Variance Application
NPDES/SDS Permit Renewal
Permit No. MN0067687

Mesabi Nugget LSDP Facility

Prepared for
Steel Dynamics, Inc.
Mesabi Nugget, LLC

June 2010

BARR

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MESABI NUGGET
A new age of iron.

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1.0 Variance Application

When the current National Pollutant Discharge Elimination System and State Disposal System (NPDES/SDS) Permit No. MN006768 was issued in 2005, the Minnesota Pollution Control Agency (MPCA) recommended and the United States Environmental Protection Agency (EPA) granted variances from the water quality standards for alkalinity, hardness, TDS and specific conductance for the discharge from Area 1 Pit to Second Creek. At the time that the variances were granted, it was assumed that the Large Scale Demonstration Plant (LSDP) would be built and operated for several years, providing additional data for permit and variance reissuance. As it happened, the LSDP was not built until 2009, and did not begin operating until January 2010. The LSDP has not achieved its full production rate, and as a result, there is little additional operational data to inform decisions regarding reissuance of variances than was available in 2005.

During the interim, several other changes have occurred which change the premises under which the original variances were granted. Whole effluent toxicity testing conducted in 2008 and 2009 has shown that the discharge from Area 1 Pit, prior to operation of the LSDP, has an intermittent chronic toxicity to *Ceriodaphnia Dubia (C. Dubia)* during the late summer. The effluent is not acutely toxic to either fathead minnows or the *C. Dubia*. The effluent is not chronically toxic to fathead minnows any time of the year, or to the *C. Dubia* (except as noted above in the late summer).

In February 2010, the MPCA announced that it had a new interpretation of a nearly 40 year old Class 4 water quality standard for protection of wild rice production areas. MPCA advised Mesabi Nugget that effective immediately, the MPCA would require that wherever wild rice is present, water quality must meet a 10 mg/L sulfate standard. During the summer of 2009, a wild rice survey (required by the MPCA) discovered wild rice in the Partridge River, just downstream from the confluence of Second Creek.

Mesabi Nugget requests a continuation of the variances from these water quality standards for the 5-year term of the reissued permit. Mesabi Nugget proposes to reduce the magnitude and duration of the variances as originally granted in 2005. Mindful of the new interpretation of sulfate limits , and mindful of the need to protect the aquatic life uses in Second Creek and the Partridge River, Mesabi Nugget proposes to reduce the magnitude of the variances for TDS and specific conductance, and to limit the time during the year when the variances will be needed.

Mesabi Nugget will stop discharging to Second Creek during the following time periods:

1. April through June: During periods when wild rice, present downstream in Partridge River, is allegedly sensitive to impacts of sulfate; and
2. August through September: When water in Area 1 pit has exhibited intermittent toxicity characteristics based on previous toxicity tests. Future testing may provide information to minimize or eliminate this discharge period.

Thus, discharging to Second Creek from Area 1 pit will occur only during the month of July and October through March. Mesabi Nugget will monitor the effluent mercury concentrations in the discharge from Area 1 Pit and manage the maximum discharge flow rate to ensure that the daily allowable mercury mass discharge limit in the current permit of 0.00007 kg/day is not exceeded. This will prevent the discharge from causing or contributing to downstream impairments for mercury.

The period for protection of wild rice is based upon the only known precedent for imposition of a water quality based effluent limit based on the 10 mg/L sulfate standard for protection of wild rice in production: the Minnesota Power Clay Boswell permit, originally issued in the mid 1970's, but with WQBEL which continues to the present day. This period (April through June) is also consistent with the available research on wild rice.

This variance application provides information indicating water treatment is technically infeasible for the Area 1 Pit.

This variance application is submitted in accordance with Minn. Rules Part 7000.7000 subpart 2 and Minn. Rules part 7053.0280 and 7052.0320.

1.1 Minn. Rule Part 7000.7000 Subp. 2

Minnesota Rules 7000.7000 – Variances – provides in relevant part:

> *Subp. 2. In no case shall the board or commissioner grant a variance unless a written application has been made to the board or commissioner. The application must be served upon the commissioner.*

Subsections 1.1.1 through 1.1.8 provide the information required by MN Rules 7000.7000, Subpart 2, A. through H.

1.1.1 Name and address of the applicant

A. Name and address of the applicant and the person who prepared the application.

Applicant

Jeff Hansen

Mesabi Nugget Delaware, LLC

P.O Box 235

Hoyt Lakes, MN 55750

218-225-6000

Person Who Prepared the Application

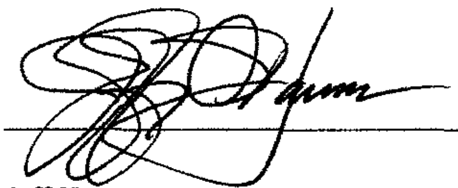
Barr Engineering Company

4700 West 77th Street

Minneapolis, MN 55435-4803

1.1.2 Signature of the applicant

B. The signature of the applicant or authorized representative



Jeff Hansen

Plant Manager

Mesabi Nugget Delaware, LLC

1.1.3 Description of facility for which variance is being sought

C. A description, including the location, of the business, plant, system, or facility for which a variance is sought.

In January 2010, Mesabi Nugget began operating a 600,000 metric tons/year iron nugget production facility at the Cliffs Erie site (formerly LTV Taconite) at Hoyt Lakes, Minnesota. The nuggets produced contain approximately 96 to 98% iron, and can be fed directly to electric arc furnaces (mini-mills) as well as to foundries and conventional integrated iron and steel manufacturing facilities. Although the facility is operational, it is not operating at full capacity. The following is a description of the existing facility to aid in understanding the project.

