Minnesota Pollution Control Agency/Environmental Outcomes Division
Variance Issue Statement
For
Mesabi Nugget Delaware, LLC and Steel Dynamics, Inc.
NPDES/SDS Permit No. MN0067687

DRAFT – November 9, 2011

Issue Statement

Mesabi Nugget Delaware, LLC (Mesabi Nugget) and Steel Dynamics, Inc. (SDI) operates an iron nugget production facility (Large Scale Demonstration Plant – LDSP) located near Hoyt Lakes, Minnesota. This facility was originally permitted in 2005, however, construction was delayed until 2009 because of financing issues and a change in ownership. The facility became operational on a limited, commissioning basis in January of 2010.

The facility appropriates process makeup water from an inactive, water-filled mine pit (Area 1 Pit) at the former Cliffs Erie/LTV mining site for process temperature control (contact and non-contact cooling) and for process water (e.g. scrubber water supply). The wastewater generated from the contact cooling water and the process water is treated prior to return back to the Area 1 Pit. The wastewater treatment system consists of chemical coagulation, precipitation and clarification, followed by microfiltration and final mercury removal through a proprietary mercury filtration system. The treated wastewater is routed back into Area 1 Pit for additional settling prior to reuse as makeup water or discharge to Second Creek through a designated pipe outfall (SD001). A second mercury filtration system is available for additional treatment, if needed, before the discharge to Second Creek. The average and maximum rates of flow of the discharge to Second Creek are 1.5 mgd and 5.8 mgd, respectively. As necessary, the discharge is proposed to be controlled such that it can be temporarily reduced or eliminated so as not to violate any applicable seasonal water quality standard or to otherwise minimize adverse impact to the receiving water. The Area 1 Pit being an inactive mining area undergoing closure and reclamation is a water body under NPDES/SDS permit and is not a Waters of the State as defined in Minnesota Rules.

With its application for reissuance of its existing NPDES/SDS permit Mesabi Nugget has submitted an application requesting a variance from water quality-based effluent limitations and the underlying water quality standards for hardness, specific conductance, total dissolved salts (solids or TDS), and bicarbonates. The applicable water quality standards are:

- 500 mg/L for hardness for Class 3C waters;
- 1000 µmhos/cm (µS/cm) for specific conductivity for Class 4A waters;
- 700 mg/L for total dissolved salts (solids) for Class 4A waters; and

- 250 mg/L for bicarbonates for Class 4A waters

The concentration of the above parameters in the existing discharge from Area Pit 1 to Second Creek is currently above their respective water quality standards. Because the production facility has only recently commenced operation in a limited capacity, the current concentration in the discharge reflects pre-operation conditions that have not been materially affected by the limited operation of the nugget plant. Nondegradation is not triggered because loadings are below currently permitted loadings and will remain so for the life of this permit.

The basis for the variance request is the technical infeasibility of additional treatment to meet the final effluent limitations, which is characterized as technically infeasible, complex, and economically risky. The request conforms to the requirements for applying for a variance specified in Minnesota Rules, Parts 7050.0190 and 7000.7000.

The existing permit issued in 2005 included a variance, with corresponding interim effluent limitations, for the same parameters as in the current variance request. The currently requested variance is in essence a continuation of the existing variance. For two of the four parameters (specific conductivity and TDS), however, the magnitude of the current requested variance is less than that granted in the previous variance. In addition, by controlling the timing of the discharge, Mesabi Nugget is proposing to reduce the duration of the requested variance as compared to the previous variance. Mesabi Nugget is proposing to eliminate the discharge to Second Creek from April 1st through August 31st due to the potential for impacts to downstream wild rice from sulfate in the discharge. As part of the permit development MPCA staff determined that the downstream waters used for the production of wild rice are susceptible to damage from high sulfate levels during the months of April through August. In addition, because intermittent seasonal chronic toxicity in the discharge has been observed in the past, the discharge would be restricted during the month of September each year pending demonstration through whole effluent toxicity (WET) testing that chronic toxicity does not exist in the discharge. Thus, the current variance request represents a reduction in both magnitude and duration as compared to the previously granted variance.

This memorandum discusses the basis presented by Mesabi Nugget for requesting a variance from the hardness, specific conductivity, total dissolved salts (solids), and bicarbonate water quality-based effluent limitations, and the conditional Agency staff position for granting the variance.

A. Background

Nugget Plant Description

Mesabi Nugget in January 2010 commenced operation of a 600,000 metric ton/year iron nugget production facility at the Cliffs Erie mining site (formerly LTV Steel Mining Company) located in Hoyt Lakes, Minnesota. The iron nuggets are approximately 96 to 98% iron, and are suitable for direct feed to electric arc furnaces (mini-mills) as well as to foundries and conventional integrated iron and steel manufacturing facilities. Although production has commenced as of early 2010, current production levels remain well under rated capacity.

Mesabi Nugget appropriates process makeup water from an inactive, water-filled mine pit (Area 1 Pit) for contact and non-contact cooling needs and for an air pollution control wet scrubber system. All process wastewaters generated from the cooling and scrubber systems are treated prior to return back to the Area 1 Pit. This wastewater is treated using a two stage metals removal and softening system utilizing lime, ferric chloride, cationic polymers, caustic (soda ash), and water treatment chemicals to form insoluable metal hydroxides and sulfides precipitates which settle out in a sludge for subsequent disposal. Effluent from the solids contact clarifier is passed through a microfilter, a mercury filter (for additional solids and mercury removal) and then is routed to the Area 1 pit. Water from the pit will be directed through a second mercury filter, if needed, prior to discharge to Second Creek. The treatment is capable of meeting the effluent limitations for the underlying 1.3 ng/L mercury water quality standard applicable to the Lake Superior Basin.

