Book 3
Total Suspended Solids (TSS)

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Executive Summary

Minnesota's (State) Water Quality Standards (WQS) in Minnesota Rule chapter 7050 currently provide statewide standards for water turbidity. The existing rule includes two numeric standards that apply broadly. For Class 2A waters (cold waters), the current standard is 10 Nephelometric Turbidity Units (NTU) and for Class 2Bd, 2B and 2C waters (cool or warm waters) the current standard is 25 NTU. The Minnesota Pollution Control Agency (MPCA) is proposing to repeal the existing turbidity standards and adopt regionally-based standards based on Total Suspended Solids (TSS). TSS is comprised of two components: Nonvolatile Suspended Solids (NVSS) which is comprised of non-organic particles and is predominantly storm-event driven; and Volatile Suspended Solids (VSS) which are comprised mainly of algae, but also contain other organic materials. As described fully later, this distinction is important in implementation of the proposed TSS standards.

Since TSS from nonpoint sources comprises the majority of the Nonvolatile Suspended Solids in Minnesota's rivers and is driven by storm events, it is appropriate for the WQS to focus on long-term rather than daily concentrations. As such, the MPCA is proposing TSS numeric standards that are seasonal and based on a long-term, multiyear approach to data assessments. Also, the current turbidity standards are statewide; the proposed amendments will change the TSS WQS to a more refined regional basis, using the River Nutrient Regions proposed in this rulemaking for river eutrophication standards. Also, since the organic portion of TSS in wastewater is controlled by biochemical oxygen demand limits, and the main impact to stream fish and macroinvertebrates is the particulate portion of TSS, Nonvolatile Suspended Solids will be the focus of TSS permit limits.

The proposed WQS for TSS is based on a combination of biological data and chemical data. Chemical data uses reference stream data, although storm-event data are specifically excluded. Biological data includes fish and macroinvertebrates, which live in rivers through high flows and low flows; their presence or absence can provide a long-term history of aquatic life stressors, like TSS. Additionally, very large rivers can be functionally different from the tributaries that feed in to them. Two mainstem rivers – the Red River of the North and the Mississippi River below the mouth of the Minnesota River – have been assigned mainstem-specific TSS WQS. Using biology and chemistry together ensures complementary strengths.

The dataset available and used was limited both in season, April through September, and to rivers and streams. Because little to no data are available from lakes and wetlands, they are not a part of this rulemaking.

In this Book the MPCA provides a discussion of the specific need for and reasonableness of the turbidity to TSS amendments and also, where applicable, a discussion of the required Administrative Procedures Act questions that are specific to this set of amendments. More extensive detail regarding the development of the TSS standards is provided in the Technical Support Document (TSD) developed for these amendments (Exhibit TSS -1).

1. Background

Turbidity in water is caused by suspended soil particles, algae, and other organic and inorganic substances, that scatter light in the water column making the water appear cloudy. High inorganic particles can harm aquatic life; both the current turbidity measure in NTU and improved proposed TSS standards are founded in protecting aquatic organisms if not exceeded. Excess turbidity can result in:

- Negative effects on aquatic organisms such as difficulty finding food, affected gill function, and buried spawning beds;
- Significant degradation of the aesthetic qualities of waterbodies, limiting recreational use; and
- Increasing costs of treating water for drinking or food processing uses.

The importance of ensuring clear water has been reflected in Minnesota rules since the development of Minnesota's earliest WQS. The existing WQS for turbidity has been in place since 1967. In this rulemaking, the MPCA is changing the existing WQS from turbidity standards in Nephelometric Turbidity Units to standards based on Total Suspended Solids. The new TSS standards will serve the same purpose as the previous turbidity standard: to provide a measure of the relative clarity of water.

The term "turbidity" is not currently defined in either Minnesota state statute or rule, but in a guidance manual, the United States Environmental Protection Agency (EPA) describes turbidity as follows:

> *"Turbidity is a principal physical characteristic of water and is an expression of the optical property that causes light to be scattered and absorbed by particles and molecules rather than transmitted in straight lines through a water sample. It is caused by suspended matter or impurities that interfere with the clarity of water. These impurities may include clay, silt, finely divided inorganic and organic matter, soluble colored organic compounds, and plankton and other microscopic organisms. Typical sources of turbidity … include the following …:*
>
> - *Waste discharges,*
> - *Runoff from watersheds, especially those that are disturbed or eroding,*
> - *Algae or aquatic weeds and products of their breakdown in water reservoirs, rivers, or lakes, and*
> - *Humic acids and other organic compounds resulting from decay of plants, leaves, etc. … "*

The term "Total Suspended Solids" or "TSS" is used in several State rules (e.g., Minn. R. chs. 7001 (general permitting rules), 7045 (hazardous waste rules), 7049 (wastewater pretreatment rule), and 7080, 7081 and 7083 (subsurface sewage treatment system rules), but is not currently referred to in Minn. R. ch 7050 or 7052, which address the State's WQS. The only definition currently in State rule or statute is found in Minn. R. 7083.0020, subp. 21, which defines "Total Suspended Solids" or "TSS" as:

> *"solids that are in suspension in water and that are removable by laboratory filtering, expressed as mg/l."*

2. Need for the Proposed TSS WQS

A. Suspended sediments in surface waters adversely affect aquatic life

The need for having WQS to address turbidity and to protect water quality has been established since the existing standards were adopted in the 1960s and is supported by extensive scientific data. There is a vast array of scientific literature describing the impacts of excess suspended sediment on biota. The foundation of this information is fully described in the MPCA *Aquatic Life Water Quality Standards Draft Technical Support Document for Total Suspended Solids (Turbidity)* (Exhibit TSS-1). Suspended solids affects light penetration important for the growth of submerged aquatic plants and causes direct and indirect effects on aquatic animals. The TSS TSD (Exhibit TSS-1) cites a number of studies that reported effects on fishes' (e.g., trout) abilities to search and find prey. Trout, an important fish in Minnesota, rely primarily on sight for obtaining food. In another example, researchers studied fish and groups of highly interconnected plants or animals, with similar function, known as guilds, in northeast Missouri. As the percentage of fine particulate substrate increased, the distinction among riffle, run, and pool guilds decreased. The loss of distinction indicates a diminution of diversity. The guild analysis indicated that species with similar ecological requirements had a common response to habitat degradation by siltation.

In another study, principle components analysis indicated that the distinction between tolerant and intolerant classifications of aquatic species was determined largely by tolerance to suspended sediment, specific conductance, chloride, and total phosphorus. For example, the total abundance of benthic invertebrate and family richness declined as suspended sediment pulse duration increased. Analysis also suggests that the direct effects of fine sediment on trout (impaired vision leading to reduced prey capture and/or increased metabolic costs from physiological stress) are more important to trout growth than indirect effects (decreased drift and benthic invertebrate richness and drift abundance). These studies establish the fundamental need for a WQS to address water clarity, which is the protection of aquatic biological communities (see Exhibit TSS-1 for full references and discussion).

B. Advances in scientific basis for replacing the turbidity standards with TSS

Since the existing turbidity WQS were adopted in 1967, the level of understanding of water quality, and also the scientific basis for water assessment protocols has improved greatly. In this SONAR the MPCA will not re-establish the fundamental need for the State to have turbidity WQS to protect aquatic life and designated water uses. The MPCA does however, propose the amendments based on the need to revise the turbidity WQS to:

1. Add regional and water body-specific flexibility to the application of the standard;
2. Add time-related components to address stormwater events; and
3. Replace the existing measurement for turbidity in NTU to a more accurate TSS analytical method.

