



Environmental Quality Board

**Tools to Assist Local Governments
in
Planning for and Regulating
Silica Sand Projects**

March 7, 2014

Minnesota Environmental Quality Board

The Environmental Quality Board (EQB) brings together leaders of nine state agencies, five citizens, and a representative of the Governor. The Board reviews interagency issues that affect Minnesota's environment, advises policymakers, and creates long-range plans. Strategic planning and coordination activities are important EQB functions. Minnesota Statutes direct the EQB to:

- Study environmental issues of interdepartmental concern
- Coordinate programs that are interdepartmental in nature and affect the environment
- Ensure compliance with state environmental policy
- Oversee the environmental review program
- Develop the state water plan and coordinate state water activities
- Convene environmental congresses
- Develop energy and environment reports
- Advise the Governor and the Legislature

Acknowledgements

Tools to Assist Local Governments in Planning for and Regulating Silica Sand Projects was prepared with assistance from several state agencies, including:

Department of Natural Resources
Pollution Control Agency
Department of Health
Department of Transportation
Department of Agriculture
Environmental Quality Board



Environmental Quality Board

520 Lafayette Road North
Saint Paul, MN 55155-4194
651-757-2873

www.eqb.state.mn.us

This report is available online at www.eqb.state.mn.us and is available in alternative formats upon request.

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I. INTRODUCTION

A. BACKGROUND

In May 2013 the Minnesota Legislature adopted Laws 2013, chapter 114, now codified in Minnesota Statutes chapter 116C. Minnesota Statute 116C.99, subdivision 2 requires the Environmental Quality Board (EQB) to develop model standards and criteria that may be used by local units of government in developing local ordinances regarding the mining, processing, and transporting of silica sand. This *Tools to Assist Local Governments* document fulfills this legislative requirement.

This document is organized by topic: air, water, transportation, operations, and setbacks. Each topic section or subsection discusses potential impacts from silica sand activities. Considerations for addressing potential impacts are discussed and then suggestions are provided on how to address the impacts.

This document is essentially a box of tools available for consideration by local governmental units (LGUs). In some situations, several tools may be chosen and used in conjunction with other tools in order to address a particular concern. The toolbox also includes instructions on how to use the tools themselves. As with any box of tools, the user should decide what is to be built before selecting a tool. Not all tools are appropriate for a given situation and, like any tool, each one should be used properly. The EQB acknowledges these are not the only tools available to local governments.

The statute highlights two regions of the state: the Minnesota River Valley and southeastern Minnesota. These two regions are the areas most likely to experience the greatest effects of silica sand operations because they are where most of the sand exists. However, the toolbox can be applied to other areas of the state. An LGU could compare its own circumstances to the geology, hydrology, and other characteristics discussed in this document and use the appropriate tools.

Authority to plan for and regulate land use activities rests primarily with local government. Enabling statutes grant the authority for planning and zoning for counties, cities, and townships: Minnesota Statutes 394, 462, and 366, respectively. The EQB supports good local planning that articulates the future vision of a community. This should be supported with the adoption of sound local ordinances as the means to implement the planning. This document provides information intended to be useful to LGUs when discussing issues related to silica sand and considering how to address those issues. The information, recommendations, standards, criteria, and considerations included in this document are not substitutes for local government planning. Nor are they a comprehensive list of options available to local governments.

Similarly, the contents of this document should not be considered a substitute for legal advice. This document does not represent legal advice or legal opinions. The EQB strongly encourages

each individual local unit of government to seek the advice of legal counsel in connection with the use of this document and its contents and before making any decisions to adopt or amend its official controls.

Local units of governments are not required to adopt any elements of this document and Minn. Stat. 116C.99 does not authorize the EQB or any other state agency to impose or enforce anything on local governments. The EQB and its member agencies are not enforcing or attempting to enforce the suggestions in this document as if they are duly adopted state rules.

The EQB was directed to consult with local units of government in the development of this document. Since August 2013, the EQB has hosted public meetings in Red Wing, Winona, Mankato, St. Charles, St. Paul, and Wabasha. Surveys were sent to local units of government, and two public comment periods were opened to solicit input. This document incorporates input received from various sources as well as technical information from the Minnesota Department of Natural Resources, Minnesota Pollution Control Agency, Minnesota Department of Transportation, Minnesota Department of Health, Minnesota Department of Agriculture, and the Environmental Quality Board. The EQB extends its thanks to all contributing state agencies as well as agencies, organizations, industry representatives, and members of the public who commented on the document and otherwise participated in the process of its preparation.

ADDITIONAL RESOURCES FOR LOCAL GOVERNMENTS

The tools contained in this document are those that were prescribed by the Legislature, which both mandated and funded the creation of this report. These are not the only tools available to local governments and the EQB acknowledges this. Some LGUs have already enacted regulations that go above and beyond the scope of this report and others may seek to do so as well. The following discusses additional resources that local governments can access to support their planning, zoning, and regulatory efforts related to silica sand mining and processing. The EQB supports and recommends the use of these resources when an LGU finds it appropriate.

Silica Sand Technical Assistance Team

This “Tools” document is one of several resources available to LGUs. The statute amendment requiring the model standards and criteria work also ordered the creation of a silica sand technical assistance team. The EQB adopted a resolution in October 2013 that formally created the Technical Assistance Team. The Team is available to provide assistance when an LGU requests it on issues arising from silica sand mining and processing operations.

The Technical Assistance Team draws upon the staff resources and expertise of state agencies including the Minnesota Department of Natural Resources, Minnesota Pollution Control Agency, Minnesota Department of Health, the Board of Water and Soil Resources, and the Department of Transportation. In addition, the Team may also include representatives from the University of Minnesota, Minnesota State Colleges and Universities, and federal agencies. The expertise and

individual staff who participate on the Team in response to requests from LGUs may vary depending on the issues raised by the requests.

Based on several factors—the statutory language, the variables anticipated in requests, and the operating procedures for the EQB required by Minn. Rules 4405—there are two separate processes for how the Technical Assistance Team will respond to requests for assistance.

Request Related to a Specific Project: One process would be followed if the request is for a recommendation on issues arising from activities related to a specific project that requires the LGU to take an action to approve or deny the project. For example, an LGU may receive an application for a mining conditional use permit and ask the Technical Assistance Team for advice about some aspect of the project. In this situation, the Technical Assistance Team is required to conduct a meeting that is open to the public and then prepare findings and a recommendation. These findings and recommendations then must be submitted to the Environmental Quality Board for a vote by the Board to adopt them. As with any Board action, the results will be available on the EQB website for reference.

Requests related to a specific project should start with contacting the EQB to discuss the topic for which assistance is requested and the background information on the project that will be needed by the Team. A schedule will be determined based on the information.

Request for General Assistance, Not Related to a Specific Project: Local governments are welcome to ask questions that are not related to specific silica sand projects. For example, an LGU may be considering amending requirements listed in its zoning ordinance and request information about the technical aspects of monitoring. This type of request does not require a meeting of the Team. The request will be forwarded to the state agency staff with the appropriate technical expertise. The response could be a letter, a series of conversations, or other means of conveying information that will assist the LGU. However, it is the Board's discretion whether or not such general assistance advice is a matter to be decided by the Board. General assistance advice from the Technical Assistance Team will be available on the EQB website for reference.

General assistance requests can be submitted via e-mail, phone call, or hard copy. The nature of the inquiry will determine the most appropriate means of providing assistance.

Local governments can contact the EQB regarding the Technical Assistance Team via e-mail to silicasand.EQB@state.mn.us or to the EQB offices at: Environmental Quality Board, 520 Lafayette Road North, St. Paul, MN 55155-4194. Phone inquiries: (651)757-2873.

The section of the statute requiring the creation of the Technical Assistance Team can be found below.

Ordinance and Permit Library

Another part of the statute amendment requires the EQB to create and maintain a library of ordinances and permits that have been approved by local governments for the regulation of silica sand projects. Available online, the library includes ordinances and permits of numerous counties, municipalities, and townships.

The regulation of mining activities typically is included in a local government's zoning ordinance rather than with a separate ordinance. Because of this, the library includes a variety of documents. Most are compilations of elements from zoning ordinances that pertain or might pertain to regulating silica sand activities. For each of these, the entire zoning ordinance was examined and only pertinent elements were extracted. This includes elements such as definitions, zoning districts that allow mining or other activities such as processing or outdoor storage of sand, as well as requirements for conditional use permits and for mine reclamation.

The library also includes moratoria on silica sand activities that were established with interim ordinances as well as a number of permits approved for specific projects.

The library is an ongoing project that will be updated over time. It can be accessed at: <http://www.eqb.state.mn.us/silicaLibrary.html>

The section of the statute requiring the creation of the ordinance and permit library can be found below.

Rulemaking

A separate section of the legislation that required these projects also ordered three state agencies to adopt or amend rules relating to silica sand activities.

The Pollution Control Agency is to adopt rules pertaining to the control of particulate emissions from silica sand projects. The Department of Natural Resources is to adopt rules pertaining to the reclamation of silica sand mines.

The EQB is to amend the rules for environmental review, taking into account the increased activity in the state and concerns over the size of specific operations. The environmental review rules are Minnesota Rules 4410. As part of this, the legislation states that the EQB must consider whether the requirements of Minnesota Statutes, section 116C.991, should remain part of the environmental review requirements for silica sand and whether the requirements should be different for different geographic areas of the state. That section of statute, which was part of the amendments made by the same legislation, establishes what are, in effect, temporary thresholds for mandatory environmental assessment worksheets. That is, any project that exceeds the thresholds requires the preparation of an environmental assessment worksheet.

These three state agencies began the rulemaking process as required by Minn. Statutes 14. To gather stakeholder input, the agencies assembled an advisory committee representing local

governments, the mining industry, and citizens. This committee will meet regularly through 2014. The agencies will draft rules and continue through the rulemaking process.

The section of the legislation requiring the rulemaking can be found below.

Local Planning and Zoning Training, Information for Local Governments

Several organizations exist to assist local governments with planning, zoning, and other governing topics. Of particular interest are the League of Minnesota Cities, the Minnesota Association of Townships, and the Minnesota Counties Intergovernmental Trust. These organizations offer services to their member governmental units.

Many elements of planning for and regulating silica sand activities involve legal issues. The organizations listed here offer training to their member governments on planning and zoning issues. Taking advantage of the training and consultation offered by these organizations is not only useful to improve the planning and zoning activities but it may also help avoid costly legal actions that can arise from land use regulatory decisions. This often is referred to as risk management or loss control. Depending on the organization, this training may take the form of workshops, online modules, or direct consultation. The training is designed for the member governments and is not available to the general public.

The EQB encourages city, county, and townships to take advantage of the resources available to them from these organizations.

The following links provide information about these resources:

League of Minnesota Cities
145 University Ave. W
Saint Paul, MN 55103-2044
(651) 281-1200
(800) 925-1122

<http://www.lmnc.org/>
<http://www.lmnc.org/page/1/risk-management.jsp>
<http://www.lmnc.org/page/1/loss-control.jsp>

Minnesota Counties Intergovernmental Trust
100 Empire Drive, Suite 100
St. Paul, MN 55103-1885
(651)209-6400
(866)547-6516

<https://www.mcit.org/Default.aspx>
<https://www.mcit.org/training.aspx>

Minnesota Association of Townships
Edgewood Professional Building
PO Box 267
St. Michael, MN 55376
(763) 497-2330
(800) 228-0296
Email: info@mntownships.org

<http://www.mntownships.org/>

Environmental Review

The purpose of the Minnesota Environmental Review Program is to avoid and minimize damage to Minnesota's environmental resources caused by public and private actions. The program accomplishes this by requiring certain proposed projects to undergo environmental review prior to obtaining approvals and permits.

The program assigns a unit of government—the Responsible Governmental Unit (RGU)—to conduct the review of a project. The review itself follows a standardized public process designed both to disclose information about potential environmental effects and identify ways to minimize and avoid them. An environmental review is not an approval process: it does not include approval or disapproval of a proposed action. Nor does the program give any governmental unit authority over the decisions of other governments. It is an information gathering process to help governmental units that have permitting authority over a project make better-informed decisions.

Two basic review documents are used in this program: the Environmental Impact Statement (EIS) and the Environmental Assessment Worksheet (EAW). An EIS is a thorough study of the project's environmental impacts and a comparative analysis of its economic and sociological effects. It considers reasonable alternatives, including a "no-build" alternative. When completed, the review provides governmental units information to help determine whether the project is environmentally acceptable and what mitigation measures are needed. The EIS is reserved for projects with "the potential for significant environmental effects."

The other and much more common level of review is the EAW. This review procedure uses a worksheet with a standardized list of questions to screen projects that may have the potential for significant environmental effects. The EAW is subject to a public review period before the RGU makes a decision about whether the project also needs an EIS.

The program rules require that the costs of preparing an EIS must be borne by the project proposer. The RGU must not proceed with the scoping process until payment of the estimated cost of the scoping is submitted. Similarly, The RGU must not proceed with preparing the draft EIS until a cost agreement is signed by both parties and at least one half of the estimated cost of

the EIS is submitted. The schedule for the remainder of the payment must be included in the cost agreement.

The costs of preparing an EAW are not addressed in the program rules. Many local governments adopt a requirement that the project proposer submit money that is deposited into an escrow account when an EAW is needed. This escrow is used to pay the RGU's costs of preparing the EAW. Other local governments require payment by other means as part of a project application process. The EQB recommends that each local government formally adopt some form of requirement that the project proposer submits payment for EAW costs before the RGU begins preparation of an EAW.

An important element of the program is the listing of mandatory categories for specific project types. If a proposed project crosses the threshold in its category, an environmental review is mandatory. In addition, even if a project does not cross a threshold, an RGU can require a "discretionary" EAW if the RGU determines that the project may have the potential for significant environmental effects.

The information gathered for an environmental review is very useful for government decision makers. It can inform redesign of a project to prevent or minimize effects on the environment. Permits and other forms of approval can include measures to accomplish this as well, based on the information assembled for an environmental review. In this way, an environmental review and the required process can serve as a valuable planning tool.

In addition to providing useful information about the environmental effects of a project, the environmental review process serves to provide the public with systematic access to decision makers. This helps to maintain public awareness of environmental concerns and encourage accountability in public and private decision making.

The EQB website includes a great number of documents providing information and guidance for RGUs and citizens. These can be accessed from the "Environmental Review Program" link on the website.

<http://www.eqb.state.mn.us/program.html?Id=18107>
<http://www.eqb.state.mn.us/program.html?Id=18107>

Legislative Directives

For reference, Minn. Stat. 116C.99, 116C.991 and 116C.992 are included below in their entirety. The section of the 2013 legislation that orders the rulemaking is included as well.

<p>116C.99 SILICA SAND MINING MODEL STANDARDS AND CRITERIA.</p>
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<p>Subdivision 1. Definitions. The definitions in this subdivision apply to sections 116C.99 to 116C.992.</p>
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- (a) "Local unit of government" means a county, statutory or home rule charter city, or town.
 - (b) "Mining" means excavating silica sand by any process, including digging, excavating, drilling, blasting, tunneling, dredging, stripping, or by shaft.
 - (c) "Processing" means washing, cleaning, screening, crushing, filtering, sorting, processing, stockpiling, and storing silica sand, either at the mining site or at any other site.
 - (d) "Silica sand" means well-rounded, sand-sized grains of quartz (silicon dioxide), with very little impurities in terms of other minerals. Specifically, the silica sand for the purposes of this section is commercially valuable for use in the hydraulic fracturing of shale to obtain oil and natural gas. Silica sand does not include common rock, stone, aggregate, gravel, sand with a low quartz level, or silica compounds recovered as a by-product of metallic mining.
 - (e) "Silica sand project" means the excavation and mining and processing of silica sand; the washing, cleaning, screening, crushing, filtering, drying, sorting, stockpiling, and storing of silica sand, either at the mining site or at any other site; the hauling and transporting of silica sand; or a facility for transporting silica sand to destinations by rail, barge, truck, or other means of transportation.
 - (f) "Temporary storage" means the storage of stock piles of silica sand that have been transported and await further transport.
 - (g) "Transporting" means hauling and transporting silica sand, by any carrier:
 - (1) from the mining site to a processing or transfer site; or
 - (2) from a processing or storage site to a rail, barge, or transfer site for transporting to destinations.

Subd. 2. Standards and criteria. (a) By October 1, 2013, the Environmental Quality Board, in consultation with local units of government, shall develop model standards and criteria for mining, processing, and transporting silica sand. These standards and criteria may be used by local units of government in developing local ordinances. The standards and criteria shall be different for different geographic areas of the state. The unique karst conditions and landforms of southeastern Minnesota shall be considered unique when compared with the flat scoured river terraces and uniform hydrology of the Minnesota Valley. The standards and criteria developed shall reflect those differences in varying regions of the state. The standards and criteria must include:

- (1) recommendations for setbacks or buffers for mining operation and processing, including:
 - (i) any residence or residential zoning district boundary
 - (ii) any property line or right-of-way line of any existing or proposed street or highway
 - (iii) ordinary high water levels of public waters
 - (iv) bluffs
 - (v) designated trout streams, Class 2A water as designated in the rules of the Pollution Control Agency, or any perennially flowing tributary of a designated trout stream or Class 2A water
 - (vi) calcareous fens
 - (vii) wellhead protection areas as defined in section 103I.005
 - (viii) critical natural habitat acquired by the commissioner of natural resources under section 84.944
 - (ix) a natural resource easement paid wholly or in part by public funds
- (2) standards for hours of operation

-
- (3) groundwater and surface water quality and quantity monitoring and mitigation plan requirements, including:
 - (i) applicable groundwater and surface water appropriation permit requirements
 - (ii) well sealing requirements
 - (iii) annual submission of monitoring well data
 - (iv) storm water runoff rate limits not to exceed two-, ten-, and 100-year storm events
 - (4) air monitoring and data submission requirements
 - (5) dust control requirements
 - (6) noise testing and mitigation plan requirements
 - (7) blast monitoring plan requirements
 - (8) lighting requirements
 - (9) inspection requirements
 - (10) containment requirements for silica sand in temporary storage to protect air and water quality
 - (11) containment requirements for chemicals used in processing
 - (12) financial assurance requirements
 - (13) road and bridge impacts and requirements
 - (14) reclamation plan requirements as required under the rules adopted by the commissioner of natural resources

Subd. 3. Silica sand technical assistance team. By October 1, 2013, the Environmental Quality Board shall assemble a silica sand technical assistance team to provide local units of government, at their request, with assistance with ordinance development, zoning, environmental review and permitting, monitoring, or other issues arising from silica sand mining and processing operations. The technical assistance team may be chosen from representatives of the following entities: the Department of Natural Resources, the Pollution Control Agency, the Board of Water and Soil Resources, the Department of Health, the Department of Transportation, the University of Minnesota, the Minnesota State Colleges and Universities, and federal agencies. A majority of the members must be from a state agency and all members must have expertise in one or more of the following areas: silica sand mining, hydrology, air quality, water quality, land use, or other areas related to silica sand mining.

Subd. 4. Consideration of technical assistance team recommendations. (a) When the technical assistance team, at the request of the local unit of government, assembles findings or makes a recommendation related to a proposed silica sand project for the protection of human health and the environment, a local government unit must consider the findings or recommendations of the technical assistance team in its approval or denial of a silica sand project. If the local government unit does not agree with the technical assistance team's findings and recommendations, the detailed reasons for the disagreement must be part of the local government unit's record of decision.

(b) Silica sand project proposers must cooperate in providing local government unit staff, and members of the technical assistance team with information regarding the project.

(c) When a local unit of government requests assistance from the silica sand technical assistance team for environmental review or permitting of a silica sand project the local unit of government may assess the project proposer for reasonable costs of the assistance and use the funds received to reimburse the entity providing that assistance.

116C.991 ENVIRONMENTAL REVIEW; SILICA SAND PROJECTS.

(a) Until July 1, 2015, an environmental assessment worksheet must be prepared for any silica sand project that meets or exceeds the following thresholds, unless the project meets or exceeds the thresholds for an environmental impact statement under rules of the Environmental Quality Board and an environmental impact statement must be prepared:

(1) excavates 20 or more acres of land to a mean depth of ten feet or more during its existence. The local government is the responsible governmental unit; or
(2) is designed to store or is capable of storing more than 7,500 tons of silica sand or has an annual throughput of more than 200,000 tons of silica sand and is not required to receive a permit from the Pollution Control Agency. The Pollution Control Agency is the responsible governmental unit.

(b) In addition to the contents required under statute and rule, an environmental assessment worksheet completed according to this section must include:

(1) a hydrogeologic investigation assessing potential groundwater and surface water effects and geologic conditions that could create an increased risk of potentially significant effects on groundwater and surface water;
(2) for a project with the potential to require a groundwater appropriation permit from the commissioner of natural resources, an assessment of the water resources available for appropriation;
(3) an air quality impact assessment that includes an assessment of the potential effects from airborne particulates and dust;
(4) a traffic impact analysis, including documentation of existing transportation systems, analysis of the potential effects of the project on transportation, and mitigation measures to eliminate or minimize adverse impacts;
(5) an assessment of compatibility of the project with other existing uses; and
(6) mitigation measures that could eliminate or minimize any adverse environmental effects for the project.

116C.992 TECHNICAL ASSISTANCE, ORDINANCE, AND PERMIT LIBRARY.

By October 1, 2013, the Environmental Quality Board, in consultation with local units of government, shall create and maintain a library on local government ordinances and local government permits that have been approved for regulation of silica sand projects for reference by local governments.

Laws 2013, Chapter 114, Article 4**Sec. 105. RULES; SILICA SAND.**

(a) The commissioner of the Pollution Control Agency shall adopt rules pertaining to the control of particulate emissions from silica sand projects. The rulemaking is exempt from Minnesota Statutes, section 14.125.

(b) The commissioner of natural resources shall adopt rules pertaining to the reclamation of silica sand mines. The rulemaking is exempt from Minnesota Statutes, section 14.125.

(c) By January 1, 2014, the Department of Health shall adopt an air quality health-based value for silica sand.

(d) The Environmental Quality Board shall amend its rules for environmental review, adopted under Minnesota Statutes, chapter 116D, for silica sand mining and processing to take into account the increased activity in the state and concerns over the size of specific operations. The Environmental Quality Board shall consider whether the requirements of Minnesota Statutes, section 116C.991, should remain part of the environmental review requirements for silica sand and whether the requirements should be different for different geographic areas of the state. The rulemaking is exempt from Minnesota Statutes, section 14.125.

B. DIFFERENT GEOGRAPHIC AREAS OF THE STATE

The geographic distribution of silica sand resources in Minnesota are generally found in two regions: the Minnesota River Valley and the Paleozoic Plateau. The geographic attributes of the two regions differ in terms of geology, hydrology, mining techniques, infrastructure, biodiversity and cultural resources.

Geology

The bedrock in southeastern Minnesota, spanning from the Mississippi River Valley to the Minnesota River Valley, is characterized by mostly flat lying layers of dolostones, limestones, sandstones, and shales deposited in the Paleozoic era of geologic time from 505 to 305 million years ago. Paleozoic sandstones are sought after because they are a premiere source of industrial silica sand. Among many other industrial and constructional applications, this silica sand is highly desirable because it can be processed into a product called frac sand, which is used in hydraulic fracturing method of producing oil and gas.



The term “Paleozoic Plateau” is an ecological classification used to describe the bedrock dominated landscape of southeastern Minnesota. The landscape is characterized by relatively flat plateaus and mesas separated by escarpments and cut by narrow valleys that expose Paleozoic bedrock formations (Runkel, Steenberg, Tipping, and Retzler, 2013). Where unconsolidated sediment is observed on top of the bedrock, it is generally less than 50 feet thick

(Runkel, et al., 2003). As a result, karst features such as caves, sinkholes, and springs, are observable within the landscape and play an integral part of the hydrogeologic system of the region.

Traveling westward from the Mississippi River to the Minnesota River Valley the topography changes from bluffs, to rolling hills, to flat expanses of land. The change marks the boundary between an older, erosional landscape to one that is covered by thick glacial sediment. The same underlying Paleozoic-aged bedrock formations found within the Paleozoic Plateau extend to Mankato, but the thickness of glacial sediment is generally 50 feet or greater.

The only exposures of near surface occurrences of silica sand are limited to a relatively thin ribbon along the Minnesota River Valley stretching from the Mankato area to the Twin Cities. The mile-wide valley was carved by Glacial River Warren, one of the largest glacial meltwater channels in Minnesota. As it drained Glacial Lake Agassiz, River Warren's fast moving water scoured the valley removing thick sequences of glacial sediment and bedrock. As a result, silica sand resources are relatively accessible beneath the old river terrace deposits that lay between the modern day Minnesota River floodplain alluvium and the bluffs composed of glacial materials. The Minnesota River Valley and portions of Twin Cities metropolitan area have historically and continue to host large-scale silica sand mining.

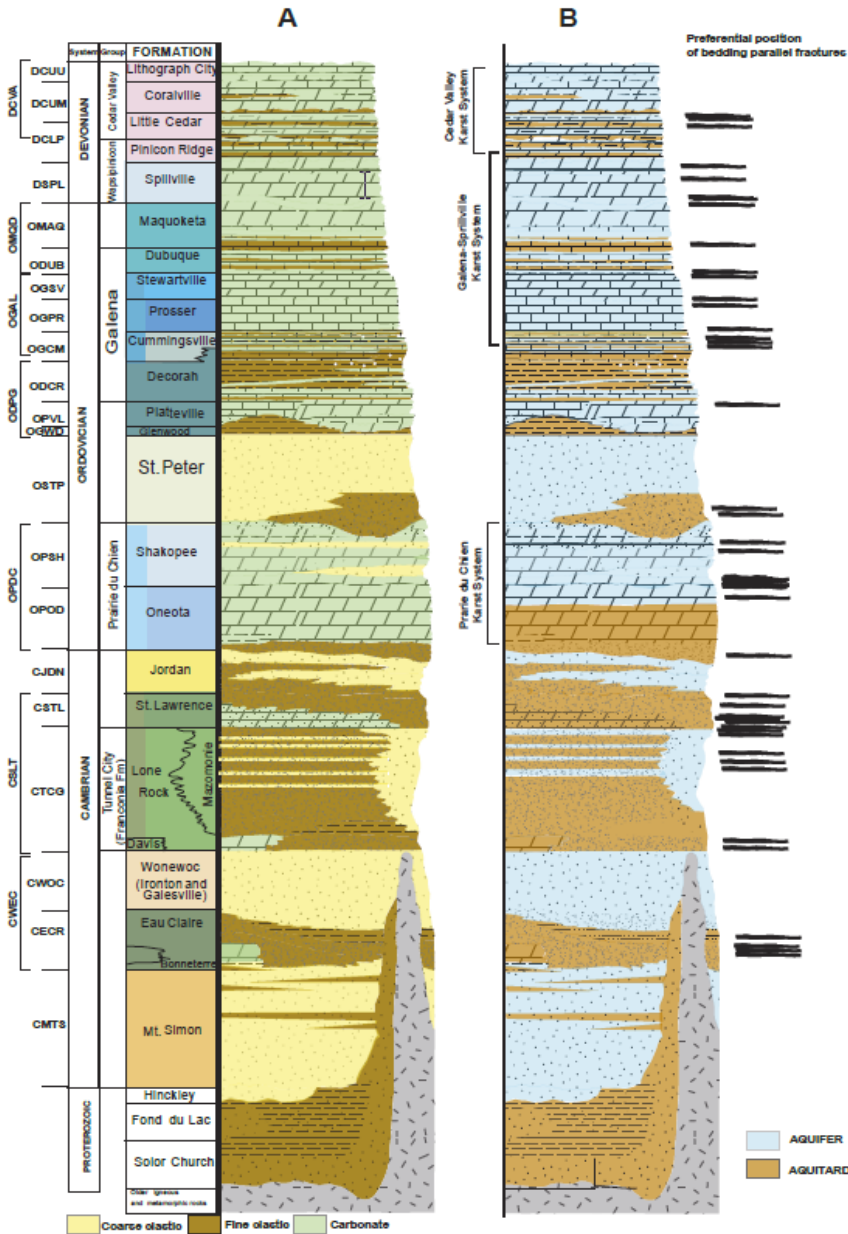
Hydrology and Hydrogeology

The two geographic regions share some hydrogeologic characteristics, as both regions are underlain by bedrock of Paleozoic age. However, southeast Minnesota contains a greater thickness of rock and a greater number of rock formations supporting a larger number of discernible bedrock aquifers. Significant volumes of groundwater move through dolostone, limestone, and sandstone aquifers which provide water to domestic wells, municipal wells, trout streams, calcareous fens, springs, seeps, wetlands, lakes and rivers. The aquifers are separated by shale layers that act to confine or semi-confine the water bearing rocks. The alternating rock types along with fractures and conduits in the rock facilitate the emergence of springs and seeps, some of which have groundwater and environmental conditions that support and sustain rare calcareous fen wetlands.

Streams in southeast Minnesota tend to rise and fall quickly following a rain storm because of the mature, dendritic drainage patterns in the steep valleys of the Paleozoic Plateau. Regional groundwater flow is generally to the Mississippi River but many of the deeply incised valleys intercept groundwater which then discharges from springs and seeps. During dry periods, the base flows in trout streams are kept cold and clear by groundwater inputs.

The Paleozoic Plateau is a mature karst landscape with many surface and subsurface features that dominate the flow of groundwater and surface water in this region. The karst landscape is formed by dissolution of dolostone and limestone that has resulted in the widening of fractures, bedding planes and voids over tens of millions of years. The solution-widened vertical fractures and horizontal bedding planes and fractures form enhanced permeability zones within the rock that are labeled conduits. These conduits are characterized by turbulent, high velocity groundwater

flow which is a fundamental component of karst systems. Recent investigations show that vertical fractures are found throughout all rock formations. Rocks near the surface and near valley walls tend to have a greater number, higher density and wider vertical fractures. Essentially karst is a three-dimensional transport system moving water and material through the landscape via solution enhanced channels. While these geologic processes also occur in Paleozoic bedrock in the Minnesota River Valley, it is not as extensively observed at or near the land surface as it is within the Paleozoic Plateau.



Surface karst features, such as sinkholes, are expressed in the Paleozoic Plateau because of the relatively thin layer of weathered soils or very old unconsolidated sediment on top of the bedrock surface. Sinkholes are found in those areas with less than 50 feet of unconsolidated material over the karst bedrock. The surface expression of karst features come and go as weathering processes, hydrology, hydrogeology, land cover and land use changes. Karst surface features such as sinkholes, coupled with conduit flow conditions, make this geographic region highly vulnerable to pollutants entering the aquifers with very limited filtering or biological treatment. Changes in surface hydrology or groundwater levels can induce the expression of karst features at the surface. There is a high potential for spills or pollutants associated with land use activities to travel great distances underground to domestic wells and water dependent resources such as trout streams and fish hatcheries. The groundwater flow direction and divides typically do not correspond to surface watersheds making it difficult to use surface topography to predict groundwater flow directions. Dye tracing is used to delineate subsurface groundwater springsheds and calculate flow velocities which are often on the order of miles per day. The technique is labor intensive and only a small portion of the Paleozoic Plateau has been mapped. Predicting where and when a karst surface feature will be expressed in the future is very difficult if not impossible to determine. Karst surface features can sometimes be successfully sealed using engineering techniques involving the placement of fill and the diversion of surface water.

The potential for groundwater contamination due to the direct surface connections and high flow rates found in the karsted areas of the Paleozoic Plateau has focused attention recently on the importance of the Decorah Edge. The Decorah Edge is found primarily along bluffs in the western part of the Paleozoic Plateau where the Decorah Shale is present at or near the surface. When downward migrating groundwater encounters these relatively impermeable formations, it tends to flow horizontally along the top of the formation and discharges as seeps, springs and wetlands along the bluffs and valleys before re-infiltrating into the underlying soils. These areas are marked by biologically diverse, and often unique, ecological zones. Studies suggest that movement of the water through the soils at the base of these bluffs and beneath the wetlands, sometimes referred to as the *Edge Support Area*, plays a critical role in groundwater recharge of underlying aquifers and the removal of contaminants (Lindgren, 2001; Center for Rural Design, 2008). Recognition of the importance of these areas for protecting the quality and quantity of water supplies in this region has led to greater attention to, and in some cases, restriction of development activities along the Decorah Edge and its “Edge Support Areas.”

In contrast, unconsolidated sediment and relatively few rock formations play a role in the hydrology and hydrogeology of the Minnesota River Valley. Typically within the old river terraces, where silica sand mining has occurred to date, only the lower section of the Paleozoic Oneota Dolomite is present above the Jordan Sandstone. On top of the Oneota is a relatively thin terrace deposit composed of cobble, gravel, and sand. Bordering the Minnesota River Valley are thick sequences of glacial deposits dominated by glacial till.

Groundwater flow is generally towards the Minnesota River Valley. There are relatively fewer trout streams designated in the region. A large number of calcareous fens are found at the base of the floodplain escarpment where the Jordan Sandstone outcrops or is buried by a thin layer of weathered rock, alluvium and fen peat. Karst features may form in the Oneota Dolomite, but such features are not as well-documented in the Minnesota River Valley region and the relative

importance of these features in groundwater transport is not as well-understood as in the Paleozoic Plateau.

Mining Sites and Techniques

Mining techniques used to access silica sand are determined by the geologic and hydrologic conditions of each region. Within the Paleozoic Plateau, mining silica sand resources can vary depending on the slope of the landform being mined. Currently, the resource is being mined along hill slopes, within ridges, or by excavating flat-topped buttes. In areas with greater slopes and vertical topographic relief, contour or underground mining could be employed to access silica sand. While this form of mining is possible and potentially speculated, no contour or underground mining project has yet to be formally proposed for environmental review in Minnesota. In the Paleozoic Plateau, mine sites tend to be above the water table, which is commonly referred to as *dry mining*.

Within the Minnesota River Valley, mining occurs along the flats of the river valley terraces or adjacent to the valley walls. Quarries in the Minnesota River Valley typically are developed as excavations below the existing grade of the landscape and below the water table, which is commonly referred to as *wet mining*. Some silica sand mines in this region pump groundwater from a sump to dewater an active mine cell in order to employ dry mining techniques which lowers the water level in the mine, thereby reducing the depth below the water surface where mining occurs. To gain access to the sandstone, geologic material, such as terrace deposits and dolomite, must first be removed. Blasting may or may not be employed at a mine. The use of blasting depends on the nature of the overburden (if it is rock or glacial sediment) and the degree to which the sandstone is cemented together.

Infrastructure

Access to transportation infrastructure also plays a critical role in siting silica sand mines and the development of the frac sand industry. Mines located within the Minnesota River Valley generally have better access to railroad spurs at or near the mine site. As a result, silica sand companies within the Valley tend to mine, process, and transport the material at a single, contained site. In contrast, silica sand operations in the Paleozoic Plateau have developed a hub and spoke model of operations that involves multiple modes of transportation. For example, sand can be mined at one site, transported by truck to be processed or stored at a second site, transported again to a transload facility at a third site before it is finally hauled to market by either rail or barge. Consequently, ports and rail terminals along the Mississippi have developed within town and city limits which funnel haul trucks onto designated truck routes and interstate highways that intersect residential and commercial areas.

Biodiversity

The Paleozoic Plateau is home to approximately 156 Species of Greatest Conservation Need (SGCN), which includes state and federally-listed species and is known for its unique ecological habitats. Within the Paleozoic Plateau, four major river systems, the Root, Whitewater, Zumbro, and Cannon, dominate the landscape and ultimately drain into the Mississippi River through the course of steep bluffs and valleys. The river systems provide a well-used “roadway” for migrating birds, including high numbers of rare birds and are highly regarded by bird watching enthusiasts. Forest cover in this region is primarily restricted to steep slopes and narrow valleys. Native plant communities grade from predominantly maple-basswood forest along the upper valley slopes and small streams on north facing slopes, to drier oak forest and occasional bluff prairies on south facing slopes and bluff tops. Lowland hardwood forest occurs in valley bottoms, with occasional small black ash swamps. Several rare and fragile plant communities found in this area are dependent on *algific* (cold producing) talus slopes and *maderate cliffs* (algific slope lacking talus). The communities associated with cold-air slopes are found only in the Paleozoic Plateau, which hosts some of the highest concentrations of rare animal and plant species in Minnesota. On top of the bluffs, historic native plant communities were largely prairie and oak savanna. However, most of the native vegetation has been converted to row crop.

The Minnesota River Valley once grew tall grass prairie dominated by big bluestem, little bluestem, switch grass, and Indian grass with many large patches of wet prairie. Near the Mankato area and north, the vegetation changed to the Big Woods complex that included oak, maple, basswood and hickory. Although now greatly altered by agricultural activities, recent work by ecologists indicates that the river valley and its immediate environs support the majority of the remaining native plant communities and rare species. This is particularly true near the Twin Cities metropolitan area.

Natural resource features within the Minnesota River Valley consists of floodplain forests and marshes, wet meadows, trout streams, fens and lakes. Most of the wetlands are dependent on the river and by the spring-fed streams draining from the base of the bluffs. These features attract thousands of song birds and waterfowl each year making this area well known for bird watching and waterfowl hunting. The river and trout streams also make the area well known for fishing opportunities.

Historic Properties and Cultural Resources

The distinct region of the Paleozoic Plateau has been occupied by Native Americans for nearly 12,000 years and contains a number of archaeological site types. Due to exposed and easily erodible bedrock, it is the region of Minnesota that contains the most potential for rock shelters and caves used as prehistoric habitation sites. Bedrock faces also have the potential to contain rock art either painted or engraved. The bedrock of southeastern Minnesota is known to contain chert cobbles suitable for stone tool manufacture and many quarry and workshop sites have been mapped throughout the region. Southeastern Minnesota has more prehistoric burial mounds than any other region of Minnesota which are found on bluff tops or high terraces along the river

valleys, especially the Mississippi River Valley. Both prehistoric and early historic Indian camp sites and villages are also found on river terraces and alluvial fans, especially near major river junctions.

With regard to historic properties, southeastern Minnesota was one of the first regions settled by Euro-American immigrants. Property types associated with this period include archaeological remnants of forts, fur posts, ghost towns, and early farmsteads, as well as Indian villages. Graves, cemeteries, and burial grounds may be associated with these sites. There are also numerous non-archaeological historic resources in the region including buildings, structures, cultural landscapes, and traditional cultural properties (TCPs) such as sacred sites.

The Minnesota River and its associated valley were also important natural features attractive to past human populations. The riparian environment served as an excellent source of aquatic plants and animals valuable for human subsistence. The trees lining the valley were a critical human resource, providing wood for constructing shelters and building fires. The river itself was an important transportation corridor. Over the last 12,000 years, Native Americans had villages and campsites on the terraces and alluvial fans lining the river valley, some of which have been deeply buried by colluvium and alluvium sediment. On the high terraces, burial mounds were built.

Euro-American settlers also found the Minnesota River Valley attractive for a variety of reasons. Steamboats could navigate much of the river as far as New Ulm. Roads and railroads were built along the river terraces linking towns in the valley. As with southeastern Minnesota, historic period cultural resources can include archaeological sites as well as architectural, landscape, and TCP properties, some with associated graves, burial grounds, and cemeteries.

Distinctions Based on Geographic Regions

Since there are notable differences in geography and natural resources between the Paleozoic Plateau and the Minnesota River Valley, the Minnesota State Legislature required that the silica sand model standards and criteria for silica sand projects be differentiated by region (M.S 116C.99 Subd. 2). Where appropriate, the recommendations, standards, criteria, and considerations in the following sections reflect “those differences in varying regions of the state.”

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II. TOOLS TO ASSIST LOCAL GOVERNMENTS

A. AIR QUALITY

A.1. AIR MONITORING AND DATA REQUIREMENTS

a. Description of Silica Sand Project Concerns

Particle pollution is regulated by particle size. A particle's size has implications for how the particle can enter the body and affect human health. Current USEPA and Minnesota regulations describe the allowable amount of particulate matter in terms of mass concentrations. Because the regulations are currently written this way, the control efficiencies and ambient standards referenced throughout this section are described in terms of mass concentrations. The EQB recognizes that there is a growing body of literature regarding the health impacts of very small particles termed 'ultrafines,' and that there may be parameters other than mass that are better suited to characterize these particles. The air pollutants of most concern from silica sand operations include particulates of various size fractions and chemical compositions.

b. Narrative Description, Background Information, Potential Impacts

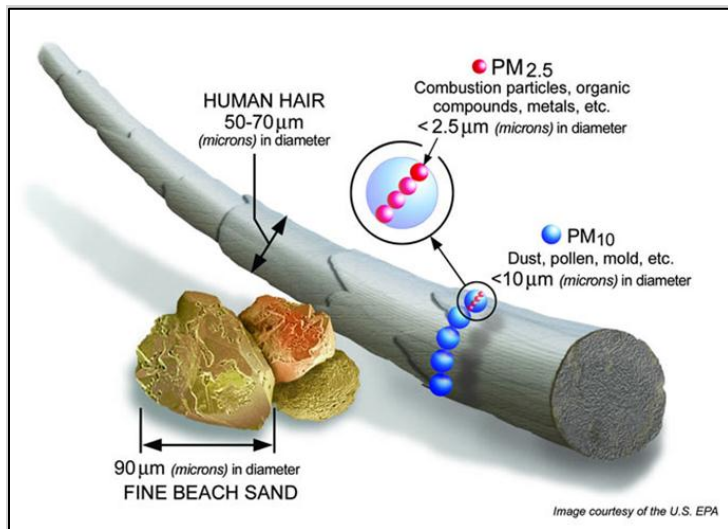
In response to potential air quality impacts resulting from increased mining, processing, and transport of silica sand in Minnesota, this section was written to help facilitate air quality assessments in impacted communities. The MPCA routinely collects air monitoring data for broad geographic areas, but also has required some silica sand facilities to collect property line monitoring data. The MPCA has made this air quality monitoring data available on its website.

The air pollutants of most concern from silica sand mining operations and transport include particulates of various size fractions and chemical compositions. This section will address methods for assessing air concentrations of the following air pollutants:

- Total suspended particles (TSP)
- Inhalable particles (PM₁₀)
- Fine particles (PM_{2.5})
- Crystalline silica as PM₁₀ or PM₄
- Diesel exhaust

Ultrafine particles, or particles with an aerodynamic diameter of 0.1 microns or less (PM_{0.1}), are an aspect of particulate emissions that have received increasing scrutiny in recent years. Particles of this size are being investigated for their possible human health effects. The Clean Air Act requires the USEPA to re-evaluate the science that supports each ambient air standard on a five year cycle. This review is compiled into a report called an Integrated Science Assessment, or ISA. The ISA is a compilation of peer-reviewed literature and is informed by both internal

and external experts. The ISA describes the link, or ‘causality’, between a set of adverse health effects and a pollutant. The ISA uses a 5 stage classification system that assigns a causality rating ranging from ‘causal relationship’ to ‘not likely to be a causal relationship.’ The ISA for particulate matter was last released in 2009, and indicated that ultrafine particles are rated as ‘suggestive of a causal relationship’, which is the middle of the five possible classifications. This classification also indicates that USEPA does not have enough evidence to rule out chance, bias, and confounding factors. As a first step toward understanding ultrafine particles in Minnesota, the MPCA will be installing and operating an ultrafine particle counter near the interchange of Interstates 35 and 94 in the Twin Cities Metropolitan area.



Particle pollution is regulated by particle size. A particle’s size is determined by measuring the particle’s aerodynamic diameter, which has implications for how the particle can enter the body and affect human health. Human health research has shown that the smallest particles are of greatest concern for public health. Silica sand mining operations have the potential to emit particles across all size ranges including TSP, PM₁₀, PM₄ (not pictured), and PM_{2.5}.

Air pollution assessment methods

There are two methods for assessing air pollution concentrations associated with pollutant emissions from silica sand mining operations: ambient air monitoring and air dispersion computer modeling. Ambient air monitoring provides direct measurements of pollutant concentration at a specific location and period of time. Air dispersion modeling estimates air pollution concentrations across a broader area utilizing computer models which incorporate total air emissions from nearby sources and local meteorology. This document will focus primarily on options for conducting ambient air quality monitoring to assess the community level air quality impacts of silica sand mining. It is expected that this document could inform the plan for a site-specific air monitoring study. A silica sand facility or an LGU may initiate the planning and monitoring process. Regardless of who initiates the planning and implementation, the MPCA should be involved early on in the process. The MPCA has, and will continue to do the following: (1) provide technical assistance to LGUs regarding air monitoring issues, (2) review and approve an air monitoring plan, (3) review the data, (4) host the data through its website, and (5) perform audits of monitoring equipment.

Planning an air monitoring study

In choosing locations for an air monitoring site, particular attention should be paid to the goals of the air monitoring study. A community interested in assessing the air quality impacts of silica sand mining operations should consider the following monitoring objectives:

Source-oriented monitoring: An air monitoring site is located at the property line of an air pollution emissions source in the area of expected maximum pollution concentration. An upwind (non-impacted) and downwind (impacted) monitoring site may be established to measure the air quality impact of the emissions source.

Hot-spot monitoring: Similar to source-oriented monitoring, air pollution hot-spot monitors are located in the area of expected maximum pollution concentration. An air pollution hot-spot may be the result of a single emission source, or multiple emission sources concentrated in a small area, such as a heavily trafficked roadway.

Area background monitoring: Area background monitors are located to measure “typical” air pollution concentrations in a community. These monitors are located in areas that are not directly impacted by distinct emission sources; rather they are sited to measure the cumulative impact of air pollution emissions in a community. Area background monitoring provides a baseline for air pollution concentrations in a community, which can be used to measure the relative air pollution impact of air pollution sources assessed through source-oriented or hot spot monitors.

In addition to meeting the objectives of the air monitoring study, an air monitoring site should meet all siting criteria established by the U.S. Environmental Protection Agency (EPA) which are described in 40 Code of Federal Regulations Part 58 Appendix E. Important factors to consider when establishing an ambient monitoring site include:

Measuring ambient air: To compare air monitoring results with air quality standards, the air monitoring site must be measuring ambient air. According to 40 CFR 50.1 (e), ambient air is defined as the portion of the atmosphere, external to buildings, to which the general public has access. Air monitoring sites located within a facility’s property line are not considered ambient if a fence or other physical obstruction prevents public access. However, if no such obstruction exists, air quality monitors located within a facility’s property boundary may be considered ambient. TSP, PM_{2.5} and PM₁₀ air monitors must conform to US EPA’s design standards as outlined in 40 CFR pts. 50, 53 and 58. Requiring the use of reference or equivalent methods helps to assure the reliability of air quality measurements including: ease of specification, guarantee of minimum performance, better instruction manuals, flexibility of application, comparability with other data, and increased credibility of measurements. For example, the MPCA performs QA/QC checks that includes: flow rate verifications / audits, pressure verifications, leak checks, timer verifications, and zero/span checks. Data quality assurance requirements are described in a five-part handbook available here: www.epa.gov/ttn/amtic/qalist.html .

Horizontal and vertical placement: The objectives of the monitoring study will determine the criteria for placement of air monitoring probes or sample inlets. In most cases, air monitoring probes and inlets must be located between 2 and 7 meters above ground level. As a result, monitoring sites located at ground level typically require the installation of an elevated platform or shelter. Air monitoring sites may also be located on the roof of a building which is no higher than two-stories.

Spacing from emission sources: The proximity of the air monitor to air pollution emission sources is dependent on the objectives of the monitoring study. For source-oriented or hot-spot monitoring, air monitors should be located as close to the area of expected maximum air pollution concentration as safely possible. If the monitoring objective is to assess air pollution concentrations representative of a wider area, such as the average air pollution concentration across a community, air monitors should be located further away from emission sources.

Spacing from obstructions: Buildings and other obstacles can impact air monitoring results by scavenging pollutants and restricting airflow to the monitor, resulting in inaccurate air concentration measurements. In general, if an obstruction is located near an air monitoring site, the distance of the air monitor from the obstruction must be two-times the height of the obstruction.

Cost of establishing an air monitoring site

The costs associated with establishing an air monitoring site will vary depending on the physical characteristics of the chosen monitoring location, the type of monitoring platform chosen (e.g. ground-level platform, shelter/trailer, rooftop), pollutants measured and existing infrastructure. The following section will describe the estimated costs associated with establishing a new air monitoring site in 2013. These cost estimates have been developed assuming all site infrastructure and equipment will be purchased and may not reflect the costs associated with establishing a temporary air monitoring site through a contractor.

Site Infrastructure

Capital costs for site infrastructure at ground-level sites - \$10,000

- Land clearing and grading to access the site and meet siting criteria Utility drop and electrical connections to power instrument platforms
- Building permits
- Materials to construct elevated monitoring platforms
- Security fence and gate to enclose the monitoring site -

Capital cost considerations for alternative site configurations

- Ground level shelter/trailer and associated infrastructure - \$32,000
- Rooftop installation and associated infrastructure - \$6,000

Supporting Equipment (equipment needs will depend on pollutants measured at the site)

- Data logger and wireless telemetry for continuous monitoring instruments - \$9,000
- Meteorological equipment and tripod - \$3,500
- Laptop and uninterruptable power supply - \$4,500
- Certified meters and devices to calibrate and perform quality control checks- \$2,500
- Dynamic Dilution Calibrator with gas phase titration chamber (GPT) - \$21,000
- NO₂ Calibration gas cylinder and regulators - \$1,000

Recurring annual site operation costs - \$31,000

- Weekly site operation and maintenance - \$20,000
- Project administration, contract management, site construction, procurement, QA/QC audits, data management, analysis and reporting - \$10,000
- Consumable field supplies and miscellaneous hardware - \$1,000

The following sections provide additional information about the pollutants of concern from silica sand mining operations including information on health effects, relevant air quality standards, and available air monitoring equipment and associated costs.



Example air monitoring sites: rooftop monitoring (left); ground-level monitoring including a shelter (right).

Total suspended particles (TSP)

Total suspended particles (TSP) are small airborne particles or aerosols that are less than 100 micrometers in diameter. Common components of TSP include soot, dust, fumes, and sea mist. In contrast to smaller size particulates (such as fine particles), the human body effectively blocks TSP, reducing the adverse health effects associated with exposure. Nearly all inhaled TSP is either directly exhaled or trapped in the upper areas of the respiratory system and expelled. If TSP enters the windpipe or lungs, it becomes trapped in protective mucous and is removed

through coughing. While TSP pollutants are not expected to cause serious health effects in humans, high levels of TSP can be a nuisance, cause property damage, and reduce visibility.

In Minnesota, TSP is regulated by two Minnesota Ambient Air Quality Standards (MAAQS), including a daily (24-hour) and annual standard. To meet the daily standard, the 2nd maximum 24-hour average TSP concentration in an area must not exceed 150 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$). An area meets the annual standard if the annual average TSP concentration does not exceed $60 \mu\text{g}/\text{m}^3$.

Total suspended particulate monitoring is conducted by collecting a 24-hour mass sample on a glass fiber filter. The fiber filter is weighed in a laboratory pre and post sample collection. The mass difference is used to calculate the total TSP concentration in a volume of air. The standard annual operating schedule for TSP monitoring is a midnight to midnight 24-hour mass sample collected once every six days.

Total suspended particulate monitors should be sited to meet the goals of the specific monitoring project. To measure TSP concentrations associated with silica sand mining, TSP monitors should be located directly downwind of the TSP emission source of concern. When establishing a TSP monitoring site additional factors which must be considered include, maintaining unobstructed airflow in all directions of the air monitor, placing the sample inlet between 2-15 meters above ground level, and removing public access to the monitor through fencing or locating the monitor on the roof of a building.

On average, the cost of an EPA certified TSP monitor is \$8,000. For regulatory comparisons with ambient air quality standards, all TSP monitoring networks must meet applicable quality assurance and quality control requirements, including a 10% monitor collocation requirement. For community level monitoring projects, the collocation requirement means that at least one monitoring site must have two TSP monitors operating at the same time. An additional collocated monitor is required for every 10 monitoring sites.



