

# Wisconsin Department of Natural Resources Industrial Sand Mining in Wisconsin

*Strategic Analysis*

*June 2017*



## Foreword

This document is a strategic analysis of the industrial sand mining (ISM) industry in Wisconsin, and is authorized by the provisions of ch. NR 150, Wis. Adm. Code, and s. 1.11, Stats., the Wisconsin Environmental Policy Act (WEPA).

This strategic analysis is an informational document for the public and policy makers. It summarizes our best current information on ISM operations in the state, the known and possible environmental impacts, and applicable regulations. This document is an expansion of the DNR's 2012 Silica Sand Mining white paper. The 2012 document was intended to be a dynamic document, and this can be considered an update to that, with the latest information and facts on the industry.

There are no oil or gas wells located in Wisconsin, thus this document does not address the effects of hydraulic fracturing (fracking).

For the purpose of this document, the definition of industrial sand is as follows:

Industrial Sand is sand that is used for industrial purposes. This includes sand used for: abrasives, blasting, metal casting, chemical production, water filtration, foundry, grinding and molding, glass making, construction, as well as oil and gas recovery.<sup>1</sup>

Public comments on the strategic analysis were received by the Department from July 5 to August 22, 2016. The Department also held a public hearing on July 26, 2016.

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<sup>1</sup> OSHA website, "Description for 1446: Industrial Sand." Accessed 10-22-15.  
[https://www.osha.gov/pls/imis/sic\\_manual.display?id=397&tab=description](https://www.osha.gov/pls/imis/sic_manual.display?id=397&tab=description). WISA website, "What is Industrial Sand?" <http://www.wisconsinsand.org/industrial-sand>. Accessed 10-22-15.

## **Executive Summary**

A Strategic Analysis examines a broad environmental issue or topic rather than a specific project. The purposes of this document are to provide up-to-date information about industrial sand mining (ISM) in Wisconsin, update the department's 2012 summary paper on the subject, and address environmental topics that the public expressed interest in during the public scoping process. This report provides information about the industry and typical operations, as well as air quality, water quality, wetlands, groundwater, wildlife, endangered resources, and socioeconomics.

The demand for industrial sand has increased significantly since 2008. Wisconsin has areas that contain high quality silica sands desirable for use in the extraction of petroleum and natural gas in other parts of the country. Industrial sand mining operations in Wisconsin are primarily located in the west central part of the state.

There are currently (as of 5/23/2016) 128 industrial sand mine facilities in Wisconsin. Of these, 92 are active facilities, including 69 mine sites, 19 stand-alone processing facilities, and 4 rail loading operations. Thirty-eight of the active mine sites include an onsite processing facility. Reported acreages of active mine sites (listed below) are as permitted. At any given time, many sites are mined in sections smaller than the permitted acreage.

The permitted acreage of active mine sites is distributed as follows:

- Mine less than 100 acres: 20 sites, totaling 910 acres
- Mine of 100 to 499 acres: 32 sites, totaling 7,291 acres
- Mine of 500 to 999 acres: 9 sites, totaling 6,090 acres
- Mine greater than 1,000 acres: 6 sites, totaling 10,057 acres

### **Permits and Enforcement**

Depending on the type of facility and location, local, state, and federal regulations may apply. Land use decisions, such as allowing conversion of a property from one land use to industrial sand mining, occur at the local levels of government. All counties in Wisconsin are required to implement a nonmetallic mining reclamation permit program under DNR oversight. These programs ensure that mining sites are reclaimed to a suitable post mining land use. DNR permits to operate may be required, as well as state permits associated with construction of the mining facilities, roads, ponds, parking lots, and railroads. Many of the state permits require a full consideration of potential impacts to endangered and threatened species, fisheries, and cultural resources. Federal permits from the U.S. Army Corps of Engineers may be required for construction affecting wetlands and waterways.

The most common state permit violations with regard to nonmetallic mining involve a lack of attention to erosion control or storm water management and not obtaining the proper permits for the operation. Enforcement options through the DNR's stepped enforcement process may include the issuance of civil citations or referrals to the Department of Justice. Since 2012, the DNR has pursued enforcement for ISM facilities for 29 cases including 5 air related issues, 23 water permit issues, and one case that was combined air and water related issues.

## **Air Quality**

The main air pollutants associated with industrial sand mining facilities are particulate matter (PM). Particulate matter from these types of facilities can contain crystalline silica. There is not currently a National Ambient Air Quality Standard (NAAQS) or federally approved ambient air monitoring method for crystalline silica as it is not a pollutant explicitly regulated by the Clean Air Act. There are sampling and analysis methods approved for evaluation of occupational exposures to crystalline silica, but these are insufficient for detecting and quantifying crystalline silica at ambient levels and have not been endorsed for ambient monitoring by EPA. Industrial sand mining facilities that are required to monitor for particulate (under ch. NR 415, Wis. Adm. Code, pertaining to industrial sand mines and ledge rock quarries), typically monitor for PM<sub>10</sub> (particulate matter less than 10 microns in size) because the particulate from industrial sand mines is primarily composed of larger size fractions. Particulate matter less than 2.5 microns (PM<sub>2.5</sub>) is a particulate size derived from combustion activities or chemical reactions in the atmosphere between precursor pollutants like nitrates and sulfates, and not from processing or mining of sand. Air quality monitors in western Wisconsin have not detected elevated levels of PM<sub>2.5</sub>. Particulate emissions are addressed by health-based regulations, and existing monitoring data have not identified problematic air quality at sand mining and sand processing sites.

Industrial sand activities and their impact on air quality have been regulated for many years. Particulate emissions are addressed in Ch. NR 415 Wis. Adm. Code, with s. NR 415.075, specifically addressing particulate emissions from ledge rock quarries and industrial sand mines. Federal and state ambient air quality standards exist for particulate matter and many commonly emitted hazardous air pollutants, but state standards do not explicitly exist for diesel exhaust or crystalline silica.<sup>2</sup> Crystalline silica can be a component of particulate matter, but is not a component of all particulate matter (i.e., such as particulates from combustion sources, pollen).<sup>2</sup> All crystalline silica that is in the ambient air exists in the form of particulates. Therefore, any control measures designed to reduce particulate matter in general, will also reduce the levels of any particles that also contain crystalline silica. Diesel exhaust emissions are addressed through Federal standards regulating the sulfur content in fuels and engine efficiency.

## **Groundwater**

Most industrial sand mines and processing plants utilize groundwater from high capacity wells. Of the 92 active Industrial Sand sites in Wisconsin, 63 have registered withdrawals over 100,000 gallons per day, including high capacity wells and surface water withdrawals.

Storm water ponds, if unlined, allow mine site runoff to infiltrate to the groundwater. In the fall of 2017, the department will convene a team of stakeholder experts to direct new research regarding possible linkages to increased concentrations of dissolved metals in groundwater at ISM pond sites.

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<sup>2</sup> For more information about crystalline silica, see the Silica report to the Natural Resource Board, August 2011 (<http://dnr.wi.gov/files/pdf/pubs/am/am407.pdf>).

Operations that clean or process industrial sand commonly use polyacrylamides as a flocculant to remove unwanted minerals and fines from water used to wash the sand. Current data has not detected acrylamides in groundwater at or near ISM facilities.

### **Surface Water**

To date, no industrial sand mines have been authorized to mine sand material from the bed of any lake or stream.

Potential impacts to surface waters from ISM facilities include the discharge of storm water runoff from the mine, dewatering processes taking place in the mine, or inadvertent releases from wastewater storage ponds or pollutant spills. Construction of certain aspects of ISM facilities may have waterway impacts due to stream crossings and grading near waterways. The primary water pollutant of concern near mining sites is earthen materials that result in total suspended solids. A review of discharge monitoring data of process wastewater in 2014 from 17 different industrial sand mine facilities showed total suspended solids ranging from no detect to 199 mg/l.

### **Wetlands**

Impacts to wetlands related to the ISM industry are most often associated with the infrastructure required in the many aspects of ISM, including mine sites, processing facilities, or transportation facilities. Since 2008, the DNR has issued 46 wetland individual permits and 21 wetland general permits to 36 different ISM permit applicants resulting in a total of 47 acres of permanent wetland impacts. Fifty-one acres of wetland compensatory mitigation has been authorized in the form of mitigation bank credit purchase or through the utilization of the state's in-lieu fee credit program.

### **Transportation**

The industry is largely rail dependent, but trucks may be used to transport sand from the mine to the processing facility and from the processing facility to the rail load-out facility. The increased use of public roads by heavy trucks can cause road damage, as well as traffic safety concerns. These issues are regulated by local units of government and the Wisconsin Department of Transportation, who reports that impacts to the State highway system from ISM has been minimal.

Wisconsin railroads have invested significantly in upgrading their infrastructure to handle the increased loads and frequency of industrial sand going out of the state. Increased rail traffic has raised concerns about noise, delays, rail grade crossing safety and emergency vehicle delays. Conversion of current "railbanked" trails, built on historic rail corridors, could occur in the future.

### **Agriculture**

According to the USDA 2014 Wisconsin State Overview Survey, there were 14.5 million acres in agriculture use in the state, compared with nearly 34,000 acres of permitted industrial sand mines. In the five counties with the highest number of permitted ISM facilities, there were just over 1.48 million acres of agricultural lands according to the USDA 2012 Census and 19,825 acres in industrial sand mining in those same counties, as of 2016.

## **Local and State Economy**

Statewide estimates of the number of people directly employed in ISM range from 2,300 to 4,200, a ten to twenty-fold increase over the last decade. The average ISM worker earns the equivalent of \$57,000 a year, although data on recent layoffs suggest that ISM employment is vulnerable to fluctuations in oil and gas prices. Several studies have looked at the broader impact of ISM on state and local economies. While these studies differ in their focus, scale and approach, some general findings emerge. First, ISM generates positive spillover effects in construction, retail, and other industries, as well as tax revenues, although some locales are better positioned than others to capture these benefits. Second, negative externalities such as noise and increased truck traffic are likely to reduce the value of nearby residential properties and may affect tourism in some areas. Finally, recent trends associated with other types of mining raise concerns that ISM could follow a boom-and-bust cycle whereby short-term benefits are negated over time.

## **Property Values**

Property values of industrial sand facilities may go up due to the physical improvements to the site, and could hold that value as long as a mine is in operation and is maintained. The tax base in local areas may go up in response to the increase in property values and improvements at production sites. The value of nearby residential properties may go down due to the close proximity of mine facilities.

## **Archaeological, Cultural, Tribal and Historic Resources**

Under provisions of Wisconsin statutes, DNR works 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 a sovereign nation, each Tribe has the ability to regulate their tribal lands. However when an activity is located on non-tribal lands, they typically have little to no input on the location or activity. Tribal governments can request formal consultation with the DNR so that the State and the Tribe can discuss the issues at a government-to-government level.

## **Safety**

The Mine Safety and Health Administration is responsible for overseeing safety and health standards at the nation's mines. The Wisconsin Department of Safety and Professional Services (DSPS) is responsible for ensuring the safe and competent practice of licensed professionals in the state. DSPS also has jurisdiction over building construction, fuel storage tanks and blasting on mine or processing plant properties.

## **Visual and Auditory**

Regulation of impacts due to light and noise are not under DNR jurisdiction. Several counties and towns have chosen to adopt ordinances to restrict hours of operations to limit impacts of light disturbance, and to address hours of operations and decibel limits at the perimeter of facilities to limit impacts of noise disturbance.

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# 1 Introduction to Industrial Sand Mining

## 1.1 Historical Sand Mining

Sand mining has occurred in Wisconsin since the arrival of the first permanent European 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 19<sup>th</sup> century. Sand is also mined for filter beds for drinking water and wastewater treatment, well screen packing, glass manufacture, and bedding sand for dairy operations. The highly desirable physical and mineralogical properties of Wisconsin's industrial sand resources for use in the petroleum extraction industry has resulted in significant increases in demand for the product since 2008. This increase corresponds with rising oil prices and the subsequent growth of the domestic oil shale well construction industry.

## 1.2 Current Sand Mining

### 1.2.1 Current Market

Industrial sand is a significant sector of the nation's economy, with over \$8 billion in sales in 2015. According to the U.S. Geological Survey's (USGS) most recent Mineral Commodity Summaries,<sup>3</sup> nearly 95 million metric tons of industrial sand were produced in 2015. This represents a 14% decrease from 2014, coinciding with a drop in oil prices, but a 53% increase from 2013. Seventy-one percent of the sand produced in 2015 was used as either frac sand or well-packing and cementing sand. Industrial sand is also used in glassmaking, foundry sand, whole-grain fillers, building products, whole-grain silica, ground and unground sand for chemicals, and other uses (USGS 2016).

<b>Salient Statistics—United States</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015<sup>b</sup></b>
Production	43,800	50,600	62,100	110,000	94,900
Imports for consumption	316	306	160	244	300
Exports	4,330	4,360	2,960	4,450	4,500
Consumption, apparent	39,800	46,600	59,300	106,000	90,700
Price, average value, dollars per ton	45.74	52.80	55.80	74.80	86.93
Employment, quarry and mill, number <sup>b</sup>	3,000	3,500	3,800	4,000	3,800

<sup>a</sup> Data in thousand metric tons unless otherwise noted  
<sup>b</sup> Estimated.  
Source: U.S. Geological Survey, Mineral Commodity Summaries, January 2016

Wisconsin is the leading state for industrial sand production. Industrial sand produced in the state is either processed at the mine or shipped to processing facilities before being shipped to market. Processed sand used for hydraulic fracturing is shipped to oil and gas

<sup>3</sup> U.S. Geological Survey (USGS). 2016. Mineral Commodity Summaries 2016. Reston, VA: USGS. <http://minerals.usgs.gov/minerals/pubs/mcs/2016/mcs2016.pdf>.

wells in Pennsylvania, North Dakota, Texas and other states where shale deposits contain economic reserves of oil and gas.

The DNR has experienced a substantial increase in permit requests from companies seeking to mine industrial sand since 2008. This has led to production capacity upgrades, ongoing permitting, and opening of new mines. New and more efficient fracking techniques, which require more silica sand use per well, have also increased demand for frac sand. Recent market downturns have not completely shut down the demand; however, there has been a reduction in production that appears to follow the cyclical nature of the market.

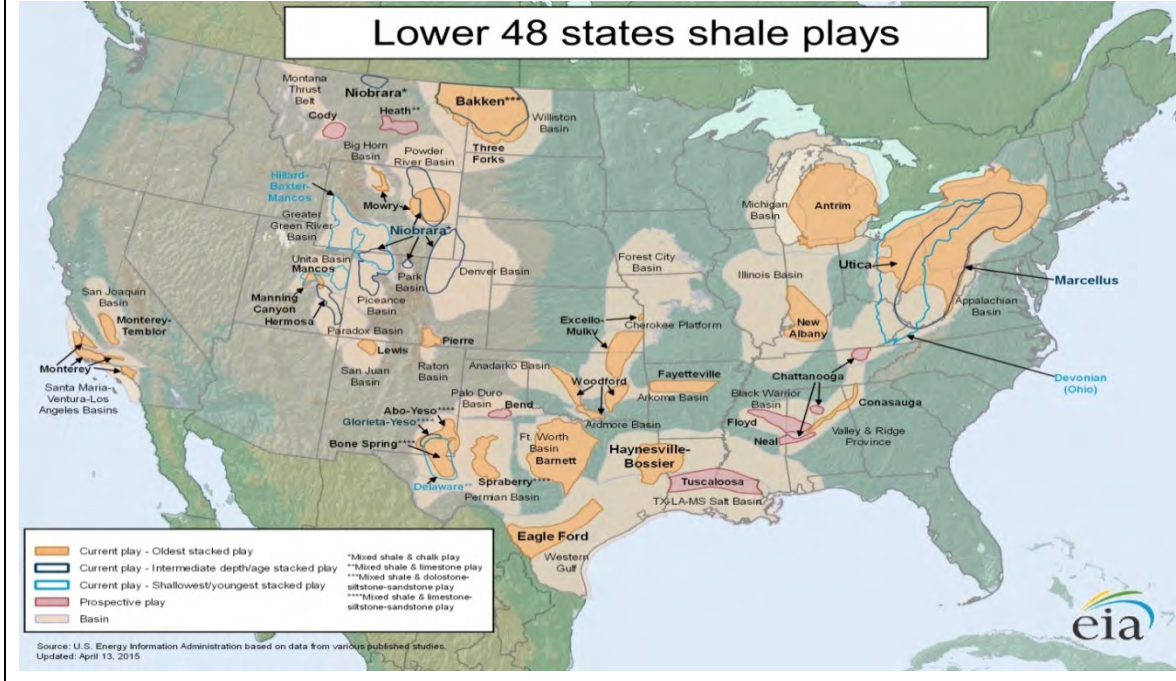
### **1.2.2 Explanation of Hydraulic Fracturing**

Hydraulic fracturing (or fracking) 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. After drilling, water, "frac sand," and chemicals are pumped into the well under high pressure. The fluid pressure drives open and expands 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. This functionality has resulted in frac sand and alternative materials that are used to hold fractures open being called proppants. Some alternative proppants used in fracking include ceramic grains and resin coated sand. Alternatives are used in the same way as sand and are added to a fracking fluid which may vary in composition depending on the type of fracturing used, and can be gel, foam or water-based.

Fracking has been around for over 60 years but recent developments in directional boring and other technologies in combination with fracking now allow for the extraction of natural gas and oil that was previously not extractable. Industrial sand for use in the petroleum industry as fracking material (frac sand) has been produced in Wisconsin for over 40 years. By fracturing the rock and then holding these fractures open it is possible to access and remove the resources sequestered in the rock. 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 fracking and thus an increase in demand for industrial sand. Most of the natural gas shale rock wells are located in Texas, Oklahoma, Mississippi, Arkansas, New York, North Dakota and Pennsylvania.

Wisconsin has no known oil or gas deposits. Therefore no fracking related to oil and gas production exists in the state.

**Figure 1-1** Shale formations where hydraulic fracturing may occur  
(source: U.S Energy Information Administration)



Frac sand is silica sand or silicon dioxide (SiO<sub>2</sub>), 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.

Not all silica sands can be used for fracking. 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 hold its structural integrity under high pressures, therefore it is imperative that the grains have a high compressive strength, or crush strength. The desirable crush strength for frac sand generally falls 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.

### 1.2.3 Location of Sand Resources

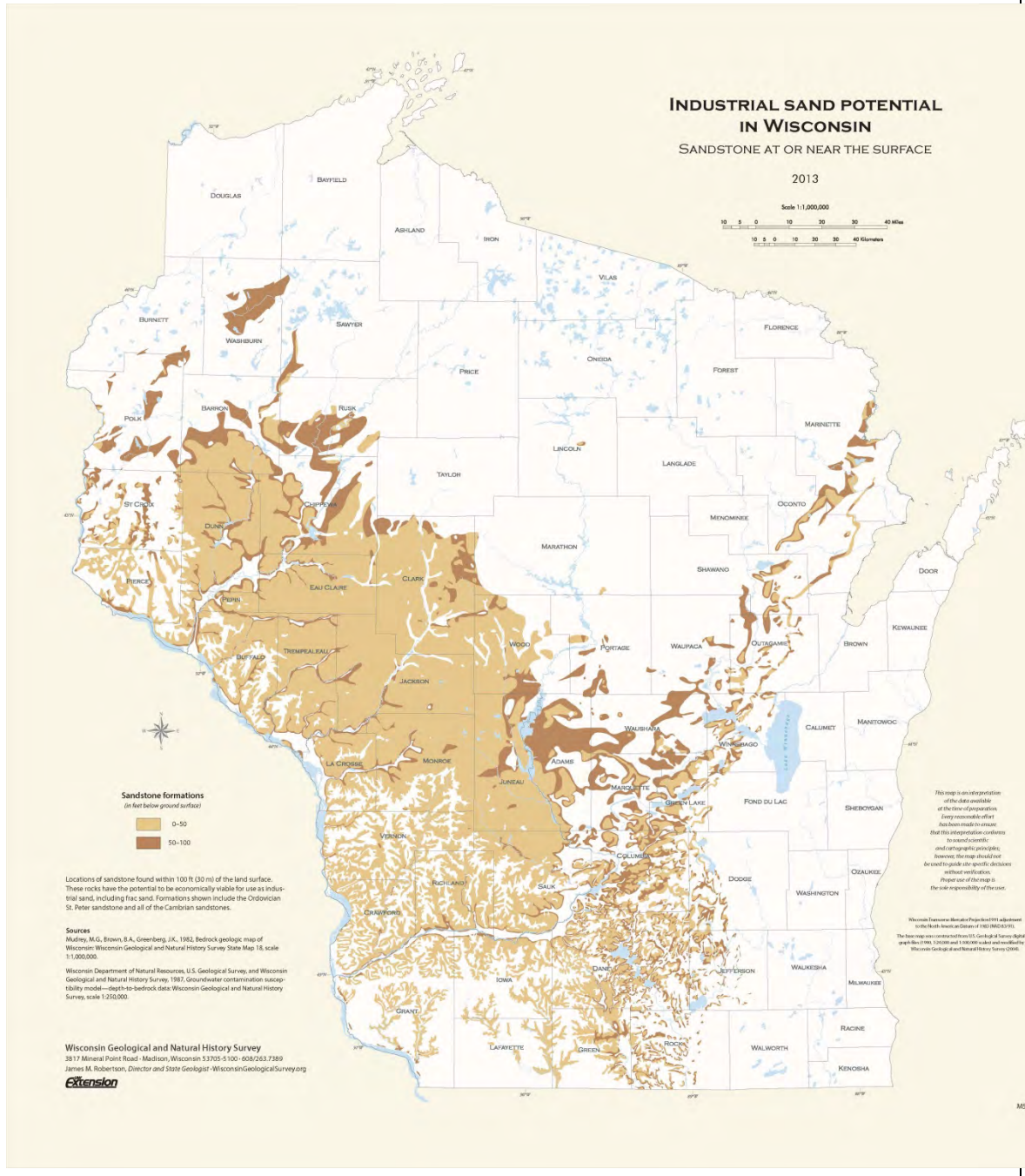
Wisconsin sand resources that meet industrial frac sand specifications are found in the Cambrian-age Jordan, Wonewoc, and Mt. Simon Formations (see Figure 1-2), and in the younger, Ordovician-age St. Peter Formation. Principal areas of interest for sand mining have been in western Wisconsin, from Burnett 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 some portions of the Tunnel City sandstones are unsuitable for frac sand, although they