Receiving Water Classification and Applicable Water Quality Standards

Second Creek has been assigned beneficial use classifications under Minnesota Pollution Control Agency (MPCA) rules Chapter 7050.0430, Unlisted waters; 2B, 3C, 4A, 4B, 5, and 6. Second Creek is part of the Partridge River and St. Louis River watershed that ultimately flows to Lake Superior. The water quality standards for which Mesabi Nugget is seeking a variance from; hardness, specific conductance, total dissolved salts (solids or TDS), and bicarbonates, are standards set to protect the beneficial uses of industrial consumption and irrigation. There are no known existing uses of Second Creek water for industrial purposes or for irrigation. Other industrial uses are either upstream of Second Creek in the Partridge River or much farther downstream in the St. Louis River.

The following table contains the applicable water quality standards for which Mesabi Nugget is requesting the variance:

POLLUTANT	WATER QUALITY STANDARD	CLASSIFICATION	DESIGNATED USE
Hardness, Ca and Mg as $CaCO_3$	500 mg/L	3C	General industrial purposes
Specific Conductivity	1000 µmhos/cm	4A	Irrigation
Total Dissolved	700 mg/L	4A	Irrigation

Salts (solids)*			
Bicarbonates as $CaCO_3$	5 milliequivalents or 250 mg/L	4A	Irrigation

*Total dissolved salts and total dissolved solids are used interchangeably and termed TDS

Current Conditions in the Discharge

The quality of the water in the Area Pit 1 and in the existing discharge from the Pit to Second Creek (Outfall SD001) indicates that these four pollutants will exceed applicable water quality standards in Second Creek, assuming little or no dilution is available for the discharge. Current water quality in the pit and in the existing discharge SD001 (based on an average of the most recent 12 month period of discharge through SD001; July 2009 through June 2010) is listed in the table below.

POLLUTANT	**WATER QUALITY STANDARD**	**CURRENT PIT 1**	**CURRENT DISCHARGE (SD001)**
Flow, *mgd*	---	---	3.8
Hardness, Ca and Mg as $CaCO_3$, *mg/L*	500	726	740
Specific Conductivity, *µmhos/cm*	1000	1205	1194
Total Dissolved Salts (solids), *mg/L*	700	617	824
Bicarbonates as $CaCO_3$, *mg/L* or (*milliequivalents*)	250 (5)	332	330

Current Conditions in the Receiving Water (Second Creek)

Monitoring of the flow and water quality in Second Creek upstream and downstream of the discharge is required by the existing permit. Upstream flow ranges between 0.3 to 2.1 mgd with an average of 0.9 mgd. Downstream flow increases to a range of 4.0 to 12 mgd with an average of 6.9 mgd, the increase being due to the existing discharge as well as other contributions from the watershed. Specific conductance, hardness, and TDS hovered close to water quality standards upstream (some above, some below) but were generally above water quality standards downstream. Monitoring of flow at the headwaters to Second Creek (outfall SD026 of the Cliffs Erie NPDES/SDS Permit MN0042536) indicates flows near zero at certain times of the year. It is expected (and has been documented) that for substantial parts of the year water quality standards will not be met for these four pollutants in Second Creek downstream of the discharge given the minimal upstream flows and the predominance of the Mesabi Nugget discharge.

The following table summarizes the results of monitoring in Second Creek (based on data from the most recent 12 month period of discharge through SD001; July 2009 through June 2010).

POLLUTANT	WATER QUALITY STANDARD	SECOND CREEK UPSTREAM	SECOND CREEK DOWNSTREAM
Flow, Ave., *cfs (mgd)*	---	1.0 (0.65)	7.9 (5.1)
Flow, Min – Max, *cfs (mgd)*	---	0 – 2.9 (0 – 1.9)	0.1 – 20 (0.1 – 13)
Hardness, Ca and Mg as $CaCO_3$, *mg/L*	500	580	661
Specific Conductivity, *µmhos/cm*	1000	1083	1030
Total Dissolves Salts (solids), *mg/L*	700	686	751
Bicarbonates as $CaCO_3$, *mg/L* or (*milliequivalents*)	250 (5)	337	294

It should be noted that site and watershed conditions for the receiving water have changed since July 2010, the time from what is represented in the table above. First, Mesabi Nugget is currently temporarily storing water within on-site mine pits such that there is no discharge through SD001 and second, Cliffs Erie has installed a collection and pumpback system at the SD026 headwaters to Second Creek thereby reducing the volume of flow upstream of the SD001 discharge point. The combined effect of these activities has been a marked decrease in upstream and especially downstream flow rates in Second Creek as well as a general overall decrease in pollutant concentrations. Some of the influences are temporary (cessation of discharge through SD001) and some are more permanent (SD026 pumpback system) so it is difficult to assess what future conditions will be.

B. Discussion

Variance Request

Mesabi Nugget is requesting the variance from the water quality standards for hardness, specific conductivity, bicarbonates, and total dissolved salts (solids) based on provisions in Minn. R. part 7050.0190, subpart 1, and in conformance with the provisions included in Minn. R. part 7000.7000, subp. 2. The variance request is directed at the final effluent limitations for hardness derived from the underlying 500 mg/L Class 3C water quality standard in Minn. R. 7050.0223, subp. 3; for specific conductivity from the underlying 1000 µmhos/cm Class 4A water quality standard; for bicarbonates from the underlying 5 milliequivalent (250 mg/L) Class 4A water quality standard; and for total dissolved salts (solids) from the underlying 700 mg/L Class 4A water quality standard in Minn. R. 7050.0224, subp. 2.