High-volume TSP Sampler

Operational costs associated with TSP monitoring include sample media purchase, preparation, and post sample analysis; weekly visits by a site operator and quarterly visits by a QA officer; motor replacement and/or brush repair; and power.

TSP Summary Information	Regulatory Standards
Equipment Cost: \$8,000/monitor O&M Cost: \$5,000/monitor	Daily MAAQS: Annual 2 nd high 24-hour TSP concentration does not exceed 150 µg/m ³
Operational Considerations: Collocated monitor required at one sampling site	Annual MAAQS: Annual average TSP concentration does not exceed 60 µg/m ³

Inhalable particulate (PM₁₀)

Inhalable particles (PM₁₀) are very small particles less than 10 micrometers in diameter. Sources of PM₁₀ include crushing and grinding operations, natural (crystal) and road dust, and biological sources. Scientific studies have linked short term exposure to elevated PM₁₀ concentrations to decreased lung function, increased respiratory symptoms in children, increased doctor’s visits and hospital admissions, and premature death in people with heart or lung disease.

In Minnesota, PM₁₀ is regulated through national and state ambient air quality standards including a daily (24-hour) and annual standard. To meet the daily PM₁₀ National Ambient Air Quality Standard (NAAQS) the 3-year average of the annual count of 24-hour PM₁₀ concentrations greater than 150 µg/m³ site must be less than or equal to 1. To meet the annual PM₁₀ MAAQS, the annual average PM₁₀ concentration must not exceed 50 µg/m³.

The Code of Federal regulations requires that any monitor operated for the purpose of comparison of NAAQS must have a Federal Reference or Equivalent Method Designation, except as otherwise provided in Appendix C of 40 Code of Federal Regulations 40, Part 58. A complete list of acceptable monitors can be found in the 40 CFR, Part 53, Sections 53.2 and 53.3.

There are several PM₁₀ monitoring methods included among the EPA certified monitors. The three most common monitoring methods used for measuring PM₁₀ concentrations include high volume and low volume monitors that collect a 24-hour mass sample on a filter and semi-continuous monitors that collect hourly PM₁₀ measurements on an auto-advancing filter tape. There are advantages and disadvantages for each of these monitor types. Choosing the best monitor for the monitoring study will depend on the monitoring objective.



High-volume PM₁₀ monitor (top); semi-continuous PM₁₀ monitor (bottom)

To assess the PM₁₀ impacts of silica sand mining operations in a community, the MPCA recommends utilizing a semi-continuous PM₁₀ monitor. When paired with hourly meteorological or site activity data, hourly PM₁₀ concentration data can be used to identify PM₁₀ sources. Additionally, the semi-continuous monitor requires less frequent site operator visits than the high-volume sampler. The average cost of a semi-continuous PM₁₀ monitor, including the monitor enclosure is \$28,000. Because the semi-continuous PM₁₀ monitors do not collect the PM₁₀ sample on a retrievable filter, crystalline silica analysis cannot be performed with this collection method.

PM₁₀ Summary Information	Regulatory Standards
Equipment Cost: High-volume filter: \$10,000 Low-volume filter: \$12,500 Semi-continuous: \$28,000	Daily NAAQS: 3-year average of the annual count of 24-hour PM ₁₀ concentrations greater than 150 µg/m ³ must be less than or equal to 1
O&M Cost: \$5,000/monitor	Annual MAAQS: Annual average PM ₁₀ concentration does not exceed 50 µg/m ³

Fine particles (PM_{2.5})

Fine particles such as those found in smoke and haze are 2.5 micrometers in diameter and smaller. Fine particles can be emitted directly from combustion activities or they can form in the air when other pollutant gases react in the air. Fine particles are created through most combustion activities, but the most common sources of fine particle pollution includes power plants, industries, automobiles, and fires.

Due to their very small size, fine particles can get deep into the lungs and cause serious health problems. Numerous scientific studies have linked fine particle exposure to respiratory discomfort, decreased lung function, aggravated asthma, irregular heartbeat and heart attacks, increased doctor's visits and hospitalizations, and premature death in people with heart or lung disease.

Fine particle pollution is regulated through two national ambient air quality standards including a daily (24-hour) and annual standard. To meet the daily PM_{2.5} standard, the 3-year average of the annual 98th percentile 24-hour PM_{2.5} concentration must not exceed 35.4 µg/m³. To meet the annual PM_{2.5} standard, the 3-year average of the annual average PM_{2.5} concentration must not exceed 12.0 µg/m³.



Low-volume PM_{2.5} filter monitor

The Code of Federal regulations requires that any monitor operated for the purpose of comparison of NAAQS must have a Federal Reference or Equivalent Method Designation. Except as otherwise provided in 40 CFR, Part 58, Appendix C. A complete list of acceptable monitors can be found in the 40 CFR, Part 53, Sections 53.2 and 53.3.

Several PM_{2.5} monitoring methods are included among the EPA certified monitors. The most common monitoring methods used for measuring PM_{2.5} concentrations include low-volume monitors that collect a 24-hour mass sample on a filter and semi-continuous monitors that collect hourly PM_{2.5} measurements on an auto-advancing filter tape. There are advantages and disadvantages for each of these monitor types. Choosing the best monitor for the monitoring study will depend on the monitoring objective.

To assess PM_{2.5} impacts of silica sand mining operation in a community the MPCA recommends utilizing a semi-continuous PM_{2.5} monitor. When paired with hourly meteorological or site activity data, hourly PM_{2.5} concentration data can be used to identify PM_{2.5} sources. Additionally, the semi-continuous monitor requires less frequent site operator visits than the filter based sampler. The average cost of a semi-continuous PM_{2.5} monitor, including the monitor enclosure is \$30,000.

PM_{2.5} Summary Information	Regulatory Standards
Equipment Cost: Low-volume filter: \$12,500 Semi-continuous: \$30,000	Daily NAAQS: 3-year average of the annual 98 th percentile 24-hour PM _{2.5} concentration does not exceed 35.4 µg/m ³
O&M Cost: \$5,000/monitor	Annual NAAQS: 3-year average of the annual average PM _{2.5} concentration does not exceed 12.0 µg/m ³
Operational Considerations: Collocated monitor required at one sampling site	

Crystalline silica

Respirable crystalline silica is a dust-sized particle invisible to the naked eye that when inhaled is deposited deep within the lungs. Crystalline silica is a very common component of soil and well-known occupational hazard in certain trades. Activities such as mining for crystalline silica and other natural resources, as well as construction activities related to cutting and sawing of common materials such as concrete, create respirable crystalline silica particles.. People who work in the hydraulic fracturing or frac sand mining industries are most at risk for exposure to elevated levels of respirable crystalline silica, but people living downwind of silica sand mining, processing, or hauling operations could also be exposed to respirable crystalline silica. Due to the greater risk for exposure in the occupational environment, respirable crystalline silica is routinely measured in the workplace. However, levels of respirable crystalline silica in ambient (outdoor) air are rarely determined. Diseases associated with chronic exposure to respirable

crystalline silica over many years include: silicosis, emphysema, chronic obstructive pulmonary disease, tuberculosis, lung cancer, and immune system diseases.

There are no federal or state standards for respirable crystalline silica in ambient air. However, the MPCA uses a risk guideline value developed by the MDH to assess the risk of adverse health effects from exposure to measured levels of respirable crystalline silica in the air. In July 2013, the MDH established a chronic Health Based Value for respirable crystalline silica of $3 \mu\text{g}/\text{m}^3$ in ambient air for non-occupational exposures occurring in the general population. The MPCA compares annual average monitoring results to the chronic health based value to assess the health risk associated with respirable crystalline silica concentrations in the air. Quantitative health based guidance for shorter duration exposures to respirable crystalline silica were not developed because data are lacking and the extremely high levels of respirable crystalline silica required to cause short-term health effects in occupationally-exposed individuals are far beyond the scope of ambient exposure scenarios the general public would be expected to encounter. The Minnesota Department of Health's chronic Health Based Value for respirable crystalline silica of $3 \mu\text{g}/\text{m}^3$ is very conservative and highly protective guidance. Short-term increases in ambient levels of respirable crystalline silica in excess of the chronic Health Based Value do not necessitate an immediate cause for concern. Therefore measured 24-hour average concentrations of respirable crystalline silica in ambient air will be used to calculate the 95% upper confidence limit of an annual mean concentration and compared to the chronic Health Based Value of $3 \mu\text{g}/\text{m}^3$. The EPA has not established a standard method for measuring crystalline silica in ambient air. The MPCA recommends utilizing a modified low-volume particulate sampler to collect 24-hour mass samples of PM_{10} on a 47 mm mixed ester sample filter. Following sample collection, the loaded filter should be sent to a certified laboratory for crystalline silica analysis using the National Institute for Occupation Safety and Health (NIOSH) Method 7500 or NIOSH Method 7602. The average cost of the low-volume particulate sampler is \$12,500. The estimated annual cost of analysis of 60 crystalline silica samples from a certified laboratory is \$25,000.

Respirable Crystalline Silica Summary Information

Equipment Cost: \$12,500/monitor	No regulatory standard
O&M Cost: \$25,000/monitor	Chronic health based value: $3.0 \mu\text{g}/\text{m}^3$ See MDH Silica Health Based Value Summary at: http://www.health.state.mn.us/divs/eh/risk/guidance/air/silicasumm.pdf

Diesel exhaust

The exhaust from diesel engines contains a complex mixture of air pollutants including gases and particles. Major chemical components of diesel exhaust include carbon dioxide, carbon monoxide, nitrogen dioxide, nitric oxide, particles (coarse, fine, and ultra-fine), black carbon, and sulfur dioxide. Diesel exhaust also contains air toxic pollutants such as acrolein, benzene, formaldehyde and polycyclic aromatic hydrocarbons (PAHs).

The majority of scientific studies conducted to measure the health risks associated with exposure to diesel exhaust focus on the particle components of the exhaust. Similar to the health effects associated with fine particle pollution, exposure to diesel particles can cause adverse respiratory and cardiovascular health effects including decreased lung function, aggravated asthma, irregular heartbeat and heart attacks, increased doctor's visits and hospitalizations, and premature death in people with heart or lung disease. The U.S. EPA has also classified diesel exhaust as a likely carcinogen due to increased risk for lung cancer resulting from long term exposure.

There is no ambient air standard for diesel exhaust. The MPCA uses a health based value to assess the risk of adverse health effects from exposure to diesel particulate. The chronic non-cancer health risk value for diesel particulate is $5 \mu\text{g}/\text{m}^3$.

Methods do not currently exist to measure the amount of diesel exhaust in ambient air directly. Instead, researchers typically monitor other pollutants that may be signatures of diesel exhaust. These pollutants include fine particles, ultra-fine particles (particle diameter less than 1 micrometer), elemental carbon, and nitrogen oxides. Utilizing surrogate pollutants to assess the amount of diesel exhaust in the air has significant limitations, as the relationship between the surrogate pollutant and the amount of diesel exhaust in the air varies geographically and by the characteristics of the emissions source.

If surrogate monitoring is conducted to assess diesel exhaust concentrations, the MPCA recommends establishing an upwind (non-impacted) and downwind (impacted) monitoring site. Comparing the result from these monitors may help identify the relative impact of increased diesel exhaust emissions if other pollutant emissions are relatively uniform between the two monitors. While either hourly $\text{PM}_{2.5}$ or nitrogen oxides can be used as a surrogate for diesel exhaust, the MPCA recommends utilizing hourly measurements of $\text{PM}_{2.5}$.

Due to the difficulties associated with measuring diesel exhaust through air monitoring, the MPCA assesses the health risks associated with diesel exhaust emissions through air dispersion modeling. Air dispersion models integrate information on emission sources and local geography and meteorology to estimate pollution concentrations in the air. To assess the increased health risks associated with diesel exhaust emissions from silica sand mining operations, information on diesel emission sources should be gathered. This may include information on the engine type, size, and age; fuel type; and in the case of on-road diesel engines, the number of vehicles and miles traveled on a roadway.

Diesel Exhaust Summary Information	
No direct monitoring methods	No regulatory standard
Surrogate measurements: Fine particles: \$30,000 Nitrogen dioxide: \$12,000	Chronic non-cancer health based value: $5 \mu\text{g}/\text{m}^3$ diesel particulate
O&M Cost: \$5,000/monitor	

Summary of estimated air monitoring site capital and annual operation costs in 2013 dollars

All monitoring sites must meet the guidelines described in 40 CFR Part 58 Appendix E.

Site infrastructure		
	Rooftop site	\$6,000
	Ground-level site (no shelter)	\$10,000
	Shelter/trailer site (with HVAC)	\$32,000
Pollutant monitors		
	Semi-continuous PM _{2.5} (with environmental shelter, but without HVAC)	\$30,000
	Semi-continuous PM ₁₀ ((with environmental shelter, but without HVAC)	\$28,000
	High-volume TSP	\$8,000
	Low-volume PM ₄	\$12,500
	Nitrogen oxides	\$12,000
Supporting equipment		
	Data logger/wireless telemetry	\$9,000
	Meteorological sensors and tripod	\$3,500
	Laptop and uninterruptable power supply	\$4,500
	Certified meters and devices for calibration and QA/QC	\$2,500
	Dynamic Dilution Calibrator with gas phase titration chamber (GPT)	\$21,000
	NO ₂ Calibration gas cylinder and regulators	\$1,000
Sample analysis		
	TSP sample prep and post-weigh analysis	\$5,000/year
	Low-volume PM ₄ sample silica analysis (60 samples)	\$25,000/year
	Data processing and analysis for PM _{2.5} , PM ₁₀ , and nitrogen oxides	\$5,000/year
Operations and maintenance		
	Weekly site operations and maintenance	\$20,000/year
	Project administration, contract management, site construction, procurement, QA/QC audits, data management, analysis and reporting	\$10,000/year
	Consumable field supplies and hardware	\$1,000/year

Estimated one-time capital expenses per monitoring site*: \$19,000 - \$142,000**

Estimated annual expenses per monitoring site*: \$12,000*- \$56,000

*Post-construction upwind/downwind monitoring will require at least two monitoring sites

**Low-end of range based on a single rooftop monitoring site measuring TSP and meteorological parameters only.

c. Recommendations, Standards, Criteria, Considerations

The proposed standards, criteria, and considerations are informed by both the processes within the proposed silica sand project and the geographic location of the project. The monitoring plan for a silica sand project should include the following:

What to monitor:

- Every silica sand project involving a mine of any size should conduct monitoring for Total Suspended Particulate, PM₄-silica, and meteorological data.
- Every silica sand project involving processing should monitor for PM₁₀, PM₄-silica, and meteorological data; the term ‘processing’ means washing, cleaning, screening, crushing, filtering, sorting, stockpiling, and storing silica sand.
- Every silica sand project involving over-the-road transportation should monitor for PM_{2.5}, PM₄-silica, and meteorological data at each site where silica sand is either loaded or unloaded from a transportation carrier (e.g. truck, rail, barge).

Note that if a silica sand project involves one or more of the above activities, then the monitoring plan should reflect all of the indicated monitors (e.g. a project that encompasses a mine, processing facility, and over-the-road transportation should monitor for TSP, PM₁₀, PM_{2.5}, and PM₄-silica).

When to monitor:

- All silica sand projects should conduct ambient monitoring prior to startup of the project. The pre-construction monitoring period should continue until at least one year of valid data is collected.
- All silica sand projects should conduct ambient monitoring after startup of the project. The post-construction monitoring period should continue until at least three (3) years of valid data are collected.

How often to monitor:

- Each TSP sampler should run for a 24-hour midnight-to-midnight period once every six days on the schedule found here: <http://www.epa.gov/ttnamti1/calendar.html>
- Each PM₁₀ analyzer should run on a semi continuous (hourly) basis
- Each PM_{2.5} analyzer should run on a semi continuous (hourly) basis
- Each PM₄ sampler should run for a 24-hour midnight-to-midnight period once every six days on the schedule found here: <http://www.epa.gov/ttnamti1/calendar.html>

Which monitor and test method should be used:

- Each TSP, PM₁₀, and PM_{2.5} monitor should be one that has been designated as a Federal Reference Method (FRM) or as a Federal Equivalent Method (FEM); an electronic list of monitors that hold this designation is available at <http://www.epa.gov/ttnamti1/files/ambient/criteria/reference-equivalent-methods-list.pdf>
- Each PM₄ monitor should be approved by the MPCA on a case-by-case basis. The silica test method should be NIOSH 7500.

Monitor Siting

- Historical wind patterns (direction, intensity) from nearby meteorological stations and the on-site meteorological station should be compiled to inform the siting conditions in order to construct 'upwind / downwind' monitor placement. The monitors should be placed as close to the facility as possible while remaining in ambient air. This is typically the fence line of the facility.
- Monitor sites should meet criteria laid out at 40 CFR pt. 58, Appendix E. This appendix contains information such as vertical and horizontal placement, spacing, distance from obstructions, and more.

Data Reporting

- All data should be sent to the MPCA and the LGU
- TSP, PM₁₀, PM_{2.5}, and Crystalline Silica data should be reported on a quarterly basis no later than one month following the end of each quarter.
- Data may be provided in a written report but must also be provided in an electronic format that can be directly read into a spreadsheet or database
- For parameters that are measured hourly or sub-hourly, electronic data submissions should include hourly averaged data
- The silica sand project proposer should notify both the MPCA and the LGU within 24 hours of receiving sample results exceeding ambient standards. The notification should include the date of the exceedance, the concentration of the sample, and a summary of the measures taken by the proposer to reduce emissions at the silica sand project.

A.2. DUST CONTROL & CONTAINMENT OF SAND

a. Description of Silica Sand Project Concerns

Virtually all stages of silica sand mining, processing, and transportation may emit particulate matter, which is commonly known as dust. The control strategies share a common feature: they

are designed to minimize the interaction between wind and silica sand. In general, all processes after the mining process should be enclosed. Those portions of the process that cannot be enclosed (i.e. roads) should utilize alternative methods such as watering and sweeping in order to suppress the movement of particulate matter. These methods should be itemized and documented within a fugitive dust control plan in order to identify the emission sources, control strategies, triggers for action, and facility contact information.

b. Recommendations, Standards, Criteria, Considerations

The recommendations, standards, criteria, and considerations are informed by the processes within the proposed silica sand project. If the LGU is interested in methods that could be used to reduce the particulate emissions from a silica sand facility, then the LGU could implement dust control measures within their local permit. The dust control strategy for the proposed silica sand project could include the following measures:

Mine Haul Roads within a Silica Sand Facility

Emissions from mine haul roads that are within the property line of the silica sand facility should be suppressed by the daily application of water. Water should be applied at a rate of 0.10 gallons per square foot per day, unless the one of the following events occurs:

- The facility receives rainfall of 0.16 inches during the previous 24 hour period, or
- the ambient air temperature will be less than 35 degrees, or
- the weather conditions, in combination with the application of water, could create hazardous driving conditions. If water is not applied for this reason, watering should resume once the hazardous conditions have abated.

On a daily basis, the facility owner should keep records of the water applications, including the following:

- The roads watered, the amount of water applied, the time watered, and the method of application. If water was not applied because there was a 0.16 inch or greater rainfall in the previous 24 hours, or because of the low temperature or other weather conditions that would result in unsafe driving conditions, it must be noted in the record along with the source of the measurement (i.e. on-site rain gauge or thermometer).
- Records of watering equipment breakdowns and repairs, and records of contingency efforts undertaken.

Processing

After the sandstone has been mined, all subsequent processing steps should be enclosed. Processing encompasses the following activities: washing, cleaning, crushing, filtering, drying, sorting, and stockpiling of silica sand. All emissions from the enclosed processes should be ducted to control equipment designed to mitigate particulate matter emissions. There are numerous control technologies that are capable of controlling particulate matter, such as a

cyclone, an electrostatic precipitator, a wet scrubber, a fabric filter, and a high efficiency particulate air (HEPA) filter. While the more efficient devices include fabric filters and HEPA filters, the other control technologies can be arranged in series in order to meet or exceed the efficiency of filter-based technologies. Cyclones rely on inertial separation and are typically less efficient at controlling PM₁₀ sized particles. Cyclones can be used as a first stage in a series of control devices in order to control emissions of larger sized particles. Electrostatic precipitators rely on the ability to apply an electrostatic charge to particulate matter. Silica does not readily accept an electric charge, and therefore will not be well controlled by an electrostatic precipitator. Wet scrubbers are typically more efficient than cyclones at controlling PM₁₀-sized material, but not as efficient as a fabric filter. Wet scrubbers rely on a liquid spray to knock particulate matter out of the gas stream, but create a liquid process stream that must be addressed. Fabric filters are typically woven into the shape of a cylindrical bag, which are then arranged within a structure called a ‘baghouse.’ Process air is ducted such that it must pass through the fabric filter in order to exit to the atmosphere. Over time, a cake of dust will accumulate on each bag. This dust is periodically cleaned from the bag and collected in an enclosed hopper.

Another similar control technology is called a high efficiency particulate air (HEPA) filter. When compared to a baghouse fabric filter, a HEPA filter has finer fibers that have a higher packing density. HEPA filters usually take the form of a cartridge that must be periodically replaced. The use of a baghouse does not preclude the use of a HEPA filter, and a HEPA filter could be added at a later date should the need arise. A baghouse can routinely achieve greater than 99% control of all particulate matter by mass, and 93% of all particulate matter sized smaller than PM₁₀ by mass. A HEPA filter can remove 99.98% of all particulate matter by mass, and 99.98% of all particulate matter sized smaller than PM₁₀ by mass. When arranged in series, this control strategy can achieve control greater than 99.99% of all particulate matter on a mass basis, and greater than 99.99% of all particulate matter sized smaller than PM₁₀ on a mass basis. Each of these devices are typically guaranteed by their respective manufacturer to achieve a certain level of control, provided that they are operated within certain operating parameter ranges. One such operating parameter is called ‘pressure drop.’ Pressure drop is a measure of the resistance to flow through the control device. The control device manufacturer will indicate the proper operating range. The pressure drop across each control device should be regularly monitored in order to verify that the device is working properly.

Another periodic monitoring method is called a triboelectric sensor, or bag leak detector. Bag leak detectors are designed to identify situations where a process stream has a relatively large jump in concentrations, such as a tear or hole in a fabric filter. Bag leak detectors are useful tools, but they do have limitations. These sensors are sensitive to moisture condensation and variations in flow, which does not make them suited to all processes at silica sand facility. Triboelectric sensors are useful on stacks that have a continuous flow and maintain a temperature above the dew point. All particulate matter that has been collected by the baghouse should be stored in an enclosed location until the material is either used in mine reclamation or transported off-site. The suggested dust mitigation strategy for processing activities includes:

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- **Capture Strategy:** Enclose all processes and vent all emissions through a particulate matter control device. Keep all doors and windows closed, and maintain negative gauge pressure within the building.
 - **Control Strategy:** Operate and maintain one or more filter-based particulate matter control devices arranged in series. (for example: first the process air is ducted to a baghouse, then the air exiting the baghouse is routed to the HEPA filter, which is then exhausted to atmosphere).
 - **Periodic Monitoring and Recordkeeping:** On each day of operation, record the operating time and material throughput for each air emission unit. Utilize a continuous parameter monitoring system to monitor and record pressure drop across each control device every fifteen minutes. Store each data point for at least five years. Conduct maintenance and inspections on the following schedule:
 - A.** maintain an inventory of spare parts that are subject to frequent replacement, as required by the manufacturing specification or documented in records under items H and I;
 - B.** train staff on the operation and monitoring of control equipment and troubleshooting, and train and require staff to respond to indications of malfunctioning equipment, including alarms and other indicators of abnormal operation;
 - C.** thoroughly inspect all control equipment at least annually, or as required by the manufacturing specification (this often requires shutting down temporarily);
 - D.** inspect monthly, or as required by the manufacturing specification, components that are subject to wear or plugging, for example: bearings, belts, hoses, fans, nozzles, orifices, and ducts;
 - E.** inspect quarterly, or as required by the manufacturing specification, components that are not subject to wear including structural components, housings, and ducts;
 - F.** check daily, or as required by the manufacturing specification, monitoring equipment, for example: pressure gauges, chart recorders, and recorders;
 - G.** calibrate annually, or as required by the manufacturing specification, all monitoring equipment;
 - H.** maintain a record of activities conducted in items A to G consisting of the activity completed, the date the activity was completed, and any corrective action taken; and
 - I.** maintain a record of parts replaced, repaired, or modified for the previous five years.
 - **Corrective Actions:** If the recorded pressure drop range or component of the control device need repair corrective action should be taken as soon as possible. Corrective action should return the pressure drop to the manufacturer's indicated range and/or include completion of necessary repairs identified during the inspection.

Transportation

The following recommendations are intended to minimize particulate matter emissions that are associated with transportation of silica sand, but these recommendations could also be used for other bulk-transport industries. If the LGU is interested in reducing the effects of particulate matter from transportation-related processes, then the following suggestions could form the basis

for LGU permit requirements. The drop height at each material transfer point should be minimized by using telescopic chutes and skirting. Trucks and railcars that receive silica sand should do so via a telescoping loading spout that meets the design requirements described in the reference book *Industrial Ventilation Handbook—A Manual of Recommended Practice for Design*, currently in the 26th edition. Trucks that unload should do so within an enclosed structure. The doors that allow the truck to enter and exit the unloading station should be closed prior to the unloading procedure. The drop height from truck bed to the surface or receiving hopper should not exceed eight inches of open drop. Airborne material should be ducted to particulate control equipment meeting the same efficiencies described in the preceding silica sand processing section. Bottom dump trucks with dump gate skirts should be used for all over-the-road transportation. The skirting should have a maximum vehicle-to-ground clearance of six inches (air gap). As described by Minn. Stat. Section 169.81, subd. 5b(b), all trucks in silica sand service should be covered. All railcars in silica sand service should be covered hoppers. All trucks that leave the facility should be processed by a vehicle wheel wash station. The silica sand facility should keep and maintain the following records for the trucks in silica sand service:

1. The number of trucks used on each operating day,
2. The number of hours that each truck was operated each day,
3. The haul route or routes used on each operating day,
4. The rated capacity of each truck's engine,
5. The vehicle identification number (VIN) for each truck,
6. The amount of fuel used and fuel economy as averaged over a month,
7. The percent of time on idle,
8. The federal emission standards that each truck engine is subject to, and
9. The tailpipe emission control technology used by each truck, such as:
 - a. diesel oxidation catalyst,
 - b. diesel particulate filter, or
 - c. selective catalytic reduction.

Both on-road and off-road engines emit an array of pollutants at the tailpipe. These engines emit particulate matter directly, and also emit pollutants such as nitrogen oxides (NOx) that contribute to the formation of particulate matter in the atmosphere. The USEPA summarized this relationship in the 2010 Regulatory Impact Assessment regarding NO2 regulation: "Our analysis of the benefits associated with the NO2 NAAQS includes the ancillary benefits of reducing concentrations of particulate matter (PM). Because NOx is also a precursor to PM2.5, reducing NOx emissions in the projected non-attainment areas will also reduce PM2.5 formation, human exposure, and the incidence of PM2.5-related health effects." Additional information regarding USEPA regulation of mobile sources can be found here: <http://www.epa.gov/otaq/standards/basicinfo.htm>

The standards for non-road compression ignition engines (i.e. earth-moving equipment) are assigned a 'tier' rating. Generally speaking, a higher 'tier' indicates a more stringent emission standard for one or more pollutants. When compared to a 'Tier 1' engine, a 'Tier 2' engine has a more stringent standard for particulate matter. When compared with a 'Tier 2' engine, a 'Tier 3'

or newer engine has a more stringent NOx standard. Again, the pollutant NOx can contribute to formation of particulate matter in the atmosphere.

In contrast with non-road engines, on-road heavy duty highway compression ignition engines are regulated by their model year. Model year 2007 was the most recent regulatory standard for heavy duty highway compression-ignition engines. When compared with a 2006 model year engine, a 2007 model year engine has more stringent standards for particulate matter.

The on-road truck fleet should meet the following criteria:

- All diesel trucks used in the sand mining operation should be Model Year 2007 or newer,
- All trucks should follow an anti-idling plan that minimizes excessive idling, but accounts for traffic, temperatures in excess of 90 degrees and less than zero degrees Fahrenheit, and inclement weather. The plan should be developed by the LGU and the silica sand facility. Examples of anti-idling regulations can be found at the following:
 - The City of Minneapolis an anti-idling ordinance
http://www.minneapolismn.gov/environment/air/airquality_antiidling_home
 - American Transportation Research Institute
http://www.atri-online.org/research/idling/ATRI_Idling_Compndium
 - US EPA
<http://epamap10.epa.gov/website/StateIdlingLaws.pdf>
- All trucks should pass a state highway safety inspection.

The non-road vehicle fleet should meet the following criteria:

- At least 50% of the diesel-powered equipment used in sand mining operations should have a EPA certified Tier-3 or better engine, and
- the remaining equipment should be certified to Tier-2, and
- All trucks should follow an anti-idling plan that minimizes excessive idling, but accounts for traffic, temperatures in excess of 90 degrees and less than zero degrees Fahrenheit, and inclement weather. The plan should be developed by the LGU and the silica sand facility.

All roads at a silica sand facility, other than mine haul roads, should be paved. Paved surfaces should be vacuum swept on a daily basis. The facility owner should maintain records of the following:

1. The roads swept, the time the roads were swept, and the method of sweeping.
2. Records of sweeping equipment breakdown and repairs, and records of contingency efforts undertaken.

Temporary Storage

Temporary storage is defined to be the storage of stockpiles of silica sand that have been transported and await further transport. Storage piles that are intended to be used at the facility on a recurring basis are not considered temporary storage; rather, these piles should be enclosed

and controlled in the manner described in the ‘processing’ section above. In situations where silica sand is to be stored on a temporary basis and the material cannot be enclosed, then the sand should be checked for moisture content and watered until the moisture content of the pile exceeds the amount indicated below. After the temporary pile has been removed, the paved surfaces at the former storage area should be swept as soon as possible. The US EPA guidance document ‘AP-42’ identifies emission estimates for uncontrolled and controlled processes. The controlled processes were operated with a wet suppression system. Footnote b to Table 11.19.2-2 of ‘AP-42’ indicates that the moisture content of the material ranged from 0.55% to 2.88%. The recommended moisture content value is on the conservative end of the indicated range. Suggested requirements for open-air storage piles include:

- Moisture content: Greater than or equal to 2.9%
- Test method / compliance assessment: American Society for Testing and Materials (ASTM) method D 2216-92 or D 4643-93 (or equivalent). These test methods involve weighing a wet sample, heating it, and then weighing it again.
- Test frequency: once per day, within 2 hours of 12 noon. Testing is not recommended if any of the following three items are true:
 - The facility receives rainfall of 0.16 inches during the previous 24 hour period, or
 - the ambient air temperature will be less than 35 degrees, or
 - the weather conditions, in combination with the application of water, could create a hazard near the storage pile.
- Corrective action: If the test result is below the suggested moisture content requirement, then the operator should apply water to all exposed surfaces until subsequent moisture content testing demonstrates that the moisture content is at or above the suggested percentage.
- Recordkeeping: keep on-site records of each moisture content test summarizing the method used, results, time, date, temperature, and person performing the test
- Temporary stockpiles or stripping/overburden stored outside the pit should have sediment control mechanisms in place until the material is completely removed. Materials should not be placed in surface water or stormwater conveyances such as curb and gutter systems, or conduits and ditches.

A.3. NOISE MONITORING AND TESTING

a. Narrative Description and Background Information

Noise is a pollutant. While its physical and emotional effects are difficult to define quantitatively, the noise level itself can be measured.

The MPCA is empowered to enforce the state of Minnesota noise rules; however, the noise rules apply to all persons in the state, with municipalities having some responsibility for compliance

with the rules. All sources of noise must comply with the noise level standards, unless specifically exempted or a variance has been granted.

The MPCA has established standards for noise limits for residential and other areas in Minnesota Rules Chapter 7030. These standards are set by “noise area classification,” (NAC) based on the land use at the location of the receiver (person hearing the noise). Noise is measured with sound meters for a period of one hour, and compared to state noise standards. Two measurements are used – the L10 and the L50. The L10 standard is the noise level (in A- weighted decibels) that cannot be exceeded for more than 10%, or 6, minutes of the hour. "A-weighted" means a specific weighting of the sound pressure level for the purpose of determining the human response to sound. The specific weighting characteristics and tolerances are those given in American National Standards Institute S1.4-1983, section 5.1. The L50 standard is the noise level that cannot be exceeded for more than 50%, or 30 minutes, of the hour. Noise limits are most stringent in NAC 1, which includes residential areas, and least stringent in NAC 3, which includes industrial facilities.

The noise standards itemized in the table below describe the limiting levels of sound established on the basis of present knowledge for the preservation of public health and welfare. These standards are consistent with speech, sleep, annoyance, and hearing conservation requirements for receivers within areas grouped according to land activities by the noise area classification (NAC) system established in part 7030.0050. However, these standards do not, by themselves, identify the limiting levels of impulsive noise needed for the preservation of public health and welfare. Noise standards in the table below apply to all sources.

Noise Area Classification	Daytime		Nighttime	
	<u>L50</u>	<u>L10</u>	<u>L50</u>	<u>L10</u>
1	60	65	50	55
2	65	70	65	70
3	75	80	75	80

Compliance with Noise Standards

Unless specifically exempted under Minnesota Statute 116.07, Subdivision 2a, all sources of noise must comply with the state standards. Local governments have the authority to enforce state noise standards, and may choose to adopt their own local ordinances regarding noise, though they may not set standards describing maximum levels of sound pressure more stringent than those set by the MPCA. In effect, local ordinances addressing outdoor sound level standards may set levels identical to the MPCA rules, and/or may address noise in ways not included in the MPCA rule (for example, limiting permissible operating hours of noisy lawn equipment).

The MPCA assists LGUs in ensuring compliance with state noise standards by providing advice, loaning monitoring equipment to assist LGUs to measure noise levels, and reviewing projects for

noise issues through the environmental project review process. The MPCA also works to ensure compliance at facilities for which it has issued an air emissions permit.

When evaluating noise, it is important to consider the proximity of the receiver to the noise generator. A NIOSH study entitled “Snapshot of Noise and Worker Exposures in Sand and Gravel Operations” by E.R. Bauer and E.R. Spencer indicates that plant operations can emit noise of up to 97 db(A) in plant areas; these measurements were made 1 to 2 meters from the equipment. Sound pressure is reduced by 6 dB for every doubling of distance. If the most stringent noise standard in Minnesota is 50 dB, then the distance required in order to achieve a noise reduction from 97 dB to 50 dB is equal to $[2 \text{ meters} * 2^{(47/6)} = 456 \text{ meters}]$, or about 1500 feet. Therefore, noise monitoring should occur at residences within 1500 feet of the facility.

b. Recommendations, Standards, Criteria, Considerations

The most effective means of avoiding noise pollution is proper land use planning and implementation of planning through land-use regulation; these regulations should be designed to ensure that land uses with more stringent noise standards are located away from land uses with less stringent noise requirements. Municipalities with the authority to regulate land use must take all reasonable measures to ensure that the establishment of a particular land use activity will not result in immediate violation of the state noise standards. Distance between noise sources and receptors (people) is the most useful method for reducing sound levels.

Physical barriers can help to further reduce noise levels, but such methods do require consideration of necessary barrier heights, location, materials, cost, and durability. Shrubbery is not typically an effective sound barrier, though it may change the perception of disturbances. In general, a 100-foot deep barrier of dense, tall, evergreen vegetation would have the effect of reducing noise by 5 dB. A solid, wooden privacy fence will typically have a greater noise mitigation impact than landscaping. Buffers may also be used to create separation; buffers are described later in this document in Section E.

A noise survey should be used to verify that the noise impacts from a silica sand facility have been reviewed. The noise survey should include the following: any silica sand project should conduct a pre-construction noise monitoring at every residence within 1500 feet. This distance should be measured from the property line of the silica sand facility to the property line of the residence. The monitoring should include both a daytime and a nighttime monitoring period, and should comport with the measurement methodology prescribed by the Minnesota Noise Rules at 7030.0060. The road surfaces within the site should be constructed to maximize the use of traffic circles. This will, in turn, minimize the need for vehicles to use their back-up alarm. After construction and startup of the silica sand project, then the facility should conduct post-construction monitoring at the same locations and time periods. Any exceedance of the noise standards should be mitigated by raising berm heights and adding landscaping until subsequent testing shows compliance with the noise standards. Additional noise mitigation methods that are specific to vehicles include: directional backup warnings, flashers, and proximity sensors. If railcars are used, then they should be coupled and uncoupled only during daytime hours

B. WATER QUANTITY, WATER QUALITY

B.1. WATER QUANTITY

a. Description of Silica Sand Project Concerns

Silica sand activities such as mining, mine dewatering, slurry pipeline transportation and wet processing have the potential to impact groundwater and surface water resources. Mining at or below the water table often requires the removal of large volumes of groundwater to dewater the mine to facilitate dry mining operations. Washing of sand to remove fine-grained particles, dust control and the transportation of sand from the mine to the wet processing facility may also require large volumes of water.

A cone of depression forms within the water table aquifer near any well or mine sump that is pumping groundwater. Depending on sump depth, well construction, pumping regime, and local geology, the degree and lateral extent of the water table drawdown will vary. Dewatering of a mine has the potential to impact water availability in nearby domestic wells, municipal production wells and water dependent resources. Dewatering of a silica sand mine, or other large appropriations of groundwater, can reduce discharge to surface water resources such as calcareous fens, wetlands, ponds, lakes, trout streams, springs, seeps, and watercourses leading to potential degradation of fish and wildlife habitat.

b. Narrative Description and Background Information

The Commissioner of the DNR administers the use, allocation and control of all waters of the state. This includes both surface water and groundwater. The DNR is required to manage water resources to ensure an adequate supply to meet Minnesota's long-term needs. The Water Appropriation Permit Program exists to balance competing management objectives that include both development and protection of Minnesota's water resources.

A water use permit (appropriation permit) from the DNR Ecological and Waters Resources Division is required for all users withdrawing more than 10,000 gallons of water per day or 1 million gallons per year. In accordance with Minnesota Rule 6115, an application must be submitted for each surface or ground water source from which water is proposed to be appropriated. The applicant must provide written evidence of ownership, or control of, or a license to use, the land overlying the groundwater source or abutting the surface water source from which water will be appropriated. The DNR commissioner is authorized to grant permits, with or without conditions, or deny them.

The Legislature has set the following water allocation priorities for Minnesota:

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1. Domestic water supply
 2. Consumptive use less than 10,000 gallons of water per day
 3. Agricultural irrigation and processing
 4. Power production
 5. Other consumptive uses in excess of 10,000 gallons per day, and
 6. Nonessential Uses

Silica sand mining related activities are considered a fifth or sixth water allocation priority depending on specific details of the operation.

An appropriation permit application for a silica sand mine should consist of the following submittals*:

1. Permit Application Form - completed with all background information
2. Mining Plan - for the duration of the mine operations
3. Reclamation Plan - including final disposition of the land or land use
4. Comprehensive Domestic Well Inventory - for the potentially impacted area
5. Wetland Delineation - for the potentially impacted area
6. Hydrogeologic Investigation Report - including a resource impact analysis, water well and boring records, information on the subsurface geologic formations penetrated by the well, geological formation or aquifer that will serve as the water source, and geologic information from test holes drilled to locate the site of the production well, the maximum daily, seasonal, and annual pumpage rates and volumes being requested, information on groundwater quality and the articulation of a groundwater conceptual model for the area.
7. Aquifer Test Report - with quantified aquifer properties
8. Groundwater Computer Model - developed in coordination with DNR that is parameterized using aquifer test results, calibrated, verified and used to run simulations of future possible mining and reclamation scenarios
9. Calcareous Fen Management Plan - (if a calcareous fen is potentially impacted)
10. Proposed Monitoring Plan - for groundwater and surface water resources
11. Proposed Mitigation Plan - for water use and water resource impacts including a proactive domestic well interference remediation policy.

*It is noted that some items as listed above, such as the Mining Plan or Reclamation Plan, may evolve throughout the life of the proposed project. Applicable materials to this point should be provided in the application package that has been coordinated and finalized to the extent possible with the LGU. If throughout the life of the project, the proposed project changes such that these plans are revised and proposed changes may affect the hydrogeology, the revised materials should be provided to the DNR for further evaluation on how it pertains to the existing permit.

Upon receipt, the DNR Area Hydrologist distributes the permit application and coordinates a request for comments with the LGUs and DNR Divisions of Fisheries, Wildlife and Ecological and Water Resources staff. Groundwater technical review will be completed by the DNR Regional Groundwater Specialist as the required reports and plans are submitted to the DNR Area Hydrologist. Groundwater technical review will often include a domestic well risk analysis, interpretation of the data, comments on any technical deficiencies and recommendations for

additional technical work, water monitoring or permit condition language. All water appropriation installations must be equipped with a flow meter to measure the quantity of water used. The methods used for measuring water use are based on the quantity of water appropriated, the source of water, and the method of appropriating or using water. Records of the amount of water appropriated must be kept for each installation. The readings and the total amount of water appropriated must be reported annually to the DNR along with payment of the water use fees on or before February 15 of the following year.

The installation of monitoring equipment to detect potential impacts from permitted appropriators is generally required for large users of water. Monitoring installations are to be equipped with devices capable of accurately measuring water levels, flows, or conditions. DNR staff will determine the type, frequency and duration of measurements based on the quantity of water appropriated or used, the source of water, potential connections to other water resources, the method of appropriating or using water, seasonal and long-term changes in water levels, and any other facts supplied to the DNR Area Hydrologist. Permit conditions generally require quarterly electronic reporting of monitoring data in a standard DNR format. The permittee is responsible for all costs related to establishing and maintaining monitoring installations, measuring and reporting data.

If the total withdrawals and uses of ground or surface waters exceeds the available supply based on established resource protection limits, including protection elevations and protected flows for surface water and safe yields for groundwater, resulting in a water use conflict among proposed users and existing users, a plan must be developed that includes proposals for allocating the water.

In a recent survey of LGUs by EQB for the purposes of this document, 14 of 16 respondents reported that they defer to State requirements for addressing any non-metallic mining water quantity concerns. Of the participating LGUs, 93% (14 of 15 respondents) said they defer any drinking water quantity and quality concerns for domestic wells and public water supply wells to the State agencies. In addition, 37% (6 of 16 respondents) of the participating LGUs developed or negotiated water monitoring plans with permittees. The LGU monitoring plans included groundwater static water level measurements (2 of 7 responses), groundwater quality sampling (2 of 7 responses), stream water quality sampling (1/ 7 responses), spring or seep water quality sampling (1 of 7 responses and other types of monitoring (4 of 7). Not included were stream gaging, lake or wetland depths, and spring or seep discharge measurements. For mitigation plans, 88% (14 of 16 responses) of the participating LGUs defer to State Wetland Conservation Act or Public Waters requirements.

c. List of Silica Sand Project Potential Impacts

Potential impacts are similar for both the Minnesota River Valley and the Paleozoic Plateau.

- Reduced water availability in domestic wells
- Reduced water availability in municipal production wells

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- Reduced discharge to water dependent resources including calcareous fens, wetlands, ponds, lakes, trout streams, springs, seeps, and watercourses
 - Degradation of fish and wildlife habitat
 - Impacts to state protected species
 - Well interference complaints
 - Water use conflicts

d. Recommendations, Standards, Criteria, Considerations

In order to protect surface water, groundwater and water dependent resources from potentially negative impacts associated with silica sand mining, processing, stockpiling and transportation activities, Paleozoic Plateau and Minnesota River Valley LGUs could consider the following actions be required of applicants:

i. Surface Water and Groundwater Appropriation Requirements

1. **Permit Application Comments** – The LGU should consider providing technical comments and policy concerns on appropriation permit applications when requested by DNR Area Hydrologist.

ii. Monitoring and Annual Submission of Monitoring Data Requirements

1. Develop a comprehensive and detailed monitoring plan that requires the type, frequency and duration of measurements necessary to adequately monitor site conditions. Measurements could include groundwater static water levels, stream stages and discharges, pond and wetland stages, spring and seep discharges, specified water quality parameters, wetland communities, listed species and other data that satisfies the monitoring needs of state agency and LGU permits.
2. Monitoring Data Submittals - Data submittals should be reported quarterly in a standardized electronic format to the LGU and state agency designated contact.
3. Annual Monitoring Report - An Annual Monitoring Report due by February 15th of each year should be required that compiles, summarizes, analyzes and interprets the data for the year as well as over the entire period of record. Based on the Report, LGUs and state agencies may require changes in the monitoring plan, amendment of permits or changes in operations.

iii. Mitigation Plan Requirements

1. Well Interference – a proactive well interference response plan should be submitted, approved and made a condition of all permits. If the permittee fails to respond adequately, DNR has a well interference complaint investigation authority and process in place to determine if the well interference report is related to an appropriation permit and will take action to restore water to the complainants if warranted.
2. Water Use Conflicts – If the DNR anticipates or determines that there is a limited volume of available water to one or more existing or proposed large water appropriator with the

same level of water allocation priority (i.e. two competing silica sand operations), the DNR will invite the LGU to participate in a water use conflict resolution process to develop an allocation plan in accordance with Minnesota Rules.

3. Calcareous Fen Impacts – If based on the hydrogeologic investigation report and monitoring data, the DNR determines that a calcareous fen will be impacted, a Calcareous Fen Management Plan (CFMP) must be approved by the DNR Commissioner prior to the commencement of the silica sand activity that would cause the impact (M.S. 103G.223). The project sponsor is responsible for preparing the Draft CFMP. The DNR will coordinate the review and approval the CFMP in cooperation with the Wetland Conservation Act (WCA) LGU and the Technical Evaluation Panel (TEP). See subsection E.6. Calcareous Fens for more details.
4. Impacts to other Wetland Dependent Resources - If based on the hydrogeologic investigation report and monitoring data that there is an impact to a water dependent resource, the DNR and LGU should enter into discussions with the permit applicant to identifying appropriate actions or changes to operations to avoid, mitigate or compensate for the impact and amend permit conditions accordingly.
5. Trout Stream Setback Permit Requirement in Paleozoic Plateau - In the Paleozoic Plateau area of southeast Minnesota, all new silica sand mining operations within a mile of a designated trout stream are required to apply for and obtain a trout stream setback permit from the DNR prior to operation of the mine. See subsection E.5. on Trout Streams and Class 2A Waters for more details.

References

Minnesota Statute:

103G.255 ALLOCATION AND CONTROL OF WATERS OF THE STATE
103G.261 WATER ALLOCATION PRIORITIES
103G.281 WATER USE PROHIBITED WITHOUT MEASURING QUANTITIES
103G.282 MONITORING TO EVALUATE IMPACTS FROM APPROPRIATIONS.
103G.287 GROUNDWATER APPROPRIATIONS

Minnesota Rules:

6115.0710 ADDITIONAL REQUIREMENTS AND CONDITIONS FOR DEWATERING
6115.0730 WELL INTERFERENCE PROBLEMS INVOLVING APPROPRIATIONS
6115.0740 WATER USE CONFLICTS.
6115.0750 PROVISIONS AND CONDITIONS OF WATER APPROPRIATION PERMITS

DNR web page:

http://www.dnr.state.mn.us/waters/watermgmt_section/appropriations/index.html

LCMR Study of the Hydraulic Impacts of Limestone Quarries

files.dnr.state.mn.us/publications/waters/Quarries_Impacts_Section_2_Outcomes.pdf

B.2. WATER QUALITY

B.2.A. WELL SEALING

a. Description of Silica Sand Project Concerns

Silica sand operations require the use of groundwater wells for a variety of reasons. Wells are installed for monitoring purposes or when groundwater is needed for uses such as dewatering, industrial processes, and drinking water. Wells that are no longer in use can become buried and forgotten; if they have not been properly sealed, they may then act as a drain for surface runoff, debris, and other contaminants to groundwater supplies. Therefore, when wells are no longer in use or needed, to help ensure that groundwater is protected to the fullest extent possible, proper well sealing procedures should be implemented to help eliminate accelerated pathways for surface contaminants to reach the groundwater.

Pre-existing wells within the footprint of the mine site may also pose a risk to groundwater if damaged or altered during mining operations. Such wells, if still in use, require adequate protection to prevent damage. If they are not in use, they should be properly sealed or completely removed.

b. Narrative Description and Background Information

Minnesota Statute 103I.241 requires that any well or boring that threatens groundwater quality, or otherwise poses a threat to health or safety, or is not in use (unless the property owner has a maintenance permit), must be sealed by a licensed contractor. Once a well is sealed, the contractor must submit a well and boring sealing record to MDH. An existing well within the mine site footprint that is damaged and threatens groundwater, or any well installed during mine operations that is no longer needed, must be properly sealed to prevent potential contamination of the groundwater.

c. List of Silica Sand Project Potential Concerns

Potential impacts are applicable to both the Minnesota River Valley and the Paleozoic Plateau

Both the Minnesota River Valley and the Paleozoic Plateau have the:

- Potential for contaminants to discharge to and contaminate groundwater through unused, unsealed and/or abandoned wells.

d. Recommendations, Standards, Criteria, Considerations

For both the Minnesota River Valley and the Paleozoic Plateau, LGUs could consider the following:

1. In order to prevent contamination of groundwater through abandoned wells or wells previously used in silica sand operations, requirements should be put in place at the silica sand site for procedures and notifications on the closing of wells and borings on the mine property when they are no longer in use. Therefore, any unused, unsealed wells should be brought back into use or sealed in accordance with Minnesota Statutes, Chapter 103I, and Minn. R. 4725. A licensed contractor should be hired by the applicant to perform the sealing. The applicant should be required to submit notification to the LGU when well sealing has occurred.
2. In addition, if the applicant constructs any boreholes for the purpose of exploration, the boreholes should be properly sealed to prevent adverse impacts on groundwater sources. Documentation supporting proper borehole sealing should be submitted to the LGU.
3. Furthermore, prior to construction of any new silica sand operations, a study should be done by the applicant to identify all wells including any potential pre-existing unused or abandoned wells on the property and on property surrounding within one statute mile in all directions from property boundaries. At a minimum, this should include a review of the publicly available well records in the County Well Index (CWI). For residential properties in areas not serviced by a public water supply, but for which no well record exists in CWI, it should be assumed that a drinking water supply well is present and likely located near the residence. Documentation showing the results of this well search and inventory should be submitted to the LGU.

Additional information on the construction of wells can be found at <http://www.health.state.mn.us/divs/eh/wells/construction/>; further information on sealing of wells can be found at <http://www.health.state.mn.us/divs/eh/wells/sealing/>.

B.2.B. MONITORING AND MITIGATION PLANS

i. Groundwater quality monitoring and mitigation plan requirements with annual submittal

a. Description of Silica Sand Project Concerns

All mining operations pose a potential risk to groundwater as a result of the removal of protective geological materials that help to filter contaminants from water infiltrating from the

surface or prevent their migration into lower aquifers. Proper site planning, careful site management during mine operations, and appropriate site reclamation following completion of mining activities can help to minimize or eliminate risks to the groundwater, but this should be verified with monitoring.

Silica sand mining operations that infiltrate process wastewaters (meaning any discharge not comprised entirely of stormwater), water from mine pit dewatering (meaning any water that is impounded or that collects in the mine and is pumped, drained or otherwise removed from the mine through the efforts of the mine operator), or stormwater (meaning stormwater runoff, snow melt runoff, and surface runoff and drainage) should be required to conduct groundwater monitoring to assure that aquifers have not been adversely affected by site operations. Surface water monitoring may also be required if contaminated groundwater discharges to surface waters.

