Appendix 1C: Attachments/Exhibits to Comment #1367

WATERLEGACY

nmw
northeastern minnesotans
for wilderness

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June 30, 2021

Paul Proto (proto.paul@epa.gov)
Region 5
United States Environmental Protection Agency
77 West Jackson Boulevard
Chicago, IL 60604

RE: Comments on EPA's April 27, 2021 Decision Document Regarding the Sulfate Impaired Waters EPA is Adding to the Minnesota's 2020 CWA Section 303(d) List.

Dear Mr. Proto

These comments are submitted on behalf of WaterLegacy and Northeastern Minnesotans for Wilderness ("NMW"). We and the thousands of Minnesotans we represent support the oversight exercised by the U.S. Environmental Protection Agency ("EPA") under the Clean Water Act ("CWA") to partially disapprove Minnesota's 2020 CWA Section 303(d) impaired waters list on March 26, 2021 and to propose listing of an initial 30 Water Quality Limited Segments ("WQLS") as impaired due to sulfate affecting their beneficial use for wild rice.

EPA's action was not only welcome, but obligatory under the CWA. For decades, the Minnesota Pollution Control Agency ("MPCA") has violated the CWA by failing to list wild rice waters impaired due to sulfate in excess of Minnesota's federally approved water quality standard of 10 milligrams per liter ("mg/L").

WaterLegacy has requested EPA intervention to list wild rice sulfate impaired waters since 2014. On October 22, 2020, WaterLegacy wrote to EPA Region 5 Regional Administrator Kurt Thiede and Water Division Director Tera Fong requesting that EPA assume oversight of Minnesota's Section 303(d) process and list wild rice waters impaired due to sulfate. With that letter, we provided exhibits reflecting MPCA's failure to list wild rice waters. We received no response.

On March 12, 2021, WaterLegacy wrote to EPA Region 5 Acting Regional Administrator Cheryl Newton and Director Fong, copying David Pfeifer and Paul Proto, requesting that EPA exercise its authority under the CWA, partially disapprove Minnesota's 2020 impaired waters list due to failure to list wild rice waters impaired by sulfate, and list sulfate impaired waters. Both this March 12, 2021 letter and attachments and the documents enclosed with an email to Barbara Wester on April 14, 2021 have been submitted as part of WaterLegacy's comments in this administrative record. We rely on these prior records and incorporate them by reference.

NMW is committed to the protection of the Boundary Waters Canoe Area Wilderness, which requires the protection of its watersheds in northeastern Minnesota. NMW conducts water quality monitoring in Birch Lake and submits with these comments a report of its protocols and 2020-2021 sulfate data.

These comments by WaterLegacy and NMW seek to reinforce the EPA's actions to date in partially disapproving Minnesota's 2020 CWA Section 303(d) list and listing an initial 30 wild rice waters as sulfate impaired WQLS. These comments also seek the additional listing of 20 additional wild rice WQLS impaired due to sulfate, as summarized in the Exhibit A spreadsheet.

The discussion below supports EPA's non-discretionary duty under the CWA to disapprove Minnesota's failure to list wild rice WQLS impaired due to sulfate in Minnesota's 2020 Section 303(d) list. The CWA also requires that EPA's listing of sulfate impaired wild rice waters be an independent decision based on all readily available data. The discussion provides additional support for two of the specific WQLS proposed by EPA and then explains the grounds for listing the additional 20 wild rice sulfate impaired waters summarized in Exhibit A.

DISCUSSION

1. EPA had a non-discretionary duty to partially disapprove Minnesota's 2020 CWA Section 303(d) list and list wild rice WQLS impaired due to sulfate.

The CWA requires that states identify all waterbodies within their boundaries that do not meet or are not expected to meet water quality standards. 33 U.S.C. § 1313(d)(1)(A); 40 C.F.R. § 130.7(b)(1). EPA is then required to either approve or disapprove the state's impaired waters listings not later than 30 days after the date of submission. 33 U.S.C. § 1313(d)(2); 40 C.F.R. § 130.7(d)(2). EPA is authorized to approve a state impaired waters list "only if it meets the requirements" of the CWA. 40 C.F.R. § 130.7(d)(2). If the EPA disapproves the state's listing of impaired waters, the EPA has another 30 days after the date of disapproval to identify impaired waters in the State. *Id*.

MPCA's 2020 CWA Section 303(d) list failed to list any wild rice WQLS impaired due to sulfate. MPCA has a valid water quality standard limiting sulfate to 10 mg/L in waters used for the production of wild rice ("wild rice waters"), Minn. R. 7050.0224, subp. 2, and there are many Minnesota wild rice waters where the state water quality standard is exceeded.

Under the CWA, Minnesota's numeric sulfate standard applies when the use of waters for wild rice is an existing use since November 28, 1975. 40 C.F.R. § 131.3(e) ("Existing uses are those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards."). The Minnesota Court of Appeals has determined that Minnesota's wild rice sulfate rule must be applied under the CWA, even if the Legislature may limit its effect on state-only programs, stating "The wild rice rule is a water-quality standard that is subject to enforcement under the CWA, including through the NPDES permitting program." *In re Reissuance of an NPDES/SDS Permit to U.S. Steel Corp.*, 937 N.W.2d 770, 788 (Minn. App. 2019).

States cannot "shirk their responsibility" for listing impaired waters "simply by claiming a lack of current data." *Sierra Club, Inc. v. Leavitt*, 488 F.3d 904, 913 (11th Cir. 2019). When the EPA disapproves a state's impaired waters list, the EPA has a non-discretionary duty to issue its own list. *Id*. at 908; 33 U.S.C. § 1313(d)(2); 40 C.F.R. §130.7(d)(2).

2. EPA's listing of Minnesota wild rice WQLS impaired for sulfate is an independent decision under the CWA based on beneficial use and all readily available data.

Once the EPA has disapproved a state's Section 303(d) list for failure to list WQLS, the EPA has an independent responsibility to "identify such waters in such State and establish such loads for such waters *as he determines necessary* to implement the water quality standards applicable to such waters." 33 U.S.C. § 1313(d)(2) (emphasis added); 40 C.F.R. § 130.7(d)(2) ("identify such waters in such state. . . as determined necessary to implement applicable WQS"). EPA's duty is neither based on MPCA's process, timing, or methodology. A reviewing court will evaluate EPA's decision, not the methodology used by the state. *Sierra Club v. Leavitt*, 488 F.3d at 913.

As detailed in Attachments A through C to WaterLegacy's March 12, 2021 letter to EPA, MPCA's process for limiting wild rice waters based on acreage and density, is inconsistent with the CWA and would exclude hundreds if not thousands of Minnesota waters for which wild rice is or has been an existing beneficial use at any time since November 28, 1975. The Administrative Law Judge and Chief Administrative Law Judge who reviewed MPCA's proposed rulemaking both found that MPCA's proposed list of approximately 1,300 wild rice waters was impermissibly underinclusive under CWA regulations. EPA's independent determination of sulfate impaired waters cannot exclude wild rice waters due to "insufficient information" on acreage or density, as MPCA proposed to do.

EPA must use all data that must be considered under the CWA, whether or not a state has used that data. In *Thomas v. Jackson*, 581 F.3d 658 (8th Cir. 2009), the court upheld EPA's decision to review Iowa's impaired waters list "in accordance with existing federal regulations" rather than in compliance with a statute enacted by the Iowa legislature to limit "credible data" to that within the past five years. *See also Sierra Club, Inc. v. Leavitt*, 488 F.3d at 914 (for EPA to adopt Florida's 7.5-year data cutoff "contradicts the CWA's statutory and regulatory language such that it is not entitled to deference").

CWA regulations for listing impaired waters require that a state (or the EPA when listing waters necessary to implement water quality standards) "assemble and evaluate all existing and readily available water quality-related data and information." 40 C.F.R. § 130.7(b)(5). This data shall, specifically, include information about waters "for which water quality problems have been reported by local, state, or federal agencies; members of the public; or academic institutions." *Id.* at (iii). In fact, "[t]hese organizations and groups should be actively solicited for research they may be conducting or reporting." *Id.*

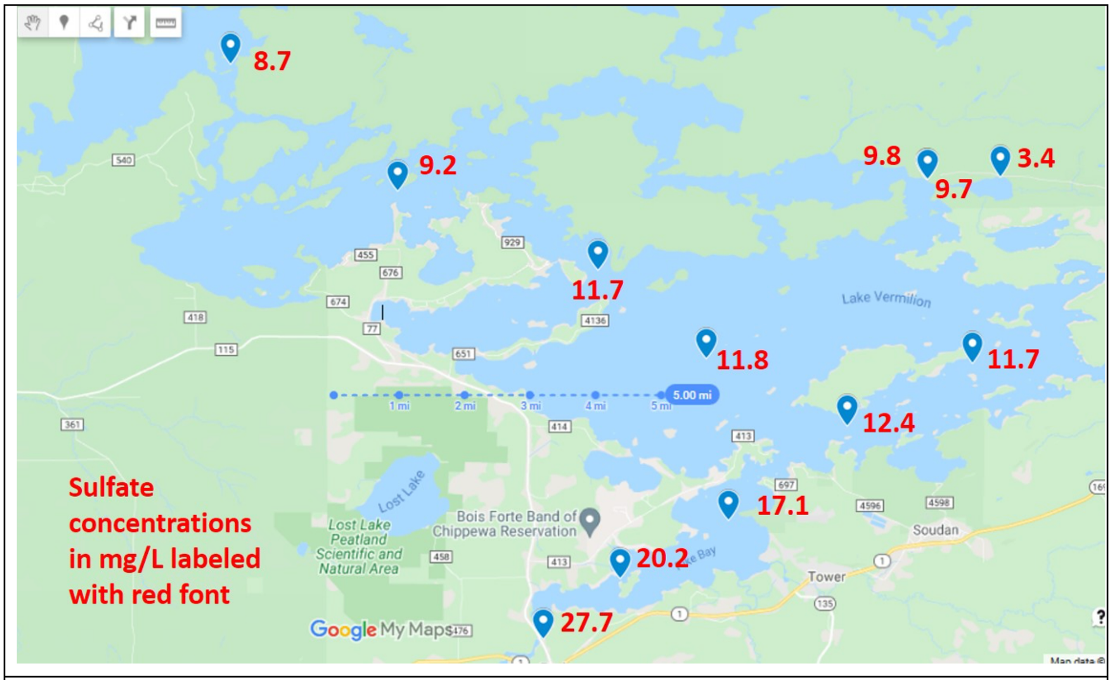
EPA's Decision Document Regarding the Sulfate Impaired Waters EPA is Adding to the Minnesota's 2020 CWA Section 303(d) List ("EPA DD") correctly considered data outside MPCA's cutoff period (2008-2018). *See* EPA DD at 12-13. This consideration is particularly necessary when the readily available water quality data is more recent than MPCA's 2018 cutoff. Finally, under CWA regulations, it is incumbent on an agency listing impaired waters not only to assemble and evaluate, but to solicit research that members of the public, academic institutions, and other local, state, or federal agencies have conducted. These comments rely on timely research and data provided by all of these sources.

3. EPA's initial listing of 30 wild rice WQLS impaired for sulfate is a reasonable and good faith list, for which the undersigned organizations offer additional support.

WaterLegacy and NMW support listing of the 30 wild rice WQLS EPA proposed to add to Minnesota's Section 303(d) list as sulfate impaired waters on April 27, 2021 Additional support is provided for the listing of specified waters below.

<u>Vermillion Lake – Pike Bay (AUID 69-0378-03)</u>

EPA proposed to list Vermillion Lake – Pike Bay as a sulfate impaired wild rice water. The attached 1854 Treaty Authority survey map[1] confirms wild rice in Pike Bay. Additional sulfate data confirms that Pike Bay is a sulfate impaired water. Citizen scientists organized as the Northern Lakes Technical Scientific Advisory Panel ("NLSAP") completed recent additional sulfate sampling in Vermillion Lake. Their June 2021 report,[2] found sulfate concentrations in Pike Bay of 20.2 mg/L and 17.1 mg/L, with an even higher concentration of sulfate, 27.7 mg/L, in the Pike River flowing to Pike Bay. Figure 2 (below) from NLSAP's report confirms that Vermillion Lake – Pike Bay must be listed as a wild rice WQLS due to excessive sulfate.



<u>Embarrass River (AUID 04010201-A99)</u>

EPA proposed to list Embarrass River segments AUID 04010201-579 (upstream of Embarrass Lake), A99 (Embarrass Lake to Esquagama Lake) and B00 (downstream of Esquagama) as sulfate impaired wild rice waters. MPCA's final list of sulfate impaired waters identified -579 and -A99 as wild rice waters. EPA DD, Appx. 1. EPA concluded that segment -A99 has excessive sulfate based on sampling in the upstream (-579) and downstream (B00) Embarrass River segments, as well as segment -A99. Additional support for EPA's listing of -A99 as sulfate impaired is provided

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[1] 1854 Treaty Authority, Lake Vermillion Map showing wild rice (blue dots), Exhibit B.

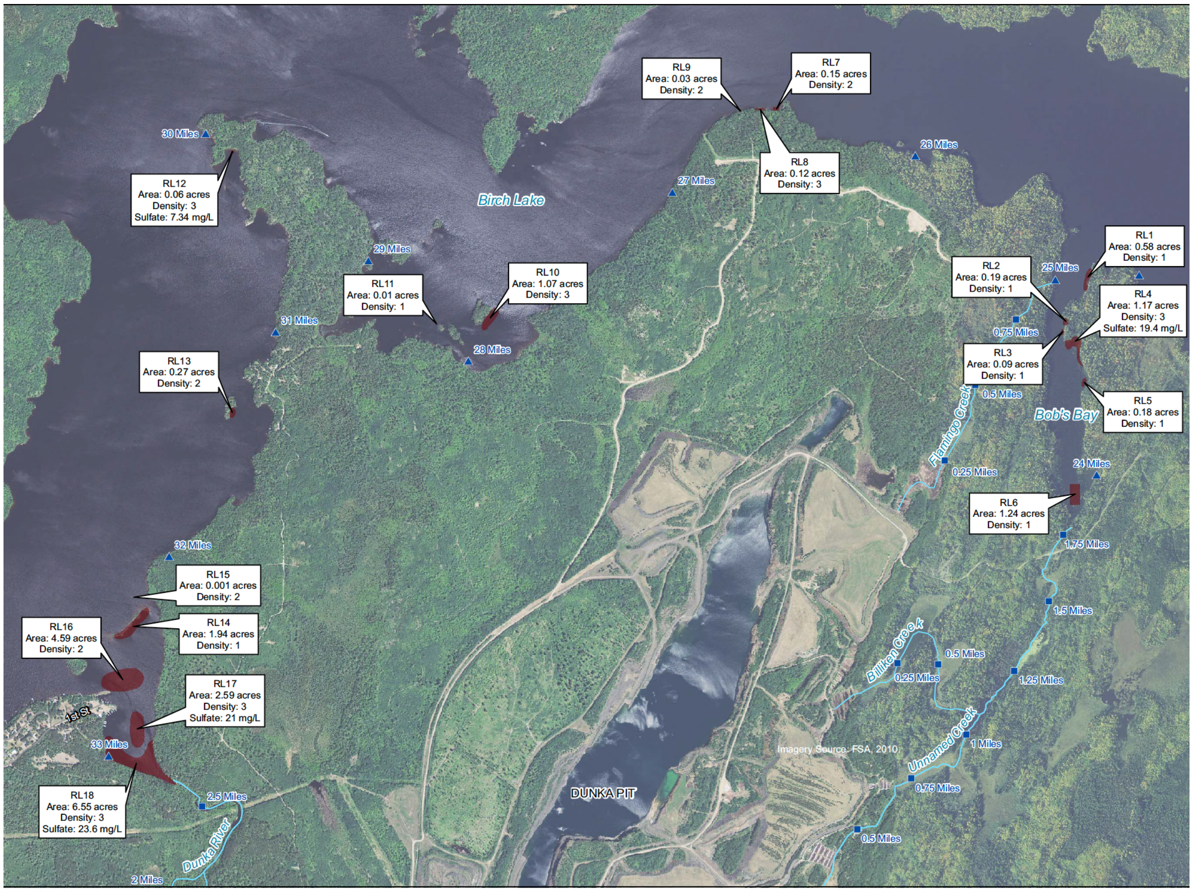
[2] NLSAP, Lake Vermillion Minnesota, Water Quality Technical Report (June 2021), Exhibit C.

by MPCA's Sulfate Data Summary for the immediately upstream Embarrass Lake (69-0496-00),[3] and MPCA data for the proximate downstream Esquagama Lake (65-0002-00).[4] Sulfate in both lakes exceeds 10 mg/L and confirms that -A99 must be listed as a sulfate impaired WQLS.

4. EPA must list additional wild rice WQLS based on the existing use of waters for wild rice and readily available data that sulfate exceeds Minnesota's 10 mg/L standard.

Birch Lake (St. Louis County) (AUID 69-0003-00) (Bob Bay -301, Dunka Bay -303, S009-182, areas north of Dunka Bay -202, -203, and -503)

EPA must list several segments of Birch Lake as wild rice WQLS impaired by sulfate. MPCA proposed to list Birch Lake as a wild rice water[5] and confirmed this designation in a March 15, 2021 letter to EPA. Field surveys conducted for Cliffs Erie in 2011 identified wild rice in Dunka Bay, Bob Bay, and numerous sites between.[6]



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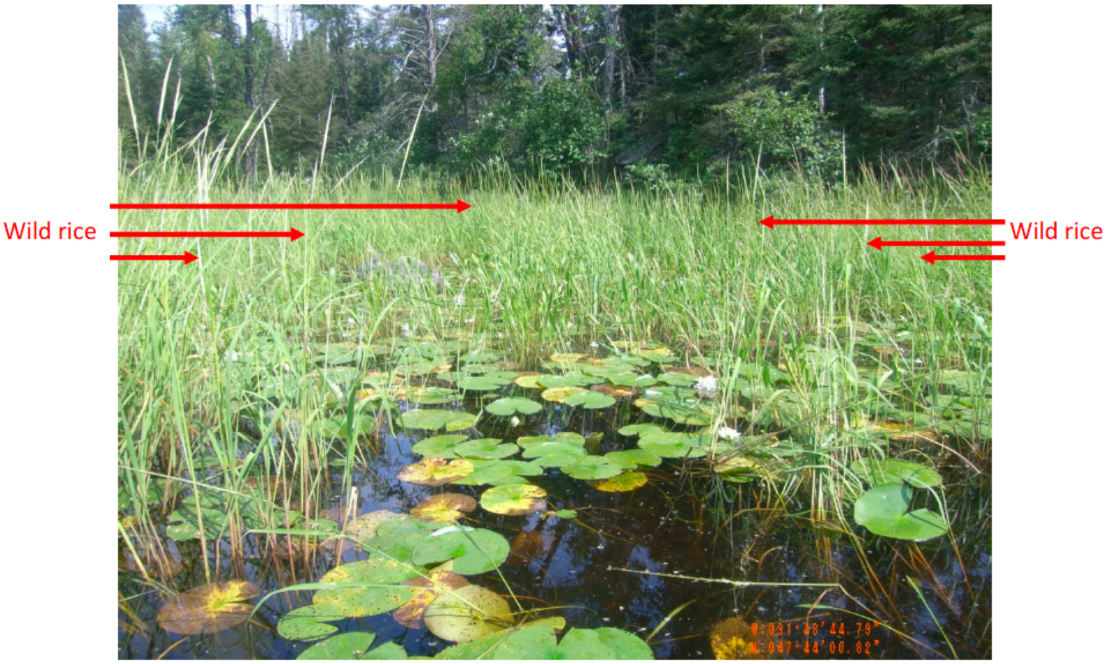
[3] MPCA Sulfate Data Summaries All WIDs (Apr. 9, 2021) in Appx. 4 to EPA DD.

[4] MPCA Data is surface water data online at https://webapp.pca.state.mn.us/surface-water/search. Data - Esquagama Lake was provided in Attach. C to WaterLegacy letter to EPA on Apr. 14, 2021

[5] EPA DD, Appx. 1.

[6] Barr, Wild Rice Literature Review and 2011 Field Survey for the Dunka Mining Area, Figure 3, (Dec. 20, 2011), Exhibit D. *See also* Twin Metals. Scoping Environmental Assessment Worksheet, Wild Rice in Birch Lake Figure 8-7 (Dec. 18, 2019), Exhibit E.

The Barr report also included photographs showing wild rice in both Bob Bay and Dunka Bay of Birch Lake.[7]



Birch Lake, Bob's Bay, 8/15/2011, wild rice and lily pads. Emergent vegetation is predominantly wild rice. Photo taken at reference location RL4.

Birch Lake, 8/17/2011, wild rice near Dunka River outlet, facing east. Vegetation in photograph is predominantly wild rice. Photo taken at reference location RL18.

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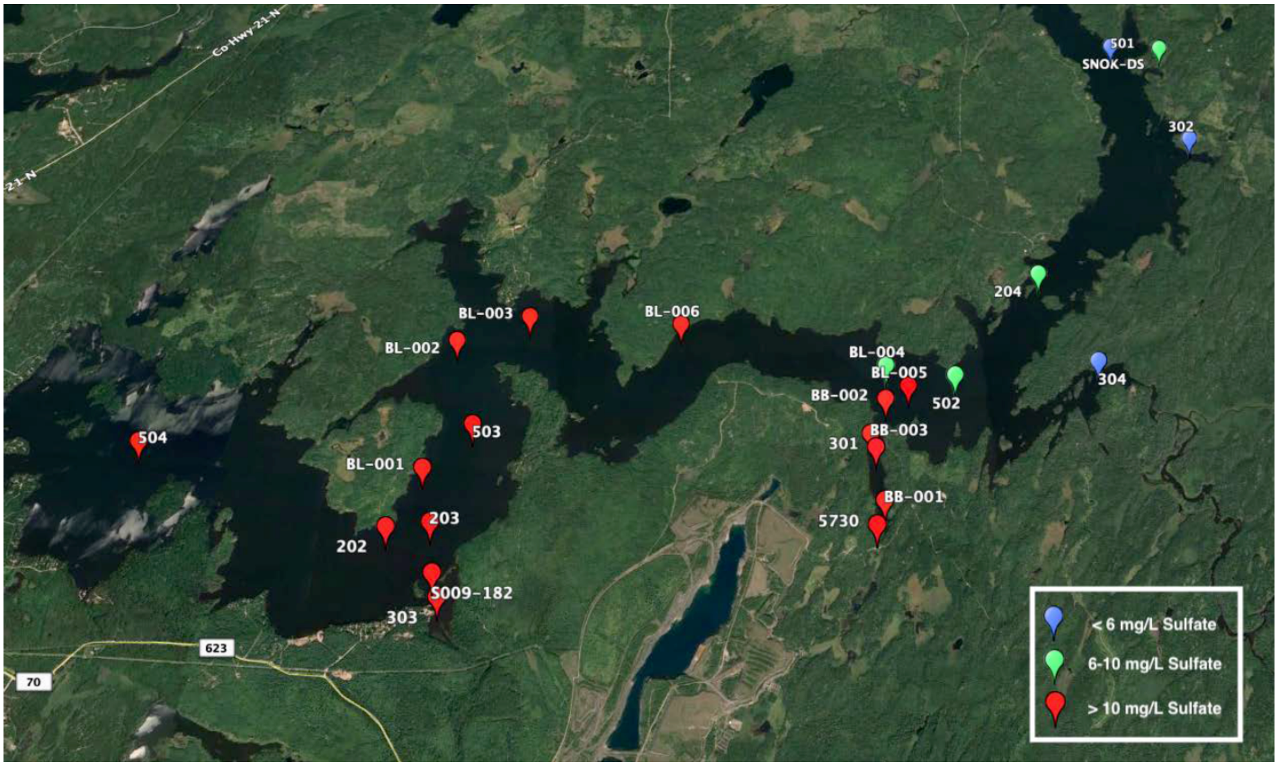
[7] *Id.* at D-1, D-2.

MPCA sulfate data on Birch Lake is sparse and outdated, but MPCA's single sulfate sample from Bob Bay (AUID 69-0003-00-301) in 2019 was 19.9 mg/L.[8] Data from the 1854 Treaty Authority and from NMW's and NLSAP's independent monitoring demonstrates that both Bob Bay and Dunka Bay are impaired waters. NMW field research also shows that a significant segment of Birch Lake has sulfate concentrations in excess of 10 mg/L apparently due to Dunka River sulfate.

Data from the 1854 Treaty Authority show that Dunka Bay (-303)) exceeded 10 mg/L sulfate in both 2013 (13.1 mg/L) and 2021 (21.0 mg/L). Bob Bay (-301) had a 53 mg/L sulfate concentration in 2021, and sulfate from Unnamed Creek flowing to Bob Bay was 194 mg/L.[9]

NMW's Birch Lake water quality sampling protocols and results are detailed in a report, 2020-2021 Sulfate Sampling Effort for Birch Lake (69-0003-00), June 28, 2021, Exhibit G ("NMW Report"). NMW data is summarized in the Exhibit H spreadsheet. The NMW Report includes the results of a total of 104 samples taken in Birch Lake, most during May and June, 2021. NMW Report at 8-20. NMW sampling locations in the segments near Bob Bay and Dunka Bay are shown below. NMW Report at 20.



In Bob Bay (AUID -301 and proximate NMW sites BB-001, -002, -003), NMW reported 17 sulfate samples, 100% of which exceeded 10 mg/L; average sulfate was 29.58 mg/L. Exhibit H. NMW reported 6 sulfate samples in Dunka Bay (AUID -303 and S009-182), 100% of which exceeded 10 mg/L; average sulfate was 15.35. *Id*. North of Dunka Bay itself (AUID -202, -203, -503 and BL-

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[8] MPCA Data provided in Apr. 14, 2021, Attach. C, *supra*.

[9] 1854 Authority Birch Lake Data, Exhibit F.

001, -002, -003) sulfate impairment persisted. NMW took 43 sulfate samples, all of which fell between 10.5 and 12.40 mg/L, with an average of 11.44 mg/L. *Id.*

NLSAP sampled Birch Lake in 2021, taking three sulfate samples in Bob Bay, 100% of which exceeded 10 mg/L, with an average of 25.23 mg/L.[10] Three sulfate samples taken by NLSAP in Dunka Bay all exceeded 10 mg/L, with an average of 12.1. *Id.* Adjacent areas of Birch Lake also exceeded 10 mg/L, and the Dunka River where it enters Dunka Bay had sulfate of 19.9 mg/L.

MPCA's single recent Bob Bay sample as well as extensive data from the 1854 Treaty Authority, NMW, and NLSAP support listing Birch Lake as a sulfate impaired WQLS. Although MPCA documents few recent sulfate exceedances in Birch Lake,[11] MPCA data in the Exhibit J folder shows that sulfate upstream in the Dunka River (S002-765), which flows to Dunka Bay, has exceeded 10 mg/L both historically (37.82 mg/L) and recently (24.93 mg/L).

EPA must list Birch Lake – Bob Bay (69-0003-00-301) and Birch Lake – Dunka Bay (69-0003-00-303) as wild rice WQLS impaired due to sulfate. The weight of the evidence further suggests that anthropogenic sulfate from the Dunka River has resulted in sulfate impairments in Birch Lake north of Dunka Bay (69-0003-00-202, -203, -503 and beyond), suggesting broad segments of Birch Lake should also be listed as wild rice sulfate impaired WQLS.

St. Louis River Estuary (St. Louis County) (AUID 0410201-532 and 0410201-533 also identified as **AUID 69-1291-04 and 69-1291-03)**

MPCA online GIS mapping of Minnesota AUIDs, sampling locations and sites where MPCA has identified wild rice[12] confirms wild rice in both AUID 0410201-532 and -533 in the Upper Estuary of the St. Louis River. MPCA identified these Estuary AUIDs as draft wild rice impaired waters in 2013.[13]

Locating data for sulfate levels in the St. Louis River Upper Estuary is complicated by MPCA's changeover from river AUID designations 0410201-532 and -533 to, respectively, lake AUID designations 69-1291-04 and 69-1291-03. MPCA's surface water data site lacks cross-references to locate sampling data, and some sites have few samples. However, sulfate data showing that AUID's -532 (69-1291-04) and -533 (69-1291-03) are impaired for excessive sulfate was provided by MPCA counsel for stations S007-206, -444, -507, -510, -512, -515, and -516.[14] This data shows that for the 69-1291-04 Upper Estuary area, MPCA identified nine sulfate samples, five of which exceeded 10 mg/L, with average sulfate of 12.39 mg/L. For the 69-1291-03 area, MPCA identified one sample in Spirit Lake with a sulfate concentration of 20.8 mg/L. *Id.*

Reviewing MPCA online GIS maps, two other sampling locations are within these Upper Estuary AUIDs. S000-021 is within -532 and S000-277 is within -533. Exhibit K at 2, 4. Data for the St.

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[10] NLSAP, Birch Lake Minnesota, Water Quality Technical Report at 4 (June 2021), Exhibit I.

[11] *See* Data – Birch Lake (Revised) in Exhibit J, Folder of MPCA Surface Water Data

[12] MPCA online ArcGIS mapping with AUIDs, sampling sites, and wild rice sites is found at https://www.arcgis.com/home/webmap/viewer.html?useExisting=1. Screenshots for proposed Upper Estuary wild rice sulfate impaired WQLS are provided in Exhibit K at 2-4

[13] MPCA 2013 Draft Impaired Waters is included in Appx. 4 to EPA DD.

[14] MPCA Email, Sulfate Data in St. Louis River Estuary (May27, 2021), Exhibit L. *See also* Data St. Louis Upper Estuary (MPCA Email) in Exhibit J folder.

Louis River Estuary S000-021 and S000-277 are provided in the Exhibit J folder. For S000-021, historic MPCA data shows an exceedance of the 10 mg/L sulfate standard. There are 43 recent samples, of which 36 or 84% exceed 10 mg/L, with an average of 15.04 mg/L. For S000-277, historic MPCA data also shows an exceedance of the 10 mg/L sulfate standard. There are seven recent samples, 100% of which exceed 10 mg/L, with an average 18.01 mg/L.

Based on all readily available data, both St. Louis River Estuary AUID locations 0410201-532 (69-1291-04) and 0410201-533 (69-1291-03) must be listed as wild rice WQLS due to sulfate impairment.

Additional Lakes and Lake Segments.

Additional lakes and lake segments must be listed as wild rice WQLS impaired due to sulfate. Lake segments proposed for addition to Minnesota's Section 303(d) list as sulfate impaired WQLS are listed below in alphabetical order and summarized in Exhibit A.

Bear Lake (Freeborn County) (AUID 24-0028-00)

Bear Lake is listed as a wild rice water in the Minnesota Department of Natural Resources ("DNR") 2008 report to the Minnesota Legislature.[15] MPCA GIS mapping confirms wild rice. Exhibit K at 5. MPCA Sulfate Data Summaries, Appx. 4 to EPA DD, show 10 sulfate samples, with 90% above 10 mg/L, a mean of 25.27 mg/L, and a lower 95% confidence interval of 17.93 mg/L. Bear Lake must be listed as a wild rice WQLS impaired due to sulfate.

Dark Lake (St. Louis County) (AUID 69-0790-00)

The presence of wild rice in Dark Lake is confirmed in the field research done by the University of Minnesota ("U of M") for MPCA, led by Amy Myrbo, PhD.[16] MPCA data for Dark Lake in the Exhibit J folder includes 12 sulfate samples, 100% of which are above 10 mg/L with average sulfate of 144.6 mg/L. The four samples in U of M data all exceed 10 mg/L and average 174.75 mg/L. Dark Lake must be listed as a wild rice WQLS impaired due to sulfate.

Mississippi Pool 4/Robinson Lake (Wabasha County) (AUID 79-0005-02)

The presence of wild rice is confirmed by U of M field study data, Exhibit N, and by MPCA online GIS mapping, Exhibit K at 6. MPCA data for Miss. R. Robinson Lake has four samples, three of which exceed 10 mg/L, with an average of 23.5 mg/L. Exhibit J folder. The samples taken in U of M field research all exceed 10 mg/L, with an average of 29.57 mg/L. Exhibit N. Although it would be desirable to have additional samples, Mississippi Pool 4/Robinson Lake should be listed as a wild rice WQLS impaired due to sulfate.

Pearl Lake (Stearns County) (AUID 73-0037-00)

Pearl Lake was identified as a wild rice water in MPCA's 2013 Draft Impaired Waters, Appx. 4, EPA DD, and through DNR interagency data collaboration in the wild rice sulfate rulemaking process, as reflected in MPCA's Wild Rice Waters database.[17] MPCA Sulfate Data Summaries (Appx. 4, EPA DD) identify 45 sulfate samples, 100% of which exceed 10 mg/L, with mean sulfate

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[15] DNR, Natural Wild Rice in Minnesota, Report to Minn. Legislature (Feb. 15, 2008), Exhibit M at 67.

[16] Univ. of Minn., Field Survey Data (Feb. 6, 2015), excerpted for sulfate data and highlighted, Exhibit N.

[17] MPCA Wild Rice Waters database (July 19, 2016) provided to Wild Rice Sulfate Standard Advisory Committee on Jan. 25, 2017 is included as Attach. A in Appx. 4 to EPA DD, see row 2193 for Pearl Lake.

of 24.88 mg/L and a lower 95% confidence interval of 22.79 mg/L. Pearl Lake must be listed as a wild rice WQLS impaired due to sulfate.

Rice Lake (Stearns County) (AUID 73-0196-00)

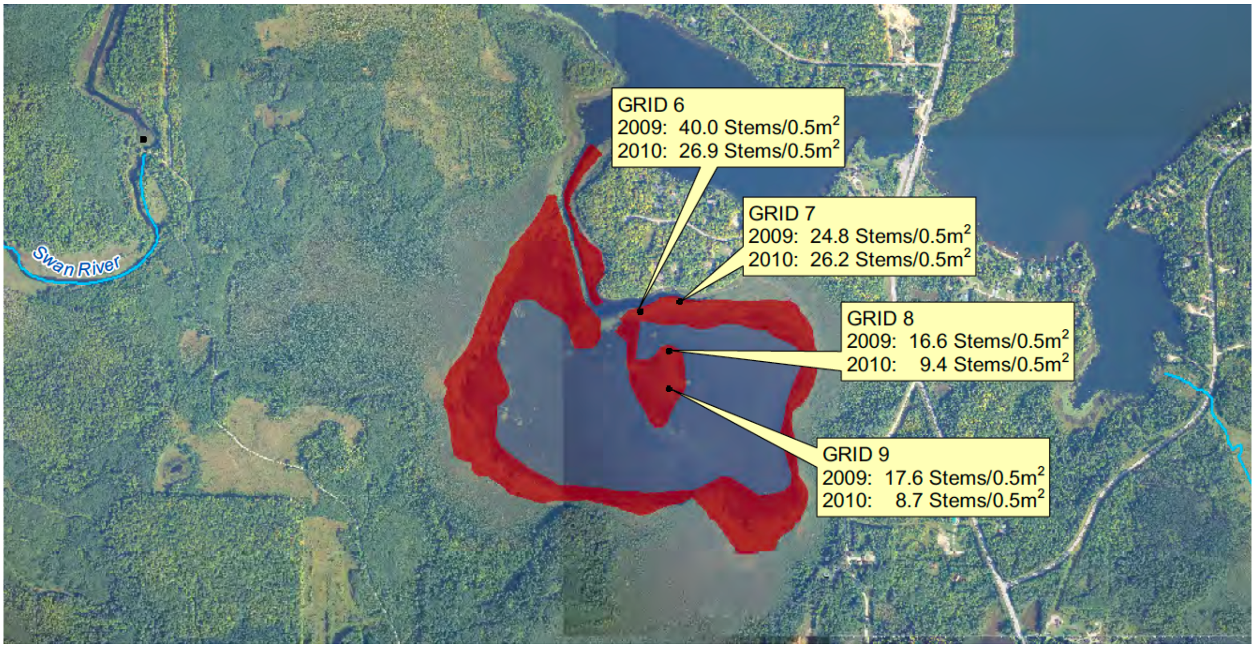
Rice Lake was identified as a wild rice water in DNR's 2008 legislative study, Exhibit M at 82. Wild rice is confirmed by MPCA online GIS mapping, Exhibit K at 7. MPCA Sulfate Data Summaries (Appx. 4, EPA DD) identify 13 sulfate samples, 11 of which or 84.6% exceed 10 mg/L, with a mean of 29.13 mg/L and a lower 95% confidence interval of 23.01 mg/L. Rice Lake must be listed as a wild rice WQLS impaired due to sulfate.

Sturgeon Lake (Goodhue County) (AUID 25-0017-01)

Sturgeon Lake was identified as a wild rice water in MPCA's final list of approximately 1,300 wild rice waters, Appx. 1, EPA DD. MPCA Sulfate Data Summaries (Appx. 4, EPA DD) identify 58 sulfate samples, 100% of which exceed 10 mg/L, with a mean of 52.55 mg/L and a lower 95% confidence interval of 48.06 mg/L. Sturgeon Lake must be listed as a wild rice WQLS impaired due to sulfate.

Swan Lake (Itasca County) (West Bay AUID 31-0067-01 and Main Basin 31-0067-00, -02)

The EPA listed the Southwest Bay of Swan Lake (AUID 31-0067-03) as a proposed wild rice sulfate impaired WQLS. Current MPCA GIS mapping identifies the Swan Lake West Bay (not just the southern part of the West Bay) as AUID 31-0067-01. *See* Exhibit K at 8. The Keetac expansion environmental impact statement ("EIS") also both the southern and northern areas as the Swan Lake West Bay.[18] The 2011 Barr Engineering Report for U.S. Steel Keetac shows wild rice in the West Bay in the southern area extending to the neck of northern part of the bay.[19]



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[18] DNR, Keetac Mine Expansion Project, Final EIS, Vol. II, (Nov. 2010) Figure 4.9.7.1 Exhibit O. This "Keetac Final EIS" is at https://www.dnr.state.mn.us/input/environmentalreview/keetac/index.html.

[19] Barr Engineering, 2010 Water Quality, Hydrology, and Wild Rice Monitoring Year End Report for U.S. Steel Corp. Keetac Expansion Project, Figure 11 (Jan. 2011), Exhibit P.

MPCA data for "Swan West Bay" AUID 31-0067-01 is more recent and robust than data for -03, "Swan Southwest Bay." *See* Data Swan - Lake in Exhibit J folder. For -01, MPCA data shows 27 sulfate samples, of which 21 or 78% exceed 10 mg/L, with average sulfate of 22.34 mg/L. Swan Lake West Bay (AUID 31-0067-01) must be listed as a wild rice WQLS impaired due to sulfate.

DNR's 2008 wild rice report identified the main basin of Swan Lake (AUID 31-0067-00) as a wild rice water with 50 acres of wild rice. Exhibit M at 72. As the MPCA online surface water data and GIS maps show, the Swan Lake Main Basin has previously been identified both as 31-0067-00 and -02, and there is wild rice in the Main Basin. Exhibit K at 8.

MPCA's online surface water Data- Swan Lake, in the Exhibit J folder, contains no data for -00, but comprehensive and recent data for -02, suggesting that this is the AUID now used for the Swan Lake Main Basin. MPCA data for -02 shows 81 sulfate samples, of which 100% exceed 10 mg/L, with and average sulfate level of 27 mg/L. Swan Lake Main Basin (AUID 31-0067-00, -02) must be listed as a wild rice WQLS impaired due to sulfate.

Additional River and Stream Segments

Rivers and streams proposed for addition as wild rice WQLS impaired due to sulfate are listed below in alphabetical order and summarized with applicable data in Exhibit A.

Bostick Creek (Lake of the Woods County) (AUID 09030009-537)

Bostick Creek was identified as a wild rice water in DNR's 2008 legislative study, Exhibit M at 75. Wild rice is confirmed by MPCA online GIS mapping, Exhibit K at 9, and MPCA proposed Bostick Creek in its 2013 Draft Impaired Waters List, Appx. 4 to EPA's DD. MPCA Sulfate Data Summaries (Appx. 4, EPA DD) identify 10 sulfate samples, 100% of which exceed 10 mg/L, with a mean of 32.77 mg/L and a lower 95% confidence interval of 30.29 mg/L. Bostick Creek must be listed as a wild rice WQLS impaired due to sulfate.

Cannon River (Goodhue County) (AUID 07040002-501 or -551)

Cannon River was identified as a wild rice water in DNR's 2008 legislative study, Exhibit M at 67, and several segments of the Cannon River were listed in MPCA's 2013 Draft Impaired Waters list, with the explanation that the DNR's listing did not identify where on the river wild rice was present, although "[w]herever sampled, the Cannon River has high sulfate concentrations." MPCA 2013 Draft Impaired Waters at 1, Appx. 4, EPA DD. For these comments, each of the segments identified by MPCA were evaluated.

One of the Cannon River segments identified by MPCA as a draft impaired water in 2013 is -501. As shown in MPCA online GIS mapping, Exhibit K at 10, segment 501 does not appear to contain wild rice, but its immediate downstream river segment -551 is a confirmed wild rice location. There is no sulfate sampling available in -551, but MPCA's Sulfate Data Summaries (Appx. 4, EPA DD) for the proximate upstream -501 Cannon River segment identify 10 sulfate samples, 100% of which exceed 10 mg/L, with a mean of 24.56 mg/L and a lower 95% confidence interval of 22.01 mg/L. The Cannon River must be listed as a wild rice WQLS impaired due to sulfate. Listing of either segment -501 or segment -551 would allow calculation of a total maximum daily load for sulfate to protect wild rice in segment -551, just before the Cannon River junction with the Mississippi River.

<u>Chippewa River (Chippewa County) (AUID 07020005-501)</u>
Several segments of the Chippewa River, including segment -501, were listed in MPCA's 2013 Draft Impaired Waters list with the explanation that DNR's study point is not clear where on the Chippewa River wild rice is present and that "[w]herever sampled the Chippewa River has high sulfate concentrations." MPCA 2013 Draft Impaired Waters at 1, Appx. 4, EPA DD. For these comments, each of the segments identified by MPCA in 2013 were evaluated. The presence of wild rice was confirmed in segment -501, as shown in Exhibit K at 11.

MPCA data for Chippewa River segment -501, Exhibit J folder, shows historic elevated sulfate. MPCA data also includes nine recent sulfate samples 100% of which exceed 10 mg/L, with an average sulfate concentration of 139.4 mg/L. The Chippewa River segment -501, just before the Minnesota River junction, must be listed as a wild rice WQLS impaired due to sulfate

<u>Hay Creek (Itasca County) (AUID 07010103-545)</u>
Tribes have identified Hay Creek as a wild rice water. The presence of wild rice in Hay Creek is clearly demonstrated in Figure 4.7.4 of the Keetac Final EIS.[20] Wild rice is also confirmed in Hay Creek by MPCA online GIS mapping, Exhibit K at 12. MPCA Sulfate Data Summaries (Appx. 4, EPA DD) identify 11 sulfate samples, 100% of which exceed 10 mg/L, with a mean of 24.99 mg/L and a lower 95% confidence interval of 22.02 mg/L. Hay Creek must be listed as a wild rice WQLS impaired due to sulfate.

<u>Mississippi River Root R. to Iowa, including Pool 8 (Houston County) (AUID 07060001-509)</u>
<u>(Stations S007-222, S007-556)</u>
University of Minnesota field research, Exhibit N, demonstrates that AUID 07060001-509, described as Mississippi River Pool 8, is a wild rice water at Genoa and Reno (S007-222, S007-556). The presence of wild rice is also confirmed by MPCA online GIS mapping at several locations just south of the Root River confluence with the Mississippi River segment, as well as further south near Genoa and Reno. Exhibit K at 13. MPCA data for segment -509 in the Exhibit J folder has nine sulfate samples, six or 66% of which are above 10 mg/L, with average sulfate of 18.44 mg/L, excluding no outliers. The five samples in U of M data, Exhibit N, all exceed 10 mg/L, with average sulfate of 28.58 mg/L. Mississippi River segment 07060001-509 must be listed as a wild rice WQLS impaired due to sulfate

<u>Raven Stream West Branch (Scott County) (AUID 07020012-842)</u> <u>(Station S004-617)</u>
Raven Stream West Branch was initially listed as a wild rice water in MPCA's 2016 Wild Rice Waters database. Attach. A in Appx. 4 to EPA DD, row 2043. The presence of wild rice is confirmed by MPCA online GIS mapping, Exhibit K at 14. MPCA data for Raven Stream West Branch in the Exhibit J folder provides 26 sulfate samples, 100% of which are above 10 mg/L, with average sulfate of 26.73 mg/L. Raven Stream West Branch must be listed as a wild rice WQLS impaired due to sulfate.

<u>Rice Creek (Sherburne) (AUID 07010203-512)</u> <u>(Station S001-523)</u>
MPCA proposed Rice Creek from Rice Lake to Elk River in its 2013 Draft Impaired Waters List (Appx. 4 to EPA's DD). Wild rice is confirmed by MPCA online GIS mapping, Exhibit K at 15.

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[20] Keetac Final EIS, *supra*, Figure 4.7.4, Exhibit Q.

MPCA data for Rice Creek in the Exhibit J folder provides 15 sulfate samples, 100% of which are above 10 mg/L, with average sulfate of 22.61 mg/L. Rice Creek must be listed as a wild rice WQLS impaired due to sulfate.

Conclusion

WaterLegacy and NMW strongly support the EPA's initial listing of 30 wild rice WQLS impaired due to sulfate and request that EPA list the additional 20 WQLS identified in these comments and listed in summary form in Exhibit A. WaterLegacy and NMW believe that the EPA's oversight of Minnesota's failure to list a single wild rice water impaired due to excessive sulfate is not only reasonable but necessary to fulfill EPA's obligations under the CWA and its implementing regulations.

WaterLegacy and NMW would underscore that the EPA's duty to list impaired waters upon partial disapproval of a state's Section 303(d) list is an independent obligation based on what EPA determines is necessary under the CWA considering all readily available data. On this basis, NMW has conducted rigorous testing and has provided a detailed report on sulfate concentrations in Birch Lake, one of the most sensitive bodies of water affected by existing taconite mining and threatened by potential copper-nickel mining. In these comments, as well as in comments, attachments, and exhibits submitted to EPA in October 2020, March 2021, and April 2021, WaterLegacy has sought to provide not just legal argument, but detailed information from government agencies, academic sources, regulated parties, and members of the public to support the EPA's obligation to list sulfate impaired waters in compliance with the CWA.

Please feel free to contact Matt Norton (matt@savetheboundarywaters.org) if you have any questions about Birch Lake or the NMW Report and to contact Paula Maccabee (paula@waterlegacy.org or pmaccabee@justchangelaw.com) if you have questions about other data or materials. We welcome communications and look forward to the EPA's additional listings of Minnesota wild rice WQLS impaired due to excessive sulfate.

Respectfully submitted,

Paula G Maccabee

Paula G. Maccabee
Advocacy Director and Counsel
WaterLegacy

Matthew Norton

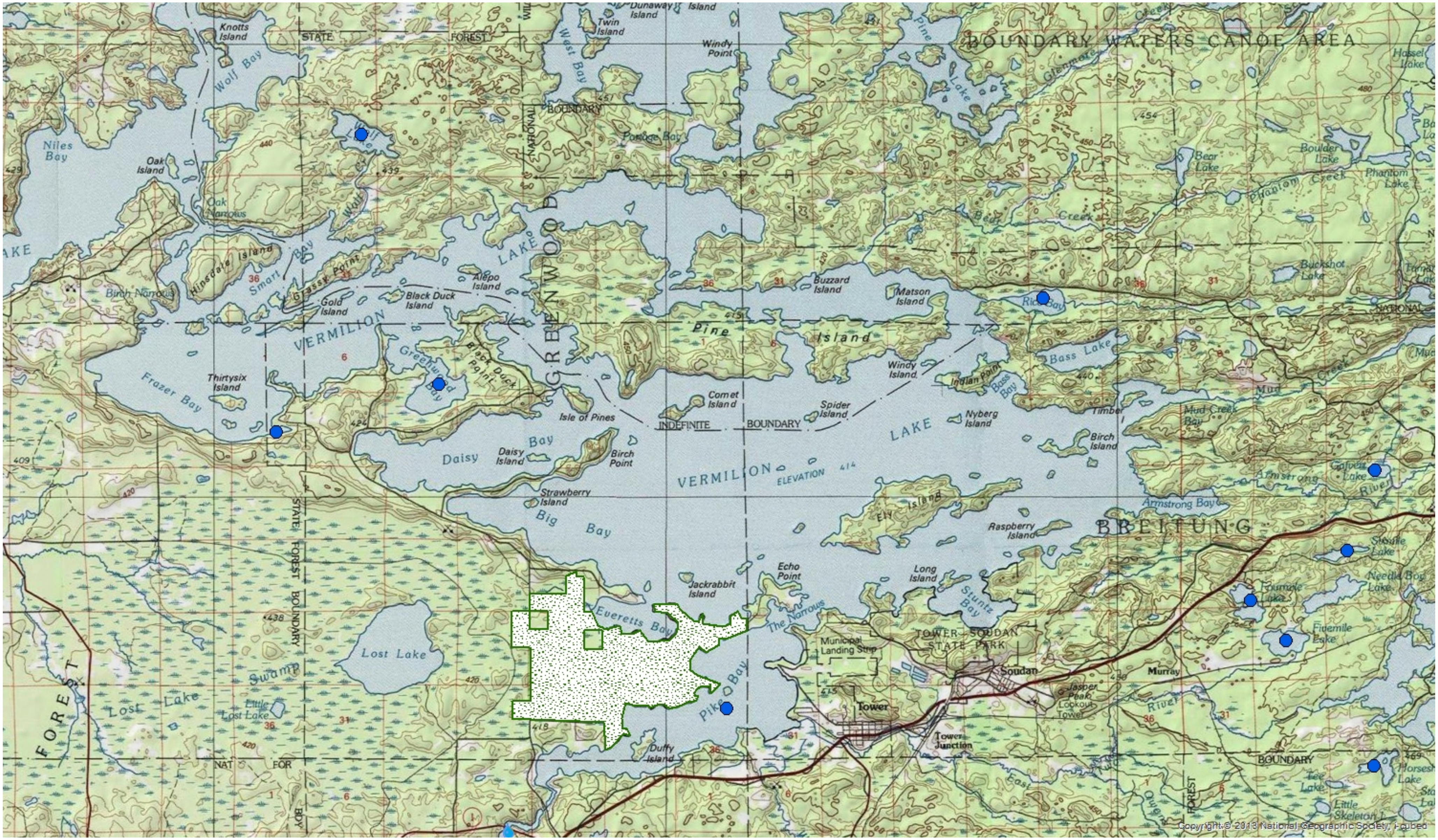
Matt Norton
Policy and Science Director
Campaign to Save the Boundary Waters

EXHIBIT LIST
WaterLegacy and NMW Comments
Minnesota Wild Rice Sulfate Impaired WLQS (June 30, 2021)

Exhibit A	Additional Wild Rice WQLS Impaired Due to Sulfate
Exhibit B	1854 Treaty Authority Map Lake Vermillion Wild Rice
Exhibit C	NLSAP Water Quality Report Lake Vermillion (2021)
Exhibit D	Barr Engineering Dunka River and Birch Lake Wild Rice Report (2011)
Exhibit E	Twin Metals. Scoping EAW, Wild Rice in Birch Lake Fig. 8-7 (2019)
Exhibit F	1854 Treaty Authority Birch Lake Sulfate Sampling Results (2013, 2021)
Exhibit G	NMW, 2020-2021 Sulfate Sampling Report for Birch Lake (June 28, 2021)
Exhibit H	Summary of NMW Report Data – Birch Lake (2020-2021)
Exhibit I	NLSAP Water Quality Report Birch Lake (2021)
Exhibit J	MPCA Surface Water Data (Folder) Birch Lake Chippewa River Dark Lake Dunka River Mississippi River Pool 4/Robinson Lake Mississippi River Root River to Iowa Border/Pool 8 Raven Stream W. Branch Rice Creek St. Louis River Estuary (MPCA Email, AUID 04010201-532, -533) St. Louis River Estuary (S000-021) St. Louis River Estuary (S000-277)
Exhibit K	MPCA online GIS Mapping Locations Screenshots
Exhibit L	MPCA email Sulfate Data for St. Louis River Estuary (May 27, 2021)
Exhibit M	DNR, Natural Wild Rice in Minnesota, Report for Legislature (Feb. 15, 2008)
Exhibit N	Univ. of Minn. Field Survey Data (Feb. 6, 2015), sulfate data excerpt
Exhibit O	DNR, Keetac Expansion Final EIS, Fig. 4.9.7.1, Swan Lake (2010)
Exhibit P	Barr Engineering, Keetac Expansion Wild Rice Fig. 11, Swan Lake (2011)
Exhibit Q	DNR, Keetac Expansion Final EIS, Fig. 4.7.4, Hay Creek (2010)

NOTE: Cmt 1367c is a Excel Spreadsheet titled *Exhibit A - Additional Wild Rice WQLS Impaired Due to Sulfate.xlsx*, please contact proto.paul@epa.gov if you are interested in reviewing this spreadsheet

Wild Rice WQLS, Exhibit B



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Lake Vermilion Minnesota

Minnesota DNR / Minnesota PCA Lake ID Numbers 69037800, 69037801, 69037802, and 6907803

Water Quality Technical Report

Northern Lakes Scientific Advisory Panel (NLSAP)

Prepared for
Water Legacy

Prepared by
Eric Morrison, PhD
info@NLSAP.org
651.334.8399

June 2021

Summary

Water from the Minntac tailings basin drains to the Sandy River which is a tributary to the Pike River and Lake Vermilion. The Minnesota Pollution Control Agency granted water discharge permit No. MN0057207 to U.S. Steel for the Minntac tailings basin which contains no limits on sulfate pollution. The flux of sulfate into Lake Vermilion via the Pike River is measured in tons per day. In the absence of mine pollution, sulfate levels for EPA Ecoregion 50n lakes are almost without exception under 2 mg/L.

Lakes with greater than 10 mg/L sulfate concentration are impaired for wild rice.

This Water Quality Technical Report has been prepared to provide a survey of existing surface sulfate concentrations in Lake Vermilion. Because of the size, Lake Vermilion has been divided into three zones each with a unique Lake ID in the Minnesota Department of Natural Resources Lake Finder system – Lake Vermilion (lake ID 69037800), East Vermilion (lake ID 69037801), and West Vermilion (lake ID 69037802). MPCA surface water data also separately designates the Lake Vermillion Pike Bay area with lake ID 69-0378-03. Note that lake ID numbers are used in hyphenated and unhyphenated formats, for example 69-0378-03 and 69037803.

Samples for analysis of sulfate concentration were gathered on June 3, 2021 as explained below.

Sulfate concentrations in 6 of 10 of locations in Lake Vermilion (including sections with lake ID 69-0378-00, 69-0378-01, 69-0378-02, and 69-0378-03) were above 10 mg/L. Two sample locations in Pike Bay were significantly elevated with sulfate concentrations of 17.1 and 20.2 mg/L. The 4 locations with concentrations below 10 mg/L are geographically the furthest from Pike Bay, and of these 4 locations, 3 are within 1 mg/L of the 10 mg/L standard. One location tested in West Vermilion (lake ID 69-0378-02) had a sulfate concentration within 1.5 mg/L of the standard.

Locations and Methods

1. **Sampling locations.** Locations for sample collection were accessed by boat and included locations designated “Vermilion,” “Vermillion -Pike Bay” “East Vermilion,” and “West Vermilion” by the Minnesota DNR. The Minnesota PCA separately designates Pike Bay with lake ID number 69-0378-03. Maps from the Minnesota DNR LakeFinder web site are shown in Figure 1 and Minnesota PCA map for Pike Bay ID number 69037803 is shown in Figure 2. Locations where samples were collected are shown in Figure 3, and GPS coordinates and lake ID numbers for sampling locations are listed in Table 1.

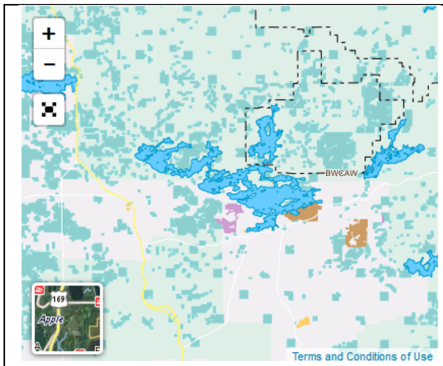	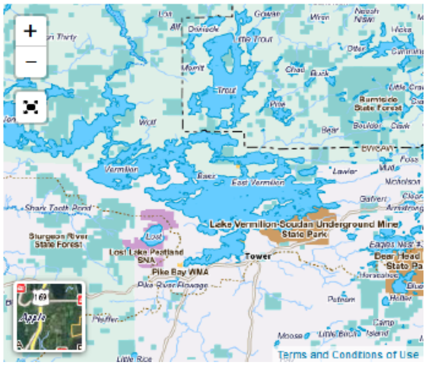	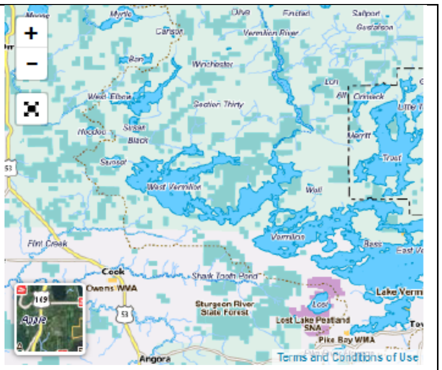
Figure 1a. LakeFinder: Vermilion, Lake ID 69-0378-00	Figure 1b. LakeFinder: East Vermilion, Lake ID 69-0378-01	Figure 1c. LakeFinder: West Vermilion, Lake ID 69-0378-02

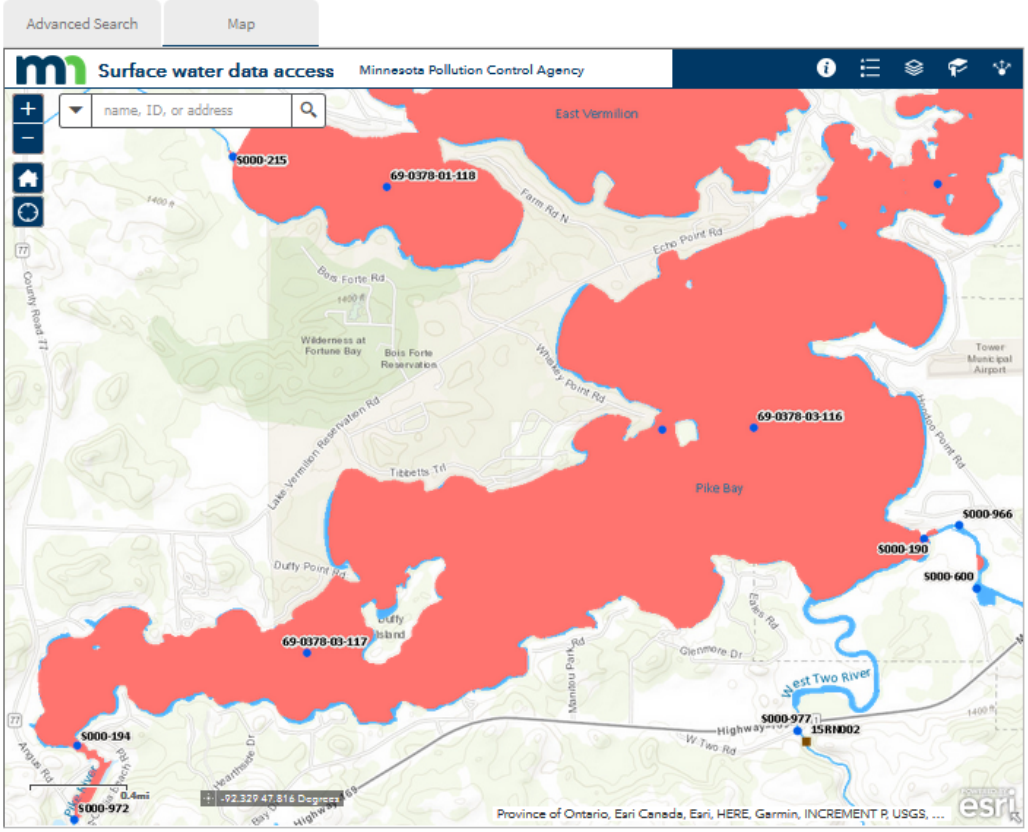

Figure 2. Minnesota PCA Lake ID number 69-0378-03, Pike Bay of Lake Vermilion

Table 1: Sampling Locations

site	site description	lake ID number	date collected	latitude	longitude
1	Rice Bay	69-0378-01	6/3/2021	47.89389	-92.21750
2	Glenwood Lodge	69-0378-01	6/3/2021	47.89333	-92.24194
3	Glenwood Lodge	69-0378-01	6/3/2021	47.89333	-92.24139
4	Under Pike River bridge		6/3/2021	47.79167	-92.36806
5	Middle of big bay	69-0378-01	6/3/2021	47.85361	-92.31444
6	Between Isle of Pines and Pine Island	69-0378-01	6/3/2021	47.87333	-92.35000
7	Between Fectos Point and Black Duck Island	69-0378-00	6/3/2021	47.89083	-92.41611
8	Next to Oak Island	69-0378-02	6/3/2021	47.91889	-92.47083
9	Near Ely Island	69-0378-01	6/3/2021	47.83889	-92.26806
10	Near Ely Island	69-0378-01	6/3/2021	47.85278	-92.22667
11	Between Whiskey Island and Hoodoo Point	69-0378-03	6/3/2021	47.81806	-92.30722
12	In front of Duffy Island	69-0378-03	6/3/2021	47.80500	-92.34278

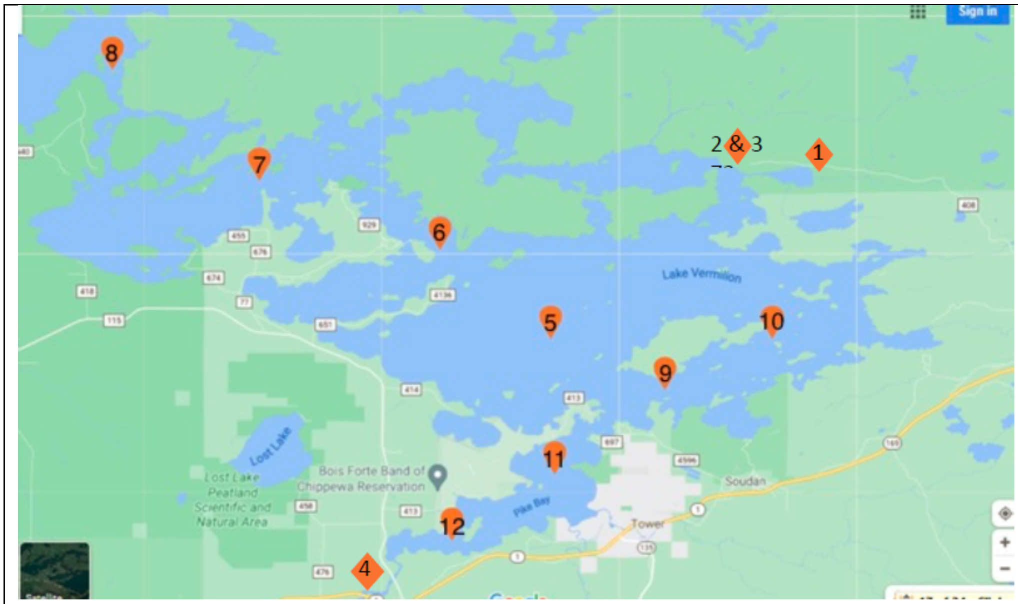

Figure 3. Sampling locations

2. **Sampling Methodology**. Samples were collected by Sue Okerstrom and Lucy Okerstrom at the water surface by immersing inverted sample bottles to 10 to 20 cm depth and turning over to fill. GPS coordinates were recorded at the time of sample collection using a GPS enabled smartphone and a screenshot was taken showing GPS coordinates, cell phone signal strength and time. Sample containers were either new polypropylene or new

polyethylene terephthalate bottles. After collecting, samples were stored between 4 C and 8 C in a secure location in the custody of persons personally known to the sample collectors including transportation to the lab where sulfate analyses were performed. Samples were analyzed within 28 days of collection and upon logging into the analytical lab, sample temperatures were confirmed to be between 2 C and 8 C.) Sample collectors were trained in proper sample collection including location mapping, bottle filling method, acceptable sample bottles, data collection, sample storage, and proper chain of custody.

3. **Sample Analysis.** Samples were analyzed by RMB Environmental Laboratories, Inc. 22796 Co Hwy 6, Detroit Lakes, MN 56501

   Sulfate concentrations were determined as sulfate using EPA METHOD 300.0 DETERMINATION OF INORGANIC ANIONS BY ION CHROMATOGRAPHY within 28 days of sample collection. The limit of quantification (LOQ) for the chromatographic method was less than 1 mg/L.

Results

Sulfate concentrations in mg/L are shown in Table 2. A map showing sample collection locations and sulfate concentrations is shown as Figure 4.

Table 2: Sulfate concentrations

site	site description	lake ID number	date collected	latitude	longitude	sulfate, mg/L
1	Rice Bay	69-0378-01	6/3/2021	47.89389	-92.21750	3.4
2	Glenwood Lodge	69-0378-01	6/3/2021	47.89333	-92.24194	9.8
3	Glenwood Lodge	69-0378-01	6/3/2021	47.89333	-92.24139	9.7
4	Under Pike River bridge		6/3/2021	47.79167	-92.36806	27.7
5	Middle of big bay	69-0378-01	6/3/2021	47.85361	-92.31444	11.8
6	Between Isle of Pines and Pine Island	69-0378-01	6/3/2021	47.87333	-92.35000	11.7
7	Between Fectos Point and Black Duck Island	69-0378-00	6/3/2021	47.89083	-92.41611	9.2
8	Next to Oak Island	69-0378-02	6/3/2021	47.91889	-92.47083	8.7
9	Near Ely Island	69-0378-01	6/3/2021	47.83889	-92.26806	12.4
10	Near Ely Island	69-0378-01	6/3/2021	47.85278	-92.22667	11.7
11	Between Whiskey Island and Hoodoo Point	69-0378-03	6/3/2021	47.81806	-92.30722	17.1
12	In front of Duffy Island	69-0378-03	6/3/2021	47.80500	-92.34278	20.2

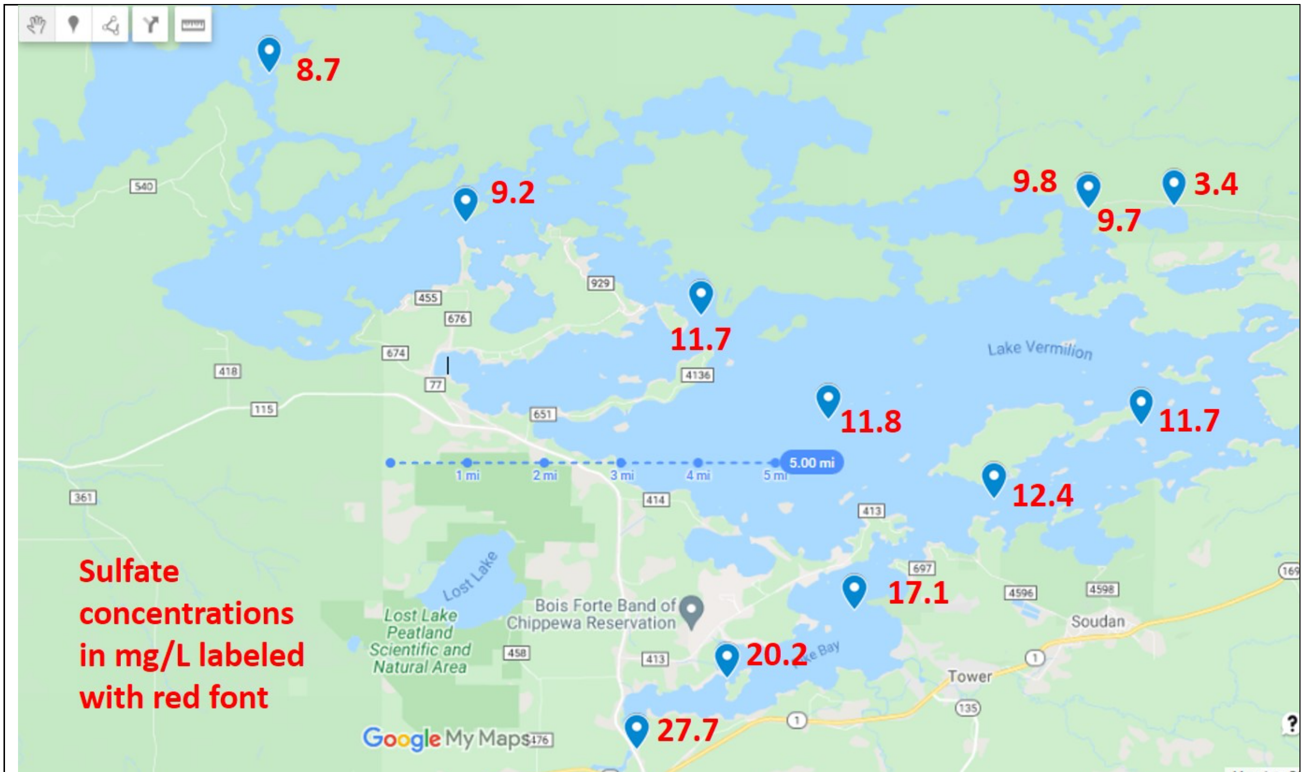

Figure 4. Sampling locations and sulfate concentrations of surface water grab samples. Sulfate concentrations in mg/L are depicted with red font for the blue pin location markers.

Conclusions

Sulfate ion concentrations in Lake Vermilion are significantly increased by sulfate pollution entering from the Pike River. In the absence of mine pollution, sulfate concentrations under 2 mg/L would be expected based on comparison to nearby unimpacted lakes. Sulfate concentrations in most of the lake are above the wild rice sulfate standard value of 10 mg/L. In Lake Vermilion, water moves from the mouth of the Pike River at the southernmost extremity of the lake and exits flowing north over the Vermilion Dam into the Vermilion River, with additional flow originating from several bays including Black, Wakemup, Rice, Armstrong, and Mud Creek Bay. The concentration of sulfate drops between Pike Bay and the Vermilion Dam due to the flow contribution of unimpacted water entering from bays other than Pike Bay.

Contributors

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Technical Memorandum

To: Craig Hartmann, Cliffs Erie
From: Kevin Menken and Rachel Walker, Barr Engineering
Subject: Wild Rice Literature Review and 2011 Field Survey for the Dunka Mining Area
Date: December 20, 2011
Project: 23/69-1241

Introduction

The Minnesota Pollution Control Agency (MPCA) sent an email to Cliffs Erie (Attachment A - dated March 16, 2011) requesting that a literature review and field survey be carried out with respect to the presence of wild rice (*Zizania palustris* L.) on water bodies identified as receiving waters downstream of the Dunka Mining Area. The following water bodies were listed in the MPCA email:

1) Unnamed Creek;
2) Billiken Creek;
3) Flamingo Creek;
4) Dunka River (downstream of SD001); and
5) Birch Lake (from Dunka River to Bob's Bay)

These water bodies (shown on Figure 1) make up the Study Area for the literature review and field survey described in this memorandum. The work was conducted by Barr on behalf of Cliffs Erie.

Wild Rice Literature Review

Barr reviewed publicly available documents containing information on the presence and absence of wild rice. Minnesota Department of Natural Resources (DNR) files and reports related to the Study Area waters are stored at the DNR offices in Tower, Minnesota. Other reports and resources (published by various agencies and organizations) that were reviewed for this evaluation were downloaded from digital or internet sources. Birch Lake was the only water body in the Study Area with a presence of wild rice documented in the literature. Information pertaining to wild rice in the Study Area that was obtained from the literature review is described below.

Literature Review Findings: DNR Lake/Stream Survey Files

Each DNR Fisheries Office maintains files on select surface waters within its management zone. All water bodies in the Study Area are within the management zone of the DNR office in Tower, Minnesota. The following is a summary of the documentation reviewed from each water body's file.

Unnamed Creek

Several files for waters named "Unnamed Creek" were observed, and one was close to or within the Study Area, based on Public Land Survey description. None of the files contained references to wild rice.

Billiken Creek

No files were located for Billiken Creek.

Flamingo Creek

No files were located for Flamingo Creek.

Dunka River

A file for Dunka River was located in the DNR Fisheries Office. The file contained a Lake Survey Summary, dated June 17, 1968. The aquatic vegetation of the lake was included in the summary; wild rice was not among the listed species.

Birch Lake

A file for Birch Lake was located in the DNR Fisheries Office, with numerous records dating back to 1954.

> Aquatic vegetation was documented in a 1954 Lake Survey Report, but no observations of wild rice were recorded. The 1954 report indicates a sulfate concentration of "0.0 p.p.m" and notes that "Birch Lake is a soft water lake of moderate fertility. It is low in phosphorus and suphates [sic] are lacking."
>
> The 1975 Lake Survey Report indicated that emergent vegetation covered less than one percent of the lake, in "scattered spots around the shoreline [in] shallow bays protected from wind action". Wild rice was observed during the 1975 survey and was given a

rating of “rare,” although the report recorded “substantial wild rice beds in the lower part of Birch River.” [Birch River flows into Birch Lake from the west].

In 1997, the DNR completed 50 vegetation transects along the Birch Lake shoreline. Of the 28 transects that contained vegetation, wild rice was listed as “rare” in nine, and “abundant” in two. Values for “maximum vegetation depth” range from one to four feet for those eleven transects. Shoalwater substrate information was also collected in 1997 and indicated that substrates around the lake were composed mostly of bedrock, boulders, and rubble. The only readily observable pattern was that the substrates of the two transects containing abundant wild rice had abundant muck. Field notes indicate that “wild rice continues to increase in abundance.” A review of the field maps indicated that the rice occurred primarily in the farthest reaches of the bays.

The 2004, 2006, and 2009 Standard Lake Survey Reports do not record rice in the text of the report, but note that “Aquatic vegetation grows to a depth of 5 feet and is sparse, with small clusters in protected bays; water lilies, various pondweeds, and floating-leaf burreeds are the most common plants.” Birch Lake ranks as mesotrophic-to-eutrophic according to Carson’s Trophic State Index.

Literature Review Findings: Regional Resource Documents

Wild rice investigational reports with regional or statewide significance were also reviewed. Many of the documents reviewed did not contain any information about wild rice within the Study Area. Information pertaining to wild rice from the reviewed reports is included below. The following documents were reviewed:

Investigational Report #22. Moyle. 1941. *Report on Minnesota Wild Rice for 1940*. Bureau of Fisheries Research, Division of Game and Fish

None of the Study Area waters were listed in this report as a wild rice resource.

Investigational Report #40. Moyle. 1942. *The 1941 Minnesota Wild Rice Crop*. Bureau of Fisheries Research Division of Game and Fish

Birch Lake is listed as a wild rice resource, but no information is given on acreage, density, or other population and/or growth parameters.

2008 Natural Wild Rice in Minnesota Report – DNR

Birch Lake is listed as a wild rice resource, with an estimated wild rice coverage of 381 acres.

2009 Wild Rice Resource Guide (3rd Ed.) – 1854 Treaty Authority.

Of the Study Area waters, only Birch Lake was listed. It was noted as having easy access and a "good" potential for wild rice.

2010 Wild Rice Management Workgroup's "350 Significant Wild Rice Waters in Minnesota"

Of the Study Area waters, only Birch Lake was listed. It was noted as having easy access, low harvesting pressure, and good harvest potential.

2011 Wild Rice Field Survey

A field survey was conducted by Barr Engineering in August of 2011. No wild rice was found on the streams within the Study Area. Wild rice was identified at several locations on Birch Lake. Details of the wild rice field survey are below.

Field Survey Methodology

The purpose of the qualitative survey and water quality sampling was to document the presence or absence of wild rice and its relative stand density, as well as collect surface water samples (for sulfate analysis) in or near wild rice stands. The method used was similar to one used by the 1854 Treaty Authority, "Wild Rice Monitoring and Abundance in the 1854 Ceded Territory (1998 – 2008)" and other vegetation plot data surveys designed to quantify *in situ* plant species (e.g., *A Handbook for Collecting Vegetation Plot Data in Minnesota: The Relevé Method* (Minnesota Department of Natural Resources, 2007)).

Where wild rice was encountered, field crews recorded the GPS location, took photographs, and documented the location and a brief description of the wild rice stand. Dominant vegetation was noted along water bodies surveyed; Attachment B provides a list of common names for the scientific names included in this memorandum. Surface water samples were collected at select locations where wild rice was observed. Water samples were sent to Pace Analytical Laboratory in Virginia, Minnesota and analyzed for sulfate (SO_4^{2-}).

A wild rice density rating, on a scale of 1 to 5, was applied to each observation of wild rice. The density rating is used to qualitatively assess the density of wild rice over a given area and relates to the approximate percent coverage of wild rice as listed in Table 1 and shown by example in the photos included in Attachment C. As discussed above, a similar method was used by the 1854 Treaty Authority. The 1854 Treaty Authority only surveyed known wild rice water bodies and did not include reconnaissance of small stream systems.

Table 1: Wild Rice Density Scale

Wild Rice Density Rating	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

For the 2011 field survey described in this memorandum, an initial evaluation of the Study Area water bodies was conducted by reviewing aerial photographs to identify access points and potential property issues. Aerial photographs were also used to get a preliminary understanding of stream conditions prior to the field visit, to corroborate what was seen in the field during the field visit, and to evaluate and document channel conditions along stream stretches that were not accessed by foot or kayak. The Birch Lake shoreline within the Study Area was surveyed by canoe. Where accessible, every stream section in the Study Area was surveyed by kayak or on foot. Some of the stream reaches were unnavigable by kayak or not accessed by foot due to the physical characteristics of the habitat. The habitat characteristics that limited physical access to certain stream sections included:

- Very low water levels (depths less than 1 foot)
- Predominantly rocky or sandy substrate

- Narrow channel conditions with little to no open water (often due to thick vegetation growth (*Typha* spp., *Phalaris arundinacea*, *Calamagrostis canadensis*, etc.) or channel morphology)
- Dense algal growth
- Dense overhanging vegetation
- The presence of forest species such as *Alnus* spp., *Fraxinus nigra, Betula* spp., *Picea mariana*, and *Populus tremuloides*

These habitat characteristics that limited physical access are also characteristics that limit the suitability of habitat for wild rice growth. Wild rice typically grows in open water with direct sunlight. Other conditions that favor wild rice growth include some flowing water (water bodies with an inlet and an outlet), water depths ranging from 1 to 4 feet, and predominantly mucky substrate. Stream reaches that were unnavigable by kayak or not accessed by foot were surveyed by consulting aerial photographs and by observing stream conditions from the nearest accessible points on the stream.

The field survey was conducted between August 15 and August 22, 2011. The method of survey and descriptions of each water body's channel characteristics are described below.

Wild Rice Survey Findings

After surveying approximately 7 miles of streams and 9 miles of shoreline within the Study Area, wild rice was found in two bays and along some shoreline of Birch Lake. Observations from the wild rice survey of each water body are described below and shown on Figures 2 and 3. Photographs of the Study Area are included as Attachment D.

Water Bodies Where Wild Rice Was Observed

Birch Lake – Surveyed 8/15/11 to 8/20/11

The southern shore of Birch Lake was reviewed using aerial photographs and was surveyed by canoe from Bob's Bay (Mile 23) to the bay at the outlet of Dunka River (Mile 33). Each occurrence of wild rice is listed in Table 2 and shown on Figure 3 (provided with a reference location (RL) label). Data collected at these locations include approximate stand dimensions, density rating, and the approximate number of plants (for one very small stand where an approximation was possible). Stands were generally located near the shoreline and in water approximately 1 to 3 feet deep. Stand sizes ranged from approximately

0.001 to 6.5 acres. *Potamogeton* spp. was identified growing in RL17 and RL18, comprising approximately 40% of the vegetation present in those stands. Other plant species growing near or within wild rice stands included *Sparganium* spp., *Calamogrostis canadensis, Scirpus* spp., *Tyhpa* spp., *Carex* spp. The shore was dominated by dense forest species.

Table 2: Wild Rice Stand Summary of Birch Lake

Wild Rice Observation Point	Wild Rice Stand Size (acres)	Wild Rice Stand Density
RL1	0.58	1
RL2	0.19	1
RL3	0.09	1
RL4	1.17	3
RL5	0.18	1
RL6	1.24	1
RL7	0.15	2
RL8	0.12	3
RL9	0.03	2
RL10	1.07	3
RL11	0.01	1, <20 stems
RL12	0.06	3
RL13	0.27	2
RL14	1.94	1
RL15	0.001	2
RL16	4.59	2
RL17	2.59	3
RL18	6.55	3

Sulfate concentrations in water samples collected from Birch Lake during the 2011 survey (Table 3) ranged from 7.34 to 23.6 mg/L. Sulfate concentrations are listed on Figure 2 at the locations where samples were collected.

Table 3: Birch Lake Sulfate Concentrations

Sample ID	Wild Rice Observation Point	Date Collected	Sulfate Concentration (mg/L)
TM-BIR-KSW-01	RL4	8/15/11	19.4
TM-BIR-RMK-04	RL17	8/17/11	21.0
TM-BIR-RMK-05	RL18	8/17/11	23.6
TM-BIR-JDS-05	RL12	8/18/11	7.34

Water Bodies Where Wild Rice Was Not Observed

Billiken Creek – Surveyed 8/22/11

No wild rice was observed. Billiken Creek was surveyed from Mile 0.0 to its confluence with Unnamed Creek. As discussed in the Methodology section, all creek sections were initially reviewed by consulting aerial photographs. Multiple beaver dams and large wetland complexes were present in portions of the creek reach. Water levels appeared low at the time of the survey, based on water marks lining rocks and channel vegetation. No areas of suitable wild rice habitat were identified in this creek.

Mile 0.0 to Mile 0.25 was surveyed while walking (and dragging the kayak) in the creek channel or alongside the channel. The channel was initially dominated by a dense stand of *Typha* spp. and then transitioned to an open area with a wet, exposed, mucky substrate. Little or no surface water was present in the *Typha* spp. stand. There was up to 6 inches of water in the creek channel in the open area. Channel vegetation was initially dominated by *Typha* spp. and transitioned to a mix of *Typha* spp., *Carex* spp. and *Calamogrostis canadensis*.

Mile 0.25 to Mile 0.42 was surveyed by kayak through open water ponded behind a large beaver dam. The creek channel in this area was submerged and the width of the beaver pond was approximately 300 feet, with a water depth up to approximately 4 feet. There was no vegetation in the open water area. Along the shoreline, there was either an exposed mucky substrate or rocky ledges and boulders. Vegetation was sparse along the shoreline, with some scattered *Carex* spp. present.

Mile 0.42 to Mile 0.68 was surveyed by walking (and dragging the kayak) in the creek channel or alongside the creek channel and small ponds. There were small ponds of open water at the beginning and end of this reach, with water depths up to 2 feet. These ponds were generally too shallow to navigate with a kayak. Between these ponds the stream channel was located within dense stands of either *Typha* spp., *Calamogrostis canadensis* or *Alnus* spp. The transition area between these dense stands was generally a mix of *Typha* spp., *Carex* spp. and *Calamogrostis canadensis*. The soil was saturated but little or no surface water was present, except in the two small ponded areas.

Mile 0.68 to the confluence with Unnamed Creek at Mile 0.76 was surveyed by kayak. The channel was submerged by water that was ponded behind a large beaver dam located on Unnamed Creek downstream of the confluence. Water depths in this area were 3 to 4 feet. Dead *Alnus* spp., *Picea mariana* and *Larix laricina* were found throughout this reach, with *Lemna* spp. found on the water surface along the shoreline. The shoreline was either exposed mucky substrate or rocks, with scattered *Carex* spp. present.

Unnamed Creek – Surveyed 8/22/11

No wild rice was observed. Unnamed Creek was surveyed from Mile 0.0 to its outlet at Bob's Bay. As discussed in the Methodology section, all creek sections were initially reviewed by consulting aerial photographs. Multiple intact beaver dams and large wetland complexes were present along most of the creek reach. No areas of suitable wild rice habitat were identified in this creek.

Mile 0.0 to 0.2 was surveyed by kayak in open water ponded behind a large beaver dam . The creek channel in this area was submerged and the width of the beaver pond was approximately 350 feet. The water depth ranged from 2 to 6 feet. Dead coniferous trees were present in the water, within 50 feet of the shoreline. The shoreline was dominated by either dense stands of *Typha* spp. or a mix of *Typha* spp. and *Calamogrostis canadensis.*

Mile 0.2 to 0.7 was surveyed by walking along the beaver dam at Mile 0.2, by visual observations while standing on a ridge overlooking the creek at Mile 0.25, and by visual observations at Mile 0.7. At Mile 0.2, the channel was not readily visible because it was located within a wetland complex dominated by a dense stand of *Typha* spp. and *Calamogrostis canadensis*, with scattered mature *Larix laricina* and *Picea mariana* trees also present. This wetland complex had soft mucky substrates with 4 to 6 inches of water visible at the surface. The ground was too soft to safely walk through the wetland and there was not enough open water to kayak. Therefore, observations were conducted on a ridge that overlooked the wetland complex at Mile 0.25. The creek channel was not visible and the wetland was completely covered with herbaceous vegetation and scattered small coniferous trees, with mature coniferous forest observed at the wetland edge. No open water was visible.

Mile 0.7 to 1.0 was accessed by kayaking from Billiken Creek to the beaver dam at Mile 1.0 on Unnamed Creek, and then walking upstream along the edge of a wetland complex. The creek channel is located within a large wetland complex from Mile 0.7 to Mile 0.9 that was characterized by dense stands of *Calamogrostis canadensis, Scirpus cyperinus* and *Sparganium* spp. in the center, with *Alnus* spp., *Larix laricina and Picea mariana* at the edges. The channel was not visible. The soil in this area was saturated, but no surface water was observed. From Mile 0.9 to 1.0 there was a small open water area ponded behind a beaver dam. Scattered *Sparganium* spp. was observed in the ponded area, with dense stands of *Calamogrostis canadensis, Scirpus cyperinus* and *Sparganium* spp. found outside of the ponded area.

Mile 1.0 to 1.4 was surveyed by kayaking through open water and dragging the kayaks over multiple beaver dams. Water ponded behind the beaver dams was 2 to 5 feet deep. The ponds were up to 200 feet in width. Dead *Alnus* spp.was found throughout these ponded areas with scattered dead *Picea mariana* and *Larix laricina* also observed. In some areas, the surface of the water was either covered with 1 to 3 inches of Lemna spp. or the water was covered by dense mats of aquatic vegetation. The shoreline of the ponded areas was generally rocky. Vegetation along the shoreline included *Calamogrostis canadensis*, *Alnus* spp., and conifers, which shaded the edge of the water.

Mile 1.4 to Mile 1.7 was surveyed by walking (and dragging the kayaks). The creek narrowed at Mile 1.4 to a width of 2 to 3 feet, with meanders that were too sharp to navigate in a kayak. The channel was entrenched up to 6 feet and located within a wide wetland complex. The water depth ranged from 1 to 3 feet. The water surface was covered by *Lemna* spp. in some areas. The wetland was characterized by hummocks and dominated by *Calamogrostis canadensis* with *Alnus* spp., *Picea mariana* and *Larix laricina* also present. Vegetation in the creek channel included *Scirpus* spp. and *Sparganium* spp. The water in the channel was generally shaded by the overhanging vegetation.

Mile 1.7 to Bob's Bay was reviewed by visual observations from the road at Mile 1.7, kayaking on Bob's Bay to the mouth of Unnamed Creek, and using aerial photographs. At Mile 1.7, the channel entered into a dense *Alnus* spp. and *Picea mariana* wetland with no visible surface water. This wetland also had a closed canopy, which is not conducive for the growth of wild rice (which typically grows in open water with direct sunlight). Visual observations were conducted at the mouth of Unnamed Creek by kayaking through Bob's Bay. At the mouth, the channel was obstructed by downed trees and woody debris. As at Mile 1.7, there was a dense canopy shading the channel that included *Alnus* spp. and mature coniferous trees. Aerial photographs were used to confirm that a dense canopy was present from Mile 1.7 to Bob's Bay.

Flamingo Creek – Surveyed 8/22/11

No wild rice was observed. Flamingo Creek was surveyed from Mile 0.0 to its outlet in Bob's Bay. As discussed in the Methodology section, all creek sections were initially reviewed by consulting aerial photographs. No areas of suitable wild rice habitat were identified in this creek.

Mile 0.0 to 0.3 was analyzed by visual observation from an overlook above Mile 0.0 and an overlook at Mile 0.3. There is no defined creek channel or observed surface water flow in this reach. The creek is located within a 200-foot wide wetland complex from Mile 0.00 to Mile 0.25, with small shallow, open water areas. The wetland is dominated by a dense stand of *Typha* spp. with some areas of *Alnus* spp. The dominant tree species along the edge of the wetland included *Populus tremuloides* and other deciduous trees.

Mile 0.3 to Mile 0.4 was surveyed while walking in the creek channel or alongside the channel. The channel was located within a wetland complex that was up to 280 feet wide. The creek channel was located within a large wetland complex that was characterized by dense stands of *Calamogrostis canadensis, Scirpus* spp. and *Sparganium* spp. in the center, with *Alnus* spp., *Larix laricina and Picea mariana* at the edges. The surface water in the wetland was approximately 6 to 12 inches deep. At Mile 4.0 there was a small pond surrounded by *Typha* spp., with floating mats of aquatic vegetation covering nearly 75 percent of the pond.

Mile 0.4 to 0.53 was surveyed while walking in the creek channel or alongside the channel. The creek narrowed at Mile 0.4 to a width of 1 to 2 feet and the water depth was approximately 6 inches. The channel was entrenched up to 2 feet, with a mucky substrate. The creek channel was located within a forested wetland area that was 50 to 100 feet wide. The vegetation shading the creek channel included *Alnus* spp., mature deciduous trees and *Calamogrostis canadensis*. On both sides of the road that crosses this reach at about Mile 0.51, there were small open water areas that were shaded by *Alnus* spp. Beyond the pond on the west side of the road, the creek channel was located within a wetland dominated by *Alnus* spp. The creek channel was dry and completely shaded by the vegetation.

Mile 0.53 to Mile 0.75 was surveyed while walking in the creek channel or alongside the channel. The creek channel transitioned from the *Alnus* spp.-dominated wetland into a dense stand of *Typha* spp, and then into a dense stand of *Scirpus cyperinus*. The water in the creek channel in the *Typha* spp. area was 3 to 6 inches deep. Just downstream of the *Scirpus cyperinus* area, the creek channel continued into a small ponded area located behind a beaver dam. The pond had a mucky substrate and the water depth was approximately 1 to 2 feet. Vegetation around the edge of the pond included *Scirpus cyperinus*, *Typha* spp., *Sparganium* spp. and *Calamogrostis canadensis.* Downstream of the beaver dam, the creek channel was not well defined, making it difficult to determine where the channel was located in the forested area. While there was not a well-defined channel, the topography and aerial photographs indicated the creek continued to the northeast into a forested area. The forested area had a dense canopy which is not conducive for the growth of wild rice (which typically grows in open water with direct sunlight).

Mile 0.75 to Bob's Bay was analyzed by visual observations at Mile 0.75, by kayaking on Bob's Bay to the mouth of Flamingo Creek, and using aerial photographs. At Mile 0.75, the creek entered into a dense forest with no defined channel and no visible surface water. Visual observations were conducted at the mouth of Flamingo Creek by kayaking across Bob's Bay. There was not an obvious creek channel along the shoreline where the aerial photographs indicated the mouth was located. Along the shoreline, there was a dense canopy shading the channel that included *Alnus* spp. and mature coniferous trees. Aerial photographs were used to confirm that a dense canopy was present from Mile 0.75 to Bob's Bay.

Dunka River – Surveyed 8/20/11

No wild rice was observed. As discussed in the Methodology section, all creek sections were initially reviewed by consulting aerial photographs. Surveying began at SD001, near Mile 0.5.

Mile 0.5 to approximately Mile 0.8 was surveyed by kayak. At Mile 0.5, the river channel passes through two large culverts. East of the culverts, the stream channel ranged from 30 to 40 feet in width. At approximately Mile 0.55, a trail crossed the channel where the substrate was comprised of shifting, fine sand and the stream was 4 to 6 inches deep. Signs of ATV traffic were present in the area and included tracks in the stream channel and trails on the shoreline. West of the trail crossing, the river channel was 2 to 5 feet deep with a mucky substrate. Vegetation along the channel included *Alnus* spp., *Chamaedaphne calyculata* and *Populus tremuloides.* The banks of the river generally had boulders on the shoreline with vegetation overhanging the river. Vegetation observed in the shallow water along the banks included *Sparganium* spp. and *Calamogrostis canadensis*.

The stream reaches from Mile 0.8 to approximately Mile 2.3 and Mile 2.4 to the outlet at Dunka Bay were not surveyed by kayak or foot. Based on review of aerial photographs and past surveys conducted on foot along this reach (surveyed in 2009), these channel stretches were comprised of continuous rocky and sandy substrate, several sets of rapids, dense overhanging vegetation along the shore, and water depths ranging from 4 to 6 inches. No areas of suitable wild rice habitat were identified in these stream reaches in previous surveys or on aerial photographs.

Mile 2.3 to 2.4 was accessed via a transmission line corridor and surveyed by foot. The width of the river along this reach ranged from 20 to 120 feet. Water depths ranged from approximately 6 inches to 4 feet. Dominant vegetation included *Fraxinus nigra*, *Alnus* spp., and *Chamaedaphne calyculata.*

Wild Rice Survey Summary

The wild rice survey for Cliffs Erie consisted of evaluating approximately 7 miles of stream and 9 miles of Birch Lake shoreline (Figure 1), as identified by the MPCA, to document the presence or absence of wild rice in the water bodies. The fieldwork was completed between August 15 and August 22, 2011. Birch Lake was surveyed by canoe, and the streams were surveyed either by foot, by kayak, or by examination of aerial photographs combined with visual observations from the nearest accessible locations.