The process consists of the following basic steps:

- Raw material delivery and preparation
- Iron nugget production and product separation
- Product handling and shipping

Raw material delivery and preparation

Raw materials consist of iron ore concentrate from various sources, various coals, fluxes and binders. All raw materials are delivered by rail, truck, or in bulk supersacks with iron ore concentrate and other raw materials stored in outdoor storage piles and/or storage bins. The coals and fluxes are pulverized on-site. Air emissions from material transfer and pulverizing will be controlled by baghouses. Fugitive dust emissions from storage piles, roadways and material handling are controlled by procedures in a fugitive dust plan.

Iron Nugget Production and Product Separation

Coals, fluxes, binders and iron ore concentrate are mixed and formed into green balls (similar to taconite operations). The balls are dried and fed into a rotary hearth furnace, where they are converted to metallic iron and slag material. The iron and slag are cooled and separated. The iron nuggets are directly loaded into rail cars, or stored in stockpiles for shipment at a later date. The slag will be stored in a slag storage pile area for shipment at a later date.

Air Pollution Control

Carbon monoxide (CO), volatile organic compounds (VOCs), and organic hazardous air pollutants (HAPs) from the rotary hearth furnace are controlled by oxidation using an air infiltration system. This system allows air to enter the rotary hearth furnace exhaust duct at a controlled rate, sufficient for oxidation of CO, VOCs and organic HAPs in the rotary hearth exhaust.

After heat recovery, the rotary hearth off gases pass through emission control devices to control sulfur dioxide, acid gases, inorganic HAPs (metallic HAPs and mercury), and particulate matter. A wet scrubber is used to control these pollutants. RHF staged combustion inherent to the process (with low excess air in some zones) and low NO_x burners will be used to control NO_x emissions.

Particulate matter generated during pellet formation, pellet/product drying, product separation and material handling is controlled by fabric filters or baghouses. NO_x from pellet drying is controlled by low NO_x burners. CO and VOC from pellet drying are controlled by good combustion practices.

Fugitive dust emissions from storage piles, roadways, and material handling by heavy equipment is controlled by procedures specified in the fugitive dust plan.

Water Treatment Materials

Materials required for water treatment are transported by truck or rail and pneumatically conveyed, or otherwise conveyed in a closed system, or hydraulically transported to containers at the water treatment plant. Smaller volumes of some materials may be delivered by drum, supersack, tote bin, or other suitable containers for each material

Similarly, sludge and other byproducts from the water treatment plant are transported as wet cake (e.g. filter cake) by truck or rail from the facility for beneficial reuse or proper disposal.

Water Supply and Treatment

Mesabi Nugget is using water from the Area 1 Pit for the water supply primarily for process equipment protection and for process water (e.g. scrubber water supply). The wastewater generated from the process water is treated prior to return back into the Area 1 Pit. Mesabi Nugget employs chemical coagulation and precipitation to remove sulfates, fluorides, solids and metals, followed by a mercury filter, if needed. The treated wastewater is discharged back into Area 1 Pit. The discharge from Area 1 Pit is treated by a mercury filter and/or a sand filter to meet permit limits prior to a direct discharge through SD001 to Second Creek. Water from Area 1 Pit will be discharged to Second Creek only during the months of July and October through March as previously described.

1.1.4 Nature of the variance sought

D. If the applicant seeks a variance primarily on grounds of economic burden, financial statements prepared or approved by a certified public accountant, or other person acceptable to the agency, which shall fairly set forth the status of the business, plant, system, or facility for each of the three financial years immediately preceding the year of the application, and an analysis of the effect of such financial status if the variance is not granted (if the business, plant, system, or facility has not been in operation for this period, then the financial statements and analysis must be based on the most complete data available);

Mesabi Nugget requests MPCA to grant a continuance of the variances from the water quality standards for alkalinity, hardness, TDS and specific conductance. For TDS and specific conductance, the requested average monthly limits are based on water quality projections provided in Section 8.3.1 of the Dissolved Solids and Chemical Balance report (Barr, 2009a). The requested maximum daily TDS limit was calculated by multiplying this average monthly limit by the ratio of the maximum daily limit to average monthly limit in the current permit.

Table 1-1 provides a summary of the past and present Area 1 Pit variance parameter concentrations; current and requested variance limits; and water quality standard criteria applicable to Second Creek.

Table 1-1 Area 1 Pit Water Quality Predictions Summary

Parameter	Average/ Maximum Concentrations Prior to LSDP Operation (Aug. 2008- Dec. 2009)	Average/ Maximum Concentrations during LSDP Operation (Jan-May 2010)	Predicted Concentrations (Year 5)	Current Variance Limits (Monthly Avg./Daily Max.)	Requested Variance Limits (Monthly Avg./Daily Max.)	Second Creek Water Quality Standard Criteria (mg/L)
Alkalinity, Bicarbonates as CaCO3 (mg/L)	328/362	344/347	280	396/445	396/445	250
Hardness (mg/L)	728/806	770/800	570	740/831	740/831	500
TDS (mg/L)*	806/932	843/871	1,200	1619/1818	1200/1348	700
Specific Conductance (µS cm^{-1})*	1152/1331	1204/1244	2,000	2159/2425	2000/2246	1,000

* Based on TDS (mg/L) = Specific Conductance (µS cm^{-1}) X 0.7

Based on water quality predictions, levels of alkalinity and hardness will continue to decrease through time with the operation of the LSDP and scrubber water treatment system discharge to Area 1 Pit. However, it is estimated that TDS and specific conductance will continue to increase through time.

Period of Time for Which Variance is Requested

Mesabi Nugget requests that this variance remains in effect until the end of the permit term.

Reasons Relied upon by the Applicant Requesting the Variance

The primary reason for requesting the variance is the technical infeasibility of implementing a water treatment technology to reduce the levels of constituents in Area 1 Pit water prior to discharge to meet water quality standards. There are only two technologies which may meet the 10 mg/L sulfate standard (see Section 1.1.5 of this application). No commercial facility exists which has met a water quality standard of 10 mg/L. Extensive pilot testing and engineering would be required to verify if these technologies can in fact achieve the 10 mg/L standard, and to conduct the detailed engineering for such systems. It is not reasonable to require construction and attempted operation of a treatment system which is not commercially available and which is likely not technically feasible. .