Some silica sand processing operations use flocculants to accelerate settling of fine-grained materials from sand washing water. This allows for the wash water to be rapidly recycled, so less water and smaller settling ponds may be used at the processing facility. The primary flocculants used are polyacrylamide and, less often, polydiallyldimethyl aluminum chloride (pDADMAC). While these chemicals are considered to be nontoxic and are used in the food production and drinking water treatment industries, small residual amounts of the chemicals from which they are formed, acrylamide and diallyldimethyl aluminum chloride (DADMAC) are found in the flocculants and may pose a risk for groundwater and surface water contamination. As a result, it is critical that flocculant addition rates are controlled to keep acrylamide concentrations below levels of health concern; any waters or water-sediment slurries that may contain acrylamide are properly managed to prevent degradation of water quality; and adequate monitoring is employed to detect any changes in water quality. There is some evidence to suggest that acrylamide may be present in some blasting agents, however further study is needed to distinguish contributing sources and cumulated impacts of acrylamide in the environment. If additional evaluation confirms that some blasting agents are a source of acrylamide, additional monitoring requirements may be established to protect water quality. No analytical methods have yet been developed for pDADMAC or DADMAC.

In addition to generating wastewater that requires proper management, mine excavation below the water table and subsequent dewatering, may create new pathways for shallow groundwater contaminants to migrate to deeper aquifers. This is of particular concern in the Minnesota River Valley Region, where accessing the Jordan Sandstone often requires the removal of confining layers near the base of the Prairie du Chien Group. Dewatering of the upper Jordan may create a localized “cone of depression” that can draw any shallow groundwater contaminants downward into the deeper aquifer.

A related concern is that mines requiring dewatering may also require engineered infiltration galleries (meaning a pond, trench, or other structure through which water is infiltrated to control the potentiometric surface of groundwater in order to mitigate the effects of dewatering on nearby wells or natural features, such as wetlands and surface water bodies) to prevent drawdown impacts to nearby wells or surface water features. Infiltration galleries in limestone or dolomite formations may potentially create conditions conducive to the formation of karst

features, such as sinkholes and solution cavities, which can accelerate the migration of surface contaminants to groundwater.

b. Narrative Description and Background Information

The type of mine operation, hydrogeologic setting, and presence of groundwater users and contaminant sources will determine the specific groundwater monitoring and mitigation requirements for a given mine site. Thorough site characterization is critical to the development of appropriate groundwater monitoring and mitigation plans. Issues to consider include:

- The amount and type of geologic materials to be removed and the potential for this to increase the vulnerability of groundwater to contamination;
- The type of wastewater (e.g., from sand processing, dewatering, or stormwater) stored in ponds or reinfiltreated at the site;
- The proximity of the site to surface water features and the potential for those surface waters to enter the mine site during periods of flooding;
- The type and volumes of chemicals used at the site and their potential to reach the groundwater;
- The use of dewatering at the mine, its potential to alter local groundwater flow systems and aquifer characteristics, and the possibility of capturing any nearby groundwater contaminant plumes;
- The potential for infiltration galleries and similar structures, used to manage dewatering drawdown impacts, to alter aquifer characteristics and increase the potential for contaminants to reach the groundwater; and
- The location and proximity of groundwater users (especially public or private drinking water wells) and sensitive surface waters that may be negatively impacted by any changes to groundwater quality or chemistry.

Groundwater in the Paleozoic Plateau of SE Minnesota is particularly vulnerable to contamination due to its really extensive karst landscape. Karst development occurs from the dissolution of carbonate bedrock. Karst features such as sinkholes, caverns, and solution-enlarged fractures allow infiltrating surface water and any contaminants it contains to rapidly enter the groundwater system and move large distances, without the beneficial filtering that occurs in most non-karsted aquifers. While karst features may be present within the Minnesota River Valley (MRV), their location and distribution is not as well-studied as in the Paleozoic Plateau. In addition, the area where bedrock is within 50 feet from the surface is restricted to a narrow ribbon within the MRV, which is a significantly smaller area than the Paleozoic Plateau karst landscape.

Sinkholes and other karst features tend to align along large bedrock joints that allow vertical migration of infiltrating water through otherwise massive, low permeability limestone and dolomite to occur. In SE MN, these joints are often present in subparallel, intersecting sets and sinkholes are particularly apt to form where two joints intersect. Investigations in SE MN have determined that sinkholes and other karst features are particularly likely to occur in areas where the contact zone between the Shakopee and Oneota members of the Prairie du Chien formation

is at or near the surface of the bedrock beneath a thin (<50 feet) layer of overlying sedimentary deposits and/or when this zone is near the water table (Dalglish and Alexander, 1984; Alexander and Maki, 1988; Alexander, et al., 2013). Also, activities that alter surface drainage to sinkholes may result in new sinkholes opening nearby (Alexander and Lively, 1995). Sinkholes are also known to form in the basal St. Peter Sandstone, often due to the upward propagation of karst features from the underlying carbonate formations.

Because of the greater risk to groundwater in the Paleozoic Plateau, the hydrogeologic evaluation of proposed mine sites in SE Minnesota should include an assessment of on-site and nearby karst features, including an evaluation of the alignments of mapped karst features within a one mile radius of the proposed mine to determine possible locations of intersecting joint sets. New remote sensing tools, such as LiDAR (Light Ranging and Detection), provide imagery that reveals surface and near surface structures better than aerial photography and should be used to locate currently unmapped karst features. In areas mapped as having a high probability of karst formation (or where the contact of the Shakopee and Oneota members of the Prairie du Chien group is less than 50 ft. below the ground surface and/or at or near the water table), geophysical surveys may be required to evaluate the subsurface below the proposed mine for karst features. This investigation could be used to consider establishing, on a case by case basis, mining setbacks from any sinkholes, disappearing streams and blind valleys that may be of concern.

Mining activities in areas of SE Minnesota designated by the Minnesota Department of Natural Resources, in Part B of the County Geologic Atlases, as having a “moderate to high probability of karst development” should be analyzed carefully. Removal of sand-bearing formations below the elevation of the surrounding land surface could lead to the creation of a depression in the bedrock surface that might act as a focal point for water infiltration that may accelerate karst formation. In addition, it should be noted that the very act of removing the overlying sandstone may increase the probability of karst development, causing an area designated as low or moderate probably to having a moderate or high probability.

Additionally, mining activity that occurs in the Decorah Edge, and its respective “Edge Support Areas,” should also be analyzed carefully. Removal of soils or aquifer materials in these critical aquifer recharge and filtration zones may result in degraded water quality. If mining is allowed to occur in these areas, care must be taken to ensure the mining activities do not alter the groundwater flow patterns that sustain the ecologically fragile springs, seeps, and wetlands of this region and provide groundwater filtration and aquifer recharge critical to numerous city water supplies.

In the Minnesota River Valley, only the base of the Prairie du Chien Group is usually present and is removed by the mining activities, as the target formation is the underlying Jordan Sandstone. Since many of these mines are at least partially dewatered during active mining, water quality issues within the mines would tend to have more impact on the Jordan aquifer than the overlying Prairie du Chien. However, changes in the water table elevation as a result of dewatering and/or infiltration of excess water through infiltration galleries or other structures may locally affect karst feature formation in the Prairie du Chien and could result in water quality impacts to that

aquifer. Where dewatering or infiltration is planned, the presence of karst features, or the potential for their formation, should be evaluated as described above.

c. List of Silica Sand Project Potential Impacts

It is important to understand the regional hydrogeology of a project and to adjust groundwater monitoring accordingly. If silica sand mining and/or operations occur in an area outside of the two regions indicated below, then whichever geology and hydrology most closely matches that at the proposed site should be the set of recommendations followed. It is recommended that, if needed, the LGU hire a consultant to assist with the recommendations below and charge the fee to the applicant; different consulting firms should be used by the LGU and applicant.

It should also be noted that some of the following recommendations may be included as a requirement in a state National Pollutant Discharge Elimination System (NPDES)/State Disposal System (SDS) permit. However, not all silica sand facilities are required to obtain state permits. Additionally, depending on the type of state permit the facility is eligible for, certain requirements and conditions such as groundwater monitoring may or may not be included. LGUs can contact state agencies with any questions on when a state permit is required and what may or may not be covered in a state permit.

In a recent survey of LGUs by EQB for the purposes of this document, 13 of 16 respondents reported that they defer to State requirements for addressing any non-metallic mining water quality concerns. Of the participating LGUs, 44% (7 of 16 respondents) developed or negotiated water monitoring plans with permittees. The LGU monitoring plans included groundwater static water level measurements (2 of 7 responses), groundwater quality sampling (2 of 7 responses), stream water quality sampling (1/ 7 responses), spring or seep water quality sampling (1 of 7 responses and other types of monitoring (4 of 7). Not included were stream gaging, lake or wetland depths, and spring or seep discharge measurements. In regards to mitigation plans, 19% (3 of the 16 responses) of the participating LGUs developed or negotiated a mitigation process and requirements, 88% (14 of 16 responses) defer to State Wetland Conservation Act or Public Waters requirements, and 56% (9 of 16 responses) defer to Federal requirements.

Both the Minnesota River Valley and the Paleozoic Plateau have the:

- Potential for process wastewater, dewatering and stormwater constituents to contaminate groundwater;
- Potential for dewatering to capture nearby contaminant plumes;
- Potential for contaminated groundwater to discharge to surface waters and cause contamination;
- Potential for re-infiltrated waters to change aquifer characteristics; and
- Potential for complex hydrogeology, high groundwater flow velocities and sensitivity to contamination.

Minnesota River Valley Consideration:

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- Potential for removal of confining layers above Jordan Sandstone and increased potential for shallow groundwater contamination being drawn downward due to mine pit dewatering.

d. Groundwater Monitoring and Mitigation Plan Recommendations, Standards, Criteria, Considerations:

i. Groundwater Monitoring Plan

1. Site Characterization:

- a. Review of all available geologic and hydrogeologic information for the site and provide:

- i. Assessment of and map indicating groundwater elevation, hydrologic gradient, and groundwater flow direction for the project area.
- ii. Cross-section showing pre-mining overburden and deposit thickness, geologic composition, and the approximate groundwater elevation as determined by hydrogeological investigations.
- iii. Cross-section showing post-mining topography of project site and thicknesses of remaining geologic formations
 1. *Paleozoic Plateau*: indicate if the contact of the Shakopee and Oneota members of the Prairie du Chien group will be less than 50 feet below the ground surface, as this is a predictor of increased potential for sinkhole formation (Dalglish and Alexander, 1984; Alexander and Maki, 1988; Alexander, et al., 2013).
- iv. Assessment of groundwater vulnerability before, during, and after mine operations.
- v. Identification of any chemicals, such as flocculants, that will be used at the site, description of how the chemicals will be managed, and an evaluation of any potential pathways for the chemicals to enter surface water or groundwater.
- vi. *Paleozoic Plateau*:
 1. Review all available on-line databases, aerial photos and LiDAR images to identify any karst features within one mile of the project site, including possible intersections of joint sets.
 2. Identify any structural bedrock features such as anticlines, synclines, monoclines and domes, as such features are often associated with higher densities of bedrock fracturing.
 3. Conduct an on-the-ground site reconnaissance to identify any karst features on and within 500 feet of the project site.
 - a. Karst features include: open and filled sinkholes, sinkhole drainage areas, depressions, known caves, resurgent springs, seeps, disappearing streams, karst windows, blind or dry valleys, and open fractures and joints.

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- ii. Additional wells may be needed over time if site monitoring indicates groundwater flow directions differ significantly than those used in planning the monitoring well network.
 - iii. In areas where dewatering or infiltration is occurring, or vertical flow of groundwater is otherwise indicated, the monitoring well network should include nested wells to detect vertical movement of groundwater and contaminants.
 - b. The network must include monitoring wells located between the project site and any downgradient groundwater receptors, such as public or private drinking water wells.
 - i. The depth of such monitoring wells should be appropriate for detecting any site-related contaminants migrating toward the drinking water well.
 - c. At mines where dewatering occurs, monitoring wells should be placed between the project site and any off-site contaminants that may be drawn toward the project site.
 - d. Bedrock monitoring wells could be considered and be logged (gamma, caliper, video, fluid temperature, and conductivity/resistivity) in order to identify zones of preferential flow. Information provided by these monitoring wells may be especially beneficial if a contaminant spill were to occur.
 - e. *Minnesota River Valley Region*
 - i. Regional groundwater flow for mines in this area will generally be toward the Minnesota River, but the potential influence of bedrock structures such as buried bedrock valleys and upwelling from deeper aquifers near the river should be considered in planning monitoring well networks for this region.
 - f. *Paleozoic Plateau*
 - i. The complexity of the hydrogeology of this region requires careful tailoring of monitoring well networks to site-specific conditions and should account for and intercept:
 - 1. significant fluctuations in water table elevations typical of karsted aquifers, and
 - 2. the presence of high permeability zones along bedding planes
 - a. If no such zones are identified in the site characterization, wells should be cased to the depth where competent rock is encountered and left open below that for a minimum interval of ten (10) feet.
 - ii. Natural monitoring points, such as springs, cave streams, and seeps identified as being potential discharge points for groundwater from the facility must be incorporated into the groundwater monitoring network.
 - iii. Dye tracer studies can also be employed to determine flow regimes.
 - g. All monitoring well construction shall follow MDH requirements in Minn R. Chapter 4725. Any silica sand operation should be consistent with wellhead protection (WHP) plans as outlined in MN Rules 4720 and the Wellhead Protection Issues Related to Mining Activities document created by the Minnesota Department of Health in August 2009; this document can be found at: <http://www.health.state.mn.us/divs/eh/water/swp/mining.pdf>

3. Sample Collection and Analysis

- a. Prior to mining operations at the site, groundwater samples should be collected from monitoring wells and nearby drinking water wells to evaluate “background” groundwater quality. This important step could be accomplished by sampling from any or all of the following:
 - i. Monitoring wells
 - ii. Nearby drinking water wells
 - iii. Natural monitoring points, such as springs, cave streams, and seeps identified as being potential discharge points for groundwater from the facility.
- b. The hydraulic conductivity and groundwater flow velocity of the potentially affected aquifer(s) should be determined to help set an appropriate sampling frequency.
- c. The frequency of groundwater monitoring well sampling once mining begins will vary depending on the hydrogeologic setting and site operations, however, a typical monitoring plan initially requires quarterly monitoring. The frequency of sampling may change in response to such things as:
 - i. Sampling results over time that support either more or less frequent sample collection;
 - ii. Potential contamination events, such as chemical releases within the project site or flood waters from a nearby surface water entering the mine pit or infiltration areas;
 - iii. Detection of site-related contaminants or changes in groundwater chemistry.
- d. The parameters analyzed will vary depending on the hydrogeologic setting and site operations, however a typical analyte list includes:
 - i. pH
 - ii. specific conductivity
 - iii. temperature
 - iv. total coliform bacteria
 - v. nitrite + nitrate-nitrogen
 - vi. naturally occurring metals, such as iron, manganese, and arsenic, that may be mobilized as a result of changing groundwater chemistry
 - vii. petroleum hydrocarbons or volatile organic compounds (VOCs) to detect any leakage from vehicles or other equipment used at the site.
- e. In addition to the above, monitor on an annual basis (at least initially) for:
 - i. Hardness
 - ii. Aluminum (dissolved and total), antimony, barium, beryllium, boron, cadmium, chromium, cobalt, copper, lead, magnesium, molybdenum, nickel, selenium, silver, thallium, total tin, and zinc.
- f. The frequency of drinking water well monitoring near the site should be based on aquifer hydraulic conductivity and distance and direction of the well from the project site, but initially should be at least annual.

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- i. Detection in monitoring wells of site-related contaminants, bacteria, or changes in groundwater chemistry should result in sampling of downgradient private wells.
 - ii. As a precaution, if flood waters enter the mine pit or site infiltration areas, downgradient drinking water wells should be sampled for bacteria and any other relevant contaminants.
 - g. At sites where flocculants will be used, the following chemicals should be included in the groundwater monitoring (both before and after mining begins):
 - i. Polyacrylamide-based flocculants:
 - 1. Acrylamide
 - 2. Total Kjeldahl nitrogen (EPA method 351.2)
 - 3. Nitrate + nitrite (EPA method 353.2)
 - ii. Poly-diallyldimethylammonium chloride (p-DADMAC) based flocculants:
 - 1. p-DADMAC, if an analytical method is available
 - 2. Diallyldimethylammonium chloride (DADMAC), if an analytical method is available.
 - h. At minimum, all sampling and monitoring results should be submitted to the LGU on an annual basis. Any monitoring and sampling that shows potential of contamination should be subject to additional monitoring and to mitigation by the applicant as requested by the LGU following their review of the previous year's results.
 - i. Groundwater monitoring should continue for some period of time following the cessation of mining activities to monitor for contaminant migration over time and to ensure the adequacy of site reclamation. The duration and frequency of sampling will vary depending on the hydrogeologic setting, previous sampling results, site operation history (i.e. any record of chemical spills or flooding), etc., but should continue for no less than 5 years following final site reclamation. Further monitoring should be based on a review of the monitoring data compiled up to that time.
 - j. *Paleozoic Plateau*
 - i. The inherent variability of karst settings should be evaluated by sampling during three major recharge events (i.e. large rainfall event or snowmelt) prior to the start of mining operations to characterize groundwater flow. This should include measurement of:
 - 1. hydraulic head, temperature and specific conductance at nearby wells, and
 - 2. discharge volume, temperature, and specific conductance at natural discharge points such as springs.
 - ii. These same parameters should also be measured at these points during all other routine site monitoring events.
 - k. *Minnesota River Valley Region*
 - i. Many areas of this region have naturally occurring elevated concentrations of manganese in the groundwater. Monitoring of this metal, both before, during, and after mining operations should be required to determine if changes in water chemistry at or near the project site affect these already high concentrations.

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- ii. Where the site evaluation indicates the presence of karst features on or near the mine site, sampling during three major recharge events, to the extent possible, as described above for the Paleozoic Plateau, should also occur.

ii. Groundwater Mitigation Plan

- a. The applicant shall provide a plan for responding to detections of site-related contaminants or alterations in groundwater chemistry. This plan must specify:
 - i. Response actions to be taken for detections in monitoring wells; and
 - ii. Response actions to be taken for detections in drinking water wells.

ii. Surface Water Quality Monitoring and Mitigation Plan Requirements with Annual Submittal

a. Description of Silica Sand Project Concerns

Silica sand mining operations that have process wastewaters (meaning any discharge not comprised entirely of stormwater), mine pit dewatering (meaning any water that is impounded or that collects in the mine and is pumped, drained or otherwise removed from the mine through the efforts of the mine operator), or stormwater (means stormwater runoff, snow melt runoff, and surface runoff and drainage) have the potential to impact surface waters (meaning all streams, lakes, ponds, marshes, wetlands, reservoirs, springs, rivers, drainage systems, waterways, watercourses, and irrigation systems whether natural or artificial, public or private). Silica sand mining operations that have process wastewaters, dewatering and/or stormwater discharges to surface waters are required per Minn. R. 7001.0150 to conduct wastewater and surface water monitoring to assure that waters of the state (meaning all streams, lakes, ponds, marshes, wetlands, watercourses, waterways, wells, springs, reservoirs, aquifers, irrigation systems, drainage systems and all other bodies or accumulations of water, surface or underground, natural or artificial, public or private, which are contained within, flow through, or border upon the state or any portion thereof) have not been adversely affected by site operations.

b. Narrative Description and Background Information

Differences in surface water monitoring and mitigation plan requirements for site wastewater management and direct runoff to surface waters are not expected for the different regions of the state (MN River Valley and Paleozoic Plateau). However, the potential for rapid movement of groundwater to surface water without benefit of filtration by aquifer materials, which is typical in karsted areas such as the Paleozoic Plateau, means surface waters in that region may be more vulnerable to contamination from silica sand mining. Surface water sampling plans should reflect the possibility of groundwater discharge to surface waters in this region. Groundwater discharge points to surface waters identified during site characterization should be monitored for site-related contaminants and changes to water chemistry, as discussed in the Groundwater

Monitoring and Mitigation Plans subsection. Additional sampling of the receiving surface waters should be based on these results. If silica sand mining and/or operations occur in an area outside of the two regions indicated below, then whichever geology and hydrology most closely matches that at the proposed site should be the set of recommendations followed. It is recommended that, if needed, the LGU hire a consultant to assist with the recommendations below and charge the fee to the applicant; different consulting firms should be used by the LGU and applicant.

It should also be noted that process wastewaters, dewatering, and stormwater discharges are likely covered under a state National Pollutant Discharge Elimination System (NPDES)/State Disposal System (SDS) permit. However, not all silica sand facilities are required to obtain state permits. Additionally, depending on the type of state permit the facility is eligible for, the following monitoring recommendations and conditions may or may not be included. LGUs can contact state agencies with any questions on when a state permit is required and what may or may not be covered in a state permit.

In a recent survey of LGUs by EQB for the purposes of this document, 13 of 16 respondents reported that they defer to State requirements for addressing any non-metallic mining water quality concerns. Of the participating LGUs, 44% (7 of 16 respondents) developed or negotiated water monitoring plans with permittees. The LGU monitoring plans included groundwater static water level measurements (2 of 7 responses), groundwater quality sampling (2 of 7 responses), stream water quality sampling (1/ 7 responses), spring or seep water quality sampling (1 of 7 responses and other types of monitoring (4 of 7). Not included were stream gaging, lake or wetland depths, and spring or seep discharge measurements. In regards to mitigation plans, 19% (3 of the 16 responses) of the participating LGUs developed or negotiated a mitigation process and requirements, 88% (14 of 16 responses) defer to State Wetland Conservation Act or Public Waters requirements, and 56% (9 of 16 responses) defer to Federal requirements.

c. List of Silica Sand Project Potential Impacts

Both the Minnesota River Valley and the Paleozoic Plateau have the:

- Potential for process wastewater, mine pit dewatering, and stormwater constituents to discharge to surface waters and cause contamination.

Minnesota River Valley

- As most of the mine dewatering activities are likely to happen in in this region, some additional focus on possible impacts of dewatering and associated wastewater management may be necessary for mines along the Minnesota River Valley.

Paleozoic Plateau

- Karst features, such as sinkholes, caves, and solution enlarged fractures, can accelerate movement of site-related contaminants from groundwater to surface waters. Additional surface water monitoring may be needed, based on the site characterization, to evaluate whether site-related contaminants are impacting nearby surface waters.

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- Additional precautions should be required if wastewater pond construction will occur in karst regions due to the potential for sinkhole development beneath such structures.

d. Recommendations, Standards, Criteria, Considerations

As mentioned above, there are three potential types of surface water discharges from silica sand mining and processing operations: process wastewaters (e.g., wash water), dewatering, and stormwater discharges. To the degree possible, this water should be captured on-site and reused, to minimize water demand. If water is infiltrated on-site then proper infiltration techniques, good engineering, and best management practices need to be in place to protect groundwater from potential contamination.

Therefore, to ensure that these discharges do not pose a risk to surface and groundwater contamination, the following requirements are recommended:

i. Surface Water Monitoring Plan

1. **Process wastewater:** Process wastewaters (e.g., wash water) that occur at silica sand operations are often treated through the use of settling ponds. If chemical additives, such as flocculants, are used to treat process wastewaters at silica sand mines then additional precautions are needed. Flocculants are a chemical additive commonly used by silica sand operations to speed up the settling rate of very fine particles present in the wastewater. If chemical additives, such as flocculants, are proposed for use by the applicant, then:
 - a. Lining of all settling ponds is recommended so that a closed-loop system with no discharges to waters of the state (groundwater and/or surface water) is obtained. Lining of settling ponds should be in compliance with state requirements; more information on pond lining can be found at <http://www.pca.state.mn.us/index.php/water/water-types-and-programs/wastewater/wastewater-technical-assistance/wastewater-engineering/technical-information.html>
 - i. If wastewater ponds are lined and a closed-loop system is in place so that no discharges to waters of the state are occurring (i.e., no discharge to surface waters or groundwater), then process wastewater monitoring for the parameters listed below is likely not needed, but is at the discretion of the LGU.
 - b. If wastewater ponds are not lined and a close-loop system is not in place, and discharges to waters of the state will occur, in addition to any required state NPDES/SDS permit, then the following monitoring of process wastewater, as needed based on site specific conditions, is recommended:
 - i. For process wastewater discharges to groundwater, follow the Sample Collection and Analysis recommendations found in the Groundwater Monitoring Plan section above.
 - ii. For process wastewater which will discharge to a surface water(s), monitoring on a quarterly basis is recommended for:

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- a. Total suspended solids (TSS)
 - b. pH
 - c. Temperature
 - d. Specific conductivity
 - e. Flow
 - f. Oil & grease and surfactants
 - g. Chemical additives
 - a. If polyacrylamide flocculants are used, then **monthly** monitoring of acrylamide, total Kjeldahl nitrogen (EPA Method 351.2), and nitrate+nitrite (EPA Method 353.2) in the process wastewater and any *waste or water-sediment slurry* should be required initially (reduced sampling frequency may be considered after two years of monitoring has occurred). In addition a dosage rate of polyacrylamide flocculant should be limited to 1 ppm with no more than 0.05% residual monomer, by weight, present in the flocculant so that that the concentration of residual acrylamide monomer does not exceed 0.5 ppb, the National Primary Drinking Water Regulation (NPDWR) established by the US Environmental Protection Agency (EPA) for acrylamide, or any future health based value determined by Minnesota Department of Health, in the wastewater, groundwater, and/or slurry.
 - b. Once analytical methods are developed to detect poly-diallyldimethylammonium chloride (pDADMAC) and diallyldimethylammonium chloride (DADMAC), if pDADMAC flocculants are used, then **monthly** monitoring of pDADMAC and DADMAC in the process wastewater, groundwater, and any *waste or water-sediment slurry* should be required. Reduced sampling frequency may be considered after two years of monitoring has occurred.
 - c. Studies indicate that acrylamide, pDADMAC, and DADMAC are readily degraded in surface water, but less readily so in groundwater. Where process wastewater that contains such chemicals is eventually discharged to the groundwater, the LGU may consider requiring degradation testing to determine the appropriate retention time in the holding ponds before the water can be discharged to the mine or infiltrated to the groundwater.
 - i. In addition to the parameters listed above, monitor on an annual basis (at least initially) for:
 - 1. Hardness
 - 2. Antimony, arsenic, beryllium, cadmium, chromium, copper, lead, nickel, selenium, silver, thallium, and zinc.
 - 3. Aluminum, barium boron, cobalt, iron, magnesium, manganese, molybdenum, total tin, and total aluminum.Additional parameters may be needed based on site specific conditions.
 - ii. The frequency of sampling may change in response to events such as:

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4. Sampling results over time that support either more or less frequent sample collection;
 5. Potential contamination events, such as chemical releases within the project site or flood waters from a nearby surface water entering the mine pit;
 6. Detection of site-related contaminants.
- iii. It is recommended that applicants monitor any *water-sediment slurries used as backfill* for all parameters as listed above. It is further recommended that such water-sediment slurries not be discharged to the mine in which contact with groundwater will occur until they meet state and federal health-based drinking water criteria if applicable.
 - iv. It is also recommended that prior to mine construction the applicant monitor any nearby surface waters that could receive discharges from the silica sand operation (within 1 mile radius of the site property boundaries) for all parameters listed above to establish a baseline for natural background conditions.
 - v. All parameters above should be monitored for following the completion of all post-construction and reclamation activities to ensure that any potential negative impact to nearby surface waters is not occurring. Considerations used in the Groundwater Monitoring Sample Collection and Analysis part could be applied here (see section B.2.b.i.d.3.i.).
 - vi. At minimum, all sampling and monitoring results should be submitted to the LGU on an annual basis.
- d. Regardless of whether a closed or open loop system is utilized for wastewater treatment at silica sand operation, proper wastewater basin construction is vital to protect against potential overflow and other issues associated with improper basin design that could lead to contamination of waters of the state. The LGU should require submittal of all engineering specifications for the design and construction of all wastewater basins to ensure appropriate wastewater basin design standards have been met. At minimum, the wastewater basins should be designed to hold all precipitation and wastewater and should be managed to maintain the design capacity of the system. In addition, wastewater basins should be designed with a minimum of three feet freeboard as a factor of safety. Wastewater pond design criteria can be found in the Recommended Pond Design Criteria manual located at <http://www.pca.state.mn.us/index.php/view-document.html?gid=11503> .
 - a. *Paleozoic Plateau and where bedrock is within 50 feet of the surface within the Minnesota River Valley*: In addition to the requirements listed above in a. through c., for wastewater pond construction within karst regions of the state, the pond site should not be located on sites which show evidence of karstification (i.e. sink holes or solution channeling generally occurring in areas underlain by limestone or dolomite). Proposed pond sites as well as existing pond sites which are being upgraded should be subject to intensive hydrogeologic and geotechnical site evaluation before approval can be given if they exist in a known or suspected karst region. This evaluation should include not only an assessment of the current potential for karst feature development, but also whether the mining activities will alter the bedrock topography in ways that may increase the potential for karst

feature development (including post-reclamation). Before approval of a pond site in a karst area, the applicant may be required to utilize additional lining materials beyond normal sealing requirements. An intensive hydrogeological and geotechnical site evaluation in karst areas would be required and include seismic and resistivity studies of the site.

- e. Any monitoring and sampling that shows potential of contamination should be subject to additional monitoring and to mitigation by the applicant as requested by the LGU following their review of the previous year's results.
2. Mine Pit Dewatering: Dewatering discharges present at silica sand operations typically consist completely of groundwater and stormwater (no process wastewaters). Dewatering discharges consisting solely of uncontaminated groundwater and stormwater, with no chemical additives, typically pose low risk to the environment. Therefore, discharge to surface waters and groundwater, with appropriate state permits, is usually acceptable. *If the dewatering discharge contains chemical additives, then it should be treated as a process wastewater and recommendations listed above for Process Wastewater should be followed.*

For dewatering discharges (consisting solely of uncontaminated groundwater and stormwater) to surface waters and groundwater, monitoring of the following parameters and conditions, as needed based on site specific conditions, are recommended:

- a. For dewatering discharges to groundwater, follow the Sample Collection and Analysis recommendations found in the Groundwater Monitoring Plan section above.
- b. For dewatering discharges which will discharge to a surface water(s), monitoring on a quarterly basis is recommended for:
 - 1. Total suspended solids (TSS)
 - 2. pH
 - 3. Temperature
 - 4. Specific conductivity
 - 5. Flow
- c. In addition to the above, monitor on an annual basis (at least initially) for:
 - a. Hardness
 - b. Antimony, arsenic, beryllium, cadmium, chromium, copper, lead, nickel, selenium, silver, thallium, and zinc.
 - c. Aluminum, barium boron, cobalt, iron, magnesium, manganese, molybdenum, total tin, and total aluminum.

Additional parameters may be needed based on site specific conditions, particularly if there are known areas of groundwater contamination or sources of potential groundwater contaminants located within the capture zone of the dewatering system.

- d. The frequency of sampling may change in response to events such as:
 - i. Sampling results over time that support either more or less frequent sample collection;

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- ii. Potential contamination events, such as chemical releases within the project site or flood waters from a nearby surface water entering the mine pit;
 - iii. Detection of site-related contaminants.
 - e. It is also recommended that the applicant monitor any nearby surface waters that could receive dewatering discharges from the silica sand operation (within 1 mile radius of the site property boundaries) for all parameters listed above, pre-construction, to establish a baseline for natural background conditions.
 - f. All parameters above should be monitored for following the completion of all post-construction and reclamation activities to ensure that any potential negative impact to nearby surface waters is not occurring. Considerations used in the Groundwater Monitoring Sample Collection and Analysis part could be applied here (see section B.2.b.i.d.3.i.).
 - g. In addition to the monitoring requirements listed above, the following conditions should be in place at silica sand operations if dewatering will occur:
 - 1. Any outlet pipe, culvert or hose outlets for the discharge should all be located on the ground. The silica sand operation should install and maintain outlet protection measures such as properly sized riprap, splash pads, or gabions at the discharge stations to prevent erosion.
 - 2. All water from dewatering or basin draining activities should discharge in a manner that does not cause nuisance conditions, erosion in receiving channels and/or on downslope properties, or inundation in wetland causing significant adverse impact to the wetland.
 - 3. Dewatering activities should be suspended when downstream flooding is occurring, to the extent possible, to further prevent increased erosion of receiving stream channels.
 - h. At minimum, all sampling and monitoring results should be submitted to the LGU on an annual basis. Any monitoring and sampling that shows potential of contamination should be subject to additional monitoring and to mitigation by the applicant as requested by the LGU following their review of the previous year's results.

3. Stormwater: Stormwater present at silica sand operations can become contaminated when runoff comes in contact with industrial activities, processes, and/or significant materials (significant materials includes, but is not limited to: raw materials; materials such as solvents, degreasers, detergents, fuels, and lubricants; fertilizers and pesticides; finished materials such as nonmetallic products; and waste products such as slurry that have the potential to be released with stormwater discharges. When determining whether a material is significant, the physical and chemical characteristics of the material should be considered (e.g., the material's solubility, transportability, and toxicity characteristics) to determine the material's pollution potential. In addition to monitoring, appropriate stormwater controls, as discussed in the next section, C. Stormwater management, should be implemented to protect stormwater runoff from contamination.

For stormwater discharges to waters of the state, monitoring of the following parameters and conditions, as needed based on site specific conditions, is recommended:

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- a. For stormwater runoff discharges to groundwater, follow the Sample Collection and Analysis recommendations found in the Groundwater Monitoring Plan section above.
 - b. Stormwater runoff leaving silica sand operations site property boundaries should be no different than pre-project rates (more on this in C. Stormwater management section).
 - c. For any stormwater runoff that is discharging to surface waters, in addition to any required state NPDES/SDS permits, the following monitoring requirements, as needed based on site specific conditions, should be in place:
 - d. Monitoring on a quarterly basis is recommended for:
 - a. Total suspended solids (TSS)
 - b. pH
 - c. Temperature
 - d. Specific conductivity
 - e. In addition to the above, monitor on an annual basis (at least initially) for:
 - a. Hardness
 - b. Antimony, arsenic, beryllium, cadmium, chromium, copper, lead, nickel, selenium, silver, thallium, and zinc.
 - c. Aluminum, barium boron, cobalt, iron, magnesium, manganese, molybdenum, total tin, and total aluminum.
 - f. Additional parameters may be needed based on site specific conditions.
 - g. The frequency of sampling may change in response to events such as:
 - i. Sampling results over time that support either more or less frequent sample collection;
 - ii. Potential contamination events, such as chemical releases within the project site;
 - iii. Detection of site-related contaminants.
 - h. It is also recommended that the silica sand operation monitor stormwater runoff that has not come into contact with any industrial activity, processes, or significant materials for all parameters listed above to obtain natural background conditions for comparison.
 - i. All parameters above should be monitored for following the completion of all post-construction and reclamation activities to ensure that any potential negative impact to nearby surface waters and groundwater is not occurring.
 - j. At minimum, all sampling and monitoring results should be submitted to the LGU on an annual basis. Any monitoring and sampling that shows potential of contamination should be subject to additional monitoring and to mitigation by the applicant as requested by the LGU following their review of the previous year's results.

ii. Surface Water Mitigation Plan

- a. Any monitoring and sampling that shows potential of contamination to surface waters should be subject to mitigation by the applicant as requested by the LGU.
 - i. The applicant should provide a plan for responding to detections of site-related contaminants or alterations in surface water quality. The plan should specify

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1. Response action to be taken for detections in surface waters.

B.2.C. STORMWATER MANAGEMENT

i. Stormwater Management Plan Elements

a. Description of Silica Sand Project Concerns

Silica sand mining operations that have stormwater (meaning stormwater runoff, snow melt runoff, and surface runoff and drainage) have the potential to impact surface waters (meaning all streams, lakes, ponds, marshes, wetlands, reservoirs, springs, rivers, drainage systems, waterways, watercourses, and irrigation systems whether natural or artificial, public or private) and groundwater. Stormwater runoff can come into contact with silica sand mining processes and significant materials (i.e., materials with potential to contaminate stormwater). Stormwater runoff that is contaminated by industrial activities and significant materials may lead to contamination of receiving surface water and groundwater. Therefore, stormwater controls and best management practices (BMP) should be implemented to protect surface and groundwater from contamination.

Stormwater runoff can become contaminated through contact with significant materials such as storage piles, process equipment, and dust emitted during processing. Stormwater can be discharged two ways: through groundwater or surface water. The site should enclose all significant materials to the extent possible and contain all stormwater on-site to prevent contamination of nearby surface waters. Evapotranspiration or proper infiltration methods should be used to treat stormwater prior to discharge to groundwater.

In areas prone to sinkhole development, alterations of sinkhole drainage areas may result in formation of new sinkholes nearby, with the potential for unanticipated impacts to groundwater and surface water. The stormwater management plan should identify and avoid, or minimize and mitigate, any changes to surface drainage to nearby sinkholes.

It should also be noted that stormwater management is typically regulated through required state National Pollutant Discharge Elimination System (NPDES)/State Disposal System (SDS) stormwater permits. If LGUs have questions on the types of stormwater discharges that are regulated through state permits and what these permits requirements consist of, LGUs can contact the Minnesota Pollution Control Agency.

In a recent survey of LGUs by EQB for the purposes of this document, 11 of 15 respondents reported that they defer to State Wetland Conservation Act or Public Waters requirements for addressing any concerns related to: erosion control, on-site stormwater management, temporary sand storage, and stormwater pond design. Of the participating LGUs, 40% (6 of 15 respondents) developed or negotiated a stormwater management process and requirements with permittees.

b. Narrative Description and Background Information

Pollutants conveyed in stormwater discharges from active and inactive mineral mining and processing facilities will vary. A number of factors influence to what extent industrial activities and significant materials can affect stormwater discharges and water quality:

- Mineralogy of the extracted resource and the surrounding rock
- How the mineral was extracted (e.g., quarrying/open face, dredging, solution, or underground mining operations)
- Type of ground cover (e.g., vegetation, crushed stone, or dirt)
- Outdoor activities (e.g., material storage, loading/unloading, vehicle maintenance)
- Size of the operation
- Type, duration, and intensity of precipitation events
- Inadequate BMPs

These factors should be taken into consideration so that stormwater control and BMPs utilized on site are adequate and effective in preventing contamination of waters of the state from impacted stormwater.

c. List of Silica Sand Project Potential Impacts

Both the Minnesota River Valley and the Paleozoic Plateau have the:

- Potential for stormwater constituents to discharge to waters of the state and cause contamination.

d. Recommendations, Standards, Criteria, Considerations

For both the Minnesota River Valley and the Paleozoic Plateau, LGUs can consider the following:

To the extent possible, all significant materials and processes should be enclosed so that no contact with stormwater is made. In addition, as described in the Air Quality Standards A.2. Dust Control and Containment of Sand 'Processing' section above section above, after the sandstone has been mined, all subsequent processing steps should be enclosed. Processing encompasses the following activities: washing, cleaning, crushing, filtering, drying, sorting, and stockpiling of silica sand.

The main method of treatment utilized to control stormwater involves a variety of best management practices (BMPs). BMPs are applicable to eliminate or minimize the presence of pollutants discharges from mineral mining and processing facilities. A combination or suite of

BMPs will likely be needed to address stormwater and process wastewater contained on-site and/or discharging from the facility.

The first consideration should be for pollution prevention BMPs such as enclosure (designed to prevent or minimize pollutants from entering stormwater runoff and/or reduce the volume of stormwater requiring management), followed by treatment BMPs (engineered structures, intended to treat stormwater runoff and/or mitigate the effects of increased stormwater runoff peak rate, volume, and velocity). The former includes regular cleanup and spill control, and the latter includes infiltration devices and sediment ponds. Finally, source reduction BMPs are methods by which discharges of contaminants are controlled with little or no required maintenance, and include diversion dikes, vegetative covers, and berms.

Mining facilities often operate only seasonally or intermittently, yet year-round controls remain important because significant materials remain exposed when reclamation is not completed. These characteristics make a combination of source reduction and treatment BMPs the most desirable controls. Source reduction BMPs are typically low in cost and relatively easy to implement, while more intensive treatment BMPs, including sedimentation ponds and infiltration devices, may also be necessary.

To ensure appropriate BMPs have been put into place at a site, the development and submittal of a Stormwater Management Plan to the LGU (commonly referred to as a Stormwater Pollution Prevention Plan (SWPPP) or Pollution Prevention Plan (PPP)) should be required which documents consideration and implementation of, at a minimum, the following:

- Description of BMPs in place and any enclosure
- Infiltration device and/or stormwater pond design, construction, and management
- Erosion and sediment control practices
- Vehicle tracking control of sediment
- Good housekeeping
- Maintenance of BMPs in place
- Management of spills and leaks
- All methods used to control stormwater runoff rate and volume so that pre and post-construction runoff is not different for a 100-year 24-hour storm event
- Inspections
- Management of surface drainage and nearby sinkholes

Again, enclosure of significant materials and a combination of BMPs is expected to yield the most effective wastewater and stormwater management for minimizing the offsite discharge of pollutants. All BMPs require regular maintenance to function as intended. BMPs must be regularly inspected to ensure they are operating properly, including during runoff events. As soon as a problem is found, action to resolve it should be initiated immediately. Documentation of inspections and any problems encountered and how they were resolved should be included in the required Stormwater Management Plan submittal as well. Further guidance on stormwater control and management can be found in the Minnesota Stormwater Manual located at http://stormwater.pca.state.mn.us/index.php/Main_Page.

In addition, in sinkhole-prone areas, especially in the Paleozoic Plateau, Stormwater Management Plans should identify and avoid, or minimize and mitigate, any changes to surface drainage to nearby sinkholes.

ii. Rate and Volume Control

a. Description of Silica Sand Project Concerns

Silica sand mining operations can change the pre-existing natural landscape and topography. Changes to landscape and topography impact stormwater (means stormwater runoff, snow melt runoff, and surface runoff and drainage) and have the potential to impact surface waters (meaning all streams, lakes, ponds, marshes, wetlands, reservoirs, springs, rivers, drainage systems, waterways, watercourses, and irrigation systems whether natural or artificial, public or private), groundwater, and neighboring properties. Therefore, in addition to stormwater controls and best management practices (BMP), stormwater rate and volume should be controlled.

b. Narrative Description and Background Information

Two distinct geologic settings exist where silica sand is mined in Minnesota; however, different responses by the silica sand operation a regarding stormwater rate and volume control is not expected. It is recommended that, if needed, the LGU hire a consultant to assist with the recommendations below and charge the fee to the applicant; different consulting firms should be used for the LGU and applicant.

c. List of Silica Sand Project Potential Impacts

Both the Minnesota River Valley and the Paleozoic Plateau have the:

- Potential for an increase in stormwater rates and volumes which can impact surface water, groundwater, and neighboring properties exists in both regions.

d. Recommendations, Standards, Criteria, Considerations

For both the Minnesota River Valley and the Paleozoic Plateau, LGUs should consider the following:

To help eliminate the concern of stormwater runoff contaminating waters of the state and nearby properties, sites should be designed to minimize the rate of stormwater runoff. This can be achieved by minimizing new impervious surfaces; minimizing the discharge from connected impervious surfaces by discharging to vegetated areas, or grass swales, and through use of other

non-structural controls. In addition, sites should be designed with capabilities to control and contain stormwater on-site so that the pre and post-project runoff rates and volume from a 100-year 24-hour precipitation event are not different. The NOAA Atlas 14, or most recent version of the NOAA Atlas, should be used for precipitation frequency estimates. Further guidance regarding stormwater rate and volume control can be found in the Minnesota Stormwater Manual located at http://stormwater.pca.state.mn.us/index.php/Main_Page.

Additionally, any potential risks associated with stormwater run-on should be considered. Mining could remove protective soils above a vulnerable aquifer or, if mining occurs below the water table, contaminated stormwater run-on could increase the potential for aquifer degradation.

iii. Pond Design

a. Description of Silica Sand Project Concerns

Stormwater runoff that is contaminated by industrial activities and significant materials may lead to contamination of receiving surface water. Therefore, in addition to stormwater management and stormwater rate and volume controls, stormwater should be contained on site. To contain stormwater runoff on site, ponds will likely be needed so that pre and post project runoff rates are not different for a 100-year 24-hour storm event. Proper pond design, construction, and management should be required to aide in prevention of unintended discharges which can lead to contamination of waters of the state and nuisance conditions on neighboring properties.

As noted in the discussion of mine pit dewatering, infiltration galleries constructed above or in limestone or dolomite bedrock formations may create conditions for development of karst features. This should be carefully evaluated when such systems are proposed for managing stormwater.

b. Narrative Description and Background Information

Two distinct geologic settings exist where silica sand is mined in Minnesota; different responses by operators regarding pond design is expected. If silica sand mining and/or operations occur in an area outside of the two regions indicated below, then whichever geology and hydrology most closely matches that at the proposed site should be the set of recommendations followed.

c. List of Silica Sand Project Potential Impacts

Both the Minnesota River Valley and the Paleozoic Plateau have the:

- Potential for improper construction of stormwater ponds which can lead to discharges to waters of the state and potentially cause contamination.
- Potential for improper construction of stormwater ponds which can lead to discharges causing nuisance conditions on nearby properties.

Paleozoic Plateau

- Extra caution and consideration is needed if constructing ponds in karst prone areas of the state.

d. Recommendations, Standards, Criteria, Considerations

Minnesota River Valley Region

To help eliminate the concern of stormwater runoff contaminating waters of the state, sites should be designed to contain stormwater runoff on site.

To contain stormwater on site, containment basins such as industrial stormwater ponds, sedimentation basins and/or infiltration devices should be constructed to allow for infiltration of stormwater; be constructed to allow for maximum separation distance from groundwater with a minimum of three feet of separation distance from the bottom of the infiltration system to the elevation of the seasonally saturated soils or the top of bedrock; should not be constructed in areas with standing water; and designed with capacity to contain a 100-year 24-hour storm event if need be. In addition, a minimum of three feet of freeboard should be in place as a factor of safety.

Much of the poor performance exhibited by ponds employed in the sand and gravel mining industry is due to improper management and design. This is demonstrated by the construction of ponds without prior determination of settling rate and detention time. The chief problems associated with settling ponds are rapid fill-up, insufficient retention time and the closely related short circuiting. This can be avoided by proper sizing, construction, and management. Therefore, it is recommended to request documentation of engineering specification and management to insure ponds are properly sized and maintained. Further information regarding pond design criteria, good engineering practices and proper settling techniques can be found at:

<http://www.pca.state.mn.us/index.php/water/water-types-and-programs/wastewater/wastewater-technical-assistance/wastewater-engineering/technical-information.html>

Paleozoic Plateau

In addition to the requirements listed above, for pond construction within karst regions of the state, the pond site should not be located on sites which show evidence of karstification (i.e. sink holes or solution channeling generally occurring in areas underlain by limestone or dolomite). Proposed pond sites as well as existing pond sites which are being upgraded should be subject to intensive hydrogeologic site evaluation before approval can be given if they exist in a known or suspected karst region. An intensive hydro-geological site evaluation in karst areas would be required and include seismic and resistivity studies of the site. This evaluation should be included with the Site Characterization as recommended in the Groundwater Monitoring Plan section above.

Also, for stormwater management basins within karst regions of the state, an appropriate combination of measures such as shading, filtered bottom withdrawal, vegetated swale discharges or constructed wetland treatment cells that will limit temperature increases and

protect groundwater from any potential contamination should be considered. However, based on results of the hydro-geological site evaluation and the likelihood of infiltration accelerating karst formation, lining of stormwater ponds may be necessary with additional lining materials beyond normal lining requirements. More information on pond lining can be found at <http://www.pca.state.mn.us/index.php/water/water-types-and-programs/wastewater/wastewater-technical-assistance/wastewater-engineering/technical-information.html>

B.2.D. CONTAINMENT REQUIREMENTS FOR CHEMICALS USED IN PROCESSING

a. Description of Silica Sand Project Concerns

Silica sand mining operations utilize chemicals that could contaminate surface waters and groundwater if exposed. Therefore, any chemicals used in silica sand operations should be managed carefully.

b. Narrative Description and Background Information

Two distinct geologic settings exist where silica sand is mined in Minnesota; different responses by silica sand operations regarding chemical containment and management are not expected. It is recommended that, if needed, the LGU hire a consultant to assist with the recommendations below and charge the fee to the applicant; different consulting firms should be used for the LGU and applicant.

c. List of Silica Sand Project Potential Impacts

Both the Minnesota River Valley and the Paleozoic Plateau have the:

- Potential for chemicals to discharge to waters of the state and cause contamination.

d. Recommendations, Standards, Criteria, Considerations

For both the Minnesota River Valley and the Paleozoic Plateau, LGUs should considering the following:

In order to prevent contamination of waters of the state from chemicals used in silica sand operations, limits and controls should be put in place at the site for use of materials at the facility that may cause exceedances of surface or groundwater standards specified in Minnesota Rules, ch. 7050 and 7060. These materials include, but are not limited to, detergents and cleaning agents, solvents, chemical dust suppressants, lubricants, fuels, hydraulic fluids, drilling fluids, oils, fertilizers, explosives and blasting agents. These materials must be properly stored, including secondary containment, to prevent spills, leaks or other discharge. Storage and

disposal of any hazardous waste should be in compliance with applicable solids and hazardous waste management rules; any necessary state permits for hazardous waste and/or above ground storage tanks should be obtained. These materials should not be discharged to surface waters or groundwater of the state.

In addition, the applicant should eliminate or minimize contact of stormwater with significant materials that may result in pollution of the runoff. *Therefore, measures to prevent or minimize stormwater contact with any storage piles of materials containing chemicals (e.g., slurry or waste containing polyacrylamide or poly-diallyldimethylammonium chloride (pDADMAC)) should be implemented.* Also, measures to prevent or minimize stormwater contact with fuel areas should be utilized. The applicant should consider covering the fueling area, using spill and overflow protection and cleanup equipment, minimizing run-on/run-off of storm water to the fueling area, using dry cleaning methods, collecting the storm water runoff and providing treatment or recycling or other equivalent measures.

Furthermore, materials management practices should be evaluated to determine whether inventories of exposed materials can be reduced or eliminated. This can include clean-up of equipment yards, periodic checking of dust control equipment to ensure minimal accumulation of dust in the area of control equipment, consolidation of materials from multiple areas into one area, and training employees regarding proper handling and disposal of materials. Significant materials (i.e., materials with potential to contaminate stormwater) may also be moved indoors or covered with a tarp or structure to eliminate contact with precipitation.

B.2.E. CONTAINMENT REQUIREMENTS FOR SILICA SAND IN TEMPORARY STORAGE TO PROTECT WATER QUALITY

a. Description of Silica Sand Project Concerns

Silica sand operations commonly handle raw, intermediate, and final product that are considered significant materials (i.e., materials with potential to contaminate stormwater). Significant materials are stored indoors and/or outdoors on site for temporary or extended durations. As described in the Stormwater Management section, outdoor storage of raw, intermediate and final grade silica sand should be contained in a manner that eliminates or reduces exposure of the significant materials to stormwater (meaning stormwater runoff, snow melt runoff, and surface runoff and drainage) so that waters of the state (i.e., groundwater and surface waters) are protected.

b. Narrative Description and Background Information

Inadequate best management practices (BMPs), poor housekeeping and failing to reduce and/or minimize exposure of temporary storage piles of raw, intermediate, and final grade silica sand

and other significant materials to stormwater can potentially contaminate waters of the state that receive stormwater discharges associated with an industrial activity.

c. List of Silica Sand Project Potential Impacts

Both the Minnesota River Valley and the Paleozoic Plateau have the:

- Potential for temporary stockpiles of raw, intermediate, and final grade silica sand and storage of other significant materials to contaminate waters of the state.

d. Recommendations, Standards, Criteria, Considerations

As described in the Air Quality Standards, Dust Control and Containment of Sand ‘Temporary Storage’ section, temporary storage is defined to be the storage of stockpiles of silica sand that have been transported and await further transport. Storage piles that are intended to be used at the facility on a recurring basis are not considered temporary storage; rather, these piles should be enclosed and controlled in the manner described in the Air Quality Standards Dust Control and Containment of Sand ‘Processing’ section above.