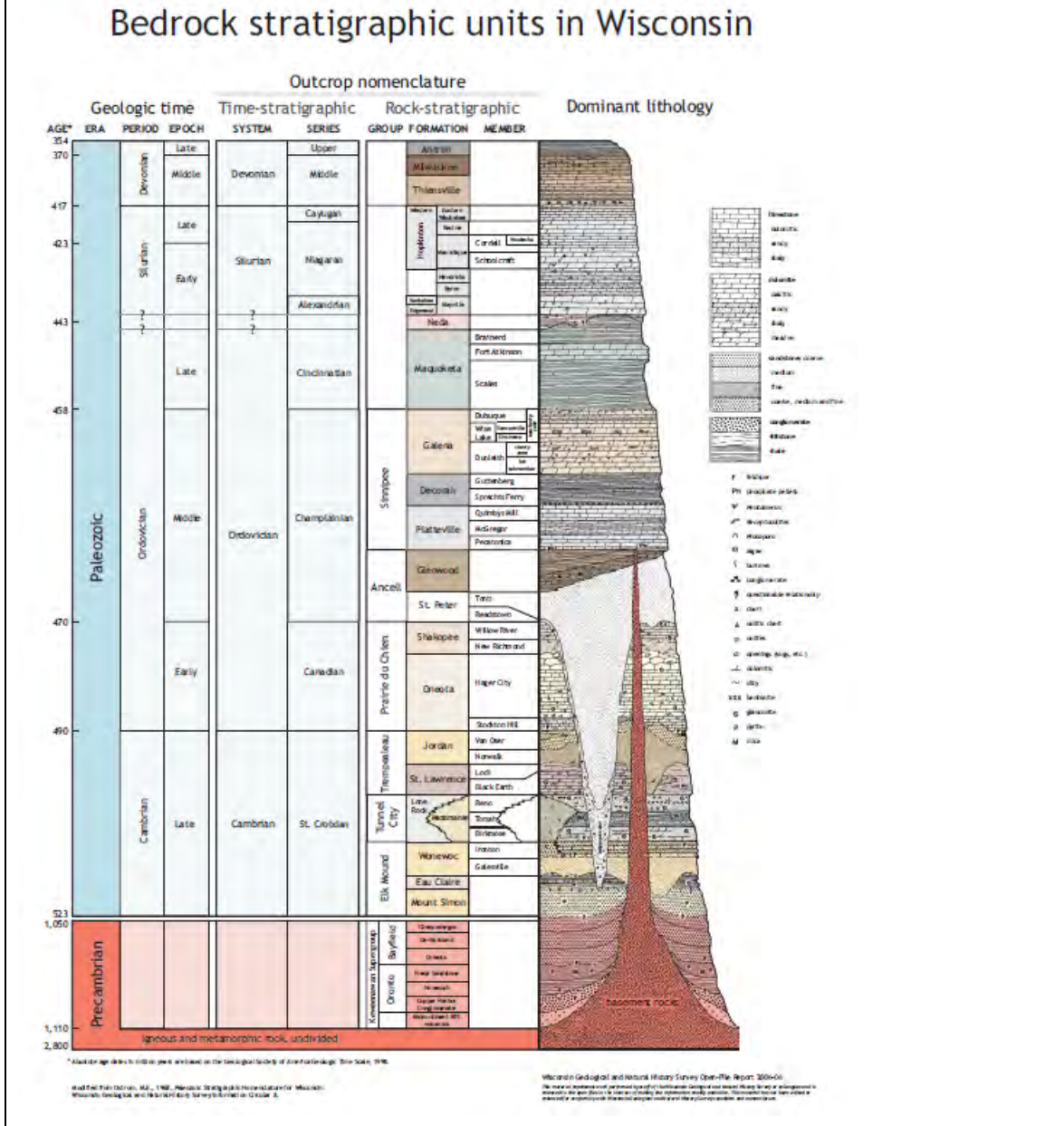


may have other industrial sand applications. In Pierce County, Jordan Sandstone (the upper coarser grained Van Oser member) has been mined underground for many years from tunnels driven into the bluffs beneath the Prairie du Chien Dolomite. The fact that the Van Oser Member is near the top of the Jordan 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.

**Figure 1-2 Sandstone at or near the surface in Wisconsin**  
(source: Wisconsin Geological and Natural History Survey)



**Figure 1-3** Bedrock stratigraphic units in Wisconsin  
(source: Wisconsin Geological and Natural History Survey)



### 1.2.4 Current Operations

Current mining operations are primarily located in West Central Wisconsin, but there are also facilities in Burnett, Green Lake, Outagamie and Waupaca Counties. The following table and [interactive map](#)<sup>4</sup> contain information that is current as of May 23, 2016.

<sup>4</sup> The online map can be accessed at <http://dnr.wi.gov/topic/Mines/ISMMMap.html>.

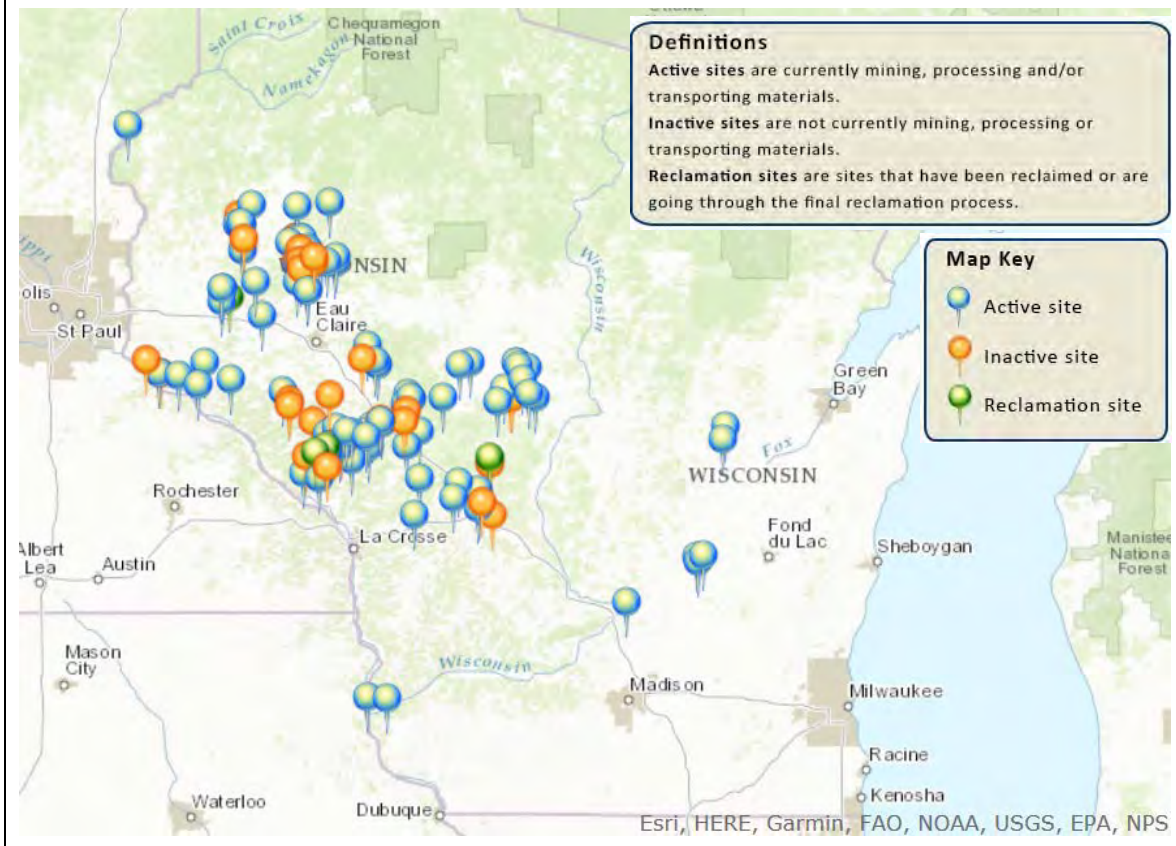
**Table 1-2** Current industrial sand mine site totals

Total Number of Industrial Sand Facilities (Mines, Processing & Rail Loading)	128
Number of Active Facilities (Blue Pins on Figure 1-4)	92
Number of Inactive Facilities (Orange Pins)	32
Number of Facilities Reclaimed/In Process of Final Reclamation (Green Pins)	4

Data source: <http://dnr.wi.gov/topic/Mines/ISMap.html>

Statewide, the permitted acreage for ISM facilities is 33,517 acres. Of the 92 active facilities, 69 are mine sites, 19 are stand-alone processing facilities, and 4 are rail loading operations. Of the active mine sites, 38 include onsite processing facilities. The size distribution of the 69 active mine sites is as follows: 20 are less than 100 acres, for a total area of 910 acres. Thirty-two are between 100 to 499 acres in size, for a total area of 7,291 acres. Nine mine sites are between 500 to 999 acres, for a total area of 6,090 acres. And six sites are greater than 1,000 acres, for a total area of 10,057 acres.

**Figure 1-4** Map of active, inactive, and reclaimed industrial sand facilities  
(source: <http://dnr.wi.gov/topic/Mines/ISMap.html>)



### 1.3 Aspects of Industrial Sand Mining

Contemporary ISM in Wisconsin is typically conducted using either dry or wet surficial mining techniques with the exception being two underground mining operations in western Pierce County. The applicability of the mining method is dependent on the



location, depth, competency of material, accessibility of the targeted sand unit, and depth to groundwater. Targeted sand units may occur as either sandstone outcrops where the rock containing the desired material is exposed and readily available at the surface, or as subsurface units that require removal of vegetation and overburden materials. All mining methods may require further processing for sizing and removal of impurities from the sand, generating non-marketable materials that are most often reused in mine reclamation activities. Additional information on Industrial Sand Mining can be found at the Wisconsin Geologic and Natural History Survey website<sup>5</sup>.

### **1.3.1 Dry Mining**

Dry mining techniques incorporate the phased removal of vegetation, overburden, and finally the desired formation without intercepting the water table. Mine shape and structure varies depending on the topography, competency of the unconsolidated material or rock units, the thickness of the targeted sand formation, and location requirements for engineered structures.

#### **Land Clearing and Overburden Removal**

To access the targeted sand unit at a site, it may be necessary to remove vegetation and overburden. Overburden is broadly classified as topsoil, subsoil, unconsolidated sediment or undesirable rock units overlying the targeted unit. Overburden thickness can be highly variable. Wisconsin's sand formations, however, are generally accessible close to the surface, meaning there is often minimal overburden to remove. What is removed is typically stockpiled or used to create engineered structures on the mine site such as berms, roads, and containment structures. Topsoil is separated and either stockpiled or laid over berms so that the structures can be seeded and mulched for stabilization. Berms often 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, they act as a noise barrier, and/or they provide a barrier to stormwater running off the site.

#### **Excavation**

Once the overburden has been removed, the targeted sand unit can be excavated. Depending on the mineralogy, physical properties, and morphology of the formation, the sand grains may be loose (unconsolidated), or aggregated with cementing materials to form sandstone. It is the degree of cementation and the mineralogy of the cement that determines what type of excavation equipment and process will be necessary to mine the sand. If the formation is very well cemented, blasting may be necessary to make the sand-containing material more amenable to excavation. Depending on the depth of the targeted material, mining techniques may include surface, bench, or underground. With the desired sand in western Wisconsin being near the surface, the need for underground mining is not in demand. The relative costs associated with underground mining (smaller excavation equipment, ventilation systems, and safety methods) are also a factor in the type of mining in Wisconsin.

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<sup>5</sup> <http://wgnhs.uwex.edu/wisconsin-geology/frac-sand-mining/frac-sand-mining-process/>

Surface mining is the removal of shallow targeted sand units by use of an excavator or dragline on relatively flat terrain. This is most efficient when the desired formations are at, or close to, the surface and horizontally oriented. Depending on the level of cementation, the material may be excavated, or may need blasting to facilitate removal. Unconsolidated sand units in Wisconsin generally occur as glacial or alluvial deposits in low-lying areas. The excavation of these deposits is typically performed by large tracked excavators or rubber-tired front end loaders, much like construction earth moving activities. Surface mines are generally relatively simple to reclaim and stabilize due to the low relief; however, they often intercept the water table and are in close proximity to waterway and wetland resources, increasing the risk for discharge impacts.

**Figure 1-5** *A surface mine*  
(photo: Zoe McManama, DNR)



Bench mining or highwall mining is common throughout the coulee area of western Wisconsin, where the targeted sand units are found within hills. The slopes may require benching of the landscape in order for the material to be accessed while remaining stable, resulting in a stepped appearance. Although the occurrence of wetlands and surface water bodies is unlikely in these hills, and the targeted rock units are generally unsaturated by groundwater, bench mines do require the disturbance of steep slopes which increases erosion potential. If the material is competent and stable, the back wall may be left un-benched, resulting in the formation of highwalls.

**Figure 1-6** A high wall showing industrial sand layers in the middle  
(photo Roberta Walls, DNR)



Depending on the level of cementation, the material may be excavated, or may need blasting to facilitate removal. The success of bench mining is largely dependent on the stability and competency of the materials that are being worked, and the ability of the mine operators to effectively reposition fill materials to achieve specified reclamation objectives.

### **Blasting**

In situations where the sand-bearing geological formation is tightly cemented, it may be necessary to utilize blasting to make the material more amenable to excavation. Blasting practices can result in noise, vibration, and fugitive dust emissions. Blasting at mines will vary with site-specific geology and the needs of the operator. While some sites do not need to blast at all, others may need to blast as frequently as every day or only once every few months.

Blast scenarios are specific to each mining operation and geological formation. An example of a typical sand mine blast consists of drilling a series of holes, 2 to 3 inches in diameter, into the formation to be blasted. The holes could be up to 50 to 150 feet deep and located in a grid pattern (20' x 20' is typical). A charge of explosives (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 - 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 dependent on what is readily available at the mine site and is typically 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.

**Figure 1-7** Blast at an industrial sand mine  
(photo Roberta Walls, DNR)



Federal Mine Safety and Health Administration (MSHA) rules require the use of water injection when drilling the blasting holes in order to control 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.

## **Crushing**

Crushing is the term applied to the mechanical process of liberating sand grains from their cementing matrix, while keeping the sand grains intact. If the targeted sand unit is cemented enough to require blasting, it is likely that the material will then need to be crushed to isolate the desired sand from the cementing material. After blasting, the mix of rocks and boulders displaced by the blast, or *shot rock*, is transported to a crushing unit by conveyors or haul trucks. Crushing units may range in size from small, portable units to large in-situ facilities.

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 an electric motor and 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 sand grains are separated into discrete sizes, and hauled to designated stockpiles. Larger pieces are recycled within the plant to the secondary crusher and screens until they have reached the desired size.

## **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 slurry by the addition of water, which is typically provided in a closed-loop system (onsite water reuse). A slurry system may require approximately 3,000 gallons per minute 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. Not every facility uses this process to settle colloidal materials. Some facilities may use clarifiers or ultrafine recovery systems. Please refer to the section 2.4.2 of this document for more information regarding wastewater discharge.

Processing is conducted with equipment that may include screening, hydrocyclones and other wet processing methods (see section 1.3.3 for details on processing). Flocculants (chemical additives) may be used to settle suspended fine particulate materials such as colloidal clays. The materials (mainly sand) processed are within a closed-loop wet system. The coarse graded finished sand from the wet process is then sent to a stockpile for storage or transport.

## **Stockpiling**

Stockpiles are temporary piles of unprocessed or processed material that has been excavated and relocated within the footprint of the mine site, or processing facility. The piles and their immediate area are regulated under DNR air and stormwater rules. Local county and town regulations may also address stock pile regulations under ordinance and/or reclamation permits. Stockpiles may contain segregated materials such as topsoil or processed sands, or aggregated material such as shot rock or raw excavated material, non-marketable post-processing waste materials, and/or fill materials. Stockpiles may be formed by conveyors, loaders, or dump trucks, and take many geometric forms.



Stockpiles containing fine-grained waste materials are prone to instability and runoff problems, especially those that have been combined with flocculants. These problems can be addressed by the timely incorporation of these materials into reclamation areas, covering the piles, or by mulching and seeding for revegetation, in the case of soil stockpiles.

### **1.3.2 Wet Mining**

Wet mining or wet extraction techniques involve the mechanical or hydraulic removal of raw materials from targeted formations that are underwater. In Wisconsin, wet mining is undertaken when the location of targeted formations occurs below the water table, resulting in the flooding of the open pit or trenches as they are excavated. Removal of materials from the water-filled pit is commonly achieved using either dredge barges or draglines.

#### **Land Clearing**

Land clearing for wet mining uses the same methodology as dry mining; however, depending on the final post-mining land use that the mine operator has proposed in the reclamation plan, the stockpiling of overburden and non-marketable materials on site may differ. If the plan proposes back filling of open water areas, then non-marketable materials will be stockpiled in a manner similar to dry mining to use as fill. If the final land use proposes a permanent pond, then materials may be removed from the site for other uses such as soil amendments, fill, and/or road building.

#### **Dredging Operations**

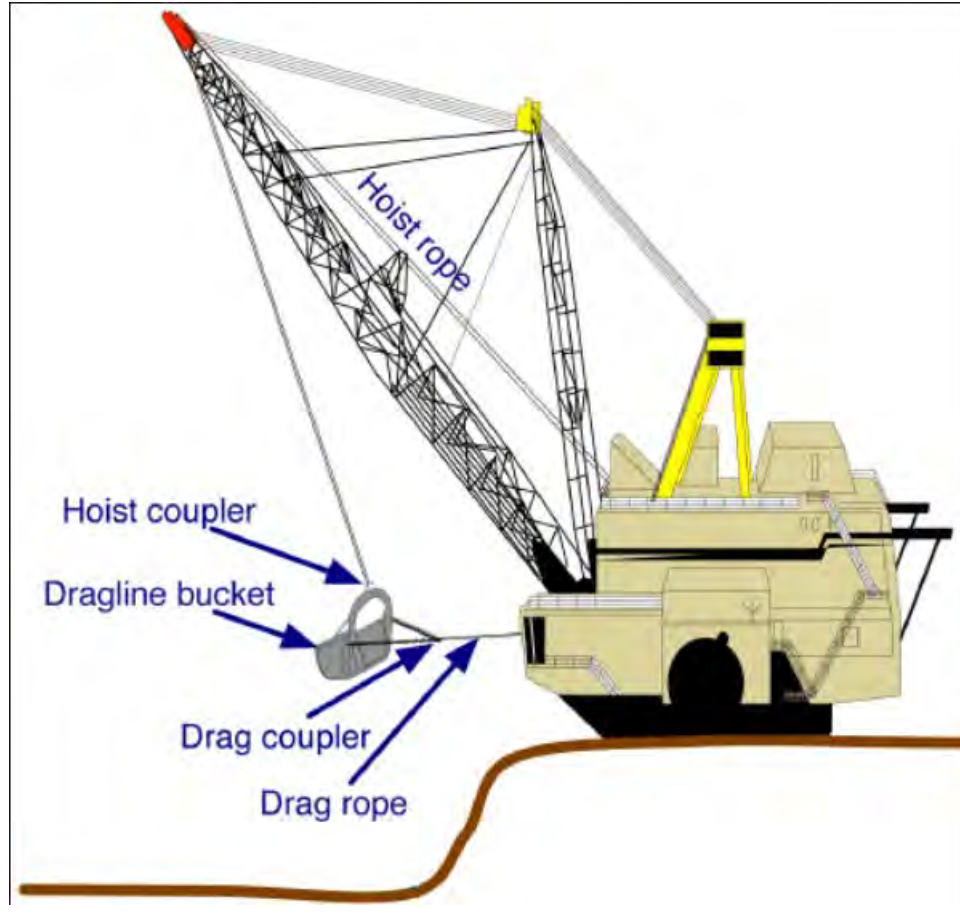
Dredging is defined as the excavation and removal or repositioning of material from an underwater or saturated environment. Depending on the competency and quantity of the material that is being extracted, and the depth of water over that material, dredging is undertaken using either mechanical or hydraulic dredging.

Dredging on industrial sand mine sites is either implemented as part of the sand extraction process, or as a mechanism to clean out stormwater and process water retention ponds on site. The management of accumulated sediment in stormwater management structures is regulated under Ch. NR 528, Wis. Adm. Code, while process water fines are regulated under the facility's WPDES permit (see section 2.4.2).

#### **Mechanical Dredging**

Mechanical dredging is undertaken by heavy machinery equipped with buckets. The configuration of the equipment may be as simple as the placement of an excavator equipped with a clam-shell or scoop bucket on a barge with a companion barge on which to place dredged material, or the more complex dragline configuration with a longer boom operating as a barge mount or from onshore.

**Figure 1-8** *Dragline excavator*  
(source: Wikipedia)



Barge mounted excavators are generally used for limited quantity extractions in shallow areas, due to their limited reach.

Draglines consist of crane-like booms equipped with guide lines and lifting cables attached to a toothed excavation bucket. They are limited in scope by the length of the boom and lifting capacity (which controls depth of excavation and bucket load size), and can be mounted on barges. When on upland areas, draglines can be used for strip dredging along an active face where the rig can run along high ground while excavating the adjacent underwater material. Draglines can be used for both above and below water excavation, and to remove material from areas too shallow or small for barges to operate, such as stormwater and process water ponds.

### **Hydraulic Dredging**

As opposed to dredging equipment mounted on barges for access purposes, hydraulic dredges are whole barge units equipped with an auger (cutterhead), or high-pressure water jet to break apart the material to be removed, and a suction line to transport the dislodged material to the surface. Dredge barges that operate on water are stabilized by counterweight piles called spuds, which are deployed at the opposite end of the barge as the operating head, and by guidelines tethered to shore to control drift.

