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September 15, 2009

Erik Carlson
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500 Lafayette Road
St. Paul, MN 55155-4029

Jeff Udd
Minnesota Pollution Control Agency
525 Lake Avenue S, Suite 400
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**Re: Wild Rice and Sulfate Water Quality Data Submittal
U. S. Steel – Keetac Expansion Project and Perry Pit NPDES Permit Application
Keewatin, Minnesota**

Dear Mr. Carlson and Mr. Udd

On behalf of U. S. Steel enclosed is the wild rice and sulfate water quality data that has been collected to date as requested by the MPCA in response to the initial Perry Pit Dewatering NPDES permit application. It our understanding that this information will also be used by the DNR in drafting the Draft Environmental Impact Statement (DEIS) for the Keetac Expansion Project. A revised NPDES permit application for the Perry Pit Dewatering is expected to be submitted to the MPCA on October 1, 2009.

In addition to the wild rice survey data and sulfate water quality data collection, a meeting was held with representatives from the Chippewa bands to determine if there was any additional information available for Swan Lake and/or Hay Lake in terms of historical use of the wild rice in these lakes or any additional wild rice or sulfate data.

The results of the wild rice survey found a large stand of wild rice in a bay off of the southwest portion of Swan Lake and in Hay Lake. Both stands seem to be healthy although only one year of data has been collected and wild rice stands are known to cycle over a 3 – 6 year period. Spring time sulfate concentrations in Swan Lake were found to be higher than historical values but results for the August samples were very similar to historical values. The reason for the increase in the spring time concentrations in unknown. No historical data for sulfate concentrations in Hay Lake exists. Concentrations in Hay Lake are higher than those in Swan Lake and are similar to what would be expected given the historical discharges to Hay Lake from the Keetac facility. The thickest stand of wild rice was found at the outlet of Hay Lake.

Additional sampling is planned to occur in September and October until the lake “turns over”. That additional data will be submitted upon completion of the fall sampling events and receipt of the data from

the laboratory. If you have any questions regarding this information please contact Chrissy Bartovich or Scott Coleman from U. S. Steel or me.

Sincerely,



Lori L. Stegink
Vice President
Barr Engineering Company

Enclosure

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***2009 Water Quality, Hydrology, and Wild Rice
Monitoring***

Mesabi Nugget Phase II Project

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

September 2009



2009 Water Quality, Hydrology, and Wild Rice Monitoring

September 14, 2009

Table of Contents

1.0 Background	1
2.0 Water Quality and Hydrologic Monitoring	3
2.1 Water Quality Monitoring.....	3
2.1.1 Water Quality Monitoring Locations	3
2.1.2 Water Quality Monitoring Methodology	3
2.1.3 Water Quality Monitoring Results	4
2.1.3.1 Sulfate Analysis by Turbidimetric Method	4
2.1.4 Historic Sulfate Concentrations for Swan Lake.....	5
2.2 Hydrologic Monitoring	5
2.2.1 Hydrologic Monitoring Locations	5
2.2.2 Hydrologic Monitoring Methodology.....	5
2.2.3 Hydrologic Monitoring Results	6
3.0 Wild Rice Survey	7
3.1 Wild Rice Survey Methodology	7
3.1.1 Methodology of Literature Search for Wild Rice in Downstream Receiving Waters from the Project	7
3.1.2 Methodology of Historic Aerial Photographic Imagery Analysis	7
3.1.3 Methodology of Ground Verification and Density/Acreage Calculations.....	8
3.1.4 Methodology for Acquisition of 2009 Aerial Photographs.....	8
3.2 Wild Rice Survey Results	8
3.2.1 Methodology for Acquisition of 2009 Aerial Photographs.....	9
3.2.2 Results of Historic Aerial Photographic Imagery Analysis	9
3.2.3 Results of Ground Verification and Density/Acreage Calculations.....	9
3.2.4 Results of 2009 Aerial Photographs.....	10
3.3 Wild Rice Survey Discussion	10

List of Tables

Table 1	Iron and Sulfate Concentrations in Surface Water Samples, 2009.
Table 2	Comparison of Tubidimetric and Ion Chromatography Sulfate Analyses, 2009.
Table 3	Hydrologic Monitoring of Hay Creek and Hay Lake, 2009.

List of Figures

Figure 1	2009 Water Quality and Wild Rice Monitoring Locations
Figure 2	Sulfate Concentrations (Ion Chromatography Method) in Hay Lake, Hay Creek, Moose Lake, and Hart Creek 2009
Figure 3	Sulfate Concentrations (Ion Chromatography Method) in Swan Lake Surface Samples 2009
Figure 4	Swan Lake, Center: Historic Concentrations of Sulfate in Water Samples Collected at Lake Surface, 2005-2009
Figure 5	Potential Wild Rice USGS Photographic Survey Results, August 2008
Figure 6	Ground Wild Rice Survey Results for Swan Lake Southwest Bay, Moose and Hay Lakes, July 2009

List of Appendices

Appendix A	Water Quality Monitoring Field Parameters
Appendix B	Historic Swan Lake Sulfate Concentrations
Appendix C	Details of Wild Rice Surveys on Hay Lake, Moose Lake, and Swan Lake Southwest Bay
Appendix D	Photographs of Wild Rice on Hay Lake, Moose Lake, and Swan Lake Southwest Bay

1.0 Background

The purpose of this report is to provide information in response to the data request sent to U.S. Steel by the MPCA requesting additional information as part of a NPDES permit application for a discharge of mine pit dewatering from the Perry Pit at the Keetac facility. In addition, the information in this report will be used by the DNR in preparation of the Environmental Impact Statement (EIS) for the Keetac Expansion project.

The MPCA requested the following information:

- 1.0 A literature review to determine the potential location of wild rice in the downstream receiving waters,
- 2.0 A cooperative information gathering/exchange process with Bands of Chippewa potentially affected by the project and the 1854 Authority,
- 3.0 A field survey of wild rice, and
- 4.0 Information on current sulfate concentrations in the bodies of water where wild rice was located.

The information for items 1, 3 and 4 is provided in the following sections. A summary of item 2 is provided in the remainder of this section.

As part of the cooperative information exchange with the Bands of the Chippewa (Bands), U. S. Steel held a meeting at the Keetac facility on September 8, 2009. Invitations were sent to representatives of all of the Bands, and representatives from Bois Forte, 1854 Treaty Authority, and Leech Lake attended the meeting. As part of the meeting, a boat tour was taken to observe the wild rice in the southwest bay of Swan Lake and a presentation was made summarizing the sulfate and wild rice data collected to date. This same information is summarized in this report.

One purpose of the meeting was to determine if the Bands had any additional information regarding the cultural and historical use of the wild rice or sulfate or water level information for the water bodies included in the study. The MPCA data request asked that U. S. Steel try to ascertain historic uses for wild rice beds potentially affected by Keetac's discharge. A Bois Forte representative helped the group understand the difficulty of determining historic use of wild rice beds because tribal groups, or groups of families, may have moved as many as six times in a year to various villages to harvest various natural resources as they came into season, including but not limited to wild rice,

maple sugar, fish, game, etc. There is historic evidence that tribes started harvesting in the southern part of the state, where seasons begin earlier, and moved northward. Identifying relatively recent history would require interviewing tribal elders on reservations, in Duluth, and in the Twin Cities about their recollections of harvesting with their parents and grandparents. This would be a time-intensive undertaking. An existing Trygg map indicates one village in the area on Swan River at the outlet of Swan Lake. However, it is possible that there could have been more villages, because such maps tend to under-represent the villages that were present according to the Bois Forte representative. In addition, recent DNR wild rice harvest reports indicate that wild rice is harvested from Swan Lake. Given this information, it is likely that wild rice was historically harvested in the area.

None of the representatives present at the meeting were aware of any additional information regarding historical sulfate, water level, or wild rice data for the water bodies in this study. The remainder of this report discusses the sulfate, hydrologic, and wild rice data that has been recently collected.

2.0 Water Quality and Hydrologic Monitoring

Water quality and hydrologic monitoring are currently ongoing for 2009. Results of measurements collected to date are presented in this report. A final water quality and hydrologic monitoring report will be generated after 2009 monitoring activities are completed.

2.1 Water Quality Monitoring

The purpose of water quality monitoring is to evaluate the concentration of sulfate and corresponding basic water quality parameters (e.g., pH) in water bodies that contain wild rice, and to continue characterizing sulfate levels in Swan Lake. Water quality monitoring activities for 2009 commenced on June 23, 2009, and are scheduled to continue until fall turnover of Swan Lake occurs (typically September or October).

2.1.1 Water Quality Monitoring Locations

The water quality monitoring locations are identified in [Figure 1](#). The water discharges from the Keetac facility all end up flowing into Hay Creek upstream of Hay Lake. Hay Creek flows through Hay Lake and eventually discharges to the southeast corner of Swan Lake. Swan Lake discharges to the Swan River west of monitoring location KSW6. Monitoring location KSW7 is located in a shallow (approximately 2- to 3-feet deep) unnamed bay at the southwest corner of Swan Lake near the outlet to the Swan River. The bay, further referred to in this report as Swan Lake Southwest Bay, is attached to the main body of Swan Lake by a small channel. There are no other substantial inlets or outlets to Swan Lake Southwest Bay.

Neither Hart Creek (KSW8) nor Moose Lake (KSW2) receive any direct discharges related to mining activities, and are therefore considered control sites.

2.1.2 Water Quality Monitoring Methodology

Water quality samples were collected from the surface of Hay Creek, Hart Creek, Hay Lake, Moose Lake, and Swan Lake. In addition, water quality samples were collected from 2-meter depth intervals at two locations in Swan Lake (KSW4 and KSW5). Lake water quality samples were collected with a stainless steel Kemmerer sampler. Water quality samples collected from streams were collected by directly filling sample bottles while facing upstream. Samples were placed on ice and shipped to Braun Intertec laboratories for sulfate and total iron analyses. Water quality analyses consisted of unfiltered sulfate analysis by ion chromatography method (EPA 9056) and unfiltered total iron

analysis (EPA 6010B). Select samples were analyzed for comparison to historical data for sulfate by turbidimetric method (EPA 9038) in addition to ion chromatography method.

Field measurements of pH, specific conductivity, temperature, dissolved oxygen, and oxidation-reduction potential (ORP) were collected using an YSI® model 556 multiprobe. Depth profiles of field parameters were collected at 1-meter intervals in Hay Lake (KSW1B), Moose Lake (KSW3), and Swan Lake (KSW4 and KSW5).

2.1.3 Water Quality Monitoring Results

Results of sulfate (ion chromatography method) and total iron analyses are summarized in [Table 1](#). Field parameter measurements are included as [Appendix A](#). Sulfate concentrations (ion chromatography method) for Hay Lake and Hay Creek ranged from 41 mg/L to 84 mg/L, while sulfate concentrations for Hart Creek and Moose Lake were 8.4 mg/L or less ([Figure 2](#)). Sulfate concentrations (ion chromatography method) in surface samples collected from the main body of Swan Lake (KSW4, KSW5, and KSW6) ranged from 23 mg/L to 51 mg/L, and concentrations in Swan Lake Southwest Bay (KSW7) ranged from 6.9 mg/L to 48 mg/L ([Figure 3](#)). The ion chromatography analytical method has an error range of 20 percent according to the method documentation. Error bars representing this are also shown for each data point in [Figures 2 and 3](#). Overlapping error bars between data points indicates that results are not significantly different. As can be seen in [Figures 2 and 3](#), although there is a wide range in the results, many of the values are not significantly different when considering the method error.

