0.01
PM-PR-LAD-WR05	23	0.09	0.15	0.98	1.21	1.21	0.00
PM-PR-LAD-WR06	37	0.08	0.12	1.23	1.44	1.43	0.01
PM-PR-LAD-WR07	14	0.06	0.09	0.97	1.13	1.13	0.00
PM-PR-LAD-WR08	22	0.07	0.16	0.68	0.89	0.90	-0.01
PM-PR-LAD-WR09	16	0.11	0.05	0.61	0.77	0.77	0.00
PM-PR-LAD-WR10	8	0.07	0.06	0.51	0.63	0.63	0.00
PM-PR-LAD-WR11	14	0.04	0.02	0.47	0.54	0.53	0.01
PM-PR-LAD-WR12	20	0.07	0.04	0.83	0.94	0.94	0.00
PM-PR-LAD-WR13	22	0.07	0.12	1.13	1.34	1.32	0.02
PM-PR-LAD-WR14	10	0.08	0.10	0.63	0.81	0.82	-0.01
PM-PR-LAD-WR15	19	0.07	0.25	0.99	1.31	1.31	0.00
PM-PR-LAD-WR16	13	0.04	0.00	0.33	0.37	0.37	0.00
PM-PR-LAD-WR17	10	0.01	0.07	0.59	0.68	0.67	0.01
PM-PR-LAD-WR18	16	0.07	0.04	0.50	0.61	0.61	0.00
PM-PR-LAD-WR19	17	0.07	0.13	0.60	0.80	0.80	0.00
PM-PR-LAD-WR20	12	0.15	0.05	0.80	1.00	1.00	0.00
Mean	18	0.07	0.10	0.79	0.96	0.96	0.00
Median	17	0.07	0.10	0.74	0.92	0.92	0.00
Standard Deviation	7	0.03	0.07	0.30	0.36	0.36	0.01

Appendix C

Partridge River Upstream of Second Creek

Plant Data 2011

Sample ID	Seed Count (#)	Seed Weight (g)	Root Weight (g)	Shoot Weight (g)	Actual Total Plant Weight (g)	Calculated Total Plant Weight (g)	Difference (g)
PM-PAR-KDM-WR01	0	0.00	1.30	3.65	4.93	4.95	-0.02
PM-PAR-KDM-WR02	0	0.00	0.28	2.22	2.50	2.51	-0.01
PM-PAR-KDM-WR03	7	0.02	0.05	0.45	0.51	0.52	-0.01
PM-PAR-KDM-WR04	0	0.00	0.26	0.71	0.97	0.96	0.01
PM-PAR-KDM-WR05	29	0.06	0.19	0.90	1.15	1.15	0.00
PM-PAR-KDM-WR06	46	0.17	0.40	3.00	3.56	3.57	-0.01
PM-PAR-KDM-WR07	82	0.34	0.49	4.33	5.16	5.16	0.00
PM-PAR-KDM-WR08	20	0.10	0.31	2.34	2.75	2.75	0.00
PM-PAR-KDM-WR09	30	0.09	0.70	5.44	6.23	6.24	-0.01
PM-PAR-KDM-WR10	77	0.22	1.03	4.89	6.14	6.14	0.00
PM-PAR-KDM-WR11	62	0.17	0.97	5.95	7.09	7.10	-0.01
PM-PAR-KDM-WR12	21	0.05	0.08	1.87	2.00	2.01	-0.01
PM-PAR-KDM-WR13	46	0.12	0.19	2.47	2.80	2.79	0.01
PM-PAR-KDM-WR14	97	0.22	0.39	3.59	4.20	4.20	0.00
PM-PAR-KDM-WR15	67	0.33	0.20	4.06	4.58	4.59	-0.01
PM-PAR-KDM-WR16	66	0.20	0.22	4.04	4.46	4.46	0.00
PM-PAR-KDM-WR17	58	0.28	0.56	5.17	6.02	6.01	0.01
PM-PR-KJN-WR01	12	0.05	0.04	0.75	0.85	0.84	0.01
PM-PR-KJN-WR02	12	0.04	0.06	1.17	1.27	1.27	0.00
PM-PR-KJN-WR03	8	0.03	0.06	1.24	1.32	1.32	0.00
PM-PR-KJN-WR04	32	0.10	0.10	1.53	1.73	1.73	0.00
PM-PR-KJN-WR05	25	0.07	0.06	1.41	1.53	1.53	0.00
PM-PR-KJN-WR06	28	0.09	0.06	1.94	2.08	2.09	-0.01
PM-PR-KJN-WR07	13	0.05	0.03	0.95	1.02	1.03	-0.01
PM-PR-KJN-WR08	13	0.03	0.03	0.62	0.67	0.68	-0.01
PM-PR-KJN-WR09	13	0.05	0.05	1.02	1.11	1.11	0.00
PM-PR-KJN-WR10	19	0.06	0.13	1.02	1.22	1.21	0.01
Mean	33	0.11	0.31	2.47	2.88	2.89	0.00
Median	25	0.07	0.19	1.94	2.08	2.09	0.00
Standard Deviation	28	0.10	0.34	1.69	2.03	2.03	0.01

Appendix D

Memorandum to MPCA (6/29/2011) on Embarrass River and PM 11 Wild Rice

Technical Memorandum

To: Richard Clark, MPCA
From: Cheryl Feigum
Subject: Request from MPCA for Additional Information Regarding Unnamed Creek Northwest of the Former LTV Tailings Basin
Date: June 29, 2011
Project: NorthMet Project
c: Jim Scott and Kevin Pylka, PolyMet Mining Company

Barr prepared this technical memorandum in response to requests provided by email from Richard Clark on March 18, 2011. This memorandum addresses the request by the MPCA and other commenters who want to know if wild rice is present in Unnamed Creek which flows from the northwestern corner of the former LTV Tailings Basin to the Embarrass River. A portion of Unnamed Creek was surveyed as part of the PolyMet 2010 Wild Rice and Water Quality Monitoring Report (2010 Wild Rice Survey). The remaining portions of this creek were not surveyed in 2010, in large part due to safety concerns associated with access. This memorandum includes detailed site specific information for the portion of Unnamed Creek that was not surveyed during the 2010 Wild Rice Survey. It also includes information regarding the former cultivated (paddy) wild rice farm located south of the Embarrass River.

Summary

The information presented in this memorandum discussed Unnamed Creek, which has been divided into the following five stream reaches (Figures 1 and 2) for discussion purposes: 1) PM11 to the west end of the reach for the 2010 Wild Rice Survey, 2) the alder thicket/shallow marsh, 3) the west channel of Unnamed Creek, 4) the black ash swamp, and 5) the alder thicket located northwest of the black ash swamp to the Embarrass River. These stream reaches were reviewed using 2003, 2006, 2008, 2009 and 2010 Farm Services Administration (FSA) true color aerial photographs; 2008 FSA color infrared (CIR) aerial photograph; and 2005 Minnesota Department of Natural Resources (MnDNR) CIR stereopair photographs with 60 percent overlap. In addition, we included our best professional judgment based on knowledge obtained during fieldwork conducted from 2006-2011 in creeks, streams, lakes and wetlands

around the area. This fieldwork included wetland delineations, wetland hydrology monitoring, wild rice surveys, aquatic macroinvertebrate surveys, fish surveys and threatened and endangered botanical species surveys.

The five reaches of Unnamed Creek are described as follows:

1. **PM11 to western boundary of the 2010 Wild Rice Survey** - This stream reach is approximately 0.3 miles in length beginning at surface water monitoring station PM11 and ending at the west end of the 2010 Wild Rice Survey. Along this reach, the creek flows through an incised channel with a gravelly and sandy substrate (Figure 3). The banks along this reach are primarily reed canary grass with scattered willow shrubs. Northwest of unnamed creek, the vegetation transitions to primarily willow shrubs and then to forest (Figure 4). The meandering creek channel is visible on the aerial photographs (Figures 1, 2 and 5). At the west end of this reach, the creek flows through an area where stands of black spruce are present north of and close to the creek. North of the black spruce stands, aspen are present at higher elevations. South of Unnamed Creek the area transitions to an upland area that was previously logged (Figure 2). The creek channel is shown on Figures 1 and 2, however at the western end of this reach the creek channel is not readily visible on the aerial photographs. No wild rice was observed in this reach during the 2010 Wild Rice Survey.

2. **Alder thicket/ shallow marsh** – This stream reach is approximately 0.4 miles in length. The reach starts at the west end of the 2010 Wild Rice Survey and ends in an alder thicket with cattails present in small, open water areas (Figure 2). The meandering creek channel is visible in the aerial photographs through this reach; however, the channel appears to be covered by vegetation in some areas and also splits into two channels at times. In these area, the channel likely splits and flows around dense alder stands. Assuming this reach is similar to the shallow marsh and alder thickets located north of the Tailings Basin; the water depth is likely approximately 3 to 5 feet with a mucky organic substrate (Figure 5). Based on wild rice surveys in nearby water bodies, the substrate conditions could potentially support wild rice populations. However, based on other surveys, alder thicket/ shallow marsh systems do not appear to support wild rice populations. In addition, the presence of dead trees in the reach indicates the area was previously shaded which is not conducive to the growth of wild rice.

3. **West channel of unnamed creek** – This reach is approximately 0.4 miles in length and begins at the main channel of unnamed creek (Figure 2). This creek flows northwest and meanders around the southwestern edge of a black ash swamp. The creek also flows along the north edge of an upland logged area (Figures 1, 6 and 7). The channel ends at a north to south logging road which was constructed between 2006 and 2008. This channel in this reach is similar to the rest of the alder thicket/shallow marsh area and therefore is not likely to support wild rice.

4. **Black Ash swamp** – In this reach, Unnamed Creek flows north into a black ash swamp and crosses a transmission line corridor (Figures 1, 2 and 6). The creek at this junction is small and not navigable. Once it crosses the transmission line corridor, the channel is not visible on aerial photographs (represented by a dashed line on Figures 1 and 2). The creek channel shown on these figures was approximated using stream flowlines from the MnDNR Public Waters Inventory (PWI), including both electronic data and printed maps. The creek flows through an area that is dominated by a closed tree canopy with minimal sunlight reaching the soil surface (Figure 8). The channel in the black ash swamp is likely narrow with shallow water. As discussed above for Reach 2, it is possible but not likely that substrate and stream channel conditions support wild rice populations.