**Figure 1-9** A hydraulic dredge and suction line at an industrial sand mine  
(photo Roberta Walls, DNR)



## **Dewatering**

Dewatering is the surface or subsurface mechanical removal and relocation of water from a working area or proximity to facilitate the operation of excavation equipment, other machinery, or processes. The water may be the result of groundwater interception, precipitation, and/or lateral infiltration from ponds. Dewatering may be permitted by the DNR's Groundwater Program if a well is used (see section 2.3.11 of this document) and by the DNR's Stormwater Program (section 2.4.2).

### **1.3.3 Processing**

To be used for industrial applications, sand usually has to undergo further processing to remove impurities, be placed into uniform size classes, and be graded for physical properties such as crush strength. To achieve this uniformity, the sand is run through a processing plant. The plant will wash, dry, sort, and store the sand.

#### **Types of Process Systems**

The primary goal of processing is to remove unwanted particle sizes (typically finer fractions) from the sand to create the desired size mixture. At the most basic level, washing is done by spraying the crushed material 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 into which water and sand are continuously directed. The water washes the sand and the

overflow water, along with the fines, overflow from 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 sent to a surge pile where water adhering to the sand particles is collected for treatment and reuse, or is allowed to infiltrate back into the ground or evaporate. Collection and reuse of process waters is common, with the water diverted to ponds or clarifiers for treatment before being recirculated. In Wisconsin, the wet portion of the processing facilities typically runs from April to mid-November, though some wash plants may be enclosed in order to wash sand year-round. 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, which 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 air is introduced through holes in plates in the bottom of the dryer. This heated air lifts the sand and 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 industrial applications is kept, and sand that is not suitable may be sold for other uses.

Some specialized processing plants may further treat the sand by applying a resin coating to the sand particles to increase the crush strength and help them flow as a slurry in fracking activities. Other facilities may treat the sand particles with acid to remove as many impurities as possible. This is important for sands used in the production of glass, steel, and specialized sands for laboratory and consumer products.

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 that support the processing facility. In the latter scenario the sand is transported to the processing plant by dump trucks or tractor-trailer units.

### **Processing-Related Additives and Chemicals**

Additives are commonly used in wet processing – primarily to assist in the removal of very fine particulates, or colloids, from recirculated wash water. These additives may include coagulants that destabilize the suspended colloids. Flocculent is then added, which binds the destabilized colloids together to make larger, heavier particles that fall to the bottom of the pond or clarifier. To assist in the efficacy of these additives, and help clear the water for reuse, it is also sometimes necessary to apply pH adjusters and/or algaecides.

Coatings (such as resins), finishing products, cleaning agents, and/or surfactants may also be used in processing. The disposal of these waste materials must be in compliance with state and federal waste and wastewater rules.

### **1.3.4 Process Water and Stormwater Management**

Rain falling on bare soils can cause erosion and create stormwater runoff carrying soil particles called sediment. Permitted facilities are required to use best management practices (BMPs) to control and prevent pollutants in stormwater runoff and process water discharge. Chapter NR 216 of the Wis. Administrative Code contains a list of industrial facilities that must obtain stormwater discharge permit coverage and includes non-metallic mining. The determination of whether an industrial facility must obtain stormwater discharge permit coverage is based on the facility's Standard Industrial Classification (SIC) code of which Industrial Sand Mines are classified as SIC 1446. Regulation of Stormwater and process wastewater from industrial sand mines is covered under a WPDES general permit (GP). See section 2.4.2 for more information on WPDES permit requirements for stormwater and wastewater discharges, which is a combined permit for both discharges.

#### **Erosion Control and Stormwater Treatment**

Permitted facilities must develop a site-specific Stormwater Pollution Prevention Plan (SWPPP). The goal of this plan is to encourage source-area control through identification of a stormwater pollution prevention individual, site-specific best management practices, and implementation schedules to help decrease the amount of contaminated stormwater runoff from a facility. Some industrial facilities may also be required to conduct annual chemical monitoring for pollutants in runoff from their sites.

#### **Process Water Sources and Management**

A WPDES permit for nonmetallic mining sites includes requirements for discharges of mining wastewater to groundwater and surface water resources from operations. Types of wastewater covered under the permit include dewatering of mining areas to remove excess water (from stormwater or groundwater), aggregate and equipment washing, noncontact cooling of machinery or boilers, and dust control. The pumping of mine dewatering wastewater off the mining site is required to be monitored as well. The pumping of stormwater to seepage areas (the recommended Best Management Practice) within the mining site is not required to be monitored.

### **1.3.5 Spill Prevention and Response**

#### **Process**

With any industry that uses vehicles and heavy machinery the potential for spills of gasoline, diesel fuel, and hydraulic fluid exists. The use of processing equipment could also result in spills of cleaning solvents and paints. Excavation work may also expose evidence of spills that occurred several years ago. Ch. NR 706, Wis. Adm. Code, specifies when a hazardous substance spill must be reported to the DNR. The definition of a "hazardous substance" is provided in s. 292.01(5), Wis. Stats and the determination of who is responsible for reporting and cleanup is specified in s. 292.11(3), Wis. Stats. All hazardous substance spills need to be cleaned up to the extent possible and contaminated materials need to be properly disposed of.

## **Equipment**

Mining contractors that have a reasonable chance of being responsible for hazardous substance spills should ensure that they have access to basic spill response supplies. These can include, but are not limited to: dry loose adsorbent material, absorbent pillows, pads, boom, plugs, drip pans, spill berms, and drums to containerize and dispose of spilled materials.

## **Waste Management**

Proper management of nonmetallic mining wastes is necessary to ensure compliance with environmental regulations, achieve mine site stability, and undertake successful reclamation activities. Most waste materials generated by ISM stay on the mine site, with the exception being those that are generated at sand processing facilities and then returned to the site for reclamation material.

Hazardous materials on industrial sand mine sites are generally limited to heating fuels, heavy equipment fuels and machinery maintenance products. Specialized facilities using acid or solvents in their processing may be considered hazardous waste generators and regulated accordingly. Non-hazardous wastes generated by mining operations, including nonmetallic mining, are either classified as solid waste or wastewater.

### **1.3.6 Transportation and Load-out Facilities**

Transportation of sand, from the time it is mined, processed and eventually delivered to the location where it will be used, can take many forms depending on the location of the mine, the processing facility and the ultimate destination.

#### **Road Systems**

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 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 Systems**

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 covered hopper cars that open at the top, while some are compartmentalized, bottom-unloading gondola type cars.

**Figure 1-10** *A rail siding*  
(photo Roberta Walls, DNR)



### **Barge Systems**

Silica sand is hauled by barge in applications similar to rail, open or closed, depending on the condition of the sand. Environmental Protection Agency air and water rules apply. Normal payload is 1,500 tons per barge. A river tow (collection of barges under control of a single towboat) may carry 22,500 tons or more (MN Environmental Quality Board). Some Wisconsin operations truck sand to Minnesota to be processed, after which the sand is loaded onto barges and transported to market down the Mississippi River.

### **Conveyor Systems**

Conveyors are used throughout industrial sand mines and processing plants. 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 does not require any further BMPs. However, sand conveyed from the storage piles to further processing (transfer to dryers) is typically drained and may require fugitive dust minimization practices.



**Figure 1-11** *Industrial sand conveyor system in near Augusta, WI*  
(photo: Dan Reiland, Leader Telegram website)



### **1.3.7 Reclamation**

All counties in the state of Wisconsin are required by Ch. NR 135, Wis. Adm. Code to implement a nonmetallic mining reclamation permit program – the purpose of which is to ensure that mining sites are reclaimed to a post-mining land use. This program includes the adoption of a nonmetallic mining ordinance, as well as the administration of the reclamation program, including: permitting, collection of fees, mine inspection, and management of financial assurance. Program administration is conducted by either county or local regulatory authorities (RAs). These RAs are designated under the authority of NR 135, and are regulated by the DNR’s Nonmetallic Mining Program. Common post-mining land uses include: wildlife habitat, lakes or ponds, agriculture, silviculture, industry, and recreation.



**Figure 1-12** *Sierra Frac – Suchla mine in final reclamation*  
(photo Tom Portle, DNR)



## 2 Environmental Topics

### 2.1 Air Quality

Though sand has been mined in Wisconsin for decades, air quality near non-metallic mining sites has been a public concern in recent years due to the increase in both the number and size of these facilities. Sand mines and ledge rock quarries are most commonly associated with emissions of particulate matter. In addition, there have been concerns about carcinogenic hazardous air pollutants like crystalline silica and diesel exhaust.

Industrial sand activities and their impact on air quality have been regulated for many years. Particulate emissions are addressed in Ch. NR 415 Wis. Adm. Code; specifically, s. NR 415.075 addresses particulate emissions from ledge rock quarries and industrial sand mines. Federal and state ambient air quality standards exist for particulate matter and many commonly emitted hazardous air pollutants, but state standards do not explicitly exist for diesel exhaust or crystalline silica.<sup>4</sup> Crystalline silica can be a component of particulate matter, but is not a component of all particulate matter (i.e., such as particulates from combustion sources, pollen)<sup>6</sup>. All crystalline silica that is in the ambient air exists in the form of particulates. Therefore, any control measures designed to reduce particulate matter in general, will also reduce the levels of any particles that also contain crystalline silica. Diesel exhaust emissions are addressed through Federal standards regulating the sulfur content in fuels and engine efficiency.

The following sections discuss air pollutant emissions associated with activities at ISM and processing facilities, along with the regulatory framework used to address them. Specifically, the first two sections (2.1.1 and 2.1.2) provide background about particulate matter, including silica, and describe the sources of particulate emissions at sand mining facilities. Section 2.1.3 outlines the state and federal air regulations that apply to ISM operations. The subsequent three sections (2.1.4 to 2.1.6) describe the DNR permitting and compliance processes used to ensure that applicable requirements are met. Next, section 2.1.7 explains the air monitoring activities that take place at industrial sand mine facilities. Section 2.1.8 describes recent trends in permitting, compliance, and monitoring activities at the facilities. Finally, section 2.1.9 explains that, as a result of existing regulations, ISM operations in Wisconsin are not expected to cause negative health and air quality impacts.

#### 2.1.1 Air Pollutants

The main air pollutants associated with industrial sand mines are particulate matter (PM) and crystalline silica, which can be a component of particulate matter. These pollutants are described in more detail below.

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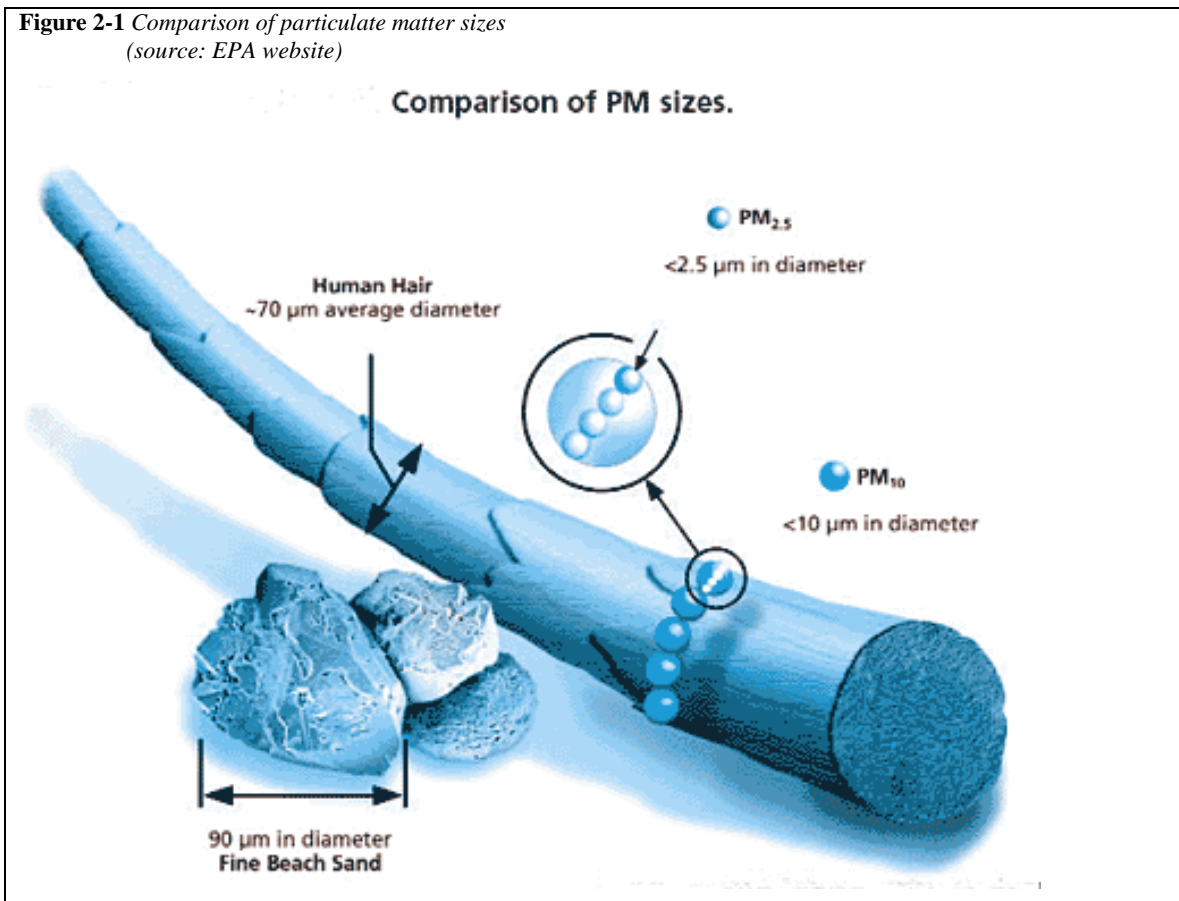
<sup>6</sup> For more information about crystalline silica, see the Silica report to the Natural Resource Board, August 2011 (<http://dnr.wi.gov/files/pdf/pubs/am/am407.pdf>).

## Particulate Matter (PM)

Particulate matter is a general term for solid particles in the air. The chemical components of particulate matter are not specifically defined. Particulate matter is frequently referred to according to the particle size. For example, PM<sub>10</sub> refers to the fraction of particulate matter with an aerodynamic diameter smaller than 10 micrometers (a micrometer is one millionth of a meter, or about 0.000039 inch). Ambient air quality standards have been set for some fractions; for example, PM<sub>10</sub> and PM<sub>2.5</sub>. An ambient standard used to exist for all particulate matter, regardless of size (i.e., total suspended particulate or TSP); however, that standard was replaced by the size-based standards. EPA repealed the TSP standard in 1987. WDNR repealed the TSP standard effective on December 1<sup>st</sup> 2011.<sup>7</sup>

Because the human eye cannot see particles smaller than about 30 microns, PM<sub>10</sub> and PM<sub>2.5</sub> particles are invisible to the naked eye.

**Figure 2-1** Comparison of particulate matter sizes  
(source: EPA website)



Monitoring of particulate matter is required at industrial sand mines and ledge rock quarries under s. NR 415.075. Because most of the particulate matter from industrial sand

<sup>7</sup> Source: Wis. Admin. Register November 30, 2011:  
<http://docs.legis.wisconsin.gov/code/register/2011/671b/register/toc>

mines is composed of larger sized fractions, PM<sub>10</sub> monitoring is most appropriate (see section 2.1.7 for a summary of monitoring results to date). Smaller sized particles are not as likely to be released into the ambient air for the following reasons: a) sand formations are comparatively easy to break apart to begin with; b) crystalline silica (quartz) is a very hard and crush-resistant mineral that is unlikely to create a large amount of smaller particles with the relatively lower energies typically used to break-up a sand formation (even if blasting is used); and c) the physical shape of the particles in the sand formations are rounded, such that breaking these particles into smaller sizes during sand mining and processing operations would result in particles that would not be suitable for use as proppants in oil and gas extraction wells. The PM<sub>10</sub> and smaller sized particles are not desirable in the products used for oil and gas well extraction.

Fine particulates, less than PM<sub>2.5</sub> microns have been identified as being particularly important to public health because these particles can enter more deeply into the lung than larger particles. Evidence from epidemiology studies suggests that these sized particles are more likely to explain the association between particulate exposure and disease. While there are standards for PM<sub>2.5</sub>, particles in this size fraction are primarily attributed to combustion sources and secondary formation which travels regionally. Sand mining and processing mainly involves mechanical processes that would be expected to generate particulate matter larger than PM<sub>2.5</sub>.

Occupational health and industrial hygiene professionals also use another particulate size measure in their work. Particle samplers used in occupational settings collect particulates that are about 4 microns in size and smaller. These occupational standards and guidelines rely on the use of monitoring equipment that is different than that used by ambient air pollution professionals and is focused on conditions inside a facility. Therefore, while the U.S. Environmental Protection Agency (EPA) and air pollution agencies have standard reference methods for monitoring PM<sub>10</sub> and PM<sub>2.5</sub>, no standard methods have been developed, proposed, or accepted by air pollution agencies for monitoring PM<sub>4</sub> particulate matter in ambient air, nor are there standards for PM<sub>4</sub> in ambient air.

### **Silica Content of Particulate Matter**

As discussed in the August 2011 silica report to the Natural Resource Board,<sup>8</sup> silica is a compound made up of silicon and oxygen atoms. If the atoms are arranged in a repeating pattern, it is referred to as crystalline silica. Crystalline silica occurs widely in many forms and sources include manufacturing related processes (e.g., construction, foundries, glass manufacturing, abrasive blasting or any industrial or commercial use of sand and quartz, and mining and rock crushing operations), as well as paved and unpaved roads, windblown soil and agricultural activities (e.g., tilling and harvesting). The three most commonly occurring forms of crystalline silica are quartz, cristobalite and tridymite. In industrial and occupational studies, respirable crystalline silica (RCS is the PM<sub>4</sub> sized fraction) has been associated with adverse respiratory effects like silicosis as well as cancer and other diseases.

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<sup>8</sup> Available at <http://dnr.wi.gov/files/pdf/pubs/am/am407.pdf>

Because crystalline silica occurs so commonly and is a component of particulate matter, it will be a portion of the particulate matter present in any particulate matter sample, regardless of the particle size range sampled. EPA estimated that a reasonable estimate for crystalline silica is 10% of the total PM<sub>10</sub> concentration.<sup>9</sup> Appendix A of the August 2011 silica report to the Natural Resource Board contains more information related to the percent of crystalline silica in ambient air.<sup>10</sup> For example, the report found that an upper estimate for crystalline silica in ambient air would be about 1-2% of the PM<sub>2.5</sub> concentration. The national trends network PM<sub>2.5</sub> monitors evaluated in the 2011 study were not placed near any known sources of crystalline silica and therefore reflect general (background) levels of crystalline silica in PM<sub>2.5</sub> in Wisconsin.

### **Non-Silica Content of Particulate Matter**

Non-metallic mining results in other forms of particulate matter emissions, such as from handling and processing soil and mineral deposits (e.g., carbonates, halites, sulfates, clays, silicates and other minerals that are not classified as silica), as well as from fuel combustion processes (e.g., process and building heaters and dryers, electrical generation and stationary and mobile engines).

In a typical ambient sample, the majority of particulate matter is expected to be non-crystalline silica such as from windblown soils, combustion sources, vehicles, construction related dusts, pollens, soot and smoke. By comparison, in urban air particulate matter samples, the largest contributors to these particulate matter concentrations are from construction, fuel combustion and traffic related sources in addition to plant based materials like pollen.

In any particulate matter sample taken, there is also a level of particulate matter that is considered a regional background level that cannot be attributed to any specific sources. Emissions of air pollutants undergo reactions in the atmosphere to create particulate matter due to processes called secondary formation. This secondary formation of particulates also adds to the regional background levels of particulate matter.<sup>11</sup>

### **2.1.2 Sources**

There are three types of air pollutant emissions from industrial sand mining sites and industrial sand processing facilities: a) fugitive emissions that may be emitted during the mining, processing and handling of sand; b) point source emissions that come directly from a stack, and; c) mobile source emissions from the combustion of fossil fuels in truck, train, or other engines. The mining and processing activities associated with these emission types are listed below. Additional information about these activities, regulations that apply to them and potential emission control methods can be found later in this section. Each industrial sand facility is a unique combination of these activities. Some

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<sup>9</sup> U.S. EPA. 1996. Ambient Levels and Non-cancer Health Effects of Inhaled Crystalline and Amorphous Silica: Health Issue Assessment. EPA/600/R-95/115.

<sup>10</sup> Available at <http://dnr.wi.gov/files/pdf/pubs/am/am407.pdf>

<sup>11</sup> Stacey, P., A. Thorpe, and P. Roberts. 2011. Levels of respirable dust and respirable crystalline silica at construction sites. UK Health and Safety Executive. Research report 878. <http://www.hse.gov.uk/research/rrpdf/rr878.pdf>.

facilities may consist solely of a mine, while others may have multiple mines and processing plants.

### **Fugitive Sources**

Fugitive emissions are those from any emission point other than a flue or stack, as defined in s. NR 400.02(71), Wis. Adm. Code. Many sources of airborne particulate matter at industrial sand operations are fugitive in nature. The following are examples of activities and emission sources which generate fugitive air emissions (also known as fugitive dust) at industrial sand operations:

- Construction
- Blasting
- Overburden removal, excavation, and crushing
- Stockpiles
- Loading/unloading – mining operations
- Loading/unloading – processing plant operations
- Conveyors

Emissions from transfer points located along conveyors, associated with loading/unloading or storage of sand may be fugitive, captured or controlled and vented to a stack. Please see the sections in 2.1.3 relating to each specific type of equipment for applicable regulatory requirements.