Wild rice was found with density ratings between 1 and 3 (on a scale of 1 to 5) in Birch Lake (Figures 2 and 3).

Wild rice was not identified along the 7 miles of streams. Channel conditions in the streams, including sections with very low water levels, a narrow stream channel, the presence of overhanging dense vegetation and the presence of forest species such as *Alnus* spp., were generally not conducive to the growth of wild rice. These conditions also made portions of the streams difficult to navigate by kayak or on foot.

Figures

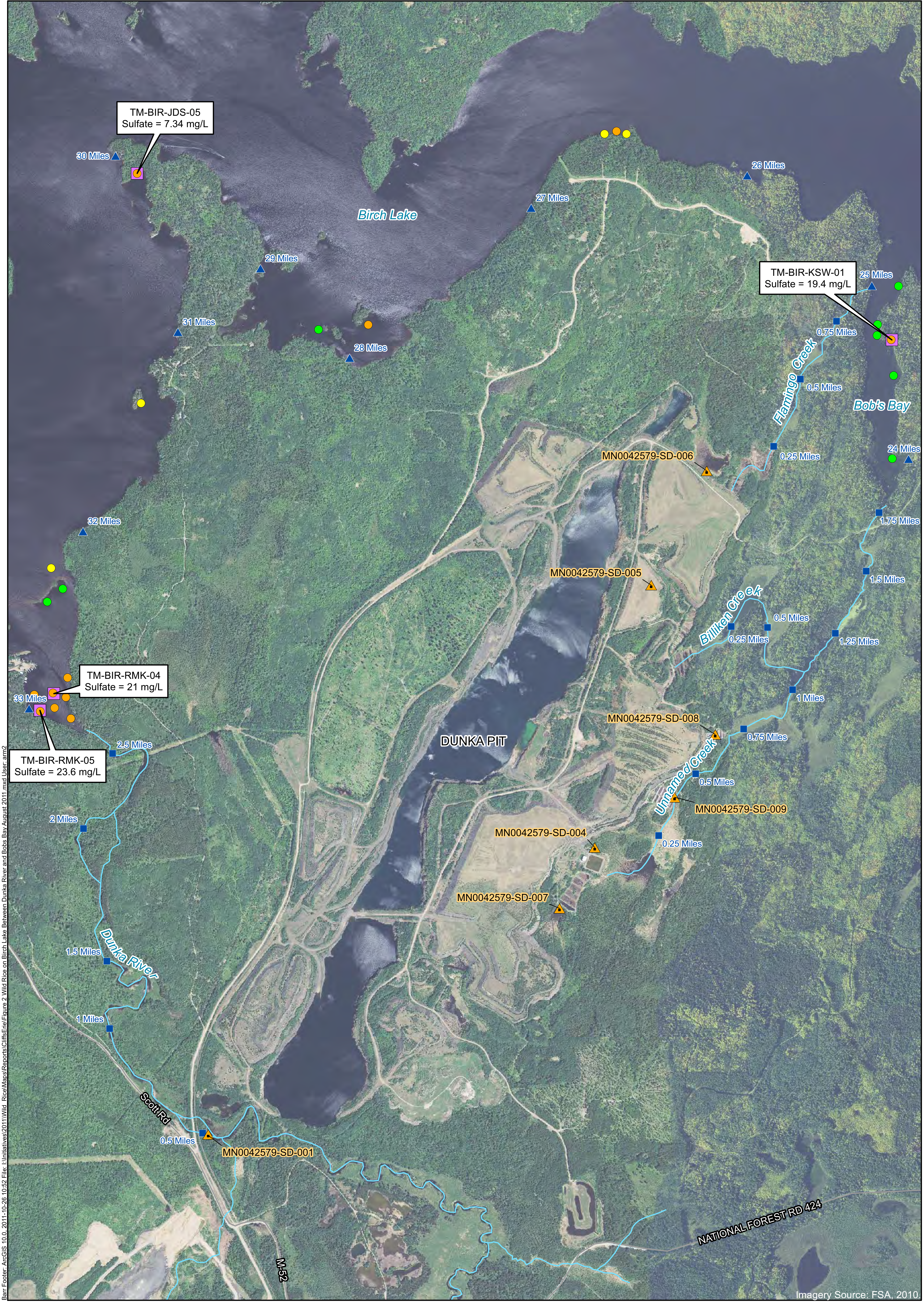
Wild Rice WQLS, Exhibit D

▲	NPDES Water Quality Monitoring Station for Cliffs Erie
▲	Mile Markers - Birch Lake
■	Mile Markers - Rivers & Streams
—	Stream and Shoreline Segments Surveyed in 2011
~	Other Rivers & Streams

0 800 1,600 3,200

Feet

Figure 1
2011 WILD RICE STUDY AREA
Cliffs Erie - Dunka
St. Louis County, MN

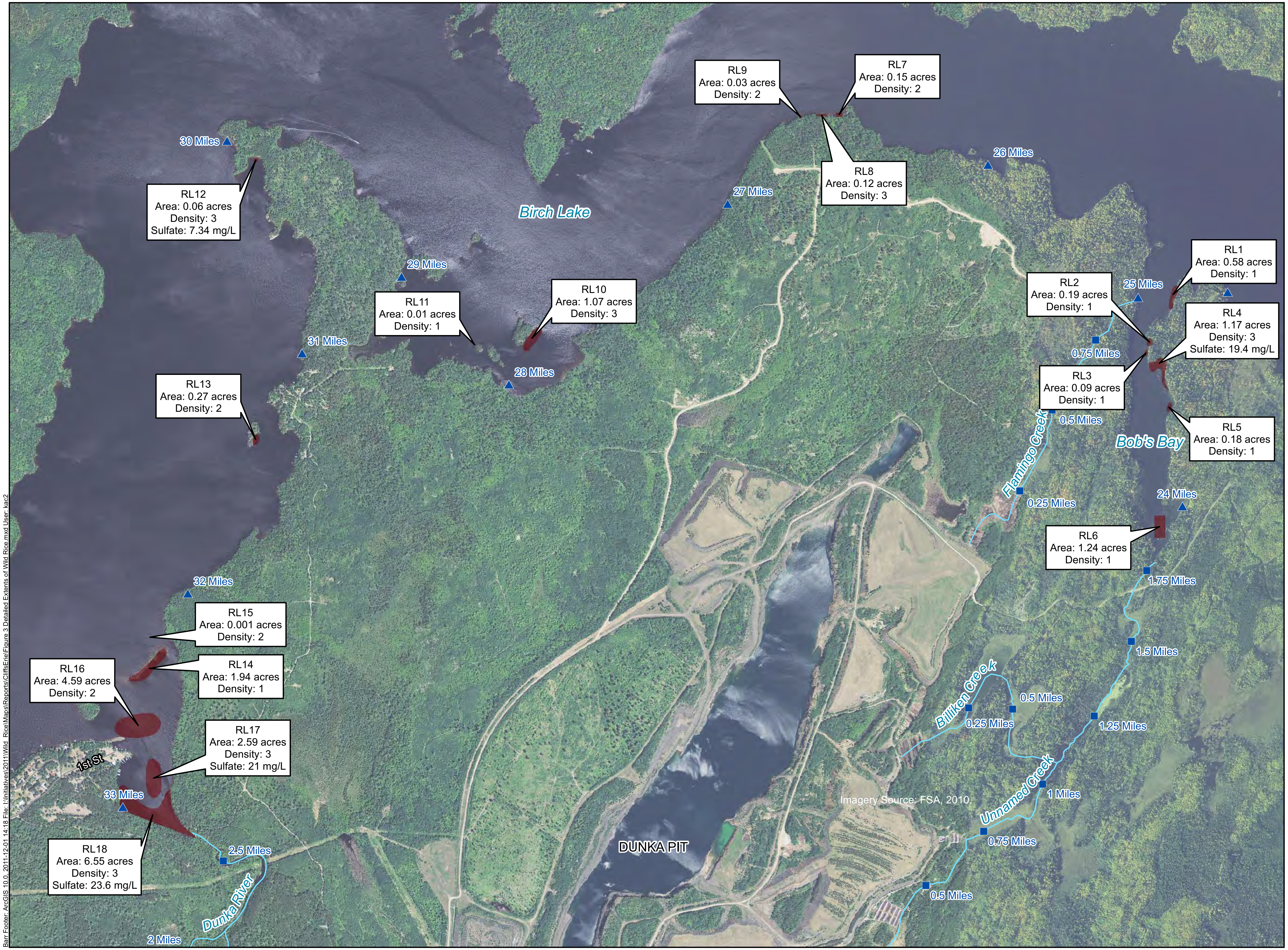


Wild Rice Density
- 🟢 1 <10% Wild Rice Coverage
- 🟡 2 10-25% Wild Rice Coverage
- 🟠 3 25-50% Wild Rice Coverage
- 🔴 4 50-75% Wild Rice Coverage
- ● 5 >75% Wild Rice Coverage
- ▲ Mile Markers - Birch Lake
- ■ Mile Markers - Rivers & Streams

- ▲ NPDES Water Quality Monitoring Station for Cliffs Erie
- ■ Water Sampling Locations
- — Rivers & Streams

Figure 2
WILD RICE OBSERVED IN STUDY AREA
AUGUST 2011
Cliffs Erie - Dunka
St. Louis County, MN

Wild Rice WQLS, Exhibit D



- Wild Rice Extents
- ▲ Mile Markers - Birch Lake
- ■ Mile Markers - Rivers & Streams
- — Rivers & Streams

N

0 700 1,400 2,800
Feet

Figure 3
DETAILED EXTENTS OF
WILD RICE - AUGUST 2011
Cliffs Erie - Dunka
St. Louis County, MN

Attachment A

MPCA Email to Cliffs Erie (March 16, 2011)

Wild Rice WQLS, Exhibit D

Attachment A - MPCA Email to Cliffs Erie

Hartmann, Craig

From: Handeland, Stephanie (MPCA) [Stephanie.Handeland@state.mn.us]
Sent: Wednesday, March 16, 2011 8:30 AM
To: Hartmann, Craig
Cc: Clark, Richard (MPCA); Foss, Ann (MPCA); Thomas, John (MPCA)
Subject: Request for Information on Wild Rice - Dunka Mining Area (MN0042579)

March 16, 2011

Craig Hartmann, Area Manager
Cliffs Natural Resources
County Road 666 – PO Box 900
Hoyt Lakes, MN 55750

RE: NPDES/SDS Permit No. MN0042579
Cliffs Erie – Dunka Mining Area
Request for Information on Wild Rice

Dear Mr. Hartmann:

The Minnesota Pollution Control Agency (MPCA) is in the process of reissuing the NPDES/SDS permit for the Cliffs Erie – Dunka Mining Area. One of the goals of the MPCA is to protect surface waters used for the production of wild rice. Over the last several months, MPCA staff has been working to develop guidance to help determine, on a case-by-case basis, what waters of the state are "used for the production of wild rice" and subject to the 10 mg/L sulfate standard under Minn. R. 7050.0224, Subp. 2. The discharges from the Dunka site may have impacts to potential wild rice waters downstream of the discharges.

Due to the elevated levels of sulfates in the mine pit dewatering and in the constructed wetland treatment system discharges, the MPCA is requesting the company to conduct a search for wild rice downstream of its discharge points and to gather additional information regarding wild rice downstream of its permitted discharge points. This information will be important for the permitting process to ensure that appropriate water quality standards are applied and to ensure that surface waters, including those used for the production of wild rice, are adequately protected.

We are requesting the company to survey the following receiving waters downstream of the Dunka mining area discharges for the presence of wild rice:

- Unnamed Creek
- Billiken Creek
- Flamingo Creek
- Dunka River (downstream of the SD001 discharge)
- Birch Lake (to the nearest proximity of and/or downstream of the mouths of Dunka River and Unnamed Creek, and in particular including Bob Bay)

The company should provide the following information to the MPCA:

1. A literature search for wild rice in the downstream receiving waters listed above potentially impacted by the discharges. Some data sources that may be used to determine the potential for wild rice impacts include Appendix A of the 2008 DNR Wild Rice Report, the most recent DNR Wild Rice Harvester Survey, and the 1854 Treaty Authority List. For waters listed in the DNR Wild Rice Report, Gary Drotts at 218-833-8620 and Ann Geisen at 218-833-8625 may be contacted to gather all the available Department of Natural Resources (DNR) data on those sites. Information on any active or proposed DNR management activities designed to establish, protect, or enhance the

wild rice resources of these waters would be helpful.

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

3. The results of water quality monitoring for sulfate in the waters potentially impacted by the discharges in which wild rice is found to be present. The company should attempt to collect at least one grab sample in each water where wild rice is found to be present.

The wild rice literature search and field survey work should be conducted in 2011. The company may incorporate results from previous wild rice survey work that may have been done in the recent past as part of its submittal.

We appreciate your cooperation in this matter. If you have any questions regarding this request, please contact me at 651-757-2405 or by e-mail at stephanie.handeland@state.mn.us.

Sincerely,

Stephanie Handeland
Industrial Division
Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, Minnesota 55155
Voice (651) 757-2405 Fax (651) 296-8717
stephanie.handeland@state.mn.us

Attachment B

Scientific and Common Names of Emergent Macrophytes

Attachment B
Vegetation Summary
Wild Rice Survey Report
Cliffs Erie, LLC

Scientific Name	**Common Name**
Alnus spp.	Alder
Betula spp.	Birch
Calamagrostis canadensis	Canada bluejoint
Carex spp.	Sedge
Thuja occidentalis	Northern whitecedar
Chamaedaphne calyculata	Leatherleaf
Fraxinis nigra	Black ash
Larix laricina	Tamarack
Lemna spp.	Duckweed
Picea mariana	Black spruce
Populus tremuloides	Quaking aspen
Potamogeton spp.	Pondweed
Scirpus cyperinus	Woolgrass
Scirpus spp.	Bulrush
Sparganium spp.	Burreed
Sagitarria graminea	Grassy arrowhead
Typha angustifolia	Cattail, narrow-leaved
Typha latifolia	Cattail, broad-leaved

Attachment C

Photographs Depicting Range of Wild Rice Densities

Density Level 1

Density Level 2

Density Level 3

Density Level 4

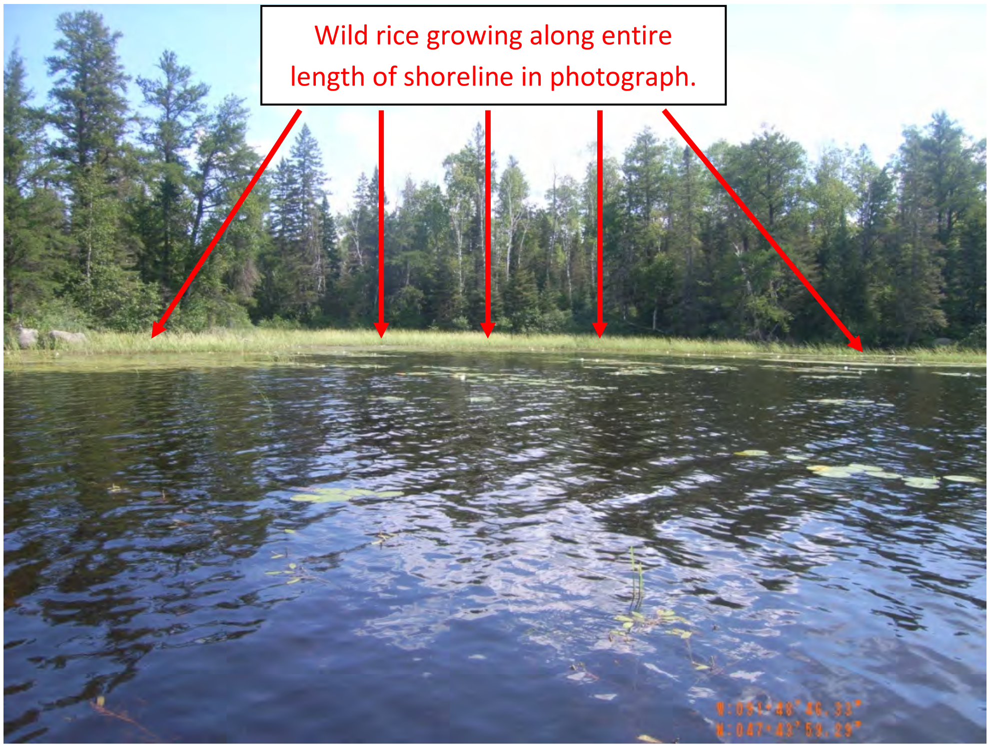
Density Level 5

Attachment C

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

Attachment D

Photographs of Study Area



Birch Lake, Bob's Bay, 8/15/2011, wild rice growing along shoreline. Shoreline vegetation is predominantly wild rice. Photo taken at reference location RL4.

Birch Lake, Bob's Bay, 8/15/2011, wild rice and lily pads. Emergent vegetation is predominantly wild rice. Photo taken at reference location RL4.

Birch Lake, 8/17/2011, wild rice near Dunka River outlet, facing north. Vegetation in photograph is predominantly wild rice. Photo taken at reference location RL18.

Birch Lake, 8/17/2011, wild rice near Dunka River outlet, facing east. Vegetation in photograph is predominantly wild rice. Photo taken at reference location RL18.

Billiken Creek, 8/22/2011, looking northeast towards Mile 0.25 – no wild rice

Billiken Creek, 8/22/2011, near Mile 0.5 – no wild rice

Unnamed Creek, 8/22/2011, between Mile 1.0 and 1.5 – no wild rice

Unnamed Creek, 8/22/2011, north of Mile 1.5 – no wild rice

Flamingo Creek, 8/22/2011, looking north from Mile 0.0 – no wild rice

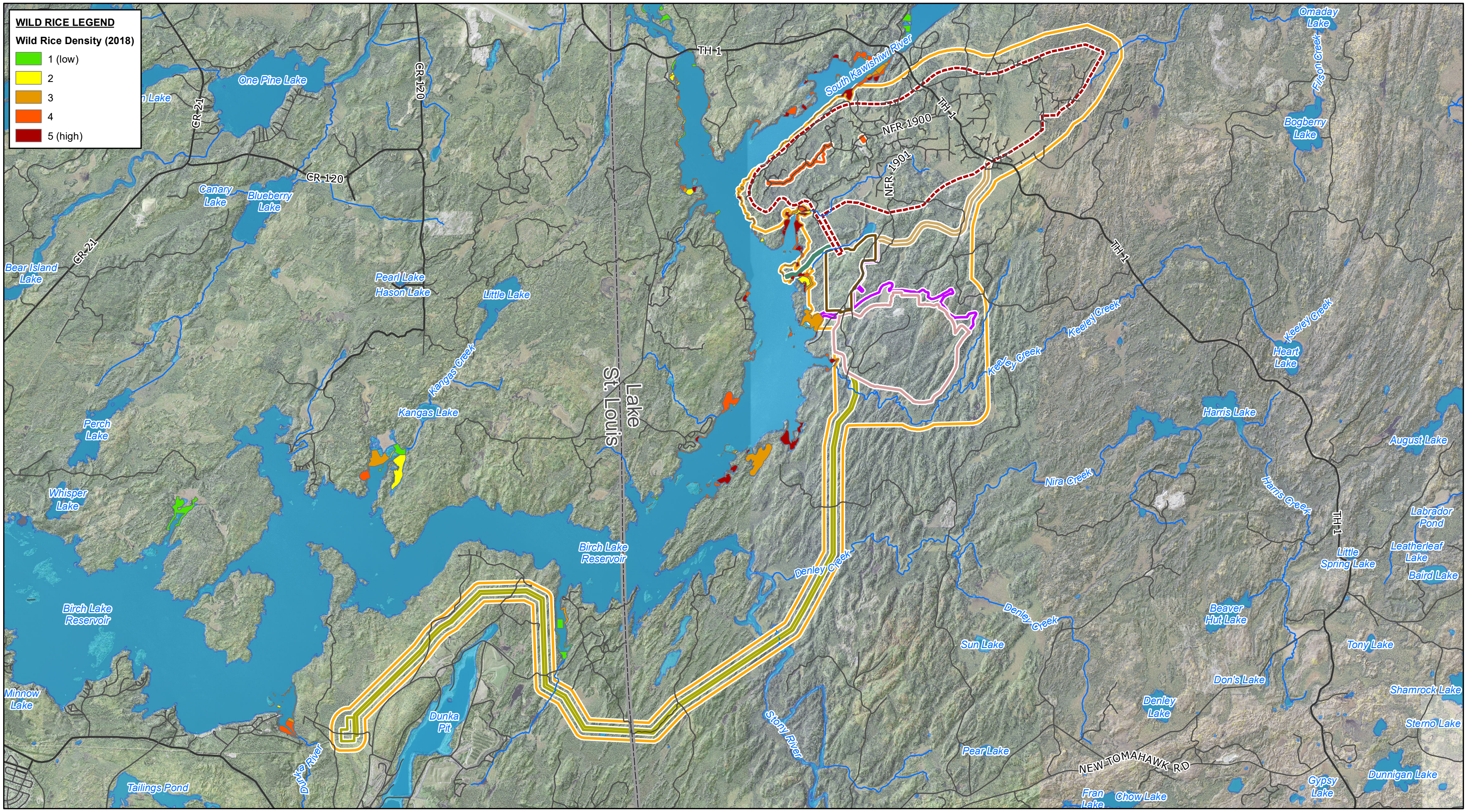
Flamingo Creek, 8/22/2011, looking south just past Mile 0.5 – no wild rice

Dunka River, 8/30/2011, upstream from culverts at Mile 0.5 – no wild rice

Dunka River, 8/30/2011, downstream from culverts at Mile 0.5 – no wild rice

SCOPING ENVIRONMENTAL ASSESSMENT WORKSHEET DATA SUBMITTAL - FIGURES

Wild Rice WQLS, Exhibit E



NOTES:
1. Base air photo from the U.S. Department of AgricultureFarm Service Agency, Aerial Photography Field Office.
2. Hydrographic data from Minnesota Department of Natural Resources.
3. Wild rice survey data from Barr Engineering Co.
4. Horizontal datum based on NAD 1983. Horizontal coordinates based on Minnesota State Plane North (feet).

LEGEND

— Primary Road
— Secondary Road
— River/Stream
▭ Lake/Pond
▭ County Boundary
▭ Project Area
▭ Underground Mine Area
▭ Plant Site
▭ Tailings Management Site
▭ Non-Contact Water Diversion Area
▭ Transmission Corridor
▭ Water Intake Corridor
▭ Ventilation Raises and Ventilation Raise Access Road
▭ Access Road Corridor

TWIN METALS MINNESOTA

Foth

TWIN METALS MINNESOTA

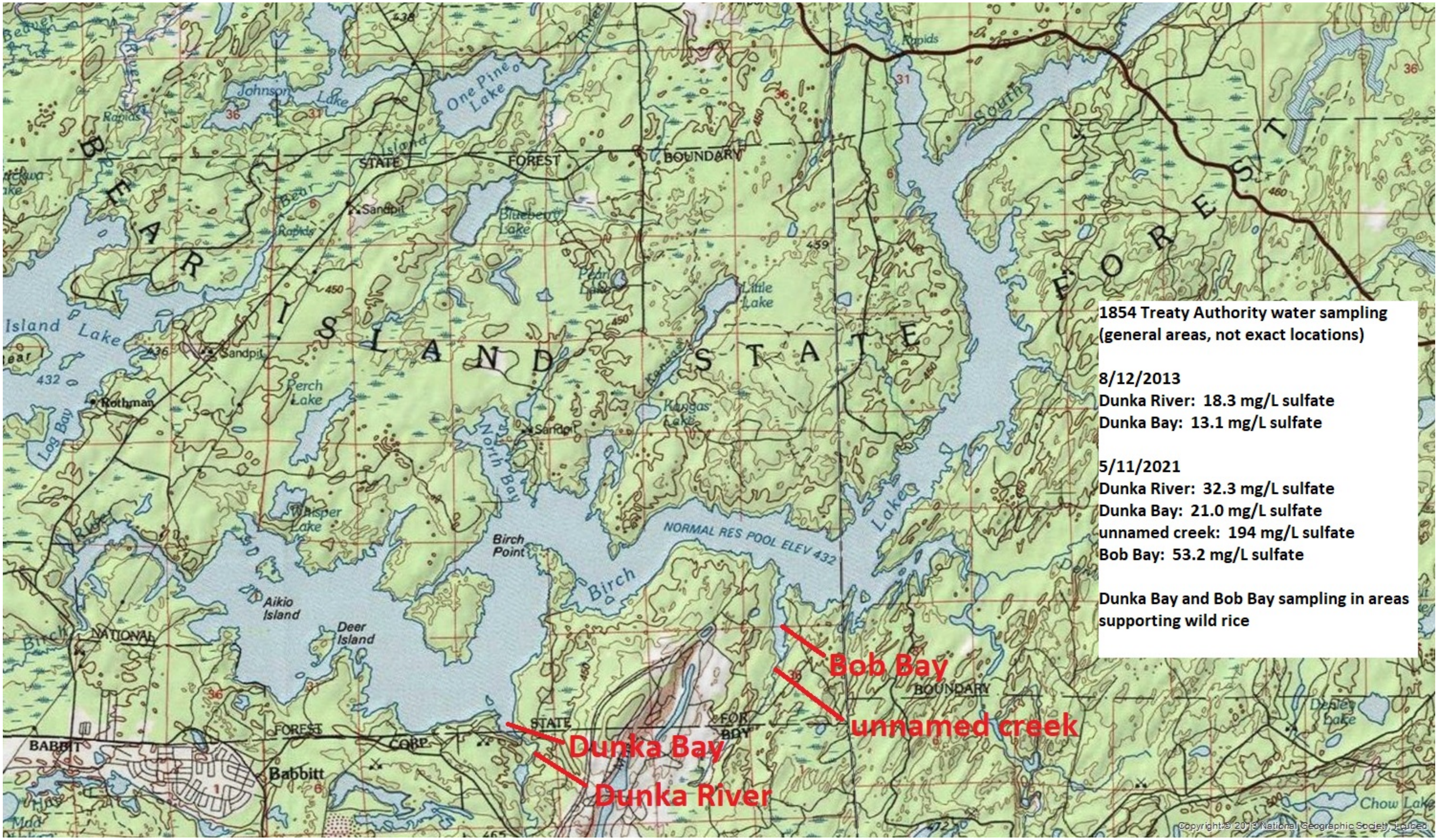
FIGURE 8-7

WILD RICE SURVEYS

Scale: 0 2,500 5,000 Feet

Date: SEPTEMBER 2019

Wild Rice WQLS, Exhibit F



1854 Treaty Authority water sampling (general areas, not exact locations)

8/12/2013
Dunka River: 18.3 mg/L sulfate
Dunka Bay: 13.1 mg/L sulfate

5/11/2021
Dunka River: 32.3 mg/L sulfate
Dunka Bay: 21.0 mg/L sulfate
unnamed creek: 194 mg/L sulfate
Bob Bay: 53.2 mg/L sulfate

Dunka Bay and Bob Bay sampling in areas supporting wild rice

Wild Rice WQLS, Exhibit G

2020-2021 SULFATE SAMPLING EFFORT
for
BIRCH LAKE (69-0003-00)

Prepared by Lisa Pugh
Northeastern Minnesotans for Wilderness

June 28, 2021

Northeastern Minnesotans for Wilderness
P.O. Box 625, Ely, MN 55731 | 218-365-5541
Founder and lead organization of the Campaign to Save the Boundary

nmw
northeastern minnesotans
for wilderness

Table of Contents

1 Executive Summary

Northeastern Minnesotans for Wilderness (NMW) is a 501(c)(3) nonprofit environmental organization founded and incorporated in Minnesota more than 25 years ago by residents in and around Ely, Minnesota and the Boundary Waters Canoe Area Wilderness region. NMW has collected sulfate data from 20 sites in Birch Lake and its tributaries in 2020 and 2021. NMW's sampling, sample handling, and QA/QC methods have followed the MPCA's and EPA's direction for data collection, as instructed by a retired MPCA employee whose agency responsibilities covered water quality monitoring, sample collection and training.

The results of NMW sampling show that sulfate concentrations in the western portion of Birch Lake, including Dunka Bay and Bob Bay, were greater than 10 mg/L. In several sites near to the north and northeast of Bob Bay, sulfate concentrations range from well above to just below 10 mg/L. Sites in the eastern third of Birch Lake show sulfate concentrations generally range from 5 to 8 mg/L.

2 General Information

2.1 Credentials & Training

Lisa Pugh is the monitoring coordinator and data manager for NMW's sulfate data collection project. Lisa has a Bachelor of Science degree in Fisheries, Wildlife, and Conservation Biology from the University of Minnesota. Lisa has 3 years of experience in water quality sampling on Birch Lake. On March 2, 2020, Lisa attended and was certified through the 17th Annual Red River Basin Water Quality Monitoring Training at the University of Minnesota in Crookston. The training was held by the International Water Institute, Red River Watershed Management Board, Minnesota Pollution Control Agency, and RMB Labs. The training and certification included MPCA surface water monitoring Standard Operating Procedures; data gathering and submittal tools; field and laboratory quality control; YSI sonde set-up, calibration, operation, and data collection; as well as field procedures and equipment including sample collection, Van Dorn use, stage measurements, Secchi tube use, Turbidimeter use, field sheet use, and photo documentation.

Lisa was field-trained in sample collection and handling as well as field procedures by subject matter expert Dr. Joe Magner[1] on May 11th and 12th, 2020. Lisa Pugh, Rajan Singh and Noah Greer were trained in sample collection, handling, and field procedures by Dr. U. Singh[2] on August 12th and 13th, 2020. Lisa was trained in sonde maintenance and calibration as well as QA/QC procedures by Bruce Paakh[3] in a series of phone and video calls in May, June, and July 2020. Lisa Pugh trained Levi Lexvold on May 11th, 2021 and Hunter Strubhart on June 15th, 2021 in sample collection and field procedures.[4]

---

[1] Joe Magner, PhD, is a licensed professional hydrologist (WI), a licensed professional soil scientist (MN) and an American Institute of Hydrology registered professional hydrogeologist. He received degrees from the University of Wisconsin-River Falls and the University of Minnesota and has served as an environmental scientist and educator in varying roles for 42 years; primarily with the MN Pollution Control Agency but also advising US federal and local governments, and officials in China, India, Azerbaijan, and South Africa. Dr. Magner is currently a research professor in the Department of Bioproducts & and Biosystems Engineering at the University of Minnesota. He teaches classes and advises students in field methods in hydrology and water quality

[2] U. Singh, PhD, PE, has a Master of Engineering, Agricultural Land and Water Development Program with special emphasis on Water Resources Planning and Management and Irrigation and Drainage Engineering, from the Asian Institute of Technology, Bangkok, Thailand; and an MS and PhD in Civil and Environmental Engineering from Texas Tech University, Lubbock, Texas

[3] Bruce Paakh is a retired MPCA Hydrologist and Liminologist with 34 years of experience in the field of water quality. He was the Red River Basin Monitoring Coordinator with a strong focus on data quality/integrity. Bruce was responsible for designing and implementing numerous monitoring-related programs including basin-wide load monitoring in the Red River Basin, citizen-collected lake productivity data monitoring in MN in over 1000 lakes, and the Red River Basin Annual Monitoring Training Program. Bruce co-authored the MPCA Volunteer Surface Water Monitoring Guide

[4] The 08-13-2020 sampling event occurred under the direction and training of Dr. Singh and all subsequent sample collection was handled directly by Lisa Pugh with Levi Lexvold or Hunter Strubhart assisting in motor boat operation, deployment of Van Dorn and Integrated Sampler, and reading sonde measurements.

2.2 Purpose

In 2020, NMW developed a water quality monitoring plan for the general purpose of documenting the environmental conditions on and near the project site for the Twin Metals Minnesota (TMM) proposed sulfide-ore copper mine south of Ely Minnesota. NMW began collecting additional samples on Birch Lake in May, 2021 in an 11-mile portion of Birch Lake, particularly in the south and western areas of the lake, where publicly available sulfate data are relatively limited, to determine water quality conditions with respect to sulfate.

2.3 NMW Data Collection

Sulfate data was collected in 2020 from a total of three sites on Birch Lake over one sample day. Sulfate data was collected in 2021 at a total of 20 sites on Birch Lake over five sample days. The sample locations range from the west end of the Birch Lake, to in and around Dunka Bay, and east and northward in an approximately 11-mile span of Birch Lake. See Figure 1.

Field sampling for sulfate on Birch Lake occurred on 08-13-2020, 05-11-2021, 06-01-2021, 06-02-2021, 06-07-2021, and 06-15-2021. Water samples were collected in accordance with EPA Surface Water Sampling Procedures, MPCA Volunteer Surface Monitoring Guide Procedures, and RMB Environmental Laboratories, Inc. (RMBEL) online training videos for Integrated Sampler use and maintenance.[5,6,7] Water samples were hand delivered to an accredited laboratory following proper protocols and chain of custody procedures. See sections 2.3.2 and 2.3.3 below.

At each lake site, field measurements were recorded for water temperature, specific conductance, dissolved oxygen, and pH using a YSI 600XL sonde. Sonde readings were recorded at the surface of each site on sample dates 08-13-2020 and 5-11-2021. On sample dates 06-01-2021, 06-2-2021, 06-07-2021, and 06-15-2021, sonde readings were recorded at 1-meter intervals from the lake surface to the lake bottom.[8]

Water samples for lab analysis were collected using the grab sample method,[9] a 2-meter Integrated Sampler (IS),[10] or a WaterMark Vertical Water Sampler (Van Dorn-style discrete depth sampler)[11] depending on the depth of the sample site. On sample dates 06-01-2021, 06-02-

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[5] EPA. December 16, 2016. Science and Ecosystem Support Division Operating Procedure: Surface Water Sampling https://www.epa.gov/sites/production/files/2017-07/documents/surface_water_sampling201_af.r4.pdf (EPA, 2016)

[6] MPCA. 2003. Volunteer Surface Water Monitoring Guide. https://www.pca.state.mn.us/sites/default/files/wq-s1-15.pdf

[7] RMBEL. Lake Monitoring Training Videos: https://www.rmbel.info/training/videos/

[8] See attached datasheet for sonde profile readings under tab labeled "Sonde Profile Data"

[9] EPA, 2016. P. 11. "A sample may be collected directly into the sample container when the surface water source is accessible by wading or other means. The sampler should face upstream if there is a current and collect the sample without disturbing the bottom sediment."

[10] A 2-meter Integrated Sampler enables the sampler to collect an integrated sample of the top 2 meters of the water column. It is simply a 2-meter pvc pipe with a rubber stopper on one end and a valve on the other.

[11] EPA, 2016. P. 14. "When discrete samples are desired from a specific depth, and the parameters to be measured do not require a Teflon-coated sampler, a standard Kemmerer or Van Dorn sampler may be used. The Kemmerer sampler is a brass cylinder with rubber stoppers that leave the ends of the sampler open while being lowered in a vertical position, thus allowing free passage of water through the cylinder. The Van Dorn sampler is plastic and is lowered in a horizontal position. In each case, a messenger is sent down a rope when the sampler is at the designated

2021, and 06-07-2021, samples were collected at varying depths depending on the total depth of the lake site. Where sites were less than 2m deep, one sample was collected using the Van Dorn. Where sites were between 2m-4m deep, two samples were collected, one using the IS at the lake surface, and one using the Van Dorn within 1m of the lake bottom. Where sites were deeper than 4m, a third sample was collected at a mid-point in the water column. Naming conventions for samples collected at varying depths at one lake site are as follows: lake site number followed by the letter “S”, “M”, or “D” indicating a sample taken at the surface (0-2m integrated or grab sample), mid-column, or deep (within 1m of lake bottom) respectively. See Table 3 for the following example. On 6-1-21, water samples were collected at site 204 at three depths: 204-S was sampled at 0-2m using an IS; 204-M was sampled at 4m using a Van Dorn; and 204-D was sampled at 8m using a Van Dorn.

2.3.1 Lake Site Selection

Lake sites 202, 203, 503, 502, 204, 501, and 504 are MPCA surface water monitoring stations. These sites were selected for sampling as representative sites of Birch Lake water quality. These sites are located over deeper water and away from stream inlets, aquatic plant beds, islands, sand bars and other areas that can have localized water quality that fails to represent the main lake basin water quality. See Figure 2.

Lake sites 303, S009-182, 301, 304, and 302 are also MPCA surface water monitoring stations. These sites were selected closer to stream inlets in order to observe the influence of Birch Lake tributaries on Birch Lake. See Figure 3.

Lake sites BL-001, BL-002, BL-003, BL-004, BL-005, and BL-006 were established by NMW in 2021 to augment MPCA-established sites. These sites were selected in locations between MPCA sites where bathymetric maps show a depth of greater than 15 feet.[12] See Figure 4.

Lake site SNOK-DS was established by NMW in 2020 in a bay of Birch Lake near the inlet of South Nokomis Creek. See Figure 5.

Lake sites BB-001, BB-002, and BB-003 were established by NMW in 2021 to augment publicly-available data from MPCA station, 69-0003-00-301, which is located in Bob Bay of Birch Lake, and to inform an understanding of the influence of Unnamed Creek, which drains to the head of Bob Bay, on water quality in the bay and Birch Lake.[13] See Figure 7.

2.3.2 Laboratory Information

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depth, to cause the stoppers to close the cylinder, which is then raised. Water is removed through a valve to fill respective sample containers.” Note that the WaterMark Vertical Water Sampler functions vertically, similar to the Kemmerer sampler, but is constructed of materials similar to the Van Dorn sampler.

[12] DNR Recreation Compass https://www.dnr.state.mn.us/maps/compass/index.html

[13] MPCA-posted data for station 69-0003-00-301 show it to have been visited once, on 8-14-2019 when sulfate levels were documented to be 19.1mg/L.For comparison, NMW-collected samples demonstrated the following sulfate levels at the same site: 28.3 mg/L on 6-7-21; 23 mg/L on 6-1-21; and 42 mg/L on 5-11-21 with a field replicate sample testing at 41.8 mg/L.

Water samples were analyzed by RMBEL located at 1111 7th Avenue E in Hibbing, Minnesota. RMBEL is certified by the Minnesota Department of Health under State Laboratory ID: 027-137-480.[14] RMBEL is accredited in sulfate analysis using EPA Method 300.0 Ion Chromatography.[15,16]

2.3.3 Sample Handling and Preservation Requirements

Upon collection, samples were stored in a cooler with ice packs and then delivered to RMBEL in a cooler packed in loose ice with sample temperatures remaining at or below 4 degrees Celsius per EPA Method 300.0 requirements. Sulfate samples require no chemical preservation. All samples were documented on RMBEL-provided Chain of Custody Records[17] and remained in the custody of Lisa Pugh during each sampling event. The sample hold time for sulfate analysis is 28 days. Samples were stored in a secured location at the appropriate temperature overnight before transport to the laboratory each morning following a sampling event. Samples collected on 08-13-2020 and 06-15-2021 were hand delivered to RMBEL in Hibbing, MN by sample custodian Rajan Singh, following the chain of custody procedures. All other samples were hand delivered to RMBEL by Lisa Pugh.

2.3.4 Quality Control

Bottle blanks (BB) were collected at a rate of one BB per sampling day. Equipment blanks (EB) were collected at a rate of one EB per piece of sampling equipment per day. Field duplicates (FD) were collected at a rate of one FD per ten sample sites per day. The sampling equipment (IS and Van Dorn) were triple-rinsed at each site prior to sample collection. On each field sampling day, the YSI sonde was calibrated prior to use in the field and a calibration check was performed following the final sample of each day. The dissolved oxygen probe membrane was changed once every 30 days during the sampling season.

3 Results Summary

3.1 Results Summary Overview

The results of NMW sampling show that sulfate concentrations in the western portion of Birch Lake, including Dunka Bay and Bob Bay, were greater than 10 mg/L. In several sites near to the north and northeast of Bob Bay, sulfate concentrations range from well above to just below 10 mg/L. Sites in the eastern third of Birch Lake show sulfate concentrations generally range from 5

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[14] RMBEL Lab Certification https://www.rmbel.info/wp-content/uploads/2021/03/2021-HB-2-certificate-03292021.pdf

[15] RMBEL Scope of Certification https://www.rmbel.info/wp-content/uploads/2021/03/2021-HB-2-scope-03292021.pdf

[16] EPA Method 300.0 Determination of Inorganic Anions by Ion Chromatography https://www.epa.gov/sites/production/files/2015-08/documents/method_300-0_rev_2-1_1993.pdf

[17] RMBEL Chain of Custody Record. https://www.rmbel.info/wp-content/uploads/2020/01/C-of-C-Modification-10-08-19.pdf

to 8 mg/L, with the exception of one site (304) located well into Stony River Bay, where sulfate concentrations are less than 1.0 mg/L.[18]

3.2 08-13-2020 Data Summary

On 08-13-2020 water sampling occurred at lake sites 204 and 501 with a field duplicate (FD) collected at site 204. Sampling at both sites was done using the IS in the top 2m of the water column. Sampling of these two sites began at 0754 hrs and 0948 hrs, respectively. Winds were out of the SE with wind speeds between 0-5mph while sampling site 204 and increasing to 11-15mph while sampling site 501. Cloud cover was between 10-15 percent. No significant weather events had occurred in the week prior to sampling. While Bob Bay was not sampled on this date, Unnamed Creek, which discharges to Bob Bay, was sampled at USGS station 05125730, and showed a sulfate concentration of 237 mg/L. Samples were collected by Lisa Pugh, Rajan Singh, and Noah Greer. Samples were delivered to the lab at 0931 hrs on 08-14-2020. See Table 1 for sample result summary and attached spreadsheet for full dataset.

3.2.1 Table 1. Birch Lake sulfate data collected 08-13-2020

Site ID	Date	Time (24 hrs)	Sample Depth (to nearest 0.5 m)	Sulfate result (mg/L)
501	2020-08-13	948	0-2	5.4
204-S	2020-08-13	755	0-2	6.8
204-S FD	2020-08-13	756	0-2	6.8
SNOK-DS	2020-08-13	1042	0	6.0

3.3 05-11-2021 Data Summary

On 05-11-2021 water sampling occurred at 12 lake sites. Field duplicates were collected at sites 301 and BB-002. The IS was used to collect samples in the top two meters of the water column. At sites with a water depth less than 2 meters, a grab sample was collected at the lake surface. Sampling began at 1126 hrs and the final sample was collected at 1558 hrs. Wind speeds were 0-5mph with winds out of the SW and 5 percent cloud cover. No significant weather events had occurred in the week prior to sampling. Samples were collected by Lisa Pugh assisted by Levi Lexvold. Samples were delivered to the lab at 1005 hrs on 05-12-2021. See Table 2 for sample result summary and attached for full dataset.

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[18] Other NMW sampling data from streams in the area shows that sulfate concentrations of roughly 0.5 mg/L are typical in streams draining naturally vegetated watersheds with minimal land alteration. Data may be requested by contacting the author.

3.3.1 *Table 2. Birch Lake sulfate data collected 05-11-2021*

Site ID	Date	Time (24 hrs)	Sample Depth (to nearest 0.5 m)	Sulfate result (mg/L)
301	2021-05-11	1452	0	42
301 FD	2021-05-11	1453	0	41.8
302	2021-05-11	1558	0-2	5.6
303	2021-05-11	1255	0-2	21.4
304	2021-05-11	1530	0-2	0.8
202-S	2021-05-11	1331	0-2	11.8
203-S	2021-05-11	1343	0-2	11.8
502-S	2021-05-11	1517	0-2	5.9
503-S	2021-05-11	1400	0-2	12.4
BB-001	2021-05-11	1414	0	53.9
BB-002	2021-05-11	1504	0-2	19.1
BB-002 FD	2021-05-11	1505	0-2	18.2
S009-182	2021-05-11	1318	0	15

3.4 06-01-2021 Data Summary

On 06-01-2021 water sampling occurred at eight lake sites. Field duplicates were collected at sites BB-002 and 301. Samples were collected at varying depths depending on the total depth of the lake site. Where sites were less than 2m deep, one sample was collected using the Van Dorn. At sites where the lake is between 2m-4m deep, two samples were collected, one using the IS at the lake surface, and one using the Van Dorn within 1m of the lake bottom. Where sites were deeper than 4m, a third sample was collected at a mid-point in the water column. Sonde readings were also recorded at 1m intervals from the lake surface to lake bottom.[19] Sampling on 06-01-21 began at 1401 hrs and the final sample was collected at 1717 hrs. Wind speeds were 0-5mph with winds out of the SW and 20 percent cloud cover. No significant weather events had occurred in the week prior to sampling. Samples were collected by Lisa Pugh assisted by Levi Lexvold. Samples were delivered to the lab at 0837 hrs on 06-03-2021. See Table 3 for sample result summary and attached spreadsheet for full dataset.

3.4.1 *Table 3. Birch Lake sulfate data collected 06-01-2021*

Site ID	Date	Time (24 hrs)	Lake Depth (to nearest 0.5 m)	Sample Depth (to nearest 0.5 m)	Sulfate result (mg/L)
301	2021-06-01	1423	1.5	1	23
204-S	2021-06-01	1709	8.5	0-2	8.2

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[19] See attached datasheet for sonde profile readings under tab labeled “Sonde Profile Data”

204-M	2021-06-01	1713	8.5	4	7.4
204-D	2021-06-01	1717	8.5	8	7.6
502-S	2021-06-01	1639	5.5	0-2	9.3
502-M	2021-06-01	1642	5.5	3	8.3
502-D	2021-06-01	1647	5.5	5	8.6
BB-001	2021-06-01	1401	1	0.5	44
BB-002-S	2021-06-01	1614	3	0-2	10.7
BB-002-D	2021-06-01	1620	3	3	12.8
BB-003	2021-06-01	1436	2	1	20.9
BB-003 FD	2021-06-01	1437	2	1	21.5
BL-004-S	2021-06-01	1547	6	0-2	9.9
BL-004-M	2021-06-01	1550	6	3	8.7
BL-004-D	2021-06-01	1556	6	5	9.6
BL-004-D FD	2021-06-01	1557	6	5.5	10.1
BL-005-S	2021-06-01	1520	6	0-2	10.5
BL-005-M	2021-06-01	1522	6	3	9.2
BL-005-D	2021-06-01	1527	6	5	10.9

3.5 06-02-2021 Data Summary

On 06-02-2021 water sampling occurred at eight lake sites. Field duplicates were collected at sites BL-001 and 203. Samples were collected at varying depths depending on the total depth of the lake site. Where sites were less than 2m deep, one sample was collected using the Van Dorn. Where sites were between 2m-4m deep, two samples were collected, one using the IS at the lake surface, and one using the Van Dorn within 1m of the lake bottom. Where sites were deeper than 4m, a third sample was collected at a mid-point in the water column. Sonde readings were also recorded at 1m intervals from the lake surface to lake bottom.[20] Sampling on 06-02-21 began at 0805 hrs and the final sample was collected at 1118 hrs. Wind speeds were 0-5mph with winds out of the SW and 40 percent cloud cover. No significant weather events had occurred in the week prior to sampling. Samples were collected by Lisa Pugh assisted Levi Lexvold. Samples were delivered to the lab at 0837 hrs on 06-03-2021. See Table 4 for sample result summary and attached spreadsheet for full dataset.

3.5.1 Table 4. Birch Lake sulfate data collected 06-02-2021

Site ID	**Date**	**Time (24 hrs)**	**Lake Depth (to nearest 0.5 m)**	**Sample Depth (to nearest 0.5 m)**	**Sulfate result (mg/L)**
303	2021-06-02	805	1.5	1	16.3
202-S	2021-06-02	838	7	0-2	11.6
202-M	2021-06-02	841	7	4	11.7

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[20] See attached datasheet for sonde profile readings under tab labeled "Sonde Profile Data"

202-D	2021-06-02	848	7	6	11.8
203-S	2021-06-02	909	6	0-2	12
203-M	2021-06-02	911	6	3	11.4
203-D	2021-06-02	918	6	6	11.5
203-D FD	2021-06-02	919	6	5	11.4
503-S	2021-06-02	951	6.5	0-2	11.6
503-M	2021-06-02	954	6.5	4	11.2
503-D	2021-06-02	957	6.5	6	11.5
BL-001-S	2021-06-02	1106	7	0-2	11.4
BL-001-M	2021-06-02	1108	7	4	11.7
BL-001-D	2021-06-02	1118	7	6	11.5
BL-001-M FD	2021-06-02	1109	7	4	11.5
BL-002-S	2021-06-02	1015	7	0-2	11.4
BL-002-M	2021-06-02	1018	7	4	11.3
BL-002-D	2021-06-02	1024	7	6	11.2
BL-003-S	2021-06-02	1039	7	0-2	11.3
BL-003-M	2021-06-02	1043	7	4	10.5
BL-003-D	2021-06-02	1046	7	6	11
S009-182	2021-06-02	819	1.5	1	14

3.6 06-07-2021 Data Summary

On 06-07-2021 water sampling occurred at 17 lake sites. Field duplicates were collected at sites 203, 503, BB-001, and BL-005. Samples were collected at varying depths depending on the total depth of the lake site. Where sites were less than 2m deep, one sample was collected using the Van Dorn. Where sites were between 2m-4m deep, two samples were collected, one using the IS at the lake surface, and one using the Van Dorn within 1m of the lake bottom. Where sites were deeper than 4m, a third sample was collected at a mid-point in the water column. Sonde readings were also recorded at 1m intervals from the lake surface to lake bottom.[21] Sampling on 06-07-21 began at 0731 hrs and the final sample was collected at 1333 hrs. Samples were collected by Lisa Pugh assisted by Levi Lexvold. Samples were delivered to the lab at 1120 hrs on 06-08-2021. See Table 5 for sample result summary and attached spreadsheet for full dataset.

3.6.1 Table 5. Birch Lake sulfate data collected 06-07-2021

Site ID	Date	Time (24 hrs)	Lake Depth (to nearest 0.5 m)	Sample Depth (to nearest 0.5 m)	Sulfate result (mg/L)
301	2021-06-07	923	1.5	1	28.3
303	2021-06-07	1034	1.5	1	13.9
202-S	2021-06-07	1104	7	0-2	11.3

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[21] See attached datasheet for sonde profile readings under tab labeled "Sonde Profile Data"

202-M	2021-06-07	1106	7	4	11.2
202-D	2021-06-07	1112	7	6	11.3
203-S	2021-06-07	1128	6	0-2	11.4
203-S FD	2021-06-07	1129	6	0-2	11.3
203-M	2021-06-07	1132	6	3	11.5
203-D	2021-06-07	1136	6	5	11.5
204-S	2021-06-07	731	8.5	0-2	8.1
204-M	2021-06-07	733	8.5	4	6.9
204-D	2021-06-07	736	8.5	8	6.1
502-S	2021-06-07	800	5.5	0-2	10.2
502-M	2021-06-07	802	5.5	3	9
502-D	2021-06-07	805	5.5	5	8.9
503-S	2021-06-07	1211	6.5	0-2	11.2
503-S FD	2021-06-07	1212	6.5	0-2	11.4
503-M	2021-06-07	1214	6.5	4	11.5
503-D	2021-06-07	1217	6.5	6	11.3
BB-001	2021-06-07	938	1	0.5	57.1
BB-001 FD	2021-06-07	939	1	0.5	65.1
BB-002-S	2021-06-07	850	3	0-2	10.4
BB-002-D	2021-06-07	852	3	3	11.9
BB-003	2021-06-07	914	2	1	22.1
BL-001-S	2021-06-07	1152	7	0-2	11.2
BL-001-M	2021-06-07	1154	7	4	11.3
BL-001-D	2021-06-07	1158	7	6	12.2
BL-002-S	2021-06-07	1234	7	0-2	11.3
BL-002-M	2021-06-07	1238	7	4	11.9
BL-002-D	2021-06-07	1242	7	6	11.1
BL-003-S	2021-06-07	1302	7	0-2	11.6
BL-003-M	2021-06-07	1304	7	4	11
BL-003-D	2021-06-07	1307	7	6	11.1
BL-004-S	2021-06-07	957	6	0-2	10
BL-004-M	2021-06-07	1000	6	4	9.7
BL-004-D	2021-06-07	1004	6	5	9.3
BL-005-S	2021-06-07	824	6	0-2	10.2
BL-005-M	2021-06-07	826	6	3	9.9
BL-005-D	2021-06-07	831	6	5	9.3
BL-005-D FD	2021-06-07	832	6	5.5	9
BL-006-S	2021-06-07	1324	6	0-2	11.3
BL-006-M	2021-06-07	1328	6	4	10.1
BL-006-D	2021-06-07	1333	6	5	9.3

S009-182	2021-06-07	1047	1.5	1.5	11.5

3.7 06-15-2021 Data Summary

On 06-15-2021 water sampling occurred at lake site 504. One sample was collected at the lake surface using an IS and a second sample was collected at 5.5m using a Van Dorn. Sonde readings were also recorded at 1m intervals from the lake surface to lake bottom.[22] Samples were collected at 0905 hrs and 0907 hrs, respectively. Samples were collected by Lisa Pugh assisted by Levi Lexvold and Hunter Strubhart. Samples were delivered to the lab at 0900 hrs on 06-16-2021. See Table 6 for sample result summary and attached spreadsheet for full dataset.

3.7.1 Table 6. Birch Lake sulfate data collected 06-15-2021

Site ID	**Date**	**Time (24 hrs)**	**Lake Depth (to nearest 0.5 m)**	**Sample Depth (to nearest 0.5 m)**	**Sulfate result (mg/L)**
504-S	2021-06-15	0905	6	0-2	11.1
504-D	2021-06-15	0907	6	5.5	11.2

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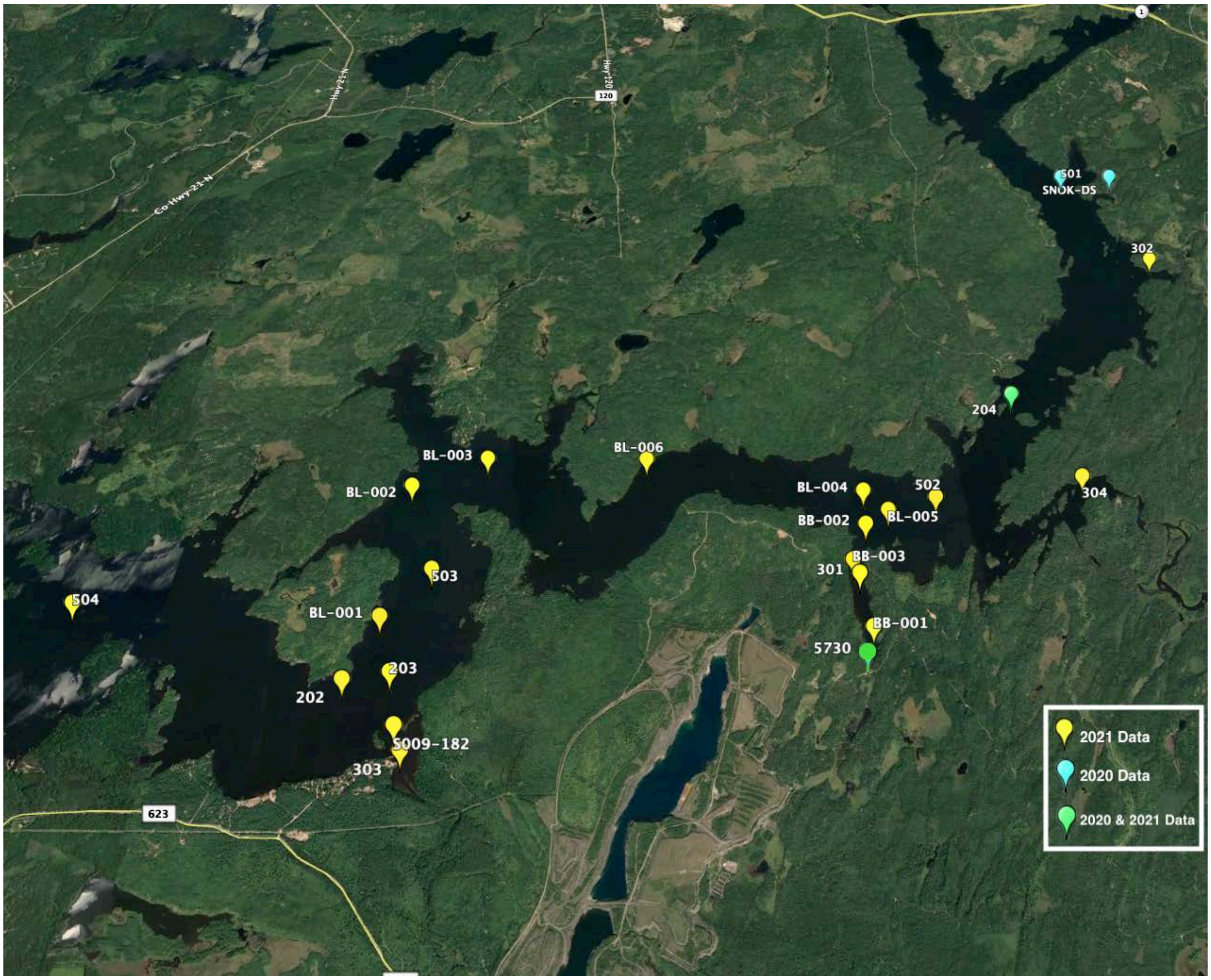
[22] See attached datasheet for sonde profile readings under tab labeled "Sonde Profile Data"

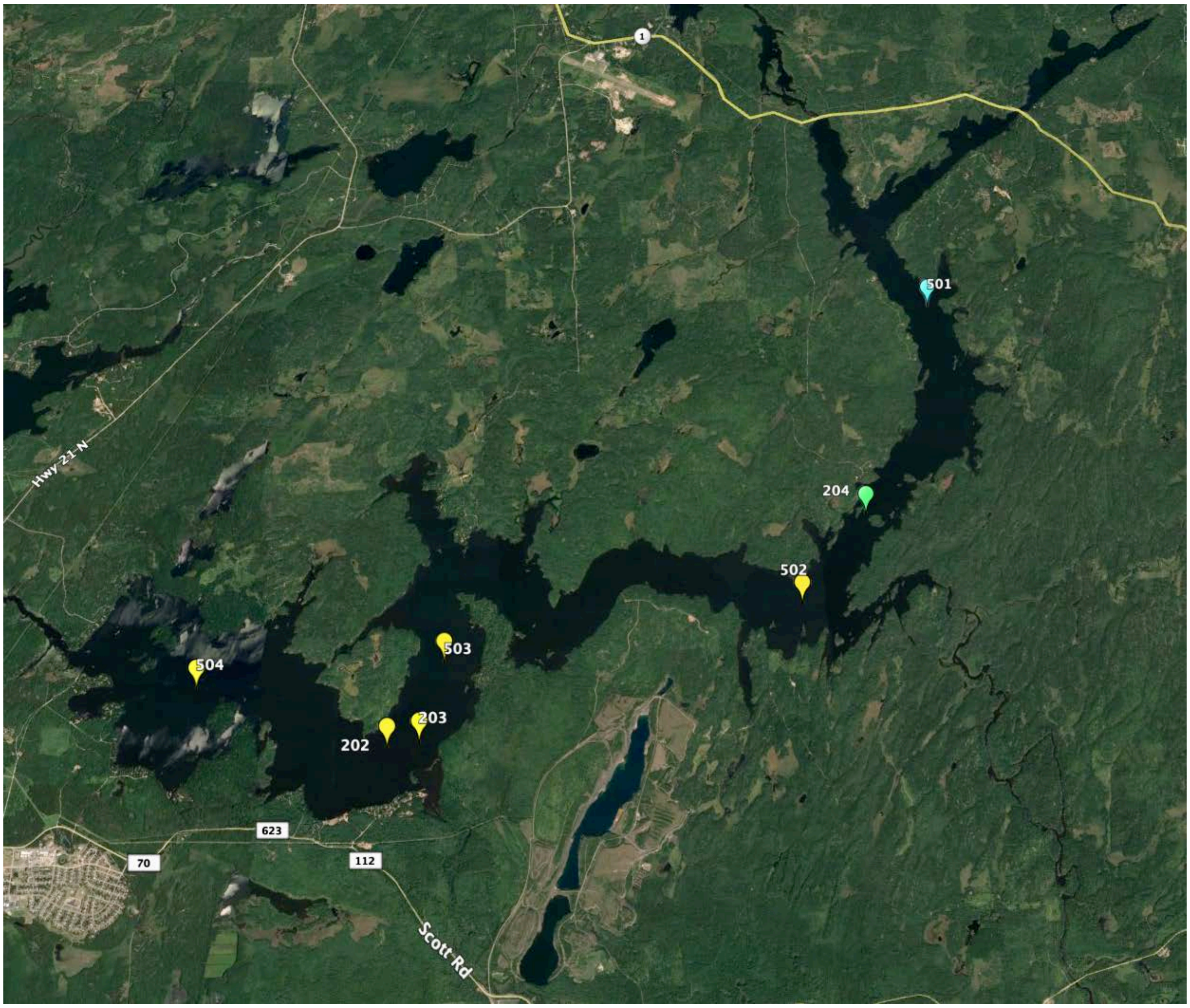
4 Appendix

4.1 Figures

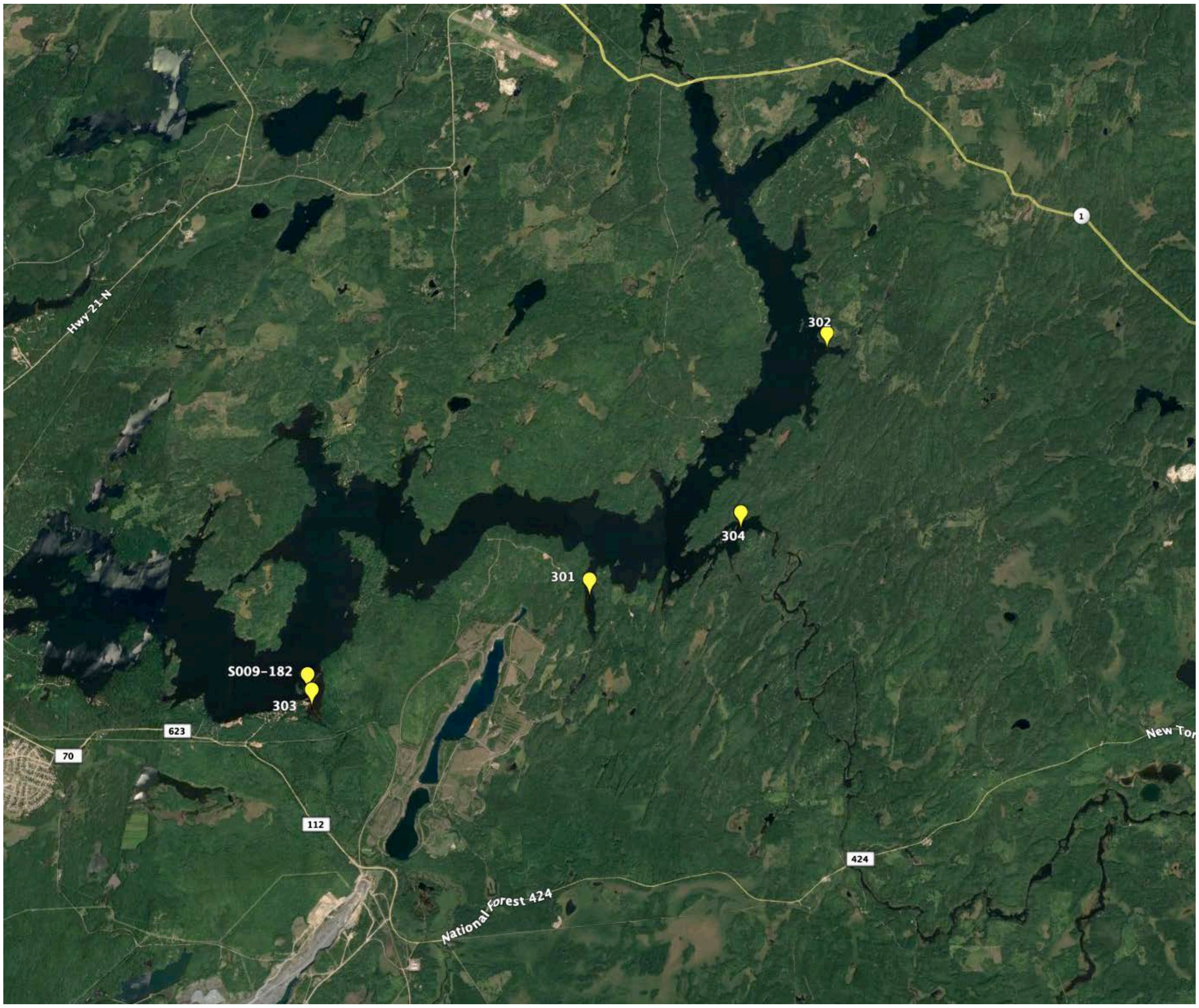
4.1.1 Figure 4. Birch Lake sulfate sampling locations.



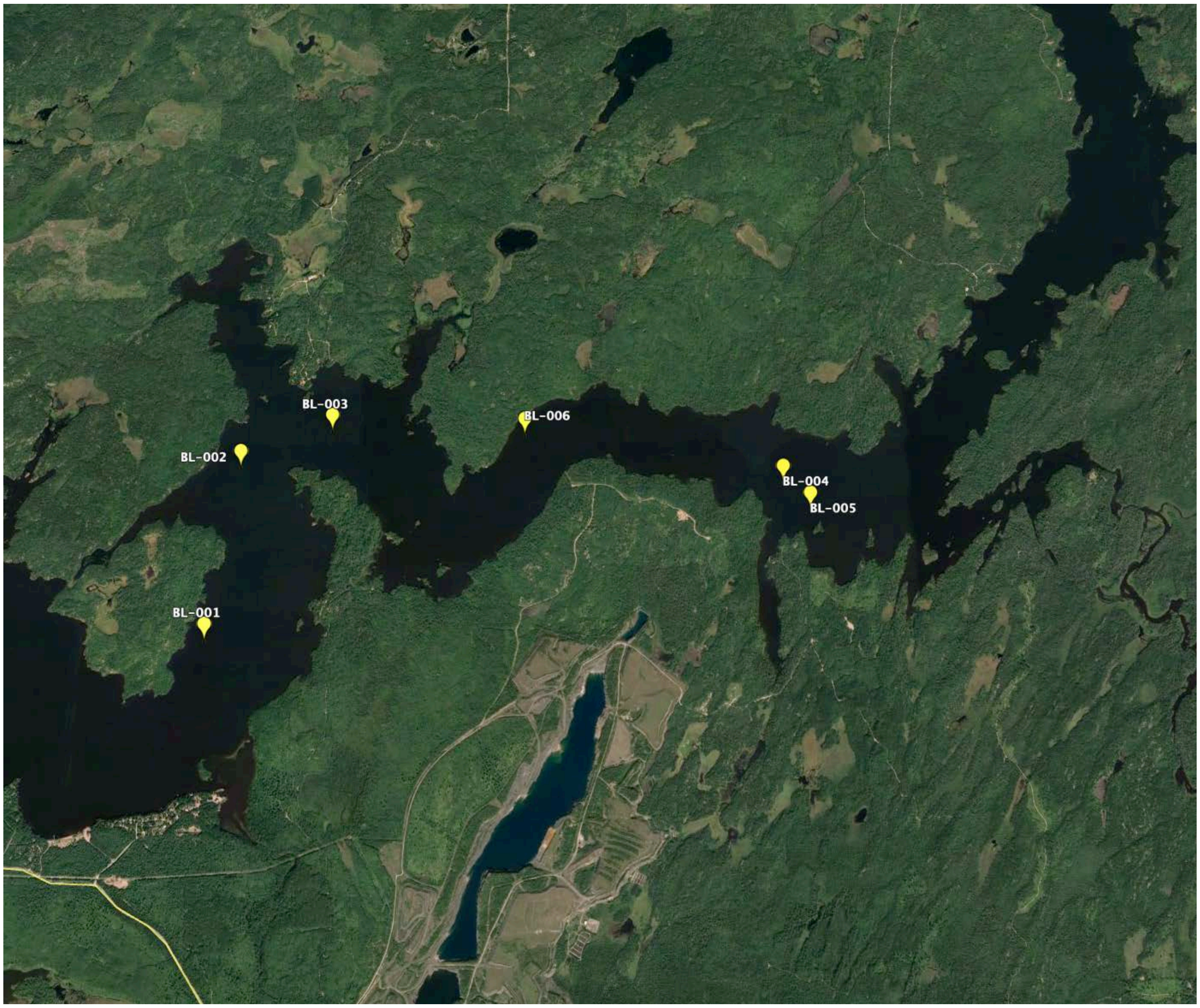
4.1.2 Figure 5. MPCA lake stations – representative surface water site



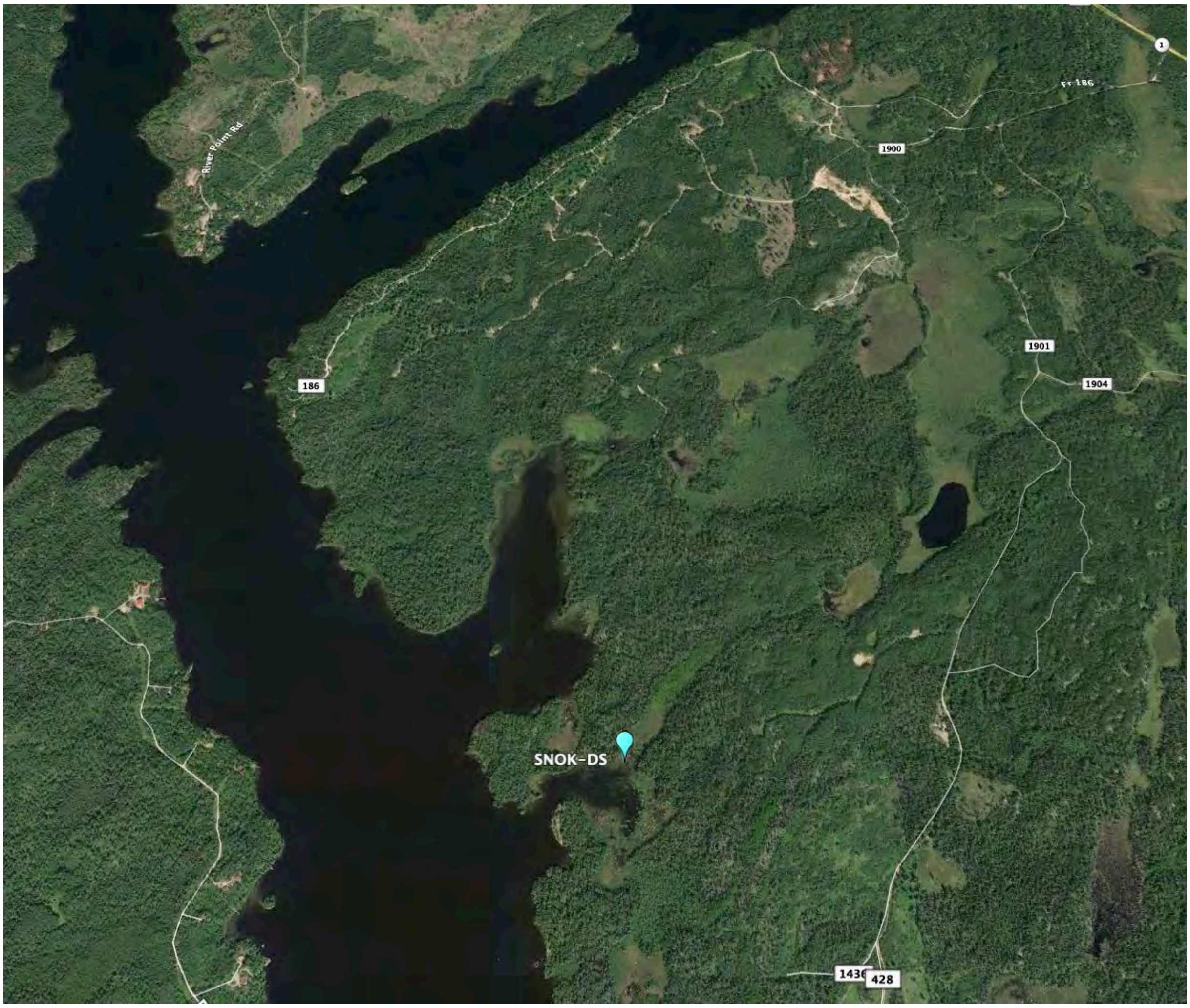
4.1.3 Figure 6. MPCA lake stations - stream inlet sites



4.1.4 *Figure 7. NMW-established lake sites - supplemental representative sites*



4.1.5 Figure 5. NMW-established lake site – supplemental stream inlet site



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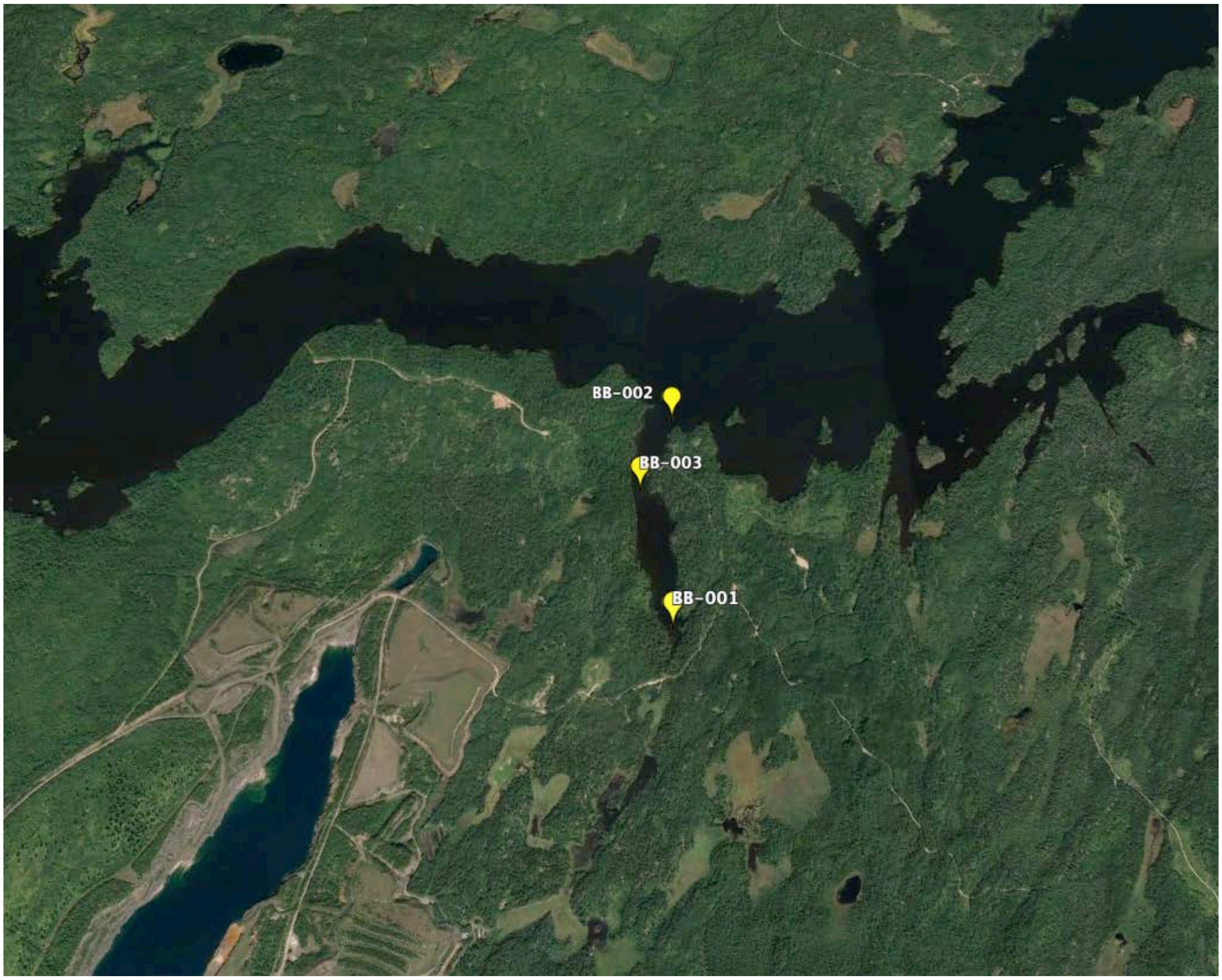
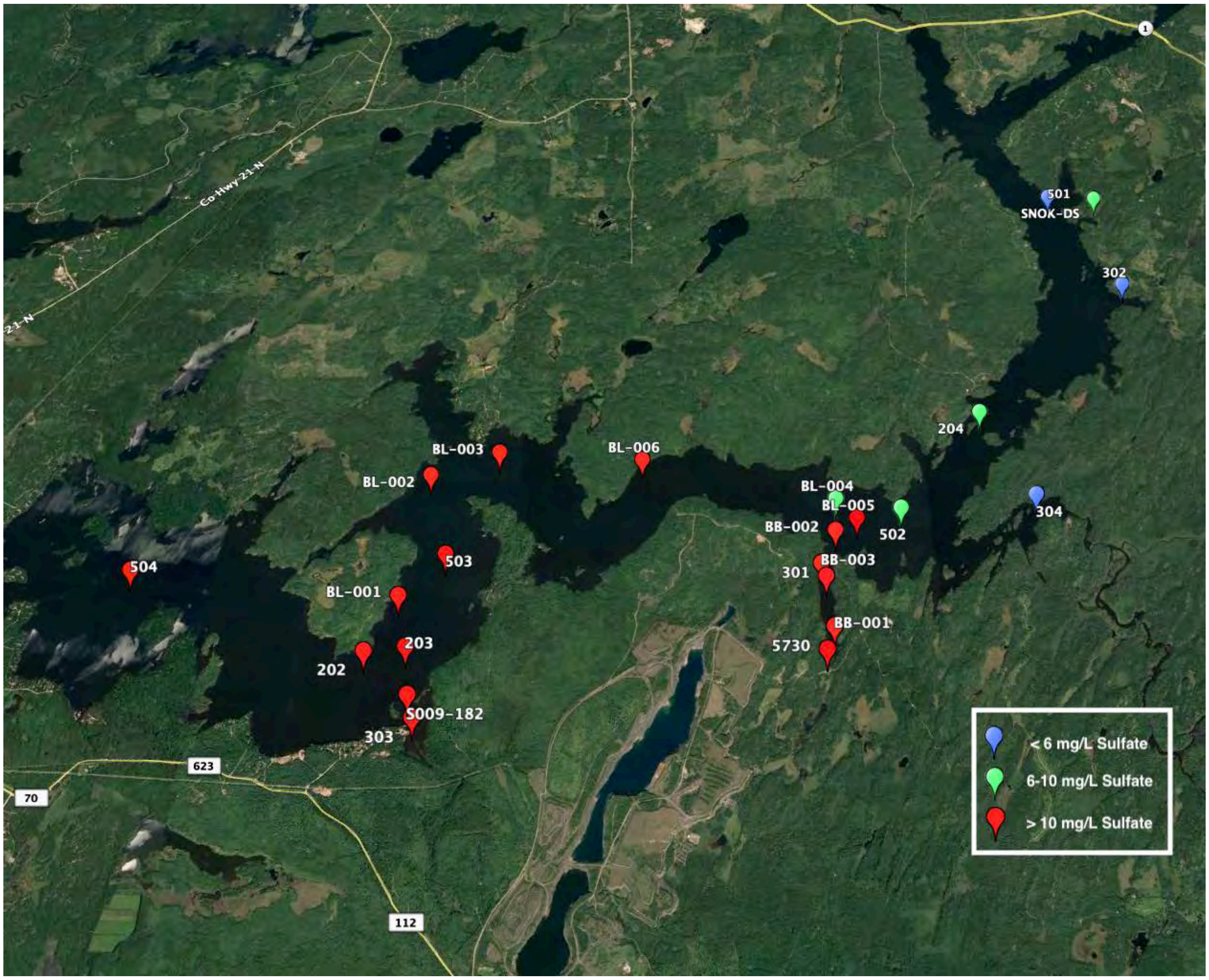
5.1.5 *Figure 6. NMW-established lake sites - supplemental Bob Bay sites*



5.1.6 *Figure 7. Lake site locations and sulfate levels*



Wild Rice WQLS, Exhibit G

Save the Boundary Waters Sonde Calibration Work Sheet

Date & Time of Calibration: 8/13/20 0405

Sonde Serial # 07F101105

Technician: Lisa Pugh

Hand Pad Serial # 06E1765_AB

DO membrane changed? Y [✓ N]
Last changed 8/11/20

Note: Should wait 6 to 8 hours before final DO calibration, run sensor for 15 minutes in Discrete Run to accelerate burn-in.

Turbidity wiper changed? Y N N/A

Wiper parks ≈ 180° from optics? Y N N/A

Note: Change wiper if probe will not park correctly.

Record battery voltage: 80%

Record the following diagnostic numbers after/during calibration.

Conductivity cell constant	4.80234	Range 5.0 ±.5
pH MV Buffer 4	164.3	Range +177 from 7 buffer MV
pH MV Buffer 7	-11.1	Range 0 MV ±50 MV
pH MV Buffer 10	-189.6	Range –177 from 7 buffer MV

NOTE: Span between pH 4 and 7 and 7 and 10 millivolt numbers should be ≈ 165 to 180 MV

DO charge	70.0	Range 50 ±25
DO gain	1.07507	Range 1.0 .7 to 1.5
Pressure Offset		Range –14.7 ± 6 (non-vented)
Pressure Offset		Range 0 ± 6 (vented)
ORP mV Offset		Range 0 ± 100

Record Calibration Values

		Before Calibration	/After calibration	/ Cal. Standard Expiration Date	
Conductivity	22.38°	1014	1000	10/12/21	
pH 4	22.40°	4.02	4.00	3/13/22	164.3 mV
pH 7	23.50	6.97	7.00	3/13/22	-11.2 mV
pH 10	23.69	10.05	10.01	3/13/22	-189.8
Turbidity 0					
Turbidity 123					
DO	8.30 mg/L	97.4%	95.7%	8.16 mg/L	
ORP					
Depth					

DISSOLVED OXYGEN SENSOR OUTPUT TEST (after DO calibration probe in saturated air)

The following tests will confirm the proper operation of your DO sensor. The DO charge and gain must meet spec before proceeding.

610/650– Turn off the 610/650, wait 60 seconds. Power up 610/650 and go to the Run mode, watch the DO % output; it must display a positive number and decrease with each 4 second sample, eventually stabilizing to the calibration value in approximately 60 to 120 seconds. **Note:** You can disregard the first two samples they can be affected by the electronics warm-up.

PC – Stop discrete and unattended sampling. Confirm that auto-sleep RS-232 is enabled (found in Advanced Menu under Setup). Wait 60 seconds. Start discrete sampling at 4 seconds. Watch the DO % output, it must display a positive number and decrease with each 4 second sample, eventually stabilizing to the calibration value in approximately 60 to 120 seconds. **Note:** You can disregard the first two samples they can be affected by the electronics warm-up.

The **ACCEPT/REJECT** criteria as follows:
The DO output in % must start at a positive number and decrease during the warm up. Example: 117, 117, 114, 113, 110, 107, 104, 102, 101, 100, 100. Should the output display a negative number or start at a low number and climb up to the cal point, the probe is rejected and must not be deployed.

✓ **ACCEPT** ______ **REJECT**

Notes:

DO output values not recorded

Wild Rice WQLS, Exhibit G

FINAL CALIBRATION CHECK (to be done asap after each monitoring run)

Date & Time of Calibration Check: 8/13/20 2135

	Record Calibration Check Values	Known Standard Value	Temperature °C
Conductivity	997	1000	22.60
pH 4	4.02	4.0	22.61
pH 7	6.97	7.0	22.14
pH 10	10.08	10.0	22.39
DO % saturation	93.%		18.99
DO mg/L	8.62		19.04

Wild Rice WQLS, Exhibit G23

Save the Boundary Waters - Lake Field Data Sheet

Lake Name
Birch Lake

Lake ID #
69-0003-00

Date 8/13/20

Time (24hr) 09:48

Sampled by: LP Lisa Pugh Noah Greer, Prajan Singh

Weather

Wind Speed
☐0-5 ☐6-10 ☒11-15
☐16-20 ☐>21
% Cloudy 15
Significant Weather
Rain ☐ Fog ☐
Other

Wind Direction
N
W E
S

Sonde SN: 07 F 101105
Handpad SN: 06E1765 AB

FIELD INFO.	A	B	C	D	E	F	G
SITE NAME	501	204					
DATE	8.13.20	8/13/20					
TIME (24hr)	09:48	0754					
Latitude	47.782769	47.7519					
Longitude	-91.766165	-91.7855					
Depth (ft)	18	28					
Sample Collected? (Y/N)	Y	Y					
Secchi (nearest 0.5ft):	4.0	4.0					
Appearance:	1A-clear; 1B-tea-colored; 2-cloudy; 3-muddy; 4-green; 5-muddy & green						
Appearance:	1B	1B					
Recreation Suitability:	1-Beautiful; 2-Excellent body contact; 3-Body contact impaired; 4-no swim/boating OK; 5-recreation nearly impossible						
Recreation Suitability	1	1					
Water Temp °C	21.95	21.78					
Conductivity (uS/cm)	93.0	107					
pH (pH units)	7.24	7.47					
DO (% Saturation)	91.1%	90.8					
DO (mg/l)	7.96	8.0					
Color* (APHA platinum cobalt color units)	0-100 / [✓ 0-500] 200	0-100 / [✓ 0-500] 200	0-100 / 0-500	0-100 / 0-500	0-100 / 0-500	0-100 / 0-500	0-100 / 0-500
Turbidity YSI Sonde (FNUs)							
SAMPLE DEVICE* (Van Dorn / None)	2M Integrated Sampler	2M Integrated Sampler					
SAMPLE TYPE* (Grab, Integrated)	I	I					
QA* (Field Dup)		FD, BB, EB					
Field Notes	Wind 11-15 from SE	Wind 0-5 from SE Sample taken @ 0755					

*See back of sheet for additional instructions/information

Updated 8-12-2020

Save the Boundary Waters – Lake Water Profile and Field Data Sheet

Lake Name Birch Lake		
Lake ID # 69-0003-00	Site ID# 204	Photo Taken ☐
Date 8/13/20	Time (24hr) 0754	
Sampled by:	Lisa Pugh Rajan Singh, Noah Greer	Lat 47.7519 lon -91.7855
Lake Depth at sampling point (M) 28'		Secchi Depth (Ft) 4.0

Weather

Wind Speed
☒0-5 ☐6-10 ☐11-15
☐16-20 ☐>21
% Cloudy 10
Significant Weather
Rain ☐ Fog ☐
Other

Wind Direction

Sonde SN: 07 F 101105
Handpad SN: 06E1765 AB

Lake Observations

Water Color	Green☐ Sediment ☐ Stain☒ Clear☐	
Physical Condition	Crystal Clear	1☒
	Some Algae Present	2☐
	Definite Algae Present	3☐
	High Algae Color	4☐
	Severe Bloom (odorous scum)	5☐
Suitability for Recreation	Beautiful	1☒
	Minor Aesthetic Problems	2☐
	Swimming Slightly Impaired	3☐
	No Swimming/Boating OK	4☐
	No Aesthetics Possible	5☐
Lake Uses Observed	Swimming☐ Skiing☐ Fishing☐ Sailing or Boating☒	
Macrophyte Problems	Depth (Ft)____ Inhibits: Navigation ☐ Fishing☐ Swimming☐	
Color	Scale Used (circle) 0 to 100 or [✓ 0 to 500]	Color Units: 200
Zooplankton Abundance	None 0 Few 1 Moderate 2 Fair 3 High 4	
Zooplankton Size	Very Small 1 Small 2 Medium 3 Large 4	
Zooplankton notes		

Lake Profile

Depth (M)	TEMP (°C)	DO (mg/l)	DO %	Cond. (us/cm)	pH (pH units)
0	21.78	8.0	90.8	107	7.47
1	21.88	7.97	90.8		
2	21.8	7.95	90.7		
3	21.79	7.96	90.7		
4	21.79	7.94	90.5		
5	21.68	7.25	82.0		
6	~~21.63~~	~~7.10~~	~~77.4~~		
~~7~~ 6	21.63	7.20	79.0		
~~8~~ 7	21.60	6.82	77.5		
~~9~~ 8	21.54	6.18	70.0		
~~10~~ 9	21.42	5.43	61.8		
~~11~~ 10					
12					

Samples

Depth Top	Depth Bot.	General Chem.	Nutrient	Metals	Hg	Algal Toxins	Zoopl-Ankton
X		☒	☒	☒	☐	☐	☐
		☐	☐	☐	☐	☐	☐
		☐	☐	☐	☐	☐	☐
Chl-a Filter Volume mL							
QA Type		FD☒	SB☒	BB☒	TB☐		

FD= Field Dup, SB=Sampling Blank, BB=Bottle Blank, TB=Trip Blank

Field Observations

Lake not stratified, only surface sample collected

Save the Boundary Waters - Stream Field Sheet

Project Name:
Sampler Code:
Individual Observers-First and Last Names:

Sonde SN: 07F101105
Handpad SN: 06E1765AB

FIELD INFO.	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**
SITE NAME	SNOK-B5	S002-812	4990	~~4988~~	5730	5035				
DATE	8-13-20	8-13-20	8/13/20		8/13/20	8/13/20				
TIME (24hr)	10:42	15:55	16:37		1859	2014				
STAGE (* if USGS)		2.27								
Latitude	47.78248	47.839903	47.83472		47.724353	47.78017				
Longitude	-91.75788	-91.695421	-91.67417		-91.814043	~~[illegible]~~ -91.68386				
Depth	4'	[illegible]	3'9"		6"	1',5"				
Sample Collected? (Y/N)	Y	Y	Y		Y	Y				
GAGE TYPE*	Manual	Staff gage	Manual		Manual	manual				
T Tube (cm): Disap / Reap	/	/	/	/	95/100	75/68	/	/	/	/
AVG	100cm	100	69 77 (73)		97	71.5				
Appearance:	1A-clear; 1B-tea-colored; 2-cloudy; 3-muddy; 4-green; 5-muddy & green									
Appearance:	1B	1B	1B		1B	1B				
Recreation Suitability:	1-Beautiful; 2-Excellent body contact; 3-Body contact impaired; 4-no swim/boating OK; 5-recreation nearly impossible									
Recreation Suitability	1	1	See notes	[illegible]	5	4				
Stream Condition: *	High; Normal; Low; Z = No flow; Dry; Interstitial									
Stream Condition	Low	Low	Low		L	L				
Rain Event (Y/N)*	N	N	N		N	N				
Water Temp °C	21.60	22.95	20.92		20.17	20.05				
Conductivity (uS/cm)	92	57	74		710	73				
pH (pH units)	6.54	7.06	6.13		7.24	6.23				
DO (% Saturation)	56.3	97.5	55		54.4	13.6				
DO (mg/l)	5.03	8.37	4.89		4.92	1.22				
Color* (APHA platinum cobalt color units)	[✓ 0-100] 0-500 80	[✓ 0-100] 0-500 70	~~0-100~~ [✓ 0-500] 350	0-100 / 0-500	0-100 / [✓ 0-500] 150	0-100 / [✓ 0-500] 300	0-100 / 0-500	0-100 / 0-500	0-100 / 0-500	0-100 / 0-500
Turbidity YSI Sonde **(FNUs)**										
SAMPLE DEVICE* (Van Dorn / None)	N	N	N		N	N				
SAMPLE TYPE* (Grab, Integrated)	G	G	G		G	G				
QA* (Field Dup)										

* **See back of sheet for additional instructions/information**

Updated 7-15-2020

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CHAIN OF CUSTODY RECORD

Page 1 of 2

Electronic version available at http://www.rmbel.info/lab/chains-of-custody/

Client: Save the Boundary Waters
Phone #:
Fax #:
Project Name:
Project Task Code:
PO/WO #:
Sampler: (print name) Lisa Pugh
Sampler Phone # 952-237-6714
Report to: Lisa Pugh
Bill to: Northeastern Minnesotans for Wilderness
Report to Email: lisa@savetheboundarywaters.org
Bill to Email: nicole@savetheboundarywaters.org

☐ "EQUIS" EDD Lab Format - MPCA Data Submittal

Analyses Requested

Lab Code	Station ID/Sample Description	Date	Time	# of Bottles	Sample Method	Start Depth (m)	End Depth (m)	Sample Type	Matrix	Cations	Anions	General Chemistry	Alkalinity	Nutrients	Sulfide	Chlorophyll-a	Sample Comments: (Equipment Type, Filtration, AIS, Preservation)
	204 / Lake surface	8/13/20	0759	~~6~~7	LKSURF-2M	0	2	Sample	Wtr-Surf	X	X	X	X	X		X	
	501 / Lake Surface	8/13/20	0948	7	LKSURF-2M	0	2	Sample	Wtr-Surf	X	X	X	X	X		X	
	204 / Field dup	8/13/20	0756	7	LKSURF-2M	0	2	QC-FR	Wtr-surf	X	X	X	X	X		X	
	204 / Equip. blank	8/13/20	0757	7	LKSURF-2M	0	2	QC-EB	~~Wtr-Surf~~	X	X	X	X	X		X	QC-Blank
	SNOK-DS	8/13/20	1042	6	LKSURF-2M	0	2	Sample	Wtr-Surf	X	X	X	X	X			
	Bottle Blank	8/13/20	1350	6	QC-Blank	0	0	QC-FB	QC-Blank	X	X	X	X	X		X	
	5002-812	8/13/20	1355	5	Grab	0	0	Sample	Wtr-Surf	X	X	X	X	X			
	4990	8/13/20	1637	5	Grab	0	0	Sample	Wtr-Surf	X	X	X	X	X			
	5730	8/13/20	1859	5	Grab	0	0	Sample	Wtr-Surf	X	X	X	X	X			
	5035	8/13/20	2014	5	Grab	0	0	Sample	Wtr-Surf	X	X	X	X	X			

_______ (Initials) In the event that samples are received by the lab at a temperature greater than 6 ° C, I hereby authorize RMB Environmental Laboratories to process the samples as received.