The Agency, in proceeding to grant a variance, must consider the items listed in Minn. R. 7000.7000. The discharger has provided the necessary information in their application

for these items, and has provided any additional information that the MPCA has requested.

Comparison of Current Variance Request with Previously Approved Variance
The existing permit issued in 2005 included a variance for the same parameters. The current request is in essence a continuation of the existing variance. For two of the four parameters (specific conductivity and TDS), however, Mesabi Nugget requested a variance of less magnitude than was previously granted. Additionally, MPCA staff review of the current variance request resulted in proposed variance effluent limitations below both the previous variance effluent limits and Mesabi Nugget's current request for variance effluent limits for three of the four parameters. This is shown in the table below.

POLLUTANT	**CURRENT VARIANCE EFFLUENT LIMITS (Mo. Ave./Daily Max.)**	**REQUESTED VARIANCE EFFLUENT LIMITS (Mo. Ave./Daily Max.)**	**PROPOSED VARIANCE EFFLUENT LIMITS (Mo. Ave./Daily Max.)**
Hardness, Ca and Mg as $CaCO_3$, *mg/L*	740 / 831	740 / 831	740 / 831
Specific Conductivity, *µmhos/cm*	2159 / 2425	2000 / 2246	1393.4 / 1449.5
Total Dissolved Salts (solids), *mg/L*	1619 / 1818	1200 / 1348	1049.4 / 1111
Bicarbonates as $CaCO_3$, *mg/L* or	396 / 445	396 / 445	362.7 / 378

In addition, by controlling the timing of the discharge, Mesabi Nugget is proposing to reduce the duration of the requested variance as compared to the previous variance. Mesabi Nugget is proposing to eliminate the discharge to Second Creek from April 1st through August 31st due to the potential for impacts to downstream wild rice from sulfate in the discharge – this will decrease the duration of impacts from the variance parameters as well - and potentially for the month of September pending demonstration through whole effluent toxicity (WET) testing that chronic toxicity does not exist in the discharge during this time period (which is the period when intermittent chronic toxicity in the discharge has been observed in the past). As part of the permit development MPCA staff determined that the downstream waters used for the production of wild rice are susceptible to damage from high sulfate levels during the months of April through August. The reissued permit will include requirements that avoids and/or restricts a discharge during these times.

Applicability of Variances from Water Quality Standards - Minn. R. 7050.0190, subp.1.
Minn. R. 7050.0190, subp. 1 allows a variance for discharges of hardness, bicarbonates, specific conductivity, and total dissolved salts (solids) in a situation where strict compliance with the standards would cause the discharger undue hardship; and that strict conformity with the standards would be unreasonable, impractical, or not feasible under the circumstances.

Conditions to Grant a Variance
The discharger must conform to the provisions of Minn. R. 7000.7000

Items A through C – Name, address, signature and facility location and description
Mesabi Nugget has provided this information.

Item D - Nature of the variance sought
Mesabi Nugget has identified the applicable variance provisions and is asking for a variance for the duration of the permit. Permit duration can be no longer than five years. The reasons specified in seeking the variance are described in Item F below.

Item E - Grounds based on economic burden
The company's analysis relies predominately on technical infeasibility (see discussion under Item F below). The company maintains that wastewater treatment alternatives that may theoretically be capable of providing treatment are complex, unproven and therefore economically risky, and even if they were technically feasible would be exceptionally expensive to install and operate at the flows and concentrations projected for their facility. Preliminary costs estimates of a treatment system theoretically capable of meeting treatment objectives is approximately $40 - 52 million in capital costs (depending on the specific objective to be achieved) and $3.3 - 4.8 million in annual operating costs corresponding to a net present value of approximately $92 - 113 million over the 20 year design life of the facility.

Item F - Grounds based on technological infeasibility
Mesabi Nugget investigated the technical feasibility of several wastewater treatment technologies that were identified as having a potential of effectively treating the discharge including biological treatment (anaerobic reactors, wetlands), chemical precipitation (lime softening, ettringite precipitation, barium precipitation), ion exchange (Sulf-IX) and membrane treatment (nanofiltration, reverse osmosis). Of those technologies evaluated, the only option considered potentially technically capable of reducing the levels of the variance parameters to water quality standards was reverse osmosis with evaporation and crystallization of the reject water. However, even this technology was considered uncertain at the projected flow volumes and concentrations for a variety of reasons including scale-up (design) considerations, likely fouling and scaling of the heat input surfaces and disposition of the reject brine.

Mesabi Nugget concluded that reverse osmosis (RO) treatment with or without evaporation and crystallization to treat mine dewatering is not feasible for three primary reasons: (1) while other mining projects have proposed treatment of process water, no such system for mine dewatering has been built in Minnesota; (2) while other industry sectors have employed RO treatment systems to some extent at their facilities, no such system to treat the exceptionally high volume of water with relatively low concentrations of pollutants needing treatment and at low ambient temperature in this case has been designed or built in Minnesota; and (3) a means to treat the large volume of reject water does not exist within the Lake Superior basin and international treaties prevent the transport of large volumes of water from the Great Lakes basin.

Advanced treatment systems utilizing membrane technology have been proposed to treat scrubber water at U.S. Steel – Keetac and Essar Steel, tailings basin water at U.S. Steel – Minntac and mine site water at PolyMet. None of these systems has yet been built and operated so no data on actual system feasibility or performance is available.