The structure of the existing turbidity WQS is inflexible. It is a statewide WQS, (with the exception of turbidity in cold water streams) which can be improved with the availability of newer data and current advances in understanding of regional differences across Minnesota. Minnesota's waters have a wide range of quality and characteristics and no one numeric standard for addressing turbidity is appropriate across all waters. There is a need to have a TSS WQS with sufficient flexibility to reflect the range of conditions that exist throughout Minnesota's waters.

Since nonpoint source TSS is driven by storm events, it is not appropriate to focus on daily concentrations. The impact of storm discharges on water quality is a major concern. The current turbidity WQS are not consistent with the storm-induced, flashy nature of how suspended sediments

get into surface waters and their dynamics in State waters. With the expansion of the scientific understanding of the impact of stormwater, there is a definite need to amend the turbidity WQS to address the time-related aspect of water quality impacts. The proposed TSS WQS are more technically accurate by accounting for seasonal aspects and frequency of higher TSS events, and recognizes natural variations of TSS in dynamic stream systems. The previous turbidity standards were not fully described in WQS to provide this specificity in protecting the beneficial use.

The use of a TSS standard will address an additional need of having a more reliable standard analytical method. TSS monitoring for assessments of water quality standards and permitting improves upon the use of turbidity. Turbidity is measured by probes that are more likely to differ in their results. TSS is a recognized laboratory analytical method that lends itself better for consistent and more reliable results across labs and monitoring groups.

C. EPA supports MPCA's use of TSS to address waters impaired for turbidity

EPA supported Minnesota's initial effort to use a TSS standard in lieu of an NTU standard. In 2012 the MPCA recognized the unique features of the stretch of the Mississippi River known as the "south metro Mississippi River", by developing, with input from several interested parties and Wisconsin Department of Natural Resources, a site-specific TSS standard for this water resource. The site-specific standard is an integral part of a pollution study, called a Total Maximum Daily Load (TMDL). For each water body that fails to meet standards, federal law requires that individual states, such as Minnesota, determine the load, or amount, for each relevant pollutant that a water body can accept and still meet standards. This amount is called a TMDL or loading capacity. Federal and state governments establish standards to protect specific designated or beneficial uses, such as recreation, fishing, irrigation, and support of aquatic life. In the case of the south metro Mississippi, the purpose of the WQS is to support aquatic life. This use includes sight-feeding fish and submersed aquatic vegetation, which requires sunlight for photosynthesis. River biologists and natural resource agencies have identified submersed aquatic vegetation as a keystone species to maintain a healthy ecology in the altered river. Scientists have also discovered a close linkage between TSS and desirable species of submersed aquatic vegetation. The MPCA has drawn on this scientific work to establish the basis for a site-specific standard in the south metro Mississippi River. This site- specific WQS for TSS to replace the NTU-based turbidity standard used as the basis for this impaired water has been approved by the EPA (Exhibit TSS-2). The MPCA expects that the EPA will equally support the proposed statewide transition from NTU to TSS.

3. Reasonableness of the Proposed TSS WQS

The reasonableness portion of the SONAR provides the discussion and background on the data and approaches used to develop the proposed rule amendments. The discussion includes the data quality and technical and policy foundation for the proposed amendments.

A. What are the proposed TSS WQS?

In the current rule, Minn. R. ch. 7050, turbidity is measured in Nephelometric Turbidity Units. The current numeric standards, and the waters to which they apply, are:

- 10 NTU, Class 2A waters
- 25 NTU, Class 2Bd, 2B, 2C waters

The proposed amendments will apply to the same use classes of waters, but will change the basis of the current standard from turbidity as measured in NTU and as applied statewide and year-round, to standards of Total Suspended Solids (TSS) as measured in mg/L, applied on a regional basis and as seasonally applied.

The dataset available and used was limited both in season, April through September, and to rivers and streams. Because little to no data are available from lakes and wetlands, they are not a part of this rulemaking.

The River Nutrient Regions (RNR) noted in the proposed standards include the Northern, Central, and Southern Regions. Concurrent with the development of the proposed TSS WQS is the development of river nutrient WQS (discussed in Book 2). One important component of the river nutrient WQS effort is the development of RNR. Many of the watershed dynamics that contribute to excess nutrients in rivers are very similar to the watershed dynamics that contribute to excess turbidity. As a result, the same statewide mapping schema used for the eutrophication WQS is used for the proposed TSS WQS.

B. General reasonableness.

Replacing the existing Class 2B turbidity WQS, which is expressed in NTUs, to a TSS WQS, expressed by an analytically preferred measure in mg/L, to protect the Class 2 Aquatic Life beneficial use classification (Minn. R. 7050.0140, subp. 3 and 7050.0222), serves multiple purposes:

1. Transitioning from a statewide WQS to regionally appropriate WQS
2. Revising turbidity WQS only marginally based on biotic protection to ones fully derived directly through evaluation of the effect of TSS on organisms sensitive to increasing concentrations of suspended sediments; and
3. Making the WQS directly useful in TMDL load determinations.

Each of these purposes is an improvement on the existing numeric standards and therefore a reasonable revision to the WQS.

The TSS WQS is a water quality parameter that is widely used as a measure of the suspended particles in rivers. It is often used as a measure of the amount of inorganic sediment suspended in water, although it also includes the organic suspended material present in water. As a measure of suspended sediment, TSS concentrations provide an indication of water quality condition for use in evaluating aquatic life use support. Based on the analysis of water quality data from “least impacted” and/or reference streams and rivers in Minnesota, the MPCA is proposing numeric standards for TSS for Minn. R. ch. 7050 for the protection of aquatic life uses. Reference conditions are established through systematic monitoring of actual sites that represent the natural range of variation in "least disturbed" water chemistry, habitat, and biological condition. Reference sites can be used in monitoring programs to establish reasonable expectations for biological, chemistry, and habitat conditions. “Least impacted” sites are recognized as not having water quality potential equivalent to “reference” sites but are relatively the best available in the watershed under study.

The proposed standards are established by a combination of major watershed and aquatic regions to account for differing conditions expected in each area. In addition, the proposed TSS WQS are written to encompass the variable nature of suspended sediment in rivers due to snowmelt and rainfall storm-events. To address this variability, the proposed rules establish TSS concentrations in rivers that are not to exceed basin or regional standards in more than 10 percent of the water samples collected. All the rationale and description of these factors are described in the TSS Technical Support Document (Exhibit TSS -1).

C. Why refer to River Nutrient Regions in the proposed TSS WQS?

The proposed TSS WQS were developed concurrently with the proposed river eutrophication WQS. One important component of the river eutrophication WQS effort is the development of RNR. Many of the watershed dynamics that contribute to excess nutrients in rivers are very similar to the watershed dynamics that contribute to excess TSS. As such, the same statewide mapping schema used for the river eutrophication WQS is proposed for the TSS WQS. The details of the development of the RNR are provided in Book 2. The MPCA considers that it is reasonable to use the same RNR maps for both the eutrophication WQS and the TSS WQS given the related regional factors that affect TSS, and to minimize confusion as to where standards apply.

The MPCA's preferred approach is to use biological data to develop the TSS WQS that protect the aquatic life designated use. When this is not possible, the use of TSS reach datasets from reference streams provides a reasonable alternative. Because biological datasets with comparable TSS were sparse and TSS reach datasets were comparatively more robust, the results were combined. Because of the differences in the types of data and the types of statistical tests used, the overall development of the proposed TSS standards combined the two approaches as a narrative-type Best Professional Judgment and Weight of Evidence approach.

D. What is the biological basis for the proposed Northern, Central, and Southern region and specific river TSS WQS?

For the development of the proposed regional and river-specific TSS WQS, the MPCA has relied on field-collected aquatic community or biological data. The use of field-collected biological data has benefits beyond simple lab dose-response methodology. The advantages of this approach include avoiding artifacts caused by lab experiments and the ability to take advantage of the extensive biological data the MPCA collects to determine biological impairments in Minnesota's surface waters. There are also a number of new statistical tools which make use of field data to allow for more accurate and precise measures of biological thresholds for WQS development. Some disadvantages of using field-collected data include the lack of control of environmental and process variables; these limitations are fully discussed in the TSS TSD (Exhibit TSS -1). The MPCA considers that these disadvantages are not significant in relation to the benefits of using field-collected data.