Mitigation of the existing water quality in the Area 1 Pit depends upon treating the wastewater discharge as well as mitigating the source of the dissolved solids in the pits. It is unfortunate that: 1) the quantities of materials involved are so enormous and 2) conventional mitigation techniques will likely not provide sufficient mitigation.

Area 1 Pit currently contains roughly 50 million cubic meters or 13 billion gallons of water. Average inputs to these pits (P-E and runoff+ groundwater inflow) are 223 gpm and 2,232 gpm respectively (See Section 6.2.1 - Mine Pit Hydrogeology and Water Balances (Barr, 2009b)). Area 1 Pit is currently being pumped to Second Creek at a rate of up to 4,000 gpm. Traditional secondary water treatment systems, such as aerobic and anaerobic biological treatment, will have no affect on the products of sulfide oxidation and neutralization found in the pits. Traditional physical/chemical treatments, such as precipitation or softening, would have little effect, as the concentrations of the pollutants which are elevated above the water quality criteria are below saturation and therefore cannot be easily removed via chemical precipitation. As discussed in the Executive Summary of the Area 1 Pit Water Treatment Evaluation in Support of the Non-Degradation Analysis (Barr, 2009c), the only treatment technology which could reduce elevated concentrations to meet water quality standards is membrane technology – nanofiltration or reverse osmosis. Based on information provided in this evaluation, the annual electrical usage required to operate such a treatment system of adequate scale would be 8.3 million kilowatt-hours per year. As indicated in Section 3.3 of the Greenhouse Gas Emission Inventory Report (Barr, 2009d) and Section 3.1.2 of the Climate Change

Evaluation Report (Barr, 2009e), electrical usage of this magnitude will require a significant increase in electrical power generation requirements and greenhouse gas emissions.

Although there are similar systems at smaller scales in place in mining situations throughout the world, most are employed in areas where there is the potential for either ocean disposal of brine or evaporation ponds. Many of the systems in use are at gold and precious metal mines, where recovery of even trace amounts of those metals makes economic sense.

Lacking the ability to use ocean disposal or evaporation ponds, the brine must be concentrated, evaporated and crystallized, at great expense. Section 3.4.3 of the Area 1 Pit Water Treatment Evaluation in Support of the Non-Degradation Analysis (Barr, 2009c) provided a preliminary cost estimate of $52.2 million in capital costs, with annual operating costs of $4.8 million to treat a flow rate of 4,000 gpm. Net present value of such a system operated in perpetuity is $113 million. Additionally, there are serious concerns that such a system would be feasible in northern Minnesota during winter months.

Additional information is provided in Section 1.1.5.

1.1.5 Economic Burden

E. If the applicant seeks a variance on grounds that compliance is not technologically feasible, a report from a registered professional engineer, or other person acceptable to the agency, stating fully the reasons why compliance is not technologically feasible;

Table 1-2 below provides an overview of the effectiveness, implementability, dependability, and cost considerations relative to water treatment technologies for sulfate removal.

Table 1-2 Water Treatment Technology Summary

	Effectiveness			Implementability	Status	Cost Considerations			
Treatment Technology	**Can achieve 250 mg/L sulfate?**	**Can achieve 10 mg/L sulfate?**	**Can reduce other parameters of concern (TDS, hardness, alk)?**	**Multiple commercial installations?**	**Emerging or established technology?**	**Relative net present value**	**Relative Chemical Consumption**	**Relative Power Consumption**	**Relative Solid Waste Generation**
Biological Treatment (Sulfate Reduction)									
Constructed wetlands	P	N	N	Y	Established	$$	Low	Low	Low
Floating wetlands	P	N	N	P	Emerging	$$	Medium	Low	Low
Natural wetlands	P	N	N	Y	Established	$	Low	Low	Low
Biofilters	P	N	N	Y	Established	$$	Low	Low	Low
In-pit biological treatment	P	N	N		Emerging	$$	Low	Low	Low
Anaerobic reactors	P	N	N	Y	Established	$$$	Medium	Medium	Medium
Chemical Precipitation									
Barium precipitation	Y	Y	P	P	Established	$$$$	High	Medium	High
SAVMIN (Ettringite)	Y	P	N	N	Emerging	$$$	High	Medium	High
CESR (Ettringite)	Y	P	N	N	Emerging	$$$	High	Medium	High
Gypsum precipitation	N	N	Y	Y	Established	$$$	High	Medium	High
Lime softening (hardness and alkalinity reduction)	N	N	Y	Y	Established	$$$	High	Medium	High
Ion Exchange									
Sulf-IX (Bioteq)	Y	P	P	N	Emerging	$$$	Medium	Medium	High

	Effectiveness			Implementability	Status	Cost Considerations			
Treatment Technology	Can achieve 250 mg/L sulfate?	Can achieve 10 mg/L sulfate?	Can reduce other parameters of concern (TDS, hardness, alk)?	Multiple commercial installations?	Emerging or established technology?	Relative net present value	Relative Chemical Consumption	Relative Power Consumption	Relative Solid Waste Generation
Membrane Treatment									
Microfiltration	N	N	N	Y	Established	$$	Medium	Medium	Medium
Ultrafiltration	N	N	N	Y	Established	$$	Medium	Medium	Medium
Nanofiltration	Y	N	Y	Y	Established	$$$	Medium	High	Medium
Reverse Osmosis	Y	Y	Y	Y	Established	$$$	Medium	High	Medium
Electrodialysis reversal	Y	P	Y	Y	Established	$$$	Medium	High	Medium

Y = Yes, known

P = Potential, but some uncertainty or limited installations

N = No, very unlikely

Notes:

The qualitative comparisons provided in this table are based upon the following information, which was compiled or developed for numerous projects from 2008-2010:

1. Peer-reviewed scientific literature
2. Vendor-supplied information and costs
3. Design manuals and guidance developed by professional water treatment organizations
4. Reviews compiled by the U.S. and Canadian governmental agencies
5. Chemical modeling and conceptual designs

In the Executive Summary of the Area 1 Pit Water Treatment Evaluation Report in Support of the Non-degradation Analysis (Barr, 2009c), a summary is provided on the evaluation of several potential water treatment technologies and the estimated cost of implementation to demonstrate that "additional control measures [which] are not reasonable", per MN Rules 7050.0185, subpart 8. This evaluation concluded that implementation of reverse osmosis (RO) with zero liquid discharge is the only potential treatment alternative that could be implemented to consistently achieve applicable water quality standards. It was estimated that the net present value of implementation of this treatment option would be more than $113 million dollars over the 20-year project life.