MPCA staff is aware that RO systems, with and without evaporation/crystallization, are in use for treatment of wastewater generated by other industry sectors in Minnesota. However, in general the design considerations for these systems are significantly different with respect to volume and concentration. Mesabi Nugget will need to treat a very large volume of low temperature water with relatively low constituent concentrations – membrane systems capable of providing treatment for such mine pit dewatering systems have not yet been designed or piloted in Minnesota.

Theoretically it would be possible to operate a membrane system without an evaporator/crystallizer using multiple stage membrane treatments to reduce the volume of brine so that it could be transported to a larger wastewater treatment facility. However, disposal of the brine presents a significant challenge. Mesabi Nugget looked at a number of brine disposal options that have been employed elsewhere outside of Minnesota including evaporation, underground injection, disposal to a municipal publicly owned treatment system (POTW) and ocean disposal, but each was determined to be not technically feasible for application at Mesabi Nugget. Each of these is discussed briefly below.

The feasibility of evaporation ponds for brine management is fundamentally determined by local climatology, specifically the annual evaporation rate versus the annual precipitation rate. Mean annual precipitation at Hoyt Lakes is approximately 27.4 in/yr and mean evapotranspiration is estimated at 20.0 in/yr. The excess precipitation precludes the use of evaporation ponds for brine disposal at Mesabi Nugget.

Underground injection involves the injection of the brine into deep, brackish or saline aquifers. In Minnesota there is currently a prohibition on the use of injection wells for waste disposal. Even if a variance from this prohibition was sought, there are no aquifers of suitable capacity, permeability and degree of isolation from aquifers used for drinking water in northeastern Minnesota making this disposal option technically infeasible.

The brine could be trucked to a municipal POTW for disposal. However municipal wastewater treatment systems are not designed to remove the pollutants of concern but would only ‘treat’ them through dilution. In addition, it does not appear that there is a treatment system within the Lake Superior watershed (including the Western Lake Superior Sanitary District in Duluth) that would have the capacity to accept the volume and strength of the waste brine, and other larger systems such as the Metropolitan Wastewater Plant in St. Paul, being outside the Great Lakes basin, are unacceptable from a regulatory perspective.

Ocean disposal is not a viable options for the obvious reason of geography as well as regulations and treaties governing the diversion of water from the Great Lakes Basin.

Agency review of the Mesabi Nugget technology infeasibility assessment determined that a RO system would be required to reduce salts to levels where the effluent limitations for the salinity parameters may be met – other technologies would not be likely to meet effluent limitations. RO is a pressure driven process that retains ions on one side of a RO filter while passing water through the filter to the other side. The pressure applied exceeds the osmotic pressure of the solution against a semi-permeable membrane, and thus forces water through the membrane leaving ions behind. RO has been used quite successfully for the removal of hardness and total dissolved solids, and certain RO systems have been used for removal of specific ions such as chloride and sulfate. RO systems are typically applied on smaller scales (relatively low flows) using relatively clean sources of groundwater or water as make up water for production of boiler water, or other water uses requiring waters with low levels of hardness or salinity. Large scale or high flow RO systems for removal of salinity have seen limited use, and are generally limited to large plants for the desalinization of sea water for drinking water supplies in countries with inadequate freshwater supplies.

To adequately implement an RO system at Mesabi Nugget for treatment of wastewater effluent salinity, pre-treatment would be required to remove the suspended solids and to remove the hardness ions (softening). This is needed to avoid "fouling" of the RO membrane with scale from hardness and solids. The hardness is removed by a lime softening process, and sand filtration is used to control suspended solids. Solids are generated from the softening process, which are ultimately dewatered and require disposal. The RO system has a reject stream, which also requires subsequent treatment to remove the highly concentrated inorganic dissolved solids (salts). The dissolved solids removal is accomplished by total evaporation of the reject stream (brine concentration and crystallization of the solids. The process is very energy intensive in that large amounts of energy are required for the evaporation and crystallization process. To operate a system of adequate scale to treat the Area 1 Pit discharge would require an estimated energy usage of approximately 8.3 million kilowatt-hours per year. In addition, the crystallized solids would require off-site disposal which translates to additional energy consumption.

The conceptual system then required to remove salinity in the Mesabi Nugget effluent would consist of lime softening, sand filtration, the RO process, dewatering and thickening of lime solids, brine concentration (evaporation) and crystallization of the RO reject water, and disposal equipment.

Mesabi Nugget has characterized this level of treatment as technically infeasible both from a purely technical feasibility perspective and from a risk perspective, on the grounds that constructing an additional removal plant (in addition to the chemical precipitation and mercury filtration systems already in use) for the small reduction in pollutants in the treated water necessary to meet water quality standards is complex, technically and economically risky and impractical.

MPCA staff has thoroughly reviewed the technology assessment submitted by Mesabi Nugget's consultant, which determined that an RO, brine concentration/evaporation, and crystallization system would be the most applicable system for removal of salinity in the Mesabi Nugget effluent. In addition, the assessment was reviewed by engineering staff in MDNR with extensive experience in the treatment of mining-related wastewater. Staff concurs with Mesabi Nugget's assessment on the technical feasibility of this technology as well as on the more general concepts of its uncertainty, costs and practicality.

