

Silica Sand Mining in Wisconsin

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1.0 Introduction

Sand mining has occurred in Wisconsin for hundreds of years; however, recently there has been a dramatic increase in the number of mining proposals. This increase is attributed to a surge in *hydrofracking*, a technique used by the petroleum industry to extract natural gas and/or crude oil from rock formations, which requires a certain quality of sand in the process. Wisconsin possesses high-quality sand resources and therefore is seeing a substantial rise in mining permit requests to mine for *frac sand*. Consequently, the topic of sand mining in Wisconsin has generated interest from regulators, legislators, local government, and the general public.

2.0 Purpose of this document

This is an informational document that summarizes our best current information on the mining process, possible environmental impacts, and applicable regulations. There are no oil or gas wells located in Wisconsin, thus this document does not address the effects of the hydrofracking technique. This document is intended to be a dynamic document and will be updated periodically as new significant information becomes available.

3.0 Background Information Hydrofracking, Frac Sand and Frac Sand Mining in Wisconsin

3.1 What is Hydrofracking?

Hydrofracking is also referred to as *hydraulic fracturing* or *fracing*. The technique involves drilling a typical oil or natural gas well thousands of feet below the earth's surface and using explosives to create small cracks in the rock. Then water, frac sand, and chemicals are pumped under high pressure into the well for the purpose of expanding the cracks and holding them open. By fracturing the rock and then holding these fractures open it is possible to more easily remove the resources sequestered in the rock. Hydraulic fracturing has been around for over 60 years but recent developments in directional boring and other technologies in combination with hydraulic fracturing now allow for the extraction of natural gas and oil that was previously not extractable. Use of these techniques has also made it more economical to extract oil and gas from formations that were previously too expensive to mine. Because of this, there has been a large increase in hydraulic fracing and thus an increase in demand for frac sand. Most of the natural gas shale rock wells are located in Texas, Oklahoma, Mississippi, Arkansas, New York, North Dakota and Pennsylvania.

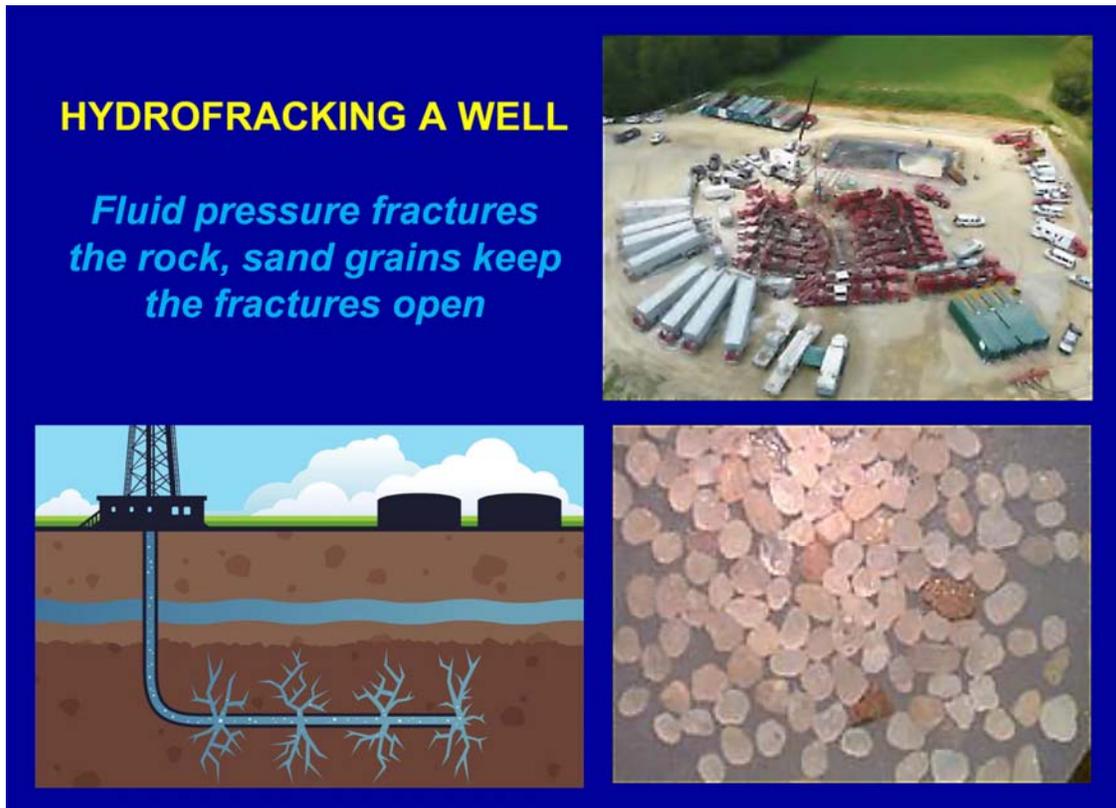


Figure 1, Clockwise: Trailers of sand and compressor trucks around a well during a hydrofrac job. Lower right, well rounded pure quartz sand typical of Wisconsin Cambrian sandstones. Lower left, basic principles of hydrofracking. Fracturing low permeability gas bearing shale with fluid pressure, sand is injected as a proppant to hold fractures open and allow gas to flow from rock.

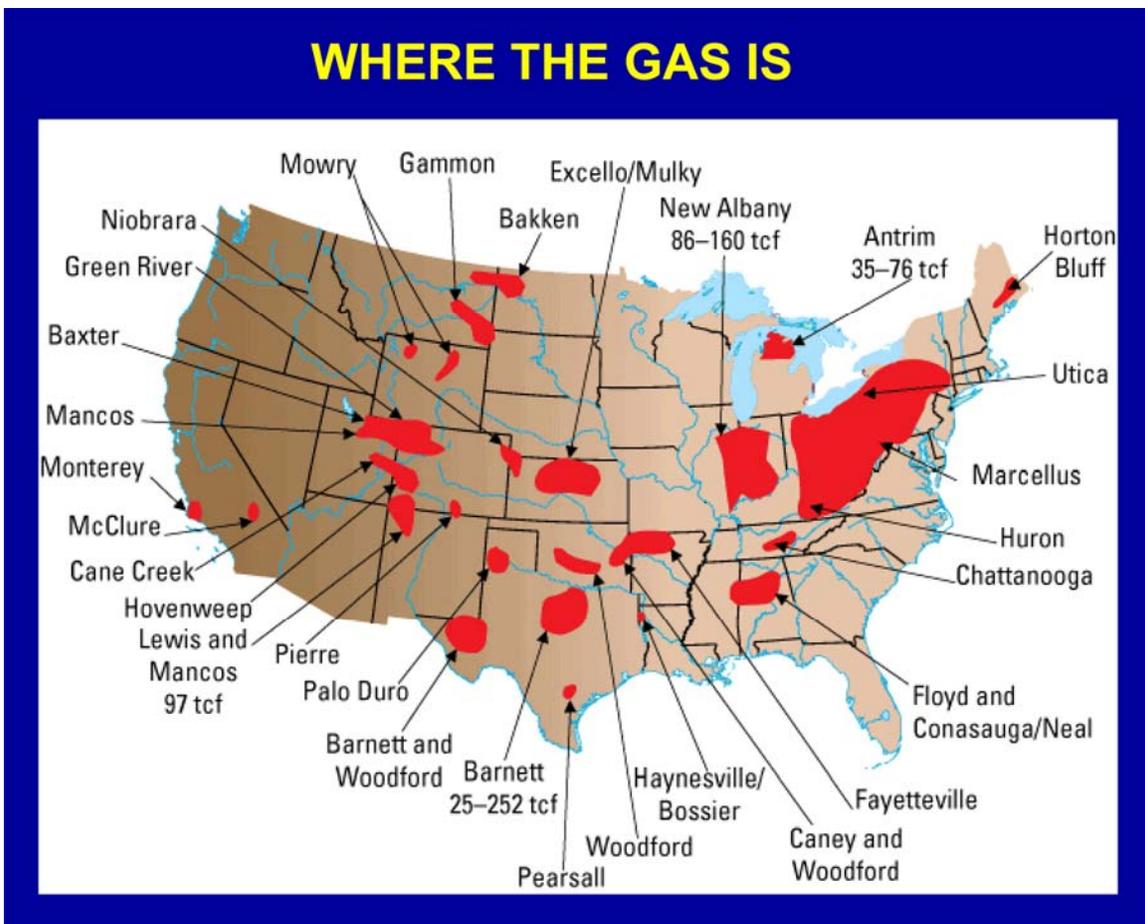


Figure 2, Locations of major shale gas resources (American Petroleum Institute)

3.2 What is Frac Sand?

Frac sand is silica sand or silicon dioxide (SiO_2), also referred to as quartz. Silica sand has been mined for thousands of years as it has many uses, from paving roads to filtering drinking water. It is also used in the hydrofracking process: fluid pressure fractures the rock and opens natural fractures and pores that would normally be closed due to the weight of the overlying rock, the sand grains are then carried into these fractures and prop them open after the fluid pressure is released. Hence the name *proppant*; a term commonly applied to frac sand.

Not all silica sands can be used for hydrofracking. To meet the industry specifications, frac sand needs to be nearly pure quartz, very well rounded, and must meet tight size gradation standards. The sand must also have a high compressive strength, generally between 6,000 psi and 14,000 psi. Sands that meet these specifications are mined from poorly cemented Cambrian and Ordovician sandstones and from unconsolidated alluvial sands locally derived from these sandstones. Sands derived from Quaternary glacial deposits, and most beach and riverbank sands are too impure and too angular to be used as frac sand. Wisconsin has areas which contain high-quality silica sands which are desirable for use in hydrofracking.

3.3 Sand Mining in Wisconsin

Wisconsin has abundant resources of sand that range in age from Quaternary glacial deposits to marine sandstones of Cambrian age (500 million years). Sand has been mined in Wisconsin since the arrival of the first permanent settlers. The oldest continuing use has been as fine aggregate for mortar and concrete. Molding sand has been mined since the beginnings of the foundry industry in the 19th century. Sand has also been mined for filter beds for drinking water and wastewater treatment, well screen packing, glass manufacture, and bedding sand for dairy operations.

Frac sand for use in the petroleum industry has been produced in Wisconsin for over 40 years. However, the demand for frac sand has increased exponentially in the past two to three years. Wisconsin has approximately 60 mining operations involved in extraction of frac sand and approximately 30 processing facilities operating or under construction. Current mining operations are primarily located in West Central Wisconsin but there are also facilities in Burnett, Green Lake and Waupaca Counties. This does not include very small operations or the frac sand being removed and sold as a result of excavations associated with cranberry culture.

A conservative estimate of Wisconsin frac sand mining capacity based on existing mines, mines under construction, and processing plants would be in excess of 12 million tons per year. Currently there are approximately 20 new mining operations being proposed and the impacted counties report considerable interest and many mine and processing plant proposals are under consideration.

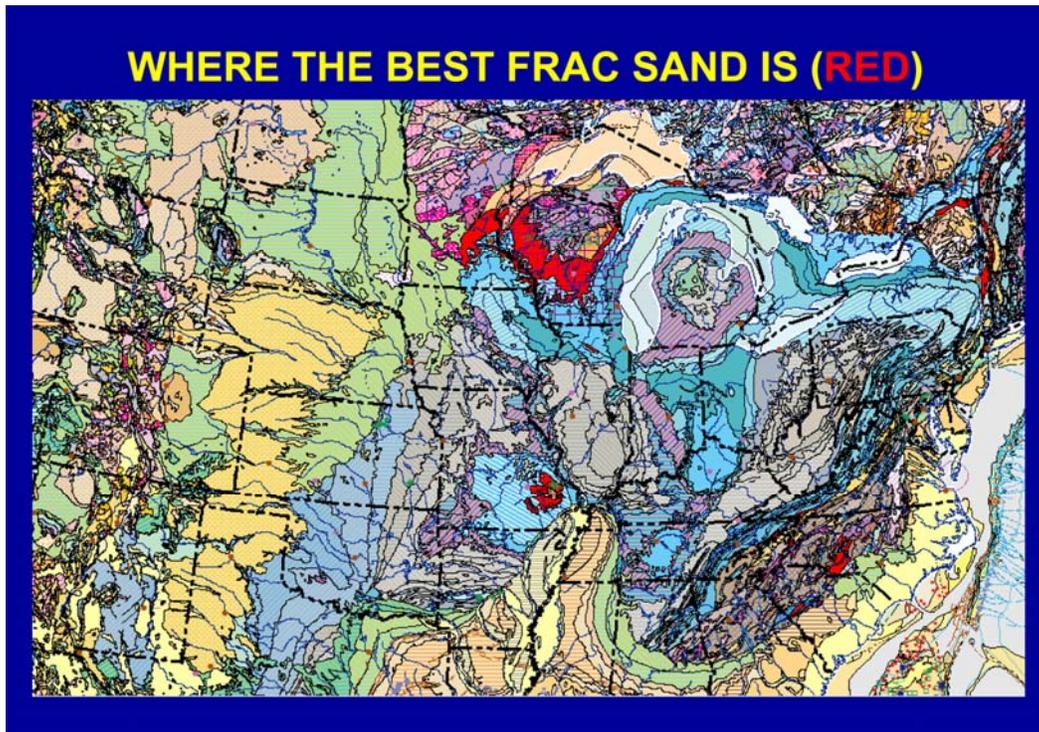


Figure 3, Outcrop areas of Cambrian quartz sandstones (*USGS Geologic map of the U.S.A.*)

3.4 Location of Frac Sand in Wisconsin

Sand that will meet frac sand specifications is found in the Cambrian: Jordan; Wonewoc; and Mt. Simon Formations; and in the younger Ordovician-age St. Peter Formation (Figure 4 and 5).