P (Initials) In the event that samples are received by the lab at a temperature greater than 6 ° C, please contact client at phone # 952-237-6714 before processing samples.

Relinquished by: (client signature)	Date	Time	Relinquished by Lab: (signature)	Date	Time
	9/14/20	9:31			
Received by Lab: (signature)	Date	Time	Received by Lab: (signature)	Date	Time

☐ DOES meet proper sample storage and transportation guidelines
☐ Does NOT meet proper sample storage and transportation guidelines
Explain: ____________
☐ Rcvd on ice ☐ Rcvd at room temp Rcvd Temp: ________ ° C
☐ Samples received same day as collection LTG: ________
Comments: ____________ Chlorine: No Yes NA

☐ DOES meet proper sample storage and transportation guidelines
☐ Does NOT meet proper sample storage and transportation guidelines
Explain: ____________
☐ Rcvd on ice ☐ Rcvd at room temp Rcvd Temp: ________ ° C
☐ Samples received same day as collection LTG: ________
Comments: ____________

BILLING
Shipping / Courier:
Mileage:
Field Staff:
Equipment:
Other:

SHIPPING TO LAB
☐ Speedee
☐ UPS
☐ USPS
☐ FedEx
☒ Hand Delivery
☐ Courier
☐ RMB Courier

INTERLAB SHIPPING
☐ Speedee
☐ UPS
☐ USPS
☐ FedEx
☐ Courier
☐ RMB Courier

Save the Boundary Waters Sonde Calibration Work Sheet

Wild Rice WQLS, Exhibit G

Date & Time of Calibration: 5/11/21 1045

Sonde Serial # 07F101105

Technician: Lisa Pugh

Hand Pad Serial # 06E1765 AB

DO membrane changed? Y [✓ N]

Last changed 4/27/21

Note: Should wait 6 to 8 hours before final DO calibration, run sensor for 15 minutes in Discrete Run to accelerate burn-in.

Turbidity wiper changed? Y N N/A

Wiper parks ≈ 180° from optics? Y N N/A

Note: Change wiper if probe will not park correctly.

Record battery voltage: 100%

Record the following diagnostic numbers after/during calibration.

Conductivity cell constant	4.952	Range 5.0	±.5
pH MV Buffer 4	149.9	Range +177 from 7 buffer MV	
pH MV Buffer 7	-30.3	Range 0 MV	± 50 MV
pH MV Buffer 10	-197.4	Range –177 from 7 buffer MV	
DO charge	72.7	Range 50	± 25
DO gain	1.04438	Range 1.0	.7 to 1.5
Pressure Offset		Range –14.7	± 6 (non-vented)
Pressure Offset		Range 0	± 6 (vented)
ORP mV Offset		Range 0	± 100

NOTE: Span between pH 4 and 7 and 7 and 10 millivolt numbers should be ≈ 165 to 180 MV

Record Calibration Values

	Before Calibration	After calibration	Cal. Standard Expiration Date
Conductivity	1004	15°C 1000	10/12/21
pH 4	4.15	14.42°C 4.00	3/13/22
pH 7	6.95	14.47°C 7.00	3/13/22
pH 10	10.14	14.54°C 10.01	3/13/22
Turbidity 0			
Turbidity 123			
DO	94.2	13.44°C 96.5	
ORP			
Depth			

30.25 inHg × 25.4 = 768.35 − (2.5 × $\frac{1427}{100}$)

= 732.675 mmHg

DISSOLVED OXYGEN SENSOR OUTPUT TEST (after DO calibration probe in saturated air)

The following tests will confirm the proper operation of your DO sensor. The DO charge and gain must meet spec before proceeding.

610/650– Turn off the 610/650, wait 60 seconds. Power up 610/650 and go to the Run mode, watch the DO % output; it must display a positive number and decrease with each 4 second sample, eventually stabilizing to the calibration value in approximately 60 to 120 seconds. **Note:** You can disregard the first two samples they can be affected by the electronics warm-up.

PC – Stop discrete and unattended sampling. Confirm that auto-sleep RS-232 is enabled (found in Advanced Menu under Setup). Wait 60 seconds. Start discrete sampling at 4 seconds. Watch the DO % output, it must display a positive number and decrease with each 4 second sample, eventually stabilizing to the calibration value in approximately 60 to 120 seconds. **Note:** You can disregard the first two samples they can be affected by the electronics warm-up.

The **ACCEPT/REJECT** criteria as follows:
The DO output in % must start at a positive number and decrease during the warm up. Example: 117, 117, 114, 113, 110, 107, 104, 102, 101, 100, 100. Should the output display a negative number or start at a low number and climb up to the cal point, the probe is rejected and must not be deployed.

✓ **ACCEPT** ______ **REJECT**

Notes:

107.4 107.3 107.1 104.1 102.3 101.1 100.2 99.6 99.0 98.7

98.4 98.2 98.1 98.0 97.9 97.6

FINAL CALIBRATION CHECK (to be done asap after each monitoring run)

Date & Time of Calibration Check: 5/11/21 1708

	Record Calibration Check Values	/	Known Standard Value	/	Temperature °C
Conductivity	1000	/	1000	/	16.59
pH 4	4.0	/	4.0	/	15.94
pH 7	6.93	/	7.00	/	15.80
pH 10	10.11	/	10.00	/	16.03
DO % saturation	99.0	/	96.5	/	14.23
DO mg/L		/		/	

Save the Boundary Waters - Lake Field Data Sheet

Lake Name
Birch Lake

Lake ID #
69-0003-00

Date
5/11/21

Time (24hr)

Sampled by: Lisa Pugh | Levi Lexvold

Weather

Wind Speed
☒0-5 ☐6-10 ☐11-15
☐16-20 ☐>21
% Cloudy 5%
Significant Weather
Rain ☐ Fog ☐
Other ______

Wind Direction
N W E S

Sonde SN: 07 F 101105
Handpad SN: 06E1765-AB

FIELD INFO.	A	B	C	D	E	F	G
SITE NAME	Equip blank	Bottle Blank	303	6009-182	202	203	503
DATE	5/11/21	5/11/21	5/11/21	5/11/21	5/11/21	5/11/21	5/11/21
TIME (24hr)	1126	1132	1255	1318	1331	1343	1400
Latitude			47.717441	47.71972	47.724148	47.7246	47.734729
Longitude			-91.87452	-91.87546	-91.882408	-91.8763	-91.871397
Depth (m)			1.5	1.5	7	6	6.5
Sample Collected? (Y/N)			Y	Y	Y	Y	Y
Secchi (nearest 0.5ft):			4.0	4.0	5.0	5.0	5.0
Appearance:	1A-clear; 1B-tea-colored; 2-cloudy; 3-muddy; 4-green; 5-muddy & green						
Appearance:			1B	1B	1B	1B	1B
Recreation Suitability:	1-Beautiful; 2-Excellent body contact; 3-Body contact impaired; 4-no swim/boating OK; 5-recreation nearly impossible						
Recreation Suitability			1	1	1	1	1
Water Temp °C			9.56°	7.27°	9.54	9.53	9.06
Conductivity (uS/cm)			230	238	122	120	119
pH (pH units)			7.30	7.29	7.29	7.37	7.3
DO (% Saturation)			101.5	98.9	97.8	99.2	95.6
DO (mg/l)			11.41	11.86	11.16	11.33	11.03
Color* (APHA platinum cobalt color units)	0-100 / 0-500	0-100 / 0-500	0-100 / [✓ 0-500] 10×5=50	0-100 / [✓ 0-500] 10×5=50	0-100 / [✓ 0-500] 10×5=50	0-100 / [✓ 0-500] 5×5=25	0-100 / [✓ 0-500] 10×5=50
Turbidity YSI Sonde (FNUs)							
SAMPLE DEVICE* (Van Dorn / None)			N	N	IS	IS	IS
SAMPLE TYPE* (Grab, Integrated)			G	G	I	I	I
QA* (Field Dup) Chain of Custody	EB	BB	COC	COC	COC	COC	COC
Field Notes	Equip. Blank Integrated Sampler	Bottle Blank	Too shallow for 2M IS	Too shallow for 2M IS			

Integrated Sampler

*See back of sheet for additional instructions/information

Updated 8-12-2020

1/3

Wild Rice WQLS, Exhibit G 30

Save the Boundary Waters - Lake Field Data Sheet

Lake Name
Birch Lake

Lake ID #
69-0003-00

Date 5/11/21 | Time (24hr)

Sampled by: Lisa Pugh | Levi Lexvold

Weather

Wind Speed
☒0-5 ☐6-10 ☐11-15
☐16-20 ☐>21

% Cloudy 5%

Significant Weather
Rain ☐ Fog ☐
Other ______

Wind Direction
N W E S

Sonde SN: 07 F 101105
Handpad SN: 06E1765 AB

FIELD INFO.	A	B	C	D	E	F	G
SITE NAME	BB-001	301	301-FD	BB-002	BB-002 FD	502	304
DATE	5/11/21	5/11/21	5/11/21	5/11/21	5/11/21	5/11/21	5/11/21
TIME (24hr)	1441	1452	1453	1504	1505	1517	1530
Latitude	47.72677	47.732252		47.73746		47.740078	47.741637
Longitude	-91.81266	-91.813176		-91.81108		-91.800436	-91.778835
Depth (m)	1	1.5		3		5.5	2.5
Sample Collected? (Y/N)	Y	Y	Y	Y	Y	Y	Y
Secchi (nearest 0.5ft):	2.5 *	4.0		4.5		3.0	3.0
Appearance:	1A-clear; 1B-tea-colored; 2-cloudy; 3-muddy; 4-green; 5-muddy & green						
Appearance:	1B	1B		1B		1B	1B
Recreation Suitability:	1-Beautiful; 2-Excellent body contact; 3-Body contact impaired; 4-no swim/boating OK; 5-recreation nearly impossible						
Recreation Suitability	1	1		1		1	1
Water Temp °C	13.22	9.90		9.64		9.77	10.29
Conductivity (uS/cm)	189	185		100		73	47
pH (pH units)	7.38	7.31		7.18		7.03	6.98
DO (% Saturation)	104	98.8		96.5		93.3	100.3
DO (mg/l)	10.92	11.15		10.9		10.54	11.24
Color* (APHA platinum cobalt color units)	0-100 / [✓ 0-500] 20 x5 = 100	0-100 / [✓ 0-500] 15×5 = 75	0-100 / 0-500	0-100 / [✓ 0-500] 30 ×5 = 150	0-100 / 0-500	0-100 / [✓ 0-500] 30×5 = 150	0-100 / [✓ 0-500] 30×5 = 150
Turbidity YSI Sonde (FNUs)							
SAMPLE DEVICE* (Van Dorn / None)	N	N	N	IS	IS	IS	IS
SAMPLE TYPE* (Grab, Integrated)	G	G	G	I	I	I	I
QA* (Field Dup) Chain of Custody	COC	COC	FD, COC	COC	FD, COC	COC	COC
Field Notes	Bottom Visible	Water depth <2M	Water depth <2M				

IS = Integrated Sampler

*See back of sheet for additional instructions/information

Updated 8-12-2020

2/3

Save the Boundary Waters - Lake Field Data Sheet

Lake Name
Birch Lake

Lake ID #
69-0003-00

Date 5/11/21

Time (24hr)

Sampled by: Lisa Pugh Levi Lexvold

Weather

Wind Speed
☒0-5 ☐6-10 ☐11-15
☐16-20 ☐>21
% Cloudy 5
Significant Weather
Rain ☐ Fog ☐
Other

Wind Direction

Sonde SN: 07 F 101105
Handpad SN: 06E1765 AB

FIELD INFO.	A	B	C	D	E	F	G
SITE NAME	302						
DATE	5/11/21						
TIME (24hr)	1558						
Latitude	47.769427						
Longitude	-91.756711						
Depth (m)	2.5						
Sample Collected? (Y/N)	Y						
Secchi (nearest 0.5ft):	4.0						
Appearance:	1A-clear; 1B-tea-colored; 2-cloudy; 3-muddy; 4-green; 5-muddy & green						
Appearance:	1B						
Recreation Suitability:	1-Beautiful; 2-Excellent body contact; 3-Body contact impaired; 4-no swim/boating OK; 5-recreation nearly impossible						
Recreation Suitability	1						
Water Temp °C	8.9						
Conductivity (uS/cm)	60						
pH (pH units)	6.6						
DO (% Saturation)	90.4						
DO (mg/l)	9.8						
Color* (APHA platinum cobalt color units)	0-100 / [✓ 0-500] 20x5 =100	0-100 / 0-500	0-100 / 0-500	0-100 / 0-500	0-100 / 0-500	0-100 / 0-500	0-100 / 0-500
Turbidity YSI Sonde (FNUs)							
SAMPLE DEVICE* (Van Dorn / None)	IS						
SAMPLE TYPE* (Grab, Integrated)	I						
QA* (Field Dup) Chain of custody	COC						
Field Notes							

Integrated Sampler

*See back of sheet for additional instructions/information

Updated 8-12-2020

3/3

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CHAIN OF CUSTODY RECORD

Page 1 of 2

Electronic version available at http://www.rmbel.info/lab/chains-of-custody/

Client: Northeastern Minnesotans for Wilderness / Save the Boundary Waters

Phone #: 952-237-6714

Fax #:

Project Name: Sulfate

Project Task Code:

PO/WO #:

Sampler: (print name) Lisa Pugh (LP)

Sampler Phone #: 952-237-6714

Report to: Lisa Pugh

Bill to: Lisa Pugh

Report to Email: lisa@savetheboundarywaters.org

Bill to Email: lisa@savetheboundarywaters.org

☐ "EQUIS" EDD Lab Format - MPCA Data Submittal

Work Order

Analyses Requested

Sample Number	Station ID/Sample Description	Date	Time	# of Bottles	Sample Method	Start Depth (m)	End Depth (m)	Sample Type	Matrix	Preserved at Collection	Preserved at Lab Receipt	Sulfate	Sample Comments: (Equipment Type, Filtration, AIS, Preservation)
	EB - Equip. Blank	5/11/21	1126	1	QC-Blank			QC-EB	QC-Blank			X	
	BB- Bottle Blank	5/11/21	1132	1	QC-Blank			QC-FB	QC-Blank			X	
	303	5/11/21	1255	1	G			Sample	Wtr-Surf			X	
	5009-182	5/11/21	1318	1	G			Sample	Wtr-Surf			X	
	202	5/11/21	1331	1	LKSURF2M			Sample	Wtr-Surf			X	
	203	5/11/21	1343	1	LKSURF2M			Sample	Wtr-Surf			X	
	503	5/11/21	1400	1	LKSURF2M			Sample	Wtr-Surf			X	
	BB-001	5/11/21	1441	1	LKSURF2M			Sample	Wtr-Surf			X	
	301	5/11/21	1452	1	G			Sample	Wtr-Surf			X	
	301-FD	5/11/21	1453	1	G			Wtr-surf	QC-FR			X	
	BB-002	5/11/21	1504	1	LKSURF2M			Sample	Wtr-Surf			X	
	BB-002-FD	5/11/21	1505	1	LKSURF2M			Wtr-surf	QC-FR			X	
	502	5/11/21	1517	1	LKSURF2M			Sample	Wtr-Surf			X	

_______ (Initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) I hereby authorize RMB Environmental Laboratories to process the samples as received.

_______ (Initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) please contact client at phone # ____________ before processing samples.

Relinquished by: (client signature)

Print Name: Lisa Pugh

Date: 5/12/21

Time: 1005

Shipping to Lab: ☐ Speedee ☐ UPS ☐ USPS ☐ FedEx ☐ Courier ☐ RMB Courier ☒ Hand Delivery

FOR LAB USE ONLY

Received by Lab: (signature) Kathie Mitchell

Date: 5/12/21

Time: 1005

Additional Fees: Mileage: Field Staff: Shipping: Courier: Equipment: Other:

☐ **DOES** meet proper sample storage and transportation guidelines

☐ Does **NOT** meet proper sample storage and transportation guidelines

☒ Received on ice ☐ Received at room temperature

☐ Samples received same day as collection

Received Temp: ______ °C Therm. ID: LTG ______

Chlorine: No Yes N/A

Comments: ____________

VOC vials received w/o headspace: bubble < 6mm: Yes No N/A

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CHAIN OF CUSTODY RECORD

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☐ "EQUIS" EDD Lab Format - MPCA Data Submittal

Client: Save the Boundary Waters (STBW)/NMW
Phone #:
Fax #:
Project Name: Sulfate
Project Task Code:
PO/WO #:
Sampler: (print name) Lisa Pugh
Sampler Phone # 952-237-6714
Report to: Lisa Pugh
Bill to: Lisa Pugh
Report to Email: lisa.a.pugh@gmail.com
Bill to Email: lisa@savetheboundarywaters.org

Lab Code	Station ID/Sample Description	Date	Time	# of Bottles	Sample Method	Start Depth (m)	End Depth (m)	Sample Type	Matrix	Analyses Requested: Sulfate	Sample Comments: (Equipment Type, Filtration, AIS, Preservation)
	304	5/11/21	1530	1	LKSURF2M			Sample	Wtr surf	X	
	302	5/11/21	1558	1	LKSURF2M			Sample	Wtr surf	X	

________ (Initials) In the event that samples are received by the lab at a temperature greater than 6 ° C, I hereby authorize RMB Environmental Laboratories to process the samples as received.

________ (Initials) In the event that samples are received by the lab at a temperature greater than 6 ° C, please contact client at phone # ________________ before processing samples.

Relinquished by: (client signature)	Date	Time	Relinquished by Lab: (signature)	Date	Time
	5/12/21	1005			
Received by Lab: (signature)	**Date**	**Time**	**Received by Lab: (signature)**	**Date**	**Time**
	5/12/21	10:06			

☐ DOES meet proper sample storage and transportation guidelines
☐ Does NOT meet proper sample storage and transportation guidelines
Explain:
☒ Rcvd on ice ☐ Rcvd at room temp Rcvd Temp: ______ ° C
☐ Samples received same day as collection LTG: ______
Comments: ______ Chlorine: No Yes NA

☐ DOES meet proper sample storage and transportation guidelines
☐ Does NOT meet proper sample storage and transportation guidelines
Explain:
☐ Rcvd on ice ☐ Rcvd at room temp Rcvd Temp: ______ ° C
☐ Samples received same day as collection LTG: ______
Comments: ______

BILLING
Shipping / Courier:
Mileage:
Field Staff:
Equipment:
Other:

SHIPPING TO LAB
☐ Speedee
☐ UPS
☐ USPS
☐ FedEx
☒ Hand Delivery
☐ Courier
☐ RMB Courier

INTERLAB SHIPPING
☐ Speedee
☐ UPS
☐ USPS
☐ FedEx
☐ Courier
☐ RMB Courier

Save the Boundary Waters Sonde Calibration Work Sheet

Date & Time of Calibration: 6/1/21 0839

Sonde Serial # 07F101105

Technician: Lisa Pugh

Hand Pad Serial # 06E1765 AB

DO membrane changed? [✓ Y] N 5/28/21

Note: Should wait 6 to 8 hours before final DO calibration, run sensor for 15 minutes in Discrete Run to accelerate burn-in.

Turbidity wiper changed? Y N N/A

Wiper parks ≈ 180° from optics? Y N N/A

Note: Change wiper if probe will not park correctly.

Record battery voltage: 95%

Record the following diagnostic numbers after/during calibration.

Conductivity cell constant 4.87686 Range 5.0 ±.5

pH MV Buffer 4 154.6 Range +177 from 7 buffer MV

pH MV Buffer 7 -16.6 Range 0 MV ± 50 MV

pH MV Buffer 10 -195.0 Range –177 from 7 buffer MV

NOTE: Span between pH 4 and 7 and 7 and 10 millivolt numbers should be ≈ 165 to 180 MV

DO charge 70.6 Range 50 ±25

DO gain 1.03113 Range 1.0 .7 to 1.5

Pressure Offset ______ Range –14.7 ± 6 (non-vented)

Pressure Offset ______ Range 0 ± 6 (vented)

ORP mV Offset ______ Range 0 ± 100

Record Calibration Values

	Before Calibration	After calibration	Cal. Standard Expiration Date
Conductivity	16.47°C 1006	1000	10/12/21
pH 4	15.94°C 3.98	4.00	3/13/22
pH 7	16.00°C 7.01	7.00	3/13/22
pH 10	16.05°C 10.15	10.02	3/13/22
Turbidity 0			
Turbidity 123			
DO	97.2	96.0	
ORP			
Depth			

30.13 inHg × 25.4 = 765.302 - 35.675 = 729.627 mmHg

DISSOLVED OXYGEN SENSOR OUTPUT TEST (after DO calibration probe in saturated air)

The following tests will confirm the proper operation of your DO sensor. The DO charge and gain must meet spec before proceeding.

610/650– Turn off the 610/650, wait 60 seconds. Power up 610/650 and go to the Run mode, watch the DO % output; it must display a positive number and decrease with each 4 second sample, eventually stabilizing to the calibration value in approximately 60 to 120 seconds. **Note:** You can disregard the first two samples they can be affected by the electronics warm-up.

PC – Stop discrete and unattended sampling. Confirm that auto-sleep RS-232 is enabled (found in Advanced Menu under Setup). Wait 60 seconds. Start discrete sampling at 4 seconds. Watch the DO % output, it must display a positive number and decrease with each 4 second sample, eventually stabilizing to the calibration value in approximately 60 to 120 seconds. **Note:** You can disregard the first two samples they can be affected by the electronics warm-up.

The **ACCEPT/REJECT** criteria as follows:
The DO output in % must start at a positive number and decrease during the warm up. Example: 117, 117, 114, 113, 110, 107, 104, 102, 101, 100, 100. Should the output display a negative number or start at a low number and climb up to the cal point, the probe is rejected and must not be deployed.

X **ACCEPT** ______ **REJECT**

Notes: 1007.7 1003.5 101.1 99.7 98.6 97.8 97.3 96.9 96.6

96.4 96.3 96.2

96.1 96.0

DO check @ 1310
Pre-cal 97.8% Post-cal 95.7%
21.27°C

FINAL CALIBRATION CHECK (to be done asap after each monitoring run)

Date & Time of Calibration Check: 6/1/21 1835

	Record Calibration Check Values	/	Known Standard Value	/	Temperature °C
Conductivity	1003	/	1000	/	28.45
pH 4	4.09	/	4.0	/	26.33
pH 7	6.92	/	7.0	/	25.51
pH 10	10.06	/	10.0	/	26.27
DO % saturation	95.0	/	96.0	/	18.97
DO mg/L	4.79	/	N/A	/	

Samples collected by Lisa Pugh

Handpad s/N: 06E1765AB Wind direction: SW Cloud cover: 5% Sig. weather: N

	Site	lat	lon	Date	Time	Lake depth	Sample depth	Temp	DO mg/L	DO%	SC ms/cm	pH	SO4 Mg/L	Sample Collected	Sample device	Sample Type	QA/QC	Field notes
	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
45	~~BL-002~~																	
46	EB-VD			6/1/21	1357									Y	VD	QAQC	EB,coc	Equip. Blank - VD
47	BB			6/1/21	1410									Y	N	QAQC	BB,coc	Bottle Blank
48	EB-IS			6/1/21	1502									Y	IS	QAQC	EB,COC	Equip. Blank - IS
49																		
50	BL-003					6+												
51																		
52																		
53																		
54																		
55																		
56																		
57																		
58	BB-001			6/1/21	1355	1	0	22.33	9.44	100.5	180	7.78		N	N			
59	BB-001	47.72677	-91.81266	6/1/21	1401	1 >1	0.5	21.14	9.31	104.9	174	7.48		Y	VD	VD	COC	
60							1	19.18	11.15	119.0	350	7.75		N	N			Lake bottom
61	301	47.732252	-91.813176	6/1/21	1423	1.5 >2	1	16.28	9.14	94.1	110	7.48		Y	VD	VD	COC	
62							1.5	15.65	6.99	70.3	194	7.07		N	N			Lake bottom
63					1420		0	17.0	9.26	98.5	131	7.56		N	N			
64	BB-003	47.73368	-91.81376	6/1/21	1436	2	0	22.2	9.09	103.8	130	7.45		~~Y N~~	~~VD N~~	~~VD~~		
65							1	18.4	9.58	102.2	117	7.31		Y	VD	VD	COC	FD
66							2	15.52	9.5	95.4	195	7.22		N	N			Near bottom
							2*	15.52	8.1	82.6	186	6.66						Lake bottom
	Equip Blank	N/A		6/1/21	1357	NA								N	VD	VD	EB	

1

Wild Rice WQLS, Exhibit G

	Site	lat	long	Date	Time	Lake (m) depth	Sample depth (m)	Temp	DO mg/L	DO%	SC us/cm	pH	SO4 mg/L	Sample Collected	Sample Device	Sample Type	QA/QC	Field notes
	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
67	BB-003 FD			6/1/21	1437	2	1							Y	VD	QAQC	FD, COC	
68																		
69	~~BB-002~~	~~47.73746~~	~~-91.81108~~	6/1/21	1506	3 ~~3-3.5~~	0	20.0	8.92	98.2	108	7.29						
70	BB-002						1	18.3	9.23	98.3	100	7.22						
71					1506		2	17.94	9.04	95.5	98	7.10		N	N	Sample		Boat drifted, resample
72							3	15.9	8.6	87.2	101	6.67						Near bottom
73							3	15.7	8.4	85.0	103	6.56						Lake bottom
74	BL-004	47.74118	-91.81052	6/1/21	1545	6 ~~3-4.5~~	0 1	18.46 18.20	9.23 9.23	98.4 97.9	103 102	7.7 7.17		N	N			
75	BL-004 surf				1547		2	17.4	9.10	94.19	98	7.2		Y	IS	I	COC	
76	BL-004 mid				1550		3	15.85	8.73	86.7	96	7.11		Y	VD	VD	COC	Sample taken @ 3.5m
77							4	15.69	8.41	84.9	94	7.04		N	N			
78	BL-004 Deep				1556		5	15.38	7.98	80.1	99	6.94		Y	VD	VD	COC	Sample taken @ 5.5m, FD
79							6	14.8 14.7	6.25 1.15	66.6 13.5	117 130	6.82 6.75		N	N			Near bottom Lake bottom
80	BL-005	47.73889	-91.80754	6/1/21	1515	6 ~~3-4.5~~	0 1	20.8 18.5	9.12 9.33	102.2 103	107 103	7.29 7.19		N	N			
81	BL-005 surf				1520		2	18.1	9.19	97.5	100	7.15		Y	IS	I	COC	
82	BL-005 mid				1522		3	16.0	8.95	91.5	96	7.09		Y	VD	VD	COC	Sample taken @ 3.5m
83							4	15.3	7.68	77.4	99	6.9		N	N			
84	BL-005 deep				1527		5	15.21	7.24	72.4	102	6.39		Y	VD	VD	COC	Sample taken @ 5.5m
85							6.5 6	15.09 14.25	7.02 1.73	69.7 24.6	106 153	7.39 6.41		N	N			Near bottom Lake bottom
86	502	47.740078	-91.800436	6/1/21	1635	5.5 ~~4.5-6~~	0	18.36	9.14	97.0	98	7.05		N	N			
87							1	18.22	9.09	96.5	96	7.05		N	N			
88	502-S				1639		2	17.75	9.03	95	96	7.08		Y	IS	I	COC	
	BL-004-Deep FD			6/1/21	1557	6	5.5							Y	VD	QAQC	FD, COC	

2

Site	lat	long	Date	Time	lake depth (m)	Sample depth (m)	Temp	DO mg/L	DO%	SC uS/cm	pH	SO4 mg/L	Sample Collected	Sample Device	Sample Type	QA/QC	Field Notes
D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
502-M			6/1/21	1642	5.5	3	15.96	8.62	87.7	86	6.99		Y	VD	VD	COC	
						4	15.74	8.42	85.1	91	6.95		N	N			
502-D				1647		5	15.31	7.68	77.8	97	6.89		Y	VD	VD	COC	
						5.5	14.4	2.07	24.4	132	6.78		N	N			Lake bottom
204	47.7519	-91.7855	6/1/21	1705	8.5	0	20.06	9.09	100.1	93	7.06		N	N			
						1	19.78	9.14	100.1	93	7.06		N	N			
204-S				1709		2	16.8	9.13	94.8	84	7.02		Y	IS	I	COC	
						3	16.05	8.65	88.4	84	6.91		N	N			
204-M				1713		4	15.77	8.38	84.5	86	6.9		Y	VD	VD	COC	Sample taken @ 4m
						5	15.63	8.18	82.2	85	6.85		N	N			
						6	15.54	7.87	71.2	85	6.75		N	N			
						7	15.5	7.7	77.6	85	6.62		N	N			
204-D				1717		8	15.5	7.61	76.2	85	6.61		Y	VD	VD	COC	Sample taken @ 8m
						8.5	15.21	0.57	6.5	118	6.54		N	N			Lake bottom

Wild Rice WQLS, Exhibit G

	Site	Lat	Long	Date	Time	Lake Depth (m)	Sample depth (m)	Temp	DO mg/L	DO %	SC uS/cm	pH	SO4 (mg/L)	Sample Collected	Sample Device	Sample Type	QA	Field Notes
	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
67	BB-003 cont																	
68																		
69	BB-002	47.73746	-91.81108	6/1/21	1610	3 ~~3.5~~	0	21.42	9.08	102.8	116	7.2		N	N			
70							1	18.35	9.4	105	103	7.25		N	N			
71	BB-002-S				1614		2	17.35	9.07	94.8	104	7.16		Y	IS	I		
72	BB-002-D				1620		3	16.26	8.81	90	105	7.08		Y	VD	VD		Sample taken @ ~ 3m; sonde read near botto
73							3	~~15.77~~ 15.8	~~7.71~~ 6.32	~~80.4~~ 60.3	~~128~~ 111	~~6.94~~ 6.84		N	N			Lake bottom
74	BL-004					3-4.5												
75																		
76																		
77																		
78																		
79																		
80	BL-005					3-4.5												
81																		
82																		
83																		
84																		
85																		
86	502	47.740078	-91.800436			4.5-6												
87																		
88																		

4

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CHAIN OF CUSTODY RECORD

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Page 1 of 4

Client: Save the Boundary Waters / Northeastern Minnesotans for Wilderness
Phone #:
Fax #:
Project Name: Sulfate rd 2
Project Task Code:
PO/WO #:
Sampler: (print name) Lisa Pugh
Sampler Phone #: 952-237-6714
Report to: Lisa Pugh
Bill to: STBW
Report to Email: lisa@savetheboundarywaters.org
Bill to Email: nicole@savetheboundarywaters.org

☐ "EQUIS" EDD Lab Format - MPCA Data Submittal

Work Order

Sample Number	Station ID/Sample Description	Date	Time	# of Bottles	Sample Method	Start Depth (m)	End Depth (m)	Sample Type	Matrix	Preserved at Collection	Preserved at Lab Receipt	Analyses Requested: Sulfate	Sample Comments: (Equipment Type, Filtration, AIS, Preservation)
	Equip. Blank - VD	6/1/21	1357	1	QCBLANK			QC-EB	~~Wtr-surf~~ QC-BLANK			X	
	BB-001	6/1/21	1401	1	LKDEPTH	0.5	0.5	Sample	Wtr-surf			X	
	Bottle Blank	6/1/21	1410	1	QCBLANK			QC-FB	QCBLANK			X	
	301	6/1/21	1423	1	LKDEPTH	1	1	Sample	Wtr-surf			X	
	BB-003	6/1/21	1436	1	LKDEPTH	1	1	Sample	Wtr-surf			X	
	BB-003 - FD	6/1/21	1437	1	LKDEPTH	1	1	QC-FR	Wtr-surf			X	
	Equip. Blank - I	6/1/21	1502	1	QCBLANK			QC-EB	QCBLANK			X	
	BL-004-surf	6/1/21	1547	1	LKSURF2M	0	2	Sample	Wtr-surf			X	
	BL-004 - mid	6/1/21	1550	1	LKDEPTH	3.5	3.5	Sample	Wtr-surf			X	
	BL-004 - deep	6/1/21	1556	1	LKDEPTH	5.5	5.5	Sample	Wtr-surf			X	
	BL-004 - deep - FD	6/1/21	1557	1	LKDEPTH	5.5	5.5	QC-FR	Wtr-surf			X	
	BL-005 - surf	6/1/21	1520	1	LKSURF2M	0	2	Sample	Wtr-surf			X	
	BL-005 - mid	6/1/21	1522	1	LKDEPTH	3.5	3.5	Sample	Wtr-surf			X	

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________ (Initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) please contact client at phone # ________________ before processing samples.

Relinquished by: (client signature)
Print Name: Lisa Pugh
Date 6/3/21
Time 0837

Shipping to Lab: ☐ Speedee ☐ UPS ☐ USPS ☐ FedEx ☐ Courier ☐ RMB Courier ☒ Hand Delivery

FOR LAB USE ONLY

Received by Lab: (signature)
Date 6/3/21
Time 0835

Additional Fees: Mileage: Field Staff: Shipping: Courier: Equipment: Other:

☐ **DOES** meet proper sample storage and transportation guidelines
☐ Does **NOT** meet proper sample storage and transportation guidelines
☐ Received on ice
☐ Received at room temperature
☐ Samples received same day as collection
Received Temp: ______ ° C Therm. ID: LTG ______
Chlorine: No Yes N/A

Comments: ________________________________

VOC vials received w/o headspace: bubble < 6mm: Yes No N/A

Wild Rice WQLS, Exhibit G

RMB Environmental Laboratories, Inc.

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Page 2 of 4

ent: STBW / NMW
oject Name: Sulfate rd. 2
mpler: (print name) Lisa Pugh
port to:
port to Email:
Phone #:
Project Task Code:
Sampler Phone #:
Bill to:
Bill to Email:
Fax #:
PO/WO #:

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Analyses Requested

Work Order

mple mber	Station ID/Sample Description	Date	Time	# of Bottles	Sample Method	Start Depth (m)	End Depth (m)	Sample Type	Matrix	Preserved at Collection	Preserved at Lab Receipt	Sulfate	Sample Comments: (Equipment Type, Filtration, AIS, Preservation)
	BL-005-deep	6/1/21	1527	1	LKDEPTH	5.5	5.5	Sample	Wtr surf			X	
	BB-002-surf	6/1/21	1614	1	LKSURF2M	0	2	Sample	Wtr surf			X	
	BB-002-deep	6/1/21	1620	1	LKDEPTH	3	3	Sample	Wtr surf			X	
	502-surf	6/1/21	1639	1	LKSURF2M	0	2	Sample	Wtr surf			X	
	502-mid	6/1/21	1642	1	LKDEPTH	3	3	Sample	Wtr surf			X	
	502-deep	6/1/21	1647	1	LKDEPTH	5	5	Sample	Wtr surf			X	
	204-surf	6/1/21	1709	1	LKSURF2M	0	2	Sample	Wtr surf			X	
	204-mid	6/1/21	1713	1	LKDEPTH	4	4	Sample	Wtr surf			X	
	204-deep	6/1/21	1717	1	LKDEPTH	8	8	Sample	Wtr Surf			X	
	Bottle blank	6/2/21	0725	1	QCBLANK			QC-FB	QC-BLANK			X	
	Equip. Blank-VD	6/2/21	0730	1	QCBLANK			QC-EB	QC-BLANK			X	
	Equip. Blank-I	6/2/21	0735	1	QCBLANK			QC-EB	QC-BLANK			X	
	303	6/2/21	0805	1	LKDEPTH	1	1	Sample	Wtr surf			X	

_______ (Initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) I hereby authorize RMB Environmental Laboratories to process the samples as received.

_______ (Initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) please contact client at phone # _______________ before processing samples.

Relinquished by: (client signature)
Print Name: Lisa Pugh
Date 6/3/21
Time 0837

Shipping to Lab: ☐ Speedee ☐ UPS ☐ USPS ☐ FedEx ☐ Courier ☐ RMB Courier ☒ Hand Delivery

FOR LAB USE ONLY

Received by Lab: (signature)
Date 6/3/21
Time 0835
Mileage:
Additional Fees: Field Staff: Shipping: Courier: Equipment: Other:

☐ **DOES** meet proper sample storage and transportation guidelines
☐ Does **NOT** meet proper sample storage and transportation guidelines
☐ Received on ice ☐ Received at room temperature
☐ Samples received same day as collection
Received Temp: _______ ° C Therm. ID: LTG _______
Chlorine: No Yes N/A

Comments: _______________

VOC vials received w/o headspace: bubble < 6mm: Yes No N/A

Wild Rice WQLS, Exhibit G

RMB Environmental Laboratories, Inc.
Bloomington, MN   Detroit Lakes, MN   Hibbing, MN
1.888.200.5770 • rmbel@rmbel.info • www.rmbel.info

CHAIN OF CUSTODY RECORD

Electronic version available at http://www.rmbel.info/lab/chains-of-custody/

Page 3 of 4

Client: STBW/NMW
Phone #:
Fax #:
Project Name: Sulfate rd. 2
Project Task Code:
PO/WO #:
Sampler: (print name) Lisa Pugh
Sampler Phone #:
Report to:
Bill to:
Report to Email:
Bill to Email:

☐ "EQUIS" EDD Lab Format - MPCA Data Submittal

Analyses Requested

Work Order

Sample Number	Station ID/Sample Description	Date	Time	# of Bottles	Sample Method	Start Depth (m)	End Depth (m)	Sample Type	Matrix	Preserved at Collection	Preserved at Lab Receipt	Sulfate	Sample Comments: (Equipment Type, Filtration, AIS, Preservation)
	S009-182	6/2/21	0819	1	LKDEPTH	1	1	Sample	Wtr-surf			X	
	202-surf	6/2/21	0838	1	LKSURF2M	0	2	Sample	Wtr-surf			X	
	202-mid	6/2/21	0841	1	LKDEPTH	4	4	Sample	Wtr-surf			X	
	202-deep	6/2/21	0848	1	LKDEPTH	6.5	6.5	Sample	Wtr-surf			X	
	203-surf	6/2/21	0909	1	LKSURF2M	0	2	Sample	Wtr-surf			X	
	203-mid	6/2/21	0911	1	LKDEPTH	3.5	3.5	Sample	Wtr-surf			X	
	203-deep	6/2/21	0918	1	LKDEPTH	5	5	Sample	Wtr-surf			X	
	203-deep-FD	6/2/21	0919	1	LKDEPTH	5	5	QC-FR	Wtr-surf			X	
	503-surf	6/2/21	0951	1	LKSURF2M	0	2	Sample	Wtr-surf			X	
	503-mid	6/2/21	0954	1	LKDEPTH	4	4	Sample	Wtr-surf			X	
	503-deep	6/2/21	0957	1	LKDEPTH	6	6	Sample	Wtr-surf			X	
	BL-002-surf	6/2/21	1015	1	LKSURF2M	0	2	Sample	Wtr-surf			X	
	BL-002-mid	6/2/21	1018	1	~~L~~KDEPTH	4	4	Sample	Wtr-surf			X	

________ (Initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) I hereby authorize RMB Environmental Laboratories to process the samples as received.

________ (Initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) please contact client at phone # ________________ before processing samples.

Relinquished by: (client signature)
Print Name: Lisa Pugh
Date 6/3/21
Time 0837
Shipping to Lab: ☐ Speedee ☐ UPS ☐ USPS ☐ FedEx ☐ Courier ☐ RMB Courier ☒ Hand Delivery

FOR LAB USE ONLY

Received by Lab: (signature)
Date 6/3/21
Time 0835
Additional Fees:
Mileage:
Field Staff:
Shipping:
Courier:
Equipment:
Other:

☐ **DOES** meet proper sample storage and transportation guidelines
☐ Does **NOT** meet proper sample storage and transportation guidelines
☐ Received on ice
☐ Received at room temperature
☐ Samples received same day as collection
Received Temp: ______ ° C
Therm. ID: LTG ________
Chlorine: No Yes N/A

Comments: ________________________________

VOC vials received w/o headspace: bubble < 6mm: Yes No N/A

RMB Environmental Laboratories, Inc.
Bloomington, MN Detroit Lakes, MN Hibbing, MN
1.888.200.5770 • rmbel@rmbel.info • www.rmbel.info

CHAIN OF CUSTODY RECORD

Page 4 of 4

Electronic version available at http://www.rmbel.info/lab/chains-of-custody/

☐ "EQUIS" EDD Lab Format - MPCA Data Submittal

Work Order

Client: STBW/NMW
Project Name: Sulfate rd 2
Sampler: (print name) Lisa Pugh
Report to:
Report to Email:
Phone #:
Project Task Code:
Sampler Phone #:
Bill to:
Bill to Email:
Fax #:
PO/WO #:

Analyses Requested

Sample Number	Station ID/Sample Description	Date	Time	# of Bottles	Sample Method	Start Depth (m)	End Depth (m)	Sample Type	Matrix	Preserved at Collection	Preserved at Lab Receipt	Sulfate												Sample Comments: (Equipment Type, Filtration, AIS, Preservation)
	BL-002-Deep	6/2/21	1024	1	LKDEPTH	6	6	Sample	Wtr-surf			X												
	BL-003-Surf	6/2/21	1039	1	LKSURF2M	0	2	Sample	Wtr-surf			X												
	BL-003-mid	6/2/21	1043	1	LKDEPTH	4	4	Sample	Wtr-surf			X												
	BL-003-deep	6/2/21	1046	1	LKDEPTH	6	6	Sample	Wtr-surf			X												
	BL-001-Surf	6/2/21	1106	1	LKSURF2M	0	2	Sample	Wtr-surf			X												
	BL-001-mid	6/2/21	1108	1	LKDEPTH	4	4	Sample	Wtr-surf			X												
	BL-001-mid FD	6/2/21	1109	1	LKDEPTH	4	4	~~Sample~~ QC-FR	Wtr-surf			X												
	BL-001-deep	6/2/21	1118	1	LKDEPTH	6	6	Sample	Wtr-surf			X												

_______ (Initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) I hereby authorize RMB Environmental Laboratories to process the samples as received.

_______ (Initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) please contact client at phone # ____________ before processing samples.

Relinquished by: (client signature)
Print Name: Lisa Pugh
Date 6/3/21
Time 0837

Shipping to Lab:
☐ Speedee ☐ UPS ☐ USPS ☐ FedEx ☐ Courier ☐ RMB Courier ☒ Hand Delivery

FOR LAB USE ONLY

Received by Lab: (signature)
Date 6/3/21
Time 0835

Additional Fees:
Mileage:
Field Staff:
Shipping:
Courier:
Equipment:
Other:

☐ **DOES** meet proper sample storage and transportation guidelines
☐ Does **NOT** meet proper sample storage and transportation guidelines
☐ Received on ice
☐ Received at room temperature
☐ Samples received same day as collection

Received Temp: ______ ° C Therm. ID: LTG ______
Chlorine: No Yes N/A

Comments: ____________________

VOC vials received w/o headspace: bubble < 6mm: Yes No N/A

Save the Boundary Waters Sonde Calibration Work Sheet

Date & Time of Calibration: 6/2/21 0610

Sonde Serial # 07F101105

Technician: Lisa Pugh

Hand Pad Serial # 06E1765_AB

DO membrane changed? Y [✓ N]
Last changed 5/28/21

Note: Should wait 6 to 8 hours before final DO calibration, run sensor for 15 minutes in Discrete Run to accelerate burn-in.

Turbidity wiper changed? Y N
N/A

Wiper parks ≈ 180° from optics? Y N
N/A

Note: Change wiper if probe will not park correctly.

Record battery voltage: 80%

Record the following diagnostic numbers after/during calibration.

Conductivity cell constant	4.91631	Range 5.0	± .5
pH MV Buffer 4	152.3	Range +177 from 7 buffer MV	
pH MV Buffer 7	-19.8	Range 0 MV	± 50 MV
pH MV Buffer 10	-197.7	Range −177 from 7 buffer MV	
DO charge	75.7	Range 50	± 25
DO gain	1.02309	Range 1.0	.7 to 1.5
Pressure Offset		Range −14.7	± 6 (non-vented)
Pressure Offset		Range 0	± 6 (vented)
ORP mV Offset		Range 0	± 100

NOTE: Span between pH 4 and 7 and 7 and 10 millivolt numbers should be ≈ 165 to 180 MV

Record Calibration Values

	Before Calibration	After calibration	Cal. Standard Expiration Date
Conductivity 17.99°C	990	1000	10/12/21
pH 4 18.08°C	4.0	4.0	3/13/22
pH 7 14.16°C	7.0	7.0	3/13/22
pH 10 18.16°C	10.12	10.01	3/13/22
Turbidity 0			
Turbidity 123			
DO	96.6	96.0	
ORP			
Depth			

30.14 mbHg × 25.4 = 765.556 −35.675 = $\boxed{729.881}$

DISSOLVED OXYGEN SENSOR OUTPUT TEST (after DO calibration probe in saturated air)

The following tests will confirm the proper operation of your DO sensor. The DO charge and gain must meet spec before proceeding.

610/650– Turn off the 610/650, wait 60 seconds. Power up 610/650 and go to the Run mode, watch the DO % output; it must display a positive number and decrease with each 4 second sample, eventually stabilizing to the calibration value in approximately 60 to 120 seconds. **Note:** You can disregard the first two samples they can be affected by the electronics warm-up.

PC – Stop discrete and unattended sampling. Confirm that auto-sleep RS-232 is enabled (found in Advanced Menu under Setup). Wait 60 seconds. Start discrete sampling at 4 seconds. Watch the DO % output, it must display a positive number and decrease with each 4 second sample, eventually stabilizing to the calibration value in approximately 60 to 120 seconds. **Note:** You can disregard the first two samples they can be affected by the electronics warm-up.

The **ACCEPT/REJECT** criteria as follows:
The DO output in % must start at a positive number and decrease during the warm up. Example: 117, 117, 114, 113, 110, 107, 104, 102, 101, 100, 100. Should the output display a negative number or start at a low number and climb up to the cal point, the probe is rejected and must not be deployed.

✓ **ACCEPT** ______ **REJECT**

Notes:

103.9 101.6 100.1 99.1 98.3 97.8 97.4 97.1 97.0

96.7 96.6 96.5 96.4

FINAL CALIBRATION CHECK (to be done asap after each monitoring run)

Date & Time of Calibration Check: 6/2/21 1251

	Record Calibration Check Values	Known Standard Value	Temperature °C
Conductivity	1003	1000	18.19
pH 4	3.97	4.0	17.8
pH 7	6.9	7.0	17.94
pH 10	9.95	10.00	18.00
DO % saturation	91.0		17.15
DO mg/L	8.77		

Wild Rice WQLS, Exhibit G

Samples collected by Lisa Pugh + Levi Lexvold

Sonde S/N 07F101105 Handpad S/N 06E1765AB

Wind speed 0-5 mph

Wind direction: SW

Cloud cover: 20%

p 1 of 3

Significant weather: N

	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1	te	Latitude	Longitude	Date	Time	Lake Depth (m)	Sample Depth (m)	Water Temp (∘C)	DO (mg/L)	DO (% saturation)	Specific Conductance (uS/cm)	pH (pH units)	Sulfate result (mg/L)	Sample Collected (Y/N)	Sample Device (Van Dorn; 2M Integrated Sampler; None)	Sample Type (Grab/Integrated)	QA (Field Dup; Bottle Blank; Equipment Blank)	Field notes
2	303	47.717435	-91.874516	6/2/21	0800	1.5 >2	0	18.36	9.42	100.3	147	7.76		N	N			
3					0805		1	18.28	9.49	100.8	153	7.53		Y	VD	VD	CoC	Sample taken @ 0805
4							1.5	16.8 16.86	9.03 3.03	94.5 32.8	202 186	7.33 6.98		N	N			Near bottom Lake bottom
5	S009-182	47.71972	-91.87546	6/2/21	0815	1.5 >2	0	18.24	9.36	99.2	132	7.46		N	N			
6					0819		1	18.07	9.41	99.9	133	7.43		Y	VD	VD	CoC	Sample taken @ 0819
7							1.5	17.3 17.3	8.85 8.02	93.3 84.0	145 143	7.25 7.08		N	N			Near bottom Lake bottom
8	202	47.724148	-91.882408	6/2/21	0835	7 8+	0	17.28	9.57	99.5	119	7.45		N	N			
9							1	17.28	9.68	100.7	119	7.38		N	N			
10	202-S				0838		2	16.5	9.64	98.5	119	7.32		Y	2MI	I	CoC	
11							3	15.15	9.06	90.8	117	7.17		N	N			
12	202-M				0841		4	14.91	8.84	87.4	118	7.12		Y	VD	VD	CoC	
13							5	14.8	8.73	86.2	119	7.1		N	N			
14	202-D				0848		6	14.3	8.47	83.4	120	7.04		Y	VD	VD	CoC	Sample taken @ 6.5m
15							7	13.5 13.56	4.2 ~~1.81~~	48.1 [illegible]	133 142	6.65 6.7		N	N	N		Near bottom Lake bottom
16	203	47.7246	-91.8763	6/2/21	0905	5.5 ~~4.5~~	0	17.56	0.48 9.4	5.1 98.5	122	7.34		N	N			
17							1	17.40	9.39	98.2	122	7.30		N	N			
18	203 surf				0909		2	16.66	9.16	94.1	118	7.22		Y	IS	I	CoC	
19	203-mid				0911		3	15.16	8.77	87.2	116	7.07		Y	VD	VD	CoC	Sample taken @ 3.5m
20							4	15.03	8.66	86.1	117	6.92		N	N			
21	203-deep				0918		5	14.77	8.54	84.7	118	6.89		Y	VD	VD	CoC	FD taken @ this site + depth
22							5.5	14.56 13.73	8.14 2.1	80.7 20.0	120 140	6.83 6.86		N	N			Near bottom Lake bottom
	203-deep FD	↓	↓	6/2/21	0919	5.5	5							Y	VD	VD	FD, CoC	

1

Wild Rice WQLS, Exhibit G

	Site	Lat	Long	Date	Time	Lake (m) Depth	Sample Depth (m)	Temp	DO mg/L	DO%	SC uS/cm	pH	SO4 mg/L	Sample Collected	Sample Device	Sample Tybe	QA/QC	Field Notes
	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
23	BL-001	47.73013	-91.87808	6/2/21	1100	6.5 6+	0	17.49	9.29	97.3	117	7.17		N	N			
24							1	16.02	9.01	91.5	116	7.10		N	N			
25	BL-001-S				1106		2	15.39	8.48	84.9	113	6.98		Y	IS	I	CoC	
26							3	15.25	8.47	84.5	115	6.95		N	N			
27	BL-001-M				1108		4	15.18	8.51	84.5	116	6.92		Y	VD	VD	CoC	
28							5	15.15	8.47	84.3	116	6.94		N	N			
29	BL-001-D				1118		6	14.51	8.22	80.3	119	6.83		Y	VD	VD	CoC	FD taken @ this site
30							6.5	13.88	6.31	63.1	121	6.67		N	N			Near bottom
31							6.5	13.78	3.34	38.1	125	6.52		N	N			lake bottom
32	503	47.734729	-91.871397	6/2/21	0945	6.5 6+	0	17.13	9.48	98.5	120	7.36		N	N			
33							1	17.02	9.48	98.1	118	7.28		N	N			
34	503-S				0951		2	16.86	9.44	97.3	117	7.23		Y	IS	I	CoC	
35							3	16.5	9.3	95.6	116	7.16		N	N			
36	503-M				0954		4	15.7	9.12	92.3	115	7.02		Y	VD	VD	CoC	
37							5	14.95	9.47	85.1	116	6.79		N	N			
38	503-D				0957		6	14.6	7.98	79.3	117	6.79		Y	VD	VD	CoC	
39							6.5	14.0	6.6	64.0	122	6.62		N	N			Near bottom
40							6.5	13.96	3.7	40.0	127	6.5		N	N			Lake bottom
41	BL-002	47.7440	-91.87434	6/2/21	1010	6.5 6+	0	17.77	9.42	99.1	118	7.24		N	N			
42							1	17.65	9.44	99.0	118	7.25		N	N			
43	BL-002-S				1015		2	17.53	9.41	98.5	118	7.26		Y	IS	I	CoC	
44							3	16.1	9.13	93.2	115	7.14		N	N			
	BL001-mid-FD			6/2/21	1109	6.5	4							Y	VD	VD	FD, coc	

2

	Site	Lat	Long	Date	Time	Lake Depth (m)	Depth (m)	Temp	DO mg/L	DO%	SC uS/cm	pH	SO4 (mg/L)	Sample Collected	Sample Device	Sample Type	QA/QC	Field notes
	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
45	BL-002-M cont.			6/2/21	1018	6.5	4	15.5	8.7	87.5	113	7.02		Y	VD	VD	CoC	
46							5	15.26	8.43	84.4	112	6.83		N	N			
47	BL-002-D				1024		6	14.7	8.0	80.2	117	6.62		Y	VD	VD	CoC	
48							6.5	14.23	6.27	63.4	119	6.45		N	N			Near bottom
49							6.5	13.93	1.78	20.4	127	6.4		N	N			Lake bottom
50	BL-003	47.74677	-91.86386	6/2/21	1035	7 6+	0	18.44	9.37	99.8	117	7.31		N	N			
51							1	17.89	9.41	99.4	117	7.29		N	N			
52	BL-003-S				1039		2	17.52	9.38	98.2	117	7.30		Y	IS	I	CoC	
53							3	15.93	8.86	92.7	108	7.17		N	N			
54	BL-003-M				1043		4	15.6	8.4	84.4	108	6.99		Y	VD	VD	CoC	
55							5	15.31	8.31	82.8	110	6.95		N	N			
56	BL-003-D				1046		6	14.94	7.91	78.9	113	6.92		Y	VD	VD	CoC	Sample taken @ 6.5m
57							7	14.13	6.43	62.5	117	6.71		N	N			Near bottom
58							7	13.85	3.84	39.6	133	6.58		N	N			Lake bottom
59	BB-001	47.72677	-91.81266			>1												
60																		
61	301	47.732252	-91.813176			>2												
62																		
63																		
64	BB ~~BB-003~~			6/2/21	0725									Y	N	QC		Bottle Blank
65	EB-VD			6/2/21	0730									Y	VD	QC		Equip. Blank -VD
66	EB-IS			6/2/21	0735									Y	IS	QC		Equip. Blank -IS

Save the Boundary Waters Sonde Calibration Work Sheet

Date & Time of Calibration: 6/7/21 0455

Sonde Serial # ~~07F101105~~ 02C0885 AC

Technician: Lisa Pugh

Hand Pad Serial # 06E1765_AB

DO membrane changed? [✓ Y] N

Changed 6/6/21; all o-rings cleaned/replaced

Note: Should wait 6 to 8 hours before final DO calibration, run sensor for 15 minutes in Discrete Run to accelerate burn-in.

Turbidity wiper changed? Y N N/A

Wiper parks ≈ 180° from optics? Y N N/A

Note: Change wiper if probe will not park correctly.

Record battery voltage: 85%

Record the following diagnostic numbers after/during calibration.

Conductivity cell constant	4.90494	Range 5.0	± .5
pH MV Buffer 4	155.4	Range +177 from 7 buffer MV	
pH MV Buffer 7	-19.4	Range 0 MV	± 50 MV
pH MV Buffer 10	-198.8	Range –177 from 7 buffer MV	
DO charge	56.1	Range 50	± 25
DO gain	1.15502	Range 1.0	.7 to 1.5
Pressure Offset		Range –14.7	± 6 (non-vented)
Pressure Offset		Range 0	± 6 (vented)
ORP mV Offset		Range 0	± 100

NOTE: Span between pH 4 and 7 and 7 and 10 millivolt numbers should be ≈ 165 to 180 MV

Record Calibration Values

	Before Calibration	After calibration	Cal. Standard Expiration Date
Conductivity 24.76°C	1010	1000	10/12/21
pH 4 24.60°C	3.18	4.0	3/13/22
pH 7 25.05°C	7.22	7.0	3/13/22
pH 10 24.30°C	10.08	10.01	3/13/22
Turbidity 0			
Turbidity 123			
DO 19.83°C	73.6%	93.8%	
re calib @ 0750	95.5%	94.4%	22.40°C
ORP			
Depth			

24.57 inHg × 25.4 = 751.078 − 35.675 = 715.403 mmHg

DISSOLVED OXYGEN SENSOR OUTPUT TEST (after DO calibration probe in saturated air)

The following tests will confirm the proper operation of your DO sensor. The DO charge and gain must meet spec before proceeding.

610/650– Turn off the 610/650, wait 60 seconds. Power up 610/650 and go to the Run mode, watch the DO % output; it must display a positive number and decrease with each 4 second sample, eventually stabilizing to the calibration value in approximately 60 to 120 seconds. **Note:** You can disregard the first two samples they can be affected by the electronics warm-up.

PC – Stop discrete and unattended sampling. Confirm that auto-sleep RS-232 is enabled (found in Advanced Menu under Setup). Wait 60 seconds. Start discrete sampling at 4 seconds. Watch the DO % output, it must display a positive number and decrease with each 4 second sample, eventually stabilizing to the calibration value in approximately 60 to 120 seconds. **Note:** You can disregard the first two samples they can be affected by the electronics warm-up.

The **ACCEPT/REJECT** criteria as follows:
The DO output in % must start at a positive number and decrease during the warm up. Example: 117, 117, 114, 113, 110, 107, 104, 102, 101, 100, 100. Should the output display a negative number or start at a low number and climb up to the cal point, the probe is rejected and must not be deployed.

✓ **ACCEPT** ______ **REJECT**

Notes:

98.0 97.8 96.5 95.6 95.0 94.5 94.2 93.9 93.7 93.6

FINAL CALIBRATION CHECK (to be done asap after each monitoring run)

Date & Time of Calibration Check: 1452 6/7/21

	Record Calibration Check Values	/	Known Standard Value	/	Temperature °C
Conductivity	998	/	1000	/	~~23.85~~ 24.07
pH 4	3.99	/	4.0	/	23.78
pH 7	6.95	/	7.0	/	23.93
pH 10	9.98	/	10.00	/	23.80
DO % saturation	93.6	/		/	23.83
DO mg/L	7.90	/		/	23.83

Wild Rice WQLS, Exhibit G

02C0885 AC

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1	Site	Latitude	Longitude	Date	Time	Lake Depth (m)	Sample Depth (m)	Water Temp (°C)	DO (mg/L)	DO (% saturation)	Specific Conductance (uS/cm)	pH (pH units)	Sample Collected (Y/N)	Sample Device (Van Dorn; 2M Integrated Sampler; None)	QC (Field Dup; Bottle Blank; Equipment Blank)	Field notes	Sampled by	Wind Speed (mph)	Wind Direction	Cloud Cover (%)	Significant Weather	Sonde S/N	Handpad S/N
2	303	47.717435	-91.874516	6/7/21	1030	4'8" 1.42M	0	21.42	7.9	89.5	150	7.26	N	N			Lisa Pugh, Levi Lexvold	0-5	SW	40	N	~~07F101105~~	06E1765AB
3					1034		1	19.48	8.0	87.1	123	7.2	Y	VD	COC								
4							1.5	19.05	7.51	81.1	122	7.04	N	N		Near bottom							
5							1.5	18.9	5.25	66.3	124	6.97	N	N		Lake bottom							
6	S009-182	47.71972	-91.87546	6/7/21	1045	4'8" >2	0	21.22	8.12	92.2	119	7.22	N	N			Lisa Pugh, Levi Lexvold	0-5	SW	40	N	~~07F101105~~	06E1765AB
7					1097		0.5	20.97	8.10	90.8	119	7.21	Y	VD									
8							1.5	19.55	8.00	87.6	119	7.13	N			Sample taken near bottom							
9							1.5	19.33	7.33	80.4	121	6.96	N	N		Lake bottom							
10	202	47.724148	-91.882408	6/7/21	1100	23'5" 7.12m	0	21.25	8.14	91.8	116	7.25	N	N			Lisa Pugh, Levi Lexvold	0-5	SW	40	N	07F101105	06E1765AB
11							1	20.13	8.13	89.6	113	7.20	N	N									
12	202-S				1104		2	19.55	7.99	87.1	117	7.15	Y	IS	COC								
13							3	19.00	7.93	86.0	117	7.09	N	N									
14	202-M				1106		4	18.38	7.64	81.8	116	6.96	Y	VD	COC	Sample taken @ 4.5m							
15							5	16.33	7.02	72.3	118	6.70	N	N									
16	202-D				1112		6	15.02	6.06	67.8	118	6.45	Y	VD	COC	Sample taken @ [illegible]							
17							7	14.90	1.89	20.5	120	6.26	N	N		Near bottom							
18							7	14.94	4.18	42.2	119	6.30	N	N		Lake bottom							
19	203	47.7246	-91.8763	6/7/21	1125	19'8" 4.5-6	0	20.89	8.13	91.0	119	7.20	N	N			Lisa Pugh, Levi Lexvold	0-5	SW	40	N	07F101105	06E1765AB
20							1	20.66	8.11	90.4	119	7.19	N	N									
21	203-S				1128		2	19.88	7.97	88.7	121	7.16	Y	IS	COC	FD taken @ this site							
22	203-M				1132		3	19.25	7.90	85.2	118	7.12	Y	VD	COC	Sample taken @ 3.5m							
23							4	18.83	7.76	83.4	118	7.06	N	N									
24	203-D				1136		5	15.97	7.28	73.7	117	6.95	Y	VD	COC	Near bottom							
25							5.5	15.32	6.09	61.4	117	6.63	N			Sample taken @ 5.5m							
26							5.5	15.29	5.16	51.5	119	6.26	N	N		Lake bottom							
27	BL-001	47.73013	-91.87808	6/7/21	1150	23'3" 7m	0	22.39	8.21	94.4	117	7.25	N	N			Lisa Pugh, Levi Lexvold	0-5	SW	40	N	~~07F101105~~	06E1765AB

1/5

02C0885 AC

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1	[illegible]e	Latitude	Longitude	Date	Time	Lake Depth (m)	Sample Depth (m)	Water Temp (°C)	DO (mg/L)	DO (% saturation)	Specific Conductance (uS/cm)	pH (pH units)	Sample Collected (Y/N)	Sample Device (Van Dorn; 2M Integrated Sampler; None)	QC (Field Dup; Bottle Blank; Equipment Blank)	Field notes	Sampled by	Wind Speed (mph)	Wind Direction	Cloud Cover (%)	Significant Weather	Sonde S/N	Handpad S/N
28	BL 001 cont			6/7/21			1	20.29	8.14	90.1	116	7.14	N	N			LP • LK	0-5	SW	40	N		
29	BL-001-S				1152	~~2~~	2	19.57	8.06	88.0	116	7.13	Y	IS	COC								
30						~~3~~	3	19.25	7.98	86.3	116	7.10	N	N									
31	BL-001-M				1154	~~4~~	4	19.17	7.90	85.5	116	7.08	Y	VD	COC								
32						~~5~~	5	18.26	7.72	82.0	115	7.03	N	N									
33	BL-001-D				1158	~~6~~	6	15.66	7.14	71.8	117	6.87	Y	VD	COC	Sample taken @ 6.5m							
34							7	15.1	3.82	41.3	119	6.24	N	N		near bottom							
35							7	15.11	1.97	23.2	125	6.27	N	N		Lake bottom							
36	503	47.734729	-91.871397	6/7/21	1210	22'8" 6.8M	0	23.65	8.05	94.9	117	7.27	N	N			Lisa Pugh, Levi Lexvold	0-5	SW	40	N	~~[illegible]~~	06E1765AB
37							1	20.92	8.39	94.3	117	7.27	N	N									
38	503-S				1211	~~1211~~	2	20.53	8.16	90.7	116	7.20	Y	IS	EOC	FD taken @ this site							
39							3	19.39	8.11	88.1	118	7.16	N	N									
40	503-M				1214	~~1214~~	4	19.10	7.96	86.1	117	7.13	Y	VD	COC								
41							5	18.85	7.82	84.3	116	7.08	N	N									
42	503-D				1217	~~1217~~	6	17.5	7.42	77.5	115	6.97	Y	VD	COC								
43							6.5	[illegible]	1.67	19.2	114	6.27	N	N		Near bottom							
44							6.5	17.3	6.04	61.7	115	6.58	N	N		Lake bottom							
45	BL-002	47.74369	-91.87436	6/7/21	1230	22' 8" 7M	0	21.86	8.19	93.5	116	7.25	N	N			Lisa Pugh, Levi Lexvold	0-5	SW	40	N	~~07F101485~~	06E1765AB
46							1	21.64	8.2	93.1	116	7.26	N	N									
47	BL-002-S				1234		2	20.37	8.05	89.5	115	7.21	Y	IS	COC								
48							3	18.91	7.89	84.9	116	7.14	N	N									
49	BL-002-M				1238		4	18.79	7.7	82.8	116	7.06	Y	VD	COC								
50							5	18.02	7.51	79.8	115	7.00	N	N									
51	BL-002-D				1242		6	17.38	7.19	75.5	114	6.87	Y	VD	COC								
52							[illegible]	15.28	3.33	33.3	112	6.21	N	N		near bottom							
53							[illegible]	15.44	4.04	7.8	11[illegible]	6.79	N	N		Lake bottom							

7/

02C0885 AC

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1	Site	Latitude	Longitude	Date	Time	Lake Depth (m)	Sample Depth (m)	Water Temp (°C)	DO (mg/L)	DO (% saturation)	Specific Conductance (uS/cm)	pH (pH units)	Sample Collected (Y/N)	Sample Device (Van Dorn; 2M Integrated Sampler; None)	QC (Field Dup; Bottle Blank; Equipment Blank)	Field notes	Sampled by	Wind Speed (mph)	Wind Direction	Cloud Cover (%)	Significant Weather	Sonde S/N	Handpad S/N
54	BL-003	47.74677	-91.86386	6/7/21	1300	23' 1" 7m	0	23.50	8.10	95.6	116	7.1	N	N			Lisa Pugh, Levi Lexvold	0-5	SW	40	N	~~07F101105~~	06E1765AB
55							1	21.35	8.37	94.8	175	7.14	N	N									
56	BL-003- S				1302		2	20.82	8.25	92.2	115	7.04	Y	IS	COC								
57							3	19.5	7.92	86.5	115	7.09	N	N									
58	BL-003-M				1304		4	18.76	7.68	82.8	114	7.0	Y	VD	COC								
59							5	18.06	7.51	79.7	116	6.93	N	N									
60	BL-003 D				1307		6	17.00	7.02	72.6	114	6.86	Y	VD	COC	Sample taken @ 6.5m							
61							6.57	15.97	5.96	60.8	114	6.41	N	N		Near bottom							
62							6.67	15.59	2.94	33.3	122	6.18	N	N		Lake bottom							
63	BB-001	47.72677	-91.81266	6/7/21	0935	2'10" 0.8m>1	0	22.36	7.62	88.5	199	7.15	N	N		FD taken @ this site,	Lisa Pugh, Levi Lexvold	0-5	SW	40	N	~~07F101105~~	06E1765AB
64					0938		0.5	21.79	7.24	83.1	240	7.08	Y	VD	COC	Sample taken above bottom							
65							0.81	21.31	0.58	7.1	277	6.82	N	N		Lake bottom							
66	301	47.732252	-91.813176	6/7/2	0920	5' 4" 1.5 >2	0	22.07	7.70	88.0	145	7.14	N	N			Lisa Pugh, Levi Lexvold	0-5	SW	40	N	~~07F101105~~	06E1765AB
67					0923		1	21.63	7.68	87.3	146	7.14	Y	VD	COC								
68							1.5	19.39	4.6	49.8	109	6.79	N	N		above bottom							
69							1.5	19.18	2.3	28.9	115	6.7	N	N		Lake bottom							
70	BB-003	47.73368	-91.81376	6/7/21	0912	6'8" 2	0	21.63	7.63	86.7	130	7.14	N	N			Lisa Pugh, Levi Lexvold	0-5	SW	40	N	~~07F101105~~	06E1765AB
71					0914		1	21.4	7.64	86.4	136	7.11	Y	VD	COC								
72							2	19.3	6.85	75.4	106	6.98	N	N		above bottom							
73							2	18.9	5.35	57.6	110	6.9	N	N		Lake bottom							
74	BB-002	47.73746	-91.81108	6/7/21	0845	10' 8" 3m	0	21.66	7.85	89.2	106	7.11	N	N			Lisa Pugh, Levi Lexvold	0-5	SW	40	N	~~07F101105~~	06E1765AB
75							1	21.32	7.81	86.2	106	7.11	N	N									
76	BB002 [illegible]				0850		2	21.14	7.67	86.5	111	7.07	Y	IS	COC								
77	BB002 Deep				0852		3	20.35	7.34	82.0	105	6.98	Y	VD	COC	Sample taken above bottom							
78							3	19.68	4.37	47.7	108	6.82	N	N		Lake bottom							
79	BL-004	47.74118	-91.81052	6/7/2	0955	20' 4" 6m	0	21.77	7.91	90.1	104	7.25	N	N			Lisa Pugh, Levi Lexvold	0-5	SW	40	N	~~07F101105~~	06E1765AB

3/5

Wild Rice WQLS, Exhibit G

02C0885AC

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1	[illegible]e	Latitude	Longitude	Date	Time	Lake Depth (m)	Sample Depth (m)	Water Temp (°C)	DO (mg/L)	DO (% saturation)	Specific Conductance (uS/cm)	pH (pH units)	Sample Collected (Y/N)	Sample Device (Van Dorn; 2M Integrated Sampler; None)	QC (Field Dup; Bottle Blank; Equipment Blank)	Field notes	Sampled by	Wind Speed (mph)	Wind Direction	Cloud Cover (%)	Significant Weather	Sonde S/N	Handpad S/N
80	BL 004 cont			6/7/21	[illegible]	6	1	21.82	7.84	89.3	105	7.2	N	N				0-5	SW	40	N		
81	BL-004-S				0957		2	21.19	7.86	88.8	104	7.13	Y	IS	COC								
82							3	20.7	7.7	86.3	101	7.04	N	N									
83	BL-004-M				1000		4	20.11	7.43	82.2	99	6.97	Y	VD	COC								
84	BL-004-D				1004		5	17.33	6.77	70.6	94	6.82	Y	VD	COC	Sample taken @ 5.5m							
85					[illegible]		6	15.6	5.18	52.1	98	6.67	N [illegible]	N [illegible]		~~Sample taken near~~ ~~near~~ bottom ~~bottom~~							
86							6	15.17	2.91	29.0	105	6.45	N	N		Lake bottom							
87	BL-005	47.73889	-91.80754	6/7/21	0820	20' 4" 6m 6	0	21.4	7.89	89.5	105	7.16	N	N			Lisa Pugh, Levi Lexvold	0-5	SW	40	N	~~07E101105~~	06E1765AB
88							1	21.32	7.83	88.4	105	7.15	N	N									
89	BL-005-S				0824		2	21.21	7.8	87.9	105	7.11	Y	IS	COC								
90	BL-005-M				0826		3	20.91	7.72	86.7	103	7.08	Y	VD	COC	Sample taken @ 3.5m							
91							4	20.03	7.57	83.3	99	6.99	N	N		FD taken @ this site							
92	BL-005-D				0831		5	18.79	7.22	78.5	101	6.92	Y	VD	EQC	Sample taken @ 5.5m							
93							6	15.62	5.1	51.7	96	6.66	N	N		above bottom							
94							6	15.72	2.6	26.2	100	6.63	N	N		lake bottom							
95	502	47.740078	-91.800436	6/7/21	0755	17' 11" ~~4.5-6~~ 5.5m	0	21.25	7.79	88.0	104	7.24	N	N			Lisa Pugh, Levi Lexvold	0-5	SW	40	N	~~07E101105~~	06E1765AB
96							1	21.31	7.82	88.2	105	7.16	N	N									
97	502-S				0800		2	21.11	7.69	86.6	101	7.16	Y	IS	COC								
98	502-M				0802		3	20.96	7.65	85.8	98	7.08	Y	VD	COC	Sample taken @ 3.5m							
99							4	20.26	7.46	82.4	95	7.01	N	N									
100	502-D				0805		5	19.05	6.85	74.9	97	6.89	Y	VD	COC								
101							5.5	18.3	5.8	64.0	98	6.73	N	N		above lake bottom							
102							5.5	17.3	4.8	42.7	130	6.65	N	N		lake bottom							
103	204	47.7519	-91.7855	6/7/21	0730	30' 1" 8.5	0	20.75	7.73	86.0	94	7.27	N	N			Lisa Pugh, Levi Lexvold	0-5	SW	40	N	~~07E101105~~	06E1765AB
104							1	20.71	7.66	85.4	94	6.88	N	N									
105	204-S				0731		2	20.65	7.61	84.9	93	6.46	Y	IS	COC								

4/5

02C088
06E1765A

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1	Site	Latitude	Longitude	Date	Time	Lake Depth (m)	Sample Depth (m)	Water Temp (°C)	DO (mg/L)	DO (% saturation)	Specific Conductance (uS/cm)	pH (pH units)	Sample Collected (Y/N)	Sample Device (Van Dorn; 2M Integrated Sampler; None)	QC (Field Dup; Bottle Blank; Equipment Blank)	Field notes	Sampled by	Wind Speed (mph)	Wind Direction	Cloud Cover (%)	Significant Weather	Sonde S/N	Handpad S/N
106	204 [illegible]			6/7/21			3	20.5	7.5	83.5	89	6.4	N	N				0-5	SW	40	N		
107							4	20.01	7.13	78.5	84	6.3	N	N									
108	204-M				0733		5	19.32	6.83	74.5	83	6.22	Y	VD	COC								
109							6	18.81	6.47	69.4	81	6.14	N	N									
110							7	18.4	6.19	66.3	80	6.08	N	N									
111	204-D				0736		8	18.13	5.96	63.1	79	6.03	Y	VD	COC								
112							8.5	17.83	5.3	56.1	80	5.96	N	N		Near bottom							
113							8.5	17.62	4.7	58.5	80	5.94	N	N		Lake bottom							
114	BB																						
115	BB																						
116	EB																						
117	EB																						
118	BL005 deep FD	[illegible]		6/7/21	0832	6	5.5						Y	VD	FD, COC								
119	BB 00. FD			6/7/21	0939	[illegible]	0.5						Y	VD	FD, coc	~~Near bottom~~							
120	203-Surf ~~mid~~ FD			6/7/21	1129	6	0-2						Y	IS	FD, coc								
121	503-Surf FD			6/7/21	1212	6.5	0-2						Y	IS	FD, coc								
122	FD																						
123	FD																						
124	BL 006	47.74588	-91.84093	6/7/21	1320	20'4" 6m	0	21.7	8.01	91.1	110	7.10	N	N			Lisa Pugh + Levi Loxuold	0-5	SW	40	N		
125							1	20.62	8.05	89.9	107	7.0	N	N									
126	BL-006-S				1324		2	20.33	7.88	87.3	106	7.05	Y	IS	COC								
127							3	20.24	7.73	85.7	106	7.01	N	N									
128	BL-006-M				1328		4	19.89	7.52	82.4	105	6.99	Y	VD	COC								
129	BL-006-D				1333		5	18.75	7.16	77.7	102	6.98	Y	VD	COC	Sample taken @ 5.5							
130	[illegible]						6	15.8	5.28	57.0	97	6.71	N	N		Near bottom							
131							6	15.95	4.58	47.3	95	6.62	N	N		Lake bottom							

5/5

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CHAIN OF CUSTODY RECORD

Page 1 of 4

Electronic version available at http://www.rmbel.info/lab/chains-of-custody/

Client: Save the Boundary Waters	Phone #:	Fax #:	
Project Name: Sulfate rd 3	Project Task Code:	PO/WO #:	
Sampler: (print name) Lisa Pugh	Sampler Phone #: 952-237-6714		
Report to: Lisa Pugh	Bill to: Northeastern Minnesotans for Wilderness		
Report to Email: lisa@savetheboundarywaters.org	Bill to Email: nicole@savetheboundarywaters.org		

☐ "EQUIS" EDD Lab Format - MPCA Data Submittal

Analyses Requested

Work Order

Sample Number	Station ID/Sample Description	Date	Time	# of Bottles	Sample Method	Start Depth (m)	End Depth (m)	Sample Type	Matrix	Preserved at Collection	Preserved at Lab Receipt	Sulfate	Sample Comments: (Equipment Type, Filtration, AIS, Preservation)
	Bottle Blank	6/7/21	0534	1	QC-BLANK			QC-FB	QC-BLANK			X	
	Equip Blank - VD	6/7/21	0656	1	QC BLANK			QC-EB	QC BLANK			X	
	Equip Blank - IS	6/7/21	0700	1	QC BLANK			QC-EB	QC-BLANK			X	
	284 - surf	6/7/21	0731	1	LKSURF2M	0	2	Sample	Wtr-Surf			X	
	204 - mid	6/7/21	0733	1	LKDEPTH	5	5	Sample	Wtr-surf			X	
	204 - deep	6/7/21	0736	1	LKDEPTH	8	8	Sample	Wtr-Surf			X	
	502 - surf	6/7/21	0800	1	LKSURF2M	0	2	Sample	Wtr-Surf			X	
	502 - mid	6/7/21	0802	1	LKDEPTH	3.5	3.5	Sample	Wtr-surf			X	
	502 - deep	6/7/21	0805	1	LKDEPTH	5.5	5.5	Sample	Wtr-surf			X	
	BL005 - surf	6/7/21	0824	1	LKSURF2M	0	2	Sample	Wtr-surf			X	
	BL-005 - mid	6/7/21	0826	1	LKDEPTH	3.5	3.5	Sample	Wtr-surf			X	
	BL-005 - deep	6/7/21	0831	1	LKDEPTH	5.5	5.5	Sample	Wtr-surf			X	
	BL-005 - deep FD	6/7/21	0832	1	LKDEPTH	5.5	5.5	QC-FR	Wtr-surf			X	

________ (Initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) I hereby authorize RMB Environmental Laboratories to process the samples as received.

________ (Initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) please contact client at phone # ________________ before processing samples.

Relinquished by: (client signature)	Print Name: Lisa Pugh	Date 6/8/21	Time 1120	Shipping to Lab: ☐ Speedee ☐ UPS ☐ USPS ☐ FedEx ☐ Courier ☐ RMB Courier ☒ Hand Delivery

FOR LAB USE ONLY

Received by Lab: (signature)	Date	Time	Additional Fees: Mileage: Field Staff: Shipping: Courier: Equipment: Other:

☐ **DOES** meet proper sample storage and transportation guidelines
☐ Does **NOT** meet proper sample storage and transportation guidelines

☐ Received on ice ☐ Received at room temperature
☐ Samples received same day as collection

Received Temp: ______ ° C Therm. ID: LTG ________
Chlorine: No Yes N/A

Comments: ________________________________

VOC vials received w/o headspace: bubble < 6mm: Yes No N/A

Wild Rice WQLS, Exhibit G

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CHAIN OF CUSTODY RECORD

Page 2 of 4

Electronic version available at http://www.rmbel.info/lab/chains-of-custody/

Client: STBW/NMW
Project Name: Sulfate rd 3
Sampler: (print name) Lisa Pugh
Report to:
Report to Email:
Phone #:
Project Task Code:
Sampler Phone #:
Bill to:
Bill to Email:
Fax #:
PO/WO #:

☐ "EQUIS" EDD Lab Format - MPCA Data Submittal

Work Order

Analyses Requested

Sample Number	Station ID/Sample Description	Date	Time	# of Bottles	Sample Method	Start Depth (m)	End Depth (m)	Sample Type	Matrix	Preserved at Collection	Preserved at Lab Receipt	Sulfate	Sample Comments: (Equipment Type, Filtration, AIS, Preservation)
	BB 002 surf	6/7/21	0850	1	LKSURFZM	0	2	Sample	Wtr-surf			X	
	BB-002-deep	6/7/21	0852	1	LKDEPTH	3	3	Sample	Wtr-surf			X	
	BB-003	6/7/21	0914	1	LKDEPTH	1	1	Sample	Wtr-surf			X	
	301	6/7/21	0923	1	LKDEPTH	1	1	Sample	Wtr-surf			X	
	BB-001	6/7/21	0938	1	LKDEPTH	0.5	0.5	Sample	Wtr-surf			X	
	BB-001-FD	6/7/21	0939	1	LKDEPTH	0.5	0.5	QC-FR	Wtr-surf			X	
	BL-004-surf	6/7/21	0957	1	LKSURFZM	0	2	Sample	Wtr-surf			X	
	BL-004-mid	6/7/21	1000	1	LKDEPTH	4	4	Sample	Wtr-surf			X	
	BL-004-deep	6/7/21	1004	1	LKDEPTH	5.5	5.5	Sample	Wtr-surf			X	
	303	6/7/21	1034	1	LKDEPTH	1	1	Sample	Wtr-surf			X	
	S009-182	6/7/21	1047	1	LKDEPTH	1	1	Sample	Wtr-surf			X	
	202-surf	6/7/21	1104	1	LKSURFZM	0	2	Sample	Wtr-surf			X	
	202-mid	6/7/21	1100	1	LKDEPTH	4.5	4.5	Sample	Wtr-surf			X	

_____ (Initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) I hereby authorize RMB Environmental Laboratories to process the samples as received.

_____ (Initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) please contact client at phone # _____ before processing samples.

Relinquished by: (client signature)
Print Name: Lisa Pugh
Date 6/8/21
Time 1120
Shipping to Lab: ☐ Speedee ☐ UPS ☐ USPS ☐ FedEx ☐ Courier ☐ RMB Courier ☒ Hand Delivery

FOR LAB USE ONLY

Received by Lab: (signature)
Date
Time
Additional Fees:
Mileage:
Field Staff:
Shipping:
Courier:
Equipment:
Other:

☐ **DOES** meet proper sample storage and transportation guidelines
☐ Does **NOT** meet proper sample storage and transportation guidelines
☐ Received on ice
☐ Received at room temperature
☐ Samples received same day as collection
Received Temp: _____ ° C Therm. ID: LTG _____
Chlorine: No Yes N/A

Comments: _____
VOC vials received w/o headspace: bubble < 6mm: Yes No N/A

Wild Rice WQLS, Exhibit G

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CHAIN OF CUSTODY RECORD

Page 3 of 4

Electronic version available at http://www.rmbel.info/lab/chains-of-custody/

Client: STBW / NMW
Project Name: Sulfate rd 3
Sampler: (print name) Lisa Pugh
Report to:
Report to Email:
Phone #:
Project Task Code:
Sampler Phone #:
Bill to:
Bill to Email:
Fax #:
PO/WO #:

☐ "EQUIS" EDD Lab Format - MPCA Data Submittal

Work Order

Sample Number	Station ID/Sample Description	Date	Time	# of Bottles	Sample Method	Start Depth (m)	End Depth (m)	Sample Type	Matrix	Preserved at Collection	Preserved at Lab Receipt	Analyses Requested Sulfate												Sample Comments: (Equipment Type, Filtration, AIS, Preservation)
	202 - deep	6/7/21	1112	1	LKDEPTH	6.5	6.5	Sample	Wtr-surf			X											
	203 - ~~mid~~ surf	6/7/21	1128	1	LKSURFZM	0	2	Sample	Wtr-surf			X											
	203 - surf FD	6/7/21	1129	1	LKSURFZM	0	2	QC-FR	Wtr-surf			X											
	203 - mid	6/7/21	1132	1	LKDEPTH	3.5	3.5	Sample	Wtr-surf			X											
	203 - deep	6/7/21	1136	1	LKDEPTH	5.5	5.5	Sample	Wtr-surf			X											
	BL-001-surf	6/7/21	1152	1	LKSURFZM	0	2	Sample	Wtr-surf			X											
	BL-001-mid	6/7/21	1154	1	LKDEPTH	4	4	Sample	Wtr-surf			X											
	BL-001-deep	6/7/21	1158	1	LKDEPTH	6.5	6.5	Sample	Wtr-surf			X											
	503 - surf	6/7/21	1211	1	LKSURFZM	0	2	Sample	Wtr-surf			X											
	503 - Surf - FD	6/7/21	1212	1	LKSURFZM	0	2	QC-FR	Wtr-surf			X											
	503 - mid	6/7/21	1214	1	LKDEPTH	4'	4	Sample	Wtr-surf			X											
	503 - deep	6/7/21	1217	1	LKDEPTH	6'	6	Sample	Wtr-surf			X											
	BL-002-surf	6/7/21	1234	1	LKSURFZM	0'	2	Sample	Wtr-surf			X											

_______ (Initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) I hereby authorize RMB Environmental Laboratories to process the samples as received.

_______ (Initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) please contact client at phone # _______________ before processing samples.

Relinquished by: (client signature)
Print Name: Lisa Pugh
Date 6/8/21
Time 1120
Shipping to Lab: ☐ Speedee ☐ UPS ☐ USPS ☐ FedEx ☐ Courier ☐ RMB Courier ☒ Hand Delivery

FOR LAB USE ONLY

Received by Lab: (signature)
Date
Time
Additional Fees:
Mileage: Field Staff: Shipping: Courier: Equipment: Other:

☐ **DOES** meet proper sample storage and transportation guidelines
☐ Does **NOT** meet proper sample storage and transportation guidelines
☐ Received on ice ☐ Received at room temperature
☐ Samples received same day as collection
Received Temp: _______ ° C Therm. ID: LTG _______
Chlorine: No Yes N/A

Comments: _______________

VOC vials received w/o headspace: bubble < 6mm: Yes No N/A

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CHAIN OF CUSTODY RECORD

Electronic version available at http://www.rmbel.info/lab/chains-of-custody/

Page 4 of 4

☐ "EQUIS" EDD Lab Format - MPCA Data Submittal

Client: STBW/NMW
Project Name: Sulfate Rd 3
Sampler: (print name) Lisa Pugh
Report to:
Report to Email:
Phone #:
Project Task Code:
Sampler Phone #:
Bill to:
Bill to Email:
Fax #:
PO/WO #:

Work Order

Sample Number	Station ID/Sample Description	Date	Time	# of Bottles	Sample Method	Start Depth (m)	End Depth (m)	Sample Type	Matrix	Preserved at Collection	Preserved at Lab Receipt	Analyses Requested: Sulfate	Sample Comments: (Equipment Type, Filtration, AIS, Preservation)
	BL-002-mid	6/7/21	1238	1	LKDEPTH	4	4	Sample	Wtr-Surf			X	
	BL-002-deep	6/7/21	1242	1	LKDEPTH	6	6	Sample	Wtr-Surf			X	
	BL-003-surf	6/7/21	1302	1	LKSURF2M	0	2	Sample	Wtr-Surf			X	
	BL-003-mid	6/7/21	1304	1	LKDEPTH	4	4	Sample	Wtr-Surf			X	
	BL-003-deep	6/7/21	1307	1	LKDEPTH	6	6	Sample	Wtr-Surf			X	
	BL-006-surf	6/7/21	1324	1	LKSURF 2M	0	2	Sample	Wtr-Surf			X	
	BL-006-mid	6/7/21	1328	1	LKDEPTH	4	4	Sample	Wtr-Surf			X	
	BL-006-deep	6/7/21	1333	1	LKDEPTH	5.5	5.5	Sample	Wtr-Surf			X	

_______ (Initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) I hereby authorize RMB Environmental Laboratories to process the samples as received.

_______ (Initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) please contact client at phone # _______________ before processing samples.

Relinquished by: (client signature)	Print Name:	Date	Time	Shipping to Lab:
	Lisa Pugh	6/8/21	1120	☐ Speedee ☐ UPS ☐ USPS ☐ FedEx ☐ Courier ☐ RMB Courier ☒ Hand Delivery

FOR LAB USE ONLY

Received by Lab: (signature)
Date
Time
Additional Fees: Mileage: Field Staff: Shipping: Courier: Equipment: Other:

☐ **DOES** meet proper sample storage and transportation guidelines
☐ Does **NOT** meet proper sample storage and transportation guidelines
☐ Received on ice
☐ Received at room temperature
☐ Samples received same day as collection
Received Temp: _______ ° C Therm. ID: LTG _______
Chlorine: No Yes N/A

Comments: _______________

VOC vials received w/o headspace: bubble < 6mm: Yes No N/A

Save the Boundary Waters Sonde Calibration Work Sheet

Wild Rice WQLS, Exhibit G 60

Date & Time of Calibration: 6/15/21 0525

Sonde Serial # ~~07F101105~~ 02C0885AC

Technician: Lisa Pugh

Hand Pad Serial # 06E1765 AB

DO membrane changed? Y [✓ N]
Last changed 6/6/21

Note: Should wait 6 to 8 hours before final DO calibration, run sensor for 15 minutes in Discrete Run to accelerate burn-in.

Turbidity wiper changed? Y N
N/A

Wiper parks ≈ 180° from optics? Y N
N/A

Note: Change wiper if probe will not park correctly.

Record battery voltage: 66%

Record the following diagnostic numbers after/during calibration.

Conductivity cell constant	4.9073	Range 5.0	± .5
pH MV Buffer 4	151.4	Range +177 from 7 buffer MV	
pH MV Buffer 7	-20.3	Range 0 MV	± 50 MV
pH MV Buffer 10	-200.2	Range −177 from 7 buffer MV	

NOTE: Span between pH 4 and 7 and 7 and 10 millivolt numbers should be ≈ 165 to 180 MV

DO charge	57.4	Range 50	± 25
DO gain	1.12755	Range 1.0	.7 to 1.5
Pressure Offset		Range −14.7	± 6 (non-vented)
Pressure Offset		Range 0	± 6 (vented)
ORP mV Offset		Range 0	± 100

Record Calibration Values

	Before Calibration	After calibration	Cal. Standard Expiration Date
Conductivity 18.49°C	999	1000	10/12/21
pH 4 18.50°C	4.06	4.00	3/13/22
pH 7 18.55°C	6.95	7.00	3/13/22
pH 10 18.63°C	10.18	10.00	3/13/22
Turbidity 0			
Turbidity 123			
DO 15.16°C	97.0	96.3	
ORP			
Depth			

30.22 inHg × 25.4 = 767.588 - 35.675 =
731.913 mmHg

DISSOLVED OXYGEN SENSOR OUTPUT TEST (after DO calibration probe in saturated air)

The following tests will confirm the proper operation of your DO sensor. The DO charge and gain must meet spec before proceeding.

610/650– Turn off the 610/650, wait 60 seconds. Power up 610/650 and go to the Run mode, watch the DO % output; it must display a positive number and decrease with each 4 second sample, eventually stabilizing to the calibration value in approximately 60 to 120 seconds. **Note:** You can disregard the first two samples they can be affected by the electronics warm-up.

PC – Stop discrete and unattended sampling. Confirm that auto-sleep RS-232 is enabled (found in Advanced Menu under Setup). Wait 60 seconds. Start discrete sampling at 4 seconds. Watch the DO % output, it must display a positive number and decrease with each 4 second sample, eventually stabilizing to the calibration value in approximately 60 to 120 seconds. **Note:** You can disregard the first two samples they can be affected by the electronics warm-up.

The **ACCEPT/REJECT** criteria as follows:
The DO output in % must start at a positive number and decrease during the warm up. Example: 117, 117, 114, 113, 110, 107, 104, 102, 101, 100, 100. Should the output display a negative number or start at a low number and climb up to the cal point, the probe is rejected and <u>must not be deployed</u>.