### **Point Sources**

Point source emissions are those exhausted to the ambient air directly from a flue or stack. The following are examples of activities commonly vented through stacks:

- Processing operations located within enclosed buildings. Examples may include loading/unloading, screening and conveying
- Generators
- Dryers
- Storage bins/silos

### **Mobile Sources**

Mobile source emissions at sand mines and processing plants are those generated from fuel combustion in equipment that moves. These sources include vehicles such as front-end loaders, trucks, and construction equipment. Emissions from mobile sources are regulated by EPA on a national level by setting standards on emissions and by setting sulfur standards in fuels. Standards can be found on EPA's website. Please see section 2.1.3. relating to specific types of equipment.

#### **2.1.3 Air Regulations**

The air pollution emission sources outlined in the previous section are subject to a number of regulations. These regulations are described below. Because all crystalline silica that is in the ambient air exists in the form of particulates, any control measures designed to reduce particulate matter, will also reduce the levels of crystalline silica.

## **Control of Particulate Matter**

Ch. NR 415, Wis. Adm. Code addresses “Control of Particulate Matter,” with ss. NR 415.04 and NR 415.075 addressing fugitive dust control. Particulate matter emitted from process lines directly exhausted to a stack is regulated by NR 415.05, and particulate matter emitted from fuel burning of stationary sources is regulated under NR 415.06.

## **Fugitive Dust Control**

Fugitive dust is regulated differently than particulate matter emitted directly from a stack, because the methods for quantifying and mitigating point source and fugitive emissions are different. Particulate matter emitted as fugitive dust is regulated by secs. NR 415.04 and NR 415.075. Section NR 415.075 specifically applies to “Particulate matter emission limitations for ledge rock quarries and industrial sand mines.”

This section establishes requirements for fugitive dust control methods, visible emission limitations and protocols for ambient air monitoring. The code requires facilities to prepare, submit, and follow detailed fugitive dust control plans (FDCPs). WDNR requires FDCPs to be submitted with permit applications. To provide the industry with guidance when developing comprehensive FDCPs, WDNR developed a template of best management practices (BMPs) titled “Fugitive Dust Control Plans for the Ledge Rock Quarry and Industrial Sand Mining Industries,” which can be found at:

[http://dnr.wi.gov/cias/guidance/guidanceexternal/GuidanceItem.aspx?item\\_seq\\_no=2091](http://dnr.wi.gov/cias/guidance/guidanceexternal/GuidanceItem.aspx?item_seq_no=2091).

The guidance covers all sections of industrial sand mining including expectations for mining, blasting, roadways, storage piles, control during freezing weather, and records. Fugitive dust control plans include the criteria when specific dust suppression activities will be implemented and requires facilities to maintain records of those dust suppression activities. The sand industry standard for adequate fugitive dust control is accomplished by applying water or other suppressants on wind-exposed sand piles, excavation areas, conveyors, drop points and truck travel routes. Water and/or other suppressants must be present in abundant supply at the mine and processing sites. Covering or enclosure of conveyors and covering of truck transport, especially when shipping dried sand product, may be necessary for adequate dust control. For the control of fugitive dust emissions from truck traffic on facility unpaved haul roads, the option of paving these haul roads is to be considered. To reduce emissions from facility paved haul roads, sweeping and cleaning of these paved roads is addressed. If visible dust emissions are observed they need to be suppressed. All industrial sand mining, processing and loading operations with actual production over 2,000 tons of sand per month are required to maintain and follow fugitive dust control plans. In addition to these requirements, all sources are required to follow Fugitive Dust requirements in NR 415.04.

To quantify fugitive dust emissions and meet the requirements of NR 415, visual emission observations of opacity are made according to EPA methods and records maintained. Opacity is defined as the degree to which emissions reduce the transmission of light and obscure the view of an object in the background.

The following sections provide examples of how specific activities associated with ISM and processing may be addressed in a fugitive dust control plan.



### *Construction Impacts*

Minimizing fugitive emissions from construction impacts include paving or placing gravel on access roads, watering of roads or work areas with tanker trucks as needed, and stabilizing piles to prevent material loss from high winds and water.

### *Overburden Removal, Excavation, and Crushers*

Water trucks or recycled water from the pumps and slurry system (washing operations) may be used to suppress fugitive dust during removal and excavation. Wetting techniques may be used to minimize dust from crusher units. Soil stockpiles can be seeded and mulched for re-vegetation as soon as the season's work is complete. These practices may limit fugitive dust from escaping off-site except during periods of strong winds and prolonged dry conditions at those sites.

### *Blasting*

Blasting using various types of explosives is often used to loosen materials while mining (see section 1.3.1 for details). Drilling activities performed using a wet method or other means reduces fugitive emissions. Blasting shall use blast hole stemming materials approved through Mine Safety and Health Administration (MSHA). Fugitive emissions from drilling are limited to 20% opacity at the source.

Immediately following a blast, fugitive dust is often observed. To exceed the opacity standard, emissions in excess of 10% opacity must occur for at least six minutes following U.S. EPA methods. Observations of blasting by trained DNR inspectors have not observed exceedances of the opacity standard.

### *Loading/Unloading Operations*

The conveyor system and spout used in loading operations may be enclosed to capture particulate or minimize fugitive particulate dust. The dump station typically used in unloading operations may also be enclosed.

Resulting particulate from the loading and unloading processes may be controlled by the use of a cyclone or baghouse, or by unloading processes through underground or covered conveyor systems.

### *Vehicle Activity*

Roadway fugitive dust emissions, associated with truck traffic, are controlled using measures that 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 (these precautions to prevent particulate matter from becoming airborne are required by s. NR 415.075(2)(a)).

## **National Ambient Air Quality Standards**

Emissions from ISM and processing facilities, as well as nearby sources that contribute to impacts, must meet federal ambient air quality standards (National Ambient Air Quality



Standards or NAAQS) for several pollutants. These standards are set to protect public health (primary standards) and welfare (secondary standards), specifically at levels such that the most susceptible populations (children, elderly, and people with respiratory conditions) are protected. Additionally, the welfare of the public is also protected, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.

The federal air quality standard most relevant to ISM and processing is the PM<sub>10</sub> standard. The level of the standard is 150 micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ). This concentration must not be exceeded more than once per year on average over a three year period. There is no applicable regulatory standard for either ambient total suspended particulate (TSP) or PM<sub>4</sub>.

### **New Source Performance Standards**

Several federal standards also apply to sand dryers and crushing equipment typically operated at industrial sand processing plants. These standards are called New Source Performance Standards (NSPS) and regulate particulate matter and opacity (visible emissions) from the affected equipment. NSPS establish specific particulate matter exhaust concentrations and opacity limits for the different types of operations. The standards also specify control methods. Many of the NSPS are contained in Chapter NR 440, Wis. Adm. Code.

#### *Crushers*

Any facility that operates a crusher unit is subject to an NSPS under s. NR 440.688, Wis. Adm. Code and 40 CFR part 60, subpart OOO, Standards for Performance for Nonmetallic Mineral Processing Plants. The standard limits particulate concentrations in the air to 15% opacity. Most crushers do not utilize any capture system associated with their operation/emissions, and are considered fugitive sources of emissions.

#### *Dryers*

Emissions from the dryer are subject to an NSPS in s. NR 440.73, Wis. Adm. Code. Particulate matter and PM<sub>10</sub> emissions from the drying process are limited to 0.057 grams per dry standard cubic meter (g/dscm). Furthermore, emissions are also subject to a visible emissions limit of 10% opacity. Typically, complying with the particulate matter limit requires the use of a control technology. Facilities are required to either use 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 opacity each day of operation.

Emissions from the drying process are typically controlled by a mechanical collector designed to remove particulate matter prior to emissions being exhausted through a stack. Mechanical collectors can be either fabric filters (baghouse) or wet collectors (scrubbers). Emission standards, compliance demonstration methods and record keeping protocols for each type of device are laid out in the NSPS standards. The dried sand is then fed by conveyors to storage bins or directly to a screen house via conveyors

Air pollution resulting from drying activity includes emissions from the combustion of natural gas or propane, and particulate matter. 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 baghouse or wet scrubber. These devices are able to achieve a control efficiency of at least 98% or better (some baghouses can achieve 99.5% or better control). Collected materials in the baghouse are disposed of at the mine site as fines or reject material.

#### *Screening*

The screening process may be subject to the non-metallic mineral processing NSPS in s. NR 440.688 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. The NSPS limits opacity to 7%.

#### *Storage Bins/Silos*

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

Resulting particulate from the storage (loading of bins/silos) process may be controlled by the use of a cyclone or baghouse, and the bins/silos may be equipped with an air displacement vent filter.

### **Hazardous Air Pollutant Standards**

Hazardous air pollutants (HAP) may be emitted as a by-product of fuel combustion and from some sand processing operations. Ch. NR 445, Wis. Adm. Code contains the applicable requirements covering emissions of state regulated hazardous contaminants. National Emission Standards for Hazardous Air Pollutants (NESHAPs) may also cover some operations. These federal standards are contained in 40 CFR Part 63. Crystalline silica is not currently a regulated HAP under federal or state regulations.

### **Requirements for Vehicle/Mobile Equipment and Other Engine Emissions**

Fuel combustion in trucks, trains, and other moving equipment is not regulated as a stationary source but is instead subject to federal standards addressing fuel efficiency and fuel composition (i.e., the amount of sulfur allowed in diesel fuel). These regulations minimize diesel particulate or other types of emissions. As described earlier, fugitive dust requirements regulate the movement of mobile equipment on paved or unpaved roads within the mine or processing plant site.

Most mining operations include the utilization of electrical generators to supply electricity to equipment such as pumps, conveyors, and crushers/screen plants. Because the electrical generators used in mining operations are usually not stationary for any 12-month period, they are not regulated as stationary sources and are not included in air permits. Occasionally, a facility permanently places a generator and then it is considered a stationary source and is included in the air permit for the facility. All stationary engines are subject to federal NSPS and NESHAP requirements.

As of 2015, all such generators whether or not they are considered stationary require the use of ultra-low sulfur diesel fuel. Emissions from such units are subject to federal standards and are included in air permit analyses.

## **Visibility Requirements**

Any facility emitting sulfur dioxide (SO<sub>2</sub>), PM/PM<sub>10</sub>, and/or nitrogen oxides (NO<sub>x</sub>) 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 major air pollution sources. (Note: A Class I area is an area that is afforded additional protection 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.).

### **2.1.4 Air Permits**

Any stationary source that emits air pollution must obtain the appropriate air pollution control permits unless it is exempt from the requirement to obtain a permit. Air permits contain specific provisions ensuring that permitted operations meet all applicable state and federal air regulations, such as the regulations described in the previous section. This section describes the permitting process for ISM operations.

There are two types of exemptions that may apply to a mining operation. There is a specific exemption for very small mines that produce less than 2,000 tons of sand per month averaged over any 12 consecutive month period. The Air Program also exempts mines that will not emit particulate matter and fugitive dust in excess of 10 tons per calendar year. Emissions at mining operations vary depending on the amount of paved and unpaved roadways, how much sand is stored on site, and whether sand is screened, or if crushing occurs on site. Mining operations that produce up to approximately 20,000 tons of wet sand per month can usually meet this exemption threshold.

Mining operations that are exempt must keep production records demonstrating that the exemption thresholds are not exceeded. Sources exempt from permitting are still subject to applicable state and federal air pollution regulations.

Mining operations exceeding 20,000 tons per month must be reviewed in more detail and, depending on specific operations, may be exempt. If not exempt, these facilities usually qualify for coverage under the Type A Registration Permit. This is a general permit that covers facilities emitting less than 25% of the major source threshold of air pollution emissions. Because of how a major source is defined in state and federal regulations, fugitive emissions are not included when determining whether emissions exceed the major source threshold. Since the bulk of emissions at mining operations are fugitive, these types of sources are almost always able to demonstrate that they emit less than the threshold for coverage under the Type A Registration Permit.

To obtain coverage under a registration permit, facilities must submit an application that shows the criteria for coverage can be met. The application includes a description of the proposed operations and equipment and estimates of the annual emissions of air pollutants. A fugitive dust plan is submitted along with the application. Once the complete application is received, the Air Program makes a determination of coverage within 15 days. No additional public notice or comment is available prior to coverage determinations. All applications for coverage under registration permits and review documents are available to the public on the DNR's website.

Registration permits require compliance with all applicable state and federal regulations and the facility must monitor all control equipment, implement fugitive dust control plans and maintain records of sand production and records that show fugitive dust control measures are in place and being implemented.

Operations that include sand dryers are not exempt from air pollution control permitting requirements and do not qualify for coverage under a registration permit. The Air Program issues individual source specific permits for equipment that is being added or changed through its construction permitting program as laid out in ch. NR 406, Wis. Adm. Code.

Once constructed, the whole facility must obtain an operation permit as well. The Air Program determines which activities constitute the facility when reviewing applications for operation permits. Sources that are under common ownership or control, that are on contiguous or adjacent property and all working together to produce a common product or service are considered a single facility for purposes of the operation permit regulations. Operation permits for sand processing may cover sand dryers, sand coating operations, and any mining activities on site but may also include activities at nearby mines transporting sand to the drying or processing facility. Sometimes activities several miles away from are determined to be a single source and therefore must be covered under a single operation permit. Operation permit requirements are contained in Ch. NR 407, Wis. Adm. Code.

When processing permits, the Air Program reviews the application submitted by the facility. No construction activity may be commenced prior to issuance of the permit unless the facility applies for and obtains a construction waiver under s. NR 406.03(2). The DNR may grant a construction waiver if the facility demonstrates that delaying construction would result in undue hardship such as substantial economic or financial hardship that could preclude the project in its entirety. Waivers may only be granted for projects that do not trigger review under the federal New Source Review permit program. If a facility is granted a waiver, it may begin construction but under no circumstances may operation of any equipment or mining activities begin until a final permit is issued.

Air permit applications contain information on the proposed location, site characteristics, equipment specifications, air pollution emission estimates, and applicable regulations. The DNR reviews applications to determine if the proposed project can meet the criteria for permit approval in s. 285.63, Wis. Stats.:

- The stationary source will meet all applicable emission limitations and other requirements;
- The source will not cause or exacerbate a violation of any ambient air quality standard;
- The source will not preclude construction or operation of another source.

The Air Program prepares an analysis and preliminary determination and a draft of the permit with all the conditions necessary to ensure that the criteria for permit approval are met. The program then notifies the facility and the public that the analysis and draft permit are available for review and takes comments on the project for 30 days. A public hearing may also be held if one is requested. Comments may be received from the public

as well as the facility and may be submitted in writing or through an oral statement at a hearing.

After the 30-day public comment period is over, the permit writer compiles all public comments received and addresses them, sometimes making changes to the final permit if warranted. The program must make a final decision on permit issuance within 60 days of the end of the comment period. The final permit documents and the response to comments are posted on the DNR's website and available for public review.

After permit issuance, a facility may begin construction and operation of the facility. The air permit contains monitoring, recordkeeping and reporting requirements that must be followed by the facility. Air Program compliance inspectors check compliance of the facility with all air pollution regulations and permit requirements. Facilities with permits must submit an annual certification of compliance and a report containing the results of monitoring done to ensure proper operation of equipment and controls. Deviations from permit conditions must be reported promptly to the DNR.

### **2.1.5 Air Impacts Analysis**

Before the DNR approves an air permit, staff members conduct analyses to ensure that permitted operations are compliant with all applicable air regulations and requirements. These analyses are described below.

#### **Ambient Air Dispersion Modeling**

The DNR uses dispersion modeling to evaluate the ambient air impact of air emission 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 that a particular facility will have with respect to ambient concentrations of a given pollutant. The modeling information is vital in assessing a facility's likely compliance with respect to federal ambient air quality standards (National Ambient Air Quality Standards or NAAQS) as well as federal and state Hazardous Air Pollutant (HAP) standards. The air standards protect against both primary, or health-based, impacts, as well as secondary, or welfare-based, impacts.

Dispersion modeling incorporates information about a facility, such as source/stack parameters, facility layout information and emission rates, along with meteorological data in order to predict concentrations of pollutants in the vicinity of the facility.

The DNR evaluates cumulative air impacts by adding the facility's pollutant concentration at the point of highest impact to a previously determined background concentration. The background concentration is derived from ambient air measurements throughout Wisconsin and includes the impact of both nearby and distant sources. The sum of the modeled impact from the facility plus the background concentration must be less than the corresponding ambient air standard for a permit to be issued. The review is conducted to ensure that the cumulative impacts from all sources considered will result in attainment of all air quality standards when the sources operate in compliance with their existing or proposed air pollution control permits.

The conditions that demonstrate compliance with the federal air quality standards 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.

All modeling completed in the State of Wisconsin for use by the DNR is conducted in accordance with these DNR 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 DNR.

The ambient air quality analysis most relevant to industrial sand mine operations is the assessment of particulate matter (PM<sub>10</sub>) impacts. Depending on project specific conditions and proposals, the analysis may include analysis of point sources (stacks) and fugitive sources.

Fugitive PM<sub>10</sub> emissions from truck traffic onsite are typically included in the air dispersion model as part of the background concentration. These modeled emissions may be subject to restrictions, which are permit enforceable, such as hours of operation for truck traffic. These restrictions protect against localized visibility impacts.

Analyses of PM<sub>10</sub> impacts of ISM or processing facilities show that the impact of a facility decreases quickly with distance, dissipating within 0.3-1.0 kilometers from the sources. This means that it is unlikely that PM<sub>10</sub> levels near these facilities are significantly greater than general background levels.

### **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 as part of the permitting process. 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.

#### **2.1.6 Air Compliance Activities**

The DNR Air Program has four compliance inspectors who specialize in industrial sand operations. These individuals annually perform at least one complete compliance evaluation for all permit requirements, plus multiple other compliance evaluations on all active sites. Compliance evaluations include observations of visible emissions (opacity), visual checks of the equipment and mining activity, records review, evaluations to ensure the practices identified in the fugitive dust control plan and site specific permit requirements are followed, and verification of compliance with federal New Source Performance Standards. If an inspector finds a source to be noncompliant, follow up actions are taken according to the DNR's enforcement policy and practices. Compliance engineers also respond to complaints as a top priority, typically responding within the next business day. In addition, DNR personnel witness stack emission testing. Stack

testing is used as a compliance tool to evaluate particulate matter emissions and is required by federal New Source Performance Standards.

### **2.1.7 Monitoring of Particulate Matter near Sand Mines**

Industrial sand mines producing over 2,000 tons of sand per month on a rolling 12 month average are required to conduct ambient air monitoring for particulate matter unless the source applies for, and DNR approves, a variance from this monitoring requirement. The DNR may approve a variance from the requirement for a mining operation to perform industrial monitoring if the facility demonstrates that the general public will not be exposed to significant levels of particulate matter from the source, and that the source's emissions units and processes are controlled to a level which meets all applicable requirements. Many small mining operations with wet sand operations only received monitoring variances based on their low emission levels and demonstrated ability to meet applicable requirements. As of early 2016, nine monitoring variance requests for larger facilities that include dry sand processing plants have been made, and five have been approved.

The DNR's role in the ambient air monitoring at sand mines has been to assist and provide guidance to industry in their needs to monitor facilities. Historically, industrial sand mines and ledge rock quarries were required to monitor for total suspended particulate matter. However, the state and federal standards for total suspended particulate matter were replaced by federal and state standards for PM<sub>10</sub> and PM<sub>2.5</sub> (see section 2.1.1). The DNR now requires industrial sand mines and rock ledge quarries to monitor for PM<sub>10</sub> sized particles.

#### **Facility Monitoring of PM<sub>10</sub>**

Between 2010 and December of 2015, sixteen facilities have operated a total of 18 PM<sub>10</sub> monitors. All monitors are still active and more have been proposed. A total of 2,478 valid samples have been collected. The average reading from all samples as of December 2015 is 13.5 micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ). This is less than 10% of the PM<sub>10</sub> ambient air standard. Of those 2,478 data points, one sample recorded a value higher than the PM<sub>10</sub> standard of 150  $\mu\text{g}/\text{m}^3$ . Evaluation of the filter shows the high value appears to have been caused by farming activities in a field next to the monitor; the nearest industrial sand mine facility was not operating the day the ambient sample was taken. Other relatively higher ambient sample values (which were still below the ambient standard) have been attributed to construction activities, new mining activity or deviations from fugitive dust plans (e.g., water truck out of service).

#### **Facility Monitoring of PM<sub>4</sub>/Crystalline Silica**

There are no federal or state standards or certified methodology for the monitoring PM<sub>4</sub> or crystalline silica in ambient air. Therefore, the DNR has not requested or implemented any testing for these components. The DNR has provided technical assistance for some facility-sponsored studies and has reviewed the results from others.

Facility-sponsored studies indicate that industrial sand mine contribution to crystalline silica concentrations in the ambient air are minimal. Recent studies have been conducted by Dr. John Richards and Todd Brozell of Air Control Techniques, P.C. at the following facilities in Wisconsin: EOG Resources, Fairmount Santrol, Mathy Construction, and

U.S. Silica.<sup>12</sup> Crystalline silica levels measured during these studies typically showed values less than 3 micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ) with most measurements below the detection limit of  $0.3 \mu\text{g}/\text{m}^3$ . The studies also indicate that crystalline silica levels are not significantly different upwind versus downwind of the facilities when samples were collected simultaneously. This suggests that the contribution of crystalline silica to ambient air concentrations by industrial sand facilities is minimal.

The DNR was contacted by Dr. John Richards regarding the EOG study and has received information and provided feedback on the methods and the reported results. The DNR acknowledges that the methodology and equipment used was based on a federal reference method (FRM) for  $\text{PM}_{2.5}$  with two deviations. Flow rate was adjusted to obtain a  $\text{PM}_4$  cut size and PVC filters were used instead of Teflon to allow for the crystalline silica analysis. Because EOG also has a regulatory  $\text{PM}_{10}$  monitor, the DNR also conducted audits on  $\text{PM}_4$  samplers. To learn more about the study see: <http://www.mdpi.com/2073-4433/6/8/960/htm>.

The DNR was made aware of the studies being conducted at other facilities but had no direct involvement.

### **Independent/Citizen Research and Monitoring**

The DNR is aware of many independent monitoring and research efforts, including work done by university faculty and students at the UW Eau Claire and the University of Iowa, county health departments, the Institute for Wisconsin's Health, Inc. and citizen scientists. The DNR has provided technical assistance, when requested, on study design, existing data sets, data interpretation and conclusions. However, final reports and conclusions are independently produced and do not necessarily reflect the advice and expertise provided by the DNR.