Quantile regression has also been used by the MPCA as a tool to identify threshold concentrations and to develop the proposed TSS criteria and the proposed eutrophication WQS. Quantile regression is well suited for the wedge-shaped plots (caused by heterogeneous variances; *i.e.*, heteroscedasticity) that are common with biological monitoring data. These wedge-shaped plots are the result of the limitation of biological attributes (*e.g.*, taxa richness) by the variable of interest on the outer or upper edge of the wedge. A more complete discussion of the biological basis for the proposed TSS amendments is contained in the TSS Technical Report (Exhibit TSS -1).

The MPCA has advanced the use of field-collected biological data, in conjunction with the use of quantile regression analysis, to develop the most accurate and reliable methodology for determining the adverse effects of pollutants on aquatic communities and provide a reasonable basis for the proposed TSS standards.

E. What is the TSS chemical data analysis basis for the proposed Northern, Central, and Southern regional TSS WQS?

The MPCA used monitoring data to develop TSS reference levels which were then used in the development of the proposed TSS WQS. The overall approach for this portion of the evaluation is to consider a standard based on TSS levels in "reference" or "least-impacted" Minnesota streams. Because TSS levels vary, even for "least-impacted" streams, depending on factors such as topography, soils, climate, etc., it is reasonable to provide for variability even among the reference waters. This concept of variability is reflected in the proposed TSS standards, which vary across the State according to River Nutrient Regions.

As described fully in the TSS TSD (Exhibit TSS-1), chemical and biological monitoring data from streams across the State were examined, and various measures were used to filter out non-representative (mostly storm-event) data. Of the non-mainstem stream reaches of at least five miles in length, 168 were found to have acceptable, sizeable data sets. (The larger mainstem reaches are unique in character and not suitable for a least-impacted reference stream approach and stream reaches less than five miles in length are often very small or are for other reasons not representative of the more general range of streams). These 168 reaches were then ranked within the three RNR according to mean TSS levels. Stream reaches ranking from the 10^{th} to the 40^{th} percentiles in terms of mean TSS water quality in the South RNR and the 30^{th} to the 50^{th} percentiles in the Central and North RNR were considered to be reference streams. Because streams in the latter two regions are generally less impacted than streams in the South River Nutrient Region, a reference concentration was used that is closer to average existing conditions.

As for the time period over which the 10^{th} percentile, TSS level is measured and is used as a basis of comparison for the reference streams and the streams to be assessed, the MPCA selected the period from April through September. This time period and percentile is applied to all waters, except for the Lower Mississippi River mainstem, which is applied from June through September. The period from April through September is used as the assessment season because:

1. TSS monitoring is generally targeted during this period;
2. The data used to determine reference-stream TSS concentrations are much better quality for this period than they are for the year as a whole; and
3. TSS impacts to aquatic community habitat and organisms are most relevant during this period.

A complete discussion of the development of the data analysis basis for the proposed TSS amendments is contained in the TSS Technical Report (Exhibit TSS -1).

Table 3.1 Biological and Chemical Summaries by Region:

Regional water quality criteria (mg TSS/L)	Reference or least impacted TSS water quality data statistical test recommendations	Fish and invertebrate Index of Biotic Integrity statistical test recommendations	Combined & rounded as appropriate
All Class 2A waters (Trout Streams)		7	10
Northern River Nutrient Region	16	14	15
Central River Nutrient Region	31	24	30
Southern Nutrient Region	60	66	65
Red River mainstem – Headwaters to Border	100		100
For the criteria above, concentration can be exceeded no more than 10 percent of the time. The assessment season is April through September			
Lower Mississippi River mainstem – Pools 2 through 4; this criterion has already been approved by the EPA – it is included here for information purposes		32	32
Lower Mississippi River mainstem – below Lake Pepin to the State line		30	30
For the Lower Mississippi River mainstem criteria above, summer average TSS concentrations must be met in at least one half of the time. The assessment season is June through September			

F. What is the basis for the proposed river-specific TSS WQS for the Lower Mississippi River mainstem and the Red River of the North?

Lower Mississippi River mainstem

The mainstem Mississippi River has been extensively studied for many decades, by the MPCA [http://www.pca.state.mn.us/enzqa08], by the Metropolitan Council through the Long-Term Resource Monitoring Program [http://www.umesc.usgs.gov/reports_publications/ltrmp_rep_list.html], and also by the Upper Mississippi River Conservation Committee [UMRCC] [http://mississippi-river.com/umrcc/]. As a result of these studies, the MPCA has access to a large amount of data regarding the water quality of the Lower Mississippi River on which to base the proposed TSS WQS.

One aspect of the available research addresses the Submersed Aquatic Vegetation (SAV) in the Lower Mississippi River. The SAV is considered the keystone community for ensuring a healthy aquatic community. The SAV are sources of food for waterfowl, serve as substrate for invertebrates and

periphyton, and as habitat for larval and adult fish. SAV also helps stabilize sediments by creating quiescent areas around their stems and leaves. SAV are used by the UMRCC as a measure of ecosystem health.

The stretch of the Lower Mississippi River, from Pool 2 to the mouth of Lake Pepin is considered to be in the Central Region and would normally be subject to the TSS WQS applicable to that region. However, this stretch of the Mississippi is currently impaired and subject to the conditions of a TMDL. (For details on the MPCA south metro Mississippi TMDL TSS Impairment, link to the following MPCA website: http://www.pca.state.mn.us/ktqh98b.) Because the TMDL has established a site-specific standard for TSS for this stretch of river that was approved by the EPA on November 8, 2010, (Exhibit TSS-2), that TSS standard of 32 mg/L, will be listed in Minn. R. ch. 7050 for that reach, instead of the regional TSS standard of 30 mg/L that is being proposed for the remainder of the Central Region. The site-specific modified standard of 32 mg/L, as a summer average, was established on an extensive data set and historical information. The MPCA agrees that for this stretch of the Mississippi, the recommendation of the UMRCC is reasonable. A TSS WQS of 32 mg/L allows for adequate transparency for SAV to reach their target community densities. Another key document used in setting the TSS WQS for this stretch of the Mississippi River mainstem is by Sullivan *et al* (Sullivan et al SAV 2009.pdf) of the Wisconsin Department of Natural Resources.

In regard to the stretch of the Mississippi River mainstem below Lake Pepin, the MPCA has relied on another recent document that relates light penetration to TSS (Giblin *et al*, 2010). They recommended a TSS goal of 30 mg TSS/L to maintain SAV densities below Lake Pepin. That recommendation forms the basis for the reasonableness of the proposed TSS WQS of 30 mg TSS/L as a summer average of the Mississippi below Lake Pepin and also for the rest of the rivers in the Central Region.

The time period and percentile proposed for assessment on the Lower Mississippi River mainstem is related to the water clarity requirements for submersed aquatic vegetation (SAV) that are important plant communities in the Lower Mississippi River mainstem. The south Metro Mississippi River site specific WQS was approved by EPA on November 8, 2010; additional details are described more fully in the TSS TSD (Exhibit TSS-1).

Red River of the North

In establishing a TSS water quality criterion for use as the basis for the proposed numeric standards for the mainstem of the Red River, the MPCA considered some additional factors. The Red River is known for its high concentration of suspended solids. The fine clay and silt lake plain sediments of the region are easily suspended, and tend to stay in suspension even during relatively long low-flow conditions. Red River median concentrations of TSS ranged from 58 mg/L to 342 mgl/L for 2003-2004 (see detailed references in Exhibit TSS-1).