X **ACCEPT** ____ **REJECT**

Notes:

99.1 98.4 97.8 97.4 97.0 96.8 96.6 96.4
96.3 96.2 96.1

Wild Rice WQLS, Exhibit G

FINAL CALIBRATION CHECK (to be done asap after each monitoring run)

Date & Time of Calibration Check: 6/15/21 [illegible] 1955

	Record Calibration Check Values	Known Standard Value	Temperature °C
Conductivity	997	1000	19.80
pH 4	4.00	4.00	19.16
pH 7	6.96	7.00	18.93
pH 10	10.0[illegible]3	10.00	18.99
DO % saturation	96.8		15.41
DO mg/L	9.66		15.42

Recalibrated 6/15/21 @ 1410

	Pre calibration Value	Post calibration Value	Temp °C	
Conductivity	1001	1000	18.69	Cond. cell [illegible] constant: 4.90097
pH 4	3.85	4.0	18.35	pH mv 15[illegible].0
pH 7	7.0	7.0	18.36	pH mv -20.1
pH 10	10.13	10.01[illegible]	18.44	pH mv -198.0
DO %	96.2	96.1	15.6°C	Do Charge 57.4
Do mg/L	9.56	9.55	15.73	Do gain 1.12528

30.17 mbHg × 25.4 = 766.318 - 35.675 = 730.643 mmHg

98.7 97.7 97.1 96.8 96.5 96.3 96.1 96.0 95.9

Wild Rice WQLS, Exhibit 6

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
1	Site	Latitude	Longitude	Date	Time	Lake Depth (to nearest 0.5 m)	Sample Depth (to nearest 0.5 m)	Secchi Depth ft (nearest 0.5ft)	Water Temp (°C)	DO (mg/L)	DO (% saturation)	Specific Conductance (uS/cm)	pH (pH units)	Color (0-100 APHA platinum cobalt color units)	Color (0-500 APHA platinum cobalt color units)	Sample Collected (Y/N)	Sample Device (Van Dorn; 2M Integrated Sampler; None)	QC (Field Dup; Bottle Blank; Equipment Blank)	Field notes	Sampled by	Wind Speed (mph)	Wind Direction	Cloud Cover (%)	Significant Weather	Appearance	Recreation Suitability	Lake Uses Observed	Sonde S/N	Handpad S/N
2	504	47.732892	-91.919338	6/15/	0900	6.5	0	6	20.83	7.75	86.7	118	7.24	70						Lisa Pugh, Levi Lexvold	0-5	SW	0	N			Boating	02C0885 AC	06E1765AB
3				21			1		20.44	7.73	85.9	118	7.18						ICP + RMB	+Hunter									
4	504-surf				0905		2		20.39	7.6	84.3	118	7.13	[illegible]		Y	IS	CoC	Sample	5									
5							3		20.37	7.59	84.1	118	7.04																
6							4		20.34	7.54	83.6	118	6.58						RMB										
7	504-deep				0907		5		20.32	7.54	83.4	118	6.54			Y	VD	CoC	Sample taken @ 5.5m										
8							6		18.58	6.43	68.8	119	6.46																
9							6.5		17.13	3.5	36.3	125	6.13						Near bottom										
10						6.5	[illegible]		17.23	2.21	23.0	132	6.10						Lake bottom										
11																													
12	XXX	47.7262	-91.89683	6/15/2	0935	7	0	5.5	21.6	7.97	88.6	117	7.14	70						Lisa Pugh, Levi Lexvold	0-5	W	30	N				02C0885 AC	06E1765AB
13							1		20.4	7.82	86.8	117	7.07	[illegible]															
14	xxx-surf				0940		2		20.39	7.75	86.0	116	6.99			Y	IS	CoC	ICP + RMB.										
15							3		20.35	7.73	85.7	117	6.89																
16							4		20.31	7.69	85.2	117	6.56																
17							5		20.1	7.48	83.0	117	6.57																
18	xxx-deep				0942		6		17.34	5.95	62.0	121	6.46			Y	VD	CoC.	RMB										
19							7		16.76	3.29	33.8	123	6.12						Near bottom										
20							7		16.8	1.72	18.2	123	6.1						Lake bottom										
21																													
22	503	47.734729	-91.871397	6/15/2	1015	5.5	0	5.5	20.96	7.9	88.7	114	7.03	75						Lisa Pugh, Levi Lexvold	0-5	N	50	N				02C0885 AC	06E1765AB
23							1		20.3	7.94	88.1	114	6.99																
24					1020		2		20.24	7.8	86.2	114	7.0			Y	IS	COC	ICP + Iso + RMB										
25							3		20.22	7.76	85.8	114	6.87																
26							4		20.2	7.73	85.3	114	6.5																
27					1022		5		20.16	7.73	81.2	114	6.64			Y	VD	COC	RMB Sample @ 5.5										
28							6		18.5	6.27	68.4	116	6.54																
29							6.5		17.08	4.78	51.2	116	6.3						Near bottom										
30							6.5		16.46	1.63	16.7	124	6.04						Lake bottom										
31	101	47.746376	-91.835278	6/15/2	1100	6.0	0	5	21.17	7.68	86.6	106	6.99	80						Lisa Pugh, Levi Lexvold								02C0885 AC	06E1765AB
32							1		20.13	7.4	81.7	105	6.92																
33					1104		2		20.01	7.28	80.1	105	6.86			Y	IS	CoC	ICP + RMB										
34							3		20.0	7.25	79.9	105	6.83																

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CHAIN OF CUSTODY RECORD

Electronic version available at http://www.rmbel.info/lab/chains-of-custody/

Page 1 of 2

Client: Save the Boundary Waters
Phone #:
Fax #:
Project Name: Routine rd. 1
Project Task Code:
PO/WO #:
Sampler: (print name) Lisa Pugh
Sampler Phone #: 952-237-6714
Report to: Lisa Pugh
Bill to: Northeastern Minnesotans for Wilderness
Report to Email: lisa@savetheboundarywaters.org
Bill to Email: lisa@savetheboundarywaters.org

☐ "EQUIS" EDD Lab Format - MPCA Data Submittal

Work Order

Sample Number	Station ID/Sample Description	Date	Time	# of Bottles	Sample Method	Start Depth (m)	End Depth (m)	Sample Type	Matrix	Preserved at Collection	Preserved at Lab Receipt	Cations	Anions	Gen. Chem	TP	Chloro-A										Sample Comments: (Equipment Type, Filtration, AIS, Preservation)
	Bottle Blank	6/15/21	0544	4	QCBLANK			QCBLANK	QC-FB	X		X	X	X	X	X										See attached
	Equipment Blank-IS	6/15/21	0548	4	QCBLANK			QCBLANK	QC-EB	X		X	X	X	X	X										lab list
	Equipment Blank-VD	6/15/21	0552	4	QCBLANK			QCBLANK	QC-EB	X		X	X	X	X	X										for
	504-surf	6/15/21	0905	4	LKSURF2M	0	2	Sample	Wtr-surf	X		X	X	X	X	X										Cation
	504-deep	6/15/21	0907	3	LKDEPTH	5.5	5.5	Sample	Wtr-surf	X		X	X	X	X											anion
	XXX-surf	6/15/21	0940	4	LKSURF2M	0	2	Sample	Wtr-surf	X		X	X	X	X	X										gen.
	XXX-deep	6/15/21	0942	3	LKDEPTH	6	6	Sample	Wtr-surf	X		X	X	X	X											chem
	503-surf	6/15/21	1020	4	LKSURF2M	0	2	Sample	Wtr-surf	X		X	X	X	X	X										analytes
	503-deep	6/15/21	1022	3	LKDEPTH	5.5	5.5	Sample	Wtr-surf	X		X	X	X	X											
	101-surf	6/15/21	1104	4	LKSURF2M	0	2	Sample	Wtr-surf	X		X	X	X	X	X										
	101-deep	6/15/21	1107	3	LKDEPTH	5	5	Sample	Wtr-surf	X		X	X	X	X											
	204-surf	6/15/21		4	LKSURF2M	0	2	Sample	Wtr-surf	X		X	X	X	X	X										
	204-deep	6/15/21		3	LKDEPTH	7.5	7.5	Sample	Wtr-surf	X		X	X	X	X											

_____ (Initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) I hereby authorize RMB Environmental Laboratories to process the samples as received.

_____ (Initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) please contact client at phone # __________ before processing samples.

Relinquished by: (client signature)	Print Name:	Date	Time	Shipping to Lab:
	Rajan Singh	6/16/21	09:00	☐ Speedee ☐ UPS ☐ USPS ☐ FedEx ☐ Courier ☐ RMB Courier ☒ Hand Delivery

FOR LAB USE ONLY

Received by Lab: (signature)	Date	Time	Mileage:	Field Staff:	Shipping:	Additional Fees: Courier:	Equipment:	Other:
	6/16/21	0905						

☒ **DOES** meet proper sample storage and transportation guidelines
☐ Does **NOT** meet proper sample storage and transportation guidelines

☑ Received on ice ☐ Received at room temperature
☐ Samples received same day as collection

Received Temp: 4.1 °C Therm. ID: LTG 15-IR3
Chlorine: No Yes [✓ N/A]

Comments:

VOC vials received w/o headspace: bubble < 6mm: Yes No [✓ N/A]

RMB
Environmental Laboratories, Inc.
www.rmbel.info

Bloomington
2200 West 94th Street
Bloomington, MN 55431
952-456-8470

Detroit Lakes
22796 County Highway 6
Detroit Lakes, MN 56501
218-846-1465

Hibbing
1111 7th Ave. E.
Hibbing, MN 55746
218-440-2043

October 07, 2020
Laboratory Report

Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN 55731

RE: Surface Water (Metals to MDL)

Work Order :H000909

Enclosed are the results of analyses for samples received by the laboratory on 08/14/2020 09:31. If you have any questions concerning this report, please feel free to contact me at (218) 440-2043.

Report approved by:

Kristin Hanson
Project Manager
Kristin.Hanson@rmbel.info

Laboratory Results
October 07, 2020

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water (Metals to MDL)
Lab Code: H000909-01
Matrix: Water
Date/Time Sampled: 08/13/2020 07:55
Date/Time Received: 08/14/2020 09:31

Sample Description: 204/ Lake Surface
Collection Method:
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Analyte Qualifiers	Sample RL	Sample MDL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Facility
Organic Carbon											
Dissolved Organic Carbon	**14.9**	mg/L		1.0		1			EPA 5310	08/22/20 16:48	BL
Classical Chemistry Parameters											
Alkalinity, Total (as CACO3)	**32.0**	mg/L		1.00		1			SM2320 B-2011	08/18/20 12:08	HB
Chlorophyll-a, Pheophytin Corrected	**13.4**	ug/L		1.00					SM10200H	08/26/20 11:10	DL
Nitrogen, Total	**0.479**	mg/L		0.0300		1			TKN + (N+N)	08/20/20 13:48	DL
Ammonia as N	**0.070**	mg/L	msl	0.060		1	EPA 350.1	08/24/20 13:12	EPA 350.1	08/25/20 10:21	DL
Nitrate/Nitrite as N (N+N)	**<0.03**	mg/L		0.03		1			EPA 353.2	08/18/20 15:35	DL
Nitrogen, Total Kjeldahl (TKN)	**0.48**	mg/L		0.30		1	EPA 351.2	08/20/20 08:45	EPA 351.2	08/20/20 13:48	DL
Phosphorus, Total as P	**0.017**	mg/L		0.003		1	EPA 365.3	08/18/20 10:37	EPA 365.3	08/18/20 16:08	DL
Anions by IC											
Chloride	**3.14**	mg/L		0.50		1			EPA 300.0	08/14/20 19:22	HB
Nitrate as N	**<0.03**	mg/L		0.03		1			EPA 300.0	08/14/20 19:22	HB
Nitrite as N	**<0.03**	mg/L		0.03		1			EPA 300.0	08/14/20 19:22	HB
Sulfate as SO4	**6.8**	mg/L		0.5	0.3	1			EPA 300.0	08/14/20 19:22	HB

Laboratory Results
October 07, 2020

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water (Metals to MDL)
Lab Code: H000909-02
Matrix: Water
Date/Time Sampled: 08/13/2020 09:48
Date/Time Received: 08/14/2020 09:31

Sample Description: 501/ Lake Surface
Collection Method:
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Analyte Qualifiers	Sample RL	Sample MDL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Facility
Organic Carbon											
Dissolved Organic Carbon	**14.1**	mg/L		1.0		1			EPA 5310	08/22/20 16:48	BL
Classical Chemistry Parameters											
Alkalinity, Total (as CACO3)	**28.0**	mg/L		1.00		1			SM2320 B-2011	08/18/20 12:08	HB
Chlorophyll-a, Pheophytin Corrected	**12.3**	ug/L		1.00					SM10200H	08/26/20 11:10	DL
Nitrogen, Total	**0.520**	mg/L		0.0300		1			TKN + (N+N)	08/20/20 13:48	DL
Ammonia as N	**0.071**	mg/L		0.060		1	EPA 350.1	08/24/20 13:12	EPA 350.1	08/25/20 09:47	DL
Nitrate/Nitrite as N (N+N)	**<0.03**	mg/L		0.03		1			EPA 353.2	08/18/20 12:57	DL
Nitrogen, Total Kjeldahl (TKN)	**0.52**	mg/L		0.30		1	EPA 351.2	08/20/20 08:45	EPA 351.2	08/20/20 13:48	DL
Phosphorus, Total as P	**0.016**	mg/L		0.003		1	EPA 365.3	08/18/20 10:37	EPA 365.3	08/18/20 16:08	DL
Anions by IC											
Chloride	**2.46**	mg/L		0.50		1			EPA 300.0	08/14/20 19:40	HB
Nitrate as N	**<0.03**	mg/L		0.03		1			EPA 300.0	08/14/20 19:40	HB
Nitrite as N	**<0.03**	mg/L		0.03		1			EPA 300.0	08/14/20 19:40	HB
Sulfate as SO4	**5.4**	mg/L		0.5	0.3	1			EPA 300.0	08/14/20 19:40	HB

Laboratory Results
October 07, 2020

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water (Metals to MDL)
Lab Code: H000909-03
Matrix: Water
Date/Time Sampled: 08/13/2020 07:56
Date/Time Received: 08/14/2020 09:31

Sample Description: 204/ Field DUP
Collection Method:
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Analyte Qualifiers	Sample RL	Sample MDL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Facility
Organic Carbon											
Dissolved Organic Carbon	**14.4**	mg/L		1.0		1			EPA 5310	08/22/20 16:48	BL
Classical Chemistry Parameters											
Alkalinity, Total (as CACO3)	**32.0**	mg/L		1.00		1			SM2320 B-2011	08/18/20 12:08	HB
Chlorophyll-a, Pheophytin Corrected	**14.4**	ug/L		1.00					SM10200H	08/26/20 11:10	DL
Nitrogen, Total	**0.578**	mg/L		0.0300		1			TKN + (N+N)	08/20/20 13:48	DL
Ammonia as N	**0.061**	mg/L		0.060		1	EPA 350.1	08/24/20 13:12	EPA 350.1	08/25/20 09:47	DL
Nitrate/Nitrite as N (N+N)	**<0.03**	mg/L		0.03		1			EPA 353.2	08/18/20 12:58	DL
Nitrogen, Total Kjeldahl (TKN)	**0.58**	mg/L		0.30		1	EPA 351.2	08/20/20 08:45	EPA 351.2	08/20/20 13:48	DL
Phosphorus, Total as P	**0.025**	mg/L		0.003		1	EPA 365.3	08/18/20 10:37	EPA 365.3	08/18/20 15:53	DL
Anions by IC											
Chloride	**3.14**	mg/L		0.50		1			EPA 300.0	08/14/20 19:58	HB
Nitrate as N	**<0.03**	mg/L		0.03		1			EPA 300.0	08/14/20 19:58	HB
Nitrite as N	**<0.03**	mg/L		0.03		1			EPA 300.0	08/14/20 19:58	HB
Sulfate as SO4	**6.8**	mg/L		0.5	0.3	1			EPA 300.0	08/14/20 19:58	HB

Laboratory Results
October 07, 2020

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water (Metals to MDL)
Lab Code: H000909-04
Matrix: Water
Date/Time Sampled: 08/13/2020 07:57
Date/Time Received: 08/14/2020 09:31

Sample Description: 204/ Equip. Blank
Collection Method:
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Analyte Qualifiers	Sample RL	Sample MDL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Facility
Organic Carbon											
Dissolved Organic Carbon	**0.9**	mg/L		1.0		1			EPA 5310	08/22/20 16:48	BL
Classical Chemistry Parameters											
Alkalinity, Total (as CACO3)	**<1.00**	mg/L		1.00		1			SM2320 B-2011	08/18/20 12:08	HB
Chlorophyll-a, Pheophytin Corrected	**<1.00**	ug/L		1.00					SM10200H	08/26/20 11:10	DL
Nitrogen, Total	**<0.0300**	mg/L		0.0300		1			TKN + (N+N)	08/20/20 13:48	DL
Ammonia as N	**<0.060**	mg/L		0.060		1	EPA 350.1	08/24/20 13:12	EPA 350.1	08/25/20 09:47	DL
Nitrate/Nitrite as N (N+N)	**<0.03**	mg/L		0.03		1			EPA 353.2	08/18/20 12:59	DL
Nitrogen, Total Kjeldahl (TKN)	**<0.30**	mg/L		0.30		1	EPA 351.2	08/20/20 08:45	EPA 351.2	08/20/20 13:48	DL
Phosphorus, Total as P	**<0.003**	mg/L		0.003		1	EPA 365.3	08/18/20 10:37	EPA 365.3	08/18/20 16:08	DL
Anions by IC											
Chloride	**<0.50**	mg/L		0.50		1			EPA 300.0	08/14/20 14:54	HB
Nitrate as N	**<0.03**	mg/L		0.03		1			EPA 300.0	08/14/20 14:54	HB
Nitrite as N	**<0.03**	mg/L		0.03		1			EPA 300.0	08/14/20 14:54	HB
Sulfate as SO4	**<0.3**	mg/L		0.5	0.3	1			EPA 300.0	08/14/20 14:54	HB

Laboratory Results
October 07, 2020

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water (Metals to MDL)
Lab Code: H000909-05
Matrix: Water
Date/Time Sampled: 08/13/2020 10:42
Date/Time Received: 08/14/2020 09:31

Sample Description: SNOK- DS
Collection Method:
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Analyte Qualifiers	Sample RL	Sample MDL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Facility
Organic Carbon											
Dissolved Organic Carbon	**14.4**	mg/L		1.0		1			EPA 5310	08/22/20 16:48	BL
Classical Chemistry Parameters											
Alkalinity, Total (as CACO3)	**32.0**	mg/L		1.00		1			SM2320 B-2011	08/18/20 12:08	HB
Nitrogen, Total	**0.537**	mg/L		0.0300		1			TKN + (N+N)	08/20/20 13:48	DL
Ammonia as N	**0.068**	mg/L		0.060		1	EPA 350.1	08/24/20 13:12	EPA 350.1	08/25/20 09:47	DL
Nitrate/Nitrite as N (N+N)	**<0.03**	mg/L		0.03		1			EPA 353.2	08/18/20 13:00	DL
Nitrogen, Total Kjeldahl (TKN)	**0.54**	mg/L		0.30		1	EPA 351.2	08/20/20 08:45	EPA 351.2	08/20/20 13:48	DL
Phosphorus, Total as P	**0.013**	mg/L		0.003		1	EPA 365.3	08/18/20 10:37	EPA 365.3	08/18/20 16:08	DL
Anions by IC											
Chloride	**2.42**	mg/L		0.50		1			EPA 300.0	08/14/20 20:16	HB
Nitrate as N	**<0.03**	mg/L		0.03		1			EPA 300.0	08/14/20 20:16	HB
Nitrite as N	**<0.03**	mg/L		0.03		1			EPA 300.0	08/14/20 20:16	HB
Sulfate as SO4	**6.0**	mg/L		0.5	0.3	1			EPA 300.0	08/14/20 20:16	HB

Laboratory Results
October 07, 2020

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water (Metals to MDL)
Lab Code: H000909-06
Matrix: Water
Date/Time Sampled: 08/13/2020 13:50
Date/Time Received: 08/14/2020 09:31

Sample Description: Bottle Blank
Collection Method:
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Analyte Qualifiers	Sample RL	Sample MDL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Facility
Organic Carbon											
Dissolved Organic Carbon	**0.8**	mg/L		1.0		1			EPA 5310	08/22/20 16:48	BL
Classical Chemistry Parameters											
Alkalinity, Total (as CACO3)	**8.00**	mg/L		1.00		1			SM2320 B-2011	08/18/20 12:08	HB
Chlorophyll-a, Pheophytin Corrected	**<1.00**	ug/L		1.00					SM10200H	08/26/20 11:10	DL
Nitrogen, Total	**<0.0300**	mg/L		0.0300		1			TKN + (N+N)	08/20/20 13:48	DL
Ammonia as N	**<0.060**	mg/L		0.060		1	EPA 350.1	08/24/20 13:12	EPA 350.1	08/25/20 09:47	DL
Nitrate/Nitrite as N (N+N)	**<0.03**	mg/L		0.03		1			EPA 353.2	08/18/20 13:01	DL
Nitrogen, Total Kjeldahl (TKN)	**<0.30**	mg/L		0.30		1	EPA 351.2	08/20/20 08:45	EPA 351.2	08/20/20 13:48	DL
Phosphorus, Total as P	**<0.003**	mg/L		0.003		1	EPA 365.3	08/18/20 10:37	EPA 365.3	08/18/20 16:08	DL
Anions by IC											
Chloride	**<0.50**	mg/L		0.50		1			EPA 300.0	08/14/20 18:29	HB
Nitrate as N	**<0.03**	mg/L		0.03		1			EPA 300.0	08/14/20 18:29	HB
Nitrite as N	**<0.03**	mg/L		0.03		1			EPA 300.0	08/14/20 18:29	HB
Sulfate as SO4	**<0.3**	mg/L		0.5	0.3	1			EPA 300.0	08/14/20 18:29	HB

RMB Environmental Laboratories, Inc.

Bloomington, MN Detroit Lakes, MN Hibbing, MN
1.888.200.5770 rmbel@rmbel.info www.rmbel.info

CHAIN OF CUSTODY RECORD

Page 1 of 2

Electronic version available at http://www.rmbel.info/lab/chains-of-custody/

Client: Save the Boundary Waters
Phone #:
Fax #:
Project Name:
Project Task Code:
PO/WO #:
Sampler: (print name) Lisa Pugh
Sampler Phone # 952-237-6714
Report to: Lisa Pugh
Bill to: Northeastern Minnesotans for Wilderness
Report to Email: lisa@savetheboundarywaters.org
Bill to Email: nicole@savetheboundarywaters.org

☐ "EQUIS" EDD Lab Format - MPCA Data Submittal

1000909

Analyses Requested

Lab Code	Station ID/Sample Description	Date	Time	# of Bottles	Sample Method	Start Depth (m)	End Depth (m)	Sample Type	Matrix	Cations	Anions	General Chemistry	Alkalinity	Nutrients	Sulfide	Chlorophyll-a		Sample Comments: (Equipment Type, Filtration, AIS, Preservation)
-01	204 / lake surface	8/13/20	0759	~~6~~7	LKSURF-2M	0	2	Sample	Wtr-Surf	X	X	X	X	X		X	515346	
-02	501 / Lake surface	8/13/20	0948	7	LKSURF-2M	0	2	Sample	Wtr-surf	X	X	X	X	X		X	515347	
-03	204 / Field dup	8/13/20	0756	7	LKSURF-2M	0	2	QC-FR	Wtr-surf	X	X	X	X	X		X	515348	
-04	204 / Equip. blank	8/13/20	0757	7	LKSURF-2M	0	2	QC-EB	~~Wtr-Surf~~	X	X	X	X	X		X	515349	QC-Blank
-05	SNOK-BS	8/13/20	1042	6	LKSURF-2M	0	2	Sample	Wtr-Surf	X	X	X	X	X			515350	
-06	Bottle Blank	8/13/20	1350	6	QC-Blank	0	0	QC-FB	QC-Blank	X	X	X	X	X		X	515351	
-07	5002-812	8/13/20	1355	5	Grab	0	0	Sample	Wtr-Surf	X	X	X	X	X			515352	
-08	4990	8/13/20	1637	5	Grab	0	0	Sample	Wtr-Surf	X	X	X	X	X			515353	
-09	5730	8/13/20	1859	5	Grab	0	0	Sample	Wtr-Surf	X	X	X	X	X			515354	
-10	5035	8/13/20	2014	5	Grab	0	0	Sample	Wtr-Surf	X	X	X	X	X			515355	

________ (Initials) In the event that samples are received by the lab at a temperature greater than 6 ° C, I hereby authorize RMB Environmental Laboratories to process the samples as received.

LP (Initials) In the event that samples are received by the lab at a temperature greater than 6 ° C, please contact client at phone # 952-237-6714 before processing samples.

Relinquished by: (client signature)	Date	Time	Relinquished by Lab: (signature)	Date	Time
	08/14/20	9:31			
Received by Lab: (signature)	**Date**	**Time**	**Received by Lab: (signature)**	**Date**	**Time**
	08/14/20	0945			

☑ DOES meet proper sample storage and transportation guidelines
☐ Does NOT meet proper sample storage and transportation guidelines
Explain:
☑ Rcvd on ice ☐ Rcvd at room temp Rcvd Temp: ~~9.8~~ 9.0 °C
☑ Samples received same day as collection LTG: 03
JRW
Comments: Chlorine: No Yes NA

☐ DOES meet proper sample storage and transportation guidelines
☐ Does NOT meet proper sample storage and transportation guidelines
Explain:
☐ Rcvd on ice ☐ Rcvd at room temp Rcvd Temp: ____ °C
☐ Samples received same day as collection LTG:
Comments:

BILLING
Shipping / Courier:
Mileage:
Field Staff:
Equipment:
Other:

SHIPPING TO LAB
☐ Speedee
☐ UPS
☐ USPS
☐ FedEx
☒ Hand Delivery
☐ Courier
☐ RMB Courier

INTERLAB SHIPPING
☐ Speedee
☐ UPS
☐ USPS
☐ FedEx
☐ Courier
☐ RMB Courier

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Bloomington
2200 West 94th Street
Bloomington, MN 55431
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Detroit Lakes
22796 County Highway 6
Detroit Lakes, MN 56501
218-846-1465

Hibbing
1111 7th Ave. E.
Hibbing, MN 55746
218-440-2043

May 14, 2021
Laboratory Report

Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN 55731

RE: Surface Water

Work Order :H002949

Enclosed are the results of analyses for samples received by the laboratory on 05/12/2021 10:06. If you have any questions concerning this report, please feel free to contact me at (218) 440-2043.

Report approved by:

Kristin Hanson
Project Manager
Kristin.Hanson@rmbel.info

RMB Environmental Laboratories, Inc.
www.rmbel.info

Bloomington
2200 West 94th Street
Bloomington, MN 55431
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Hibbing, MN 55746
218-440-2043

Laboratory Results
May 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H002949-01
Matrix: QC-BLANK
Date/Time Sampled: 05/11/2021 11:26
Date/Time Received: 05/12/2021 10:06

Sample Description: EB - Equipment blank
Collection Method: QC-BLANK
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**<0.5**	mg/L	0.5	1			EPA 300.0	05/13/21 04:52		HB

The results in this report apply only to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Laboratory Results
May 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H002949-02
Matrix: Surface Water
Date/Time Sampled: 05/11/2021 11:32
Date/Time Received: 05/12/2021 10:06

Sample Description: BB - Bottle blank
Collection Method:
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**<0.5**	mg/L	0.5	1			EPA 300.0	05/13/21 05:10		HB

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Laboratory Results
May 14, 2021

Report To: Save the Boundary Waters
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206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H002949-03
Matrix: Surface Water
Date/Time Sampled: 05/11/2021 12:55
Date/Time Received: 05/12/2021 10:06

Sample Description: 303
Collection Method: G
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**21.4**	mg/L	0.5	1			EPA 300.0	05/13/21 05:27		HB

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Detroit Lakes, MN 56501
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Hibbing
1111 7th Ave. E.
Hibbing, MN 55746
218-440-2043

Laboratory Results
May 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H002949-04
Matrix: Surface Water
Date/Time Sampled: 05/11/2021 13:18
Date/Time Received: 05/12/2021 10:06

Sample Description: S009-182
Collection Method: G
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**15.0**	mg/L	0.5	1			EPA 300.0	05/13/21 05:45		HB

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Wild Rice WQLS, Exhibit G

Laboratory Results
May 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
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Ely, MN, 55731

Project: Surface Water
Lab Code: H002949-05
Matrix: Surface Water
Date/Time Sampled: 05/11/2021 13:31
Date/Time Received: 05/12/2021 10:06

Sample Description: 202
Collection Method: LKSURF2M
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.8**	mg/L	0.5	1			EPA 300.0	05/13/21 06:03		HB

Laboratory Results
May 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H002949-06
Matrix: Surface Water
Date/Time Sampled: 05/11/2021 13:43
Date/Time Received: 05/12/2021 10:06

Sample Description: 203
Collection Method: LKSURF2M
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.8**	mg/L	0.5	1			EPA 300.0	05/13/21 15:15		HB

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Laboratory Results
May 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H002949-07
Matrix: Surface Water
Date/Time Sampled: 05/11/2021 14:00
Date/Time Received: 05/12/2021 10:06

Sample Description: 503
Collection Method: LKSURF2M
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**12.4**	mg/L	0.5	1			EPA 300.0	05/13/21 15:32		HB

Laboratory Results
May 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H002949-08
Matrix: Surface Water
Date/Time Sampled: 05/11/2021 14:41
Date/Time Received: 05/12/2021 10:06

Sample Description: BB-001
Collection Method: LKSURF2M
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**53.9**	mg/L	0.5	1			EPA 300.0	05/13/21 23:52		HB

Laboratory Results
May 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H002949-09
Matrix: Surface Water
Date/Time Sampled: 05/11/2021 14:52
Date/Time Received: 05/12/2021 10:06

Sample Description: 301
Collection Method: G
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**42.0**	mg/L	0.5	1			EPA 300.0	05/14/21 00:46		HB

The results in this report apply only to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Laboratory Results
May 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H002949-10
Matrix: Surface Water
Date/Time Sampled: 05/11/2021 14:53
Date/Time Received: 05/12/2021 10:06

Sample Description: 301-FD
Collection Method: G
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**41.8**	mg/L	0.5	1			EPA 300.0	05/14/21 01:03		HB

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Laboratory Results
May 14, 2021

Report To:
Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To:
Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H002949-11
Matrix: Surface Water
Date/Time Sampled: 05/11/2021 15:04
Date/Time Received: 05/12/2021 10:06

Sample Description: BB-002
Collection Method: LKSURF2M
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**19.1**	mg/L	0.5	1			EPA 300.0	05/14/21 01:21		HB

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Laboratory Results
May 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project:	Surface Water	**Sample Description:**	BB-002-FD
Lab Code:	H002949-12	**Collection Method:**	LKSURF2M
Matrix:	Surface Water	**Sampled by:**	Lisa Pugh
Date/Time Sampled:	05/11/2021 15:05	**Sample Receipt Information**	See chain of custody.
Date/Time Received:	05/12/2021 10:06		

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**18.2**	mg/L	0.5	1			EPA 300.0	05/14/21 01:39		HB

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Laboratory Results
May 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H002949-13
Matrix: Surface Water
Date/Time Sampled: 05/11/2021 15:17
Date/Time Received: 05/12/2021 10:06

Sample Description: 502
Collection Method: LKSURF2M
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**5.9**	mg/L	0.5	1			EPA 300.0	05/14/21 01:57		HB

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Laboratory Results
May 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project:	Surface Water
Lab Code:	H002949-14
Matrix:	Surface Water
Date/Time Sampled:	05/11/2021 15:30
Date/Time Received:	05/12/2021 10:06
Sample Description:	304
Collection Method:	LKSURF2M
Sampled by:	Lisa Pugh
Sample Receipt Information	See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**0.8**	mg/L	0.5	1			EPA 300.0	05/14/21 02:15		HB

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Laboratory Results
May 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H002949-15
Matrix: Surface Water
Date/Time Sampled: 05/11/2021 15:58
Date/Time Received: 05/12/2021 10:06

Sample Description: 302
Collection Method: LKSURF2M
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**5.6**	mg/L	0.5	1			EPA 300.0	05/14/21 02:33		HB

Qualifiers and Definitions

Item	Definition
RL	Reporting Limit (Corrected for dilution factor when applicable due to sample preparation variation.)
DF	Dilution Factor
HB	Indicates test performed by RMB Environmental Laboratories - Hibbing.

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CHAIN OF CUSTODY RECORD

Electronic version available at http://www.rmbel.info/lab/chains-of-custody/

Page 1 of 2

☐ "EQUIS" EDD Lab Format - MPCA Data Submittal

Analyses Requested H002949

Order

Client: Save the Boundary Waters / Northeastern Minnesotans for Wilderness
Phone #: 952-237-6714
Fax #:
Project Name: Sulfate
Project Task Code:
PO/WO #:
Sampler: (print name) Lisa Pugh (LP)
Sampler Phone #: 952-237-6714
Report to: Lisa Pugh
Bill to: Lisa Pugh
Report to Email: lisa@savetheboundarywaters.org
Bill to Email: lisa@savetheboundarywaters.org

Sample Number	Station ID/Sample Description	Date	Time	# of Bottles	Sample Method	Start Depth (m)	End Depth (m)	Sample Type	Matrix	Preserved at Collection	Preserved at Lab Receipt	Sulfate	Sample Comments: (Equipment Type, Filtration, AIS, Preservation)
01	EB - Equip. Blank	5/11/21	1126	1	QC-Blank			QC-EB	QC-Blank			X	
02	BB Bottle Blank	5/11/21	1132	1	QC-Blank			QC-FB	QC-Blank			X	
03	303	5/11/21	1255	1	G			Sample	Wtr-Surf			X	
04	5009-182	5/11/21	1318	1	G			Sample	Wtr-Surf			X	
05	202	5/11/21	1331	1	LKSURF2M			Sample	Wtr-Surf			X	
06	203	5/11/21	1343	1	LKSURF2M			Sample	Wtr-Surf			X	
07	503	5/11/21	1400	1	LKSURF2M			Sample	Wtr-Surf			X	
08	BB-001	5/11/21	1441	1	LKSURF2M			Sample	Wtr-Surf			X	
09	301	5/11/21	1452	1	G			Sample	Wtr-Surf			X	
10	301-FD	5/11/21	1453	1	G			Wtr-Surf	QC-FR			X	
11	BB-002	5/11/21	1504	1	LKSURF2M			Sample	Wtr-Surf			X	
12	BB-002-FD	5/11/21	1505	1	LKSURF2M			Wtr Surf	QC-FR			X	
13	502	5/11/21	1517	1	LKSURF2M			Sample	Wtr-Surf			X	

_______ (Initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) I hereby authorize RMB Environmental Laboratories to process the samples as received.

_______ (Initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) please contact client at phone # ______________ before processing samples.

Relinquished by: (client signature)
Print Name: Lisa Pugh
Date 5/12/21
Time 1005

Shipping to Lab:
☐ Speedee ☐ UPS ☐ USPS ☐ FedEx ☐ Courier ☐ RMB Courier ☒ Hand Delivery

FOR LAB USE ONLY

Received by Lab: (signature) Kathie Mitchell
Date 5/12/21
Time 1005

Additional Fees:
Mileage: Field Staff: Shipping: Courier: Equipment: Other:

☒ **DOES** meet proper sample storage and transportation guidelines
☐ Does **NOT** meet proper sample storage and transportation guidelines

☒ Received on ice ☐ Received at room temperature
☐ Samples received same day as collection

Received Temp: 5.7 °C Therm. ID: LTG HBIR3
Chlorine: No Yes N/A

Comments: ______________

VOC vials received w/o headspace: bubble < 6mm: Yes No [✓ N/A]

Wild Rice WQLS, Exhibit G

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CHAIN OF CUSTODY RECORD

Page 2 of 2

Electronic version available at http://www.rmbel.info/lab/chains-of-custody/

☐ "EQUIS" EDD Lab Format - MPCA Data Submittal

H002949

Client: Save the Boundary Waters (STBW)/NMW
Phone #:
Fax #:
Project Name: Sulfate
Project Task Code:
PO/WO #:
Sampler: (print name) Lisa Pugh
Sampler Phone # 952-237-6714
Report to: Lisa Pugh
Bill to: Lisa Pugh
Report to Email: lisa.a.pugh@gmail.com
Bill to Email: lisa@savetheboundarywaters.org

Analyses Requested

Lab Code	Station ID/Sample Description	Date	Time	# of Bottles	Sample Method	Start Depth (m)	End Depth (m)	Sample Type	Matrix	Sulfate	Sample Comments: (Equipment Type, Filtration, AIS, Preservation)
14	304	5/11/21	1530	1	LKSURFZM			Sample	Wtr-surf	X	
15	302	5/11/21	1558	1	LKSURFZM			Sample	Wtr-surf	X	

_______ (Initials) In the event that samples are received by the lab at a temperature greater than 6 ° C, I hereby authorize RMB Environmental Laboratories to process the samples as received.

_______ (Initials) In the event that samples are received by the lab at a temperature greater than 6 ° C, please contact client at phone # ____________ before processing samples.

Relinquished by: (client signature) Date 5/12/21 Time 1005
Received by Lab: (signature) Kathie Mitchell Date 5/12/21 Time 10:06

☒ DOES meet proper sample storage and transportation guidelines
☐ Does NOT meet proper sample storage and transportation guidelines
Explain: ____________
☒ Rcvd on ice ☐ Rcvd at room temp Rcvd Temp: 5.7 °C
☐ Samples received same day as collection LTG: HBIR3
Comments: ____________ Chlorine: No Yes NA

Relinquished by Lab: (signature) Date Time
Received by Lab: (signature) Date Time

☐ DOES meet proper sample storage and transportation guidelines
☐ Does NOT meet proper sample storage and transportation guidelines
Explain: ____________
☐ Rcvd on ice ☐ Rcvd at room temp Rcvd Temp: ________ °C
☐ Samples received same day as collection LTG: ________
Comments: ____________

BILLING
Shipping / Courier:
Mileage:
Field Staff:
Equipment:
Other:

SHIPPING TO LAB
- ☐ Speedee
- ☐ UPS
- ☐ USPS
- ☐ FedEx
- ☒ Hand Delivery
- ☐ Courier
- ☐ RMB Courier

INTERLAB SHIPPING
- ☐ Speedee
- ☐ UPS
- ☐ USPS
- ☐ FedEx
- ☐ Courier
- ☐ RMB Courier

Wild Rice WQILS, Exhibit G 91

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June 08, 2021
Laboratory Report

Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN 55731

RE: Surface Water

Work Order :H003200

Enclosed are the results of analyses for samples received by the laboratory on 06/03/2021 08:35. If you have any questions concerning this report, please feel free to contact me at (218) 440-2043.

Report approved by:

Kristin Hanson
Project Manager
Kristin.Hanson@rmbel.info

Laboratory Results
June 08, 2021

Report To:
Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To:
Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003200-01
Matrix: QC-BLANK
Date/Time Sampled: 06/01/2021 13:57
Date/Time Received: 06/03/2021 08:35

Sample Description: Equip. Blank -VD
Collection Method: QC-BLANK
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**< 0.5**	mg/L	0.5	1			EPA 300.0	06/03/21 16:32		HB

The results in this report apply only to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Laboratory Results
June 08, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003200-02
Matrix: Wtr-Surf
Date/Time Sampled: 06/01/2021 14:01
Date/Time Received: 06/03/2021 08:35

Sample Description: BB-001
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**44.0**	mg/L	0.5	1			EPA 300.0	06/03/21 16:49		HB

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Laboratory Results
June 08, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003200-03
Matrix: QC-BLANK
Date/Time Sampled: 06/01/2021 14:10
Date/Time Received: 06/03/2021 08:35

Sample Description: Bottle Blank
Collection Method: QC-BLANK
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**0.9**	mg/L	0.5	1			EPA 300.0	06/03/21 17:07		HB

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Laboratory Results
June 08, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project:	Surface Water	**Sample Description:**	301
Lab Code:	H003200-04	**Collection Method:**	LKDEPTH
Matrix:	Wtr-Surf	**Sampled by:**	Lisa Pugh
Date/Time Sampled:	06/01/2021 14:23	**Sample Receipt Information**	See chain of custody.
Date/Time Received:	06/03/2021 08:35		

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**23.0**	mg/L	0.5	1			EPA 300.0	06/03/21 17:25		HB

Laboratory Results
June 08, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
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Project: Surface Water
Lab Code: H003200-05
Matrix: Wtr-Surf
Date/Time Sampled: 06/01/2021 14:36
Date/Time Received: 06/03/2021 08:35

Sample Description: BB-003
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
<u>Anions by IC</u>										
Sulfate as SO4	**20.9**	mg/L	0.5	1			EPA 300.0	06/03/21 17:43		HB

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Laboratory Results
June 08, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003200-06
Matrix: Wtr-Surf
Date/Time Sampled: 06/01/2021 14:37
Date/Time Received: 06/03/2021 08:35

Sample Description: BB-003 FD
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**21.5**	mg/L	0.5	1			EPA 300.0	06/03/21 18:01		HB

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Laboratory Results
June 08, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003200-07
Matrix: QC-BLANK
Date/Time Sampled: 06/01/2021 15:02
Date/Time Received: 06/03/2021 08:35

Sample Description: Equip. Blank- I
Collection Method: QC-BLANK
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**< 0.5**	mg/L	0.5	1			EPA 300.0	06/03/21 18:19		HB

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Laboratory Results
June 08, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
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206 E Sheridan St
Ely, MN, 55731

Project:	Surface Water	**Sample Description:**	BL-004-Surf
Lab Code:	H003200-08	**Collection Method:**	LKSURF2M
Matrix:	Wtr-Surf	**Sampled by:**	Lisa Pugh
Date/Time Sampled:	06/01/2021 15:47	**Sample Receipt Information**	See chain of custody.
Date/Time Received:	06/03/2021 08:35		

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**9.9**	mg/L	0.5	1			EPA 300.0	06/03/21 20:24		HB

Laboratory Results
June 08, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003200-09
Matrix: Wtr-Surf
Date/Time Sampled: 06/01/2021 15:50
Date/Time Received: 06/03/2021 08:35

Sample Description: BL-004-Mid
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**8.7**	mg/L	0.5	1			EPA 300.0	06/03/21 20:41		HB

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Laboratory Results
June 08, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003200-10
Matrix: Wtr-Surf
Date/Time Sampled: 06/01/2021 15:56
Date/Time Received: 06/03/2021 08:35

Sample Description: BL-004-deep
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**9.6**	mg/L	0.5	1			EPA 300.0	06/03/21 20:59		HB

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Hibbing, MN 55746
218-440-2043

Laboratory Results
June 08, 2021

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Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003200-11
Matrix: Wtr-Surf
Date/Time Sampled: 06/01/2021 15:57
Date/Time Received: 06/03/2021 08:35

Sample Description: BL-004-deep-FD
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**10.1**	mg/L	0.5	1			EPA 300.0	06/03/21 21:17		HB

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Laboratory Results
June 08, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003200-12
Matrix: Wtr-Surf
Date/Time Sampled: 06/01/2021 15:20
Date/Time Received: 06/03/2021 08:35

Sample Description: BL-005-surf
Collection Method: LKSURF2M
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**10.5**	mg/L	0.5	1			EPA 300.0	06/03/21 21:35		HB

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Laboratory Results
June 08, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003200-13
Matrix: Wtr-Surf
Date/Time Sampled: 06/01/2021 15:22
Date/Time Received: 06/03/2021 08:35

Sample Description: BL-005-mid
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**9.2**	mg/L	0.5	1			EPA 300.0	06/03/21 21:53		HB

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Laboratory Results
June 08, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003200-14
Matrix: Wtr-Surf
Date/Time Sampled: 06/01/2021 15:27
Date/Time Received: 06/03/2021 08:35

Sample Description: BL-005-deep
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**10.9**	mg/L	0.5	1			EPA 300.0	06/03/21 22:46		HB

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Laboratory Results
June 08, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
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206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003200-15
Matrix: Wtr-Surf
Date/Time Sampled: 06/01/2021 16:14
Date/Time Received: 06/03/2021 08:35

Sample Description: BB-002-surf
Collection Method: LKSURF2M
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**10.7**	mg/L	0.5	1			EPA 300.0	06/03/21 23:40		HB

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Laboratory Results
June 08, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
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Bill To: Save the Boundary Waters
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206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003200-16
Matrix: Wtr-Surf
Date/Time Sampled: 06/01/2021 16:20
Date/Time Received: 06/03/2021 08:35

Sample Description: BB-002-deep
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**12.8**	mg/L	0.5	1			EPA 300.0	06/03/21 23:58		HB

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June 08, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
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Bill To: Save the Boundary Waters
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206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003200-17
Matrix: Wtr-Surf
Date/Time Sampled: 06/01/2021 16:39
Date/Time Received: 06/03/2021 08:35

Sample Description: 502-surf
Collection Method: LKSURF2M
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**9.3**	mg/L	0.5	1			EPA 300.0	06/04/21 00:15		HB

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Laboratory Results
June 08, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
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206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003200-18
Matrix: Wtr-Surf
Date/Time Sampled: 06/01/2021 16:42
Date/Time Received: 06/03/2021 08:35

Sample Description: 502-mid
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**8.3**	mg/L	0.5	1			EPA 300.0	06/04/21 00:33		HB

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Laboratory Results
June 08, 2021

Report To: Save the Boundary Waters
Lisa Pugh
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Ely, MN, 55731

Project:	Surface Water	**Sample Description:**	502-deep
Lab Code:	H003200-19	**Collection Method:**	LKDEPTH
Matrix:	Wtr-Surf	**Sampled by:**	Lisa Pugh
Date/Time Sampled:	06/01/2021 16:47	**Sample Receipt Information**	See chain of custody.
Date/Time Received:	06/03/2021 08:35		

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**8.6**	mg/L	0.5	1			EPA 300.0	06/04/21 00:51		HB

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Laboratory Results
June 08, 2021

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Lisa Pugh
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Project: Surface Water
Lab Code: H003200-20
Matrix: Wtr-Surf
Date/Time Sampled: 06/01/2021 17:09
Date/Time Received: 06/03/2021 08:35

Sample Description: 204-surf
Collection Method: LKSURF2M
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
<u>Anions by IC</u>										
Sulfate as SO4	**8.2**	mg/L	0.5	1			EPA 300.0	06/04/21 01:09		HB

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Lisa Pugh
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Ely, MN, 55731

Project: Surface Water
Lab Code: H003200-21
Matrix: Wtr-Surf
Date/Time Sampled: 06/01/2021 17:13
Date/Time Received: 06/03/2021 08:35

Sample Description: 204-mid
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**7.4**	mg/L	0.5	1			EPA 300.0	06/04/21 01:27		HB

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Laboratory Results
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Lisa Pugh
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Ely, MN, 55731

Project: Surface Water
Lab Code: H003200-22
Matrix: Wtr-Surf
Date/Time Sampled: 06/01/2021 17:17
Date/Time Received: 06/03/2021 08:35

Sample Description: 204-deep
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
<u>Anions by IC</u>										
Sulfate as SO4	**7.6**	mg/L	0.5	1			EPA 300.0	06/04/21 02:20		HB

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Lisa Pugh
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Project: Surface Water
Lab Code: H003200-23
Matrix: QC-BLANK
Date/Time Sampled: 06/02/2021 07:25
Date/Time Received: 06/03/2021 08:35

Sample Description: Bottle blank
Collection Method: QC-BLANK
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**< 0.5**	mg/L	0.5	1			EPA 300.0	06/04/21 02:38		HB

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Laboratory Results
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Lisa Pugh
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Project: Surface Water
Lab Code: H003200-24
Matrix: QC-BLANK
Date/Time Sampled: 06/02/2021 07:30
Date/Time Received: 06/03/2021 08:35

Sample Description: Equip. Blank -VD
Collection Method: QC-BLANK
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**< 0.5**	mg/L	0.5	1			EPA 300.0	06/04/21 03:32		HB

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Laboratory Results
June 08, 2021

Report To: Save the Boundary Waters
Lisa Pugh
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Project: Surface Water
Lab Code: H003200-25
Matrix: QC-BLANK
Date/Time Sampled: 06/02/2021 07:35
Date/Time Received: 06/03/2021 08:35

Sample Description: Equip. Blank- I
Collection Method: QC-BLANK
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**< 0.5**	mg/L	0.5	1			EPA 300.0	06/04/21 03:50		HB

Laboratory Results
June 08, 2021

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Project: Surface Water
Lab Code: H003200-26
Matrix: Wtr-Surf
Date/Time Sampled: 06/02/2021 08:05
Date/Time Received: 06/03/2021 08:35

Sample Description: 303
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**16.3**	mg/L	0.5	1			EPA 300.0	06/04/21 04:08		HB

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Laboratory Results
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Project: Surface Water
Lab Code: H003200-27
Matrix: Wtr-Surf
Date/Time Sampled: 06/02/2021 08:19
Date/Time Received: 06/03/2021 08:35

Sample Description: S009-182
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**14.0**	mg/L	0.5	1			EPA 300.0	06/04/21 04:25		HB

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Laboratory Results
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Lisa Pugh
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Project: Surface Water
Lab Code: H003200-28
Matrix: Wtr-Surf
Date/Time Sampled: 06/02/2021 08:38
Date/Time Received: 06/03/2021 08:35

Sample Description: 202-surf
Collection Method: LKSURF2M
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.6**	mg/L	0.5	1			EPA 300.0	06/04/21 04:43		HB

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Laboratory Results
June 08, 2021

Report To:
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Lisa Pugh
206 E Sheridan St
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Bill To:
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206 E Sheridan St
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Project:	Surface Water	**Sample Description:**	202-mid
Lab Code:	H003200-29	**Collection Method:**	LKDEPTH
Matrix:	Wtr-Surf	**Sampled by:**	Lisa Pugh
Date/Time Sampled:	06/02/2021 08:41	**Sample Receipt Information**	See chain of custody.
Date/Time Received:	06/03/2021 08:35		

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.7**	mg/L	0.5	1			EPA 300.0	06/04/21 05:01		HB

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Laboratory Results
June 08, 2021

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Lisa Pugh
206 E Sheridan St
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Project: Surface Water
Lab Code: H003200-30
Matrix: Wtr-Surf
Date/Time Sampled: 06/02/2021 08:48
Date/Time Received: 06/03/2021 08:35

Sample Description: 202-deep
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.8**	mg/L	0.5	1			EPA 300.0	06/04/21 14:11		HB

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Laboratory Results
June 08, 2021

Report To: Save the Boundary Waters
Lisa Pugh
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Bill To: Save the Boundary Waters
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Project: Surface Water
Lab Code: H003200-31
Matrix: Wtr-Surf
Date/Time Sampled: 06/02/2021 09:09
Date/Time Received: 06/03/2021 08:35

Sample Description: 203-surf
Collection Method: LKSURF2M
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**12.0**	mg/L	0.5	1			EPA 300.0	06/04/21 14:28		HB

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Laboratory Results
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Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
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Bill To: Save the Boundary Waters
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206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003200-32
Matrix: Wtr-Surf
Date/Time Sampled: 06/02/2021 09:11
Date/Time Received: 06/03/2021 08:35

Sample Description: 203-mid
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.4**	mg/L	0.5	1			EPA 300.0	06/07/21 14:05		HB

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Laboratory Results
June 08, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
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Bill To: Save the Boundary Waters
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206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003200-33
Matrix: Wtr-Surf
Date/Time Sampled: 06/02/2021 09:18
Date/Time Received: 06/03/2021 08:35

Sample Description: 203-deep
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.5**	mg/L	0.5	1			EPA 300.0	06/07/21 14:59		HB

Laboratory Results
June 08, 2021

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Lisa Pugh
206 E Sheridan St
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Bill To: Save the Boundary Waters
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Project: Surface Water
Lab Code: H003200-34
Matrix: Wtr-Surf
Date/Time Sampled: 06/02/2021 09:19
Date/Time Received: 06/03/2021 08:35

Sample Description: 203-deep-FD
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.4**	mg/L	0.5	1			EPA 300.0	06/07/21 15:16		HB

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Laboratory Results
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Project: Surface Water
Lab Code: H003200-35
Matrix: Wtr-Surf
Date/Time Sampled: 06/02/2021 09:51
Date/Time Received: 06/03/2021 08:35

Sample Description: 503-surf
Collection Method: LKSURF2M
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.6**	mg/L	0.5	1			EPA 300.0	06/07/21 15:34		HB

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Laboratory Results
June 08, 2021

Report To:
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Lisa Pugh
206 E Sheridan St
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Bill To:
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206 E Sheridan St
Ely, MN, 55731

Project:	Surface Water	**Sample Description:**	503-mid
Lab Code:	H003200-36	**Collection Method:**	LKDEPTH
Matrix:	Wtr-Surf	**Sampled by:**	Lisa Pugh
Date/Time Sampled:	06/02/2021 09:54	**Sample Receipt Information**	See chain of custody.
Date/Time Received:	06/03/2021 08:35		

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.2**	mg/L	0.5	1			EPA 300.0	06/07/21 15:52		HB

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Laboratory Results
June 08, 2021

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Lisa Pugh
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Bill To: Save the Boundary Waters
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Ely, MN, 55731

Project: Surface Water
Lab Code: H003200-37
Matrix: Wtr-Surf
Date/Time Sampled: 06/02/2021 09:57
Date/Time Received: 06/03/2021 08:35

Sample Description: 503-deep
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.5**	mg/L	0.5	1			EPA 300.0	06/07/21 16:10		HB

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Laboratory Results
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Project: Surface Water
Lab Code: H003200-38
Matrix: Wtr-Surf
Date/Time Sampled: 06/02/2021 10:15
Date/Time Received: 06/03/2021 08:35

Sample Description: BL-002-surf
Collection Method: LKSURF2M
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.7**	mg/L	0.5	1			EPA 300.0	06/07/21 16:28		HB

Laboratory Results
June 08, 2021

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Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

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Project: Surface Water
Lab Code: H003200-39
Matrix: Wtr-Surf
Date/Time Sampled: 06/02/2021 10:18
Date/Time Received: 06/03/2021 08:35

Sample Description: BL-002-mid
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.3**	mg/L	0.5	1			EPA 300.0	06/07/21 16:46		HB

The results in this report apply only to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Laboratory Results
June 08, 2021

Report To:
Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To:
Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project:	Surface Water	**Sample Description:**	BL-002-Deep
Lab Code:	H003200-40	**Collection Method:**	LKDEPTH
Matrix:	Wtr-Surf	**Sampled by:**	Lisa Pugh
Date/Time Sampled:	06/02/2021 10:24	**Sample Receipt Information**	See chain of custody.
Date/Time Received:	06/03/2021 08:35		

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.2**	mg/L	0.5	1			EPA 300.0	06/07/21 17:39		HB

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Laboratory Results
June 08, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project:	Surface Water
Lab Code:	H003200-41
Matrix:	Wtr-Surf
Date/Time Sampled:	06/02/2021 10:39
Date/Time Received:	06/03/2021 08:35
Sample Description:	BL-003-surf
Collection Method:	LKSURF2M
Sampled by:	Lisa Pugh
Sample Receipt Information	See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.3**	mg/L	0.5	1			EPA 300.0	06/07/21 18:33		HB

The results in this report apply only to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Laboratory Results
June 08, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003200-42
Matrix: Wtr-Surf
Date/Time Sampled: 06/02/2021 10:43
Date/Time Received: 06/03/2021 08:35

Sample Description: BL-003- mid
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**10.5**	mg/L	0.5	1			EPA 300.0	06/07/21 18:51		HB

Laboratory Results
June 08, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003200-43
Matrix: Wtr-Surf
Date/Time Sampled: 06/02/2021 10:46
Date/Time Received: 06/03/2021 08:35

Sample Description: BL-003-deep
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.0**	mg/L	0.5	1			EPA 300.0	06/07/21 19:08		HB

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Detroit Lakes, MN 56501
218-846-1465

Hibbing
1111 7th Ave. E.
Hibbing, MN 55746
218-440-2043

Laboratory Results
June 08, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003200-44
Matrix: Wtr-Surf
Date/Time Sampled: 06/02/2021 11:06
Date/Time Received: 06/03/2021 08:35

Sample Description: BL-001-surf
Collection Method: LKSURF2M
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.4**	mg/L	0.5	1			EPA 300.0	06/07/21 19:26		HB

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Laboratory Results
June 08, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003200-45
Matrix: Wtr-Surf
Date/Time Sampled: 06/02/2021 11:08
Date/Time Received: 06/03/2021 08:35

Sample Description: BL-001-mid
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.7**	mg/L	0.5	1			EPA 300.0	06/07/21 19:44		HB

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Laboratory Results
June 08, 2021

Report To:
Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To:
Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project:	Surface Water	**Sample Description:**	BL-001-mid-FD
Lab Code:	H003200-46	**Collection Method:**	LKDEPTH
Matrix:	Wtr-Surf	**Sampled by:**	Lisa Pugh
Date/Time Sampled:	06/02/2021 11:09	**Sample Receipt Information**	See chain of custody.
Date/Time Received:	06/03/2021 08:35		

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.5**	mg/L	0.5	1			EPA 300.0	06/07/21 20:02		HB

Laboratory Results
June 08, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003200-47
Matrix: Wtr-Surf
Date/Time Sampled: 06/02/2021 11:18
Date/Time Received: 06/03/2021 08:35

Sample Description: BL-001-deep
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.5**	mg/L	0.5	1			EPA 300.0	06/07/21 20:20		HB

The results in this report apply only to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Qualifiers and Definitions

Item	Definition
RL	Reporting Limit (Corrected for dilution factor when applicable due to sample preparation variation.)
DF	Dilution Factor
HB	Indicates test performed by RMB Environmental Laboratories - Hibbing.

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CHAIN OF CUSTODY RECORD

Page 1 of 4

Electronic version available at http://www.rmbel.info/lab/chains-of-custody/

Client: Save the Boundary Waters / Northeastern Minnesotans for Wilderness
Phone #:
Fax #:
Project Name: Sulfate rd 2
Project Task Code:
PO/WO #:
Sampler: (print name) Lisa Pugh
Sampler Phone #: 952-237-6714
Report to: Lisa Pugh
Bill to: STBW
Report to Email: lisa@savetheboundarywaters.org
Bill to Email: nicole@savetheboundarywaters.org

☐ "EQUIS" EDD Lab Format - MPCA Data Submittal

Analyses Requested

H003200

Order

Sample Number	Station ID/Sample Description	Date	Time	# of Bottles	Sample Method	Start Depth (m)	End Depth (m)	Sample Type	Matrix	Preserved at Collection	Preserved at Lab Receipt	Sulfate	Sample Comments: (Equipment Type, Filtration, AIS, Preservation)
01	Equip. Blank - VD	6/1/21	1357	1	QCBLANK			QC-EB	~~Wtr-surf~~ QC-BLANK			X	
02	BB-001	6/1/21	1401	1	LKDEPTH	0.5	0.5	Sample	Wtr-surf			X	
03	Bottle Blank	6/1/21	1410	1	QCBLANK			QC-FB	QCBLANK			X	
04	301	6/1/21	1423	1	LKDEPTH	1	1	Sample	Wtr-surf			X	
05	BB-003	6/1/21	1436	1	LKDEPTH	1	1	Sample	Wtr-surf			X	
06	BB-003-FD	6/1/21	1437	1	LKDEPTH	1	1	QC-FR	Wtr-surf			X	
07	Equip. Blank - I	6/1/21	1502	1	QCBLANK			QC-EB	QCBLANK			X	
08	BL-004-surf	6/1/21	1547	1	LKSURF2M	0	2	Sample	Wtr-surf			X	
09	BL-004-mid	6/1/21	1550	1	LKDEPTH	3.5	3.5	Sample	Wtr-surf			X	
10	BL-004-deep	6/1/21	1556	1	LKDEPTH	5.5	5.5	Sample	Wtr-surf			X	
11	BL-004-deep-FD	6/1/21	1557	1	LKDEPTH	5.5	5.5	QC-FR	Wtr-surf			X	
12	BL-005-surf	6/1/21	1520	1	LKSURF2M	0	2	Sample	Wtr-surf			X	
13	BL-005-mid	6/1/21	1522	1	LKDEPTH	3.5	3.5	Sample	Wtr-surf			X	

_______ (Initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) I hereby authorize RMB Environmental Laboratories to process the samples as received.

_______ (Initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) please contact client at phone # ________________ before processing samples.

Relinquished by: (client signature)
Print Name: Lisa Pugh
Date 6/3/21
Time 0837
Shipping to Lab: ☐ Speedee ☐ UPS ☐ USPS ☐ FedEx ☐ Courier ☐ RMB Courier ☒ Hand Delivery

FOR LAB USE ONLY

Received by Lab: (signature)
Date 6/3/21
Time 0835
Additional Fees:
Mileage: Field Staff: Shipping: Courier: Equipment: Other:

☒ **DOES** meet proper sample storage and transportation guidelines
☐ Does **NOT** meet proper sample storage and transportation guidelines
☒ Received on ice
☐ Received at room temperature
☐ Samples received same day as collection
Received Temp: 2.1 °C Therm. ID: LTG HBIR3
Chlorine: No Yes [✓ N/A]

Comments: ____________

VOC vials received w/o headspace: bubble < 6mm: Yes No [✓ N/A]

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CHAIN OF CUSTODY RECORD

Electronic version available at http://www.rmbel.info/lab/chains-of-custody/

Page 2 of 4

Client: STBW/NMW
Project Name: Sulfate rd 2
Sampler: (print name) Lisa Pugh
Report to:
Report to Email:
Phone #:
Fax #:
Project Task Code:
PO/WO #:
Sampler Phone #:
Bill to:
Bill to Email:

☐ "EQUIS" EDD Lab Format - MPCA Data Submittal

Analyses Requested

H003200

Order

Sample Number	Station ID/Sample Description	Date	Time	# of Bottles	Sample Method	Start Depth (m)	End Depth (m)	Sample Type	Matrix	Preserved at Collection	Preserved at Lab Receipt	Sulfate	Sample Comments: (Equipment Type, Filtration, AIS, Preservation)
14	BL-005-deep	6/1/21	1527	1	LKDEPTH	5.5	5.5	Sample	Wtr surf			X	
15	BB-002-surf	6/1/21	1614	1	LKSURF2M	0	2	Sample	Wtr surf			X	
16	BB-002-deep	6/1/21	1620	1	LKDEPTH	3	3	Sample	Wtr surf			X	
17	502-surf	6/1/21	1639	1	LKSURF2M	0	2	Sample	Wtr surf			X	
18	502-mid	6/1/21	1642	1	LKDEPTH	3	3	Sample	Wtr surf			X	
19	502-deep	6/1/21	1647	1	LKDEPTH	5	5	Sample	Wtr surf			X	
20	204-surf	6/1/21	1709	1	LKSURF2M	0	2	Sample	Wtr surf			X	
21	204-mid	6/1/21	1713	1	LKDEPTH	4	4	Sample	Wtr surf			X	
22	204-deep	6/1/21	1717	1	LKDEPTH	8	8	Sample	Wtr surf			X	
23	Bottle blank	6/2/21	0725	1	QCBLANK			QC-FB	QC-BLANK			X	
24	Equip. Blank-VD	6/2/21	0730	1	QCBLANK			QC-EB	QC-BLANK			X	
25	Equip. Blank-I	6/2/21	0735	1	QCBLANK			QC-EB	QC-BLANK			X	
26	303	6/2/21	0805	1	LKDEPTH	1	1	Sample	Wtr surf			X	

_______ (Initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) I hereby authorize RMB Environmental Laboratories to process the samples as received.

_______ (Initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) please contact client at phone # ____________ before processing samples.

Relinquished by: (client signature)
Print Name: Lisa Pugh
Date 6/3/21
Time 0837

Shipping to Lab: ☐ Speedee ☐ UPS ☐ USPS ☐ FedEx ☐ Courier ☐ RMB Courier ☒ Hand Delivery

FOR LAB USE ONLY

Received by Lab: (signature)
Date 6/3/21
Time 0835
Mileage:
Additional Fees: Field Staff: Shipping: Courier: Equipment: Other:

☒ DOES meet proper sample storage and transportation guidelines
☐ Does **NOT** meet proper sample storage and transportation guidelines

☒ Received on ice ☐ Received at room temperature
☐ Samples received same day as collection

Received Temp 2.1 °C Therm. ID: LTG HBIF3
Chlorine: No Yes [✓ N/A]

Comments: ____________

VOC vials received w/o headspace: bubble < 6mm: Yes No [✓ N/A]

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CHAIN OF CUSTODY RECORD

Page 3 of 4

Electronic version available at http://www.rmbel.info/lab/chains-of-custody/

☐ "EQUIS" EDD Lab Format - MPCA Data Submittal

H003200

Order

Client: STBW/NMW
Project Name: Sulfate rd. 2
Sampler: (print name) Lisa Pugh
Report to:
Report to Email:
Phone #:
Fax #:
Project Task Code:
PO/WO #:
Sampler Phone #:
Bill to:
Bill to Email:

Sample Number	Station ID/Sample Description	Date	Time	# of Bottles	Sample Method	Start Depth (m)	End Depth (m)	Sample Type	Matrix	Preserved at Collection	Preserved at Lab Receipt	Analyses Requested: Sulfate	Sample Comments: (Equipment Type, Filtration, AIS, Preservation)
27	S009-182	6/2/21	0819	1	LKDEPTH	1	1	Sample	Wtr-surf			X	
28	202-surf	6/2/21	0838	1	LKSURF2M	0	2	Sample	Wtr-surf			X	
29	202-mid	6/2/21	0841	1	LKDEPTH	4	4	Sample	Wtr-surf			X	
30	202-deep	6/2/21	0848	1	LKDEPTH	6.5	6.5	Sample	Wtr-surf			X	
31	203-surf	6/2/21	0909	1	LKSURF2M	0	2	Sample	Wtr-surf			X	
32	203-mid	6/2/21	0911	1	LKDEPTH	3.5	3.5	Sample	Wtr-surf			X	
33	203-deep	6/2/21	0918	1	LKDEPTH	5	5	Sample	Wtr-surf			X	
34	203-deep-FD	6/2/21	0919	1	LKDEPTH	5	5	QC-FR	Wtr-surf			X	
35	503-surf	6/2/21	0951	1	LKSURF2M	0	2	Sample	Wtr-surf			X	
36	503-mid	6/2/21	0954	1	LKDEPTH	4	4	Sample	Wtr-surf			X	
37	503-deep	6/2/21	0957	1	LKDEPTH	6	6	Sample	Wtr-surf			X	
38	BL-002-surf	6/2/21	1015	1	LKSURF2M	0	2	Sample	Wtr-surf			X	
39	BL-002-mid	6/2/21	1018	1	~~LK~~KDEPTH	4	4	Sample	Wtr-surf			X	

_________ (initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) I hereby authorize RMB Environmental Laboratories to process the samples as received.

_________ (initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) please contact client at phone # ____________________ before processing samples.

Relinquished by: (client signature)
Print Name: Lisa Pugh
Date: 6/3/21
Time: 0837
Shipping to Lab: ☐ Speedee ☐ UPS ☐ USPS ☐ FedEx ☐ Courier ☐ RMB Courier ☒ Hand Delivery

FOR LAB USE ONLY

Received by Lab: (signature)
Date: 6/3/21
Time: 0835
Additional Fees:
Mileage:
Field Staff:
Shipping:
Courier:
Equipment:
Other:

☒ **DOES** meet proper sample storage and transportation guidelines
☐ Does **NOT** meet proper sample storage and transportation guidelines
☒ Received on ice
☐ Received at room temperature
☐ Samples received same day as collection
Received Temp: 2.1 °C
Therm. ID: LTG #3[illegible]
Chlorine: No Yes [✓ N/A]

Comments: ____________________

VOC vials received w/o headspace: bubble < 6mm: Yes No [✓ N/A]

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CHAIN OF CUSTODY RECORD

Electronic version available at http://www.rmbel.info/lab/chains-of-custody/

Page 4 of 4

Client: STBW/NMW
Project Name: Sulfate rd 2
Sampler: (print name) Lisa Pugh
Report to:
Report to Email:
Phone #:
Fax #:
Project Task Code:
PO/WO #:
Sampler Phone #:
Bill to:
Bill to Email:

☐ "EQUIS" EDD Lab Format - MPCA Data Submittal

Analyses Requested

H003200

Order

Sample Number	Station ID/Sample Description	Date	Time	# of Bottles	Sample Method	Start Depth (m)	End Depth (m)	Sample Type	Matrix	Preserved at Collection	Preserved at Lab Receipt	Sulfate	Sample Comments: (Equipment Type, Filtration, AIS, Preservation)
40	BL-002-Deep	6/2/21	1024	1	LKDEPTH	6	6	Sample	Wtr-surf			X	
41	BL-003-Surf	6/2/21	1039	1	LKSURF2M	0	2	Sample	Wtr-surf			X	
42	BL-003-mid	6/2/21	1043	1	LKDEPTH	4	4	Sample	Wtr-surf			X	
43	BL-003-deep	6/2/21	1046	1	LKDEPTH	6	6	Sample	Wtr-surf			X	
44	BL-001-surf	6/2/21	1106	1	LKSURF2M	0	2	Sample	Wtr-surf			X	
45	BL-001-mid	6/2/21	1108	1	LKDEPTH	4	4	Sample	Wtr-surf			X	
46	BL-001-mid FD	6/2/21	1109	1	LKDEPTH	4	4	~~Sample~~ QC-FR	Wtr-surf			X	
47	BL-001-deep	6/2/21	1118	1	LKDEPTH	6	6	Sample	Wtr-surf			X	

_________ (Initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) I hereby authorize RMB Environmental Laboratories to process the samples as received.

_________ (Initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) please contact client at phone # __________ before processing samples.

Relinquished by: (client signature)
Print Name: Lisa Pugh
Date: 6/3/21
Time: 0837
Shipping to Lab: ☐ Speedee ☐ UPS ☐ USPS ☐ FedEx ☐ Courier ☐ RMB Courier ☒ Hand Delivery

FOR LAB USE ONLY

Received by lab: (signature)
Date: 6/3/21
Time: 0835
Additional Fees:
Mileage:
Field Staff:
Shipping:
Courier:
Equipment:
Other:

☒ DOES meet proper sample storage and transportation guidelines
☐ Does **NOT** meet proper sample storage and transportation guidelines
☒ Received on ice
☐ Samples received same day as collection
☐ Received at room temperature
Received Temp: 2.1 °C Therm. ID: LTG HBIR3
Chlorine: No Yes [✓ N/A]

Comments: ______________________

VOC vials received w/o headspace: bubble < 6mm: Yes No [✓ N/A]

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Detroit Lakes, MN 56501
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Hibbing
1111 7th Ave. E.
Hibbing, MN 55746
218-440-2043

June 14, 2021
Laboratory Report

Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN 55731

RE: Surface Water

Work Order :H003246

Enclosed are the results of analyses for samples received by the laboratory on 06/08/2021 11:20. If you have any questions concerning this report, please feel free to contact me at (218) 440-2043.

Report approved by:

Kristin Hanson
Project Manager
Kristin.Hanson@rmbel.info

Laboratory Results
June 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project:	Surface Water	**Sample Description:**	Bottle Blank
Lab Code:	H003246-01	**Collection Method:**	QC-BLANK
Matrix:	QC-BLANK	**Sampled by:**	Lisa Pugh
Date/Time Sampled:	06/07/2021 05:34	**Sample Receipt Information**	See chain of custody.
Date/Time Received:	06/08/2021 11:20		

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**< 0.5**	mg/L	0.5	1			EPA 300.0	06/08/21 17:05		HB

Laboratory Results
June 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003246-02
Matrix: QC-BLANK
Date/Time Sampled: 06/07/2021 06:56
Date/Time Received: 06/08/2021 11:20

Sample Description: Equip. Blank -VD
Collection Method: QC-BLANK
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**< 0.5**	mg/L	0.5	1			EPA 300.0	06/08/21 17:58		HB

The results in this report apply only to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

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Detroit Lakes, MN 56501
218-846-1465

Hibbing
1111 7th Ave. E.
Hibbing, MN 55746
218-440-2043

Laboratory Results
June 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003246-03
Matrix: QC-BLANK
Date/Time Sampled: 06/07/2021 07:00
Date/Time Received: 06/08/2021 11:20

Sample Description: Equip. Blank- IS
Collection Method: QC-BLANK
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**< 0.5**	mg/L	0.5	1			EPA 300.0	06/08/21 18:16		HB

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Laboratory Results
June 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project:	Surface Water	**Sample Description:**	204-surf
Lab Code:	H003246-04	**Collection Method:**	LKSURF2M
Matrix:	Wtr-Surf	**Sampled by:**	Lisa Pugh
Date/Time Sampled:	06/07/2021 07:31	**Sample Receipt Information**	See chain of custody.
Date/Time Received:	06/08/2021 11:20		

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**8.1**	mg/L	0.5	1			EPA 300.0	06/08/21 18:34		HB

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Laboratory Results
June 14, 2021

Report To:
Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To:
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206 E Sheridan St
Ely, MN, 55731

Project:	Surface Water	**Sample Description:**	204-mid
Lab Code:	H003246-05	**Collection Method:**	LKDEPTH
Matrix:	Wtr-Surf	**Sampled by:**	Lisa Pugh
Date/Time Sampled:	06/07/2021 07:33	**Sample Receipt Information**	See chain of custody.
Date/Time Received:	06/08/2021 11:20		

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**6.9**	mg/L	0.5	1			EPA 300.0	06/08/21 18:52		HB

Laboratory Results
June 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
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206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003246-06
Matrix: Wtr-Surf
Date/Time Sampled: 06/07/2021 07:36
Date/Time Received: 06/08/2021 11:20

Sample Description: 204-deep
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**6.1**	mg/L	0.5	1			EPA 300.0	06/08/21 19:10		HB

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Laboratory Results
June 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

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206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003246-07
Matrix: Wtr-Surf
Date/Time Sampled: 06/07/2021 08:00
Date/Time Received: 06/08/2021 11:20

Sample Description: 502-surf
Collection Method: LKSURF2M
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**10.2**	mg/L	0.5	1			EPA 300.0	06/08/21 19:28		HB

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Laboratory Results
June 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

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206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003246-08
Matrix: Wtr-Surf
Date/Time Sampled: 06/07/2021 08:02
Date/Time Received: 06/08/2021 11:20

Sample Description: 502-mid
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**9.0**	mg/L	0.5	1			EPA 300.0	06/08/21 20:21		HB

Laboratory Results
June 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

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Ely, MN, 55731

Project: Surface Water
Lab Code: H003246-09
Matrix: Wtr-Surf
Date/Time Sampled: 06/07/2021 08:05
Date/Time Received: 06/08/2021 11:20

Sample Description: 502-deep
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**8.9**	mg/L	0.5	1			EPA 300.0	06/08/21 21:15		HB

Laboratory Results
June 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
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Project:	Surface Water	**Sample Description:**	BL-005-surf
Lab Code:	H003246-10	**Collection Method:**	LKSURF2M
Matrix:	Wtr-Surf	**Sampled by:**	Lisa Pugh
Date/Time Sampled:	06/07/2021 08:24	**Sample Receipt Information**	See chain of custody.
Date/Time Received:	06/08/2021 11:20		

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**10.2**	mg/L	0.5	1			EPA 300.0	06/08/21 21:33		HB

Laboratory Results
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Report To:
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Lisa Pugh
206 E Sheridan St
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206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003246-11
Matrix: Wtr-Surf
Date/Time Sampled: 06/07/2021 08:26
Date/Time Received: 06/08/2021 11:20

Sample Description: BL-005-mid
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**9.9**	mg/L	0.5	1			EPA 300.0	06/08/21 21:50		HB

Laboratory Results
June 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
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Project: Surface Water
Lab Code: H003246-12
Matrix: Wtr-Surf
Date/Time Sampled: 06/07/2021 08:31
Date/Time Received: 06/08/2021 11:20

Sample Description: BL-005-deep
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**9.3**	mg/L	0.5	1			EPA 300.0	06/08/21 22:08		HB

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Laboratory Results
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Report To: Save the Boundary Waters
Lisa Pugh
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206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003246-13
Matrix: Wtr-Surf
Date/Time Sampled: 06/07/2021 08:32
Date/Time Received: 06/08/2021 11:20

Sample Description: BL-005-deep FD
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**9.0**	mg/L	0.5	1			EPA 300.0	06/08/21 22:26		HB

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Laboratory Results
June 14, 2021

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Project: Surface Water
Lab Code: H003246-14
Matrix: Wtr-Surf
Date/Time Sampled: 06/07/2021 08:50
Date/Time Received: 06/08/2021 11:20

Sample Description: BB-002-surf
Collection Method: LKSURF2M
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**10.4**	mg/L	0.5	1			EPA 300.0	06/08/21 22:44		HB

Laboratory Results
June 14, 2021

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Project: Surface Water
Lab Code: H003246-15
Matrix: Wtr-Surf
Date/Time Sampled: 06/07/2021 08:52
Date/Time Received: 06/08/2021 11:20

Sample Description: BB-002-deep
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.9**	mg/L	0.5	1			EPA 300.0	06/08/21 23:02		HB

Laboratory Results
June 14, 2021

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Project:	Surface Water	**Sample Description:**	BB-003
Lab Code:	H003246-16	**Collection Method:**	LKDEPTH
Matrix:	Wtr-Surf	**Sampled by:**	Lisa Pugh
Date/Time Sampled:	06/07/2021 09:14	**Sample Receipt Information**	See chain of custody.
Date/Time Received:	06/08/2021 11:20		

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**22.1**	mg/L	0.5	1			EPA 300.0	06/08/21 23:55		HB

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Laboratory Results
June 14, 2021

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Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
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Project: Surface Water
Lab Code: H003246-17
Matrix: Wtr-Surf
Date/Time Sampled: 06/07/2021 09:23
Date/Time Received: 06/08/2021 11:20

Sample Description: 301
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**28.3**	mg/L	0.5	1			EPA 300.0	06/09/21 00:49		HB

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Laboratory Results
June 14, 2021

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Lisa Pugh
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Project: Surface Water
Lab Code: H003246-18
Matrix: Wtr-Surf
Date/Time Sampled: 06/07/2021 09:38
Date/Time Received: 06/08/2021 11:20

Sample Description: BB-001
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**57.1**	mg/L	0.5	1			EPA 300.0	06/09/21 01:07		HB

Laboratory Results
June 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
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Ely, MN, 55731

Project: Surface Water
Lab Code: H003246-19
Matrix: Wtr-Surf
Date/Time Sampled: 06/07/2021 09:39
Date/Time Received: 06/08/2021 11:20

Sample Description: BB-001-FD
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**65.1**	mg/L	0.5	1			EPA 300.0	06/09/21 01:25		HB

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Laboratory Results
June 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project:	Surface Water	**Sample Description:**	BL-004-Surf
Lab Code:	H003246-20	**Collection Method:**	LKSURF2M
Matrix:	Wtr-Surf	**Sampled by:**	Lisa Pugh
Date/Time Sampled:	06/07/2021 09:57	**Sample Receipt Information**	See chain of custody.
Date/Time Received:	06/08/2021 11:20		

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**10.0**	mg/L	0.5	1			EPA 300.0	06/09/21 01:42		HB

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Laboratory Results
June 14, 2021

Report To:
Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To:
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206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003246-21
Matrix: Wtr-Surf
Date/Time Sampled: 06/07/2021 10:00
Date/Time Received: 06/08/2021 11:20

Sample Description: BL-004-Mid
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**9.7**	mg/L	0.5	1			EPA 300.0	06/09/21 02:00		HB

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Laboratory Results
June 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
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Ely, MN, 55731

Bill To: Save the Boundary Waters
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Ely, MN, 55731

Project: Surface Water
Lab Code: H003246-22
Matrix: Wtr-Surf
Date/Time Sampled: 06/07/2021 10:04
Date/Time Received: 06/08/2021 11:20

Sample Description: BL-004-deep
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**9.3**	mg/L	0.5	1			EPA 300.0	06/09/21 02:18		HB

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Laboratory Results
June 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
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Ely, MN, 55731

Project: Surface Water
Lab Code: H003246-23
Matrix: Wtr-Surf
Date/Time Sampled: 06/07/2021 10:34
Date/Time Received: 06/08/2021 11:20

Sample Description: 303
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**13.9**	mg/L	0.5	1			EPA 300.0	06/09/21 02:36		HB

Laboratory Results
June 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003246-24
Matrix: Wtr-Surf
Date/Time Sampled: 06/07/2021 10:47
Date/Time Received: 06/08/2021 11:20

Sample Description: S009-182
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.5**	mg/L	0.5	1			EPA 300.0	06/09/21 11:43		HB

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www.rmbel.info

Bloomington
2200 West 94th Street
Bloomington, MN 55431
952-456-8470

Detroit Lakes
22796 County Highway 6
Detroit Lakes, MN 56501
218-846-1465

Hibbing
1111 7th Ave. E.
Hibbing, MN 55746
218-440-2043

Laboratory Results
June 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003246-25
Matrix: Wtr-Surf
Date/Time Sampled: 06/07/2021 11:04
Date/Time Received: 06/08/2021 11:20

Sample Description: 202-surf
Collection Method: LKSURF2M
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.3**	mg/L	0.5	1			EPA 300.0	06/09/21 12:37		HB

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Laboratory Results
June 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
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206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003246-26
Matrix: Wtr-Surf
Date/Time Sampled: 06/07/2021 11:06
Date/Time Received: 06/08/2021 11:20

Sample Description: 202-mid
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.2**	mg/L	0.5	1			EPA 300.0	06/09/21 12:55		HB

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2200 West 94th Street
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22796 County Highway 6
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218-846-1465

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Hibbing, MN 55746
218-440-2043

Laboratory Results
June 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
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Bill To: Save the Boundary Waters
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Ely, MN, 55731

Project: Surface Water
Lab Code: H003246-27
Matrix: Wtr-Surf
Date/Time Sampled: 06/07/2021 11:12
Date/Time Received: 06/08/2021 11:20

Sample Description: 202-deep
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.3**	mg/L	0.5	1			EPA 300.0	06/09/21 13:13		HB

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Laboratory Results
June 14, 2021

Report To: Save the Boundary Waters
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Project: Surface Water
Lab Code: H003246-28
Matrix: Wtr-Surf
Date/Time Sampled: 06/07/2021 11:28
Date/Time Received: 06/08/2021 11:20

Sample Description: 203-surf
Collection Method: LKSURF2M
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.4**	mg/L	0.5	1			EPA 300.0	06/09/21 13:31		HB

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Laboratory Results
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Report To: Save the Boundary Waters
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Ely, MN, 55731

Project: Surface Water
Lab Code: H003246-29
Matrix: Wtr-Surf
Date/Time Sampled: 06/07/2021 11:29
Date/Time Received: 06/08/2021 11:20

Sample Description: 203-surf-FD
Collection Method: LKSURF2M
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.3**	mg/L	0.5	1			EPA 300.0	06/09/21 13:48		HB

Laboratory Results
June 14, 2021

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Lisa Pugh
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Ely, MN, 55731

Project: Surface Water
Lab Code: H003246-30
Matrix: Wtr-Surf
Date/Time Sampled: 06/07/2021 11:32
Date/Time Received: 06/08/2021 11:20

Sample Description: 203-mid
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.5**	mg/L	0.5	1			EPA 300.0	06/09/21 14:06		HB

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Laboratory Results
June 14, 2021

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206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003246-31
Matrix: Wtr-Surf
Date/Time Sampled: 06/07/2021 11:36
Date/Time Received: 06/08/2021 11:20

Sample Description: 203-deep
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.5**	mg/L	0.5	1			EPA 300.0	06/09/21 15:00		HB

The results in this report apply only to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Laboratory Results
June 14, 2021

Report To:
Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To:
Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003246-32
Matrix: Wtr-Surf
Date/Time Sampled: 06/07/2021 11:52
Date/Time Received: 06/08/2021 11:20

Sample Description: BL-001-surf
Collection Method: LKSURF2M
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.2**	mg/L	0.5	1			EPA 300.0	06/09/21 15:53		HB

Laboratory Results
June 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project:	Surface Water	**Sample Description:**	BL-001-mid
Lab Code:	H003246-33	**Collection Method:**	LKDEPTH
Matrix:	Wtr-Surf	**Sampled by:**	Lisa Pugh
Date/Time Sampled:	06/07/2021 11:54	**Sample Receipt Information**	See chain of custody.
Date/Time Received:	06/08/2021 11:20		

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.3**	mg/L	0.5	1			EPA 300.0	06/09/21 16:11		HB

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Laboratory Results
June 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003246-34
Matrix: Wtr-Surf
Date/Time Sampled: 06/07/2021 11:54
Date/Time Received: 06/08/2021 11:20

Sample Description: BL-001-deep
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**12.2**	mg/L	0.5	1			EPA 300.0	06/09/21 16:29		HB

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Laboratory Results
June 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project:	Surface Water	**Sample Description:**	503-surf
Lab Code:	H003246-35	**Collection Method:**	LKSURF2M
Matrix:	Wtr-Surf	**Sampled by:**	Lisa Pugh
Date/Time Sampled:	06/07/2021 12:11	**Sample Receipt Information**	See chain of custody.
Date/Time Received:	06/08/2021 11:20		

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.2**	mg/L	0.5	1			EPA 300.0	06/09/21 16:47		HB

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Laboratory Results
June 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003246-36
Matrix: Wtr-Surf
Date/Time Sampled: 06/07/2021 12:12
Date/Time Received: 06/08/2021 11:20

Sample Description: 503-surf-FD
Collection Method: LKSURF2M
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.4**	mg/L	0.5	1			EPA 300.0	06/09/21 17:05		HB

Laboratory Results
June 14, 2021

Report To:
Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To:
Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003246-37
Matrix: Wtr-Surf
Date/Time Sampled: 06/07/2021 12:14
Date/Time Received: 06/08/2021 11:20

Sample Description: 503-mid
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.5**	mg/L	0.5	1			EPA 300.0	06/09/21 17:23		HB

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Detroit Lakes, MN 56501
218-846-1465

Hibbing
1111 7th Ave. E.
Hibbing, MN 55746
218-440-2043

Laboratory Results
June 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003246-38
Matrix: Wtr-Surf
Date/Time Sampled: 06/07/2021 12:17
Date/Time Received: 06/08/2021 11:20

Sample Description: 503-deep
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
<u>Anions by IC</u>										
Sulfate as SO4	**11.3**	mg/L	0.5	1			EPA 300.0	06/09/21 17:40		HB

Laboratory Results
June 14, 2021

Report To:
Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To:
Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003246-39
Matrix: Wtr-Surf
Date/Time Sampled: 06/07/2021 12:34
Date/Time Received: 06/08/2021 11:20

Sample Description: BL-002-surf
Collection Method: LKSURF2M
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.3**	mg/L	0.5	1			EPA 300.0	06/09/21 18:34		HB

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Detroit Lakes, MN 56501
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Hibbing
1111 7th Ave. E.
Hibbing, MN 55746
218-440-2043

Laboratory Results
June 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003246-40
Matrix: Wtr-Surf
Date/Time Sampled: 06/07/2021 12:38
Date/Time Received: 06/08/2021 11:20

Sample Description: BL-002-mid
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.9**	mg/L	0.5	1			EPA 300.0	06/09/21 19:27		HB

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Laboratory Results
June 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003246-41
Matrix: Wtr-Surf
Date/Time Sampled: 06/07/2021 12:42
Date/Time Received: 06/08/2021 11:20

Sample Description: BL-002-Deep
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.1**	mg/L	0.5	1			EPA 300.0	06/09/21 19:45		HB

Laboratory Results
June 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003246-42
Matrix: Wtr-Surf
Date/Time Sampled: 06/07/2021 13:02
Date/Time Received: 06/08/2021 11:20

Sample Description: BL-003-surf
Collection Method: LKSURF2M
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.6**	mg/L	0.5	1			EPA 300.0	06/09/21 20:03		HB

Laboratory Results
June 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003246-43
Matrix: Wtr-Surf
Date/Time Sampled: 06/07/2021 13:04
Date/Time Received: 06/08/2021 11:20

Sample Description: BL-003- mid
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.0**	mg/L	0.5	1			EPA 300.0	06/09/21 20:21		HB

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aboratory Results
une 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

roject: Surface Water
ab Code: H003246-44
atrix: Wtr-Surf
ate/Time Sampled: 06/07/2021 13:07
ate/Time Received: 06/08/2021 11:20

Sample Description: BL-003-deep
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

nalyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
nions by IC										
ulfate as SO4	**11.1**	mg/L	0.5	1			EPA 300.0	06/09/21 20:39		HB

Laboratory Results
June 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003246-45
Matrix: Wtr-Surf
Date/Time Sampled: 06/07/2021 13:24
Date/Time Received: 06/08/2021 11:20

Sample Description: BL-006-surf
Collection Method: LKSURF2M
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**11.3**	mg/L	0.5	1			EPA 300.0	06/09/21 20:57		HB

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218-846-1465

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1111 7th Ave. E.
Hibbing, MN 55746
218-440-2043

Laboratory Results
June 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003246-46
Matrix: Wtr-Surf
Date/Time Sampled: 06/07/2021 13:28
Date/Time Received: 06/08/2021 11:20

Sample Description: BL-006-mid
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**10.1**	mg/L	0.5	1			EPA 300.0	06/09/21 21:15		HB

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Laboratory Results
June 14, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water
Lab Code: H003246-47
Matrix: Wtr-Surf
Date/Time Sampled: 06/07/2021 13:33
Date/Time Received: 06/08/2021 11:20

Sample Description: BL-006-deep
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Anions by IC										
Sulfate as SO4	**9.3**	mg/L	0.5	1			EPA 300.0	06/09/21 22:08		HB

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Qualifiers and Definitions

Item	Definition
RL	Reporting Limit (Corrected for dilution factor when applicable due to sample preparation variation.)
DF	Dilution Factor
HB	Indicates test performed by RMB Environmental Laboratories - Hibbing.

RMB Environmental Laboratories, Inc.
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CHAIN OF CUSTODY RECORD

Page 1 of 4

Electronic version available at http://www.rmbel.info/lab/chains-of-custody/

☐ "EQUIS" EDD Lab Format - MPCA Data Submittal

H003246

Client: Save the Boundary Waters
Phone #:
Fax #:
Project Name: Sulfate rd 3
Project Task Code:
PO/WO #:
Sampler: (print name) Lisa Pugh
Sampler Phone #: 952-237-6714
Report to: Lisa Pugh
Bill to: Northeastern Minnesotans for Wilderness
Report to Email: lisa@savetheboundarywaters.org
Bill to Email: nicole@savetheboundarywaters.org

Analyses Requested

Sample Number	Station ID/Sample Description	Date	Time	# of Bottles	Sample Method	Start Depth (m)	End Depth (m)	Sample Type	Matrix	Preserved at Collection	Preserved at Lab Receipt	Sulfate	Sample Comments: (Equipment Type, Filtration, AIS, Preservation)
01	Bottle Blank	6/7/21	0534	1	QC-BLANK			QC-FB	QC-BLANK			X	
02	Equip Blank-VD	6/7/21	0656	1	QC BLANK			QC-EB	QC BLANK			X	
03	Equip Blank-IS	6/7/21	0700	1	QC BLANK			QC-EB	QC BLANK			X	
04	204-surf	6/7/21	0731	1	LKSURF2M	0	2	Sample	Wtr-surf			X	
05	204-mid	6/7/21	0733	1	LKDEPTH	5	5	Sample	Wtr-surf			X	
06	204-deep	6/7/21	0736	1	LKDEPTH	8	8	Sample	Wtr-surf			X	
07	502-surf	6/7/21	0800	1	LKSURF2M	0	2	Sample	Wtr-surf			X	
08	502-mid	6/7/21	0802	1	LKDEPTH	3.5	3.5	Sample	Wtr surf			X	
09	502-deep	6/7/21	0805	1	LKDEPTH	5.5	5.5	Sample	Wtr-surf			X	
10	BL005-surf	6/7/21	0824	1	LKSURF2M	0	2	Sample	Wtr-surf			X	
11	BL-005-mid	6/7/21	0826	1	LKDEPTH	3.5	3.5	Sample	Wtr-surf			X	
12	BL-005-deep	6/7/21	0831	1	LKDEPTH	5.5	5.5	Sample	Wtr-surf			X	
13	BL-005-deep FD	6/7/21	0832	1	LKDEPTH	5.5	5.5	QC-FR	Wtr-surf			X	

_________ (Initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) I hereby authorize RMB Environmental Laboratories to process the samples as received.

_________ (Initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) please contact client at phone # _________________ before processing samples.

Relinquished by: (client signature)
Print Name: Lisa Pugh
Date 6/8/21
Time 1120

Shipping to Lab:
☐ Speedee ☐ UPS ☐ USPS ☐ FedEx ☐ Courier ☐ RMB Courier ☒ Hand Delivery

FOR LAB USE ONLY

Received by Lab: (signature)
Date 6/8/21
Time 1120

Additional Fees:
Mileage:
Field Staff:
Shipping:
Courier:
Equipment:
Other:

☒ **DOES** meet proper sample storage and transportation guidelines
☐ Does **NOT** meet proper sample storage and transportation guidelines
☒ Received on ice
☐ Received at room temperature
☐ Samples received same day as collection

Received Temp: 0.3 °C Therm. ID: LTG HB1e3

Chlorine: No Yes [✓ N/A]

Comments:

VOC vials received w/o headspace: bubble < 6mm: Yes No [✓ N/A]

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CHAIN OF CUSTODY RECORD

Page 2 of 4

Electronic version available at http://www.rmbel.info/lab/chains-of-custody/

Client: STBW/NMW
Project Name: Sulfate rd 3
Sampler: (print name) Lisa Pugh
Report to:
Report to Email:
Phone #:
Fax #:
Project Task Code:
PO/WO #:
Sampler Phone #:
Bill to:
Bill to Email:

☐ "EQUIS" EDD Lab Format - MPCA Data Submittal

Analyses Requested H003246

Order

Sample Number	Station ID/Sample Description	Date	Time	# of Bottles	Sample Method	Start Depth (m)	End Depth (m)	Sample Type	Matrix	Preserved at Collection	Preserved at Lab Receipt	Sulfate	Sample Comments: (Equipment Type, Filtration, AIS, Preservation)
14	BB-002-surf	6/7/21	0850	1	LKSURF2M	0	2	Sample	Wtr-surf			X	
15	BB-002-deep	6/7/21	0852	1	LKDEPTH	3	3	Sample	Wtr-surf			X	
16	BB-003	6/7/21	0914	1	LKDEPTH	1	1	Sample	Wtr-surf			X	
17	301	6/7/21	0923	1	LKDEPTH	1	1	Sample	Wtr-surf			X	
18	BB-001-	6/7/21	0938	1	LKDEPTH	0.5	0.5	Sample	Wtr-surf			X	
19	BB-001-FD	6/7/21	0939	1	LKDEPTH	0.5	0.5	QC-FR	Wtr-surf			X	
20	BL-004-surf	6/7/21	0957	1	LKSURF2M	0	2	Sample	Wtr-surf			X	
21	BL-004-mid	6/7/21	1000	1	LKDEPTH	4	4	Sample	Wtr-surf			X	
22	BL-004-deep	6/7/21	1004	1	LKDEPTH	5.5	5.5	Sample	Wtr-surf			X	
23	303	6/7/21	1034	1	LKDEPTH	1	1	Sample	Wtr-surf			X	
24	S009-182	6/7/21	1047	1	LKDEPTH	1	1	Sample	Wtr-surf			X	
25	202-surf	6/7/21	1104	1	LK~~DEPTH~~ SURF2M	0	2	Sample	Wtr-surf			X	
26	202-mid	6/7/21	1106	1	LKDEPTH	4.5	4.5	Sample	Wtr-surf			X	

_______ (Initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) I hereby authorize RMB Environmental Laboratories to process the samples as received.

_______ (Initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) please contact client at phone # _______________ before processing samples.