2.1.3.1 Sulfate Analysis by Turbidimetric Method

Upon reviewing results of the June and July 2009 sulfate analyses by ion chromatography method, it was observed that sulfate concentrations in Swan Lake were higher and more variable than in data collected previously as part of the Minnesota Steel EIS. Additionally, sulfate concentrations at KSW7 increased unexpectedly compared to the first sampling event. It was identified that the turbidimetric method had been used on the historical analysis rather than ion chromatography. The turbidimetric method is no longer an approved CWA method and therefore was not used for this study. Select samples from the June sampling events were reanalyzed for sulfate by turbidimetric method for comparison. Select samples from August sampling events were also analyzed for sulfate by both ion chromatography and turbidimetric methods.

[Table 2](#) summarizes the results of samples analyzed for sulfate by both ion chromatography and turbidimetric method. No clear trend was found between the two analytical methods. Results for Hay

Lake were generally in good agreement for all samples collected and analyzed using both methods. However, the results for the July samples for Swan Lake were markedly different when comparing analytical methods, while those for the August samples were very similar. The turbidimetric method is known to have interferences and is subject to human interpretation. These are two of the reasons that this method was dropped from the list of approved CWA analytical methods. It is possible that something was present in the July 2009 Swan Lake samples that caused interference with one or both of the laboratory methods, resulting in the difference between the sulfate concentrations reported by the two methods. It is possible that these same interferences may have been present in the historical results as well.

2.1.4 Historic Sulfate Concentrations for Swan Lake

Swan Lake has been monitored for sulfate concentrations in previous years by Minnesota Steel/Essar Steel. Historic sulfate data collected from the surface of Swan are included in [Appendix B](#). Sulfate concentrations in surface water samples collected in the center of Swan Lake from 2005 to current are plotted in [Figure 4](#).

2.2 Hydrologic Monitoring

Hydrologic monitoring commenced on June 23, 2009 and will proceed into fall 2009. As hydrologic monitoring is still ongoing, the results presented in this report should be considered preliminary. A report updating the 2009 hydrologic monitoring results will be generated after 2009 monitoring activities are completed.

2.2.1 Hydrologic Monitoring Locations

Hydrologic monitoring was conducted in Hay Creek upstream of Hay Lake (KSW1A) and Hay Creek upstream of Swan Lake (KSW3), as identified on [Figure 1](#). Additionally, water levels in Hay Lake were monitored.

2.2.2 Hydrologic Monitoring Methodology

Staff gages were installed in Hay Creek at locations KSW1A and KSW3. A staff gage was also installed in Hay Lake. An In-Situ® Level Troll® water level logging device was attached to each staff gage for continuous recording of water levels. Flow was measured in Hay Creek at locations KSW1A and KSW3 during each water quality monitoring field visit. Flow was measured following USGS methodology (i.e., measuring stream velocity at 0.6 of water depth and multiplying by cross-sectional area). Water velocities were measured with a Marsh-McBirney Flo-Mate™ Model 2000 portable velocity flow meter.

2.2.3 Hydrologic Monitoring Results

Results of flow monitoring data collected to date for Hay Creek are presented in [Table 3](#). Updated results will be presented in a later report after 2009 hydrologic monitoring activities are completed. Beaver activity was observed to be prevalent in Hay Creek, and a beaver dam was observed at the outlet of Moose Lake. As a result, the water level of Moose Lake is maintained at a higher level than nearby Hay Creek, and Moose Lake does not receive water from Hay Creek under typical hydrologic conditions. It was also observed that the water level in Hay Lake increased by more than a foot as the summer progressed, suggesting a beaver dam is present on Hay Creek downstream of Hay Lake.

The water level of Swan Lake is controlled by a manmade structure on the Swan River. Therefore, the water level of Swan Lake does not change substantially.

3.0 Wild Rice Survey

The purpose of the Wild Rice Survey is to determine the presence of wild rice (*Zizania palustris* L, known as *Manoomin* in Ojibwe), an annual grass, on Hay Lake (KWR1), Moose Lake (KWR2), and the Swan Lake Southwest Bay (KWR3) (Figure 1). Since wild rice populations oscillate over an approximate 4- to 6-year period, the following analyses and ground surveys were performed to determine past and current presence of wild rice.

1. Literature search to identify waterbodies potentially affected by the Keetac Project.
2. Analysis of historic aerial photographic imagery of the study area.
3. On-the-ground verification of the presence of wild rice and sampling of the density of select wild rice stands.
4. Acquire current aerial photographic imagery to verify information obtained from the cultural data, historic aerial photographic imagery analysis, and ground surveys.

3.1 Wild Rice Survey Methodology

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

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

To determine which waterbodies downstream of the Keetac Project might potentially contain wild rice, a literature review of historic and cultural information was conducted. Information examined included the 2008 DNR “Natural Wild Rice in Minnesota” Report, U.S. Department of Interior Geological Survey maps (Topo maps), Trygg maps, and the 1854 Treaty Authority List. The Trygg maps were developed by J. William Trygg (1966) utilizing data from the original Government Land Surveys along with other historical surveys and sources (<http://www.trygglandoffice.com/maps.html>).

3.1.2 Methodology of Historic Aerial Photographic Imagery Analysis

Staff from the Geospatial Sciences and Technologies Branch USGS-BRD-Upper Midwest Environmental Sciences Center in La Crosse, WI analyzed 2004 and 2008 1-meter resolution NAIP (National Agricultural Imagery Program) natural color and color infrared aerial photographic imagery for the presence of wild rice on Hay, Moose and Swan Lakes. These photos are the best publicly available aerial images from which to identify areas with the potential for the presence of

wild rice. The USGS staff has over a decade of experience analyzing NAIP aerial images for the presence of wild rice, mostly along the backwaters and bays of the Mississippi River in southeastern Minnesota and southwestern Wisconsin. The quality of the analysis is influenced by several factors, including the date of acquisition, weather conditions, light conditions, and the quality of the “wild rice photographic signature”. While the wild rice signature is considered distinct at the end of the growing season, it can be difficult to distinguish the signature of wild rice from the signature of other emergent plants.

3.1.3 Methodology of Ground Verification and Density/Acreage Calculations

Surveys to estimate wild rice density and crop acreage were carried out the week of July 27, 2009. Qualitative estimates of wild rice coverage were carried out by canoeing along the perimeter of the wild rice beds and recording bed locations using a Trimble® GPS Pathfinder® ProXH™ receiver. Quantitative estimates of wild rice coverage were determined from representative sampling grids 10-meter x 10-meter size. Three grids were sampled on Moose Lake, three grids were sampled on Hay Lake, and four grids were sampled on Swan Lake Southwest Bay. Within each grid, 20 1-meter by 1-meter plots were randomly selected using a computer random number generator. Each randomly selected plot was sampled using a 0.5 m² sampling square made from PVC piping (0.71 m on each side). The square was placed on the water surface at each randomly selected plot and the rice stems within 0.5 m² the square were counted. Height above the water surface was measured for five plants within each 0.5 m² plot. Height was measured to the plant’s highest point (seed head or flag leaf depending on stage of plant growth). Stem count sum, mean, median, and standard deviation were calculated based on the stem count for 20 plots. The total stem count for each grid comprises 10 percent of the grid area. The total area sampled for each grid was 10 m² (20 plots x 0.5 m² each). Grid zero sampled on Moose Lake was sampled using an *in situ* randomization.

3.1.4 Methodology for Acquisition of 2009 Aerial Photographs

Aerial photographic images of the study area were acquired the first week of September 2009. The aerial photographs are color digital imagery with a 1.9 feet/pixel resolution. The sky conditions were less than 2 percent cloud interference with a sun angle of 30 degrees or higher. Due to the recent acquisition of the imagery, rectification and analysis of 2009 imagery are still ongoing.

3.2 Wild Rice Survey Results

The following details the results of the wild rice survey and analyses that have been conducted for Swan Lake Southwest Bay, Hay Lake, and Moose Lake.

3.2.1 Methodology for Acquisition of 2009 Aerial Photographs

The Trygg map of Swan Lake identifies an area on the northern shore of the bay leading to Swan Lake Southwest Bay as a location of an “Indian Village” (1966). A “Chippewa Indian House” is also identified at this location. It is likely the camp was used as a “Ricing Camp”, traditionally used by bands to camp during the ricing season, as well as a location for other hunting/gathering activities during other parts of the year (Vennum 1986, follow up discussion with tribal biologists from Leech Lake Band, Bois Forte and 1854 Authority, September 2009). From that investigation Hay Lake, Swan Lake, and Moose Lake were identified as potential wild rice waterbodies.

3.2.2 Results of Historic Aerial Photographic Imagery Analysis

The potential presence of wild rice identified from the historic aerial photographic imagery analysis is marked with red dots (2008 photos) and pink squares (2004 photos) (Figure 5). This method of identification did not include any estimates for bed size, overall acreage, or density. The 2004 NAIP aerial imagery for Swan Lake, Moose Lake, and Hay Lake were acquired during the period of June 10-19, 2004. The 2008 NAIP aerial imagery for Swan Lake was taken August 9, 2008, while the imagery for Moose Lake and Hay Lake were taken June 1, 2008. Wild rice does not typically begin to emerge above the water level until July in the project area. Therefore, only the 2008 NAIP aerial image for Swan Lake was suitable for identifying wild rice. Upon analyzing the 2008 NAIP imagery, the USGS identified wild rice along much of the perimeter of the Swan Lake Southwest Bay as well as along the channel connecting the bay to the main body of Swan Lake and Swan River flowing out of Swan Lake (Figure 5). Wild rice was not identified on either Moose or Hay Lakes in the aerial photography. Since the aerial imagery for Moose and Hay Lakes were acquired in early June in both 2004 and 2008, wild rice could not be identified by analysis of historic aerial imagery.

3.2.3 Results of Ground Verification and Density/Acreage Calculations

Wild rice was identified from ground surveys performed on Moose Lake, Hay Lake, and the Swan Lake Southwest Bay the week of July 27, 2009 (Figure 6). The aerial photography information was not obtained until after the field survey work was completed; therefore, the wild rice on the Swan River, which had not previously been identified in the other information sources, was not field surveyed. The presence of wild rice on Swan River was verified at a road leading to the dam on the Swan River. No wild rice was found in the south bay shown to potentially contain wild rice in the aerial photography (see Figure 5). Swan Lake Southwest Bay had the largest overall acreage of wild rice, while both Hay Lake and Moose Lake had less acreage but denser stands of wild rice (greater than 80 percent coverage). Wild rice stands were identified along most of the perimeter of Moose Lake with approximately 30 percent coverage; the area located at the southern end near the outlet had

the densest stands (greater than 80 percent coverage). Hay Lake had the most mature and dense wild rice of the three lakes with approximately one-third of the lake covered with wild rice near the outlet to Swan Lake (greater than 90 percent coverage). Swan Lake Southwest Bay had many patchy areas of wild rice throughout most of its extent. The density of those areas ranged from approximately 20 to 50 percent coverage. The USGS analysis of 2008 NAIP aerial imagery of Swan Lake identified wild rice along the perimeter of Swan Lake Southwest Bay, but not within the center of Southwest Bay. It is possible that wild rice beds on Swan Lake in 2008 were not present or dense enough to be captured by aerial photographs. It is also possible that the method of analysis does not distinguish between wild rice and other emergent vegetation in some cases. One example might be the case of lily pads (*Nymphaea odorata*) comprising a significant portion of the wild rice bed and making it difficult to identify the wild rice signature from aerial photographic imagery. Many of the wild rice beds observed within Swan Lake Southwest Bay in 2009 were populated with between 30 to 50 percent lily pads. Detailed information on results of the on-the-ground wild rice survey is included in [Appendix C](#). Photographs of wild rice taken from Hay Lake, Moose Lake, and Swan Lake Southwest Bay are included in [Appendix D](#).