5. **Alder thicket northwest of the Black Ash Swamp to the Embarrass River** – This section of unnamed creek is not well defined on the aerial photograph (Figure 1). The creek flows through an alder thicket and a former cultivated (paddy) wild rice farm prior to discharging to the Embarrass River. The alder thicket has no open water and therefore conditions are not likely to support the growth of wild rice populations. In the location of the former cultivated (paddy) wild rice farm, The complete species lists for the annual vegetation surveys conducted at the LTV wetland mitigation site in 2001, 2002 and 2003 did not include wild rice (Appendix A). The photograph in Figure 9 was taken September 16, 2010 from the T-3037 bridge looking east along the Embarrass River. The former cultivated (paddy) wild rice farm is located along the south bank of the river at this location. No wild rice was identified along this stretch of the Embarrass River.

Based on the available data and Barr's professional judgment, there is no evidence of, nor reason to believe there is, wild rice in Unnamed Creek.

Figures

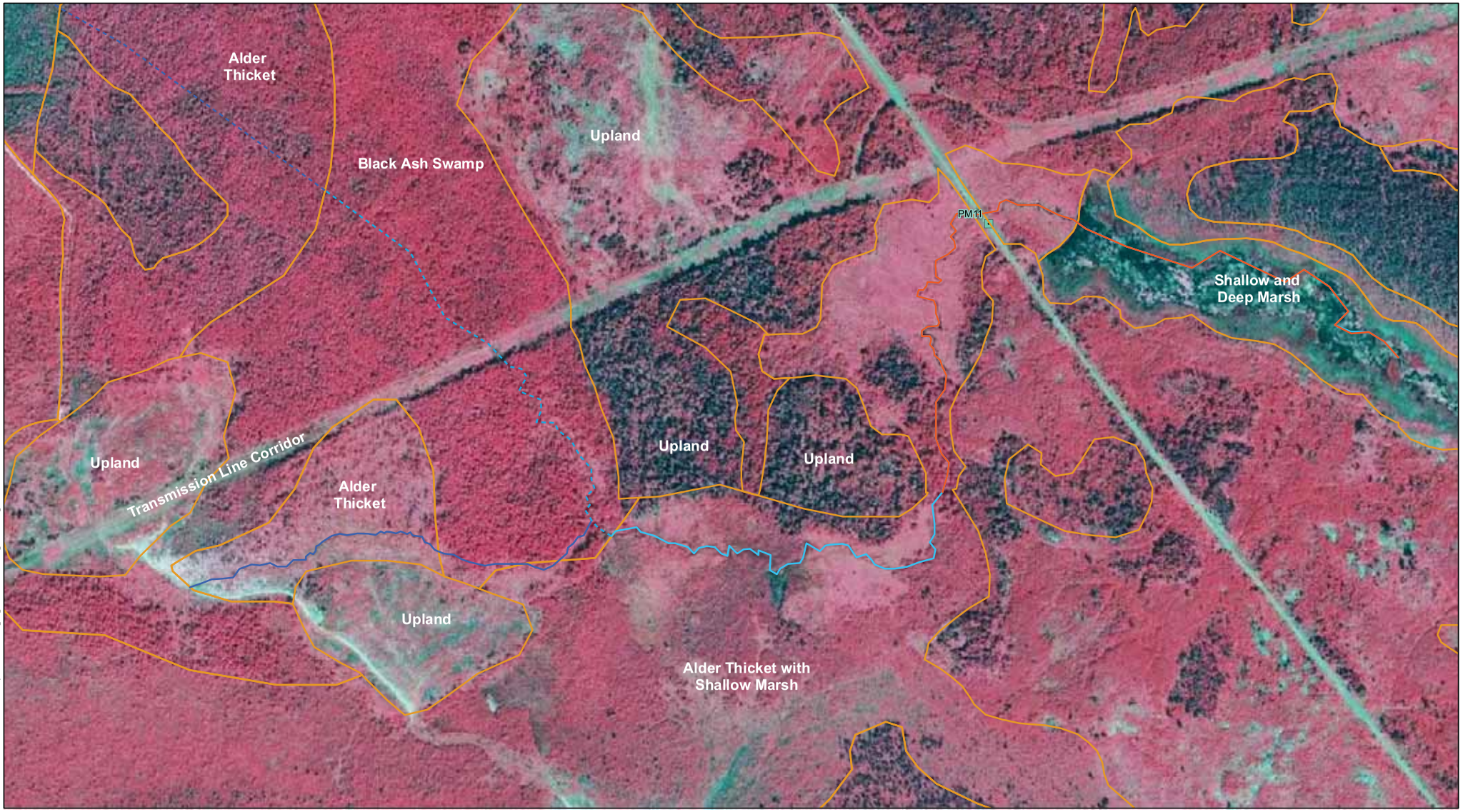
2010 FSA Aerial Photograph

- Surface Water Monitoring Location
- T-3037 Bridge
- Unnamed Creek
- Unnamed Creek (from PWI printed maps)
- PolyMet 2010 Wild Rice Survey (Unnamed Creek Reach 1 - PM11 to west end of Survey Reach)
- Unnamed Creek Reach 2 - Alder thicket / Shallow marsh
- Unnamed Creek Reach 3 - West Branch Unnamed Creek
- Unnamed Creek Reach 4 - Black ash swamp
- Unnamed Creek Reach 5 - Alder thicket to Embarrass River

0 250 500 1,000
Feet

Figure 1

UNNAMED CREEK
PolyMet Mining
Hoyt Lakes, MN



2008 FSA CIR Aerial Photograph

- Surface Water Monitoring Location
- Unnamed Creek
- Unnamed Creek (from PWI printed maps)
- PolyMet 2010 Wild Rice Survey (Unnamed Creek Reach 1 - PM11 to west end of Survey Reach)
- Unnamed Creek Reach 2 - Alder thicket / Shallow marsh
- Unnamed Creek Reach 3 - West Branch Unnamed Creek
- Unnamed Creek Reach 4 - Black ash swamp
- Unnamed Creek Reach 5 - Alder thicket to Embarrass River