Relinquished by: (client signature)
Print Name: Lisa Pugh
Date 6/8/21
Time 1120

Shipping to Lab:
☐ Speedee ☐ UPS ☐ USPS ☐ FedEx ☐ Courier ☐ RMB Courier ☒ Hand Delivery

FOR LAB USE ONLY

Received by Lab: (signature)
Date 6/8/21
Time 1120

Additional Fees:
Mileage: Field Staff: Shipping: Courier: Equipment: Other:

☒ **DOES** meet proper sample storage and transportation guidelines
☐ Does **NOT** meet proper sample storage and transportation guidelines

☒ Received on ice
☐ Received at room temperature
☐ Samples received same day as collection

Received Temp: 0.3 °C Therm. ID: LTG 4B1R3
Chlorine: No Yes [✓ N/A]

Comments: _______________

VOC vials received w/o headspace: bubble < 6mm: Yes No [✓ N/A]

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CHAIN OF CUSTODY RECORD

Electronic version available at http://www.rmbel.info/lab/chains-of-custody/

Page 3 of 4

Client: STBW / NMW
Phone #:
Fax #:
Project Name: Sulfate rd 3
Project Task Code:
PO/WO #:
Sampler: (print name) Lisa Pugh
Sampler Phone #:
Report to:
Bill to:
Report to Email:
Bill to Email:

☐ "EQUIS" EDD Lab Format - MPCA Data Submittal

Analyses Requested

H003246

Order

Sample Number	Station ID/Sample Description	Date	Time	# of Bottles	Sample Method	Start Depth (m)	End Depth (m)	Sample Type	Matrix	Preserved at Collection	Preserved at Lab Receipt	Sulfate	Sample Comments: (Equipment Type, Filtration, AIS, Preservation)
27	202-deep	6/7/21	1112	1	LKDEPTH	6.5	6.5	Sample	Wtr-surf			X	
28	203-surf	6/7/21	1128	1	LKSURF2M	0	2	Sample	Wtr-surf			X	
29	203-surf FD	6/7/21	1129	1	LKSURF2M	0	2	QC-FR	Wtr-surf			X	
30	203-mid	6/7/21	1132	1	LKDEPTH	3.5	3.5	Sample	Wtr-surf			X	
31	203-deep	6/7/21	1136	1	LKDEPTH	5.5	5.5	Sample	Wtr-surf			X	
32	BL-001-surf	6/7/21	1152	1	LKSURF2M	0	2	Sample	Wtr-surf			X	
33	BL-001-mid	6/7/21	1154	1	LKDEPTH	4	4	Sample	Wtr-surf			X	
34	BL-001-deep	6/7/21	1158	1	LKDEPTH	6.5	6.5	Sample	Wtr-surf			X	
35	503-surf	6/7/21	1211	1	LKSURF2M	0	2	Sample	Wtr-surf			X	
36	503-surf-FD	6/7/21	1212	1	LKSURF2M	0	2	QC-FR	Wtr-surf			X	
37	503-mid	6/7/21	1214	1	LKDEPTH	4	4	Sample	Wtr-surf			X	
38	503-deep	6/7/21	1217	1	LKDEPTH	6	6	Sample	Wtr-surf			X	
39	BL-002-surf	6/7/21	1234	1	LKSURF2M	0	2	Sample	Wtr-surf			X	

________ (Initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) I hereby authorize RMB Environmental Laboratories to process the samples as received.

________ (Initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) please contact client at phone # ________________ before processing samples.

Relinquished by: (client signature)
Print Name: Lisa Pugh
Date 6/8/21
Time 1120

Shipping to Lab:
☐ Speedee ☐ UPS ☐ USPS ☐ FedEx ☐ Courier ☐ RMB Courier ☒ Hand Delivery

FOR LAB USE ONLY

Received by Lab: (signature)
Date 6/8/21
Time 1120

Additional Fees:
Mileage: Field Staff: Shipping: Courier: Equipment: Other:

☒ DOES meet proper sample storage and transportation guidelines
☐ Does NOT meet proper sample storage and transportation guidelines

☒ Received on ice
☐ Received at room temperature
☐ Samples received same day as collection

Received Temp: 0.3 °C Therm. ID: LTG HBIR3

Chlorine: No Yes [✓ N/A]

Comments: ________

VOC vials received w/o headspace: bubble < 6mm: Yes No [✓ N/A]

Wild Rice WQLS, Exhibit G

RMB Environmental Laboratories, Inc.

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CHAIN OF CUSTODY RECORD

Page 4 of 4

Electronic version available at http://www.rmbel.info/lab/chains-of-custody/

Client: STBW/NMW
Project Name: Sulfate Rd 3
Sampler: (print name) Lisa Pugh
Report to:
Report to Email:
Phone #:
Fax #:
Project Task Code:
PO/WO #:
Sampler Phone #:
Bill to:
Bill to Email:

☐ "EQUIS" EDD Lab Format - MPCA Data Submittal

Analyses Requested

H003246

Work Order

Sample Number	Station ID/Sample Description	Date	Time	# of Bottles	Sample Method	Start Depth (m)	End Depth (m)	Sample Type	Matrix	Preserved at Collection	Preserved at Lab Receipt	Sulfate	Sample Comments: (Equipment Type, Filtration, AIS, Preservation)
40	BL-002-mid	6/7/21	1238	1	LKDEPTH	4	4	Sample	Wtr-surf			X	
41	BL-002-deep	6/7/21	1242	1	LKDEPTH	6	6	Sample	Wtr-surf			X	
42	BL-003-surf	6/7/21	1302	1	LKSURF2M	0	2	Sample	Wtr-surf			X	
43	BL-003-mid	6/7/21	1304	1	LKDEPTH	4	4	Sample	Wtr-surf			X	
44	BL-003-deep	6/7/21	1307	1	LKDEPTH	6	6	Sample	Wtr-surf			X	
45	BL-006-surf	6/7/21	1324	1	LKSURF2M	0	2	Sample	Wtr-surf			X	
46	BL-006-mid	6/7/21	1328	1	LKDEPTH	4	4	Sample	Wtr-surf			X	
47	BL-006-deep	6/7/21	1333	1	LKDEPTH	5.5	5.5	Sample	Wtr-surf			X	

_________ (Initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) I hereby authorize RMB Environmental Laboratories to process the samples as received.

_________ (Initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) please contact client at phone # ____________________ before processing samples.

Relinquished by: (client signature)
Print Name: Lisa Pugh
Date 6/8/21
Time 1120

Shipping to Lab: ☐ Speedee ☐ UPS ☐ USPS ☐ FedEx ☐ Courier ☐ RMB Courier ☒ Hand Delivery

FOR LAB USE ONLY

Received by Lab: (signature)
Date 6/8/21
Time 1120

Additional Fees: Mileage: Field Staff: Shipping: Courier: Equipment: Other:

☒ **DOES** meet proper sample storage and transportation guidelines
☐ Does **NOT** meet proper sample storage and transportation guidelines

☒ Received on ice ☐ Received at room temperature
☐ Samples received same day as collection

Received Temp: 0.3 °C Therm. ID: LTG 48123
Chlorine: No Yes [✓ N/A]

Comments: ____________________

VOC vials received w/o headspace: bubble < 6mm: Yes No [✓ N/A]

RMB
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Bloomington
2200 West 94th Street
Bloomington, MN 55431
952-456-8470

Detroit Lakes
22796 County Highway 6
Detroit Lakes, MN 56501
218-846-1465

Hibbing
1111 7th Ave. E.
Hibbing, MN 55746
218-440-2043

June 24, 2021
Laboratory Report

Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN 55731

RE: Surface Water (Metals to MDL)

Work Order :H003344

Enclosed are the results of analyses for samples received by the laboratory on 06/16/2021 09:05. If you have any questions concerning this report, please feel free to contact me at (218) 440-2043.

Report approved by:

Kristin Hanson
Project Manager
Kristin.Hanson@rmbel.info

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2200 West 94th Street
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1111 7th Ave. E.
Hibbing, MN 55746
218-440-2043

Laboratory Results
June 24, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water (Metals to MDL)
Lab Code: H003344-01
Matrix: QC-BLANK
Date/Time Sampled: 06/15/2021 05:44
Date/Time Received: 06/16/2021 09:05

Sample Description: Bottle Blank
Collection Method: QC-BLANK
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Organic Carbon										
Dissolved Organic Carbon	**< 1.0**	mg/L	1.0	1			SM5310C - 2011	06/18/21 12:07		BL
Classical Chemistry Parameters										
Alkalinity, Total (as CaCO3)	**< 1.00**	mg/L	1.00	1			SM2320 B-2011	06/18/21 09:04		HB
Chlorophyll-a, Pheophytin Corrected	**< 1.00**	ug/L	1.00				SM10200H-2011	06/21/21 15:08	nc	DL
Phosphorus, Total as P	**< 0.003**	mg/L	0.003	1	EPA 365.3	06/17/21 14:23	EPA 365.3	06/18/21 15:49		DL
Anions by IC										
Chloride	**< 0.50**	mg/L	0.50	1			EPA 300.0	06/16/21 16:01		HB
Nitrate as N	**< 0.03**	mg/L	0.03	1			EPA 300.0	06/16/21 16:01		HB
Nitrite as N	**< 0.03**	mg/L	0.03	1			EPA 300.0	06/16/21 16:01		HB
Bromide	**< 0.1**	mg/L	0.1	1			EPA 300.0	06/16/21 16:01		HB
Sulfate as SO4	**< 0.5**	mg/L	0.5	1			EPA 300.0	06/16/21 16:01		HB

Laboratory Results
June 24, 2021

Report To:
Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To:
Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water (Metals to MDL)
Lab Code: H003344-02
Matrix: QC-BLANK
Date/Time Sampled: 06/15/2021 05:48
Date/Time Received: 06/16/2021 09:05

Sample Description: Equipment Blank -IS
Collection Method: QC-BLANK
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Organic Carbon										
Dissolved Organic Carbon	**< 1.0**	mg/L	1.0	1			SM5310C - 2011	06/18/21 12:25		BL
Classical Chemistry Parameters										
Alkalinity, Total (as CaCO3)	**< 1.00**	mg/L	1.00	1			SM2320 B-2011	06/18/21 09:07		HB
Chlorophyll-a, Pheophytin Corrected	**< 1.04**	ug/L	1.04				SM10200H-2011	06/21/21 15:08	nc	DL
Phosphorus, Total as P	**< 0.003**	mg/L	0.003	1	EPA 365.3	06/17/21 14:23	EPA 365.3	06/18/21 15:49		DL
Anions by IC										
Chloride	**< 0.50**	mg/L	0.50	1			EPA 300.0	06/16/21 16:55		HB
Nitrate as N	**< 0.03**	mg/L	0.03	1			EPA 300.0	06/16/21 16:55		HB
Nitrite as N	**< 0.03**	mg/L	0.03	1			EPA 300.0	06/16/21 16:55		HB
Bromide	**< 0.1**	mg/L	0.1	1			EPA 300.0	06/16/21 16:55		HB
Sulfate as SO4	**< 0.5**	mg/L	0.5	1			EPA 300.0	06/16/21 16:55		HB

Laboratory Results
June 24, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project:	Surface Water (Metals to MDL)	**Sample Description:**	Equipment Blank -VD
Lab Code:	H003344-03	**Collection Method:**	QC-BLANK
Matrix:	QC-BLANK	**Sampled by:**	Lisa Pugh
Date/Time Sampled:	06/15/2021 05:52	**Sample Receipt Information**	See chain of custody.
Date/Time Received:	06/16/2021 09:05		

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Organic Carbon										
Dissolved Organic Carbon	**< 1.0**	mg/L	1.0	1			SM5310C - 2011	06/18/21 12:44		BL
Classical Chemistry Parameters										
Alkalinity, Total (as CaCO3)	**< 1.00**	mg/L	1.00	1			SM2320 B-2011	06/18/21 09:10		HB
Chlorophyll-a, Pheophytin Corrected	**< 1.04**	ug/L	1.04				SM10200H-2011	06/21/21 15:08	nc	DL
Phosphorus, Total as P	**< 0.003**	mg/L	0.003	1	EPA 365.3	06/17/21 14:23	EPA 365.3	06/18/21 15:49		DL
Anions by IC										
Chloride	**< 0.50**	mg/L	0.50	1			EPA 300.0	06/16/21 17:12		HB
Nitrate as N	**< 0.03**	mg/L	0.03	1			EPA 300.0	06/16/21 17:12		HB
Nitrite as N	**< 0.03**	mg/L	0.03	1			EPA 300.0	06/16/21 17:12		HB
Bromide	**< 0.1**	mg/L	0.1	1			EPA 300.0	06/16/21 17:12		HB
Sulfate as SO4	**< 0.5**	mg/L	0.5	1			EPA 300.0	06/16/21 17:12		HB

The results in this report apply only to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Laboratory Results
June 24, 2021

Report To: Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To: Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project:	Surface Water (Metals to MDL)	**Sample Description:**	504-surf
Lab Code:	H003344-04	**Collection Method:**	LKSURF2M
Matrix:	Wtr-Surf	**Sampled by:**	Lisa Pugh
Date/Time Sampled:	06/15/2021 09:05	**Sample Receipt Information**	See chain of custody.
Date/Time Received:	06/16/2021 09:05		

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Organic Carbon										
Dissolved Organic Carbon	**11.1**	mg/L	1.0	1			SM5310C - 2011	06/18/21 13:05		BL
Classical Chemistry Parameters										
Alkalinity, Total (as CaCO3)	**36.0**	mg/L	1.00	1			SM2320 B-2011	06/18/21 09:12		HB
Chlorophyll-a, Pheophytin Corrected	**3.06**	ug/L	1.04				SM10200H-2011	06/21/21 15:08	nc	DL
Phosphorus, Total as P	**0.017**	mg/L	0.003	1	EPA 365.3	06/17/21 14:23	EPA 365.3	06/18/21 15:49		DL
Anions by IC										
Chloride	**6.22**	mg/L	0.50	1			EPA 300.0	06/16/21 17:30		HB
Nitrate as N	**< 0.03**	mg/L	0.03	1			EPA 300.0	06/16/21 17:30		HB
Nitrite as N	**< 0.03**	mg/L	0.03	1			EPA 300.0	06/16/21 17:30		HB
Bromide	**< 0.1**	mg/L	0.1	1			EPA 300.0	06/16/21 17:30		HB
Sulfate as SO4	**11.1**	mg/L	0.5	1			EPA 300.0	06/16/21 17:30		HB

Laboratory Results
June 24, 2021

Report To:
Save the Boundary Waters
Lisa Pugh
206 E Sheridan St
Ely, MN, 55731

Bill To:
Save the Boundary Waters
NE Minnesotans for Wilderness
206 E Sheridan St
Ely, MN, 55731

Project: Surface Water (Metals to MDL)
Lab Code: H003344-05
Matrix: Wtr-Surf
Date/Time Sampled: 06/15/2021 09:07
Date/Time Received: 06/16/2021 09:05

Sample Description: 504-deep
Collection Method: LKDEPTH
Sampled by: Lisa Pugh
Sample Receipt Information See chain of custody.

Analyte	Result	Units	Sample RL	DF	Preparation Method	Prepared	Analysis Method	Analyzed	Analyte Qualifiers	Facility
Organic Carbon										
Dissolved Organic Carbon	**13.0**	mg/L	1.0	1			SM5310C - 2011	06/18/21 14:38		BL
Classical Chemistry Parameters										
Alkalinity, Total (as CaCO3)	**32.0**	mg/L	1.00	1			SM2320 B-2011	06/18/21 09:15		HB
Phosphorus, Total as P	**0.017**	mg/L	0.003	1	EPA 365.3	06/17/21 14:23	EPA 365.3	06/18/21 15:49		DL
Anions by IC										
Chloride	**6.25**	mg/L	0.50	1			EPA 300.0	06/16/21 17:48		HB
Nitrate as N	**< 0.03**	mg/L	0.03	1			EPA 300.0	06/16/21 17:48		HB
Nitrite as N	**< 0.03**	mg/L	0.03	1			EPA 300.0	06/16/21 17:48		HB
Bromide	**< 0.1**	mg/L	0.1	1			EPA 300.0	06/16/21 17:48		HB
Sulfate as SO4	**11.2**	mg/L	0.5	1			EPA 300.0	06/16/21 17:48		HB

RMB Environmental Laboratories, Inc.

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CHAIN OF CUSTODY RECORD

Page 1 of 2

Electronic version available at http://www.rmbel.info/lab/chains-of-custody/

H003344

Order

Client: Save the Boundary Waters
Project Name: Routine rd. 1
Sampler: (print name) Lisa Pugh
Report to: Lisa Pugh
Report to Email: lisa@savetheboundarywaters.org
Phone #:
Fax #:
Project Task Code:
PO/WO #:
Sampler Phone #: 952-237-6714
Bill to: Northeastern Minnesotans for Wilderness
Bill to Email: lisa@savetheboundarywaters.org

☐ "EQUIS" EDD Lab Format - MPCA Data Submittal

Sample Number	Station ID/Sample Description	Date	Time	# of Bottles	Sample Method	Start Depth (m)	End Depth (m)	Sample Type	Matrix	Preserved at Collection	Preserved at Lab Receipt	Cations	Anions	Gen. Chem	TP	Chloro-A	Sample Comments: (Equipment Type, Filtration, AIS, Preservation)
01	Bottle Blank	6/15/21	0544	4	QC BLANK			QCBLANK	QC-FB	X		X	X	X	X	X	See attached lab list for Cation anion Gen Chem analytes
02	Equipment Blank-IS	6/15/21	0548	4	QCBLANK			QCBLANK	QC-EB	X		X	X	X	X	X	
03	Equipment Blank-VD	6/15/21	0552	4	QCBLANK			QCBLANK	QC-EB	X		X	X	X	X	X	
04	504-surf	6/15/21	0905	4	LKSURF2M	0	2	Sample	Wtr-surf	X		X	X	X	X	X	
05	504-deep	6/15/21	0907	3	LKDEPTH	5.5	5.5	Sample	Wtr-surf	X		X	X	X	X		
06	XXX-surf	6/15/21	0940	4	LKSURF2M	0	2	Sample	Wtr-surf	X		X	X	X	X	X	
07	XXX-deep	6/15/21	0942	3	LKDEPTH	6	6	Sample	Wtr-surf	X		X	X	X	X		
08	503-surf	6/15/21	1020	4	LKSURF2M	0	2	Sample	Wtr-surf	X		X	X	X	X	X	
09	503-deep	6/15/21	1022	3	LKDEPTH	5.5	5.5	Sample	Wtr-surf	X		X	X	X	X		
10	101-surf	6/15/21	1104	4	LKSURF2M	0	2	Sample	Wtr-surf	X		X	X	X	X	X	
11	101-deep	6/15/21	1107*	3	LKDEPTH	5	5	Sample	Wtr-surf	X		X	X	X	X		
12	204-surf	6/15/21	1150	4	LKSURF2M	0	2	Sample	Wtr-surf	X		X	X	X	X	X	
13	204-deep	6/15/21	1153*	3	LKDEPTH	7.5	7.5	Sample	Wtr-surf	X		X	X	X	X		

________ (Initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) I hereby authorize RMB Environmental Laboratories to process the samples as received.

________ (Initials) In the event that samples are received by the lab at a temperature greater than 6° C, (10° C for micro) please contact client at phone # ________________ before processing samples.

Relinquished by: (client signature)
Print Name: Rajan Singh
Date 6/16/21
Time 09:00
Shipping to Lab: ☐ Speedee ☐ UPS ☐ USPS ☐ FedEx ☐ Courier ☐ RMB Courier ☒ Hand Delivery

FOR LAB USE ONLY

Received by Lab: (signature)
Date 6/16/21
Time 0905
Additional Fees: Mileage: Field Staff: Shipping: Courier: Equipment: 4.4 Other:

☒ **DOES** meet proper sample storage and transportation guidelines
☐ Does **NOT** meet proper sample storage and transportation guidelines
☒ Received on ice
☐ Received at room temperature
☐ Samples received same day as collection
Received Temp: ~~4.7~~ 4.4 °C Therm. ID: LTC-IR3
Chlorine: No Yes [✓ N/A]

Comments: 2 coolers *per bottles. JMP 6/16/21

VOC vials received w/o headspace: bubble < 6mm: Yes No [✓ N/A]

NOTE: Cmt 1367j is a Excel Spreadsheet titled *Exhibit H Summary of NMW Report Data - Birch Lake.xlsx*, please contact proto.paul@epa.gov if you are interested in reviewing this spreadsheet

Birch Lake Minnesota

Minnesota DNR / Minnesota PCA Lake ID Number 69000300

Water Quality Technical Report

Northern Lakes Scientific Advisory Panel (NLSAP)

Prepared for

Water Legacy

Prepared by

Eric Morrison, PhD
info@NLSAP.org
651.334.8399

June 2021

Summary

Water from the Cleveland Cliffs Northshore mine Peter Mitchell pit is discharged into Langley Creek which is a tributary to the Dunka River and Birch Lake. The flux of sulfate into Birch Lake via Langley Creek and the Dunka River is measured in tons per day. Sulfate contaminated water also drains from the vicinity of the former LTV Steel Mining Co. Dunka mine which operated from 1964 to 1994. In the absence of mine pollution, sulfate levels for EPA Ecoregion 50n lakes are almost without exception under 2 mg/L.

Wild rice waters with greater than 10 mg/L sulfate concentration are impaired for sulfate.

This Water Quality Technical Report has been prepared to provide a survey of surface sulfate concentrations on the southern portion of Birch Lake.

Samples for analysis of sulfate concentration were gathered on June 21, 2021 as explained below.

Sulfate concentrations in all nine sampling locations along the southern shore of Birch Lake were above 10 mg/L. Sulfate concentrations in Dunka Bay near the Dunka River were higher than samples in the main body of the lake. Likewise, sulfate concentrations in Bob Bay near the in the LTV Steel Mining Co. Dunka mine site were higher than in the main body of the lake.

Locations and Methods

1. **Sampling locations.** Locations for sample collection were accessed by boat. Maps from the Minnesota DNR LakeFinder web site and Minnesota PCA map is shown in Figure 1. GPS coordinates and lake ID numbers for sampling locations are listed in Table 1.

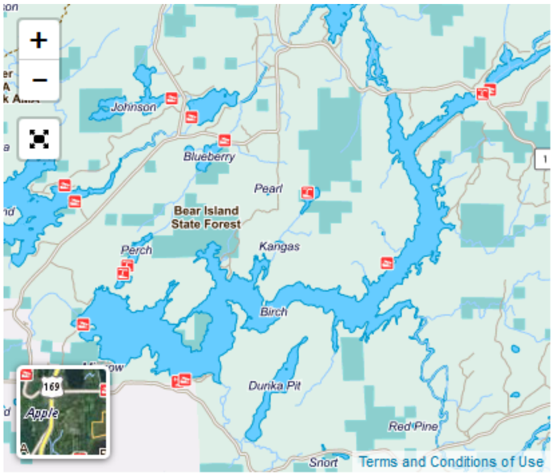


Figure 1. LakeFinder: Birch Lake, Lake ID 69-0003-00

Table 1. Sampling Locations

sample	site	site description	lake ID number	date collected	latitude	longitude
20210621EM-A	1	Dunka River		6/21/2021	47.71610	-91.87329
20210621EM-B	2	south Dunka Bay	69-0003-00	6/21/2021	47.71762	-91.87468
20210621EM-C	3	mid Dunka Bay	69-0003-00	6/21/2021	47.71864	-91.87366
20210621EM-D	4	Dunka Bay mouth	69-0003-00	6/21/2021	47.72103	-91.87608
20210621EM-F	5	200 m north of Dunka Bay	69-0003-00	6/21/2021	47.72465	-91.87433
20210621EM-G	6	200 m from SE shore	69-0003-00	6/21/2021	47.72873	-91.86806
20210621EM-H	7	south shore public landing	69-0003-00	6/21/2021	47.71654	-91.89021
20210621EM-J	8	south Bob Bay	69-0003-00	6/21/2021	47.72722	-91.81250
20210621EM-K	9	north Bob Bay	69-0003-00	6/21/2021	47.73333	-91.81306
20210621EM-L	10	Bob Bay mouth	69-0003-00	6/21/2021	47.73833	-91.81056

2. **Sampling Methodology**. Samples were collected by Eric Morrison, Nick Mattson and Mark Strandberg at the water surface by immersing inverted sample bottles to 10 to 20 cm depth and turning over to fill. GPS coordinates were recorded at the time of sample collection using a GPS enabled smartphone and / or a Garmin Etrex 10 GPS Navigator Handheld GPS Unit. Sample containers were either new polypropylene or new polyethylene terephthalate bottles. After collecting, samples were stored between 4 C and 8 C in a secure location in the custody of the sample collectors and were personally transported to the RMB Environmental Laboratories in Hibbing MN where sulfate analyses were performed. Samples were analyzed within 28 days of collection and upon logging into the analytical lab, sample temperatures were confirmed to be between 2 C and 8 C.) Sample collectors were trained in proper sample collection including location mapping, bottle filling method, acceptable sample bottles, data collection, sample storage, and proper chain of custody.

3. **Sample Analysis.** Samples were analyzed by RMB Environmental Laboratories, Inc. with headquarters at 22796 Co Hwy 6, Detroit Lakes, MN 56501

   Sulfate concentrations were determined as sulfate using EPA METHOD 300.0 DETERMINATION OF INORGANIC ANIONS BY ION CHROMATOGRAPHY within 28 days of sample collection. The limit of quantification (LOQ) for the chromatographic method was less than 1 mg/L.

Results

Sulfate concentrations in mg/L are shown in Table 2. A map showing sample collection locations and sulfate concentrations is shown as Figure 3.

Table 2. Sulfate concentrations

sample	site	site description	lake ID number	date collected	latitude	longitude	sulfate, mg/L
20210621EM-A	1	Dunka River		6/21/2021	47.71610	-91.87329	19.9
20210621EM-B	2	south Dunka Bay	69-0003-00	6/21/2021	47.71762	-91.87468	13.2
20210621EM-C	3	mid Dunka Bay	69-0003-00	6/21/2021	47.71864	-91.87366	11.6
20210621EM-D	4	Dunka Bay mouth	69-0003-00	6/21/2021	47.72103	-91.87608	11.5
20210621EM-F	5	200 m north of Dunka Bay	69-0003-00	6/21/2021	47.72465	-91.87433	10.9
20210621EM-G	6	200 m from SE shore	69-0003-00	6/21/2021	47.72873	-91.86806	10.9
20210621EM-H	7	south shore public landing	69-0003-00	6/21/2021	47.71654	-91.89021	11.0
20210621EM-J	8	south Bob Bay	69-0003-00	6/21/2021	47.72722	-91.81250	50.2
20210621EM-K	9	north Bob Bay	69-0003-00	6/21/2021	47.73333	-91.81306	15.1
20210621EM-L	10	Bob Bay mouth	69-0003-00	6/21/2021	47.73833	-91.81056	10.4

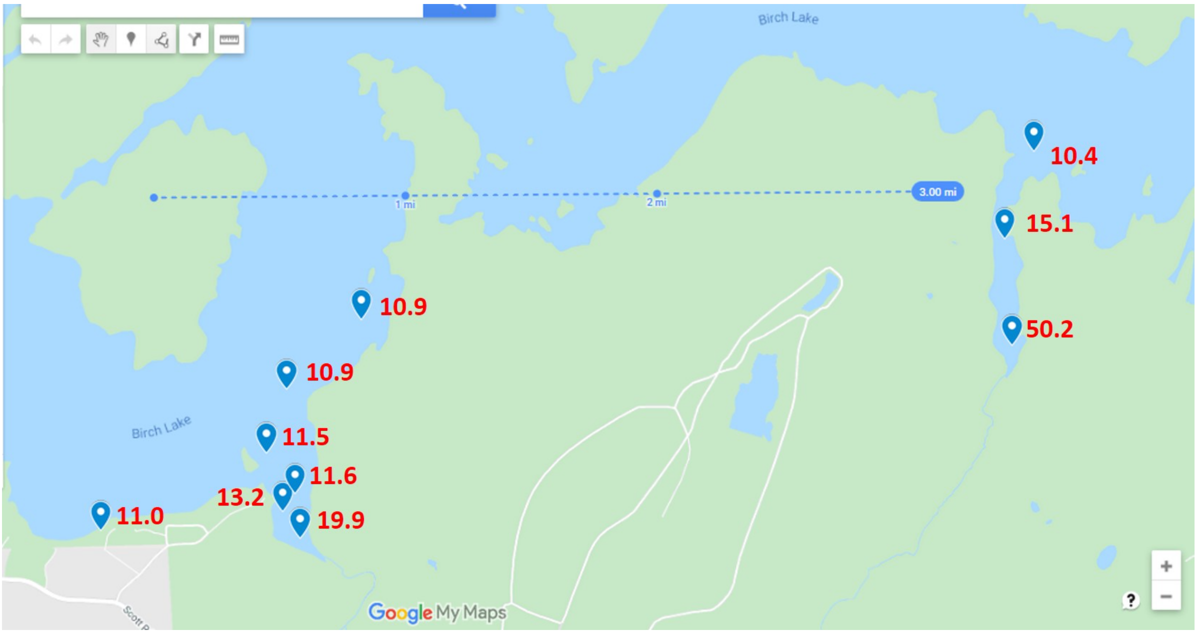


Figure 3. Sampling locations and sulfate concentrations of surface water grab samples. Sulfate concentrations in mg/L are depicted with red font for the blue pin location markers.

Conclusions

Sulfate ion concentrations in Birch Lake are significantly increased by sulfate pollution entering from the Dunka and drainage from the site of the former LTV Steel Mining Co. Dunka mine. In the absence of mine pollution, sulfate concentrations under 2 mg/L would be expected based on comparison to nearby unimpacted lakes. Sulfate concentrations in all of the sampling locations along the southern shore of Birch Lake near Dunka Bay and Bob Bay are above the wild rice sulfate standard value of 10 mg/L.

Contributors

Eric Morrison, Chief Scientific Officer, Superior Nano, St. Paul MN. BA Chemistry, University of Minnesota Minneapolis, PhD Chemistry Penn State University, University Park PA.

Nick Mattson, Electrician, Automation Department Minnesota State Capitol Building Maintenance, St. Paul MN.

Mark Strandberg, Independent Building Maintenance Contractor, St. Paul MN.

NOTE: Cmt 1367l is a series of a Excel Spreadsheets, see please contact proto.paul@epa.gov if you are interested in reviewing these spreadsheets

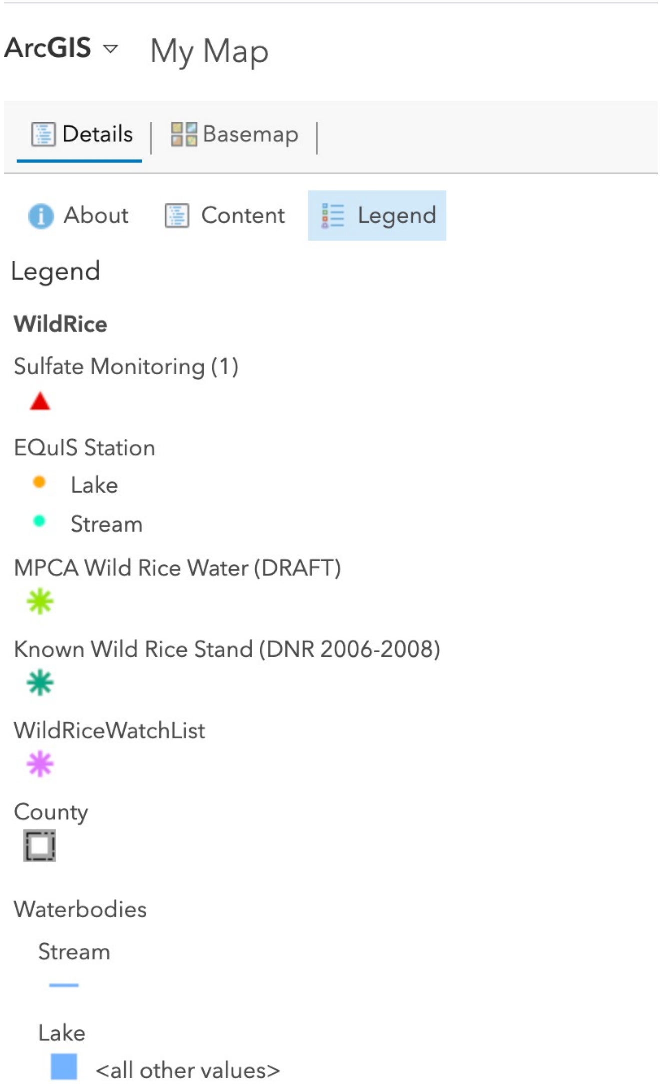
- Data Birch Lake - Revised (69-0003-00).xlsx
- Data Chippewa River (07020005-501).xlsx
- Data Dark Lake (69-0790-00).xlsx
- Data Dunka River (S002-765).xlsx
- Data Miss R Pool 4_ Robinson Lake (79-0005-02).xlsx
- Data Miss. R. Root R. to IA Border, Pool 8 (07060001-509).xlsx
- Data Raven Stream W. Branch (S004-617 at -842)).xlsx
- Data Rice Ck_Rice Lk to Elk R (S001-523).xlsx
- Data St Louis R Estuary (MPCA -532, -533).xlsx
- Data St. Louis R. Estuary (S000-021).xlsx
- Data St. Louis R. Estuary (S000-277).xlsx
- Data Swan Lake (31-0067-01, -02, and -03).xlsx

Wild Rice WQLS, Exhibit K

MPCA Mapping ArcGIS

Screenshots taken from June 20-27, 2021

Available at https://www.arcgis.com/home/webmap/viewer.html?useExisting=1.



Legend

WildRice

Sulfate Monitoring (1)

▲

EQuIS Station

- ● Lake
- ● Stream

MPCA Wild Rice Water (DRAFT)

✳

Known Wild Rice Stand (DNR 2006-2008)

✳

WildRiceWatchList

✳

County

☐

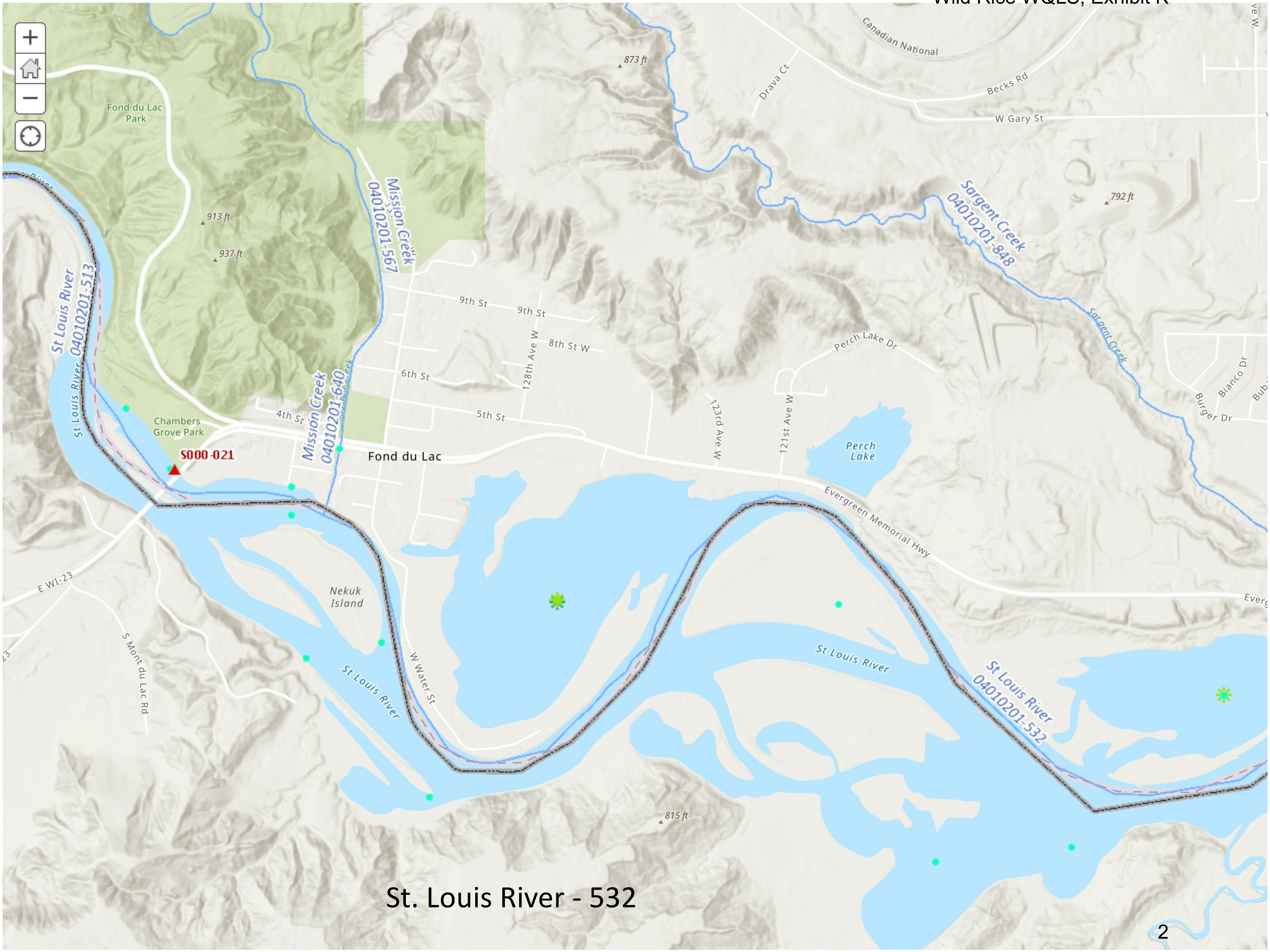
Waterbodies

Stream

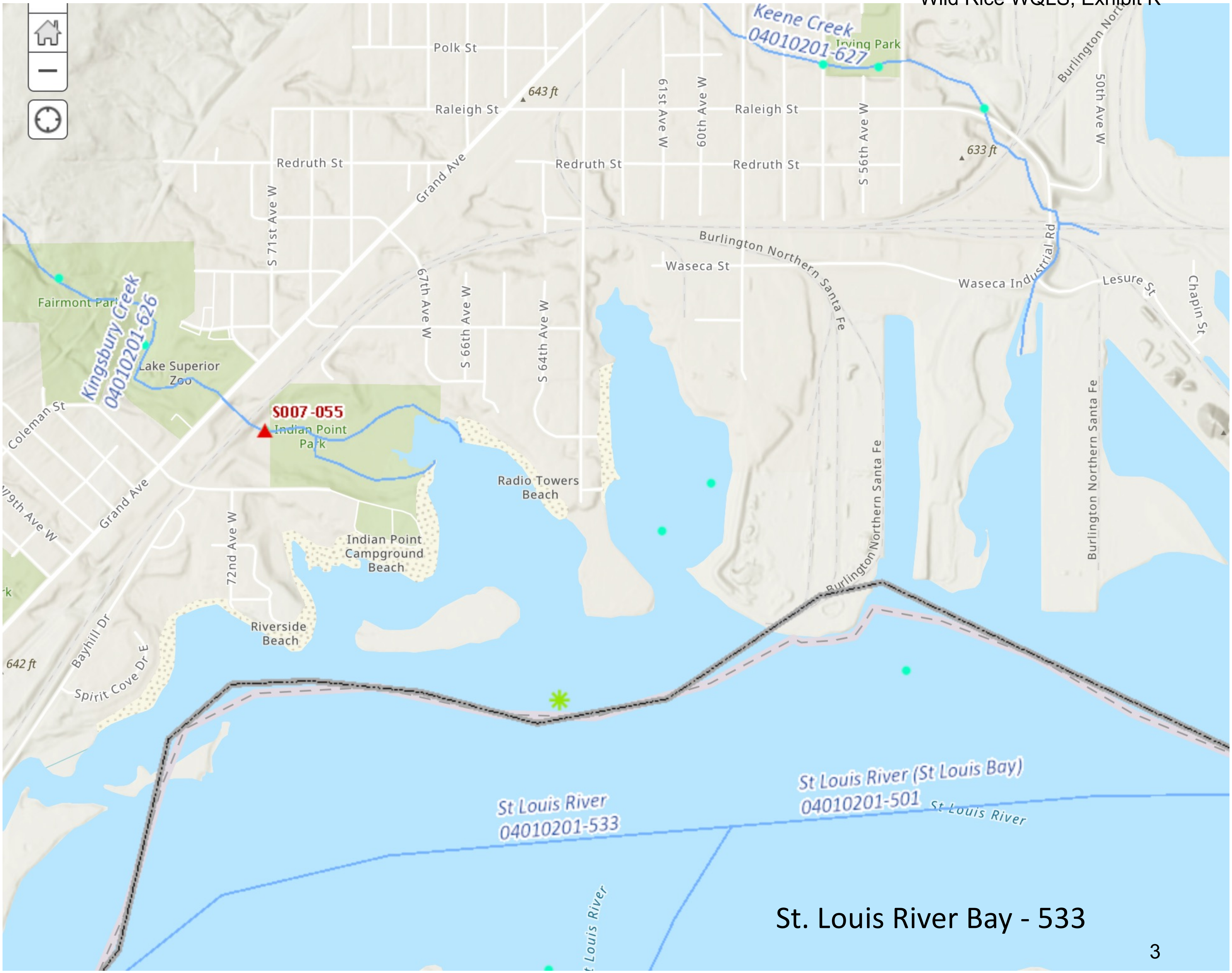
—

Lake

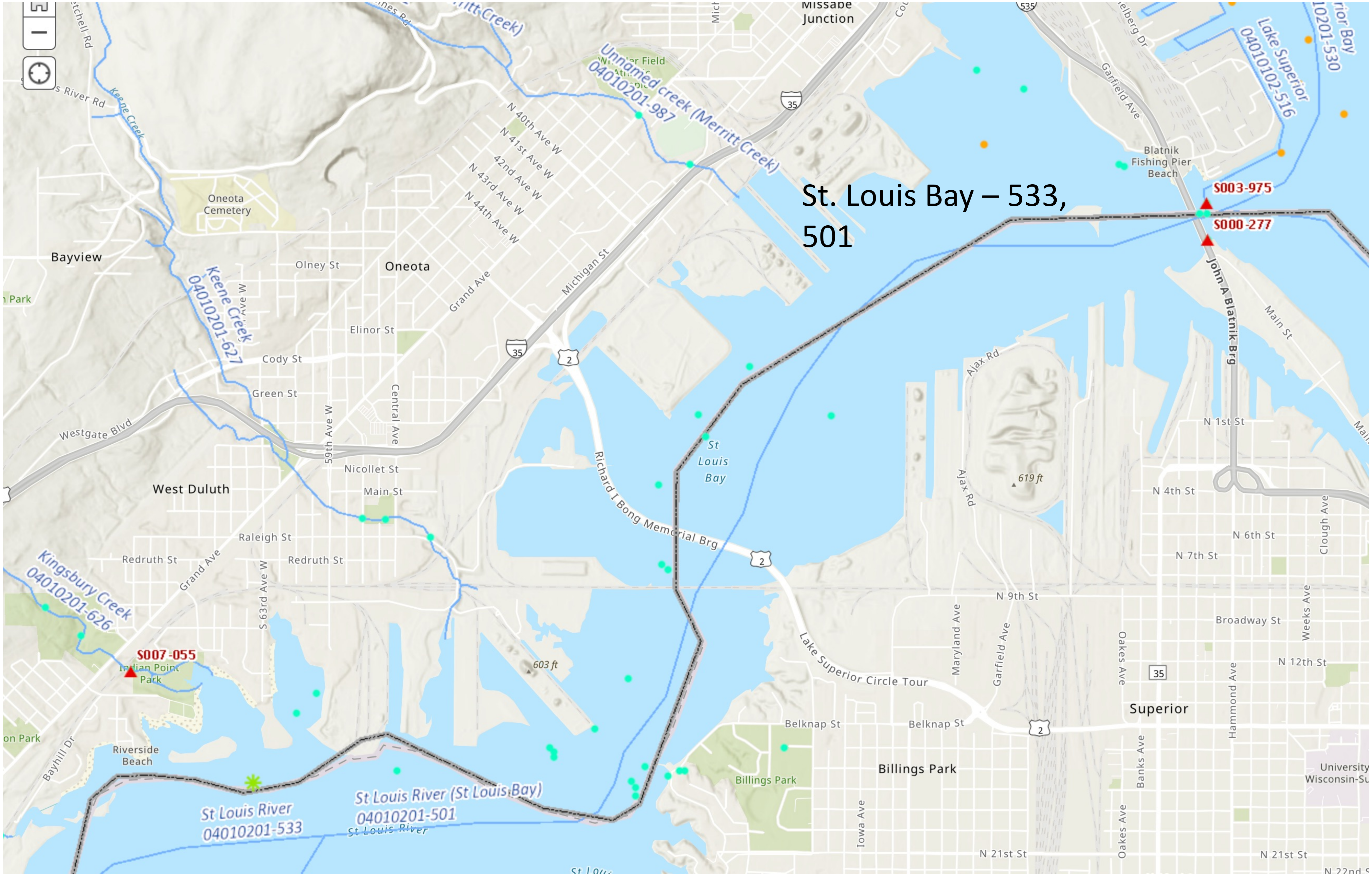
🟦 <all other values>



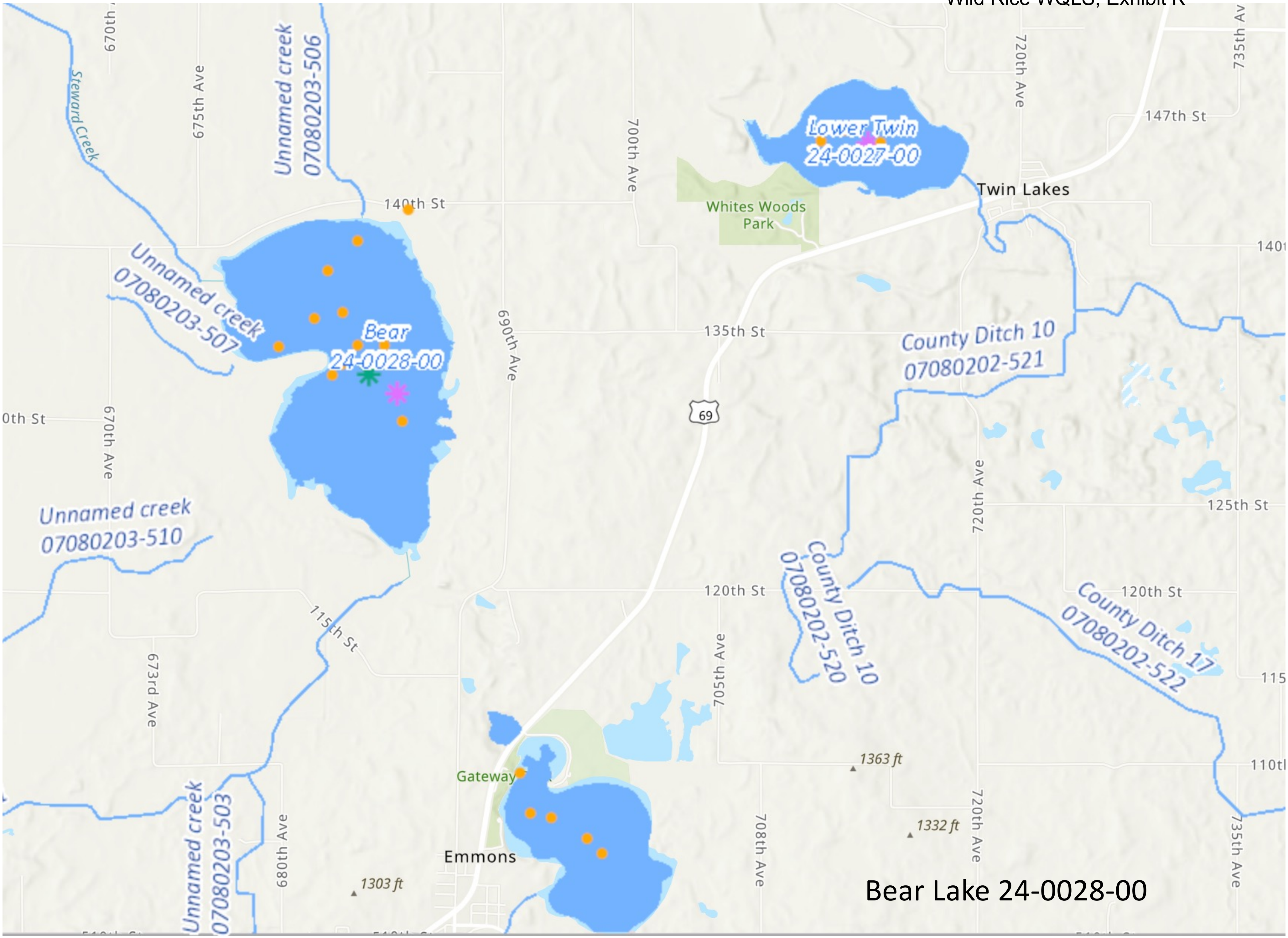
St. Louis River - 532



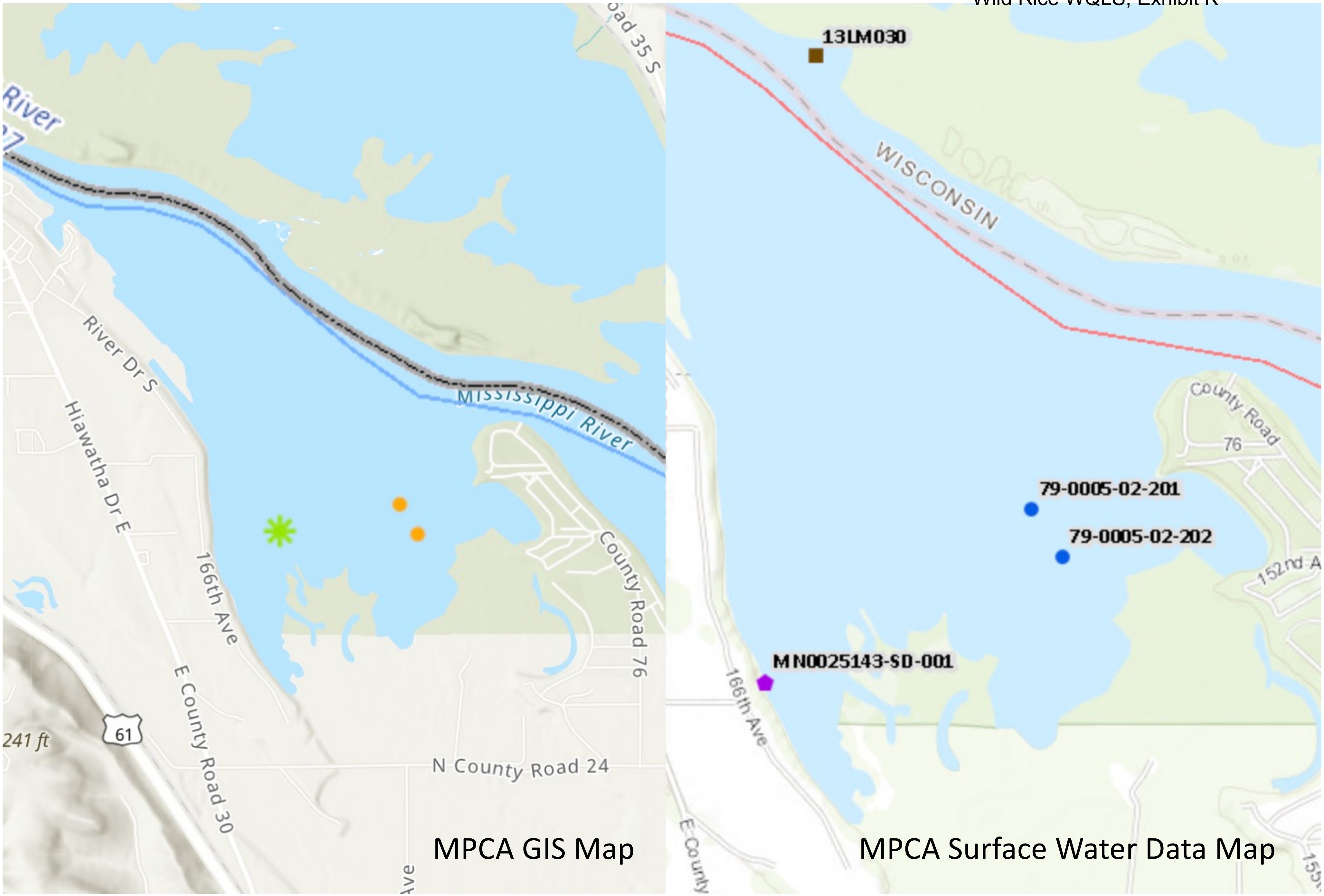
St. Louis River Bay - 533



St. Louis Bay – 533, 501



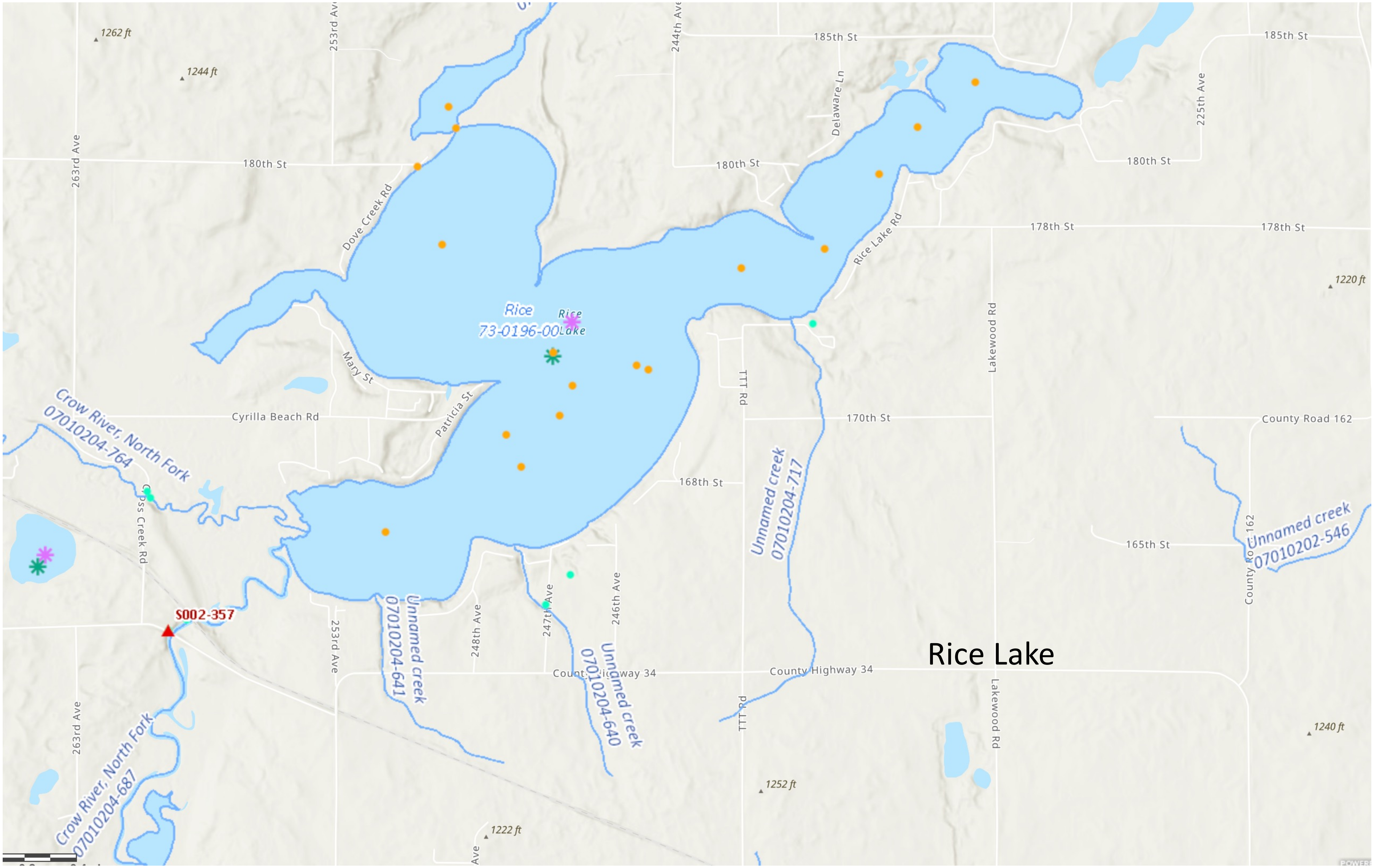
Bear Lake 24-0028-00

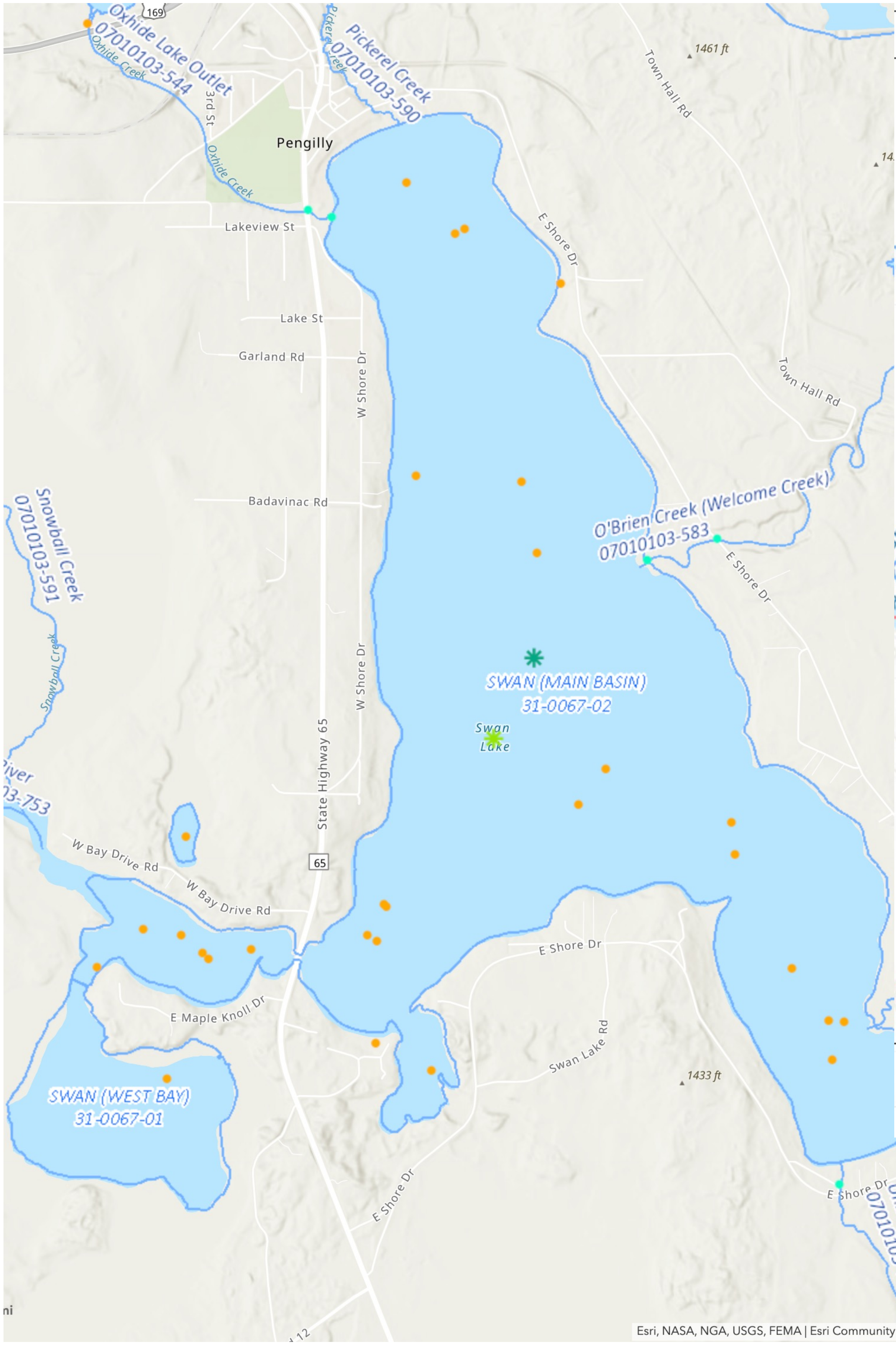


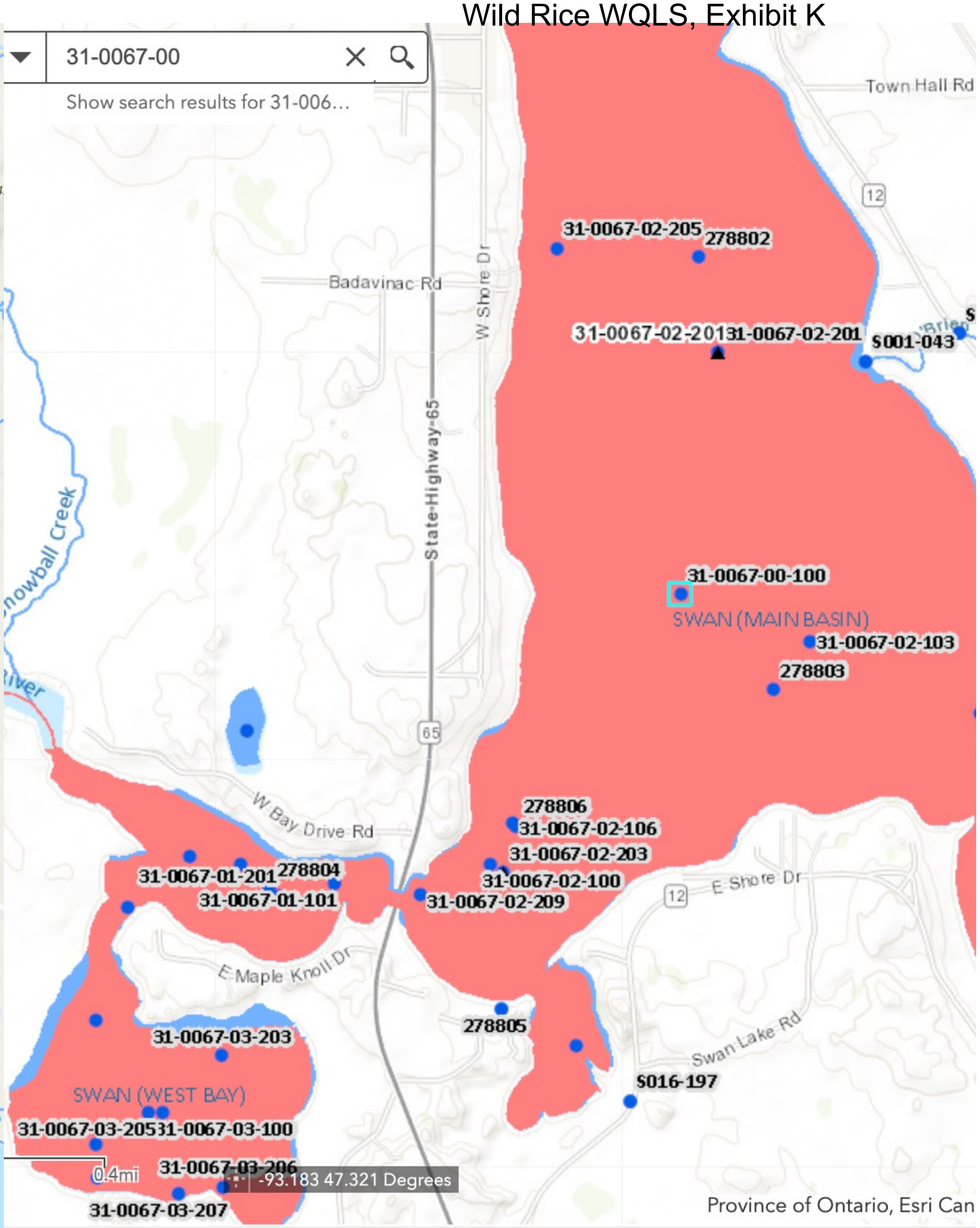
MPCA GIS Map

MPCA Surface Water Data Map

Mississippi R. Pool 4/Robinson Lake

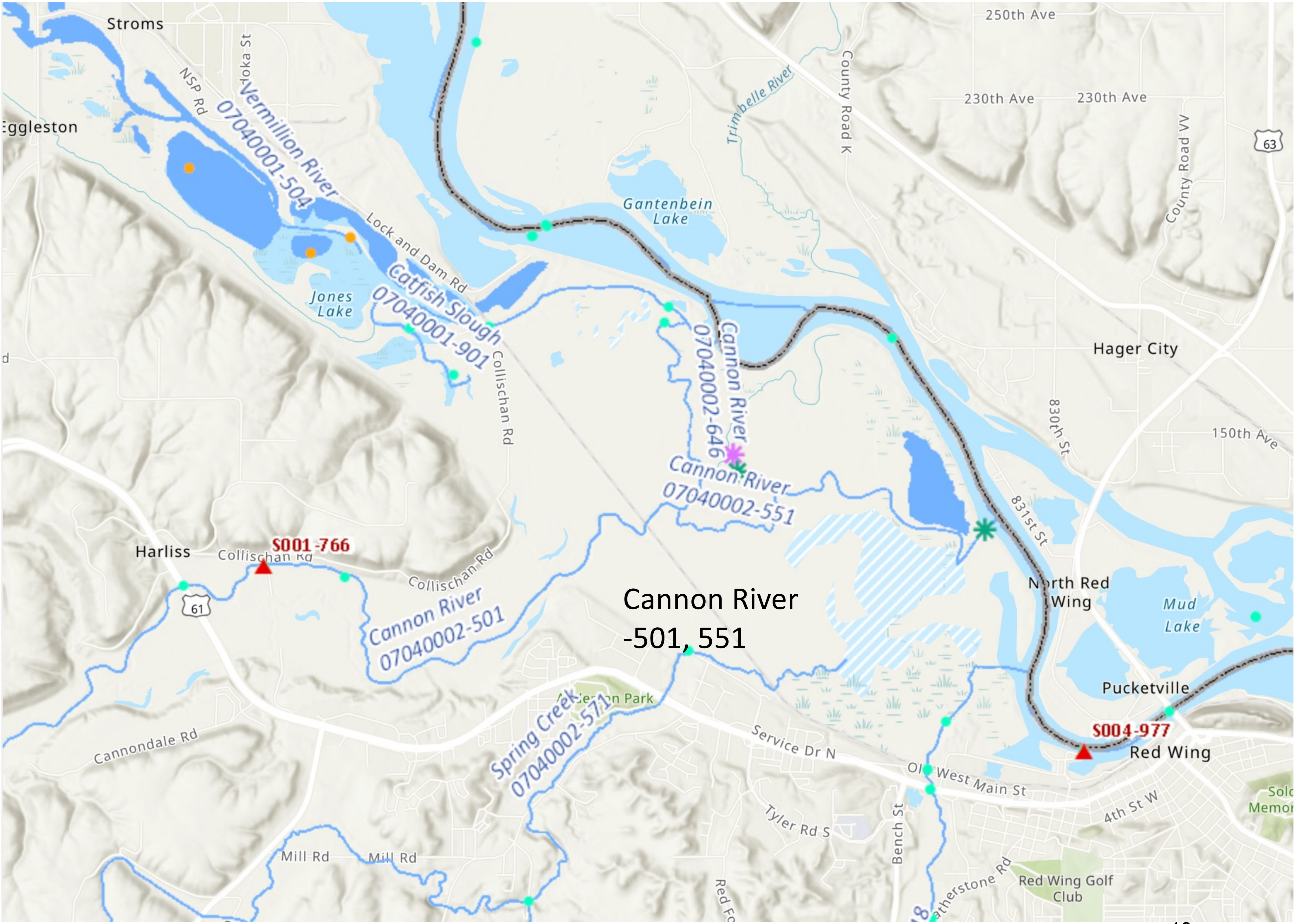

Rice Lake
Rice
73-0196-00
Rice Lake
S002-357
Crow River, North Fork
07010204-764
Crow River, North Fork
07010204-687
Unnamed creek
07010204-641
Unnamed creek
07010204-640
Unnamed creek
07010204-717
Unnamed creek
07010202-546
185th St
180th St
178th St
170th St
168th St
165th St
Cyrilla Beach Rd
County Road 162
County Highway 34
Dove Creek Rd
Mary St
Patricia St
Rice Lake Rd
Delaware Ln
TTT Rd
Lakewood Rd
Cross Creek Rd
263rd Ave
253rd Ave
248th Ave
247th Ave
246th Ave
244th Ave
225th Ave
1262 ft
1244 ft
1220 ft
1240 ft
1252 ft
1222 ft



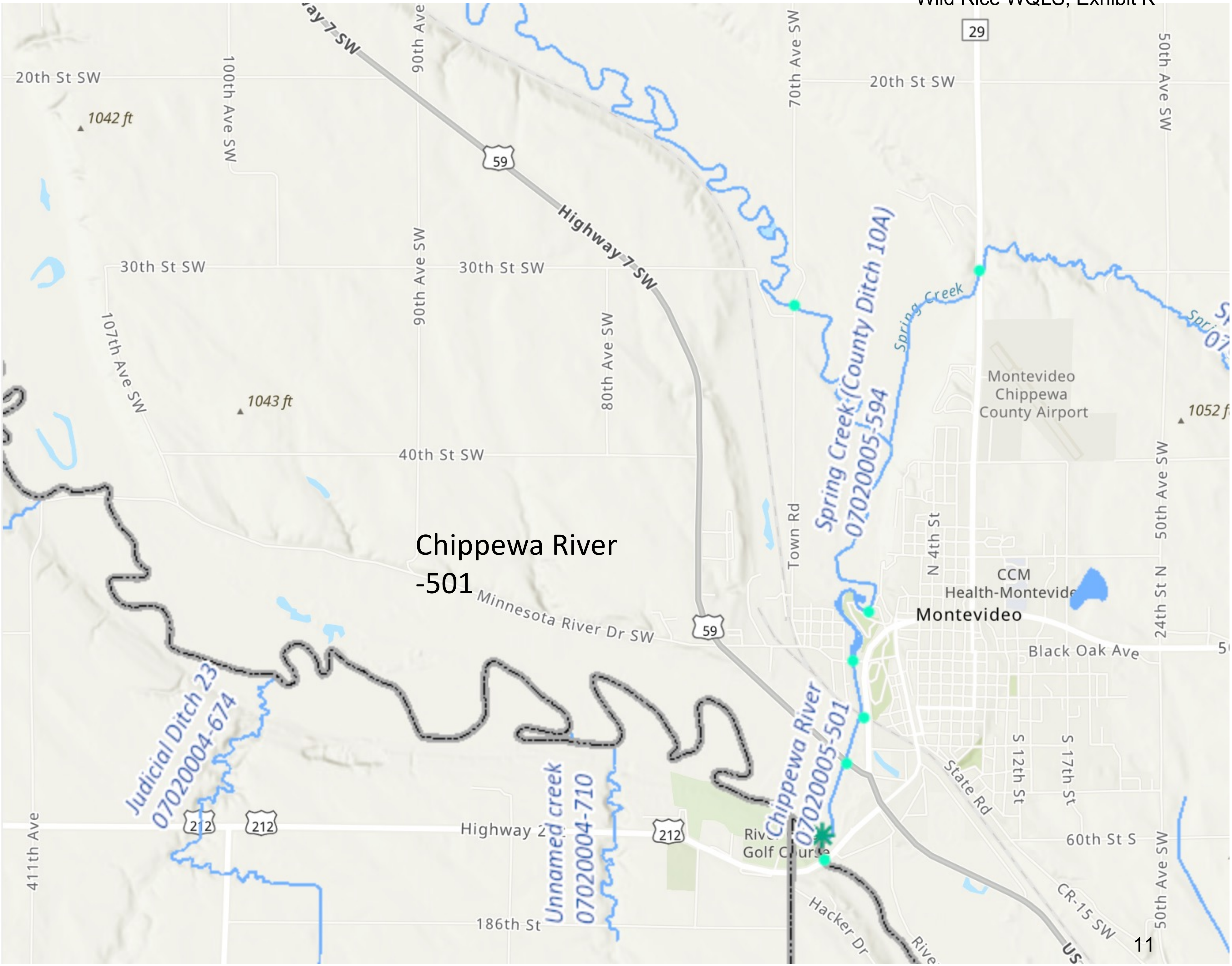


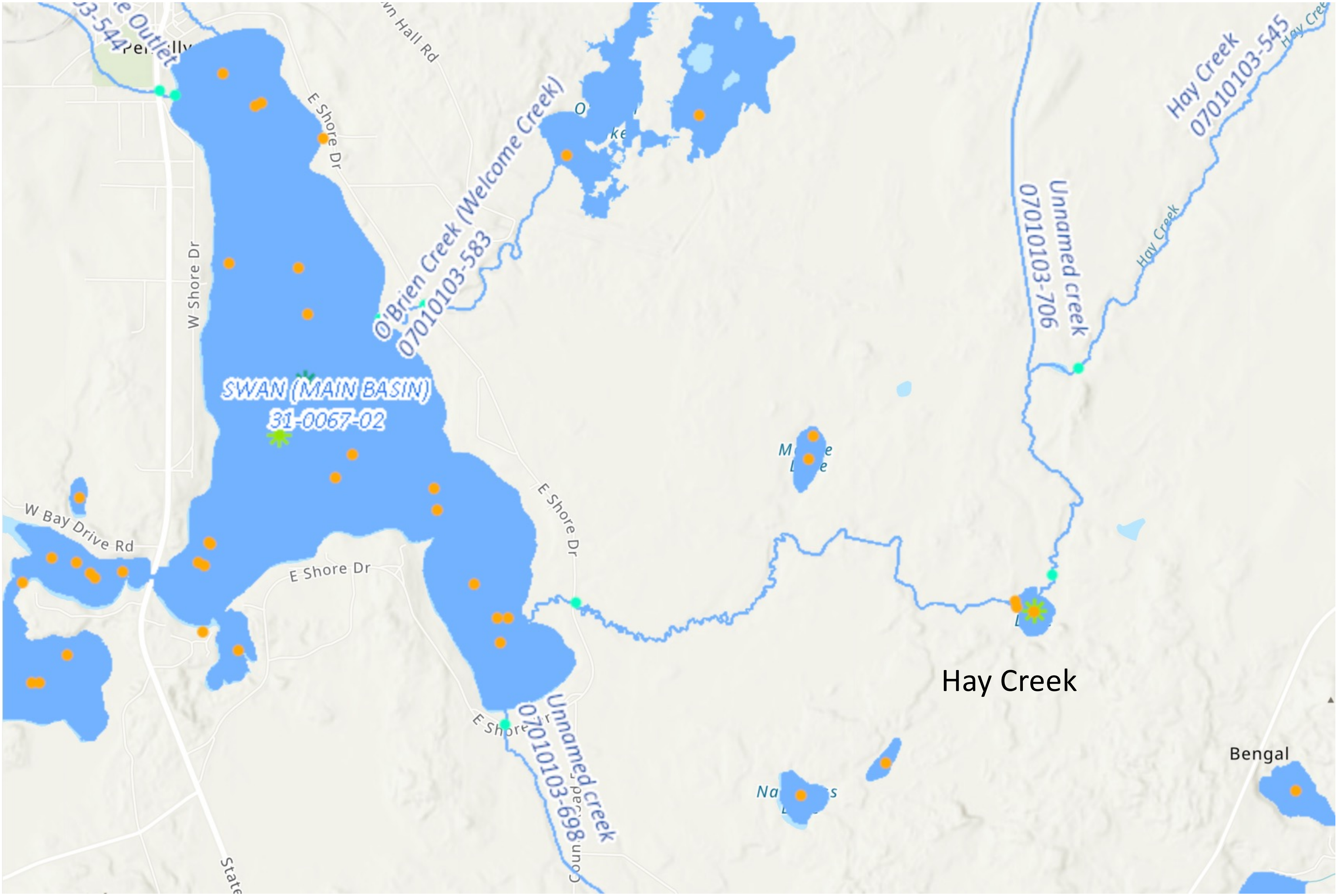
Swan Lake – Main Basin and West Bay
MPCA GIS map (left),
Surface Water Data map (above)

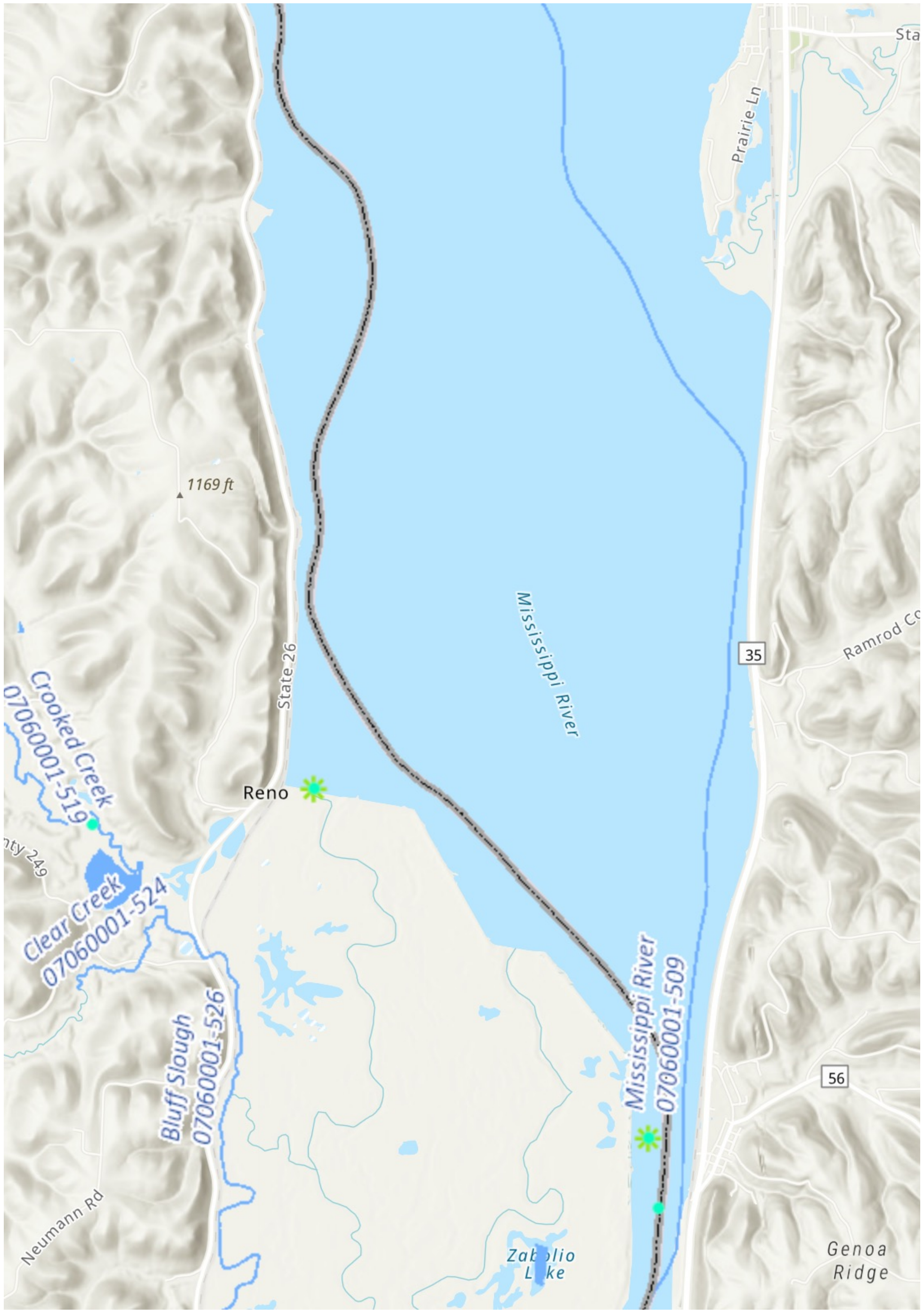
Lake of the Woods (Main)
39-0002-01
LAKE OF THE WOODS(4 MI BAY)
39-0002-02
Graceton Beach Rd NW
1064 ft
1066 ft
1116 ft
1086 ft
1081 ft
50th Ave NW
Coronado Dr NW
42nd Ave NW
Dillon Rd NW
Bostick Creek
Unnamed creek
09030009-556
Unnamed ditch
09030009-539
S005-708
40th Ave NW
38th Ave NW
34th Ave NW
28th St NW
Judicial Ditch 28
09030009-555
1071 ft
Bostick Creek
09030009-537



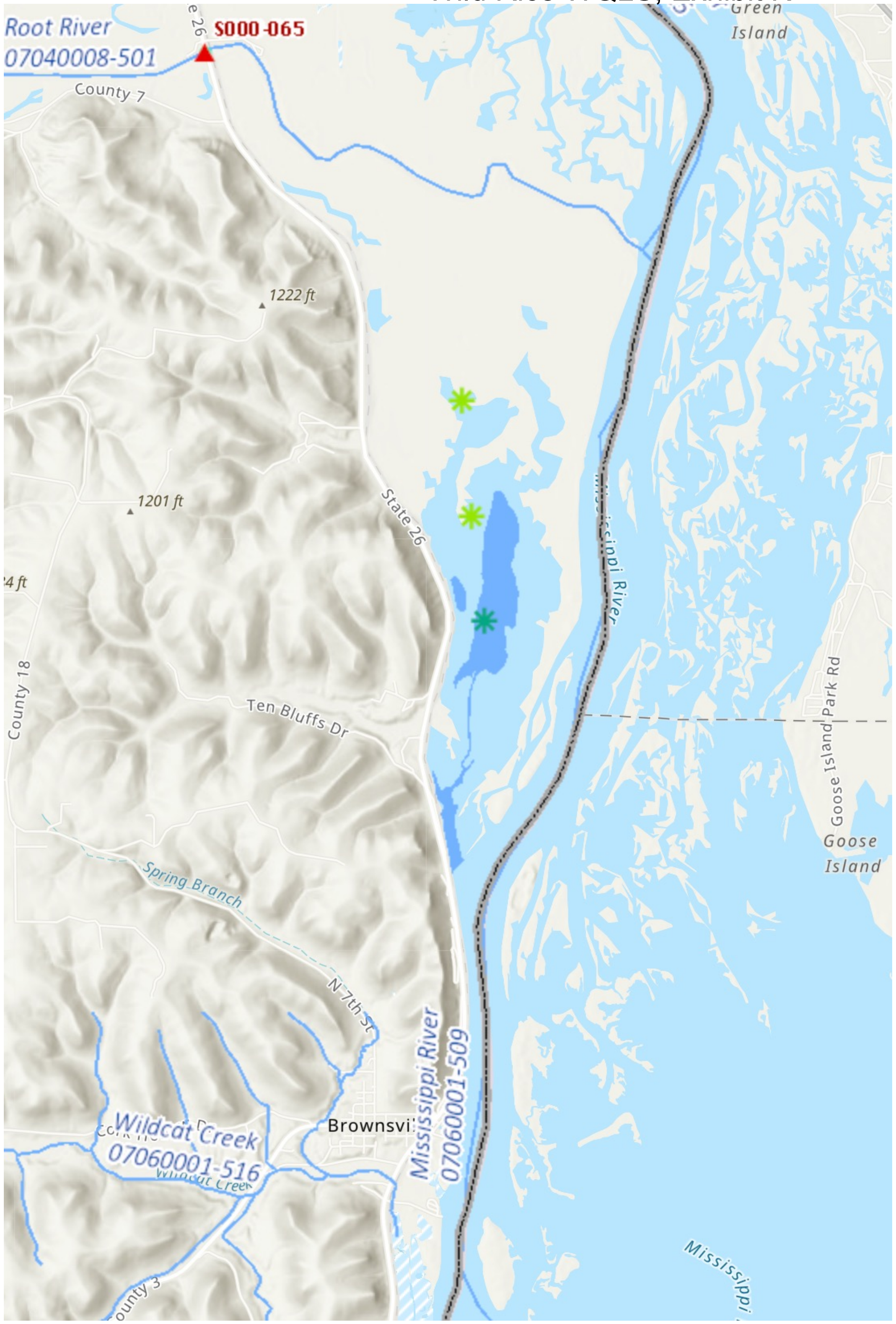
Cannon River
-501, 551


Chippewa River
-501
Chippewa River
07020005-501
Spring Creek (County Ditch 10A)
07020005-594
Spring Creek
Judicial Ditch 23
07020004-674
Unnamed creek
07020004-710
Montevideo
Montevideo Chippewa County Airport
CCM Health-Montevideo
Highway 7 SW
20th St SW
30th St SW
40th St SW
186th St
Minnesota River Dr SW
Black Oak Ave
60th St S
State Rd
Hacker Dr
CR-15 SW
Town Rd
N 4th St
S 12th St
S 17th St
24th St N
50th Ave SW
70th Ave SW
80th Ave SW
90th Ave SW
100th Ave SW
107th Ave SW
411th Ave
Highway 212
59
212
29
1042 ft
1043 ft
River Golf Course

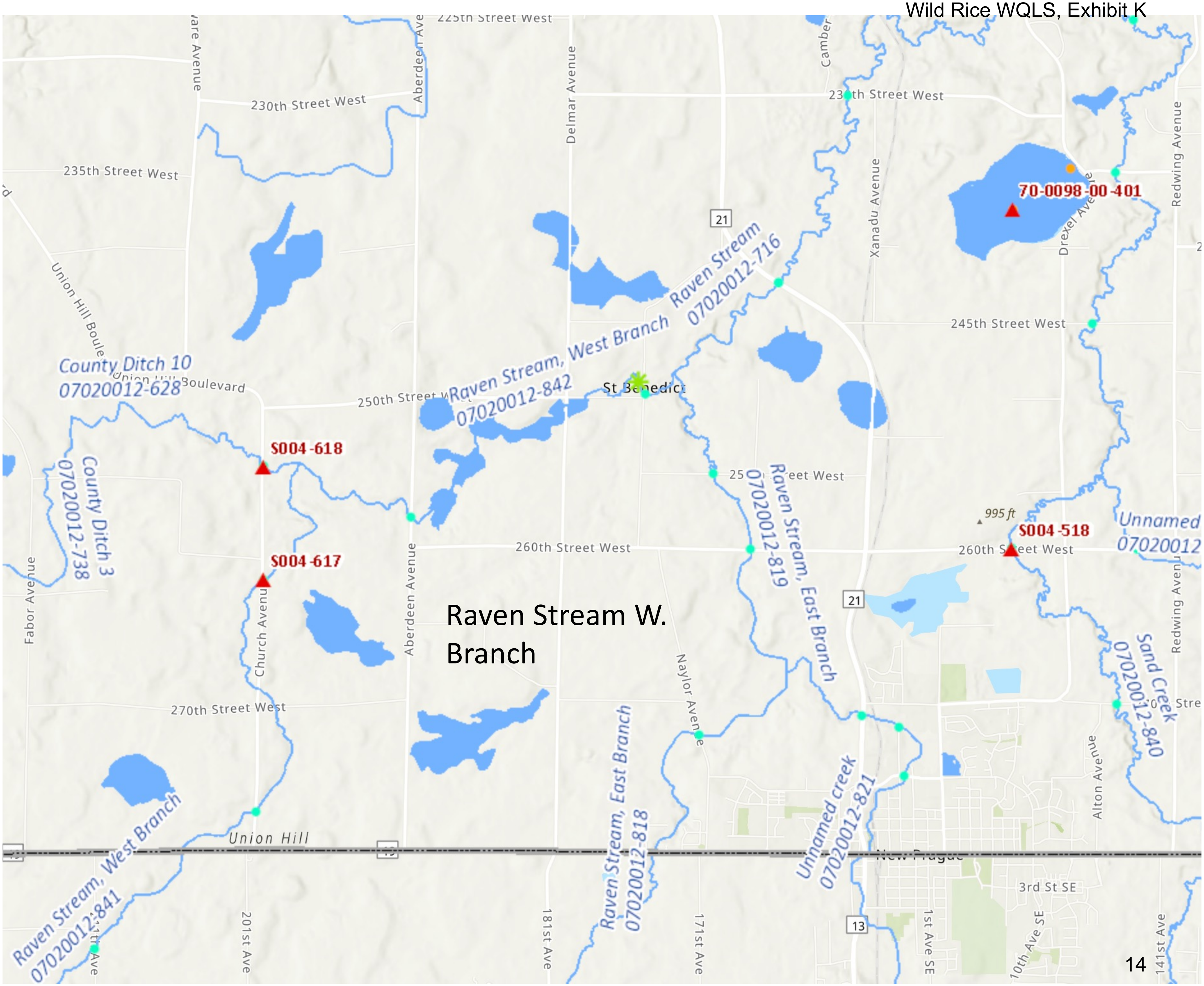

Hay Creek
SWAN (MAIN BASIN)
31-0067-02
O'Brien Creek (Welcome Creek)
07010103-583
Unnamed creek
07010103-706
Hay Creek
07010103-545
Hay Creek
Unnamed creek
07010103-698
E Shore Dr
W Shore Dr
W Bay Drive Rd
Town Hall Rd
Bengal
State



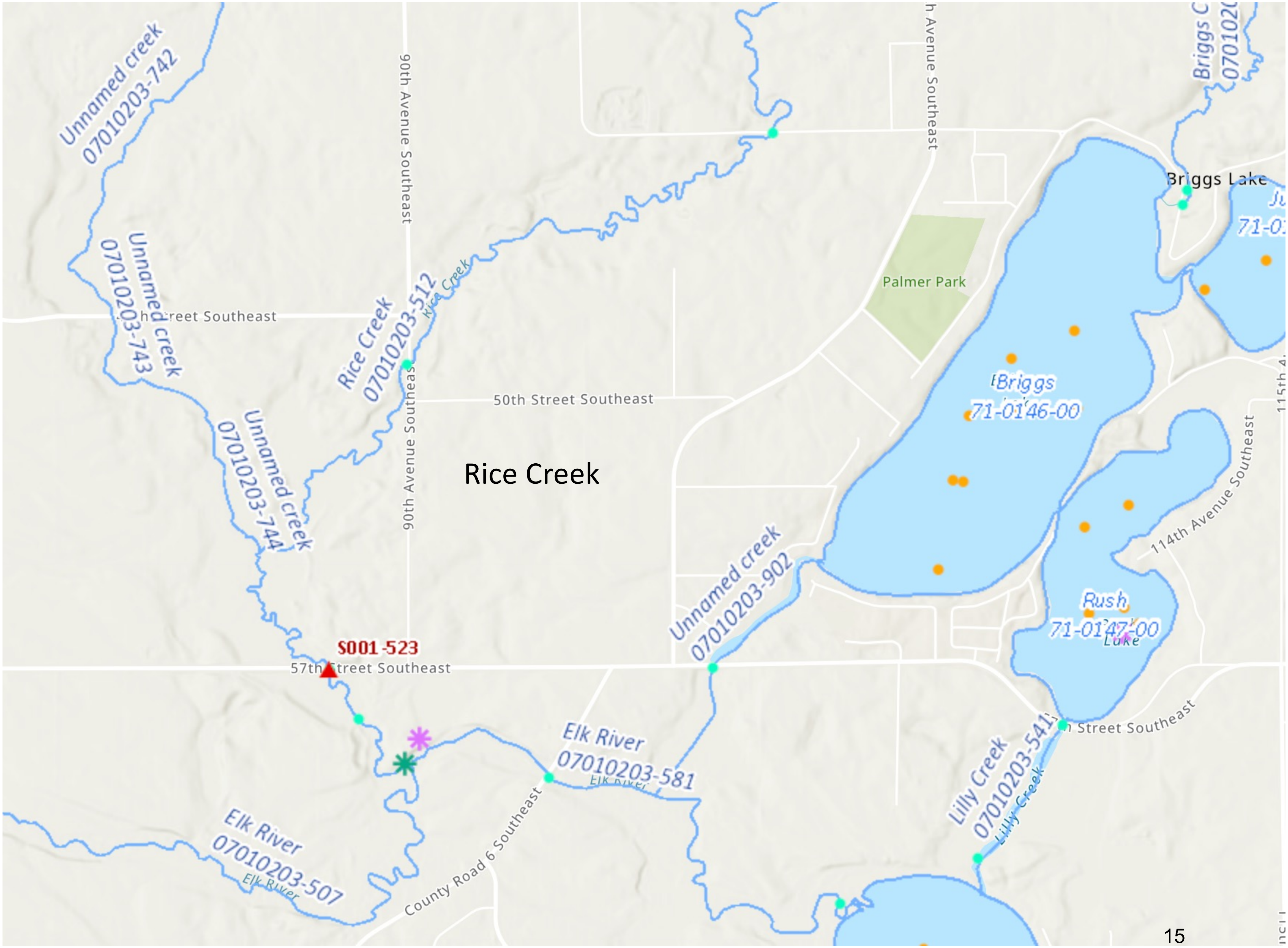
Mississippi River Pool 8 at Genoa, Reno
(07060001-509)



Mississippi R. below Root R.
(07060001-509)



Raven Stream W. Branch


Rice Creek
Unnamed creek
07010203-742
Unnamed creek
07010203-743
Unnamed creek
07010203-744
Rice Creek
07010203-512
Rice Creek
90th Avenue Southeast
50th Street Southeast
57th Street Southeast
S001-523
Elk River
07010203-581
Elk River
Elk River
07010203-507
Elk River
County Road 6 Southeast
Unnamed creek
07010203-902
Palmer Park
Briggs Lake
Briggs
71-0146-00
Rush
71-0147-00
Lake
114th Avenue Southeast
Street Southeast
Lilly Creek
07010203-541
Lilly Creek
Avenue Southeast

Wild Rice WQLS, Exhibit L

Subject: RE: MPCA Sulfate Data for St. Louis River Estuary
Date: Thursday, May 27, 2021 at 1:51:01 PM Central Daylight Time
From: Coleman, Jean (MPCA)
To: Paula Maccabee
Attachments: image004.png

Paula,

The MPCA provided the following to EPA this week. We believe it is also responsive to your questions.

“Your trouble might have something to do with these WID/AUs being retired and the fact there’s a lag between the time we retire AUs and the time they appear on our webpage. The stations still exist so I am able to confirm the data provided in that attachment (I remember looking into it) are in EQuIS. Here are the results found after 10/1/2008.