3.2.4 Results of 2009 Aerial Photographs

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

3.3 Wild Rice Survey Discussion

Results from the historic aerial imagery analysis and 2009 ground surveys identified the presence of wild rice on Moose Lake, Hay Lake, and the Swan Lake Southwest Bay. Although several dense stands of wild rice were identified on Moose Lake and Hay Lake, it is difficult to determine the health and history of wild rice in these lakes without a multi-year combined analysis of ground surveys and aerial photographic imagery, as wild rice populations oscillate over an approximate 4 to 6 year period. Delays in plant nutrient uptake and wild rice tissue chemistry influence wild rice growth and production from year to year (Walker et al., 2006; Walker et al., submitted for publication 2009). Other factors such as water level may also play a role, but no data has been collected over multiple years and published. Given that wild rice populations fluctuate over 4 to 6 years, studies carried out over a shorter time frame may not provide adequate information regarding the growth and production of wild rice.

Hay Lake had the densest stands of wild rice (between 30 and 90 stems / 0.5 m²) with sulfate levels ranging from 47 mg/L to 78 mg/L. Moose Lake had less dense stands than Hay Lake (between 33 and

43 stems / 0.5 m²) and sulfate levels ranged from 4.9 mg/L to 8.4 mg/L. From one year's data examining wild rice density data and water sulfate levels, it is not possible to determine the effects of sulfate on wild rice growth and production.

Tables

U.S. Steel Corporation - KeeTac Expansion Project

Table 1: Iron and Sulfate Concentrations in Surface Water Samples, 2009.

KSW1A - Hay Creek Upstream of Hay Lake												
	6/23/2009		7/1/2009		7/6/2009		7/14/2009		8/5/2009		8/25/2009	
Depth (m)	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron
0	42	0.780	64	0.530	84	0.440	56	0.490	48	0.410	46	0.350

KSW1B - Hay Lake												
	6/23/2009		7/1/2009		7/6/2009		7/14/2009		8/5/2009		8/25/2009	
Depth (m)	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron
0	49	0.480	60	0.310	78	0.250	55	0.190	49	0.150	47	0.180

KSW2 - Moose Lake												
	6/23/2009		7/1/2009		7/6/2009		7/14/2009		8/5/2009		8/25/2009	
Depth (m)	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron
0	8.4	0.630	NS	NS	NS	NS	NS	NS	4.9	0.340	NS	NS

KSW3 - Hay Creek Outlet to Swan Lake												
	6/23/2009		7/1/2009		7/6/2009		7/14/2009		8/5/2009		8/25/2009	
Depth (m)	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron
0	46	0.650	NS	NS	NS	NS	48	0.590	41	0.320	44	0.250

KSW4 - Swan Lake, Southeast												
	6/24/2009		7/1/2009		7/6/2009		7/15/2009		8/5/2009		8/25/2009	
Depth (m)	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron
0	35	0.057	NS	NS	NS	NS	26	< 0.020	24	0.020	24	0.019 J
2	41	0.038	NS	NS	NS	NS	26	< 0.020	25	0.019 J	24	0.029
4	45	0.045	NS	NS	NS	NS	26	< 0.020	25	0.020	24	0.031
6	44	0.022	NS	NS	NS	NS	27	< 0.020	25	0.020	25	0.019 J
8	39	0.017 J	NS	NS	NS	NS	26	< 0.020	25	0.020	24	0.019 J
8.5	40	0.016 J	NS	NS	NS	NS	26	< 0.020	25	0.023	24	0.021

U.S. Steel Corporation - KeeTac Expansion Project

Table 1: Iron and Sulfate Concentrations in Surface Water Samples, 2009.

KSW5 - Swan Lake, Center												
	6/24/2009		7/1/2009		7/6/2009		7/15/2009		8/5/2009		8/25/2009	
Depth (m)	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron
0	39	0.021	NS	NS	NS	NS	27	0.065	23	0.012 J	24	0.069
2	40	0.027	NS	NS	NS	NS	27	0.020	24	0.008 J	24	0.026
4	41	0.024	NS	NS	NS	NS	26	< 0.020	24	0.010 J	24	0.017 J
6	42	0.029	NS	NS	NS	NS	27	< 0.020	24	0.018 J	24	0.015 J
8	46	0.025	NS	NS	NS	NS	26	< 0.020	24	0.011 J	24	0.021
10	49	0.014 J	NS	NS	NS	NS	26	< 0.020	24	0.015 J	24	0.014 J
12	51	0.018 J	NS	NS	NS	NS	26	0.022	24	0.020	24	0.090
14	75	0.020	NS	NS	NS	NS	26	0.022	23	0.011 J	23	0.057
16	39	0.029	NS	NS	NS	NS	26	0.028	23	0.022	22	0.050
18	39	0.071	NS	NS	NS	NS	25	0.043	22	0.019 J	22	0.047

KSW6 - Swan Lake, West												
	6/24/2009		7/1/2009		7/6/2009		7/15/2009		8/5/2009		8/25/2009	
Depth (m)	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron
0	37	0.034	44	0.035	51	0.025	26	0.050	23	0.020	23	0.016 J

KSW7 - Swan Lake, Southwest												
	6/24/2009		7/1/2009		7/6/2009		7/15/2009		8/5/2009		8/25/2009	
Depth (m)	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron
0	11.1	0.102	48	0.080	40	0.380	8.0	0.086	8.1	0.065	6.9	0.094
0.7	12	0.140	32	0.077	45	0.089	8.0	0.086	8.0	0.068	6.9	0.079

KSW8 - Hart Creek												
	6/23/2009		7/1/2009		7/6/2009		7/14/2009		8/5/2009		8/25/2009	
Depth (m)	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron
0	2.8	0.820	NS	NS	NS	NS	NS	NS	1.5	3.90	NS	NS

U.S. Steel Corporation - KeeTac Expansion Project

Table 1: Iron and Sulfate Concentrations in Surface Water Samples, 2009.

Oxhide Creek & Lake												
	6/23/2009		7/1/2009		7/6/2009		7/14/2009		8/5/2009		8/25/2009	
Depth (m)	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron	Sulfate	Iron
Creek	NS	NS	NS	NS	NS	NS	NS	NS	28	0.150	NS	NS
Lake	NS	NS	NS	NS	NS	NS	NS	NS	29	0.017	NS	NS

Notes

Concentrations of Iron and Sulfate are in mg/L.

Sulfate results are for ion chromatography method only.

11.1 Value is an average of six surface samples collected from various locations in Swan Lake Southwest Bay.

J Detected but below the Method Reporting Limit; therefore, result is an estimated concentration (CLP J-Flag).

NS Not sampled.

U.S. Steel Corporation - KeeTac Expansion Project

Table 2: Comparison of Tubidimetric and Ion Chromatography Sulfate Analyses, 2009.

Concentrations are in mg/L

KSW1A - Hay Creek Upstream of Hay Lake								
	7/1/2009		7/6/2009		8/5/2009		8/25/2009	
Depth (m)	I.C.	Turbid.	I.C.	Turbid.	I.C.	Turbid.	I.C.	Turbid.
0	64	56	84	60	48	51	46	51

KSW1B - Hay Lake								
	7/1/2009		7/6/2009		8/5/2009		8/25/2009	
Depth (m)	I.C.	Turbid.	I.C.	Turbid.	I.C.	Turbid.	I.C.	Turbid.
0	60	50	78	57	49	52	47	54

KSW2 - Moose Lake								
	7/1/2009		7/6/2009		8/5/2009		8/25/2009	
Depth (m)	I.C.	Turbid.	I.C.	Turbid.	I.C.	Turbid.	I.C.	Turbid.
0	--	--	--	--	4.9	7.6	--	--

KSW3 - Hay Creek Outlet to Swan Lake								
	7/1/2009		7/6/2009		8/5/2009		8/25/2009	
Depth (m)	I.C.	Turbid.	I.C.	Turbid.	I.C.	Turbid.	I.C.	Turbid.
0	NS	NS	NS	NS	41	46	44	48

KSW4 - Swan Lake, Southeast								
	7/1/2009		7/6/2009		8/5/2009		8/25/2009	
Depth (m)	I.C.	Turbid.	I.C.	Turbid.	I.C.	Turbid.	I.C.	Turbid.
0	--	--	--	--	24	27	24	25
2	--	--	--	--	25	26	--	--
4	--	--	--	--	25	27	--	--
6	--	--	--	--	25	26	--	--
8	--	--	--	--	25	27	--	--
8.5	--	--	--	--	25	27	--	--

KSW5 - Swan Lake, Center								
	7/1/2009		7/6/2009		8/5/2009		8/25/2009	
Depth (m)	I.C.	Turbid.	I.C.	Turbid.	I.C.	Turbid.	I.C.	Turbid.
0	--	--	--	--	23	26	24	27
2	--	--	--	--	24	26	--	--
4	--	--	--	--	24	25	--	--
6	--	--	--	--	24	25	--	--
8	--	--	--	--	24	26	--	--
10	--	--	--	--	24	26	--	--
12	--	--	--	--	24	25	--	--
14	--	--	--	--	23	26	--	--
16	--	--	--	--	23	24	--	--
18	--	--	--	--	22	25	--	--

KSW6 - Swan Lake, West								
	7/1/2009		7/6/2009		8/5/2009		8/25/2009	
Depth (m)	I.C.	Turbid.	I.C.	Turbid.	I.C.	Turbid.	I.C.	Turbid.
0	44	24	51	26	23	25	23	27

U.S. Steel Corporation - KeeTac Expansion Project

Table 2: Comparison of Tubidimetric and Ion Chromatography Sulfate Analyses, 2009.