Significant questions exist on the feasibility of such treatment systems, given the volume and hardness of the water requiring treatment. This would be a very complex treatment facility, and would include complex equipment, such as reverse osmosis units, brine concentrators, and crystallizers, that are not typically used in projects of this scale. These additional treatment technology requirements, coupled with the operation of a first of its kind production facility (the Large Scale Demonstration Project) would add an unacceptable level of risk to the overall operations.

1.1.6 Technological Feasibility

F. If the applicant seeks a variance on grounds that compliance is not technologically feasible, a report from a registered professional engineer, or other person acceptable to the agency, stating fully the reasons why compliance is not technologically feasible;

The Executive Summary of the Area 1 Pit Water Treatment Evaluation Report in Support of the Non-Degradation Analysis (Barr, 2009c) provides a summary of an evaluation of several potential water treatment alternatives to reduce levels of several constituents, including hardness, specific conductance, total dissolved solids and bicarbonates (alkalinity). Since the concentrations of dissolved solids are, for the most part, below saturation levels, conventional coagulation and precipitation treatments will not improve water quality to meet water quality standards (including nondegradation) and reduce or eliminate toxicity. The only option considered technically capable of reducing the levels of these constituents which give rise to the need for a variance is membrane treatment with zero liquid discharge of solids using reverse osmosis and evaporation and crystallization of the reject water. Since the new interpretation of the 10 mg/L sulfate water quality for production of wild rice, only membrane treatment with zero liquid discharge or barium precipitation will meet that standard as well. However, barium precipitation will not result in other Class 3 and 4 parameters meeting existing water quality standards, and the cost of barium treatment exceeds $100 million per year. Therefore, it is not a feasible treatment technology.

The use of membrane filtration: nanofiltration with or without chemical precipitation, or reverse osmosis, with or without evaporation and crystallization to treat mine dewatering is not feasible for three reasons:

1. While other mining projects have proposed treatment of process water, no such system has been proposed, permitted, or built in Minnesota.
2. While constructed for other facilities, such as ethanol plants in Minnesota and elsewhere, evaporator/crystallizer systems performance has been unreliable.
3. A wastewater treatment facility capable of treating the large volume of reject water (brine) from such systems within the Lake Superior Basin does not exist. While sufficient large wastewater treatment facilities exist in Minnesota (e.g. the Metro plant), international treaties effectively prohibit the removal of large volumes of water from the Great Lakes Basin.

Each of these reasons is discussed below.

1. **While other mining projects have proposed treatment of process water, no such system has been permitted, or built in Minnesota for mine pit dewatering**

The four systems proposed (but not yet permitted or constructed) for northern Minnesota have been proposed to meet process water quality requirements, or to comply with federal and state regulations which prohibit new or expanded discharges to impaired water (40 CFR 122.4(i)).

At U. S. Steel's Minntac facility, it had been proposed to provide "treatment of process water, using membrane separation and chemical precipitation to reduce sulfate, chloride, hardness and specific conductance in the Minntac tailings basin reservoir"(Application for Reissuance of NPDES/SDS Permit #MN0057207 for the Minntac Tailings Basin (U. S. Steel, 2009a)).

U. S. Steel at its Keetac facility is planning to "install a nano-filtration system (or similar wastewater treatment process) to treat the scrubber blow down. The scrubber blow down is pumped to the tailings basin where it is recycled for use as process water. Presently, the wet scrubber uses hydrated lime ($Ca(OH)_2$) in the treatment system to precipitate out calcium sulfate in the wet scrubber wastewater. It is predicted that the installation of this technology would reduce sulfate concentrations by 50 percent" (Draft Environmental Impact Statement (DEIS), Keetac Taconite Expansion Project (MN DNR, 2009a)). The MPCA and other cooperating agencies had expressed concerns about increased sulfate and its impact on mercury methylation in downstream receiving waters which are impaired for mercury. In order to address concerns by the MPCA and others, Keetac is proposing to treat its process water (scrubber blow down).

Essar Steel, formerly Minnesota Steel, is being constructed at the site of the former Butler taconite operations. Because the Butler operations closed down long ago, there are no existing NPDES permits for discharge of mine or process water. Downstream waters are impaired for mercury and other pollutants, including Swan Lake, Swan River and the Mississippi River. Federal and state regulations prohibit a new discharge to impaired waters. See 40 CFR 122.4 (i). Faced with this prohibition, Minnesota Steel "committed to total reuse and recycling of process wastewater generated by the pellet plant, DRI (Direct Reduction Iron), EAF (Electric Arc Furnace) and steel mill operations. A comprehensive treatment system consisting of lime softening, reverse osmosis, crystallization and evaporation will be used, with water returned to the process and crystallized solids disposed of in permitted waste disposal facilities" (Application for NPDES/SDS Permits, (Minnesota Steel Industries, 2006a)).

Similarly, the mine site for the PolyMet project is located in a previously unmined area. Downstream waters, including the St. Louis River and Lake Superior are impaired for mercury (and other pollutants). There are no existing NPDES permits for the mine site, so water from the mine will be used for process water[1]. However, that water does not meet the stringent water quality requirements for metals processing. "The Wastewater Treatment Facility (WWTF) would use nanofiltration treatment for process water flows with lower concentrations of dissolved metals and sulfate, and chemical precipitation treatment for process water flows with high concentrations of dissolved metals and sulfate. The solids removed from the Mine Site process water in the WWTF would be reprocessed to recover any potential metals in the Hydrometallurgical Plant" (Draft Environmental Impact Statement (DEIS), NorthMet Project (PolyMet, 2009a)).