Despite the elevated TSS concentrations that exist within the Red River, fish Index of Biotic Integrity (IBI) scores in the Red River ranged from fair to good (see detailed references in Exhibit TSS-1). (Note: a high IBI score is an indication of a healthy biological community and a low score is indicative of poor water quality.) In spite of the input from a multitude of potential suspended sediment pollution sources, IBI scores did not decrease with increasing distance downstream. Rather, some of the highest scoring sites were located nearest the Canadian border where TSS levels were highest.

With these factors in mind, for the Red River, the MPCA is proposing a TSS standard specific to the reach that begins at the headwaters of the Red River near Breckenridge, Minnesota. This reach of the Red River typically exhibits the lowest TSS concentrations and for this rulemaking will be considered the "least impacted". The 90th percentile TSS concentration for this Assessment Unit Identification was

calculated as 106 mg/L. However, given this dataset being representative of a less impacted, but not reference stream condition, it is reasonable to provide an additional five percent margin of safety, so that 100 mg/L of TSS is being proposed as the TSS WQS for the Red River from the headwaters to the Canadian border. The proposed TSS WQS is written to partially encompass the variable nature of suspended sediment in streams because of snowmelt and rainfall storm events. The proposed WQS for the Red River states that TSS concentrations are not to exceed regional or mainstem criteria more than 10 percent of the time. For the Red River, this means that no more than 10 percent of the TSS values can be greater than 100 mg/l.

G. Need for and reasonableness of amendment to Minn. R. 7053.0205, subp. 9a.

Need

In the course of developing the TSS amendments, MPCA staff became aware of a need to make a clarifying change to Minn. R. 7053.0205, which is the rule that establishes the general requirements that apply to discharges to waters of the State. The clarification is needed because for certain types of facilities it is not appropriate to base the effluent limit on TSS. In those cases, and as discussed more fully in the discussion of reasonableness, the rule must recognize that in the case of wastewater treatment discharges dominated by Volatile Suspended Solids, the concentration of Nonvolatile Suspended Solids in the discharge is a better basis for establishing the effluent limit than the concentration of the discharger's TSS.

Reasonableness

Minn. R. 7053.0205 establishes the requirements for the implementation of the MPCA's effluent limit program. As the proposed TSS amendments were being developed, MPCA staff identified that there are circumstances where it would be necessary for the MPCA to base a Water Quality-Based Effluent Limit (WQBEL) on a discharger's Nonvolatile Suspended Solids concentration instead of the TSS concentrations. Discharges most likely to warrant NVSS WQBEL are municipal or other wastewater discharges dominated by organic matter, or Volatile Suspended Solids.

The MPCA will follow the same process to determine if a discharge needs a WQBEL, regardless of whether a discharge is dominated by VSS (e.g., organic wastewater) or NVSS (e.g., inorganic wastewater). Initially the MPCA will compare the existing TSS permit limit to the receiving water TSS WQS. If the existing permit limit is less restrictive than the TSS WQS for a specific receiving water, the MPCA will conduct further review to determine if the discharge has reasonable potential to cause or contribute to a violation of the WQS. This review will most likely be necessary for continuous discharges to receiving waters with TSS WQS of less than 30 mg/L and for aerated pond or controlled discharges to receiving waters with a TSS WQS less than 45 mg/L.

The type of TSS that adversely impacts aquatic life by clogging gills and filter feeding organs is the mineral or nonvolatile fraction of TSS. Unless excessive, the organic TSS fraction functions as a food source. Therefore, restrictions on effluent NVSS regulates the same type of TSS that are addressed in the TSS WQS.

The requirement that the data be obtained for the same time period that the standard is designed to protect is reasonable in order to reflect the different assessment periods being established in this rulemaking for TSS WQS. The proposed amendments to the TSS WQS assign numeric standards to specific water bodies and specific regions of the State and further, those standards are based on data obtained during a specific season. For waters in many parts of the State, the proposed TSS assessment period is April 1 to September 30. However, for the Lower Mississippi River, the assessment season is

shorter, June 1 to September 30. (The reasonableness of the differences between the assessment periods is discussed in Exhibit TSS-1.) It is reasonable that the requirements for establishing WQBEL reflect the differences that exist in the actual standards. By providing that the WQBEL will be determined based on data obtained during the same time period as the TSS WQS, the proposed amendment to Minn. R. 7053.0205, subp. 9a will provide a mechanism for the development of a TSS WQBEL that is consistent with the standard.

The proposed amendment further clarifies that this seasonal process of establishing TSS WQBEL will eliminate the need for establishing daily, weekly, or monthly WQBEL. It is reasonable to clarify that in lieu of the standard practice of establishing a WQBEL for a particular short time period, in the cases identified in the proposed amendments, a WQBEL based on the 90th percentile NVSS concentration taken over several months will instead be applied.

4. Specific Rulemaking Activities Relating to the TSS WQS

A. Public participation

Minn. Stat. §§ 14.22, 14.131 and 14.23 all relate to the need to notify the public of Agency rulemaking efforts. These statutes require the MPCA to include in its SONAR a description of its efforts to provide additional notification to persons or classes of persons who may be affected by the proposed rule, or the MPCA must explain why these efforts were not made. Minn. Stat. § 14.22 specifically states:

> *"….each agency shall make reasonable efforts to notify persons or classes of persons who may be significantly affected by the rule by giving notice of its intention in newsletters, newspapers, or other publications, or through other means of communication."*

SONAR Book 1 provides a discussion on the many formal and informal opportunities the MPCA has held to receive comment on all of the amendments being proposed in this rulemaking. By those efforts the MPCA has met the statutory requirements in its efforts to involve the public in this rulemaking. The MPCA's intent to remove the turbidity WQS and replace them with TSS have been part of those general public participation efforts. The MPCA has not conducted additional public notification activities specifically in regard to the proposed amendments to the TSS WQS.

B. Comments received

The MPCA received a number of comments in response to the publication of Requests for Comment regarding the proposed amendments. A discussion of the general comments received is provided in Book 1.

Several individuals and organizations (Exhibits A-6, A-10, A-11/A-21, A-27, and A-31) submitted comments recommending that the MPCA amend the TSS WQS to reflect regional variations and that the TSS WQS account for seasonality. None of the commenters provided specific data for the MPCA to consider in making the suggested improvements to the WQS for turbidity. The MPCA agreed with those comments and the proposed amendments include those factors explicitly, by having River Nutrient Regions, by utilizing seasonal WQS, and by considering more than one year of seasonal TSS monitoring data to account for year to year variability.

In addition to the formal requests for comments, the MPCA has posted a draft TSS TSD on the *Proposed Water Quality Standards Rule Revisions: 2008-2012 Triennial Water Quality Rule Review* webpage since November 2010, to informally solicit comments on the draft WQS (available at http://www.pca.state.mn.us/qzqh5e3) and received no substantial data from this posting either.

C. Comparison to other state standards

Minn. Stat. § 116.07, subd. 2 (f) requires:

> *(f) in any rulemaking proceeding under chapter 14 to adopt… standards for water quality under chapter 115, the statement of need and reasonableness must include:*
>
> *(1) an assessment of any differences between the proposed rule and:*
>
> *(i) existing federal standards adopted under the …Clean Water Act, United States Code, title 33, sections 1312 (a) and 1313(c)(4);…;*
>
> *(ii) similar standards in states bordering Minnesota; and*
>
> *(iii) similar standards in states within the Environmental Protection Agency Region 5; and*
>
> *(2) a specific analysis of the need and reasonableness of each difference.*

There are no other federal TSS WQS or EPA national 304(a) Ambient Water Quality Criterion. A discussion of how states are expected to promulgate state-specific standards is provided in part 5, section A. (7).