Concentrations are in mg/L

KSW7 - Swan Lake, Southwest								
	7/1/2009		7/6/2009		8/5/2009		8/25/2009	
Depth (m)	I.C.	Turbid.	I.C.	Turbid.	I.C.	Turbid.	I.C.	Turbid.
0	48	14	40	15	7.9	11	6.9	12
0.7	32	14	45	14	8.0	11	6.9	12

KSW7B - Swan Lake, Southwest								
	7/1/2009		7/6/2009		8/5/2009		8/25/2009	
Depth (m)	I.C.	Turbid.	I.C.	Turbid.	I.C.	Turbid.	I.C.	Turbid.
0	--	--	NS	NS	6.1	11	--	--

KSW7C - Swan Lake, Southwest								
	7/1/2009		7/6/2009		8/5/2009		8/25/2009	
Depth (m)	I.C.	Turbid.	I.C.	Turbid.	I.C.	Turbid.	I.C.	Turbid.
0	--	--	NS	NS	8.2	11	--	--

KSW7D - Swan Lake, Southwest								
	7/1/2009		7/6/2009		8/5/2009		8/25/2009	
Depth (m)	I.C.	Turbid.	I.C.	Turbid.	I.C.	Turbid.	I.C.	Turbid.
0	NS	NS	NS	NS	7.9	10	--	--

KSW7E - Swan Lake, Southwest								
	7/1/2009		7/6/2009		8/5/2009		8/25/2009	
Depth (m)	I.C.	Turbid.	I.C.	Turbid.	I.C.	Turbid.	I.C.	Turbid.
0	--	--	NS	NS	8.8	12	--	--

KSW7F - Swan Lake, Southwest								
	7/1/2009		7/6/2009		8/5/2009		8/25/2009	
Depth (m)	I.C.	Turbid.	I.C.	Turbid.	I.C.	Turbid.	I.C.	Turbid.
0	NS	NS	NS	NS	7.9	12	--	--

KSW8 - Hart Creek								
	7/1/2009		7/6/2009		8/5/2009		8/25/2009	
Depth (m)	I.C.	Turbid.	I.C.	Turbid.	I.C.	Turbid.	I.C.	Turbid.
0	NS	NS	NS	NS	1.5	< 5.0	--	--

Oxhide Creek & Lake								
	7/1/2009		7/6/2009		8/5/2009		8/25/2009	
Depth (m)	I.C.	Turbid.	I.C.	Turbid.	I.C.	Turbid.	I.C.	Turbid.
Creek	--	--	--	--	28	28	--	--
Lake	--	--	--	--	29	30	--	--

Notes

- I.C. - Ion chromatography analysis for sulfate.
- Turbid. - Samples reanalyzed for sulfate by turbidimetric method.
- NS - Not sampled.
- NA - Not analyzed.

U.S. Steel Corporation - KeeTac Expansion Project

Table 3: Hydrologic Monitoring of Hay Creek and Hay Lake, 2009.

<u>Location</u>	<u>Date</u>	<u>Staff Gage (ft)</u>	<u>Flow (cfs)</u>
KSW1A	6/23/2009	2.65	17.0
Hay Creek Upstream	7/1/2009	2.58	12.0
of Hay Lake	7/6/2009	2.84	11.3
	7/14/2009	2.95	7.0
	8/6/2009	3.45	15.3
	8/11/2009	3.48	14.1
	8/25/2009	3.73	19.5
KSW1B	6/23/2009	1.40	N/A
Hay Lake	7/1/2009	1.40	N/A
	7/6/2009	1.79	N/A
	7/14/2009	1.96	N/A
	8/6/2009	2.38	N/A
	8/11/2009	2.41	N/A
	8/25/2009	2.58	N/A
KSW3	6/23/2009	1.58	22.6
Hay Creek Upstream	7/14/2009	1.19	6.3
of Swan Lake	8/5/2009	1.61	18.8
	8/11/2009	1.55	13.8
	8/25/2009	1.71	21.0

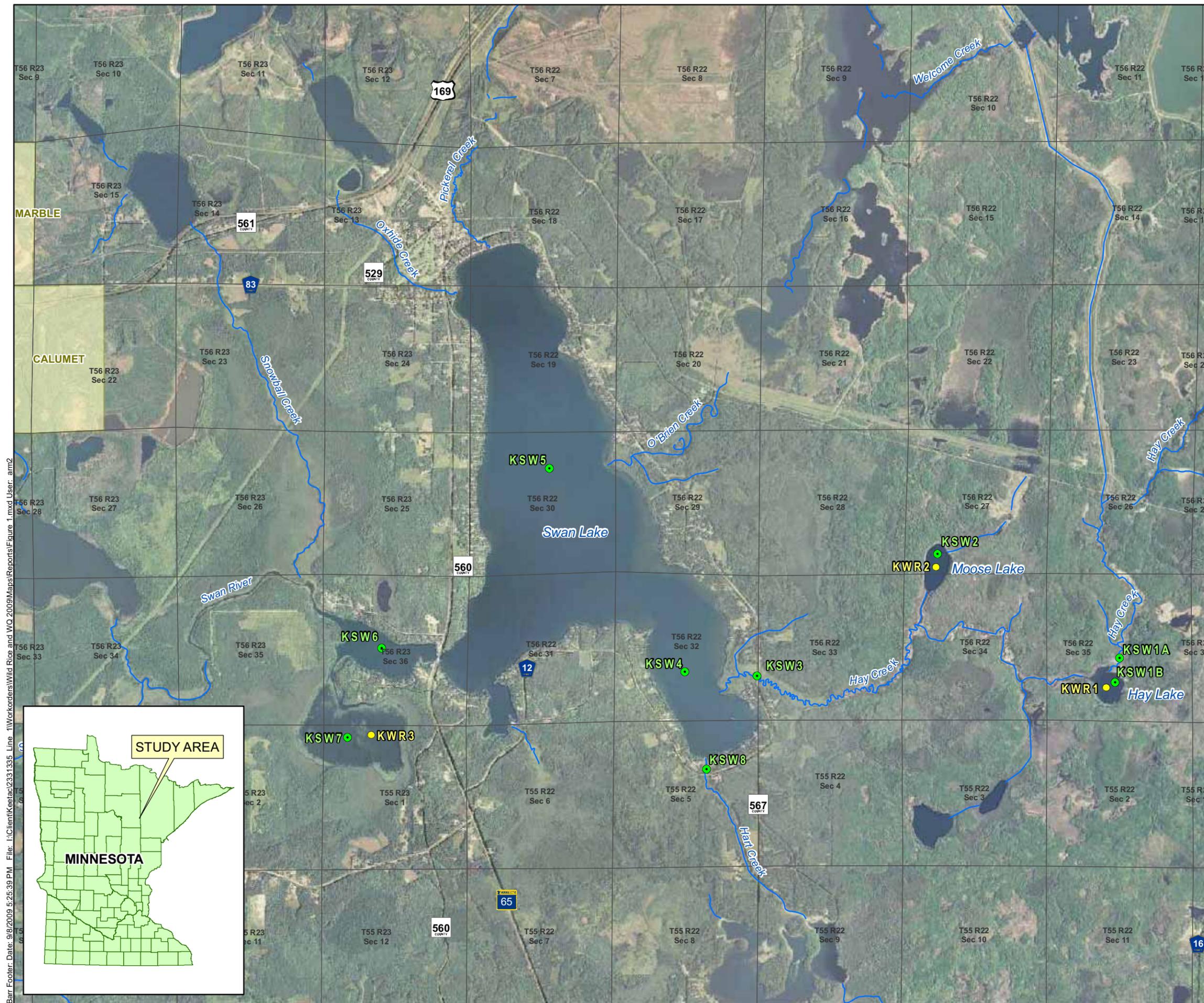
Notes

ft is feet

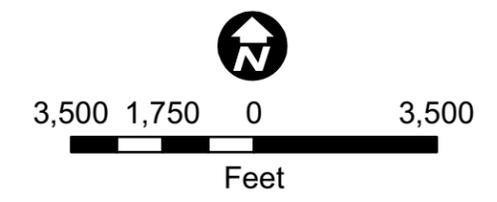
cfs is cubic feet per second

N/A is not applicable

Figures



- Wild Rice Survey Location
 - Water Quality Monitoring Location
 - ~ Stream/River
 - Sections Boundaries
 - City Boundaries
- Imagery Source: FSA, 2008



Bar Footer: Date: 9/8/2009 5:25:39 PM File: I:\Client\Kee\ac2331335 Line 1\Workorders\Wild Rice and WQ 2009\Maps\Reports\Figure 1.mxd User: arm2



Figure 1
 2009 WATER QUALITY AND
 WILD RICE MONITORING LOCATIONS
 Keetac Expansion Project
 U. S. Steel Corp
 Keewatin, Minnesota

Figure 2: Sulfate Concentrations (Ion Chromatography Method) in Hay Lake, Hay Creek, Moose Lake, and Hart Creek 2009

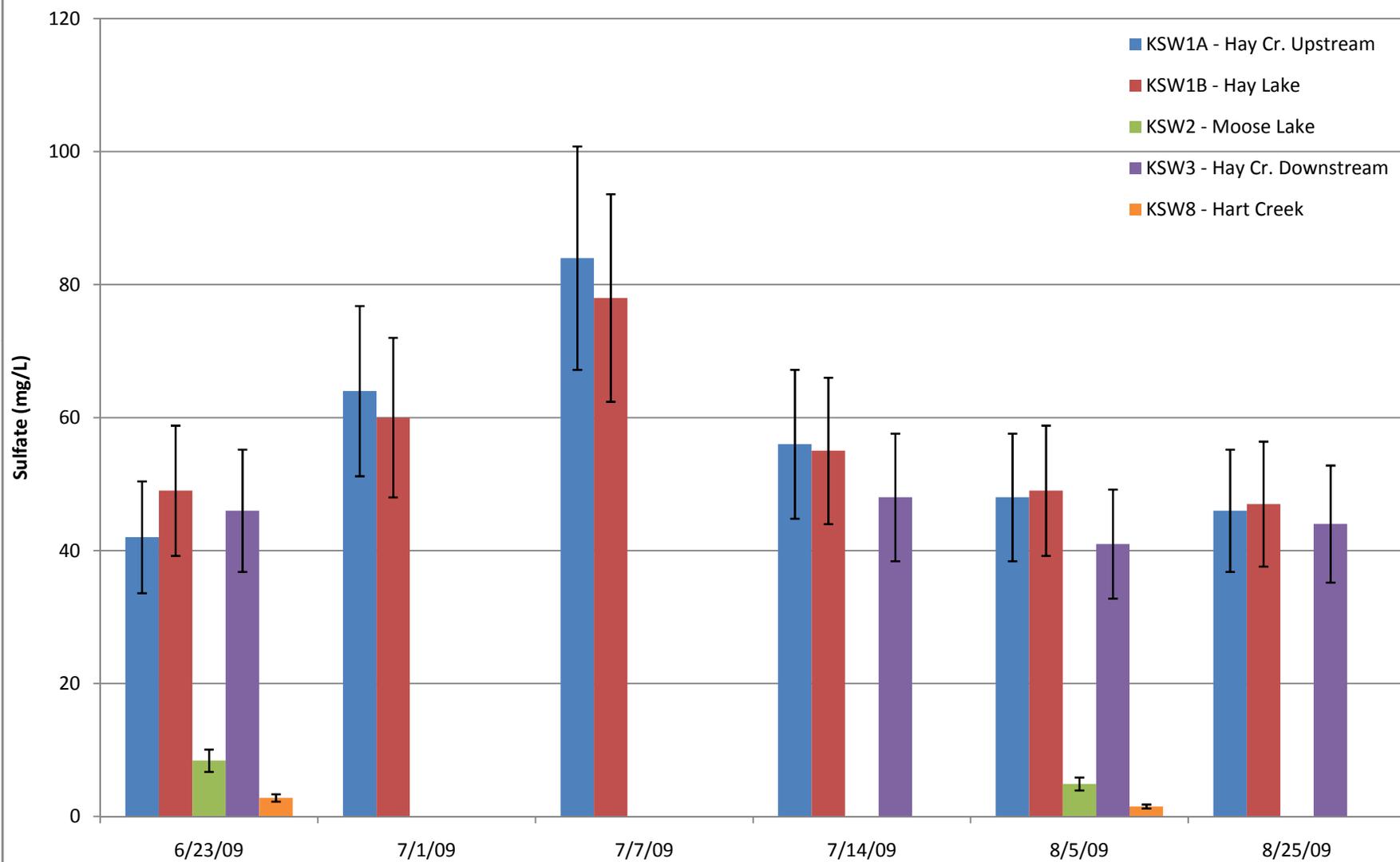


Figure 3: Sulfate Concentrations (Ion Chromatography Method) in Swan Lake Surface Samples 2009