There are no known large scale sand filtration/RO systems with lime softening and evaporation/crystallization systems in place for the removal of salinity in complex wastewater treatment effluents. Therefore, there is no assurance that this system, if implemented, would work to completely and reliably remove salinity. MPCA staff has been involved in the removal of salinity or total dissolved salts for other wastewater applications and has completed extensive review of technologies that may be applicable for salinity removal. Generally these technologies are limited and may include ultra or nanofiltration, ion exchange, and reverse osmosis systems. MPCA staff concludes that the only potential technology applicable for salinity removal is the RO technology. MPCA staff also concur that RO technology is not practical, and likely infeasible, for salinity removal contained in wastewater effluents on a large scale. MPCA staff also believes that the energy requirements needed for an RO system of this scale are impractical, and production of this energy may also result in unnecessary generation of pollutants. Accordingly, MPCA staff concurs with Mesabi Nugget that an RO system with brine concentration/evaporation and crystallization is currently an uncertain technology for removal of salinity in industrial wastewater effluents, and that the costs to install these systems would be prohibitive at this time.

Item G – Other additional data.
No additional data.

Item H.1 – Other relevant data, general description of materials handled or processed…. nature and quantity of materials discharged…. proposed methods to control these materials.
Mesabi Nugget has recently commenced operation of a 600,000 metric ton/year iron nugget production facility which produces iron nuggets capable of being fed directly to electric arc furnaces (mini-mills) as well as to foundries and conventional integrated iron and steel manufacturing facilities. Although production has commenced as of early 2010, current production levels remain well under rated capacity.

The primary sources of the pollutants in the wastewater are the makeup water appropriated from the Area 1 Pit and blowdown from the facility's air pollution control equipment. Concentrations of pollutants in the makeup water are primarily from the weathering and leaching of wasterock stockpiles within the Area 1 Pit watershed. These wasterock stockpiles are the result of previous mining at the site by the former LTV Steel Mining Company. Mesabi Nugget will be required to investigate means to reduce the loading of dissolved solids from the stockpiles to the Area 1 Pit as part of the reclamation

and closure of adjacent minelands. The iron nugget manufacturing process involves the combustion of coal as a reductant. Current air quality regulations require the use of a wet scrubber system to provide sufficient removal of particulate and acid gases from the combustion process to meet ambient air quality standards and Class I Air Quality Related Values. Blowdown from the wet scrubber system containing elevated concentrations of dissolved constituents is routed to the wastewater treatment system for treatment prior to return of the treated water to the Area 1 Pit. Mesabi Nugget is required by the existing NPDES/SDS permit to investigate alternative sources of raw materials (e.g., coal) that would result in reduced influent loadings to the wastewater treatment system, although much of that work has not yet been completed because the facility has only been operating at a limited production level and for a short period of time (since January 2010).

Item H.2 – Comprehensive proposed plan to reduce discharges to lowest levels practical……
The Mesabi Nugget facility has been issued an Air Quality Permit which required installation of Best Available Control Technology (BACT) for control of criteria pollutants, Maximum Available Control Technology (MACT) for control of hazardous air pollutants, and ambient air modeling to demonstrate attainment of National Ambient Air Quality Standards (NAAQS), increments and Air Quality Related Values (AQRVs) in the nearby Boundary Waters Canoe Area Wilderness and Voyageurs National Park. Because the facility was the first of its kind commercial installation, there was considerable question on how to scale emission factors from testing that had been done on the previous pilot plant and the efficacy of the new air control equipment to be used on the full scale plant. As a result the Air Quality Permit was issued with requirements for additional testing related to determining optimum scrubber efficiency, to determine whether additional NOx controls were needed, and whether mercury emissions could be reduced. Much of this testing was triggered off of reaching a production total of 200,000 metric tons. This production level has not yet been reached, but according to current projections by the company, is expected to be achieved in approximately January of 2012.

The reason this issue is significant in this water quality variance discussion is because the ultimate selection of air emission control technologies and operating parameters (including scrubber water usage) will have an effect on the quantity and quality of wastewater requiring treatment and ultimately discharged/recirculated in the Area 1 Pit. This in turn could have ramifications on the quality of water discharged through SD001 and the timing and process of reducing pollutant concentrations in the discharge.

In consideration of this interrelationship with the Air Quality permit and its requirements, the schedule associated with the proposed water quality variance is in part predicated on the attainment of the 200,000 metric ton trigger level identified in the air permit. The proposed schedule in the water quality permit identifies a sequence of studies and reports that must be completed and submitted with the ultimate goal of identifying a specific plan of action and schedule that will result in compliance with final effluent limitations for the variance parameters. Completion of the first of these sequenced studies, the Water

Balance Study, is triggered by Air Quality Permit requirements based on the 200,000 metric ton production level. From that point forward, the remainder of the proposed schedule requirements in the water quality permit, such as the Chemical Balance Study and Pollutant Reduction Study are governed by the specified timeframes and schedule in the draft water quality permit. Because of these factors and uncertainties, the exact timeframe for compliance with final effluent limitations is not known at this time.

In general, Mesabi Nugget is employing state of the art advanced treatment technologies for the removal of metals and other pollutants in wastewater. In addition, the facility is employing innovative mercury removal technology that to date, has resulted in compliance with stringent mercury effluent limitations. Mesabi Nugget has stated that it intends to maintain or increase plant performance, and employ new or innovative technologies as available, specifically as it relates to additional information obtained from the required air emission testing. Mesabi Nugget will be also be conducting material balance studies, alternate processing techniques or material substitutions with a goal to not only improve process efficiency, but also to ultimately reduce loadings to the wastewater treatment system and establish a downward trend in the concentration of hardness, TDS, specific conductivity, and bicarbonates in the discharge. It is projected that hardness and bicarbonate concentrations in the discharge will decrease once the facility reaches full operation and the wastewater treatment process can be stabilized and optimized, while specific conductivity and TDS are expected to slowly increase initially. Estimated discharge concentrations after 5 years are shown in the table below – actual concentrations will, in part, be dependent on the outcome of the testing required by the Air Quality permit.