For this rulemaking the MPCA contacted other states in EPA Region V and also states that border Minnesota to determine whether those states have adopted TSS standards and how those standards compare to the standards Minnesota is proposing. The MPCA surveyed the following states and tribes:

- EPA Region V states: Wisconsin, Michigan, Illinois, Indiana, and Ohio
- Neighboring states: Iowa and North and South Dakota
- Tribes: Fond du Lac, Grand Portage

The results of this benchmarking process revealed that, except for South Dakota, no states or tribes in this region have a TSS Water Quality Standard. A summary of the review is provided below:

Table 3.2 Survey of Other Standards

State	Standard	Comments
Illinois	No numeric turbidity or TSS WQS	
Indiana	No numeric turbidity or TSS WQS	
Iowa	No numeric turbidity or TSS WQS	
Michigan	No numeric turbidity or TSS WQS	
North Dakota	No numeric turbidity or TSS WQS	
Ohio	No numeric turbidity or TSS WQS	
Wisconsin	No numeric turbidity or TSS WQS	
Fond du Lac Band	No numeric turbidity or TSS WQS	
Grand Portage Band	No numeric turbidity or TSS WQS	
South Dakota		
	Coldwater permanent fish life propagation waters	≤ 30 mg/L (30-day average) ≤65 mg/L (daily maximum)
	Coldwater marginal fish life propagation waters; and Warmwater permanent fish life propagation waters; and Warmwater semi-permanent fish life propagation waters	≤90 mg/L (30-day average) ≤158 mg/L (daily maximum)
	Warmwater marginal fish life propagation waters	≤150 mg/L (30-day average) ≤263 mg/L (daily maximum)

The proposed TSS WQS provide a reasonable mechanism for addressing TSS, and are more comparable to South Dakota's standards than Minnesota's current turbidity standards. Like South Dakota's standards, Minnesota is proposing addressing turbidity through TSS and implementing seasonal averaging-times. Therefore, reliance on longer term averages is a more accurate approach for protecting aquatic life, while accounting for natural variability of TSS.

5. Statutorily Required Information and Discussion of Economic Effect

A. Discussion of the Minn. Stat. ch. 14 SONAR requirements relative to the TSS standards

Minn. Stat. § 14.131 requires that the SONAR contain information about the following specific aspects of the proposed amendments. These statutory questions are addressed at two points in this SONAR. A general discussion of these statutory questions in relation to all of the amendments being proposed

through this rulemaking is provided in Book 1. The discussion below provides additional detail specific to the proposed TSS WQS.

(1) Description of the classes of person who probably will be affected by the proposed rule, including classes that will bear the costs of the proposed rule and classes that will benefit from the proposed rule.

The classes of persons who will bear the costs of the TSS standards are generally the same as the persons who will bear the costs of the river eutrophication standards discussed in Book 2. The sources of TSS and eutrophication impairments are similar, coming from both nonpoint sources, such as is contained in stormwater flows, and from point sources from municipal and industrial facilities. It is important to note that the Clean Water Act carries no regulatory authority for nonpoint sources of pollution and therefore, actions taken to reduce the impacts from nonpoint sources are voluntary.

The classes of persons who will benefit from the TSS standards are the same as those who will benefit from adoption of all the standards that are being proposed as part of this rulemaking. Those are the persons who have an interest in the quality of Minnesota's waters, either from a personal, recreational or commercial perspective. A more complete discussion of the benefits of having clear and effective WQS, and their relationship to TMDLs and the benefits associated with the quality of Minnesota's waters is provided in Books 1 and 2.

(2) The probable costs to the agency and to any other agency of the implementation and enforcement of the proposed rule and any anticipated effect on state revenues.

The MPCA incurs costs in the implementation and enforcement of WQS by monitoring waters, developing TMDLs, and issuing permits. The MPCA's costs relating to implementing and enforcing the existing turbidity standard are primarily in the area of TMDL development. The MPCA expects the cost of TMDL development under the proposed rule to be similar to the cost of TMDL development under the existing turbidity standard, with one exception. The MPCA estimates that the proposed TSS WQS will create a slight increase in the number of newly impaired waters that are listed.

The draft 2012 TMDL list of impaired waters contains 512 new listings, including 14 that are impaired for turbidity, using the existing NTU WQS. In order to assess the probable costs of transitioning from the NTU WQS to the TSS WQS, MPCA staff conducted an informal review using the same turbidity data but using the proposed TSS criteria. The MPCA's assessment process has two steps: a pre-assessment computer-generated determination followed by a final determination that reviews the amount of data, the quality of the data, any potential stormwater collection bias, use of multiple lines of evidence, and any biological data that could be of contextual value.

The "pre-assessment determination" found that application of the proposed TSS WQS would result in no more than six possible new TSS impairment listings, all in the North region. That would be an increase of about one percent (6, or less, added to 512). Based on this review of the listing process for TSS impairments, the MPCA anticipates only minor additional TMDL development costs to the MPCA or any other agency associated with the proposed TSS WQS.

The MPCA does not expect that any other agencies will incur costs as a result of the adoption of the TSS standards. Although other agencies and local governments, such as the Board of Water and Soil Resources, watershed districts and lake associations, have a role in the development and implementation of TMDL, the MPCA is the lead agency in TMDL development. The MPCA expects that other affected agencies will similarly manage the possible 1 percent increase in the number of listings through prioritization of existing resources.

The small number of possible additional listings will be managed at the MPCA and other agencies with current staff and budget.

(3) A determination of whether there are less costly methods or less intrusive methods for achieving the purpose of the proposed rule.

The purpose of the proposed rule is to replace the existing turbidity WQS with better, scientifically based TSS WQS. The MPCA did not find any less costly or less intrusive methods that would achieve that purpose.

(4) A description of any alternative methods for achieving the purpose of the proposed rule that were seriously considered by the agency and the reasons why they were rejected in favor of the proposed rule.

The application of WQS is fundamental to the existing program for the protection of Minnesota's water quality. Because there is currently a turbidity WQS, and the amendments are simply an improvement on that existing standard, in this rulemaking the MPCA did not consider the development of an alternative to the use of WQS. The development of an alternative system for the protection of waters would have been far outside of the scope and intent of this rulemaking.

(5) The probable costs of complying with the proposed rule, including the portion of the total costs that will be borne by identifiable categories of affected parties, such as separate classes of governmental units, businesses, or individuals.

A more complete economic review of the effect of the proposed amendments is provided in part B of this section. Costs may be incurred relating to wastewater treatment by permitted dischargers and also in the area of increased impairments. The MPCA does not expect that the amendments to the existing turbidity standards will impose additional costs on most of the regulated community above the costs that are already associated with the existing turbidity standard. However, a few dischargers may incur significant additional treatment costs and a more complete discussion of those effects is provided in part B.

In regard to increased impairments, Minn. R. ch. 7050 already establishes a turbidity standard and this current standard is used in the determination of impaired waters. Although there are costs to State agencies associated with impaired waters, as discussed in (2) above, the number of impaired waters is not expected to significantly increase as a result of the amendments that are being proposed to the TSS WQS.

(6) The probable costs or consequences of not adopting the proposed rule, including those costs or consequences borne by identifiable categories of affected parties, such as separate classes of government units, businesses, or individuals.

The cost of not adopting the proposed amendments will not represent either a significant savings or expense to the regulated community or to the MPCA.

(7) An assessment of any differences between the proposed rule and existing federal regulations and a specific analysis of the need for and reasonableness of each difference.