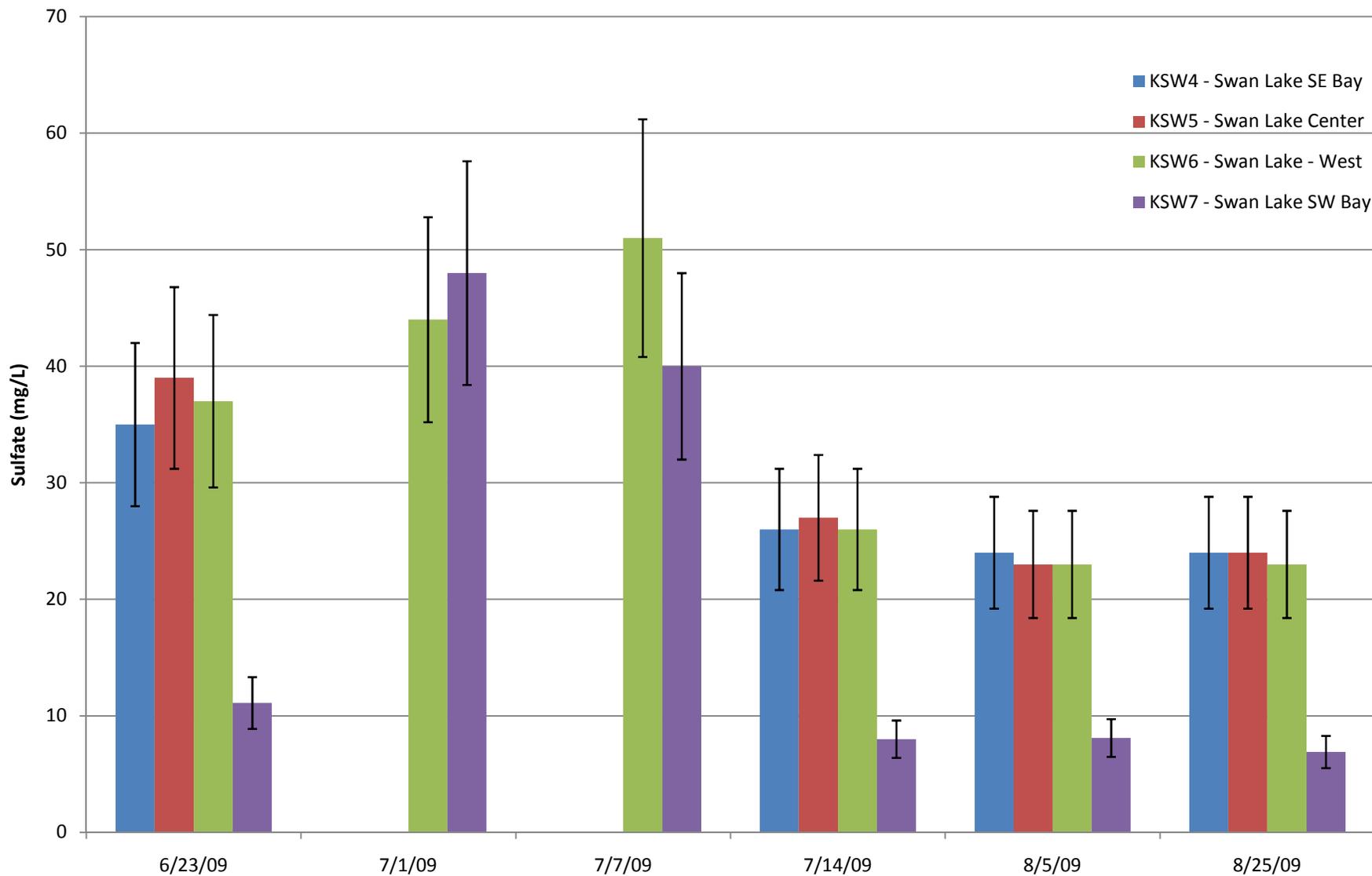
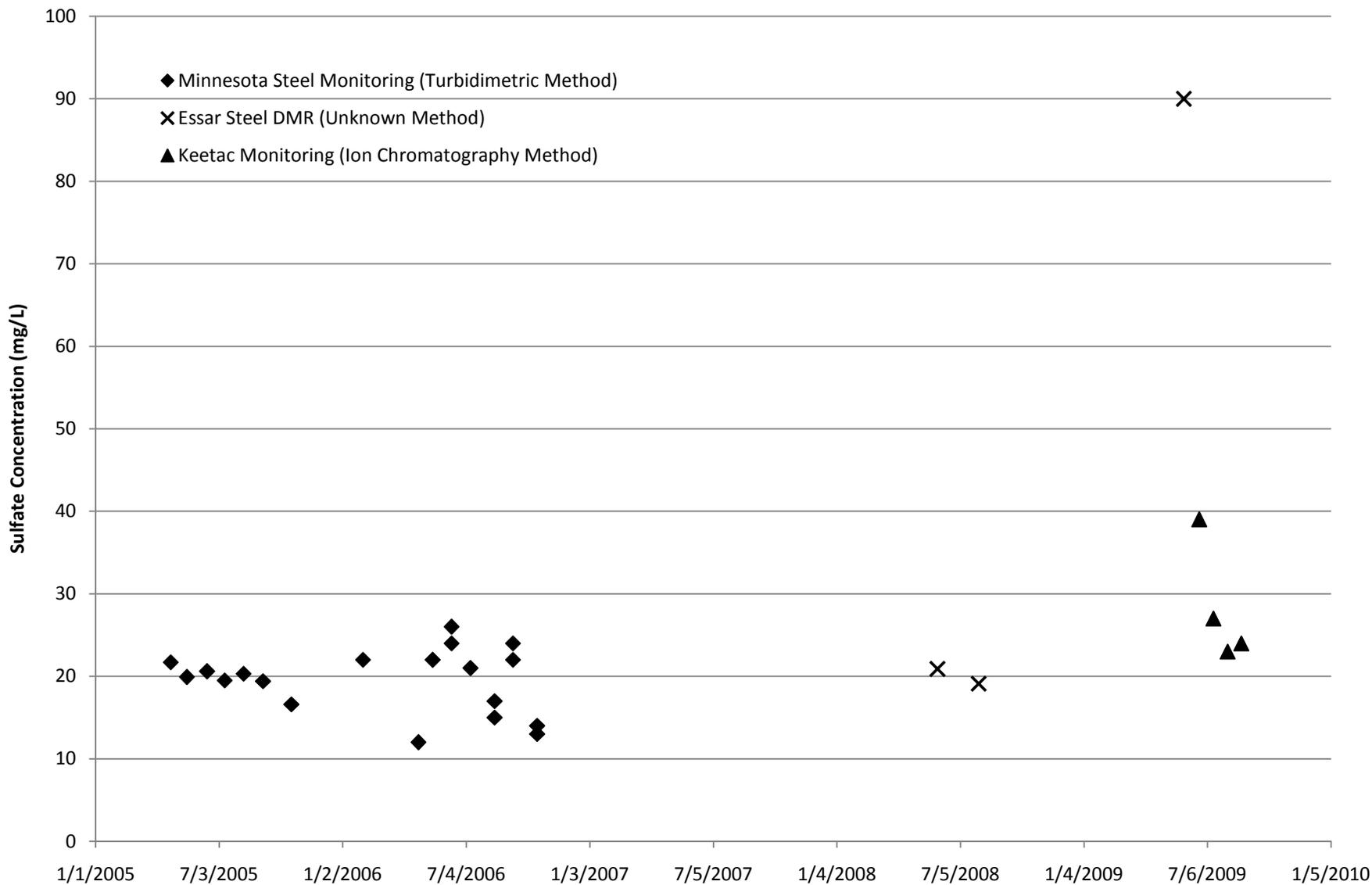
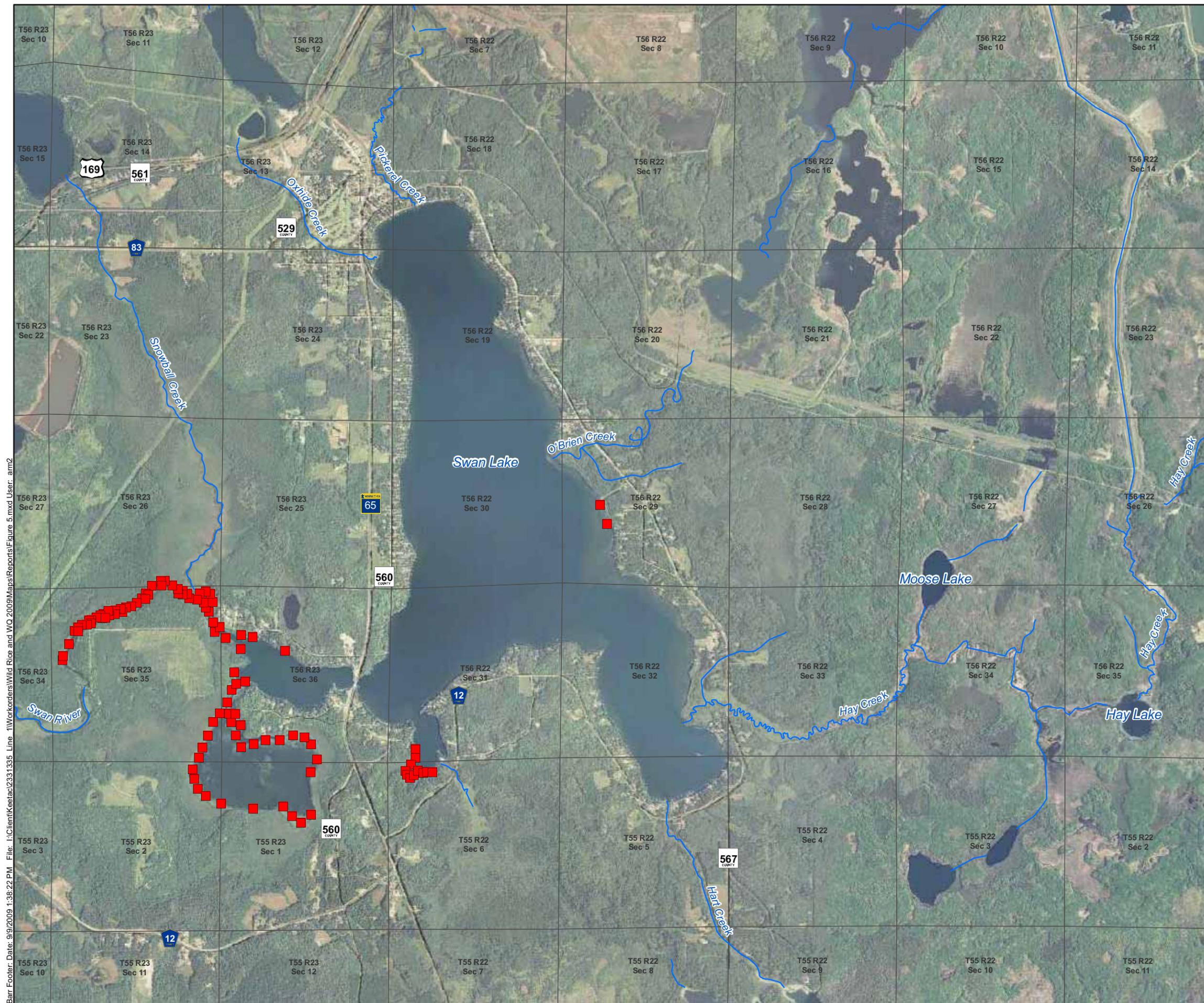
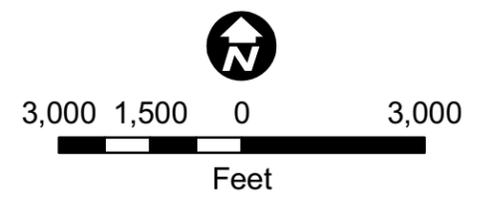


Figure 4: Swan Lake, Center: Historic Concentrations of Sulfate in Water Samples Collected at Lake Surface, 2005-2009.