Principal areas of interest for sand mining have been in western Wisconsin, from Burnett and Chippewa Counties in the north to Trempealeau, Jackson and Monroe Counties in the south.

Activity in the north, primarily in Barron and Chippewa Counties has concentrated on mining Jordan Sandstone from exposures on hilltops, and on mining Wonewoc Sandstone on lower hillsides. The lower part of the Jordan Formation, the Norwalk Member, and the underlying St. Lawrence dolomite and Tunnel City sandstones are too fine grained and contain impurities such as feldspar which make them unsuitable for use as frac sand.

In Pierce County, Jordan Sandstone (the upper coarser grained Van Oser member) has been mined underground for many years from tunnels driven into the bluffs beneath the Prairie du Chien Dolomite. The fact that the Van Oser Member is near the top of the Jordan has created interest in mining it from the floor of depleted Prairie du Chien dolomite quarries on ridge tops in Dunn, St. Croix, and Buffalo Counties.

BEDROCK SAND RESOURCES

Cambrian Wonewoc Fm.

Important producer and potential resource in west, not exposed elsewhere.

Cambrian Jordan Fm.

Extensive potential in west, currently important source of fracsand from underground mines. Poor exposure in east.

Ordovician St. Peter Fm.

Long production history and good potential in south and east. Channels can make prospecting a challenge in the northeast.

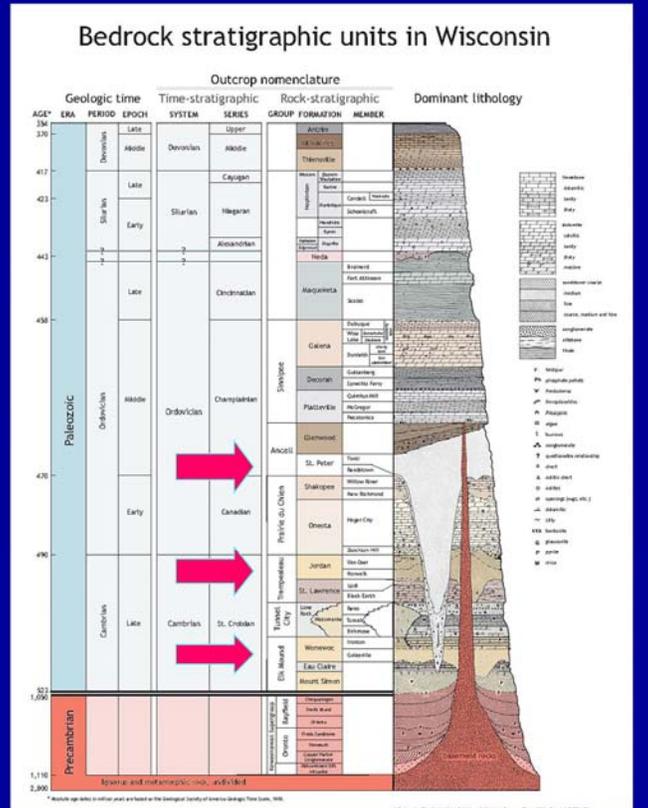


Figure 4, Stratigraphic column for Wisconsin showing position of Cambrian and Ordovician sandstones mined for frac sand. (WGNHS Educational series 51, 2011)

GEOLOGY AND SAND PRODUCTION SITES IN WEST-CENTRAL WISCONSIN

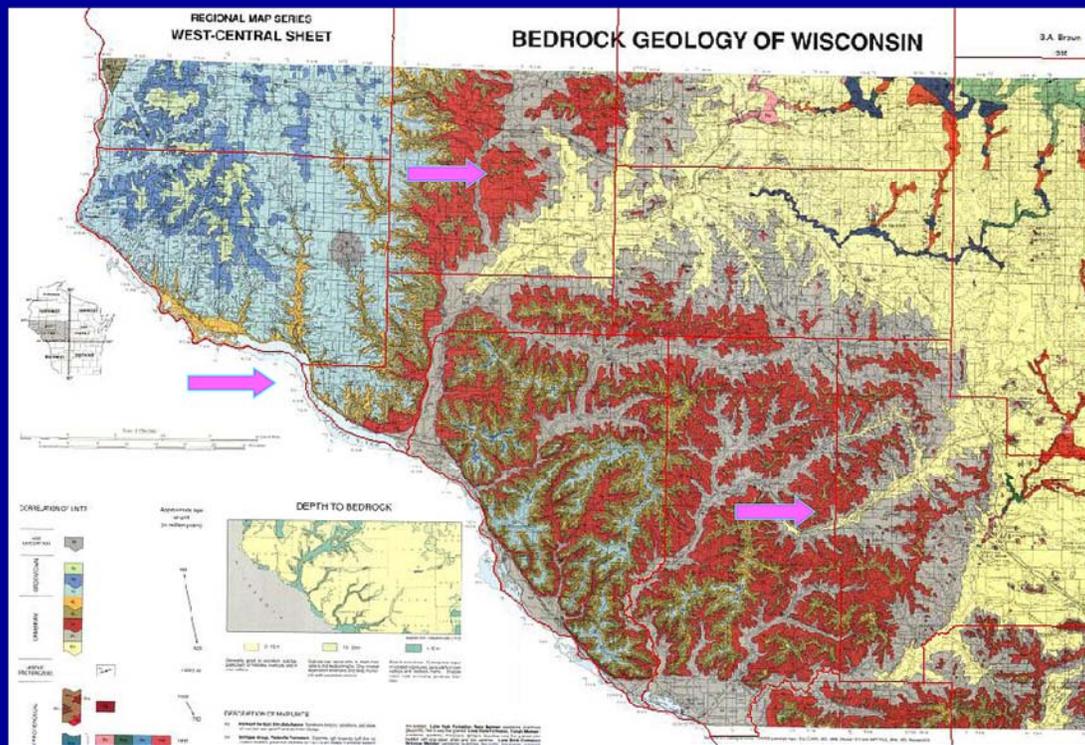


Figure 5, Regional geologic map showing Cambrian sand outcrop area in yellow and St. Peter Sandstone in green in west-central Wisconsin. (From USGS Geologic Map of USA)

Figure 5 shows the distribution of the formations that are targets for frac sand development in western Wisconsin. The rocks are essentially flat lying, with a slight dip to the west. The pattern on the map is due to erosion that has cut down through the layers, exposing the older rocks in the valleys. This is the coulee topography typical of the Driftless area, a region of Wisconsin not covered by the Quaternary glaciers.

The Jordan Formation forms a narrow outcrop band on the upper slopes of the ridges, and is exposed in the valleys of southern Pierce County and along the western side of the Chippewa Valley. The Wonewoc forms a wider outcrop area on the lower slopes.

Most new mines under development or proposed in Trempealeau, Dunn, Buffalo, Jackson, and Monroe Counties are in the Wonewoc. The Wonewoc is finer in average grain size than the Van Oser Member of the Jordan, but high purity makes some of the material that is too fine for frac sand suitable for the glass industry. Although the Wonewoc has more material not suited for frac sand, it is easier to mine in the southern region because of the much greater surface exposure, which eliminates the need to mine underground.

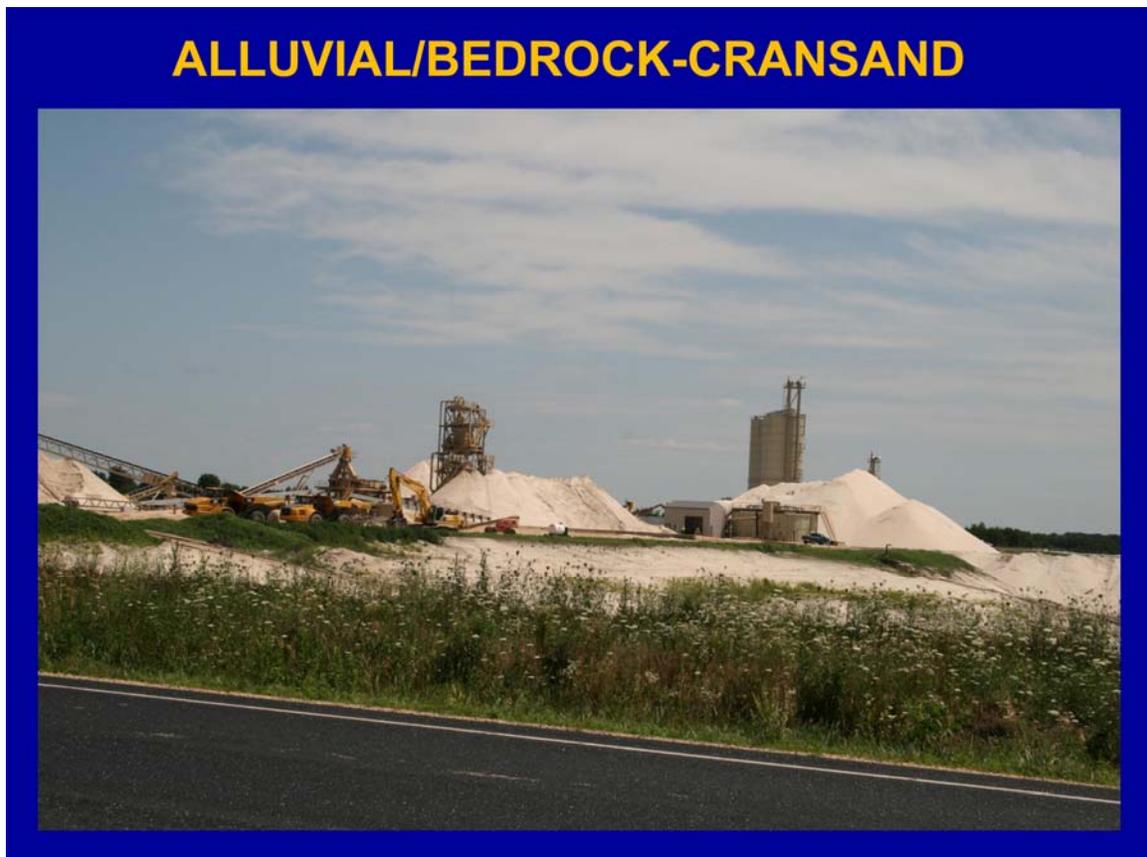


Figure 6, Sand mine in the cranberry growing area of Monroe County. Sand is part bedrock and part alluvial sand derived from weathering local bedrock. (Photo by B.A. Brown, WGNHS)

4.0 A Typical Sand Mining Operation

Although there is a great amount of variability in how sand is mined, this section describes a typical sand mine and sand processing plant. Note there are several mining facilities in operation and several proposed that mine or would mine below the groundwater level utilizing hydraulic dredging to remove the sand. The overview of the sand mining process provided below is descriptive of a more common dry mine although in both cases many of the same additional processing steps would take place with both mining methods.

4.1 OVERBURDEN REMOVAL/EXCAVATION

Prior to any actual mining being done at a site, it is necessary to remove overburden from the top of the sand formation. Overburden is topsoil or subsoil that is mainly composed of silt, loam, clay, or combinations of the three. Overburden thickness is highly variable, but as has been stated above, a desirable trait of Wisconsin's frac sand formations is that they are close to the surface, meaning there is little overburden to remove.

Removal is performed by scrapers or tracked excavators and off-road haul trucks. The overburden is often hauled to the perimeter of the mine site and piled into berms. Topsoil is kept separate and used on top of the berms once they have reached their final elevation. Finally the berms are seeded and mulched. The berms have multiple purposes; they provide storage for overburden until the mine is reclaimed, they provide a visual barrier between the active mine and roads or adjoining properties, they screen light pollution should the mine be operated after dark, and they act as a noise barrier.