0 250 500 1,000
Feet

Figure 2

UNNAMED CREEK
PolyMet Mining
Hoyt Lakes, MN

Figure 3. Looking southwest at Unnamed Creek, 9/16/2010

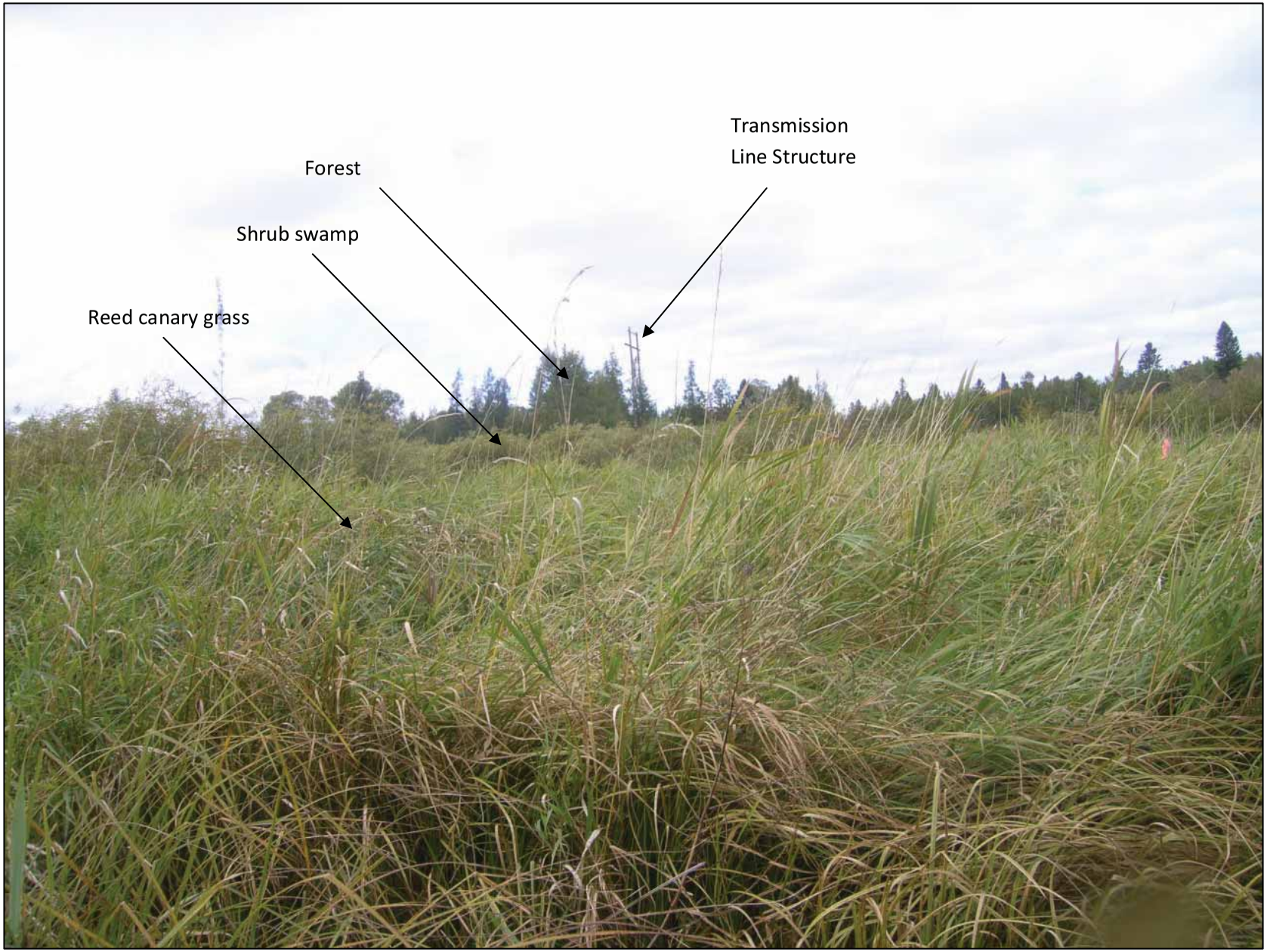


Figure 4. Looking north/northwest while standing in Unnamed Creek, 9/16/2010

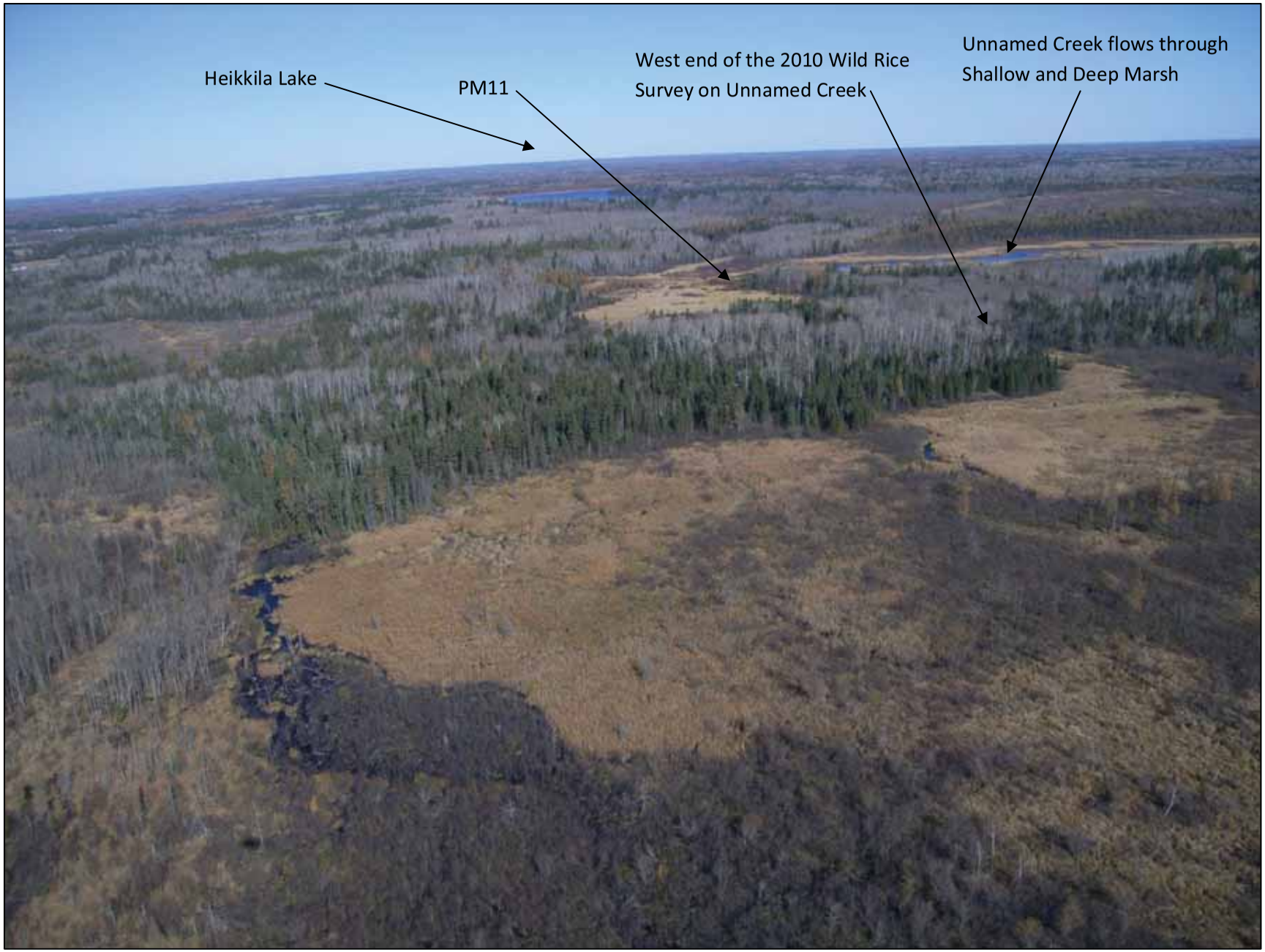


Figure 5. Looking northeast at Unnamed Creek with Heikkila Lake in the background, 9/16/2010

Figure 6. Looking south/southeast at Unnamed Creek with the Tailings Basin and Plant site in the background., 9/16/2010

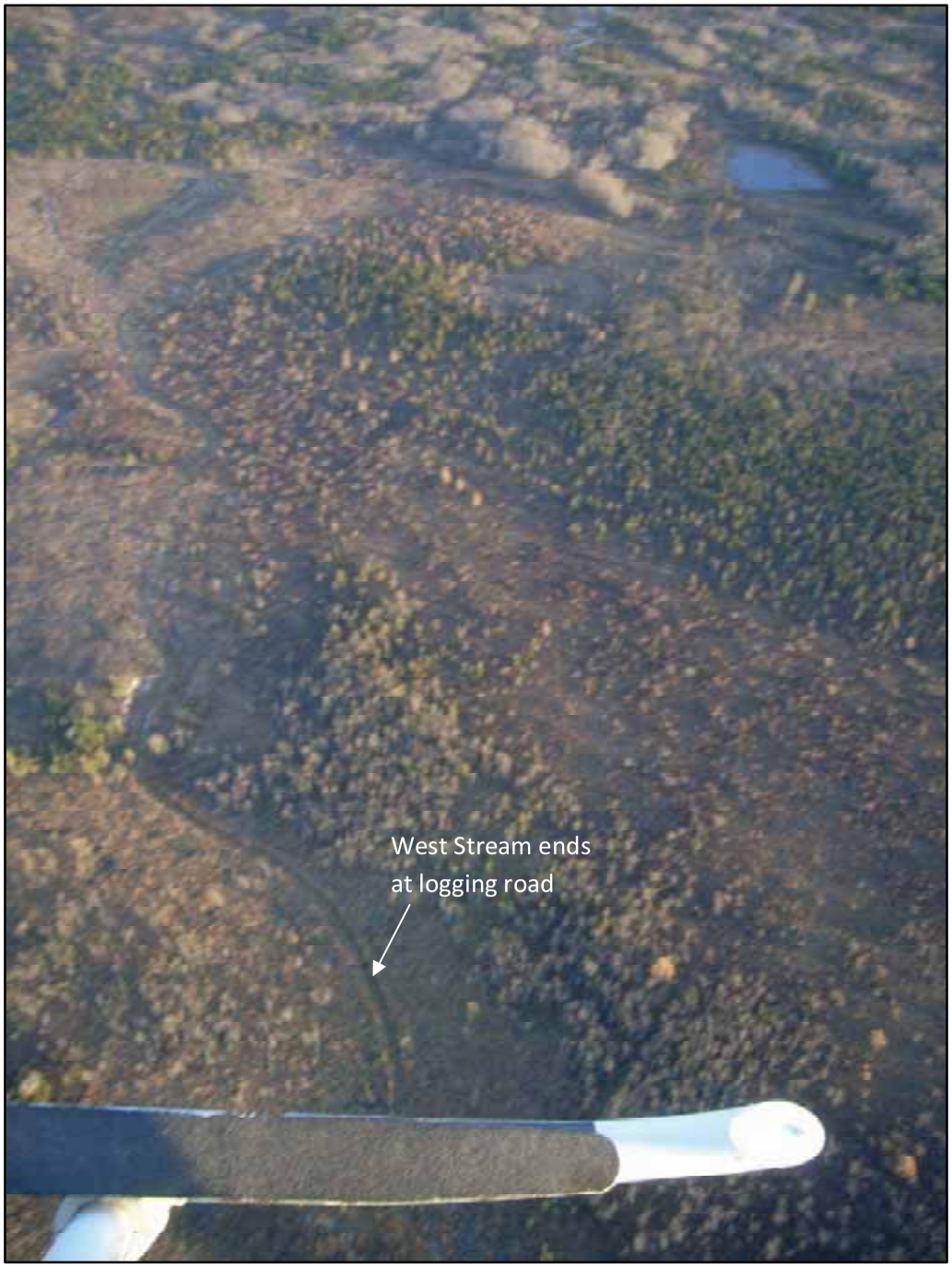


Figure 7. Looking south/southwest at the logging road, 10/14/2010

Figure 8. Looking north into the black ash swamp (Wetland #288), 9/9/2010

Figure 9. Looking east at the Embarrass River from the T-3037 bridge. The former cultivated (paddy) wild rice farm located to the south of the river, 9/16/2010

Appendix A

Wetland Mitigation Monitoring Data Sheets

2000 Annual Vegetation Survey
Embarrass River Wetland Mitigation Site

Prepared for
LTV Steel Mining COMPANY

January 2001

BARR

Table 5
Complete Species List

1	*Agrostis gigantea*	Redtop grass	FACW
2	*Alnus rugosa*	Speckled alder	OBL
3	*Aster simplex*	Panicled aster	FACW
4	*Betula pumila*	Swamp birch	OBL
5	*Calamagrostis canadensis*	Canda bluejoint grass	OBL
6	*Carex spp.*	Sedge	NI
7	*Chara sp.*	Muskgrass	OBL
8	*Eupatorium maculatum*	Joe-pye weed	OBL
9	*Euthamia graminifolia*	Grass-leaved goldenrod	FACW
10	*Fraxinus nigra*	Black ash	FACW+
11	*Glyceria striata*	Fowl meadow grass	OBL
12	*Juncus sp.*	Rush	FACW
13	*Larix laricina*	Tamarack	FACW
14	*Lemna minor*	Lesser duckweed	OBL
15	*Myriophyllum sibiricum*	Northern milfoil	OBL
16	*Panicum virgatum*	Switch grass	FAC+
17	*Phalaris arundinacea*	Reed canary grass	FACW+
18	*Picea mariana*	Black spruce	FACW
19	*Poa palustris*	Fowl blue grass	FACW+
20	*Polygonum amphibium*	Water smartweed	OBL
21	*Potamogeton sp.*	Narrow-leaved pondweed	OBL
22	*Salix spp.*	Willow	FACW
23	*Scirpus cyperinus*	Woolgrass	OBL
24	*Solidago gigantea*	Giant goldenrod	FACW
25	*Solidago spp.*	Goldenrod	NI
26	*Sparganium sp.*	Bur-reed	OBL
27	*Spiraea alba*	Meadowsweet	FACW+
28	*Typha sp.*	Cattail	OBL
29	*Utricularia sp.*	Bladderwort	OBL
30	*Viola spp.*	Violet	NI

OBL Obligate wetland species (>99% probability that species occur in wetland)
FACW Facultative wetland species (67-99% probability that species occurs in wetland)
FAC Facultative wetland and upland species (34-66% probability that species occurs in wetland)
FACU Facultative upland species (1-3% probability that species occur in wetland)
NI No indicator status assigned