POLLUTANT	**CURRENT SDOO1 WATER QUALITY**	**DISCHARGE CONCENTRATION AT 5 YEARS**
Hardness, Ca and Mg as $CaCO_3$, *mg/L*	740	570
Specific Conductivity, *µmhos/cm*	1194	2000
Total Dissolved Salts (solids), *mg/L*	824	1200
Bicarbonates as $CaCO_3$, *mg/L* or	330	280

Item H.3 - Effect upon air, water, land resources of the state and upon the public and other persons affected,.....
Mesabi Nugget concludes that there will be no impacts on air resources and only a slight potential for minor impacts to land resources (i.e., soils) should downstream waters be 'unofficially' used as a source of water for private gardens or grasses. There are no endangered species impacts associated with this discharge.

The potential exists for impact on sensitive macroinvertebrates as a result of the ionic concentrations in the discharge and immediate receiving water. Chronic toxicity testing conducted on the existing discharge indicates no effect on fathead minnows but the potential for effect on *ceriodaphnia*. Testing results seem to suggest that this potential for impact to *ceriodaphnia* is of concern primarily in late summer and is intermittent in nature (i.e., toxicity is not observed each year). In addition, any potential for impact should be localized to the immediate area of discharge given the larger flows of downstream waters such as the Partridge and St. Louis Rivers relative to the discharge. As a result of these test results, toxicity identification and evaluation (TIE) testing has been initiated. Focused ongoing TIE evaluations will be continued to understand the test results and mitigate the intermittent toxicity as appropriate. In the interim, Mesabi Nugget will be required to control the discharge as necessary to avoid adverse impact on the receiving water. Specifically, discharge from SD001 will not be authorized during September of each year unless Mesabi Nugget can demonstrate through WET testing that toxicity exceeding one toxicity unit is not present.

Mesabi Nugget has evaluated the potential for impact on downstream waters should the variance be granted. This evaluation include potential impacts on the concentration of the variance parameters (hardness, TDS, specific conductance and bicarbonate) and sulfate to the immediate receiving water, Second Creek, as well as potential impacts to the downstream waters of the Partridge and St. Louis Rivers. The evaluation included projections for both average stream flow and 'worst-case' 7Q10 low flow conditions and covered the SD001discharge both with and without consideration of the subsurface contribution to the receiving waters from the Area 6 Pit. (The inactive Area 6 Pit is covered under a separate NPDES/SDS permit issued to Mesabi Mining, LLC. It does not have a surface discharge, but is known to impact Second Creek via subsurface contributions.)

In general, under average stream flow conditions the applicable water quality standards for the variance parameters would continue to be exceeded in Second Creek downstream of the SD001 discharge; however, water quality standards for these parameters would continue to be met in the Partridge and St. Louis Rivers. This is the case whether the subsurface contributions from the Area 6 Pit are included or not. Under 'worst-case' 7Q10 low flow conditions (which by definition would occur only approximately 0.2% of the time), the SD001 discharge when considered alone was projected to result in standards continuing to be exceeded in Second Creek for all four variance parameters and exceedances being extended to Partridge River for TDS and specific conductance. When contributions from the Area 6 Pit were included in the 7Q10 low flow evaluation, exceedance of standards for hardness, TDS and specific conductance could extend into the St. Louis River.

It should be noted that the Area 1 Pit would continue to discharge through SD001 whether the Mesabi Nugget plant is in operation or not, albeit without the wastewater treatment of pit waters that the nugget facility is currently providing. Pit 1 watershed hydrology is such that total water inflows exceed water losses to groundwater and evaporation resulting in a long-term overflow or discharge of the pit to Second Creek.

Even if the Mesabi Nugget plant was not present or operating, discharges from the Area 1 Pit to Second Creek would continue at levels exceeding water quality standards.

When evaluating the impact to the environment from an innovative technology such as employed at Mesabi Nugget, it can be informative to compare the *total* release of pollutants of the new technology against the traditional in-place technology. As an example, Mesabi Nugget has provided a comparison of total air emissions resulting from the ITMK3 iron making technology that the nugget process employs and that from traditional blast furnace technologies. Emissions of carbon monoxide, NOx, SO2, particulates, carbon monoxide and VOCs are all much less (approximately 50 – 90 percent less, depending on pollutant) from the ITMK3 technology than from blast furnaces. In addition, total emissions of carbon dioxide and mercury are also significantly less for the ITMK3 process. It should be noted these are not comparisons for the immediate local or Hoyt Lakes area but rather represent total emissions for the iron making process wherever the facilities are located (i.e., local to Hoyt Lakes for the ITMK3 process but including the steel and coke manufacturing centers in Gary and Pittsburgh, etc. for the traditional blast furnace processes). What this shows, however, is that overall the innovative technology being used by Mesabi Nugget results in fewer air emissions.

Item H.4 – statement of alternatives…..considered.
The choice for wastewater treatment alternatives is driven by the choices made on the raw materials used in the manufacturing process, particularly on the type and source of coal and fluxes. Both the coal and fluxes are essential to the process so they cannot be eliminated, however, Mesabi Nugget will be investigating various raw material sources and compositions and fuels to determine which combination of operations will provide optimum reductions to both media. It is anticipated that whatever choice is made that reduces exhaust gas emissions will likely reduce subsequent loading to the scrubber and the wastewater treatment system.