Federal regulations do not establish specific TSS WQS. However, the fact that there are no federal TSS standards does not mean that there is an inconsistency between the State and federal water protection programs or that the adoption of a State TSS WQS is inconsistent with federal intentions for the State implementation of the CWA requirements. Section 304 of the Clean Water Act requires EPA to develop

guidance and criteria for water pollutants which will then be implemented by states in order to meet the goals of the CWA. The nature of the relationship between the role of EPA and the mandate to states to develop state-specific WQS ensures that there will be differences between proposed state rules and federal regulations but that those differences are necessary and intentional. The MPCA has established in this Book that the proposed TSS standards are needed and reasonable to address the conditions and needs specific to Minnesota and that they meet the federal expectation for states to adopt state-specific WQS. A more detailed discussion of the specific differences between the proposed TSS standards and the standards that are in effect federally and in neighboring states is provided in part 4 C. of this Book.

(8) The statement must describe how the agency, in developing the rules, considered and implemented the legislative policy supporting performance-based regulatory systems set forth in Minn. Stat. § 14.002.

Minn. Stat. § 14.002 requires State agencies, whenever feasible, to develop rules that are not overly prescriptive and inflexible, and rules that emphasize achievement of the MPCA's regulatory objectives while allowing maximum flexibility to regulated parties and to the MPCA in meeting those goals.

The proposed TSS WQS are "prescriptive" as are all numeric standards. However, because river standards are unique in several respects, greater flexibility is built into the proposed standards than into most numeric standards. Separate TSS standards are being proposed for three River Nutrient Regions, Mississippi River navigational pools and for Lake Pepin. This was done to accommodate the regional patterns, uses, and varying impact of TSS on these resources. The MPCA considers that by adapting the WQS to consider specific regional variations, the TSS WQS are as "performance-based" as a numeric standard can reasonably be.

(9) Determination regarding whether the cost of complying with the proposed rule in the first year after the rule takes effect will exceed $25,000.

Minn. Stat. § 14.127 requires an agency to:

> *"determine if the cost of complying with a proposed rule in the first year after the rule takes effect will exceed $25,000 for any one business that has less than 50 full-time employees, or any one statutory or home rule charter city that has less than ten full-time employees."*

The MPCA does not expect that the costs of implementing the proposed changes will exceed $25,000 for any small city or small business in the first year after adoption. The MPCA's complete discussion of this determination in relation to all of the proposed amendments, including the proposed TSS WQS, is provided in Book 1.

B. Economic review of the TSS standards

Introduction

The MPCA's discussion of the benefits resulting from the adoption of WQS in general is discussed in Book 1 under the general discussion of the proposed amendments. The MPCA's detailed discussion of the economic effect of the proposed TSS standards, specifically the costs associated with them is provided below.

The discussion is divided according to the type of discharge that will be affected by the proposed standards. Nonpoint (unregulated) discharges are those discharges that are not associated with a distinct outfall or source. For this consideration of costs, nonpoint sources are discharges of pollutants from agricultural and un-regulated urban stormwater sources. The second area of discussion is the

economic effect on point sources of pollutant discharge. These are the permitted municipal and industrial wastewater dischargers as well as permitted stormwater discharges from industrial, construction, and municipal activities.

The MPCA considers that the proposed amendments that eliminate the use of the turbidity WQS and replace it with regional-specific TSS WQS will result in relatively small additional costs statewide, although a few affected parties could have large additional costs. For some regulated parties, the proposed TSS WQS will not represent an increase in costs because, under Minnesota's existing turbidity standard, they are already conducting monitoring to address the issue of suspended solids. In addition, the process of identifying impaired waters currently includes assessments based on water turbidity and the change from a turbidity WQS to a TSS WQS will not represent a significantly new perspective on the assessment of water quality. The MPCA expects that in most cases, the costs of monitoring and TMDL implementation will continue to approximately the same extent with the adoption of the proposed TSS WQS. There are costs associated with protecting water clarity regardless of whether the WQS being applied is turbidity or TSS. The MPCA believes that depending on the circumstances, there will be cases where the proposed amendments will result in either a more stringent or less stringent application of the WQS than would have existed under the current turbidity WQS.

For purposes of this SONAR, the MPCA has conducted an assessment of the costs associated with the implementation of a standard to protect water clarity. The costs identified in this discussion are general and are equally applicable to the costs of the current turbidity standard as well as the proposed TSS WQS.

Economic Impact to Unregulated Sources of Pollutants

The proposed TSS WQS will not have a direct economic effect on agricultural producers or municipalities with unregulated stormwater because, as unregulated sources, there is no permit that imposes conditions that incur costs. However, in some situations, such as cropland in sensitive areas or in areas of impairment, an entity may be encouraged to implement voluntary Best Management Practices (BMPs) which may result in an economic impact.

Agricultural producers in impaired watershed, specifically those with cropland in sensitive areas near surface waters or with connections to surface waters, may be encouraged to implement BMPs. BMPs seek to minimize the transport of soil to surface waters. Similarly, municipalities with unregulated stormwater in impaired watersheds may also be encouraged to implement BMP's to minimize the amount of runoff from impervious surfaces, encourage infiltration, and reduce the transport of soil to surface waters. The MPCA provides extensive guidance on urban BMP's and for BMPs in impaired watersheds that will reduce the costs to participants. Cost-share dollars may be available to promote adoption of the BMP's and minimize their economic impact.

Costs to the MPCA and Other Entities Associated with Promulgation of Proposed Standards

Implementation of the proposed TSS WQS would require the support of MPCA monitoring, assessment, effluent limit setting, permitting, and compliance/enforcement activities, as well as TMDL program support to address waters that do not attain the proposed standards. However, because the proposed TSS standards are not a new standard, but are a transition from the existing turbidity standard, which currently requires support of all of the above identified program elements, there should be no additional cost to the MPCA.

For this same reason, the MPCA does not expect that other entities or organizations that assess or monitor Minnesota's rivers and streams, e.g., watershed districts or water management organizations, will encounter additional laboratory costs associated with collecting data to assess compliance with the new WQS.

Costs to Regulated Sources

Overview

The Agency is transitioning from a turbidity WQS, expressed as mass-less NTU, to a total suspended solids WQS, expressed as mg TSS/L. TSS has dual components – Volatile Suspended Solids (VSS) and Nonvolatile Suspended Solids (NVSS).

The VSS component is organic in nature; its deleterious impact in rivers is to lessen the available dissolved oxygen. In Wastewater Treatment Facilities (WWTF), organics removal is a required element. The organic component of TSS is already subject to effluent limits controlling all aspects of organics in wastewater, usually expressed in terms of biochemical oxygen demand limitations. WWTFs reduce organic solids concentrations through the use of bacterial respiration.

The NVSS component is the inorganic fraction of the TSS concentration. The NVSS component has different deleterious actions than the VSS component – the NVSS impacts include smothering of eggs, gill abrasion, and other physical impacts described in the TSS Technical Support Document (Exhibit TSS-1).

NVSS is not amenable to breakdown by bacterial respiration; WWTF use a different approach to reducing the NVSS in wastewater. Settling is the most common approach, through the use of clarifiers. Coagulants and filtration can also be used for additional reduction.

Anticipating the transition from an NTU WQS to a TSS WQS, MPCA staff explored the different aspects connecting WQS and effluent limit setting and developed an assessment and recommendation paper and follow-up MPCA staff e-mail (Exhibit TSS-6 and Exhibit TSS-7).

Exhibit TSS-6 makes the following recommendations:

- *Consistent with the literature supporting the proposed TSS criteria, and the predominately organic nature of Wastewater Treatment Facility TSS, it is recommended that the proposed TSS criteria should be implemented into municipal and industrial wastewater permits as NVSS effluent limits.*

- *It is also recommended that NVSS effluent limits should only apply during the same part of the year that the proposed TSS criterion is active, April through September. To conform with how the TSS Water Quality Standard will be applied, a NVSS effluent limit should be the average effluent NVSS concentration for the six month TSS season. It should not be applied as a monthly effluent limit.*

- *It is further recommended that NVSS effluent limits should be included in permits for Wastewater Treatment Facilities that showed a reasonable potential to cause or contribute to a violation of the proposed TSS criteria.*

Exhibit TSS-6 notes that there are three criteria in the proposed TSS WQS that could result in increased costs to Wastewater Treatment Facilities: the Central River Nutrient Region with its 30 mg/L TSS value, the Northern River Nutrient Region with 15 mg/L, and trout streams with a 10 mg/L TSS concentration.