222208.xls

2001 Annual Vegetation Survey
Embarrass River Wetland Mitigation Site

Prepared for
Cliffs Erie LLC

January 2002

BARR

Table 5
Complete Species List

	Common Name	Scientific Name	
1	*Agrostis gigantea*	Redtop grass	FACW
2	*Alnus rugosa*	Speckled alder	OBL
3	*Aster simplex*	Panicled aster	FACW
4	*Aster spp.*	Asters	FACW
5	*Betula pumila*	Swamp birch	OBL
6	*Calamagrostis canadensis*	Canda bluejoint grass	OBL
7	*Carex spp.*	Sedge	NI
8	*Chara sp.*	Muskgrass	OBL
9	*Cornus stolonifera*	Red-osier dogwood	FACW
10	*Eupatorium maculatum*	Joe-pye weed	OBL
11	*Euthamia graminifolia*	Grass-leaved goldenrod	FACW
12	*Fraxinus nigra*	Black ash	FACW+
13	*Glyceria striata*	Fowl meadow grass	OBL
14	*Larix laricina*	Tamarack	FACW
15	*Lemna minor*	Lesser duckweed	OBL
16	*Myriophyllum sibiricum*	Northern milfoil	OBL
17	*Phalaris arundinacea*	Reed canary grass	FACW+
18	*Picea mariana*	Black spruce	FACW
19	*Poa palustris*	Fowl blue grass	FACW+
20	*Polygonum amphibium*	Water smartweed	OBL
21	*Polygonum pensylvanicum*	Pinkweed	FACW+
22	*Potamogeton sp.*	Narrow-leaved pondweed	OBL
23	*Salix spp.*	Willow	FACW
24	*Scirpus cyperinus*	Woolgrass	OBL
25	*Scirpus validus*	Soft-stem bulrush	OBL
26	*Solidago gigantea*	Giant goldenrod	FACW
27	*Solidago purshii*	Bog goldenrod	OBL
28	*Solidago spp.*	Goldenrod	NI
29	*Sparganium sp.*	Bur-reed	OBL
30	*Spiraea alba*	Meadowsweet	FACW+
31	*Typha spp.*	Cattail	OBL
32	*Typha latifolia*	Broad-leaved cattail	OBL
33	*Utricularia sp.*	Bladderwort	OBL
34	*Viola spp.*	Violet	NI

OBL Obligate wetland species (>99% probability that species occur in wetland)
FACW Facultative wetland species (67-99% probability that species occurs in wetland)
FAC Facultative wetland and upland species (34-66% probability that species occurs in wetland)
FACU Facultative upland species (1-3% probability that species occur in wetland)
NI No indicator status assigned

230816.xls

2002 Annual Vegetation Survey
Embarrass River Wetland Mitigation Site

Prepared for
Cliffs Erie LLC

January 2003

BARR

Table 5
Complete Species List
Embarrass River Wetland Bank
Cliffs Erie, L.L.C.

	Common Name	Scientific Name	
1	*Agrostis gigantea*	Redtop grass	FACW
2	*Alnus rugosa*	Speckled alder	OBL
3	*Aster simplex*	Panicled aster	FACW
4	*Aster spp.*	Asters	FACW
5	*Betula pumila*	Swamp birch	OBL
6	*Calamagrostis canadensis*	Canda bluejoint grass	OBL
7	*Ceratophyllum demersum*	Coontail	OBL
8	*Carex spp.*	Sedge	NI
9	*Chara sp.*	Muskgrass	OBL
10	*Cornus stolonifera*	Red-osier dogwood	FACW
11	*Eupatorium maculatum*	Joe-pye weed	OBL
12	*Euthamia graminifolia*	Grass-leaved goldenrod	FACW
13	*Fontinalis antipyretica*	Common water moss	OBL
14	*Fraxinus nigra*	Black ash	FACW+
15	*Glyceria striata*	Fowl meadow grass	OBL
16	*Larix laricina*	Tamarack	FACW
17	*Lemna minor*	Lesser duckweed	OBL
18	*Phalaris arundinacea*	Reed canary grass	FACW+
19	*Picea mariana*	Black spruce	FACW
20	*Poa palustris*	Fowl blue grass	FACW+
21	*Polygonum pensylvanicum*	Pinkweed	FACW+
22	*Potamogeton pectinatus*	Narrow-leaved pondweed	OBL
23	*Potamogeton sp.*	Narrow-leaved pondweed	OBL
24	*Salix bebbiana*	Beaked willow	FACW+
25	*Salix spp.*	Willow	FACW
26	*Scirpus cyperinus*	Woolgrass	OBL
27	*Scirpus validus*	Soft-stem bulrush	OBL
28	*Solidago gigantea*	Giant goldenrod	FACW
29	*Solidago purshii*	Bog goldenrod	OBL
30	*Solidago spp.*	Goldenrod	NI
31	*Sparganium sp.*	Bur-reed	OBL
32	*Spiraea alba*	Meadowsweet	FACW+
33	*Typha sp.*	Cattail	OBL
34	*Typha latifolia*	Broad-leaved cattail	OBL
35	*Utricularia sp.*	Bladderwort	OBL
36	*Viola spp.*	Violet	NI

OBL Obligate wetland species (>99% probability that species occur in wetland)
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FAC Facultative wetland and upland species (34-66% probability that species occurs in wetland)
FACU Facultative upland species (1-3% probability that species occur in wetland)
NI No indicator status assigned

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Photographs of wild rice on the Embarrass River between Wynne Lake and Hwy 135, years 2009-2011

Reference Point 1 – North end of Wynne Lake

2009 

2010 

2011 

Reference Point 2 – Embarrass River Mile 22.9

2009

No wild rice observed.

2010

2011	No wild rice observed.

Reference Point 3 – Embarrass River Mile 23.0

2009

No wild rice observed.

2010

2011	No wild rice observed.

Reference Point 4 – Embarrass River Mile 23.6

2009

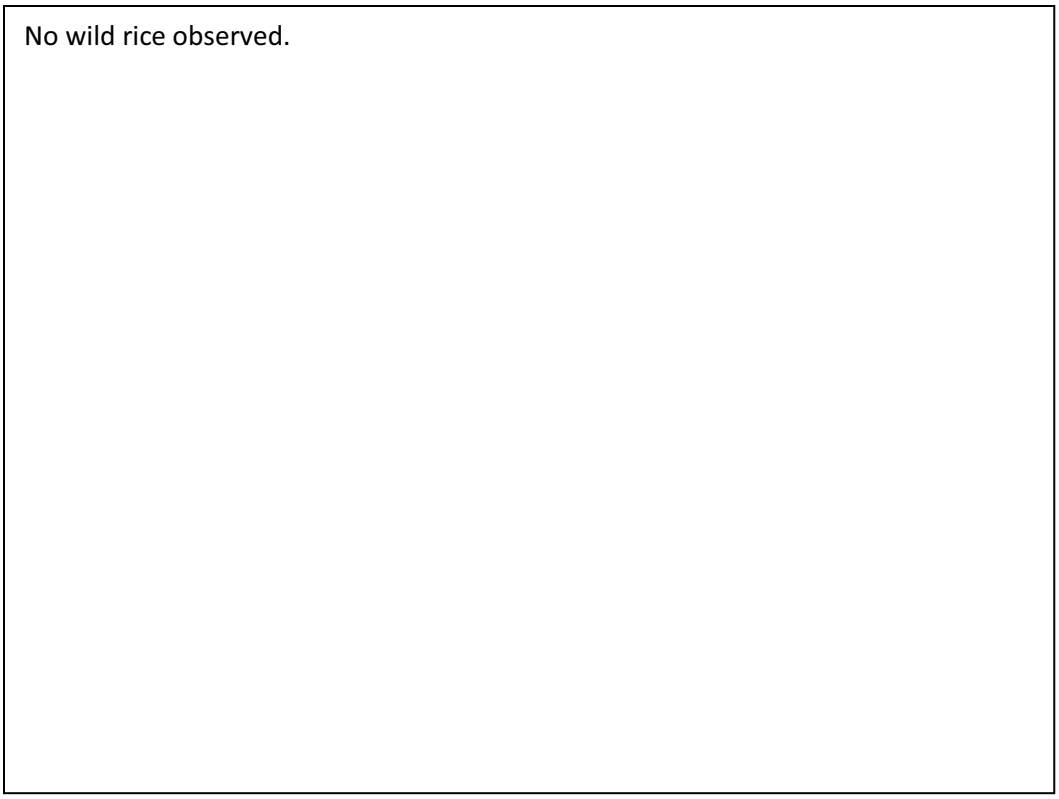
No wild rice observed.

2010

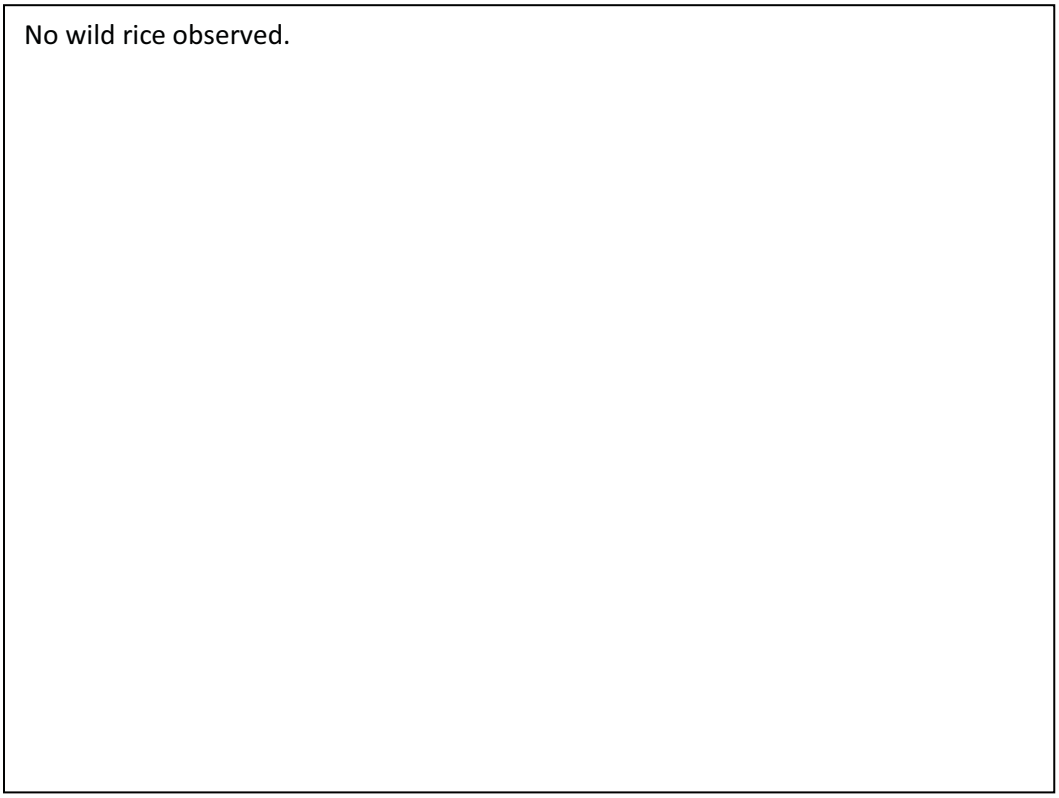
2011	No wild rice observed.