2. **While constructed for other facilities, such as ethanol plants in Minnesota and elsewhere, evaporator/crystallizer system performance has been unreliable.**

The only reverse osmosis (RO) system with an evaporator/crystallizer in Minnesota is installed at an ethanol plant in southwestern Minnesota. While ownership has changed hands and operations have been curtailed in the recent past, the plant is currently operating. However, the plant has struggled to get and keep the RO system online, particularly the evaporator/crystallizer. Currently, brine is stored onsite, and options for managing the brine, including trucking to a sufficiently large wastewater treatment facility are being investigated, along with improvements to the treatment system.

There is concern that the only operating RO system in Minnesota has not been able to consistently operate and manage the brine. Given the operating history, such a system does not appear feasible.

3. **A wastewater treatment facility capable of treating the large volume of reject water (brine) from such systems within the Lake Superior Basin does not exist. While sufficient large wastewater treatment facilities exist in Minnesota (e.g. the Metro plant), international treaties effectively prohibit the removal of large volumes of water from the Great Lakes Basin.**

An option for operating membrane systems without an evaporator/crystallizer is to use multiple stage membrane treatments to reduce the brine stream flow to a small enough volume that it can be trucked to a nearby, larger wastewater treatment facility for 'treatment'. The physical and biological treatment processes employed at municipal wastewater treatment facilities would do nothing to remove the pollutants of concern from the brine and water quality standards would only be met through dilution with other wastewater streams. There is no known large scale treatment process implemented in Minnesota or the upper Midwest where a brine stream is trucked to a POTW for treatment. Dairies and other food manufactures in California's Central Valley transport concentrate by truck to a POTW that has an ocean discharge, and thus, no limit for TDS and salts. This option is not available in the upper Midwest.

Using membrane technologies to treat the Area 1 Pit discharge of up to 4,000 gpm, with permeate recovery in the 80% to 85% range, Mesabi Nugget would produce approximately 1.0 MGD, or approximately 150, 7,000 gallon truck loads of concentrate per day. The concentrate would have an expected TDS concentration of between 10,000 to 12,500 mg/L, and an alkalinity concentration between 2,000 and 2,500 mg/L. Concentrations of hardness, chlorides, and sulfates are also expected to be elevated.

The largest wastewater facility in the Lake Superior Basin is the Western Lake Superior Sanitary District (WLSSD) located in Duluth. However, this amount of high-strength concentrate would cause or contribute to an exceedance of water quality standards at WLSSD for the following pollutants: hardness, chloride, and TDS. Also, WLSSD currently does not have infrastructure in place to facilitate the off-loading of 150 tanker trucks of wastewater per day. If implemented, a new truck off-loading station would need to be constructed somewhere in WLSSD's collection system.

There is a larger wastewater treatment facility in the region: the Metropolitan Wastewater Plant in the St. Paul, MN operated by the Metropolitan Council Environmental Services. That plant, which treats 251 million gallons per day (MGD), could at least in theory, take the brine solution from a membrane treatment facility in Hoyt Lakes. The Mississippi River, to which the Metro Plant discharges, is not an ORVW or OIRW (although it is part of the National Park System). However, the "Annex 2001"of – the Great Lakes Compact—St. Lawrence River Basin Water Resources Compact – effectively prohibits the diversion of water from the Lake Superior Basin (in which is located the Project).

Since it is not feasible for any POTWs in the area to treat concentrate from Mesabi Nugget, costs to truck or pipe the concentrate were not further explored. Undoubtedly, the costs to truck such a large quantity of wastewater would be exorbitantly high.

Given these constraints, it would not be feasible to operate a membrane treatment system, without an evaporator/crystallizer. Evaporator/crystallizers have not yet been proven to be effective to dewater brine.

Professional Engineer Statement

I concur that the information and conclusions contained in this section are true and accurate. I am a duly licensed professional engineer registered in the State of Minnesota.

Michael J Hansel	13936
	Registration Number

2.1.7 Other Data or Information Required By Rule or Standard

G. Other additional data or information that is required by any applicable agency rule or standard.

No additional data has been required by the MPCA.

2.1.8 Other Relevant Data or Information

H. Any other relevant data or information that the agency or the commissioner deems essential to a determination on the application, including, but not limited to the following:

1. **a general description of the materials handled or processed by the applicant that are pertinent to the project application, and a statement of the nature and quantity of the materials being discharged, emitted, or disposed of, and that can reasonably be expected to be discharged, emitted, or disposed of during the period of the proposed variance, and proposed methods for the control of these materials;**

A general description of the LSDP process is provided in Section 1.1.3.

2. **a comprehensive proposed plan indicating the steps to be taken by the applicant during the period of the variance, even if the applicant is seeking a permanent variance, to reduce the emission levels or discharges to the lowest limits practical;**

At the time that the variances were granted, it was assumed that the LSDP would be built and operated for several years, providing additional data for permit and variance reissuance. However, the LSDP was not built until 2009, and did not begin operating until January, 2010. As a result, there is currently minimal additional operational data to inform decisions regarding reissuance of variances.

During the interim, several other changes have occurred which change the premises under which the original variances were granted. Toxicity testing conducted in 2008 and 2009 have shown that the discharge from Area 1 Pit, prior to operation of the LSDP, has an intermittent chronic toxicity for Ceriodaphnia Dubia. The effluent is not acutely toxic to either fathead minnows or the daphnia, and is not chronically toxic to fathead minnows or to the daphnia, except on occasion during the late summer.