In situations where silica sand is to be stored on a temporary basis and the material cannot be enclosed, then the following requirements should be in place to ultimately protect waters of the state from contamination:

1. Temporary stockpiles or stripping/overburden stored outside the pit should have sediment control mechanisms in place until the material is completely removed. Materials should not be placed in surface water or stormwater conveyances such as curb and gutter systems, or conduits and ditches.
2. After the temporary pile has been removed, the area should be swept as soon as possible to prevent contamination of stormwater.
3. Temporary stockpiles of materials containing chemicals such as flocculants (e.g., *polyacrylamide or poly-diallyldimethylammonium chloride (pDADMAC)*) should be managed so that stormwater contact is prevented or minimized and discharges of contaminated stormwater to groundwater and surface waters does not occur.
4. Silica sand should be checked for moisture content and watered until the moisture content of the pile exceeds the amount indicated in the Air Quality Standards, Dust Control and Containment of Sand ‘Temporary Storage’ section.
5. All other requirements for open-air storage piles included in Air Quality Standards, Dust Control and Containment of Sand ‘Temporary Storage’ section should be followed to help protect water quality.

References

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C. TRANSPORTATION: ROAD AND BRIDGE IMPACTS

Overview

Silica sand is a common bulk material that falls into the freight transportation category of a low value, high volume, heavy and dense undifferentiated commodity. Silica sand mined and processed for use as a proppant in oil field hydraulic fracturing operations represents a new and large scale use of this commodity. Because of the geographic locations of the end use of this product, virtually all of the material is transported to consumers distant from the main sources of high grade commercial “frac” sand in Wisconsin, Illinois, and Minnesota. Mine sites for silica sand with the required physical properties are relatively dispersed, while processing plants and transload sites to access rail and barge common carriers are more concentrated and naturally benefit from economies of scale and access to long distance, low cost transportation.

A large percentage of mine-generated traffic will be in heavy commercial trucks operating over the public road network, which by law and ownership is open without discrimination to all users. Despite that right to transport persons and property on public roads, the applicants and the local government units are equally cognizant of the previously unforeseen impacts on road structure, safety, and the environment that these new large scale and highly concentrated traffic patterns place on the infrastructure, and that specially conditioned and contractual arrangements may need to be made to maintain ongoing viable transportation operations. In addition, the long distance nature of this transportation chain automatically involves interstate movements and the federal government in its role as regulator of national commerce, a further complicating factor for LGU’s consideration. The tension between local and national interests is an ongoing issue but comprehensively addressed in federal legislation, rules, and case law.

The following recommendations, standards, criteria, and considerations specifically address those impacts and issues that are in the purview of state and local government officials and can effectively be monitored and mitigated through local ordinances and conditional use permits negotiated with applicants for silica sand facilities.

C.1. WEIGHT LIMITS: TRUCK LOADINGS AND LEGAL COMPLIANCE

a. Description of Silica Sand Project Concerns

Adherence to road and bridge weight limits by silica sand truck transporter.

b. Narrative Description and Background Information

The road wear in particular on local light duty roads and bridges is due largely to the use of heavy commercial trucks. On a designated silica sand haul route from mine to process plant or transload facility, this wear is concentrated and continuous, unlike the dispersed truck traffic patterns created by other uses such as sand and gravel quarries, distribution centers, ethanol plants and grain elevators. Although history and practice in the silica sand industry show that the normal truck operations are legal in truck size, configuration, and axle loading, significantly increased wear may result if overloading occurs. In addition, distinct postings of roads and bridges for lighter weights, and seasonal road down-postings such as spring thaw restrictions should be recognized and adhered to. The state of Minnesota has an aggressive bridge inspection and posting program that may down-post existing bridge weight limits in the presence of new, concentrated heavy truck traffic. Local government units are encouraged to contact MnDOT District engineers and State Aid highway contacts to check on any associated bridge posting issues that may arise from new silica sand operations on a preferred route.

Much of the risk of impacts due to new heavy commercial truck traffic can be mitigated by targeted monitoring of load weights and reported traffic volumes. Monitoring should include audits of weights recorded on strategically placed private scales, solid state scale devices on loading equipment, conveyors, and trucks, and regular routine communications between the operator and the road personnel at the LGU, the County, and MnDOT to monitor truck weights and flows.

c. List of Silica Sand Project Potential Impacts

- Accelerated wear and road or bridge damage caused by truck overloads
- Unsafe operation exacerbated by overloaded trucks or deteriorated road surfaces
- Severe road damage caused by ignoring condition-based or seasonal road weight down-postings

d. Recommendations, Standards, Criteria, Considerations

Below is model language for permit conditions:

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1. The applicant will adhere to all legal weight limits, axle loadings and truck configuration regulations without exception. Special postings and seasonal conditions will be observed in all cases.
 2. The operator will demonstrate to LGU the installation and operation of weight measuring equipment sufficient to control the loading of all trucks within specified load limits.
 3. The operator will consult as necessary and appropriate with local, county, and state road officials about operational matters and regulatory compliance, but not less than on an annual basis.

C.2 DESIGNATED TRUCK ROUTES

a. Description of Silica Sand Project Concerns

Designate a mutually acceptable silica sand haul route for regular use by operator's trucks from mine to processing plant and transload sites.

b. Narrative Description and Background Information

Silica sand mining is a very high volume and concentrated activity. A mine may generate from 50 to 250 loads per day of raw silica sand. While some silica sand operations are self-contained with mining, processing and rail loading all on a single property or adjacent properties, others rely on truck hauling from an active mine site to an associated but distant processing plant and transload site for rail or barge loading. This entails a high level of truck traffic on a single highway route by vehicles loaded to the 80,000 pound gross vehicle limit (GVW). The applicant will normally desire uninhibited use of the shortest heavy-duty network of roads, in good condition and allowing safe operation, that is possible.

In the case of normal transportation over public roads, this constitutes a right of free movement that is the responsibility of local government units and the state to maintain in intrastate (within state boundaries) transportation, and a constitutional right of free movement (commerce clause of the U.S. Constitution) maintained by the federal government between states, both on roads and via common carriers charged with public service in providing transportation for hire of any proffered goods. Common carriers in interstate commerce include interstate trucking, railroads and barge lines, and their associated facilities. These rights to public facilities and unrestricted transportation may be interpreted as an intentional act to promote general public trade and movement, ranking above local or parochial interests that may tend to restrict the rights and actions of neighboring citizens. This principle has been a cornerstone of the overall prosperity and freedoms of movement, property, and enterprise within the United States. It does not have the intent of limiting local police powers, including those established in zoning and conditional

use permits, which are meant to be exercised by local government units for the welfare and safety of their residents.

The local government units along the route will have concerns in several areas. These include accelerated wear on local roads and bridges on the route that may have a light duty design, safety of other local road users including passenger vehicle, farm implements, recreational users, and non-motorized vehicles, and traffic impacts on residents and businesses adjacent to the route that may see increased levels of traffic, dust, and noise. Other local government units on the route but not directly authorized to permit the sand facilities will have similar concerns but reduced authority to control the impacts. State highway officials will have an interest in the route's use of state and federal roads and bridges, not necessarily for accelerated wear but certainly for safety and connectivity issues.

The designation of the preferred haul route should be mutually acceptable to all parties. Local government units should operate from the principle that public roads are by definition provided for the free movement of all persons and their goods, but that unusual or unforeseen levels of wear caused by a user or users is a mutual responsibility of both parties if regular use of the public road is to be maintained. This stewardship of the public road system by the local government unit justifies including road wear in a conditional use permit for a facility, with compensation for unusual wear a distinct responsibility of the applicant that is initiating the new activities. A factual, technically sound and negotiated fee or other compensation arrangement is recommended and has numerous examples and precedents at other established sites.

Under current law, the request to participate by other impacted LGU's in permitting negotiations is solely at the pleasure of the permitting LGU, and represents the only opportunity for impacted LGU's to have a say in the preferred routing, traffic impact studies, and any road use compensation agreements. The impacted non-permitting LGU's have no other recourse to request consideration under current state law. The Minnesota Department of Transportation recommends this cooperative approach and also may need to be represented among the impacted governmental units particularly in District 6 (Southeast Minnesota).

The designation of the primary route may also be accompanied by an intentional designation of preferred detours in the case of required road maintenance, traffic issues, or emergencies. The route designation should be determined with the routine and maximum truck volumes in mind. The route designation allows the performance of a targeted Traffic Impact Study for the entire route, and identification of needed rehabilitation, corrective design and construction, and refined maintenance schedules.

Reference: www.dot.state.mn.us/frac/; Use of Public Roads
www.dot.state.mn.us/frac/; Land Use and Federal Pre-emption for Railroads and Waterways (Albemarle County, VA, brief)

c. List of Silica Sand Project Potential Impacts

- Accelerated wear and failure of light-duty roads and bridges from intensive use, and disruption of transportation for both silica sand operator and existing road users
- Unsafe travel conditions for all users in areas of substandard road condition or design due to increased heavy truck traffic
- Environmental and life style impacts for residents and businesses immediately adjacent to designated route.
- Reduction or elimination of recreational and non-motorized uses on some road segments, impacting tourism, recreational businesses and culturally distinct local religious and farming communities.

d. Recommendations, Standards, Criteria, Considerations

Below is model language for permit conditions:

1. Within the permitting process, a trip origin and destination will be specified for each expected or preferred haul route. Multiple origins or destinations will require a distinct route designation for each Origin/Destination pair. Designated routes will include identification of all roads regardless of road class or jurisdiction, including local, county, state, and federal roads. At least one secondary route must be specified for each primary designated route. A significant route change during or after the permitting process will trigger a permit review. Each government unit responsible for a highway segment will be involved in any discussion of routing and the impacts caused by specified routings, with resolution of any unresolved issues the prerogative of the permitting LGU.
2. A maximum permitted daily trip volume and an expected routine daily trip volume will be specified on each designated route. In the case of converging routes on one processing or transload site, a consolidated maximum and routine trip volume will be produced, with sub-segment volumes individually designated.
3. Each designated primary route and secondary route will be subject to a Traffic Impact Study prior to the issuance of any permit. The Traffic Impact Study will involve the entire length of the designated route regardless of class and governmental ownership of the public road. The Traffic Impact Study will address traffic impacts at current and projected traffic levels and comment on safety and alternative road uses, including recreational use and culturally distinct communities and the presence of non-motorized vehicles.

C.3. COMPENSATION FOR IDENTIFIED ROAD WEAR ON DESIGNATED ROUTE

a. Description of Silica Sand Project Concerns

Determining reasonable and necessary compensation for identified road wear on Designated Route segments, including establishment of Road Use and Maintenance Agreements between the applicant and impacted local governing units.

b. Narrative Description and Background Information

Heavy commercial truck traffic concentrated on a single designated route with fully loaded and frequent truck trips will notably accelerate the wear and reduce the expected life of certain segments of the designated silica sand truck route. The impacted segments will be local lightly designed and constructed roads in particular. Almost all responsible local government units in central and southeast Minnesota have insufficient financial resources to maintain the local road segments under this heavy use, resulting in failure of the road surface and structure for all users including the silica sand producers. The precedent exists in numerous other neighboring states to negotiate a level of compensation specifically for maintenance and upgrade of the designated road segments that are determined to be deficient through engineering analysis and traffic projections.

A current Aggregate Material Removal Tax, Minnesota Statute 298.75, subd. 2a, b, and d, is available to counties to offset road wear caused by sand and gravel hauling, and the resulting revenue may be distributed to local cities and townships. The tax can be no more than 15 cents per ton of material either transported, sold, or imported into the county. Research done by Mankato State University under commission from the Local Road Research Board (LRRB) on road wear specified in Equivalent Single Axle Loadings (ESAL's) noted that intensive use of a road by commercial trucks loaded to the maximum legal vehicle weight limits may significantly shorten a road's design life, and incur a direct maintenance or replacement cost of up to 22 cents per ton per mile of sub-standard roads subjected to intensive heavy commercial use. Depending on the length of the sub-standard road segment and other relevant conditions, the Aggregate Tax may be inadequate by a factor of 10 or more to provide adequate revenue. A further complicating factor is 298.75, subd. d, prohibiting collection of "additional host community fees" if the aggregate tax is being collected. This prohibition could be interpreted as preventing a negotiated road use fee included in a CUP.

The agreement to cooperate on road maintenance and upgrades may be included in a Road Use and Maintenance Agreement (RUMA) linked to the conditional use permit process. RUMA's have been widely employed in similar circumstances in several states, including Ohio, Pennsylvania, and Wisconsin. The National Center for Freight and Infrastructure Research and Education (CFIRE) describes this tool in a whitepaper on Wisconsin sand mining, noted in the references. A RUMA may employ any of a number of financing schemes for the necessary work. The Minnesota County Engineers Association, the Local Road Research Board, Mankato State University, and MnDOT have cooperated in developing a road wear calculator that in part identifies a fee of up to 22 cents per ton-mile applied to the length of the deficient segments under load, based on ESAL and design life considerations. The road wear calculator is available to potential users on the MnDOT website, and MnDOT and county engineers are available to offer technical assistance in applying the calculator to local conditions. This calculated fee should apply only until such time as the necessary repairs and upgrades are accomplished to put

the road segment into a heavy-duty category in a good state of repair. Other negotiated alternatives may include a lump sum payment to the road authority to complete upgrades before mine start up, an annual stipend to assist accelerated repair schedules, and contracting for supplemental road crews by the operator, in coordination with local government activities. Local government units are encouraged to contact other Minnesota and Wisconsin counties who have successfully implemented these measures, as well as refer to the EQB Silica Sand library for reports of other local actions. The RUMA should also detail any necessary sub-agreements covering financial assurances, funds transfers, cooperative construction projects, safety accommodations, and other impact mitigation conditional to the CUP.

References

www.dot.state.mn.us/frac/; Findings from Winona County Task Force
www.dot.state.mn.us/frac/; CFIRE Whitepaper: Chippewa County Sand Mining

c. List of Silica Sand Project Potential Impacts

- Rapid deterioration of road pavement under increased heavy commercial traffic.
- Deterioration and failure of bridges and drainage systems along the designated route.
- Collapse of road edges and shoulders under load.
- Unsafe operating conditions for all users.
- Depletion of financial resources of local government unit.
- Loss of access to mine sites and other users of the deteriorated road segment.

d. Recommendations, Standards, Criteria, Considerations

Below is model language for permit conditions:

1. The permitting LGU and adjacent governmental units with roads directly impacted by the haul route will assess the existing condition of roads and bridges, and remaining design life. Assessment will be at cost to the applicant. Assessment will include an estimate of any pre-start up remediation deemed necessary for safe and efficient operation without immediate damage to road structure, and other geometric or safety improvements engendered by the intensive operation of commercial trucks in the employ of the applicant.
2. Upon identification of light-duty or deficient roadways, the haul distance will be specified for each segment of light-duty road needing ongoing maintenance and improvement. The ton-miles hauled over these segments will be subject to a negotiated road use and maintenance fee specified in a Road Use and Maintenance Agreement (RUMA), with each impacted government unit along the route party to the RUMA. The ton-mile fee is not to exceed 22 cents per ton-mile on the identified mileage until such time as road structure including bridges is brought up to full ten-ton, heavy duty condition. A lump-sum remediation amount may be negotiated as part of the RUMA, as well as periodic payments above and beyond the

ton-mile fee to be used toward accelerated road maintenance as agreed or needed. Each governmental unit involved in haul route impacts will receive a corresponding share of the remittances. The RUMA will include sub-agreements addressing the detailed operating and financial arrangements.

C.4 SAFETY ISSUES AND MITIGATION

a. Description of Silica Sand Project Concerns

Identifying safety issues specific to road locale and traffic levels, and implement mitigation measures to restore road to safe condition for all users.

b. Narrative Description and Background Information

As part of a comprehensive Traffic Impact Study, the applicant in cooperation with the local governing units affected along the route will study and identify specific safety issues that arise from a significant increase in heavy commercial vehicle traffic. Safety issues are a particular concern in certain areas of southeast Minnesota. The area is heavily dependent on a thriving tourism business hinging in part on hiking and bicycling in rural areas of the region. They are particularly frequent users of local roads during summer months. A second consideration unique to the southeast is the presence of Amish and Mennonite colonies in the area. Their culture and religious beliefs eschew modern conveniences including cars and trucks. As a result, they employ horse drawn buggies, wagons, and farm implements in their normal daily activities. Their horse and buggies are a constant presence year round, operating at slow speeds and using light vehicles that leave riders extremely vulnerable in traffic collisions. Many of the two-lane rural roads they frequently use are potential connectors to proposed mine sites. The current roads generally do not have wide shoulders or any other accommodation for use by widely different vehicle traffic. The Traffic Impact Study is expected to address these concerns in the southeast, and lead to agreements that will correct safety deficiencies that are the result of heavy commercial truck traffic. These responses to the identified safety problems may include employee, community, and public education efforts to improve the visibility of the issues of threatened users.

MnDOT supports the adoption of appropriate road design improvements to address these safety conflicts. Turning and climbing lanes may be specified at specific sites. Areas along the preferred haul route that host non-motorized vehicle traffic should be a candidate for installation of 10 foot wide graded, partially paved, shoulders for the complete distance of the identified conflict. Locally acceptable alternatives including bypasses and dedicated trails may also be adopted as part of the CUP.

c. List of Silica Sand Project Potential Impacts

-
- Safety threats to established recreational and non-motorized road uses by implementation of heavy haul routes on certain road segments.
 - Increased risk to health and life of culturally distinct community members in the southeast
 - Economic damage to the area due to degradation of tourism and recreational uses
 - General safety risks and conflicts for all road users on designated routes

d. Recommendations, Standards, Criteria, Considerations

Below is model language for permit conditions:

1. The Traffic Impact Study will identify traffic safety impacts specifically involving the common use of roadways along the designated haul route with recreational uses, including pedestrian (hiking and running) and biking activities, and non-motorized vehicle uses, in particular horse-drawn buggies, wagons, and farm implements. The Traffic Impact Study will further identify the origin or sources of these conflicting uses, including trails, resorts, and culturally distinct religious communities including Amish and Mennonite communities and colonies. (may be specific to southeast region, but applicable statewide)
2. Safety conflicts or potential hazards will be mitigated through mutually agreeable improvements, including but not limited to road widening, shoulder widening and surfacing, surface use designation and signage, warning signs, both commercial driver and general public education, speed limits, correction of limited lines-of-sight, and other recognized effective design and operational measures. These may be at cost to applicant.

C.5. TRANSPORTATION RELATED COMMUNICATIONS

a. Description of Silica Sand Project Concerns

Establish formal contacts and regular communications to monitor and coordinate transportation activities related to silica sand transportation.

b. Narrative Description and Background Information

Successful ongoing operation of silica sand facilities and transportation under the Conditional Use Permit and RUMA terms will depend on a regular and professional communication regimen. Operating officials at the Applicant Company and counterparts at the local government level should be in routine contact to monitor and address emerging issues around the transportation agreements and the implementation of mitigation measures. The designated contacts should be authorized to act for their respective organizations in order to effectively and promptly respond

to problems. Best practices in other regions suggest at least monthly face-to-face meetings and regular phone or electronic communications as needed.

c. List of Silica Sand Project Potential Impacts

- Effects of emerging problems or deteriorating infrastructure conditions may reach critical proportions without regular monitoring and response
- Information on company operations and community complaints lost for responsible officials
- Lack of responsiveness to changes in volumes, operations, or routes if not monitored
- Local conflicts for employees and residents an ongoing issue

d. Recommendations, Standards, Criteria, Considerations

Below is model language for permit conditions:

1. The applicant and each governmental unit party to the Road Use and Maintenance Agreement (RUMA) will specify an authorized and responsible staff contact. The RUMA will include a requirement to maintain regular professional communications between all contacts at least monthly and more often as needed in order to monitor operations, road conditions, construction, routing, and maintenance as necessary.

D. OPERATIONS

Many operational functions of non-metallic mining activity, which include silica sand mines, are regulated at the local level. LGUs have two regulatory mechanisms available to them to address concerns associated with silica sand mining, processing, transload, and transportation (referred to collectively in this section as silica sand projects):

- (1) Setting conditions within local permits and
- (2) Land use planning and ordinance development.

If a proposed project triggers environmental review (see [Introduction](#) for overview), conditions placed in the local permit are guided by information generated in environmental review process. In fact, one of the primary purposes for environmental review is to inform decision-makers about project effects and measures that can be taken to avoid, minimize, and mitigate those effects. Key decision makers, which may include state and federal agencies that require various project permits or approvals, work collaboratively to understand the potential effects of a proposed project. Therefore, environmental review is an integral part and a coordinating mechanism of local, state, and federal permitting processes. Rules prohibit final decisions on permits and approvals for projects that are subject to environmental review, until the review is complete. Depending on the size and scope of the proposed project, the length of time to complete environmental review process varies.

While environmental review is a tool that guides LGU's decisions about specific projects, LGUs also have the authority to implement broader controls to address and mitigate potential impacts of silica sand projects through comprehensive land-use plans and ordinance development. Setting operational standards and criteria in ordinance is one method to control potential impacts and adverse effects related to silica sand projects. When combined with other mitigating strategies, such as screening with vegetation (buffers), berms, and setbacks (see [Considerations for Setbacks and Buffers](#) for further discussion), nuisance issues such as noise, dust, and vibration can be reduced or eliminated.

The experience level in regulating silica sand projects is highly varied between LGUs in Minnesota. While LeSueur County regulates one of the largest producing silica sand mines in the country, other communities have little to no experience regulating large-scale mining operations. With that said, much of the regulatory framework that is applied to other non-metallic mining, like crushed stone and sand and gravel, is applicable to regulating the operations of silica sand projects. Notable differences generally considered unique to silica sand mining include multiple modes and overall length of transportation and the more common use of flocculants for the processing of silica sand into frac sand.

The purpose of this section is to give LGUs information about six operational topics specified in legislation (Minnesota Statute 116C.99, subd 2) for silica sand projects: lighting, hours of operation, reclamation, financial assurance, blasting, and inspection. Most of the recommendations, standards, criteria, and considerations listed in this section was derived or

modified from state administrative rules or procedures, federal and state sponsored research, peer-reviewed publications, consultation with LGUs, existing local permits, and public input.

The Operation Section is not intended to be a one-size fits all or an encyclopedic approach on each topic. Instead, the information is intended to be a foundation that will guide LGUs as they determine how to develop or modify their ordinances or permitting process to address concerns related to silica sand projects. Additional resources, such as the Silica Technical Advisory Committee and the Silica Sand Ordinance Library (and others mentioned in the Introduction), are available to LGUs for specific questions and issues that may arise as they build upon the information presented below and within other sections of the document. Where appropriate, special considerations for geographic regions are addressed.

D.1. LIGHTING

a. Description of Silica Sand Project Concerns

Silica sand mining and related projects have the potential for producing light emissions and contributing to ambient light pollution. Although ambient light is a regional environmental problem with many contributing sources that include residential, commercial, and recreational land uses, the concern is that bright lights emanating from a silica sand project site would further degrade the night sky and further impact the circadian rhythm of humans and wildlife.

Setting lighting requirements, which would need to be applied to *all sources* of light, are best addressed in ordinance. Model ordinances created by the International Dark-Sky Association (IDA) and the Illumination Engineering Society (IES) are available for LGUs to consider and adopt. In lieu of existing lighting ordinances, lighting requirements can also be addressed during the issuance of a local permit with Photometric Plans for proposed projects with specified performance standards.

b. Narrative Description and Background Information

For silica sand projects, outdoor lighting plays a critical role for the safety of workers employed during night-time hours. Low luminance contributes to the disproportionate number of fatal motor vehicle injuries occurring after dark (Plainis et. al., 2006 and Wanvik, P.O., 2009). However, on-going research indicates night-time light emissions also have environmental and human health impacts.

Ecologists are beginning to research and better understand some of the impacts of artificial night lighting. Impacts, such as the deaths of migratory birds around tall lighted structures, are better known (Evans-Ogden, 1996). Other more subtle influences of light pollution, such as the influence on behavior and impacts to community of ecology of species, are less well recognized

(Longcore and Rich, 2004 and Buchanan, 1993). Medical research is just starting to link health impacts to the disruption of circadian rhythms and sleep deprivation (Stevens *et. al.*, 2004,).

Furthermore, dark starry nights, like natural landscapes, forests, clean water, wildlife, and unpolluted air are valued by residents and communities. Ambient light pollution by man-made light is one of the most rapidly increasing alterations to the natural environment (Cinzano *et al.*, 2001). The first World Atlas of artificial night sky brightness (seen in figure 1) produced by Cinzano *et al* indicates that all of southern Minnesota is impacted by ambient, night-time light levels.

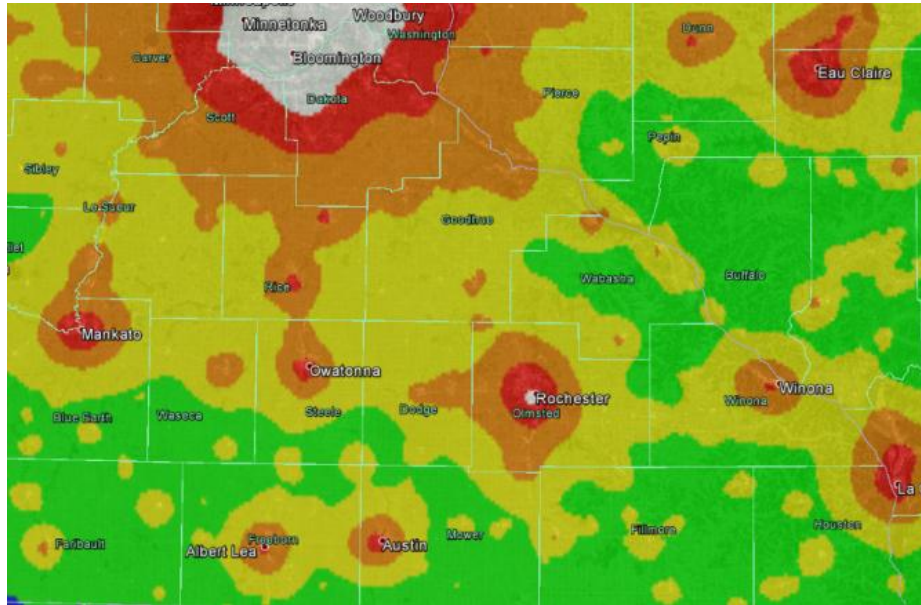


Figure 1: Artificial Night Sky Brightness of Southern Minnesota, 2001. Based on the data from Cinzano, et. al., 2001. Overlay of model brightness on Google Maps, downloaded 11/14/2013.

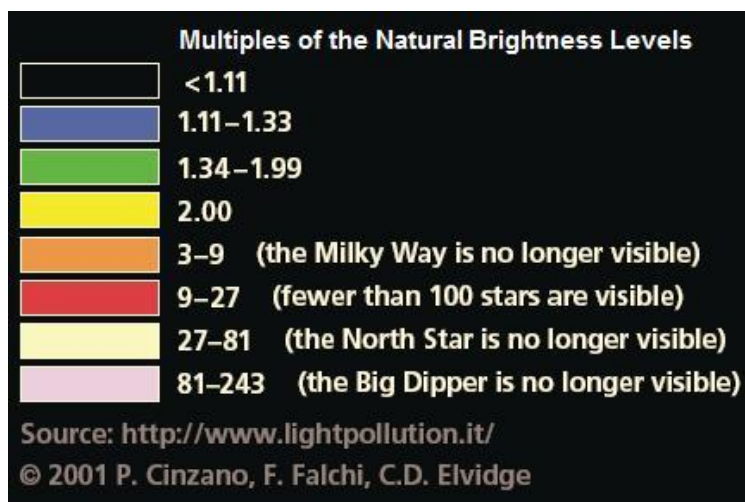


Figure 2: Scale of brightness.

Lighting requirements of silica sand projects are regulated by local, state, and federal standards. The Occupational Safety and Health Administration (OSHA) set standards and guidelines for lighting requirements within the workplace (CFR 29, Part 1910). These guidelines would apply to processing plants and loading stations that are independent from a mine site. The Minnesota Department of Labor and Industry also has some regulatory oversight and sets minimum levels of illumination (MN Rule 5205.0120), which are also applicable independently silica sand facilities outside of a mine site. Within a mine, Mining Health and Safety Administration (MSHA) has federal jurisdiction in Minnesota. For lighting, MSHA has a general safety performance standard requiring:

30 CFR § 56.17001 - Illumination of surface working areas:

Illumination sufficient to provide safe working conditions shall be provided in and on all surface structures, paths, walkways, stairways, switch panels, loading and dumping sites, and work areas.

Even though federal and state standards and guidelines must be met for silica sand projects, an LGU has the authority to stipulate outdoor lighting emissions and specifications of a mine site or facility. LGUs are encouraged to work with companies to implement energy efficient and emission reducing lighting designs. With that said, a collective issue like night sky brightness requires a collective approach to improve the overall quality of the night sky. If an LGU wants to reduce light pollution, they would need to develop ordinances that would apply to all lighting sources. For more information about lighting ordinances, please refer to “Additional Resources” near the end of this section for internet links to Model Lighting Ordinances (MLO) and state resources available to communities interested in better public lighting designs.

c. Potential Impacts as it Relates to Lighting

The use of outdoor lighting is necessary for adequate nighttime safety and utility, but common lighting practices can also interfere with other legitimate public concerns which include:

- The increase of sky glow or the brightening of the night sky due to the accumulation of lights.
- Light trespassing onto neighboring properties.
- Wasted light emissions where it is not needed or intended.
- Excessive brightness, or glare, which causes visual discomfort and decreased visibility.
- Unnecessary consumption of energy and resources in the production of wasted light.
- The impact of visible light emissions within the wavelength 500 nanometer or less (blue to violet light in the spectrum of visible light) on wildlife and human health.
 - Wildlife impacts include species becoming distracted or attracted to artificial light; species being exposed to higher levels of predation; species navigational abilities can be disrupted; and species can be induced into early breeding due to long artificial days.

-
- Human health impacts including disruption of hormone production (melatonin) which is linked to insomnia, depression, and cancer (Chespesiuk, 2009).



Figure 3: Example of how glare from lights can distress the eyes. (Photo Source: International Dark-Sky Association)

d. Recommendations, Standards, Criteria, Considerations

For creating lighting ordinances:

- It is recommended that a community establishes lighting ordinances that can be used to determine performance standards for all sources of ambient night-time light.
 - A recommended guide to establish lighting overlay districts is the “Model Lighting Ordinance” (MLO) jointly produced by the Illuminating Engineering Society (IES) and the International Dark-Sky Association (IDA) in 2011.
 - Lighting Zones defined by the MLO range from
 - LZ0 – A recommended default zone for wilderness areas, parks, preserves, and undeveloped rural areas to
 - LZ4 – This pertains to areas of very high ambient lighting levels and may be used for extremely unusual installations such as high density entertainment districts and heavy industrial uses.
- Any new development, including silica sand projects, would have to comply with lighting performance standards prescribed by Lighting Zones. A majority of silica sand projects would fall into LZ1-LZ3.

Lighting Zone	LZ 0	LZ 1	LZ 2	LZ 3	LZ 4
Allowed Lumens Per SF	0.5	1.25	2.5	5.0	7.5
Allowed Base Lumens Per Site	0	3,500	7,000	14,000	21,000

For permitting individual silica sand projects, considerations include:

- The size of the project, surrounding land-use, and hours of operations would factor into the lighting needs and requirements for a silica sand project.
- For projects expected to require significant outdoor lighting, an LGU may want to require Photometric Plans as a condition of a local permit, which could include:
 - Pre-construction analysis to assess baseline lighting conditions.
 - Future assessment of light impacts from a silica sand project and consideration of impacts from additional sources of light not associated with the project site.
 - Once the plan is approved, any additional new or temporary outdoor lighting with exception to emergency lighting must submit a new outdoor lighting plan to LGU(s) and receive approval prior to implementation of the revised plan.
 - Plan should include location and limits of outdoor lights and a photometric diagram showing predicted maintained lighting levels of proposed lighting fixtures.

Standards and criteria for consideration of all projects:

- Specifying zero percent uplight above 90 degrees for area lighting for rural areas.
- Specifying zero percent “property-line” backlight emissions to prevent light trespass onto adjacent properties where appropriate. Variances may be required where light is needed for worker safety.
- Requiring outdoor lighting fixtures and designs with lights that must be aimed, located, and maintained to prevent glare.

Standards and criteria for projects requiring night-time illumination of large areas:

- Encourage use of adaptive lighting controls to dim or extinguish lighting when not needed would reduce wasted light.
- Encourage use of narrow-spectrum Light Emitting Diode (LED) lighting systems.
- Encourage use of outdoor lighting with color temperature specifications no greater than 4000K.

As with any aspect of permitting, an LGU may need to hire an engineer or lighting professional to assist the review and approval processes at the cost of the applicant.

Additional Resources

To download the Joint IDA-IES Model Lighting Ordinance (MLO), go to the [Illuminating Engineering Society website](http://www.ies.org/PDF/MLO/MLO_FINAL_June2011.pdf): http://www.ies.org/PDF/MLO/MLO_FINAL_June2011.pdf

For additional State support in developing efficient outdoor lighting, contact the [MPCA GreenStep Cities Program](#):

Website: www.mngreenstep.org

Phone: 651/757-2594 or 800/657-3864

For more information on the impacts of light pollution, sample ordinances, and approved “Dark-Sky” lighting, go to the [International Dark-Sky Association website](http://www.darksky.org/): <http://www.darksky.org/>

[Effects of Artificial Lights on Wildlife](http://www.wildlandscpr.org/biblio-notes/effects-artificial-lighting-wildlife):

[Http://www.wildlandscpr.org/biblio-notes/effects-artificial-lighting-wildlife](http://www.wildlandscpr.org/biblio-notes/effects-artificial-lighting-wildlife). N.p., n.d., Web 4 Nov. 2013

[Florida Atlantic University Astronomical Observatory](http://physics.fau.edu/observatory/lightpol-environ.html):

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[Flagstaff Arizona Lighting Regulations](http://www.flagstaff.az.gov/DocumentCenter/Home/View/14707):

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D.2. HOURS OF OPERATION

a. Description of Silica Sand Project Concerns

For most silica sand activities, setting the hours of operations is determined at the local level. Hours of operation are best determined on a project by project basis through the permitting process. Operational hours may also be broadly addressed in ordinance, but should include the option of modifying them as needed within the permitting process.

Setting the hours of operations is one means to mitigate noise impacts, light pollution, and traffic issues originating from a project site. Hours of operations could be broken out and specified by activity or be all inclusive (all activity is to occur during a specified interval). Typically, for mines or facilities with longer operational life-spans and multiple phases of activity, addressing hours by activity may make sense. Additionally, LGUs could also adjust hours of operation seasonally to compensate for changes in daylight hours and the potential loss of vegetated buffers during leaf-off conditions.

b. Narrative Description and Background Information

Determining the hours of operation of a silica sand project is a function of many different parameters of a given site: proximity to residences and residential districts, residential density, adjacent land use and activities, the placement of processing equipment within the mine, width of buffers, height of berms, school bus routes and schedules, type of back-up alarms, etc. For projects undergoing environmental review, the information needed to make decisions about hours of operations would be addressed in noise and traffic impact studies. An LGU could require necessary studies be performed regardless of whether a project meets the thresholds for a formal environmental review, especially if concerns arise about a project's proximity to incompatible land uses.

Additional activities that may be associated with silica sand projects include independently operated truck terminals and maintenance facilities. Independent trucking facilities may be established to support silica sand transport from mine site to processing facility and/or transload

sites. These truck facilities may include routinely regulated activities such as equipment fueling, lubrication, and washing. A silica sand truck fleet may consist of ten to fifty dedicated trucks. The hours of operation will tend to begin before sand facility start-up, and end after specified sand facility hours of operations end. This may constitute an extension of specified hours of operation that will impact residences and businesses in immediately adjoining areas and on travel routes. Ordinances and conditional use permit terms may be designed to limit this extension of operating hours.

Specified conditions and ordinances must be specific to link this limitation of operations to the intensive operations of the sand mining and processing activities, due to risk of overlap of these controls onto other commercial operations and businesses that may be supported by the same truck terminal. This would constitute an unintended and unapproved restriction on trade to unassociated business activities if the truck terminal is operated by an independent or contracted operator, which would in turn be subject to a valid challenge by the impacted parties.

c. List of Silica Sand Project Potential Impacts

When determining the hours of operation for silica sand projects and related activities, a number of factors should be considered:

- Potential impacts of silica sand projects and independent trucking facilities may include:
 - Noise and vibration from engines, wheels and brakes, horns, back-up alarms, and communication systems.
 - Light pollution from yard lights in terminal and headlights of trucks.
 - Extension of truck transportation related noise, vibration, and traffic impacts beyond plant hours of operation.
 - Route and terminal specific impacts to immediately adjacent residences and businesses.
- Compatibility to adjacent land uses.
- Results of the Noise Impact Study and Traffic Study.
- Best and appropriate time for a specific activity associated with the project and life span of a project.
- Special cultural or community characteristics of an area.
- It is also important to weigh the possible benefit and impact of concentrating mining, processing, or transporting activities to a given timeframe:
 - Limiting hours of operations has the benefits of restricting noise and traffic impacts to daylight hours and to times when a percentage of people are presumed not to be home.
 - However, restricting hours of production may result in:
 - A larger mine footprint to maintain production rates,
 - A longer lifespan of the mine,
 - A higher density of truck traffic during peak traffic hours, and/or
 - Additional equipment being operated on-site and increased noise.

d. Recommendations, Standards, Criteria, Considerations

As previously mentioned, site-specific issues and concerns related to hours of operation are best addressed with information generated in environmental review, local government review of a project application, and with stipulations specified within the local permit.

- Based on the location and scope of the project and results of various impact studies, **examples** of hours of operations include:
 - Restricted hours (EXAMPLE: 7:00 A.M. to 6:00 P.M., no weekends or federal holidays) could be considered when a project is near higher densities of population or incompatible land uses.
 - Non-restricted hours (24 hours/7 days a week) could be considered when mines are located near compatible land uses, large distances from residential dwellings, etc.
- An LGU may consider further limitations on specific activities that generate additional nuisance impacts. Examples of such activities include:
 - **BLASTING:** For safety considerations, blasting could be limited to daylight hours. Another option is to specify hours in which this activity is allowed within the permit to mine. For example, language used in the LeSueur County CUP (#29000), Kasota Township and Scott County IUP (May 1, 2012) includes:

All blasting shall be conducted between the hours of 10 AM and 6 PM, Monday through Saturday. Every effort possible should be made to limit blasts between the hours of 10 AM and 3 PM. No blasting on weekends or holidays (holidays should be designated/identified – i.e. federal holidays) without County Board prior approval.
 - **REMOVAL OF OVERBURDEN:** For some mining operations, this activity can generate additional noise from heavy equipment. An LGU may want to consider restricting the removal of overburden to specified hours within a local permit: *i.e. conducted between the hours of 7:00 A.M. and 6:00 P.M., except on Sundays and federal holidays. Any modification would require prior approval from LGU.*
 - **BERM CONSTRUCTION:** Since this activity occurs near the property line, a more restrictive timeframe can be considered: *i.e. conducted between the hours of 8:00 A.M. and 4:30 P.M., except on Sundays and holidays. Any modification would require prior approval from LGU.*
 - **PROCESSING:** If processing is not enclosed within a structure, an LGU may want to limit hours of processing depending on the location of the facility.
 - **TRUCKING RATES/LIMITATIONS:** Depending on the location of the mine and the rate of trucks leaving, an LGU may want to specify in the local permit limitations on truck activity:
 - During hours of school transportation.
 - During high traffic levels

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- During inclement weather and poor road conditions and upon notification by the LGU
 - ASSOCIATED TRUCKING: Stipulate that truck terminal operations remote from the silica sand mining and processing facilities may not begin associated truck fleet operations more than one hour before the specified plant hours of operation, nor extend more than one hour beyond daily end of specified plant hours of operations. This will not, however, limit movements of individual trucks at the terminal for unit maintenance, repositioning, delivery of supplies, or the movement of employees and their individual vehicles on, around, or to and from the terminal, nor will it apply to established operations of the terminal for other customer's services.
 - MAINTANCE/REPAIR at the MINE SITE: Similar to "Associated Trucking", LGUs could stipulate the hours in which repair and maintenance of equipment and heavy machinery is to occur if noise generated from this activity has a potential to impact adjacent land uses.
 - It is recommended to develop a grievance process in which neighboring properties owners, residents, and other affected persons have the ability to address issues and problems stemming from a silica sand project. The grievance process can be incorporated in the local permit and is applicable to address several operational processes addressed in this section. Criteria and considerations to include in a grievance process:
 - All grievances are addressed in writing or phone call to the applicant.
 - Require the applicant to keep a log of all grievances they have received. If the grievance can be mitigated immediately, then the applicant should address the concern.
 - Require the applicant to give updates at specified durations or triggers that would address complaints and responses to complaints. LGU could require public meetings as a condition of the permit.
 - Specify that meetings should review all grievances and mitigation efforts over specified time period. If the grievance requires further consultation from the LGU, specify that the applicant should work with the LGU to determine if a violation of federal, state, or local regulations has occurred.
 - Specify that the organization of public meetings should be the sole responsibility of the applicant.
 - Determine if outreach meetings require jointly leadership by the applicant and a representative of an LGU.
 - Stipulate within the local permit or in ordinance corrective actions, fines, and/or temporary revocation of permit that may be implemented if an applicant is non-compliant on terms specified in permit.
 - Truck terminals remote from the silica sand mining and processing but supporting significant and continuing fleet operations for sand transportation should be subject to reasonable nuisance mitigation measures specified by the local jurisdiction directly associated with the sand transportation fleet activity. This may include but is not limited to noise regulation in the form of employee operating protocols to reduce truck, horn, and warning device noise; noise barriers at points of close contact

between facility and neighboring residents or businesses; and light regulation in the form of shutters, baffles, or barriers to block direct light impacts from truck terminal's fixed lighting or from truck headlights during hours of darkness.

D.3. RECLAMATION

a. Brief Description of Silica Sand Project Concerns

Reclamation serves the interest of the general welfare to control the possible adverse environmental effects of mining, to conserve natural resources, and to encourage the planning of future land utilization, while promoting good mining practices. The objective of a reclamation plan is to produce a landscape that is safe, stable, and compatible with the surrounding landscape and final land use. Inadequate mine reclamation may result in undesirable outcomes, often not immediately observed, such as the focused infiltration of surface contaminants to groundwater, altered water quality in nearby springs and streams, accelerated soil erosion, and the creation of physical hazards, such as sinkholes.

b. Narrative Description and Background Information

All stakeholders benefit from good mine planning and effective reclamation of a mine site. For the general public, reclamation ensures that land disturbances are minimized. In addition, reclamation ensures that disturbed land areas are returned to productive use for agriculture, forestry, natural environments, recreation, residential, or industrial use as soon as possible. For operators, good mine planning promotes efficient mining practices and extraction of a resource. For the environment, good mine planning reduces hazards such as water contamination, production of dust, loss of topsoil, destruction of fish and wildlife habitat, and promote an operation's environmental sustainability.

To protect groundwater, future land use options require well-thought-out planning. Where mining activities remove critical protective geologic materials above an aquifer, post-reclamation land uses have the potential to degrade groundwater quality. Agricultural crop production, with its inherent use of nutrients and pesticides (and in many cases, animal waste), landfills, and manufacturing are land uses of particular concern on reclaimed mining sites. Karst areas in the Paleozoic Plateau are particularly susceptible to groundwater contamination; however, the removal of protective materials has the potential to impact groundwater quality in the Minnesota River Valley as well.



Figure 4 - Foster Arend Park, Rochester - Example of a surface mine reclaimed into recreational land use.

Planning for reclamation and mine closure should occur before the mine opens. Even though a reclamation plan is agreed upon, it is important to convey to the applicant the expectation of continuous improvement in operating practices and equipment with the goal of increasing environmental performance of a mining, processing, or transload facility. Therefore, reclamation objectives are best achieved with some level flexibility to site-specific situations and concerns. Areas of continuous improvement include, but not limited to:

- Minimizing the footprint of the development
- Minimizing the disturbance to sensitive features, the environment, and cultural resources.
- Maximizing resource extraction
- Minimizing water use
- Decreasing dust, noise, and vibration output
- Improving recovery and processing of soil
- Maximizing the direct placement of topsoil
- Increasing rate of progressive reclamation
- Reducing emissions from equipment, processing facilities, and transload sites
- Increasing energy efficiency in lighting
- Minimizing the length of time disturbed lands are unreclaimed.

While there is much technical information presented in this section, the document cannot broadly serve as handbook or guide to reclamation. Fortunately, many resources, guides, and handbooks dedicated to assisting LGUs with reclamation issues are available, and are listed in *Additional Resources* of this section. Another consideration, the Department of Natural Resource is in the process of developing and adopting rules for the reclamation of silica sand mines (MN Law 2013, Chapter 114, Article 4, Section 105b) which are expected to be completed in 2015. Rule development will follow procedures specified by Minnesota Administrative Procedure Act (APA), Minnesota Statute Chapter 14. As a result, the adopted reclamation rules that are finalized may differ from the information presented in this document.

As LGUs process project proposals and environmental review, they have the ability to hire qualified consultants at the expense of the project proposer to assist the review process. LGUs can solicit assistance through issuance of a *Request for Proposal*. As LGUs consider potential firms or individuals to hire, it is important to check credentials and professional licensure.

c. List of Silica Sand Project Potential Impacts

A poorly planned mine site has an increased potential to impact the environment and surrounding communities in the following ways:

- Lack of mine and reclamation planning can result in larger open mining areas, creation of additional sources of dust, increased exposure of ambient dust, negative effect on cultural resources, and increase of visual impacts.

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- Improper site drainage has the potential to funnel water to sensitive features, create karst features, and impact groundwater.
 - Groundwater contamination from the removal of protective geologic materials.
 - Groundwater contamination from inappropriate land uses on previously mined areas where protective geologic materials have been removed.
 - Unintended subsidence due to underground mining.
 - Inadequately managed sites
 - Pose safety hazards to the public.
 - Result in soil loss, have lack of erosion control and increase sediment load to nearby streams and lakes.
 - Result in the introduction or spread of invasive species.
 - Withholding all reclamation until the end of the mine's life can result in:
 - Deteriorated and less fertile soils that have been stockpiled over time.
 - More expensive and longer establishment of revegetation.
 - Lack of reclamation segments and test plots for revegetation
 - Higher financial assurance and liability.
 - Increased likelihood of infestations of invasive species.

d. Recommendations, Standards, Criteria, Considerations

The following standards and criteria have been partially derived or modified from Wisconsin Admin Code NR135, Minnesota DNR Sand and Gravel Reclamation Handbook, Alberta, Canada- A Users Guide to Pit and Quarry Reclamation in Alberta, and Washington DNR Best Management Practices for Reclaiming Surface Mines in Washington and Oregon.

Setting performance standards is one means to ensure desired reclamation outcomes. Examples of reclamation performance standards that could be included in ordinance are:

- Silica sand reclamation shall be conducted, to the extent practicable, to minimize the disturbed area by mining and to provide for reclamation of portions of the site while mining continues on other portions of the mine site.
- The mine site shall be restored, to the extent practicable, to a condition at least as suitable as that which existed before the lands were affected by silica sand mining operations.
- Reclamation of silica sand mines shall comply with any other applicable federal, state, and local laws including those related to environmental protection, zoning, and land use controls.
- A silica sand mine site shall be reclaimed in a manner that does not cause a permanent lowering of the water table and result in adverse effects on surface waters or significant reduction in the quantity of groundwater reasonably available for future users of groundwater.
- Reclamation of a silica sand mine shall be conducted in a manner which does not negatively impact groundwater quality as regulated by federal, state, or local law.
- Intermittent mining may be conducted provided that the possibility of intermittent cessation of operations is addressed in an operator's reclamation permit, no

environmental pollution or erosion of sediments is occurring, and financial assurance for reclamation is maintained covering all remaining portions of the site that have been affected by silica sand mining and that have not been reclaimed.

- During reclamation, landforms shall be designed and constructed to complement nearby natural terrain, minimize adverse water quality and quantity effects on receiving waters, enhance the survival and propagation of vegetation, be structurally sound, control erosion, promote early completion and progressive reclamation, and encourage the prompt conversion from mining to an approved subsequent use.

Paleozoic Plateau

- Flow of water shall be managed during mine development and reclamation activities so not to accelerate the development of karst and other secondary porosity features in the underlying bedrock materials.

Requirements for Mine and Reclamation Plans: The following information is recommended to be included in mine and reclamation plans submitted to an LGU. Some information may already be required in other portions of a local permit, water management plans, and state required permits.

(1) Applicant Information

- A brief description of the general location and nature of the silica sand project.
- A legal description of the property on which the silica sand project is located or proposed, including the parcel(s) identification numbers.
- The names, addresses, telephone numbers, and email addresses of all persons or organizations who are owners of the property on which the silica sand project is located.
- If the property is being leased, the names, addresses, telephone numbers, and email addresses of all persons or organizations who are lessors of the property on which the silica sand project is located.
- If the project operation is being managed by a third-party company or organization that is not the owner or lessor, the name, addresses, telephone numbers, and email addresses of the all persons or organizations responsible for operating the mine and/or facility in the project area.
- Stipulate that an LGU must be notified 120 days in advance of any changes in status of owner, lessor, and/or operator and pursuant of financial assurance agreements.
- List any mines owned or operated by your company that currently are or have been placed on MSHA's pattern of violations/repeat offender list.

(2) Assessment of Pre-mining Conditions: The applicant should describe the pre-mining conditions of the site and adjacent to the site, which includes:

- Description and map of current land use within and ½ mile adjacent to project area.
- Map indicating ownership within and ½ mile adjacent to the project area.
- Map of all structures within and adjacent up to ½ mile adjacent to the project area and the purpose for which each structure is used, including buildings, pipelines, cables, railroads, and power lines.

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- Assess and provide a map indicating groundwater elevation, hydrologic gradient, and groundwater flow direction for the project area and other additional information specified in the “Groundwater Monitoring Plan – Site Characterization” section.
 - Provide maps and cross-section of pre-mining conditions as they currently exist in the project area:
 - Size 10-20 acres, not less than 1” = 100’
 - Size of 20-80 acres, not less than 1”= 200’
 - Size of >80 acres, ~ 1” = 400’ or scale that is determined to be most appropriated.
 - Cross-sections that adequately characterized the geologic variability of overburden and deposit thickness, geologic composition of the deposit, contacts between geologically distinct material and the approximate groundwater elevation as determined by hydrogeological investigations.
 - Conduct a field assessment to determine topsoil thickness of both A and B horizons. Display this information on a site map overlaying topsoil units using Natural Resource Conservation Service (NRCS) soil data. Make special note where topsoil is less than 1 foot to C horizon.
 - Map of existing roads within project area.
 - Map of previous excavations in the project area.
 - Notify U.S. Surface Transportation Board, as well as LGU, if excavation is planned to occur within 50 feet of an existing railroad track, structure, or facility.
 - A list and description of known or inferred cultural resources and historic properties, including any sites known by the State Historic Preservation Office within a project area.
 - Contours within the project area at intervals no larger than two (2) feet.
 - Map and description of a pre-mining vegetation and wildlife survey. Survey should indicate percent of grass basal cover, native vegetation cover, invasive species cover, rock cover, etc. Identify native and invasive species, diversity of plant and wildlife. The applicant should describe data collection methods and provide photos of transects. This baseline data on the existing plant community can be used in part to establish criteria for release of financial assurance.