Independent monitoring and research tends to have similar results as the DNR monitoring, but there are often significant differences. Many of these differences are due to differences in methodology, study design and presentation of limited data sets versus established standards. EPA has been providing guidance on the use of sensor technology often used in independent monitoring, and currently notes that this type of technology is generally good at identifying "hot spots" (areas where concentrations may be higher with respect to other locations) or changes, but is not reliable for direct measurement purposes. Sensor monitoring equipment used is usually not appropriate for regulatory purposes, and the accuracy and comparability of the monitoring results are not known. Additionally, sampling procedures and protocols are often not documented. Finally, the measurements made are often of short duration (minutes or hours). Much longer duration monitoring is required to make valid comparison with air quality standards that are based on 24-hour samples or annual averages of 24-hour samples.

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<sup>12</sup> The studies were conducted over the following periods: EOG Resources (October, 2012 to October, 2015); Fairmount Santrol (March, 2013 to March, 2014); Mathy Construction (August, 2012 to September, 2013); and U.S. Silica (September, 2012 to March, 2014).



### **2.1.8 Current Trends**

This section provides information on recent trends in permitting, compliance, and monitoring activities involving industrial sand mine operations.

#### **Permit Trends**

As noted in section 2.1.4, the Air Program has several types of permits and permit exemptions that are available to industrial sand mines and processing plants. Over the last decade, the Air Program has received over 250 applications for permits or permit exemptions from facilities involved in ISM with 200 of those received in the last five years. In 2014 alone, 60 applications were received; however, that number dropped to 30 in 2015. Currently, there are 94 facilities with either active permits or approved permit exemptions; however, not all these facilities are operating.

#### **Compliance Trends**

Active sources are checked for compliance multiple times per year (see section 2.1.6). Over the past two years, there have been three enforcement cases involving Air Program violations at industrial sand mine facilities. Two of those cases involve failed emission stack tests, while the third case involves inadequate record keeping.

The Air Program will continue its commitment of staff to compliance and surveillance activities at ISM facilities. Compliance inspectors are reporting that fugitive dust control practices are meeting requirements. The DNR's efforts will continue to focus on working with facilities to ensure that 1) fugitive dust control plans are up to date and that fugitive dust control measures are applied; and that 2) malfunction, prevention and abatement plans (MPAPs) are accurate and up to date for all equipment and control devices. This includes verifying that MPAPs address fine materials from waste products (such as dryers and building dust collectors) to ensure proper containment and transfer to reduce the potential for materials to become airborne.

#### **Monitoring Trends**

Overall, monitoring near sand mines has consistently shown ambient levels of PM<sub>10</sub> to be well below the federal PM<sub>10</sub> ambient air quality standard, and has not identified any ambient monitored values above the standard that can be attributed to industrial sand mine operations. DNR Air Monitoring will continue to work with industries to maintain compliance with the standard. As the body of data grows and continues to show acceptable PM<sub>10</sub> concentrations around mining operations, monitoring variances could become more common in the industrial sand mine industry. See s. NR 415.075(4) for the requirements related to ambient particulate monitoring and the variance process.

### **2.1.9 Impacts on Air Quality and Health**

The DNR air management regulatory program is structured to attain and maintain national ambient air quality standards. Over the course of the recent rapid expansion of industrial sand mine operations in Wisconsin, the DNR Air Program has utilized existing regulations to issue permits, check compliance, take enforcement actions where necessary, and assess ambient monitoring data at industrial sand mine facilities. The information presented in the previous sections demonstrates the following:

- There are a number of permit types that can be used to regulate emissions from industrial sand mine operations, and the existing permit mechanisms have been successfully utilized with the industrial sand mine industry.
- Sufficient Air Program compliance staff resources have been dedicated to adequately assess industrial sand mine facility compliance with permit requirements, and to take necessary enforcement actions to appropriately respond to violations. Air Program staff has been able to conduct multiple compliance evaluations of industrial sand mine operations annually, and has responded quickly to complaints.
- Ambient air monitoring required of industrial sand mine sources has not identified any reported values attributable to the sources that are above the federal PM<sub>10</sub> ambient air quality standard.
- Though there are no ambient air quality standards for PM<sub>4</sub> or crystalline silica, ambient monitoring conducted voluntarily by industrial sand mine sources has shown levels to typically be less than 3 µg/m<sup>3</sup>, and in most cases, below the level of detection. The California Office of Environmental and Human Health Assessment (OEHHA) adopted a chronic Reference Exposures Level (REL) of 3 ug/m<sub>3</sub> for respirable crystalline silica (RCS) for PM sized particles in 2005.<sup>13</sup> A chronic REL is an airborne level of a chemical at or below which no adverse health effects are anticipated in individuals indefinitely exposed to that level.

For the reasons described above, the industrial sand mine industry is not expected to have significant impacts on air quality. Particulate emissions are addressed by existing regulations and monitoring data have not identified problematic air quality at sand mining and processing sites. In addition, point source emissions from industrial sand facility operations (for example, from combustion sources such as electric generators or dryers) are not significant and are unlikely to significantly contribute to secondary formation of other pollutants such as ozone.

As a result of existing regulations and the permitting and compliance activities described above, health related impacts from industrial sand facilities are not likely to be an issue. The executive summary for the Health Impact Assessment of Industrial Sand Mining in Western Wisconsin, published by the Institute for Wisconsin's Health, Inc. (2016), states:

*Health effects from the impact of industrial sand mining on community-level air quality related to PM10 are unlikely. In addition, it is unlikely that community members will be exposed to respirable crystalline silica from industrial sand mining as currently regulated; therefore, health effects from exposure are unlikely. Data collected at several facilities in the upper Midwest do not indicate that health-based standards have been exceeded in regard to these potential pollutants.*<sup>14</sup>

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<sup>13</sup> <http://oehha.ca.gov/air/document/adoption-chronic-reference-exposure-levels-silica-crystalline-respirable>

<sup>14</sup> <http://www.pewtrusts.org/en/multimedia/data-visualizations/2015/hia-map/state/wisconsin/silica-sand-mining-in-western-wisconsin>

Fugitive dust from stockpiles or other industrial sand facility operations has the potential to cause nuisance conditions in areas close to an industrial sand facility. However, this can be addressed within the current DNR industrial sand regulatory scheme by assuring that a facility's fugitive dust control plan is up to date and is being implemented.

## **2.2 Waste Management**

Proper management of nonmetallic mining wastes is necessary to ensure compliance with environmental regulations, achieve mine site stability, and undertake successful reclamation activities. Most waste materials generated by ISM stay on the mine site, with the exception being those that are generated at sand processing facilities and then returned to the site for reclamation material.

### **2.2.1 Hazardous Waste**

Hazardous materials on industrial sand mine sites are generally limited to heating fuels, heavy equipment fuels and machinery maintenance products. Specialized facilities using acid or solvents in their processing may be considered hazardous waste generators and regulated accordingly.

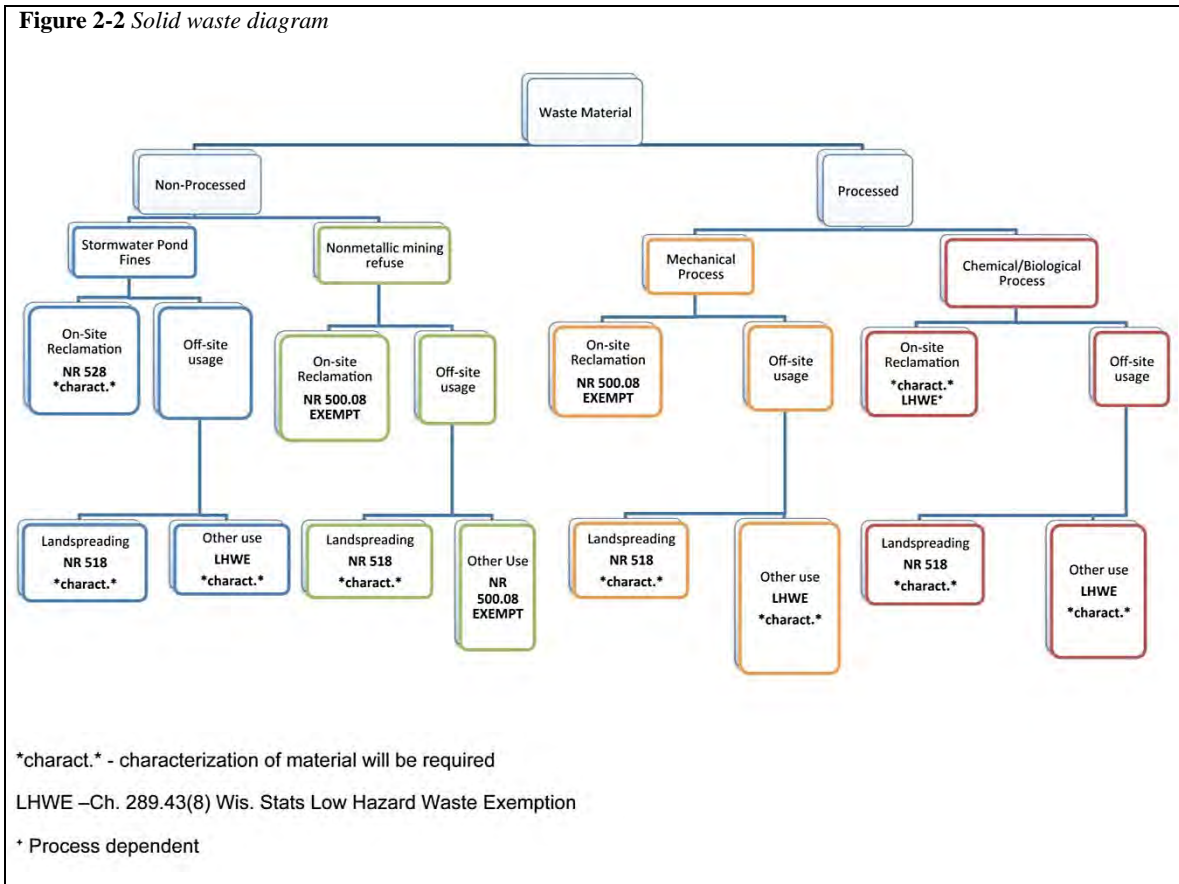
### **2.2.2 Non-Hazardous Waste**

As defined in s. 289.01(33), Wis. Stats, wastes generated by mining operations, including nonmetallic mining, are either classified as solid waste or wastewater. While all wastes are regulated, most nonmetallic mine wastes are eligible for exemptions under s. NR 500.08(2)(b), Wis. Adm. Code. However, it is important to note the difference in regulations governing wastes generated through mining activities (unprocessed material wastes), and wastes generated from the processing of mined materials (processed material wastes).

Unprocessed material wastes include a type of material referred to as nonmetallic mining refuse. This is defined in s. 295.11(5), Wis. Stats, as waste soil, rock, mineral and other natural material resulting from nonmetallic mining that does not have any marketable by-products. This may include undesirable excavated rock that is not crushed or screened or particulate matter that accumulates on haul roads and internal mine areas. This definition also includes material categorized as spoils (defined as waste material brought up during the course of an excavation or a dredging or mining operation) but does not include topsoil that is either stockpiled for reclamation or sold.

Accumulated sediment in stormwater ponds is also considered an unprocessed material waste. This material is generated when the particulate matter that accumulates on haul roads and internal mine excavation areas is transported to stormwater ponds by precipitation, water applied during dust suppression, and/or irrigation activities. Accumulated sediment is defined in s. NR 528.03(1), Wis. Adm. Code as a settleable solid material contained in stormwater runoff that is collected, retained and subsequently removed from stormwater structures. When comingled with process water, any stormwater and its associated solids are considered process material and must be treated as such.

Figure 2-2 Solid waste diagram



Processed industrial sand mine (ISM) wastes are those that result from the partial or complete mechanical, biological or chemical liberation of the silica grain from the cement fraction, those derived from the application of finishing products such as resins and acids, and any non-marketable byproducts that have been treated with additives such as flocculants.

Mechanically processed ISM waste is material consisting of the cementing material or other unsuitable rock component that is separated from individual silica grains and discarded during mechanical processing, either through bag fines, screening, or through post-washing dry press. Mechanically processed wastes are considered conditionally exempt under s. NR 500.08(2)(b), and may be used as fill material for reclamation, with the caveat that they are to be disposed in a nuisance-free and aesthetic manner that does not result in a detrimental effect on any surface water, groundwater, wetland or floodplain. Processed material originating from a formation that is suspected to contain deleterious substances may require waste characterization prior to reclamation fill placement to ensure the protection of surface and ground waters. If deleterious substances are found to be present within the waste material, further approval, such as a low-hazard grant of exemption under s. 289.43(8), Wis. Stats., may be needed before disposal.

Biologically or chemically processed ISM wastes are materials that contain any form of additive other than water. Additives may include flocculants, coagulants, pH adjusters, algacides, coating remnants, finishing products, cleaning agents, and/or surfactants.

Biological or chemical processing characterization requirements for solid and liquid fractions will be determined based upon the final intended use of the material, and restrictions for placement will be dependent on contaminant levels. Materials that may be required to be characterized include post-process clarified waters, liquid containing suspended fines, and settled material in process ponds or clarifiers.

The applicability of regulations is dependent on the end-use of the generated waste product – and further dependent on the chemical characteristics of that waste. Waste materials which, through processing (e.g., the use or recirculation of wash water, concentrated deposition of post-process liquid, solid, or semi-solid particulate matter, or product addition) are not exempt from solid waste rules, are also not exempt from applicable storage and disposal requirements. To date, the physical and chemical interactions between ISM-generated wastes and surface water and groundwater resources have not been investigated; therefore, further research is required to ascertain any potential impacts.

## **2.3 Groundwater**

### **2.3.1 Introduction**

Groundwater is found beneath the ground surface, filling the pores or other voids in soil, sediment and rock formations. Groundwater is widely used as a source of water supply for private wells, communities, farms and industrial applications. As discussed in section 1.3, water is an important resource for sand mining operations and is used for transporting sand (in slurry form), cleaning and sorting sand, and dust suppression. Groundwater can also affect the economic viability of some ISM operations, as sand reserves at some sites occur below the water table, making extraction more difficult and costly. Groundwater is preferred for ISM water supply because it is a more reliable source and contains fewer suspended solids than surface water.

### **2.3.2 Process ponds**

Most industrial sand mines and processing plants utilize groundwater to some extent. Potential uses include transporting, cleaning, and sorting sand, as well as controlling dust. Typically, water is pumped from a well and stored in ponds designed for specific aspects of the process. Ponds are generally filled at the beginning of the season. Throughout the remainder of the year, water is added to replace what is lost to seepage, evaporation and incorporation into product. This is known as “make-up” water. The required volume of water is calculated based on the anticipated rate of water loss. See section 2.3.17 for information on water use at industrial sand facilities.

### **2.3.3 Stormwater ponds**

Stormwater ponds (described in section 1.3.4 of this document), if unlined, allow runoff that is collected from the mine site to infiltrate to the water table. Infiltration of stormwater may help offset some of the pumping impacts from mine operations, but this is difficult to predict or quantify. It should be noted that infiltration rates in unlined ponds may reduce over time as fine particles accumulate.

### **2.3.4 Dredge Ponds**

In some areas, target formations (geologic unit containing desired resources, in this case sand) may occur below the water table (see section 1.3.2). In these locations an operator may either lower the water table to access sandstone or remove material from below the water table, a process known as dredging. Dredging involves lowering a dragline below the water table and using it to remove material from the target formation. Dredging is generally slower and more difficult than dewatering, and may require significant upfront capital investments, but it is less likely to impact nearby water resources since it does not require removal of water. In some locations dredging may not be a feasible option due to sandstone deposits that are tightly cemented, shallow depth to groundwater or other factors. There are currently four facilities that use dredging to excavate sand in Wisconsin. See section 2.3.7 for a discussion on groundwater quality impacts.

### **2.3.5 Borehole Abandonment**

When evaluating a potential industrial sand mine site it is common to drill exploratory boreholes to assess the economic potential of a site. Information from the boreholes is used to characterize the quality and thickness of a deposit, and the feasibility of extraction by determining the thickness of overburden and depth to target formation. Boreholes may be constructed without DNR approval or prior notification.

There is, however, a requirement to fill and seal unused wells or drillholes no later than 90 days after they have been removed from service under Ch. NR 812, Wis. Adm. Code. Unsealed boreholes provide a conduit for contamination from the surface to the aquifer below. DNR field staff and citizens have reported unsealed boreholes in the vicinity of some industrial sand operations. NR 812 defines drillhole as an opening deeper than it is wide and at least 10 feet deep. Any opening that intersects the water table requires proper filling and sealing to ensure protection of groundwater resources, even if the drillhole is less than 10 feet deep, and thus does not meet the definition of drillhole. (see glossary for definition of drillhole).

Sandstone aquifers of western Wisconsin are commonly used for drinking water supply. Contaminants that may be found where exploratory boreholes are constructed include nitrates, pesticides and fertilizers from nearby farm fields, volatile organic compounds (VOCs) from vehicles, equipment or on site storage tanks, chloride from road salt, bacteria or viruses from runoff, and any chemicals used in sand processing. Properly sealing boreholes closes off a potential contaminant pathway that could put drinking water supplies at risk.

### **2.3.6 Drinking Water**

All non-community potable wells are subject to construction standards found in NR 812 (Well Construction and Pump Installation). If a well on an industrial sand facility is determined to serve a public system, then the operation standards and maintenance of public water systems of ch. NR 810, Wis. Adm. Code, 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 DNR to ensure safe, reliable drinking water.

If a mining or processing operation provides drinking water to more than 25 people and has drinking water available over 6 months a year it is regulated as a non-community non-transient water system (assuming no one resides onsite). Additionally, it is subject to conditions and testing in chs. NR 809 and NR 810, Wis. Adm. Code. These water systems need a certified operator and 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) is required by NR 809.

In addition to operator and sampling requirements, NR 810 also has requirements for water distribution systems and technical, managerial and financial capacity. A DNR public water system specialist is assigned to the facility. The public water supply system is inspected every five years.<sup>15</sup>

### **2.3.7 Metals**

There is some concern that operations at ISM facilities may be linked to increased concentrations of dissolved metals in groundwater. The risk of an ISM increasing metals concentrations in groundwater is highly dependent on preexisting geochemical conditions and the geologic formations that are being manipulated. Some areas of western Wisconsin may have low pH in groundwater (pH values between 4 and 6 have been reported) and surface water (pH values between 5 and 6 have been reported).

If redox<sup>16</sup> conditions are altered in an area with pre-existing low pH where the Tunnel City formation is being worked as either a target formation or overburden, metals such as aluminum, arsenic and lead may become mobilized. The Tunnel City formation is known to contain sulfides that can lower pH when redox conditions are altered (e.g., when pumping lowers water levels). Researchers from the Wisconsin Geologic Natural History Survey (WGNHS) and the UW System are investigating this issue. Their work should provide baseline data characterizing geochemistry of western Wisconsin. Additional study is needed to determine if there is a risk of impact to groundwater quality and, if so, to what degree.

### **2.3.8 Polyacrylamides**

Operations that clean or process industrial sand occasionally use polyacrylamides as a flocculant to remove unwanted silt and clay particles (fines) from water used to wash the sand. The purpose is to remove the fines so that the wash water can then be reused to wash more sand. It is used for a similar purpose at publicly owned treatment works (POTW), municipal water supply plants, and the food industry.

Acrylamide (mono) is classified as a probable human carcinogen, while polyacrylamide does not have documented negative health effects. Both the acrylamide monomer and the

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<sup>15</sup> <http://dnr.wi.gov/topic/drinkingwater/>

<sup>16</sup> An oxidation-reduction (redox) reaction is a type of chemical reaction that involves a transfer of electrons between two species. An oxidation-reduction reaction is any chemical reaction in which the oxidation number of a molecule, atom, or ion changes by gaining or losing an electron. Source: [http://chemwiki.ucdavis.edu/Core/Analytical\\_Chemistry/Electrochemistry/Redox\\_Chemistry/Oxidation-Reduction\\_Reactions](http://chemwiki.ucdavis.edu/Core/Analytical_Chemistry/Electrochemistry/Redox_Chemistry/Oxidation-Reduction_Reactions).

polyacrylamide polymer appear to be biodegradable in aerated soils, with half-lives on the order of a few days.<sup>17</sup> As a result, unless polyacrylamide levels are extremely high in the wastewater or waste sludge (concentrated fine particles) it is unlikely that acrylamide presents a hazard to human health.<sup>18</sup>

The Chippewa County Department of Land Conservation and Forest Management has required monitoring for the acrylamide monomer at four mine sites. Acrylamide has not been found in any of the soil or groundwater samples collected downgradient from potential acrylamide release locations.<sup>19</sup> More research may be needed to determine if concentrations of acrylamide in industrial sand wash water and waste sludge are high enough to impact groundwater when mines are using polyacrylamide polymer as a flocculant.

When used, the amount of polyacrylamides is limited by two factors. The first is the cost of the product. The less a facility needs to use to eliminate the problem, the lower the cost. The second is that any excess flocculent would be transferred with the wash water and could inhibit the washing process.

### **2.3.9 Oil and Grease**

As with other non-metallic mines, industrial sand mines must monitor stormwater and wastewater for the release of oil and grease as a contaminant. The primary source for potential oil and grease contamination is the equipment used in the ISM operation, such as large machinery and generators, as well as fuel storage vessels. Oil and grease monitoring is required by the WPDES Non-Metallic Mine General Permit (see section 2.4.2 for details).