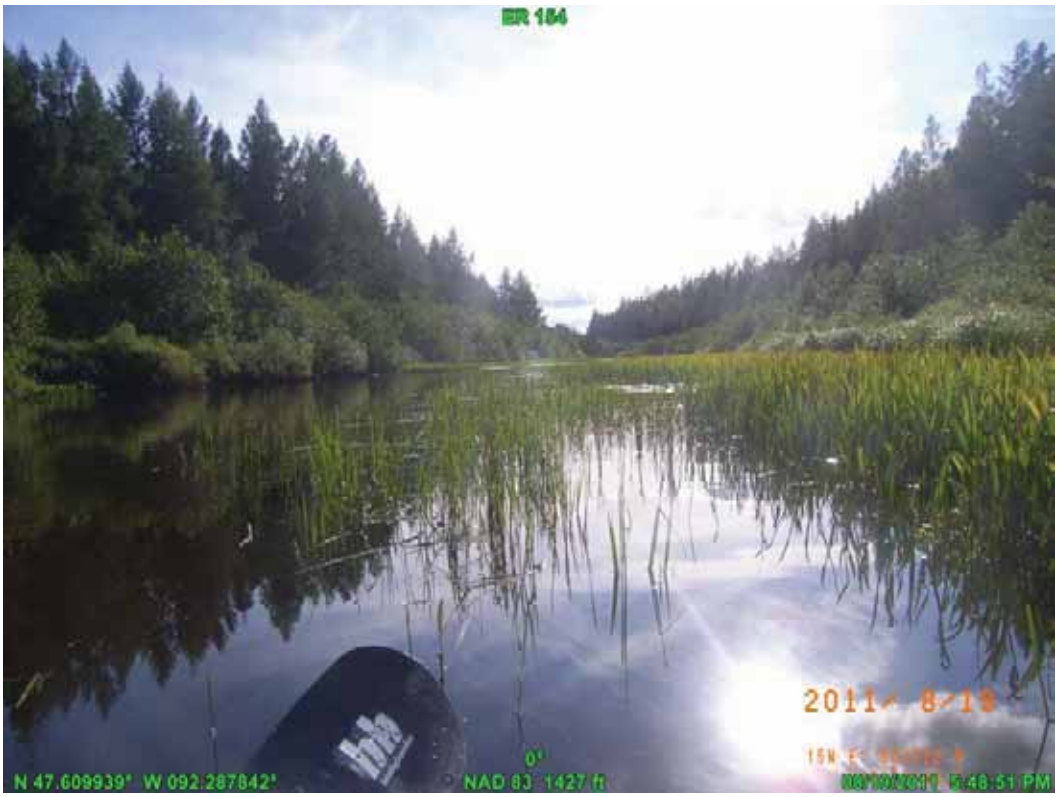
Reference Point 5 – Embarrass River Mile 23.9

2009



2010





2011

Reference Point 6 – Embarrass River Mile 24.1

2009

2010

2011 

Reference Point 7 – Embarrass River Mile 24.2

2009

No wild rice observed.

2010

2011	No wild rice observed.

Reference Point 8 – Embarrass River Mile 25.6

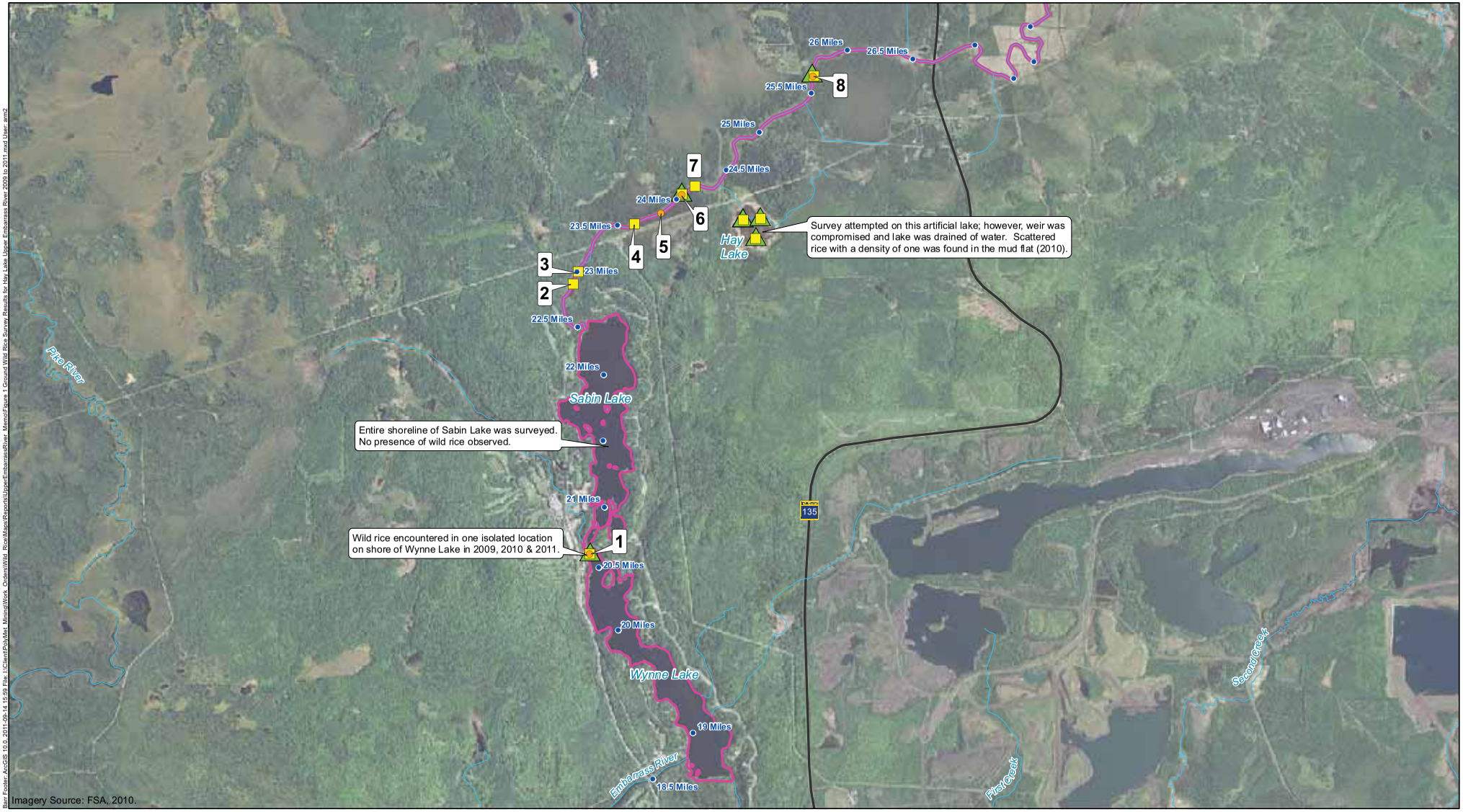
2009

2010

2011 

Occurences of Wild Rice on Embarrass River Between Wynne Lake and Hwy 135, Years 2009-2011

Reference Point	River Mile	2009 Wild Rice Survey Observations	2010 Wild Rice Survey Observations	2011 Wild Rice Survey Observations
1	20.5	Isolated group of wild rice plants on north end of Wynne Lake.	Isolated group of wild rice plants on north end of Wynne Lake.	Isolated group of wild rice plants on north end of Wynne Lake.
2	22.9	No wild rice was observed at this location.	Approximately nine wild rice plants observed.	No wild rice was observed at this location.
3	23	No wild rice was observed at this location.	Several wild rice plants observed.	No wild rice was observed at this location.
4	23.6	No wild rice was observed at this location.	Approximately six wild rice plants observed.	No wild rice was observed at this location.
5	23.9	No wild rice was observed at this location.	No wild rice was observed at this location.	Approximately a dozen wild rice stems observed.
6	24.1	Approximately five wild rice plants observed.	Approximately 30 wild rice plants along 20' of shoreline, plus a few additional plants nearby. Many of the plants are missing seed heads due to apparent animal grazing.	Approximately 75 wild rice stems observed along 25' of shoreline
7	24.2	No wild rice was observed at this location.	Two wild rice plants observed.	No wild rice was observed at this location.
8	25.6	Approximately half dozen wild rice plants observed.	Approximately half dozen wild rice plants observed.	Approximately 17 wild rice stems observed.



Wild Rice Observed in 2009
Wild Rice Observed in 2010
Wild Rice Observed in 2011
Stream or Shoreline Surveyed in 2009, 2010 and 2011

1 Reference Point

N

0 1,750 3,500 7,000
Feet

GROUND WILD RICE SURVEY RESULTS
FOR HAY LAKE (MNID 69435) & THE
EMBARRASS RIVER BETWEEN WYNNE LAKE
AND STATE HIGHWAY 135
2009 - 2011
NorthMet Project
PolyMet Mining, Inc.
Hoyt Lakes, Minnesota

Appendix E

Correspondence to MPCA (9/15/2011) on Embarrass River Wild Rice

From: Rachel E. Walker
Sent: Thursday, September 15, 2011 10:29 AM
To: 'Clark, Richard (MPCA)'
Cc: Rachel E. Walker
Subject: Wild Rice in the Upper Embarrass -- Additional Detail

Richard,

Please find more detail about the area from Highway 135 to Embarrass Lake.

Please note:

- All numbers are approximations. It is very difficult to approximate plants at this level of detail without physically counting them.
- In all photos, wild rice is easily dominated by other emergent vegetation. It is difficult to distinguish wild rice from other emergent macrophytes looking at these photographs.