Paleozoic Plateau

- Indicate the location of the site and if it is within 1 mile of a designated trout stream or class 2A waters and subject to additional permitted authorized by Minn. Stat, section 103G.217 and would require an issuance of a Trout Stream Setback permit from the DNR.
- Location of all seeps, springs, sinkholes, and other karst features within 1 mile of the mine site (as recommended in the Considerations for Setbacks – Trout Stream and Class 2A section).
- Since this region is an ecologically sensitive region, LGUs may want to require Natural Heritage Reviews (<http://www.dnr.state.mn.us/nhnrp/index.html>) be done on all projects regardless of size in order to assess the project’s potential to negatively impact any state-listed species or other rare features.

(3) Mine Planning: During the lifetime of the mine, the applicant should provide the information about the logical sequencing of a mine.

- Describe the projected life of the operations including beginning and ending of operations and any phases or stages. Indicate on a map the proposed sequence of mining the deposit and display the following information:
 - Permitted area of the mine (shape, size, and depth of mine), including boundaries of the areas that will be disturbed by mining, setback boundaries that apply to the silica sand project, all permanent boundary markers, and location of buffers, berms, fences, and gated mine entrance.
 - Location of proposed access roads and rail road spurs to be built in conjunction with the silica sand mining operation.
 - Numbered segments and the direction and sequence of mining.
 - Soil storage areas and sequence of stripping, storing, and replacement of overburden on mined segments. If topsoil to the C horizon is less than 1 foot over a significant area of the mine, stipulate that both A and B horizons may be stockpiled together. Mine sites where A and B soil horizons are greater than 1 foot, keep distinguishable soil horizons in separate piles and reclaim in the original soil sequence. Vegetate soil piles with crop cover or native groundcover to prevent wind erosion as well as maintain soil health if pile is standing for greater than 6 months. Soil health and viability is greatest when soils structure is preserved, is uncompact, and is used soon after stripping.
 - Location of operation plant, processing areas, transload sites and related infrastructure.
 - Location of wells, water pipes, and settling ponds.

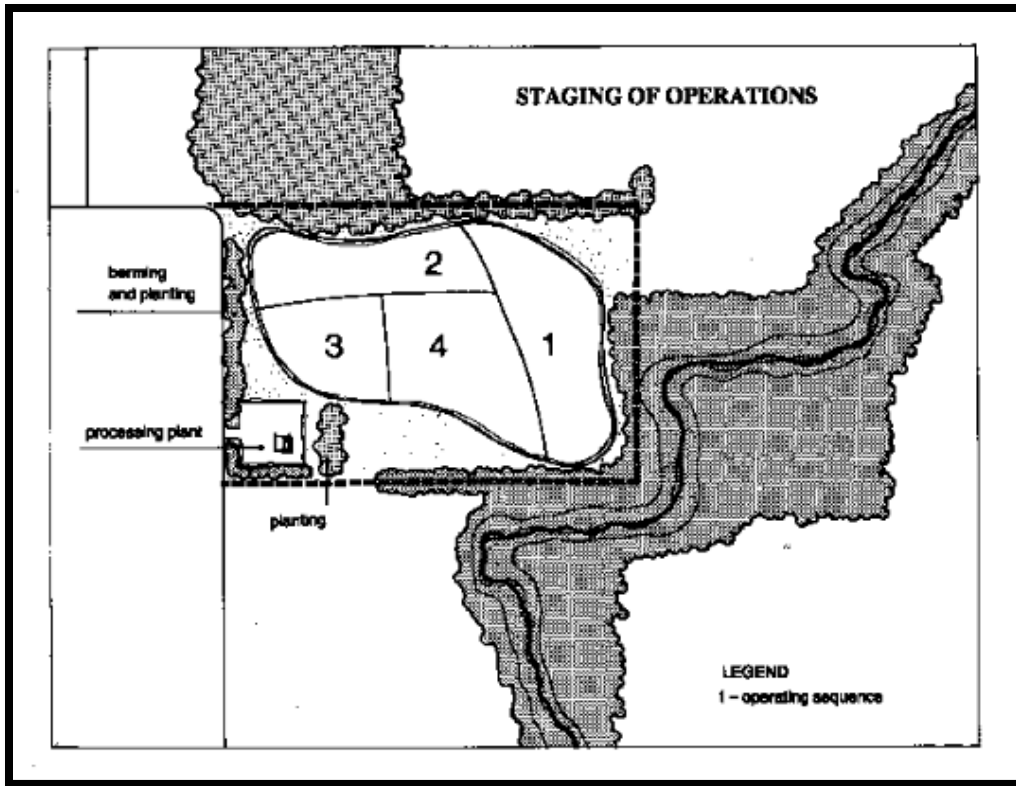


Figure 4. Example of map showing sequence of mining

LEGEND

- 1) Dogleg access to screen view from road
- 2) Buffer Strip
- 3) Fencing
- 4) Topsoil Storage
- 5) Overburden Storage
- 6) Reclaimed
- 7) Progressive Active Reclamation
- 8) Working Space
- 9) Exposed Gravel
- 10) Overburden goes to active reclamation (7)
- 11) Topsoil goes to topsoil storage (4)
- 12) Cleared Area

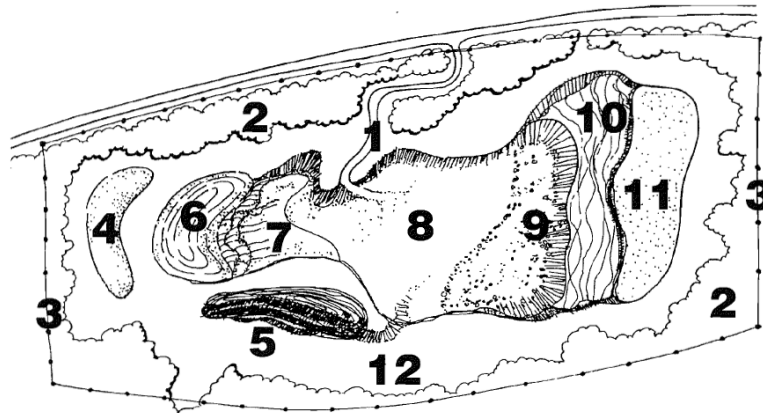


Figure 5. A number of structures and mine features are associated with typical non-metallic mining operations: the mine pit, topsoil storage, overburden storage, product stockpiles, berms, mine entrance, processing facilities, ponds, and weigh station (Alberta Land Conservation, Pit and Quarries, Reclamation in Alberta).

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- Negotiate berm height with respect to visual impacts to nearby residences and stipulate that berms are to be maintained and kept free of invasive species.
 - Negotiate or stipulate largest open mine cell-size.
 - Negotiate or stipulate lowest elevation of pit floor.
 - For visual and noise impacts reduction, describe how the existing topography and site characteristics of the mine will be maximized, i.e.:
 - Storage of overburden in berms along the site, plant vegetation on berms to reduce noise and dust emissions.
 - Plant vegetation (such as trees, shrubs, forbs, and native grasses) well ahead of mining to maximize time of establishment.
 - Place loud stationary equipment, such as the crusher, in an excavated area below the surrounding terrain.
 - Describe how the equipment will to be used in excavating and processing of silica sand.
 - Describe the use of flocculants, range of potential consumption/use of flocculants.
 - Provide estimates for the following:
 - The volume to be mined in each phase of mining.
 - Volume of waste products (processed sand) used in reclamation. An LGU should specify if off-site silica sand is allowable to use in reclamation.
 - Volume of overburden and topsoil to be used in reclamation.
 - Describe the methods that will be used at the cessation of seasonal operations to stabilize slopes from erosion, prevent topsoil from erosion, and prevent the establishment of invasive species.
 - Identify representative areas and conduct plot testing to determine vegetation/reclamation success.
 - Describe how invasive species and weeds will be managed on the entire site including stockpiles, berms, and road shoulders.
 - Describe how silica sand tracked out from site, spilled on to rail road, and/or any other unintentional dispersion of sand will be removed.

Underground Mining

- For underground mining, an LGU may want to consider ordering a discretionary EAW (MN Rules 4410.4500) due to the potential for significant impacts, such as unintended subsidence.
- While underground mining is more complex in terms of planning and reclamation, there are several examples in Wisconsin and Iowa where underground mines of non-metallic minerals have a long-operational history. If an LGU receives an underground mining proposal, it is recommended that the LGU consults with licensed engineers and geologists as they proceed with environmental review and potential permitting.
- The Underground Mining section provides general information for LGUs to consider when permitting an underground mine. The information is by no means an exhaustive list of all parameters associated with underground mining, but is intended to be a starting point in gathering the topical information related to underground mining. Considerations for underground mining includes but is not limited to the following:
 - A subsidence control plan which may include a survey of all structures and surface features, monitoring protocol for land disturbances.

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- Information pertaining to where surface disturbance is expected to occur.
 - An underground operational or excavation plan with descriptions of the underground geotechnical design factors, including detailed map of proposed mine tunnels, tunnel slopes, pillars, rooms, ventilation shafts, and other mine access points. This information is especially helpful for emergency response.
 - Information on the services required to safely operate the underground mines, including communication and ventilation plans.
 - Location of existing underground mine features.
 - Information on the technique of silica sand extraction to be used, blasting plans, and dewatering plans.
 - Information about the percentage of silica sand to be removed, pillar dimensions and spacing, pillar load strength, extraction/room dimensions, secondary extraction, geologic strata above and below the mine.
 - Permits should specify that damage to land must be repaired to its full pre-subsidence capability at the expense of the operator. Repairs to land and structures should occur after subsidence movements have stabilized. Permittee must compensate the owner at pre-subsidence value by repairing or replacing structure(s).
 - If planned subsidence is proposed, the permittee should define its extent and location as well as measures to be taken to mitigate any material damage to land and structures.
 - Information about underground electrical power usage and wiring plans.
 - Information about explosive storage and handling.
 - How much and where additional waste sand will be returned to mine.

(4) Interim Reclamation: Mines may experience a period inactivity for a number of reasons, such as downturns in the market or changes of ownership. Also, portions of the mine may become inactive, like an unused stockpile or working face. Setting conditions within the local permit to address interim reclamation during suspension of mining is important in controlling dust, invasive species, as well as storm water run-off. Conditions may include:

- Describing methods used to stabilize slopes with earthwork and use of using fast-growing vegetation, such as cereal grains, that establish quickly.
- Set and define durations of inactivity (i.e. one year for a mine, two years for an unused/unmodified stockpile) before reclamation activities need to be implemented.
- Topsoil should not be moved for interim reclamation purposes due to the significant loss of soil each time it is moved.

(5) Final Land Use and Proposed Reclamation: Depending of the lifespan of the mine, reclamation plans may need to be adaptive to implement continuous improvement objectives, changing community needs, site-specific geologic conditions. Adaptive reclamation plans are especially relevant for mines with long-life spans, complex mine designs, and continuous monitoring programs. While reclamation planning details such as final topography are specified below, it is important to allow adaptive reclamation strategies so mines can meet performance standards and objectives.

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- Describe proposed reclamation including final slopes, high wall reduction, benching, terracing, and other slope stabilization.
 - Provide a map showing location of anticipated topography, water impoundments, and artificial lakes. The topographic interval for maps can be specified (i.e. 2 foot contour intervals). The final topography should take into consideration of stormwater runoff and prevention of stormwater contaminants from the entering site.
 - Provide information about the location of surface structures, roads, and related facilities to remain on the site after reclamation.
 - Describe the methods proposed for the disposal or reclamation of oversized and undersized material. Stipulate if sand processed with polyacrylamide-based and/or polydiallyldimethylammonium chloride based flocculants are acceptable reclamation material.
 - Describe short-term and potentially long-term maintenance needed to support reclamation.
 - Define the site's Reclaimed Desired Plant Community (RDPC).
 - The RDPC should be comprised of species native to the area, or introduced species where the need is documented for inclusion to achieve the approved post-mining land use.
 - Seed sources should be from the Minnesota State Approved Seed Mix that is pre-approved by MnDOT, BWSR, and the DNR. Seed selection should be sourced within the same ecological subsection, as described by the Ecological Classification System (ECS). Seed should not require regular or seasonal applications of nutrients or pesticides.
 - The use of test plots, demonstration areas, or areas concurrently reclaimed areas within the mine site or within similar representative areas adjacent to serve as the RDPCs as long as they meet the reclamation goal is recommended.
 - Stipulate that the placement of overburden and soil should be placed in original stratigraphic sequence.
 - Specify criteria for assessing when reclamation is complete and financial assurance may be released, example of performance measures include-
 - Percent cover of an area that is covered, shaded or intercepted by desired vegetation. A performance standard to use may be 90% cover averaged over the site at 90% statistical confidence level. Measurement of revegetation should correspond with peak vegetative growth, which is usually in August.
 - Diversity of species- a predictor of the long-term stability of a plant community.
 - Tree regeneration standards- in terms of species and stems per acre, were specifications in reclamation plan met.
 - For wetlands restoration, an evaluation measuring species frequency of occurrence and density and percent cover along transects.
 - High walls, cut slopes, and/or topographic depression be eliminated, unless otherwise approved, and topography restored in accordance with reclamation plan.

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- Underground mining projects will have site-specific considerations that should be considered during reclamation. Examples of reclamation considerations include but are not limited to:
 - Removal of all hazardous materials from underground storage.
 - Sealing all surface openings, especially those connecting the underground workings to the surface.
 - Comply with Minnesota Department of Health abandonment procedures for wells and boreholes.
 - Securing of underground shafts or vent raise openings using concrete or other methods to ensure permanent closure.
 - Permanently securing access/audit openings.
 - Determination of long-term stability of pillars after mining activities cease, are pillars able to sustain their own weight and, if applicable, the weight of geologic material, water bodies, and all surface loads.
 - A long-term water management plan within the mine.
 - LGUs may need to hire the qualified persons to determine completeness of reclamation. Cost can be charged to project proposer.
 - Financial Assurance is released when goals specified by the reclamation plan are met and the LGU is satisfied the mine site is reclaimed to a stable, self-sustaining condition.

Additional Resources - Reclamation Guidebooks

Alberta. Reclamation Research Technical Advisory Committee, & Green, J. E. (1992). *A User Guide to Pit & Quarry Reclamation in Alberta*. Alberta Land Conservation and Reclamation Council, Reclamation Research Technical Advisory Committee.

Buttleman, C. G. (1992). *A handbook for reclaiming sand and gravel pits in Minnesota*. Dept. of Natural Resources, Division of Minerals.

Porle, T., Fauble P., and Jakubowski, R., (2002). "A Guide to Developing Reclamation Plans for Nonmetallic Mining Sites in Wisconsin". Wisconsin Department of Natural Resources, Bureau of Waste Management, Publication WA- 834 2002.

References

Hustrulid, W. A., and Bullock, R.L., eds. *Underground Mining Methods: Engineering Fundamentals and International Case Studies*. Littleton, Colorado: Society for Mining, Metallurgy, and Exploration, 2001.

Wampler, P. J., Throop, A. H., Schnitzer, E. F., & Roloff, J. M. (1997). *Best management practices for reclaiming surface mines in Washington and Oregon*. Oregon Department of Geology and Mineral Industries.

Wisconsin Code of Administration, NR 135

U.S. Department of the Interior, Bureau of Land Management, Guidelines for Successful Revegetation, Reclaimed Desired Plant Communities for Mining Operation Disturbances, viewed 11/19/2013. <http://www.blm.gov/or/programs/minerals/reclamation-revegetation.php>

D.4. FINANCIAL ASSURANCE

a. Description of Silica Sand Project Concerns

The purpose of requiring financial assurance is to ensure LGUs have access to funds to implement closure of a mining operation if the operator (permit holder) is unable to fully complete reclamation and closure of the mine lands and surrounding lands affected by mining activities. In this way the general public will not bear the cost of reclaiming and fully closing an abandoned mine site. It is to be used only in the case that the operator/permit holder is no longer able to complete the reclamation of the site. Any progressive reclamation, reclamation or closure activities would be conducted as needed and paid for by the operator.

In terms of silica sand projects, the potential financial impacts of closing a mine site depends on the size of the mine and the scope of the project. Silica sand projects can range from a single, small acreage mine sites, to a collection of several small mine sites, to multi-phased mines sites that encompass greater than 1000 acre and include processing and transload facilities.

b. Narrative Description and Background Information

The State has several options regarding financial assurance mechanisms to choose from in protecting LGUs and providing financial assurance. Financial assurance guarantees that funds will be available for an LGU to implement the reclamation plan of a mine site in the event of abandonment of a mine site or facility, temporary or permanent closure of a mine site, or the unsuccessful reclamation of mine areas which do not meet the specified reclamation performance standards specified within the reclamation plan. The calculated cost of site closure at any given time should be enough to close the site at that time. The amount should be modified as the site changes over time and adjusted annually. The plan and associated financial assurance mechanism is called the contingency reclamation plan. Financial assurance can be supplemented (increased) to include any corrective actions resulting from non-compliance with design and operating criteria of the permitted activity.

c. List of silica Sand Project Potential Impacts

The impacts of not requiring financial assurance include:

- Leaving an open and unreclaimed mine site may be unsafe to the general public.

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- The financial burden of reclaiming abandoned mine sites falling onto the county or township.

d. Recommendations, Standards, Criteria, Considerations

The state has well-developed information for LGUs on financial assurance mechanisms for solid waste disposal facilities. Since LGU have the authority to regulate non-metallic mining, these tools could also be applied and adapted to the varying range of silica sand projects across the state. The criteria/suggestions for financial assurance are addressed in this section in three components:

- (1) Financial Assurance Mechanisms
- (2) Items to Consider When Calculating Financial Assurance
- (3) Managing Financial Assurance

(1) FINANCIAL ASSURANCE MECHANISMS: The Minnesota Pollution Control Agency (MPCA) wrote rules, adopted in 2010, specifying financial assurance mechanisms for solid waste disposal facilities (Minn. R. Ch. 7035.2705 – 7035.5000). While there are other Financial Assurance mechanisms that can be implemented by LGUs, the information listed below were developed in accordance to the Administrative Procedure Act and in consultation with an advisory committee. These rules were partially based upon experience of implementing financial assurance for large-scale mining operations.

These rules are a useful financial assistance tool for local regulatory authorities because specific contract language, calculation tools, and suggested processes can be modified by LGUs and applied to silica sand projects. Summaries of financial assurance mechanisms from *Solid Waste Financial Assurance* ([W-SW3-25](#); Minnesota Pollution Control Agency published document) are described below. Additional language for these mechanisms can be found in Minnesota Rules, Chapter 7035.

- TRUST FUNDS ([Minn. R. Ch. 7035.2805](#)): A trust can be set up, with the LGU or LGU named as the beneficiary, through a trust agreement. An independent trustee manages the reserve funds and has the authority to engage in trust operations. Applicants must make monthly payments into the fund until it equal the sum of the current cost estimates and is considered fully funded. The rule provides a method for calculating the monthly payment amount.
- DEDICATED LONG-TERM CARE TRUST FUNDS ([Minn. R. Ch. 7035.2720](#)): This is a special kind of trust fund that may be used only by public sector applicants. The elements are similar to those of the trust fund described above except the trustee, under a dedicated fund, is a local government official and the trust set up is a part of the municipal treasury. The dedicated trust fund is set up by a resolution enacted by the appropriate local governmental unit such as a city council or county board.

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- SURETY BOND GUARENTEEING PAYMENT INTO A TRUST FUND ([Minn. R. Ch. 7035.2725](#)): A surety bond is a contract which assures that if the applicant fails to establish a trust fund before beginning final site closure, the surety will deposit the required amount (the penal sum of the bond which must equal current cost estimates) into the trust account before final site closure. A surety bond has no expiration date.
 - SURETY BOND GUARANTEEING PERFORMANCE ([Minn. R. Ch. 7035.2735](#)): This bond has basic provisions similar to the payment guarantee bond, but makes a different guaranty. The surety, in this case, guarantees that the applicant will perform closure, postclosure care, and corrective action activities in accordance with appropriate plans and LGU orders. If the applicant does not perform as required, the surety promises to deposit the required funds into a standby trust.
 - LETTER OF CREDIT ([Minn. R. Ch. 7035.2745](#)): A letter of credit extends the credit of the issuing bank or institution to the LGU, on behalf of the applicant. The LGU may draw on the credit if the applicant fails to perform required closure, post-closure care, or corrective action work. The letter of credit is issued equal to the sum of the current cost estimates. It should be irrevocable and must be issued for at least one year. It should be non-expiring and extended automatically from year to year unless the lender gives the LGU prior notice of intent not to renew it. A standby trust fund must also be established with a letter of credit.
 - STANDBY TRUST ([Minn. R. Ch. 7035.2705](#)): If an applicant provides a surety bond, a letter of credit, or self-insurance as financial assurance, the applicant must also establish a “standby” trust account that receives payment from either the surety or the bank which issues the letter of credit. Payment would be made into the standby trust account if the applicant fails to perform as promised or before final closure operations begin.

(2) ITEMS TO CONSIDER WHEN CALCULATING FINANCIAL ASSURANCE: The following list identifies some activities associated with reclaiming a mine site. This list is not exhaustive but gives a framework of discussion for an applicant and an LGU to review tasks required for the reclamation of mine lands.

The calculation of the financial assurance is dependent upon the size and scope of the mining activity. The calculation should be based upon current dollar value at the time of the estimate and the cost to the LGU of administering and hiring a third party to conduct corrective action and reclamation activities. No salvage value attributed to the sale of stockpiles, waste, facility structures, equipment, land or other assets should be used for estimating purposes. For each item, the applicant should consider the cost per unit (i.e. disturbed acres of land) and the number of units to determine the final amount.

- REMOVAL OF BUILDINGS and INFRASTRUCTURE: Activities necessary to remove and properly dispose of permanent structures, roads, utilities, equipment, etc.

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- **GRADING AND REGRADING:** Activities necessary to ensure soil and slope stabilization. This would include the cost of erosion control materials, fill materials, equipment and labor.
 - **TOPSOIL:** Activities and funds necessary to redistribute, purchase, apply, and amend topsoil to a thickness specified within the reclamation plan, including the cost of equipment and labor.
 - **REVEGETATION and SEEDING:** Activities and funds necessary to transplant and seed the site to performance standards specified within the reclamation site, including the cost of equipment and labor.
 - **VEGETATION STABILIZATION:** The cost of mulching, netting or other stabilization materials, equipment, amendments, and labor.
 - **SHORT-TERM SITE MAINTENANCE:** Covers a period of time until the mine meets interim reclamation performance standards as determined from reclamation plan. This may include costs for additional seeding, sloping, and regrading slopes (i.e. repair damaged areas; improve poorly performing areas) as well as the costs for equipment and labor.
 - **LONG-TERM SITE MAINTENANCE:** Covers periods of time between first interim reclamation until the site is deemed to meet final reclamation performance standards. This would coincide with when the financial assurance may be returned. Depending on the reclamation plan, costs for additional seeding, vegetation, equipment and labor may be needed to sustain the site.
 - **ADMINISTRATIVE COST of IMPLEMENTING RECLAMATION PLAN:** LGUs would need to determine what percentage above the cost of reclamation is required to cover expenses in overseeing the reclamation process.

(3) MANAGING FINANCIAL ASSURANCE: Financial assurances ensures a source of funds for an LGU if an applicant fails to perform reclamation activities including closure and post-closure maintenance needed if operations cease as well as corrective actions as required by LGUs if noncompliance with design and operation criteria in the permit occurs.

General criteria for financial assurance include:

- Assurance of funds sufficient to cover cost estimated reclamation and corrective action cost estimates;
- Assurance that the funds will be available and made payable to the LGU when needed;
- Assurance that the funds will be fully valid, binding, and enforceable under state and federal law;

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- Assurance that the funds will not be dischargeable through bankruptcy, and
 - All terms and conditions of the financial assurance must be approved by the LGU. The LGU, in evaluating financial assurance, should use individuals with documented experience in the analysis. The reasonable cost of the evaluation shall be paid by the applicant.

Financial assurance in the amount equal to the estimated contingency reclamation cost:

- Should be submitted to the LGU for approval before the issuance of a permit to mine and before granting an amendment to the permit
- Continuously maintained by the applicant
- Adjusted annually for the following reasons
 - If the new cost estimate is approved and is greater than the amount of the existing financial assurance, the applicant provides additional financial assurance in an amount equal to the increase; or
 - If the new cost estimate is approved and is less than the amount of existing financial assurance, the applicant can be released from maintaining financial assurance in an amount equal to the decrease.
 - Yearly update of cost estimate.

Financial assurance should be made available to the LGU when the operator is not in compliance with either the contingency reclamation plan or the corrective action plan.

- An LGU would need to develop a procedural process of commencement, for example:
 - Serving an order to forfeit the financial assurance on the person, institution, or trustee holding the financial assurance; and
 - Serving a notice of measures required to correct the situation and the time available for correction on the applicant.
- If conditions that provided grounds for the order are corrected within a period established by the LGU and if measures approved by the LGU are taken to ensure that the conditions do not recur, the order can be canceled.
- If the conditions that provided grounds for the order are not corrected, the LGU can proceed with accessing and expending the funds provided by this part to implement the contingency reclamation or corrective action plans.

Financial assurance may be canceled by the applicant, on approval of the LGU, only after it is replaced by an alternate mechanism or after the applicant is released from the financial assurance when:

- An operator/applicant substitutes alternative financial assurance;
- The LGU determines all reclamation activities have been completed according to the reclamation plan;
- Conditions necessitating post-closure maintenance no longer exist and are not likely to recur, and
- Any corrective actions have been successfully accomplished.

The applicant must ensure that the provider of financial assurance gives the LGU notice on the order of 120 days prior to cancellation of the financial assurance mechanism. Upon receipt of this notice, the LGU initiates a proceeding to access the financial assurance. That process could be halted if acceptable financial assurance is reestablished.

If the mine or facility changes ownership, the new applicant must be in compliance with the requirements set in financial assurance ordinance/conditional use permit before the permit is transferred. Only after the new owner re-establishes their new financial assurance mechanism and it is approved may the former applicant be released from their requirements.

If there is a failure to comply with the specified criteria, an LGU may deny, suspend, revoke, or modify the permit to mine.

References

[Minnesota Statutes, Chapter 93.44 to 93.51](https://www.revisor.mn.gov/statutes/?id=93): <https://www.revisor.mn.gov/statutes/?id=93>
[Minnesota Rules, Chapter 7035, Solid Waste](https://www.revisor.mn.gov/rules/?id=7035): <https://www.revisor.mn.gov/rules/?id=7035>
[Minnesota Rules, Chapter 6130 \(ferrous\)](https://www.revisor.mn.gov/rules/?id=6130): <https://www.revisor.mn.gov/rules/?id=6130>
[Minnesota Rules, Chapter 6132 \(non-ferrous\)](https://www.revisor.mn.gov/rules/?id=6132): <https://www.revisor.mn.gov/rules/?id=6132>
[MPCA Solid Waste Financial Assurance Document 3.25, April 2003](http://www.pca.state.mn.us/index.php/view-document.html?gid=12790):
<http://www.pca.state.mn.us/index.php/view-document.html?gid=12790>

D.5. BLASTING AND BLAST PLAN REQUIREMENTS

a. Brief Description of Silica Sand Project Concerns

Blasting is the controlled use of explosives to excavate or remove rock. Sandstone deposits vary in terms of how well individual sand grains are cemented together. For moderately to well-cemented sandstone deposits, blasting may be required to break up and access a deposit.

b. Narrative Description and Background Information

Regulation and Guidance

Some regulatory oversight of non-metallic blasting in Minnesota is the purview of an LGU. Since Minnesota is one of a few non-coal producing states, federal standards developed by the Office of Service Mining and Reclamation and Enforcement (OSM) are not applied within the state. Therefore, federal jurisdiction in Minnesota is limited to confines of the mine and overseen

by Mining Safety and Health Administration (MSHA). MSHA regulations are specific to the storage, transportation, and use of explosives (30 C.F.R §56.61-56.63) and do not regulate the blasting activity itself. However, OSM does have very well-developed blasting performance standards based on continuous research and development for regulation of the coal industry. Portions of the federal blasting standards are commonly adapted by LGUs via ordinance (Dunn County, WI Blasting Ordinance) or specified in local permits (Le Sueur County CUP #29000).

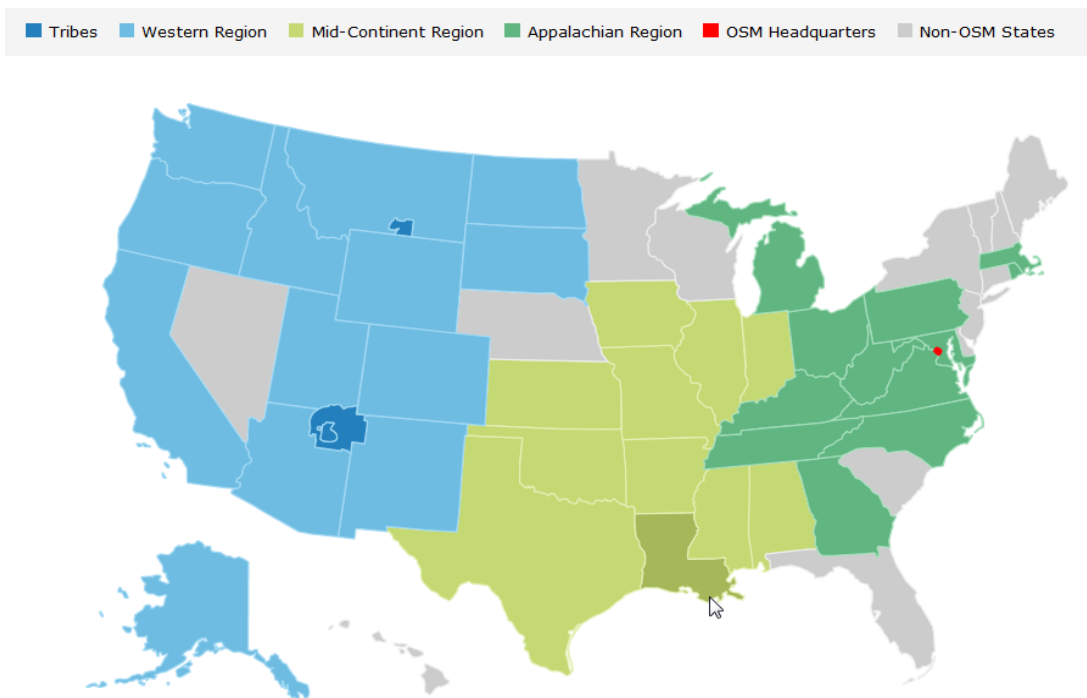


Figure 6. Map of the United States of America showing the regulatory authority of the Office of Surface Mining Reclamation and Enforcement (OSM).

At the state level, the State Fire Marshal, a division within the Minnesota Department of Public Safety, issues licenses and permits (MN Statute 299F.73 and 299F.74) “for persons who manufacture, assemble, warehouse or store explosives or blasting agents as well as those who possess explosives or blasting agents.” The state also regulates blasting for ferrous and non-ferrous mining.

The Department of Natural Resources (DNR) has rules for blasting related to ferrous and non-ferrous mining (MN Rule 6132.2900). Although these standards do not apply to non-metallic mining, they are commonly used by LGUs regulating aggregate and silica sand quarries.

The Minnesota Department of Transportation (MnDOT) regularly mitigates and monitors sources of vibration associated with road construction activities, which includes blasting. Construction related blasting often travels farther than that for large mining/quarrying blasts. As a result, MnDOT has assembled a geotechnical manual that includes blasting standards used for transportation-related projects ([MnDOT, 2013 Geotechnical Engineering Manual](#)).

LGUs have the authority to regulate and monitor blasting activity within their jurisdiction. The designated approval authority may impose additional restriction or conditions as it deems necessary to protect the public interest. In a recent survey of LGUs by EQB for the purposes of this document, 93% of the respondents said “yes” to the question “does your jurisdiction host or expect to host mining activity that requires blasting?”

Impacts of Blasting

Blasting, as well as other activities, can produce vibrations that may impact nearby structures. Two types of vibrations sources generated by human activity (Jones and Stokes, 2004) include:

- (1) Transient - i.e. blasting, pile driving, and pavement breaking.
- (2) Continuous – i.e. trains, heavy truck traffic, and heavy equipment.

Impacts of blasting to nearby structures are dependent upon many site-specific, geologic factors, such as the density of the rock, the type of overburden (material that needs to be stripped away to access a deposit), the presence and thickness of unconsolidated overburden, and the direction of the blast. Therefore, each site where blasting is occurring should require a site-specific blasting plan and monitoring plan.

Blasting also has environmental impacts. Concerns associated with chemicals present within blasting agents and water quality is well-documented (Forsyth, Cameron, Miller, 1995; Hackbarth, 1979; Pommen, 1983). In some instances, materials such as detonators and explosives are not entirely combusted during blasting and result in the release of nitrates into the groundwater (Kernen, 2010). Also, there is evidence to suggest that polyacrylamide and acrylamide may be present in some blasting agents. However further study is needed to distinguish the contributing sources and cumulated impacts of polyacrylamides in the environment.

Loading practices and blasting efficiency, as well as the presence of water, control the amount of nitrates that enter groundwater (Forsyth et al., 1995). Because groundwater in some areas have highly elevated levels of nitrates due to agricultural practices, it may be difficult to discern potential sources of nitrates. However, best management practices associated with blasting can help reduce the input of nitrates and is usually achieved through care and attention to detail in the mining operation with little added cost to the mining operation (Forsyth et al., 1995).

Within this section, information, protocols and specifications that can applied to blasting activities are addressed, which consist of a compilation of protocols developed by LGUs, state rules, state and federal guidance documents, and the Code of Federal Rules (C.F.R).

c. List of Silica Sand Project Potential Impacts

Blasting could present serious risk to human health and safety, damage to property, as well as potential risk to groundwater contamination. Over the past 100 years, the federal government has developed safety protocols that improved the reliability and safety of blasting methodologies. With that said, some risks and impacts associated with blasting include:

- Inadequate blast area security and pre-blasting notification can pose a safety threat to the public.
- Vibration through the air (overpressure/air blast): a shock wave caused by blasting that is over and above atmospheric pressure. Air blasts are measured in wave frequencies (Hz) and with sound (dB). Air blasts from mining activity have the potential to rattle and break windows.
- Vibration through the earth (ground vibration): elastic waves that propagate through the ground. Ground vibrations are measured in wave frequencies hertz (Hz). Ground vibrations from mining activity have the potential to crack walls, crack foundations of structures, and detrimentally impact historical buildings and structures.
- Ground vibrations have greater potential impacts in areas with thicker unconsolidated sediment and in older houses that have plaster walls.
- Chemicals used to blast have the potential to contaminate groundwater by the release of nitrates. A widely used industrial blasting agent is ammonia nitrate/fuel oil (ANFO). ANFO that has not been waterproofed quickly dissolves in water leaching ammonium and nitrate to groundwater as it dissolves in the blast hole.

d. Recommendations, Standards, Criteria, Considerations

The intent of this section is not to review safety protocols that are implemented within a mine and regulated by MSHA, but to give tools for LGUs to consider for mitigating and monitoring the potential impacts of blasting that occur outside the mine site boundary. In terms of geographic region, extra precaution is needed in the Minnesota River Valley where thickness of unconsolidated sediment is generally greater than in the Paleozoic Plateau and ground vibrations may travel farther (Siskind, et. al., 1980).

(1) Application to Blast: An LGU can require an application for a permit to blast within the applicable jurisdiction. This application would have to apply to all blasting activity that includes but is not limited to the construction, placement or erection of a structure; operations of non-metallic mine; and the demolition of buildings or other structures.

- Application for a permit to blast should require (1) an individual who holds a valid blaster's license issued by the Minnesota State Fire Marshall or comparable licensure through another state, and (2) submission by and issuance to a lasting business entity.
- Application for a blasting permit may include the following information:
 - Applicant name including individuals of a partnership, and officers of a corporation including a limited liability corporation, license number, address, contact phone numbers, and email address of the applicant.

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- A statement (devised by the LGU) and signature indicating acceptance of responsibility for blasting activity, by an individual who holds a valid blaster's license issued by the Minnesota State Fire Marshall with the proper classification. Name, address, license number, contact phone numbers, and email address of the blaster in charge of the blast, if different from the applicant.
 - Name, address, contact phone numbers, and email address of any person (agent or employee) in charge of the operation who will respond to inquiries by the LGU.
 - A map showing the location of the blasting site including the location of all the buildings located within ½ mile of the controlled blasting site, names, addresses, and contact information of owners of those buildings.
 - The LGU would have to establish a procedure to process applicants which could include, but not limited to:
 - A process of application review to determine completeness and compliance with existing permit or ordinance.
 - A process of approval/denial through a department, commission, or board.
 - Development a fee structure or application fee.

(2) Pre-blast Survey: Is a record on paper, video, or an unalterable electronic file to document the condition of a dwelling, structure, or water well within a specified radius of the blasting before the commencement of blasting activity. It is recommended that ordinance or a local permit includes language specifying protocols for pre-blasting surveys such as:

- The survey is to be completed by a third party consultant and available to the landowner upon request.
- At least 30 days before initiation of blasting, the operator should notify neighbors within ½ mile of the blast by using reasonable efforts.
- Written notification by the company should indicate that, upon written request, the mine company will perform a pre-blasting survey. The notification will indicate that no survey will be completed unless the resident and/or landowner makes a written request for the pre-blast survey and a water quality test for existing wells to the LGU.
- Survey is to include and record through inspection the baseline condition of a house or structure, including assessments of both the interior and exterior condition of a structure, condition of a water well, and water well testing (see Water Quality Standards Section, Sample Collection and Analysis Subsection for private well monitoring standards).
- The survey and water well testing should be completed at the expense of the mine company.
- The resident of owner can request a copy of the survey and well test at any time. The company has 72 hours to provide the pre-blasting survey results upon request.

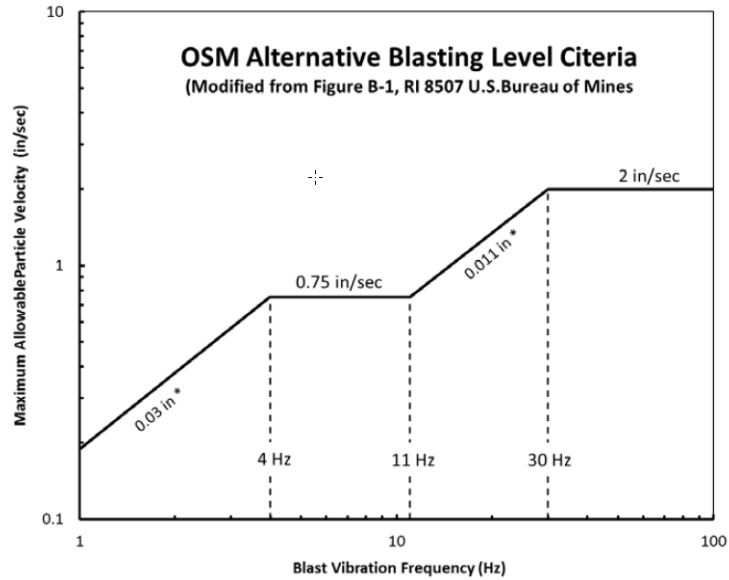
(3) Notification Plans: Is a process to notify neighbors, residents, and landowners within a specified radius around a blast site. Parameters for a notification plan should be developed by the company and can include:

- Time at which to notify residents and neighbors of initial blasting activities. Common practice requires a 30 day notice (OSM Blasting Performance Standards, 30 Code of Federal Regulations).

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- Identify or negotiate the frequency to notify county, township, residents and neighbors of subsequent blasting activities .
 - Specified reasonable efforts of notification. Reasonable efforts can include a written notice, phone call, email, or verbally in person.
 - Criteria in which utilities need to be notified of blasting.

(4) Blasting Standards: Some of the language below can be modified to be incorporated into ordinance or within a local permit.

- Whenever explosives are used, they shall be of such character and in such amount as is permitted by state and local laws and ordinances and all respective agencies having jurisdiction over them.
- The regulatory requirements of OSHA Safety and Health Standards 29 CFR, Part 1926, Subpart U, "Blasting and Use of Explosives", shall be applied.
- Operators will use all industry standard measures to control fly rock with the intent that fly rock not leave the mine property.
- Prior to any blasting event at the excavation and mining site, the mining operation is responsible for giving notice of the impending blasting event by displaying a fluorescent flag and legible sign within 100 feet of all public roads bordering the blasting site.
- Untreated ANFO should not be used in blastholes with standing water in the bottom. Waterproof blasting agents such as emulsions or gels, developed to prevent the release of nitrates into the groundwater, should be used in blastholes with standing water at the bottom.
- The maximum single component peak particle velocity resulting from construction activity should not exceed the safe blasting criteria established in Office of Surface Mining recommendations, OSM Alternative Blasting Level Criteria (Modified from Figure B 1, RI 8507 U.S. Bureau of Mines). This criteria allows a constant peak particle velocity (ppv) of 2.0 inches per sec (ips) above 30 Hz. Below 30 Hz, the maximum velocity decreases at a rate equivalent to a constant peak displacement of 0.01 inch to 11 Hz. Between 11 Hz and 4 Hz the maximum velocity is 0.75 ips. Below 4 Hz the maximum velocity decreases at a rate equivalent to a constant peak displacement of 0.03 inch.



- Very fragile, historic buildings commonly have extra precaution. The National Cooperative Highway Research Program (NCHRP) and the American Association of State Highway and Transportation Officials (AASHTO) both recommend a vibration limit of 0.12 in/sec to prevent cosmetic damage to historic sites or critical locations. MnDOT’s vibration criteria for historic buildings are defined as:

Structure and Condition	Maximum PPV (in/sec)	
	Transient Sources	Continuous/Frequent Intermittent Sources
Extremely fragile historic buildings, ruins, ancient monuments	0.12	0.08
Fragile Buildings	0.2	0.1

- The NCHRP study, *Current Practices to Address Construction Vibration and Potential Effect to Historic Buildings Adjacent to Transportation Projects* (2012), also suggests taking a “cautious approach in setting vibration limits for historic buildings and allow for flexibility on a case-by-case basis.”

(5) **Blasting plans, logs and monitoring:** Is a tool to record details associated with a blasting event. Logs can be used to help mitigate issues associated with a blast.

- Require blasting plans to be prepared as a condition of the local permit.
- Blasting plans should specify handling and loading practices. (Forsyth, 1995)
 - Spillage around the blasthole should be placed in the borehole or cleaned up and placed in secured containers for off-site disposal.
 - Loaded explosives should be detonated as soon as possible and should not be left in the blastholes overnight, unless weather or other safety concerns reasonably dictate that detonation should be postponed.
 - Loading equipment should be cleaned in an area where wastewater can be properly contained and handled in a manner that prevents release of contaminant to the environment.

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- Manufacturer's data sheets for all explosive products.
 - Procedures to inform and protect the public and adjacent property (e.g. signs, horns, letters, personal visits, etc.)
 - Require a flyrock control plan.
 - Post-blast observation and safety procedure.
 - Require modifications of the blasting plan to be reviewed and approved by the LGU to address safety and public concerns.
 - Hire a third party reviewer to analyze the competency of plans and blasting proposals. Cost of review can be charged to the company.
 - Require companies to prepare blasting logs to record each blasting event that is maintained for a period not less than 5 years after a blasting event.
 - Copies of blasting logs shall be given to the LGU within 5 working days upon request.
 - Information to record in a blasting log includes:
 - Name, signature, and license number of the blaster in charge of the blast
 - Specific blast location, including address, bench and station number if applicable
 - Type of blasting operation
 - Date and time of the blast
 - Meteorological conditions, including temperature inversions, wind speed, and directions as can be determined from the United States Weather Bureau, and ground-based observations
 - Diagram of the blast layout and the delay pattern
 - Number of holes
 - Hole depth and diameter
 - Spacing of holes
 - Burden
 - Maximum holes per delay
 - Maximum pounds of explosives per delay
 - Number, type and length of stemming used between decks
 - Total pounds and type of explosives per each delay
 - Distance to nearest inhabited building not owned by the applicant
 - Type of initiation used
 - Seismographic and airblast records, which shall include all of the following:
 - Type of instrument and last laboratory calibration date.
 - Maps of the exact location of monitoring instrument(s)
 - Records of the date, time, and distance from the blast.
 - Trigger levels for ground and air vibrations
 - The vibration and airblast levels recorded.
 - Particle velocity should be recorded in three mutually perpendicular directions.
 - In the event that seismograph monitoring exceeds standards identified in either the Blast Plan or local permit, the company will notify the LGU(s) within 5 working days.
 - Water Resource Management Plan should address potential nitrate contamination due to blasting.

[MnDOT, 2013 Geotechnical Engineering Manual:](http://www.dot.state.mn.us/materials/geotmanual.html)
<http://www.dot.state.mn.us/materials/geotmanual.html>

National Cooperative Highway Research Program (NCHRP), 2012, [Current practices to address construction vibration and potential effects to historic buildings adjacent to transportation projects](http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP25-25(72)_FR.pdf): [http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP25-25\(72\)_FR.pdf](http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP25-25(72)_FR.pdf)

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[Office of Surface Mining Reclamation and Enforcement Technical Library:](http://www.techtransfer.osmre.gov/NTTMainSite/osmlibrary.shtm)
<http://www.techtransfer.osmre.gov/NTTMainSite/osmlibrary.shtm>

LeSueur County, Conditional Use Permit (CUP) #29000, February 26, 2013.

Town of Dunn, Ordinance #11-21

D.6. INSPECTIONS

a. Description of Silica Sand Project Concerns

Inspections of a silica mine, processing facility, or transload facility helps enforce and monitor compliance of conditions specified within a local permit.

b. Narrative Description and Background Information

As mentioned in other Operations sections, the Mining Safety and Health Administration (MSHA) is charged with inspecting a mine site with the protection of the worker in mind. It is the purview of the LGU to inspect and enforce the requirements of their own permit. The inspection could be done by LGU staff or contracted to a third party. The cost of the inspection can be incorporated into an escrow account that can be accessed by the LGU to cover the cost of administering the permit.

To enter and inspect an active mine site, the inspector on behalf of the LGU must hold and show a current certificate of safety training by MSHA. Additional training may be required to enter underground mines.

c. List of Silica Sand Project Potential Impacts

- LGUs may lack the resources needed to determine if a silica sand facility is operating within the conditions outlined in a local permit.
- LGUs may lack the staff that has the expertise to conduct on-site inspections.
- Authority to inspect may be omitted in local permits which can potentially limit an LGUs ability to determine if a silica sand facility is operating within the conditions outlined in a local permit.
- Corrective action implementation may be omitted from a local permit.

d. Recommendations, Standards, Criteria, Considerations

Detailed inspection protocols listed below are derived from California's Surface Mine Inspection Guidelines. Guidelines were developed by the California State Mining and Geology Board with cooperation from the California Department of Conservation's Office of Mine Reclamation. The guidelines intend to recognize that those who conduct surface mining field inspections will have specific professional expertise, but may not be fully knowledgeable in all facets of surface mine inspections or state and federal environmental standards. The recommendations, criteria, standards, and considerations listed below are not applicable to underground mines. It is

recommended that an inspection protocol for an underground mine be developed for a specific project and conducted by a licensed mining engineer.

- As a condition of approval for a local permit for a silica sand project (mine, processing, and/ or transload facility), the LGU shall reserve the right to go on and inspect the subject property, at the discretion of the LGU.
- It is recommended LGUs make, at a minimum, annual inspections.
- Per Minnesota Statute 471.59 (Joint Exercise of Powers): “Two or more governmental units, by agreement entered into through action of their governing bodies, may jointly or cooperatively exercise any power common to the contracting parties or any similar powers, including those which are the same except for the territorial limits within which they may be exercised. The agreement may provide for the exercise of such powers by one or more of the participating governmental units on behalf of the other participating units.”
- LGUs should consider implementing corrective action plans and/or requirements within local permits to ensure silica sand facilities correct the noncompliance identified by the LGU as a result of an inspection. The corrective actions are intended to bring a silica sand facility back into compliance with local permit requirements.
- If an LGU does not have the staff or expertise to conduct mine site inspections, hiring of third party consultants at the expense of the applicant is recommended.

PRE-INSPECTION: Prior to conducting the inspection, the inspector should contact the mine operator, owner, or agent and schedule a time for the inspection. Also, contact or invite state regulators for joint inspection if site requires. It is important that a representative who is knowledgeable about the mine’s operations be present during the inspection.

- Pre-inspection work-up should take note of any previously documented deficiencies or violations and determine the operation’s current state with respect to any remedial actions or timetables to correct the deficiencies or violations.
- Thoroughly review the reclamation plan. Pay special attention to maps, figures, cross-sections, and schematics. Review any conditions of approval that may have been imposed during the permitting process that relate to reclamation/operation activities. The local permit may specify requirements to which the mine must adhere during its operations.
- Thoroughly review the current financial assurance and amount. Determine if the financial assurance is still in effect, completed correctly on the approved form, or if is to expire. If either the financial assurance amount or the financial assurance instrument is not current (i.e. out of date or does not address all reclamation plan issues, has not been updated, is incorrect), note the areas of inadequacy and include them as possible deficiencies in final inspection report.
- Obtain a recent base map or aerial photograph of the mine/facility site showing the site’s facilities for ease in mapping the conditions observed during the actual inspection.
- Thoroughly review location of any known springs, sink holes, seeps within 1 mile of site location. Examples of potential sources of information include DNR Karst Features

database, Minnesota Geologic Survey County Atlas Maps, and high resolution elevation data (i.e. LiDAR).

MINE/FACILITY INSPECTION: During the conduct of the site inspection, it is recommended that the operator, mine manager, or operator's representative that is familiar with the mine site and activities accompany the inspector. As the inspection proceeds, the inspector should ask questions about any activities that the inspector believes may not be in compliance with the local permit, or that appear to be new from the previous year's operations.

- Prior to commencing the mine/facility inspection, the inspector should meet with the operator/representative at the site.
 - Introduce members of the inspection party.
 - Explain the purpose and scope of the inspection
 - Review safety requirements with the operator or safety officer of that mine/facility.
 - Ask the operator for information on the mine/facility current activities (i.e. is the site idle, currently mining, is blasting to take place, are trucks operating, is sand being processed, etc.) Ask about any safety concerns about which the inspector needs to be aware.
- During the inspection, the following items should be observed and described.
 - Any inconsistencies with the requirements of the reclamation plan and other plans referenced within the Conditional Use Permit.
 - Photographs and physical measurements of the site and its features should be obtained to document findings and the condition and appearance of the mine site, especially any conditions that preclude reclamation of the site in accordance with the approved reclamation requirements.
 - Describe location, including UTM or latitude and longitude from GPS.
 - Describe mine inspection activity, who was present, areas observed and why, and any areas that were not allowed to be observed if applicable (i.e. an area prepared for blasting).
 - Describe and inspect restrictions to public access to the site (e.g. gate, fences, warning signs) as specified by the local permit.
 - Observe and describe the current mining operation/facility and mineral product(s). Identify any unique or relevant sand extraction, processing, or storage characteristics that are not described in the reclamation plan and other plans referenced with the local permit.
 - Observe and visually describe stability of any cut or fill slopes within a mine. Note the current slope configuration and conditions (e.g. are slopes clean or vegetated, do they have erosion rills or gullies, are slumps or slides apparent, etc.); do the slopes appear to be at the correct angles and heights as prescribed in the reclamation plan or local permit; are the slopes supposed to be benched at specific intervals; what is the condition of the inter-bench slope stability? Based on the observed condition of the slope, should a licensed geologist or engineer be consulted to assess the long term stability of the slope; that is, might the present condition of the slope indicate that its approved final design as called for in the reclamation plan may not be achievable?