In February, 2010, the MPCA announced that it had a new interpretation of a nearly 40 year old water quality standard for protection of wild rice in production. MPCA advised Mesabi Nugget that effective immediately, the MPCA would require that wherever wild rice is present, water quality must meet a 10 mg/L sulfate standard. During the summer of 2009, a wild rice survey (required by the MPCA) discovered wild rice in the Partridge River, just downstream from the confluence of Second Creek.

Mesabi Nugget proposes to reduce the magnitude and duration of the variances as originally granted in 2005. Mindful of the need to protect the wild rice in the Partridge River, and mindful of the need to protect the aquatic life uses in Second Creek and the Partridge River, Mesabi Nugget proposes to reduce the magnitude of the variances for TDS and specific conductance, and to limit the time during the year when the variances will be needed.

Mesabi Nugget will stop discharging from Area 1 Pit to Second Creek, holding the water in Area 1 Pit, during the following time periods:

1. April through June: During periods when wild rice, present downstream in Partridge River, is sensitive to impacts of sulfate; and
2. August through September: When water in Area 1 pit has exhibited intermittent toxicity characteristics based on previous toxicity tests. Future testing may provide information to minimize this discharge period.

Thus, discharging will occur only during the months of July and October through March.

Operation of the LSDP and associated process water treatment plant, alkalinity and hardness levels will decrease in Area 1 Pit (see Table 1-1). Because it is difficult to predict the rate at which levels will decrease, Mesabi Nugget is requesting that the variance limits for these constituents remain the same. For the other constituents, TDS and specific conductance, Mesabi Nugget is requesting lower variance limits in this application.

3. **a concise statement of the effect upon the air, water, and land resources of the state and upon the public and other persons affected, including those residing in the area the variance will take effect, which will result from agency approval of the requested variance;**

Air Impacts

Because hardness, total dissolved solids and specific conductance are all the result of dissolved minerals in the water, there are no expected air impacts. The minerals will remain dissolved in the water at the temperatures and chemistry at which Second Creek, the Partridge and St. Louis Rivers flow.

There are no municipal or industrial users of Second Creek. The only user of the Partridge River is the city of Hoyt Lakes (see water impacts below), but their withdrawal point is upstream of the entrance of Second Creek and so is unaffected by the discharge. The closest industrial user of downstream water is the United Taconite located in Forbes, MN which appropriates water from the

St. Louis River over 35 miles downstream of the Mesabi Nugget facility. It is not likely that air emissions from that facility would be impacted by the water quality of the discharge at SD001.

Thus, there does not appear to be significant impact on air resources which will result from the agency's approval of the requested variance.

Water Impacts

Because of the relatively high concentration of dissolved solids and hardness in Area 1 Pit, discharging water from the pit into Second Creek will affect the water quality in the creek. It will also affect the water quality in the Partridge River, into which Second Creek drains. Given the large flows in the St. Louis River (into which the Partridge River flows), it is unlikely that the volume of water from Area 1 Pit, especially after its flow is reduced by its use for the Mesabi Nugget facility, will significantly impact the water quality in the St. Louis River. Section 8.3.1 of the Dissolved Solids and Chemical Balance report (Barr, 2009a) and Section 5.1.1 of the Partridge River Water Quality report, (Barr, 2009f) address the potential impacts that the changes in water quality may have on users of the water from Second Creek and the Partridge River.

With respect to hardness, the Mesabi Nugget project will actually reduce the hardness of the water in the Area 1 Pit, and thus reducing any impact on the wetland and downstream waters. The effect of increased dissolved solids (and associated specific conductance) is addressed below.

For this study, the river water users were separated into four groups: (1) Municipal water treatment facilities, (2) Industrial river water users, (3) Other permitted river water users, and (4) Non-permitted river water users. A separate analysis was conducted for each of the four groups. While the analysis was general, the data presented are based on existing water quality data available on the MPCA and DNR websites.

Municipal Water Treatment Facilities - Based on a review of the water appropriation permits issued by the Minnesota DNR,[2] the only municipal user of water in the vicinity of Mesabi Nugget is the City of Hoyt Lakes. However, they appropriate water from a point on Partridge River that is located upstream of the confluence of Second Creek. Thus, the City of Hoyt Lakes is not affected by the discharge. There are no municipal users of water downstream of the Mesabi Nugget facility on the Partridge River or the St. Louis River to Lake Superior.

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[2] www.dnr.state.mn.us/waters/watermgmt_section/appropriations/wateruse.html

Industrial Water Users - Based on a review of the water appropriation permits issued by the Minnesota DNR, there are no industrial uses of Second Creek or the Partridge River downstream of the discharge. The only appropriations permits noted are United Taconite, Tate & Lyle Citric Acid, Inc., USG, Minnesota Power, Sappi, Heathmark, Inc. and WLSSD, which all appropriate water from the St. Louis River located far down stream of the SD001 discharge point.

Other Permitted River Water Users - There are no appropriations permits for using the water for agricultural irrigation (either crop or livestock watering), or for other uses.

Non-Permitted River Water Users - A principal difficulty in characterizing the potential effects on non-permitted users was locating those users; agency listings of such users are unavailable, and local officials are wary of providing the names of persons using the river water without a permit. Permits for river water use are required only when certain withdrawal thresholds are reached; therefore, reluctance to identify non-permitted users is probably unfounded. No unpermitted users are known to use either Second Creek or the Partridge River. Much of the property surrounding Second Creek is owned by Cliffs Erie, which has no plans to appropriate the water.

Fish - Salinity Sensitivities - In accordance with NPDES permit MN0067687, Mesabi Nugget, is required to perform chronic whole effluent toxicity (WET) tests in August of each year with water from outfall SD001. Test species prescribed by the permit include *C. dubia* and fathead minnow. For fathead minnows the primary endpoint by which toxicity is judged is the weight of the minnows (a decline in weight indicates toxicity). For *C. dubia*, the primary endpoint is the number of young that are produced during the test. Area 1 Pit water has not been toxic to fathead minnows in any tests; however, this water has been chronically toxic to *C. dubia* in just over 50% of the tests conducted.