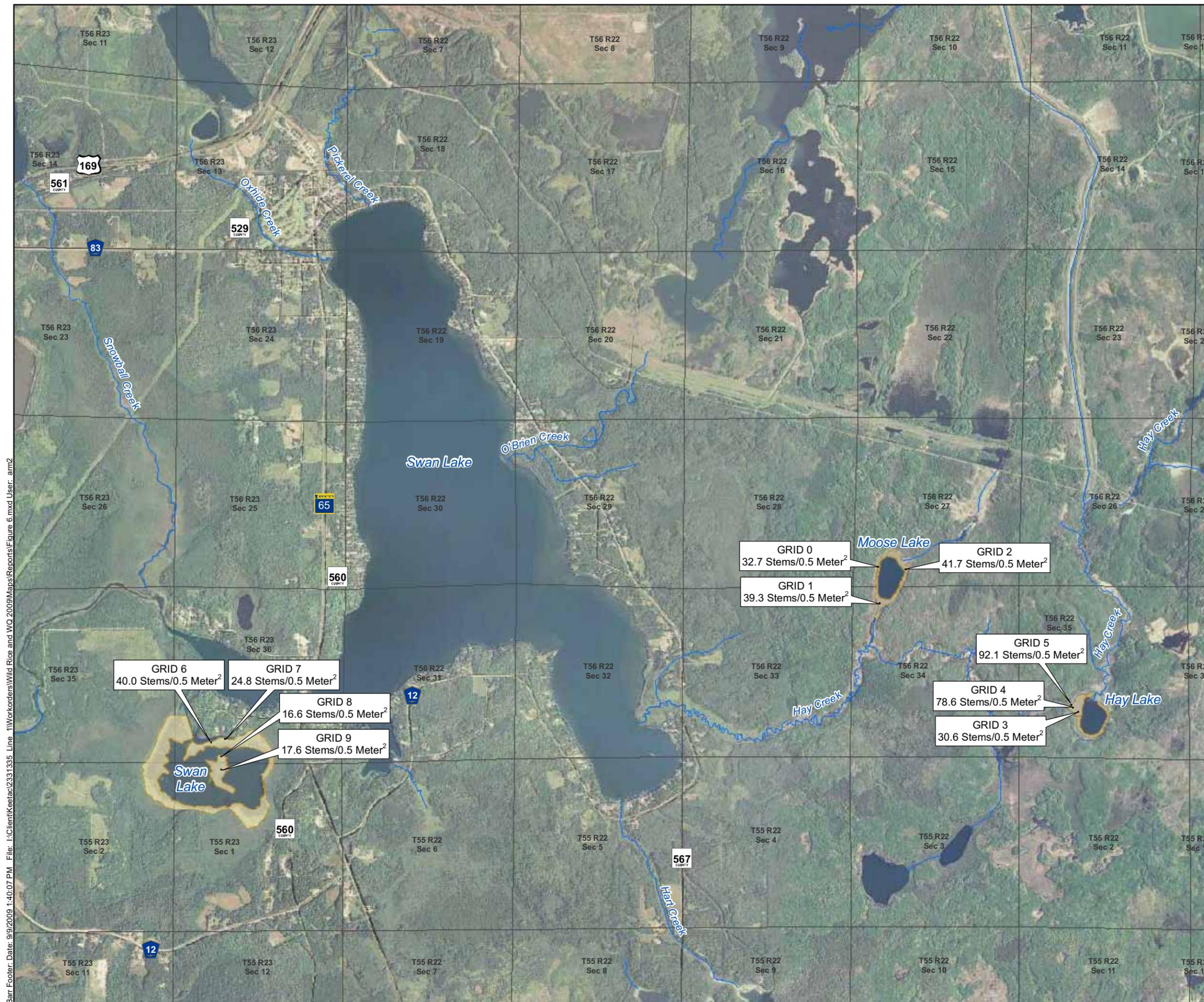


■ Potential Wild Rice Location - 2008
— Stream/River
 Sections Boundaries
 Imagery Source: FSA, 2008.



Bar Footer: Date: 9/9/2009 1:38:22 PM File: I:\Client\Keelac\2331335 Line 1\Workorders\Wild Rice and WQ 2009\Maps\Reports\Figure 5.mxd User: arm2

Figure 5
 POTENTIAL WILD RICE USGS PHOTOGRAPHIC
 SURVEY RESULTS, AUGUST 2008
 Keetac Expansion Project
 U. S. Steel Corp
 Keewatin, Minnesota



- 10x10 Meter Grid
- ~ Stream/River
- Approximate Extent of Wild Rice Stands
- Sections Boundaries

Imagery Source: FSA, 2008.

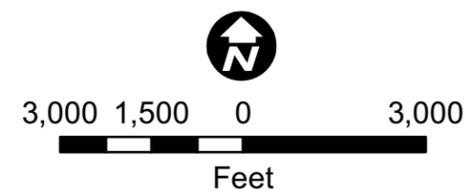


Figure 6
 GROUND WILD RICE SURVEY RESULTS FOR SWAN LAKE SW BAY, MOOSE AND HAY LAKES
 Keetac Expansion Project
 U. S. Steel Corp
 Keewatin, Minnesota

Appendices

Appendix A

Water Quality Monitoring Field Parameters

KSW1A - Hay Creek Upstream of Hay Lake

Sample Date	Sample Depth (m)	Temperature (°C)	Specific Conductivity (mS/cm)	pH	Dissolved Oxygen (mg/L)	ORP (mV)
6/23/2009	0	22.2	0.385	7.80	6.86	34.1
7/1/2009	0	15.1	0.482	7.24	9.51	63.2
7/6/2009	0	19.0	0.502	8.12	7.44	7.6
7/14/2009	0	19.2	0.483	7.90	6.12	--
8/5/2009	0	16.4	0.474	6.80	7.21	55.5
8/25/2009	0	19.1	0.484	8.31	6.84	1.5

Notes

mg/L is milligrams per Liter

°C is degrees Celcius

mS/cm is milliSiemens per centimeter

mV is milliVolts

KSW1B - Hay Lake

Sample Date	Sample Depth (m)	Secchi Depth (m)	Temperature (°C)	Specific Conductivity (mS/cm)	pH	Dissolved Oxygen (mg/L)	ORP (mV)
6/23/2009	0	--	25.2	0.416	8.21	7.84	-3.9
	1		22.2	0.405	7.91	7.84	-1.3
	2		18.3	0.467	7.82	7.06	0.3
	3		14.6	0.482	7.68	6.84	5.2
	4		12.9	0.471	7.42	3.50	9.0
	5		11.9	0.470	7.24	0.88	14.4
	6		10.2	0.479	7.35	0.43	-32.3
7/1/2009	0	2.4	16.4	0.447	7.78	8.96	33.4
	1		16.4	0.448	7.79	9.03	35.4
	2		16.3	0.445	7.77	8.49	31.4
	3		15.6	0.464	7.47	7.32	37.0
	4		13.5	0.477	7.15	0.62	36.7
	5		11.5	0.480	7.54	0.34	-7.9
	6		10.5	0.484	8.12	0.30	-51.9
7/6/2009	0	2.0	21.6	0.479	8.41	8.43	-6.8
	1		20.6	0.487	8.23	7.58	-0.8
	2		18.0	0.467	8.13	9.30	4.1
	3		15.8	0.463	7.67	6.04	16.7
	4		13.9	0.478	7.37	0.36	20.6
	5		11.4	0.481	7.67	0.17	-9.0
	5.8		10.7	0.489	8.42	0.15	-70.2
7/14/2009	0	2.4	21.0	0.476	8.49	8.32	165.0
	1		21.0	0.476	8.48	8.32	167.7
	2		20.0	0.482	8.21	6.93	171.6
	3		17.4	0.459	7.92	6.13	175.6
	4		14.3	0.474	7.56	0.56	181.2
	5		11.9	0.482	7.57	0.22	88.9
	5.8		11.2	0.486	7.59	0.16	-11.2

KSW1B - Hay Lake

Sample Date	Sample Depth (m)	Secchi Depth (m)	Temperature (°C)	Specific Conductivity (mS/cm)	pH	Dissolved Oxygen (mg/L)	ORP (mV)
8/6/2009	0	2.4	18.7	0.471	8.23	7.67	0.9
	1		18.5	0.476	8.13	7.42	4.5
	2		17.9	0.484	7.97	6.52	9.6
	3		17.6	0.476	7.74	5.45	14.8
	4		16.6	0.472	7.53	2.57	16.7
	5		13.4	0.485	8.14	0.20	-61.5
	6		12.3	0.487	8.24	0.17	-38.5

Notes

mg/L is milligrams per Liter

°C is degrees Celcius

mS/cm is milliSiemens per centimeter

mV is milliVolts

KSW2 - Moose Lake

Sample Date	Sample Depth (m)	Secchi Depth (m)	Temperature (°C)	Specific Conductivity (mS/cm)	pH	Dissolved Oxygen (mg/L)	ORP (mV)
6/24/2009	0	--	24.2	0.136	8.39	7.74	3.0
	1		23.3	0.136	7.87	5.05	15.9
	2		15.7	0.132	7.67	6.39	33.3
	3		12.8	0.149	7.42	0.36	34.2
	4		10.8	0.274	7.58	0.25	-0.6
	4.5		9.9	0.355	8.77	0.23	-96.6
8/6/2009	0	2.3	20.4	0.142	8.26	7.30	-5.3
	1		19.9	0.142	8.09	7.25	0.9
	2		18.4	0.146	7.41	4.15	18.5
	3		16.0	0.155	7.33	1.10	17.8
	4		12.2	0.320	9.31	0.25	-134.5