Item H.5 – statement of the effect on…..business, commerce, trade, traffic, and other economic factors……..
As a Large Scale Demonstration Plant, the Mesabi Nugget facility provides a unique opportunity for the Minnesota iron range for new jobs and economic growth that has otherwise experienced a long economic decline. The construction and operation of the facility provided a much-needed economic stimulus to the local economy. The plant currently employs over 70 full time employees. Taxes paid to local government are expected to be on the order of $40 million over 30 years.

As discussed above, the company's analysis relies predominately on technical infeasibility. MPCA staff concur with the company's analysis that maintains wastewater treatment alternatives that may theoretically be capable of providing treatment are complex, unproven and therefore economically risky, and even if they were technically feasible would be exceptionally expensive to install and operate at the flows and concentrations projected for their facility. Preliminary costs estimates of a treatment system theoretically capable of meeting treatment objectives is approximately $40 - 52

million in capital costs (depending on the specific flows to be treated and objectives to be achieved) and $3.3 - 4.8 million in annual operating costs corresponding to a net present value of approximately $92 - 113 million over the 20 year design life of the facility.

Mesabi Nugget has provided a brief evaluation of how such a theoretical (currently technically infeasible) wastewater system could affect the cost of iron nugget production and how that could affect market competitiveness. Considering annualized capital costs over a 20 year design life of a full-scale treatment system and annual operating and maintenance costs would result in an increase in the cost of production of approximately $14.20 per metric ton of nuggets produced. Market prices of a comparable product, Brazilian Pig Iron, over the past decade have ranged from $95 to nearly $700 per metric ton with a median price of $256 per metric ton. The theoretical $14.2 per ton increase in cost of production would therefore represent more than a 5% increase over the median market price of the nuggets. With worldwide competition in iron supply, such an increase in operating costs would present the company with a significant competitive disadvantage during all economic cycles and particularly so during downturns in iron pricing such as occurred in 2009. According to the company, this competitive disadvantage level of impact could jeopardize the entire $300 million dollar investment in the nugget Large Scale Demonstration Plant and could potentially result in the abandonment of the development and expansion of this groundbreaking iron-making technology.

Variance application submittal, public notice of preliminary determination, and notice requirements - Minn. R. 7052.0280, subp. 4.
Mesabi Nugget has submitted the required application information Minn. R. 7000.7000, subp. 2, so that the requirements of Minn. R. 7000.7000 directed at Agency review of the variance application and public notice of the variance can be fulfilled. The proposed variance is included into and will be public noticed with the draft reissued permit.

Agency final decision; variance requirements – Minn. R. 7050 and Minn. R. 7000.7000
As a condition of granting a variance, the agency includes permit conditions that accompany the variance. Minn. R. part 7050 or 7000.7000 specify provisions necessary for a permit that contains a variance for hardness, bicarbonates, specific conductivity, total dissolved salts (solids). The permit will include:

> *Item A. Interim effluent limitation based on currently achievable treatment* – The interim permit limitations applicable at issuance for each pollutant are projected based on current levels for hardness, bicarbonates, conductivity and TDS provided in the variance application. The daily maximums are calculated from the ratio of daily maximum to monthly average limits (1.03-1.06) in establishing the final WQBELs. It is expected that the permittee will be investigating alternate technologies to improve treatment and/or stockpile mitigation to establish a downward trend towards meeting the water quality standards for TDS, specific conductivity, and bicarbonates. The interim permit limitations applicable at issuance for each pollutant are:

Pollutant / Permit Limitation	Hardness	Bicarbonates (as $CaCO_3$)	Specific Conductivity	Total Dissolved Salts (solids)
Daily maximum	863 mg/L	378 mg/L	1449µmhos/cm	1111 mg/L
Monthly average	831 mg/L	362 mg/L	1393 µmhos/cm	1049 mg/L

Item B. Special permit requirements – The permittee will be required to complete a number of evaluations and studies during the life of the permit with the purpose of reducing the loading of pollutants to the wastewater treatment facility and to the Area 1 Pit resulting in a downward trend in variance pollutant concentration at outfall SD001. These include a Water Balance Study which will identify and quantify water flows into and out of the Area 1 Pit, a Chemical Balance Study which will identify the source and fate of pollutant loadings into the Area 1 Pit, including those from operation of the plant as well as those from watershed sources such as from leaching of adjacent stockpiles, and a Pollutant Reduction Study which will include an evaluation of source control strategies, treatment technologies and process optimizations that would result in reductions of pollutant loadings to the Area 1 Pit.

The information developed by the above studies will lead to the development of a Pollutant Reduction Study Report that will identify the specific treatment and/or mitigation necessary to meet final effluent limitations. The Pollutant Reduction Study Report is required to be submitted prior to, or with the application for reissuance of the permit such that the findings, recommendations and conclusions of the Report can be incorporated into the drafting of the next reissued permit (thereby making any subsequent permit requirements available for public review and comment during the public notice period of the reissued permit). The Pollutant Reduction Study Report is required to propose a specific plan of action with a schedule that will result in actions bringing the discharge in compliance with final effluent limitations as soon as possible. This plan of action may include, but is not limited to, installation of wastewater treatment equipment, source mitigation, a proposal for alternative discharge location and/or submittal of information necessary to support a request for development of site specific water quality standards. To provide assurance that requirements of the permit are being completed in a timely manner, progress reports to be submitted every 6 months describing the activities that have been completed and including a general summary of ongoing monitoring data collection and the progression towards attaining compliance with final effluent limitations are required by the permit.