Let me know whether you have additional questions/ concerns.

Rachel E. Walker, PhD

Senior Environmental Scientist
Minneapolis office: 952.832.2849
cell: 612.991.9108
rwalker@barr.com
www.barr.com

From: Clark, Richard (MPCA) [mailto:richard.clark@state.mn.us]
Sent: Tuesday, September 06, 2011 10:26 AM
To: Rachel E. Walker
Subject: RE: Map for Upper Embarrass

Hi Rachel,

Yes this is helpful – thanks! However, one thing that would help additionally is to have the details on what is meant when, as it states on the map, that "wild rice was encountered". If possible, if you could provide what this means in terms of extent, density, number of stalks, etc. between the two survey years. I'm not sure if the information exists in this format, but one thing that could help (for example) would be to have excerpts from field notes or other such written documentation.

What we are struggling with is just how much rice is their when the info says 'rice was encountered' and is that amount significant – I suppose it goes back to what does a green dot mean. Having only 'encountered' doesn't give us much to put it in perspective to what conservatively could be called 'waters used for the production of wild rice'.

I realize this is a difficult request, but any additional info would help.

We are focused on the reach of the Embarrass between the north end of Sabin L and Hwy 135 and on the short stretch of stream between Wynne and Sabin.

Also, any preliminary info from the 2011 survey for those specific sections would be ***extremely*** helpful. We are facing a real time crunch in getting our 'staff recommendation' out there

Thanks!

Richard
651-757-2280

From: Rachel E. Walker [mailto:RWalker@barr.com]
Sent: Thursday, September 01, 2011 2:41 PM
To: Clark, Richard (MPCA)
Cc: Jim Scott; John Borovsky; kpylka@polymetmining.com; 'Brad Moore'
Subject: FW: Map for Upper Embarrass

Dear Richard,

As promised please find a figure clarifying where we identified rice and associated densities along the Embarrass River from Hwy 135 to the north end of Embarrass Lake for 2009 and 2010.

Let me know if this is clear and satisfies the request.

We will have data for 2011 later in September.

Thank you,

Rachel E. Walker, PhD

Senior Environmental Scientist
Minneapolis office: 952.832.2849
cell: 612.991.9108
rwalker@barr.com
www.barr.com

Photographs of wild rice on the Embarrass River between Wynne Lake and Hwy 135, years 2009-2011.

Reference Point 1 – North end of Wynne Lake

2009 

2010 

2011 

Reference Point 2 – Embarrass River Mile 22.9

2009

No wild rice observed.

2010

2011	No wild rice observed.

Reference Point 3 – Embarrass River Mile 23.0

2009

No wild rice observed.

2010

2011	No wild rice observed.

Reference Point 4 – Embarrass River Mile 23.6

2009

No wild rice observed.

2010

2011	No wild rice observed.

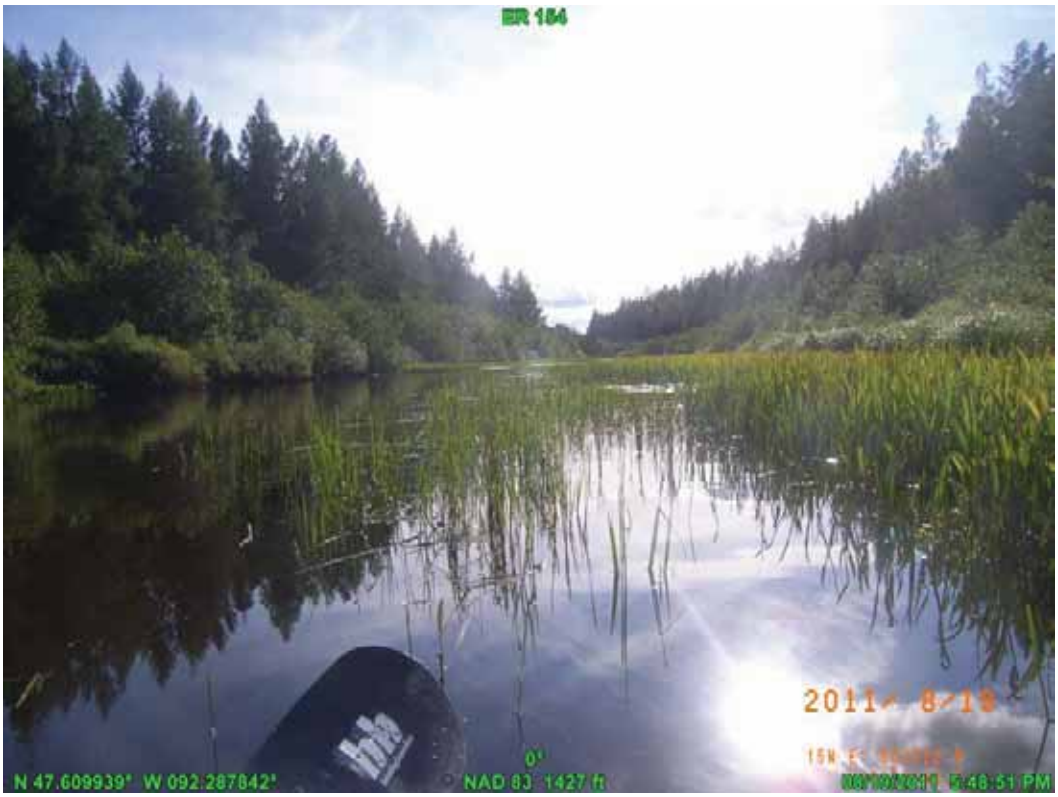
Reference Point 5 – Embarrass River Mile 23.9

2009

No wild rice observed.

2010

No wild rice observed.

2011 

Reference Point 6 – Embarrass River Mile 24.1

2009 

2010 

2011 
ER 148
2011/ 8/19
N 47.612184° W 092.283678°
0'
NAD 83 1434 ft
08/19/2011 5:29:43 PM

Reference Point 7 – Embarrass River Mile 24.2

2009

No wild rice observed.

2010

2011	No wild rice observed.

Reference Point 8 – Embarrass River Mile 25.6

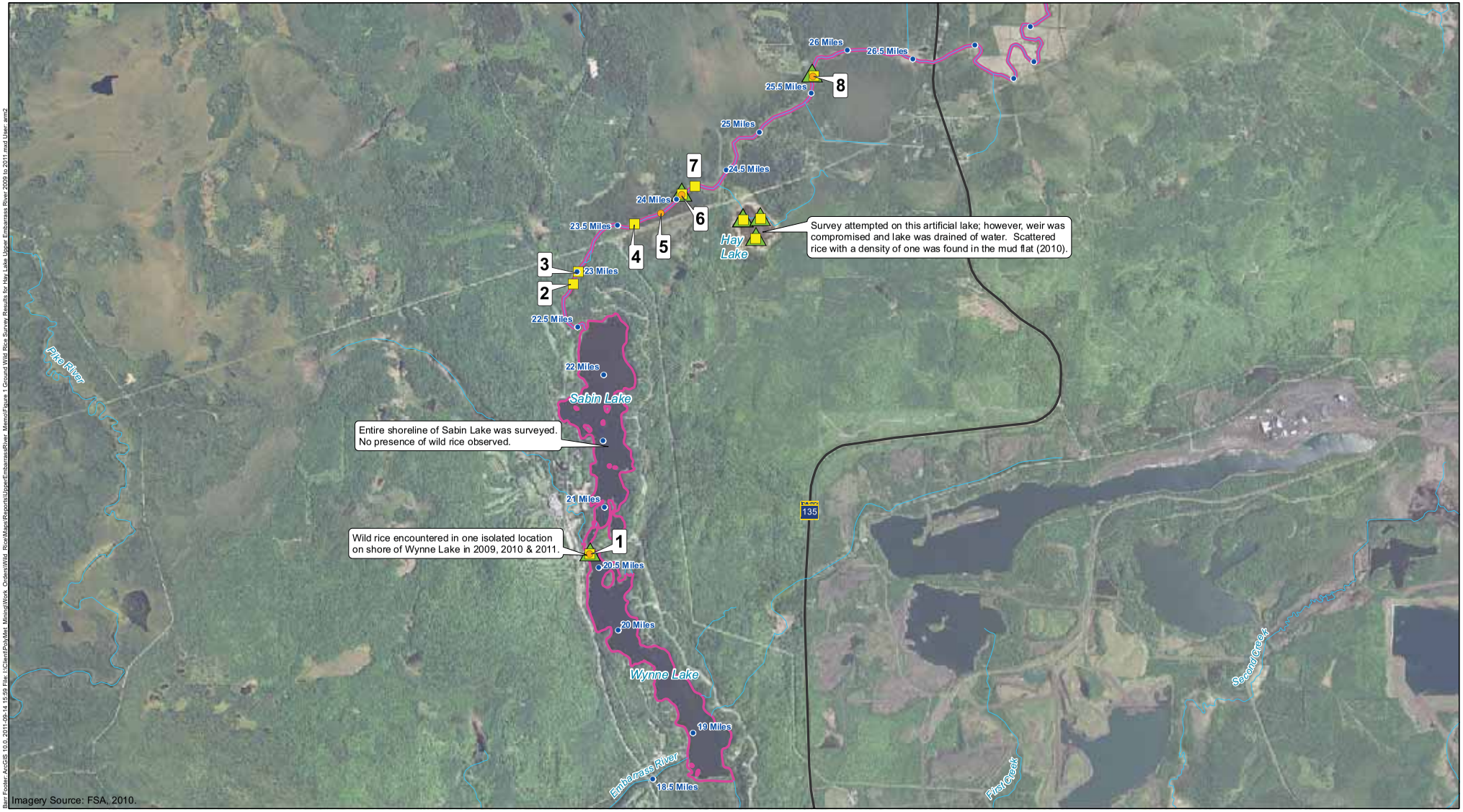
2009

2010

2011 

Occurences of Wild Rice on Embarrass River Between Wynne Lake and Hwy 135, Years 2009-2011

Reference Point	River Mile	2009 Wild Rice Survey Observations	2010 Wild Rice Survey Observations	2011 Wild Rice Survey Observations
1	20.5	Approximately 24 wild rice plants on north end of Wynne Lake.	Approximately 24 wild rice plants on north end of Wynne Lake.	Approximately 24 wild rice plants on north end of Wynne Lake.
2	22.9	No wild rice was observed at this location.	Approximately nine wild rice plants observed.	No wild rice was observed at this location.
3	23	No wild rice was observed at this location.	Several wild rice plants observed.	No wild rice was observed at this location.
4	23.6	No wild rice was observed at this location.	Approximately six wild rice plants observed.	No wild rice was observed at this location.
5	23.9	No wild rice was observed at this location.	No wild rice was observed at this location.	Approximately a dozen wild rice stems observed.
6	24.1	Approximately five wild rice plants observed.	Approximately 30 wild rice plants along 20' of shoreline, plus a few additional plants nearby. Many of the plants are missing seed heads.	Approximately 75 wild rice stems observed along 25' of shoreline
7	24.2	No wild rice was observed at this location.	Two wild rice plants observed.	No wild rice was observed at this location.
8	25.6	Approximately half dozen wild rice plants observed.	Approximately half dozen wild rice plants observed.	Approximately 17 wild rice stems observed.