4.2 EXCAVATION

Once the overburden has been removed, the sand is excavated. Depending upon the geological formation, blasting may be used to make the sand containing material more amenable to excavation. Excavation is typically performed by large tracked excavators or rubber-tired front end loaders. The excavated material may be taken directly to the washing process, stockpiled on site for later processing, trucked to a processing facility or trucked to a rail load-out where it would be taken by rail to a processing plant. Stockpiles may be formed by conveyors, or trucks may deposit the sand in a pile and a dozer or rubber-tired loader will push the sand, gradually building a large pile that the trucks drive on top of to deposit more sand.

4.3 BLASTING

In situations where the sand-bearing geological formation is tightly cemented it may be necessary to utilize blasting to make the sand more amenable to removal. Blasting practices can result in noise, vibration, and fugitive dust emissions. Blasting at mines will vary with site specific geology. It may be conducted as frequently as every day or only once every few months.

It is difficult to describe an average blast scenario since it is specific to each mining operation and the particular geological formation. An example of typical sand mine blast might consist of drilling 40 holes, 2 to 3 inches in diameter into the formation to be blasted. The holes could be 50 to 150 feet deep and located in a grid 20'x 20' (example only). A charge of explosive (types of explosive vary depending upon the intended result of the blast) is placed at the bottom of the hole. A detonation cord is connected and run to the top of the hole. The space between the charge and the top of the hole is filled with stemming material. Stemming material is an inert material used to backfill a borehole for the purpose of containing the explosive energy. The stemming material also acts to minimize fugitive dust (airblast) emissions from the explosion. The type of stemming used is dependant on what is readily available at the mine site and may be composed of such things as sand or crushed rock. After the stemming material has been placed a blasting cap is attached to the detonation cord and all of the blasting caps are connected to a detonator. In modern blasting techniques the detonators are typically electronically sequenced to detonate individual blasting caps milliseconds apart. This sequencing improves the effectiveness of the blasts and reduces off site vibrations, minimizing impacts to nearby structures.

Federal Mine Safety and Health Administration (MSHA) rules require the use of water injection when drilling the blasting holes in order to control drilling dust. Prior to drilling, sand mine operators usually remove overburden, which also lessens the amount of fine material that can become airborne by blasting. If needed during summer periods, water may also be sprayed onto blast areas to minimize fugitive dust emissions.

Impacts to nearby neighbors from blasting can be minimized by using proper blasting techniques, notifying neighbors of blasts, and limiting blasting to daylight hours.

The Wisconsin Department of Safety and Professional Services regulates blasting activities. Blasting regulations in Wisconsin are found in SPS 307, Wis. Adm. Code. SBS 307 regulates licensing of individuals involved in blasting activity, allowable blasting explosives and methods, recordkeeping of blasts, notification of neighbors, monitoring of seismic and airblast energy and sets allowable seismic and airblast energy limits. This code applies to all nonmetallic mines including frac sand mine sites

The State Mine Safety program is also administered by the Department of Safety and Professional Services. Their charge is to inspect mining operations, training, complaint response enforcement of state code and liaison with federal Mine Safety and Health Administration (MSHA).

4.4 CRUSHING

If the formation is of such a nature that it requires blasting, it is likely that the material will then need to be crushed to reduce the size of the particles for later handling. After blasting, the sand is in a mix of rocks and boulders on the floor of the mine. This material is often referred to as *shot rock*. A mobile crushing unit is brought to the mine and is placed close to the blast area in order to minimize the distance the shot rock needs to be hauled to be loaded into the crusher. Larger mines may have a permanently placed crushing plant. In these cases the shot rock is either conveyed or hauled to the crusher by haul trucks loaded by front end loaders or large excavators.

Crushing plants are usually composed of a primary crushing unit and a secondary crusher with a screen plant. Crushing plants are powered by either a large diesel engine, or by a generator. The shot rock is picked up by front end loaders from the blast area and carried to the primary crusher. The primary crusher breaks the shot rock into what is referred to as *breaker run*. Breaker run is conveyed to the secondary crusher where it is further broken down. The resulting material is fed to a screen plant where it is sorted by size. Smaller particles of a targeted size are carried away to stockpiles. Larger particles are recycled within the plant to the secondary crusher and screens until they have reached the desired size.

4.5 PROCESSING

To be used for the hydrofracking technique, sand usually has to undergo further processing. Frac sand, as has been stated above, must be of uniform size and shape. To achieve this uniformity the sand is run through a processing plant. The plant will wash, dry, sort, and store the sand.

The sand is washed to remove fine particles. Washing is done by spraying the sand with water as it is carried over a vibrating screen. The fine particles are washed off the sand and the coarse particles are carried along the screen by the vibration. Some processing operations also use what is called an upflow clarifier to wash the sand. An upflow clarifier is essentially a tank where water and sand are continuously directed into the tank. The water washes the sand and the overflow water along with the fines overflow the tank while the washed sand falls by gravity to the bottom of the tank and is sent for further processing.

After washing the sand is then sent to a surge pile where much of the water adhering to the sand particles infiltrates back into the ground. In Wisconsin the wet portion of the processing facilities typically runs from April to mid November. The drying portion of the process can operate year round thus necessitating stockpiling of washed sand adequate to last through the winter processing months.

From the surge pile the sand is sent to the dryer and screening operation. The sand may be dried by feeding it into a large rotating drum. This drum has hot air blasted into it by burning natural gas or liquid propane. Fins inside the drum agitate the sand and carry it forward through the dryer. When it reaches the end of the drum the sand is cooled and may be further sorted by screening. Another newer drying technology is the fluidized bed dryer. Sand is introduced into the dryer and heated gas from combustion of natural gas or propane is introduced through holes in plates in the bottom of the dryer. This gas lifts or fluidizes the sand and the heated gas dries the sand. Once the sand is dried it is cooled and may be further sorted by screening. This sorting is performed so that sand particles of similar sizes may be selected and stored. Sand that is suitable for fracking is kept, and sand that is not suitable may be sold to industry for other uses that have been listed above.

Some specialized processing plants may further treat the sand by applying a resin coating to the sand particles. This coating helps the sand to flow as a slurry, and increases the crush strength.

Processing plants may be located on the same site as the mine or in some cases the processing plant is located separate from a number of mines which support the processing facility. In the later scenario the sand is transported to the processing plant by dump trucks or tractor-trailer units.

4.6 TRANSPORTATION

Transportation of sand from the time it is mined, processed, and eventually delivered to the location where it is going to be used can take many forms depending upon the location of the mine, the processing facility and the destination where the sand will ultimately be used. Within the mine the sand may be transported by front end loaders, large open-topped off-road trucks, or dump trucks. Open-topped dump trucks and closed gondola compartmentalized trucks (similar to grain trucks) are currently being used to transport sand directly to rail spurs for shipment or to processing facilities.

Vehicular traffic on local roads will have an impact on the service life and condition of the roads. The degree of road deterioration will depend on the amount of traffic, the type of vehicles, and the design of the road.

Rail currently seems to be the preferred method of transporting sand from the mine or from the processing plant to the location of final use. Most of the rail cars being used are open-topped, while some are compartmentalized bottom unloading gondola type cars. Reportedly one operation is trucking sand to Minnesota where it is being processed, then this sand is loaded onto barges and transported to market down the Mississippi River.

4.7 RECLAMATION

NR 135 Wis. Adm. Code requires all counties in the state of Wisconsin to implement a nonmetallic mining reclamation permit program including adoption of an ordinance and administration of a mining reclamation program. The purpose of this program is to assure mining sites are reclaimed to a post mining land use. Nonmetallic mining permits are subject to uniform reclamation standards that are provided in NR 135 Wis. Adm. Code.

NR 340 Wis. Adm. Code is administered by WDNR and it also has reclamation requirements. This law applies to a mine or portions of a mine that are adjacent to navigable waterways.

Because large frac sand mines are designed to be mined and reclaimed in phases there will, in most cases, be on-going contemporaneous reclamation. In any case, when the supply of sand at the mine site has been exhausted, the mine owner/permittee is required to reclaim the mine area. Mine reclamation is administered by the county regulatory authorities (RA) where the mine is located. There is some variation in what counties require for reclamation, but generally the site will be graded so that slopes do not exceed a 3:1 slope. This generally applies to slopes that will receive topsoil or substitute plant growth material but steeper slopes may be approved by the RA based on test plots or other justification. Vertical or near vertical highwalls may be approved by the county RA, if shown to be safe and stable, or if the highwall was in existence before NR135. Once grading is complete the site will have topsoil applied, and then be seeded and mulched. In some instances a mine will be converted to a building site or a farm field.

Mine owners are required to provide the RA with a bond or some other form of financial assurance as a condition of the NR 135 permit. The financial assurance must be in place prior to initiating mine development activities and must be payable to the county RA. This ensures that should an operator fail to fulfill their obligation under the reclamation plan that the County will have sufficient funding available to carry out the approved reclamation plan. It is important that County RAs periodically check to ensure that the dollar amount continues to be adequate to perform all reclamation activities necessary to comply with the uniform statewide reclamation standards in NR 135, the county reclamation ordinance, and the approved reclamation plan.

5.0 Environmental Impacts

The environmental impacts of a sand mining facility will vary by location and type of operation. This document summarizes the types of impacts that could occur.

5.1 AIR IMPACTS

Nonmetallic mining sites and frac sand processing facilities have two types of air emissions. The first is from dust that may be emitted during the mining and handling of sand. The second is from various pollutants emitted from equipment used to mine, handle, and/or process the sand.

Each mine and/or processing plant may differ within the industry. An industrial sand mine may consist of the following operational equipment:

- Blasting
- Overburden Removal and Excavation
- Backfilling
- Crushers
- Pumps
- Washing
- Stockpiles
- Conveyors
- Loading/Unloading
- Mobile Equipment Traffic
- Generators (Electrical Generating Units)

The processing of sand may consist of the following operational equipment, which could also include those processes identified above for mining operations:

- Conveyors
- Dryers
- Screening
- Storage Bins/Silos
- Loading/Unloading

Each subsection below includes an evaluation and explanation of air emissions and potential regulations as it applies to each part of the construction phase or operation.

5.1.1 Construction Impacts

No major air impacts are expected during site development. Excavation and earth work is anticipated for planned new facilities. Fugitive dust during construction would be minimized by BMPs which include paving or placing gravel on access roads and watering down roads or work areas with tanker trucks as needed. Diesel emissions from construction equipment would be temporary and minor.

5.1.2. Operational Impacts

5.1.2.1 Blasting

Depending upon the geological formations, blasting may be used to make the sand more amenable to removal. Blasting activities are likely to be performed on an intermittent basis at mining sites. Air pollution emissions related to this activity are commonly considered fugitive in nature and insignificant, and may be controlled through various methods.

Mining operators would be required to maintain a fugitive dust prevention plan, whereby methods to minimize fugitive dust emissions resulting from blasting operations would be described and followed. The WDNR can review, make suggestions, and approve these methods and typically facilities will work with their surrounding community on awareness of such events. Materials used in blasting are also regulated by the department or the department of industry, labor and human relations.

Allowable fugitive dust emissions from blasting are covered by the facility's air management permit issued by the WDNR and are limited to 10% opacity. Opacity is defined as the degree to which emissions reduce the transmission of light and obscure the view of an object in the background. Limited observation at existing mine sites by WDNR inspectors has shown fugitive dust emissions from blasting are not significant.

5.1.2.2 Overburden Removal, Excavation, and Crushers

The removal and protection of topsoil and subsoils that lie above the target sandstone is typically required through NR 135 reclamation permits when a new mine or phase of a mine is opened during mine expansion. This work may be accomplished by using hydraulic excavators, trucks, dozers, and scrapers. Extraction is performed by front-end loaders in less consolidated deposits while blasting is required in others. When blasting is necessary, the process begins by drilling holes into the sandstone in order to allow breaking it into smaller more workable pieces by blasting with explosives (see Blasting section above). Materials will then be excavated by front-end loaders and, depending on the conglomeration of such material, a crusher unit may be utilized to further reduce particle size. Resulting materials would then be conveyed, likely by slurry transport, to further processing (see Pumps and Washing sections below). The soils are typically stored and protected in stockpiles or vegetated berms.

Air pollution resulting from this activity would include minor combustion emissions from equipment and fugitive dust (particulate). Combustion emissions are typically considered insignificant per s. NR 407.05(4)(c)9.f. Wis. Adm. Code. Those emissions may be minimized through routine maintenance of equipment to operate most effectively and efficiently. Water trucks or recycled water from the pumps and slurry system (washing operations) may be used to eliminate fugitive dust concerns during removal and excavation. Water bars or other wetting techniques may be used to minimize dust from crusher units. Soil stockpiles are seeded and mulched for revegetation as soon as the season's work is complete, which helps minimize and eliminate fugitive dust.