ORIGIN_STN_ID	STN_ORIGIN_CODE	Previous_WID	WID	SAMPLE_DATE	TotalSulfate_
S007-206	Equis	04010201-532	69-1291-04	9/5/2012 10:15	
S007-444	Equis	04010201-532	69-1291-04	5/27/2013 11:45	
S007-444	Equis	04010201-532	69-1291-04	6/24/2013 12:00	
S007-444	Equis	04010201-532	69-1291-04	7/22/2013 12:45	
S007-444	Equis	04010201-532	69-1291-04	8/26/2013 15:45	
S007-507	Equis	04010201-532	69-1291-04	8/17/2009 0:01	
S007-510	Equis	04010201-532	69-1291-04	8/17/2009 0:01	
S007-512	Equis	04010201-533	69-1291-04	8/17/2009 0:01	
S007-515	Equis	04010201-533	69-1291-03	8/17/2009 0:01	
S007-516	Equis	04010201-532	69-1291-04	8/17/2009 0:01	

There’s one station provided by the tribes, S000-262, with a lot of old data and you can find that, if you want to confirm it, here (and also going to the search page and typing in the Station ID).”

Jean

Jean Coleman, Senior Attorney
Minnesota Pollution Control Agency
651-757-2631
jean.coleman@state.mn.us

From: Paula Maccabee <pmaccabee@justchangelaw.com>
Sent: Thursday, May 27, 2021 11:45 AM
To: Coleman, Jean (MPCA) <jean.coleman@state.mn.us>
Subject: MPCA Sulfate Data for St. Louis River Estuary

Hi Jean,

We are writing to request all available sulfate data pertaining to two St. Louis River estuary sites.

In reviewing materials pertaining to wild rice impaired waters, we found that the MPCA included two St. Louis River Estuary sites in its preliminary August 2013 identification of wild rice waters impaired due to excessive sulfate. Both are on the list of 1300 wild rice waters acknowledged by the MPCA. These estuary sites are:

> St. Louis R: Mission Ck to Oliver Br., with the WID number 04010201-532 and the previous DNR designation of S007-444.
>
> St. Louis R: Oliver Br. to Pokegama R., with the WID number 04010201-533, which we believe was designated ;by DNR as S006-928.

We found no data for either waterbody in the MPCA's online surface water data base, as shown in the attached spreadsheets which I personally downloaded from the site. The sulfate data summaries for "all WIDs" that you sent WaterLegacy in April similarly had no data for each estuary site.

We would request all data that MPCA has pertaining to sulfate concentrations in these estuary sites. We would also appreciate any insight you can share as to why this data was not more readily accessible.

I look forward to hearing from you.

Thank you,
Paula

Paula Maccabee (she/her)
WaterLegacy Advocacy Director and Counsel
1961 Selby Ave., St. Paul MN 55104
phone: 651-646-8890
mobile: 651-775-7128
email: pmaccabee@justchangelaw.com
email: paula@waterlegacy.org
WATERLEGACY

Natural Wild Rice In Minnesota

A Wild Rice Study document submitted to the Minnesota Legislature by the Minnesota Department of Natural Resources

February 15, 2008

https://files.dnr.state.mn.us/fish_wildlife/wildlife/wildrice/natural-wild-rice-in-minnesota.pdf

Fiscal Disclosure

Pursuant to Minnesota Statutes, Section 3.197, we estimate that it cost approximately $72,614 to produce this report. This includes Minnesota Department of Natural Resources (MNDNR) staff time for conducting the inventory, attending meetings, drafting and reviewing the report and compiling comments and recommendations ($45,159) and meeting expenses, including travel, for consultation with the Technical and Partnership Teams ($1,772). In addition, costs accrued to other agencies and individuals participating on the Technical Team are $22,618 for time and $3,065 for travel. These costs do not include the costs of preceding research and public participation efforts conducted by the MNDNR or Team members prior to the requirement that this report be prepared.

Table of Contents

Executive Summary

Introduction

This report fulfills the requirements of Session Law 2007, Chapter 57, Article 1, Section 163 requiring the Commissioner of Natural Resources to prepare a study for natural wild rice that includes: (1) the current location and estimated acreage and area of natural stands; (2) potential threats to natural stands, including, but not limited to, development pressure, water levels, pollution, invasive species, and genetically engineered strains; and (3) recommendations to the house and senate committees with jurisdiction over natural resources on protecting and increasing natural wild rice stands in the state.

In fulfilling these requirements, the Minnesota Department of Natural Resources (MNDNR) established a Technical Team of wild rice experts from State, Tribal, and Federal governments, as well as academia and the private sector. The MNDNR also established a Partnership Team representing major stakeholders.

Importance of Natural Wild Rice

Nowhere has natural wild rice been more important, nor had a richer history, than in Minnesota. No other native Minnesota plant approaches the level of cultural, ecological, and economic values embodied by this species. Natural wild rice has been hand harvested as a source of food in the Great Lakes region for thousands of years.

The Ojibwe people have a special cultural and spiritual tie to natural wild rice. Known to their people as Manoomin, it is revered as a special gift from the Creator. In addition many immigrants to Minnesota adopted hand harvesting of natural wild rice as an annual ritual. Annual sales of state licenses for wild rice harvesting peaked in 1968 at over 16,000. In recent years, annual sales have averaged fewer than 1500. In many instances, though, tribal harvesters are not required to buy state licenses. It is thought that more than 3000 tribal members participate in wild rice harvesting, providing a statewide total (tribal and nontribal) of 4000-5000 individuals annually.

The value of natural wild rice to wildlife has been long appreciated by American Indians and was marveled at by early European explorers. Research since then has documented that wild rice provides food and shelter for many fish and wildlife species. It is one of the most important foods for waterfowl in North America. More than 17 species of wildlife listed in the MNDNR's Comprehensive Wildlife Conservation Strategy as "species of greatest conservation need" use wild rice lakes as habitat for reproduction or foraging.

Wild rice harvest has provided important economic benefits to local economies. As with other commodities, the price paid for unprocessed natural wild rice can vary considerably. Although pricing is mainly determined by supply, marketing also plays a role. During the past 70 years, the price of one pound of unprocessed wild rice has ranged from $0.10 in 1940 to $2.17 in 1966. Adjusted for inflation these prices in today's dollars are equivalent to $0.75 and $13 per pound, respectively. As an example, the 1966 harvest of 924,000 lbs would have been worth over $12 million today.

Prior to 1970, Minnesota provided half of the global market supply of wild rice. Most of this rice was from hand harvested natural stands. By 1990, the large-scale production of cultivated wild rice had expanded, and natural wild rice accounted for less than 10% of the global market supply. The total annual yield of cultivated and hand harvested wild rice in Minnesota today ranges from four to eight million pounds. A recent MNDNR survey found the average annual hand harvest of natural stands to be 430 pounds per individual.

Background

Although stands of natural wild rice occur most commonly in central and north-central Minnesota, the historic range of wild rice included all of the state. Based on the inventory conducted for this report, the range of natural wild rice today includes 55 counties in Minnesota. Stands of natural wild rice were present or occurred in recent history on approximately 1286 lakes and river/stream segments. These areas support a minimum of 64,328 acres of natural wild rice when growing conditions are favorable.

The greatest concentration of lakes supporting natural wild rice is in Aitkin (4,859 acres), Cass (8,323 acres), Crow Wing (3,751 acres), Itasca (8,448 acres), and St. Louis (8,939 acres) counties. These counties contain over 60% of the inventoried natural wild rice acreage in Minnesota. These counties also account for over 70% of the harvesting trips for natural wild rice.

Natural wild rice generally requires some moving water, with rivers, flowages, and lakes with inlets and outlets being optimal areas for growth. Wild rice grows well at depths of 0.5 to 3 feet of water, although some plants may be found in deeper waters. As an annual plant, natural wild rice develops each spring from seeds that fell into the water during a previous fall. Germination requires a dormancy period of three to four months of cold, nearly freezing water (35° F or colder). Seeds are unlikely to survive prolonged dry conditions.

The entire process, from germination of a new plant to dropping of mature seeds, requires about 110 to 130 days, depending on temperature and other environmental factors. Seeds begin ripening at the top of the stem and then ripen over several days on an individual plant. Plants within a stand ripen at different times because of genetic, developmental, and environmental variation. This staggered maturation process means that ripe seeds may be available within individual stands for several weeks, and across the entire range of natural wild rice in Minnesota for a month or longer.

The earliest laws and regulations concerning wild rice in Minnesota focused on wild rice harvest and date back more than 75 years. Today, there is a complex mix of tribal, federal, state, and local laws and regulations. These are associated with the formal recognition of the significance of natural wild rice and its protection, management, and harvest. The application of regulations varies by jurisdiction (i.e., tribal versus state) and geography (i.e., on-reservation versus off-reservation, or within various ceded territories). Regulatory authority governing different aspects of wild rice management occurs within several state agencies yet within state statutes there is no unifying policy to provide overall guidance in implementation.

Threats

Despite its rich history and abundance in Minnesota, natural wild rice faces many current and potential threats in this region. In general, any factor that can affect water quality, seasonal water levels, lakebed conditions, regional climate, aquatic vegetation, or the natural genetic diversity of wild rice could potentially threaten natural stands. These threats may work in concert or individually to damage wild rice stands.

Important threats that impact local stands of natural wild rice include changes in local hydrology due to dams and channelization, water-based recreation and shoreland development, and mining and other industrial activities. Although the impacts are to local stands, the cumulative effect of these threats can have statewide implications. Hydrological impacts and shoreland development are particularly important.

On a statewide and regional scale, the most important threats are the potential loss of genetic integrity, invasive species, and climate change. Nearly all of the concern expressed about wild rice genetics focuses on the potential of genetic engineering. Invasive species are an ongoing statewide issue impacting aquatic systems in general. Climate change has the potential for the greatest long-term impacts on natural wild rice.

As citizens become more distant from positive experiences with natural wild rice through harvesting, hunting, trapping, or wildlife watching, they are less likely to recognize the very real impacts that the previously noted threats could have on natural wild rice in Minnesota. This loss of appreciation, while not a direct threat to the wild rice resource, nevertheless increases the risks because the level of resource protection and management is often based on the perceived value of a resource.

Unfortunately wild rice harvesters are relatively few in number and have experienced a long-term decline, although the number of tribal harvesters has rebounded in recent years. Only about 4000-5000 people participate in hand harvesting natural stands of wild rice annually.

The future of natural wild rice in Minnesota will depend in large part on its protection and management by state and tribal natural resource agencies. The role of the agencies is complicated by the limitations of their authority and the challenges posed by multiple jurisdictions, annual variability of wild rice crops due to weather and other factors, and lack of information concerning the natural ecology of wild rice, historical losses, trends in abundance and distribution, threats to its future, and a better understanding of wild rice harvesters.

Recommendations

The following recommendations were developed with valuable input and discussion from the members of the Wild Rice Study Technical Team and Partnership Team. However, the MNDNR assumes sole responsibility for these recommendations as written and presented here.

MNDNR recognizes the importance of protecting natural wild rice beds from genetic modification and agrees with wild rice stakeholders that this protection is critical to the future of this resource. We strongly support the Minnesota Environmental Quality Board in adopting rules that require an Environmental Impact Statement for a proposed release of genetically engineered wild rice (MS 116C.94 Subd.1b).

Recommendation 1

Recodify current wild rice harvest statutes and rules to remove duplication and inconsistencies.

Rationale: The state's wild rice statutes and rules have been developed and modified piecemeal over a long period of time. As a result they contain a number of inconsistencies and duplication.

Recommendation 2

Establish statutory policy guidance on wild rice and its management.

Rationale: Within state statutes there is no unifying policy that provides direction to agencies responsible for some aspect of wild rice management.

Recommendation 3

The MNDNR will convene an interagency workgroup in 2008 to identify desired statutory updates in harvest regulations.

Rationale: Harvest regulations and license fee structure should be reviewed by an interagency work group for suggested changes.

Recommendation 4

The MNDNR will designate and publish a list of important natural wild rice areas.

Rationale: Recognizing important wild rice areas and publishing the list would call attention to the importance of these areas, indicate management priorities, and provide a formal list that may prove useful for local units of government that are considering zoning and surface use restrictions.

Recommendation 5

The MNDNR will convene a standing interagency wild rice workgroup to share information and develop recommendations for inventory methodology and trend assessments, education and information outreach, lake planning and management, harvester recruitment and retention, and other management issues as they arise.

Rationale: Comprehensive protection and management of wild rice involves multiple agencies. Management needs include better inventory information including consistent methodology for trend analysis, documenting natural genetic diversity, and establishing long-term case studies on identified lakes.

Recommendation 6

Increase intensive natural wild rice lake management efforts and accelerate the restoration of wild rice stands within its historic range.

Rationale: Protecting and managing natural wild rice resources on many lakes requires active annual management activities to maintain free flowing outlets. Active management is also required to restore wild rice to wildlife habitat areas within its historic range. These efforts should be accelerated as funding, time, and opportunity permit.

Sacred Food and Medicine

Wild rice, or manoomin, is a sacred food and medicine integral to the religion, culture, livelihood, and identity of the Anishinaabeg. According to our sacred migration story, in the long ago a prophet at the third of seven fires beheld a vision from the Creator calling the Anishinaabe to move west (to a land previously occupied long ago) until they found the place "where food grows on the water." The Anishinaabeg of the upper Mississippi and western Great Lakes have for generations understood their connection to anishinaabe akiing (the land of the people) in terms of the presence of this plant as a gift from the Creator. In the words of White Earth's Tribal Historian, Andy Favorite, "Wild rice is part of our prophecy, our process of being human, our process of being Anishinaabe … we are here because of the wild rice. We are living a prophecy fulfilled."

In our Ojibwe language, manoomin is animate, grammatically referred to as "him/her" not "it," a non-human being, not just an inanimate "resource." It is both difficult and of utmost importance to adequately translate and appreciate this worldview in the language of mainstream culture and society with its scientific advisory boards for the study of humans and animals but not plants. According to Anishinaabe author, Basil Johnson, "…in essence each plant ... was a composite being, possessing an incorporeal substance, its own unique soul-spirit. It was the vitalizing substance that gave to its physical form growth, and self-healing." The Anishinaabeg believe that wild rice will always grow where they live. Menominee chief Chieg Nio'pet said his people did not need to sow rice because it would follow them wherever they went. He told of how Shawano Lake never had manoomin until the Menominee moved there. Similarly when they were banned from Lake Winnebago, the rice that had been plentiful there all but disappeared. Whatever happens to the land and to manooomin happens to the Anishinaabe.

Our ceremonies and aadizookanag -sacred stories- also tell of our people's relations with this plant. White Earth Anishinaabe, Joe LaGarde, notes that wild rice and water are the only two things required at every ceremony. Manoomin accompanies our celebrations, mourning, initiations, and feasts, as both a food and a spiritual presence. It holds special significance in traditional stories, which are only told during ricing time or when the ground is frozen. "In these stories, wild rice is a crucial element in the realm of the supernaturals and in their interactions with animals and humans; these legends explain the origin of wild rice and recount its discovery…" by Wenabozhoo, or Nanabozho, the principal manidoo or spirit in our sacred aadizookanag.

Manoomin is just as central to our future survival as our past. While we try to overcome tremendous obstacles to our collective health, the sacred food of manoomin is both food and medicine. "Wild rice is consequently a very special gift, with medicinal as well as nutritional values—belief reflected in the Ojibwe use of wild rice as a food to promote recovery from sickness as well as for ceremonial purposes." (Vennum 62). Manoomin is inextricably bound to the religion and identity of the Anishinaabeg. This is why these threats are potentially so devastating and why it is essential that the sanctity and integrity of this plant be preserved. If artificially produced or engineered varieties of wild rice were to compromise the wild manoomin that has existed in the lakes for thousands of years, it will compromise the Anishinaabe people and our way of life. Joe LaGarde puts it plainly, "If we lose our rice, we won't exist as a people for long. We'll be done too."

Erma Vizenor, Tribal Chairwoman, White Earth Nation
With the participation of Carlton College Students.

Introduction

This report fulfills the requirements of Session Law 2007, Chapter 57, Article 1, Section 163:

By February 15, 2008, the commissioner of natural resources must prepare a study for natural wild rice that includes: (1) the current location and estimated acreage and area of natural stands; (2) potential threats to natural stands, including, but not limited to, development pressure, water levels, pollution, invasive species, and genetically engineered strains; and (3) recommendations to the house and senate committees with jurisdiction over natural resources on protecting and increasing natural wild rice stands in the state.

In developing the study, the commissioner must contact and ask for comments from the state's wild rice industry, the commissioner of agriculture, local officials with significant areas of wild rice within their jurisdictions, tribal leaders within affected federally recognized tribes, and interested citizens.

In fulfilling these requirements, the Minnesota Department of Natural Resources (MNDNR) established a Technical Team of wild rice experts from State, Tribal, and Federal governments; the Minnesota cultivated wild rice industry; Ducks Unlimited; Save Our Rice Alliance (SORA), an organization of interested citizens who hand harvest natural wild rice; White Earth Land Recovery Project; the University of Minnesota; and the University of Wisconsin (Appendix A). The MNDNR also established a Partnership Team representing the Minnesota wild rice industry, the state commissioner of agriculture, the Association of Minnesota Counties, tribal leaders within affected federally recognized tribes, the United States Fish and Wildlife Service, Ducks Unlimited, Minnesota Waterfowl Association, and SORA (Appendix A).

The Technical Team, working with MNDNR staff, developed drafts of the wild rice study document for review by the Partnership Team. The collaboration of these two teams was instrumental in producing this document for MNDNR review and approval. The MNDNR is indebted to team members for their contributions of time, expertise, and hard work. It should be clear, however, that the MNDNR assumes sole responsibility for the content and recommendations of this document.

The wild rice study document and its appendices are intended to provide the reader with a thorough background on the importance of natural wild rice to Minnesota, its natural ecology and distribution, threats to its future, challenges in managing the resource, and recommendations to insure its abundance for future generations.

Importance of Natural Wild Rice in Minnesota

As directed by the legislature, the wild rice study document focuses on natural wild rice. For this study, we define natural wild rice as native species of wild rice (*Zizania*) that are growing in public waters and are not subject to cultivation. The simplest description of natural wild rice in Minnesota is that it is an annual aquatic grass that produces an edible grain.

This simple description, of course, does not do justice to this unique and valuable plant. History is replete with examples of its importance to wildlife and value to humans both nutritionally and culturally. Wild rice (manoomin to the Ojibwe) is a spiritually significant resource for Native Americans in the Great Lakes region, and it has been for centuries. Nowhere has this grain been more important, nor had a richer history, than in Minnesota. No state harbors more acres of natural wild rice than Minnesota (Moyle and Krueger 1964). No other native Minnesota plant approaches the level of cultural, ecological, and economic values embodied by natural wild rice.

Cultural Importance

Natural wild rice has been hand harvested as a source of food in the Great Lakes region for thousands of years. Evidence of its human use dates back to the Late Archaic and Early Woodland periods, more than 2000 years ago (Valppu 2000). Archeological evidence indicates that from the 1600s to the 1800s wild rice was a staple food for the Algonquian and Dakota peoples throughout the area now known as Minnesota. It has been important historically for gifting and trading, as well. For example, when Dakota Chief Wabasha hosted Zebulon Pike in 1805 he offered gifts of wild rice to the explorer (Vennum 1988).

The Ojibwe people have a special cultural and spiritual tie to natural wild rice. Their Migration Story describes how they undertook a westward migration from the eastern coast of North America. Tribal prophets had foretold that this migration would continue until the Ojibwe people found “the food that grows on water” (Benton-Banai 1988). That food was wild rice, known as manoomin, and is revered to this day by the Ojibwe as a special gift from the Creator (Ackley 2000; Schlender 2000).

Early European explorers and fur traders were impressed with the availability and nutritional quality of wild rice, and attempts were made to import it to Europe as early as 1790 (Oelke 2007). Many immigrants to Minnesota adopted hand harvesting of natural wild rice as an annual ritual. The importance of this harvest to European settlers lessened only when cultivated non-native grains became more readily available.

The tradition of hand harvesting natural wild rice continue~~s~~ to this day among both tribal and nontribal cultures. This tradition has been preserved through tribal code and state regulations that reflect traditional methods of harvesting. State statutes in Minnesota include regulations that restrict the maximum length (18 feet) and width (36 inches) of the harvesting boat, as well as the maximum weight (1 pound) and length (30 inches) of hand flails. The regulations also require that push poles have forks 12 inches or less in length. The use of any machine or mechanical device to harvest natural wild rice is generally prohibited.

Annual sales of state licenses for wild rice harvesting peaked in 1968 at over 16,000. In recent years, annual sales have averaged fewer than 1500. However, because in many instances tribal harvesters are not required to buy state licenses, state numbers do not adequately reflect the numbers of individuals participating in wild rice harvesting. It is thought that more than 3000 tribal members participate in wild rice harvesting providing the statewide total (tribal and nontribal) of 4,000 to 5,000 individuals.

Annual harvests can vary greatly. Rice productivity, weather, and harvester participation are all important factors. The MNDNR survey of state licensees from 2004 to 2006 found the average annual harvest to be 430 pounds per individual (MNDNR 2007). Aitkin, Cass, Crow Wing, Itasca, and St. Louis counties accounted for over 70% of the harvesting trips for natural wild rice. Estimates of annual harvest of natural stands in Minnesota between 1940 and 1972 ranged from 20 thousand to nearly 4 million pounds of unprocessed grain (Oelke et al. 1973).

Another aspect of the cultural importance of wild rice is its nutritional value. Noted for its importance as a whole grain, wild rice is an excellent source of complex carbohydrates, vitamins, minerals, fiber and protein. It is a particularly good source of potassium, zinc and riboflavin (Oelke 2007). Access to traditional foods is felt to be an important element of restoring individual and community health of the Ojibwe people (W. LaDuke, personal communication). Natural wild rice is one of the mainstays of traditional foods for the Ojibwe community.

Concerns for the preservation of hand harvesting traditions and related issues led to the formation in 2007 of a tribal and nontribal partnership called Save Our Rice Alliance (SORA). The stated mission of SORA is “To preserve and enhance the culture, economy, and sustainability of native wild rice” (A. Drewes, personal communication).

Ecological Importance

The value of natural wild rice to wildlife has been long appreciated by American Indians and was marveled at by early European explorers (Jenks 1900). Jonathan Carver traveled through eastern portions of North America in the 1760s and observed of wild rice that “the sweetness and nutritious quality of it attracts an infinite number of wild fowl of every kind which flock from distant climes to enjoy this rare repast, and by it become inexpressively fat and delicious” (Stoddard 1957).

Both migrating and resident wildlife rely on the nutritious and abundant seeds of natural wild rice. One acre of natural wild rice can produce more than 500 pounds of seed. These seeds have long been recognized as an important source of food during fall migrations (McAtee 1917). Martin and Uhler (1939) listed wild rice as the ninth most important source of food for ducks throughout the United States and Canada, and the third most important source of food for ducks in the eastern portions of the continent. Research conducted on the Chippewa National Forest found that natural wild rice was the most important food for mallards during the fall (Stoudt 1944). Although the value of wild rice to mallards, wood ducks, and ring-necked ducks is most commonly recognized, other ducks such as black ducks, pintail, teal, wigeon, redheads, and lesser scaup also use stands of wild rice (Rossman et al. 1982, Huseby 1997).

The stems of wild rice provide nesting material for such species as common loons, red-necked grebes, and muskrats; and critical brood cover for waterfowl. The entire wild rice plant provides food during the summer for herbivores such as Canada geese, trumpeter swans, muskrats, beaver, white-tailed deer, and moose (Martin et al.1951, Tester 1995). In addition, rice worms and other insect larvae feed heavily on natural wild rice. These, in turn, provide a rich source of food for blackbirds, bobolinks, rails, and wrens. In the spring, decaying rice straw supports a diverse community of invertebrates and thus provides an important source of food for a variety of wetland wildlife including birds, small fish, and amphibians. Indeed, every stage of growth of natural wild rice provides food for wildlife (McAtee 1917, Stoudt 1944).

As a result, wild rice lakes and streams are breeding and nesting areas for many species. More than 17 species of wildlife listed in the MNDNR's Comprehensive Wildlife Conservation Strategy (2006) as "species of greatest conservation need" use wild rice lakes as habitat for reproduction or foraging (Henderson 1980, Martin et al.1951). Listed bird species can be found in Table 1.

Table 1. Minnesota birds that utilize wild rice habitat and are listed in *Tomorrow's Habitat for the Wild and Rare* as species of special concern.

Birds of Special Concern	Life Cycle Stage
American Black Duck	Breeding and migration
Lesser Scaup	Migrant
Northern Pintail	Migration, Rare Breeder
Trumpeter Swan	Breeding and migration
American Bittern	Breeding and migration
Least Bittern	Breeding and migration
Red-necked Grebe	Breeding and migration
Common Loon	Breeding and migration
Sora Rail	Breeding and migration
King Rail	Casual migrant
Virginia Rail	Breeding and migration
Yellow Rail	Breeding and migration
Black Tern	Breeding and migration
Bobolink	Foraging and migration
Rusty Blackbird	Foraging and migration
Sedge Wren	Breeding and migration
Bald Eagle	Foraging and migration

Natural wild rice has other ecological values as well. Emergent aquatic plants such as wild rice, bulrush, and cattails protect shorelines and provide habitat for fish (Radomski and Goeman 2001). Dense stands of wild rice stabilize loose soils and form natural windbreaks that can limit the mixing of soil nutrients into the water column (Meeker 2000). In addition, natural wild rice has relatively high requirements for nutrients such as phosphorus and nitrogen (Oelke et al. 2000). During periods of rapid growth, which occurs in spring and summer, the plants sequester these nutrients. Thus stands of natural wild rice counter the effects of nutrient loading and the potential increases in algal growth and lake turbidity.

Economic Importance

Prior to European settlement of Minnesota, natural wild rice was the most important grain available to native peoples, early explorers, and fur traders (Vennum1988). Properly dried, and stored in clean, dry conditions, uncooked wild rice has an estimated shelf life of up to 10 years. One pound yields up to ten and a half cups of cooked wild rice (Oelke 2007). As a dietary staple that was so easily stored and used, wild rice had considerable economic value. With the influx of immigrant settlers and the agricultural production of non-native grains, the overall economic value of wild rice waned. Nevertheless, harvest of natural wild rice continued to be popular in Minnesota. During the 1960s, sales of state licenses averaged over 10,000 per year.

The economic value of wild rice is reflected in the efforts of many to expand its occurrence into new waters. Native peoples have long sown wild rice to create additional sources of grain (Vennum 1988). Waterfowl hunters have commonly planted wild rice to attract ducks. The demand for seed of wild rice and other aquatic wildlife foods presumably fostered the establishment of Wildlife Nurseries, Inc. in Oshkosh, Wisconsin in 1898 (Oelke 2007). This firm continues selling wild rice for planting today. Conservation agencies have long participated in planting efforts as well, working to establish new stands of wild rice and perpetuate traditional areas (Moyle 1944b).

David Owens noted the potential benefits of cultivating wild rice as early as 1852 (Vennum 1988). In 1853, Oliver H. Kelley published an article discussing the merits of wild rice cultivation. Albert E. Jenks discussed wild rice cultivation as part of “agricultural development” in 1901. Yet not until 50 years later did James and Gerald Godward pioneer the first real efforts. They began production of cultivated wild rice in central Minnesota, near Merrifield, in 1950 (Oelke 2007).

The 1950s and 1960s may well have been the peak of modern hand harvesting of wild rice. From 1957 to 1963 the state of Minnesota sold an average of 10,012 wild rice harvest licenses (Table 2). The average annual harvest of unprocessed wild rice exceeded 2 million pounds or about 227 pounds per picker per year (Moyle and Krueger 1964).

Table 2. Hand harvesting of natural wild rice 1957-1963.

Year	Licenses sold	Harvest *
1957	7,535	1,057,000
1958	9,702	3,224,000
1959	9,332	2,067,000
1960	9,664	2,301,000
1961	14,660	2,772,000
1962	6,709	1,292,000
1963	12,482	3,212,000

*Harvest is in unprocessed pounds

As with other commodities, the price paid for unprocessed natural wild rice can vary considerably. Although pricing is mainly determined by supply, marketing also plays a role. During the past 70 years, the price of one pound of unprocessed wild rice has ranged from $0.10 in 1940 to $2.17 in 1966 (Oelke 2007). Adjusted for inflation these prices in today’s dollars are equivalent to $0.75 and $13 per pound, respectively. The 1966 harvest of 924,000 lbs would have been worth over $12 million today. Since 1990, the price paid for unprocessed rice from the Leech Lake Reservation has varied between $1.00 and $1.50 per pound (R. Robinson, Jr., personal communication). Sales during this period ranged from approximately 7,400 to 280,000 pounds.

Prior to 1970, Minnesota provided half of the global market supply of wild rice. Most of this rice was from hand harvested natural stands. By 1990, the large-scale production of cultivated wild rice had expanded, and natural wild rice accounted for less than 10% of the global market supply. Cultivated wild rice from Minnesota provided 40% of the market and California provided 50% (Lee 2000). California still leads the cultivated wild rice industry. The total annual yield of cultivated and hand harvested wild rice in Minnesota today ranges from four to eight million pounds.

Although cultivated rice dominates these production numbers, hand harvested natural wild rice remains a vital component of tribal and local economies in Minnesota. The MNDNR survey of 2004 – 2006 state license buyers found an average annual individual harvest of 430 pounds. In 2007, nearly 300,000 pounds of unprocessed rice were purchased from LLBO-licensed harvesters. At $1.50 per pound, this harvest generated more than $400,000 of income for tribal members (R. Robinson, Jr., personal communication).

Wild Rice Background

Taxonomy

Native North American wild rice is classified as a grass in the family *Poaceae* and the genus *Zizania*. The most common species throughout Minnesota is northern wild rice, or *Zizania palustris* L. (Ownbey and Morley, 1991). Two varieties of natural wild rice occur in this region and in other parts of the Upper Midwest: Z. *palustris* var. *palustris* and Z. *palustris* var. *interior* (Gleason and Cronquist, 1991; Flora of North America, 1993+).

A more southern and eastern species, *Zizania aquatica* L., is uncommon but thought by many to occur in Minnesota as well. The precise distribution of *Z. aquatica* is unclear because of differences in taxonomic interpretations and potentially overlapping ranges. *Z. aquatica* is physically larger than *Z. palustris* but its grain is more slender and difficult to harvest. Both of these species are native only to North America.

Distribution and Abundance

Minnesota historically harbored more acres of natural wild rice than any other state (Moyle and Krueger 1964). Despite losses of wild rice habitat, the importance of Minnesota as a center of natural wild rice abundance has actually increased as wild rice acreage has declined elsewhere in the United States. For thousands of years, wild rice thrived in shallow lakes, rivers, and streams left behind by melting glaciers. Although stands of natural wild rice occur most commonly in areas of glacial moraines, such as in central and north-central Minnesota, the historic range of wild rice included all of Minnesota (Moyle 1944b).

Its range also extended westward into the present-day Dakotas and eastward to the Atlantic coast. While not distributed evenly, wild rice likely occurred in many places where its ecological requirements were met. Because wild rice also was planted in areas where it did not occur naturally, it is sometimes difficult today to distinguish between historically natural stands and successfully seeded stands (Vennum 1988).

An updated inventory of the distribution and abundance of natural wild rice was compiled for this study by selected members of the Technical Team and the MNDNR (Appendix B). Data are from lake-habitat surveys, reported observations, and interviews with field personnel of state, federal, and tribal agencies. Although this inventory provides a marked improvement in our understanding of natural wild rice distribution in Minnesota, it should be considered a minimum estimate. The data for many wild rice lakes, streams and rivers is incomplete or totally lacking.

Based on this inventory, the range of natural wild rice today includes 55 counties in Minnesota (Figure 1). The only Minnesota counties without significant populations of natural wild rice are along the western and southwestern boundaries of the state. It should be noted, however, that historical records of wild rice include herbarium specimens that were collected in several western counties not documented by the current inventory. These counties include Pipestone, Cottonwood, Chippewa, Swift, Clay, and western Polk (Moyle 1939, Ownbey and Morley, 1991).

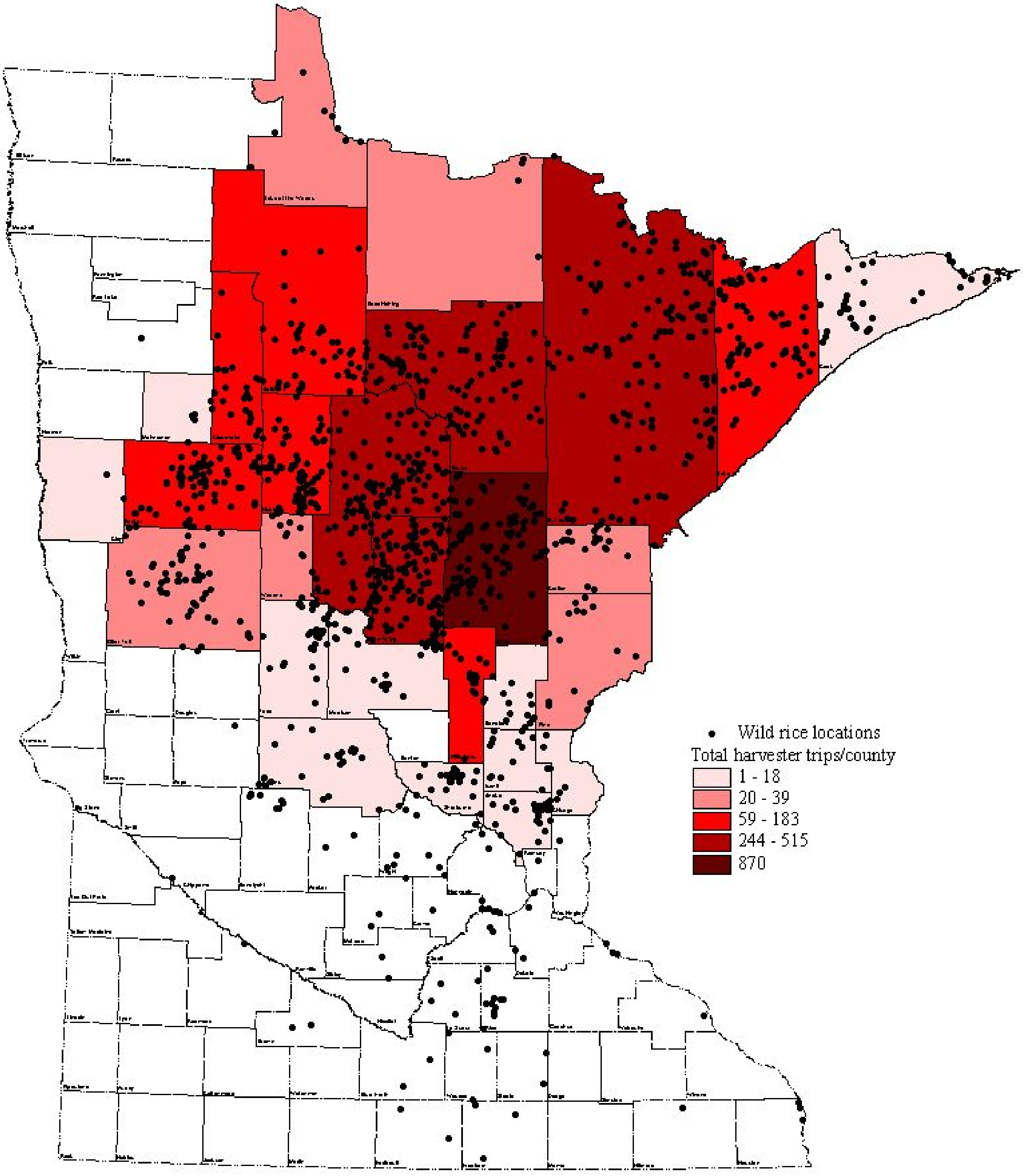


Figure 1. Distribution of wild rice lakes and wild rice harvesting pressure in Minnesota.

Stands of natural wild rice were present or occurred in recent history on approximately 1,286 lakes and river/stream segments (Figure 1). These areas support a minimum of 64,328 acres of natural wild rice when growing conditions are favorable. These areas vary from large, shallow lakes dominated by natural wild rice stands (i.e. Nature's Lake in Cass County) to significant bays within large fish lakes (i.e. Leech Lake) to a narrow fringe along lake/river shorelines. The greatest concentrations of lakes that support natural wild rice are in Aitkin (4,859 acres), Cass (8,323 acres), Crow Wing (3,751 acres), Itasca (8,448 acres), and St. Louis (8,939 acres) counties. These counties contain over 60% of the inventoried natural wild rice acreage in Minnesota. These counties also account for over 70% of the harvesting trips for natural wild rice (MNDNR 2006 harvest survey, Appendix C).

The abundance of natural wild rice in Minnesota today is largely due to abundant suitable habitat, favorable climate, and natural genetic variability that allows for environmental selection of traits that perform well under varying conditions. Studies in Wisconsin found sufficient genetic diversity between geographically separated stands of wild rice to potentially identify regional populations. Within-stand diversity also varied greatly, with larger and denser stands having greater genetic diversity (Waller et al. 2000).

Life History

While the historical range of natural wild rice illustrates its broad distribution, its specific occurrence and abundance is in large part dependent on local environmental conditions. For example, clear to moderately colored (stained) water is preferred, as darkly stained water can limit sunlight and may hinder early plant development.

Wild rice grows within a wide range of chemical parameters (i.e. alkalinity, salinity, pH, and iron; Meeker 2000). However, productivity is highest in water with a pH of 6.0 to 8.0 and alkalinity greater than 40 ppm. While researchers have observed that natural wild rice stands are relatively nutrient rich, excess levels of some nutrients, especially phosphorus, can have significant adverse effects on productivity (Persell and Swan 1986).

Natural wild rice generally requires some moving water, with rivers, flowages, and lakes with inlets and outlets being optimal areas for growth. Seasonal water depth is critical, however. Water levels that are relatively stable or decline gradually during the growing season are preferred. In particular, abrupt increases during the early growing season can uproot plants. Wild rice grows well at depths of 0.5 to 3 feet of water, although some plants may be found in deeper waters (M. McDowell, J. Persell personal communication).

Shallower sites can allow strong competition from perennial emergent plant species, while deeper sites can stress wild rice plants and limit seed production. Although wild rice may occur in a variety of lake bottoms, the most consistently productive stands are those with soft, organic sediment (Lee 1986). Nitrogen and phosphorus are limiting nutrients for wild rice (Carson 2002).

As an annual plant, natural wild rice develops each spring from seeds that fell into the water and settled into the sediment during a previous fall. Germination requires a dormancy period of three to four months of cold, nearly freezing water (35° F or colder). Seeds are unlikely to survive prolonged dry conditions.

Seed germination typically occurs when the substrate and surrounding water temperatures reach about 40° F. Depending on water depth, latitude, and the progression of spring weather, wild rice germinates in Minnesota sometime in April, well ahead of most but not all perennial plants. Within three weeks, the seedlings develop roots and submerged leaves.

The emergent stage begins with the development of one or two floating leaves and continues with the development of several aerial leaves two to three weeks later. The floating leaves appear in late May to mid June in Minnesota, again dependent on water depth, latitude, and weather. Because of the natural buoyancy of the plant, it is at this stage of growth that wild rice is most susceptible to uprooting by rapidly rising water levels. Plants can be significantly stressed even when they remain rooted.

Natural wild rice begins to flower in mid to late July in Minnesota. Flowering times are dependent on both day length and temperature. Flowers are produced in a branching panicle. Female flowers (pistillate or seed-producing) occur at the top of the panicle on appressed branches. Male flowers (staminate or pollen-producing) occur on the lower portion of the panicle on nearly horizontal branches. Natural wild rice is primarily pollinated by wind. High temperatures and low humidity can negatively affect fertilization rates.

Cross-pollination is typical in natural wild rice stands because female flowers develop, become receptive, and are pollinated before male flowers on the same plant shed pollen. Cross-pollination is further enhanced by plant-to-plant variation in flowering times within stands. This cross-pollination within and among wild rice populations helps to preserve the genetic variability and thus biologic potential for wild rice to adapt to changing conditions such as the highly variable climate of the Great Lakes region.

The genetic variability that exists today in natural wild rice may be a critical determinant of whether stands of wild rice can adapt to long-term changes in regional climate. Studies in northern Wisconsin found sufficient genetic diversity among geographically distinct stands of natural wild rice to identify four regional populations. The degree of diversity within stands varied widely as well, with larger and denser stands having greater diversity (Waller et al. 2000).

Wild rice seeds are visible two weeks after fertilization, and they mature in four to five weeks. Immature seeds have a green outer layer that typically turns purplish black as the seed reaches maturity. Seeds begin ripening at the top of the stem and then ripen over several days on an individual plant. Plants within a stand ripen at different times because of genetic and developmental variation. In general, natural wild rice in rivers ripens earlier than that in lakes, rice in shallow waters earlier than that in deeper waters, and rice in northern Minnesota earlier than that in more southerly stands.

This staggered maturation process means that ripe seeds may be available within individual stands for several weeks, and across the entire range of natural wild rice in Minnesota for a month or longer. This extended period of “shattering”, or dropping of ripened seed, is an important mechanism to ensure that some seeds will survive environmental conditions and perpetuate the natural stand. The entire process, from germination of a new plant to dropping of mature seeds, requires about 110 to 130 days, depending on water and air temperatures and other environmental factors.

Not all wild rice seeds germinate the following year. Seeds may remain dormant in the bottom sediment for many years to several decades if conditions are not suitable for germination. This mechanism allows wild rice populations to survive through years of high water levels or storms that reduce or eliminate productivity. Moreover, natural wild rice can germinate and re-colonize sites after other species have been reduced or eliminated by environmental disturbance (Meeker 2000).

Even under ideal growing conditions, populations of natural wild rice undergo approximately three to five year cycles in which productivity can vary greatly (Jenks 1900, Moyle 1944b, Pastor and Durkee Walker 2006, Durkee Walker et al. 2006). Highly productive years are frequently followed by a year of low productivity, that is then followed by a gradual recovery in wild rice yield (Moyle 1944b, Grava and Raisanen 1978, Atkins 1986, Lee 1986, Aiken et al. 1988, Archibold et al. 1989).

Recent studies suggest that oscillations in wild rice productivity may be caused in part by the accumulation of old straw from previous growth that inhibits plant growth and seed production (Pastor and Durkee Walker 2006, Durkee Walker et al. 2006). In particular, the amount of wild rice straw, its stage of decay, and its tissue chemistry likely affect nutrient availability, influence wild rice productivity, and thus drive cycling of wild rice populations (Durkee Walker, Ph.D. thesis 2008).

Legal Considerations

The earliest laws and regulations concerning wild rice in Minnesota date back more than 75 years. While some harvesting regulations existed through earlier session laws and statutes, comprehensive state regulation of the wild rice harvest was apparently first codified in 1939. These regulations controlled methods and locations of harvest to reduce damage to natural beds and to distribute the harvest.

Today, there is a complex mix of tribal, federal, state, and local laws and regulations. These are associated with the formal recognition of the significance of natural wild rice and its protection, management, and harvest. It is difficult to capture all the important details that exist within these myriad regulations in a summary overview. The application of regulations varies by jurisdiction (i.e., tribal versus state) and geography (i.e., on-reservation versus off-reservation, or within various ceded territories). In addition, some regulations may be changed over time.

The following discussion is not intended to provide a complete legal brief of the law as it relates to natural wild rice. Rather the intent is to indicate the complexity of this law and to make clear the multiple jurisdictions that have recognized legal interests in Minnesota wild rice.

Treaties and Tribal Regulations

Tribal regulations of the harvest and protection of wild rice within reservation boundaries vary from tribe to tribe. Therefore individual tribal governments or their natural resource departments should be contacted for details.

In addition to tribal regulations, treaties and other agreements with the U.S. government reserved off-reservation harvesting rights for some tribes. For example, the Ojibwe tribes that co-signed the Treaty of 1837 reserved the right to gather wild rice from the lands ceded in that treaty. These include an area that eventually became part of east-central Minnesota. The standing of these off-reservation rights was upheld by the U.S. Supreme Court in 1999. [1,2,3]

Similar off-reservation rights are reserved for other Ojibwe tribes in the 1854 ceded territory, in northeastern Minnesota. Rights of traditional tribal harvesting have also been preserved through other agreements between tribes and the U.S. government. For example, in the early 1900s the U.S. began buying lands adjacent to wild rice stands on Minnesota lakes. These were stands that had traditionally been harvested or lands that were to be used as rice camps by the Minnesota Chippewa Tribe (MCT). Lands were purchased and placed into trust status on Swamp, Mallard and Minnewawa Lakes in Aitkin County; on Basswood Lake in Becker County; on Leech, Mud, and Laura Lakes in Cass County; on Lower Dean Lake in Crow Wing County; on Sugar and Bowstring Lakes in Itasca County; on Onamia and Ogechie Lakes in Mille Lacs County; and on Star Lake in Ottertail County.

MCT members can harvest wild rice on these lakes with a tribal identification card issued under the sovereign authority of their respective tribal governments and current Minnesota statute (MS 84.10). Similarly, local tribal members can harvest wild rice on Rice Lake National Wildlife Refuge and on Tamarack National Wildlife Refuge under the 1936 Collier agreement between the U.S. Bureau of Indian Affairs and Bureau of Biological Survey (predecessor to the U.S. Fish and Wildlife Service).

This Wild Rice Study document is not intended to provide an indepth analysis of treaties and subsequent agreements affecting tribal harvest of wild rice in Minnesota. Tribal governments have sovereignty over the harvest of wild rice within the boundaries of their reservations. Some tribal governments also have the authority to regulate harvest by tribal members within certain ceded lands, while other tribal rights exist for specific off-reservation waters. The state of Minnesota has jurisdiction over the wild rice harvest by nontribal harvesters within ceded territories and over all off-reservation wild rice harvest outside of the ceded lands.

[1,2,3] [Minnesota, et al., Petitioners v. Mille Lacs Band of Chippewa Indians et al. [No. 97-1337].

[2] See McClurken et al., 2003: 30 for a map of ceded lands in Minnesota under this and subsequent treaties.

[3] See McClurken et al., 2003: 486 for exact treaty language pertaining to cession of land and gathering wild rice.

State and Local Regulations

State laws addressing issues of wild rice in Minnesota date back to 1929 or perhaps earlier. These statutes state that wild rice and other aquatic vegetation is owned by the state and that a person may not acquire a property interest in or destroy wild rice except as allowed by law (MS 84.091). State statutes also regulate the harvest of natural wild rice with the exceptions of tribal jurisdictions and regulations, as noted above (MS 84.10, 84.15, 84.027, 84.28). State regulations address the methods and timing of natural wild rice harvest (MS 84.105, 84.111, and 84.152). In addition, several Agency rules also govern the harvest of wild rice in Minnesota (Minnesota Rules 6284.0300 to 6284.0700).

Because State statutes and rules affecting wild rice in Minnesota have been developed and modified over many years, they contain inconsistencies and duplications. These laws could be clarified and made more concise through recodification.

A long-standing tradition of tribal governments and the state of Minnesota involved posting of “closed” signage on selected individual lakes until the wild rice was deemed ripe for harvest. In 1996, after years of criticism from harvesters about particular decisions to open or close wild rice stands, a state law was passed that would open the ricing season on July 15 each year (MS 84.105). The new law also made it illegal to pick wild rice that is not ripe. Wild rice usually ripens in Minnesota between the third week of August and the second week of September, thus the new law was intended to employ a “pick when ripe” philosophy. The opening date was set early enough so that it would always precede the ripening of the rice, and it would also help avoid opening day rushes that can potentially damage rice stands.

One of the rationales behind the new state law was that most other plant products harvested from the wild are picked when the harvester judges them as ready for food, decorative, or medicinal use. Harvesting wild rice before it is ripe produces a product that has no value as a food or cash crop. The new law reduced the need for extensive MNDNR staff time and subjective judgments. It also helps avoid the opening day “stampede” that seems to be associated with all “opening days”, which are often perceived as the best day based on “first-come, first-served”.

Most of the treaties, agreements, and statutes discussed above are concerned with the harvest of the wild rice grain rather than with protection or enhancement of natural wild rice ecosystems. Harvest issues are moot if the wild rice resource is lost due to damage of natural stands. The viability of these stands often depends on active management.

For example, more than 200 wild rice lakes benefit annually from removal of beaver dams. These dams block the outlets of significant wild rice lakes, and their removal allows the outlets to flow freely; reducing the threat of excessive flooding of wild rice stands. The authority to remove beaver, beaver dams, and beaver lodges is found in MS 97A.045 Subd.1; 97A.401 Subd. 5; and 97B.655, Subd. 2. Without these statutes the current management efforts of the DNR and its partners (i.e., Ducks Unlimited) would be significantly restricted.

Wild rice and other aquatic plants are protected from unauthorized removal under the MNDNR Aquatic Plant Management Program (MS 103G.615). Guidelines prohibit the removal of emergent aquatic plants, including wild rice, without an approved permit. Notable exceptions involve the building of duck hunting blinds and gaining access to open water from shorelines. Removal of aquatic plants is allowed for such access though removal is limited to an area 15 feet or less in width.

Less direct, although important, protection is also provided through shoreland protection laws and regulations (MS 103F.201 through 103F.221). This protection is based on a system of classification for lakes and rivers that applies different zoning regulations depending on classification. Classifications include three for lakes and six for rivers. These regulations are implemented by local units of government within a statewide statutory framework that dictates minimum standards. These standards address issues of shoreland development and uses such as sewage treatment, storm water management, minimum lot size and water frontage, building and septic system setbacks, building heights, subdivisions, and alterations of land and vegetation close to the shore.

The stakeholders group for a pilot project in the five-county north-central lakes area surrounding Brainerd raised concerns about increased shoreline development potentially threatening water quality and the traditional use of individual lakes. One result was the development of alternative shoreland management standards through an advisory committee. The alternative standards provide options for local governments to address specific shoreland issues identified in the five-county area. Subsequently, local governments outside the pilot area began considering elements of these alternative standards for use in their own shoreland ordinances.

In 2005, for example, Beltrami County initiated a review of all of their Natural Environment Lakes in cooperation with the MNDNR and Minnesota Pollution Control Agency (PCA). The MNDNR Section of Wildlife and Division of Ecological Resources procured funding to hire two 2-person crews to conduct site visits to inventory these lakes. Surveys were completed with additional funding from the MNDNR Section of Wildlife in 2006. As a result of this work and the input from a Citizen Advisory Committee, Beltrami County rewrote their shoreland ordinance and reclassified their Natural Environment Lakes. They created one additional lake class, Sensitive Area, with protection criteria intermediate between Natural Environment and the more protective Special Protection. The new Beltrami County Shoreland Ordinance was voted on and approved by the Beltrami County Board in December 2006 (R. Gorham personal communication).

Alternative shoreland management standards may include the promotion of conservation subdivisions over conventional subdivisions (i.e., lot and block); multiple classifications on a single lake (i.e. Natural Environment bay within a General Development lake); districts designated as Sensitive Areas for lakeshore segments so that development standards follow Natural Environment Lake class standards; and a new classification of Special Protection for lakes that have considerable wetland fringe, shallow depth, or unique fish and wildlife habitat.

While these alternative standards can provide protection for natural wild rice habitat, local governments too often lack information on the locations of significant stands of natural wild rice. An updated inventory of wild rice stands in Minnesota would help provide this information.

Further regulation of wild rice occurs through the Minnesota Department of Agriculture (MDA). The MDA has approval authority over the permit-regulated release of genetically modified organisms (GMO), which would include genetically engineered wild rice, under MS Chapter 18. MS Chapter 18 also provides for the issuance of export certificates for the international sale of wild rice. In addition, the MDA inspects and certifies that wild rice seed is free of weed contamination and meets germination standards, and that the labeling of packaged wild rice is truthful and accurate (MS Chapter 21).

The 2006 Minnesota Legislature provided the state Environmental Quality Board (EQB) additional authority over issues related to natural wild rice. The EQB is now required to notify interested parties if a permit to release genetically engineered wild rice is issued anywhere in the United States (MS 116C.92, Subd. 2). The 2006 legislation also requires that EQB adopt rules requiring an Environmental Impact Statement (EIS) for any proposed release and a permit for an actual release of genetically engineered wild rice (MS 116C.94 Subd.1b).

While two other State statutes further signify the importance of natural wild rice in Minnesota, they do not provide additional protection for the resource. One statute, adopted in 1977, recognizes wild rice as the State Grain of Minnesota (MS 1.148). This law needs to be amended, however, to accommodate revised scientific nomenclature.

Another important State statute is the labeling law for packaged wild rice (MS 30.49). This was adopted in 1989 following a joint effort between tribal governments and the Minnesota Cultivated Wild Rice Council. Consumers of wild rice benefit from this law in that it distinguishes among natural lake or river wild rice that is hand-harvested, wild rice that is machine-harvested, and wild rice that is cultivated. This legislation further distinguishes between wild rice that is grown in Minnesota and that which is grown outside of the state.

Threats to Natural Wild Rice in Minnesota

Despite its rich history and abundance in Minnesota, natural wild rice faces many current and potential threats in this region. In general, any factor that can affect water quality, seasonal water levels, lakebed conditions, regional climate, aquatic vegetation, or wild rice's natural genetic makeup could potentially threaten stands of natural wild rice. These threats may work in concert or individually to damage wild rice stands. The order in which the threats are presented in this report is not intended to portray or imply the significance of the threat. Instead these threats are divided into stand level or statewide level categories.

Stand-Level Threats

Hydrologic Changes

Wild rice is by its very nature a shallow water plant and sensitive to changes in water levels. The status of natural wild rice in Minnesota was particularly threatened in the late 1800s and 1900s by installations of dams to increase water levels for navigation, logging, flood control and power production. Although wild rice may persist at depths greater than three feet, these plants typically have poor or no seed production. Over time the plants will decline in numbers and density (Engel 1994). Although some aquatic plants will readily migrate to newly created shallow waters, wild rice apparently does so much less frequently. This may be due to limitations on its rate of seed dispersal.

Even when the normal runout elevation of a lake remains steady, heavy precipitation can cause an abrupt though temporary change in water level that can uproot aquatic plants. Natural wild rice is particularly susceptible to uprooting during its floating-leaf stage, which occurs in early summer. At this stage, any rapid increase in water level can cause damage to natural stands. Changes in lake outlets that reduce flow capacity can also significantly impact wild rice by increasing the frequency and severity of these temporary flood events. For example, permanent dams, beaver dams, culverts, and debris such as mats of vegetation can reduce outlet flow capacity and impact wild rice habitat (Ustipak 1983).

These factors can work in concert to produce cumulative effects. For example, culverts can attract beaver because the culvert is a much more restricted area than the creek or riverbed which channels through it. The roadbed often associated with culverts acts as a ready made dike that further contributes to the ease of blockage. As another example, dams and other outlets can be plugged by vegetation such as floating bogs that break loose in high winds. The effect of the dam in reducing outflows is compounded by the blockage raising water levels and increasing the probability of additional bog breaking off.

Changes in upstream watersheds can also reduce the productivity of natural wild rice stands. Drainage ditches and tiles, pumps, and channelization can increase the quantity and speed of waters moving downstream. The resulting peaks in water levels can produce the same effects as reduced outlet capacity by creating abrupt "bounces" or rapid increases in water depth. Increased sedimentation caused by drainage and channelization can also bury seeds and reduce germination.

Increased sedimentation can also increase the height of runout elevations and reduce outlet capacity. These changes can cause long-term damage to natural wild rice stands. The situation is acerbated by the installation of artificial dams. Removing the natural flushing action at outlets causes sediment to accumulate more readily (R. Ustipak, personal communication).

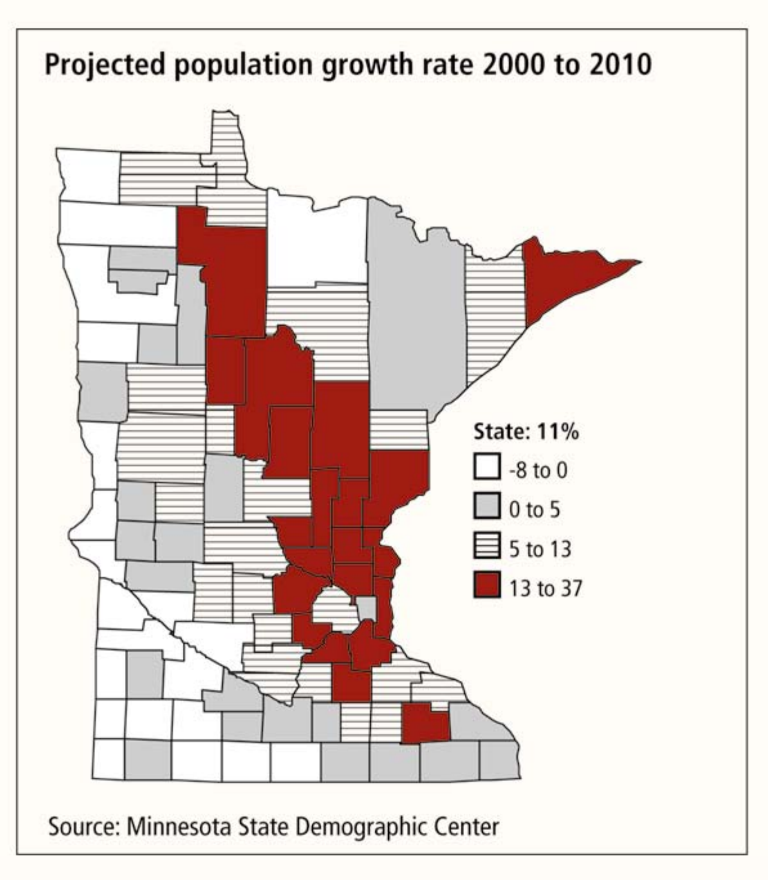
Dams that maintain stable water levels can have long-term deleterious effects on natural wild rice, as well. Water levels that are held stable year after year can create conditions that favor perennial vegetation and shoreline encroachments that impair wild rice habitat.

Recreational Water Use and Shoreland Development

Natural wild rice represents different things to different people. While some consider this native aquatic grass to be a nuisance, others value it greatly as a spiritual entity or as prime habitat for fish and wildlife.

Minnesota is a national leader in numbers of recreational boaters and anglers, with approximately 862,937 registrations for recreational watercraft. Although wild rice provides habitat for spawning fish and their offspring, stands of wild rice can be very frustrating for anglers to fish. Recreational boaters often consider wild rice to be a nuisance because it can be difficult to motor through. The strong stems of erect plants are easily tangled in propellers and may require removal by hand, often by forcibly cutting the tightly wrapped stems.

As a result, wild rice plants are often removed by boaters near docks, in navigational channels, and in other high-use areas. Removal can be direct or incidental due to cutting by propellers or dislodging by excessive wave action (Asplund 2000, Tynan 2000).



Projected population growth rate 2000 to 2010

Source: Minnesota State Demographic Center

Figure 2. Greatest predicted population growth will occur within the primary range of wild rice in Minnesota.

As the human population increases, so will the number of boaters. Predictions of demographic changes in Minnesota suggest that the areas of greatest population increases over the next 20 years will include those counties that currently have the highest occurrence of natural wild rice (Figure 2, Minnesota Department of Administration 2007).

The damming of lakes to enhance recreational water use often corresponds with the increased development of shorelands. Shoreland development has increased dramatically in Minnesota, especially in those counties that include the greatest amount of habitat for natural wild rice. This development is often associated with installations of docks, removal of aquatic vegetation, and increases in nutrient-rich runoff.

Seasonal housing across the lake country of the upper Midwest jumped 500% during the past twenty years (United States Forest Service 2007). As lands bordering deeper lakes become more fully developed, prospective lakeshore buyers are increasingly considering lakes that are shallower, often well-vegetated, and more likely to support wild rice habitat.

The changing pattern of forestland ownership in Minnesota is adding to development pressure. Internationally-owned timber corporations are increasingly divesting of their land holdings as part of their fiscal management strategy. These lands have previously been managed somewhat as public lands and have been protected from development. However, as market values increase for shorelands and riparian areas, corporate stockholders are increasingly interested in selling these parcels. About seven million acres of forestland in Minnesota is privately owned, and predictions are that about one million of these acres may be sold for development (Myers 2006).

Such development often accompanies major changes in shorelines and near-shore vegetation (Radomski and Goeman 2001). Natural wild rice is often viewed only as a nuisance to boaters and other lakeshore users. Few shoreland owners consider the cumulative impacts of docks, vegetation removal, dredging, and runoff.

Although known violations of MNDNR Aquatic Plant Management permits do not always indicate which vegetative species were removed, wild rice is a common target where it occurs. A recent permit violation included the removal of 600 feet of natural wild rice from the shoreline of Upper Whitefish Lake in Crow Wing County. The violator was a new landowner who explained that the plants were an “eyesore”.

Wildlife Activity

Natural stands of wild rice provide excellent habitat for wildlife such as waterfowl and aquatic furbearers. The activities of these animals generally have minimal impact on wild rice stands. Although animals use plant stems for building overwater bird nests and muskrat houses, this activity usually affects only small areas. Moreover, wildlife activity often enhances overall aquatic habitat by creating stand diversity.

An exception to this is when beaver use wild rice stems and other vegetation to plug outlets. The resulting dam increases overall water levels and the probability of damage to natural stands by uprooting wild rice plants.

Birds generally have little impact on natural wild rice. For example, blackbirds, waterfowl and other birds can consume most of the ripening wild rice grain yet still leave more than 200 seeds per square foot (Haramis and Kearns 2004). Canada geese, though, can seriously damage stands of wild rice by grazing on emerging stems. For example, researchers monitored tidal marshes along the Patuxent River in Maryland and documented the loss of existing stands of wild rice due to season-long grazing by the geese (Haramis and Kearns 2004).

Although currently not common in Minnesota, some damage to rice stands has been attributed to Canada geese. High concentrations of geese on small lakes or impoundments have eliminated wild rice crops in some years through overgrazing of the emerging stems (R. Naplin and D. Rhode, personal communication). However, ongoing management of resident populations of Canada geese in Minnesota can limit this type of depredation through increased harvest levels . By contrast, shoreline development that converts communities of native vegetation to managed lawns can result in locally concentrated populations of geese that then may overgraze adjacent wild rice stands.

The effect of trumpeter swans on natural stands of wild rice is less clear. Populations of these native birds are slowly recovering after extirpation in the 1800s from most of their range. Anecdotal reports suggest that swans can damage natural stands of wild rice in particular areas (P. David and R. Naplin, personal communication). Nevertheless, low numbers of trumpeter swans combined with a preference for submergent vegetation suggest that these birds pose a minimal threat to natural wild rice (LaMontagne 2000, Norrgard 2006).

Some non-native species of wildlife do threaten stands of wild rice. These will be discussed below (Non-native Invasive Species section).

Plant Competition

Natural wild rice must compete for space, light, and nutrients with other aquatic plants, particularly perennial species (Rogosin 1951). Competitive species include submerged pondweeds (primarily *Potamogeton* L. spp.), floating leaved plants such as waterlilies (*Nuphar* J.E. Smith and *Nymphaea* L. spp.), and emergents such as cattail (*Typha* L. spp.) and pickerelweed (*Pontederia cordata* L.). Seasonal water levels play an important role in this competition (Meeker 2000). Natural wild rice may be favored at depths of one to two feet.

Pickerelweed may be an exception in at least three locations in Minnesota where ongoing management to benefit wild rice also found pickerelweed increasing significantly (N. Hansel-Welch, personal communication). Promising management responses have included lowering water levels in winter to freeze and desiccate pickerelweed roots, and cutting competitive species during spring and summer using airboats (McDowell, 2006) or harvesting machines (T. Howes, personal communication). However, maintaining stable water levels over many years may favor other species (D. Vogt, personal communication). Perennial species such as pickerelweed can establish footholds and thus gain the advantage in lakes that are maintained at constant levels. .

The seeds of natural wild rice can remain dormant for years until conditions are more favorable for germination. This trait allows rice to maintain long-term viability through years of low productivity. Natural wild rice is well-adapted to annual fluctuations in water levels, while other species may be less suited to such changes.

Strong competition among native aquatic plants appears to be localized and specific to individual stands. It does not appear to be a significant factor limiting the distribution or abundance of natural wild rice in Minnesota (Meeker 2000, Norrgard 2006).

Mining and Other Industrial Activity

Mining and industrial activities can potentially adversely affect stands of natural wild rice. For example, this can occur when hydrology is altered in watersheds that support natural wild rice. Alterations can result from the pumping and dewatering of sites. This increases downstream flows (discussed earlier in Hydrologic Changes section) and subsequent depressions in groundwater in surrounding areas. The potential effects of groundwater depression are not well understood. Water levels in basins with higher gradients could be sufficiently lowered to cause shallow areas inhabited by wild rice to dry out.

Other adverse effects can result from the release of chemicals such as sulfate from mine pits and tailings. These chemicals can negatively affect wild rice as well as other plant and animal species in the area. Seepages from tailings can exceed the state established water quality criteria of 10 mg/L for wild rice waters. For example, sulfate has been measured at 1,000 mg/L in these seepages (Udd 2007). State agencies are working with mining companies to decrease sulfate concentrations in discharge waters. Tribal governments express strong concern over the cumulative impacts of the many historic, currently operational, and planned mines in northeastern Minnesota.

Statewide Threats

Loss of Natural Genetic Characteristics

The cultural, ecological, and economic value of natural wild rice distinguishes it as a unique natural resource in Minnesota. There is strong agreement among stakeholders that it is critically important to maintain the natural genetic diversity of natural stands of wild rice (Porter et al. 2000, LaDuke and Carlson 2003). This importance reflects an understanding of spiritual and cultural values, biological and ecological principles, and agricultural and economic realities.

Natural population diversity provides wild rice the ability to adapt to changing environmental conditions such as annual variations in temperature and precipitation. Maintaining natural genetic diversity provides the best chance for any species to survive variations related to global warming, for example (BSU-CRI 2007). Ongoing analyses continue to support the position that managing for high biodiversity will best insure the survival of plant and animal communities that have characterized the Great Lakes region for thousands of years.

The flower structure and timing of maturation of wild rice promotes cross-pollination within and among stands. Wind pollination further insures genetic diversity. Genetic variability allows for the natural selection of traits that perform best under different environmental conditions. Studies in Wisconsin found sufficient genetic diversity between distinct stands of natural wild rice to identify potentially distinct regional populations. The degree of diversity within the stands also varied widely, with larger and denser stands being most diverse (Lu et al. 2005, Waller et al., 2000). The degree of genetic variability within and among natural stands of wild rice in Minnesota is not known. Thus our ability to recognize changes in the genetics of natural wild rice in this region is limited.

Although some studies of wild rice pollen travel have been conducted (Cregan 2004), more research is needed to understand the potential for genetic transfer among natural and cultivated stands. Drift of wild rice pollen may exceed that of other cultivated crops due to the small size of the pollen and its relatively slow settling rate (P. Bloom, personal communication). In addition, a study in Canada has provided evidence that wild geese, and perhaps ducks, can be important transporters of pollen to lake sediments (McAndrews et al. 2007). This raises the possibility that waterfowl may also serve as transporters of viable pollen.

Another means of introducing new genotypes into local populations is the intentional seeding of wild rice to restore historical sites or to develop new stands. Such plantings have a long history in Minnesota. For example, the demand for seeds of wild rice and other native plants helped to establish businesses such as Wildlife Nurseries, Inc. in 1898, in Oshkosh, Wisconsin (Oelke 2007). However, the risks associated with introducing nonlocal genes into local native gene pools are of increasing concern to many scientists (Maki and Galatowitsch 2004).

Plant breeding programs have developed strains of wild rice suitable for commercial production (Oelke 2007). Consistency in plant morphology, control of shattering, and disease resistance have been important objectives of these programs. Because wild rice pollen is airborne, some have expressed concerns about unplanned cross-pollination between cultivated stands and natural stands. At this point in time, however, traditional wild rice breeding programs are not thought to pose a threat to natural stands since the cultivated varieties reflect the selection of genes from within the naturally occurring gene pool (R. Porter, personal communication).

There have been concerns expressed about the potential impact of transgenic engineering. The dramatic increase in use of this technique to alter food crops has been followed by questions concerning its safety, economic losses, potential impact on the natural environment, regulatory framework and compliance, and the ability to mediate unplanned releases. One of the driving forces behind these concerns is evidence that current gene containment practices cannot achieve absolute protection from unwanted pollination (Thai 2005). The unplanned cross-pollination between cultivated crops such as creeping bentgrass and wild relatives has fueled the concerns of both environmentalists and agricultural producers (Haygood et al. 2003, Weiss 2006).

These concerns are evident in the international guidelines for sustainable forest management developed by the Forest Stewardship Council (FSC). The state of Minnesota has actively sought certification of its public forestlands under the Regional Forest Stewardship Standards published by the council. These standards specifically prohibit the use of genetically modified organisms within certified forests (Minnesota Forest Resource Council 2004).

While there are no known research programs in any country to produce transgenic varieties of wild rice (R. Phillips, personal communication), DNA of wild rice has been transferred to white rice (Abedinia et al., 2000). The very possibility of transgenic engineering wild rice generates deep cultural, economic, and ecologic concerns. These include issues surrounding Native American rights, food safety and nutritional value, protection of economic markets, patenting of species, and protection of natural resources that already face significant threats (LaDuke and Carlson 2003).

This controversy ultimately relates to differing worldviews and the valuation of risk and consequences. For some stakeholders, there is no level of acceptable risk. For others, the potential benefits of genetically engineered wild rice may be worth the possible consequences of escaped transgenic traits. A thorough analysis of the cultural, economic, and ecological consequences of genetic contamination of natural wild rice in Minnesota is required to assess potential impacts.

Transgenic alterations of some U.S. crops will likely continue for the foreseeable future. Traditional plant breeding will also continue. A better understanding of the natural genetic variability of wild rice in Minnesota would increase our understanding of the potential impacts of these activities. Efforts to restore native wild rice to its historical range should be encouraged. Studies of the natural variability and ecological requirements of natural wild rice in this region would enhance these efforts.

Non-native Invasive Species

Non-native invasive species impact every aspect of natural resource management in Minnesota. Protecting and managing natural stands of wild rice is no exception. The movement of watercraft from one wild rice lake to another creates the potential for transfer of invasive animals and plants.

The common carp (*Cyprinus carpio*) leads the way in historical presence and impact. Common carp feed primarily on invertebrates in bottom soils. Their feeding action dislodges plants and suspends fine particles into the water column. The increased turbidity, caused both by disturbed sediments and by algae stimulated by the phosphorus released from disturbed sediments, shades out aquatic plants. Turbidity then increases as non-vegetated lake bottoms are disturbed by wind. The reduction in aquatic vegetation also allows for increased boat traffic and wave action that can further dislodge plants such as wild rice (Pillsbury and Bergey 2000).

Natural stands of wild rice are negatively impacted by turbid conditions during early stages of growth and by disturbances to bottom soils and boat traffic in later stages. The common carp is primarily a problem today in southern Minnesota, where the species occurs in high densities. Carp likely contributed to the loss of natural wild rice from its historic range in this region (Norrgard, 2006). If the predicted changes in climate in northern Minnesota result in warmer waters, carp could achieve higher densities in that region and cause significant damage within the core of prime habitat for natural wild rice.

The non-native rusty crayfish (*Orconectes rusticus*) can directly impact wild rice by cutting stems of the plant. Although the extent of this depredation in Minnesota is not known, significant impacts of native crayfish on cultivated wild rice have been documented (Richards et al. 1995). Native to parts of some states in the Great Lakes region, rusty crayfish have invaded portions of Minnesota, Wisconsin, and Ontario, including areas that are important for wild rice. Rusty crayfish frequently displace the native crayfish, reduce the diversity and abundance of aquatic plants and invertebrates, and reduce some fish populations (MNDNR 2007).

Rusty crayfish were first documented in Minnesota in 1967, at Otter Creek in southern Minnesota. Twenty years later, a statewide survey documented their presence in many areas (Helgen 1990). To date, rusty crayfish have been found in 31 lakes and streams in 11 counties. They prefer areas where rocks, logs, or other debris provide cover. Preferred sediment types include clay, silt, sand, gravel, and rock. The soft organic sediments usually favored by wild rice do not seem to be favored by rusty crayfish and may help minimize their impact.

The non-native mute swan (*Cygnus olor*) can seriously threaten the sustainability of natural wild rice stands (P. Wilson, personal communication). To date, Minnesota has limited the number of these birds to only a few that are held in captivity. With continued efforts to identify free-ranging non-native swans and to respond rapidly with control measures, their impact on natural wild rice in Minnesota could be minimal.

Invasive plants such as purple loosestrife (*Lythrum salicaria* L.), curlyleaf pondweed (*Potamogeton crispus* L.), and Eurasian water milfoil (*Myriophyllum spicatum* L.) occur throughout much of the range of natural wild rice. Although these species may prefer water depths that do not favor wild rice, more research is needed to better understand the potential for competition. It is known that these invasive species can disrupt local aquatic ecosystems and lower habitat quality overall. However, it is also important to monitor the mechanisms of control to insure that these do not have unintended effects on natural wild rice.

Hybrid cattail (*Typha* x *glauca*), a cross of native and non-native cattail (*Typha latifolia* L. and *Typha angustifolia* L., respectively), competes directly with natural wild rice for shallow-water habitat. These plants aggressively form thick mats of roots that can float as water levels fluctuate. The bog-like mats expand across areas of shallow water and can plug lake outlets when broken off and blown by high winds.

Native sedge bogs often border wild rice lakes in northern regions. These bogs are increasingly being invaded and eventually dominated by hybrid cattails. High infestations of hybrid or non-native cattails near lake outlets can increase rates of sedimentation. This, in turn, can combine with the additional plant material to further decrease outlet capacity (R. Ustipak, personal communication).

A relatively new threat to natural stands of wild rice is the non-native flowering rush (*Butomus umbellatus* L.). Found in similar habitats as native bulrush (*Scirpus* L. spp.), which it resembles, flowering rush can persist in either emergent or submergent forms. Though its distribution in Minnesota is limited, its range is expanding. Flowering rush spreads primarily through rootstalks. At a site in Idaho, flowering rush was documented to be out-competing other plants such as willow (*Salix* L. spp.) and cattail (MNDNR 2007).

Another potential threat to natural wild rice in Minnesota is the non-native form of phragmites, or common reed [*Phragmites australis* (Cav.) Trin.]. While phragmites appears in fossil records for North America as early as 40,000 years ago, the non-native form was likely introduced in the late 1700s in ship ballast from Europe. Common reed has since dominated Atlantic coastal marshes and migrated landward, particularly during the 1900s. To date, the non-native form of common reed has invaded natural areas in 18 states including Wisconsin and other Great Lakes states. Although it is still rare in Minnesota, this exotic has been observed in a few disturbed sites in the Minneapolis-St. Paul area and in Duluth harbor (L. Skinner, personal communication).

Although phragmites can spread by seed, the most aggressive growth occurs through rhizomes. Non-native phragmites forms a dense network of roots that can reach several feet in depth. It spreads horizontally by sending out rhizome runners that can grow ten or more feet in a single season if conditions are favorable. Very dense stands are formed, that include live stems as well as standing dead stems from the previous year. The stems of non-native phragmites often reach 15 feet in height along the Atlantic coast.

In a recent study of phragmites in wetlands at Long Point, Lake Erie, researchers found that the occurrence of phragmites increased exponentially in the late 1990s. Of the 31 stands analyzed, 28 (90%) were dominated by the non-native strain (Wilcox et al. 2003). Part of the rapid expansion of the non-native form may be related to its ability to weaken the root structure of adjacent plants through the secretion of gallic acid, which attacks a structural protein (tubulin) in the roots of competing plants (Murray 2007).

Climate Change

The warming of the earth is now evident from measurements and observations. These include increases in average global air and ocean temperatures, widespread melting of snow and ice, and rising global sea levels. The average surface temperature of Earth has risen by about 1.3° F since 1850. The Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC), published in 2007, projects that the average global surface temperature is likely to further increase by 3 to 7° F by the year 2100. This projection assumes a moderate level of action to reduce anthropogenic emissions of greenhouse gases.

According to the IPCC, the lower end of this range (i.e., a further warming of 3° F) represents a threshold for the earth beyond which irreversible and possibly catastrophic changes are likely. If the projections of global warming this century are met, most living things on Earth will likely face severe consequences.

What will predicted changes in climate mean for natural stands of wild rice in Minnesota?

Although climatologists agree that temperatures in this region will increase, predictions of precipitation vary (Figure 3, Kling et al. 2003). Some climate models predict that increasing temperatures will lead to increasing frequency and duration of droughts in the Dakotas and western Minnesota. Hot, dry conditions can negatively impact the pollination of wild rice and thereby reduce its seed production.

Warmer temperatures will also reduce the severity of winters. The required cold temperature (35° F or less) dormancy of three to four months for wild rice seeds could be reduced, particularly in the southern portions of its range. In addition, warmer conditions often favor non-native species. In particular, warmer waters may increase the survival and spread of carp across Minnesota. Because wild rice lakes, rivers, and wetlands are interconnected, protection of wild rice habitat from carp could become very difficult.

Invasive species such as the non-native phragmites may also benefit from warmer temperatures. Many exotics, such as hydrilla *[Hydrilla verticillata* (L. f.) Royle] and water hyacinth *[Eichhornia crassipes* (Martius) Solms-Laub.] are limited by cold climates (Holm et al. 1977; Langeland 1996). Increased average temperatures may enable these extremely invasive non-native species to migrate and gain footholds in Minnesota. Species such as these could have severe impacts on wild rice waters.

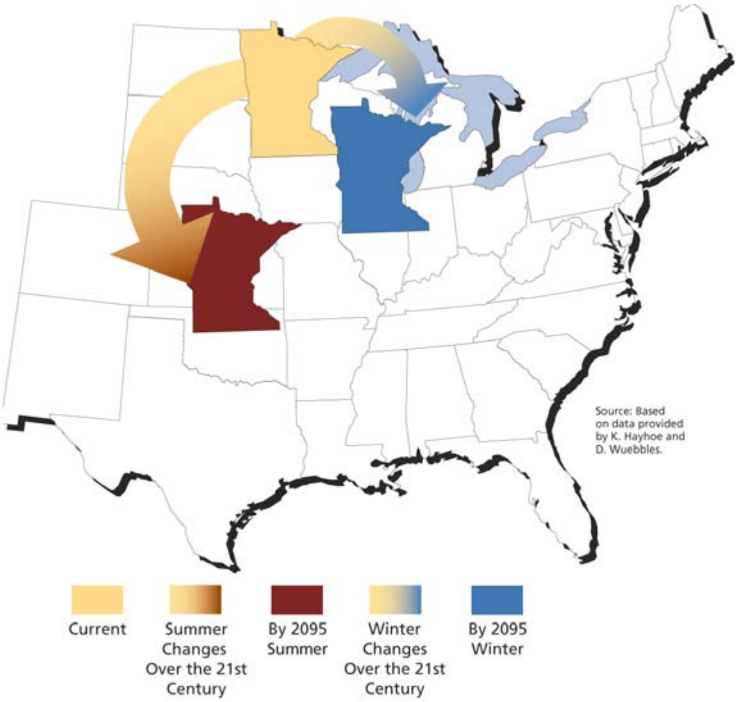

Source: Based on data provided by K. Hayhoe and D. Wuebbles.

Figure 3. Predicted climate change will effectively alter Minnesota to reflect the climate of states to the south.

The frequency of dewpoints above 70° F is already trending upward in Minnesota (Seeley 2007a). Warm, humid conditions support diseases of wild rice such as brown spot (*Bipolaris oryzae* Luttrel and *Bipolaris sorokiniana* Luttrell) and other pathogens. For example, high humidity and sustained warm overnight temperatures in early August 2007 promoted the development of brown spot in many natural wild rice stands in Minnesota. Estimated crop losses in some stands were 70 to 90% (R. Ustipak, personal communication).

There is strong agreement that global warming will result in increased severity of individual weather events (Seeley 2006). According to Dr. Mark Seeley, University of Minnesota climatologist, 2007 may be representative of the future conditions in Minnesota. In August 2007, the U.S. Department of Agriculture declared 24 Minnesota counties to be in severe drought and eligible for federal assistance. Also in August 2007, the Federal Emergency Management Agency declared seven counties in southeastern Minnesota to be flood disasters, also eligible for federal assistance (Seeley 2007b).

In nearly two hundred years of weather history, there are no records of such extremes occurring in the same month of the same year in Minnesota. Increasing severity of storm events will cause more flooding and hence more abrupt changes in lake levels during the growing seasons of wild rice and other aquatic vegetation. Natural wild rice will be particularly susceptible to damage while in the floating-leaf stage.

The southern edge of the range for natural wild rice may already be receding northward. While many factors have likely contributed to a decline in range of natural wild rice, climate may well be involved.

Lack of Recruitment and Retention of Harvesters

As Minnesotans have fewer positive experiences with natural wild rice through harvesting, hunting, trapping, or wildlife watching, they are less likely to recognize or have concerns about its potential loss. They are also less likely to appreciate the severe impacts that the previously noted threats could have on wild rice, and thus on the historic and culturally rich quality of life in Minnesota. This loss of appreciation, while not a direct threat to rice in itself, nevertheless increases the risks for wild rice because the level of resource protection and management is often based on its perceived value.

The protection and management of natural wild rice relies not only on tribes and agencies, but on the users of the resource, as well. Harvesters support management activities through the purchase of annual licenses. Because they have a personal stake in the future of natural wild rice in Minnesota, they are the ones most likely to report activities that are damaging the resource. Harvesters are also great advocates for natural wild rice. They promote its value within the ricing community and to the state as a whole.

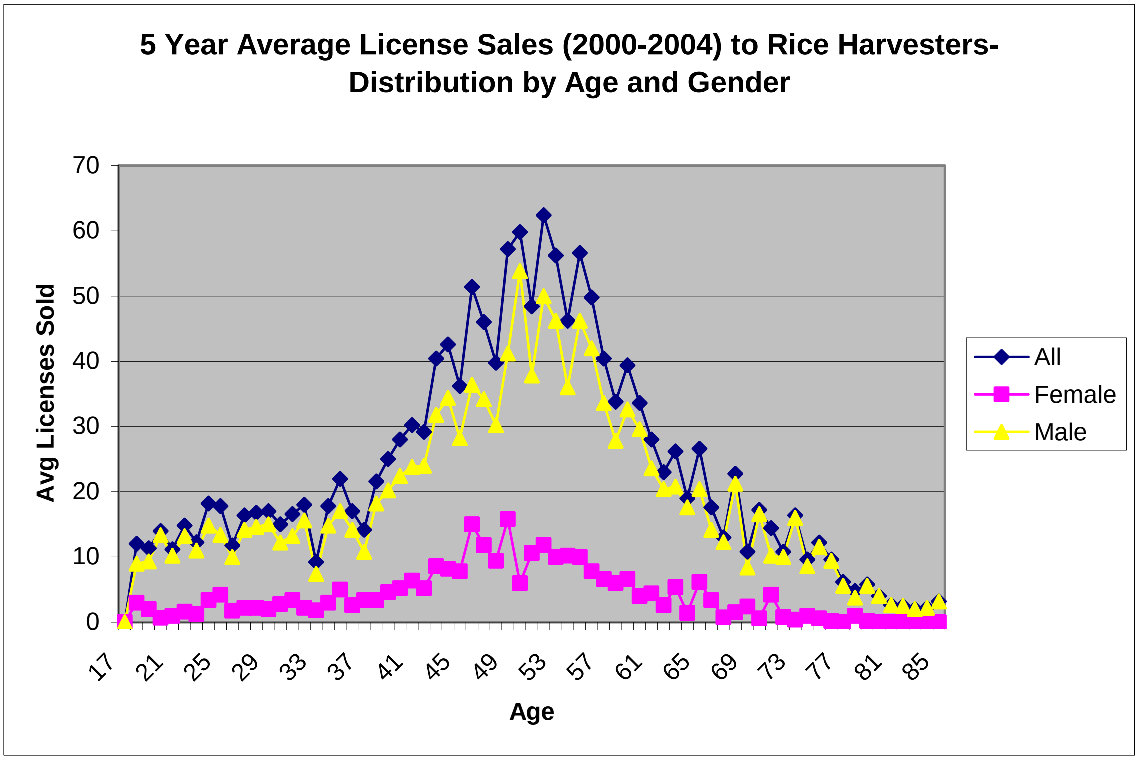


Figure 4. Age distribution of state licensed wild rice harvesters.

Wild rice harvesters are relatively few in numbers, though, and these numbers have declined over the last fifty years. During the 1960s, sales of state licenses in Minnesota averaged over 10,000 per year. Since 2000, these sales have averaged fewer than 1,500 annually. Harvesters under tribal regulations are not required to purchase a state license. Their numbers are estmated to exceed 3000 (R. Norrgard personal communication) and have likely experienced moderate increases in recent years (J. Persell, personal communication).

The MNDNR surveyed wild rice harvesters who purchased licenses from 2004 to 2006 to gather information on harvester characteristics and potential barriers to participation. This survey found that the majority of harvesters were male and at least 40 years old (82% and 81%, respectively). Figure 5 illustrates a similar age distribution from 2000 to 2004. Nearly all of the harvesters who responded had been introduced to wild rice harvesting by a friend or family member (87%).

Although most were satisfied with their harvest experience (82.3%), those surveyed identified several barriers to continuing this tradition. The most important barriers were time, knowing when to harvest, knowing where to harvest, and finding a wild rice processor. Other barriers included finding a ricing partner, physical challenges, financial expenses, finding a buyer, and having proper equipment.

Even for experienced harvesters, the difficulty of finding information on where and when to harvest can limit participation. For those living outside of natural wild rice areas, finding this information can be particularly difficult. For new harvesters, even finding a processor to finish the rice is a significant challenge.

Difficulty in acquiring harvest-related information may influence the distribution of harvesters and harvesting pressure on individual stands. The MNDNR 2006 survey revealed that only 25 lakes accounted for half of all harvesting trips. By contrast, the inventory of wild rice stands compiled for this document indicates that 119 lakes (100+ acres in size) account for more than half of the acreage of natural wild rice in Minnesota.

Addressing the educational or informational needs of Minnesotans interested in natural wild rice has been largely ignored. As with other natural resources in Minnesota, the lack of recruitment and retention of harvesters threatens the sustainability of natural wild rice in the state. Without readily available information and inspiring programs of education, public support of protection and management of the very resources that define Minnesota will likely decline.

Management Challenges

The future of natural wild rice in Minnesota will depend in large part on its protection and management by state and tribal natural resource agencies. The most important management issues relate to those threats identified in the previous section. The challenges that managers of natural wild rice face are further complicated because of limitations to their authority, inherent variability of wild rice production, and the need for additional information concerning wild rice in Minnesota.

Multiple Jurisdictions

Minnesota state statutes provide that ownership of wild rice and other aquatic vegetation is vested in the state (MS 84.091). State statutes also establish regulatory control over wild rice removal and harvest (MS 84.10, 84.15, 84.027, 84.28). Exceptions to state harvest regulations apply in geographic locations that are described by treaties and subsequent agreements, statutes, and rules (MS 84.10, MR 6284.0600 and 6284.0700). State and tribal enforcement officers often operate under temporary agreements until formal agreements are finalized.

The enforcement of harvest regulations in Minnesota is mainly stable and without major controversy. One issue still being discussed, however, is the posting of lakes as “closed” to wild rice harvest until it is determined that the grain is ripe. Both state and tribal governments have done this in the past on lakes that are popular with harvesters. In 1996, a new state law was passed that opened the ricing season on July 15 each year and made it illegal to pick rice that is not ripe (MS 84.105). Because wild rice usually ripens in Minnesota between the third week of August and the second week of September, the new law was intended to encourage a “pick when ripe” philosophy.

Most tribal governments have continued to post popular wild rice lakes within their jurisdictions. For many tribes, this practice is part of a long-standing tradition that relies on counsel provided by tribal committees. Tribes have urged the state to work cooperatively to post additional lakes. The position of the state, however, is that posting is unnecessary for the long-term health of the wild rice resource and the MNDNR currently has statutory authority only to post lakes as “closed” to “protect against undue depletion of the crop so as to retard reseeding or restocking of such area or so as to endanger its effective use as a natural food for waterfowl” (MS 84.15). In some cases, productive wild rice lakes are within both tribal and state jurisdictions. For these lakes, the differences in management philosophy have created conflicts between tribal and state agencies and with some harvesters.

Jurisdictional issues also arise over management of lake resources in general. Although the state of Minnesota has the responsibility of ownership of natural wild rice, the state includes many agencies, and each has its own mission and interest groups. No single agency or governmental entity in Minnesota assumes all of the responsibility for protecting natural wild rice. In public waters, the MNDNR takes the lead to regulate harvest and damage or removal of wild rice plants. Counties take the lead, within state statutory guidelines, to regulate shoreline development and most local recreational surface-water use. The Minnesota Pollution Control Agency regulates discharges to waters throughout the state; the Minnesota Department of

Agriculture assumes the lead for issues involving cultivated wild rice; and the state Environmental Quality Board has the lead responsibility to coordinate, notify, and evaluate any potential release of genetically engineered wild rice.

Within the MNDNR, the Division of Waters assumes the lead on shoreline regulations; the Division of Ecological Resources leads on aquatic plant management and invasive species; and the Division of Fish and Wildlife leads on habitat management for fisheries and wildlife values. The MNDNR Division of Enforcement is responsible for enforcement of natural resource regulations including the harvest of natural wild rice except when tribal regulations apply.

A formal, interdisciplinary planning process for Minnesota lakes does not exist. Lake management plans typically reflect the specific goals of the sponsoring entity. The plans often focus on aspects of either fisheries, wildlife, water quality, or vegetation without considering a comprehensive approach that addresses all of these components of a lake ecosystem.

Within Minnesota state statutes, there is no unifying policy of wild rice management that provides integration of these various agencies. By contrast, a unifying policy is clear regarding wetlands. Under public water laws, state statutes declare that it is in the public interest to increase the quantity, quality, and biological diversity of Minnesota's wetlands (MS 103A.201 subd. 2). A similar policy statement would help insure the sustainability of the natural wild rice resource in Minnesota.

Annual Crop Variability

Management by MNDNR and its conservation partners to maintain water levels beneficial to natural wild rice stands has never been greater. Water level monitoring, beaver control, debris removal, and invasive species management has annually taken place on more than 200 lakes and impoundments with significant wild rice stands. This management is based on the combined efforts of the Minnesota Department of Natural Resources, U. S. Fish and Wildlife Service, Ducks Unlimited, Tribal governments, and at least three lake associations. Much of the funding for these management efforts comes from the revenue generated by wild rice license sales.

Nevertheless, the expectations of those who value natural wild rice often exceed the capabilities of those responsible for protecting and managing this resource in Minnesota. A particularly difficult challenge for managers is the critical role that weather plays in wild rice development. Even when growing conditions have been exceptionally favorable, a single storm can reduce or even devastate the local harvest. At best, wild rice managers can “set the table” by maintaining free-flowing outlets or by setting appropriate runout elevations on water control structures. These management actions improve the harvest potential in good years and lessen the impact of poor conditions in less favorable years.

It can be easy for both user groups and managers to overlook the reality that natural wild rice has adapted to changing weather patterns through strategies that promote long-term survival rather than consistent annual abundance. The boom and bust cycle of natural wild rice has been recognized for centuries. This variation in annual productivity may be driven as much by seed dormancy and nutrient cycling as it is by variable weather. Resource managers, wild rice harvesters, and other stakeholders must remember that productivity of natural wild rice is highly variable, both by stand and by year. Responsible management of this unique resource should strive to maximize its long-term sustainability in the Great Lakes region.

Information Needs

To effectively manage natural wild rice for future generations, resource managers need a better understanding of its natural ecology; its historical losses and patterns of abundance and distribution; threats to its sustainability; and the needs of harvesters.

While much has been learned about the ecology of wild rice over the last several decades, adequate information is still lacking on environmental tolerances and limiting factors such as water and sediment chemistry, seasonal water levels, and disturbance. This information will help create a better understanding of the historical reductions in wild rice distribution and provide much needed guidance for restoration of wild rice habitat.

In addition, a better understanding of ecological relationships in wild rice waters could guide strategies to counter threats such as mining and climate change. Improved ecological understanding would also provide much needed insight into the issues of invasive species. Of particular concern is the potential spread of carp, flowering rush, and exotic phragmites. Better assessments of the damage caused by rusty crayfish are needed as well.

Another concern is that basic information concerning the natural genetic makeup of native stands of wild rice is lacking. An understanding of the natural genetic variability of natural wild rice in the Great Lakes region and genetic drift between stands is critical. This information is needed to guide restoration efforts, particularly in the face of changing climate, and to help detect changes in diversity. We also need to better understand reproduction and its role in population genetics of natural wild rice.

More thorough information is needed on the distribution and overall acreage of natural wild rice in Minnesota. For this study, the MNDNR and the Wild Rice Study Technical Team revised and updated an earlier database of this information (Appendix B). While the recent revision is the most complete and detailed information of its kind for Minnesota, it still represents a gross estimate because information for many lakes, wetlands, rivers, and streams is incomplete or totally lacking. Further refinements and updates to this database are needed. In addition, refined methods are needed to improve the monitoring of annual productivity and the effects of management actions. This information would also help identify new opportunities for harvesters and better distribute harvesting pressure. With improved methods of monitoring and more complete databases, the overall health of the wild rice resource will be better managed.

Managers also need to better understand the harvesters of natural wild rice. What are annual trends? How can agencies and the wild rice community encourage retention of existing harvesters and recruit new people to continue this tradition? Who are the potential harvesters and what do they need in terms of ricing information, education, and support to be successful? The future of the wild rice resource in Minnesota may very well depend on the level of interest in its harvest and traditions.

Department of Natural Resources Recommendations

Introduction

This section is in response to the legislative request to include recommendations “on protecting and increasing natural wild rice stands in the state”. The following recommendations were developed with valuable input and discussion from the members of the Wild Rice Study Technical Team and Partnership Team. However, the Minnesota Department of Natural Resources assumes sole responsibility for these recommendations as written and presented here.