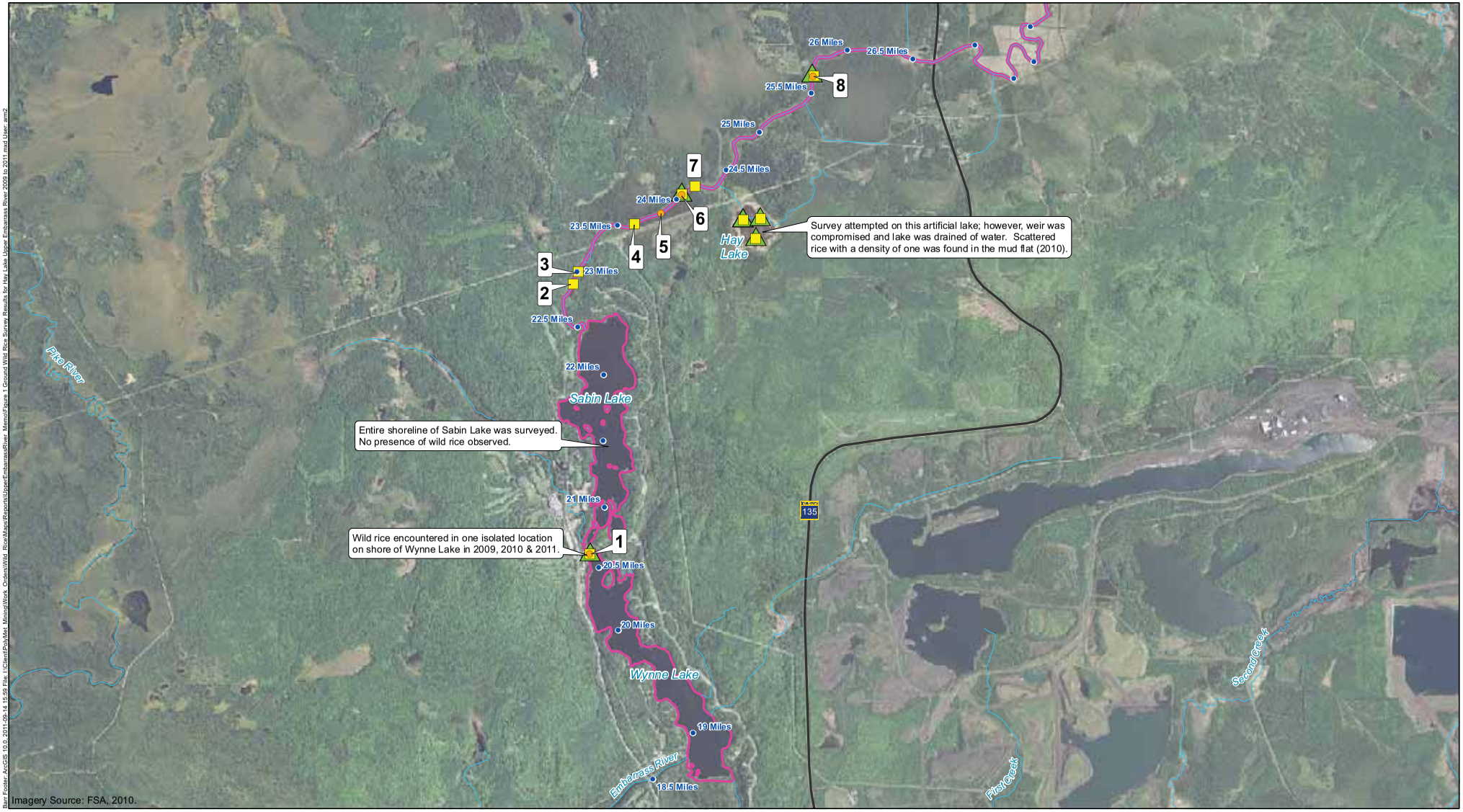
Wild Rice Observed in 2009
Wild Rice Observed in 2010
Wild Rice Observed in 2011
Stream or Shoreline Surveyed in 2009, 2010 and 2011

1 Reference Point

N

0 1,750 3,500 7,000
Feet

GROUND WILD RICE SURVEY RESULTS
FOR HAY LAKE (MNID 69435) & THE
EMBARRASS RIVER BETWEEN WYNNE LAKE
AND STATE HIGHWAY 135
2009 - 2011
NorthMet Project
PolyMet Mining, Inc.
Hoyt Lakes, Minnesota



Wild Rice Observed in 2009

Wild Rice Observed in 2010

Wild Rice Observed in 2011

Stream or Shoreline Surveyed in 2009, 2010 and 2011

1 Reference Point

N

0 1,750 3,500 7,000

Feet

GROUND WILD RICE SURVEY RESULTS
FOR HAY LAKE (MNID 69435) & THE
EMBARRASS RIVER BETWEEN WYNNE LAKE
AND STATE HIGHWAY 135
2009 - 2011
NorthMet Project
PolyMet Mining, Inc.
Hoyt Lakes, Minnesota

Appendix F

Memorandum to MPCA (11/4/2011) on Upper Partridge River Wild Rice

Technical Memorandum

To: Richard Clark, Minnesota Pollution Control Agency
From: Kevin Menken and Rachel Walker, Barr Engineering Co.
Subject: Wild Rice Observations on the Upper Partridge River
Date: November 4, 2011
Project: 23/69-0862
c: Jim Scott and Kevin Pylka, PolyMet Mining Inc.

Barr Engineering Co. (Barr), on behalf of Polymet Mining Inc. – NorthMet Project (PolyMet), performed wild rice (*Zizania palustris* L.) field surveys on the Partridge River upstream of Colby Lake in 2009, 2010 and 2011. Based on review of the field notes, photographs, discussions with personnel and subsequent surveys, Barr concludes that field personnel conducting the 2009 wild rice survey misidentified a grass species, *Glyceria borealis*, as wild rice. The following sections summarize the relevant survey data and present the rationale for adjustment of 2009 survey data.

Summary Results of 2010 and 2011 Wild Rice Survey on the Upper Partridge River

Wild rice was identified in several locations on the Upper Partridge River in 2010 and 2011 (Figure 1). Wild rice was identified in two additional locations in 2011 compared to 2010. The most upstream occurrence of wild rice was 0.2 miles north of the railroad crossing (Reference Point #6, Figure 1). The largest stand of wild rice was identified in a small backwater bay east of the river channel (Reference Point #3, Figure 1). The Partridge River was not surveyed from County Road 565 to Colby Lake because of the near continuous large cobble/ boulder substrate and rapids on this stretch of river. Additional observations of wild rice are summarized in Table 1. Photographs of wild rice at the locations listed in Table 1 are included in Attachment A.

Table 1. Summary of 2010 and 2011 Wild Rice Observations on the Upper Partridge River

Reference Point	2010 Wild Rice Survey Observations	2011 Wild Rice Survey Observations
1	No wild rice plants were observed at this location.	Approximately five wild rice plants.
2	Sporadic wild rice, density "1", number of plants unknown.	Density "2" stand approximately 30' in diameter; second wild rice stand of approximately 10 wild rice plants.
3	Several dozen wild rice plants in backwater off of main river channel	Several dozen wild rice plants in backwater off of main river channel
4	Single wild rice plant.	No wild rice plants were observed at this location.
5	No wild rice plants were observed at this location.	Several wild rice plants.
6	A few wild rice plants.	Approximately six wild rice plants.

Rationale for Adjustment of Some 2009 Wild Rice Survey Data

- Barr responded to requests from multiple clients to survey water bodies for wild rice in 2009. Barr trained personnel (some without training in botany, plant biology or equivalent subjects) to recognize identifying morphological traits of wild rice. Barr also deployed personnel confident and capable of navigating difficult stream and lake terrain. Barr tried to balance teams with those who could identify wild rice in the field with those who were skilled using a variety of water craft in a variety of stream and lake conditions.

- Barr sent a team of two to survey the Upper Partridge River in early September 2009. One had been trained for wild rice identification by experienced, botanically trained staff in locations where wild rice grew in abundance and in locations not populated by other emergent macrophytes. The other was adept at navigating difficult terrain but had not received wild rice identification training. The Upper Partridge is challenging to navigate and requires travel by kayak, periodic disembarking to portage around large boulders, rapids or shallow water.