### **2.3.10 High Capacity Wells**

High capacity wells are regulated under s. 281.34, Wis. Stats, and are defined as “a well, except for a residential well or fire protection well, that, together with all other wells on the same property, except for residential wells and fire protection wells, has a capacity of more than 100,000 gallons per day.” Any well, regardless of pump capacity, on a high capacity property is considered a high capacity well.<sup>20</sup> Section NR 812.09 Wis. Adm. Code requires prior DNR approval for the construction or reconstruction of a high capacity well. Technical review of high capacity wells proposed for use at ISM facilities is no different than any other type of high capacity well. The review process and approval criteria are the same as those described in state statute and code. Two components are considered by DNR when reviewing a high capacity well application: construction and water withdrawal.

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<sup>17</sup> [http://www.cdc.gov/biomonitoring/Acrylamide\\_BiomonitoringSummary.html](http://www.cdc.gov/biomonitoring/Acrylamide_BiomonitoringSummary.html)

<sup>18</sup> Institute for Wisconsin’s Health Inc. 2016. See: <http://www.pewtrusts.org/en/multimedia/data-visualizations/2015/hia-map/state/wisconsin/silica-sand-mining-in-western-wisconsin>.

<sup>19</sup> Barr Engineering. 2013. Environmental Impacts of Water Treatment Chemicals at Industrial Sand Mines. Barr White Paper. See: <https://www.barr.com/download/331>.

<sup>20</sup> 2015 Wis Act 177 granted an exception for wells used for residential or fire protection purposes from being considered high capacity wells effective October 1, 2016. s. 281.34(1)(b) Wis. Stats.



The proposed well construction is reviewed to ensure that it both meets the specifications of the well construction code (NR 812) and that the proposed well does not contribute to, or worsen any groundwater contamination. Contaminants can be anthropogenic or naturally-occurring, and both are considered when reviewing well construction. For example, there are areas of Wisconsin that have naturally occurring arsenic in aquifer formations. Mobility of this arsenic may have been increased when pumping of large volumes of groundwater altered redox conditions of the aquifer from reducing to oxidized. In these areas, applicants may be required to construct wells in such a manner that they do not draw water from formations or intervals that are known to contain arsenic bearing minerals. It is also important that wells be constructed with a good seal of the annular space around the well casing. A properly sealed annulus prevents the well from becoming a pathway for contaminants to migrate from the surface or shallow subsurface to water supply aquifers below.

For the withdrawal portion of the review, the DNR changed its procedures in July 2011 in response to a 2011 Wisconsin Supreme Court decision<sup>21</sup> to review each application for a new high capacity well to determine whether the well, along with other high capacity wells on the contiguous property, would result in significant adverse environmental impacts to waters of the state – which includes all streams, lakes, wetlands, public and private wells. Section NR 820.12(19), Wis. Adm. Code defines significant adverse environmental impact as:

*Alteration of groundwater levels, groundwater discharge, surface water levels, surface water discharge, groundwater temperature, surface water temperature, groundwater chemistry, surface water chemistry, or other factors to the extent such alterations cause significant degradation of environmental quality including biological and ecological aspects of the affected water resource.*

If the DNR determined the proposed well could directly result in significant adverse environmental impacts, the DNR would either deny the well application or request that an applicant modify their proposed construction or operation of the well to prevent such impacts. DNR based the need to modify or deny an application on the projected impacts to the affected water resource, e.g., estimated reductions in stream flow or lake level, and the resultant impacts to water temperature, the fishery and other ecological aspects of the stream or lake. In conducting these assessments, DNR considered site-specific hydrogeology, separation distance between the well(s) and the water resource, the hydrology and characteristics of potentially-affected surface waters, construction details of nearby wells, characteristics of the proposed wells such as construction, pump capacity, and the water use and pumping schedule for the proposed well and any other existing wells on the property. This version of the technical review methodology was in place from July 2011 through May 2016.

In May 2016 the Wisconsin Attorney General issued a formal opinion (OAG-01-16) regarding the DNR's authority to consider environmental impacts when reviewing high

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<sup>21</sup> *Lake Beulah Management District v. Department of Natural Resources*, 2011 WI 54, 355 Wis. 2d 47, 799 N.W.2d 73.

capacity well applications. The Attorney General concluded that through the adoption of 2011 Act 21 (§ 227.10(2m)), “[t]he Legislature has defined the parameters in which DNR can act to protect the state’s navigable waters and additionally has clarified the ways in which DNR can regulate non-navigable waters.” (OAG ¶52). The Attorney General concluded that section 227.10(2m), Stats., prohibits the DNR from conducting an environmental review of a high capacity well unless it is in one of the specific categories identified in Wis. Stat. § 281.34, such as a well in a groundwater protection area; with a water loss of more than 95 percent of the amount of water withdrawn; or that may have a significant environmental impact on a spring (these categories are specified in Wis. Stat. § 281.34(4)); or if it may impair the water supply of a public utility (as described in Wis. Stat. § 281.34(5)). According to the Attorney General, the Department lacks explicit authority to review the environmental impact of wells outside of those specific categories identified in Wis. Stat. § 281.34. High capacity well reviews are conducted in accordance with the Attorney General opinion as of June 2016.<sup>22</sup>

### **2.3.11 Dewatering**

Dewatering is the pumping of groundwater so that work can be done at a depth that is below the water table. It is a common practice during road construction or utility work in areas where there is shallow groundwater. Water may be pumped using wells, which are referred to as temporary high capacity dewatering wells if they have a capacity greater than 100,000 gallons per day. This is more common at construction sites, road projects or utility work.

Dewatering at industrial sand facilities is typically done if the target formation is below the water table, in order to expose the formation so that sand mining operations may be conducted without the need for dredging. Dewatering is most often accomplished by pumping directly out of a pit or trench. Dewatering may increase the potential for impacts to groundwater and surface water resources. Any increased potential for impact is given consideration during high capacity well technical review, and is regulated as a secondary impact if wetland permits are required for the site. Discharge of dewatering water is regulated under a WPDES permit (see section 2.4.2 for more information). 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 (Ch. NR 815, Wis. Adm. Code.) The majority of sand mining in Wisconsin is done above the level of the water table where no dewatering is required, although dewatering is becoming more common. There are currently four facilities that utilize pit dewatering to access target formations in Wisconsin.

### **2.3.12 Recycling**

Water use efficiency (inverse of water loss) varies from site to site, but is generally high for the ISM sector. As described in section 1.3.4, many facilities use closed-loop systems for processing sand, which greatly increases water use efficiency. As mentioned above in section 2.3.2, when a closed-loop system is used, evaporation and incorporation are the

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<sup>22</sup> <http://dnr.wi.gov/topic/wells/highcapacity.html>

only processes in which water is lost during the processing phase of silica sand production. Infiltration of stormwater and process water that may take place in storage ponds could be considered a form of water recycling as water that occurs as runoff or is pumped for process water seeps back into the aquifer. It should be noted that the water that infiltrates may be recharging a different aquifer than it originated from if the facility is pumping from a confined aquifer.

### **2.3.13 Permit Process and standards**

Groundwater related permits relevant to ISM include high capacity well approval, dewatering approval, water loss approval and consumptive uses, water use permits, and borehole abandonment. There is some overlap with wetland permits and reclamation plans, which may have groundwater components.

Issuance of most high capacity well approvals is considered a minor action under the framework of the Wisconsin Environmental Policy Act (WEPA) and as such no formal environmental review is required other than the regulatory review described above. The exceptions to this would be wells that are located within groundwater protection areas (within 1,200 feet of a trout stream, outstanding resource water or exceptional resource water), wells that could affect a spring that has a flow of at least 1 cubic foot per second or wells that result in at least 95% water loss. In those cases a separate review following the WEPA process, as delineated in Ch. NR 150, Wis. Adm. Code, is generally required per Ch. NR 820.

Applicants for a high capacity well approval, including temporary dewatering approvals must submit an application fee of \$500 and the appropriate application form. The application includes information about existing wells on the property along with details concerning the intended construction and operation of any proposed wells and a description of the anticipated geology. DNR staff use this information and other available information, such as geological reports, well construction information, surface water inventories, and hydrogeologic and hydrologic models to complete the assessment of the proposed well(s). In some cases, additional information may be required and an applicant may need to conduct site specific studies including pumping tests and development of groundwater models to facilitate the review. As discussed in section 2.3.10, the Attorney General has provided an opinion on DNR's authority to review the environmental impacts of high capacity well applications. According to the Attorney General, DNR has explicit authority to consider the environmental impacts of only certain high capacity wells.

Anyone planning to operate a temporary high capacity dewatering well system must have DNR approval per s. NR 812.09. The DNR may deny or limit the proposed high capacity dewatering well if it is likely to have an adverse impact on water availability to a public utility well, if the dewatering pumping could cause an area of groundwater contamination to spread, or the proposed dewatering system does not meet the requirements of ch. NR 812.<sup>23</sup>

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<sup>23</sup> <http://dnr.wi.gov/topic/wells/dewatering.html>

Pit or trench dewatering more typical for an industrial sand facility requires a WPDES discharge permit (see section 2.4.2 for details) if it results in discharge into or near a surface water body. Dewatering water may be used for process water, in which case it would be treated as wastewater.

Water loss and consumptive use is currently regulated under Ch. 281, Wis. Stats, and Ch. NR 142, Wis. Adm. Code. Water loss is defined as “the amount of water that is withheld or not returned to the basin from which it is withdrawn as a result of a diversion or consumptive use or both.” (s. 281.246(1)(wm), Stats.). Consumptive use is defined as “a use of water that results in a loss of or failure to return some or all of the water to the basin from which the water is withdrawn due to evaporation, incorporation into products or other processes.” (s. 281.346(1)(e), Stats.).

A detailed water balance for a specific site may be required as part of the application process to determine the amount of water loss associated with the proposed withdrawals on the property; or, water loss may be estimated for the withdrawal at 20% based on USGS-estimated consumptive use coefficients from nonmetallic mining operations in the Great Lakes Basin (see Shaffer and Runkle, 2007, Table 1-15, p. 149).<sup>24</sup> If water loss averages more than 2 million gallons per day (MGD) in any 30-day period or the person proposes to increase a withdrawal that will result in water loss averaging more than 2 MGD in any 30-day period above the person’s authorized base level of water loss, an application must be submitted to the DNR for a new water loss approval or modification of an existing water loss approval under s. NR 142.06(2), Wis. Adm. Code.

If the withdrawal is located in the Great Lakes Basin, a Water Use permit is required before persons may withdraw water in quantities that average 100,000 gallons per day or more in any 30-day period<sup>25</sup>.

See section 2.5 for wetland permitting process and standards in general. Groundwater impacts are found in section 2.5.4 (Secondary Impacts). See section 2.10 for Reclamation permit process and standards.

### **2.3.14 Secondary Impacts**

Direct impacts associated with groundwater withdrawals include situations where pumping from a particular well results in drawdown in another well to the extent that the availability of water in the second well is significantly reduced and could reach a point of no longer producing water.

Secondary or indirect impacts include changes in groundwater chemistry resulting from the withdrawal and changes to the nature of water resources as a result of groundwater discharge reductions in lakes, wetlands and streams. For example, impact to a stream is often quantified in terms of the effect of the potential flow reduction on the fish population that resides in the particular stream of interest. Reducing the amount of groundwater that flows to the stream (known as streamflow depletion) may affect the water temperature in the stream, since groundwater is generally colder than runoff. Water

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<sup>24</sup> [https://pubs.usgs.gov/sir/2007/5197/pdf/SIR2007-5197\\_low-res\\_all.pdf](https://pubs.usgs.gov/sir/2007/5197/pdf/SIR2007-5197_low-res_all.pdf)

<sup>25</sup> For more information, see: <http://dnr.wi.gov/topic/wateruse/permits.html>

temperature is strongly correlated with fish species, since fish like trout require cold water to survive and thrive. If a high capacity well or dewatering well is diverting groundwater that would have flowed to the stream, water temperature could increase and the stream may become unsuitable for coldwater fish.

### **2.3.15 Cumulative Impacts**

If there are a number of high capacity wells or mine dewatering systems operating in close proximity, the drawdown-related impacts to waters of the state can be additive. That is, the total impact to a particular water resource will represent the sum of the impact caused by each separate withdrawal. As part of its review of proposed high capacity wells, DNR previously assessed the extent of combined impacts to any water of the state as a result of the proposed well in combination with other wells (or other withdrawal sources) in the area of a proposed well. In May 2016, the Attorney General advised that DNR lacks the explicit authority to consider cumulative impacts when evaluating a high capacity well application.

### **2.3.16 Monitoring**

Monitoring of groundwater quantity and quality may be required as part of a conditional use permit issued by a county or township (see section 4.1.3), or may be conducted on a voluntary basis. Monitoring groundwater levels can be a useful tool to verify predictions of groundwater drawdown and to serve as an early warning of potential problems.

All high capacity well owners are required to submit an annual report of their water use. Owners must record the amount of water they use each month and submit the data at the end of each calendar year. In addition, owners pay an annual water use fee of \$125 per property, as authorized by s. 281.346, stats. Additional annual fees may also apply if the withdrawal occurs within the Great Lakes drainage basin.

### **2.3.17 Current Trends**

Of the 128 active Industrial Sand sites in WI, 63 of them have registered withdrawals over 100,000 gallons per day (this includes high capacity wells and surface water withdrawals). As of May 2016, there are 16 pending high capacity well applications seeking approval for 37 wells related to Industrial Sand sites. Beginning in June 2016, high capacity well reviews will be based on the Attorney General opinion. See above for details.

In 2015, 9 high capacity wells were approved for industrial sand preparation use, compared to 13 in 2014, 6 in 2013, 16 in 2012 and 14 in 2011. As of May, 14 high capacity wells on 4 properties have been approved in 2016.

ISM water use has changed rapidly in the past several years with the number of properties reporting high capacity withdrawals increasing from 12 in 2011 to 31 in 2014. The number of high capacity wells approved for ISM applicants increased from 35 in 2011 to 65 in 2014. However, the withdrawal capacity of newer ISM sites is considerably less than older sites. For instance, sites active in 2011 had an average withdrawal capacity of 2.5 million gallons per day whereas sites that became active after 2011 have an average capacity of less than 1.4 million gallons per day. In addition, the daily withdrawal capacity for ISM properties ranges considerably, from the smallest site

capable of 200,000 gallons per day, to the largest site capable of withdrawing over 7,000,000 gallons per day. The average ISM site is capable of withdrawing 1,800,000 gallons per day.

Despite the 160% increase in Industrial Sand facilities that have high capacity wells between 2011 and 2014, the total statewide ISM withdrawal increased only 25% from 2011 to 2014, from 1.5 billion gallons to 1.8 billion gallons. This is primarily due to the fact that the 4 largest sites, all of which were active in 2011, withdrew 60% to 90% of the total statewide ISM withdrawal from 2011 to 2014. In fact, the largest site in the state, Badger Mining’s Taylor plant has averaged 400 million gallons per year, or 25% of the state’s total ISM withdrawal.

## 2.4 Surface Water Resources

### 2.4.1 Introduction

Wisconsin is home to about 84,000 miles of streams and 1.2 million acres of lakes. On a statewide basis this amounts to approximately 1.55 miles of stream for every 1 square mile of land area, while surface water in lakes and impoundments accounts for approximately 3.3,5% of total surface area across Wisconsin. Although more than 47% of Wisconsin’s original wetlands have been lost, more than 5.3 million acres of wetland (or approximately 15% of Wisconsin’s total land area) are still present across the state. The water resources of the 13 counties where sand mining and associated activities are most prevalent vary greatly (Table 2-1). Due to the state’s numerous wetlands and streams, combined with the expansion of sand mining, some mines are located near Wisconsin surface water and wetland resources.

**Table 2-1** *Surface water resources by county*

County	County Area	ISM Facilities <sup>a</sup>	Stream Density <sup>b</sup>	Surface Water	Mapped Wetland	Wetland Indicator Soils
Barron	892 mi <sup>2</sup>	21	0.76	3.3 %	9.2 %	21 %
Buffalo	721 mi <sup>2</sup>	4	5.23	6.9 %	10.3 %	13 %
Chippewa	1,041 mi <sup>2</sup>	14	0.76	3.1 %	20.0 %	35 %
Clark	1,213 mi <sup>2</sup>	4	0.76	0.3 %	22.5 %	56 %
Dunn	855 mi <sup>2</sup>	4	1.26	0.6 %	9.6 %	15 %
Eau Claire	643 mi <sup>2</sup>	5	0.97	0.8 %	15.6 %	25 %
Jackson	997 mi <sup>2</sup>	16	0.89	1.1 %	N/A	38 %
Monroe	907 mi <sup>2</sup>	8	0.82	0.7 %	11.3 %	21 %
Pepin	273 mi <sup>2</sup>	1	1.56	15.0 %	6.2 %	15 %
Pierce	626 mi <sup>2</sup>	6	3.00	8.3 %	2.6 %	8 %
St. Croix	738 mi <sup>2</sup>	2	0.53	2.1 %	5.2 %	17 %
Trempealeau	735 mi <sup>2</sup>	22	7.66	0.3 %	8.3 %	12 %
Wood	806 mi <sup>2</sup>	11	0.92	1.6 %	30.6 %	73 %

<sup>a</sup> Industrial sand mines, processing and rail facilities.  
<sup>b</sup> Miles of stream ÷ mi<sup>2</sup> land area.

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 streambed, 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 impact to 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 waterbody. Other direct impacts to surface waters from nonmetallic mining sites can include the discharge of contaminated stormwater runoff from the mine and discharges of process water used to wash the sand. Impacts may include increased siltation and deposition of sand that could lead to loss of fish and aquatic life habitat. These discharges are regulated under permit (see below section 2.4.2) to avoid and minimize these impacts.

Indirect impacts to surface water can include drawdown effects of high capacity well use, dewatering processes taking place in the mine, or inadvertent diversion of sources such as redirecting drainage patterns outside the watershed and other changes in hydrology. The temperature and thermo-warming of surface waters may occur due to the release of stormwater or as a result of reduced groundwater inputs. Other potential indirect impacts include the 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.

Cumulative impacts to surface waters can be related to multiple facilities located within a watershed that can multiply the direct or indirect impacts to one resource. There could be both positive and negative impacts including significant changes in hydrology and sedimentation. Many surface waters in areas of sandy soils have a large non-point source contribution that is not regulated or controlled. When several mines are proposed in a single watershed, the potential to change land use from an un-regulated one to a regulated one is an opportunity to bring benefit through reduced sedimentation and contamination. Conversely, multiple sources mean multiple contributions of pollutants that may not be covered in the regulation as well as the potential for permit violations that can result in large scale impacts of runoff events. Specific information about current cumulative impacts is not known at this time.

#### **2.4.2 WPDES Permitted Discharges for Stormwater and Wastewater**

The DNR regulates wastewater discharges and stormwater discharges to waters of the state<sup>26</sup> from nonmetallic mining (NMM) operations under the authority of ch. 283, Stats. The Wisconsin Pollutant Discharge Elimination System (WPDES) requirements for permitting wastewater discharges and stormwater discharges are outlined in ss. 283.31 and 283.33, Stats., respectively, and these discharges are further regulated under various provisions of the Wisconsin Administrative Code, including ch. NR 216, Wis. Adm. Code for stormwater, chs. NR 102, 103, 105, 106, and 207 for surface water discharges of wastewater, and ch. NR 140 for groundwater discharges. Discharges to waters of the state resulting from industrial sand operations are regulated primarily by two general

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<sup>26</sup> Waters of the State is defined in ch. 283, Stats, and generally includes lakes, rivers, streams, wetlands, and groundwater.

WPDES permits: the Nonmetallic Mining Operations General Permit (NMM Operations General Permit) and the Construction Site Stormwater Discharge Permit. The NMM Operations General Permit (WPDES Permit No. WI-0046515-5) expired in 2014 and is currently in the process of being reissued. The Construction Site Stormwater General Permit (WPDES Permit No. WI-S06731-3) was reissued on September 30, 2011 and expires on September 30, 2016.

When nonmetallic mining activities commence, including initial excavation and removal of overburden, they are typically covered by the Nonmetallic Mining Operations General Permit. In some cases, the initial construction of the processing plant or associated rail yard or buildings is covered by the Construction Site Stormwater general permit. At the point in time the facilities begins to process product, the facilities are then covered by the NMM Operations General Permit. The activities associated with nonmetallic mining are regulated under this general permit to ensure that the site is operated “cradle to grave” to prevent discharges of pollutants to waters of the state. The NMM Operations General Permit is issued on 5-year terms and regulates the discharges of pollutants associated with both stormwater and wastewater. Coverage under the Nonmetallic Mining Operations General Permit is required from the initial commencement of preparation of the nonmetallic mining site, throughout operation, and until the site has been reclaimed. If the site is adjacent to a navigable waterway or wetland, other DNR permits may be required and local shoreland zoning regulations may also apply. Some work related to nonmetallic mining operations outside the scope of the active area of mining such as processing facilities, access roads, rail spurs, etc. may require coverage under the Construction Site Stormwater General Permit.

As of the date of this document, the NMM Operations General Permit is in the process of being reissued. The Department is proposing to reissue the NMM Operations General Permit as two general permits. One general permit would cover nonmetallic mining operations not involved in industrial sand mining (e.g., crushed stone, construction sand, gravel, etc.) (WPDES General Permit No. WI-A046515-6). The other general permit would cover industrial sand mining and processing facilities defined by the Standard Industrial Classification Code 1446, *Industrial Sand* (WPDES General Permit No. WI-B046515-6). Permit No. WI-B046515-6 would contain provisions to address the specific concerns associated with sand washing, processing and drying operations and the degree of processing at industrial sand mining facilities. The proposed NMM Operations General Permits are discussed in more detail below.

The goal of the NMM Operations General Permit is to require the facility operator to develop plans and implement procedures to prevent water pollution of both surface water and groundwater. Discharges from nonmetallic mining operations may include sediment, total suspended solids, residual water treatment additives, metals, or other pollutants from exposure of nonmetallic mining operation activities to stormwater, and wastewater contaminants directly related to the mining and processing activities. Physical controls, such as pollution prevention or treatment best management practices, are required to minimize the discharge of pollutants via stormwater to wetlands, surface waters, and groundwater. Nonmetallic mining operators are encouraged to divert stormwater from wastewater treatment practices to prevent overflows and to allow sediment to be retained on-site. For other pollutants, such as metals, residual water treatment additives, petroleum



products, etc., source area pollution prevention practices are needed to minimize contamination and mixing with the wastewater and stormwater. However, treatment best management practices may also be needed if contamination cannot be prevented.