These activities are typically located further within the mine area rather than near property boundaries. Therefore, it is uncommon for fugitive dust to escape off-site except during periods of strong winds and dry conditions. BMPs and fugitive dust control plans are utilized to minimize fugitive dust. These practices or plans are requirements under NR 415 Wis. Adm. Code, with specific requirements for industrial

sand mines under s. NR 415.075(6), Wis. Adm. Code, for mines that produce 2,000 tons per month or more. Facilities that implement such practices and/or plans reduce potential impacts to public health, and are subject to review and approval by the WDNR and may be made available to the public upon request.

Finally, any facility that operates a crusher unit is subject to the New Source Performance Standards (NSPS) under s. NR 440.688, Wis. Adm. Code. These units would be subject to a limitation of no greater than 15% opacity. Since most crushers do not utilize any capture system associated with their operation/emissions, the unit is considered a fugitive source of emissions. Beyond the requirements of the NSPS, the unit would also be covered by the fugitive dust prevention plan (previously discussed above).

5.1.2.3 Pumps and Washing

Some facilities utilize a slurry pump and washing system to further prepare the sand for storage, drying or loading (transport). Once the mined sand is collected and has gone through a crusher (if required), the sand is converted to a slurry by the addition of water typically provided by a closed-loop (onsite water reuse). A slurry system may require approximately 3,000 gmp of water (this can differ greatly depending on the type of slurry system utilized at each site). To the extent possible, water will be conserved and recycled by means of a settling pond. Please refer to the Storm water/Wastewater section for more information regarding wastewater discharge.

Processing is conducted with equipment which may include screening, hydrocyclones and other wet processing methods. Flocculents (chemical additives) may be used to treat colloidal clays. The materials (mainly sand) processed are within a closed-loop system, and are wet. Therefore, there will be very minimal, if any, associated air pollution emissions from this process; and this is typically considered an insignificant activity. Finished sand from the wet process will be a coarse graded material that will be stored in a stockpile.

5.1.2.4 Stockpiles

Stockpiles seen at mining or processing sites typically contain the coarse sand raw material that will eventually be fed to a dryer. The stockpiled sand is typically wet at first, but then may dry out as it sits in the open environment. Moving sand from the stockpiles and to a dryer is usually done with front end loaders and material conveyors. Please refer to the conveyor section below for more information on that activity.

Air pollution resulting from this activity would include fugitive dust (particulate). Operators would be required to maintain and follow a fugitive dust prevention plan. Depending on the processing steps taken prior to stockpiling, the grain size of the sand in the stockpiles are typically larger than PM (PM, or particulate matter, is defined as any airborne finely divided solid or liquid material with an aerodynamic diameter smaller than 100 micrometers); especially if hydrosizers are utilized during the washing phase.

5.1.2.5 Loading/Unloading – Mining Operations

Loading operations at a mine may include the transfer of raw materials into trucks or railcars for transport. Unloading operations at a mine may include the dumping of fines/reject sand brought from processing plants or other operations. Loading operations

may or may not be within an enclosed structure. Material is loaded in an enclosed structure to reduce fugitive emissions and/or assist in the capture and return of raw materials back into the process (less loss of material that could be used further down the process line). Unloading typically is done in the open environment as a fugitive source.

Activities resulting in fugitive emissions would need to follow a fugitive dust prevention plan, whereby methods to minimize fugitive dust emissions resulting from the activity would be described and followed. Such activities are considered significant and may be further regulated by specific emission limitations; whereby the limitations and compliance demonstration methods would be described by any air pollution control permit issued to the facility. Those operations that are captured and/or controlled would also be considered a significant activity, and would follow the same protocol for regulation as above.

5.1.2.6 Mobile Equipment Traffic (Fugitive Particulate & Diesel Particulate)

Mines and processing plants will include mobile equipment traffic on-site (e.g., front-end loaders, trucks, etc.). The WDNR does not account for mobile equipment emissions off-site, but has regulations for the minimization of fugitive dust that may apply to any transportation. Air pollution resulting from this activity would include minor combustion emissions from equipment and fugitive dust (particulate). Combustion emissions are typically considered insignificant per s. NR 407.05(4)(c)9.f., Wis. Adm. Code. Those emissions may be minimized through routine maintenance of equipment.

Roadway fugitive dust emissions, associated with truck traffic, may be controlled through BMPs included within a fugitive dust prevention plan. Control measures may include: (1) paving roadways, (2) spraying of water on dusty roads or sweeping of dust laden roadways, (3) utilization of a wheel wash or tire bath at the entrance/exit of the facility, (4) posting and maintenance of a low speed limit on paved or unpaved roads or other areas used by haul trucks inside the facility's property line, and (5) covering, treatment or securing of materials likely to become airborne from haul trucks during transport, prior to any transportation off site from the quarry or mine (precautions to prevent particulate matter from becoming airborne, according to s. NR 415.075(2)(a), Wis. Adm. Code).

Diesel exhaust emissions off-site are not regulated by stationary source air pollution control permits. Emissions from diesel exhaust specific to a facility/project are not directly included in an air quality dispersion modeling analysis. They are included indirectly through inclusion of background. Diesel exhaust (mobile source) emissions are included in the air quality dispersion model only as part of the background concentrations and are added to the total impact from the stationary source emission impacts and do show attainment of the ambient air quality standards. Federal EPA regulations apply to diesel engine manufacturers for the minimization of diesel particulate or other types of emissions, and consequently those emissions are not regulated by WDNR.

5.1.2.7 Generators (Electrical Generating Units)

Most mining operations include the utilization of an electrical generator to supply electricity to equipment such as pumps, conveyors, and crushers/screen plants. The generators typically combust diesel fuel. The engines usually have very short exhaust stacks and could have relatively high potential emissions if operated 24 hours per day, 7 days a week. However, most units do not operate year round and when operated at a

location within the mine within a timeframe established by the operator and WDNR, will attain and maintain ambient air standards.

Depending on the use and portable status of the units, several regulations (Federal and State) may apply, which would further minimize pollution and ambient air impacts. One common best management practice (BMP) to meet these standards is the firing of ultra-low sulfur diesel fuel, although this is not required by Federal law. Emissions from such units are included in the WDNR's air dispersion analysis (see section 5.1.3), which is used to establish permit requirements to assure attainment of ambient air standards.

5.1.2.8 Conveyors

Conveyors are used throughout the mine and processing plant. They are used to transport sand short distances to different operations on the sites or to stockpile material. Sand conveyed from the active mining area to storage piles is typically wet and would not require any further BMPs. However, sand conveyed from the storage piles to further processing (transfer to dryers) is typically dry and would require fugitive dust minimization practices.

Air pollution resulting from this activity would include fugitive dust (particulate). Operators would be required to maintain and follow a fugitive dust prevention plan, whereby methods to minimize fugitive dust emissions resulting from the conveyors would be described and followed. Some conveyors at larger operations would also be subject to a visible emission limitation (visible dust plume), thereby potentially making the fugitive dust prevention practices more stringent or requiring utilization of better controls (e.g., covering of conveyors).

5.1.2.9 Dryers

Prior to sand being sized and stored as a final product, it typically goes through a drying process to reduce the moisture content. Sand is brought from stockpiles to the dryer via conveyors. The dryers operate on natural gas (or propane fuel as backup) and heat the sand to evaporate water. Emissions from the drying process are typically controlled by some mechanical collector (cyclone or baghouse), reducing particulate matter exhausted through a stack. The dried sand is then fed by conveyors to storage bins or directly to a screen house via conveyors.

Air pollution resulting from this activity would include combustion emissions and particulate. Combustion emissions are minimized by firing clean burning fuels such as natural gas or propane. Resulting particulate (mainly sand and very small quantities of combustion particulate) from the drying process is typically controlled by the use of a cyclone or baghouse. These devices are able to achieve a control efficiency of at least 95% or better (some baghouses can achieve 99.5% or better control). Collected materials in the baghouse will be disposed of at the mine site as fines or reject material.

Emissions from the dryer are subject to the new source performance standards (NSPS) in s. NR 440.73, Wis. Adm. Code. Particulate matter and PM₁₀ (particles smaller than 10 microns) emissions from the drying process are limited to 0.057 grams per dry standard cubic meter (g/dscm), according to s. NR 440.73(3)(a), Wis. Adm. Code. Furthermore, emissions are also subject to a visible emissions limit of 10 percent opacity, per s. NR 440.73(3)(b), Wis. Adm. Code. Typically by complying with the particulate matter limit

and utilization of a control technology, the visible emission limitation will be met. However, some facilities will also be required to either utilize a continuous opacity monitoring system to measure and record the opacity of emissions discharged, or have a certified visible emissions observer measure and record 3-6 minute averages of the opacity of visible emissions to the atmosphere each day of operation.

5.1.2.10 Screening

Sand is transferred from dry storage bins or directly from the dryer and then passed through vibrating screens. The sand is screened into one of several grades (sizes) and then conveyed to storage or to trucks for shipping. The screen house may contain the following pick-up points (dust collection points): bucket elevators, screens, and conveyors. The pick-up points within the screening area are typically routed to a mechanical control device.

Air pollution resulting from this activity would include particulate, stacked and/or fugitive. Resulting particulate from the screening process is typically controlled by the use of a cyclone or baghouse. Some facilities enclose the screening operation within a building, further minimizing fugitive emissions from the pick-up points.

The screening process may be subject to the NSPS in s. NR 440.688, Wis. Adm. Code if the processing plant has a capacity greater than 25 tons per hour. The NSPS applies to each crusher, grinding mill, screening operation, bucket elevator, belt conveyor, bagging operation, storage bin, enclosed truck or railcar loading station, per s. NR 440.688(1), Wis. Adm. Code. The NSPS provides limitations on visible emissions (opacity) of no greater than 7 percent.

Operators would be required to maintain and follow a fugitive dust prevention plan, whereby methods to minimize fugitive dust emissions resulting from the screening would be described and followed.

5.1.2.11 Storage Bins/Silos

Storage bins or silos are located throughout the processing plant and are utilized to store raw materials or final product. Materials or product are transferred to these devices via conveyors.

Air pollution resulting from this activity would include particulate, stacked and/or fugitive. Resulting particulate from the storage (loading of bins/silos) process could be controlled by the use of a cyclone or baghouse, and the bins/silos may be equipped with an air displacement vent filter. Operators may be required to maintain and follow a fugitive dust prevention plan for any fugitive emissions, whereby methods to minimize fugitive dust emissions resulting from the storage activities would be described and followed.

The storage bins/silos may be subject to the NSPS in s. NR 440.688, Wis. Adm. Code, if the processing plant has a capacity greater than 25 tons per hour.

5.1.2.12 Loading/Unloading – Processing Plant Operations

A processing plant located at a mine will not have unloading operations, whereas a processing plant that is located in a different location than the mine(s) will have truck or rail unloading of raw materials. The processing plant will have loading operations regardless of its location relative to a mine. Unloading operations typically consist of a dump station that may be enclosed to capture most fugitive emissions. Unloaded sand is dumped into an auger or conveying system which transports the sand to storage piles or bins/silos. Loading operations typically consist of a conveyor system (from storage bins/silos) to a spout over trucks or railcars. The conveyor system and spout may be enclosed to capture particulate or minimize fugitive particulate dust.

Air pollution resulting from this activity would include particulate matter from either stacks or fugitive sources. Resulting particulate from the loading and unloading processes could be controlled by the use of a cyclone or baghouse, or unloading processes through underground or covered conveyor systems. Operators may be required to maintain and follow a fugitive dust prevention plan for any fugitive emissions, whereby methods to minimize fugitive dust emissions resulting from the loading/unloading activities would be described and followed.

5.1.3 Potential Emissions, Ambient Air Dispersion Modeling and Risk Analysis

The WDNR uses dispersion modeling to evaluate the ambient air impact of air pollution sources. The following is a brief description of how the modeling process works. A model is a mathematical simulation, designed to predict what can or will happen in real-world scenarios. Atmospheric dispersion modeling is useful in predicting the impact a particular facility will have with respect to a given pollutant. The major benefit of dispersion modeling is that it is an inexpensive way to assess the impact of a source. This information is vital in assessing a facility's compliance with respect to the National and State Ambient Air Quality Standards (NAAQS) and increments as well as the various Hazardous Air Pollutant (HAP) standards, both federal and state. Dispersion modeling incorporates information about a facility, such as source/stack parameters, facility layout information and emission rates, along with 5 years of meteorological data in order to predict concentrations of pollutants in the vicinity of the facility. The point of highest impact is determined through the use of a receptor grid that is set up by the modeler, and could be the result of (besides other factors) inversions. The pollutant concentration at the point of highest impact is added to a previously determined background concentration and then is compared to the corresponding ambient air quality standard. The emissions from the facility (and nearby sources that contribute to impacts) must attain and maintain the NAAQS, which are set to protect public health and welfare, in order for any permit to be considered approvable by the WDNR. Those standards (NAAQS) are set at levels such that the most susceptible populations (children, elderly, and people with respiratory conditions) are protected.