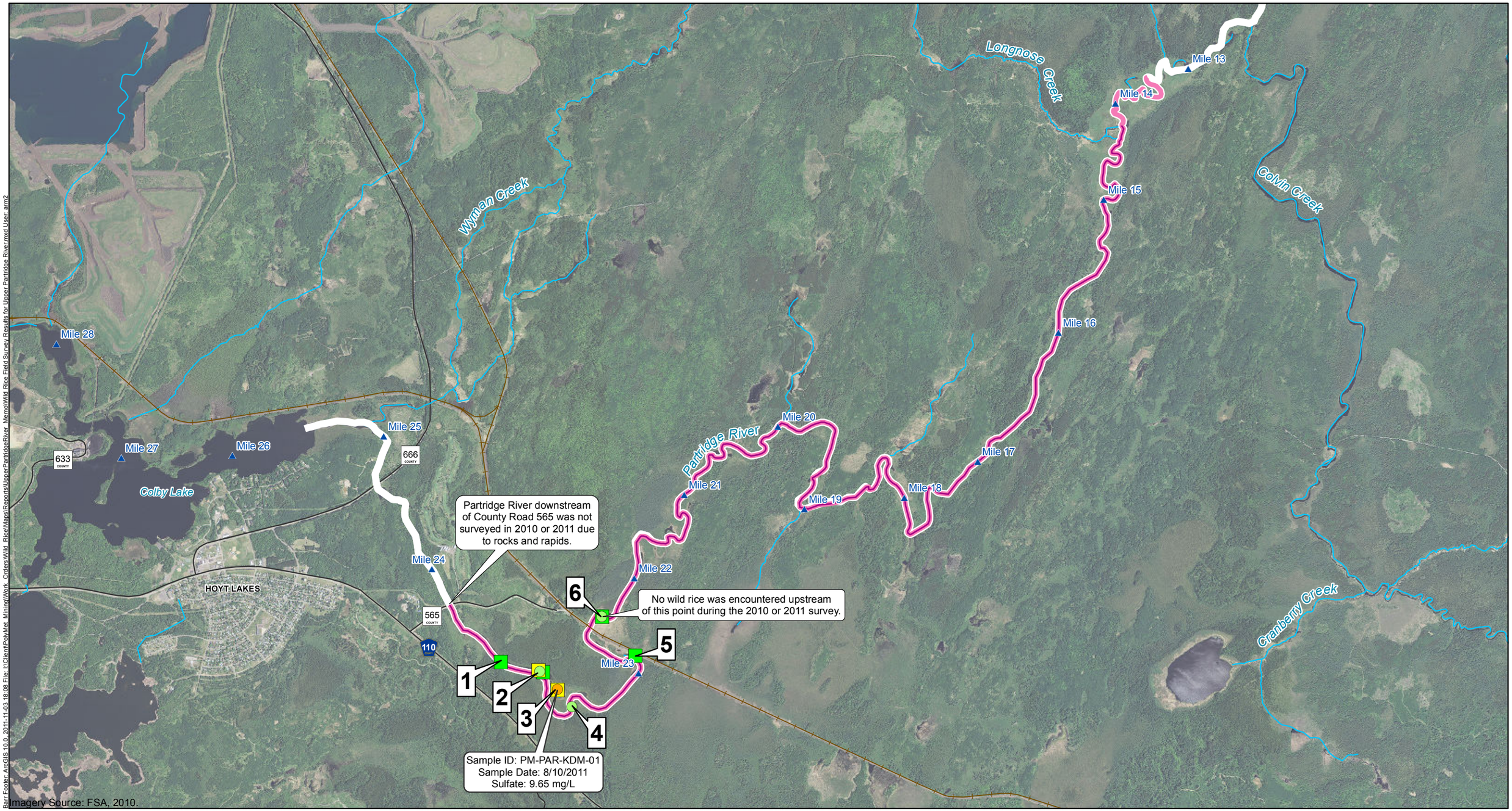
- By September, wild rice and other emergent macrophytes begin to senesce, lose their seeds, florets, stems and other distinguishing characteristics. Under such conditions, positive identification may be difficult even for experienced botanists or plant biologists.

- In 2010 and 2011, two different personnel, one trained in plant biology and both with extensive experience (three years) in recognizing wild rice in diverse locations returned to the Upper Partridge River. They expected to identify wild rice in locations identified in 2009. They did not,

however, identify rice in 2010 or 2011 until 0.2 miles north of the railroad crossing (Reference Point #6, Figure 1) as described on p.1 of this memorandum. They identified predominantly *Glyceria borealis* in the locations where the 2009 team identified wild rice upstream of the railroad crossing. *Glyceria borealis* is a perennial grass and can be hard to distinguish from wild rice particularly if missing identifying traits such as seeds, florets and stems.

- Following the 2010 and 2011 field seasons when wild rice was not encountered upstream from Reference Point #6, the Barr lead on wild rice projects and other staff with extensive training in plant biology and/or identifying wild rice examined photographs and field notes, and spoke to the 2009 team. In 2011, after a second season identifying wild rice only downstream of Reference Point #6, Figure 1 and identifying *Glyceria borealis* in the same locations upstream as in 2010 and 2011, six of Barr's most experienced botanists and plant biologists examined the field notes and photographs from 2009 and spoke to the 2009 team.

Based on two years of additional field surveys, analysis of photographs and notes, and discussion with many experienced, qualified staff, Barr concludes that the 2009 team misidentified *Glyceria borealis* as wild rice upstream from Reference Point #6 (Mile 22.3). Barr requests adjustment of 2009 survey data to exclude wild rice observed upstream of 0.2 miles north of the railroad crossing (Reference Point #6, Figure 1).



Parr Foster; ArcGIS 10.0; 2011-11-03 18:08; File: I:\Client\PolyMet Mining\Work Orders\Wild Rice\Maps\Reports\Upper Partridge River.mxd User: arm2

Wild Rice Density in 2010
- 1 <10% Wild Rice Coverage
- 2
- 3
- 4
- 5 >75% Wild Rice Coverage

1 Reference Point

Wild Rice Density in 2011
- 1 <10% Wild Rice Coverage
- 2
- Partridge River Miles
- Stream Segments Surveyed in 2009
- Stream Segments Surveyed in 2010
- Stream Segments Surveyed in 2011
- Stream Segments Surveyed in 2009-2011

Other Rivers and Streams
Railroads

N

3,000 1,500 0 3,000
Feet

DRAFT

Figure 1
WILD RICE FIELD SURVEY RESULTS
FOR THE UPPER PARTRIDGE RIVER
2010 and 2011
NorthMet Project
PolyMet Mining, Inc.
Hoyt Lakes, Minnesota

Upper Partridge River, 8/25/2010

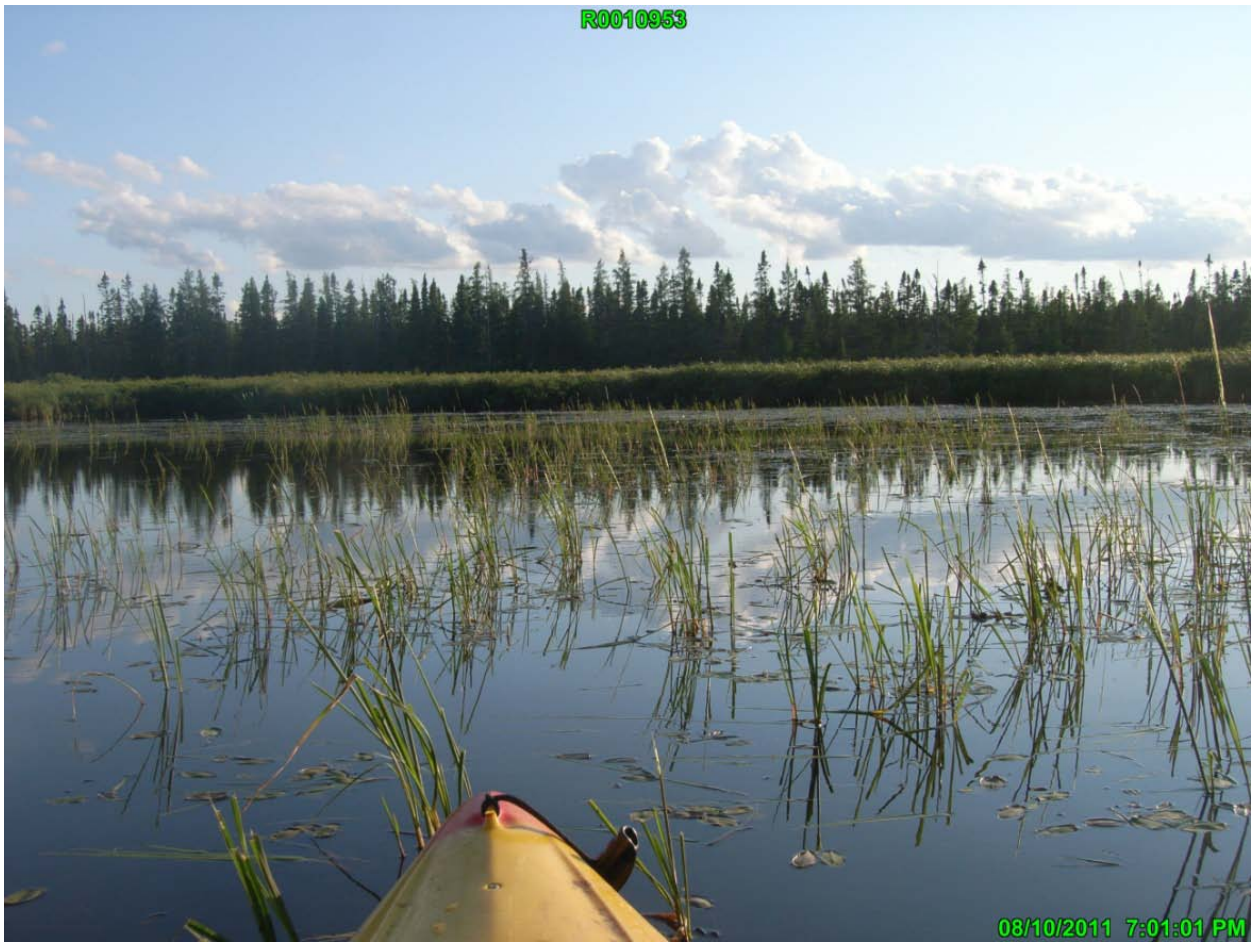
Emergent vegetation, including *Glyceria* sp. in foreground. No wild rice was identified at this location.

Reference Location 2

Sparse Wild Rice among other emergent vegetation, floating leaf bur-reed, and lily pads.
Emergent grass in foreground of picture is not Wild Rice, and is likely *Glyceria* sp.
Wild Rice was identified as very sparse at this location at the time of the photograph, and the majority of emergent plants visible in photograph are not Wild Rice.

Reference Location #3, 8/25/2011

Several dozen Wild Rice plants in backwater adjacent to Partridge River.
Floating leaf bur-reed (*Sparganium* sp.) and floating leaf pondweed (*Potamogeton* sp.) also present.



Reference Location #3, 8/10/11

Several dozen Wild Rice plants in backwater adjacent to Partridge River.
Plants show significant damage from herbivory, and many are missing seed heads and/or portions of leaves.

Reference Location 4, August 25, 2010

Single Wild Rice plant

Reference Location #5, 8/10/2011

Several Wild Rice plants growing among arrowhead plants.
Horsetail (*Equisetum* sp.) behind Wild Rice plants.

Reference Location #6, 8/25/2010

A few Wild Rice plants growing among arrowheads near shore.

Reference Point #6, 8/10/2011

A few Wild Rice plants growing among arrowhead plants