All active nonmetallic mining operations are required to perform annual site compliance inspections to confirm pollution source locations, site drainage patterns, and that stormwater best management practices are implemented and maintained. All industrial sand nonmetallic mining operations are required to develop and implement a Stormwater Pollution Prevention Plan (SWPPP), including preparation of a site drainage map, identification of potential pollutant sources, implementation of pollutant prevention and pollutant treatment best management practices as needed, and quarterly visual inspections. The permit also authorizes the discharge of wastewater directly related to the process of nonmetallic mining, such as dewatering wastewater, mining material wash waters, contact and noncontact cooling water, vehicle and equipment wash water, and other similar wastewaters. Appropriate treatment technology, such as settling of suspended solids or use restrictions on chemical treatment additives, are required for these pollutants prior to discharge to surface waters or groundwater.

### **Wastewater Pollutant Discharges**

The DNR regulates a number of mining process wastewaters that may contain pollutants associated with nonmetallic mining activity. The most common discharges include mining pit dewatering (regardless of whether the water results from precipitation or groundwater) and wash water generated from separating unwanted material (fines, etc.) from the specified industrial sand products (see section 1.3.3). The primary pollutants associated with mining sites are earthen materials that result in total suspended solids (TSS) and sediment in wastewater and stormwater. The NMM Operations General Permit requires surface water discharges of wastewater meet a limit of 40 mg/L of TSS. The primary concern with wastewater discharges to groundwater is the potential for dissolved metals that may become mobilized by changes in pH. Wastewater discharges are to be held to a pH range of 6.0 to 9.0.

The NMM Operations General Permit also specifies the requirements for water treatment additives that may be used at a facility and DNR guidance prescribes the water quality review and approval process for additives (see DNR guidance [#3400-2015-03](#)). The most common additive used at industrial sand facilities is polyacrylamide flocculants to control turbidity and remove suspended solids.

Permittees are required to submit a discharge monitoring report annually for surface water and groundwater discharges. A review of discharge monitoring data of process wastewater in 2014 from 17 different industrial sand mines facilities showed two facilities discharging to both groundwater and surface water. Eleven of the facilities had a discharge to surface water while four facilities had discharge to groundwater. The duration of discharges ranged from one day to 243 days. The discharge flow rates were highly variable with some facilities reporting discharges of 2,000 to 3,000 gallons per day and other facilities reporting discharges up to 3.1 million gallons per day. The variability of discharge rates may be connected to the amount of dewatering or stormwater that may be combined with process water.

The NMM Operations General Permit requires sample results for oil and grease. In the discharge monitoring data reviewed in 2014, all 17 facilities reported both groundwater and surface water discharges that were lower than the annual permit limit of 15 mg/l. Additionally, all facilities reported that the oil and grease levels were below 7.5 mg/l on the first annual result, which exempted the facilities from further testing. Discharge sample results for total suspended solids (TSS) ranged from no detect to 199 mg/l. The average reported TSS was 29.58 mg/l with greater than 50% of the samples less than 16.63 mg/l. Five reported sample values exceeded 40 mg/l, the standard for TSS. Discharge sample results for pH ranged from 6.2 to 9.52 with an average of 7.3. Three reported sample results exceeded 9.0 and no pH values were reported less than 6.

Department stormwater staff regularly conducts inspections to assess the status of compliance with the NMM Operations General Permit. The frequency by which stormwater staff inspect facilities is based on a number of factors including initial start-up, proximity to water resources, sensitivity of the resources, and the potential impacts due to steep slopes and degree of processing. This approach leads to some facilities receiving more frequent inspections than others. Where the permit conditions are not met, the department has authority under ch. 283, Stats., to take enforcement action. From 2012 to 2015, the department took enforcement action against 21 facilities for stormwater violations. Of these, 15 returned to compliance and the remaining facilities were placed under compliance schedules.

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 to a settling pond, which then, through infiltration, recharges groundwater and ultimately feeds a nearby stream. In either case, groundwater may be warmed, and thermal effects may be seen in cool water or coldwater streams. Other considerations include chemical changes such as addition of water treatment additives and changes in pH.

The DNR has conducted limited exploratory sampling at ISM sites to better understand the quality of wastewater treatment ponds that could potentially impact groundwater. In 2013, the DNR collected a series of water samples from wastewater treatment ponds at approximately 21 industrial sand mines across 8 western Wisconsin counties. The wastewater treatment ponds were a mixture of exclusively process water ponds and ponds with both stormwater and waste water components (DNR unpublished data, 2013). The range of pH was relatively narrow between 6.0 and 9.2 and overall, sufficiently neutral or basic to avoid significant contribution to the mobilization of heavy metals. However, a number of heavy metals were detected in some of the 2013 samples at levels that exceeded the groundwater enforcement standard specified in Ch. NR 140, Wis. Adm. Code. This includes heavy metals such as aluminum, manganese and zinc. A number of other metals were reported at levels greater than the groundwater preventive action limits specified in NR 140, including beryllium, chromium, cobalt, lead and nickel. However, the concentrations in the ponds are not necessarily representative of the concentrations that may be discharged to groundwater through seepage, and the one time samples are considered only as indicators. The movement and dissolution of metals are related to the chemistry of the groundwater and bottom pond sediments and affected by factors such as pH, dissolved oxygen, oxidation-reduction potential, specific conductivity and temperature which could vary from season to season.

In the spring of 2017, the department will convene a team of stakeholder experts to direct new research regarding possible linkages to increased concentrations of dissolved metals in groundwater at ISM pond sites.

### **Wisconsin's Nonmetallic Mining Operations General Permits**

As previously mentioned, the DNR is currently in the process of reissuing the NMM Operations General Permit as two general permits, WPDES General Permit No. WI-A046515-6 and WPDES General Permit No. WI-B046515-6. Both general permits authorize and regulate discharges of storm water and process wastewater from operations whose primary income producing activity is nonmetallic mining. The Department is choosing to regulate industrial sand operations separately from other types of aggregate mining due to the rapid growth in recent years of industrial sand mining and processing for use in the hydro-fracking industry, the areal extent of these operations, and the level of potential wastewater volume and associated treatment. In addition, it's currently unknown what, if any, potential exists for the release of metals to groundwater at industrial sand mining and processing facilities. Metals may originate in the cementing materials in the sandstone formations and may be liberated during processing. Process wash water holding ponds are of particular concern, as metals may be concentrated there in both solid and dissolved forms. These ponds may not be lined or sealed. Therefore, the Department is working with ISM stakeholders to direct a study designed to determine whether sand mining operations could *potentially* impact groundwater, and therefore whether additional preventative or monitoring measures are warranted, particularly in cases where process wash water ponds are unlined or unsealed. This study will take place outside of the requirements of WPDES General Permit No. WI-B046515-6.

#### **2.4.3 Permit Jurisdiction in or near Surface Waters**

In addition to the WPDES permits, a number of other environmental regulations are in place to ensure mining activities are protective of waters of the state including:

- Chs. 30 and 31, Wis. Stats. - Waterway permits for activities affecting navigable waterways;
- s. 281.36 Wis. Stats. - Activities proposing to impact wetlands;
- Ch. NR 115, Wis. Adm. Code (promulgated under s. 281.31, Wis. Stats.), and Ch. NR 116 Wis. Adm. Code, required to be implemented through ss. 59.692 and 87.30, Wis. Stats. - Shoreland zoning and floodplain regulations.
- High Capacity Well approvals under s. 281.34, Wis. Stats.

#### **Cranberry Exemption**

Some of the counties in central Wisconsin that are seeing an increase in ISM 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, thereby preventing root rot and fostering plant growth.

Ch. 94.26, Wis. Stats, was established in 1867 and exempts cranberry growers from much of the laws applying to waters of the state under Ch. 30, Wis. Stats. This exemption allows cranberry growers to mine sand for cranberry production; however, such growers

are not exempt from the state wetland regulations found in s. 281.36 Wis. Stats. A number of cranberry operations have converted portions of their facilities to mine industrial sand. The DNR has recently determined that the exemption in Ch. 94.26, Wis. Stats., from portions of chs. 30 and 31, Wis. Stats., for cranberry culture is not applicable to nonmetallic mining sites where a Ch. 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.

#### **2.4.4 Regulations and Permit Process**

Activities proposed in or near navigable waterways may be subject to Ch. 30 and/or Ch. 31, Wis. Stats. Ch. 31 applies to the regulation of dams and as such in the past has had limited applicability to sand mining since the industry has not proposed construction of dams as part of their operations; however, the DNR is beginning to evaluate proposals where cranberry operations are converting to ISM facilities. This will require permitting under s. 30 and 31, Wis. Stats., which have been historically exempted under s. 94, Wis. Stats.

Ch. 30 is the most likely statute to be invoked when an industrial sand mine, processing, or rail facility is proposed. Through the Ch. 30 review process, the DNR's responsibility is to review a specific proposal for significant adverse impacts to the public interest in navigable waterways. Such public interests include: fish and wildlife habitat, natural scenic beauty, water quality and quantity, navigation, and other recreational uses of the waterway. Specific activities may have additional review criteria which may include flood-flow capacity, and impacts to neighboring riparian property owners.

Activities regulated under Ch. 30 include (with reference to the associated Administrative Code):

- 30.12 – The Placement of a structure or deposit on the bed of a navigable waterway (Ch. NR 329, Wis. Adm. Code)
- 30.123 – Bridges and Culverts (Ch. NR 320, Wis. Adm. Code)
- 30.18 – Withdrawal of water from lakes and streams
- 30.19 – Enlargement and Protection of Waterways (ponds, grading) (chs. NR 340, 341, and 343, Wis. Adm. Code may apply)
- 30.195 – Changing of a stream course (Ch. NR 340, Wis. Adm. Code)
- 30.20 – Removal of material from beds of navigable waters (chs. NR 340, 345, 346, and 347 Wis. Adm. Code)

The DNR implements a three-tier system of authorization based on the projected level of environmental impact for activities proposed to impact navigable waterways. Such tiers are outlined in Ch. NR 310, Wis. Adm. Code and include exemptions, general permits, and individual permits.

Exemptions are available for certain low-impact activities that do not present a significant risk to the public interest in navigable waterways. In order to be eligible for an exemption, an activity must meet all the design and eligibility criteria for the specific activity proposed. There is no formal review process required to operate under an exemption; rather, a project sponsor may choose to submit an exemption determination

request at no cost to the DNR in order to verify within 15 days of receipt whether their project meets the exemption criteria. Examples of activities that may be eligible for an exemption include: biological shoreline erosion control, riprap repair and replacement, culvert replacement, dry fire hydrant, intake/outfall structure, manual dredging, and certain ponds.

The DNR has a General Permit (GP) process available for certain activities in navigable waterways which meet pre-specified design, construction, and location requirements designed to minimize the project's impact to the public interest in navigable waterways. To qualify for a GP, all eligibility requirements must be met by the applicant, and an application must be submitted to the DNR. Water management staff review GP applications and verify that standards are met, and make a final determination on applications within 30 days of submittal of a complete application. In certain circumstances where the DNR determines the eligibility criteria for such an activity are not sufficient to protect the public interest, the DNR has required a more thorough review of the project through an individual permit process. The DNR has GPs available for the following activities: shoreline erosion control structures, fish and wildlife habitat structures, boat ramps, culverts, fords, clear span bridges, grading, ponds, and intake/outfall structures.

For activities that are not eligible for an exemption or general permit, a more detailed review through the DNR's individual permit process is required. Through this process, an applicant must submit an application to the DNR to be reviewed by the DNR's water management specialist, fisheries biologist, water quality biologists, and wildlife biologists who rely on fishery, wildlife, and water quality data, and may choose to visit a site to observe navigation patterns and habitat features at the project location, in order to come to a decision on a permit application.

Individual permits require a 30-day public comment period where the DNR publishes a web-based notice of pending application and the applicant is required to publish the same notice in the local newspaper and send a copy of the notice to adjacent riparian property owners and other interested parties. During the comment period, an informational hearing may be requested. Under such circumstances, a separate notice for the public informational hearing would be required and the informational hearing would be conducted by the DNR to gather additional observations and facts from others to consider, aside from its own data in making a final decision.

Individual permits are generally granted for projects when the DNR concludes the public interest in navigable waterways will not be significantly adversely impacted by the proposal. Often times, the DNR advises applicants on project modifications to reduce impacts and gain approvals. The individual permit process generally takes 105-135 days to complete and is dependent on application completeness at the time of original submittal, and whether or not a public information hearing is requested during the public comment period. Some activities, such as dredging, require the applicant to have a pre-application meeting with the DNR's water management specialist in order to review any additional application submittal requirements (such as required sediment sampling for characterization of possible contamination) prior to a formal application being submitted.

Activities conducted by NMM operations are generally subject to the waterway general permit process or the individual permit process due to the nature of the activities typically conducted. The DNR does not have the ability to impose additional conditions beyond standard eligibility criteria for general permits; however, projects falling under the individual permit process have been subject to project-specific conditions in order to ensure the project does not result in significant impacts to the public interest. Examples of conditions that have been imposed through the individual permit process include: site screening, erosion control, site reclamation and posting of a bond (i.e., the same conditions required by the county permit). Other DNR permit conditions have typically included: no disturbance in, or along outstanding/exceptional resource waters or trout streams; prohibition or minimization of disturbance to identified sensitive areas such as wetlands, rare species or habitats they use or historical/archeological sites; and requiring that any excavated floodplain ponds are designed to prevent fish kills and are publicly accessible.

The waterway permit program is structured in a manner such that, generally, each separate regulated activity requires a separate permit to be granted and permit review fee to be collected. Under these circumstances, a project that involves multiple activities regulated under both the general and individual permit processes has separate permit review timelines for those activities which fall under the different permit processes. Many ISM facilities require both general and individual waterway permits for their construction and operation activities.

### **NR 340 Implementation and Financial Capability Standards**

Chapter NR 340, Wis. Adm. Code – Nonmetallic mining and reclamation associated with navigable waterways and adjacent areas – applies to any NMM mine where certain non-exempt activities regulated by Ch. 30 are proposed. For typical industrial sand mines, this includes the following activities:

- Ponds within 500 feet or connected to navigable water (certain exemptions within s. 30.19, stats. or NR 340 and/or NR 343 Wis. Adm. Code may apply)
- Grading on or near the bank of a navigable water (certain exemptions within s. 30.19, stats. may apply)
- Changing of a stream course
- Removal of material from beds of navigable waterways

NR 340 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. chs NR 340.15, directs the DNR to assume that excavation from stream channels and immediate banks shall be avoided where reasonable alternatives exist:

*It is the policy of the natural resources board that nonmetallic mineral excavation in the channel and immediate banks of streams be carefully regulated in order to avoid or minimize adverse effects on aquatic*

*resources. Therefore, the department shall, in its review of permit applications under this chapter, presume that excavation in the channel and immediate banks should be avoided where reasonable alternatives are available.*

As of the date of this report, no industrial sand mines have been authorized to mine sand material from the bed of any lake or stream.

NR 340 applies when mining activities are proposed which require either an individual or general permit from the DNR under sections 30.19, 30.195, or 30.20, Wis. Stats.; however, the standards found in NR 340 are implemented through the individual permit process. The standards in NR 340 specify permit application requirements, mine operation and reclamation plan requirements, financial assurance requirements, permit review standards and expirations, permit modifications, permit extensions, and inspection requirements. It is important to note that NR 340 is only implemented on that portion of the mining site that is regulated under Ch. 30. This can lead to multiple jurisdictional authorities having mine reclamation plan requirements for separate portions of a mine site (under both NR 135 and NR 340), and a requirement for a mining company to provide separate financial assurances to each of the appropriate regulatory authorities having jurisdiction over a mine site.

### **Other Regulated Waterway activities**

ISM facilities may also be regulated under s. 30 and 31, where activities not directly related to mining are proposed in or adjacent to a navigable waterway. Examples of such activities include:

- Placement of a bridge, culvert, or ford stream crossing
- Placement of a water intake or outfall structure
- Placement of shoreline erosion protection
- Construction of a dam
- The withdrawal of water from lakes and streams
- Placement of structures in waterways, including fish habitat structures

### **2.4.5 Secondary Impacts**

The DNR's review criteria for individual permits considered under chs. 30 and 31 are specific to the regulated activity; however, most sections under chs. 30 and 31 include a provision for consideration of the effects of a project on the public interest, many of which have been considered as secondary impacts. Secondary impacts have been considered along with primary impacts provided a connection can be drawn between the regulated activity, a primary impact, and a resultant secondary impact.

For example, to approve an individual permit for grading on the bank of a navigable waterway, under s. 30.19, Wis. Stats., the DNR considers whether the following criteria are met:

1. The activity will not be detrimental to the public interest.
2. The activity will not cause environmental pollution, as defined in s. 299.01 (4), Wis. Stats.

3. Any enlargement connected to a navigable waterway complies with all of the laws relating to platting of land and sanitation.
4. No material injury will result to the riparian rights of any riparian owners of real property that abuts any water body that is affected by the activity.

In such a case, the DNR would review a proposal for the likelihood of sediment mobilization into the waterway, as well as other factors. Such sediment mobilization would be considered a direct impact and also may be defined as environmental pollution under criteria number 2 above. Once the sediment has entered the waterway, there is the possibility for secondary impacts such as sedimentation of known fish spawning areas (considered under the public interest criterion number 1, above) or water quality impacts, such as an increase in turbidity or a change in nutrient status depending on sediment constituents. These factors are also considered under the public interest criteria number 1, but are considered secondary impacts since they are the result of a primary impact (sediment entering the waterway).

#### **2.4.6 Cumulative Impacts**

Similar to secondary impacts, projects subject to the individual permit process under chs. 30 and 31, Wis. Stats., are reviewed for potential cumulative adverse impacts to the public interest as part of the DNR's standard individual permit review process. The possibility for cumulative adverse impacts is dependent on the specific risks pertaining to the regulated activity under consideration. If there is a strong possibility for cumulative impacts to a resource, DNR staff have sought to impose conditions on such projects to reduce the likelihood of cumulative impacts. Where significant adverse cumulative impacts of a proposed project that is otherwise eligible for a general permit are identified, the DNR may require an applicant to apply for an individual permit rather than a general permit, in order to more thoroughly evaluate the proposal. However, the use of individual permits has not been common.

#### **2.4.7 Monitoring**

The DNR conducts routine compliance monitoring for permits issued under chs. 30 and 31, Wis. Stats., in order to ensure that applicants are meeting all eligibility criteria and permit conditions for permitted projects. Such compliance monitoring is generally done on permits issued the preceding calendar year; however, staff have discretion to conduct compliance monitoring on any permitted projects as they determine to be necessary. In addition, the DNR has designated staff to evaluate permit applications submitted for both stormwater and waterway/wetland permit activities. These staff perform regular combined (stormwater/waterway/wetland) compliance inspections on permitted facilities, with many sites being inspected on multiple occasions annually.

In addition to being subject to routine compliance monitoring, project applicants are generally required through permit conditions to submit photos of their permitted projects within 7 days of project completion. The submission of such photos allows staff to identify whether projects appear to be constructed in accordance with the permit that was issued, and inform staff of the possible need for follow-up compliance inspections.



NR 340 also specifies that each operation falling under the authority of NR 340 shall be inspected by DNR personnel at least once annually to ensure that the operation is in conformance with the operation's permit and progressive reclamation plan.

#### **2.4.8 Current Trends**

As of May 2015, the DNR has issued general and individual waterway permits to 22 different ISM facilities across 9 different counties, with most of the waterway permits being granted for activities associated with mine and/or processing facilities.

The general permits issued for waterway activities include: waterway crossings, such as fords or culverts; grading; and ponds within 500' of a navigable waterway.

During the same time period, the DNR has issued 25 individual permits across 9 counties (Trempealeau and Monroe counties making up over 50% of the ISM waterway IP workload) for waterway activities, which include ponds within 500 feet of a navigable waterway, stream realignments, grading, and waterway crossings. Many of the facilities required to obtain individual permits for waterway activities are subject to the non-metallic mining standards found in NR 340.

The DNR has completed over 10 jurisdictional determinations (navigability determinations, ordinary high water mark determinations) for facilities proposing projects in close proximity to surface water resources.

### **2.5 Wetlands**

Wetlands are a valuable natural resource and are important to the ecology and economy of Wisconsin. They are protected by State and often Federal 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 the delineation procedures 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 Wisconsin's wetlands are associated with a stream, river, or lake. The 13 counties listed in Table 2-1 have a significant percentage of the total land surface area mapped as wetland in the state – with most of these counties nearing 10% of their surface area or greater. Because of the extensive network of waterways and wetlands in this region, it can be challenging for an ISM operation to completely avoid wetland impacts, whether within the direct footprint of the mining site or processing facility, or more commonly, for the construction of necessary transportation infrastructure, including roadways, rail spurs/sidings, and load out facilities. Because rail lines have historically

been constructed in floodplains – due to the level nature of this landscape position and the fact that the high incidence of wetlands was generally unfavorable for other uses – connections to or the expansion of existing rail facilities tend to be located in the same type of landscape, with proposed wetland impacts common for such projects.

### **2.5.1 Locating Wetlands**

To determine if wetlands are likely present on a potential sand mining property, the DNR recommends that applicants use the Wisconsin Wetland Inventory maps, hydric soil data layer, and other map layers located on the DNR’s online Surface Water Data Viewer (<http://dnr.wi.gov/topic/surfacewater/swdv>). These maps should only be used as guides. An onsite investigation by a professional wetland delineator is required to verify the presence or absence of wetlands.

### **2.5.2 Impacts to Wetlands**

Impacts to wetlands related to the ISM industry can be classified as either direct or indirect and are most often associated with the infrastructure required in the many aspects of ISM, including mine sites, processing facilities, or transportation facilities. Direct impacts are caused by the physical alteration of a wetland through the discharge of fill material, excavation within a wetland to mine a sand deposit, or the discharge of wastewater directly to a wetland (see section 2.4.2 of this document). Each type of direct impact may result in the partial or complete loss of a wetland.