MNDNR recognizes the importance of protecting natural wild rice beds from genetic modification and agrees with wild rice stakeholders that this protection is critical to the future of this resource. We strongly support the Environmental Quality Board in adopting rules that require an environmental impact statement for a proposed release of genetically engineered wild rice (MS 116C.94 Subd.1b).

Recommendation 1

Recodify current wild rice harvest statutes and rules to remove duplication and inconsistencies.
Rationale: The state’s wild rice statutes and rules have been developed and modified piecemeal over a long period of time. As a result they contain a number of inconsistencies and duplication. Most of these changes relate to the harvest regulations (MS 84.27 – 84.91) although statutory recognition of wild rice as the state grain (MS 1.148) is also out of date in its nomenclature.

Recommendation 2

Establish statutory policy guidance on wild rice and its management.
Rationale: Within state statutes there is no unifying policy that provides direction to agencies responsible for some aspect of wild rice management. In contrast, the policy of the state is clear when it comes to wetlands. State statutes declare that it is in the public interest to increase the quantity, quality, and biological diversity of Minnesota's wetlands (MS 103A.201 subd. 2). A similar policy statement concerning natural wild rice would be useful guidance for state and local agencies. Suggested language includes “The legislature finds that natural wild rice in Minnesota provides public value by its contributions to fish and wildlife habitat, ecological diversity, environmental quality, recreational opportunities, cultural traditions, human sustenance, and economic well-being, and that it is in the public interest to protect existing natural wild rice stands, including their inherent genetic diversity, and restore wild rice to its historic range and abundance for its ecological, economic, and cultural values.”

Recommendation 3

The DNR will convene an interagency workgroup in 2008 to identify desired statutory updates in harvest regulations.
Rationale: Harvest regulations and license fee structure should be reviewed by an interagency work group for suggested changes that would work towards resolution of posting lakes closed to harvest and regulating reservation border lakes, as well as encouraging recruitment and retention of wild rice harvesters. Possible changes include broadening the use of funds deposited in the wild rice account to allow for information and education, removal of the season framework, adding a combination (spouse) license, extending special one-day license, providing special one-day mentored license for resident and nonresident participants in formal education programs, and establishing a special youth day when mentors are not required to have a license.

Recommendation 4

The DNR will designate and publish a list of important natural wild rice areas.
Rationale: Recognizing important wild rice areas and publishing the list would call attention to the importance of these areas, indicate management priorities, and provide a formal list that may prove useful for local units of government that are considering zoning and surface use restrictions.

Recommendation 5

The DNR will convene a standing interagency wild rice workgroup to share information and develop recommendations for inventory methodology and trend assessments, education and information outreach, lake planning and management, harvester recruitment and retention, and other management issues as they arise.
Rationale: Comprehensive protection and management of wild rice involves multiple agencies. Management needs include better inventory information including consistent methodology for trend analysis, documenting natural genetic diversity, and establishing long-term case studies on identified lakes. This information will encourage sound restoration strategies and help foster the development of interdisciplinary lake management plans. In addition, the workgroup should focus on developing outreach information for harvesters, shoreline owners, realtors, boaters, and outdoor educators.

Recommendation 6

Increase intensive natural wild rice lake management efforts and accelerate the restoration of wild rice stands within its historic range.
Rationale: Protecting and managing natural wild rice resources on many lakes requires active annual management activities to maintain free flowing outlets. The MNDNR works cooperatively with other agencies and nonprofit organizations such as Ducks Unlimited to accomplish this management. Tribal agencies also conduct independent management efforts on specific lakes. In recent years these efforts have improved wild

rice habitat on approximately 200 lakes and impoundments annually. Additional funding could expand accomplishments beyond current efforts.

The MNDNR has also been involved to a lesser extent in restoring wild rice to wildlife habitat areas within the historic range of natural wild rice. These efforts should be accelerated as funding, time, and opportunity permit.

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Appendix A

Natural Wild Rice Study Development Process

Scope: This study provided an information document on natural wild rice developed with conservation partner input, review, and possible endorsement. The document included the current location and estimated acreage and area of natural stands; potential threats to natural stands, including, but not limited to, development pressure, water levels, pollution, invasive species, and genetically engineered strains; and recommendations to the house and senate committees with jurisdiction over natural resources on protecting and increasing natural wild rice stands in the state.

Format: The final document was formatted to include an Executive Summary, Introduction, Background, Threats, Management Challenges, Recommendations, and Appendices.

Process: A Partnership Team was organized to review, comment, and consider endorsement of the planning process, interim draft of the document, and the final draft to be released for public review. DNR Assistant Commissioner Bob Meier chaired the Partnership Team. Invited members of the Partnership Team included representatives from other agencies and organizations including DNR Tribal Liaison Paul Swenson, the DNR Divisions of Ecological Services, Enforcement and Waters, MN Department of Agriculture, Board of Water and Soil Resources, Minnesota legislature (Representatives Frank Moe and Sondra Erickson), U. S. Bureau of Indian Affairs, U. S. Fish and Wildlife Service, U. S. Natural Resources and Conservation Service, Minnesota Chippewa Tribe, Tribal representatives, Ducks Unlimited, MN Wild Rice Council, Minnesota Waterfowl Association, Save Our Rice Alliance, Minnesota Waters, and the Association of Minnesota Counties. The Partnership Team was offered the opportunity to submit dissenting reports to be included in the appendices.

A Technical Team was organized to propose the document development process, develop the draft document and incorporate revisions as the process proceeded. DNR Wetland Wildlife Program Leader Ray Norrgard chaired the team and assumed the role of lead writer. Invited members of the Technical Team will include DNR wildlife field staff Gary Drotts, Ann Geisen, Shelley Gorham, Beau Liddell, Rob Naplin and Regional Enforcement Supervisor Ken Soring, along with Michelle McDowell (Fish and Wildlife Service), Becky Knowles (Leech Lake Department of Resource Management), Rod Ustipak (Consultant), Jon Schneider (Ducks Unlimited), MN Wild Rice Council (Beth Nelson and Jon Dokter), Rachel Walker (University of Minnesota – St. Paul), Dr. Ron Phillips (University of Minnesota – St. Paul), Dr. Raymie Porter (University of Minnesota- Grand Rapids), Annette Drewes (University of Wisconsin), Thomas Howes (Fond du Lac Reservation), Darren Vogt (1854 Authority), Steve Smith and John Persell (Minnesota Chippewa Tribe), Mike Swan (White Earth Reservation), Andrea Hanks (White Earth Land Recovery Project), and Peter David (Great Lakes Indian Fish and Wildlife Commission).

Timelines: The process began with the passage of the 2007 legislative request and will end with a completed report to the legislature by February 15, 2008. The Technical Team met on August 14, 2007 to develop the final draft of the proposed document development process, and a draft outline of the final document. The Technical Team communicated by email and followed up with meetings on November 13, 2007 and January 7, 2008. The draft study document underwent 10 revisions in all. The Partnership Team met on September 19 and December 3, 2007 to review the Technical Team’s proposals. Review of the final working draft of the study document was conducted by mail. The final document will be presented to the legislature by February 15, 2008. Copies of the final document will be posted on the MNDNR website and available upon request through DNR regions and central office.

Partnership Team Roster

Organization	Name	Title
Association of Minnesota Counties	Anna Lee Garletz	Policy Analyst
Bois Forte DNR	Cory Strong	Commissioner
Bureau of Indian Affairs	Bob Jackson	
Clearwater County	Tom Anderson	County Commissioner
DNR Commissioner's Office	Bob Meier	Asst Commissioner/Policy
DNR Division of Ecological Resources	Lee Pfannmuller (Donna Perleberg)	Director
DNR Division of Enforcement	Mike, Hamm	Director
DNR Division of Waters	Kent, Lokkesmoe	Director
DNR Northwest Region Office	Paul Swenson	Tribal Liaison
Ducks Unlimited	Ryan Heiniger	Director, Cons Programs
Fond du Lac Resource Management	Reginald Defoe (Tom Howes)	Director
Grand Portage Tribal Council	Norman Deschampe	Chairman
Leech Lake DRM	Rich Robinson	Director
Mille Lacs Natural Resources	Curt Kalk	Commissioner
Minnesota Chippewa Tribe	Gary Frazer	Executive Director
Minnesota Legislature	Sondra Erickson	State Representative
Minnesota Legislature	Frank Moe	State Representative
Minnesota Waters	Bruce Johnson	Executive Director
Minnesota Wild Rice Council	Beth Nelson (Peter Imle, Ken Gunvalson)	President
MN Board of Water & Soil Resources	John Jaschke (Greg Larson)	Executive Director
MN Department of Agriculture	Gene, Hugoson (Chuck Dale, Chuck Dryke, Geir Friisoe)	Commissioner
MN Valley National Wildlife Refuge	Jim Leach (Barb Boyle)	Director
MN Waterfowl Association	Brad Nylin	Executive Director
Natural Resources Conservation Service	Bill Hunt	State Conservationist
Red Lake DNR	Al Pemberton	Director
Save Our Rice Alliance	Richard Draper	
White Earth DNR	Mike Swan (Doug McArthur)	Director
White Earth Land Recovery Project	Winona LaDuke	Founding Director

Technical Team Roster

First Name	Title	Organization
Peter David	Wildlife Biologist	Great Lakes Indian Fish and Wildlife Commission
Jon Dokter	Associate Director	Wild Rice Council
Annette Drewes	Ph.D Candidate Environmental Studies	University of Wisconsin-Madison Save Our Rice Alliance
Gary Drotts	Area Wildlife Supervisor	MN Department of Natural Resources
Ann Geisen	Wildlife Shallow Lakes Specialist	MN Department of Natural Resources
Shelley Gorham	Area Wildlife Supervisor	MN Department of Natural Resources
Andrea Hanks	Wild Rice Campaign Coordinator	White Earth Land Recovery Project (WELRP)
Tom Howes	Natural resources Manager	Fond du Lac Department of Resource Management
Becky Knowles	Plant Ecologist	LLBO DRM-Fish, Wildlife, and Plants
Beau Liddell	Area Wildlife Supervisor	MN Department of Natural Resources
Doug McArthur	Biologist	White Earth Dept. of Natural Resources
Michelle McDowell	Wildlife Biologist	Rice Lake National Wildlife Refuge
Rob Naplin	Area Wildlife Supervisor	MN Department of Natural Resources
Beth Nelson	President	Wild Rice Council
Ray Norrgard	Wetland Wildlife Program Leader	MN Department of Natural Resources
John Persell	Biologist	LLBO DRM-Fish, Wildlife, and Plants
Ron Phillips	Regents Professor	University of Minnesota
Raymie Porter	Research	University of Minnesota
Jon Schneider	Manager MN Conservation Programs	Ducks Unlimited
Steve Smith	Acting Director - Water Quality	Minnesota Chippewa Tribe
Ken Soring	NE Regional Enforcement Supervisor	MN Department of Natural Resources
Mike Swan	Director	White Earth Dept. of Natural Resources
Rod Ustipak	Consultant	
Darren Vogt	Wildlife Biologist	1854 Treaty Authority
Rachel Walker	Ph.D Candidate Water Resources	University of Minnesota

Appendix B

Wild Rice Distribution and Abundance in Minnesota

EXECUTIVE SUMMARY

Project Leader
Gary Drotts
Minnesota Department of Natural Resources
Area Wildlife Supervisor - Brainerd

Purpose

To further the understanding of natural wild rice distribution and abundance in Minnesota, Minnesota Department of Natural Resources (MNDNR) staff and other Technical Team members of the Natural Wild Rice in Minnesota Legislative Study undertook an effort to consolidate and update existing natural wild rice inventory information. The following objectives guided inventory design and development.

1. Consolidate various data/information on the location (i.e. lake, wetland, or river segment) of natural wild rice stands in Minnesota.
2. Determine size and natural wild coverage for each location.
3. Determine type of water level management structure (if present) on each location and primary management authority.
4. Document Tribal, Treaty and/or State authority for each location.
5. Determine natural wild rice harvest potential, harvest pressure, and access for each location.
6. Provide a starting point for a useable data framework/information system for the long-term protection, management and monitoring of natural wild rice in Minnesota.

Methods

An existing dataset (Microsoft Access) maintained by the MNDNR Shallow Lake Program provided the starting point for this effort. This dataset originated in the late 1980’s based on a review and consolidation of the best existing data sources at that time (i.e. MNDNR Enforcement wild rice lists, tribal rice camps, etc.) followed up with field interviews to MNDNR Area Wildlife and Tribal offices in the primary natural wild rice range. This initial assessment found over 700 lakes in 31 counties totaling 1.5 million basin acres contained approximately 61,000 acres of natural wild rice.

Since this initial dataset was formed, various MNDNR, federal, treaty and tribal authorities have accomplished a significant amount of additional inventory work. This information was reviewed, consolidated and added to the initial dataset and sent out for review to MNDNR Area Wildlife and Treaty/Tribal authorities for their comments and input. Return information was entered into a finalized dataset.

Primary information collected consisted of a location (i.e county, basin name), basin area and estimated natural wild rice coverage. For basins having a significant stand of natural wild rice, additional information was requested as to: water level management restrictions (i.e. dam at outlet); general wild rice location within the basin; treaty/tribal authority; and harvest potential, pressure and access.

Information sources

Information sources included the following:

- Minnesota DNR – initial survey data, 2006 Wild Rice Harvesters Survey, Fisheries lake surveys, Wildlife/shallow lake surveys, aquatic plant management permits, and aquatic plant survey data from Ecological Resources.
- Treaty/Tribal - 1854 Treaty Authority, Great Lakes Indian Fish and Wildlife Commission, Fond Du Lac Indian Reservation, Mille Lacs Indian Reservation, Leech Lake Indian Reservation, and, White Earth Indian Reservation.
- U.S. Fish and Wildlife Service, National Wildlife Refuge System

Results

Inventory results note that stands of natural wild rice were present or occurred in recent history on 1,292 lakes or river/stream segments in Minnesota. Of these 1,286 locations, 777 have information on natural wild rice coverage, which totals approximately 64,328 acres. The remaining 509 locations that currently do not have coverage information are primarily small lakes/wetlands on the edge of the current natural wild rice range (southern and western Minnesota) or river/stream segments.

On a county basis, the greatest concentration of natural wild rice locations is in St. Louis (8,939 acres), Itasca (8,448 acres), Cass (8,323 acres), Aitkin (4,859 acres), and Crow Wing (3,751 acres). These five counties contain over 60% of the inventoried natural wild rice acreage in Minnesota.

Recommendations

- This inventory should be considered a work in progress. Further edits and review are needed, especially for small lakes/wetlands on the edge of current natural wild rice range and the numerous river/stream segments that may been missed in this inventory.
- A procedure to review and update this inventory on a regular basis (every 5-10 years) should be undertaken.
- Information gathered on harvest potential, pressure and access to these natural wild rice locations should be listed/posted on appropriate web sites (i.e. MNDNR web site).

County name	Location Name (i.e. Lake or River)	MN Lake ID	Location size (acres)	Estimated wild rice coverage (acres)
Aitkin	Aitkin	01004000	850	298
Aitkin	Anderson	01003100	97	30
Aitkin	Bear	01006400	127	1
Aitkin	Big Sandy	01006200	9,380	94
Aitkin	Birch	01020600	449	5
Aitkin	Blind	01018800	323	39
Aitkin	Brown	01007800	97	34
Aitkin	Camp	01009800	127	30
Aitkin	Clear	01010600	123	20
Aitkin	Cornish Pool	01042700	600	30
Aitkin	Davis	01007101	76	30
Aitkin	Deer	01008600	47	3
Aitkin	Elm Island	01012300	656	30
Aitkin	Farm Island	01015900	2,025	20
Aitkin	Fleming	01010500	326	1
Aitkin	Flowage	01006100	720	432
Aitkin	Gun	01009900	735	60
Aitkin	Hammal	01016100	376	1
Aitkin	Hay	01005900	133	1
Aitkin	Hickory	01017900	183	10
Aitkin	Jenkins	01010000	127	1
Aitkin	Jewett State WMA - Impoundment	01038300	180	30
Aitkin	Johnson	01013100	27	6
Aitkin	Killroy	01023800	23	4
Aitkin	Kimberly State WMA - Lower Pool	01043300	300	30
Aitkin	Kimberly State WMA - Upper Pool	01041100	900	76
Aitkin	Krilwitz	01IMP002	30	6
Aitkin	Lily	01008800	50	2
Aitkin	Little Hill River State WMA - Pool 1	01043300	135	18
Aitkin	Little McKinney	01019700	26	6
Aitkin	Little Pine	01017600	126	1
Aitkin	Little Prairie	01001600	78	1
Aitkin	Little Red Horse Lake	01005200	32	3
Aitkin	Little Willow River State WMA - Upper Pool	W0642001	50	20
Aitkin	Little Willow State WMA - Lower Pool	01033200	140	50
Aitkin	Mallard	01014900	354	320
Aitkin	Mandy	01006800	107	27
Aitkin	Minnewawa	01003300	2,451	130
Aitkin	Monson	01012600	48	25
Aitkin	Moose	01014000	148	117
Aitkin	Moose River	01r4		

County name	Location Name (i.e. Lake or River)	MN Lake ID	Location size (acres)	Estimated wild rice coverage (acres)
Aitkin	Moose Willow State WMA - Moose Pool	01035800	900	89
Aitkin	Moose Willow State WMA - Willow Pool	01043100	300	50
Aitkin	Moulton	01021200	282	1
Aitkin	Mud (Grayling Marsh WMA, pool 1)	01002900	400	1
Aitkin	Mud (Little White Elk)	01019400	135	68
Aitkin	Nelson	01001000	71	1
Aitkin	Newstrom	01009700	97	76
Aitkin	Pine	01000100	391	4
Aitkin	Portage	01006900	387	5
Aitkin	Prairie River	01r6		
Aitkin	Rat	01007700	442	45
Aitkin	Rat House	01005300	122	100
Aitkin	Red	01010700	97	4
Aitkin	Rice	01000500	83	50
Aitkin	Rice (Big)	01006700	3,635	1,700
Aitkin	Rice River	01r1	190	25
Aitkin	Ripple	01014600	676	50
Aitkin	Ripple River	01r3		
Aitkin	Rock	01007200	366	50
Aitkin	Round	01013700	634	1
Aitkin	Salo Marsh State WMA - Pool	01041500	690	76
Aitkin	Sanders	01007600	55	36
Aitkin	Sandy River	01006000	368	200
Aitkin	Sandy River	01r2		
Aitkin	Savanna	01001400	86	1
Aitkin	Savanna River	01r5		
Aitkin	Section Ten	01011500	440	52
Aitkin	Section Twelve	01012000	167	1
Aitkin	Shovel	01020000	230	207
Aitkin	Sissabagamah	01012900	386	39
Aitkin	Sitas	01013200	59	5
Aitkin	Sixteen	01012400	18	1
Aitkin	Sjodin	01031600	43	28
Aitkin	Spectacle	01015600	107	1
Aitkin	Spirit	01017800	523	26
Aitkin	Split Rock	01000200	27	1
Aitkin	Spruce	01015100	80	80
Aitkin	Steamboat	01007102	59	15
Aitkin	Stony	01001700	52	5
Aitkin	Sugar	01008400	23	1
Aitkin	Sugar	01008700	416	1
Aitkin	Swamp	01009200	270	1

County name	Location Name (i.e. Lake or River)	MN Lake ID	Location size (acres)	Estimated wild rice coverage (acres)
Aitkin	Tamarack River	01r7		
Aitkin	Twenty	01008500	153	119
Aitkin	Unnamed (L. Wolf)	01002000	19	1
Aitkin	Unnamed (Rice)	01041900	16	1
Aitkin	Unnamed (Round Lake Pothole)	01028500	15	12
Aitkin	Unnamed (Upper Blind)	01033100	14	3
Aitkin	Unnamed (W. Washburn)	01026200	14	1
Aitkin	Washburn	01011100	73	4
Aitkin	Waukenabo	01013600	819	49
Aitkin	West	01028700	51	20
Aitkin	White Elk	01014800	780	350
Anoka	Carlos Avery WMA - Pool 1	W9001001	180	15
Anoka	Carlos Avery WMA - Pool 13	W9001013	586	2
Anoka	Carlos Avery WMA - Pool 14	W9001014	749	15
Anoka	Carlos Avery WMA - Pool 15	W9001015	365	1
Anoka	Carlos Avery WMA - Pool 16	W9001016	67	
Anoka	Carlos Avery WMA - Pool 17	W9001017	185	
Anoka	Carlos Avery WMA - Pool 2	W9001002	683	20
Anoka	Carlos Avery WMA - Pool 22	W9001022	141	10
Anoka	Carlos Avery WMA - Pool 23	W9001023	1,600	
Anoka	Carlos Avery WMA - Pool 24	W9001024	35	2
Anoka	Carlos Avery WMA - Pool 26	W9001026	200	5
Anoka	Carlos Avery WMA - Pool 3	W9001003	186	120
Anoka	Carlos Avery WMA - Pool 5	W9001005	52	25
Anoka	Carlos Avery WMA - Pool 6	W9001006	200	1
Anoka	Carlos Avery WMA - Pool 7	W9001007	240	3
Anoka	Carlos Avery WMA - Pool 9	W9001009	269	120
Anoka	Carlos Avery WMA - Pool 9(2)	W9001011	71	30
Anoka	East Twin	02002000	171	1
Anoka	Grass	02011300		
Anoka	Grass	02009200		
Anoka	Hickey	02009600	41	
Anoka	Little Coon	02003200	486	10
Anoka	Pickerel	02013000	303	25
Anoka	Rice	02000800		
Anoka	Rice	02004300		
Anoka	Rice Creek	02r1		
Anoka	Rondeau	02001500	552	
Anoka	Rum River	02r2		
Anoka	Swan	02009800	273	33
Anoka	West Twin	02003300	18	
Becker	Abners	03003900	100	80

County name	Location Name (i.e. Lake or River)	MN Lake ID	Location size (acres)	Estimated wild rice coverage (acres)
Becker	Albertson	03026600	73	
Becker	Aspinwall	03010400	178	18
Becker	Axberg	03066000	47	
Becker	Balsam	03029200	148	10
Becker	Bass	03048000	28	
Becker	Bass	03008800	208	10
Becker	Bean	03041100	19	
Becker	Big Basswood	03009600	586	304
Becker	Big Rat	03024600	1,102	110
Becker	Big Rush	03010300	1,128	20
Becker	Blackbird	03019700	284	42
Becker	Blueberry	03000700	160	2
Becker	Booth	03019800	48	43
Becker	Buffalo	03035000	444	89
Becker	Bullhead	03031200	39	6
Becker	Bush	03021200	110	40
Becker	Cabin	03034600	38	
Becker	Camp Seven	03015100	78	8
Becker	Carman	03020900	217	30
Becker	Chippewa	03019600	960	288
Becker	Dahlberg	03057700	77	
Becker	Dead	03016000	296	
Becker	Dinner	03004400	53	11
Becker	Eagen	03031800	85	
Becker	Equay	03021900	73	7
Becker	Flat	03024200	1,970	197
Becker	Gull Creek	03r2		
Becker	Gyles	03006600	42	16
Becker	Halverson	03041200	18	
Becker	Height of Land	03019500	3,943	197
Becker	Hubbel Pond	03024000	561	168
Becker	Indian Creek Imp.	03r4		
Becker	Johnson	03019900	181	40
Becker	Kneebone	03009000	149	15
Becker	Little Basswood	03009200	105	31
Becker	Little Dinner	03004500	12	5
Becker	Little Flat	03021700	235	211
Becker	Little Mud	03002200	25	6
Becker	Little Rice	03023900	110	21
Becker	Little Round	03030200	565	
Becker	Lower Egg	03021000	171	75
Becker	Lyman WPA	03IMP003		

County name	Location Name (i.e. Lake or River)	MN Lake ID	Location size (acres)	Estimated wild rice coverage (acres)
Becker	Manomin Creek	03r5		
Becker	Mary Yellowhead	03024300	68	7
Becker	Mud	03012000	170	
Becker	Mud	03002300	85	42
Becker	Mud	03006700	88	83
Becker	Mud	03001600	86	
Becker	Ottertail River	03r1		
Becker	Pearl	03048600	268	
Becker	Rice	03028500	51	
Becker	Rice	03017300	37	
Becker	Rice	03029100	245	196
Becker	Rice	03020100	245	245
Becker	Rock	03029300	1,198	240
Becker	Round	03015500	1,094	
Becker	Schultz	03027800	103	82
Becker	Shell	03010200	3,147	169
Becker	Shipman	03000500	71	1
Becker	Spindler	03021400	185	125
Becker	Tamarack	03024100	2,227	245
Becker	Tamarack NWR - Ogemash Pool	03IMP002	71	20
Becker	Tea Cracker	03015700	122	30
Becker	Town	03026400	117	35
Becker	Trieglaff	03026300	111	56
Becker	Twin Island	03003300	71	5
Becker	Two Inlets	03001700	643	40
Becker	Unnamed	03008700	23	
Becker	Unnamed	03060000	59	
Becker	Unnamed	03059800	36	
Becker	Unnamed	03059900	34	
Becker	Unnamed	03014000	43	
Becker	Unnamed	03109300	72	7
Becker	Unnamed	03077600	20	10
Becker	Unnamed	03071600	25	12
Becker	Unnamed	03043400	21	17
Becker	Upper Egg	03020600	493	24
Becker	Wild Rice River	03r3		
Becker	Winter	03021600	117	43
Becker	Wolf	03010100	1,453	10
Beltrami	Big	04004900	3,565	250
Beltrami	Big Rice	04003100	642	96
Beltrami	Bootleg	04021100	308	185
Beltrami	Burns	04000100	131	105

County name	Location Name (i.e. Lake or River)	MN Lake ID	Location size (acres)	Estimated wild rice coverage (acres)
Beltrami	Campbell	04019600	462	23
Beltrami	Carr	04014100	51	8
Beltrami	Cass	04003000	15,958	10
Beltrami	Clearwater	04034300	1,039	
Beltrami	Cranberry	04012300	77	46
Beltrami	Dutchman	04006700	171	
Beltrami	Erickson	04006800	111	50
Beltrami	George	04017500	89	18
Beltrami	Grant Creek	04r1		
Beltrami	Grass	04021600	233	
Beltrami	Gull	04006400	170	34
Beltrami	Heart	04027100	10	
Beltrami	Irving	04014000	644	97
Beltrami	Kitchi	04000700	1,850	185
Beltrami	Little Puposky	04019700	158	95
Beltrami	Little Rice	04017000	72	
Beltrami	Little Rice	04001500	123	60
Beltrami	Little Rice Pond	04002300		
Beltrami	Little Turtle	04015500	464	23
Beltrami	Manomin	04028600	288	144
Beltrami	Marquette	04014200	578	
Beltrami	Medicine	04012200	458	69
Beltrami	Mississippi	04r2		
Beltrami	Moose	04001100	617	96
Beltrami	Moose	04034200	133	
Beltrami	Norman	04002900	61	8
Beltrami	Pimushe	04003200	1,350	135
Beltrami	Puposky	04019800	2,120	236
Beltrami	Rabideau	04003400	723	217
Beltrami	Rice	04017400	55	
Beltrami	Rice	04012100	36	
Beltrami	Rice	04025000	124	
Beltrami	Rice Pond	04005900	247	123
Beltrami	Three Island	04013400	836	125
Beltrami	Turtle River	04011100	1,664	
Beltrami	Upper Red	04003501	119,271	
Beltrami	Whitefish	04030900	126	
Blue Earth	Rice	07005900		
Blue Earth	Rice Creek	07r1		
Brown	Altematt	08005400		
Brown	Rice Lake	08003500		
Carlton	Bang	09004600	58	1

County name	Location Name (i.e. Lake or River)	MN Lake ID	Location size (acres)	Estimated wild rice coverage (acres)
Carlton	Bob	09002600	78	1
Carlton	Cedar	09003100	62	10
Carlton	Cross	09006200	110	6
Carlton	Dead Fish	09005100	153	115
Carlton	Flower	09006400	14	10
Carlton	Hardwood	09003000	100	25
Carlton	Hay	09001000	103	1
Carlton	Island	09006000	456	46
Carlton	Jaskari	09005000	74	74
Carlton	Kettle	09004900	611	415
Carlton	Long	09006600	17	4
Carlton	Miller	09005300	156	156
Carlton	Moose	09004300		
Carlton	Moosehead	09004100		
Carlton	Perch	09003600	796	597
Carlton	Rice Portage	09003700	832	120
Carlton	Sterle Pool	W0854002	29	2
Carlton	Tamarack	09006700	228	11
Carlton	Tamarack River	09r1		
Carlton	Wild Rice	09002300	54	36
Carlton	Woodbury	09006300	59	10
Cass	Baby	11028300	736	7
Cass	Bergkeller	11044700	120	5
Cass	Beuber	11035300	135	15
Cass	Big Birch	11001700	255	45
Cass	Big Portage	11030800	956	30
Cass	Big Rice (Remer)	11007300	2,717	1,411
Cass	Big Sand	11007700	752	10
Cass	Birch	11041200	1,262	1
Cass	Bluebill	11039700	51	1
Cass	Bowen	11035000	182	
Cass	Boy (& Boy River)	11014300	5,544	340
Cass	Brockway	11036600	182	55
Cass	Bullhead	11018400	88	
Cass	Cat	11050900	108	5
Cass	Cedar	11048100	34	3
Cass	Cedar	11044400	17	4
Cass	Child	11026300	295	12
Cass	Chub	11051700	57	51
Cass	Ding Pot	11056500	29	29
Cass	Donkey	11028000	54	
Cass	Drumbeater	11014500	376	5

County name	Location Name (i.e. Lake or River)	MN Lake ID	Location size (acres)	Estimated wild rice coverage (acres)
Cass	East Twin	11012300	297	50
Cass	Esterday	11051100	43	3
Cass	Farnham	11051300	142	71
Cass	Five Point	11035100	265	13
Cass	George	11010100	720	262
Cass	Gijik	11018500	118	1
Cass	Goose	11009600	844	844
Cass	Grass	11031500	113	
Cass	Grass	11009000		
Cass	Gull	11030500	9,541	15
Cass	Gull River	11r1	219	110
Cass	Hand (Lower)	11025100	122	50
Cass	Hand (Upper)	11024200	316	20
Cass	Hardy	11033200	89	2
Cass	Hattie	11023200	592	40
Cass	Hay	11019900	364	36
Cass	Hole-In-Bog	11019700	76	
Cass	Hunter	11017000	189	2
Cass	Inguadona	11012000	935	19
Cass	Island	11010200	390	10
Cass	Island	11036000	117	30
Cass	Kelly	11042800	50	10
Cass	Kerr	11026800	81	1
Cass	Kid	11026200	167	3
Cass	Laura	11010400	1,424	854
Cass	Leech	11020300	109,415	4,000
Cass	Lind	11036700	462	95
Cass	Little Birch	11001800	25	25
Cass	Little Boy	11036900	71	1
Cass	Little Boy	11016700	1,396	10
Cass	Little Swift	11013100	62	16
Cass	Little Vermillion	11003000	138	15
Cass	Little Woman	11026500	50	8
Cass	Lizotte	11023100	75	50
Cass	Lomish	11013600	282	197
Cass	Lower Milton	11008000	80	5
Cass	Lower Trelipe	11012900	618	20
Cass	Mad Dog	11019300	27	
Cass	Margaret	11022200	230	3
Cass	McCarthey	11016800	194	78
Cass	McKeown	11026100	171	3
Cass	Moon	11007800	58	5

County name	Location Name (i.e. Lake or River)	MN Lake ID	Location size (acres)	Estimated wild rice coverage (acres)
Cass	Moose	11042400	92	1
Cass	Mud	11030900	18	18
Cass	Mud	11010000	1,440	1,300
Cass	Norway	11030700	498	10
Cass	Nushka	11013700	78	
Cass	Ododikossi	11007400	20	10
Cass	Oxbow	11007500	172	4
Cass	Peterson	11015400	139	3
Cass	Pick	11026700	36	1
Cass	Pickerel	11035200	66	
Cass	Pillager	11032000	213	10
Cass	Pine Mountain	11041100	1,657	40
Cass	Portage	11047600	277	
Cass	Potshot	11014900	28	14
Cass	Rat	11028500	104	
Cass	Ray	11022000	183	37
Cass	Rice	11040200	188	5
Cass	Rice	11016200	342	137
Cass	Rice	11013800	55	1
Cass	Rice (Carrol's)	11022700	46	46
Cass	Rice (Pillager)	11032100	232	100
Cass	Rice Pad	11072000	14	4
Cass	Rock	11032400	249	10
Cass	Sailor	11001900	42	10
Cass	Schafer	11000400	44	2
Cass	Scribner	11044100	93	5
Cass	Six Mile	11014600	1,288	70
Cass	Skunk	11002700	145	30
Cass	Spring	11002200	86	12
Cass	Stephens	11021300	104	1
Cass	Swift	11013300	359	51
Cass	Tamarack	11034700	46	4
Cass	Tamarack	11018900	63	6
Cass	Thiebault	11002000	37	5
Cass	Third Guide	11000100	44	14
Cass	Thirty-Six	11017300	49	1
Cass	Thunder	11006200	1,316	2
Cass	Twin	11048400	168	
Cass	Unnamed	11077700	40	
Cass	Unnamed	11078000	10	4
Cass	Unnamed (Pistol Lake Rice Bed)	11073800	22	20
Cass	Unnamed (Rice Swamp)	11069800	11	

County name	Location Name (i.e. Lake or River)	MN Lake ID	Location size (acres)	Estimated wild rice coverage (acres)
Cass	Unnamed (Rice)	11061500	11	
Cass	Upper Gull	11021800	345	2
Cass	Upper Loon	11022500	114	
Cass	Wabedo	11017100	1,272	5
Cass	Wabegon	11040300	42	4
Cass	Washburn	11005900	1,768	60
Cass	Wax	11012400	95	10
Cass	West Twin	11012500	200	11
Cass	White Oak	11001600	68	1
Cass	Widow	11027300	197	
Cass	Winnibigoshish	11014700	69,821	1,000
Cass	Woman	11020100	5,360	54
Chippewa	Chippewa River	12r1		
Chisago	Goose	13008300	710	
Chisago	Rush	13006900	3,170	
Clay	Cromwell	14010300	27	
Clearwater	Anderson	15007400	53	3
Clearwater	Bagley	15004000	106	
Clearwater	Berg	15002500	50	
Clearwater	Clearwater River	15r1		
Clearwater	Duncan	15002400	18	
Clearwater	Elk	15001000	305	
Clearwater	First	15013900	60	3
Clearwater	Gill	15001900	380	38
Clearwater	Itasca	15001600	1,065	
Clearwater	Lomond	15008100	108	5
Clearwater	Lower Red	15020200		
Clearwater	Lower Rice	15013000	2,375	1,568
Clearwater	Mallard	15001800	123	25
Clearwater	Minerva	15007900	239	36
Clearwater	Mississippi	15r3		
Clearwater	Mud	15006100	294	103
Clearwater	Pine	15014900	1,465	220
Clearwater	Second	15014000	68	7
Clearwater	Sucker	15002000	90	14
Clearwater	Tamarack	15005600	21	
Clearwater	Tamarack	15013600	115	
Clearwater	Third	15014100	38	2
Clearwater	Unnamed (Rice Bed)	15002100	150	45
Clearwater	Upper Rice	15005900	1,860	1,116
Clearwater	Wild Rice River	15r2		
Cook	Bigsby	16034400	89	1

County name	Location Name (i.e. Lake or River)	MN Lake ID	Location size (acres)	Estimated wild rice coverage (acres)
Cook	Caribou	16036000	714	7
Cook	Christine	16037300	192	19
Cook	Elbow	16009600	415	124
Cook	Fente	16074100	35	
Cook	Four Mile	16063900	593	42
Cook	Grassy	16039000	22	
Cook	Gust	16038000	159	1
Cook	Iron	16032800	125	
Cook	Jack	16052100	127	12
Cook	Kelly	16047600	188	56
Cook	Luffs	16000600		
Cook	Mark	16025000	126	
Cook	Marsh	16048800	62	31
Cook	Moore	16048900	64	48
Cook	Mt. Maud	16wtld2		
Cook	North Fowl	16003600	297	
Cook	Northern Light	16008900	443	133
Cook	Peterson	16047800	104	1
Cook	Phoebe	16080800	758	1
Cook	Prout	16001300	18	
Cook	Rib	16054400	89	
Cook	Rice	16045300	230	92
Cook	Richey	16064300	114	
Cook	Royal River	16r1		
Cook	South Fowl	16003400	508	
Cook	Swamp	16000900		
Cook	Swamp River	16r2		
Cook	Swamp River Reservoir	16090100	165	153
Cook	Teal	16000300	73	1
Cook	Temperance River	16r3		
Cook	Toohey	16064500	369	
Cook	Turtle	16025100	61	
Cook	Unnamed	16wtld1		
Cook	Unnamed	16041600	14	14
Cook	White Pine	16036900	374	
Crow Wing	Arrowhead	18036600	285	40
Crow Wing	Bass	18001100	65	13
Crow Wing	Bass	18022900	114	1
Crow Wing	Bay	18003400	2,435	1
Crow Wing	Big Bird	18028500	205	10
Crow Wing	Birchdale	18017500	80	40
Crow Wing	Borden	18002000	1,038	31

County name	Location Name (i.e. Lake or River)	MN Lake ID	Location size (acres)	Estimated wild rice coverage (acres)
Crow Wing	Buffalo	18015200	36	18
Crow Wing	Bulldog	18001400	151	5
Crow Wing	Butterfield	18023100	225	1
Crow Wing	Camp	18001800	537	22
Crow Wing	Caraway	18017900	40	32
Crow Wing	Carlson	18039500	45	1
Crow Wing	Clark	18037400	309	3
Crow Wing	Cole	18012700	114	1
Crow Wing	Crow Wing	18015500	378	
Crow Wing	Dahler	18020400	277	28
Crow Wing	Deadman's	18018800	28	5
Crow Wing	Deer	18018200	78	30
Crow Wing	Dog	18010700	71	71
Crow Wing	Duck	18017800	310	175
Crow Wing	Duck	18031400	160	3
Crow Wing	Eagle	18029600	356	1
Crow Wing	Emily	18020300	675	2
Crow Wing	Erskine	18000900	186	7
Crow Wing	Faupel	18023700	42	25
Crow Wing	Flanders	18024700	181	20
Crow Wing	Garden	18032900	262	100
Crow Wing	Gilbert	18032000	391	7
Crow Wing	Goggle	18022300	107	11
Crow Wing	Goodrich	18022600	382	5
Crow Wing	Grass	18036200	45	1
Crow Wing	Grass	18023000	78	4
Crow Wing	Green	18023300	14	1
Crow Wing	Greer	18028700	384	20
Crow Wing	Half Moon	18023800	70	14
Crow Wing	Happy	18010100	51	36
Crow Wing	Hay	18044400	46	29
Crow Wing	Hole-in-the-Day	18040100	217	90
Crow Wing	Holt	18002900	164	10
Crow Wing	Horseshoe	18031700	33	13
Crow Wing	Island	18005200	37	18
Crow Wing	Island	18038300	85	2
Crow Wing	Jail	18041500	190	2
Crow Wing	Johnson	18032800	129	25
Crow Wing	Lily Pad	18027500	47	30
Crow Wing	Little Pine	18026600	384	20
Crow Wing	Little Pine	18017600	135	30
Crow Wing	Lizzie	18041600	384	100

County name	Location Name (i.e. Lake or River)	MN Lake ID	Location size (acres)	Estimated wild rice coverage (acres)
Crow Wing	Long	18003100	80	4
Crow Wing	Love	18038800	88	18
Crow Wing	Lower Dean	18018100	372	360
Crow Wing	Lower Mission	18024300	739	50
Crow Wing	Lows	18018000	320	45
Crow Wing	Mahnomen	18012600	238	1
Crow Wing	Mallard	18033400	73	4
Crow Wing	Maple	18004500	68	20
Crow Wing	Middle Cullen	18037700	405	2
Crow Wing	Mississippi River	18r1		1
Crow Wing	Mitchell	18029400	460	3
Crow Wing	Mollie	18033500	421	17
Crow Wing	Mud	18009400	78	6
Crow Wing	Mud	18013700	132	40
Crow Wing	Mud	18032600	82	60
Crow Wing	Mud	18019800	103	10
Crow Wing	Nelson	18016400	323	100
Crow Wing	Nisswa	18039900	213	25
Crow Wing	North Long	18037200	6,178	10
Crow Wing	Olson	18017100	28	3
Crow Wing	Ossawinnamakee	18035200	739	1
Crow Wing	Perch	18030400	181	8
Crow Wing	Pine	18026100	391	60
Crow Wing	Platte	18008800	1,768	350
Crow Wing	Pointon	18010500	193	14
Crow Wing	Rat	18041000	100	2
Crow Wing	Red Sand	18038600	569	28
Crow Wing	Rice (Blomberg's)	18012100	78	60
Crow Wing	Rice (Clark Lake rice bed)	18032700	181	124
Crow Wing	Rice (Deerwood)	18006800	185	170
Crow Wing	Rice (Hesitation State WMA)	18005300	168	138
Crow Wing	Rice (Lowell State WMA)	18040500	85	33
Crow Wing	Rice (Pratt's)	18031600	100	90
Crow Wing	Rice Bed	18018700	50	47
Crow Wing	Rock	18001600	210	10
Crow Wing	Rogers	18018400	249	4
Crow Wing	Round	18014700	144	5
Crow Wing	Round (Round-Rice Bed State WMA)	18003200	82	5
Crow Wing	Roy	18039800	310	5
Crow Wing	Sebie	18016100	180	2
Crow Wing	Sewells Pond	18044600	20	16
Crow Wing	Sibley	18040400	412	10

County name	Location Name (i.e. Lake or River)	MN Lake ID	Location size (acres)	Estimated wild rice coverage (acres)
Crow Wing	Smith	18002800	486	49
Crow Wing	South Long	18013600	1,380	4
Crow Wing	Stewart	18036700	254	5
Crow Wing	Tamarack	18031800	34	30
Crow Wing	Terry	18016200	102	55
Crow Wing	Twenty Two	18000800	169	42
Crow Wing	Twin Island	18010600	85	42
Crow Wing	Unnamed	18020100	16	1
Crow Wing	Unnamed	18041300	103	27
Crow Wing	Unnamed	18055000	30	30
Crow Wing	Unnamed	18005500	70	1
Crow Wing	Unnamed (Blackies Slough)	18054400	33	20
Crow Wing	Unnamed (Lost Rice)	18022800	157	80
Crow Wing	Unnamed (Nokasippi R. Rice Bed)	18048500	166	40
Crow Wing	Unnamed (Total's Pothole)	18054300	28	16
Crow Wing	Upper Cullen	18037600	459	23
Crow Wing	Upper Dean	18017000	263	10
Crow Wing	Upper Hay	18041200	640	2
Crow Wing	Upper Mission	18024200	895	5
Crow Wing	Upper Whitefish	18031000	7,969	50
Crow Wing	Velvet	18028400	167	2
Crow Wing	Whipple	18038700	345	40
Crow Wing	Whitefish	18000100	709	30
Crow Wing	Williams	18002400	47	3
Crow Wing	Wilson	18004900	63	4
Crow Wing	Wolf	18011200	218	25
Dakota	Blackhawk	19005900		
Dakota	Chub	19002000	301	1
Douglas	Mud	21023600	50	
Faribault	Minnesota	22003300	1,915	
Faribault	Rice	22000700		
Faribault	Rice	22007500		
Fillmore	Rice Creek	23r1		
Freeborn	Bear	24002800	1,560	
Freeborn	Geneva	24001500	1,875	18
Freeborn	Spicer	24004500	125	100
Freeborn	Trenton	24004900	184	18
Goodhue	Cannon River	25r2		
Goodhue	Rice Bottoms	25r1		
Goodhue	Sturgeon	25001701		
Hennepin	Grass	27008000	326	
Hennepin	Rice	27013200	294	

County name	Location Name (i.e. Lake or River)	MN Lake ID	Location size (acres)	Estimated wild rice coverage (acres)
Hennepin	Rice	27011600		
Houston	Blue	28000503	362	
Houston	Lawrence	28000501	142	
Houston	Target	28000502	424	
Hubbard	Alice	29028600	150	15
Hubbard	Birch Creek	29r1		
Hubbard	Clausens	29009700	222	
Hubbard	Crow Wing	29011600		
Hubbard	Crow Wing River	29river		
Hubbard	Deer	29009000	193	
Hubbard	Eagle	29025600	440	4
Hubbard	Eighth Crow Wing	29007200	493	1
Hubbard	Eleventh Crow Wing	29003600	752	1
Hubbard	Fifth Crow Wing	29009200	406	10
Hubbard	First Crow Wing	29008600	564	50
Hubbard	Fishhook River	29r4		
Hubbard	Fourth Crow Wing	29007800	523	130
Hubbard	Garfield	29006100	984	90
Hubbard	George	29021600	882	18
Hubbard	Hart	29006300	236	118
Hubbard	Hattie	29030000	359	
Hubbard	Holland-Lucy	29009500	44	
Hubbard	Horseshoe	29005900	264	
Hubbard	Island	29025400	522	60
Hubbard	Kabekona River	29r6		
Hubbard	Kabekona River	290075T2		
Hubbard	Kabenkona	29007500		
Hubbard	Little Rice	29018300	27	1
Hubbard	Little Stony	29008000	55	
Hubbard	Loon	29002000	112	
Hubbard	Lower Bottle	29018000	712	10
Hubbard	Lower Mud	29026700	30	30
Hubbard	Mantrap	29015100	1,770	200
Hubbard	Mud	29011900	146	30
Hubbard	Mud Creek	29r3		
Hubbard	Necktie River	29r2		
Hubbard	Ninth Crow Wing	29002500	235	
Hubbard	Oak	29006000	58	1
Hubbard	Oelschlager Slough	29000600	328	
Hubbard	Paine	29021700	258	
Hubbard	Plantagenet	29015600	2,620	
Hubbard	Portage	29025000	429	

County name	Location Name (i.e. Lake or River)	MN Lake ID	Location size (acres)	Estimated wild rice coverage (acres)
Hubbard	Potato	29024300	2,239	30
Hubbard	Rice	29017700	230	58
Hubbard	Schoolcraft	29021500	176	35
Hubbard	Second Crow Wing	29008500	228	5
Hubbard	Seventh Crow Wing	29009100	251	10
Hubbard	Shallow	29008900	295	9
Hubbard	Shell River	29r5		
Hubbard	Sixth Crow Wing	29009300	358	5
Hubbard	Spider	29011700	593	
Hubbard	Spring	29005400	43	
Hubbard	Sunday	29014400	62	
Hubbard	Tamarack	29009400	36	
Hubbard	Tenth Crow Wing	29004500	185	9
Hubbard	Third Crow Wing	29007700	636	40
Hubbard	Tripp	29000500	155	1
Hubbard	Twin	29029300		
Hubbard	Unnamed	29011500	16	
Hubbard	Unnamed	29011800	21	
Hubbard	Unnamed	29011400	24	
Hubbard	Unnamed	29008400	87	
Hubbard	Unnamed	29007900	38	
Hubbard	Unnamed	29017900	16	
Hubbard	Unnamed	29009900	26	
Hubbard	Unnamed	29015800	60	
Hubbard	Unnamed	29002100		
Hubbard	Unnamed	29026300	20	
Hubbard	Unnamed	29001900	15	
Hubbard	Unnamed (Boudora)	29008200	48	1
Hubbard	Unnamed (Hay Creek)	29055400	38	20
Hubbard	Upper Bass	29003400	30	
Hubbard	Upper Bottle	29014800	505	30
Hubbard	Upper Mud	29028400	50	50
Hubbard	Upper Twin	29015700	212	1
Isanti	Elizabeth	30008300	323	
Isanti	German	30010000	340	
Isanti	Grass	30014200	33	
Isanti	Krone	30014000	142	
Isanti	Lindgren	30014400	75	
Isanti	Little Stanchfield	30004400	155	
Isanti	Mud	30006500	300	
Isanti	Mud	30010600	81	
Isanti	Mud	30011700		

County name	Location Name (i.e. Lake or River)	MN Lake ID	Location size (acres)	Estimated wild rice coverage (acres)
Isanti	North Stanchfield	30014300	153	
Isanti	Rice	30001800		
Isanti	Section	30006000	130	
Isanti	South Stanchfield	30013800	433	
Isanti	Typo	30000900	273	
Isanti	Upper Rice	30005700	208	208
Itasca	Ann	31030500	94	5
Itasca	Aspen	31069000	86	5
Itasca	Bass	31057600	2,844	427
Itasca	Big Fork River	31r3		
Itasca	Birdseye	31083400	73	11
Itasca	Blackberry	31021000	240	50
Itasca	Blackwater	31056100	674	300
Itasca	Bluebill	31026500	144	14
Itasca	Bosley	31040300	41	10
Itasca	Bowstring (& Bowstring River)	31081300	8,900	1,335
Itasca	Bowstring River	31r4		
Itasca	Buckman	31027200	222	33
Itasca	Clearwater	31040200	67	10
Itasca	Clubhouse	3105400		
Itasca	Coddington	31088300	70	18
Itasca	Cophenhagen	31053900		
Itasca	Cresent	31029400	42	2
Itasca	Crooked	31020300	80	12
Itasca	Cut Foot Sioux	31085700	3,222	322
Itasca	Damon	31094400	53	20
Itasca	Decker	31093400	292	58
Itasca	Deer	31034400	1,854	
Itasca	Dishpan	31099200	15	15
Itasca	Dixon	31092100	666	67
Itasca	Dora	31088200	477	89
Itasca	Egg	31081700	118	11
Itasca	Farley	31090200	33	5
Itasca	First River	31081800	228	160
Itasca	Grass	31072700		
Itasca	Grass	31052700		
Itasca	Gunny Sack	31026700	81	8
Itasca	Hamrey	31091100	61	15
Itasca	Harrigan	31017400	27	3
Itasca	Hay	31003700		
Itasca	Helen	31084000	109	76
Itasca	Hunters	31045000	162	16

County name	Location Name (i.e. Lake or River)	MN Lake ID	Location size (acres)	Estimated wild rice coverage (acres)
Itasca	Ima	31063400		
Itasca	Irene	31087800	10	1
Itasca	Island	31075400	291	10
Itasca	Kelly	31029100	31	19
Itasca	Lawrence	31023100	382	19
Itasca	Leighton	31003200	242	12
Itasca	Lillian	31075000	90	14
Itasca	Little Ball Club	31082200	181	10
Itasca	Little Cut Foot	31085200	1,357	136
Itasca	Little Drum	31074100	89	22
Itasca	Little Island	31017900	26	3
Itasca	Little Moose	31061000	234	12
Itasca	Little Rice	31071600		
Itasca	Little Spring	31079700	121	3
Itasca	Little White Oak	31074000	493	25
Itasca	Lost	31028900		
Itasca	Lost	31090000	26	5
Itasca	Lower Pigeon	31089300	53	20
Itasca	Marble	31027100	155	20
Itasca	Marie	31093700	45	10
Itasca	Middle Pigeon	31089200	182	15
Itasca	Mississippi River	31r6		
Itasca	Morph	31092900	67	3
Itasca	Mosomo	31086100	47	5
Itasca	Mud	31020600	271	203
Itasca	Munzer	31036000	108	3
Itasca	Nagel	31037700	90	50
Itasca	Natures	31087700	2,885	2,499
Itasca	O'Donnell	31030300	47	10
Itasca	Otter	31030100		
Itasca	Pigeon Dam	31089400	511	500
Itasca	Pokegama	31053200	15,600	100
Itasca	Pothole	31099100		
Itasca	Prairie	31038400	1,167	45
Itasca	Prairie (& Prairie River)	31005300	29	1
Itasca	Rabbits	31092300	209	157
Itasca	Raven	31092500	97	70
Itasca	Rice	31031500	37	15
Itasca	Rice	31071700		
Itasca	Rice	31077700		
Itasca	Rice	31087600	911	729
Itasca	Rice	31020100	115	6

County name	Location Name (i.e. Lake or River)	MN Lake ID	Location size (acres)	Estimated wild rice coverage (acres)
Itasca	Rice	31070700		
Itasca	Rice	31094200	39	
Itasca	Rice Creek	31r5		
Itasca	Rice Creek	31r1		
Itasca	Rice River	31r2		
Itasca	Ruby	31042200	243	5
Itasca	Sand	31082600	3,391	50
Itasca	Shallow Pond	31091000	281	11
Itasca	Simpson	31086700	35	5
Itasca	Sioux	31090700	69	27
Itasca	Skimmerhorn	31093900	30	6
Itasca	Soneman	31027600	40	16
Itasca	Spruce	31034700	58	58
Itasca	Stevens	31071800	224	11
Itasca	Stone Axe	31082800	37	4
Itasca	Swan	31006700	2,472	50
Itasca	Tuttle	31082100	56	16
Itasca	Unnamed	31081500	109	5
Itasca	Unnamed	31096100	10	2
Itasca	Unnamed	31020400	28	3
Itasca	Unnamed	31032200	28	2
Itasca	Unnamed	31006600	23	3
Itasca	Unnamed	31086000	24	5
Itasca	Upper Pigeon	31090800	86	10
Itasca	Walters	31029800	120	18
Itasca	Wart	31085900	14	5
Itasca	White Fish	31014200	31	2
Itasca	White Oak	31077600	905	271
Itasca	Whitefish	31084300	493	10
Itasca	Wilderness	31090100	26	4
Kanabec	Ann	33004000	363	18
Kanabec	Grass	33001300		
Kanabec	Kent	33003500	34	
Kanabec	Knife	33002800		
Kanabec	Mud	33001500		
Kanabec	Pomroy	33000900	267	
Kanabec	Rice	33001100	172	
Kanabec	Rice	33003100		
Kanabec	Sells	33001800	64	
Kanabec	Twin or East	33001900	27	
Kanabec	Unnamed	33002900	21	
Kanabec	Unnamed	33011100	33	27

County name	Location Name (i.e. Lake or River)	MN Lake ID	Location size (acres)	Estimated wild rice coverage (acres)
Kanabec	Unnamed	33001400	30	
Kanabec	Unnamed	33007200	31	1
Kanabec	Unnamed	33001200	11	
Kandiyohi	Bear	34014800	128	
Kandiyohi	Blaamyhre	34034500	121	
Kandiyohi	Eight	34014600	89	
Kandiyohi	Glesne	34035200	205	
Kandiyohi	Monongalia	34IMP001	1,500	
Kandiyohi	Mud	34015800	2,516	
Kandiyohi	Ole	34034200	66	
Kandiyohi	Unnamed	34023600	117	
Koochiching	Nett	36000100	7,369	
Koochiching	Rainy Lake	36000100	7,301	2,000
Koochiching	Rat Root	36000600	734	
Koochiching	Tilson Creek	36r1		
Lake	Bald Eagle	38063700	1,243	
Lake	Basswood	38064500	14,610	485
Lake	Bluebill	38026100	44	11
Lake	Bonga	38076200	138	138
Lake	Cabin	38026000	71	55
Lake	Campers	38067900	56	56
Lake	Charity	38005500	26	
Lake	Christianson	38075000	158	
Lake	Clark	38067400		
Lake	Clark	38064700	49	
Lake	Cloquet	38053900	176	
Lake	Cloquet River	38r1		
Lake	Comfort	38029000	42	
Lake	Cougar	38076700	71	1
Lake	Cramer	38001400	69	55
Lake	Crooked	38002400		
Lake	Crooked	38081700		
Lake	Crown	38041900	69	
Lake	Driller	38065200	24	
Lake	Dumbbell	38039300	476	48
Lake	Ella Hall	38072700	372	1
Lake	Fall	38081100	2,322	23
Lake	Farm	38077900	1,292	
Lake	Flat Horn	38056800	52	
Lake	Fools	38076100	14	14
Lake	Gabbro	38070100	927	
Lake	Garden	38078200	4,236	212

County name	Location Name (i.e. Lake or River)	MN Lake ID	Location size (acres)	Estimated wild rice coverage (acres)
Lake	Gegoka	38057300	174	14
Lake	Greenwood	38065600	1,469	15
Lake	Harris	38073600	121	18
Lake	Hjalmer	38075800	109	2
Lake	Hoist	38025100	117	
Lake	Horse River	38r5		
Lake	Hula	38072800	121	121
Lake	Isabella	38039600	1,318	
Lake	Isabella River	38r4		
Lake	Island River	38084200	49	49
Lake	Kawishiwi	38008000	468	
Lake	Kawishiwi River	38r2		
Lake	Little Gabbro	38070300	151	
Lake	Little Wampus	38068400		
Lake	Lobo	38076600	132	99
Lake	Manomin	38061600	455	23
Lake	Middle McDougal	38065800	104	
Lake	Moose	38003600	201	
Lake	Mud	38074200	164	
Lake	Muskeg	38078800	178	71
Lake	Newton	38078400		
Lake	Nine A.M.	38044500	27	14
Lake	North McDougal	38068600	273	
Lake	Papoose	38081800	54	3
Lake	Phantom	38065300	70	
Lake	Railroad	38065500	11	1
Lake	Rice	38046500	206	206
Lake	Roe	38013900	76	
Lake	Round Island	38041700	58	58
Lake	Sand	38073500	506	51
Lake	Sand River	38r3		
Lake	Scott	38027100	52	
Lake	Silver Island	38021900	1,239	
Lake	Slate	38066600	293	
Lake	Snowbank	38052900	4,819	50
Lake	Source	38065400	35	1
Lake	Sourdough	38070800	17	17
Lake	South McDougal	38065900	277	3
Lake	Stony	38066000	409	245
Lake	Stony River	38r6		
Lake	Upland	38075600	74	1
Lake	Vera	38049100	262	

County name	Location Name (i.e. Lake or River)	MN Lake ID	Location size (acres)	Estimated wild rice coverage (acres)
Lake	Wampus	38068500	146	
Lake	Wind	38064200	952	10
Lake	Wood	38072900	587	125
Lake of the Woods	Baudette River	39r2		
Lake of the Woods	Bostick Creek	39r1		
Lake of the Woods	Lake of the Woods	39000200	950,400	225
Lake of the Woods	Rainy River	39r5		
Lake of the Woods	Roseau Flowage	39IMP001	200	100
Lake of the Woods	Silver Creek	39r3		
Lake of the Woods	Winter Road River	39r4		
Le Sueur	Rice	40wtld1		
Le Sueur	Rice	40011400		
Le Sueur	Rice	40003700		
Le Sueur	Rice	40001600		
Mahnomen	Grass	44004700	22	
Mahnomen	Long	44000200	117	
Mahnomen	Peabody	44-wetld		
Mahnomen	Rice	44002400	120	
Mahnomen	Roy	44000100	689	
Mahnomen	Sargent (Little Rice)	44010800	174	
McLeod	Grass	43001300		
McLeod	Rice	43004200		
McLeod	Schaefer Prairie	43r1		
Mille Lacs	Dewitt Marsh	48002000	110	131
Mille Lacs	Dewitt Pool	48IMP004	146	131
Mille Lacs	Ernst Pool	48003600	300	200
Mille Lacs	Korsness Pool 1	48003500	130	90
Mille Lacs	Mille Lacs WMA - Headquarters 2 Pool	W9004009	500	13
Mille Lacs	Mille Lacs WMA - Jones 1 Dk Pool	W9004008	520	3
Mille Lacs	Mille Lacs WMA - Korsness Pool 2	W9004002	33	30
Mille Lacs	Mille Lacs WMA - Korsness Pool 3	W9004003	18	5
Mille Lacs	Mille Lacs WMA - Olson Pool	W9004007	85	2
Mille Lacs	Mille Lacs WMA - Townhall Pool	W9004010	110	3
Mille Lacs	Ogechie	48001400	732	
Mille Lacs	Onamia	48000900	2,250	1,350
Mille Lacs	Rice	48001000	512	
Mille Lacs	Shakopee	48001200	771	
Mille Lacs	Unnamed	48004300	60	10
Mille Lacs	Unnamed	48004400	500	
Mille Lacs	Unnamed	48005400	32	25
Mille Lacs	W. brnch Groundhouse Riv	48IMP002	50	1
Morrison	Bernhart	49013500	39	

County name	Location Name (i.e. Lake or River)	MN Lake ID	Location size (acres)	Estimated wild rice coverage (acres)
Morrison	Coon	49002000	75	75
Morrison	Crookneck	49013300	200	
Morrison	Hannah	49001400	109	27
Morrison	Long	49001500	128	32
Morrison	Longs	49010400	60	
Morrison	Madaline	49010100	50	
Morrison	Miller	49005100	39	9
Morrison	Mud	49009500	105	
Morrison	Mud	49007200	83	5
Morrison	Mud	49002700	23	9
Morrison	Mud	49001800		
Morrison	Peavy	49000500	140	
Morrison	Pelkey	49003000	113	10
Morrison	Placid	49008000	537	
Morrison	Platte River	49r2		
Morrison	Popple	49003300	153	
Morrison	Rice	49002500	323	250
Morrison	Rice Creek	49r1		
Morrison	Round	49001900	134	14
Morrison	Skunk	49002600	320	256
Morrison	Skunk	49000700		
Morrison	Sullivan	49001600	1,199	20
Morrison	Twelve	49000600	159	80
Nicollet	Rice	52003300		
Otter Tail	Armor	56038100		
Otter Tail	Beauty Shore	56019500	233	
Otter Tail	Berger	56114900	190	
Otter Tail	Davies	56031100	69	
Otter Tail	Dead	56038300	7,827	
Otter Tail	Duck	56092500	41	
Otter Tail	East Red River	56057300	292	
Otter Tail	Emma	56019400	473	
Otter Tail	Gourd	56013900		
Otter Tail	Grass	56011500		
Otter Tail	Grass	56072300		
Otter Tail	Grass	56071700		
Otter Tail	Head	56021300	499	
Otter Tail	Little McDonald	56032800	1,506	
Otter Tail	Long	56021000		
Otter Tail	Mud	56021500	138	
Otter Tail	Mud	56022200	437	
Otter Tail	Mud	56013200	155	

County name	Location Name (i.e. Lake or River)	MN Lake ID	Location size (acres)	Estimated wild rice coverage (acres)
Otter Tail	Mud	56114800	134	
Otter Tail	North Maple	56001300	161	
Otter Tail	North Rice	56034900	103	
Otter Tail	Otter Tail River	56r1		
Otter Tail	Peterson	56047100	141	
Otter Tail	Rankle	56093500	57	
Otter Tail	Reed	56087600	155	
Otter Tail	Rice	56000600		
Otter Tail	Rice	56035200		
Otter Tail	Rice	56070200		
Otter Tail	Rice	56021100	263	
Otter Tail	Rice	56036300	350	
Otter Tail	Rush	56014100	5,340	
Otter Tail	Sharp	56048200	160	
Otter Tail	Sixteen	56010000	107	
Otter Tail	South Maple	56000400	160	
Otter Tail	Star	56038500	4,809	
Otter Tail	Tamarack	56019200	440	
Otter Tail	Tamarack	56043300	470	
Otter Tail	Unnamed	56127300	126	
Otter Tail	Unnamed	56151700	23	
Otter Tail	Unnamed	56155000	14	
Otter Tail	Unnamed	56157800	29	
Otter Tail	Unnamed	56019800	69	
Otter Tail	Unnamed	56028400	83	
Otter Tail	Unnamed	56108300	198	
Otter Tail	Unnamed	56092700	35	
Otter Tail	Unnamed	56125900	12	
Otter Tail	West Battle	56023900		
Otter Tail	West Lost	56048100	915	
Otter Tail	Wing River	56004300	138	
Pine	Big Pine	58013800		
Pine	Cedar	58008900	71	
Pine	Crooked	58002600	94	85
Pine	Fox	58010200		
Pine	Grass	58012500		
Pine	Hay Creek Flowage	58000500	66	40
Pine	Kettle River	58r2		
Pine	Little North Sturgeon	58006600	20	
Pine	McCormick	58005800		
Pine	Passenger	58007600	75	
Pine	Pokegama (& River)	58014200	1,621	16

County name	Location Name (i.e. Lake or River)	MN Lake ID	Location size (acres)	Estimated wild rice coverage (acres)
Pine	Rush	58007800	88	
Pine	Stanton	58011100	84	34
Pine	Willow River	58r1		
Polk	Unnamed (Round)	60072100	9	2
Pope	Rice	61006900		
Ramsey	Grass	62007400		
Redwood	Rice Creek	64r1		
Rice	Cedar	66005200	927	93
Rice	Dudley	66001400	83	
Rice	Hatch	66006300	102	10
Rice	Hunt	66004700	190	19
Rice	Kelly	66001500	62	
Rice	Mud	66005400	269	54
Rice	Pooles	66004600	182	
Rice	Rice	66004800		
Rice	Unnamed	66010300	26	
Rice	Weinberger	66004100	53	8
Rice	Willing	66005100	53	5
Roseau	Bednar Impoundment	68IMP002	240	40
Scott	Artic	70008500		
Scott	Blue	70008800	316	120
Scott	Fisher	70008700	396	190
Scott	Rice	70006000		
Scott	Rice	70002500	328	160
Scott	Rice	70000100		
Sherburne	Big Mud	71008500	263	100
Sherburne	Buck Lake	71IMP007	30	26
Sherburne	Clitty	71011600	56	
Sherburne	Fremont	71001600	466	
Sherburne	Jim	71011100	20	20
Sherburne	Johnson Slough	71IMP004	65	10
Sherburne	Johnson Slought	71008400		
Sherburne	Josephine	71006800	132	
Sherburne	Josephine Pool	71IMP008	143	72
Sherburne	Kliever Marsh	71000300	37	
Sherburne	Long Pond	71003600	82	
Sherburne	Lower Roadside	71IMP006	8	7
Sherburne	Lundberg Slough	71010900	50	
Sherburne	Muskrat Pool	71IMP003	299	15
Sherburne	Orrock Lake	71IMP010	215	162
Sherburne	Rice	71001500	11	
Sherburne	Rice	71007800	505	

County name	Location Name (i.e. Lake or River)	MN Lake ID	Location size (acres)	Estimated wild rice coverage (acres)
Sherburne	Rice	71014200	187	2
Sherburne	Schoolhouse Pool	71IMP009	225	90
Sherburne	Sherburne NWR - Pool 1	71IMP001	2	2
Sherburne	Sherburne NWR - Pool 2	71IMP002	30	15
Sherburne	Sherburne NWR - Pool 31	71IMP011		
Sherburne	Unnamed	71002500	31	
Sherburne	Upper Roadside	71IMP005		
Sibley	Titlow	72004200	924	
St. Louis	???	69IMP002		15
St. Louis	Alden	69013100	190	
St. Louis	Anchor	69064100	316	32
St. Louis	Angell Pool	W0889001	500	80
St. Louis	Artichoke	69062300	306	
St. Louis	Balkan	69086000	36	2
St. Louis	Bear	69011200	125	125
St. Louis	Bear Island River	69r8		
St. Louis	Bear Trap	69008900	131	
St. Louis	Big	69019000	2,049	20
St. Louis	Big Rice	69017800	416	416
St. Louis	Big Rice	69066900	2,072	1,700
St. Louis	Birch	69000300	7,628	381
St. Louis	Black	69074000	118	
St. Louis	Blueberry	69005400	130	13
St. Louis	Bootleg	69045200	352	
St. Louis	Breda	69003700	137	135
St. Louis	Burntside	69011800	7,314	
St. Louis	Canary	69005500	22	1
St. Louis	Caribou	69048900	569	3
St. Louis	Cloquet River	69r5		
St. Louis	Comet	69026700	28	
St. Louis	Cranberry	69014700	69	
St. Louis	Crane	69061600	3,396	600
St. Louis	Deadmans	69IMP001	5	
St. Louis	Dollar	69053400	51	51
St. Louis	Duck	69019100	126	
St. Louis	Eagles Nest #3	69028500	1,028	
St. Louis	East Stone	69063800	92	24
St. Louis	East Twin	69016300		
St. Louis	Echo	69061500		
St. Louis	Ed Shave	69019900	90	
St. Louis	Elliot	69064200	393	20
St. Louis	Embarrass River	69r3		

County name	Location Name (i.e. Lake or River)	MN Lake ID	Location size (acres)	Estimated wild rice coverage (acres)
St. Louis	Five Mile	69028800	106	10
St. Louis	Four Mile	69028100	86	1
St. Louis	Gafvert	69028000	33	1
St. Louis	George	69004000	42	
St. Louis	Gill	69066700	18	
St. Louis	Grand	69051100	1,742	10
St. Louis	Grass	69077600	49	1
St. Louis	Grassey	69091300		
St. Louis	Grassy	69008200		
St. Louis	Grassy	69021600		
St. Louis	Gull	69009200	196	20
St. Louis	Hay	69044100	47	
St. Louis	Hay	69043500	78	78
St. Louis	Hay	69015000	32	1
St. Louis	Hay	69057900	114	114
St. Louis	Hay	69043900	42	1
St. Louis	Hay	69041700	82	45
St. Louis	Hockey	69084900	139	70
St. Louis	Hoodoo	69080200	252	252
St. Louis	Horseshoe	69025500	39	10
St. Louis	Indian	69002300	57	
St. Louis	Jeanette	69045600		
St. Louis	Johnson	69011700	473	24
St. Louis	Joker	69001500	46	5
St. Louis	King	69000800	320	39
St. Louis	Kylen	69003400	16	2
St. Louis	La Pond	69017700	176	176
St. Louis	Leeman	69087500	284	90
St. Louis	Lieung	69012300	476	10
St. Louis	Little Birch	69027100	58	
St. Louis	Little Cloquet River	69r6		
St. Louis	Little Indian Sioux River	69r7		
St. Louis	Little Mesaba	69043600		
St. Louis	Little Rice	69061200	266	266
St. Louis	Little Sandy	69072900	89	89
St. Louis	Little Stone	69002800	163	
St. Louis	Little Vermillion	69060800	558	
St. Louis	Long (Butterball)	69004400	442	400
St. Louis	Low	69007000	353	71
St. Louis	Lower Pauness	69046400	162	1
St. Louis	Martin	69076800	71	
St. Louis	Moose	69079800	82	62

County name	Location Name (i.e. Lake or River)	MN Lake ID	Location size (acres)	Estimated wild rice coverage (acres)
St. Louis	Mud	69015100	51	
St. Louis	Mud	69080000	71	18
St. Louis	Mud	69004700		
St. Louis	Mud Hen	69049400	165	
St. Louis	Myrtle	69074900	876	
St. Louis	Nels	69008000	200	2
St. Louis	Nichols	69062700	444	22
St. Louis	One Pine	69006100	369	37
St. Louis	Oriniack	69058700	748	
St. Louis	Papoose	69002400	16	16
St. Louis	Pelican (& River)	69084100	11,944	119
St. Louis	Perch	69068800	79	32
St. Louis	Petrel Creek	69r4		
St. Louis	Picket	69007900	78	7
St. Louis	Pike River	69r1		
St. Louis	Prairie	69084800	807	16
St. Louis	Rainy	69069400	220,800	
St. Louis	Rainy (Grassy Narrows)	69064000		
St. Louis	Rat	69092200		
St. Louis	Rat	69073700		
St. Louis	Rice	69057800	41	41
St. Louis	Rice	69080300		
St. Louis	Round	69004800	336	
St. Louis	Ruth	69001400	47	9
St. Louis	Sandpoint	69061700		
St. Louis	Sandy	69073000	121	121
St. Louis	Seven Beaver	69000200	1,508	1,282
St. Louis	Shannon (& River)	69092500	135	108
St. Louis	Side	69069900	25	15
St. Louis	Simian Lake	69061900	81	5
St. Louis	Sioux River	69r9		
St. Louis	Six Mile	69028300	103	1
St. Louis	St. Louis River	69r2		
St. Louis	Stone	69004600	230	173
St. Louis	Stone	69068600	160	24
St. Louis	Sturgeon	69093900	2,050	243
St. Louis	Sunset	69076400	309	6
St. Louis	Susan	69074100	305	
St. Louis	Tommila	69003500	87	85
St. Louis	Trettel Pool	W0889002	30	3
St. Louis	Turpela	69042700	76	61
St. Louis	Twin	69050400	18	1

County name	Location Name (i.e. Lake or River)	MN Lake ID	Location size (acres)	Estimated wild rice coverage (acres)
St. Louis	Twin	69069500		
St. Louis	Unnamed	69063400	101	20
St. Louis	Unnamed (Camp 97)	69059400	25	
St. Louis	Upper Bug	69040600	23	
St. Louis	Upper Pauness	69046500	215	1
St. Louis	Vang	69087600	126	3
St. Louis	Vermilion	69037800	49,110	250
St. Louis	Vermilion River	69061300	1,125	562
St. Louis	Wabuse	69040800	64	51
St. Louis	Washusk #1	69040900	51	40
St. Louis	Watercress	69079700	43	43
St. Louis	Watercress (Mud)	69079700	30	
St. Louis	Wheel	69073500	11	6
St. Louis	Whitchel	69053100	71	53
St. Louis	White Iron	69000400		
St. Louis	Wild Rice	69037100	2,133	1
St. Louis	Wolf	69014300	456	
Stearns	Anna	73012600	133	
Stearns	Big Rice	73016800	282	
Stearns	Cedar	73022600	152	
Stearns	Crow	73027900	461	
Stearns	Fifth	73018000	76	
Stearns	Fish	73028100	204	
Stearns	Grass	73029400	157	
Stearns	Gravel	73020400	55	
Stearns	Henry	73016000	62	
Stearns	Henry	73023700	191	
Stearns	Linneman	73012700	108	
Stearns	Little Rice	73016700	56	
Stearns	Lower Spunk	73012300	269	
Stearns	McCormic	73027300	211	
Stearns	Middle Spunk	73012800	242	
Stearns	Mud	73016100	55	
Stearns	Raymond	73028500	126	
Stearns	Rice	73019600	1,568	
Stearns	Sagatagan	73009200	170	
Stearns	Schultz Slough	73020100	29	
Stearns	Tamarack	73027800	470	235
Steele	Oak Glen	74000400	350	4
Steele	Rice	74000100	697	467
Todd	Beck	77005600	57	25
Todd	Cass County	77000400	25	18

County name	Location Name (i.e. Lake or River)	MN Lake ID	Location size (acres)	Estimated wild rice coverage (acres)
Todd	Hayden	77008000	253	1
Todd	Jacobson	77014300	40	
Todd	Jaeger	77007500	46	28
Todd	Lawrence	77008300	172	
Todd	Little Fishtrap	77007400		
Todd	Little Pine	77013400		
Todd	Long	77006900	356	338
Todd	Mud	77008700	398	318
Todd	Pine Island	77007700	156	
Todd	Rice	77006100	675	60
Todd	Robbinson Pond	77IMP001	60	30
Todd	Rogers	77007300	185	130
Todd	Sheets	77012200	100	
Todd	Stones	77008100	63	
Todd	Thunder	77006600		
Todd	Tucker	77013900	43	
Todd	Twin	77002100	317	159
Todd	Unnamed	77020200	70	
Todd	Unnamed	77017600	40	2
Todd	Unnamed	77019700	53	
Todd	Unnamed	77017800	42	23
Todd	Unnamed	77014000	61	
Todd	West Nelson	77000500	84	70
Wabasha	Pool 5	79IMP001	600	35
Wabasha	Unnamed	W0580001	160	25
Wadena	Blueberry	80003400	555	30
Wadena	Burgen	80001800	92	86
Wadena	Finn	80002800	148	30
Wadena	Granning	80001200	50	50
Wadena	Jim Cook	80002700	238	
Wadena	Lower Twin	80003000	267	5
Wadena	Rice	80002400	8	1
Wadena	Round	80001900	58	58
Wadena	Strike	80001300	76	76
Wadena	Unnamed	80000700	16	16
Wadena	Yaeger	80002200	384	346
Wright	Albion	86021200	238	
Wright	Beaver Dam	86029600	253	
Wright	Butler	86019800	131	
Wright	Butternut	86025300	203	
Wright	Carrigan	86009700	162	
Wright	Cedar	86003400	191	

County name	Location Name (i.e. Lake or River)	MN Lake ID	Location size (acres)	Estimated wild rice coverage (acres)
Wright	Gilchrist	86006400	388	
Wright	Gonz	86001900	152	
Wright	Henshaw	86021300	277	
Wright	Long	86019400	255	
Wright	Louisa	86028200	183	
Wright	Malardi	86011200	149	
Wright	Mallard Pass	86018500	51	
Wright	Maple	86019700	82	
Wright	Maple Unit	86015700	177	
Wright	Mary	86004900	331	
Wright	Millstone	86015200	221	
Wright	Mink	86022900	304	
Wright	Mud	86002600	128	
Wright	Mud	86021900	66	
Wright	Pelican	86003100	2,793	
Wright	Pooles	86010200	166	
Wright	Rice	86003200	246	
Wright	Rice	86000200	57	
Wright	Sandy	86022400	118	150
Wright	School	86002500	76	
Wright	School Section	86018000	266	
Wright	Shakopee	86025500	206	
Wright	Smith	86025000	330	
Wright	Spring	86020000	63	
Wright	Taylor	86020400	78	
Wright	White	86021400	145	
Wright	Willima	86020900	246	
	1,286 total locations			
	For the 777 locations that have coverage data		1,569,889	64,328

Appendix C

Wild Rice Harvest Survey

The full report will be posted on the MNDNR website www.dnr.state.mn.us prior to March 1, 2008

Executive Summary

Introduction

The following objectives guided the study design, survey instrument and final report for this effort.

- To determine the characteristics of wild rice harvesters in Minnesota.
- To assess current harvest levels and harvester satisfaction.
- To assess current natural wild rice harvest use of Minnesota lakes and rivers.
- To obtain wild rice harvester opinions of current state regulations and proposed revisions.
- To determine factors that limit wild rice harvesting.
- Identify information needs of wild rice harvesters, and the best means to deliver information to harvesters.
- To determine support for natural wild rice management priorities.

In November of 2006 the Minnesota Department of Natural Resources initiated a self-administered, mail questionnaire of all 2006 wild rice license holders (n=1,625) to gather information on the objectives listed above, and all 2004 and 2005 license holders who did not purchase a license in 2006 (n=945) to gather information on why they did not harvest wild rice in 2006. Completed questionnaires were returned by 53 percent (n=1,365) of the 2,574-license holder sample.

Characteristics

The 2004 to 2006 wild rice license holder respondents were predominately male (82%), Minnesota residents (98%), and averaged 51 years of age. A large majority (81%) are 40 years of age or older. A majority harvested wild rice under only a state license (86%). The average age that harvesters began gathering wild rice was 31. Friends and parents were the primary means of introduction to the activity, and 69 percent of harvesters reported introducing others to gathering wild rice. The average harvester has 13 seasons of experience.

Harvest Levels

Based on responses, an estimated average of 430 pounds of unprocessed natural wild rice was gathered per harvester in 2006. Based on state issued license sales of 1,625 in 2006, this creates a total harvest estimate of approximately 700,000 pounds of natural wild rice. Approximately two percent of 2006 respondents harvested more than 2,000 pounds of rice, while 79 percent harvested less than 500 pounds. When comparing these groups (those harvesting > 500 lbs and those harvesting < 500 lbs) there is a difference in both the average age they began harvesting (20 and 33 years old, respectively) and the average number of seasons participated (25 and 12 years, respectively). A large majority (85%) of harvesters harvest for personal use.

Harvester Satisfaction

A large majority (82%) of 2006 harvesters were satisfied with their overall wild rice harvesting experience, with only one in ten expressing dissatisfaction. Harvesters were neutral on the existing wild rice season opening date (July 15th) and slightly in favor of the current wild rice season hours (9 a.m. to 3 p.m.). Other comment topics included: high licensing fees, less than ideal water levels, lack of processor information, lack of enforcement, weather, shoreline degradation, motor boats in wild rice stands, beaver control, and a need for more regulation of genetically modified wild rice.

Use of Minnesota Lake and Rivers to Harvest Wild Rice

A total of 3,151 trips were reported by 845 harvesters, resulting in an average of 4 trips per person to gather wild rice. Sixty percent (60%) of 2006 harvesters took three or fewer trips, while 12 harvesters (1%) managed 20 or more trips. One half (50%) of the respondents reported harvesting on only one lake, indicating that multiple trips were made to the same lakes. An additional 28 percent reported harvesting on two lakes. The average number of lakes visited for harvesting wild rice was 1.8 across all harvesters. The maximum number of lakes visited was six.

During 2006, over two-thirds (70%) of all wild rice harvesting trips were in Aitkin, St. Louis, Itasca, Crow Wing or Cass counties. The next five counties with the highest number of trips were Becker, Clearwater, Beltrami, Lake and Hubbard counties. The above ten counties had 91 percent of all wild rice harvesting trips. A total of 28 counties were identified as being visited for wild rice gathering.

While 407 locations were identified from the survey results to at least the county level, only 313 noted a specific name (i.e. lake name or river segment). Of these 313 locations, the top ten harvest locations based on harvest pressure (number of trips) account for 27.4 percent of the statewide total. Further review notes that 50 percent of total trips are represented by the top 32 locations and that the top 68 locations represent 66.6 percent of total trips.

State Regulations

About half (53%) of the respondents supported a change in harvesting hours from 9 a.m. - 3 p.m. to 10 a.m. - sunset, and three-fourths (77%) supported changing the wild rice season opening from July 15 to August 14. More than half (62% and 66% respectively) of the respondents opposed use of watercraft up to 38 inches wide or establishing a 7-day nonresident license.

Participation, Information Needs

The most important factors identified by respondents that limit participation in harvesting were personal time, and knowing when and where to harvest wild rice. For respondents that did not harvest is 2006, finding a rice processor ranked highest after personal time. Where and when to harvest are again ranked high for information helpful to 2006 ricers. In order of preference, the preferred method for delivery of information is through web sites, pamphlets or as a section of the DNR Hunting Regulation Handbook. Other limiting factors identified in comments include the cost of the license, fuel and transportation costs, and access (to private and reservation lakes).

Management Priorities

A large majority of respondents ranked water level management as the highest management priority, followed by availability of information. Seeding ranked third, while enforcement of regulations, access site improvement, and wild rice research were ranked fourth, fifth and sixth, respectively. Other comments included protection from genetically modified rice, increased habitat protection, and excessive license fees. Specific habitat protection comments included more restrictions on shoreline development, protection from motorized watercraft, prevention of the removal of wild rice through aquatic plant management permits, and more management of specific lakes that are historical wild rice lakes.

Appendix D

The Life History of Natural Wild Rice

Growth and Development

The following description of the growth of wild rice plants is adapted primarily from the work of Dr. Ervin Oelke and others at the University of Minnesota unless noted otherwise (Oelke et al. 2000, Oelke 2007).

As an annual plant, wild rice develops each spring from seeds that fell into the water and settled into sediment the previous fall or before. Germination requires three to four months of cold, nearly freezing water (35° F or colder). Seeds exposed to drying die. Seed dormancy is regulated through hormonal growth promoters and inhibitors and by an impermeable, tough, wax-covered pericarp. Low oxygen levels can also inhibit germination.

Seed germination typically occurs when the substrate and surrounding water temperatures reach about 40° F. Depending on water depth, latitude, and the progression of spring weather, wild rice germinates in Minnesota sometime in April, well ahead of most but not all perennial plants. Within three weeks, rooted wild rice seedlings develop three submerged leaves. These leaves usually remain submerged and decay as the plant matures. Adventitious roots arise at the first leaf node and occasionally at the second and third nodes. Most, but not all, roots are shallow, often rust-tinged due to iron deposits, and may spread 8 to 12 inches. Natural mortality can be relatively high during the submerged leaf stage (Meeker 2000).

The emergent stage begins with the development of one or two floating leaves and continues with the development of several aerial leaves two to three weeks later. The floating leaves are apparent in late May to mid June in Minnesota, again dependent on water depth, latitude, and weather. It is at this stage of growth that wild rice is most susceptible to uprooting by rapidly changing water levels due to the natural buoyancy of the plant. Rising water levels can significantly stress the plant even if it remains rooted.

The upper portion of the wild rice stem is hollow, with thin evenly spaced partitions. The number of tillers, or additional flowering stems, can vary with plant density and water depth. In deep water there may only be one stem per plant while in shallow water the number can exceed 30. Tillers typically mature 7 to 14 days later than the main stem (Meeker 2000).

Wild rice begins to flower in mid to late July in Minnesota. Flowering times are dependent on both day length and temperature. Short day lengths trigger earlier flowering but a reduction in kernel number. Longer day lengths delay flowering while increasing kernel number. Warmer temperatures will accelerate development, and cooler temperatures will slow growth. Wild rice flowers are produced in a branching panicle with female flowers (pistillate or seed-producing) at the top of the panicle on appressed branches. Female florets typically number about 130 per plant. Male flowers (staminate or pollen-producing) are produced on nearly horizontal branches on the lower portion of the panicle. Natural wild rice is primarily pollinated by wind. High temperatures and low humidity can negatively affect fertilization rates.

There are several variations of the typical wild rice panicle. One is the bottlebrush variant, often associated with male sterility, in which the male flowering branches remain appressed and give the panicle a compact bottlebrush appearance. Another variant is the crowsfoot panicle, in which the female flowering branches spread in the same manner as the male branches. In another variant, the male florets are replaced by female florets, resulting in a gynoecious or entirely female panicle.

Cross-pollination is typical for natural wild rice because the female flowers develop, become receptive, and are pollinated before the male flowers on the same plant shed pollen. The female florets are receptive over a period of about ten days (Moyle 1944b). Cross-pollination is enhanced by plant-to-plant variation for flowering within the same stand due to the effects of water depth, non-synchronous tillering, and genetic differences among plants (Moyle 1944b, Meeker 2000).

Cross-pollination within and among wild rice populations helps maintain genetic variability and the biologic potential for wild rice to adapt to changing conditions. Some changes may be seasonal or annual in nature; others, such as changing climate in the Great Lakes region, will likely be long term. The variability in natural wild rice genetics that exists today may be a critical determinant of whether natural wild rice can adapt to changes in regional weather. Studies in northern Wisconsin found sufficient genetic diversity among geographically distinct stands of natural wild rice to identify four regional populations. The degree of diversity within stands varied widely, however, with larger and denser stands having higher levels (Waller et al. 2000).

When viable pollen grains land on the female stigma, they germinate within one hour and reach the embryo sac within two. Seeds are visible two weeks after fertilization, and they mature in four to five weeks. Immature seeds have a green outer layer that turns purplish black as the seed reaches physiologic maturity.

Seeds ripen over several days on an individual stem, starting at the top. Primary stems ripen earlier than secondary tillers, plants in rivers ripen earlier than those in lakes, plants in shallow water earlier than those in deeper water, and plants in northern Minnesota earlier than those in more southerly stands.

This staggered maturation process means that ripe seeds may be available within individual stands for several weeks, and across the entire range of natural wild rice in Minnesota for a month or longer. This extended period of “shattering”, or dropping of ripened seed, is an important mechanism that insures at least some seeds will survive to perpetuate the natural wild rice stand. The entire process, from germination of a new plant to the dropping of mature seeds, takes about 110 to 130 days (or about 2600 growing-degree days) depending on temperature and other environmental factors.

Not all wild rice seed germinates the following year. Under some conditions, natural wild rice seeds can remain dormant in the bottom sediment for many years to several decades if conditions are not suitable for germination. This allows wild rice to survive years when high water levels or storms reduce or eliminate productivity. Wild rice can germinate and colonize habitats after other plants have been removed by environmental disturbance if a seed bank is present (Meeker, 1999).

Even under ideal growing conditions, wild rice populations follow approximately three to five year cycles (Jenks 1900, Moyle 1944b, Pastor and Durkee Walker 2006, Walker et al. 2006). Highly productive years are followed by unproductive ones followed by a gradual recovery (Moyle 1944b, Grava and Raisanen 1978, Atkins 1986, Lee 1986, Archibold et al. 1989). Recent study suggests that oscillations in wild rice may be caused by delays in nutrient recycling to plant uptake. Wild rice litter accumulation may inhibit plant growth and production (Pastor and Durkee Walker 2006, Walker et al. 2006). In particular, the amount of wild rice straw, stage of decay, and tissue chemistry (root litter) may affect available nutrients, influence production, and result in population cycling (Walker, Ph.D. thesis 2008).

Habitat Requirements

While the historical range of wild rice illustrates its broad distribution, its specific occurrence and abundance is in large part dependent on local environmental conditions. The following descriptions are a capsulation of the historical and current literature (Moyle 1944a, Rogosin 1951, Lee 2000, Meeker 2000, Oelke 2007). For more detailed information be sure to check the original sources.

Hydrology

Wild rice generally requires some moving water, with rivers, flowages, and lakes with inlets and outlets being optimal areas. Water basins with intermittent or seasonal flow may sustain beds, but annual production will fluctuate more widely. Seasonal water depth is critical. Wild rice grows well in about 0.5 - 3 feet of water, although plants may be found deeper. Shallower sites support strong competition from perennial emergent plants and deeper water stresses the plant to the point that seed production is limited or nonexistent. At Rice Lake National Wildlife Refuge from 2002 to 2005, production and growth parameters were highest at water depths of 1- 30 inches (McDowell, personal communication).

Water levels that are relatively stable or decline gradually during the growing season are preferred. Abrupt water level increases during the growing season can uproot plants. Wild rice is particularly sensitive to this disturbance during the floating leaf stage. However, some observers feel that water levels kept stable over the long term (multiple years) tend to favor perennial aquatic vegetation over wild rice (David and Vogt, personal communication).

Water characteristics

Clear to moderately stained water is preferred, as darkly stained water may limit sunlight penetration and hinder early plant development.

Wild rice grows over a wide range of alkalinity, pH, iron, and salinity. It does best in water that has a pH range of 6.0 - 8.0 and alkalinity greater than 40 ppm. Some of the measured chemistry parameters are alkalinity (5-250 ppm), pH (6.4-10.1 SU), Iron (0.1-3.0 ppm) and True Color (50-300 Pt-Co) (Andryk 1986, Persell and Swan 1986).

The state of Minnesota instituted a water quality criterion for sulfate in wild rice waters of 10 mg/liter. The level was established based on observations by Moyle (1944a), however, other field observations and research show that wild rice can grow in waters with significantly higher sulfate concentrations (Grava 1981, Lee and Stewart 1983, Peden 1982). This research also indicates that factors such as oxygen levels and potential sediment anoxia are involved in the wild rice-sulfate connection.

While researchers have observed that natural wild rice ecosystems are relatively nutrient rich, excess levels of nutrients, especially phosphorus, can have significant adverse effects on natural wild rice productivity (Persell and Swan 1986).

Sediment

Although wild rice may be found growing in a variety of bottom types, the most consistently productive are lakes with soft, organic sediments (Lee 1986). The high organic matter content with a rather low carbon/nitrogen ratio is necessary to meet the rather high nitrogen needs of wild rice (Carson 2002). Nitrogen and phosphorus are major limiting nutrients for wild rice (Carson 2002). Flocculent sediments with nitrogen and phosphorus concentrations less than one gram per square meter are typically incapable of supporting sustained production (Lee 1986).

Competing Vegetation

As an annual plant sprouting each year from seed, wild rice can have difficulty competing with aggressive perennial vegetation, particularly where natural hydrologic variation has been reduced. Cattail (*Typha* spp.), particularly hybrid cattail (*Typha x glauca*), yellow water lily (*Nuphar variegata*), and pickerelweed (*Pontederia cordata*) are examples of plants that have been cited as competing with wild rice (Norrgard, David, and Vogt, personal communication).

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Appendix F
Stakeholder Comments

Wild Rice WQLS, Exhibit M

UNIVERSITY OF MINNESOTA

North Central Research and Outreach Center
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Date: February 10, 2008
To: Legislators of the State of Minnesota
From: Dr. Raymie Porter, University of Minnesota Raymie Porter
Re: The report "Natural Wild Rice in Minnesota" submitted by the DNR

In this statement I do not speak on behalf of the University of Minnesota, but rather as a scientist who has been engaged in research on cultivated wildrice breeding at the University of Minnesota for almost 20 years.

I would like to commend the Technical Team convened by the DNR to pull together the information that contributed to this report. Although the participants represent diverse interests when it comes to wildrice, our meetings have been characterized by a vigorous interchange of ideas with mutual respect, while focusing on what is actually known about wildrice. I hope that future efforts to deal with the issues identified by this report will be as positive and fruitful as what I have experienced in the meetings of the Technical Team. I would like to add the following comments to the report for emphasis.

The loss of genetic diversity should be viewed *not* as a primary *cause*, but rather as an *effect* resulting from other causes. Granted, addressing the loss of genetic diversity is crucial for the species to flourish in state waters. Loss of genetic diversity means loss of the alleles (or variant forms) of genes across the many natural populations of wildrice, which also means that there are fewer genotypes (genetic types) for a given trait within a given population. Having fewer genotypes may limit a population's ability to respond to seasonal, yearly, or long-term changes in the local environment of that population. This is especially true if the genotypes lost are ones needed for adaptation to conditions that prevail at that site. But, since loss of genetic diversity is usually caused by factors that reduce the number of individuals in populations to low numbers, alleviating the problems that reduce wildrice stands will help maintain the genetic diversity of wildrice. The report does a good job of characterizing the primary threats that limit wildrice stands and that could therefore reduce genetic diversity.

But how will we know whether or how genetic diversity is being affected? Only through knowledge about the genetics of wildrice. Sound scientific knowledge about the genetic make-up of natural stands, coupled with knowledge about how different genes respond to various environmental factors, should prove useful in guiding restoration efforts. If seeds need to be brought in from other natural stands in order to restore a site, knowing the genetics of the potential donor stands could help identify those that might be most similar to the population that remains at, or that once existed at, the site.

What about cultivated wildrice? Is the breeding of wildrice really a threat to natural stands from a genetic perspective? The consensus of the Technical Team is that it is not. I agree with this perspective. In fact, I believe that cultivated wildrice should not be made a scapegoat for problems in natural stands. I have heard speculations that cultivated wildrice causes this or that problem observed in a natural stand– speculations without evidence. What I know about population genetics leads me to the conclusion that such speculations will never find evidence to support them. Some basic facts about population genetics and wildrice should shed light on this.