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- Observe and describe the condition, configuration, and characteristics of any mine waste piles and/or tailings piles.
 - Observe berms of ponds; take note of any seeps from berms. Measure or note the freeboard of ponds and. Look for regrading activities.
 - Observe and describe the activities for soil salvaging and stockpiling for future reclamation operations. Determine if the stockpiled soil is protected from erosive actions.
 - Observe and describe any reclamation activities that are concurrent with mining. Are these actions described as part of the phased reclamation activities in the reclamation plan or conditions of the local permit? Inquire as to the extent of any reclamation actions that are proposed for the coming year. Do any of the areas designated in the reclamation plan require unique protection or special attentions, such as to prevent adverse impacts to state-listed endangered or threatened species?
 - Determine if any backfilling of an excavation or creation of a fill slope has occurred. Determine if the filling activities require engineering designs or specifications or permits as described in the approved reclamation plan.
 - Observe and describe any active revegetation pilot programs. Note if the revegetation programs are in accordance with the requirements of the reclamation plan, and if monitoring is occurring. Request copies of any monitoring data.
 - Observe and describe any natural occurring revegetation. Observe the presence of invasive species that is inconsistent with the approved reclamation plan.
 - Observe and describe any sedimentation basins that will be left in place that are out of compliance with the reclamation plan.
 - Determine if previously cited deficiencies or violations have been corrected, partially corrected, or not addressed by the operator. It is recommended that the operator be informed of the inspector's determination regarding the status of previously cited deficiencies or violation during the inspection.
 - Determine if the observed operation and the physical condition of the mine site are in accordance with the requirements contained in the approved local permit. If new deficiencies or violations are observed, these should be documented and called to the attention of the operator during the inspection routine.
 - Determine if the financial assurance equates to the actual physical site conditions. Consider if the current financial assurance amount is adequate to the complete reclamation of the entire site if mining activities ceased operation at any time within the coming year. Determine if the financial assurance amount would adequately cover the remediation of any deficiencies or violations noted during the current inspection.
 - Are there any other observed and documented conditions that are related to another regulatory agency, such as some form of contamination or pollution? If so, report to appropriate State agency.
 - Sketch the mine's current development and mine/facility conditions on a base map or form with annotations of findings.
 - When the on-sight inspection is completed, observe the surrounding area of the mine for any indication of an off-site violation.

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- Following the completion of the inspection tour, the inspector should review the results and findings of the inspection with the operator or the operator's representative, and any lead agency personnel in attendance.

Paleozoic Plateau or where bedrock is within 50 feet of surface in the Minnesota River Valley:

- Ask mine/facility operator or representative of any sudden drainage of stormwater retention or settling ponds/basins.
- Look for channeling of water and development of new sinkholes or collapse features.

POST-INSPECTION: This section specifies the steps necessary to secure the inspection information and prepare an inspection report for distribution.

- Process and evaluate field inspection information.
- If possible, map mine information using GIS base map and plot location of photos. If GIS is not available, prepare a map from available database sources and other document file information.
- Download or process pictures and prepare annotated photos (date, location, photo reference, and description of view).
- Review field data and notes. Compile an inspection report consisting of a Summary of Observations, Conclusions, and Recommendations. The report should include any conversations with the mine/facility operator or other local/state agency personnel on site during the inspection activities. Include a list of conclusions regarding the conformance of the mine operations with its local permit, reclamation plan and other reference plans within the permit, and adequacy of financial assurance.
- Recommendations for proposed actions to correct observed deficiencies or violations should be made in the Summary. The recommendations may relate to proposed actions to be taken by the operator, or to further inspection activities by specialists. The recommendations may include the use of a licensed geologist or engineer to more thoroughly evaluate suspected problems dealing with slope stability issues or other geological or engineering issues, the use of botanists to investigate revegetation issues, and the use of any other specialists where the scope of concern may be outside the inspector's particular expertise.

E. CONSIDERATIONS FOR SETBACKS AND BUFFERS

BACKGROUND AND INTRODUCTION

Setbacks are among the oldest types of zoning standards. Dating from the early 20th century, they were originally used to provide space, light and air between buildings in congested cities. The application of setbacks became broader over time, and came to include separating differing land uses.

Buffers appeared in the mid-20th century with an original purpose of beautifying and screening land uses. Similar to setbacks, the application of buffers has broadened over time.

The terms “setback” and “buffer,” for the purposes of this document, have the following meanings:

- **Setback:** a required minimum distance between a proposed land use and adjacent or nearby land-use or natural feature, with the purpose of reducing the impacts resulting from the proposed land use. (“Land use” is defined as a human use of land as opposed to a natural feature of the landscape)
- **Buffer:** a strip of land containing vegetation, fencing, berming or other construction with the purpose of reducing impacts of a proposed land use upon adjacent or nearby land uses or natural features.

Setbacks and buffers are commonly used tools at the local level that can be effective in reducing adverse effects of proposed projects. However, setbacks and buffers by themselves are by no means the only way to protect surrounding land uses from potential impacts of silica sand mining, processing, and transportation. LGUs are encouraged to refer to other sections of this document for further guidance on assessing, minimizing, and mitigating adverse impacts associated with silica sand projects.

In addition, thorough and robust land use planning, followed by implementation of the planning through zoning districts, typically is the best way to avoid adverse effects by avoiding incompatibility of land uses. It is important to consider how an LGU’s requirements—including setbacks and buffers—are designed to implement the planning.

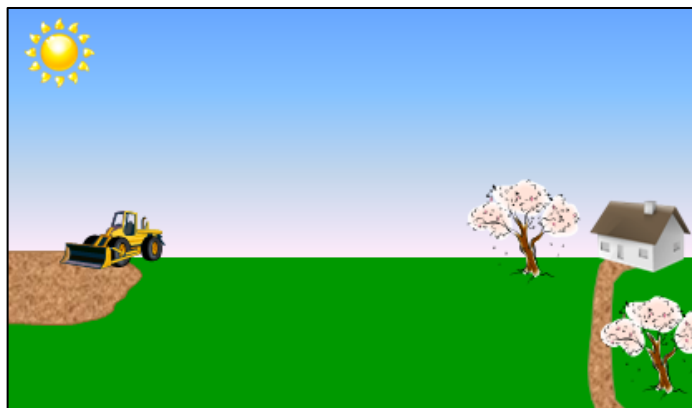
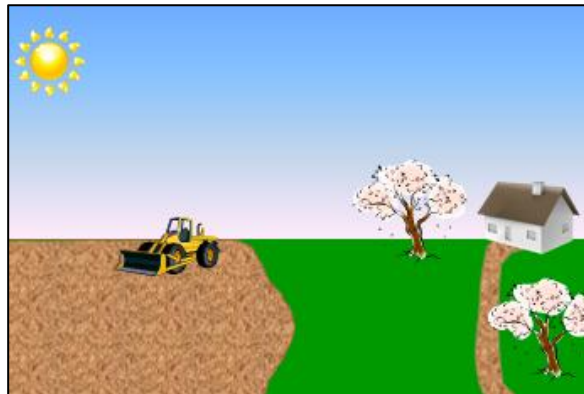
This introduction into this section of the document provides a discussion on the definition of setbacks and buffers as used in this document, how they may be used to reduce impacts to surrounding land uses, and general considerations in the application of setbacks and/or buffers. The section is further divided into eleven subsections. It is important to note that the subsection topics vary in treatment regarding setbacks and buffers. For example, the subsection on

Residential Land Uses discusses general considerations and provides setback ranges found in current local regulations but does not provide recommended setback dimensions or specific buffer designs. This is because even though planning and official controls (such as zoning and subdivision ordinances) are enabled by state law, they are almost entirely under local jurisdiction. Individual communities assess and value local resources differently, which does not go well with a “one-size-fits-all” approach.

For other subsection topics such as calcareous fens, there may be state regulations or standards and criteria that already provide regulation oversight. For those topics, the discussion may be focused on existing regulations or processes and how LGUs can work with state agencies in applying them in their local processes.

Setbacks: How They Work

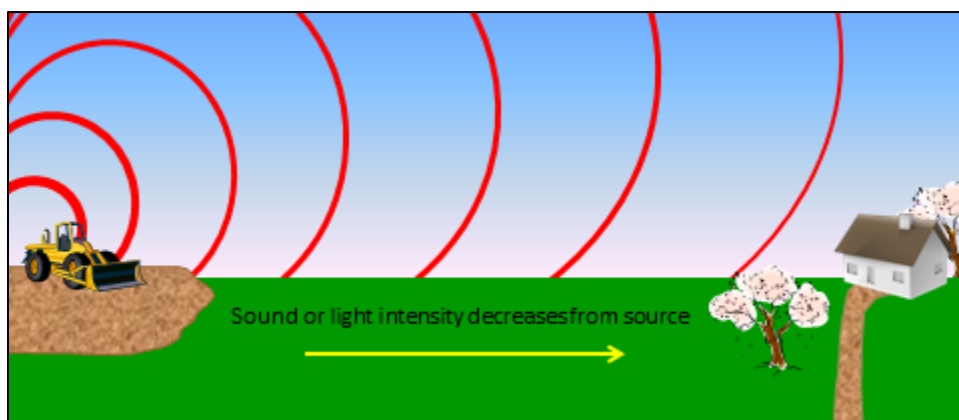
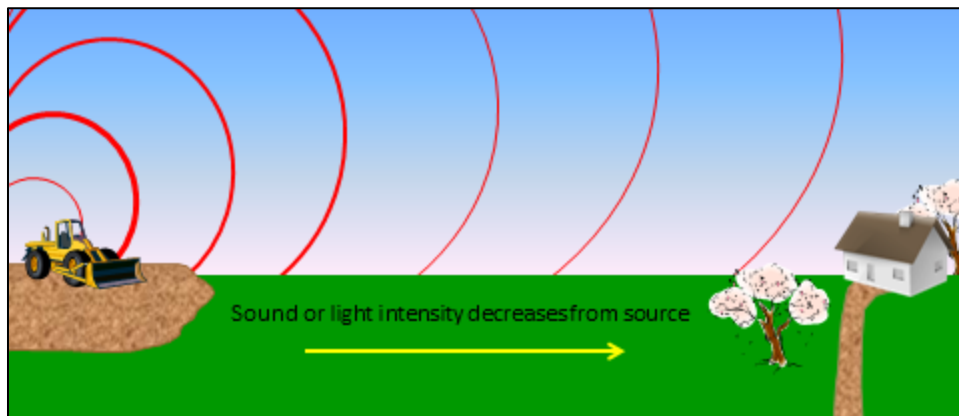
Setbacks reduce impacts of proposed land uses on surrounding land uses and natural features because the concentration of light, noise, dust, odor and other potential effects originating from a set point tend to diminish with distance (see Figures 1a and 1b). This is primarily explained by the *inverse-square law* in physics, which states that the magnitude or intensity of a physical property (such as light or sound) varies in inverse proportion to the square of the distance from the source.



Figures 1a and 1b. Depictions of operation with differing distances of separations from nearby land use.

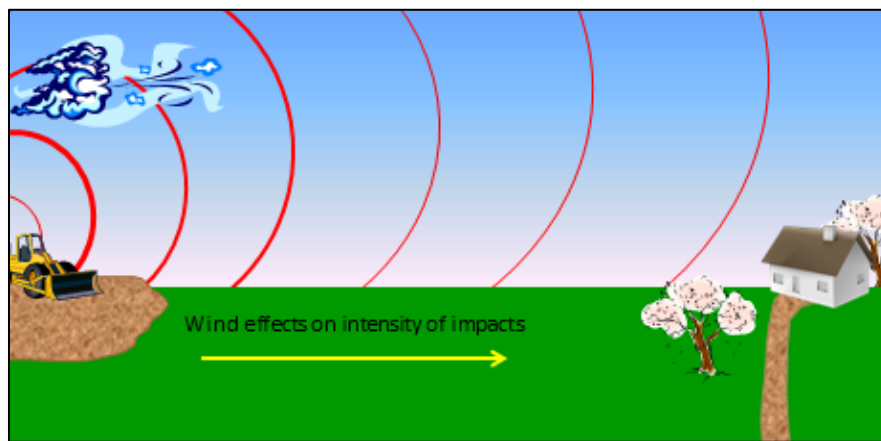
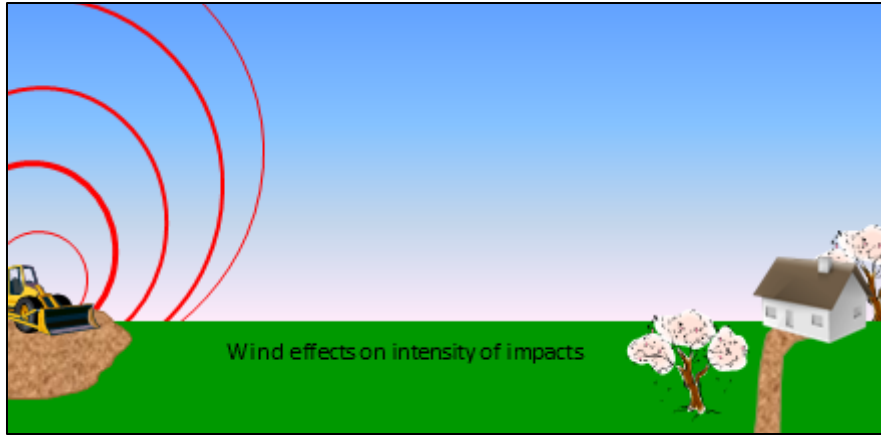
However, the application of this principle to proposed land uses becomes much more complicated because it is affected by characteristics of the proposed project, the site, and the surrounding natural and built environment. Some examples are discussed below.

- The intensity of the potential impact at its source, such as brightness, loudness or concentration of emitted particles or gasses, will affect how distance reduces the effects on other properties. A louder noise source will sound louder at a given distance than a softer noise source at the same distance (see Figure 2a and 2b). This concept applies to noise, light, emission concentrations, etc. Any mitigation employed at the source to reduce impacts (enclosures, air scrubbers) or operations constraints (restricted to daylight hours) needs to be taken into consideration as well.



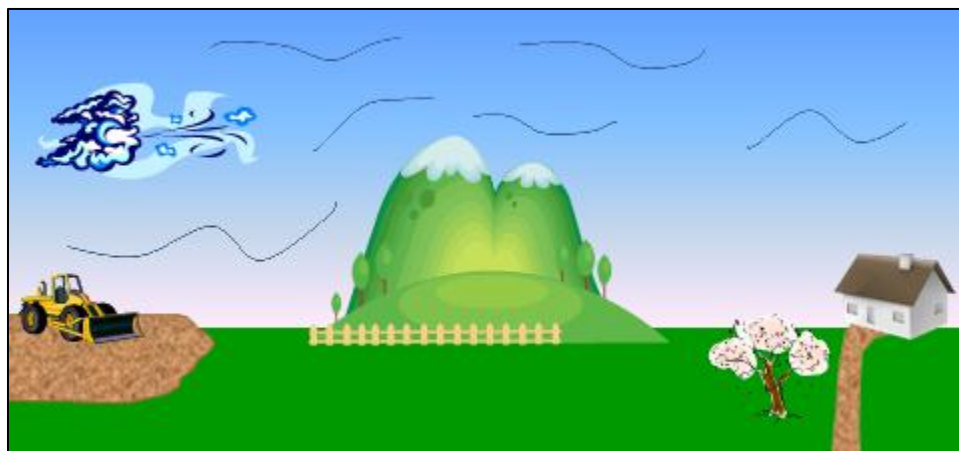
Figures 2a and 2b. Depiction of how sound, light, and other source impacts varies intensity with distance.

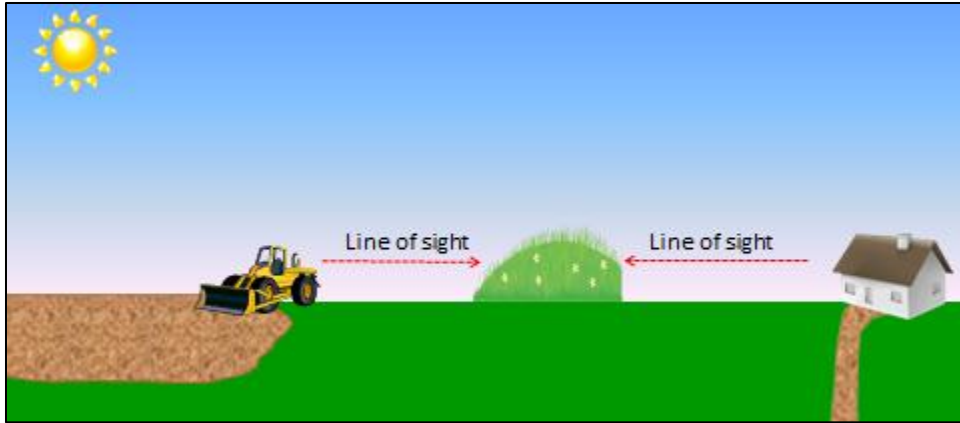
- Atmospheric conditions, such as wind, rainfall or humidity can affect the intensity of impacts at various distances. For example, wind can greatly affect the dispersion of gasses or particles (see Figures 3a and 3b). Sound can also be affected by atmospheric conditions.



Figures 3a and 3b. This depiction shows the potential impact caused by wind from a proposed land use.

- Terrain and structures such as hills, buildings or berms in between a source and a receptor can soften or block light and sound; and can impede air or water movement (see Figures 4a and 4b). Conversely, terrain and structures can reflect and focus light and sound; and channel air movement or water flow.





Figures 4a and 4b. Figures depiction how an intervening landscape feature or structure can lessen impacts by acting as a barrier.

- Water features and movement on the site or nearby can influence the concentration and flow of water contaminants (see Figure 5).

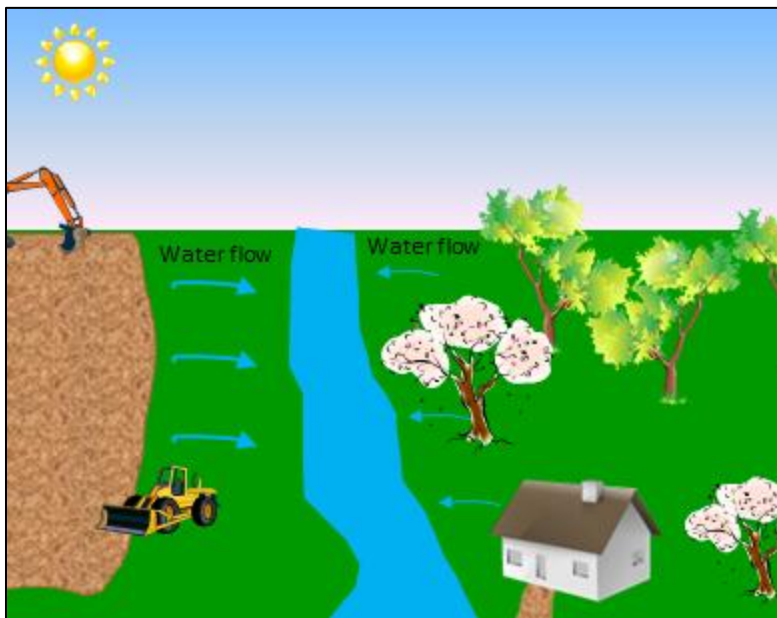


Figure 5. Figure depiction water features and water movement from proposed land use and nearby properties.

- Ground vibration varies depending on soils and underlying bedrock.

Setbacks: Considerations in Application

Because of the variation caused by the factors described above, the reduction of impacts afforded by setbacks can be more accurately determined when the characteristics of the setting, the specific site, and the project itself are taken into consideration. These typically are analyzed

through local planning, environmental review, and/or local development review as part of the local zoning approval/permitting process.

This makes it extremely difficult to establish setbacks that are appropriate for all local situations. A specific setback distance may be adequate for some situations, inadequate for other situations and excessive for still other situations. To get an idea what a setback might have to be in order to be protective in most instances, local governments may wish to review previous sections of this document and consult with experts for a professional opinion on what are estimated maximum extents of potential impacts (for example, the maximum extent of a shock wave from blasting) as it pertains specifically to their area of jurisdiction. Additionally, when setbacks are established in land use regulations, it may be prudent to clarify in the regulations that the setback (or buffer) may be adjusted (increased, decreased, or otherwise modified) through the discretionary approval of local permitting when considering the details of the proposed project, site characteristics and planned mitigation.

Local governments also have the responsibility (and challenge) to determine the appropriate balance between the rights of the landowner and the public good (health, safety, welfare and environmental quality). It is also prudent for local governments to consider legal aspects of zoning (constitutional issues, provisions of statute, implications of court decisions) when establishing land-use standards.

Regarding landowner rights, it is useful for local governments to consider the effect of setbacks on the amount of area proposed for development, recognizing that increasingly-large setbacks from property lines progressively limits the area remaining for development. Figures 6a through 6d and Figure 7 depict the effect of setbacks on land use.

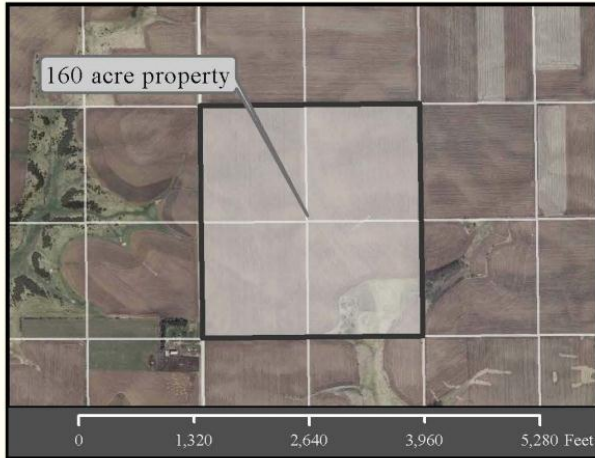


Figure 6a: Conceptual map displaying a 160 acre property (black boundary) proposed to be developed into a mine. The property owner does not own any land adjacent to this property.

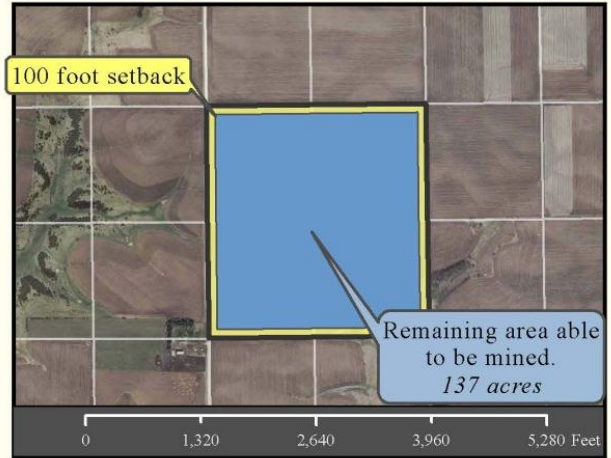


Figure 6b: Conceptual map displaying the 160 acre property and 100 foot setbacks from property lines (yellow), and remaining 86% of the total property area that is able to be mined (blue).

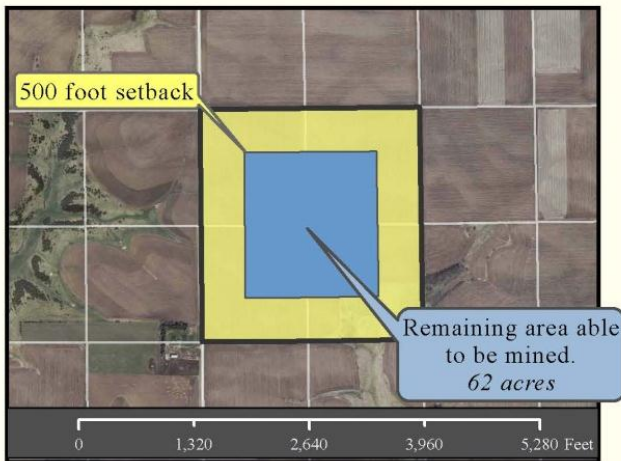


Figure 6c: Conceptual map displaying the 160 acre property and 500 foot setbacks from property lines (yellow), and remaining 39% of the total property area that is able to be mined (blue).

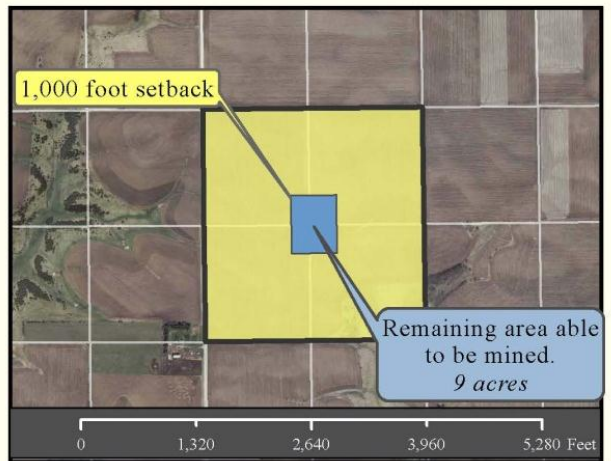


Figure 6d: Conceptual map displaying the 160 acre property and 1,000 foot setbacks from property lines (yellow), and remaining 6% of the total property area that is able to be mined (blue).

Figures 6a, 6b, 6c and 6d. Illustration of effects of increasing setbacks from property lines on development area of quarter-section of land (a 160-acre parcel).

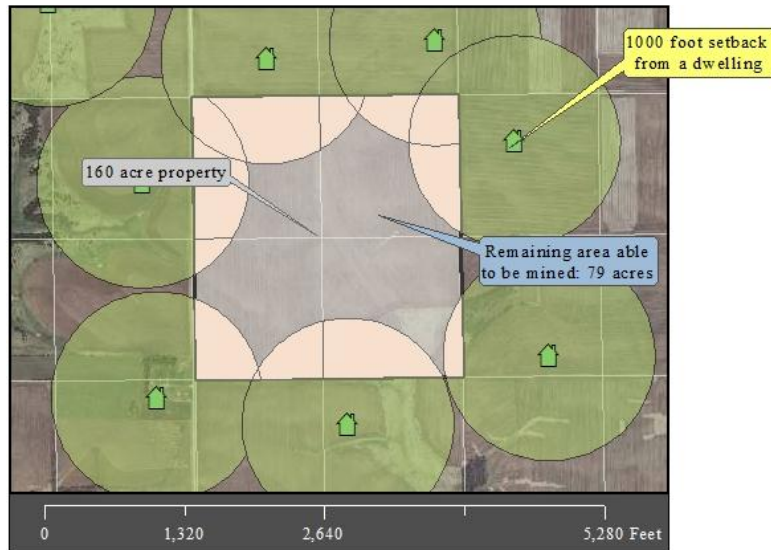


Figure 7. Conceptual map displaying a 160-acre parcel with 1,000-foot setbacks drawn around surrounding dwellings. Note the limited area between the circles.

The tables below show net acreage of developable area and developable percentage of total parcel area for various setbacks from property lines for 40-acre and 160-acre parcels.

For quarter-quarter sections (40 acres)

Setback from property line	100	200	300	500	600	1000
Net area in acres	28.80	19.43	11.90	2.35	0.33	0.00
Percentage remaining	72%	49%	30%	6%	1%	0%

For quarter sections (160 acres)

Setback from property line	100	200	300	500	600	1000
Net area in acres	136.68	115.19	95.54	61.74	47.60	9.40
Percentage remaining	85%	72%	60%	39%	30%	6%

Table 1. Shows net acreage of developable area and developable percentage of total parcel area for various setbacks from property lines for 40-acre and 160-acre parcels.

Where a setback is intended to protect a land use (human use of land – i.e. residences, churches, schools, offices, etc.) as opposed to a natural feature or historical property (i.e. lakes, bluffs, burial site, etc.), setbacks from property lines (see Figure 8) provide a more consistent separation than setbacks between the uses themselves. However, in cases of natural features or historic properties, setbacks between the feature/property are recommended to be from the feature/property itself rather than from property lines (see Figure 9). An exception is where the feature is included as part of a larger natural or historic property that serves additional purposes, such as a state park or historic districts, where setbacks to property lines may be more appropriate. These questions are discussed further in the subsection on residential land uses.

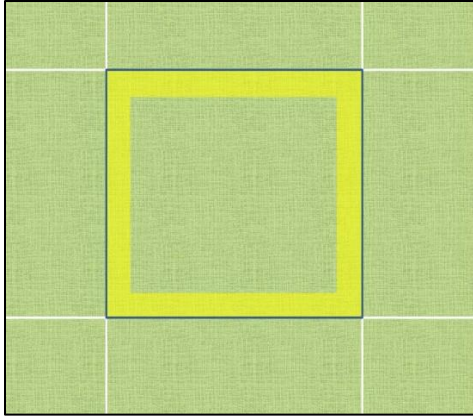


Figure 8. Depictions of setback from a property lines.

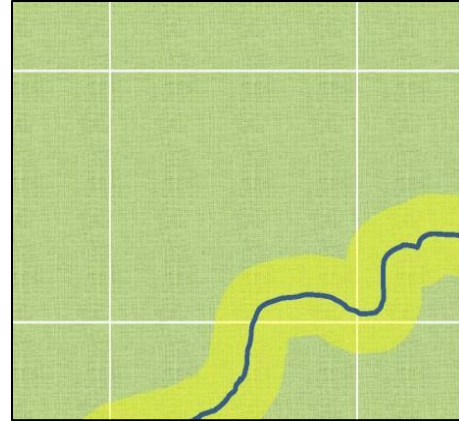


Figure 9. Depiction of setback from a stream feature.

In situations where a proposed project is located near or across differing jurisdictional areas, LGUs are encouraged to work together to determine the best course of action when considering setbacks (which may differ between the jurisdictions) and the land use for which they are being considered (human use of land and natural features).

Buffers: How They Work

Buffers can be vegetative (grasses, trees, shrubs) or they can be structural (fences, walls, berms). As mentioned above, buffers had an original purpose of beautifying and screening land uses by visually softening and improving their aesthetic characteristics. The application of buffers has broadened over time to include filtering or blocking unwanted impacts from light, sound, gases or particulates (in air or water) to reduce the effect on nearby land uses or natural features. For this purpose, buffers act as a physical filter or barrier to the impact (see Figure 10).

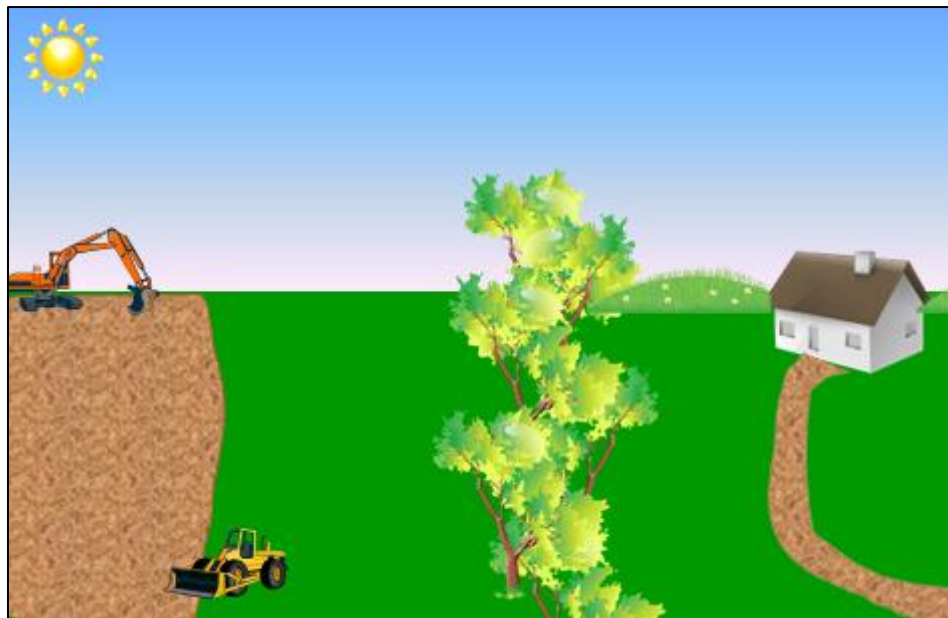


Figure 10. Depiction of a vegetative barrier which can lessen impacts by acting as a filter or barrier.

For different types of potential impacts (i.e. light and glare, noise, air, dust and water), buffers work in different ways as filters or barriers:

- Light tends to travel in a straight line, so intervening buffers can effectively filter or block light. However, light can be reflected or refracted by water vapor or other particles in the air and so can still “go around” buffers.
- Sound waves are vibrations that travel through media (air, water or other substances) and so can be transmitted through certain barriers, depending on the material. Additionally, sound waves, especially low-frequency sound waves, can travel over barriers.
- The properties of gas molecules or particles affect how they move and disperse in air and are strongly affected by air movement. Consequently, buffers work much less effectively as a filter or barrier for air impacts than for light and sound.
- Vegetation such as grasses can block particles in water and can slow surface water, causing particles to drop out and settle.

Buffers: Considerations in Application

As with setbacks, buffers are strongly affected by characteristics of the proposed project, the site, mitigation strategies and the surrounding natural and built environment and so their effectiveness can only be more accurately determined for a known proposed project (i.e. at the stage of environmental review and/or local development review as part of the local zoning approval/permitting process). To establish a fixed buffer requirement in local regulation that is appropriate for all proposed projects can be challenging.

Consequently, subsections below do not necessarily provide specific guidance on buffers for land uses. The following points could be considered when designing buffers for land uses:

- Vegetative buffers (trees and shrubs primarily) can be effective for softening visual impacts of an adjacent land use, can be moderately effective for blocking or softening light, and have been found to be generally ineffective for blocking or softening sound (noise impacts). To be effective in blocking or softening light impacts, vegetation needs to be sufficiently dense (either through buffer width, density of plantings, or a combination of the two), needs to be evergreen to provide screening in winter months and needs to be sufficiently high (which depends on the site and project characteristics). Foliage also may need to extend to the ground (i.e., shrubs or evergreen trees).
- If vegetative buffers are required, the ability to successfully establish and maintain them needs to be considered and addressed in permit conditions.
- Solid fence or berms can be effective in reducing noise and light impacts. Again, site and project-specific factors will dictate specifications such as positioning height, materials,

etc. Aesthetics (visual impacts) of the solid fence or berm itself may also need to be considered and addressed, such as through use of landscaping.

References

Davidson, M, and Dolnick, F. (Ed.) (1999), *A Glossary of Zoning, Development, and Planning Terms*, Planning Advisory Service Report Number 491/492, Washington D.C., Chicago, Planners Press, American Planning Association.

Kendig, L., Connor, S., Byrd, C., Heyman, J. (1980), *Performance Zoning*, Washington D.C., Chicago, Planners Press, American Planning Association.

(1960), *Zoning Buffers: Solution or Panacea*, Planning Advisory Service Information Report No. 133, American Society of Planning Officials

E.1. RESIDENTIAL LAND USES

While this section focuses to residential land uses, these concepts can also be applied to other land uses that may not compatible with silica sand projects such as schools, hospitals, and churches.

a. Description of Silica Sand Project Concerns

Silica sand mining, processing, and transportation (transload) facilities pose potential air quality (silica dust), noise, light, visual, vibration and stormwater runoff impacts as described in other sections of this document.

In general, potential negative impacts to residential properties do not differ between the Paleozoic Plateau and the Minnesota River Valley.

b. Narrative Description and Background Information

As discussed above, the effectiveness of setbacks and buffers can more accurately be determined for a specific proposed project and thus be determined and required as part of discretionary local approvals, such as conditional use permits. Where local governments choose to establish required setback dimensions or buffer design standards in land-use regulations, it may be prudent to clarify in the regulations that the setback or buffer may be adjusted (increased, decreased, or otherwise modified) through the discretionary approval of local permitting.

Where a setback is intended to protect a land use (human use of land—residences, churches, schools, offices, etc.—as opposed to natural or historical feature, such as lakes, bluffs, burial site, etc.), setbacks from property lines provide more consistent separation than setbacks between the uses themselves. This is because human uses of land change much more quickly over time than natural features. Similarly, a setback from the house to a proposed silica sand operation does not take into account outdoor activities on the residential property, gardens or patios for example, or future allowable developments, such as new residences, that may also be impacted by a proposed project. For these reasons, setbacks from land uses such as residences are generally recommended to be measured from the property line, rather than from the land-use feature (e.g., dwelling) (see Figure 11 below).

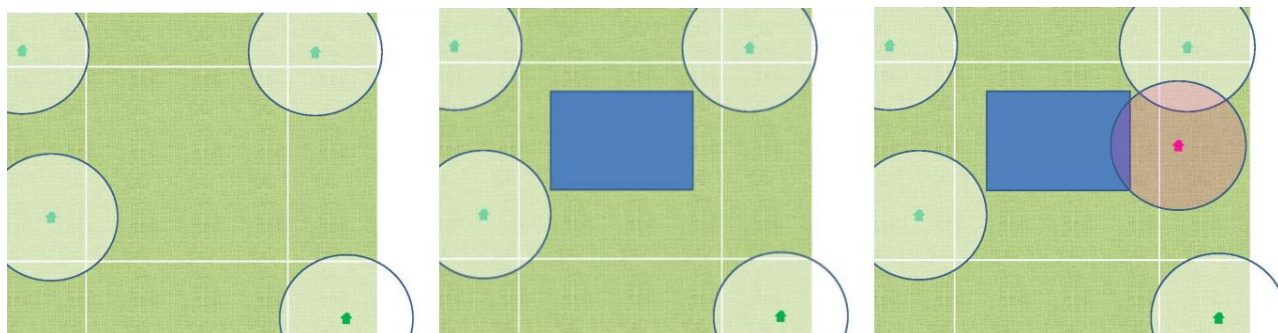


Figure 11. A developable area established to conform to a 1,000-foot setback (from a mine to a house). This would not provide protection to a landowner who planned to build a new house closer to the property line (and within allowable zoning residence setbacks).

However, an issue that can arise when establishing setbacks from property lines is where there are instances in which some houses exist closer to their property lines than is typical in a zoning district. This is illustrated in Figure 12. In the figure, a 200-foot setback from property lines is shown. The house in the upper right is 300 feet from its property line (which in this example is typical for the zoning district), so the 200-foot setback provides a total 500-foot separation (and because most residences in the area are also 300 feet or more from the property lines, the 200-foot setback from the property lines is adequate to provide a 500-foot separation in most instances). The house in the lower left, however, is atypically close to its property line, at 100 feet and so the total setback is also less than typical at 300-feet (the 100-foot distance of the house to the property lines plus the 200-foot property line setback). In such instances while the setback from property lines might provide adequate protection in the majority of cases, the dimension may not be adequately protective of the exceptions.

A solutions is to supplement or overlay setbacks from property lines with setbacks from land uses (such as from houses). When that is done, the greater of the two setbacks (from the property line or from the land use) applies (as illustrated by the circle drawn around the house in the lower left of Figure 12). The overlain 500-foot setback from the house provides an additional 200 feet of separation.

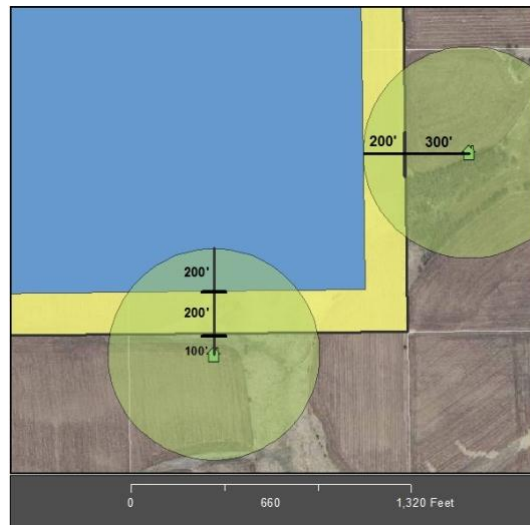


Figure 12. Diagram showing developable area boundary for silica sand activities (in blue) where 200-foot setbacks are required from the property lines or 500-foot setbacks are required from existing dwellings, whichever is greater

Where proposed silica sand sites are at the edge of zoning districts, and are adjacent to zones that allow differing land uses (for example where a zoning district that permits silica sand operations borders a residential zoning, district or adjoining city), a larger setback or buffer requirement could be considered. Additionally, the local government could consider avoiding the establishment of differing land uses and zoning districts near existing silica sand operations.

Another tool for consideration for LGUs is limiting mining to “overlay districts” within a jurisdiction. Mining overlay districts allows mining in areas of compatible land uses or within areas of low population density and concentrates mining to a given area and allows for the development of appropriate infrastructure to support mining. It is noted that mining overlay districts are considered temporary land uses. Upon cessation of mining and reclamation, land use can serve other functions for the community.

Pertaining to silica sand projects, some LGUs have already established setbacks for residences or residential districts. Established setbacks include both those set from property lines and those from residences or residential districts. In response to a request from the EQB for consideration in the production of this document, LGUs reported the following ranges of setbacks (in feet) in local regulations. Ranges presented below reflect current ordinances that may be general or silica sand specific. These survey data do not include the dates when these setbacks were adopted. Nor do these data reflect the Goodhue County setback of one-mile from residential districts and municipal boundaries, which was adopted after the EQB survey of LGUs.

Paleozoic Plateau

12 LGUs responding (also see columns labeled "N=" for number providing data)	from Property Lines (in feet)			from Residences or Residential Districts (in feet)		
	Smallest	Largest	N=	Smallest	Largest	N=
Mines	20	50	6	1,000	2,000	5
Processing	20	50	5	500	1,500	3
Trans-Load	20	50	5	500	1,500	3

Minnesota River Valley

3 LGUs responding (also see columns labeled "N=" for number providing data)	from Property Lines (in feet)			from Residences or Residential Districts (in feet)		
	Smallest	Largest	N=	Smallest	Largest	N=
Mines	30	50	3	200	500	3
Processing	50	100	3	200	500	3
Trans-Load	30	50	3	200	200	2

Other Areas in Minnesota

8 LGUs responding (also see columns labeled "N=" for number providing data)	from Property Lines (in feet)			from Residences or Residential Districts (in feet)		
	Smallest	Largest	N=	Smallest	Largest	N=
Mines	50	50	1	no data	no data	0
Processing	50	50	1	no data	no data	0
Trans-Load	50	50	1	no data	no data	0

All LGUs Surveyed

Total 18 LGUs responding (also see columns labeled "N=" for number providing data)	from Property Lines (in feet)			from Residences or Residential Districts (in feet)		
	Smallest	Largest	N=	Smallest	Largest	N=
Mines	20	50	10	200	2000	8
Processing	20	100	9	200	1500	6
Trans-Load	20	50	9	200	1500	5

Table 2. Table showing established setbacks for residences or residential districts in current ordinances – both in general or silica sand specific ordinances.

c. List of Silica Sand Project Potential Impacts

These impacts do not vary between the Minnesota River Valley and the Paleozoic Plateau.

- Air quality (silica dust)
- Noise
- Light
- Visual
- Stormwater runoff
- Vibration

d. Recommendations, Standards, Criteria, Considerations

1. Local governments may wish to consult counsel and access available legal resources to ensure legal aspects of zoning are considered in establishing setbacks and buffers.
2. Because of variation caused by the factors described above, the reduction of impacts afforded by setbacks can be more accurately determined when the characteristics of the project, the site, and the setting are known, i.e., at the point of project review (through environmental review and/or local development review as part of the local zoning approval/permitting process).
3. Where local governments choose to establish required setback dimensions or buffer design standards in land-use regulations, it may be prudent to clarify in the regulations that the setback or buffer may be adjusted (increased, decreased or otherwise modified) through the discretionary approval of local permitting.
4. Setbacks from property lines provide a more consistent separation than setbacks from residential dwellings.
5. Setbacks from residential structures, as a supplement to setbacks from property lines, may offer additional distance between residents and a given land use.
6. Local governments could consider larger setback or greater buffer requirements where silica sand operations are at the edge of zoning districts, and are adjacent to zones that allow differing uses (for example where a zoning district that permits silica sand operations borders a residential zoning, district or adjoin city). Local governments should consider avoiding the establishment of differing uses and zoning districts near existing mining operations.
7. In all recommendations above, where a proposed project is located near or across differing jurisdictional areas, LGUs are encouraged to work together to determine the best course of action when considering setbacks and the land use for which they are being considered.

E.2. STREETS, ROADS AND HIGHWAYS

a. Description of Silica Sand Project Concerns

Potential impacts to users of streets, roads, and highways include air pollutants, silica sand dust and mud tracked by vehicles, noise, light, visual, vibration, and stormwater runoff. Silica sand projects may also impact roads through their proximity or directly by causing incursions into the road structure itself, including cuts, fills, bridges and approaches, signal and support installations, shoulder uses, and etc. The proximity of silica sand projects to parkways, scenic byways, and designated trails can adversely impact natural, recreational, cultural, or scenic resources that are in the vicinity.

b. Narrative Description and Background Information

Impacts other than incursions into the road structure (i.e. air pollutants, silica sand dust and mud tracked by vehicles, noise, light, visual, vibration and stormwater runoff) are discussed in other sections of this document.

Potential incursions into the road structure itself include cuts, fills, bridges and approaches, signal and support installations, shoulder uses, and etc. The engineered structure of a heavy duty road depends on the underlying geology of the land, slopes of fill material, drainage, and constructed facilities (bridges, abutments, retaining walls, tunnels, rest areas, dedicated use shoulder such as bus lanes, turnouts, passing, recreational, etc.). The road structure needs to be adequately separated from excavations for mines, new ponds, and other construction to protect structure and safety.

Several LGUs have already established setbacks for streets, roads, and/or highways. In response to a request from the EQB for consideration in the production of this document, LGUs reported the following ranges of setbacks (in feet). Ranges presented below reflect current ordinances that may be general or silica sand specific.

Paleozoic Plateau

12 LGUs responding	Smallest	Largest
From Streets	30	30
From Township Roads	70	95
From County Roads	45	100
From State Highway	100	100

Minnesota River

3 LGUs responding	Smallest	Largest
From Streets	no data	no data
From Township Roads	no data	no data
From County Roads	30	100
From State Highway	no data	no data

Other Areas in Minnesota

3 LGUs responding	Smallest	Largest
From Streets	no data	no data
From Township Roads	no data	no data
From County Roads	50	50
From State Highway	no data	no data

All LGUs Surveyed

Total 18 LGUs responding	Smallest	Largest
From Streets	30	30
From Township Roads	70	95
From County Roads	30	100
From State Highway	100	100

Table 3. Shows already established setbacks for streets, roads, and/or highways.

Where local governments choose to establish required setback dimensions or buffer design standards in land-use regulations as discussed above, it may be prudent to clarify in the regulations that the setback or buffer may be adjusted (increased, decreased or otherwise modified) through the discretionary approval of local permitting.

c. List of Silica Sand Project Potential Impacts

Potential impacts listed are applicable to both the Minnesota River Valley and the Paleozoic Plateau.

- Air pollutants, noise, light, visual, vibration and stormwater impacts to users of streets, roads, and highways
- Incursions into the road structure
- Impacts to intrinsic qualities of parkways, scenic byways, and designated trails

d. Recommendations, Standards, Criteria, Considerations

1. Setbacks from transportation rights-of-way should be determined based on specified scope of facility, geology of land underlying the road or railroad, and presence of ancillary facilities including yards, shops, rest areas, pull-outs, and other extensions.
2. Where local governments choose to establish required setback dimensions or buffer design standards in land-use regulations as discussed above, it may be prudent to clarify in the regulations that the setback or buffer may be adjusted (increased, decreased or otherwise modified) through the discretionary approval of local permitting.
3. Parkways, scenic byways, and designated trails should be identified in permit applications. Impacts to intrinsic qualities (intrinsic qualities include natural, cultural, recreational, and scenic) of such roadways, and mitigation measures should be identified and clearly described. Consultation with MnDOT prior to filing permits applications is strongly recommended.

E.3. ORDINARY HIGH WATER LEVEL (OHWL) OF PUBLIC WATERS AND SHORELANDS

a. Description of Silica Sand Project Concerns

The Ordinary High Water Level (OHWL) is a dynamic area of high biodiversity and ecological function. Silica sand mining, processing, stockpiling and transload have the potential to remove vegetative cover, disturb soils, reconfigure topography, change surface water runoff and modify groundwater hydrology. This can lead to long-term fundamental changes to the land affected by and in the vicinity of the mining activity, especially in sensitive riparian areas such as Minnesota Public Waters and Public Waters Wetlands shoreland areas.

b. Narrative Description and Background Information

The Ordinary High Water Level (OHWL) is a reference point that defines the DNR's regulatory authority over development projects that will alter the course, current, or cross section of Public Waters. Public Waters (and Public Water Wetlands) are designated lakes, wetlands, and watercourses over which the DNR has regulatory jurisdiction (MS 103G.005 Subd. 15). Project proposers must apply to the DNR for a Public Waters Work Permit for most development projects located below the OHWL. Public Waters Work Permit Rules are detailed in MN Rules Parts 6115.0150-6115.0280 which includes permit application requirements. Permit application requirements and considerations may differ depending on the type of proposed activity (e.g. access road, mining, reclamation, etc.) Upon review of the permit application information, along with comments received from DNR and LGU, the DNR Commissioner may authorize, deny, or limit a project through the addition of conditions. If a Public Water Work Permit is required, the permit must be obtained prior to commencement of the proposed work in the Public Water. Early coordination with the DNR on project planning is strongly encouraged to avoid situations

where plans are dependent on receiving a Public Water Work Permit (such as a facility expansion) or to ensure that proposed project activities are not affecting public waters indirectly through site hydrology changes.

For lakes and wetlands, the OHWL is the highest water level that has been maintained for a sufficient period of time to leave evidence upon the landscape. The OHWL is commonly that point where the natural vegetation changes from predominately aquatic to predominantly terrestrial (See Figure 13). For watercourses, the OHWL is the elevation of the top of the bank of the channel. For reservoirs and flowages, the OHWL is the operating elevation of the normal summer pool. These guidelines apply to Public Waters as defined in Minnesota Statutes, Section 103G.005, subd.15 and subd.18, which have been inventoried by the DNR Commissioner according to Minnesota Statutes, Section 103G.201.

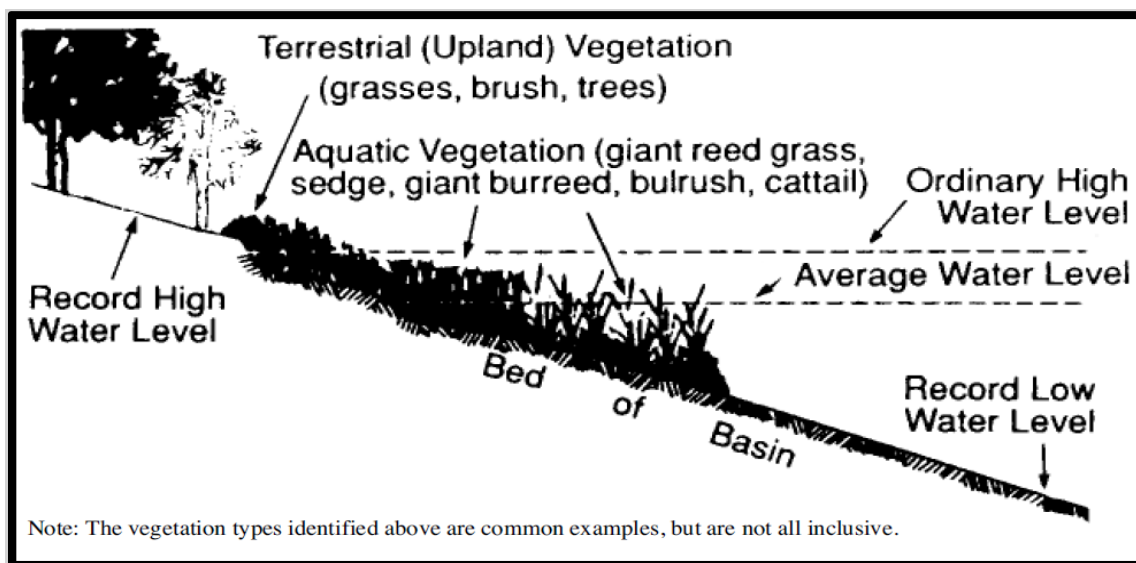


Figure 13. Depiction of vegetation transitions between upland and the ordinary high water level.