Toxicity identification and evaluation (TIE) testing was initiated in October 2008 for Area 1Pit water (Outfall SD001). Focused ongoing TIE evaluations will be continued to understand and mitigate the intermittent toxicity.

<u>Land Resources</u>

Because there are no permitted water appropriations for agricultural purposes (see above), and because there is little if any agriculture in the area, it is unlikely that there will be impacts on row crops, small grains or livestock irrigation. However, there may be unpermitted uses, so impacts on a variety of crops, trees and grasses are noted below.

The threshold levels for selected garden crops and fruits that have been studied extensively were computed based on the plant's listed tolerance and the soil types in the study area in the GRI Freshwater STR Model and Computer Program: Overview, Validation, and Application. The range of threshold levels by soil type is listed in the table below. The average value for the range was used as the threshold level for this study. Table 1-3 provides a listing of growing garden crops and fruits that are the most sensitive to salinity: beans, carrots, onions, radishes, strawberries, and raspberries (threshold levels ranging from 400 to 1,000 mg/L). Cabbage, lettuce, peppers, spinach, sweet potatoes, tomatoes, apples, pears, grapes, plums, blackberries, and boysenberries are moderately sensitive to salinity with threshold levels of 500 to 1,300 mg/L.

Table 1-3 Relative Salt Tolerance of Various Cultivated Plants*

Non Tolerant (0–1,400 mg/L)	Slightly Tolerant (1,400–2,800 mg/L)	Moderately Tolerant (2,400–5,600 mg/L)	Tolerant (5,600–11,200 mg/L)
Nurseries			
azalea cottoneaster red pine rose sugar maple viburnum white pine	apple forsythia linden Norway maple red maple	black locust boxwood beet red oak white ash white oak	arborvitae juniper Russian olive
Truck Gardening			
begonia blueberry carrot green bean onion pea radish raspberry strawberry	cabbage celery cucumber grape lettuce pepper potato snapdragon sweet corn	broccoli chrysanthemum geranium marigold muskmelon spinach squash tomato zinnia	asparagus Swiss chard
Golf Courses			
	creeping bentgrass Kentucky bluegrass perennial ryegrass red fescue	nugget Kentucky bluegrass seaside creeping bentgrass	alkaline grass

*Source: Rosen et al "Soil Test Interpretations and Fertilizer Management for Lawns, Turf Gardens, and Landscape Plants"

According to this list, there are several trees and shrubs that are described as "non-tolerant" with plant damage expected at TDS concentrations of 0 to 1,400 mg/L. All other listed trees and shrubs are tolerant of salinity levels over 1,400 mg/L. The list also shows that all grasses are tolerant of salinity levels of over 1,400 mg/L.

Given the relatively low population in the area and the short growing season, there does not appear to be a major impact on the land resources which will result from the agency's approval of the requested variance.

4. a statement of the alternatives to the proposed operation under the variance which have been considered by the applicant;

The source of many of the constituents in Mesabi Nugget's manufacturing process are from the coals and fluxes that are used in the technology. (Pollutants also enter the water from the processed mine ore which cannot be replaced with an alternative source.) Since the key to the process technology involves the use of coals and fluxes, there is no alternative available to remove the source. Mesabi Nugget has committed, as part of the air quality permit, to pursue and test, after stabilization of initial plant operations using the base case raw materials and fuels, the use of alternative raw materials and fuels, including other types of coal and process inputs that may reduce both air and water emissions of the pollutants for which a variance is being sought. Mesabi Nugget has requested authorization to use a variety of coals and alternative fuels and process inputs and will test such alternatives in the nugget process to determine if such alternative inputs can be successfully used and applied to the new technology of manufacturing iron nuggets. To the extent that these alternative fuels result in lower constituent concentrations in the process exhaust gases, it may be possible to reduce loading to the scrubber, wastewater treatment system, and ultimately the permitted water discharge.

When determining the best technology for protecting the environment as a whole, several interrelated factors must be considered. In some cases, those options that provide a positive benefit in one area may be less beneficial in another. Mesabi Nugget is in the process of selecting this equipment, considered several different categories including air emissions, water discharge, solid waste, process experience, and costs. Table 1-4 provides a summary of these considerations.

Table 1-4 Equipment Environmental Considerations

Category	Considerations
Air Emissions	PM_{10} Acid Gases (SO2/F) NOx Mercury Heavy Metals Visible Plume
Water Discharge	Water quality at discharge
Solid Waste	Quantity and composition of waste
Experience	Technically proven Probability of success
Costs	Capital costs Operating costs

Air Emissions:

The most important factor for Mesabi Nugget's control system selection for the LSDP is the demonstrated ability of the control system to remove pollutants from the offgas of the rotary hearth furnace (RHF) system used to manufacture the iron nuggets. The Pilot Demonstration Plant (PDP) that Mesabi Nugget constructed and operated at Silver Bay, Minnesota was used to collect data on the RHF emissions control system for the ITmk3 Process. A comparison was made of the control system performance data collected from the PDP against performance data relative to use of a dry baghouse using lime injection applied in similar applications. This examination indicates that a wet scrubber provides higher removal efficiencies than a dry baghouse system for PM_{10}, acid gases, and mercury. A baghouse is more efficient at PM_{10} removal relative to the filterable component of PM_{10}, but for total PM_{10} removal relative to filterable and condensable components, the scrubber is significantly superior in PM_{10} removal. The superior performance of PM_{10} removal is one of the major reasons for Mesabi Nugget's selection of a wet scrubber as the most appropriate control method for the RHF of the LSDP. Achievement of ambient air quality standards for Class II modeling requires the use of the wet scrubber for the LSDP.