Cultivated varieties (cultivars) of wildrice in Minnesota are not genetically uniform—they are heterogeneous, or made up of many different genotypes. The wildrice breeding project at the University of Minnesota has endeavored to maintain as much genetic diversity as possible in the cultivars released. Also, since all the genes in cultivars ultimately originated in the natural wildrice gene pool, they are a subset of the total genetic variability of wildrice. No new alleles or genes have been artificially added (i.e., no genetic engineering has been done, nor is it being pursued). Therefore, it seems reasonable to assume that cultivated wildrice has less total genetic diversity than natural wildrice. But this is the norm for any cultivated crop species, since breeders would tend to select only those alleles (variant forms) of genes that make the crop better adapted under the narrower range of cultivated conditions. Conversely, breeding a crop for adaptation to cultivated conditions tends to make it less fit for survival in the wild.

But even if a wildrice cultivar were genetically uniform, that uniformity should not impact the vast diversity of natural wildrice. There are many more acres of natural stands than cultivated stands, and they are rarely in close proximity to each other. That wildrice pollen travels over long distances has *not* been established. But even if pollen should travel between cultivars and natural stands, it could just as easily travel from one natural stand to another. And pollen moving from one natural stand to another natural stand nearby would likely be so few in number compared to the pollen produced locally that it would be diluted to insignificant amounts. Also, the viability of that pollen once it arrives is in doubt, given the short life of wildrice pollen.

"Migration" is the term used by population geneticists to describe gene movement between populations. But what would happen in those cases of successful migration of alleles of genes into a population? If the allele of that gene is *already* present in the population, the migration doesn't add anything new. If the allele is *not* already present, it would *add* to the genetic diversity of the population where it has found its home. This new allele, along with all the other alleles already present in the population, are then subjected to the forces of natural selection. If the allele increases the fitness of the plant to survive under the conditions of that population, natural selection favors it, and it will increase in its frequency in the population according to how much fitness it adds. If it decreases the fitness of the plant, natural selection will not favor it, and other plants with more favorable alleles will out-compete it. In this manner, natural selection will determine the genetic make-up of the population.

The heterogeneous nature of wild populations is the response of those populations to ever-changing local conditions. Any given year, some genotypes will do well, others will do poorly. In a different season, other different genotypes may prevail. In short, those plants with alleles that enable the plant to grow well and produce more seed under the local environmental conditions will contribute those genes to the next generation. Natural selection will enable the best plants to survive. This will be the case as long as there is enough genetic variability to allow adaptation to that environment.

Therefore, those factors that are known to adversely impact natural stands should be the focus of efforts to protect and enhance natural wildrice. This would accomplish the most to prevent loss of genetic diversity. It has been stated in the report that the threat of transgenic wildrice doesn't exist—no one knows of anyone who is pursuing it, and it seems unlikely that they would. Traditional (or conventional) breeding of wildrice is not a threat, by consensus of the Technical Team, for the reasons that I have just given. Other threats have been identified as important. Those threats should be addressed.

Wild Rice WQLS, Exhibit M

MINNESOTA CULTIVATED
WildRice
COUNCIL

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February 11, 2008

Ray Norrgard
Wetland Wildlife Program Leader
MN DNR
500 Lafayette Rd.
St. Paul, MN 55155-4020

Dear Mr. Norrgard:

As President of the Minnesota Cultivated Wild Rice Council (MCWRC), I appreciate the opportunity to comment on the Natural Wild Rice in Minnesota Study you were required to complete and are submitting to the Minnesota Legislature. The protection of natural stands of wild rice is an extremely important issue and is supported strongly by the MCWRC.

As I'm sure you know, cultivated wild rice plays an important role in Minnesota's rural economy. It is grown on marginal crop lands, providing income to some of the poorest counties in Minnesota. As forestry, mining, and other industries have lost jobs in the region, alternative opportunities for employment have become more important to the region. The cultivated wild rice industry has provided much-needed economic activity in these northern Minnesota counties. More than 500 people derive full or part-time employment directly from the cultivated wild rice industry in Minnesota, many of them on farms that have been in the family for four generations. On a full-time equivalent basis, these jobs equal more than 200 positions.

Additionally, the wild rice industry generates about $3.1 million in employee compensation annually. It also contributes a total of $8.7 million in total employee payroll and over $21 million in revenues to Minnesota's economy. Other industries share in about $20 million in revenues directly related to the wild rice industry. So you can see how important the cultivated wild rice industry is to northern Minnesota. *(The economic information cited herein is taken from a 1992 study of the economic impact of wild rice in Minnesota. Therefore, these figures understate the contributions of wild rice to Minnesota's economy in today's dollars.)*

With regard to the legislation passed in 2007 which requires an environmental impact statement for any proposed release of genetically modified wild rice and a study of potential threats to natural stands of wild rice, the MCWRC remained neutral. However, we feel it is very important to address a couple of specific issues as they relate to cultivated wild rice in Minnesota.

First, we would like to bring attention to the fact that, as noted in the wild rice study, traditional wild rice breeding programs do not pose a threat to natural stands. Wild rice grown in paddies is the same genus and species as that found in natural stands. Evidence to support this fact can be found by analyzing the 2007 harvest.

Wild Rice WQLS, Exhibit M

In 2007, hand harvesters enjoyed their most productive harvest in more than 40 years - at the same time cultivated wild rice producers recorded their highest production ever, a virtual impossibility if cultivated wild rice truly had a negative impact on natural stands. An article by Rod Ustipak, coordinator of a wild rice management program in Minnesota for Ducks Unlimited (DU) and the Minnesota Department of Natural Resources (DNR), which appeared in the September 16, 2007 edition of the St. Paul Pioneer Press (an article still available online at http://www.ducks.org/news/1359/DroughtimprovesMinne.html), explains how drought conditions over the past few years have actually conspired to create an environment in which natural stands thrived and produced a bumper harvest, conditions completely unrelated to cultivated wild rice production.

Secondly, although it is mentioned in the Natural Wild Rice In Minnesota Study as a concern, we feel it is extremely important to explicitly state the following: ***genetically engineered wild rice does not exist.***

There is a widely held belief, though completely inaccurate, that wild rice is somehow, somewhere being genetically modified or engineered. It is not. The MCWRC is neither developing, nor does it have plans to develop genetically engineered wild rice. We are not aware of any entity that is developing GE wild rice. The federal and state regulatory processes currently in place, coupled with the enormous investment (in the millions of dollars) necessary to develop GE wild rice, renders any effort to do so cost prohibitive. These facts, coupled with the recently passed legislation which requires an environmental impact study prior to the release of any genetically modified varieties of wild rice provide ample safeguards to the environment to ensure food safety and environmental integrity.

Since natural wild rice stands gave birth to the cultivated wild rice industry in Minnesota growers are keenly aware of the importance of protecting them. In fact, the MCWRC board of directors went on record with its support of protecting natural stands when it passed the following resolution at its July 27, 2005, board meeting, *"The MCWRC fully supports the protection of native stands of wild rice in Minnesota. There is no genetic engineering of wild rice occurring. The biosafety requirements in place through the coordinated framework of the USDA, EPA, FDA, the State of Minnesota, and the University of Minnesota are working well to assure a safe environment and food supply."*

Many threats may exist to natural stands of wild rice – shoreline development, climate change, wildlife activity, and recreational water use just to name a few. If we are to be successful in maintaining the vigor and existence of natural stands it is imperative that we analyze and focus our efforts on current threats - those that exist now - rather than perceived threats which are likely never to exist.

Sincerely,

Beth Nelson,
President

Tribal Statement Regarding MNDNR Wild Rice Study
Submitted To the State Legislature February 15, 2008

We appreciate the opportunity to provide input into the development of this *Natural Wild Rice in Minnesota* report. Manoomin (wild rice) is a remarkable and valuable component of the Minnesota landscape, and it is commendable that the State is concerned with its future. We concur with most of the wild rice history, ecology and proposed management recommendations contained therein and offer our statements below as points for emphasis and clarity to the Legislature and State DNR.

Manoomin is an inherent part of being Ojibwe. Our lifestyles and cultural identity are intimately bound to manoomin, spiritually, physically and economically. The importance of manoomin to the Ojibwe people cannot be overstated as it holds a central position in the lives and rich history of the Ojibwe people. It is more than just another grain or crop; it is a cultural resource of indescribable importance. It is a sacred gift from the creator to our people and is used for sustenance, ceremonial and commercial purposes.

The right of the Ojibwe to harvest and use manoomin was reserved and guaranteed in treaties signed between the Chippewa Bands of the region and the federal government that predate Minnesota statehood. Recent Supreme Court rulings have upheld the existence of these treaty reserved rights along with the federal trust responsibility to uphold these rights, and resources they are built upon.[1] Today, Tribal members continue to harvest manoomin, as they have for many years, in numbers greater than the rest of the state population. The very existence of the Ojibwe people depends on the vitality of their environment, their resource use and their culture which is intricately connected to natural wild rice.

Science and technology in the world is rapidly changing and challenging the environment of our daily lives. Threats to the existence and integrity of natural stands of wild rice are of immense concern to the Ojibwe. Today, the thought of genetic modification of wild rice poses an alarming threat into the possibility of irreversible genetic contamination of our natural stands of wild rice. This would have a profound negative impact on the Ojibwe people. The connection between Ojibwe culture and wild rice is not a static concept and should not be viewed as such. Rather, our relationship to wild rice should be acknowledged as a respectful, living force that guides the growth and development of our Ojibwe communities, as it has for centuries.

We feel strongly that manoomin must be protected from genetic engineering. From the beginning of the genetic engineering debate in Minnesota, the tribes have wanted GE wild rice banned. For the Ojibwe, no level of contamination is acceptable. Once genetic contamination occurs, there is likely no way to reverse it. There are published documents and reports demonstrating that genetically engineered plants can escape test plots and intermingle with native populations at distances greater than was previously thought. These same studies have shown that the range of impacts on native populations is significantly greater than currently recognized.[2] Thus, if GE wild rice were to be grown in Minnesota, it is not a question of whether contamination will occur rather, it is a question of how quickly and to what extent contamination will occur.

We recognize and appreciate that the current statute requiring an Environmental Impact Statement prior to any proposed release of GE wild rice represents progress. However, we desire complete and permanent protection for manoomin. There are currently no proven safe guards that could effectively isolate GE strains of wild rice from natural stands. The only way to prevent genetic contamination is to ensure that no GE wild rice is released into the environment. A ban on genetically engineered rice in Minnesota would be the best way to achieve this.

We recommend that the State Legislature require the Environmental Quality Board to specifically include Tribal cultural impacts as part of any GE wild rice Environmental Impact Statement process. Statements should include effects on the cultural practices of the Tribal community and State and address effects on Ojibwe culture, and traditional and customary rights.

We can not afford to hesitate when it comes to protecting natural stands of wild rice. We must conserve the biodiversity of natural wild rice stands. The rapid development of new technology and science combined with corporate exploitation of resources adds to the urgency. We must not allow Minnesota manoomin to be genetically contaminated by genetically engineered varieties that may be developed. This resource is far too precious, far too significant ecologically, economically and culturally, and far too sacred to allow this to occur. The protection and preservation of natural bed wild rice needs to be the concern of all Minnesotans. We desire to work with the State of Minnesota to ensure that wild rice is protected fully and permanently.

Bois Forte Band of Chippewa
Fond du Lac Band of Lake Superior Chippewa
Grand Portage Band of Chippewa
Leech Lake Band of Ojibwe
Mille Lacs Band of Ojibwe
White Earth Band of Ojibwe
The Minnesota Chippewa Tribe
1854 Treaty Authority
Great Lakes Indian Fish and Wildlife Commission
White Earth Land Recovery Project

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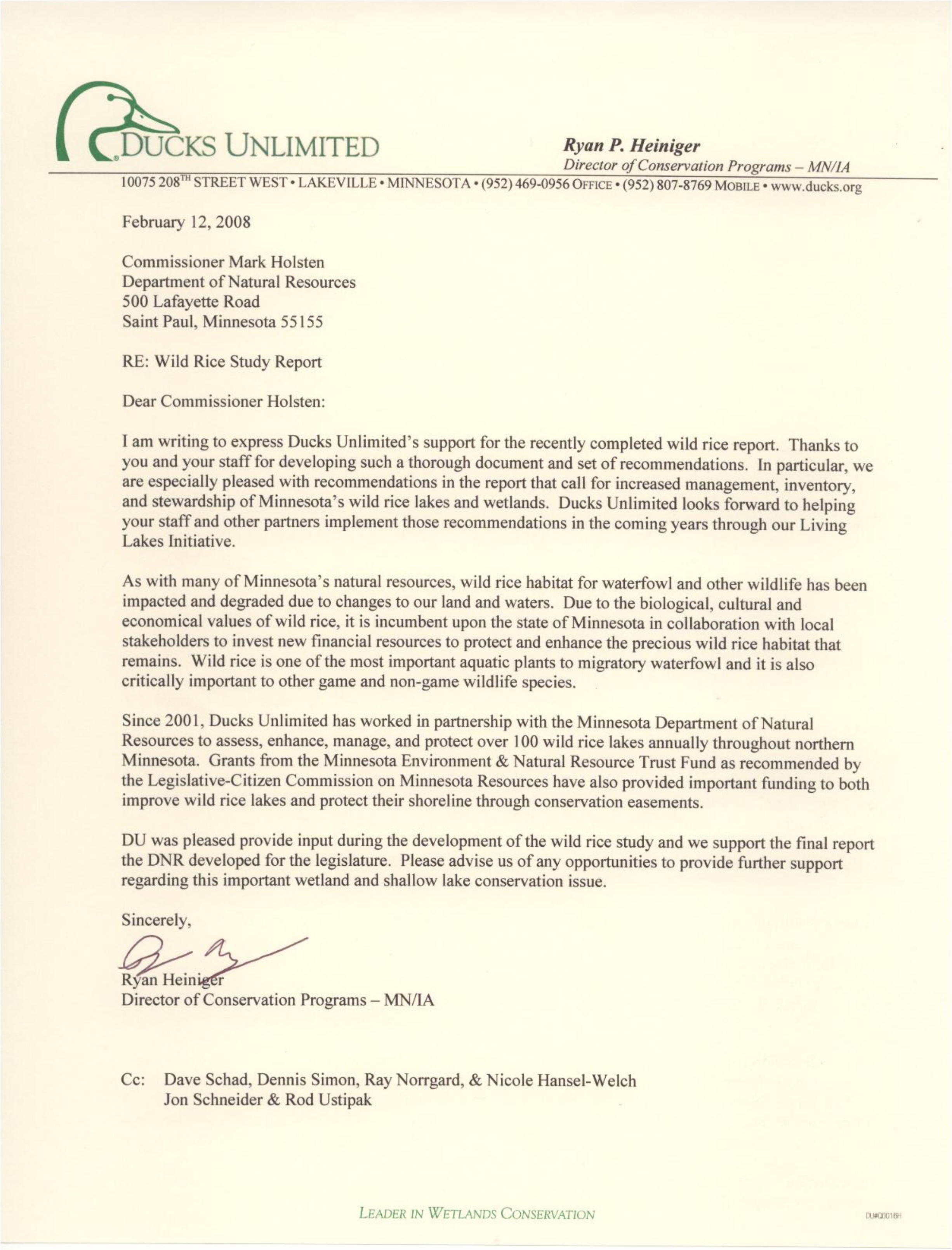
[1] None of the material in this report can be construed to abrogate, abridge, affect, modify, supersede or alter any treaty-reserved right or other sovereign rights of the regions Chippewa Bands' as recognized by any means, including but not limited to, agreements with the United States, Executive Orders, statutes, judicial decrees, or Federal law.

[2] The following references represent a small sample of the research on the uncertainty of the impact and fate of genetically engineered organisms on natural ecosystems: Schoen, DJ, Reichman JR, and Ellstrand, NC 2008. Transgene Escape Monitoring, Population Genetics, and the Law. Bioscience Vol. 58 No. 1: 71-77; Ponti, Luigi, 2005. Transgenic Crops and Sustainable Agriculture in the European Context, Bulletin of Science Technology & Society Vol. 25, No. 4: 289-305; Lundmark, C, 2007, Genetically Modified Maize, Bioscience Vol. 57, No. 11: 996.

Wild Rice WQLS, Exhibit M



DUCKS UNLIMITED

Ryan P. Heiniger
Director of Conservation Programs – MN/IA

10075 208TH STREET WEST • LAKEVILLE • MINNESOTA • (952) 469-0956 OFFICE • (952) 807-8769 MOBILE • www.ducks.org

February 12, 2008

Commissioner Mark Holsten
Department of Natural Resources
500 Lafayette Road
Saint Paul, Minnesota 55155

RE: Wild Rice Study Report

Dear Commissioner Holsten:

I am writing to express Ducks Unlimited's support for the recently completed wild rice report. Thanks to you and your staff for developing such a thorough document and set of recommendations. In particular, we are especially pleased with recommendations in the report that call for increased management, inventory, and stewardship of Minnesota's wild rice lakes and wetlands. Ducks Unlimited looks forward to helping your staff and other partners implement those recommendations in the coming years through our Living Lakes Initiative.

As with many of Minnesota's natural resources, wild rice habitat for waterfowl and other wildlife has been impacted and degraded due to changes to our land and waters. Due to the biological, cultural and economical values of wild rice, it is incumbent upon the state of Minnesota in collaboration with local stakeholders to invest new financial resources to protect and enhance the precious wild rice habitat that remains. Wild rice is one of the most important aquatic plants to migratory waterfowl and it is also critically important to other game and non-game wildlife species.

Since 2001, Ducks Unlimited has worked in partnership with the Minnesota Department of Natural Resources to assess, enhance, manage, and protect over 100 wild rice lakes annually throughout northern Minnesota. Grants from the Minnesota Environment & Natural Resource Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources have also provided important funding to both improve wild rice lakes and protect their shoreline through conservation easements.

DU was pleased provide input during the development of the wild rice study and we support the final report the DNR developed for the legislature. Please advise us of any opportunities to provide further support regarding this important wetland and shallow lake conservation issue.

Sincerely,

Ryan Heiniger
Director of Conservation Programs – MN/IA

Cc: Dave Schad, Dennis Simon, Ray Norrgard, & Nicole Hansel-Welch
Jon Schneider & Rod Ustipak

LEADER IN WETLANDS CONSERVATION

DU#Q0016H

Wild Rice WQLS, Exhibit M

MARCH 3, 1849

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Tamarac National Wildlife Refuge
35704 County Highway 26
Rochert, Minnesota 56578-9638
Phone: 218/847-2641   Fax: 218/847-9141

TMC-08-003

February 15, 2008

Ray Norrgard
Wetland Wildlife Program Leader
Minnesota Department of Natural Resources
500 Lafayette Rd.
St. Paul, MN 55155-4020

Subject: **Wild Rice Study document "Natural Wild Rice in Minnesota."**

Dear Mr Norrgard:

This is a letter of endorsement for the above mentioned document and for the document development process. The U.S. Fish and Wildlife Service (Service) has long recognized the ecological importance of natural wild rice stands and associated wetlands. The establishment of National Wildlife Refuges, such as Tamarac and Rice Lake, for the purpose of managing these wetland habitats for the benefit of migrating and resident wildlife is evidence of this appreciation. This study, which provides exceptional background information on the importance of natural wild rice as well as identifies potential threats and management challenges, will be extremely useful in the continued management of this critical resource. Additionally, the process fostered a close working relationship between State, Tribal and Federal governments, university researchers, non-government organizations and well as interested citizens. This collaborative effort is essential to insuring the abundance of natural wild rice for future generations.

Thank you for the opportunity to participate in this process and provide comments.

Sincerely,

Barbara Boyle

Barbara Boyle
Refuge Manager

Wild Rice WQLS, Exhibit N

University of Minnesota Field Survey Data (Feb. 6, 2015) Excerpted for Sulfate Data

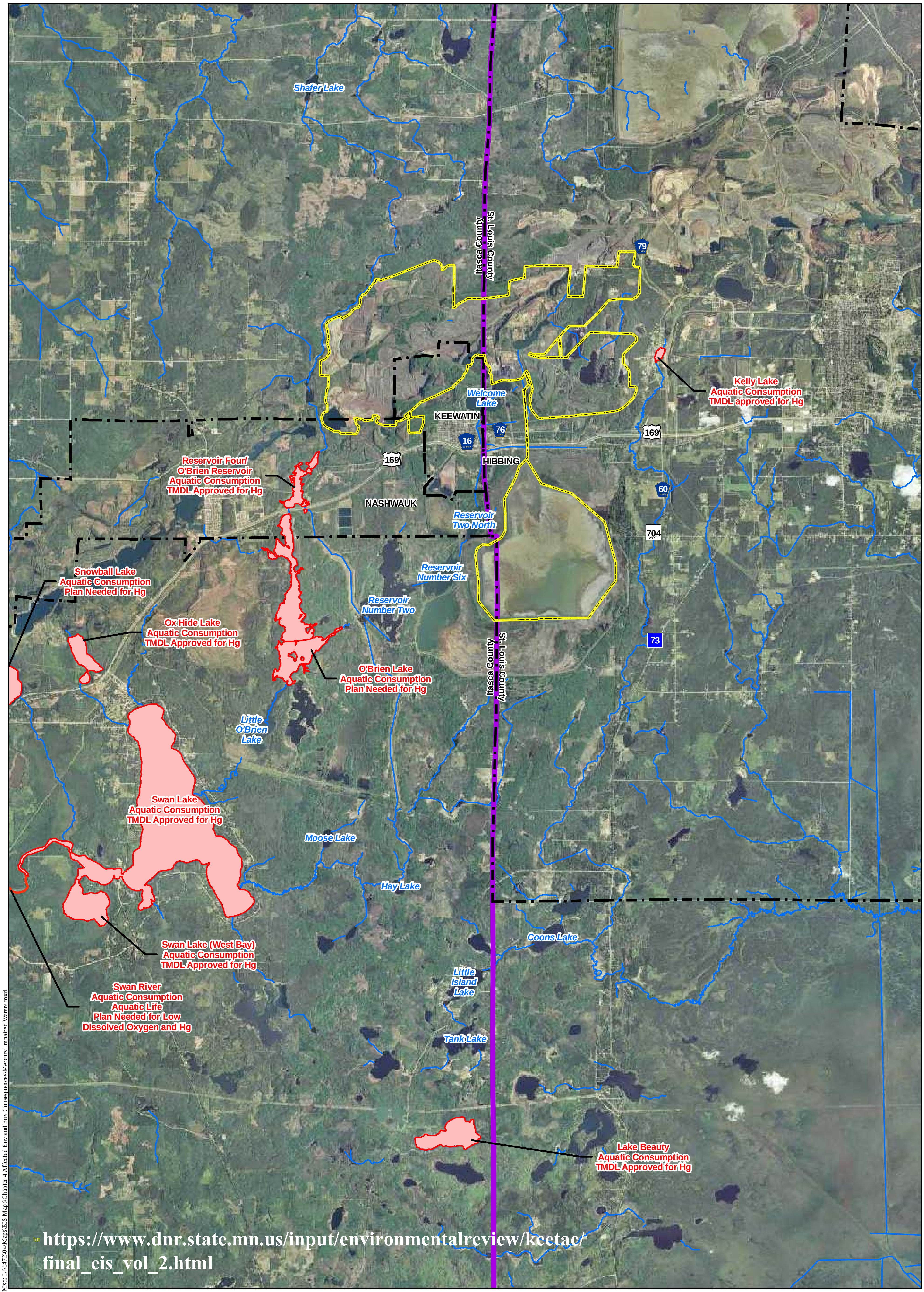
LacCore field ID	Class	Site name	DNR/State ID	County	Date	Site type (Lake/ Stream/ Paddy)	Lat	Long	Wild Rice present anywhere at site (yes/no)	Wild rice ring % cover	Ave.stems/ m2	surface water Fe (µg/L)	surface water SO4 (mg SO4/L)	pore water Total Sulfide (TS, mg S/L)	pore water DOC (mg C/L)	Sediment Fe (µg/g)
P-34	1 Pilot Survey	Anka	21-0353-00-201	Douglas	9/16/11	L	46.0769	-95.7292	yes	11.3		12.3	2.23	0.671	19	1485
P-35	1 Pilot Survey	Anka	21-0353-00-201	Douglas	9/16/11	L	46.0769	-95.7377	yes	1.3		12.3	2.23	0.493	22	2170
FS-192	4 Survey	Anka	21-0353-00-202	FS-192	8/29/12	L	46.07689	-95.7292	yes	1		<5.0	8.44	0.53	24.5	1498
FS-134	4 Survey	Bass	31-0576-00-207	Itasca	9/18/12	L	47.2844	-93.6276	yes	32.5	64.0	9.4	1.01	0.0664	18.7	3740
FS-85	4 Survey	Bean	03-0411-00-201	Becker	8/21/12	L	46.9337	-95.8706	no	0	0.0	<5.0	85	16	29.4	1967
FS-178	8 Survey-No Core	Bear	24-0028-00-206	Freeborn	7/25/12	L	43.5465	-93.5028	no	0	0.0	1560	18.3			
FS-87	4 Survey	Bee	60-0192-00-202	Polk	8/23/12	L	47.6527	-96.0504	yes	18.8	39.8	<5.0	11	0.67	15.2	3054
FS-193	4 Survey	Big Mud	71-0085-00-201	Sherburne	8/30/12	L	45.4529	-93.7418	yes	4.3	14.3	20.1	<0.5	0.0308	23.7	12943
FS-216	4 Survey	Big Sucker	31-0124-00-203	Itasca	9/12/12	L	47.3919	-93.2658	yes	1.3	3.8	<5.0	7.78	0.145	22.2	3559
FS-204	4 Survey	Big Swan	77-0023-00-207	Todd	8/10/12	L	45.8795	-94.742	yes	55	133.7	<5.0	5.49	0.0914	24.3	1731
FS-205	5 Survey Duplicate	Big Swan	77-0023-00-207	Todd	8/10/12	L	45.8795	-94.7418	yes	17.5	56.3	<5.0	5.47	0.0527	19.6	1719
P-12	1 Pilot Survey	Birch	69-0003-00-205	St. Louis	8/30/11	L	47.7357	-91.9428	yes	30		228.2	3.58	0.104		12431
FS-89	4 Survey	Birch	69-0003-00-205	St. Louis	9/10/12	L	47.7358	-91.943	yes	26.3	33.1	226	8.61	0.1	23.5	16938
FS-52	4 Survey	Blaamyhre	34-0345-00-203	Kandiyohi	8/1/12	L	45.364	-95.186	yes	15	102.2	<5.0	0.62	0.078	23.7	3517
FS-214	4 Survey	Bowstring	S007-219	Itasca	9/11/12	S	47.7024	-94.0608	yes	27.5	69.7	<5.0	1.34	0.256	11.2	1974
FS-126	4 Survey	Bray	56-0472-00-202	Otter Tail	8/20/12	L	46.4518	-95.8783	yes	1.8	7.6	<5.0	1.65	0.072	10	3937
P-32	3 Pilot- No Core	Caribou	69-0489-00-205	St. Louis	9/15/11	L	46.8991	-92.3217	no	0		145.5	0.63			
FS-63	4 Survey	Caribou	69-0489-00-206	St. Louis	9/3/12	L	46.8913	-92.3135	no	0	0.0	5.2	1.21	0.0938	29.3	13791
P-53	1 Pilot Survey	Carlos Avery Pool 9	02-0504-00-201	Anoka	8/19/11	L	45.3179	-93.0587	yes	18.8		1020	0.35	0.029		37965
FS-109	4 Survey	Carlos Avery Pool 9	02-0504-00-202	Anoka	7/3/12	L	45.3192	-93.0611	yes	23.8	52.8	1020	<0.5	<0.011	35.4	14736
FS-339	4 Survey	Christina	21-0375-00-315	Douglas	7/31/13	L	46.0734	-95.7567	yes	0.3	0.6	<5.0	14.6	1.93	17.6	1741
FS-327	7 Survey Seasonal	Clearwater	S002-121	Pennington	7/17/13	S	47.9371	-95.6906	yes	0.3	0.3	57.8	23.7	0.117	26.4	3521
FS-189	4 Survey	Clearwater	S002-121	Pennington	8/28/12	S	47.9372	-95.6906	yes	1.8	4.5	<5.0	23.8	0.117	15.8	2856
FS-314	7 Survey Seasonal	Clearwater	S002-121	Pennington	6/24/13	S	47.9372	-95.6907	yes	0.3	0.6	96.2	28	0.0664	32.6	3946
FS-373	7 Survey Seasonal	Clearwater	S002-121	Pennington	9/9/13	S	47.9372	-95.6909	yes	5	3.2	76.8	34.4	0.0354	18.7	5315
FS-337	6 Survey 2nd Year	Clearwater	S004-204	Clearwater	7/29/13	S	47.5175	-95.3906	yes	52.5	69.1	235	0.95	0.0608	11.3	14564
FS-88	4 Survey	Clearwater	S004-204	Clearwater	8/24/12	S	47.5174	-95.3904	yes	61.3	148.3	<5.0	2.04	0.0488	17.2	9874
P-31	1 Pilot Survey	Cloquet	38-0539-00-201	Lake	9/14/11	L	47.4313	-91.4844	yes	32.5		365.1	0.81	0.024	19.2	4252
FS-128	4 Survey	Cromwell	14-0103-00-201	Clay	8/22/12	L	46.9651	-96.3171	no	0	0.0	<5.0	41.2	1.22	23.1	2948
FS-368	4 Survey	Dark	69-0790-00-202	St. Louis	9/5/13	L	47.6387	-92.7782	yes	6.3	11.1	11.9	175	0.305	9.2	3354
FS-352	7 Survey Seasonal	Dark	69-0790-00-202	St. Louis	8/15/13	L	47.6388	-92.7782	yes	1.3	2.9	27.9	173	0.136	9.9	5120
FS-322	7 Survey Seasonal	Dark	69-0790-00-202	St. Louis	7/10/13	L	47.6389	-92.7781	yes	1.3	3.2	23.6	175	0.131	19.2	2480
FS-369	5 Survey Duplicate	Dark	69-0790-00-202	St. Louis	9/5/13	L	47.6389	-92.7781	yes	12.8	11.8	10.4	176	0.052	11.3	2037
												Avg.	174.75			
FS-64	4 Survey	Dead Fish	09-0051-00-202	Carlton	9/4/12	L	46.7454	-92.6865	no	0	0.0	3820	0.71	0.0608	43.2	14387
P-44	1 Pilot Survey	Dead Fish	09-0051-00-202	Carlton	9/20/11	L	46.7451	-92.6863	yes	21.3		4740	0.3	0.056	28.4	9685
FS-378	4 Survey	Duck Lake WMA	18-0178-00-202	Crow Wing	9/12/13	L	46.7521	-93.8851	yes	42.5	113.0	1020	<0.5	0.0251	41.3	12151
FS-86	4 Survey	Eighteen	60-0199-00-202	Polk	8/22/12	L	47.6397	-96.0607	yes	23.8	40.1	<5.0	4.29	0.164	22.8	1860
FS-328	7 Survey Seasonal	Eighteen	60-0199-00-203	Polk	7/18/13	L	47.6369	-96.0599	yes	27.5	44.2	10.3	3.34	0.25	44.5	5106
FS-309	7 Survey Seasonal	Eighteen	60-0199-00-203	Polk	6/13/13	L	47.6369	-96.0599	no	0	0.0	56.3	4.36	0.127	40.2	4478
FS-359	6 Survey 2nd Year	Eighteen	60-0199-00-203	Polk	8/20/13	L	47.6367	-96.06	yes	5.5	21.0	<5.0	2.83	0.118	24.3	5500
P-6	1 Pilot Survey	Elk	15-0010-00-203	Clearwater	8/25/11	L	47.1946	-95.2254	yes	11.3		21.7	0.28	0.04		8480
FS-137	4 Survey	Elk	15-0010-00-204	Clearwater	9/19/12	L	47.1952	-95.2249	yes	7.3	42.7	<5.0	<0.5	0.0936	15.8	6334
P-9	3 Pilot- No Core	Embarrass	69-0496-00-202	St. Louis	8/29/11	L	47.534	-92.3164	no	0		363.4	6.35			
FS-333	6 Survey 2nd Year	Embarrass	69-0496-00-203	St. Louis	7/26/13	L	47.5333	-92.2976	no	0	0.0	681	18.2	0.0866	4.5	11179
FS-95	4 Survey	Embarrass	69-0496-00-203	St. Louis	9/14/12	L	47.5334	-92.2979	no	0	0.0	733	18.8	0.0298	17.8	21847
FS-76	4 Survey	Field	34-0151-00-201	Kandiyohi	7/25/12	L	45.2964	-94.9058	no	0	0.0	6.3	<0.5	0.0687	17.5	7586
FS-195	4 Survey	Fisher	70-0087-00-201	Scott	8/31/12	L	44.7942	-93.4061	yes	25	20.7	88.8	6.85	0.136	28.5	11140
FS-81	4 Survey	Flowage	01-0061-00-204	Aitkin	8/7/12	L	46.688	-93.337	no	0	0.0	3750	0.78	0.134	60.2	12470
P-52	2 Pilot Duplicate	Flowage	01-0061-00-205	Aitkin	9/22/11	L	46.6895	93.338	yes	53.8		1189	0.56	0.018	52.2	3706
P-51	1 Pilot Survey	Flowage	01-0061-00-205	Aitkin	9/22/11	L	46.6896	93.338	yes	70		1189	0.56	0.014	27.8	5627
P-52	2 Pilot Duplicate	Flowage	01-0061-00-206	Aitkin	9/22/11	L	46.6895	93.338	yes	53.8		1189	0.56	0.018	52.2	4302

P-52	2 Pilot Duplicate	Flowage	01-0061-00-206	Aitkin	9/22/11	L	46.6895	93.338	yes	53.8		1189	0.56	0.018	52.2	4641
FS-194	4 Survey	Gilchrist	86-0064-00-201	Wright	8/31/12	L	45.2309	-93.824	no	0	0.0	<5.0	6.98	0.355	25	3117
FS-51	4 Survey	Glesne Slough	34-0353-00-201	Kandiyohi	7/31/12	L	45.3514	-95.1887	yes	22.5	99.6	<5.0	<0.5	0.061	33.9	7983
P-23	1 Pilot Survey	Gourd	04-0253-00-201	Beltrami	9/7/11	L	47.812	-94.9654	yes	16.8		32	0.69	0.038		2675
FS-104	8 Survey-No PW	Gourd	04-0253-00-201	Beltrami	6/27/12	L	47.8121	-94.965	no	0	0.0	6.6	0.27			1776
P-39	3 Pilot- No Core	Grand	69-0511-00-203	St. Louis	9/17/11	L	46.8872	-92.3988	no	0		74.8	0.83			
P-20	1 Pilot Survey	Gull	04-0120-00-203	Beltrami	9/6/11	L	47.6559	-94.6944	yes	6.8		19.9	0.78	0.103		1608
FS-213	4 Survey	Gull	04-0120-00-204	Beltrami	9/10/12	L	47.6558	-94.6945	yes	4.5	9.5	<5.0	1.14	0.0778	24.2	3527
P-22	3 Pilot- No Core	Ham	02-0053-00-201	Anoka	9/6/11	L	45.2572	-93.2264	no	0		119.7	0.95			
P-45	1 Pilot Survey	Hay	31-0037-00-201	Itasca	9/21/11	L	47.2874	-93.1017	no	0		199.7	10.24	0.087	28.9	12403
P-46	1 Pilot Survey	Hay	31-0037-00-201	Itasca	9/21/11	L	47.2869	-93.1018	no	0		199.7	10.24	0.026	22.1	16139
FS-130	4 Survey	Hay	31-0037-00-202	Itasca	9/6/12	L	47.2874	-93.102	yes	53.8	141.0	15	31.7	0.0738	26.5	13154
FS-367	6 Survey 2nd Year	Hay	31-0037-00-202	Itasca	9/4/13	L	47.287	-93.1009	yes	83.8	141.0	54.5	22.1	0.0447	26.5	15436
FS-221	4 Survey	Hay Creek Flowage	58-0005-00-202	Pine	9/17/12	L	46.0894	-92.4104	yes	58.8	97.7	30.8	1.95	0.119	32.9	9456
P-1	1 Pilot Survey	Height of Land	03-0195-00-209	Becker	8/22/11	L	46.9129	-95.6095	yes	27.5		22.5	0.24	0.053		1298
FS-375	6 Survey 2nd Year	Height of Land	03-0195-00-210	Becker	9/10/13	L	46.913	-95.6111	yes	63.8	117.5	152	<0.5	<0.011	14.5	1795
FS-127	4 Survey	Height of Land	03-0195-00-210	Becker	8/21/12	L	46.9133	-95.6095	yes	70	111.1	<5.0	<0.5	<0.011	14.6	2112
FS-318	7 Survey Seasonal	Height of Land	03-0195-00-210	Becker	6/26/13	L	46.9135	-95.6124	yes	22.5	43.0	181	1.21	0.0658	16.4	1349
FS-338	7 Survey Seasonal	Height of Land	03-0195-00-210	Becker	7/30/13	L	46.913	-95.6116	yes	36.3	94.2	100	<0.5	0.0554	22.3	2641
FS-131	4 Survey	Hinken	S007-207	Itasca	9/5/12	S	47.7271	-93.9923	yes	18.8	46.8	<5.0	<0.5	0.0876	20.5	2960
FS-185	4 Survey	Hoffs Slough	76-0103-00-201	Swift	8/1/12	L	45.3255	-95.7059	no	0	0.0	<5.0	273	0.0343	22.1	3512
FS-218	4 Survey	Holman	31-0227-00-202	Itasca	9/13/12	L	47.3005	-93.3445	no	0	0.0	<5.0	24.2	1.01	6.5	3035
FS-353	6 Survey 2nd Year	Holman	31-0227-00-202	Itasca	8/12/13	L	47.3009	-93.3444	no	0	0.0	<5.0	68	0.583	13.7	5094
FS-182	4 Survey	Hunt	66-0047-00-208	Rice	7/27/12	L	44.3275	-93.4443	no	0	0.0	6.8	17.1	0.0729	19	2412
P-37	3 Pilot- No Core	Ina	21-0355-00-201	Douglas	9/16/11	L	46.0822	-95.726	no	0		9.1	2.17			
FS-191	4 Survey	Ina	21-0355-00-202	Douglas	8/29/12	L	46.0715	-95.7281	yes	8.5	30.2	<5.0	7.08	0.274	17.9	2216
P-7	1 Pilot Survey	Itasca	15-0016-00-207	Clearwater	8/25/11	L	47.2332	-95.1985	yes	8.8		10.5	0.26	0.064		1650
FS-136	4 Survey	Itasca	15-0016-00-208	Clearwater	9/19/12	L	47.2343	-95.2049	yes	7.5	23.6	<5.0	<0.5	0.0636	17.6	1496
P-5	1 Pilot Survey	Itasca	15-0016-00-208	Clearwater	8/25/11	L	47.2381	-95.2065	yes	20		10.5	0.26	0.056		1355
FS-207	4 Survey	Kelly Lake	66-0015-00-204	Rice	8/13/12	L	44.3542	-93.3743	yes	0	0.0	<5.0	1.92	0.0927	21.6	4387
FS-78	4 Survey	Lady Slipper	42-0020-00-202	Lyon	7/27/12	L	44.5699	-95.6275	no	0	0.0	<5.0	335	1.68	35.6	2719
FS-79	5 Survey Duplicate	Lady Slipper	42-0020-00-203	Lyon	7/27/12	L	44.5723	-95.6216	no	0	0.0	<5.0	330	1.63	26.5	3314
P-55	1 Pilot Survey	Lady Slipper	42-0020-00-204	Lyon	9/22/11	L	44.5702	-95.6274	no	0		6.3	107.71	14.84	28.5	2814
P-18	3 Pilot- No Core	Lax	38-0406-00-203	Lake	9/2/11	L	47.3508	-91.2921	no	0		80.7	1.43			
P-61	1 Pilot Survey	Lily	81-0067-00-202	Waseca	9/28/11	L	44.194	-93.6469	yes	22.5		43	0.66	0.041	18.6	6180
FS-180	4 Survey	Lily	81-0067-00-202	Waseca	7/26/12	L	44.1947	-93.647	yes	18.8	38.2	<5.0	<0.5	0.0295	20.7	5095
P-62	2 Pilot Duplicate	Lily	81-0067-00-202	Waseca	9/28/11	L	44.194	-93.6469	no	0		42.3	0.64			5069
P-47	2 Pilot Duplicate	Little Birch	77-0089-00-101	Todd	9/21/11	L	45.7747	-94.7996	yes	11.3		9.2	3.2	0.191	14.8	2236
P-47	2 Pilot Duplicate	Little Birch	77-0089-00-101	Todd	9/21/11	L	45.7747	-94.7996	yes	11.3		9.2	3.2	0.191	14.8	3544
P-47	2 Pilot Duplicate	Little Birch	77-0089-00-101	Todd	9/21/11	L	45.7747	-94.7996	yes	11.3		9.2	3.2	0.191	14.8	2253
P-47	1 Pilot Survey	Little Birch	77-0089-00-101	Todd	9/21/11	L	45.7747	-94.7996	yes	11.3		9.2	3.2	0.05	21.7	4503
FS-54	4 Survey	Little Birch	77-0089-00-207	Todd	8/3/12	L	45.7779	-94.7978	yes	11.3	70.0	<5.0	7.4	0.0353	14.4	1794
P-4	1 Pilot Survey	Little Flat	03-0217-00-201	Becker	8/24/11	L	46.9981	-95.6641	yes	36.3		147.7	0.22	0.011		7479
FS-250	4 Survey	Little Rice	69-0612-00-201	St. Louis	9/20/12	L	47.7086	-92.4389	yes	8.8	29.3	642	1.03	0.0293	35	9488
FS-374	7 Survey Seasonal	Little Round	03-0302-00-202	Becker	9/10/13	L	46.9745	-95.738	yes	21.3	37.6	28.6	0.12	0.0391	17.4	2018
P-3	1 Pilot Survey	Little Round	03-0302-00-202	Becker	8/24/11	L	46.9759	-95.7404	yes	25		54.1	0.46	0.032		1689
FS-138	4 Survey	Little Round	03-0302-00-203	Becker	9/20/12	L	46.9726	-95.735	yes	46.3	78.0	<5.0	<0.5	0.128	25.9	3069
FS-319	7 Survey Seasonal	Little Round	03-0302-00-203	Becker	6/27/13	L	46.9724	-95.735	yes	5	17.5	239	<0.5	0.117	24	3579
FS-342	7 Survey Seasonal	Little Round	03-0302-00-203	Becker	8/5/13	L	46.9721	-95.7358	yes	18.8	58.3	96	<0.5	0.0676	27.3	4447
FS-223	4 Survey	Little Sucker	31-0126-00-202	Itasca	9/14/12	L	47.3765	-93.246	no	0	0.0	<5.0	13.7	0.534	17.3	6297
FS-203	4 Survey	Long Prairie	S007-203	Douglas	8/9/12	S	45.9729	-95.1603	yes	46.3	58.3	84.7	6.66	0.0391	20.9	5074
FS-202	4 Survey	Long Prairie	S007-204	Douglas	8/9/12	S	46.0072	-95.2634	yes	8.8	13.4	29.6	7.71	0.0793	10.7	2897
FS-200	4 Survey	Louisa	86-0282-00-205	Wright	8/8/12	L	45.2998	-94.258	no	0	0.0	11.7	7.04	0.192	24.9	7824
FS-226	4 Survey	Louise	21-0094-00-202	Douglas	8/14/12	L	45.9331	-95.4148	yes	17	46.5	<5.0	4.09	0.0746	11.5	1833
FS-357	6 Survey 2nd Year	Lower Panasa	31-0112-00-204	Itasca	8/15/13	L	47.3026	-93.2561	no	0	0.0	<5.0	28.5	1.26	12.4	2347
FS-60	4 Survey	Lower Panasa	31-0112-00-205	Itasca	8/29/12	L	47.3018	-93.2521	no	0	0.0	<5.0	33.6	0.243	15.1	8048
P-25	1 Pilot Survey	Lower Rice	S006-985	Clearwater	9/8/11	S	47.3793	-95.4834	yes	50		75.3	1.02	0.097		2337

P-26	1 Pilot Survey	Lower Rice	S007-164	Clearwater	9/8/11	S	47.3817	-95.4926	yes	52.5		81.1	0.55	0.07		2364
FS-133	4 Survey	Mahnomen	18-0126-02-201	Crow Wing	9/17/12	L	46.4985	-93.9958	no	0	0.0	<5.0	16.9	0.308	6.7	18746
FS-377	6 Survey 2nd Year	Mahnomen	18-0126-02-201	Crow Wing	9/11/13	L	46.4986	-93.9956	no	0	0.0	10.1	21.1	0.0283	5.5	16540
FS-175	4 Survey	Maloney	79-0001-00-201	Wabasha	7/23/12	L	44.2251	-91.9321	no	0	0.0	<5.0	3.15	0.0608	13.8	15126
P-63	1 Pilot Survey	Maloney	79-0001-00-201	Wabasha	9/29/11	L	44.2243	-91.9328	yes	65		127.8	1.83	0.01	18	10269
P-64	2 Pilot Duplicate	Maloney	79-0001-00-201	Wabasha	9/29/11	L	44.2243	-91.9328	yes	0		117.9	1.83			10382
FS-187	4 Survey	McCormic	73-0273-00-203	Stearns	8/2/12	L	45.722	-94.9121	yes	1.3	8.9	<5.0	1.54	0.144	27.6	1512
FS-230	5 Survey Duplicate	Mill Pond	21-0034-00-202	Douglas	8/16/12	L	46.0715	-95.2218	yes	21.5	80.9	<5.0	7.36	0.192	12.1	3969
FS-229	4 Survey	Mill Pond	21-0034-00-202	Douglas	8/16/12	L	46.0716	-95.2218	yes	30	102.2	<5.0	7.16	0.109	11.7	5143
FS-225	4 Survey	Miltona	21-0083-00-205	Douglas	8/13/12	L	46.0496	-95.4217	no	0	0.0	<5.0	4.11	0.0694	99.8	2624
FS-201	4 Survey	Mink	86-0229-00-206	Wright	8/8/12	L	45.274	-94.0269	no	0	0.0	26.4	1.31	0.0373	22.8	1740
FS-129	7 Survey Seasonal	Mink	86-0229-00-207	Wright	8/23/12	L	45.2767	-94.0299	no	0	0.0	<5.0	1.22	0.182	14.1	4247
FS-80	4 Survey	Mission	S001-646	Pine	8/6/12	S	45.8623	-93.0011	yes	52.3	87.5	673	0.62	0.0485	17.3	9231
FS-83	4 Survey	Mississippi Crow Wing	S007-205	Crow Wing	8/8/12	S	46.4386	-94.1251	no	0	0.0	590	3.13	0.127	43.3	13451
FS-211	4 Survey	Mississippi Pool 4/Robinson Lake	79-0005-02-201	Wabasha	8/16/12	S	44.3611	-91.9897	yes	51.3	57.6	8.2	17.7	0.0714	28.9	9265
FS-336	6 Survey 2nd Year	Mississippi Pool 4/Robinson Lake	79-0005-02-201	Wabasha	7/30/13	S	44.3613	-91.9901	yes	30	46.5	9.4	55.3	0.0602	21.1	8193
FS-210	4 Survey	Mississippi Pool 4/Robinson Lake	79-0005-02-202	Wabasha	8/16/12	S	44.3593	-91.9881	yes	21.3	35.3	<5.0	15.7	0.07	15	6450
												Avg.	29.57			
FS-312	7 Survey Seasonal	Mississippi Pool 5 / Spring	S007-660	Buffalo, WI	6/21/13	S	44.2018	-91.8444	yes	23.8	35.7	114	28.3	0.0844	12.8	3563
FS-371	4 Survey	Mississippi Pool 5 / Spring	S007-660	Buffalo, WI	9/10/13	S	44.2016	-91.8443	yes	26.3	39.8	13.6	34.4	0.069	15.4	3582
FS-372	5 Survey Duplicate	Mississippi Pool 5 / Spring	S007-660	Buffalo, WI	9/10/13	S	44.2016	-91.8443	yes	13.8	26.7	<5.0	34.8	0.0536	15.4	3330
FS-335	7 Survey Seasonal	Mississippi Pool 5 / Spring	S007-660	Buffalo, WI	7/30/13	S	44.1953	-91.841	yes	42.5	63.0	21.9	47.7	0.0342	12.7	4362
FS-212	4 Survey	Mississippi Pool 5 / Spring	S007-660	Buffalo, WI	8/17/12	S	44.1993	-91.8461	yes	17.5	29.6	32.4	17.2	0.0224	18.9	3674
FS-208	4 Survey	Mississippi Pool 8 at Genoa	S007-222	Houston	8/14/12	S	43.5758	-91.2334	yes	43.8	41.4	<5.0	18	0.176	19.2	2178
FS-311	7 Survey Seasonal	Mississippi Pool 8 at Genoa	S007-222	Houston	6/20/13	S	43.5766	-91.2341	yes	10	12.7	74.6	29.3	0.107	11.7	1544
FS-334	7 Survey Seasonal	Mississippi Pool 8 at Genoa	S007-222	Houston	7/29/13	S	43.5758	-91.2344	yes	28.8	52.8	7	44.2	0.102	12.1	1969
FS-370	6 Survey 2nd Year	Mississippi Pool 8 at Genoa	S007-222	Houston	9/9/13	S	43.5765	-91.2337	yes	11.3	17.8	<5.0	33.3	0.062	16.2	6558
FS-209	4 Survey	Mississippi Pool 8 at Reno Bottoms	S007-556	Houston	8/15/12	S	43.6025	-91.2686	yes	46.3	72.3	13.5	18.1	0.0711	20.1	9187
													28.58			
FS-58	4 Survey	Mississippi River above Clay Boswell	S007-163	Itasca	8/28/12	S	47.2386	-93.7197	no	0	0.0	46.9	1.19	0.0806	30.3	8636
FS-354	6 Survey 2nd Year	Mississippi River above Clay Boswell	S007-163	Itasca	8/13/13	S	47.2376	-93.7187	yes	75	132.7	22.2	1.18	0.0532	30.9	7052
P-14	1 Pilot Survey	Mississippi River above Clay Boswell	S007-163	Itasca	9/1/11	S	47.2379	-93.7196	yes	71.3		94.8	1.09	0.053		7964
FS-57	4 Survey	Mississippi River below Clay Boswell	S006-923	Itasca	8/28/12	S	47.2551	-93.6342	no	0	0.0	27.1	10.3	0.134	31.8	4225
FS-355	6 Survey 2nd Year	Mississippi River below Clay Boswell	S006-923	Itasca	8/13/13	S	47.2553	-93.634	yes	33.8	78.3	25.7	10.2	0.0819	34.2	10479
P-15	1 Pilot Survey	Mississippi River below Clay Boswell	S006-923	Itasca	9/1/11	S	47.2547	-93.6344	yes	43.8		118.1	3.65	0.035		8667
P-42	1 Pilot Survey	Monongalia	34-0158-01-201	Kandiyohi	9/20/11	L	45.3481	-94.9509	yes	2.5		70.5	16.51	0.042	14.1	46471
FS-313	7 Survey Seasonal	Monongalia	34-0158-01-203	Kandiyohi	6/23/13	L	45.3334	-94.9293	yes	32.5	50.0	13.2	34.7	0.0941	15.2	6028
FS-379	7 Survey Seasonal	Monongalia	34-0158-02-203	Kandiyohi	9/13/13	L	45.3332	-94.9292	yes	62.5	154.4	<5.0	34.6	0.242	19.2	5436
FS-340	7 Survey Seasonal	Monongalia	34-0158-02-203	Kandiyohi	7/31/13	L	45.3331	-94.9292	yes	60	87.9	<5.0	33.6	0.122	28.1	5530
FS-77	4 Survey	Monongalia	34-0158-02-204	Kandiyohi	7/26/12	L	45.3331	-94.9268	yes	38.8	121.3	<5.0	21.7	1.37	19	4953
FS-75	4 Survey	Mortenson	34-0150-02-201	Kandiyohi	7/24/12	L	45.3	-94.9062	no	0	0.0	<5.0	<0.5	0.103	22.5	9071
P-2	3 Pilot- No Core	Mud	S004-735	Otter Tail	8/23/11	S	46.6266	-95.5751	no	0						
FS-176	4 Survey	North Geneva	24-0015-00-209	Freeborn	7/24/12	L	43.7876	-93.271	no	0	0.0	<5.0	15.6	1.54	15.8	2212
FS-350	6 Survey 2nd Year	Ox Hide	31-0106-00-203	Itasca	8/14/13	L	47.3351	-93.2132	no	0	0.0	<5.0	25.9	0.119	10.1	3889
FS-198	5 Survey Duplicate	Ox Hide	31-0106-00-203	Itasca	9/7/12	L	47.335	-93.2134	yes	0.3	0.6	<5.0	26.4	0.0751	18	8743
FS-132	4 Survey	Ox Hide	31-0106-00-203	Itasca	9/7/12	L	47.335	-93.2134	yes	4	10.5	<5.0	26.4	0.042	32	14936
FS-220	4 Survey	Padua	73-0277-00-202	Stearns	8/7/12	L	45.623	-95.0186	yes	0	0.0	17.2	0.86	0.23	25.5	2291
FS-344	6 Survey 2nd Year	Padua	73-0277-00-202	Stearns	8/6/13	L	45.6231	-95.0187	yes	2.5	9.5	37.3	<0.5	0.0806	29.8	4520
P-29	1 Pilot Survey	Padua	73-0277-00-203	Stearns	9/13/11	L	45.6202	-95.0192	yes	1.5		101.6	0.76	0.13	32.3	4927
FS-301	7 Survey Seasonal	Partridge	S007-443	St. Louis	5/28/13	S	47.5213	-92.1903	no	0	0.0	421	14.8	0.125	18.6	9491
FS-331	7 Survey Seasonal	Partridge	S007-443	St. Louis	7/24/13	S	47.5212	-92.1904	yes	30	60.5	2510	14.6	0.112	15.2	10082
P-13	1 Pilot Survey	Partridge	S007-443	St. Louis	8/31/11	S	47.5212	-92.1899	yes	28.8		781	10.39	0.075		11026
FS-92	4 Survey	Partridge	S007-443	St. Louis	9/12/12	S	47.5207	-92.1909	yes	1.5	4.1	888	36.3	0.074	20.8	29463
FS-366	5 Survey Duplicate	Partridge	S007-443	St. Louis	9/3/13	S	47.5213	-92.19	yes	17.5	47.7	1950	34.2	0.057	9.8	7671
FS-365	6 Survey 2nd Year	Partridge	S007-443	St. Louis	9/3/13	S	47.5212	-92.1901	yes	31.3	76.7	1850	34.1	0.039	13.9	9179
FS-317	8 Survey-No Core	Partridge	S007-443	St. Louis	6/26/13	S	47.5215	-92.1903	no	0	0.0	801	7.65			
FS-332	4 Survey	Partridge	S007-513	St. Louis	7/24/13	S	47.5137	-92.1894	yes	53.8	79.6	2370	54.4	0.102	28.3	20512

FS-316	7 Survey Seasonal	Partridge	S007-513	St. Louis	6/28/13	S	47.5137	-92.1899	no	0	0.0	1130	24.9	0.098	11.6	6291
FS-302	7 Survey Seasonal	Partridge	S007-513	St. Louis	5/30/13	S	47.5153	-92.1894	no	0	0.0	380	43.1	0.0624	18.5	24784
FS-364	8 Survey-No PW	Partridge	S007-513	St. Louis	8/30/13	S	47.5138	-92.1894	yes	57.5	105.7					28890
P-33	3 Pilot- No Core	Pelican	26-0002-00-219	Grant	9/15/11	L	46.0616	-95.8296	no	0		7.3	5.79			
P-8	3 Pilot- No Core	Pelican	26-0002-00-219	Grant	8/26/11	L	46.0616	-95.8296	no	0						
FS-55	4 Survey	Pelkey	49-0030-00-202	Morrison	8/26/12	L	45.9962	-94.2273	no	0	0.0	15.8	3.42	0.0522	24.8	30642
FS-91	4 Survey	Pike	S006-927	St. Louis	9/11/12	S	47.7327	-92.3473	yes	23.8	3.5	985	14.2	0.0656	40	6565
P-10	1 Pilot Survey	Pike	S006-927	St. Louis	8/30/11	S	47.7325	-92.3468	yes	18.8		1219	8.31	0.063		15572
FS-190	4 Survey	Pine	15-0149-00-205	Clearwater	8/28/12	L	47.6841	-95.5414	yes	47.5	114.9	<5.0	14.7	0.368	44.8	4477
P-27	3 Pilot- No PW	Pleasant	11-0383-00-206	Cass	9/9/11	L	46.928	-94.4757	yes	12.5		15.9	0.49			5331
FS-84	4 Survey	Pleasant	11-0383-00-207	Cass	8/10/12	L	46.9228	-94.4874	yes	0	0.0	20.2	<0.5	0.0218	31.7	7065
FS-215	4 Survey	Popple	S006-188	Itasca	9/11/12	S	47.7254	-94.0817	yes	11.8	36.3	<5.0	<0.5	0.0269	12.5	2971
FS-196	4 Survey	Prairie	S007-209	Itasca	9/3/12	S	47.2519	-93.4884	yes	16.3	44.6	9.7	9.63	0.0709	25.2	15071
FS-82	4 Survey	Rabbit	18-0093-02-204	Crow Wing	8/8/12	L	46.5313	-93.9285	no	0	0.0	<5.0	15.3	0.22	15.5	10903
P-28	1 Pilot Survey	Raymond	73-0285-00-203	Stearns	9/12/11	L	45.629	-95.0234	yes	30		20.8	0.82	0.094	33.3	3922
FS-343	6 Survey 2nd Year	Raymond	73-0285-00-203	Stearns	8/6/13	L	45.629	-95.0233	yes	25	61.4	27.9	1.92	0.0903	25.9	3270
FS-53	4 Survey	Raymond	73-0285-00-203	Stearns	8/2/12	L	45.6286	-95.0225	yes	19	61.1	13.8	<0.5	0.0787	28.1	1905
FS-324	7 Survey Seasonal	Rice	18-0053-00-203	Crow Wing	7/15/13	L	46.3392	-93.8918	yes	27.5	56.7	5320	<0.5	0.11	23.5	44704
FS-376	7 Survey Seasonal	Rice	18-0053-00-203	Crow Wing	9/11/13	L	46.3394	-93.8918	yes	22.5	46.5	2520	<0.5	0.0451	27.2	65261
FS-56	4 Survey	Rice	18-0053-00-203	Crow Wing	8/27/12	L	46.3389	-93.8915	yes	3.5	19.4	98	<0.5	0.0259	40.3	83421
FS-304	7 Survey Seasonal	Rice	18-0053-00-203	Crow Wing	6/10/13	L	46.3387	-93.8906	yes	2.5	5.7	2540	<0.5	0.0236	24.9	48287
P-69	1 Pilot Survey	Rice	18-0053-00-203	Crow Wing	9/27/11	L	46.3394	-93.8913	yes	18.8		1159	0.23	0.021	25.5	50389
P-56	3 Pilot- No Core	Rice	18-0053-00-203	Crow Wing	9/23/11	L	46.3396	-93.8901	no	0		1311	0.38			
FS-181	4 Survey	Rice	66-0048-00-203	Rice	7/27/12	L	44.3332	-93.4734	no	0	0.0	<5.0	5.22	0.777	21.1	3829
FS-184	4 Survey	Rice	73-0196-00-216	Stearns	7/30/12	L	45.3864	-94.6309	no	0	0.0	<5.0	2.58	2.97	29.1	1523
FS-345	6 Survey 2nd Year	Rice	73-0196-00-216	Stearns	8/7/13	L	45.3865	-94.6313	yes	0	0.0	<5.0	6.85	2.08	15.1	2012
FS-179	4 Survey	Rice	74-0001-00-201	Steele	7/25/12	L	44.0842	-93.0737	no	0	0.0	71.3	3.84	0.217	19.2	4152
FS-199	4 Survey	Rice	S006-208	Itasca	9/5/12	S	47.6742	-93.6547	yes	29	75.4	12.3	1.57	0.0552	13.1	3273
FS-231	4 Survey	Rice	02-0008-00-206	Anoka	8/17/12	L	45.1604	-93.121	no	0	0.0	5.7	3.6	0.145	18.7	2159
FS-101	4 Survey	Rice paddy	WT00026	Beltrami	6/25/12	P	48.2161	-94.6188	yes	4.3	8.3	428	11.3	0.298	129	3284
FS-102	4 Survey	Rice paddy	WT00027	Polk	6/26/12	P	47.9265	-95.6313	yes	39.3	93.6	412	1.61	0.677	118	4932
FS-308	7 Survey Seasonal	Rice paddy	WT00028	Polk	6/12/13	P	47.8056	-95.674	yes	36.3	85.9	13.6	57.1	0.802	83.3	2779
FS-103	4 Survey	Rice paddy	WT00028	Polk	6/26/12	P	47.8053	-95.6732	yes	23.8	58.9	68.2	279	0.732	90.4	3367
FS-326	6 Survey 2nd Year	Rice paddy	WT00028	Polk	7/17/13	P	47.8055	-95.6732	yes	100	251.8	128	28.8	0.39	86.5	2842
FS-361	8 Survey-No PW	Rice paddy	WT00028	Polk	8/21/13	P	47.8054	-95.6744	yes	68.8	78.6					3089
FS-106	4 Survey	Rice paddy	WT00029	Clearwater	6/28/12	P	47.8523	-95.4732	yes	25	50.6	32	7.14	0.169	68.8	3242
FS-107	4 Survey	Rice paddy	WT00030	Clearwater	6/28/12	P	47.8521	-95.4953	yes	80	134.3	147	9.46	0.194	67.1	5647
FS-108	4 Survey	Rice paddy	WT00031	Crow Wing	6/29/12	P	46.246	-94.2548	yes	33.8	54.7	64.2	0.25	0.0313	73.4	7874
FS-325	4 Survey	Rice paddy	WT00046	Clearwater	7/16/13	P	47.8481	-95.4865	yes	51.3	79.6	362	0.46	0.115	117	4673
FS-360	8 Survey-No PW	Rice paddy	WT00046	Clearwater	8/21/13	P	47.8479	-95.4866	yes	33.8	66.5			0.0943		4221
FS-307	7 Survey Seasonal	Rice paddy	WT00046	Clearwater	6/12/13	P	47.8482	-95.4865	yes	4.3	8.3	9.3	16.6	0.039	92.7	4292
FS-90	4 Survey	Sand	S003-249	St. Louis	9/11/12	S	47.6351	-92.4234	yes	0.8	2.9	1790	15.9	0.152	44.1	7287
P-11	1 Pilot Survey	Sand	S003-249	St. Louis	8/30/11	S	47.6348	-92.4235	yes	6.3		1132	7.69	0.046		22677
FS-321	7 Survey Seasonal	Sandy-1	69-0730-00-203	St. Louis	7/9/13	L	47.6255	-92.5885	no	0	0.0	291	122	0.189	38.6	36502
FS-382	7 Survey Seasonal	Sandy-1	69-0730-00-203	St. Louis	9/17/13	L	47.6255	-92.5885	no	0	0.0	524	67.9	0.135	34	26645
FS-251	4 Survey	Sandy-1	69-0730-00-203	St. Louis	9/21/12	L	47.6254	-92.5886	yes	1.3	3.8	517	3.05	0.123	37.6	35905
FS-306	7 Survey Seasonal	Sandy-1	69-0730-00-203	St. Louis	6/11/13	L	47.6255	-92.5884	no	0	0.0	880	11	0.0918	52.1	35357
FS-320	7 Survey Seasonal	Sandy-2	69-0730-00-204	St. Louis	7/9/13	L	47.6188	-92.5936	no	0	0.0	401	118	3.08	19.4	19749
FS-305	7 Survey Seasonal	Sandy-2	69-0730-00-204	St. Louis	6/11/13	L	47.6187	-92.5937	no	0	0.0	87.6	135	1.08	22.4	19094
FS-348	7 Survey Seasonal	Sandy-2	69-0730-00-204	St. Louis	8/13/13	L	47.6186	-92.5934	yes	0	0.0	45.6	123	0.305	24.8	13216
FS-381	5 Survey Duplicate	Sandy-2	69-0730-00-204	St. Louis	9/17/13	L	47.6187	-92.5931	yes	0	0.0	24.3	126	0.0342	21.3	16172
FS-380	7 Survey Seasonal	Sandy-2	69-0730-00-204	St. Louis	9/17/13	L	47.6187	-92.5939	yes	0.3	0.6	24.3	126	0.0342	21.3	17868
FS-349	6 Survey 2nd Year	Sandy-3	69-0730-00-205	St. Louis	8/13/13	L	47.6191	-92.5898	no	0	0.0	70.6	122	0.0697	19.4	14897
P-24	1 Pilot Survey	Second	15-0091-00-201	Clearwater	9/7/11	L	47.8255	-95.3635	yes	16.3		63.4	0.87	0.139		3813
FS-105	4 Survey	Second	15-0091-00-202	Clearwater	6/27/12	L	47.8258	-95.3637	yes	13	48.4	35.9	0.74	0.119	29.8	2527
FS-384	7 Survey Seasonal	Second	S007-220	St. Louis	9/19/13	S	47.5204	-92.1925	yes	15	27.7			0.104	13.6	22634
FS-303	7 Survey Seasonal	Second	S007-220	St. Louis	5/30/13	S	47.5204	-92.1925	no	0	0.0	870	303	0.0991	10.5	13086

FS-310	7 Survey Seasonal	Second	S007-220	St. Louis	6/14/13	S	47.5205	-92.1925	yes	25	57.6	252	316	0.0927	7.2	31190
FS-323	7 Survey Seasonal	Second	S007-220	St. Louis	7/11/13	S	47.5204	-92.1925	yes	45	76.4	610	405	0.067	8.5	10036
FS-351	4 Survey	Second	S007-220	St. Louis	8/15/13	S	47.5205	-92.1925	yes	52.5	66.8	29	838	0.0447	6	7088
FS-347	6 Survey 2nd Year	Snowball	31-0108-00-202	Itasca	8/12/13	L	47.3356	-93.2439	no	0	0.0	<5.0	8.2	0.097	10.4	1136
FS-197	4 Survey	Snowball	31-0108-00-202	Itasca	9/4/12	L	47.3355	-93.244	no	0	0.0	<5.0	8.4	0.0936	34.5	4213
FS-177	4 Survey	South Geneva	24-0015-02-208	Freeborn	7/24/12	L	43.7709	-93.2851	no	0	0.0	<5.0	14.1	3.19	16.5	1618
P-16	1 Pilot Survey	St. Louis	S006-929	St. Louis	9/1/11	S	47.4015	-92.3773	no	0		358.1	24.5	0.025		1488
FS-70	8 Survey-No Core	St. Louis	S006-929	St. Louis	9/7/12	S	47.4015	-92.3772	no	0	0.0	1210	73.8			
FS-69	4 Survey	St. Louis	S007-208	St. Louis	9/7/12	S	47.4671	-91.9279	no	0	0.0	3400	1.33	0.181	52.4	11429
P-17	1 Pilot Survey	St. Louis	S007-208	St. Louis	9/1/11	S	47.4668	-91.9355	yes	30		1344	1.23	0.04		9654
FS-66	4 Survey	St. Louis Estuary	S007-206	St. Louis	9/5/12	S	46.6545	-92.2739	no	0	0.0	587	16	0.0445	51.3	6169
FS-315	7 Survey Seasonal	St. Louis Estuary	S007-444	St. Louis	6/24/13	S	46.6516	-92.2373	no	0	0.0	497	8.1	0.147	30	6056
FS-330	4 Survey	St. Louis Estuary	S007-444	St. Louis	7/22/13	S	46.6518	-92.2372	yes	8.8	11.8	1020	6.71	0.0901	30.4	5817
FS-300	7 Survey Seasonal	St. Louis Estuary	S007-444	St. Louis	5/27/13	S	46.6515	-92.2376	no	0	0.0	395	9.4	0.0713	22.3	4499
FS-363	8 Survey-No PW	St. Louis Estuary	S007-444	St. Louis	8/26/13	S	46.6518	-92.2372	yes	18.8	31.2					4761
P-40	3 Pilot- No Core	St. Louis Estuary	S007-444	St. Louis	9/19/11	S	46.6588	-92.2819	no	0		1165	4.9			
FS-67	4 Survey	St. Louis Estuary Pokegama Bay	S006-928	Douglas, WI	9/5/12	S	46.6859	-92.1606	yes	0	0.0	1200	9.97	0.112	31.5	14015
P-41	3 Pilot- No Core	St. Louis Estuary Pokegama Bay	S006-928	Douglas, WI	9/19/11	S	46.6855	-92.1619	no	0		1646	2.33			
P-30	1 Pilot Survey	Stella	47-0068-00-203	Meeker	9/14/11	L	45.0659	-94.4339	yes	13.8		6.7	7.59	0.08	18	2159
FS-188	4 Survey	Stella	47-0068-00-204	Meeker	8/27/12	L	45.0683	-94.4334	yes	0.3	0.3	<5.0	18.1	1.79	13.1	1257
FS-341	6 Survey 2nd Year	Stella	47-0068-00-205	Meeker	8/1/13	L	45.066	-94.4339	yes	28.8	57.6	7.5	24.7	0.0884	11.4	1786
FS-224	4 Survey	Stone Lake	69-0046-00-201	St. Louis	9/19/12	L	47.5039	-91.8857	yes	6.3	21.0	2830	3.26	0.0533	10.9	5225
FS-94	4 Survey	Sturgeon	S004-870	St. Louis	9/13/12	S	47.656	-92.9315	yes	13.8	37.9	471	1.62	0.0659	29	2505
FS-61	4 Survey	Swan	31-0067-02-206	Itasca	8/30/12	L	47.2888	-93.2127	yes	3	12.4	<5.0	12.5	0.332	21.9	5827
FS-62	5 Survey Duplicate	Swan	31-0067-02-206	Itasca	8/30/12	L	47.289	-93.2124	yes	0.8	3.8	<5.0	14	0.221	19	4821
FS-50	8 Survey-No Core	Swan	34-0223-00-201	Kandiyohi	7/30/12	L	45.326	-95.067	no	0	0.0	<5.0	11.7			
FS-125	4 Survey	Tamarac	56-0192-00-203	Otter Tail	8/19/12	L	46.3637	-95.5714	no	0	0.0	<5.0	2.33	0.0768	16.8	21908
FS-219	4 Survey	Trout	31-0216-00-212	Itasca	9/13/12	L	47.2592	-93.3942	no	0	0.0	<5.0	38.6	0.117	15.3	12535
FS-356	6 Survey 2nd Year	Trout	31-0216-00-212	Itasca	8/14/13	L	47.2591	-93.3942	no	0	0.0	<5.0	39.1	0.103	14.7	11992
FS-93	4 Survey	Turpela	69-0427-00-201	St. Louis	9/12/12	L	47.4613	-92.2371	yes	0.8	1.0	1650	3.3	0.115	10.1	6979
FS-358	4 Survey	Turtle River, North Branch	S007-662	Grand Forks, ND	8/19/13	S	47.9952	-97.6276	yes	22.5	121.0	5.3	198	0.083	8.1	4262
P-57	1 Pilot Survey	Unnamed	34-0611-00-201	Kandiyohi	9/23/11	L	45.2675	-94.865	yes	32.5		8.3	6.42	0.286	14.2	2311
FS-183	4 Survey	Unnamed	34-0611-00-201	Kandiyohi	7/30/12	L	45.2675	-94.865	yes	16.3	64.9	<5.0	16.8	0.15	27.3	2157
P-57	2 Pilot Duplicate	Unnamed	34-0611-00-201	Kandiyohi	9/23/11	L	45.2675	-94.865	yes	32.5		8.3	6.42	0.065	22.8	1689
P-57	2 Pilot Duplicate	Unnamed	34-0611-00-201	Kandiyohi	9/23/11	L	45.2675	-94.865	yes	32.5		8.3	6.42	0.065	22.8	1946
P-57	2 Pilot Duplicate	Unnamed	34-0611-00-201	Kandiyohi	9/23/11	L	45.2675	-94.865	yes	32.5		8.3	6.42	0.065	22.8	2193
FS-59	4 Survey	Upper Panasa	31-0111-00-202	Itasca	8/29/12	L	47.306	-93.2652	no	0	0.0	<5.0	29.6	0.126	14.7	895
FS-383	6 Survey 2nd Year	Upper Panasa	31-0111-00-204	Itasca	9/18/13	L	47.3059	-93.2676	no	0	0.0	<5.0	33.6	0.0399	41.2	19148
FS-139	4 Survey	Welby family farm	86-0231-00-202	Wright	9/21/12	L	45.3592	-94.0782	yes	2	17.2	10.2	<0.5	0.118	19.1	7267
FS-228	4 Survey	West battle	56-0239-00-204	Otter Tail	8/15/12	L	46.2906	-95.6049	yes	35	144.8	<5.0	4.03	0.189	15.5	3108
FS-186	4 Survey	Westport	61-0029-00-204	Pope	8/1/12	L	45.6897	-95.217	no	0	0.0	<5.0	7.11	1.79	15.3	4917
FS-346	6 Survey 2nd Year	Westport	61-0029-00-205	Pope	8/8/13	L	45.7042	-95.203	yes	4.5	6.7	7.9	6.3	0.205	14.5	3262
P-43	3 Pilot- No Core	Wild Rice	09-0023-00-201	Carlton	9/20/11	L	46.6735	-92.6023	no	0		7275	0.37			
FS-65	4 Survey	Wild Rice	09-0023-00-202	Carlton	9/4/12	L	46.6712	-92.6055	no	0	0.0	4120	<0.5	0.083	52.9	13650
P-36	1 Pilot Survey	Wild Rice Reservoir	69-0371-00-204	St. Louis	9/16/11	L	46.9098	-92.1636	yes	7.5		61.2	1.13	0.023	23.3	5555
FS-68	4 Survey	Wolf	69-0143-00-101	St. Louis	9/6/12	L	47.2564	-91.963	yes	2.3	8.9	1500	2.01	0.119	37.4	9526
P-19	1 Pilot Survey	Wolf	69-0143-00-202	St. Louis	9/2/11	L	47.2586	-91.9618	yes	56.3		702.5	1.54	0.139		8240



https://www.dnr.state.mn.us/input/environmentalreview/keetac/final_eis_vol_2.html

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Legend

- ▭ Current and Proposed Keetac Footprint
- — 2010 Impaired Streams
- ▨ 2010 Impaired Wetlands
- 🟥 2010 Impaired Lakes
- ▭ City Boundary
- ▭ County Boundary
- — Streams

0.5 0 0.5 1 1.5
Miles

Source: USGS, Barr, LMIC, MNDNR, National Hydro Dataset, MPCA, Itasca County, St. Louis County, City of Hibbing, City of Nashwauk, U.S. Steel, and Mn/DOT. 2008 Aerial Photograph

Figure 4.9.7.1
Mercury Impaired Waters
U.S. Steel Keetac
Keewatin, MN

Minnesota
DEPARTMENT OF NATURAL RESOURCES

2010 Water Quality, Hydrology, and Wild Rice Monitoring Year End Report

Swan Lake, Hay Lake, Moose Lake, Hay Creek, and Swan River

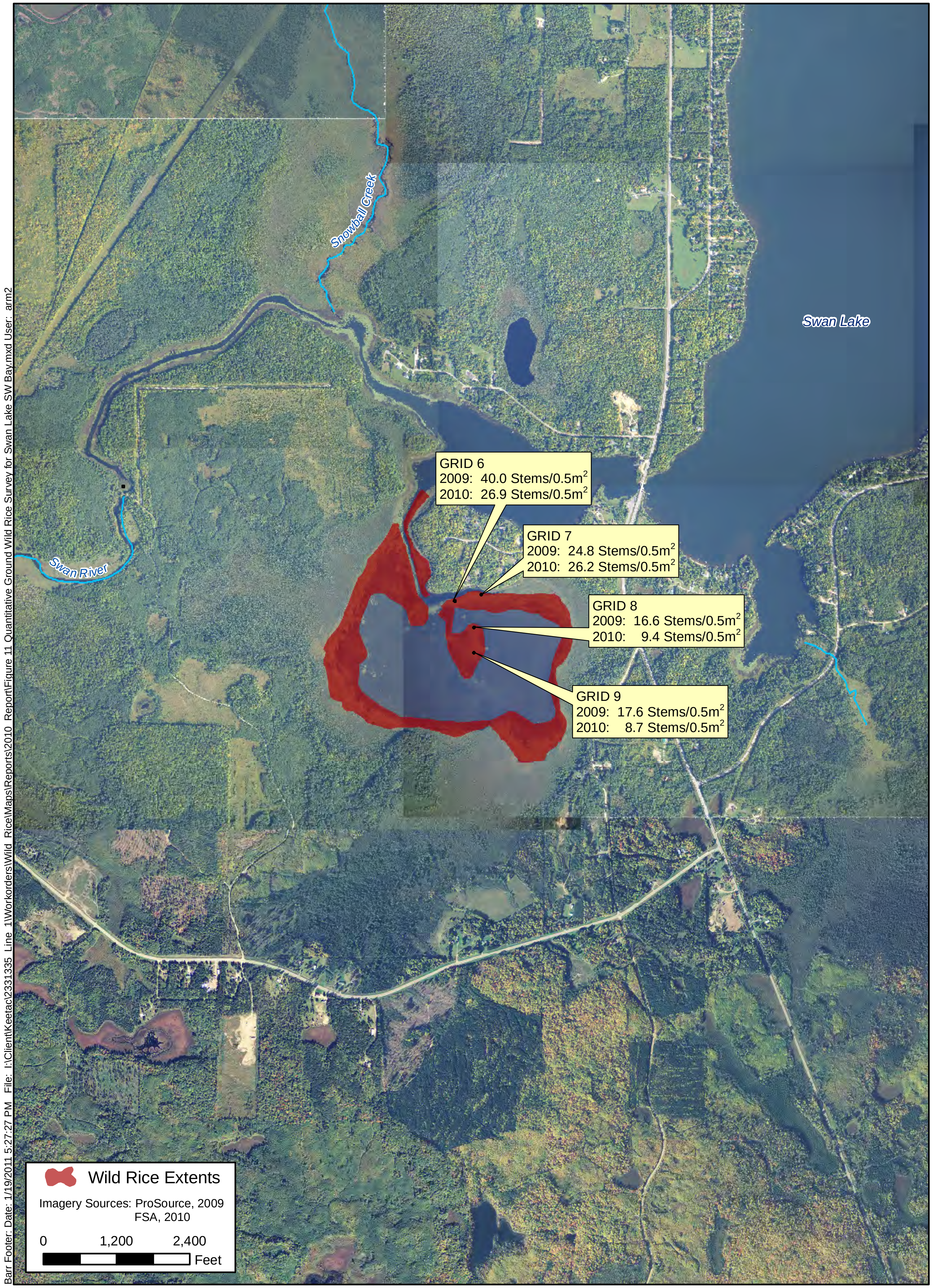
Keetac Expansion Project

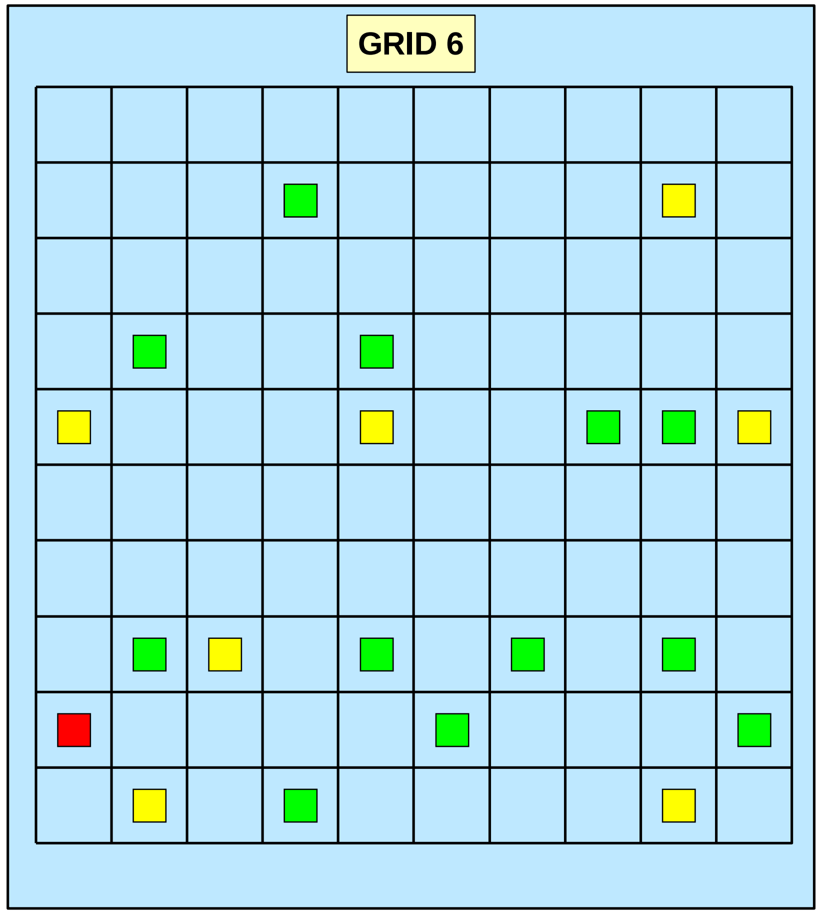
Prepared for
United States Steel Corporation
Minnesota Ore Operations – Keetac

January 2011

BARR

Wild Rice WQLS, Exhibit P





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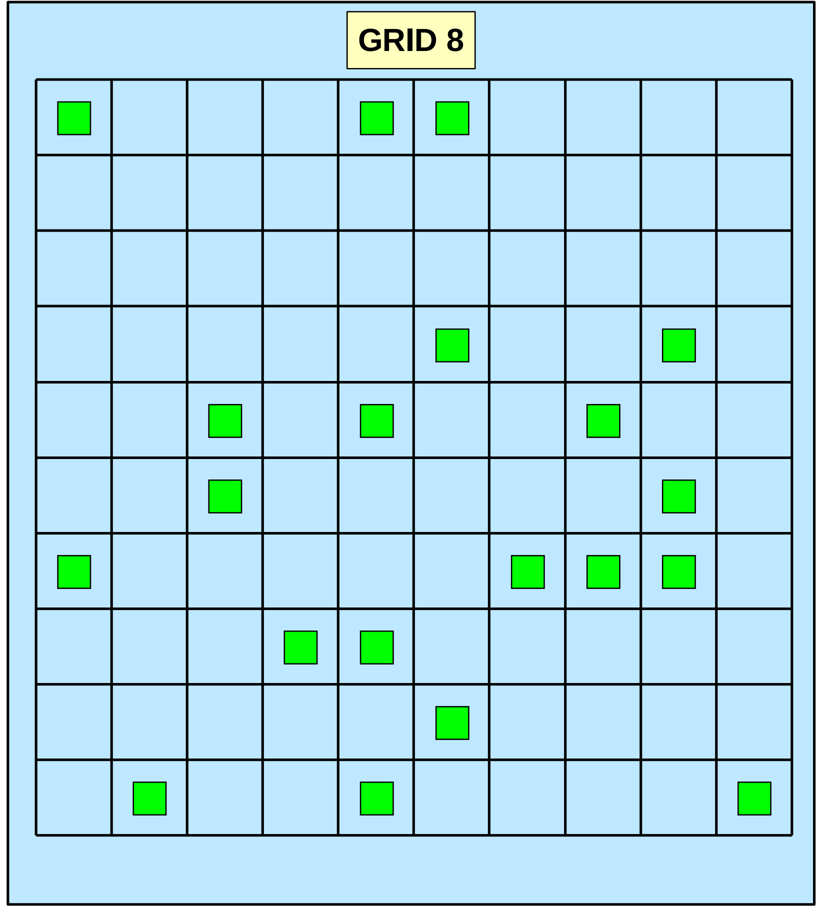

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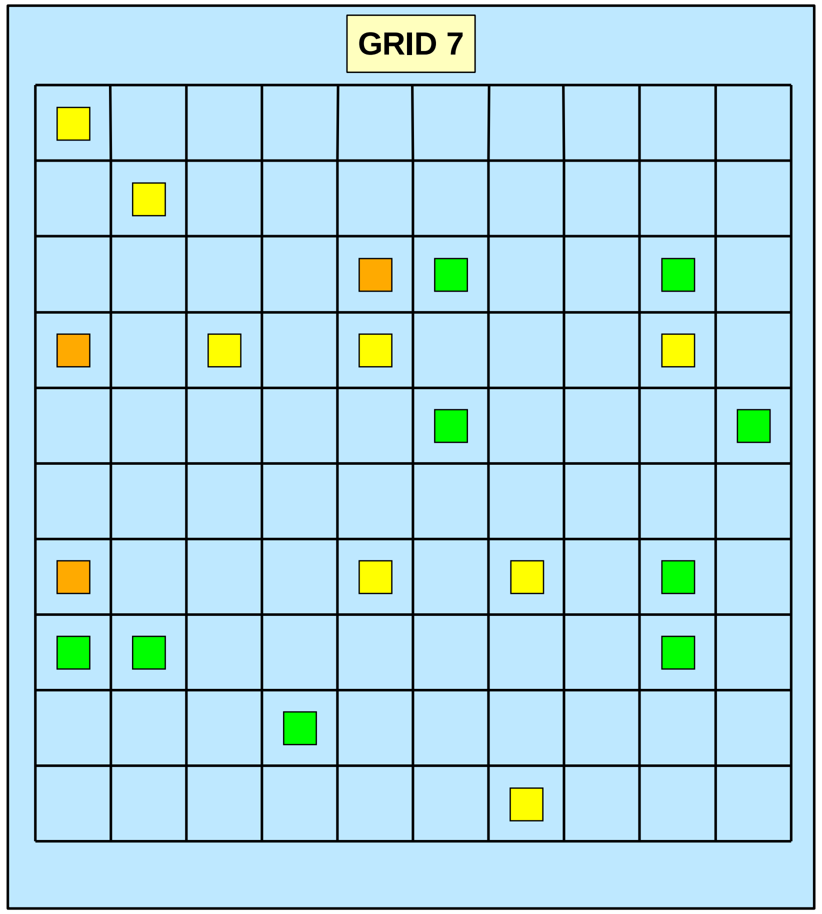

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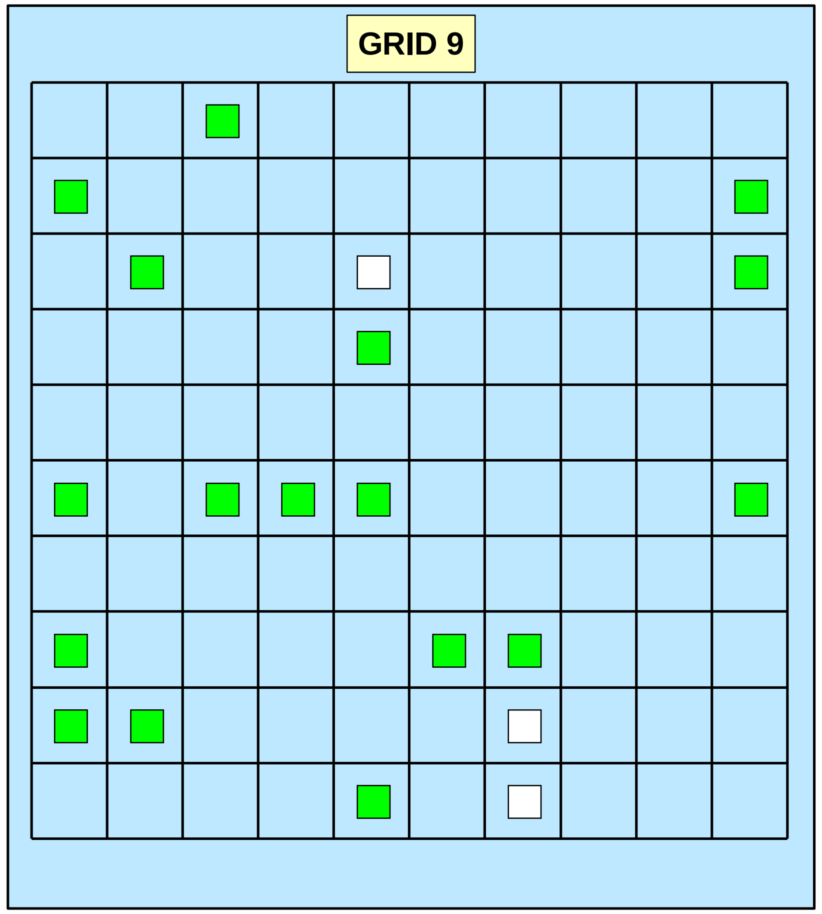

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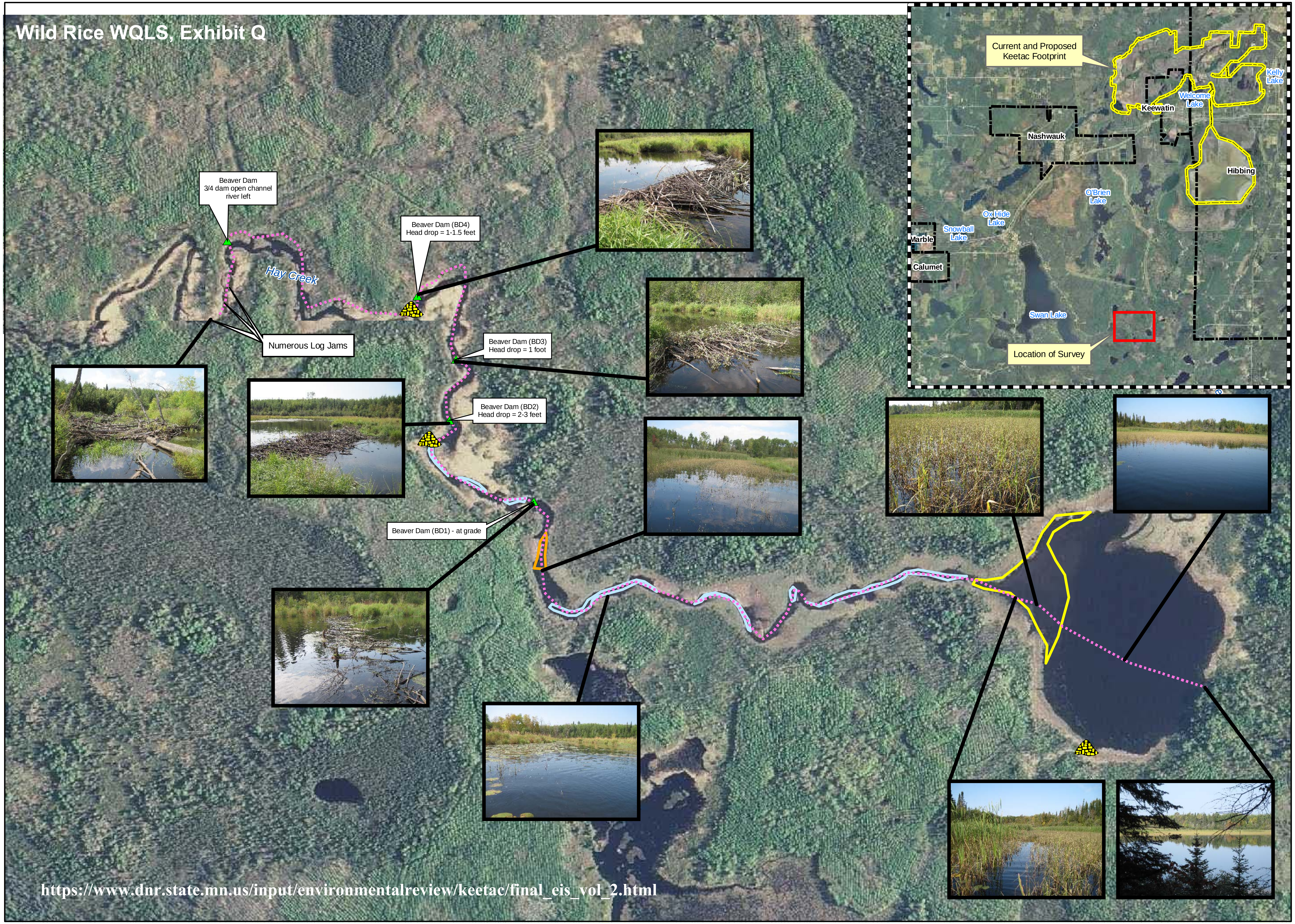
Stem Density/0.5 m2

⬜	0	🟧	51-75
🟩	1-25	🟥	76-100
🟨	26-50		

Figure 11
QUANTITATIVE GROUND WILD RICE SURVEY
SWAN LAKE SW BAY, AUGUST, 2010
Keetac Expansion Project
U. S. Steel
Keewatin, Minnesota

Wild Rice WQLS, Exhibit Q



https://www.dnr.state.mn.us/input/environmentalreview/keetac/final_eis_vol_2.html

Legend

▲ Beaver Lodges
▲ Beaver Dams
▭ Current and Proposed Keetac Footprint
⋯ Wild Rice Survey Routes

Wild Rice Density

▭ Abundant
▭ Moderate
▭ Sparse
▭ City Boundary

N

250 0 250 500
Feet

Source: USGS, Barr, LMIC, MNDNR, National Hydro Dataset, MPCA, Itasca County, St. Louis County, City of Hibbing, City of Nashwauk, U.S. Steel, and Mn/DOT. 2008 Aerial Photograph

Figure 4.7.4
Wild Rice (Zizania sp.)
Occurence and Density
in Lower Hay Creek (Hay
Lake to upstream of
confluence with Moose
Creek Outlet)
September 15, 2009
U.S Steel Keetac
Keewatin, MN

Minnesota
DEPARTMENT OF NATURAL RESOURCES

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