Shoreland Management Program

The OHWL is used by local units of government as a reference point to determine the Minnesota Shoreland Management Program's waterward district boundary. It is used as a reference point from which to measure structural setbacks from water bodies and watercourses named in a Shoreland Ordinance.

The Shoreland Management Program (Program) provides the backbone of statewide standards that local governmental units must adopt into their own land use controls to provide for the orderly development and protection of Minnesota's shorelands - both rivers and lakes. The Program's standards and criteria are intended to preserve and enhance the quality of surface waters, conserve the economic and natural environmental values of shorelands, and provide for the wise use of water and related land resources of the state. Specific goals include the preservation of natural riparian vegetation, near shore bluff protections, conservation of open

space, reduction of surface water runoff, and protection of near-shore fish and wildlife habitat. In addition, the Program helps to protect water resources from sewage, chemical and sediment pollution associated with construction storm water runoff, agriculture runoff and other hydrologic changes related to riparian development.

The regulatory purpose of the shoreland development is contained in Minnesota Statute 103F.201:

103F.201 REGULATORY PURPOSE OF SHORELAND DEVELOPMENT.

To promote the policies in section 103A.201 and chapter 116, it is in the interest of the public health, safety, and welfare to:

- (1) Provide guidance for the wise development of shorelands of public waters and thus preserves and enhance the quality of surface waters;
- (2) Preserve the economic and natural environmental values of shorelands; and
- (3) Provide for the wise use of water and related land resources of the state.

For counties, the “shoreland district” applies to all public waters basins 25 acres or larger. The shoreland district includes all land within 1,000 feet of a lake’s OHWL. On rivers and streams having a drainage area of 2 square miles or greater, the shoreland district extends 300 feet from the OHWL, which is usually the top of the stream bank. The shoreland district can expand beyond 300 feet when it is part of a designated floodplain as identified by a Federal Emergency Management Agency Flood Insurance Study (FIS).

The DNR established minimum statewide standards in the 1970 shoreland rules for land development within the shoreland district. In 1973, the legislature amended the Shoreland Management Act to include municipalities. Within cities, the shoreland district can include basins as small as 10 acres. Municipal shoreland management standards were established in 1976. At that time, DNR Waters (now DNR Ecological and Water Resources Division) began to identify and notify cities on the need to adopt the standards into their local zoning ordinances.

The existing Shoreland Management rules provide some level of protection to shorelands. Rule 6120.3200, Subp. 4, allows for “Extractive use” as a conditional use in most lake and river classes and districts in the shoreland district. The standards for extractive uses are found in Rule 6120.3300, Subp. 9:

Subp. 9. Extractive use standards. Processing machinery must be located consistent with setback standards for structures from ordinary high water levels of public waters and from bluffs. An extractive use site development and restoration plan must be developed, approved by the local government, and followed over the course of operation of the site. The plan must address dust, noise, possible pollutant discharges, hours and duration of operation, and anticipated vegetation and topographic alterations. It must also identify actions to be taken during operation to mitigate adverse environmental impacts, particularly erosion, and must clearly explain how the site will be rehabilitated after extractive activities end.

In addition, shoreland alterations are regulated under MN Rules 6120.3300, Subp. 4, which states that “Alterations of vegetation and topography must be controlled by local governments to prevent erosion into public waters, fix nutrients, preserve shoreland aesthetics, preserve historic values, prevent bank slumping, and protect fish and wildlife habitat.” It also prohibits intensive vegetation clearing within the shore impact zones (land located between the OHWL and line parallel to a setback of 50% of the structure setback), bluff impact zones (the bluff and land located within 20 feet from the top of the bluff), and on steep slopes (land where agricultural activity or development is either not recommended or described poorly suited due to slope steepness and soil characteristics).

The shoreland rules are administered through local zoning ordinances which may be stricter than statewide standards. Not all local units of government have adopted shoreland ordinances. State-wide minimum shoreland standards were last updated in 1989. The DNR led a highly participatory public process to update the shoreland rules in 2009 and 2010. In 2010, the DNR submitted draft standards to the Governor for approval. The Governor returned the draft standards for further work and the DNR’s rulemaking authority lapsed.

In a recent survey of LGUs completed for this purposes of this document, 67% (10 of 15 respondents) of the participants had established an OHWL setback in their ordinances. The setbacks ranged from 25 to 300 feet. The other 33% of participants (5 of 15 respondents) either had no setback or deemed the question not applicable to their ordinances.

c. List of Silica Sand Project Potential Impacts

Potential impacts are similar for both geographic regions.

- Degradation or loss of fish and wildlife habitat
- Loss of open space
- Increase in runoff
- Increase in water pollution
- Loss of springs and seeps
- Loss of wildlife migration corridors
- Loss of fish spawning opportunities
- Loss of future alternative riparian use or development
- Loss of landscape aesthetics
- Reduction in riparian property values
- Reduction in recreational use and enjoyment
- Additional hydrologic changes
- Degradation of trout habitat

d. Recommendations, Standards, Criteria, Considerations

In order to protect Public Waters, Public Water Wetlands and sensitive shoreland areas from potentially negative impacts associated with silica sand mining and related activities affecting or in proximity to the OHWL, the following actions could be considered by LGUs in both the Paleozoic Plateau and Minnesota River Valley:

1. Provide written comments to the DNR Area Hydrologist on all Public Waters Work Permit applications associated with silica sand mining, processing, stockpiling or transloading.
2. For LGUs with an existing shoreland ordinance, follow established state process to amend the ordinance to further restrict silica sand mining, processing, stockpiling and transloading. Options include:
 - Option 1: limit all silica sand mining activities within shore and bluff impact zones and on steep slopes, or
 - Option 2: limit all silica sand mining activities within shore and bluff impact zones, within the required setbacks for structures from the OHWL and top of bluff, as well as on steep slopes (as defined through the shoreland ordinance), or
 - Option 3: exclude all silica sand mining activities within entire shoreland district as appropriate.
3. For communities without an existing shoreland ordinance, adopt a shoreland ordinance following the state's model ordinance and established process. The ordinance may include further restriction of silica sand mining, processing, stockpiling and transloading as outlined in the options above in 2.

References

Ordinary High Water Level (OHWL)

State Statutes: 103G.001 – 103G.411 Waters of the State

Minnesota Rules: 6115.0010 – 6115.0280 Public Water Resources

DNR web page on Ordinary High Water Level:

http://www.dnr.state.mn.us/waters/surfacewater_section/hydrographics/ohw.html

Shoreland Management Program

State Statute: 103F.201– 103F.227 Shoreland Development

116. Pollution Control Agency

103A. Water Policy and Information

Minnesota Rules: 6120.2500 – 6120.3900 Shoreland Management

DNR web page on Shoreland Management Programs:

http://www.dnr.state.mn.us/waters/watermgmt_section/shoreland/index.html

E.4. BLUFFS

a. Description of Silica Sand Project Concerns

Bluffs are a definitive landscape feature in Southeast Minnesota but can also be found along the Minnesota River Valley. They are generally described as natural topographic feature such as a hill, cliff, or embankment. Silica sand mining activities have the potential to substantially and permanently modify the landscape by removing bluffs or portions of bluffs.

b. Narrative Description and Background Information

Paleozoic Plateau

In the Paleozoic Plateau, bluffs are sought after because they are a premiere source of industrial silica sand, are found close to the surface and therefore are economical to mine.

The distinctive, high relief landscape located in portions of southeast Minnesota, western Wisconsin, northeast Iowa and northwest Illinois is often referred to as the Driftless Area. In Minnesota, the area is generally referred to as the Bluffland Landscape. Officially, the DNR classifies this area as the Paleozoic Plateau Ecological Section. The DNR further differentiates the landscape by breaking the Paleozoic Plateau into two Ecological Subsections; namely the Blufflands Subsection and the Rochester Plateau Subsection.

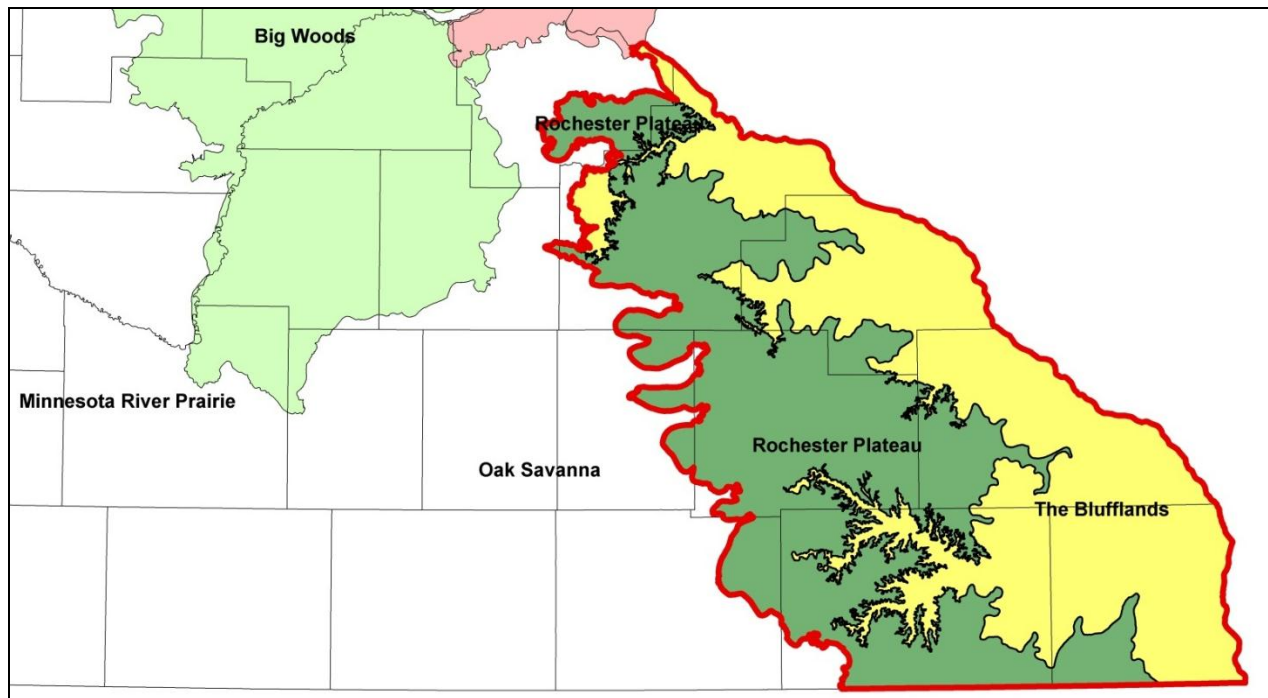


Figure 14. Figure depicting the Paleozoic Plateau and the Blufflands and Rochester Plateau Subsections.

The Blufflands and Rochester Plateau Subsections were not covered by glacial ice during the most recent Wisconsin glacial period so water and wind have sculpted the Paleozoic rocks for many thousands of years. This extensive weathering period facilitated the development of a mature surface water drainage pattern resulting in the landscape's characteristically steep valleys and high bluffs. The bluffs contained within the Rochester Plateau Subsection tend to be formed by remnant, sometimes isolated, St. Peter Sandstone buttes.

The Blufflands Subsection is a loess-capped plateau. In the east, loess lies directly on bedrock. In the southeast, loess overlies red clayey residuum that was formed directly from weathering of the limestone or sandstone. Paleozoic sedimentary rocks, including the silica sand bearing Jordan and Wonewoc Sandstones, are exposed in steep valley walls but are generally mantled with colluvium or loess. The greatest topographic relief occurs along the Mississippi River, where relief is up to 600 feet.

The Blufflands Subsection is characterized by bluff prairies, steep bluffs, and stream valleys. Numerous cold-water trout streams feed major rivers such as the Root, Whitewater, Zumbro, and Cannon Rivers. Most of the designated trout streams in Southeast Minnesota are located within the Blufflands Ecological Subsection. Rich hardwood forests grow along the river valleys, and river-bottom forests grow along major streams and backwaters. There are few lakes.

It is known or predicted that the Blufflands Ecological Subsection contains 156 species designated as being in Species of Greatest Conservation Need (SGCN) – the most of all the subsections in Minnesota. These SGCN include 82 species that are federally-listed or state-listed. In the Blufflands, nine mammal SGCN are known or predicted to occur which accounts

for 41% of all mammal SGCN in the state. These numbers will be updated with the 2014 SGCN listing.

Reptiles, amphibians, snails, mussels, and fish are special features of the Blufflands landscape, including timber rattlesnakes, milk snakes, paddlefish, shovelnose sturgeon, pallid shiners, American eels, pirate perch, skipjack herrings, and several Pleistocene snails. In addition, the Blufflands provides a critical migratory corridor for millions of forest songbirds, raptors, and waterfowl and has been identified as an Important Bird Area by Audubon. It is the most important subsection for reptiles and one of the most important subsections for mollusks. It is an important area for birds such as Henslow's sparrows, prothonotary warblers, red-shouldered hawks, Louisiana waterthrushes, and peregrine falcons. It is also an important area for Karner blue butterflies and Blanding's turtles.

The DNR has long recognized the uniqueness and importance of the Bluffland Landscape. Starting in the 1990s, the DNR funded a Bluffland Landscape Coordinator position to work with LGUs to manage growth and protect the bluffs from inappropriate development. The DNR encouraged and assisted LGUs with the writing and adoption of Bluffland Protection Ordinances. This was not a state mandated land use program but a volunteer effort supported by DNR staff to protect the bluffs. A number of counties and cities in the Paleozoic Plateau have adopted bluff protection through local ordinance.

Minnesota River Valley

Silica sand mining in the Minnesota River Valley is currently focused on old river terraces, positioned between the modern day floodplain and the bluffs that define the outer margin of the ancient River Warren floodplain. It is likely that silica sand mining will continue to pursue the terraces because they offer relatively easy access to the Jordan Sandstone.

The Importance of Bluffs

As stated in the EQB Silica Sand Report, in the Paleozoic Plateau, the Minnesota Biological Survey Sites of Biodiversity Significance predominantly fall along the blufflands and the river and stream valleys. Additionally, in both the Paleozoic Plateau and Minnesota River Valley, bluffs are prominent scenic features, and therefore are important for tourism industry. Finally, bluffs provide rare habitat for wildlife that includes rare and state-listed species.

Protection of bluffs near Public Waters and contained within the state Shoreland Management Program's shoreland district are regulated according to the standards established in the LGUs shoreland ordinance. However, the majority of all bluffs in the Paleozoic Plateau and Minnesota River Valley are located outside of shoreland districts and therefore are not protected unless the LGU has adopted a bluff protection ordinance.

c. List of Silica Sand Project Potential Impacts

Minnesota River Valley

- Disturbance of bluff toe at margin of terrace
- Loss of landscape aesthetics
- Loss of forest and prairie habitat
- Loss of open space
- Increase in water pollution
- Reduction in recreational use and enjoyment
- Hydrologic changes, including those impacting calcareous fens
- Loss of habitat corridors provided by steep slopes and tops of bluffs
- Increased vulnerability to invasive species
- Cultural resources such as burial mounds, rock shelters and caves, rock art, cultural landscapes, and traditional cultural properties/sacred sites

Paleozoic Plateau

- Major change to landscape
- Loss of forest and prairie habitat
- Loss of open space
- Increase in water pollution
- Loss of landscape aesthetics
- Reduction in recreational use and enjoyment
- Hydrologic changes including functionality of edge effect
- Degradation of trout habitat
- Loss of Species of Greatest Conservation Needs
- Loss of habitat corridors provided by steep slopes and tops of bluffs
- Increased vulnerability to invasive species
- Cultural resources such as burial mounds, rock shelters and caves, rock art, cultural landscapes, and traditional cultural properties/sacred sites

d. Recommendations, Standards, Criteria, Considerations

1. Add clear definitions to local land-use regulations. Suggested definitions are as follows:

BLUFF. A natural topographic feature such as a hill, cliff, or embankment having the following characteristics:

- A. The slope rises at least twenty-five (25) feet above the toe of the bluff; and
- B. The grade of the slope from the toe of the bluff to a point twenty-five (25) feet or more above the toe of the bluff averages thirty (30) percent or greater;

TOE OF THE BLUFF. The point on a bluff where there is, as visually observed, a clearly

identifiable break in the slope, from gentler to steeper slope above. If no break in the slope is apparent, the toe of the bluff shall be determined to be the lowest end of the lowest fifty (50) foot segment that exceeds twenty (20) percent slope.

TOP OF THE BLUFF. The point on a bluff where there is, as visually observed a clearly identifiable break in the slope, from steeper to gentler slope above. If no break in the slope is apparent, the top of the bluff shall be determined to be the highest end of the highest fifty (50) foot segment that exceeds twenty (20) percent slope.

2. LGUs may wish to consider adding the following provisions to existing bluffland protection ordinances or other land-use regulations:
 - a. In the LGU mining ordinance, require that the applicant submit a DNR Natural Heritage Information System (NHIS) Data Request Form in order to determine potential impacts to rare features. The form should be obtained early in project development so the NHIS Response can be provided with the application. *Note: A NHIS correspondence letter is valid for one year. Through project development (including early planning, application, environmental review and permitting) it may be necessary to request an updated review from the DNR to ensure that all recorded rare and natural resources are incorporated in project considerations.
 - b. In the LGU mining ordinance, require the applicant to complete a comprehensive cultural resource inventory to document the presence or absence thereof on the project site(s) and adjacent properties.
 - c. To protect the integrity of the entire bluff face, prohibit silica sand mining between the top of the bluff and toe of the bluff.
 - d. Establish a horizontal setback distance from the toe of the bluff in order to further protect the integrity of the bluff by guarding against accelerated erosion or mass wasting. A recent LGU survey found that 10 of 16 respondents had bluff protection in their ordinances. Bluff setbacks range from 30 to 300 feet with the larger setbacks providing the greater protection.
 - e. Establish a horizontal setback from the top of the bluff and limit the height of overburden and sand product stockpiling above natural grade to eliminate visual intrusion from State and County Highways and recreational viewscapes. Relatively easy to use GIS software packages are now readily available to assist in the completion of a site viewscape evaluation from identified vantage points. A recent LGU survey indicates that for those LGUs with bluff protection in their ordinances, bluff setbacks range from 30 to 300 feet with the larger setbacks providing the greater protection.
 - f. To further reduce visual impacts and stabilize the mine perimeter, require the immediate establishment of permanent vegetation on the outside facing slope of all berms.
3. LGUs may consider adopting a bluffland ordinance similar to neighboring LGUs or through consultation with the DNR and could consider the recommendations from 2 above.

References

DNR web site on the Blufflands Subsection:

<http://www.dnr.state.mn.us/ecs/222Lc/index.html>

E.5. DESIGNATED TROUT STREAMS, CLASS 2A WATER AS DESIGNATED IN THE RULES OF THE POLLUTION CONTROL AGENCY, OR ANY PERENNIALY FLOWING TRIBUTARY OF A DESIGNATED TROUT STREAM OR CLASS 2A WATER

a. Description of Silica Sand Project Concerns

Trout are very sensitive to water temperature, stream sedimentation and water clarity outside of their preferred range. Silica sand mining and related activities have the potential to negatively impact water temperature, quantity and clarity as well as other water quality parameters and stream substrates. Designated trout streams are those streams the DNR has determined to have the water quality characteristics capable of supporting trout. Streams with MPCA Class 2A water quality classification are generally capable of supporting trout and other coldwater organisms. MPCA Class 2A streams and the DNR designated trout streams are generally the same subset of streams in Minnesota.

b. Narrative Description and Background Information

DNR Designated Trout Streams

The 700 miles of DNR designated trout streams in the Paleozoic Plateau depend on groundwater inputs to supply cold and clear water necessary to sustain healthy trout populations. Fewer designated trout streams exist in the Minnesota River Valley but they are a significant resource in need of protection and preservation. The DNR strives to provide protection, improvement, and restoration of coldwater aquatic habitats and fish communities so that this unique resource is available for future generations.

The DNR follows process and criteria set by statute to identify and officially designate trout streams. A person, organization, or other entity may submit a proposal to the DNR Commissioner at any time for the designation of specific streams. Streams proposed for designation must meet criteria that indicate suitable habitat for trout, including the presence of an existing trout population or suitable water temperatures and dissolved oxygen. Riparian landowners receive written notice of any proposed designation change, public notice is published in a local paper, and the public has 90 days to comment on the proposal. Stream physical and

biological data, management goals, and public comments are considered in making a final decision. The agency's decision is reviewed by an administrative law judge prior to enactment.

A majority of streams that support trout populations are designated by the DNR. The DNR has focused management on streams with fishable trout populations but also incorporates public input into decisions regarding trout designation as described above. As a result, some streams that support trout are not currently designated as such by the DNR.

Ecologically sensitive, and popular with anglers throughout the upper Midwest, these streams require special attention to assure that they remain healthy and productive. Designated trout streams in this region rise from springs and seeps thus remaining cold in summer and relatively warm in the winter. The limestone bedrock and alluvial soils make the water hard, nonacidic, and very biologically productive. Southeast streams produce an abundant aquatic invertebrate community of mayflies, caddis flies and midges that are a critical food for trout. Shoreline trees shade streams and help keep water temperatures cold. Warming of the stream water by discharged mine processing water, stormwater or reduced shade along the stream corridor by tree removal can degrade trout habitat leading to less robust trout populations and other undesirable changes in the stream ecosystem.

Clearing of shoreline trees takes away the underwater root wads and fallen trees that provide trout cover from current and predators and leads to accelerated soil erosion and sedimentation. Shoreline trees also shade and help keep water temperatures cold. The potential for gravel riffles to be covered with fine-grained sediment originating from sand mining activities could degrade spawning habitat, suffocate buried trout eggs in redds (nests) and reduce invertebrate production.

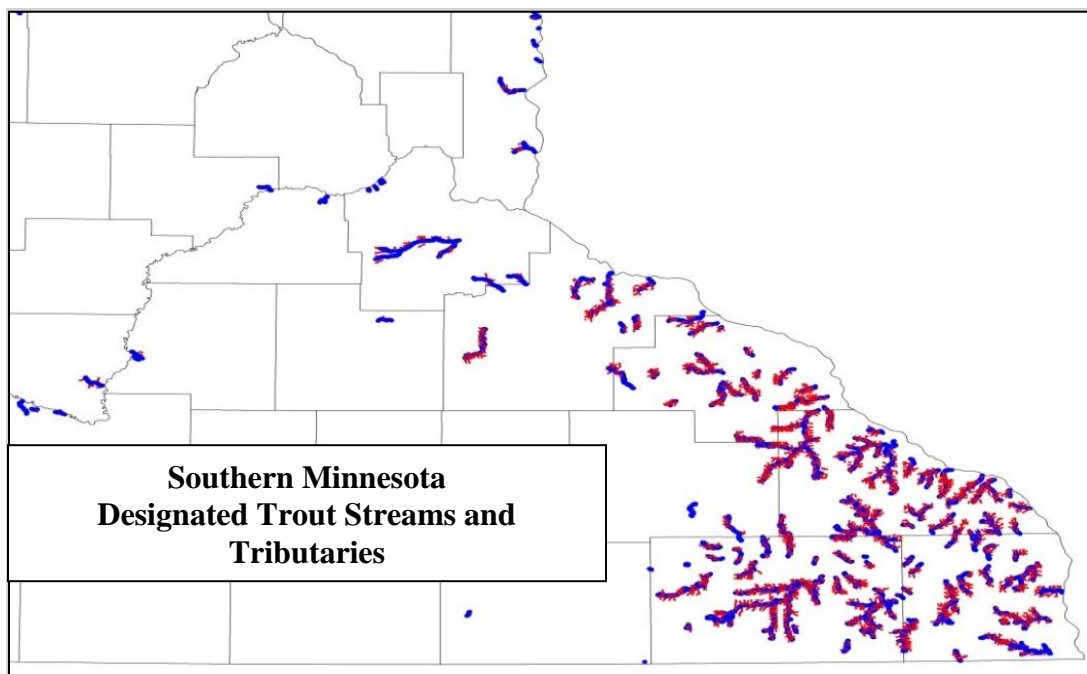


Figure 15. depicting southern Minnesota Designated Trout Streams and Tributaries

As of March 2014, the Minnesota Department of Natural Resources is early in the process of revising the trout stream designation list. Currently 10-12 streams are being considered for a designation change, which entails the department's evaluation of their potential as trout streams as well as following department procedures for public input. The number of streams under consideration may change if additional streams are identified, or if streams under consideration are dropped. Although the timeframe is not certain, the department expects to move forward with this rule-making process within approximately the next 12 months to change trout stream designations.

MPCA Class 2A waters; aquatic life and recreation.

The MPCA sets Water Quality Standards to protect beneficial uses such as healthy fish, invertebrate and plant communities, swimming, water recreation, and fish consumption. Water quality standards are also used to evaluate water monitoring data to assess the quality of the state's water resources. The standards are used to identify waters that are polluted, impaired or in need of additional protection. They also facilitate the setting of effluent limits and treatment requirements for discharge permits and cleanup activities.

MPCA defines Class 2A water as:

The quality of Class 2A surface waters shall be such as to permit the propagation and maintenance of a healthy community of cold water sport or commercial fish and associated aquatic life, and their habitats. These waters shall be suitable for aquatic recreation of all kinds, including bathing, for which the waters may be usable. This class of surface waters is also protected as a source of drinking water.

MPCA classification of 2A waters has mirrored DNR trout stream designation in the past. Recently MPCA has begun to deviate from DNR classification for some streams, applying coldwater (2A) aquatic life standards to a handful of undesignated streams that indicate the potential to support a coldwater community based on water temperature and species present.

Paleozoic Plateau

Groundwater discharge from natural springs and seeps in southeast Minnesota is vital to sustaining the region's trout streams and recreational, commercial, agricultural, environmental, aesthetic, and economic values. Recognizing this, the 2013 Legislature prohibited the excavation or mining of silica sand in this region within one mile of any designated trout stream ***unless a Silica Sand Mining Trout Stream Setback Permit has been issued by the DNR commissioner.*** In essence, State Statute 103G.217 DRIFTLESS AREA WATER RESOURCES provides a one mile setback from designated trout streams, tributaries to designated trout streams, streams that potentially could be designated trout streams (Class 2A streams) and the springs and seeps that discharge groundwater to trout streams, unless and until, the DNR Commissioner is satisfied that the propose silica sand mining activity will not have a detrimental impact.

As a result, DNR has developed a process to administer the Silica Sand Mining Trout Stream Setback Permit. The permit application process requires an applicant to complete a hydrogeologic evaluation and collect any other information necessary to assess potential impacts to trout streams, springs, seeps, calcareous fens, domestic wells and other hydrogeologic features. Based upon the evaluation, the DNR will identify appropriate setbacks from designated trout streams, springs, and other hydrogeologic features, *such as the top of the water table*, and any other restrictions necessary to safeguard these resources. The DNR commissioner is authorized to grant permits, with or without conditions, or deny them.

The permit applicant must complete a hydrogeological evaluation that is based on a properly scoped and completed investigation. The permitting application process begins with a pre-application meeting and site-visit with the project proposer to review the proposed mining operation and provide direction on the preparation of the remaining application materials.

The hydrogeological evaluation must include all information necessary to assess potential impacts to trout streams, springs, seeps, calcareous fens, and other hydrogeologic features including private and public drinking water supplies. Based upon the hydrogeological evaluation, the Commissioner will identify appropriate setbacks from designated trout streams, springs, and other hydrogeologic features and any other restrictions necessary to protect trout stream water quantity, quality, and habitat. This could include denial of the permit and restrictions on mining within the water table as mentioned above and further discussed below.

Listed below are the criteria the DNR will consider in evaluating proposed silica sand mining operations and in determining setback distances, other restrictions or reasons for permit denial:

1. Trout stream temperature. Does the proposed silica sand mining operation have the potential to increase trout stream temperature?
2. Stream base flow or stream quantity. Does the proposed silica sand mining operation have the potential to cause a reduction in groundwater base flow recharge to trout streams or a reduction in trout stream flow volumes?
3. Spring water quality. Does the proposed silica sand mining operation have the potential to lessen the quality of spring water, including its temperature, turbidity, or contamination?
4. Surface Water runoff. Is there a threat of negative impacts to streams from increased surface water runoff from silica sand mining operations?
5. Processing, stockpiling. Is there a threat of negative impacts to streams from the processing or stock piling of sand or leachate from those processes?
6. Recreation: Does the proposed silica sand mining operation have the potential to lessen the recreational use or productivity of the trout streams due to the operation of the silica mine?

Permit Application Submittals Requirements: A two-tier approach will be used in evaluating proposed silica sand mining operations. Tier 1 includes dry mining operations where mining does not extend below the water table and groundwater extraction is limited to less than 10,000 gallons per day or one million gallons per year. Typically, dry mining operations are expected to have less environmental concerns than wet mining. Tier 2 includes wet mining operations where

excavation occurs below the water table or when an appropriation permit is required. Early in the process the DNR will determine if it will be a Tier 1 (less potential for adverse effects) or Tier 2 (higher potential for adverse impacts; more rigorous information requirements) application. Tier 2 projects, if permitted, are likely to have more stringent restrictions.

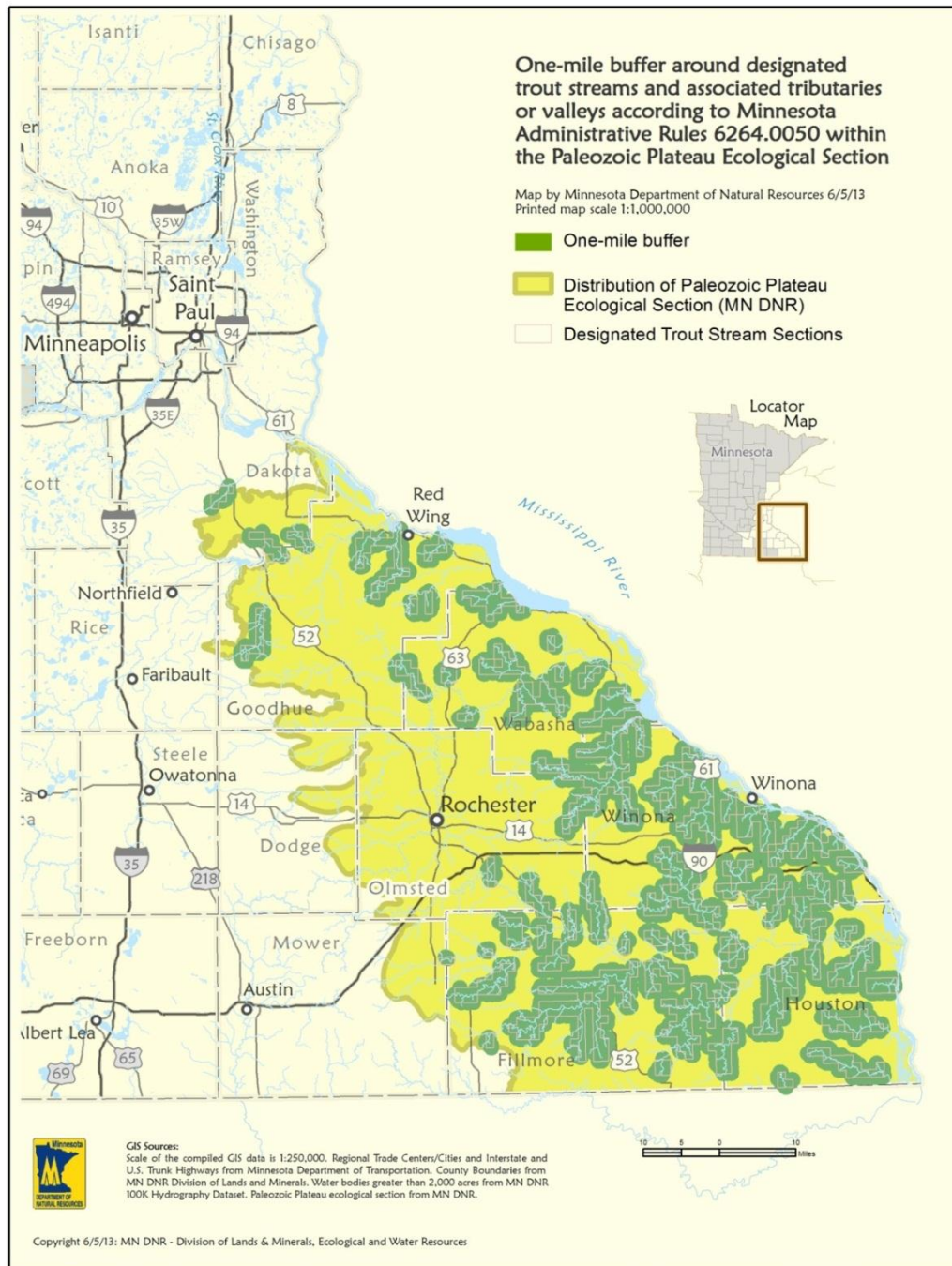


Figure 16. Depiction one-mile setback around Designated Trout Streams and associated Tributaries and Valleys in Paleozoic Plateau

Delineation of Areas of Concern: The “area of concern” is the area near the proposed mining operation and adjacent potentially impacting features such as trout streams, springs or calcareous fens. Following the submittal of a General Mine Location Map with Supporting Information document (Requirement 1. listed below), a meeting between the project proposer and DNR is required to begin the permitting process. An “area of concern” will be determined by the DNR on a site specific basis using the general mine location map, supporting information, surface watersheds, springsheds, groundwater recharge areas and other considerations. The “area of concern” will be the focus of the hydrogeological evaluation for both the Tier 1 and Tier 2 application approaches.

Pre-application water monitoring: Monitoring wells, springs, and other significant water features in the “area of concern” are to be monitored for at least one year prior to application. The “area of concern” will often extend beyond the boundaries of the mine operation. This information is required to be included with an environmental assessment worksheet (in addition to other contents required) when a silica sand project meets the thresholds of M.S. 116C.991 (effective through July 1, 2015 as of the date of this report). .

The Hydrogeological Evaluation Work Plan: A draft hydrogeological evaluation work plan must be submitted to the DNR for review and approval. The general requirements for a Silica Sand Mining Trout Stream Setback Permit Application are outlined below. All required submittals must be provided with the permit application for it to be considered complete. The DNR Commissioner may waive a specific permit application requirement if the information provided is deemed adequate by the Commissioner to fully describe and quantify the proposed mining activity’s potential to impact trout streams, springs, seeps, calcareous fens and other hydrogeologic features. Coordination with DNR staff is required for all work plans, interim reports and final documents. The DNR Commissioner may assess the project proposer fees to cover the reasonable costs of duties performed.

Tier 1 Dry Mining Permit Applications - applies to all proposed mines that are above the highest known water table and do not appropriate surface water or groundwater for dewatering, sand processing, sand transportation or mining operations. A Tier 1 permit application requires the following submittals:

1. General Mine Location Map with Supporting Information that includes:
 - a. Elevations and topographic contours
 - b. Roads
 - c. Surface water bodies
 - d. Designated trout streams, tributaries within sections that contain designated trout streams, springs, seeps, calcareous fens and other wetlands
 - e. Property lines
 - f. Mine footprint
 - g. Buildings
 - h. Equipment and fuel storage areas
 - i. Watershed boundaries

-
- j. Springshed if delineated
2. Stream and Wetland Resources Report - Field delineation, mapping and characterization of streams, springs, seeps, calcareous fens and other wetlands.
 3. Groundwater and Stream Monitoring Plan – A “Groundwater and Stream Monitoring Plan” must be submitted to the DNR which includes descriptions of the design, installation, management and operations of the planned monitoring network for the site. The monitoring network will be installed and operated prior to initiation of mining activities to establish baseline conditions. Monitoring will continue throughout mining period to track water trends over time. DNR review of the Monitoring Network Plan is required prior to initiation of work. Monitoring requirements include:
 - a. Groundwater monitoring wells in all formations including the formation below the formation targeted for mining.
 - b. Groundwater levels in private and public wells.
 - c. Monitoring of streams and springs for stage, discharge, turbidity, temperature, and specific conductivity.
 - d. *Pre-mining monitoring for 12 months will be required to determine base line conditions.*
 - e. Based on site specific conditions, it may be necessary to periodically sample streams, springs and wells for other parameters such as dissolved oxygen, specified anions and cations, potential contaminants of concern and natural and anthropogenic tracers.

The scope and requirements for the monitoring network will be adjusted based upon mining plans and the 12 months of baseline groundwater monitoring. Dry mining operations (Tier 1) will typically require a less extensive monitoring network than wet mining operations (Tier 2).

4. Hydrogeological Evaluation Report – The hydrogeological evaluation report summarizes the information gathered from the general mine location map with supporting information documentation, stream and wetlands resources report, monitoring network, additional field surveys and GIS analysis (as detailed in Items 1-3 above). The report should include:
 - a. Aerial extent and depth of the silica sand deposits.
 - b. Geologic units and contacts including unit thickness illustrated with geologic cross sections.
 - c. Aquifer units.
 - d. Confining units (clay, shale, siltstone).
 - e. Faults and structure.
 - f. Depth to bedrock.
 - g. Depth to the water table/potentiometric surface - must be determined by field measurements of static water levels in monitoring wells located on site.

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- f. Inventory, characterization and mapping of all karst features including sinkholes, sinking streams, and caves.
 - g. Comprehensive and complete inventory, characterization and mapping of domestic wells, irrigation wells, and public supply wells.
 - h. Location of exploratory boreholes with boring logs.
 - i. Location of monitoring wells with water well and boring records.
 - j. Stream flow and groundwater hydrogeologic information.
 - k. This information shall be summarized in a Hydrogeologic Conceptual Model based on the resource information/data collected and should include a hydrogeologic cross section(s) sufficient to characterize site and area conditions.

5. Mining Plan (See Operations section for further guidance)

- a. Mining progression and timing.
- b. Final depth of the mine.
- c. Spoil pile locations and treatments.
- d. Material processing plans including washing sites, transport, water sources, and treatment methods.
- e. Equipment maintenance areas.
- f. Road locations.

6. Mine Reclamation Plan – Because the interim and final disposition of the mine has the potential to negatively impact trout streams, a detailed mine reclamation plan is required. See Operations, Reclamation subsection for more guidance.

Tier 2 Wet Mining Permit Applications – additional requirements apply to all proposed silica sand mines that need to appropriate water for dewatering, sand processing, sand transportation, and mining operations below the water table. Tier 2 permit applications must include all of the Tier 1 submittal requirements plus the following submittal.

1. Comprehensive Hydrogeologic Investigation Report – A work plan must be prepared with planned activities and submitted to the DNR for review prior to initiating the work. Report component requirements are dependent on proposed project activities and may include:
 - a. Additional exploratory boreholes with boring logs.
 - b. Additional monitoring wells with water well and boring logs.
 - c. Nested monitoring wells.
 - d. Geologic cross sections parallel and perpendicular to groundwater flow direction.
 - e. Groundwater water table and potentiometric contour maps.
 - f. Flow net analysis of groundwater flow direction.
 - g. Aquifer testing to characterize aquifer, confining layer properties and boundaries.
 - h. Surface and subsurface geophysics.
 - i. Results of monitoring well logging, including the identification of any hydraulically active bedding plane fractures.
 - j. Bedrock topographic map.

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- k. Depth to bedrock map.
 - l. Dye-tracing from surface karst features to springs, seeps, streams and wells.
 - m. Fracture analysis.
 - n. Air photo interpretation.
 - o. GIS analysis.
 - p. Groundwater computer model that is properly calibrated, validated, and well documented with clearly stated input values and assumptions.
 - q. Groundwater computer model scenario comparisons and forward simulations.
 - r. Groundwater computer modeling with particle tracking and contaminant transport capabilities.
 - s. Thermal modeling/monitoring of streams and groundwater.

Annual Report

If a permit is issued, an annual report will be required which describes actual mining and reclamation completed during the past year, submits and analyzes groundwater and surface water monitoring data, identifies the mining and reclamation activities planned for the upcoming year, and submits a contingency reclamation plan to be implemented if operations cease in the upcoming year. Other information that may be required includes changes/revisions to the mine plan and reclamation plan and corrective action reports.

Corrective Action

If after a permit is issued and operations have begun, violations of the permit terms or conditions are observed, immediate action will be taken by the DNR to have the mine operator correct the violation.

Annual Permit Fee

If a permit is issued and operations begun, ongoing monitoring and regular inspection of the mining operation will help ensure the protection of the trout stream resource. An annual silica sand mining trout stream setback permit fee will be charged to the mine operator based on the level of staff effort and professional services rate and billable hours.

Existing Silica Sand Mining Operations

Silica sand mining operations which were operating before May 24, 2013 are not required to obtain the silica sand mining trout stream setback permit. However, if an existing silica sand mine expansion is proposed that requires a CUP/IUP approval (i.e. new, reissue, amendment, etc.) by the LGU, the DNR will require a silica sand mining trout stream setback permit.

d. Recommendations, Standards, Criteria, Considerations

Paleozoic Plateau

In order to protect the biologically important and sensitive trout streams from potentially negative impacts associated with silica sand mining, processing, stockpiling and transportation activities within the Paleozoic Plateau Ecological Section, LGUs could consider the following actions:

1. Provide the DNR Area Hydrologist with LGU comments on Silica Sand Mine Trout Stream Permit applications within the permit comment period.
2. Participate in coordination meetings between the DNR and the permit applicant.

Minnesota River Valley

In order to protect the biologically important and sensitive trout streams from potentially negative impacts associated with silica sand mining, processing, stockpiling and transportation activities in areas outside of the Paleozoic Plateau Ecological Section, LGUs could consider the following actions:

1. Require the permit applicant to submit a (1) scope of work and (2) hydrogeological evaluation report for LGU review and approval that is comprehensive and demonstrates that their proposed project has been adequately evaluated in regards to the following criteria:
 - Trout stream temperature. Does the proposed silica sand mining operation have the potential to increase trout stream temperature?
 - Stream base flow or stream quantity. Does the proposed silica sand mining operation have the potential to cause a reduction in groundwater base flow recharge to trout streams or a reduction in trout stream flow volumes?
 - Spring water quality. Does the proposed silica sand mining operation have the potential to lessen the quality of spring water, including its temperature, turbidity, or contamination?
 - Surface Water runoff. Is there a threat of negative impacts to streams from increased surface water runoff from silica sand mining operations?
 - Processing, stockpiling. Is there a threat of negative impacts to streams from the processing or stock piling of sand or leachate from those processes?
 - Recreation: Does the proposed silica sand mining operation have the potential to lessen the recreational use or productivity of the trout streams due to the operation of the silica sand mine?
2. The Silica Sand Technical Assistance Team is available to provide assistance to LGUs implementing hydrological evaluations, requirements, and processes outlined above that address trout stream habitat within their discretionary local permitting process.

References

- State Statutes: 97C.005 Special Management Waters
103G.201 Public Waters Inventory
103G.217 Driftless Area Water Resources
103G.285 Surface Water Appropriations
115.44 Classification of Waters
- Minnesota Rules: 6115.0190-0231 Public Waters Rules
6264.0050 Restrictions on Designated Trout Lakes and Streams
7050.0222 Specific Water Quality Standards for Class 2A Waters

DNR web page on Trout Streams:

http://www.dnr.state.mn.us/fishing/trout_streams/index.html

DNR Fact Sheet on Silica Sand Mining Trout Stream Setback Permit:

http://files.dnr.state.mn.us/lands_minerals/silicasand/silicasand-troutstream-setback-factsheet.pdf

MPCA web page on Water Quality Standards:

<http://www.pca.state.mn.us/index.php/water/water-permits-and-rules/water-rulemaking/water-quality-standards.html>

E.6. CALCAREOUS FENS

a. Description of Silica Sand Project Concerns

Calcareous seepage fens (synonymous with calcareous fens) are one of the rarest natural communities in the United States. These fens have been reported in 10 states, most of these located within the Midwest. Approximately 200 are known in Minnesota, most of which are only a few acres in extent. Calcareous fens are concentrated at the bases of terrace escarpments in river valleys in the Minnesota River Valley and on the sides of morainal hills and valley side slopes in southern, northwest and west-central Minnesota. Silica sand mining activities have the potential to physically disturb, fill or alter the hydrology of calcareous fens. Dewatering, washing, processing and transportation of sand have the potential to affect water quality and may substantially change the groundwater flow regime that supports a calcareous fen or may affect.

b. Narrative Description and Background Information

Calcareous fens are rare and distinctive wetlands characterized by a substrate of non-acidic peat and dependent on a constant supply of cold, oxygen-poor groundwater rich in calcium and magnesium bicarbonates. This calcium-rich environment supports a plant community dominated by “calciphiles,” or calcium-loving species. These fens typically occur on slight slopes where

upwelling water eventually drains away and where surface water inputs are minimal. Sometimes they occur as domes of peat that grow to the height of the hydraulic head. These settings create an unusual wetland regime where the substrate is almost always saturated to the surface, but flooding is rare and brief. In addition to the rarity of the community itself, calcareous seepage fens support a disproportionately large number of rare plant species in Minnesota, four of which occur almost exclusively in this community.

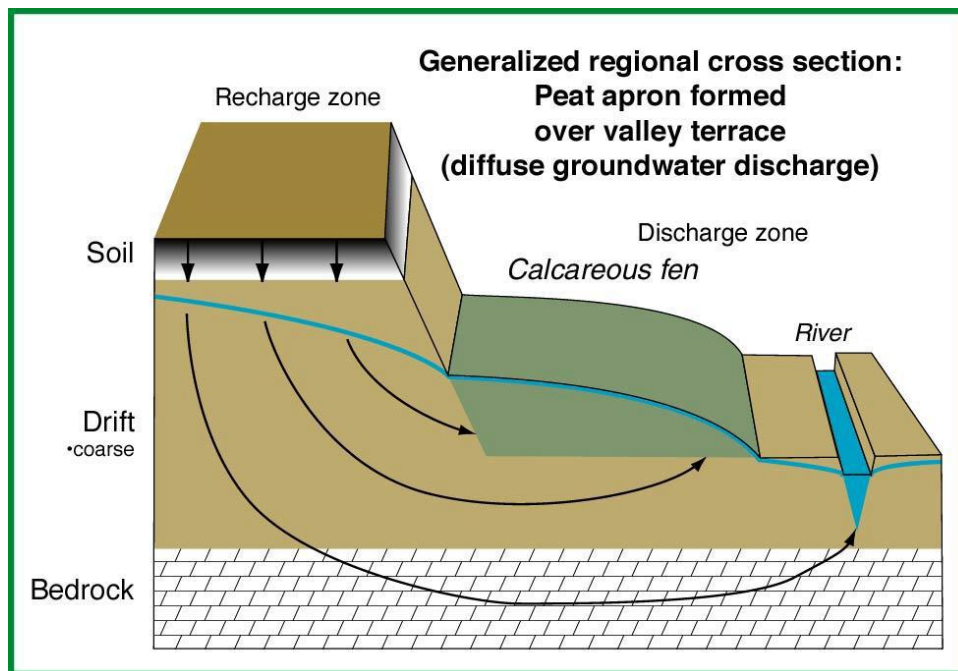


Figure 17. Generalized regional cross section of groundwater discharge for site conditions needed for calcareous fens.

Under the Minnesota Wetlands Conservation Act (WCA), impacts to calcareous seepage fens are regulated by the DNR. According to the WCA rules, calcareous fens may not be filled, drained, or otherwise degraded, wholly or partially, by any activity, unless the DNR Commissioner, under an approved calcareous fen management plan, decides some alteration is necessary.

Additional Protections

In addition to the protection afforded by WCA, destruction of any state-threatened plants occurring on a calcareous fen may be regulated under Minnesota's endangered species law. The DNR well construction approvals with subsequent appropriation permit applications within 5 miles of a known calcareous fen, submittal requirements are automatically elevated to a higher level of technical data collection, analysis and review to better understand the hydrogeologic setting and to avoid impacts. MPCA rules prohibit discharge of any sewage, industrial waste, or other waste to a calcareous fen. Other wetland types if left not impacted bordering a calcareous fen provide a critical buffer from activities in the vicinity and help to protect the integrity of the fen.

c. List of Silica Sand Project Potential Impacts

Potential impacts are similar for both geographic regions.

- Alteration of groundwater flow regime
- Physical disturbance
- Alteration of surface water flow
- Loss of protected species
- Discharge to outstanding resource value water
- Alteration of soil and water chemistry from discharges to fen
- Loss of surrounding wetland habitat that act as a buffer for calcareous fens

d. Recommendations, Standards, Criteria, Considerations

In order to protect calcareous fens from potentially negative impacts associated with silica sand mining, processing, stockpiling and transportation activities, Paleozoic Plateau and Minnesota River Valley LGUs could consider requiring the following actions in local permitting:

1. Consult the official list of known calcareous fens on the DNR's website to determine if any calcareous fens are located in the vicinity of proposed activities. If so, notify the DNR Area Hydrologist.
2. Report all known or suspected calcareous fens in the LGU's jurisdiction that are not on the official list of calcareous fens to the DNR Area Hydrologist for verification and official listing of the fens.
3. Utilize appropriate provisions of the WCA to avoid the loss of any wetlands that buffer a calcareous fen.
4. For all projects that involve dewatering, require a survey of wetlands within 1.5 miles of the project boundary to determine if any unknown calcareous fens may be present. Surveys should be conducted by personnel qualified to identify calcareous fens.
5. If potential calcareous fen impacts are identified, further consultation with the DNR is required.

References

State Statutes: 84.0895 Protection of Threatened and Endangered Species
103G.223 Calcareous Fens

Minnesota Rules: 7050.0180 Nondegradation for Outstanding Resource Value Waters
8420.0935 Standards and Criteria for Identification, Protection, and Management of Calcareous Fens.

DNR Fact Sheet on Calcareous Fens:

http://files.dnr.state.mn.us/natural_resources/water/wetlands/calcareous_fen_fact_sheet_dec_2011.pdf

DNR Native Plant Community Description on Open Rich Peatland Systems:

http://files.dnr.state.mn.us/natural_resources/npc/open_rich_peatland/opp93.pdf

DNR List of Identified Calcareous Fens:

http://files.dnr.state.mn.us/publications/waters/calcareous_fen_list_nov_2009.pdf

E.7. WELLHEAD PROTECTION AREAS AS DEFINED IN SECTION 103I.005

a. Description of Silica Sand Project Concerns

Removal of protective geologic materials can result in increased groundwater vulnerability to land use activities. Additionally, mining activities could result in different recharge patterns, groundwater flow conditions or other aquifer properties. Should these aquifer properties differ substantially from those used in delineating a nearby wellhead protection area, the integrity of the methodology used for the delineation would be undermined. If such circumstances arise, the wellhead protection area delineation will need to be re-assessed.

b. Narrative Description and Background Information

Wellhead protection planning (WHP) is a means of preventing contamination of either wells or the groundwater system supplying wells using effective management of potential sources of contamination in all or a portion of the well's recharge area. Wellhead protection is a legal requirement that was adopted by the state in December 1997. Procedures and time frames for wellhead planning are described in Minnesota Rules Parts 4720.5100 to 4720.5590, and apply to community and non-community public water supply systems that rely on groundwater for their source of drinking water.

Wellhead protection planning is conducted within Drinking Water Supply Management Areas (DWSMA), which are the management areas encompassing scientifically-derived wellhead protection areas. These areas and the vulnerability associated with them are determined by public water supply systems using site specific information. Resource protection measures embedded in wellhead protection planning efforts are derived based on the physical setting of the DWSMA and the potential sources of contamination identified at the time of plan preparation.

In general, WHP areas provide buffers to water supply wells. No additional setbacks are required unless silica sand mining activities will result in impacts to the parameters used to develop the

WHP plan. In addition, all potential contaminant sources are required to meet isolation distances to all wells as described in MN Statute I031 and MR Chapter 4725.

c. List of Silica Sand Project Potential Impacts

Most potential impacts are similar for both the Minnesota River Valley and the Paleozoic Plateau.