All modeling completed in the State of Wisconsin for use by WDNR is conducted in accordance with these WDNR procedures as well as guidance contained in the Guideline on Air Quality Models, EPA document 40 CFR part 51, Appendix W. The present EPA approved dispersion model is AERMOD. This model is used for all dispersion modeling conducted for or by the WDNR.

The air quality analysis (air dispersion modeling) uses the worse-case maximum potential emissions from the facility. Those emissions are based on several factors, including: fuel type and characteristics, emission factors, operational design and control equipment, and any enforceable operational and/or emission limitations. The conditions that demonstrate compliance with the NAAQS will be set in the air pollution control permit as enforceable emission limits, control device operations, operational parameters (fuel type and amounts used), among other requirements. Any future expansion or increase in production or combustion sought by the facility, above what may already be approved in a permit, may result in a new air pollution control permitting action, which would again analyze all aspects of compliance with all air pollution rules and regulations.

5.1.3.1 Ambient Air Dispersion Modeling for Mining and Processing Operations

Depending on project specific conditions and proposals, an air analysis may include analysis of point (stack) and fugitive sources, soil and vegetation impacts, or visibility impairment.

Fugitive based particulate emissions, including PM₁₀ and PM_{2.5}, from truck traffic onsite may be included in the model as a volume source.

Any facility emitting SO₂, PM/PM₁₀, and/or NO_x may have a potential adverse impact on visibility through atmospheric discoloration or reduction of visual range due to increased haze. The Clean Air Act Amendments require evaluation of visibility impairment in the vicinity of PSD Class I area due to emissions from new or modified air pollution sources. (Note: A Class I area is an area that is afforded additional protect under the Clean Air Act from the impacts of air pollution. National Parks, National Wilderness Areas and National Monuments are all designated as Class I areas.) If a PSD Class I area is located within 100 kilometers of the site, visibility impacts on distant Class I areas will be assessed.

Near the proposed project site, under certain meteorological conditions, the stacks will emit a visible steam plume that, after traveling a relatively short distance, will dissipate by dispersion and evaporation. A visible steam plume can be expected to occur when ambient air temperatures are relatively low with respect to plume temperature, thus promoting plume cooling and condensation, and when ambient humidity levels are relatively high, preventing evaporation of the water in the plume. The persistence of the plume is dependent upon wind speed and the time required for evaporation.

An 'Air Dispersion Analysis' Correspondence/Memorandum is generated for each project in order to demonstrate the impact of the proposed project on State or Federal ambient air quality standards. The WDNR may not issue an air pollution control permit to a facility that can't demonstrate attainment and maintaining ambient air quality standards. Assuming the results of the modeling analysis demonstrate that the primary standard for the listed pollutants will be met, the health of "sensitive" populations such as asthmatics, children, and the elderly will be protected. Additionally, the welfare of the public is also protected, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.

5.1.3.2 Inhalation Risk and Non-Carcinogenic Effects Screening for Hazardous Air Pollutant Emissions

Depending on project specific conditions and proposals, an inhalation risk and screening analysis may be conducted. Hazardous air pollutant (HAP) emissions are known to occur from sand mining and processing operations. Reviews of existing and proposed projects have identified that all HAPs are from combustion sources, and are expected to be minimal. HAPs are regulated by ch. NR 445, Wis. Adm. Code, and/or regulated by any established federal National Emission Standards for Hazardous Air Pollutants (NESHAPs), whichever is more stringent.

Crystalline silica is not currently a regulated HAP under Federal or State regulations. However, crystalline silica emissions from these operations would be considered a particulate matter type and form of pollutant, for which regulations exist and apply. Furthermore, particulate matter emission control measures (emission control equipment such as baghouses, and fugitive dust control measures) reduce emissions of crystalline silica as well. WDNR has completed a study on the pollutant in 2011, and the results of that study are available on the WDNR's website. State regulated HAPs are included within NR 445, Wis. Adm. Code (which also includes all Federal HAPs).

5.1.4 Potentially Applicable Air Pollution Regulations

Fugitive Dust, Monitoring, and Particulate Matter: NR 415, Wis. Adm. Code.
New Source Performance Standards (particulate matter and opacity): NR 440, Wis. Adm. Code
Hazardous Air Pollutants: NR 445, Wis. Adm. Code; 40 CFR Part 63.

5.1.5 Cumulative Air Impacts

The WDNR considers cumulative air impacts and includes impacts generated by the project in addition to those from the nearby local industries. DNR's independent review of cumulative air impacts from stationary sources includes analyzing ambient air impacts of emissions from other nearby sources in addition to the proposed facility (please refer to the Ambient Air Dispersion Modeling and Risk Analysis section 5.1.3 for more information.) The review is conducted to assure that the cumulative impacts from all sources considered will result in attainment of all ambient air quality standards when the sources operate in compliance with their existing or proposed air pollution control permits.

5.1.6 Conclusion for Air Impacts

Air quality impacts must be expected to be within acceptable and permissible standards. The WDNR will require enforceable operational controls as permit conditions, in addition to air emission monitoring equipment, protocol to monitor, and following a department approved fugitive dust prevention plan to assure this. Based on WDNR's analysis and considering enforceable permit requirements the proposed action is expected to achieve compliance with applicable air quality standards and regulations and maintain air quality.

5.2 IMPACTS TO WATER RESOURCES

A sand mine can have multiple interactions with water. The site may be located near a river, stream, or wetland; or groundwater may be encountered as the site is excavated.

Water may also be used during the mining or processing stages. Material will be washed to remove fines. Washing may require the installation of a high capacity well. Wash water may be reused or discharged after washing to the ground surface, surface or surface waters depending on the volume and design of the operation. Sand excavated from below the water table may be saturated with water. As this material is stockpiled the water will run off the pile and leach into the ground or may be directed to on-site settling ponds. In addition, if the mine has buildings on-site a well may be present to supply water for cleaning, cooking, drinking, or sanitation.

The sites also receive water in the form of rain or snow that may be collected or allowed to run off depending on the volume and design of the operation. Steps must be taken to ensure that this storm water is handled properly so that sediment-laden water does not leave the site and possibly contaminate water resources or wetlands.

The following sections detail how water is used in a sand mining setting, the potential for impacts as well as how that use is regulated to help prevent impacts.

5.2.1 Groundwater

5.2.1.1 Process water

Silica sand mining and processing plants are likely to utilize groundwater to some extent. Potential uses of process water at mines and processing facilities include transporting, cleaning, and sorting sand, as well as dust control. For five planned sand mines in northwest Wisconsin proposed pumping capacities range from 700 to 1380 gallons per minute (gpm). Expected average water use ranges from 420,500 gallons per day to 2 million gallons per day (292-1380 gpm). These volumes are typical of closed-loop processing systems, where evaporation and incorporation into product are the main sources of water loss. By contrast, open-loop systems that do not recycle process water could use 2000-3700 gpm. All of these wells would be classified as high capacity wells, subject to state permit requirements. Any smaller-volume wells must meet state well construction standards.

The effects of groundwater pumping are highly site-specific and vary based on local geology, hydrogeology, and proximity to surface waters. A cone of depression forms around any well when it is pumped, lowering the groundwater level to an extent based generally on the well construction and pumping regime. Depending on well construction, pumping regime, and local geology, groundwater quality may be subject to change. Wells may become a conduit for contamination of groundwater if not properly constructed and maintained.

All wells must meet construction requirements mainly designed to prevent pollutants at the land surface from entering the underlying aquifer and to protect the quality of the water being discharged from the wells (Ch 281.17 Wis. Stats., and is specifically described in NR 812 Wis. Adm. Code). The WDNR may specify more stringent well

location, well construction, and pump installation requirements when deemed necessary for the protection of public safety, safe drinking water, and the groundwater resource. The WDNR may deny, grant a limited approval, or modify an approval under which the location, depth, pumping capacity or rate of flow and ultimate use is restricted so that the supply of water for any public utility will not be impaired. Process water may not be discharged to any well including any bored, drilled or driven shaft, dug hole whose depth is greater than its largest surface dimension, improved sinkhole or subsurface fluid distribution system (NR 815, Wis. Adm. Code.)

All high capacity wells are routinely screened for potential impacts to waters of the state. Any WDNR approval for a high capacity well operation identified as having the potential to cause significant impacts to trout streams, outstanding resource waters, exceptional resource waters, or other waters of the state will contain additional conditions designed to prevent significant adverse impacts. High capacity wells proposed near springs will be reviewed to determine whether construction and operation will result in substantially reduced flow from the spring. For springs that typically flow at rates greater than 1 cubic foot per second (cfs), the WDNR may not approve a proposed well that will reduce annual spring flow by more than 20%.

A detailed water balance may be required to determine the approximate water loss related to applications for high capacity wells that may result in a water loss exceeding 95%. However, this provision is not expected to apply to nonmetallic mining operations, since the average estimated water loss from nonmetallic mining in the Great Lakes Basin is 10% (Shaffer and Runkle, 2007).

Concerns have been raised about high capacity withdrawals affecting water levels in nearby private wells. During the high capacity well screening process, the WDNR will attempt to identify nearby private wells where significant groundwater drawdowns could occur. In cases where the WDNR discovers or receives concrete scientific evidence linking the proposed well(s) to a potentially significant adverse impact to private water supplies, any high capacity well approval would be conditioned, through permit conditions, to avoid such impacts. The WDNR also recommends that private well owners establish baseline information on static water levels and water quality parameters such as arsenic, nitrate, and iron. This information should be shared with mining officials prior to any new high capacity well operations. Information on sampling and certified labs is available on the WDNR website (dnr.wi.gov).

5.2.1.3 Dewatering water

If sand mining operations are performed below the water table, they may require significant additional groundwater pumping in order to dewater the active mining area. This can lead to an increased potential for impacts to groundwater and surface water resources. The majority of sand mining in Wisconsin is done above the level of the water table where no dewatering is required.

Mines that clean or process sand commonly use *polyacrylamides* as a flocculent to remove unwanted minerals and fines from the sand. Acrylamide may be present in frac sand wash water if they are using it as a flocculent in their wash operations. Acrylamides appear to be biodegradable in aerated soils. As a result, unless polyacrylamide levels are very high in the wash wastewater there may not be a great potential for acrylamide to contaminate groundwater at sand wash water storage/discharge sites. The types of

ponds and the minerals removed may also affect the potential for groundwater impacts. Sealed ponds will have very little potential for groundwater impacts. Unsealed ponds will likely seal themselves with the fines that are removed from the frac sand. Dewatering water may not be discharged to any well including any bored, drilled or driven shaft, dug hole whose depth is greater than its largest surface dimension, improved sinkhole or subsurface fluid distribution system (NR 815, Wis. Adm. Code.) More research is needed to determine concentrations of acrylamides in frac sand wash water when mines are using polyacrylamide polymer flocculation products.

The US Environmental Protection Agency (EPA) has set a Maximum Contaminant Level Goal (MCLG) of zero for acrylamides in public drinking water. Wisconsin does not have groundwater standards for acrylamide under NR 140, Wis. Adm. Code. Because of the difficulty of testing for such compounds at very low levels, EPA limits the amount of acrylamide in the polymeric coagulant aids used by public drinking water systems to 0.05% by weight and the dosage of polymeric coagulant aid which can be added to raw water to remove particulates, to 1ppm. Some people who drink water containing high levels of acrylamide over a long period of time could have problems with their nervous system or blood, and may have an increased risk of getting cancer.

5.2.1.3 Drinking water

Any new well will, at a minimum, be subject to construction standards found in NR 812, Wis. Adm. Code (Well Construction and Pump Installation). If any of these new wells are determined to be a public system, then construction standards of NR 812, Wis. Adm. Code, and operation standards and maintenance of public water systems of NR 810, Wis. Adm. Code, will also apply. A public water system is defined as a system that has at least 15 service connections or that regularly serves an average of at least 25 individuals daily at least 60 days out of the year. All public water systems are regulated by the Department to assure safe reliable drinking water.

If a mining or processing operation provides drinking water to more than 25 people and has drinking water available more 6 months a year it would be regulated as a Non-community non-transient water system and be subject to conditions and testing in NR 809 and NR 810 Wis. Adm. Code. These water systems would need a certified operator and would need to sample at least annually for bacteria and nitrates. Sampling for other parameters such as lead, copper, inorganics, and volatile organic compounds (VOC's) would be set by NR 809 Wis. Adm. Code.