The highest monthly average TSS effluent limitation included in wastewater discharge permits is 45 mg/L. This limit is assigned to controlled discharges (aerated ponds and stabilization ponds) and takes into account the algae levels inherent in those discharges. TSS effluent limitations of 30 mg/L are assigned to continuous discharges of treated sewage and industrial wastes. For enforcement purposes, these discharge limits are expected to be met consistently. "Consistently" means a value that is met about 95 percent of the time.

Using the 30 percent NVSS consistency per the stabilization pond survey noted in Exhibit TSS-6, the amount of NVSS in the effluent from a facility with a 45 mg/L TSS effluent limit would be less than 13.5 mg/L (45 times 30 percent). The corresponding NVSS value for controlled dischargers with a 30 mg/L TSS effluent limit would be about 9 mg/L.

If the proposed TSS criteria are considered as NVSS for effluent limitation purposes, then the only remaining municipal wastewater treatment dischargers of concern are those that discharge to trout streams.

No facilities will need to do anything in order to meet the new TSS WQS of 30 (for the Central RNR) and 15 (for the Northern RNR). Because 10 NTU is equivalent to 10 mg TSS/L, no new additional costs associated with the transition to the TSS WQS will be incurred to dischargers to trout streams (Class 2A). Discharge data from industrial facilities, shown in Table 2 in Exhibit TSS-6, show that six out of fourteen industrial Wastewater Treatment Facilities would have a problem consistently meeting a 10 mg/L NVSS limit.

Subsequent to the recommendations contained in Tables 1 and 2 in Exhibit TSS-6, an MPCA internal e-mail (Exhibit TSS-7) further refined which industrial facilities would be potentially exposed to additional costs through the transition from an NTU WQS to a TSS WQS. After further analysis, MPCA staff concluded the economic review would be limited to four municipal treatment plants and four industrial discharges, based on actual Discharge Monitoring Report performance (Exhibit TSS-7).

In Exhibit TSS-6, TSS and NVSS Data for Minnesota Rivers and Streams were assessed, and information on the relationships between TSS, (NVSS), and (VSS) was explored. A summary of these relationships is presented here:

> The proportion of organic (VSS) and inorganic (NVSS) suspended solids in the water column varies throughout the year (Table A from the Attachment). There is little change in the proportions during the high flow months of April through June, while the inorganic fraction slightly decreases in the last half of the total suspended solids (TSS) season. During the high stream flow months of April through June, more inert soil particles are washed into the stream. During the TSS season's last three months, flows decline. When stream flows decline, fewer inert soil particles are washed into the receiving water; therefore the fraction of inorganic component decreases, while the organic fraction increases.
>
> An examination of U.S. Geological Survey flow recording sites was done to select the months in the proposed TSS criteria's season that typically have the greatest stream flow and the least flow. About 84 percent of the time, April had the greatest flow while May had the greatest flow 16 percent of the time. About 69 percent of the time September was the month with the least flow followed by August at 31 percent.

A set of plots in the Attachment showed the relationships between TSS, Nonvolatile, and Volatile Suspended Solids. April and September were plotted, since they represent the months with the highest and lowest amount of surface runoff.

These TSS versus NVSS plots illustrate the extremely strong correlation between TSS and NVSS in streams. An overall Pearson Product Moment Correlation Coefficient of over 0.99 for all six months of the TSS season confirms this strong relationship. As the concentration of TSS in the stream increases, the concentration of NVSS or inert solids increases proportionally.

This contrasts with the TSS versus VSS relationship. These plots show a relatively fixed relationship between TSS and VSS. The very strong positive correlation between TSS and NVSS has been replaced with a weak relationship, when VSS is considered. As the TSS concentrations increase, the VSS concentrations increase at such a low rate that it is almost stable. If a stream has a problem with high TSS values, controlling VSS will not improve the problem.

Table B from the Attachment in Exhibit TSS-6 shows the same basic trend that Table A did. As the amount of TSS in the stream increases, so does the NVSS fraction. This is to be expected, since the times of highest TSS levels would likely occur when stream flows and erosion are also highest. The NVSS percentage of TSS declines during times of low TSS levels and likely low flow in the stream. Conversely the organic fraction increases when the TSS is lower.

This examination confirms that, when water quality TSS problems occur, the high TSS concentrations are not the result of high VSS levels, but rather high nonvolatile (i.e. soil erosion) levels.

Taken as a whole the MPCA staff review of TSS (Exhibit TSS-6, and Exhibit TSS-7) demonstrates that the main impact from TSS discharges is the inorganic portion and not the organic portion, since treatment facilities are already designed to keep the organic discharge at permit levels. Treatment facilities are also designed to handle solids but there may be additional costs to handle solids at more restrictive permit limits associated with the stricter WQS in the northern region.

Costs to Municipal Dischargers

MPCA Municipal staff, in an Office Memorandum dated October 11, 2012, developed the cost estimates for municipal facilities to meet and monitor the proposed TSS WQS (TSS-4). In this memorandum, the review is separated into the same large-scale Regions the TSS WQS are divided into, as follows: Class 2A waters (Trout waters), Northern Region, and Central Region. Because the Southern Region TSS WQS are very slightly relaxed from the existing turbidity WQS, no additional costs are expected to be incurred by dischargers in the Southern Region as a result of the transition from turbidity to TSS and no further economic impact discussion is provided.

In Class 2A waters, using the MPCA staff review of TSS (Exhibit TSS-6) for applying the proposed TSS WQS as effluent limits, MPCA Municipal staff determined there were no municipal facilities expected to incur additional capital costs because of the transition from NTU to TSS WQS. However, staff found that the 13 WWTF that discharge to Class 2A waters would incur an additional monitoring cost of approximately $5,370 per year, an average of approximately $400 per year per facility. Note that additional monitoring costs were not discussed in Exhibit TSS-6.

In the Northern Region, MPCA Municipal staff determined that one WWTF would incur the capital cost of approximately $48,300 and an increase in the Operation and Maintenance (O&M) cost of approximately $5,160 annually in order to implement the proposed TSS WQS. For the other 49 WWTF in the Northern Region, the additional monitoring costs that would result from the adoption of the

proposed TSS standard totaled approximately $21,000 per year for 49 facilities, or an average of approximately $430 per year per facility. There are no anticipated additional O&M costs in the Central and Southern Regions.

Costs to Industrial Dischargers

MPCA Industrial staff, in a final Office Memorandum dated September 27, 2012, developed the cost estimates for industrial facilities to meet the draft TSS WQS (Exhibit TSS-5). This memorandum separated the economic review into the same large-scale Regions the TSS WQS are divided into, as follows: Class 2A waters (Trout waters), Northern Region, and Central Region. Because the Southern Region TSS WQS are very slightly relaxed from the existing turbidity WQS, no additional costs are expected to be incurred by dischargers in the Southern Region as a result of the transition from turbidity to TSS and no further economic impact discussion is provided.

In addition, the MPCA does not anticipate that any industrial facilities in the Central Region or that discharge to trout waters (Class 2A) will be economically affected by the proposed transition from the NTU WQS to the TSS WQS because their monitoring data demonstrate that they are currently meeting the proposed standards.