- Alteration of groundwater flow regime;
- Physical disturbance, especially the removal of confining layers that afford some geologic protection to aquifers used for water supply (causing increased vulnerability to groundwater contamination);
- Change in recharge patterns;
- Alteration of surface water flow.

The one area of concern unique to the Paleozoic Plateau is the potential for silica sand mining operations and the water handling associated with silica sand mining to lead to the development of karst features in the carbonate bedrock of the region. Such features are known to develop rapidly in some settings. The complex groundwater flow patterns and very rapid travel times associated with aquifers that exhibit these features can make protection efforts difficult. Accordingly, mine development and reclamation activities specific to the Paleozoic Plateau (as described elsewhere in this document) are designed to minimize the likelihood that mining activities would accelerate the development of karst and other secondary porosity features in the underlying bedrock materials.

d. Recommendations, Standards, Criteria, Considerations

The following language could be considered by LGUs for use in ordinance development or in permitting requirements:

- Prior to mining, an inventory of all wells, shall be conducted within the portions of a DWSMA proposed for silica sand mining activities and within a 1 mile radius of the proposed project boundary. Project proposers are responsible for wells located within the perimeter of the proposed project boundary and unused, unsealed wells shall be brought back into use or sealed in accordance with [Minnesota Statutes, Chapter 103I](#) and [Minnesota Rules, Chapter 4725](#). Additional information is available on the MDH website at [Well Sealing](#).

References

MDH maintains current information on the locations and vulnerability characteristics of wellhead protection areas and drinking water supply management areas at: <http://www.health.state.mn.us/divs/eh/water/swp/maps/index.htm>.

MDH guidance on stormwater infiltration in wellhead protection areas is available on its website: <http://www.health.state.mn.us/divs/eh/water/swp/stormwater.pdf>

MDH has compiled a list of issues and associated management measures for mining within wellhead protection areas. This information is available here: <http://www.health.state.mn.us/divs/eh/water/swp/mining.pdf>

E.8. CRITICAL NATURAL HABITAT ACQUIRED BY THE COMMISSIONER OF NATURAL RESOURCES UNDER SECTION 84.944 OF MINNESOTA STATUTES

a. Description of Silica Sand Project Concerns

“Critical natural habitats” are defined as lands or waters funded under MS 84.943 that are acquired under provisions of MS 84.944 Acquisition of Critical Natural Habitats. The lands or waters (outdoor recreation units) acquired are designated as a unit within the state Outdoor Recreation System such as a state park. Silica sand mining activities have the potential to negatively affect these outdoor recreation units through the introduction or spread of invasive species and through changes in hydrology, increased erosion, sedimentation, pollution, a reduction in the recreational user experience, loss of connectivity of landscapes, loss of wildlife habitat, loss of native plant communities and wildlife displacement. Many of these outdoor recreation units, once acquired, are protected from direct impacts.

Although these outdoor recreation units are individually established under unique criteria (e.g. outdoor recreation value, protection of natural features, historic preservation) which are intrinsically tied to their location on the landscape; the outdoor recreation units either in the Minnesota River Valley and Paleozoic Plateau Ecological Section face similar potential impacts.

The outdoor recreation units that may be affected will depend on the location and type of silica sand operations being proposed. Depending on the extent to which the silica sand resources are mined, processed or transported, the cumulative effect on Minnesota’s sensitive resources could be significant.

b. Narrative Description and Background Information

According to *Minnesota Statutes (MS)* Section 84.944 in determining what critical natural habitats shall be acquired or improved, the commissioner shall consider:

- 1) The significance of the land or water as existing or potential habitat for fish and wildlife and providing fish and wildlife oriented recreation;*

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- 2) *The significance of the land, water, or habitat improvement to maintain or enhance native plant, fish, or wildlife species designated as endangered or threatened under Section 84.895.*
 - 3) *The presence of native ecological communities that are now uncommon or diminishing; and*
 - 4) *The significance of the land, water, or habitat improvement to protect or enhance natural features within or contiguous to natural areas including fish spawning areas, wildlife management areas, scientific and natural areas, riparian habitat and fish and wildlife management projects.*

In accordance with considerations mentioned above, “critical natural habitats” may only be acquired under MS Section 84.944 if it is designated as a unit within the state Outdoor Recreational System as defined under Section 86A.05. Outdoor recreational units include; state parks; state recreation areas; state trails; state scientific and natural areas; state wilderness areas; state forests; state wildlife and management areas; state water access site; state wildlife, scenic and recreational rivers, state historic sites; state rest areas; additional parks; aquatic management areas; and state boater waysides.

“Critical natural habitats” also include those identified under Sections 89.018, subdivision 2, paragraph (a), 97A.101, 97A.125, 97C.001 and 97C.011 which include public water reserves and management areas, wildlife habitats on private land, experimental waters and muskellunge lakes, respectively.

Silica sand resources in Minnesota are found primarily in the Minnesota River Valley and the Paleozoic Plateau (southeastern) portions of the state. From a natural resource perspective, these areas include unique and critical habitats that should be protected. The Minnesota River Valley includes gently rolling hills that historically were covered with oak savanna, tallgrass prairie and maple-basswood forest. The Paleozoic Plateau is characterized by bluffs, prairies and stream valleys, is recognized as an Important Bird Area for millions of migratory birds that traverse the Mississippi River Flyway, is comprised of numerous cold-water streams, has the highest number of SGCN (as defined in Subsection E.4.), and is one of the most important areas for reptiles and mollusks. The EQB Report on Silica Sand Final Report (March 20, 2013) includes more information on sensitive resources found within these areas and potential impacts silica sand activities may have to these resources.

Most outdoor recreation units in these areas have been designated under specific criteria on a per-site basis. These criteria could be, for example, that the site contains a native prairie; a unique or historical view shed of the Mississippi River or offers recreational opportunities valued in Minnesota such as trout stream fishing, camping, and wildlife viewing for example. For this reason, management methods and recreational opportunities vary among areas. This makes it impossible to identify specific impacts silica sand activities will have on critical natural habitats, even if they fall under similar designations, without site-specific information.

Even with site specific information, it may be difficult for LGUs to assess what type of impacts may be associated with proposed activities for outdoor recreation units that aren’t directly impacted. The outdoor recreation units may consist of complex habitat systems with varying

degrees of consideration that need to be made from a broader landscape perspective (e.g. seed transport, hydrology, wildlife corridors). More obvious impacts that may be easier to assess include noise or visual impact; but the loss and value of habitat and habitat connectivity or migratory impacts may be more difficult to discern. Consultation with area experts and site managers could be a useful tool in assessing site impacts and is encouraged. In the scenario where the outdoor recreation unit is adjacent to the proposed project site, the DNR should be consulted early in the process.

The vicinity of the proposed project to these outdoor recreation units introduces another consideration. An example on visual impacts: A proposed silica sand mining operation is located on a bluff feature. Two state trails are located within ¼ mile of the proposed project; one trail is located on the toe of the bluff, the other on the top. Even though the proposed project is located within ¼ mile of both trails, the trail on the top of the bluff may have visual impacts while the other located at the toe of the bluff does not. Generally, the DNR recommends that “vicinity” be considered as critical natural habitats located within one mile of the proposed project boundary. Outdoor recreation units identified within that distance should then be evaluated individually for potential impacts applying considerations such as the one in the example above.

Features within outdoor recreation units or for which the property may have been designated may be discussed in other Considerations for Setback and Buffer subsections. For example, Seminary Fen Scientific and Natural Area is located within the Minnesota River Valley. However, one of resources for which the critical natural habitat was named is a calcareous fen. Special considerations and recommendations for calcareous fens are discussed in subsection E.6. (SNAs are discussed in this subsection). In this scenario, it is recommended that the LGU follow the recommendations for the unique feature or whichever is more restrictive. It should be noted that other site features in addition to, for example, the calcareous fen, may need to be considered when determining an appropriate course of action. Referring back to the example above, the Seminary Fen SNA also includes a designated trout stream and state-listed rare plants.

It is also important to note the obvious higher density of the designated sites within the Paleozoic Plateau. This area of the state with its many unique features is often referred to as the Driftless Area and in Minnesota, is generally referred to as the Bluffland Landscape. This should not be interpreted by LGUs to mean that resources outside of this area are not as valued or require less protection; but, rather points out that the density of these resources should be considered when considering cumulative impacts and landscape connectivity.

When considering boundaries

Some outdoor recreation units such as state parks and state recreation areas have legislatively authorized statutory boundaries. Statutory boundaries are comprised of state-acquired parcels and privately-owned properties (lands in which the landowner agrees to be included within the statutory boundary but whose property is not impacted by the agreement). Statutory boundaries allow the DNR the authorization to negotiate with willing sellers for acquisition of lands contained within that statutory boundary. Statutory boundaries provide additional opportunity to state parks and state recreational areas to preserve plant communities, natural areas and culturally significant historic sites.

When considering features

The Natural Heritage Information System (NHIS) provides information on Minnesota's rare plants, animals, native plant communities, and other rare features such as animal aggregations. The NHIS is the most complete source of data on Minnesota's rare or otherwise significant species, native plant communities, and other natural features and is continually updated as new information becomes available. The data are commonly used for land conservation programs, environmental review, planning, management research and education. A Natural Heritage Review [or NHIS Review] can be obtained through a formal request made to the DNR. If it is determined that the proposed project has the potential to adversely affect any state-listed or other rare features, recommendations for avoidance and/or minimization will be included with the response along with DNR area contact information. Information on how to obtain NHIS data along with a fee schedule for services can be found on the DNR website.

Many resources are available that provide information about the species or features associated with critical natural habitats (and other habitats in general). The DNR website link to "Nature" is one of those resources. This interactive webpage includes links to webpages on Minnesota's animals, climate, ecological classification system, forests, invasive species, native plant communities, nongame wildlife, plants, prairies, water, rocks and minerals. Numerous other resources are available via the internet that include other state websites, local governments (county/city), non-governmental organizations (e.g. The Nature Conservancy, Ducks Unlimited, the Minnesota Land Trust, etc.), university websites (e.g. University of Minnesota) and federal government websites (e.g. United States Fish and Wildlife Service, United States Park Service, etc.). Caution should be applied when using information gathered from non-research based entities.

More information on outdoor recreation units can be found on the DNR website. Most of the links are located under the Destination Tab located on the main webpage at www.dnr.state.mn.us. This information includes maps, outdoor recreation units characteristics/features and recreational features.

The locations of most of the outdoor recreation units referenced in this subsection are available in spatial data format and can be found on the DNR Data Deli website. The DNR GIS Data Deli is an internet-based spatial data acquisition site that allows users to download raw computer-readable data for use in Geographic Information System (GIS) or image processing systems. Local land-use plans and watershed plans are other resources that should include locations of outdoor recreation units and their unique and valued features.

c. List of Silica Sand Project Potential Impacts

Minnesota River Valley and Paleozoic Plateau

- Reduction in SGCN

-
- Impacts to state-listed species that rely on designated outdoor recreation units
 - Loss of habitat and habitat corridors
 - Introduction and/or spread of invasive species
 - Increase in water pollution
 - Hydrologic impacts to lakes, streams and wetlands (landscape and recreational implications)
 - Recreational user safety (increased traffic and large equipment)
 - Increased fragmentation and degradation of habitat (both protected and non-protected)
 - Visual impacts to recreational users
 - Noise impacts to recreational users

d. Recommendations, Standards, Criteria, Considerations

To protect outdoor recreation units from potential negative impacts associated with silica sand mining, processing and transportation, LGUs could consider the following be required in local application/permitting processes:

1. Require that the applicant submit a DNR NHIS Data Request Form in order to determine potential impacts to rare features. The form should be obtained early in project development so the NHIS Response can be provided with the application. *Note: A NHIS correspondence letter is valid for one year. Through project development (including early planning, application, environmental review and permitting) it may be necessary to request an updated review from the DNR to ensure that all recorded rare and natural resources are incorporated in project considerations.
2. Consult the DNR's website or DNR area offices to determine if an outdoor recreation unit is located in the vicinity of proposed activities.
3. If the outdoor recreation unit is found to be in the vicinity of the proposed project, LGUs/project proposers should consider the proposed activities and the potential impacts to the outdoor recreation units. A DNR area expert or manager could be consulted to help assess potential impacts.
4. If an outdoor recreation unit is found to be adjacent to the proposed project, the DNR should be consulted early in the process.
5. Features within outdoor recreation units or for which the property may have been designated may be discussed in other Considerations for Setback and Buffer subsections. It is recommended that other site features within the outdoor recreation unit, in addition to the outdoor recreation unit itself, be considered when determining an appropriate course of action.
6. Impacts in any scenario could be avoided or minimized to the extent feasible by requiring:
 - a. **Setbacks:** There are no existing setback requirements in *Minnesota Rules* for outdoor recreational units ("critical natural habitats"). As with residential setbacks, setbacks in land-use regulations can be used to reduce adverse effects of land use. Because of variation caused by the factors described above, the reduction of impacts afforded by setbacks can only be more accurately determined when the characteristics of the project, the site, mitigation measures,

and the setting are known, i.e., at the point of project review (through environmental review and/or local development review as part of the local zoning approval/permitting process). However, where local governments choose to establish required setback dimensions or buffer design standards in land-use regulations, it may be prudent to clarify in the regulations that the setback or buffer may be adjusted (increased, decreased or otherwise modified) through the discretionary approval of local permitting.

- b. **Vegetative buffers:** Require a vegetative buffer along the perimeter of the project area. Vegetative buffers provide both a visual and noise barrier to mining, processing and transporting activities if designed properly. Vegetative buffers also help provide erosion control, reduce soil/water runoff from the site and may help to avoid or manage the spread or establishment of invasive species.
- c. **Best Management Practices:** Project proposers should be required to follow BMPs. (discussed in more detail in the Operations section of this document)
- d. **The use of ecologically appropriate materials** both during operations and reclamation. For example, this could include the required use of wildlife-friendly erosion control mesh and native seed mixes from local seed sources (see Operations).

References

The Office of the Revisor of Statutes website:

<http://www.revisor.leg.state.mn.us>

DNR main website:

www.dnr.state.mn.us

DNR Natural Heritage Information System webpage:

<http://www.dnr.state.mn.us/eco/nhnrp/nhis.html>

DNR Index webpage on Nature:

<http://www.dnr.state.mn.us/nr/index.html>

DNR Data Deli webpage:

<http://deli.dnr.state.mn.us>

DNR Fact Sheet on Wildlife Friendly Erosion Control Mesh:

<http://files.dnr.state.mn.us/eco/nongame/wildlife-friendly-erosion-control.pdf>

DNR webpage on Minnesota State-Listed Species:

<http://www.dnr.state.mn.us/ets/rulesrevision.html>

E.9. NATURAL RESOURCE EASEMENT PAID WHOLLY OR IN PART BY PUBLIC FUNDS

a. Description of Silica Sand Project Concerns

Silica sand mining activities have the potential to negatively affect natural resource easements through the introduction or spread of invasive species; changes in hydrology; loss of wildlife habitat and wildlife displacement; reduction in the recreational user experience; loss of connectivity of landscapes; and through increased erosion, sedimentation and pollution. The potential effects are likely to be indirect impacts as easements set forth specific restrictions on development and land use which would likely protect them from direct impacts.

Natural resource easements are individually obtained for the protection of certain features or for natural resource recreation. Although the Minnesota River Valley and Paleozoic Plateau Ecological Section offer some different rare features and recreational experiences, the resources in both face similar potential impacts.

The natural resource easements (lands) that will be affected will depend on the location and type of silica sand operations. Depending on the extent to which the silica sand resources are mined, processed or transported, the cumulative effect on Minnesota's natural resources could be significant.

b. Narrative Description and Background Information

Easements are defined as a certain right to use the real property of another without possessing it. Easements often include a set of restrictions a landowner voluntarily agrees to that limits how the land can be used. The landowner who legally agrees to the easement and all future owners are legally obligated to abide to the agreed-upon restrictions that are placed on the land's development and use. The existence of an easement should be part of the recorded deed for the property. The restrictions are dependent on the features that the easement is intended to protect or serve. Public access is not always a condition of the agreement. Easements that fit under the category of "natural resource easements" include conservation, scenic and trail easements. The funding can be from local, state and/or federal sources.

It should be noted that the intention of this subsection is not to provide an exhaustive list of natural resource easements and all reasons for which they were acquired. Rather, this subsection is meant to bring attention to those which may be encountered and may need to be cogitated when reviewing a proposed silica sand project. The focus in this subsection is given to natural resource easements held by the state; however, local government, non-governmental organizations (NGOs) and federal governments also hold easements in the state of Minnesota and should be given equal consideration.

The comments and recommendations provided in this subsection are the technical opinions of state agencies. Natural Resource easements held by other entities as identified above may have

additional concerns or differing recommendations. Therefore LGUs are strongly encouraged to contact easement holders identified in the project area as appropriate.

Conservation Easements

State natural resource easements include conservation easements which are defined in Minnesota Statutes 84C. There are more than 15 different types of state-funded conservation easements, each with a different purpose. Primarily, these are administered by four easement holders: Board of Water and Soil Resources (BWSR), Department of Natural Resources (DNR), Duck Unlimited (DU), and Minnesota Land Trust (MLT). Conservation easements include those acquired for aquatic management areas; native prairie banks; wildlife management areas; Reinvest in Minnesota (RIM) Reserve Program; trout streams; scientific and natural areas; wild and scenic rivers; wildlife management areas; water banks; northern pike spawning areas; Forest Legacy; Minnesota Forests for the Future and Metro Greenways. Many of these are considered outdoor recreation units (subsection 8). Easements are another method to add additional protection to units when not all properties of interest are available to be acquired. Other conservation easements such as native prairie banks are only protected through conservation easements.

Currently more than 6,600 state-funded conservation easements protect about 600,000 acres. The Paleozoic Plateau contains 481 conservation easements, the majority of which are trout streams. The Minnesota River Valley currently has 14 conservation easements of various types. These do not include RIM conservation easements. *Conservation Easement Stewardship and Enforcement Program Plan – DNR Final Report February 28, 2011* is a good resource to learn more about conservation easements held by the DNR. As the report date is 2011, numbers provided within that document may not be representative of current easements.

Pertaining to RIM conservation easements, BWSR currently holds 6,700 RIM conservation easements that provide protection for 250,500 acres across the State. Within the Paleozoic Plateau alone there are 422 easements that encompass 10,100 acres.

Federal governments easement holders can include the United States Fish and Wildlife Service (FWS); the Natural Resources Conservation Service (NRCS) the United States National Park Service (NPS) and the United States Bureau of Land Management (BLM). These natural resource easements can be acquired and managed in various ways. For example, The NRCS offers programs to landowners who want to maintain or enhance their land in a beneficial way to the environment by providing technical help and financial assistance but depends on landowners and organizations to do the work. The conservation easement programs offered include the Grassland Reserve Program, Wetlands Reserve Program and Healthy Forest Reserve Program. The FWS provides technical and financial assistance to local land trusts and community conservation foundations similar to NRCS but also could own and manage easements such as wetland easements, grassland easement and others.

Non-governmental organization easement holders include organizations such as Ducks Unlimited, Inc. (Wetlands American Trust), Minnesota Land Trust and The Nature Conservancy.

Conservation easement types include many of those identified above under state and federal government.

Local governments can also hold easements for similar purposes as mentioned above. Conservation easement types can vary by LGU. The LGU should be prepared to provide project proposers with information on conservation easements that they hold early during project planning.

Scenic Easements

State scenic easements are those easements acquired by the Minnesota Department of Transportation under M.S. 173.04 Scenic Area. These easements are acquired to preserve the natural beauty of a specific area and its visibility from the highway. The rights may require the removal, by owner of the land, any structure necessary to accomplish visibility. These easements are federally funded.

The DNR may acquire scenic easements to implement the Wild and Scenic Rivers System. The purpose of Wild and Scenic River Systems are to preserve and protect the outstanding scenic, recreational, national, historical, and scientific values of certain Minnesota rivers and adjacent lands. There is one Wild and Scenic and Recreational River located within the Paleozoic Plateau that is a segment of the Cannon River.

Trails Easements

Trail easements are easements acquired for the purpose of developing or designating a trail segment for recreational purposes. Trail easements offer the user access to other natural resource features and critical natural habitats discussed in other sections and subsections of this document. Trail easements can be held by local, state and federal governments as well as non-governmental organizations. These easements can be designated for a variety of uses and reasons. The DNR for example manages trails and trail systems for many uses that include cross-country, biking, horseback riding, off-highway vehicles, hiking and snowmobile trails. Many of these trail types are also managed by non-state entities. Trail systems may tie into larger long-distance trails that can be held in easements by many easement holders.

Four state trail easements are managed by the DNR located within the Paleozoic Plateau. Within the Minnesota River Valley, one state trail easement that is part of the Minnesota Valley State Trail. Currently, no National Park System trails are within this area of the state.

Considerations

As discussed above, natural resources easements are obtained for a variety of reasons. Natural resource easements may be obtained for recreational purposes, the protection and preservation of rare and unique features and several of these easements may be part of or considered critical

natural habitats. For this reason, the considerations and cautionary mentions are similar to those in subsection 8 of Buffers and Setbacks.

The restrictions of each individual easement are dependent on the features that the easement is intended to protect or for the purpose for which the easement was obtained. This makes it difficult to state with any certainty what specific impacts silica sand activities may have to natural resource easements even for those that fall under similar designations, without site specific information.

Even with site specific information, it may be difficult for LGUs to assess what type of impacts may be associated with proposed activities for natural resource easements that aren't directly impacted. Natural resource easements lands may consist of complex habitat systems with varying degrees of consideration that need to be made from a broader landscape perspective (e.g. seed transport, hydrology, and wildlife corridors). More obvious impacts that may be easier to assess include noise or visual impact; but the loss and value of habitat and habitat connectivity or migratory impacts may be more difficult to discern. Consultation with area experts and site managers could be a useful tool in assessing site impacts and is encouraged. In the scenario where the natural resource easement is adjacent to the proposed project site, the easement holder should be consulted early in the process.

The vicinity of the proposed project to a natural resource easement introduces another consideration. An example on visual impacts: A proposed silica sand mining operation is located on a bluff feature. Two state trails are located within ¼ mile of the proposed project; one trail is located on the toe of the bluff, the other on the top. Even though the proposed project is located within ¼ mile of both trails, the trail on the top of the bluff may be subject to visual impacts while the other located at the toe of the bluff does not. Generally, it is recommended that “vicinity” be considered as natural resource easements located within one mile of the proposed project boundary. Natural resource easements identified within that distance should then be evaluated individually for potential impacts applying considerations such as the one in the example above.

Features within natural resource easements may be discussed in other Setback and Buffer subsections. An example would be a calcareous fen. Special considerations and recommendations for calcareous fens are discussed in subsection 6. In this scenario, it is recommended that the LGU follow the recommendations for the unique feature or whichever is more restrictive. It should be noted that other site features in addition to, for example, the calcareous fen, may need to be considered when determining an appropriate course of action.

When considering features

The Natural Heritage Information System (NHIS) provides information on Minnesota's rare plants, animals, native plant communities, and other rare features such as geologic features and animal aggregations. The NHIS is the most complete source of data on Minnesota's rare or otherwise significant species, native plant communities, and other natural features and is continually updated as new information becomes available. The data are commonly used for land

conservation programs, environmental review, planning, management research and education. A NHIS Review can be obtained through a formal request made to the DNR. If it is determined that the proposed project has the potential to adversely affect any state-listed or other rare features recommendations for avoidance and minimization will be included with the response along with DNR area contact information. Information on how to obtain NHIS data along with a fee schedule for services can be found on the DNR website.

There are many resources available that provide information about the species or features associated with natural resource easements (and other habitats in general). The DNR website link to “Nature” is one of those resources. This interactive webpage includes links to webpages on Minnesota’s animals, climate, ecological classification system, forests, invasive species, native plant communities, nongame wildlife, plants, prairies, water and rocks and minerals. Numerous other resources are available via the internet that include other state websites, local governments (county/city), non-governmental organizations (e.g. The Nature Conservancy, Ducks Unlimited, the Minnesota Land Trust, etc.), university websites (e.g. University of Minnesota) and federal government websites (e.g. United States Fish and Wildlife Service, United States Park Service, and etc.). Caution should be applied when using information gathered from non-research based entities.

How to find out where natural resource easements are located

The National Conservation Easement Database (NCED) includes records from land trusts and public agencies throughout the United States. The purpose of NCED is to provide a nationwide system for sharing and managing information about conservation easements. The website allows the user to run reports on your state(s) of interest. More advanced searches include but are not limited to easement types, easements by counties, easement holders, and easement purposes. The report includes graphs/charts that aid in the interpretation of conservation easements and queries offer map depictions. The easement records within the system are provided voluntarily and updated periodically. Easement holders and landowners both are encouraged to participate. In Minnesota several state, federal and non-governmental organizations participate in this program. Few local governments were identified as participants in the database. To run a report for your area of interest or to learn more on how to participate in the NCED, visit the website at www.conservationeasement.us.

The locations of several natural resource easements discussed in this subsection are available in spatial data format and can be found on the DNR Data Deli website. The DNR GIS Data Deli is an internet-based spatial data acquisition site that allows users to download raw computer-readable data for use in Geographic Information System (GIS) or image processing systems. Local land-use plans and watershed plans are other resources that should include locations of critical natural habitats and their unique and valued features.

Most easements are filed in the public records of the county in which the land is located. For counties who have not established an electronic database which allows them to sort land records by type, locating easements can be difficult. However, other resource planning tools such as local land-use and/or regional development plans and some watershed plans should already have identified many of these easements and could be useful tools when reviewing proposed projects.

c. List of Silica Sand Project Potential Impacts

Potential impacts are similar for both geographic regions.

- Loss of habitat and habitat corridors
- Introduction and/or spread of invasive species
- Increase in water pollution
- Hydrologic changes (landscape and recreational implications)
- Recreational user safety (increased traffic and large equipment)
- Reduction in SGCN
- Impacts to state-listed species that rely on protected resources
- Increased fragmentation and degradation of habitat (both protected and non-)
- Visual impacts to recreational users
- Noise impacts to recreational users

d. Recommendations, Standards, Criteria, Considerations

Natural resource easements are one method to protect and preserve land; other methods include zoning and local regulations, state or federal laws and regulations, and public ownership. To protect natural resource easements from potential negative impacts associated with silica sand mining, processing and transportation LGUs could consider the following be required in local application/permitting processes:

1. Require that the applicant submit a DNR NHIS Data Request Form in order to determine potential impacts to rare features. The form should be obtained early in project development so the NHIS Response can be provided with the application. *Note: A NHIS correspondence letter is valid for one year. Through project development (including early planning, application, environmental review and permitting) it may be necessary to request an updated review from the DNR to ensure that all recorded rare and natural resources are incorporated in project considerations.
2. Consult available resources to determine natural resource easements are adjacent to or in the vicinity of the proposed project. If a natural resource easement is found to be adjacent to the proposed project, the easement holder should be consulted early in the process.
3. If the natural resource easement is found to be in the vicinity of the proposed project, LGUs/project proposers should consider the proposed activities and the potential impacts to the critical natural habitat. Area experts or easement managers could be consulted to help assess potential impacts.
4. Impacts in any scenario should be avoided or minimized to the extent feasible by requiring:
 - a. **Setbacks:** There are no existing setback requirements in *Minnesota Rules* for outdoor recreational units (“critical natural habitats”). As with residential setbacks, setbacks in land-use regulations can be used to reduce adverse effects of land use. Because of variation caused by the factors described above, the reduction of impacts afforded by

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- setbacks can only be more accurately determined when the characteristics of the project, the site, mitigation measures, and the setting are known, i.e., at the point of project review (through environmental review and/or local development review as part of the local zoning approval/permitting process). However, where local governments choose to establish required setback dimensions or buffer design standards in land-use regulations, it may be prudent to clarify in the regulations that the setback or buffer may be adjusted (increased, decreased or otherwise modified) through the discretionary approval of local permitting.
- b. **Vegetative buffers:** Require a vegetative buffer along the perimeter of the project area. Vegetative buffers provide both a visual and noise barrier to mining, processing and transporting activities if designed properly. Vegetative buffers also help provide erosion control, reduce soil/water runoff from the site and may help to avoid or manage the spread or establishment of invasive species.
 - c. **Best Management Practices:** Project proposers should be required to follow BMPs. (discussed in more detail in the Operations section of this document)
 - d. **The use of ecologically appropriate materials** both during operations and reclamation. For example, this could include the required use of wildlife-friendly erosion control mesh and native seed mixes from local seed sources.

Long-term planning could include working with area experts and landowners to identify lands that contain rare and sensitive features to determine whether a natural resource easement or other method of protection such as purchasing the land in fee.

References

The Office of the Revisor of Statutes website:
<http://www.revisor.leg.state.mn.us>

DNR Data Deli website:
<http://deli.dnr.state.mn.us>

DNR main website:
<http://www.dnr.state.mn.us/>

NCED website:
<http://www.conservationaleasement.us/>

BWSR webpage on easements:
<http://www.bwsr.state.mn.us/easements/>

USFWS webpage on habitat management techniques:
<http://www.fws.gov/mountain-prairie/pfw/r6pfw8b.htm>

NRCS website on Easements:
www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/

E.10. FLOODPLAINS

a. Description of Silica Sand Project Concerns

Floodplains are areas adjacent to rivers, streams, and lakes that are susceptible to flooding. Along large rivers, such as the Mississippi and Minnesota Rivers, floodplains usually are flooded during spring after heavy snow seasons but flooding can also result from intense rain events. Floodplains may include normally dry areas adjacent to wetlands, small ponds, or other low areas. Silica sand mining activities have the potential to be flooded if located in or near a floodplain.

Flooding of a silica sand mine and associated activities could potentially result in floodwater contamination, groundwater contamination, rerouting of the stream, alteration of surface water flow, operations shut down, loss of berm or bank, loss of vegetated upland, loss of wetland buffer, accelerated erosion, loss of equipment, increased sedimentation, loss of productivity and degradation of fish and wildlife habitat.

b. Narrative Description and Background Information

In 1969, the Minnesota Legislature enacted the State Floodplain Management Act. By law, Minnesota's flood prone communities are required to: 1) adopt floodplain management regulations when adequate technical information is available to identify floodplain areas; and 2) enroll and maintain eligibility in the National Flood Insurance Program (NFIP) so that the people of Minnesota may insure themselves from future losses through the purchase of flood insurance. In 1987, the Flood Plain Management Act was amended to establish a state cost-sharing grant program to help local government units plan for and implement flood hazard mitigation measures. The DNR is the state agency with overall responsibility for implementation of the State Flood Plain Management Act.

At the state level, the DNR has promulgated minimum standards for floodplain management entitled "Statewide Standards and Criteria for Management of Flood Plain Areas of Minnesota" These standards have two direct applications: 1) all local floodplain regulations adopted after June 30, 1970 must be compliant with these standards; and 2) all state agencies and local units of government must comply with Minnesota Regulations in the construction of structures, roads, bridges or other facilities located within floodplain areas delineated by local ordinance.

Floodplain management regulations are administered by local zoning authorities. Local floodplain regulatory programs, administered by county government, predominately for the unincorporated areas of a county, and by municipal government for the incorporated areas of a county, must be compliant with federal and state floodplain management standards. Both federal and state standards identify the 100-year floodplain as the minimum area necessary for

regulation at the local level. The 100-year floodplain is the land adjoining lakes and rivers that would be covered by the 1-percent chance (or 100-year) flood. LGUs may regulate activities in the 500-year floodplain, instead of just the 1-percent chance (100-year) floodplain. Federal Emergency Management Agency (FEMA) maps usually show floodplains associated with rivers, streams, and large lakes, but the community may also regulate locally identified areas as high flooding risks. Sound floodplain management principles stress the need for a comprehensive approach to solving flood problems by emphasizing nonstructural measures.

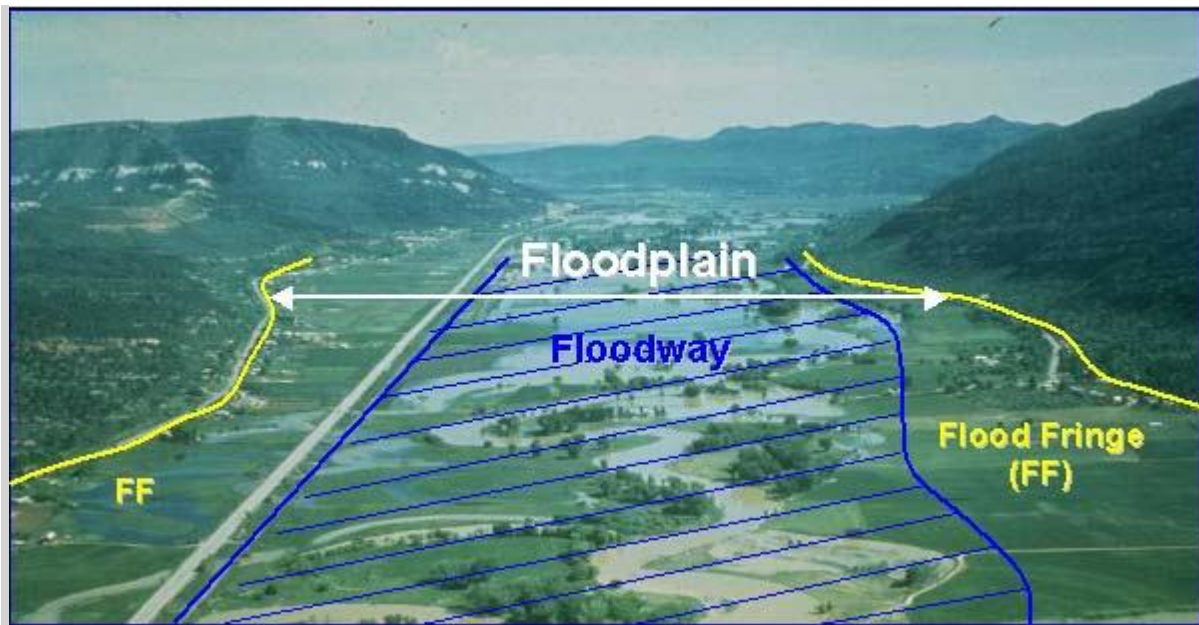


Figure 18. Depiction of floodplain, flood fringe and floodway.

The counties or municipalities floodplain management regulations must include the minimum federal and state regulations, but often have more restrictive regulations.

Local zoning regulations identify permitted land uses in the floodway and flood fringe portions of the floodplain. In the floodway portion, high-velocity floodwaters are expected so most types of development are prohibited. In the flood fringe portion of the floodplain, where the backwater or low-velocity floodwaters occur, development may be allowed if it meets standards.

Mining of many types of surface deposits is common in floodplains, and such uses are addressed in MN Rule 6120. Below are excerpts from Minnesota Rule 6120 regarding permitted and prohibited uses.

6120.5800 ZONING: LAND USES PERMITTED IN FLOODWAY AND FLOOD FRINGE AREAS.

Subp. 3. Permitted uses within the floodway or between levees. Local zoning ordinances may designate specified uses as permitted or special permit uses provided such uses have a low flood damage potential and will not materially obstruct flood flows or increase velocities or stages of the regional flood. However, uses that are likely to cause pollution

of waters, as defined in Minnesota Statutes 1969, section 115.01, and are prohibited unless adequate safeguards approved by the state water pollution control agency are provided. All other uses are prohibited including storage of any potentially hazardous materials which if subject to flooding may become buoyant, flammable, explosive, or may be injurious to human, animal, or plant life.

Subp. 3.A. The following uses may be permitted within the floodway or between levees:

A. Uses having a low flood damage potential including agricultural uses, recreational uses, parking lots, loading areas, storage yards, airport landing strips, certain sand and gravel operations, water control structures, navigation facilities, and other open space uses.

Subp. 4. Development of flood fringe areas adjacent to and outside of floodways.

Subp. 4.F. Storage of materials. Materials that, in time of flooding, are buoyant, flammable, explosive, or could be injurious to human, animal, or plant life shall be stored at or above the flood protection elevation, floodproofed, or protected by structural measures consistent with the standards set forth herein. Furthermore, storage of materials likely to cause pollution of the waters, as defined in Minnesota Statutes 1969, Section [115.01](#), if subject to flooding are prohibited unless adequate safeguards approved by the state water pollution control agency are provided.

The DNR's model floodplain ordinances allow "Extraction and storage of sand, gravel, and other materials" as conditional uses within the floodway, with specific controls:

4.41 All Uses. No conditional use shall be allowed that will cause any increase in the stage of the 1% chance or regional flood or cause an increase in flood damages in the reach or reaches affected.

4.42 Fill; Storage of Materials and Equipment:

- (a) The storage or processing of materials that are, in time of flooding, flammable, explosive, or potentially injurious to human, animal, or plant life is prohibited.
- (b) Fill, dredge spoil, and other similar materials deposited or stored in the floodplain must be protected from erosion by vegetative cover, mulching, riprap or other acceptable method. Permanent sand and gravel operations and similar uses must be covered by a long-term site development plan.
- (c) Temporary placement of fill, other materials, or equipment which would cause an increase to the stage of the 1% percent chance or regional flood shall only be allowed if the (Governing Body) has approved a plan that assures removal of the materials from the floodway based upon the flood warning time available.

Similar provisions apply in the flood fringe:

5.45 The placement of more than 1,000 cubic yards of fill or other similar material on a parcel (other than for the purpose of elevating a structure to the regulatory flood protection elevation) must comply with an approved erosion/sedimentation control plan.

- (a) The plan must clearly specify methods to be used to stabilize the fill on site for a flood event at a minimum of the regional (1% chance) flood event.
- (b) The plan must be prepared and certified by a registered professional engineer or other qualified individual acceptable to the (Governing Body).
- (c) The plan may incorporate alternative procedures for removal of the material from the floodplain if adequate flood warning time exists.

6120.5900 SUPPLEMENTAL STANDARDS AND CRITERIA FOR FLOODPLAIN MANAGEMENT.

Subpart 1. In general. Supplemental measures for floodplain management should be included in local governmental comprehensive floodplain management programs and adopted or provided in addition to local zoning ordinances when sufficient technical data and resources are available for their effectuation. All local governmental units shall provide for control of the development and use of floodplains in flood hazard areas by adopting the following specific regulations and measures where practical to supplement and complement floodplain zoning ordinances and provide comprehensive floodplain management.

In a recent survey of LGUs completed for the purposes of this document, 3 of 15 respondents had ordinances that prohibited silica sand mining in the floodplain. The majority of the remaining participating LGUs (10 of 15 respondents) had no explicit setback restrictions or deemed the question not applicable to their ordinances.

c. List of Silica Sand Project Potential Concerns

Potential impacts are similar for both geographic regions.

- Floodwater contamination
- Groundwater contamination
- Alteration of surface water flow
- Rerouting of the stream
- Loss of wetland buffer
- Accelerated erosion
- Loss of berm or bank
- Loss of vegetative buffer
- Increased sedimentation
- Degradation of fish and wildlife habitat
- Effect on historic properties

d. Recommendations, Standards, Criteria, Considerations

Silica sand mining, processing, stockpiling and transportation activities could involve storage of polluting or harmful chemicals and heavy equipment. In order to protect floodplains, surface water and groundwater from potential pollution from these activities, Minnesota River Valley and Paleozoic Plateau LGUs could consider the following actions:

1. Amend the existing local floodplain ordinance to make the approval of any conditional use permit for silica processing, stockpiling and transloading in the floodway or flood fringe contingent upon MPCA's formal approval of any required MPCA permits.
2. In addition, Minnesota Rule 6120.5900 authorizes the LGU to adopt supplemental measures to protect floodplain resources from the potential impacts (beyond pollution) associated with the inundation of a silica sand mine by floodwaters. Potential impacts include the alteration of surface water flow, rerouting of the stream, loss of wetland buffers, accelerated erosion, loss of berm or banks, loss of vegetative buffers, increased sedimentation and degradation of fish and wildlife habitat.
3. Some LGUs have already adopted more stringent controls of fill and materials storage in floodplains. For those that have not, the following supplemental standards could be considered to improve natural resources protection in floodplains:
 - a. Prohibit any temporary placement of fill and other material (as in 4.42 (c) above) along rivers with flashier flood characteristics where adequate warning time is not available.
 - b. Require a flood response plan for LGU approval that details how potential floodplain damages will be avoided, mitigated, repaired or compensated for in the event of a flood.

References

State Statutes: 103A. WATER POLICY AND INFORMATION
 103F.101- 103F.165 FLOODPLAIN MANAGEMENT
 103H. GROUNDWATER PROTECTION
 CHAPTER 115. WATER POLLUTION CONTROL
 CHAPTER 116. POLLUTION CONTROL AGENCY

Minnesota Rules: 6120.5000 - 6120.6200 FLOODPLAIN MANAGEMENT

DNR web page:

http://www.dnr.state.mn.us/waters/watermgmt_section/floodplain/index.html

Local Governmental Unit Survey Results:

https://www.surveymonkey.com/sr.aspx?sm=qkaLu71vdR_2fqmXMaOYsLnAJKgFH4Fy7NOSxsQqAaP74_3d

E.11. CULTURAL RESOURCES

a. Description of Silica Sand Project Concerns

Silica sand activities have the potential to disturb or destroy areas of cultural significance through indirect or direct means. Potential indirect effects on historic properties include but are not limited to, dust, noise, vibrations, changes in access and lighting. Direct impacts include but are not limited to, the destruction or alteration of historic properties as a result of ground disturbance through mining activities including mine, processing and transportation facility construction. While the Private Cemeteries Act applies to all levels of government and private landowners, consultation with the State Historic Preservation Office and the State Archaeologist are often only required depending upon public funding or public land use.

b. Narrative Description and Background Information

The Minnesota River Valley and the Paleozoic Plateau as well as other regions throughout Minnesota have been occupied by humans for millennia and have the potential to contain historic properties. Historic properties include significant archaeological resources, historic buildings or structures (individual properties and districts), historic landscapes, and traditional cultural properties. Historic properties are identified and designated by various processes at local, state and federal levels of government. *Identification* is accomplished by inventories of known or likely resources. *Designation* could include local listings of historic properties or could include the State or National Register of Historic Places.

In Minnesota, state law requires that all levels of government, state and local, “have a responsibility to protect the physical features and historic character of properties designated in M.S. Sections 138.662 and 138.664 or listed on the National Register of Historic Places...”. Most cultural resource investigation and protection activity is carried out through federal and state governmental actions. If any silica mining projects receives federal assistance (which includes permits, licenses, approvals, or any level of funding), then Section 106 of the National Historic Preservation Act of 1966 is triggered, and the LGU is required to work with the lead federal agency in completing the Section 106 review. If a state agency permits or funds a silica sand mining project, that state agency is required to conduct reviews under Minnesota statutes protecting historic properties. These laws apply across the state. In some situations, local governments and private landowners are required to comply with these statutes or LGUs may have ordinances of their own overseen by heritage preservation commissions (M.S. 471.193).

Minnesota Statutes pertaining to historic properties:

Chapter 138. Historical Societies; Sites; Archives; Archaeology; Folklife
Chapter 307. Private Cemeteries.

These statutes are discussed in more detail below. As mentioned above, several of these do not require action by a private landowner. In instances where action is required, the items have been “called out” below. For those that do not require action by a private landowner, similar to natural resources, actions that promote cultural resource protection and preservation are encouraged.

The hiring of a professional archaeologist and historian (qualifications can be found at http://www.cr.nps.gov/local-law/arch_stnds_9.htm) to study and review permitted projects in an effort to identify archaeological and architectural resources and consider potential impacts to these historic properties is one way to further preservation per state statute, if done in consultation with the Minnesota State Historic Preservation Office and the State Archaeologist.

Chapter 138

Minnesota Field Archaeology Act (MS 138.31-138.42) establishes the office of the State Archaeologist; requires licenses to engage in archaeology on nonfederal public land; establishes ownership, custody and use of objects and data recovered during survey; and requires state agencies to submit development plans to the State Archaeologist, the Minnesota Historical Society (MNHS) and the Minnesota Indian Affairs Council for review when there are known or suspected archaeological sites in the area.

Under MS 138.40, Subd. 3, agencies controlling said lands must submit plans to the State Archaeologist and the MHS for review of developments on their lands where archaeological resources are known or scientifically predicted to exist. The State Archaeologist and MNHS have 30 days to comment on the plans. “Land” means land or water areas owned, leased or otherwise subject to “the paramount right of the state, county, township, or municipality” where archaeological resources are or may be located. For industry projects that propose use of state agency land, the state agency needs to comply with the statute.

Minnesota Historic Sites Act (MS 138.661-138.669) establishes the requirement that state agencies and political subdivisions have a responsibility to protect historical/architectural resources . This section also defines the State Historic Sites Network and the State Register of Historic Places, and requires that state agencies consult with the State Historic Preservation Office (SHPO) at the MNHS before undertaking, funding or licensing projects that may affect properties on the Network or on the State or National Registers of Historic Places. Before carrying out any undertaking that would affect designated or listed properties, or funding or licensing an undertaking by other parties, the state department or agency must consult with the MNHS pursuant to the society's established procedures to determine appropriate treatments and to seek ways to avoid and mitigate any adverse effects on designated or listed properties. If the state department or agency and the MNHS agree in writing on a suitable course of action, the project may proceed.

Chapter 307.08.: Private Cemeteries Act

The Private Cemetery Act (M.S. 307.08) affords all human remains and burials older than 50 years and located outside of platted, recorded or identified cemeteries; protection from unauthorized disturbance. This statute applies to burials on either public or private lands or waters. The law defines what actions are felonies or gross misdemeanors related to private cemeteries. As required under Subd. 10, state or political subdivision controlling the lands or waters or, in the case of private lands, the landowner or developer, should submit construction and development plans to the state archaeologist for review prior to the time bids are advertised and prior to any disturbance within the burial area if identified. In most situations, agencies and landowners or private developers do not know where sites are located and they do not have the in-house ability to scientifically predict where sites could be located. To proactively predict the presence of sites LGUs could require a project proposer hire professionals to conduct a scientific assessment for use during project scoping and conceptual site planning to avoid effect. *It is important to note that MS 307.08 requires all levels of government and private landowners and developers to comply with the statute, unlike Field Archaeology and Historic Sites, which do not.*

Effective Practices

The most effective way to use the current non-federal environmental review process to protect historic properties in Minnesota pertaining to silica sand activities is to provide local governments with the tools to determine if projects within their jurisdiction have the potential to harm historic properties.

With regard to archaeological resources, the State Archaeologist estimates that less than 1% of sites are recorded, the official archaeological inventory for Minnesota. Thus agencies need to not only assess the impacts to known sites, but to locations that are "scientifically predicted" to contain sites assuming that 99+% of Minnesota's sites are have not been discovered. Direct access to the State Archaeologist's database would provide agencies with known site locations, but should not be provided to staff that are not profession archaeologists or to the general public as it may encourage illegal activities such as trespassing, vandalism, and burial site disturbance.

Regarding historic/architectural resources the SHPO maintains the state's inventory of historic buildings, structures, and landscapes. This list is much more complete than the archaeological inventory because the locations of most history-architecture properties can be recorded by simply viewing and/or doing archival research. In the 1970s and 1980s, the SHPO conducted intensive surveys of historic standing structures statewide. This inventory is constantly being added to and updated with information on newly identified historic properties through federal and state project reviews and local preservation efforts. There is less concern for data privacy for this database.

The first step in a historic properties impact review should always be to first contact the SHPO and the State Archaeologist to get a list of known properties and ask them for their recommendations with regard to the potential for un-inventoried historic properties, assessing impacts to known properties, and the need for a more intensive literature search or even actual site survey.

To expedite and inform permitting agencies, it is encouraged that LGUs require an applicant hire professionals to conduct an historic properties assessment for use during project scoping and conceptual site planning to avoid potential effects to historic properties. The SHPO has archaeological and architectural/history survey guidance manuals which are available for use in completing these assessments.

Definitions on the terms used within this subsection are provided below for reference:

Archeological resource: any material remains or physical evidence of past human life or activities which are of archeological interest, including the record of the effects of human activities on the environment. They are capable of revealing scientific or humanistic information through archeological research.

Cultural resource: an aspect of a cultural system that is valued by or significantly representative of a culture or that contains significant information about a culture. A cultural resource may be a tangible entity or a cultural practice. Tangible cultural resources are categorized as districts, sites, buildings, structures, and objects for the National Register of Historic Places and as archeological resources, cultural landscapes, structures, museum objects, and ethnographic resources for NPS management purposes.

Historic resource (may include historic landscapes, sites or districts) defined as:

Historic landscape: a cultural landscape associated with events, persons, design styles, or ways of life that are significant in American history, landscape architecture, archeology, engineering, and culture; a landscape listed in or eligible for the National Register of Historic Places.

Historic site: the site of a significant event, prehistoric or historic occupation or activity, or structure or landscape whether extant or vanished, where the site itself possesses historical, cultural, or archeological value apart from the value of any existing structure or landscape; see cultural landscape.

Historic district: a geographically definable area, urban or rural, possessing a significant concentration, linkage, or continuity of sites, landscapes, structures, or objects, united by past events or aesthetically by plan or physical developments. A district may also be composed of individual elements separated geographically but linked by association or history.

Historic/archeological resources: Resources as defined above.

c. List of Silica Sand Project Potential Impacts

Potential impacts are similar for both the Minnesota River Valley and Paleozoic Plateau geographic regions under consideration.

Potential Direct Impacts:

- Direct disturbance, destruction, demolition, moving or physical alteration of an historic property.

Potential Indirect Impacts:

- Impacts to access, increase in traffic, noise, dust, vibration, atmospheric and visual impacts, including adverse impacts to the setting and changes in use of an historic property;
- Also includes reasonably foreseeable cumulative impacts of all of these.

d. Recommendations, Standards, Criteria, Considerations

While Minnesota statutes regarding historic properties are more prescriptive on the process that state agencies are required to follow, political subdivisions are still required to “protect the physical features and historic character of properties designated in Sections 138.662 and 138.664 or listed on the National Register of Historic Places...” (MS 138.665). To protect and preserve historic properties from potentially negative impacts associated with silica sand mining and related activities in both the Minnesota River Valley and the Paleozoic Plateau geographic regions, the LGUs could consider requiring the following in local permitting.

1. For review of developments on lands where archaeological resources are known or scientifically predicted to exist, require a project proposer hire a professional consultant to conduct an archaeological assessment to determine if known or suspected sites are present and if consultation with SHPO and OSA should occur.
2. Regarding historic/architectural resources, require a project proposer hire a professional consultant to conduct a history/architectural assessment to identify historic properties and assess potential effects to properties as a result of silica mining activities. If historic properties are identified, consultation with SHPO should occur. Since M.S. 307.08 applies to all levels of government and private land owners, on all projects, the LGUs should consult with the State Archaeologist to determine if known or suspected burials are present, and to work through the appropriate steps under that statute if burials are present.
3. LGUs should be aware of local preservation and land use ordinances that may require local review of project activities and require project proposers to follow the local requirements for those ordinances.

Additional Resources

Minnesota State Historic Preservation Office

<http://www.mnhs.org/shpo/>

SHPO Survey & Inventory Information

<http://www.mnhs.org/shpo/survey/index.htm>

SHPO Federal and State Compliance Information
<http://www.mnhs.org/shpo/review/index.htm>

Minnesota Office of the State Archaeologist
<http://www.osa.admin.state.mn.us/>

Advisory Council on Historic Preservation
<http://www.achp.gov/>

Advisory Council on Historic Preservation: Section 106 Toolkit
<http://www.achp.gov/apptoolkit.html>

National Historic Preservation Act
<http://www.achp.gov/nhpa.html>

National Register of Historic Places
<http://www.nationalregisterofhistoricplaces.com/>

Minnesota Field Archaeology Act
<https://www.revisor.mn.gov/statutes/?id=138.31>

Minnesota Historic Sites Act
<https://www.revisor.mn.gov/statutes/?id=138.661>