In addition to operator and sampling requirements, NR 810 Wis. Adm. Code would also regulate distribution systems and system capacity. A WDNR public water system specialist would be assigned to the facility. The facility would be inspected every five years.

5.2.2 Surface Water Resources

Wisconsin is home to about 84,000 miles of streams and 1.2 million acres of lakes. Although more than 47% of Wisconsin's original wetlands have been lost, more than 5.3 million acres of wetland are still present across the state. Due to the state's numerous wetlands and streams, combined with the rapid expansion of sand mining, it is likely that some mines will be located near Wisconsin surface water resources.

The construction and operation of a nonmetallic mining site in proximity to surface water has the potential to affect surface water through a variety of mechanisms. The most direct impact is the removal of nonmetallic material directly from the stream channel, lakebed, or the immediate stream bank or lake bank. This activity changes the process of deposition and transport of sand, gravel, and other bottom material which can lead to increases in siltation, erosion, and the loss of fish and aquatic life habitat. Active construction within the stream channel and on stream banks results in the direct mortality of aquatic life, increases turbidity, and may suspend contaminated sediments. Construction or expansion of mining operations into waterways may also alter the chemical properties of the water body. In some cases these alterations may be significant enough to effect the composition of aquatic life in the waterway.

Indirect impacts to surface waters from nonmetallic mining sites include the discharge of contaminated storm water runoff from the mine, dewatering processes taking place in the mine, or inadvertent releases from wastewater storage ponds. Other indirect impacts include the interception and contamination of groundwater that flows to streams and lakes, loss of wildlife habitat near stream corridors, and degradation of natural scenic beauty associated with our public waterways.

Storm water discharges from nonmetallic mining sites are regulated by the state through WPDES Permits. However, because of the scale of frac sand surface mines it should be recognized that the NR 135 nonmetallic mining reclamation plan, enforceable by the NR135 Reclamation Permit, includes provision for the control of surface water and erosion that takes place both during site development and site reclamation. The statewide standards require that measures protective of surface waters are included in the reclamation plan and invoked during site development to protect surface water and to have no adverse effect on adjacent properties. Such measures include diverting unaffected surface flows around the disturbed area, prior to the removal, and protection of topsoil or surficial soil materials (as defined in s. NR 135.02). Such protective measures must be in place before any site disturbance and are addressed in the approved reclamation plan, enforceable under the NR 135 Reclamation Permit. Because of the magnitude of frac sand surface mines, the approved reclamation plans will involve a phased development and contemporaneous reclamation sequence to minimize the footprint of the operation and the potential for erosion due to surface water and wind.

Most nonmetallic mines are designed to be internally drained to capture and contain all storm water discharges within the active mining project site. However, the majority of mines are only designed to contain up to a 10- or 25-year rain event. During larger rain events, silt, sand, and even gravel can be washed from the mine site into surface waters.

Dewatering discharges are regulated by the WDNR and have a limit of 40 mg/l for total suspended solids (TSS). Although this TSS limit exists, dewatering discharges may contain high amounts of small particles that are not included in the TSS analysis, but can still cause significant turbidity issues at the point of discharge. Dewatering discharges must also meet a pH range of 6.0 to 9.0 and oil and grease limits of 15 mg/l or less.

Few studies have explored the impacts of nonmetallic mining sites where groundwater is intercepted and either pumped (via mine dewatering) directly to surface water or a settling pond, which then, through seepage, recharges groundwater and ultimately feeds a nearby stream. In either case, groundwater may be warmed, and thermal affects may be

seen in cool or cold water streams. Other considerations include chemical changes such as increases in biological demand (decreased oxygen concentrations) and ammonia when groundwater is diverted to a surface water pond.

5.2.2.1 Permit jurisdiction in or near surface waters

A number of environmental regulations are in place to restrict mining activities and protect waters of the state including:

- Wisconsin Pollutant Discharge Elimination System (WPDES) Storm Water Permits
- Ch. 30 and 31 Wis. Stats. waterway permits

For all nonmetallic mines, Wisconsin nonmetallic mine law (NR 340 Wis. Adm. Code) applies to any sand mines where an activity regulated by Ch. 30 or Ch. 31 Wis. Stats. is proposed. For typical sand mines, this includes activities such as:

- Ponds within 500 feet or connected to navigable water
- Grading on or near the bank of a navigable water (distance varies based on the waterway)
- Realignment of a navigable stream
- Dredging from streams and lakes
- The construction of culverts or bridges on navigable waterways

Wisconsin's nonmetallic mining code recognizes that "...without adequate controls serious degradation of water quality, fish and wildlife habitat, and public interests in recreation and scenic beauty could occur during and after the excavation, dredging or grading in or near navigable waterways." The code goes further and substantially restricts the mining of sand and aggregates from within stream channels and from the immediate banks of Wisconsin's navigable streams. Section NR 340.15, Wis. Adm. Code, directs the WDNR to assume that excavation from stream channels and immediate banks shall be avoided where reasonable alternatives exist.

5.2.2.2 Cranberry exemption

Some of the counties in central Wisconsin that are seeing an increase in frac sand mining are also home to much of the state's cranberry farming. Mining sand is a routine practice in the process of raising cranberries. Growers use sand in the cranberry beds to provide adequate drainage for the roots of the cranberry plants. The sand prevents root rot and fosters plant growth.

Chapter 94.26, Wis. Stats, was established in 1867 and exempts cranberry growers from much of the laws applying to waters of the state under Chapter 30, Wis. Stats. With this exemption in place cranberry growers can, in theory, mine sand wherever and however they desire for use in cranberry production. Some cranberry growers are taking advantage of the high demand for sand and are selling their sand on the frac sand market. However, the Department has recently determined that the exemption in Ch. 94.26, Wis. Stats., from portions of Chapters 30 and 31, Wis. Stats., for cranberry culture is not applicable to non-metallic mining sites where a NR 216, Wis. Adm. Code, stormwater permit is required. For those non-metallic mining operations where the material is sold and hauled off site, Chapters 30 and 31, Wis. Stats., jurisdiction will be applied.

5.2.3 Wetlands

Wetlands are a valuable natural resource and are important to the ecology and economy of Wisconsin. They are protected by state law and recognized as providing a variety of values and functions including:

- Storm and flood water storage
- Groundwater recharge and discharge
- Filtering capability
- Shoreline protection
- Habitat for aquatic organisms and wildlife
- Recreational, cultural, educational, scientific, and natural scenic beauty

State statutes define a wetland as "an area where water is at, near or above the land surface long enough to be capable of supporting aquatic or hydrophytic vegetation and which has soils indicative of wet conditions." This definition, along with delineation procedures described in *The 1987 U.S. Army Corps of Engineers Wetland Delineation Manual* and appropriate regional supplements are used to identify and delineate wetlands.

A high percentage of the State's wetlands are associated with a stream, river, or lake. One of the targeted areas for silica sand mining is the alluvial deposits near or within these wetlands which are found in central Wisconsin. The counties included in this area have a significant percentage of the total land surface area mapped as wetland. For example, 17% of Jackson County and 10% of Monroe County are mapped as wetland. Because of the extensive network of waterways and wetlands in this region, it is challenging for a silica sand operation to completely avoid wetland impacts within the direct footprint of the mining site and the necessary transportation infrastructure.

5.2.3.1 Locating wetlands

To determine if wetlands are likely present on a potential sand mining property, the WDNR recommends that applicants use the Wisconsin Wetland Inventory maps, the hydric soil layer, and other maps located on the WDNR's [Surface Water Data Viewer](#). These maps should only be used as guides and an onsite investigation by a professional wetland delineator is required to verify the presence or absence of wetlands.

5.2.3.2 Impacts to wetlands

Adverse impacts to wetlands related to a sand mine site can be classified as either direct or indirect. Direct impacts are caused by the physical alteration of a wetland by the discharge of fill material or excavation within the wetland to mine the sand deposit. Discharges may also be related to infrastructure development such as roads, railroads, utilities and to a lesser extent the sand handling and processing site. Both types of alterations result in loss of the wetland and the associated values and functions.

Indirect impacts typically involve changes to the landscape that affect the local hydrology by altering surface drainage patterns as well as changing groundwater levels. This can have the affect of starving a wetland of the necessary water; reducing its ability to support hydrophytic vegetation. Impacts to adjacent wetlands can be minimized if there is no dewatering of the excavation site or if the dewatering or wash water process is

developed with a closed system so all the pumped water stays on site and is not discharged to adjacent surface waters.

5.2.3.3 Wetland permitting

The excavating or placement of any material in wetlands requires a WDNR approval known as a Water Quality Certification. The WDNR reviews a project to determine if it complies with the requirements of Chapters NR 299 and NR 103, Wis. Adm. Code. State regulations require that wetland impacts be avoided if possible. As such, permit applicants will need to demonstrate that they cannot avoid or reduce wetland impacts, and that the project will not have significant adverse impacts on wetland functions and values including secondary impacts.

In addition to state regulations, the US Army Corps of Engineers may assert jurisdiction over a wetland that is connected to a federally navigable waterway. If jurisdiction is asserted, the facility would be required to attain a permit from the Corps under section 404 of the Clean Water Act.

5.2.4 Storm Water/Wastewater Management

Water generated by or contaminated with sediment as a result of frac sand operations is handled primarily with two general WPDES permits: the Nonmetallic Mining Operations Permit (NMM) (Permit No. WI-0046515-05) and the Construction Site Storm water Discharge Permit (Permit No. WI-S067831-3).

Mining activity for the purposes of the NMM begins the first time ground is broken at a mine site. This negates the need for an operator to obtain a duplicative construction site storm water discharge permit for the same area.

The NMM permit is considered an operations permit and regulates discharges of storm water and wastewater from the mine sites from the initial commencement of site development and lasts until the site has been reclaimed.

In addition to using the NMM permit to regulate the actual removal of material from the ground, the WDNR has also used it to cover adjacent/proximal processing facilities where wet and dry sorting may occur.

5.2.4.1 Storm water

Should the site discharge storm water offsite and/or to surface waters of the state, the operator is required to prepare and implement a Storm Water Pollution Prevention Plan (SWPPP) that will specify the use of standard Best Management Practices (BMPs) to be installed to control sediment in storm water runoff (defined as externally drained). If the site does not discharge offsite or to surface waters of the state, meaning all storm water runoff is directed into seepage areas where there is enough storage for the 10-year/24-hour rain event, no SWPPP is required and storm water requirements are minimal (defined as internally drained).

When new mines are opened, it is common for them to start out as externally drained. Initial operations when opening a mine include stripping topsoil, overburden, and building perimeter berm. In this beginning phase it is difficult to manage the site so that storm water drains internally. However, as the site matures the goal is usually to develop an internally drained operation.

5.2.4.2 Wastewater

The WDNR regulates a number of wastewater discharges at mine sites. The most common discharges include pit dewatering (regardless of whether the water results from precipitation or groundwater) and wash water generated from mine processes. The primary pollutant being regulated is sediment in suspension, so the requirements for the discharges vary depending on the resource being discharged to. Discharges to surface waters are more stringently regulated than are wastewater discharges to groundwater via seepage.

5.2.4.3 Construction site storm water and erosion control

The WDNR has typically required this permit only for operations where a stand-alone processing plant is being constructed or for the construction of rail spurs to service mines or processing plants. Requirements for a construction site permit include preparing an erosion control plan that details the BMPs that will be used to control erosion during construction as well as a storm water management plan that details how sediment will be controlled once construction is complete.

5.2.5 Contaminated sites

The DNR Remediation and Redevelopment program regulates sites that have been contaminated due to spills or leaks of hazardous substances from fuel storage tanks, landfills, industrial sites, etc. Ch. 292.11, Wis. Stats., assigns responsibility for cleanup of hazardous substances. A mine operator could incur liability for cleanup, if mine operations cause the release of a hazardous substance, or mobilize or alter the movement of an existing plume of hazardous substance in groundwater.

5.3 FISHERIES IMPACTS

Nonmetallic mining has not had significant negative impacts to fisheries resources in the past. This can mainly be attributed to the relatively low number of sand mines in the state. However, with the recent boom in frac sand mining the number of nonmetallic mines throughout the state has increased. In many instances they are located close to coldwater resources or in the floodplains of river systems. The following fisheries impacts may need to be considered:

- Runoff from the mine site and settling ponds into a coldwater resource causing high levels of turbidity especially in headwater streams where there is natural reproduction of trout.
- Runoff from the mine site and settling ponds causing sedimentation in streams
- If sedimentation/turbidity occurs during fall spawning period, sedimentation would cover/suffocate eggs, leading to no reproduction for that year.