Like PM_{10} removal, the wet scrubber removes more mercury from the RHF offgas than a dry baghouse system. Although the mercury removal technology and resulting removal efficiency as it exists today for either system is not particularly high, the removal efficiency of the wet scrubber for those types of mercury that tend to deposit locally (particle bound and oxidized forms) is much higher for a scrubber when compared to a baghouse. Moreover, Mesabi Nugget has also concluded that the use of a wet scrubber offers greater opportunity to advance the state of technology for removal of elemental mercury and reduction of overall process system mercury emissions. Mesabi

Nugget believes that the wet scrubber system selected for the LSDP allows for additional experimentation with proprietary reagents or mercury fixation additives to the water used in the scrubber. Mesabi Nugget is developing certain proprietary technology relative to mercury removal by use of a wet scrubber and subsequent proprietary water treatment technology which will be applicable to the LSDP and offer the potential to increase the overall mercury removal capabilities beyond that which exists today for any control system.

For heavy metals, the removal efficiencies between a wet scrubber and a dry baghouse are nearly equal. NOx removal does not occur with either system. Acid gas removal by the scrubber system is superior to a scrubber and further reinforces our conclusion that a scrubber is the superior control system for the LSDP RHF.

With a dry system, in order to reduce the temperature of the offgas to a level necessary to protect the bags of the baghouse, significant amounts of evaporative water must be added to the offgas stream prior to the baghouse. This water condenses upon discharge from the stack resulting in a highly visible wet plume. With a wet scrubber system, the quantity of moisture in the offgas stream is substantially lower and a visible plume would not exist under normal atmospheric conditions. This is the reason that a visible plume was not observed during pilot plant operation.

A wet scrubber is operationally and technologically superior to a dry baghouse system due to the specifics of the iron nugget process. For this reason and the expectations of superior performance on total emissions, the Mesabi Nugget PDP in Silver Bay utilized a wet scrubber for pollution control from the RHF. Since this is the only plant of its kind in the world, all other control equipment relative to the ITmk3 Process is unproven technology and therefore high risk technology. The stakeholders of Mesabi Nugget are primarily concerned with the complexities of scale up of the Rotary Hearth Furnace from pilot plant to production scale. The additional complexities associated with unproven offgas control technologies would add an unacceptable level of risk to the LSDP. As such, the wet scrubber system is clearly preferred with regard to the factors of experience and risk minimization.

Water Discharge:

A dry system, although inferior with regard to air emissions, does minimize the contact of the pollutants with water. As such, water quality is minimally impacted when using a dry system. However, the use of a wet scrubber and its inherently superior air emissions capabilities can be beneficially used because conventional water treatment technologies exist that allow for a substantial amount of the pollutants in the water to be removed. This includes mercury precipitation. In addition, Mesabi Nugget will implement a proprietary technology that removes a substantial amount of the mercury from the discharge.

In the Executive Summary of the Area 1 Pit Water Treatment Evaluation Report in Support of the Non-degradation Analysis (Barr, 2009c), a summary of the evaluation of several potential water treatment technologies and the estimated cost of implementation to demonstrate that "additional control measures [which] are not reasonable", per MN Rules 7050.0185, subpart 8. This evaluation concluded that implementation of reverse osmosis (RO) with solids disposal containing no moisture (zero liquid discharge) is the only potential alternative that could be implemented to consistently achieve applicable water quality standards. It was estimated that implementation of this treatment option would cost over $113 million dollars (net present worth) over the 20-year design life of the facility.

The proposed treatment system includes the best practices for mercury and metals reduction from the process wastewater.

5. **a concise statement of the effect on the establishment, maintenance, operation, and expansion of business, commerce, trade, traffic, and other economic factors that may result from approval and from denial of the requested variance.**

The Mesabi Nugget facility provides a unique opportunity for the Minnesota iron range area for new jobs and economic growth in an area that has otherwise suffered a long economic decline. The construction and operation of the Mesabi Nugget facility provides a much-needed economic stimulus in the local economy. The plant employed over 800 workers for construction of facilities. The plant currently to employs over 70 full time employees. The additional tax paid to the local governments could be on the order of $40 million over the next 30 years. In addition, this technology will provide additional steel to the US markets at costs that can compete with other sources of imported iron.

While Mesabi Nugget is committed to using the most advanced technology available, it is not technically feasible at this time to meet the water quality standards. While a technology exists which could meet the standards – a "zero discharge" system including Reverse Osmosis with evaporation and crystallization of the reject water is not a technically feasible alternative to meet water quality standards for hardness, specific conductivity and total dissolved solids (TDS).

1.2 Variance Requirements Relative to Minn. Rule Part 7052.0280 and 7052.0320

In order to receive a variance for a new or expanded discharge in the Lake Superior Basin, relative requirements in Minn. Rules 7052.0280 and 7052.0320 must be met.

Because a variance is not being requested for a GLI-pollutant, MN Rule 7052.0280 does not apply. Because a variance is not being requested for any bioaccumulative chemicals of concern (BCC) or bioaccumulative substances of immediate concern (BSIC), the requirements of MN Rules 7052.0320 are not applicable.

2.0 References

Barr Engineering Company. 2009(a). Dissolved Solids and Chemical Balance. December 2009.

Barr Engineering Company. 2009(b). Mine Pit Hydrogeology and Water Balances. October 2009.

Barr Engineering Company. 2009(c). Area 1 Pit Water Treatment Evaluation in Support of the Non-Degradation Analysis. December 2009

Barr Engineering Company. 2009(d). Greenhouse Gas Emission Inventory Report. June 2009

Barr Engineering Company. 2009(e). Climate Change Evaluation Report. October 2009

Barr Engineering Company. 2009(f). Partridge River Water Quality Report. December 2009.

MN DNR. 2009(a). Draft Environmental Impact Statement (DEIS), Keetac Taconite Expansion Project. December 2009

U. S. Steel, 2009(a). Application for Reissuance of NPDES/SDS Permit #MN0057207 for the Minntac Tailings Basin. March 2009.

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PolyMet. 2009(a). Draft Environmental Impact Statement (DEIS), NorthMet Project. November 2009.