Notes

mg/L is milligrams per Liter

°C is degrees Celcius

mS/cm is milliSiemens per centimeter

mV is milliVolts

KSW3 - Hay Creek Upstream of Swan Lake

Sample Date	Sample Depth (m)	Temperature (°C)	Specific Conductivity (mS/cm)	pH	Dissolved Oxygen (mg/L)	ORP (mV)
6/23/2009	0	25.6	0.386	7.89	6.82	-9.8
7/14/2009	0	18.9	0.465	7.90	6.28	176.6
8/25/2009	0	20.5	0.480	--	7.85	-66.8

Notes

mg/L is milligrams per Liter

°C is degrees Celcius

mS/cm is milliSiemens per centimeter

mV is milliVolts

KSW4 - Swan Lake (Southeast)

Sample Date	Sample Depth (m)	Secchi Depth (m)	Temperature (°C)	Specific Conductivity (mS/cm)	pH	Dissolved Oxygen (mg/L)	ORP (mV)
6/24/2009	0	4.0	23.9	0.341	8.89	9.45	-7.8
	1		23.5	0.342	8.96	9.91	-8.6
	2		22.5	0.341	9.04	9.78	-10.8
	3		22.0	0.341	9.01	9.96	-11.4
	4		20.3	0.338	8.92	9.79	-9.5
	5		16.6	0.339	8.69	10.75	-2.7
	6		14.1	0.341	8.30	8.66	6.1
	7		13.5	0.342	8.21	8.20	8.9
	8		13.0	0.342	8.23	8.03	9.1
	8.5		12.9	0.342	8.19	7.74	9.5
7/15/2009	0	4.5	18.9	0.344	8.31	8.07	-14.7
	1		18.9	0.344	8.32	8.00	-12.7
	2		18.8	0.344	8.31	7.92	-9.6
	3		18.8	0.344	8.29	7.95	-6.7
	4		18.7	0.344	8.25	7.84	-3.6
	5		18.6	0.344	8.21	7.81	-1.1
	6		18.6	0.344	8.19	7.71	-0.7
	7		18.4	0.344	8.17	7.59	0.1
	8		18.0	0.345	8.13	7.28	2.8
	8.5		17.3	0.343	7.92	6.55	6.4
8/5/2009	0	2.7	19.4	0.345	8.91	9.11	-26.5
	1		19.4	0.346	8.84	8.89	-19.5
	2		19.4	0.346	8.79	9.00	-15.1
	3		19.3	0.346	8.76	8.74	-12.8
	4		19.2	0.346	8.74	8.75	-9.3
	5		19.2	0.346	8.73	8.78	-7.5
	6		19.1	0.346	8.63	8.77	-5.4
	7		19.0	0.346	8.62	8.60	-2.2
	8		18.8	0.345	8.54	8.36	-0.5
	8.5		18.7	0.345	8.50	8.34	0.2

KSW4 - Swan Lake (Southeast)

Sample Date	Sample Depth (m)	Secchi Depth (m)	Temperature (°C)	Specific Conductivity (mS/cm)	pH	Dissolved Oxygen (mg/L)	ORP (mV)
8/25/2009	0	2.9	20.2	0.342	--	8.05	-101.6
	1		20.1	0.342	--	8.00	-102.0
	2		20.1	0.343	--	8.08	-102.1
	3		20.0	0.343	--	8.06	-101.1
	4		19.9	0.343	--	8.05	-100.9
	5		19.9	0.344	--	8.02	-105.5
	6		19.9	0.344	--	7.98	-100.0
	7		19.7	0.344	--	7.93	-101.9
	8		19.7	0.344	--	7.87	-102.8
8.5		19.6	0.344	--	7.71	-103.1	

Notes

mg/L is milligrams per Liter

°C is degrees Celcius

mS/cm is milliSiemens per centimeter

mV is milliVolts

KSW5 - Swan Lake (Center)

Sample Date	Sample Depth (m)	Secchi Depth (m)	Temperature (°C)	Specific Conductivity (mS/cm)	pH	Dissolved Oxygen (mg/L)	ORP (mV)
6/24/2009	0	5.0	23.4	0.344	9.17	9.47	-8.0
	1		22.8	0.343	9.08	9.37	-12.7
	2		21.3	0.342	8.97	9.79	-15.1
	3		20.6	0.341	8.93	10.17	-16.7
	4		20.0	0.340	8.92	10.12	-17.8
	5		16.8	0.338	8.74	10.65	-13.3
	6		14.3	0.341	8.49	10.05	-7.2
	7		13.4	0.341	8.26	8.80	-2.1
	8		13.2	0.341	8.33	8.93	-3.1
	9		13.0	0.340	8.33	9.27	-3.5
	10		12.8	0.341	8.30	9.05	-3.5
	11		12.7	0.341	8.28	8.52	-3.2
	12		12.6	0.342	8.22	7.40	-1.2
	13		12.4	0.342	8.16	6.81	-0.1
	14		12.3	0.343	8.10	6.34	1.5
	15		12.2	0.342	8.10	6.30	0.7
	16		11.8	0.344	7.99	2.96	3.4
	17		11.6	0.347	7.95	1.20	3.3
17.5		11.5	0.348	7.96	1.13	2.4	
18		11.5	0.349	8.03	0.90	-1.6	
7/15/2009	0	4.6	19.4	0.344	8.37	8.33	148.2
	1		19.4	0.344	8.34	8.35	141.1
	2		19.4	0.344	8.32	8.32	137.0
	3		19.4	0.344	8.33	8.37	127.1
	4		19.4	0.344	8.35	8.39	120.3
	5		19.4	0.344	8.30	8.39	115.7
	6		19.4	0.344	8.31	8.40	113.2
	7		19.4	0.344	8.23	8.32	107.3
	8		19.1	0.344	8.22	8.09	106.5
	9		18.2	0.345	8.19	7.67	106.2
	10		18.0	0.345	8.22	7.61	104.4
	11		14.7	0.346	7.51	4.29	110.0
	12		13.8	0.345	7.42	3.45	111.9
	13		12.8	0.345	7.36	2.31	111.9
	14		12.1	0.347	7.26	0.53	113.7
	15		12.0	0.348	7.23	0.18	111.8
	16		12.0	0.348	7.28	0.15	110.6
	17		11.9	0.350	7.39	0.13	98.2
18		11.9	0.351	7.36	0.12	-112.6	

KSW5 - Swan Lake (Center)

Sample Date	Sample Depth (m)	Secchi Depth (m)	Temperature (°C)	Specific Conductivity (mS/cm)	pH	Dissolved Oxygen (mg/L)	ORP (mV)
8/5/2009	0	4.0	18.9	0.343	8.16	8.69	28.7
	1		18.9	0.343	8.14	8.60	27.2
	2		18.8	0.344	8.15	8.73	25.5
	3		18.8	0.345	8.14	8.69	24.8
	4		18.8	0.345	8.16	8.61	23.9
	5		18.8	0.345	8.26	8.50	22.5
	6		18.8	0.345	8.18	8.62	22.5
	7		18.8	0.345	8.20	8.62	21.5
	8		18.6	0.346	8.24	8.37	21.2
	9		18.6	0.346	8.10	8.32	23.8
	10		17.8	0.347	7.85	6.58	26.9
	11		16.4	0.347	7.63	4.03	32.3
	12		14.9	0.348	7.46	2.07	35.8
	13		13.5	0.348	7.36	0.66	35.3
	14		12.9	0.350	7.20	0.25	37.1
	15		12.7	0.351	7.12	0.16	39.4
	16		12.5	0.345	6.98	0.14	43.2
	17		12.2	0.357	6.96	0.13	44.4
18		12.1	0.358	6.88	0.13	47.6	
8/25/2009	0	3.1	20.4	0.342	--	8.22	-111.6
	1		20.3	0.342	--	8.29	-109.5
	2		20.3	0.342	--	8.33	-108.8
	3		20.2	0.342	--	8.29	-109.1
	4		20.1	0.342	--	8.29	-106.2
	5		19.9	0.342	--	8.24	-80.4
	6		19.8	0.342	--	8.00	-83.0
	7		19.8	0.343	--	7.87	-82.2
	8		19.7	0.343	--	7.89	-80.3
	9		19.7	0.343	--	7.84	-84.2
	10		18.7	0.345	--	6.00	-86.1
	11		18.7	0.346	--	5.50	-88.5
	12		15.9	0.346	--	1.06	-92.0
	13		14.2	0.349	--	0.15	-105.1
	14		13.3	0.353	--	0.15	-109.2
	15		12.8	0.356	--	0.14	-122.2
	16		12.7	0.358	--	0.13	-129.3
	17		12.6	0.359	--	0.13	-131.2
18		12.6	0.359	--	0.12	-141.2	

KSW5 - Swan Lake (Center)

Sample Date	Sample Depth (m)	Secchi Depth (m)	Temperature (°C)	Specific Conductivity (mS/cm)	pH	Dissolved Oxygen (mg/L)	ORP (mV)
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Notes

mg/L is milligrams per Liter

°C is degrees Celcius

mS/cm is milliSiemens per centimeter

mV is milliVolts

KSW6 - Swan Lake (West)

Sample Date	Sample Depth (m)	Secchi Depth (m)	Temperature (°C)	Specific Conductivity (mS/cm)	pH	Dissolved Oxygen (mg/L)	ORP (mV)
6/24/2009	0	4.0	24.5	0.319	8.87	8.93	-1.1
7/1/2009	0	2.6	17.9	0.335	8.21	8.79	1.5
7/6/2009	0	3.7	20.01	0.339	9.39	8.55	-12
7/15/2009	0	3.5	20.1	0.339	8.27	7.42	21.8
8/5/2009	0	3.2	19.5	0.338	9.18	9.26	-7.5
8/25/2009	0	3.2	21.07	0.334	--	8.59	-90.1

Notes

mg/L is milligrams per Liter

°C is degrees Celcius

mS/cm is milliSiemens per centimeter

mV is milliVolts

KSW7 - Swan Lake (Southwest Bay)

Sample Date	Sample Depth (m)	Temperature (°C)	Specific Conductivity (mS/cm)	pH	Dissolved Oxygen (mg/L)	ORP (mV)
6/24/2009	0	27.4	0.189	8.84	8.55	17.8
	0.8	27.4	0.188	8.85	7.72	16.1
7/1/2009	0	15.5	0.185	7.97	11.00	23.2
	0.8	15.5	0.185	8.01	10.88	19.0
7/6/2009	0	24.0	0.189	8.61	8.23	-18.4
	0.7	24.0	0.190	8.60	8.21	-23.1
7/15/2009	0	18.7	0.192	8.00	7.99	4.0
	0.7	18.7	0.193	8.00	7.98	-1.2
8/5/2009	0	19.3	0.188	9.03	10.00	-22.2
	0.7	19.3	0.188	8.91	9.82	-18.3
8/25/2009	0	22.7	0.191	--	8.15	-106.2

Notes

mg/L is milligrams per Liter

°C is degrees Celcius

mS/cm is milliSiemens per centimeter

mV is milliVolts

KSW8 - Hart Creek

Sample Date	Sample Depth (m)	Temperature (°C)	Specific Conductivity (mS/cm)	pH	Dissolved Oxygen (mg/L)	ORP (mV)
6/23/2009	0	23.0	0.151	7.12	3.82	10.0
8/5/2009	0	17.9	0.161	8.65	3.39	-38.1