Cost Estimate Limitations

Because this analysis did not include a “ground truth” study to determine individual site specific conditions, it is impossible to know with complete certainty what future costs to industrial point sources might be with the adoption of a new water quality criteria for TSS. Factors that may affect the actual costs of the proposed amendments to a specific industrial facility include the following:

1. Adequacy of existing facilities
2. Outdated and worn out structures and equipment
3. Existing site constraints (available space in the existing plant footprint)
4. Additional land requirements
5. “At-grade” or subgrade deficiencies needing correction for future improvements
6. Interim treatment requirements/facilities during construction

Component costs not included/considered during this planning level analysis include expanded roadways, retaining walls and flood walls, power feeder systems and substations, expanded/upgraded control systems, associated control system infrastructure and transfer pumping, piping and appurtenances etc.

MPCA staff compiled cost estimates to reduce TSS from industrial facilities by the following: (1) search of national public domain literature on estimating costs for TSS removal at various WWTPs; (2) information collected from suppliers and consultants on WWTPs that have completed construction of TSS removal facilities, and (3) information collected from suppliers and consultants on prepared cost estimates for contemplated future TSS removal-related construction projects.

In making the estimates of the cost to meet the revised TSS effluent limitation, the MPCA assumed that all treatment plants that would be subject to more stringent TSS standards would add treatment units to the end of their existing Wastewater Treatment Facilities. The nature of the expected additional treatment is discussed below.

In the Northern Region MPCA Industrial staff, using the MPCA staff review of TSS (Exhibit TSS-6 and Exhibit TSS-7) for applying the proposed TSS WQS as effluent limits, found three facilities in this region

potentially could incur added costs. In one facility, chemical addition and enhanced precipitation (with flocculation and settling) would be required. The estimated additional capital costs of adding this type of treatment varied between $400,000 and $1,000,000 and the estimated additional annual operational expenses ranges between $100,000 and $200,000.

In the second facility, a significant amount of additional treatment might be required, as only sedimentation basins are used at this time. Typically, the organic fraction of the effluent from this type of facility dissipates rapidly downstream from the discharge and additional costs should not be incurred. If downstream monitoring demonstrates that TSS WQS cannot be met, the facility would have to add pH adjustment/settling, filtration, and sludge thickening and dewatering equipment. The estimated additional capital costs could be as high as $5,000,000 and the estimated annual operational expenses could be as high as $600,000.

In the third facility, it is very unlikely that any additional costs will be incurred as a result of the proposed TSS WQS. In this facility's effluent, the calendar month average TSS concentrations range between 18 and 36 mg TSS/L. The proposed WQS for this facility is 15 mg TSS/L. However, there is a minimum dilution ratio of receiving water to effluent of at least 84:1, so the MPCA does not expect the proposed TSS WQS to be exceeded.

Municipal, Construction, and Industrial Stormwater (NPDES permits)

The MPCA administers three types of National Pollutant Discharge Elimination System/State Disposal System permits for stormwater: municipal, industrial, and construction. Most permits issued are general permits, with a few issued as individual permits (e.g., Minneapolis and St. Paul municipal permits). The foundation of stormwater permits is BMPs, implemented using different approaches from Maximum Extent Practicable and Stormwater Pollution Prevention Plans for municipal to no exposure and adaptive management controls for industrial.

Limiting soil and particulate matter discharges that increase turbidity and transport other pollutants is a key foundation of the Stormwater Programs and the basis for many BMPs. The revision of the current turbidity standards (10 and 25 NTU) to total suspended solids (TSS) will have minimal impacts on the costs related to the current stormwater general permits or on individual permit holders. Similar to any NPDES permit, stormwater permits are also reviewed and modified as needed every five years. The following analysis of costs and benefits centers on the costs related to current permits. (Estimating future costs with changes in these permits would be permit-specific and information is not fully available at this time to make a specific analysis on future costs.) However, based on current permit approaches, the MPCA expects few affected permittees will see increased costs when implementing the proposed TSS WQS for the following reasons:

- Erosion control measures are already main components of the permits and required BMPs.
- Stormwater is primarily managed to meet WQS through different levels of BMPs and not through extensive monitoring and effluent limits like Wastewater Treatment Facilities.
- A small percentage of Industrial Stormwater permittees have effluent limits for TSS. However, in most cases, the current effluent limits are close to those that will be needed to meet the proposed TSS WQS. For those permittees that have permits with effluent limits that are less stringent than the proposed TSS standards, costs may be incurred with the development and application of Water Quality Based Effluent Limits. The extent and cost of those changes will be based on the receiving water use classification and other permit conditions.

- The TSS effluent limit benchmark value used in Industrial Stormwater permits of 100 mg/L is already in place. For Outstanding Resource Value Waters and other special waters with restricted discharges, a more stringent TSS benchmark of 65 mg/L is applied. A few sectors have TSS effluent limits that are even more stringent. Based on compliance with these effluent limits, the MPCA does not expect any exceedences of the proposed TSS WQS for those dischargers.
- The proposed TSS WQS are seasonal and fit with current approaches for turbidity management. For instance, BMPs for construction stormwater permits may allow for brief, temporary excursions from the BMP requirements, because compliance is designed to meet longer-term water quality objectives (load limits) and standards. Therefore, increases in average seasonal excursions would already mean a violation of the permit conditions.
- Another possible outcome of adopting the proposed TSS WQS is increased impaired waters listings and TMDLs. If a receiving water is listed as impaired for a pollutant regulated under stormwater permits, more comprehensive BMPs are triggered for industrial stormwater permittees, as well as, a shorter time to implement. However, the proposed TSS WQS are not expected to significantly increase the number of waters listed as impaired or subsequent costs to these permittees.

6. Conclusion

The proposed TSS WQS that transition the existing rules from a massless NTU WQS to a concentration-based mg TSS/L standard are needed to address an environmental concern for aquatic life, to provide a scientific basis for the standards, and to meet EPA's expectations for addressing this aspect of water quality regulation. In the 2010 impaired waters listing cycle, from a national perspective, EPA estimates about 12 percent of all impairment miles are connected to excess sediments and turbidity.

The proposed amendments are reasonable for several reasons. The proposed rules are biologically and regionally based, and provide a time component to address long-term effects. The proposed TSS WQS will also enhance TMDL implementation.

The biologic and chemical data used were from hundreds of MPCA biological monitoring sites. These data provided the basis for applying appropriate statistical procedures that allow for identification of criteria that will be protective of aquatic life uses. The approach is based on a combination of statistical analyses, literature review, and the recognition of regional patterns in chemistry and biologic attributes that all contributed to the proposed WQS. The proposed standards are broken out by three River Nutrient Regions that are based broadly on aggregated Level 3 ecoregions.

Based on the foregoing, the proposed Total Suspended Solids WQS are both needed and reasonable.

7. Exhibit List

TSS-1 Aquatic Life Water Quality Standards Draft Technical Support Document for Total Suspended Solids (Turbidity). H. D. Markus, Ph.D. Revised Draft, May 2011

TSS-2 Letter from EPA, Miss River TSS Approval letter.pdf, November 8, 2010

TSS-3 Giblin et al. Evaluation of Light Penetration on Navigation Pools 8 and 13 of the Upper Mississippi River. 2010

TSS-4 R. Thorson, Final cost estimates for municipal facilities to meet and monitor for the final draft Total Suspended Solids (TSS) {Turbidity} criteria, 2012. MPCA

TSS-5 S. Knowles, Final cost estimates for industrial facilities to meet and monitor for the final draft Total Suspended Solids (TSS) {Turbidity} criteria, 2012. MPCA

TSS-6 G. Rott, Recommendations on how to apply the proposed TSS Water Quality Standard as an effluent limit, 2011. MPCA

TSS-7 G. Rott, Possible problem dischargers for the proposed TSS Water Quality Standards, e-mail dated June 1, 2012; forward from Scott Knowles on October 16, 2012