Although a Source Minimization Plan was required by the existing permit it was not possible to complete the plan since construction and operation of the facility was delayed until 2010 (and even as of now is not operating at full scale) and actual operation of the facility is necessary to effectively make the evaluations. In particular, the Air Quality Permit for the facility includes a number of

requirements triggered of reaching a yet-unachieved production level of 200,000 metric tons and which could significantly affect evaluations and decisions on wastewater treatment. The intended contents of the previous Source Minimization Plan are, in essence, being folded into the series of studies required by this permit, in particular, the Chemical Balance Study and the Pollutant Reduction Study. It is expected that these studies will, among other topics, address the potential for use of alternative raw materials (coals, fluxes, chemicals) that would result in less pollutants in the process exhaust gases requiring removal by the wet scrubber system.

Chronic toxicity testing is required by the existing permit and will be carried forward into the proposed reissued permit at an increase frequency. Chronic toxicity testing is included to assess the impacts that the discharge may have on the aquatic life (Class 2B) designated use of the receiving water.

The proposed reissued permit will include requirements that will eliminate the discharge during the period April 1st through August 31st (to avoid potential impacts to downstream wild rice from sulfate in the discharge during the periods when the wild rice is susceptible to damage from high sulfate levels) and potentially during the month of September pending demonstration through whole effluent toxicity (WET) testing that chronic toxicity does not exist in the discharge during this time period (which is the period when intermittent chronic toxicity in the discharge has been observed in the past).

Item C. Water Quality Based Effluent Limitations (WQBELs) to meet the underlying Water Quality Standard – The final WQBELs for the discharge were derived using the water quality standards set as the waste load allocation, and using procedures in Part 7052.0200, Subp. 5, based on a computed Coefficient of Variation (CV) and a twice per month monitoring frequency. Over the past 5 years the Area 1 pit has been sampled approximately 60 times and the SD001 discharge over 100 times. These monitoring results were used to determine the CV, Standard Deviation and Variance of the data. The final Water Quality Based Effluent Limitations are shown in the table below.

Pollutant / **Permit Limitation**	**Hardness**	**Bicarbonates (as $CaCO_3$)**	**Specific Conductivity**	**Total Dissolved Salts (solids)**
Daily maximum	532 mg/L	267 mg/L	1066 µmhos/cm	768 mg/L
Monthly average	512 mg/L	257 mg/L	1025 µmhos/cm	726 mg/L

Item D. Permit re-opener – Specific permit language allowing for permit modification if revisions to water quality standards during the triennial review indicate applicability to this variance exists in the existing permit and will be carried forward into the proposed reissued permit.

Item E. Instream Monitoring – Monitoring of two instream monitoring stations, one immediately upstream of the discharge and one downstream after complete mixing of the receiving water and effluent, is a requirement of the existing permit and will be carried forward into the proposed reissued permit. The purposes of the monitoring are to determine the degree to which either station does not comply with water quality standards for the variance parameters, to determine any seasonality of noncompliance and to help determine the source of any noncompliance with standards.

Mesabi Nugget has provided information and documentation for each part of Minn. R. 7000.7000 that has allowed the Agency to process the application and proceed to make a preliminary determination regarding the variance and any permit conditions that should apply.

C. Conclusion

Mesabi Nugget withdraws water from the Area 1 Pit to utilize as contact water and for use in its air pollution control scrubber system. The wastewater generated from contact cooling and the scrubber system is treated prior to return back to the Area 1 Pit. The wastewater treatment system employs chemical coagulation, precipitation and clarification, followed by microfiltration and finally proprietary mercury filtration. The treated wastewater is discharged back into Area 1 Pit for additional residual treatment before being discharged to Second Creek through outfall SD001 (with a second mercury filtration system available prior to discharge should it be needed to meet mercury effluent limitations). It is technically infeasible to provide additional treatment at the projected flow rates, concentrations and ambient conditions solely for the removal of hardness, bicarbonates, specific conductivity, and total dissolved salts (employing reverse osmosis, a brine concentrator, and a crystallizer). The variance request indicates that additional treatment of this type has not been successfully built for discharges of a similar nature and scale in Minnesota, that such treatment is complex and would present significant operation and maintenance issues related to fouling and scaling, and the treatment is extremely energy intensive and expensive, especially in context to the overall environmental benefit gained.

If the variance request is granted, interim and final water quality-based effluent limitations will be placed in the permit (see permit conditions above). Monitoring data provided by Mesabi Nugget on Area 1 Pit water indicates that current hardness, bicarbonate, specific conductivity, and TDS levels will exceed the final water quality-based effluent limits. Interim limits will be included in the permit to limit the discharge during the term of the variance from the final effluent limits. The proposed interim limits were calculated based on effluent monitoring data submitted as required by the previous permit. Hardness and bicarbonates are projected to decrease. Specific conductivity and TDS are expected to increase initially. The accompanying permit includes a schedule for the completion and submittal of sequenced studies and reports with a requirement that a

Pollutant Reduction Study Report proposing a specific plan of action with a schedule that will result in actions bringing the discharge in to compliance with final effluent limitations as soon as possible be submitted as part of the application for reissuance of the permit.

D. Recommendations

Agency staff recommends that the Agency Board grant the variance. This recommendation is conditioned upon requirements that the permit include interim and final water quality-based effluent limitations for hardness, bicarbonates, specific conductivity, and total dissolved salts (solids). The permit must also include conditions that require Mesabi Nugget to control or eliminate the discharge during certain times of the year, to conduct periodic chronic toxicity testing of the discharge, and to complete a series of studies resulting in the submittal of a detailed plan of action and schedule to bring the discharge into compliance with final effluent limitations as soon as possible.