Notes

mg/L is milligrams per Liter

°C is degrees Celcius

mS/cm is milliSiemens per centimeter

mV is milliVolts

Appendix B

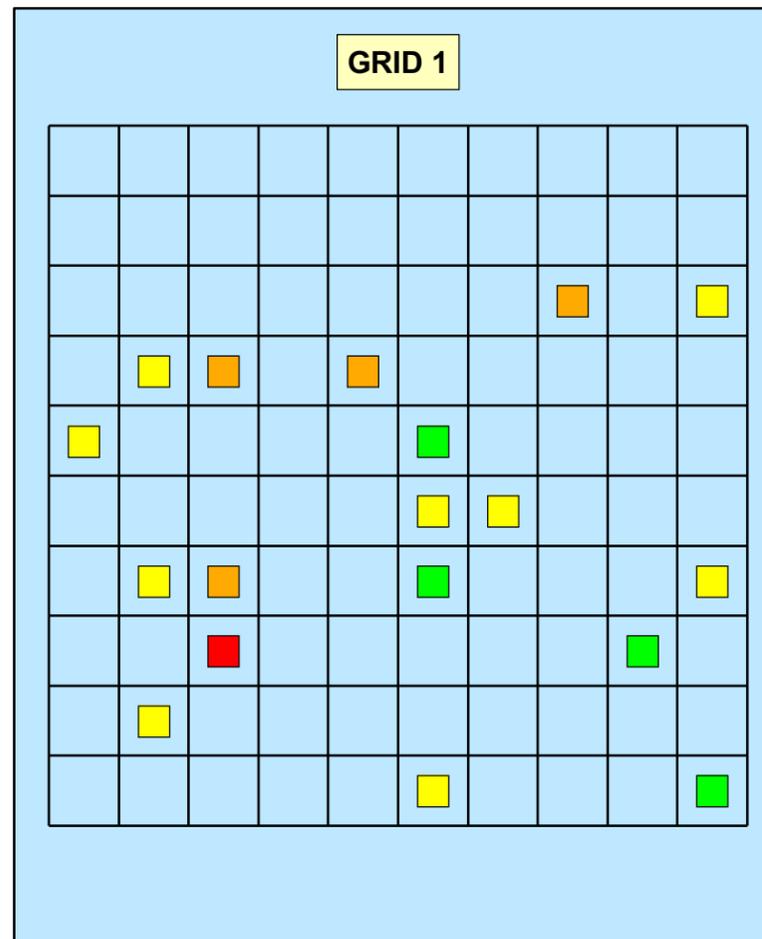
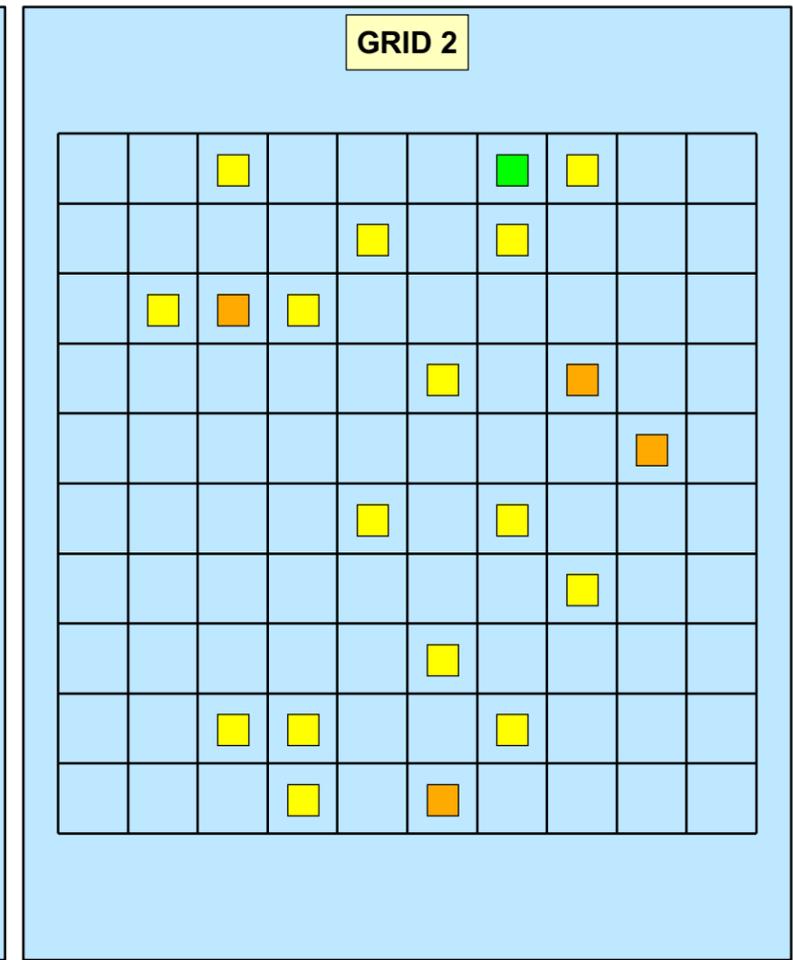
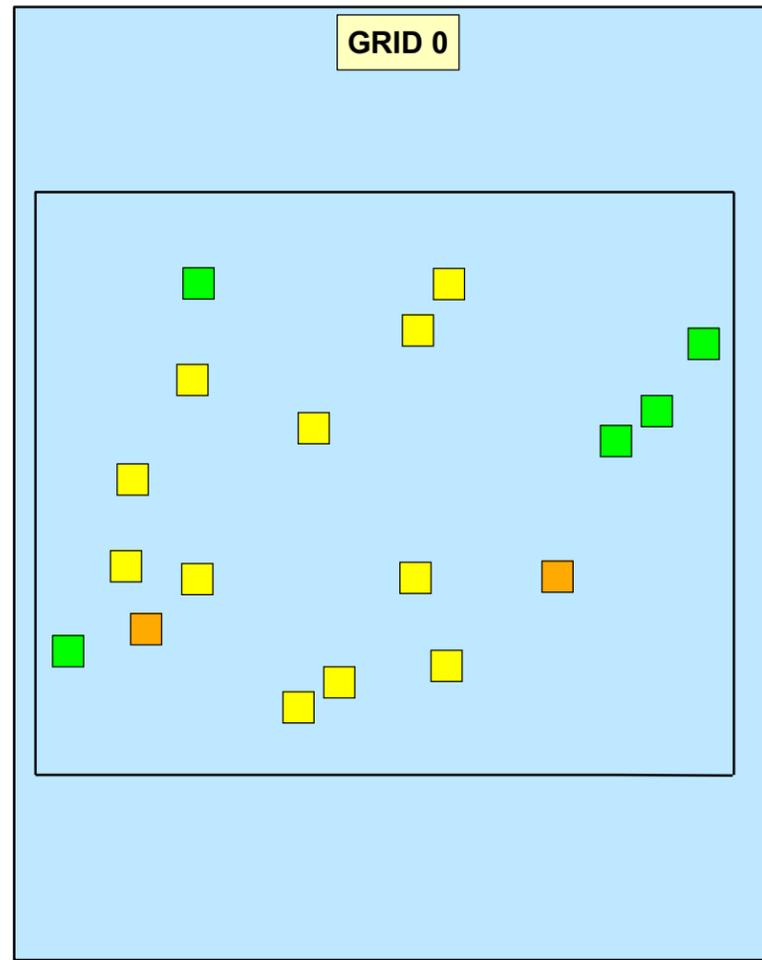
Historic Swan Lake Sulfate Concentrations

Appendix B: Historic Sulfate Concentrations in Water Samples Collected From the Surface of Swan Lake, Central

Sample Date	Sulfate Concentration (mg/L)	Method	Comment	Data Source
4/22/2005	21.7	Turbidimetric		Minnesota Steel Monitoring Report
5/16/2005	19.9	Turbidimetric		Minnesota Steel Monitoring Report
6/15/2005	20.6	Turbidimetric		Minnesota Steel Monitoring Report
7/11/2005	19.5	Turbidimetric		Minnesota Steel Monitoring Report
8/8/2005	20.3	Turbidimetric		Minnesota Steel Monitoring Report
9/6/2005	19.4	Turbidimetric		Minnesota Steel Monitoring Report
10/18/2005	16.6	Turbidimetric		Minnesota Steel Monitoring Report
2/1/2006	22	Turbidimetric		Minnesota Steel Monitoring Report
4/24/2006	12	Turbidimetric		Minnesota Steel Monitoring Report
5/15/2006	22	Turbidimetric		Minnesota Steel Monitoring Report
5/15/2006	22	Turbidimetric	Duplicate	Minnesota Steel Monitoring Report
6/12/2006	24	Turbidimetric		Minnesota Steel Monitoring Report
6/12/2006	26	Turbidimetric	Duplicate	Minnesota Steel Monitoring Report
7/10/2006	21	Turbidimetric		Minnesota Steel Monitoring Report
7/10/2006	21	Turbidimetric	Duplicate	Minnesota Steel Monitoring Report
8/15/2006	17	Turbidimetric		Minnesota Steel Monitoring Report
8/15/2006	15	Turbidimetric	Duplicate	Minnesota Steel Monitoring Report
9/11/2006	24	Turbidimetric		Minnesota Steel Monitoring Report
9/11/2006	22	Turbidimetric	Duplicate	Minnesota Steel Monitoring Report
10/17/2006	13	Turbidimetric		Minnesota Steel Monitoring Report
10/17/2006	14	Turbidimetric	Duplicate	Minnesota Steel Monitoring Report
6/1/2008	20.9	Unknown	Date is approximate	Essar Steel 2008 DMR Summary Report
8/1/2008	19.1	Unknown	Date is approximate	Essar Steel 2008 DMR Summary Report
6/1/2009	90	Unknown	Date is approximate	Essar Steel 2009 DMR Summary Report
6/24/2009	39	Ion Chromatography		KeeTac 2009 Monitoring
7/15/2009	27	Ion Chromatography		KeeTac 2009 Monitoring
8/5/2009	23	Ion Chromatography		KeeTac 2009 Monitoring
8/25/2009	24	Ion Chromatography		KeeTac 2009 Monitoring

Appendix C

Details of Wild Rice Surveys on Hay Lake, Moose Lake, and Swan Lake Southwest Bay



Appendix C-2
MOOSE LAKE WILD RICE SURVEY
 July 28, 2009
 U. S. Steel Corp.
 Keetac Expansion Project
 Keewatin, Minnesota

Stem Density/0.5m²

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

2.5 1.25 0 2.5

Meters

Appendix D

***Photographs of Wild Rice on Hay Lake, Moose Lake,
and Swan Lake Southwest Bay***



Figure D-1 Moose Lake Outlet, July 28, 2009



Figure D-2 Moose Lake Northwest Grid Location, July 28, 2009



Figure D-3 Hay Lake Southern Shore, July 29, 2009



Figure D-4 Hay Lake Northwest Grid Location, July 29, 2009



Figure D-5 Swan Lake Southwest Bay, July 30, 2009



Figure D-4 Swan Lake Northeast Grid Location, July 30, 2009