- Amount of warm water runoff from settling ponds could potentially increase the water temperature of coldwater resources.
- Warmer water temperatures could cause coldwater tolerant species of fish and invertebrates to disappear.
- High capacity well withdrawals could decrease stream flows.
- Reduced spring volume could also have thermal impacts on streams.
- Entrapment of fish in ponds located within a floodplain.
- Conversion of riverine or stream habitat to a lake habitat in cases where bed excavation/enlargements and realignments of channels occur.

5.4 SOLID WASTE MANAGEMENT/ SPILLS HANDLING

Mining and processing activities generate solid wastes similar to any business or industry including: paper and packaging from office or shop activities and break room wastes such as paper and plastic bags, paper toweling, fast food containers, plastic and aluminum beverage containers, and food wastes. These wastes should be recycled or disposed of at a licensed sanitary landfill.

Vehicles, heavy equipment, and processing equipment will also generate wastes as a result of repair or maintenance activities. These wastes will likely include engine oils, transmission and cooling fluids, hydraulic fluids, filters, parts cleaning solvents, and paints. These wastes can generally be recycled with the exception of the parts cleaning solvent which, if generated, will need to be characterized and potentially handled and disposed of as a hazardous waste. It is likely that if maintenance activities are conducted at a facility it would be classified as a Very Small Quantity Generator (VSQG) of hazardous waste and would need to comply with VSQG regulations. There are a number of companies who service VSQGs to pick up and properly dispose of or recycle small quantities of hazardous waste.

Facilities which utilize a wet process to wash the sand will generate nonmetallic mineral fines as a waste product. Section NR 500.08(2)(b), Wis. Adm. Code, exempts disposal of spoils from sand, gravel or crushed stone quarry operations and nonmetallic earth materials from most solid waste regulations. Use of these fines for mine reclamation, provided their use is consistent with the mines reclamation plan approved by the respective county under NR 135, Wis. Adm. Code, is acceptable to the WDNR.

As with any industry that uses vehicles and heavy machinery the potential for spills of gasoline, diesel fuel and hydraulic fluids exists. Chapter NR 706, Wis. Adm. Code, specifies when a spill must be reported to the WDNR. But whether a spill is reportable or not, all spills need to be cleaned up to the extent possible and contaminated materials need to be properly disposed of.

5.5 RECREATION AND MANAGED LANDS

Proximity of mining operations to state-owned and managed lands may be of concern due to potential impacts to Nature Based Outdoor Activities (NBOA's) such as hunting, trapping, fishing, hiking and cross-country skiing, as well as other "quiet" outdoor recreational pursuits (e.g., nature study, biking, etc.). There are also concerns with regard to mine operation impacts on resident wildlife. The magnitude of the impact depends on proximity of the sand mine to the given property, the type of mining operation and the hours of operation.

Specific impacts that may need to be considered include:

5.5.1 Noise

Noise from equipment operation, vehicle use (both on site and on the area road system) and blasting can impact the quality of the recreational user experience on a given property potentially diminishing the quality of that site for a particular endeavor.

Noise may also affect wildlife usage of the property. Chronic or episodic noise-related disturbance may result in wildlife movement away from the source of disturbance, potentially impacting reproductive success as well as the quality of wildlife-based recreation – hunting, trapping, and nature study.

5.5.2 Dust

Generation of airborne dust may result in aesthetic impacts to a property (vegetation, facilities covered with dust) and impacts to visitors (dust inhalation, settling on vehicles).

5.5.3 Lighting

Sand mines operating at night may require lighting that could negatively impact the quality of a park or recreation area user's experience. Lighting at night may also constitute a disturbance sufficient to affect wildlife usage patterns on a given property.

5.5.4 Traffic

Increased traffic to and from the mine will result in increased levels of noise. Depending on traffic routes and volumes, user access to a property could be impacted. Increased levels of mine related traffic may also result in higher levels of incidental wildlife mortality due to road kill.

5.5.5 Air quality

Exhaust and dust from mine operations (equipment and traffic), if detectable, may negatively impact recreational users of a property.

5.5.6 Forests

Forest cover must be removed to accommodate active mining as well as overburden storage. Forest products can be recovered and marketed during the mine development

phase, but the practice of forestry and mining are mutually exclusive because of the loss of forests.

Forest loss and the loss of associated habitats may be temporary and could be restored through mine reclamation after mining ceases. While a forested condition may be restored, it is likely that it would be different from the original forest because of changes in soil depth, soil profile, topography, depth to groundwater, etc.

5.6 ENDANGERED AND THREATENED SPECIES AND HABITATS

Wisconsin's Endangered Species Law (<http://dnr.wi.gov/org/land/er/laws/>, s. 29.604, Wis. Stats.) requires the protection of our state's endangered and threatened species and directs the WDNR to determine whether any activity the WDNR *conducts, funds, or approves* may affect endangered or threatened species. As part of the permit approval process, an Endangered Resources Review (ER Review) is required from the WDNR to make this determination. In addition, regardless of whether a WDNR permit or approval is required or funding is involved, Wisconsin's Endangered Species Law still applies to all projects.

5.6.1 ER Reviews

An ER review may be completed in two ways: permitting staff may conduct an ER Review as part of their permit process or a project proponent may request a review for their project directly from the Bureau of Endangered Resources (BER). The ER review considers several tools or sources of information to ensure compliance with state and federal laws. One of the primary tools is a search of the Wisconsin Natural Heritage Inventory (NHI) database to determine what federal and state endangered and threatened species have been confirmed in the proposed project area. The project area evaluated consists of both the specific project site and a buffer area surrounding the site. The size of the buffer varies depending on the ecological and land use characteristics of the site and surrounding area. Records from the buffer area are considered because most lands and waters in the state, especially private lands, have not been surveyed. Considering records from the surrounding landscape provides the best representation of species and communities that may be present on a specific site.

Other sources of information should be considered in the review, including information about the project site, wildlife and plant databases, and species experts. Habitat assessments or surveys may be necessary to determine whether state or federally listed species occur within a project area or to confirm whether suitable habitat is present for an identified species or community.

The NHI database includes the following information:

- Animals and plants federally listed as Endangered or Threatened, those Proposed or Candidates for federal listing, and their Proposed or Designated critical habitats. Federally listed animals are protected on all lands. Federally listed plants are protected only on federal lands or on projects that include federal funding (<http://www.fws.gov/endangered/laws-policies/index.html>). If federally protected species or habitats are likely to be impacted by a project, consultation with the United States Fish and Wildlife Service (USFWS) should occur. An exception to this pertains to the Karner Blue Butterfly (KBB), a federally listed butterfly,

which falls under special provisions of a Habitat Conservation Plan (HCP) that is administered by the WDNR. (<http://dnr.wi.gov/forestry/karner/>).

- Animals (vertebrate and invertebrate) listed as Endangered or Threatened in Wisconsin are protected by Wisconsin's Endangered Species Law on all lands and waters of the state. If state protected animals are likely to be impacted by a project, consultation with the WDNR should occur.
- Plants listed as Endangered or Threatened in Wisconsin are protected by Wisconsin's Endangered Species Law on public lands and on lands that the person does not own or lease, except in the course of forestry, agriculture or utility actions. If state protected plants are likely to be impacted by a project and are not covered by one of the exemptions above, consultation with the WDNR should occur.
- Special Concern Species, examples of high-quality natural communities (sometimes called High Conservation Value areas), and natural features (e.g., caves and animal aggregation sites) are also included in the NHI database. These resources are not legally protected by state or federal endangered species laws. However, other laws, granting, or permitting processes may require or strongly encourage protection of these resources. The main purpose of the Special Concern classification is to focus attention on species about which some problem of abundance or distribution is suspected before they become endangered or threatened.

5.6.2 Incidental Take

The Wisconsin Endangered Species Law allows the WDNR to authorize the taking of state endangered or threatened species if the taking is not for the purpose of, but will be only incidental to, the carrying out of an otherwise lawful activity, and will not jeopardize the continued existence of the species in the state (<http://dnr.wi.gov/org/land/er/take/>). Authorization generally occurs through an Incidental Take Permit, which requires an application, a Conservation Plan with required elements (including minimization and mitigation measures) and a 30-day public notice period prior to authorization.

5.7 ARCHEOLOGICAL AND HISTORIC IMPACTS

Under provisions of Wisconsin statutes, state agencies (including WDNR) are directed to cooperate with the Wisconsin Historical Society (WHS) in order to identify and protect any WHS-recorded archaeological sites, historic structures, and other cultural resources which may be adversely impacted by agency actions such as permitting. Protection of these resources may be accomplished through avoidance or required field investigations (as directed by WDNR, after internal review).

If such a project is federally funded, licensed, or permitted, additional investigations to identify and protect recorded and unrecorded cultural resources may also be required under provisions of federal law.

5.8 SOCIO-ECONOMIC IMPACTS

Construction and operation of mines and processing facilities and transportation of sand by truck or rail will have the potential to cause significant socio-economic impacts on nearby neighbors particularly in rural locations where the existing land use is predominantly agricultural. Impacts may include: noise from mining and transport operations, increase in traffic and road deterioration, visual impacts, light disturbance from night mining, and property value impacts. For those properties with deposits of frac sand present, prices exceeding \$10,000 per acre have been reported.

In the long term, mines are eventually closed and reclaimed. The reclamation plans for many mines involve replacement of the stockpiled topsoil and either a conversion to or a return to agricultural use. Where this is not feasible some mines have been reclaimed into prairie or oak savannah and provide wildlife habitat. At a very minimum mine sites need to be reclaimed by stabilizing and revegetating the area.

Construction and operation of the mines and processing facilities and transportation of the sand has the potential to have significant direct and secondary beneficial impacts on Wisconsin's economy. It is difficult to put exact numbers on the economic impact since the mines and processing operations vary in size and design but the Wisconsin Economic Development Corporation estimates that the average processing facility will create 50-80 new jobs. It is also estimated that the average mine will create around 10 new jobs. This does not include the secondary jobs that will be created by the need to transport the sand. It is estimated that the average starting wage for general laborers will be approximately \$13.50 per hour plus \$1.00 per hour in standard benefits. More skilled laborers such as welders and mechanics are estimated to make about \$20.00 per hour. Managers, engineers, and geologists will make the competitive prevailing wage for their profession.

The Wisconsin Economic Development Corporation estimates that the average processing plant will require an investment of between \$20-\$40 million dollars for equipment, buildings, and infrastructure and up to \$100 million for a processing facility that includes resin coating.

Short term secondary impacts will occur in the building and trades sectors as these facilities are being constructed. There is also potential for an increase in sales of mining and other heavy equipment such as dump trucks. There will also be the typical secondary economic impacts that would be expected as a result of any new business coming to Wisconsin and bringing new jobs.

5.9 TRANSPORTATION IMPACTS

Vehicular traffic on local roads will have an impact on the service life and condition of the roads. The degree of road deterioration will depend on the amount of traffic resulting from sand mining operations, the type of vehicles transporting the sand and the design specification the road was constructed to.

Additionally there may be terrestrial and water resource impacts as a result of creating new transportation infrastructure such as roads and rail spurs to support the mine or

processing facilities. The WDNR will work with developers to assure the impact of this infrastructure will take into consideration and comply with regulations set to protect threatened and endangered species. The developer will also need to comply with wetland regulations described in this document administered by the WDNR and local shoreland zoning regulations administered by the appropriate county as applicable.

As mentioned earlier, the preferred and most economical method of transporting frac sand is by rail. Most of the processing facilities are being located near or adjacent to existing rail lines. Planners with both the Wisconsin Department of Transportation and within the railroad industry did not anticipate the significant increase in demand for rail transport that resulted from Wisconsin's expanding frac sand mining industry. At this point no new major rail line routes are being proposed. However, a number of existing rail routes will need to be upgraded to handle the increase in rail traffic. Furthermore, some major spurs or rail sidings to stage rail cars at the processing facilities have been constructed or are under consideration.

At the present time there is no discussion of converting recreational trails back to railroads but that is a possibility.

6.0 Legal Framework

The following information is a listing of regulations that may apply to sand mining in the State of Wisconsin.

6.1 LOCAL AND COUNTY ZONING ORDINANCES

Sand mines may be regulated by local ordinances, depending on the County or Township where the facility is sited.

6.1.1 Shoreland zoning

The shoreland zoning ordinance adopted by each county in Wisconsin provides development standards for shorelands in unincorporated areas to limit impacts on water quality, fish and wildlife habitat, recreation, navigation and natural scenic beauty. NR 115 Wis. Adm. Code sets minimum standards for the local ordinances, but many counties have adopted standards that are more restrictive than the state minimum standards. Shoreland zoning pertains to lands within 1,000 feet of the ordinary high-water mark (OHWM) of a navigable lake, pond or flowage and lands within 300 feet or within the floodplain of a navigable river or stream, whichever distance is greater.

Each county's development standards may vary, but generally a permit or variance would be required for:

- A permit would be required for any "structure" within the shoreland zone
- A variance would be required for "structures" that are within 75 feet of the OHWM of a navigable waterway.
- A permit or vegetation management plan may be required for removal of shoreline vegetation that exceeds certain limits.
- Filling, grading, lagooning, dredging, ditching or excavating in a shoreland zone
- Filling or grading of more than 2000 square feet is typically regulated with a conditional use or special exception permit.
- A permit is needed to fill any area that is a wetland. If there is a practicable alternative to filling the wetland, the permit may not be granted.

6.1.2 Conditional Use permit

Each zoning district, as defined in a municipality's zoning code, has two types of uses. The first type of use is the permitted uses. These do not require additional review other than the zoning review for issuance of a building permit. The second type of use is a conditional use. These are uses not permitted outright but may be allowed if certain standards and conditions are met and the municipality grants approval.

Conditional uses assure property owners that uses of adjacent properties will be as compatible as possible with property uses established in their neighborhood.

A frac sand mine would likely be classified as an industrial facility. If a property is not zoned for this use the mine developer would have to apply for and receive a conditional

use permit from the county. These permits are usually considered at a county board meeting, which may provide an opportunity for public input on the permit decision.

6.2 WDNR REGULATIONS

6.2.1 Nonmetallic Mining

- **NR 135:** Requires reclamation of nonmetallic mining sites. Reclamation is controlled through a reclamation permit issued by the county. Reclamation may occur contemporaneously with the development of new mining phases, especially in large surface mining projects, or upon the cessation of mining operations. In either case, reclamation proceeds according to an approved reclamation plan developed to achieve a specific post mining land use. Implementation of the reclamation plan is enforceable by the reclamation permit and guaranteed through the positing of a financial assurance instrument payable exclusively to the county.
- **NR 340:** Establishes consistency in the application of state statute chapter 30 to nonmetallic mining to avoid unnecessary adverse effects caused by nonmetallic mining in or near navigable waterways.

6.2.2 Air

- **NR 407:** Regarding operation permits and permit applications for direct stationary sources.
- **NR 415:** Categorizes particulate matter air contaminant sources and to establish emission limitations for these sources in order to protect air quality.
- **NR 440:** Enables the WDNR to implement and enforce standards for new stationary sources promulgated by the US EPA.
- **NR 445:** Establishes emission limitations for hazardous contaminants from stationary sources.

6.2.3 Groundwater and Drinking Water

- **NR 135:** Reclamation standards in NR 135.08, provide that there be no adverse impact on groundwater quantity or quality, referencing NR 140, from site reclamation. This provision often applies upon cessation of mining, in the typical limestone quarry (static in terms of its footprint throughout its operation), but may apply to various phases of on-going reclamation in large surface mines where areas are being opened up for mining while a previous mined-out phase is being contemporaneously reclaimed.
- **NR 140:** Establishes groundwater quality standards for substances detected in groundwater. Specifies procedures for groundwater standards, monitoring, and WDNR response. Provides exemptions.
- **NR 299:** Establishes procedures and criteria for the application, processing and review of state water quality certifications required by the provisions of the federal water pollution control act.

- **NR 809:** Establishes minimum standards and procedures for the protection of public drinking water.
- **NR 810:** Governs the operation and maintenance of all public water systems to provide safe drinking water to consumers.
- **NR 812:** Establishes uniform minimum standards and methods to extract groundwater for any purpose while protecting groundwater and aquifers from contamination.
- **NR 815:** Prohibits the injection or discharge of fluids to any well including any bored, drilled or driven shaft, dug hole whose depth is greater than its largest surface dimension, improved sinkhole or subsurface fluid distribution system
- **NR 820:** Requirements to avoid, minimize, and manage impacts from groundwater withdrawals.
- **NR 850:** Establishes annual fees for water withdrawals from the state.
- **NR 856:** Establishes requirements for registering water withdrawals and collecting and reporting of accurate water withdrawal data to support management of the state's water resources.
- **State Statute Chapter 280:** Pure Drinking Water

6.2.4 Navigable Waters

- **NR 340:** Establishes consistency in the application of state statute chapter 30 to nonmetallic mining. The WDNR permit regulates both the operation and reclamation of nonmetallic mines. It is intended to avoid unnecessary adverse effects caused by nonmetallic mining near navigable waterways and to restrict excavation, dredging and grading where the adverse effects cannot be minimized or avoided.
- **State Statute Chapter 30:** Navigable Waters Harbors and Navigation
- **State Statute Chapter 31:** Regulation of Dams and Bridges Affecting Navigable Waterways
- **State Statute Chapter 281.** Water and Sewage.

6.2.5 Wetlands

- **NR 103 :** Establishes water quality standards for wetlands
- **NR 299:** Establishes procedures and criteria for the application, processing and review of state water quality certifications required by the provisions of the federal water pollution control act.

- **NR 350:** Establishes standards for development, monitoring, and long term maintenance of wetland mitigation projects that are approved by the WDNR.
- **NR 351:** Identifies and incorporates by rule any federal regulation for determining whether certain activities in nonfederal wetlands are eligible for exemption state statute.
- **NR 352:** Designates the wetland delineation manual procedures to be used to delineate nonfederal wetlands.
- **NR 353:** Facilitates the regulation of projects whose purpose is wetland conservation.
- **State Statute Chapter 281.** Water and Sewage.

6.2.6 Stormwater

- **NR 216:** Regulates stormwater on site by controlling erosion and sedimentation through a Non Metallic Mining Operations General Permit -WPDES GP WI-0046515-4.

6.2.7 Wastewater

- **NR 216:** Also regulates discharge of other wastewaters from a non metallic mining operation through the General Non Metallic Mining WPDES permit. These wastewaters include waters generated from washing the sand, equipment washing and any non contact cooling waters.

6.2.8 Endangered Resources

- **Chapter 29:** Wild Animals and Plants

6.2.9 Solid Waste

- **NR 500:** Provides definitions, submittal requirements, exemptions and other general information relating to solid waste facilities.
- **State Statute Chapter 287:** Solid waste reduction, recovery and recycling.
- **State Statute Chapter 289:** Solid waste facilities.

6.2.10 Hazardous Waste

- **NR 600:** Provides definitions, exemptions and requirements for the identification, management and disposal of solid wastes which are determined to be hazardous wastes.
- **State Statute Chapter 291:** Hazardous waste management.

6.2.11 Hazardous substances spills

- **NR 700- 749** Establishes requirements for emergency and interim actions, public information, site investigations, design and operation of remedial action systems, and case closure.
- **State Statute Chapter 292.11** Hazardous substances spill law.

6.2.12 Forestry

- **NR 48 and s. 28.11(11) Wis. Stats.** establish requirements and procedures for withdrawal of lands from the county forest law program prior to such lands being used for purposes contrary to the law. Commercial sand mining is a contrary purpose. Lands can only be withdrawn from the program if they can exhibit a higher and better public benefit out of the program.
- **NR 46 and s. 77 Wis. Stats.** subchapters I and VI establish requirements and procedures for withdrawal of lands designated under the Forest Cropland (FCL; subchapter I) and the Managed Forest Lands (MFL; subchapter VI) programs prior to such lands being used for purposes contrary to the law. Commercial sand mining is a contrary purpose. Withdrawal taxes and fees are assessed to the owner of record at the time of withdrawal.

6.2.13 WDNR Enforcement

With the multitude of regulations the WDNR may have over a nonmetallic mine, it is important to note that there are times when permits are either not acquired prior to an activity taking place, or permit conditions are not being followed. The most common violations with regard to nonmetallic mining are a lack of attention to erosion control or storm water management, and not obtaining the proper permits for the operation. Permitting is sometimes neglected either because of a lack of information, or because of changing conditions in the mine.

A common issue regarding mine permits arises when a mine owner obtains a permit under NR 135, Wis. Adm. Code, but as the mine continues to expand over time it reaches a wetland or navigable waterway where a Chapter 30 permit, Wis. Stats., is required in addition to the NR 135 permit. Since the mine is already permitted under NR 135 permit, the owner may not be aware of the need to attain a Chapter 30 permit.

Enforcement options for violations can include use of the Department's stepped enforcement process, the issuance of civil citations, or a combination of the two.

6.3 OTHER STATE PERMITS

6.3.1 Department of Safety and Professional Services

- Has jurisdiction on building construction and any fuel storage tanks on mine or processing plant property and Blasting.

6.3.2 Department of Transportation

- DOT has authority on licensing truck drivers transporting the sand as well as truck safety, load limits, and size restrictions.

6.4 FEDERAL REGULATIONS

6.4.1 Clean Air Act, Clean Water Act, and Safe Drinking Water Act

- Wisconsin has the responsibility to implement the Federal Clean Air Act, the Federal Safe Drinking Water Act and the Federal Clean Water Act (with the

exception of wetlands regulation which are jointly regulated by the WDNR and the US Army Corps of Engineers). If enforcement actions are necessary, the federal government may take its own action, or may work in conjunction with the state.

6.4.2 Section 7 of the Endangered and Threatened Species Act

- The previously mentioned Endangered and Threatened Species Act of 1973 is jointly administered by the Wisconsin DNR and the US Fish and Wildlife Service through a formalized cooperative agreement.

6.4.3 Mine Safety and Health Administration

- Has responsibility for worker health and safety when the mine is in production.

7.0 Conclusions

The widespread use of the hydraulic fracturing technique by the oil and gas industry has resulted in the rapid expansion of frac sand mining in Wisconsin. The current non-metallic mining regulations implemented at the county level, as well as the various environmental regulations implemented by the department are adequate to ensure that permits for individual sand mining operations and processing facilities are protective of public health and the environment. As the number of sand mines and processing facilities increase, especially if clusters of these facilities begin to occur, the department may consider examining cumulative environmental impacts.

However, most sand mine siting is controlled through local zoning decisions. Unless the mine is intended to be sited in or adjacent to a navigable water, DNR authorities will not impact most siting decisions. Public comments in response to the operations sited to date have frequently focused on several impacts that the state has no authority to regulate. These impacts include: noise, lights, hours of operation, damage and excessive wear to roads from trucking traffic, public safety concerns from the volume of truck traffic, possible damage and annoyance resulting from blasting, as well as concerns regarding aesthetics and land use changes.

8.0 Links for readers to go to for more information:

- Silica sand in Wisconsin <http://wisconsingeologicalsurvey.org/silica-sand.htm>
- [Frac sand mining would add jobs in Wood County, study finds](http://www.wisconsinrapidtribune.com/article/20111014/WRT0101/110140662/Frac-sand-mining-would-add-jobs-Wood-County-study-finds?odyssey=tab%7Ctopnews%7Cimg%7CFRONTPAGE)
<http://www.wisconsinrapidtribune.com/article/20111014/WRT0101/110140662/Frac-sand-mining-would-add-jobs-Wood-County-study-finds?odyssey=tab%7Ctopnews%7Cimg%7CFRONTPAGE>
- [Centers for Disease Control paper on silicosis](http://www.cdc.gov/niosh/docs/2004-108/pdfs/2004-108.pdf)
<http://www.cdc.gov/niosh/docs/2004-108/pdfs/2004-108.pdf>
- [Frac sand sites \(map\)](http://www.wisconsinwatch.org/wp-content/uploads/2011/07/Frac-sand-sites.pdf)
<http://www.wisconsinwatch.org/wp-content/uploads/2011/07/Frac-sand-sites.pdf>
- [More information on fracking](http://www.wisconsinwatch.org/2011/07/31/explainer-what-is-fracking/)
<http://www.wisconsinwatch.org/2011/07/31/explainer-what-is-fracking/>
- [Study on the economic impacts of frac sand mining](http://centralwisconsinhub.wausaudailyherald.com/assets/pdf/U01805151013.PDF)
<http://centralwisconsinhub.wausaudailyherald.com/assets/pdf/U01805151013.PDF>
- [Wikipedia page on Hydraulic Fracturing](http://en.wikipedia.org/wiki/Hydraulic_fracturing)
http://en.wikipedia.org/wiki/Hydraulic_fracturing
- [Article on Hydraulic Fracturing](http://www.heatingoil.com/articles/hydraulic-fracturing-hydrofracking-the-risks-and-rewards-of-the-controversial-drilling-technique1130/)
<http://www.heatingoil.com/articles/hydraulic-fracturing-hydrofracking-the-risks-and-rewards-of-the-controversial-drilling-technique1130/>
- [WDNR Silica Study](http://dnr.wi.gov/air/pdf/finalsilicareport.pdf) <http://dnr.wi.gov/air/pdf/finalsilicareport.pdf>
- A Guide to Preparing and reviewing Financial Assurance for the Reclamation of Nonmetallic Mining Sites.
<http://dnr.wi.gov/org/aw/wm/publications/mining/NonmetFinAssure.pdf>