Indirect impacts to wetlands typically involve changes to the landscape that affect the local hydrology by altering surface drainage patterns, as well as changing groundwater levels. Such landscape alterations may have substantial impacts to the hydrology of adjacent wetlands, by substantially increasing or decreasing the amount of surface or groundwater available to a wetland. Such impacts, in turn, may be determinative of future wetland conditions. 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. For more information regarding the evaluation of wetland impacts, see the following sections of this document: 2.4.2 (WPDES Permitted Discharges), 2.3.10 (High Capacity Wells), and 2.3.14 (Secondary Impacts).

### **2.5.3 Wetland Permitting**

The discharge of dredged or fill material into a wetland requires a DNR approval through either a general or individual permit under s. 281.36, stats. The DNR reviews a project to determine if it complies with the requirements of chs. 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 U.S. 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.

Similar to the waterway permitting process under chs. 30 and 31, Wis. Stats., the DNR has a tiered permitting system as it relates to the discharge of dredged or fill materials to wetlands under s. 281.36 Wis. Stats. The DNR has a number of general permit categories available for discharges to wetlands impacting less than 10,000 square feet. Of these, the general permit available for residential/commercial/industrial (WDNR-GP1-2012) development is most applicable to the sand mining industry. General permits for impacts to wetlands became available in 2012 as a result of Act 118. Prior to 2012, proposed impacts to wetlands were reviewed under a water quality certification process.

Similar to waterway general permits, an applicant may be eligible for a wetland general permit provided they can document through the application process that their project meets all of the established eligibility criteria specific to the general permit for which they are applying. The application process typically requires that an applicant first complete a wetland delineation for their project area, prepare a practicable alternatives analysis describing how their project avoids and minimizes wetland impacts to the greatest extent practicable, complete a wetland rapid assessment for functional values, and submit the application package to the DNR for review. Within 30 days of submittal of a complete application, the DNR may then either grant coverage through the general permit provided the application meets the eligibility criteria and permit issuance standards found in s. 281.36 Wis. Stats., or notify the applicant that their project does not qualify for the general permit if such standards cannot be met. If the determination is made that an applicant does not qualify for a general permit, the applicant may choose to modify their application in order to qualify, or apply for an individual permit.

If a wetland individual permit is required, the application process is similar to that of the general permit process in terms of required application materials. Prior to the application, however, the DNR requires that a pre-application meeting be held between the DNR and the permit applicant to discuss the proposed project, the application submittal requirements, and the details concerning wetland mitigation required under a wetland individual permit. The wetland individual permit process requires applicants to avoid and minimize impacts to wetlands to the greatest extent practicable, but also requires applicants to complete on-site wetland mitigation, purchase mitigation credits from a wetland mitigation bank, or purchase in-lieu fee credits for wetland mitigation, in order to off-set the impacts of their proposed project. Wetland mitigation is typically required at a rate no less than 1.2 acres of credit for each acre of wetland proposed to be impacted, and is also dependent on the wetland type and functional values of the wetland proposed to be impacted. Similar to the ch. 30 individual permit process, the DNR's wetland individual permit process requires a 30-day public comment period, and generally takes 105-140 days to complete, dependent on application completeness at the time of original submittal, and whether or not a public information hearing is requested during the public comment period.

When evaluating an application for a wetland individual permit the DNR considers all of the following information (found in s. 281.36(3m)(b), stats.):

1. The direct impacts of the proposed project to wetland functional values
2. The cumulative impacts attributable to the proposed project that may occur to wetland functional values based on past impacts or reasonably anticipated impacts caused by similar projects in the area affected by the project

3. Potential secondary impacts of the proposed project to wetland functional values.
4. The impact on functional values resulting from the mitigation that is required
5. The net positive or negative environmental impact of the proposed project

The DNR may rely on the expertise of specific resource managers such as fish or wildlife biologists, water quality biologists, Natural Heritage and Conservation staff, wetland ecologists, or others, in order to evaluate the potential impacts of a proposed project.

An individual permit may be granted (pursuant to s. 281.36(3n)(c)2, Wis. Stats.) when the DNR can conclude that:

1. The proposed project represents the least environmentally damaging practicable alternative taking into consideration practicable alternatives that avoid wetland impacts,
2. All practicable measures to minimize the adverse impacts to wetland functional values will be taken, and
3. The proposed project will not result in significant adverse impact to wetland functional values, in significant adverse impact to water quality, or in other significant adverse environmental consequences.

Both the wetland general and individual permit processes allow the DNR to postpone review of the permit application until field conditions allow the DNR to complete a site visit to the project area in order to evaluate the functional values of the wetland(s) that will potentially be impacted. The wetland permit processes also require the DNR to consider each application on the basis of whether it can be classified as a single and complete project. For example, if a proposal for a phased project is expected to impact less than 10,000 square feet of wetlands in phase 1 but future planned project phases are also likely to have wetland impacts which would result in total impacts being greater than 10,000 square feet, all planned phases of the project would be required to be considered under the individual permit process since total impacts are proposed to exceed the threshold for general permit eligibility. This can be a difficult requirement to implement when project plans change over time as a result of new property acquisitions, market conditions or the unexpected need for additional transportation infrastructure beyond that which was initially planned.

#### **2.5.4 Secondary Impacts**

Secondary impacts to wetlands are considered through the DNR's evaluation of wetland functional values and potential impacts to those functional values associated with a project proposed under both the wetland general and individual permit review processes. Examples of secondary impacts to wetlands include changes in wetland features such as hydrology or vegetation, as a result of the placement of wetland fill or other activities. Such changes in these other wetland features may have implications for the wetlands functions and values associated with the fish or wildlife habitat, or water quality functions that the wetland was known to provide. Wetland functional values and impacts to those functional values are inventoried using the Wisconsin Wetland Rapid Assessment Methodology.

### **2.5.5 Cumulative Impacts**

Cumulative impacts to wetland functional values are evaluated by the Department when a project is proposed under the wetland general and individual permit processes, and such evaluation of cumulative impacts is focused on the wetland complex proposed to be impacted by a proposed project. Under the individual permit process, cumulative impacts are one of the five criteria required to be considered by review under s. 281.36(3m)(b). Under the general permit process, cumulative impacts are considered under s. 281.36(3n)(c)(2) by evaluating the significance of any adverse impacts to wetland functional values caused by the proposed project.

The Department's permit process is not able to account for cumulative impacts of multiple projects to different wetlands across a large geographic area. A single mine which proposes to avoid and minimize wetland impacts, but still requires a wetland permit, will have little contribution to cumulative impacts at that scale. Given the potential for multiple activities surrounding the industry (other mines, rail lines, roads and other projects), additional impacts from recent and future ISM projects taken in combination, the industry has the potential to contribute to significant cumulative impacts to wetlands regionally. The wetland permit processes do not have a direct way of evaluating or preventing such large scale cumulative impacts.

### **2.5.6 Monitoring**

The DNR conducts routine compliance monitoring for permits issued under s. 281.36, Wis. Stats. in order to ensure that applicants are meeting all eligibility criteria and permit conditions for permitted projects. Such compliance monitoring is generally done on permits issued the preceding calendar year; however, staff have discretion to conduct compliance monitoring on any permitted projects as they determine to be necessary. In addition, the DNR has dedicated staff to evaluate permit applications submitted for both stormwater and waterway/wetland permit activities. These staff perform regular combined (stormwater/waterway/wetland) compliance inspections on permitted facilities, with many sites being inspected on multiple occasions annually.

In addition to being subject to routine compliance monitoring, project applicants are generally required through permit conditions to submit photos of their permitted projects within 7 days of project completion. The submission of such photos allows staff to identify whether projects appear to be constructed in accordance with the permit that was issued, and inform staff of the possible need for follow-up compliance inspections.

### **2.5.7 Current Trends**

Since 2008, the DNR has issued 46 wetland individual permits and 21 wetland general permits to 36 different applicants for ISM-related activities in the eight counties with the highest concentration of ISM facilities (Table 2-2). A total of 44 acres of wetland fill has been authorized under the individual wetland permits, while an additional 2.8 acres has been authorized under the general wetland permits, which first became available for use in 2012. Since wetland mitigation became a requirement of the wetland individual permit process in 2012, just over 51 acres of compensatory mitigation has been required for ISM-related wetland impacts, in the form of mitigation bank credit purchases or through the utilization of the state's recently established in-lieu fee credit program.

As shown in Table 2-2, Barron and Monroe counties have the highest numbers of ISM-related general wetland permits and individual wetland permits, respectively, and the largest acreages of wetland fill authorized as of May 2017. Both of these counties are estimated to have more than 20% coverage of wetland indicator soils (see Table 2-1). Alternatively, Pierce County has an estimated 8% coverage of wetland indicator soils and no ISM-related wetland permits issued to date.

Table 2-3 summarizes, by year, the ISM-related wetland permits issued by the DNR between 2008 and May of 2017, across the eight counties with the highest concentration of ISM facilities. Note that the permit years listed in the table are when the DNR initially received applications for these permits. In some cases, permits were granted in subsequent years. During this nearly ten-year period, the highest number of individual wetland permits (19) and overall permits (20) were from 2012, while the highest number of general wetland permits (9) was from 2014. In terms of area, the highest acreage of wetland fill authorized (18.7 acres) and required mitigation (30.4 acres) were from 2016.

Table 2-4 reports on all wetland permits issued by the DNR since 2008, both in the eight counties with the highest concentration of ISM facilities and statewide. Across the eight counties, ISM-related activities account for just 4.4% of all general wetland permits (472) and 9.1% of all individual wetland permits (506) issued since 2008. In terms of area, however, ISM-related activities in these eight counties account for 34% of the total wetland fill authorized (138 acres) and 67% of the total required wetland mitigation (76 acres) since 2008 (see Table 2-3 and Table 2-4). Many of the larger wetland impacts associated with ISM facilities are linked to the development of supporting infrastructure such as rail, where applicants have demonstrated that there are no practicable alternatives.

**Table 2-2** Wetland permits, wetland fill authorized, and mitigation required for ISM activities from January 2008 through May 2017 in selected counties

County	General Permits (GP)	Individual Permits (IP)	Acre of Fill Authorized Under GP	Acre of Fill Authorized Under IP	Total Acres of Fill Authorized	Total Acres of Required Mitigation
Barron	8	7	1	6.7	7.7	2.8
Chippewa	1	7	0.08	5.5	5.6	4.9
Eau Claire	1	3	0.11	2.8	2.9	1.6
Jackson	4	4	0.71	1.2	1.6	2.9
Monroe	2	19	0.37	22.5	22.9	31.7
Pierce	0	0	0	0	0	0
Trempealeau	4	5	0.48	5.2	5.7	7.3
Wood	1	1	0.08	0.2	0.3	0
Totals	21	46	2.8	44.0	46.9	51.2

*Note:* These data were generated by searching the DNR's Waterway and Wetland Permits database for known sand mining facilities, as well as key-words including "sand," "proppant," "frac," "silica," and "rail." These data may not be inclusive of all wetland permits issued for ISM-related activities in the selected counties.

**Table 2-3** Wetland permits, wetland fill authorized, and mitigation required for ISM activities from January 2008 through May 2017 in selected counties, by year

Permit Year <sup>1</sup>	General Permits (GP)	Individual Permits (IP)	Acres of Fill Authorized under GP	Acres of Fill Authorized under IP	Total Acres of Fill Authorized	Total Acres of Required Mitigation
2008	NA <sup>2</sup>	3	0	1.4	1.4	NA <sup>3</sup>
2009	NA <sup>2</sup>	1	0	0	0	NA <sup>3</sup>
2010	NA <sup>2</sup>	0	0	0.1	0.1	NA <sup>3</sup>
2011	NA <sup>2</sup>	7	0	6.0	6.0	NA <sup>3</sup>
2012	1	20	0.01	4.5	4.5	NA <sup>3</sup>
2013	4	5	0.68	4.9	5.6	8.1
2014	9	5	1.1	6.2	7.3	9.5
2015	4	1	0.58	2.5	3.1	3.2
2016	2	4	0.31	18.4	18.7	30.4
2017	1	0	0.15	0	0.15	0
Total	21	46	2.8	44.0	46.9	51.2

**Note:** These data were generated by searching the DNR's Waterway and Wetland Permits database for known sand mining facilities, as well as key-words including "sand," "proppant," "frac," "silica," and "rail." These data may not be inclusive of all wetland permits issued for ISM-related activities in the selected counties.

1. Permit Year is when the DNR received the applications. In some cases, approval was granted in a subsequent year.

2. Wetland GP's were not authorized until the passage of Act 118 Which became effective on July 1, 2012.

3. Wetland Mitigation was not required under an individual permit in Wisconsin until the passage of Act 118 which became effective on July 1, 2012; however, the U.S. Army Corps of Engineers may have required mitigation on such projects where they held joint jurisdictional authority.

**Table 2-4** All wetland permits, wetland fill authorized, and mitigation required from January 2008 through May 2017 in selected counties and statewide

	Top Seven Sand Mining Counties	Statewide
General permits (GPs) <sup>1</sup>	472 permits	3,530 permits
Individual permits (IPs)	506 permits	3,506 permits
Total number of permits	978 permits	7,036 permits
Wetland fill authorized by GPs <sup>1</sup>	21.3 acres	211.0 acres
Wetland fill authorized by IPs	116.4 acres	506.7 acres
Total wetland fill authorized	137.7 acres	717.7 acres
Required Wetland Mitigation Acreage <sup>2</sup>	76.3 acres	386.9 acres

1. Wetland GP's were not authorized until the passage of Act 118 Which became effective on July 1, 2012.

2. Wetland Mitigation was not required under an individual permit in Wisconsin until the passage of Act 118 which became effective on July 1, 2012; however, the U.S. Army Corps of Engineers may have required mitigation on such projects where they held joint jurisdictional authority.



## **2.6 Fish and Aquatic Species**

### **2.6.1 Introduction**

The ISM industry is concentrated in the Driftless area of the state. Located in the western and southwestern portion of the state, the Driftless area escaped the last glacial period and as a result is characterized by rugged topography, coldwater streams, rock outcroppings and caves, with over 4,440 miles of classified trout streams (NR 1.02(7), Wis. Adm. Code). Most waters are small to medium-sized streams and rivers. Headwaters are most often cold and spring fed.

Nonmetallic mining in Wisconsin has had no known significant negative impacts to fisheries resources in the past. This has mainly been attributed to the relatively low number of sand mines in the state. However, with the recent increase in ISM, the number of nonmetallic mines in Wisconsin has increased at a rapid rate, and in many instances these mines are located close to coldwater resources or in the floodplains of river systems.

### **2.6.2 Potential Fisheries and Aquatic Species Effects**

There is little research and documentation related to the effects of ISM on fish and other aquatic species in Wisconsin. Kanehl and Lyons (1992) focused on gravel mining and rock quarrying before the current expansion of industrial sand mining. There is a large body of research related to sedimentation and dredging due to other factors such as agriculture and dam removal (Kanehl and Lyons 1992, Waters 1995).

Sand mining in Wisconsin can have direct and indirect impacts to the waters and aquatic species. Mining in waterways directly impacts fisheries due to the removal of nonmetallic material (i.e., sand, gravel, and larger rock) from the stream channel, lakebed, or from the bank of the stream or lake. ISM usually occurs on plains or hills near streams. In all of these locations, this action can cause increased siltation, erosion, loss of spawning and nursery habitat, decrease of macroinvertebrates, and mortality of aquatic organisms. The resource may take years to recover from the effects of mining (Kanehl and Lyons 1992). Mining indirectly impacts the resource because of groundwater use and contamination, stormwater runoff, and the dewatering process (DNR 2012, Kanehl and Lyons 1992, Waters 1995). More specific concerns, indirectly impacting coldwater streams include the following:

- Runoff from the mine site and settling ponds into a stream causing high levels of turbidity, especially in headwater streams where there is natural reproduction of trout. Suspended sediment can lead to reduced feeding due to loss of ability to see food.
- Runoff from the mine site and settling ponds causing sedimentation in stream channels reducing important pool habitat for adult fish cover, covering coarse substrate needed to invertebrate production and fish spawning.
- If sedimentation/turbidity occurs during fall spawning/incubation period, sedimentation would cover/suffocate eggs, leading to a decrease in reproduction for that year.

- Potential for processing chemicals (see section 1.3.3) to bioaccumulate in the fish or directly cause harm to fish and cause a fish kill.
- Amount of warm water runoff from settling ponds could potentially increase the water temperature of coldwater resources, especially those with marginal temperatures for supporting a coldwater fishery.
- Warmer water temps could cause intolerant species of fish and invertebrates to disappear.
- Increase of high capacity wells near trout streams could negatively impact the water table which could decrease stream base flows. This in turn could impact natural reproduction or temperature of the stream.
- 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.

Fisheries monitoring protocols do not currently include any methods to assess the impacts of mines on fish and aquatic species. The long term impacts of ISM in close proximity to trout waters are unknown. Fisheries biologists who manage counties near mines have received various complaints about stream deposition, high turbidity and run-off events. The effects of these events are not always clear.

In Dunn County in early September 2014, during a localized heavy rain, the 5-6 inches of rain over a 4-hour period overwhelmed the mining operation's stormwater management system and caused the discharge of stormwater with high TSS from the detention ponds. The heavy rain caused the stormwater in the detention ponds to overtop and flow into Running Valley Creek, which is a tributary of Eighteen Mile Creek (both Class II trout streams). In order to assess the impact of the runoff on the fish community, an electrofishing survey was conducted on Running Valley Creek. The water was still high and turbid due to clay particles, so catchability was low and no fish were caught. Many of the fish had likely sought cover due the high flow conditions. A survey was also conducted on a stretch of Eighteen Mile Creek with similar results. No dead fish were seen, nor were any reports of dead fish received. Once the high flows receded, electrofishing surveys were conducted above and below the impact site and trout of several different age classes were found at each site. No impact was documented to the fish community at that time, although it is still possible that there will be long-term impacts. Since the overtopping event occurred, the sand mining company has invested in new, larger stormwater detention ponds.

**Figure 2-3** *Turbidity at confluence of Eighteen Mile Creek and the Red Cedar River near Colfax, WI, September 2014 (Source: a concerned citizen)*



Similarly, there have been incidents of excessive erosion from overburden stockpiles of mines after large rain events in Barron County. The mines were issued citations. It is not known, however, whether fish and aquatic species were affected in those situations.

**Figure 2-4** Overburden pile at an industrial sand mine near Tainter Creek in southern Barron County, Wisconsin. August 12, 2014, showing signs of erosion (Source: Aaron Cole, DNR)



**Figure 2-5** Highly turbid Tainter Creek near an industrial sand mine site in southern Barron County following a rain event, August 12, 2014 (Source: Aaron Cole, DNR)



A comparison of trout survey data from trend sites on streams with and without the presence of sands mines shows quite a bit of variability in all the data. Because many of the sites do not have an adequate amount of pre-sand mining data, evaluating the impacts of the mines is difficult (*personal communication Gerbyshak, J. 2015*). The implications of the groundwater use or potential runoff effects are not clear either, as such when a mine may be located very close to the headwaters of a Class I brook trout stream.

Due to heavy dump truck traffic in mining areas between the pit and the processing plant, roads have required resurfacing, culvert replacements and other repairs. Tiller Creek, in southwest Barron County, is slated to be rerouted due to highway improvements to accommodate increased dump truck traffic. DNR Fisheries staff plan to monitor the fish community before and after the project to assess impacts and changes.

Fisheries resources are also impacted when mining companies need to realign streams and go through a stream restoration process. Some impacts are positive. For example, a tributary to the Trempealeau River was realigned and now has a naturally reproducing population of trout. Mining companies have also contributed funds or provided volunteer labor to the DNR's trout habitat program (see section 5.2.1).

### **2.6.3 Regulation**

Fisheries Management does not specifically have authority to regulate the impact on the fisheries resource from mines. Other DNR programs regulate permits and water quality standards that would affect fish and aquatic life. See sections 2.2 and 2.3 on groundwater and surface water for details on how those programs regulate impacts to fisheries.

The fisheries program has some authority to protect waters and classify them as trout streams. Pursuant to NR 1.02(7), Wis. Adm. Code, the DNR is directed to identify and classify trout streams according to standards in that section to ensure adequate protection and proper management of this unique resource. The Bureau of Fisheries Management uses the results from approximately 300 surveys of stream sites conducted annually across the state to continuously update the classification system based on the standards and procedures in the administrative code. This same code requires the DNR to maintain a list of classified streams for public information but specifically states that the list "shall not be assumed to be exhaustive."

Trout streams are referenced several places in NR 102, Wis. Adm. Code (water quality standards). NR 102.04(3)(a) classifies cold water communities using trout stream classification. NR 102.04(4)(e) gives unique temperature and dissolved oxygen requirements for trout streams. Also in NR 102.10 and 102.11, many trout streams are listed as Outstanding or Exceptional Resource Waters and given the increased protection of those designations.

Trout streams are referenced in NR 103, Wis. Adm. Code (water quality standards for wetlands). NR 103.04 and NR 1.05 lists trout streams as areas of special natural resource interest. Trout streams are also given increased protection in several places in NR 20, Wis. Adm. Code (fishing: inland waters) and provided protection in the following sections: NR 1.05, 1.06, 1.07, Wis. Adm. Code.

The fisheries program has more regulatory authority over waters that are created during the mining process and remain after the reclamation phases. Ch. 29, Wis. Stats. (secs.



29.733, 29.736, 29.737, 29.738, stats.) outlines those authorities related to stocking of fish, natural waters used in fish farms, permits for private management and private fishing preserves. The DNR also has authority to regulate the seasons, bag limits, and size limits of fish in s. 29.014(1), stats. In some situations, such as water level reduction or fishery rehabilitation, the DNR has authority to close fishing seasons on certain waters (s. NR 20.33).

## **2.7 Endangered Species, Wildlife, and Natural Communities**

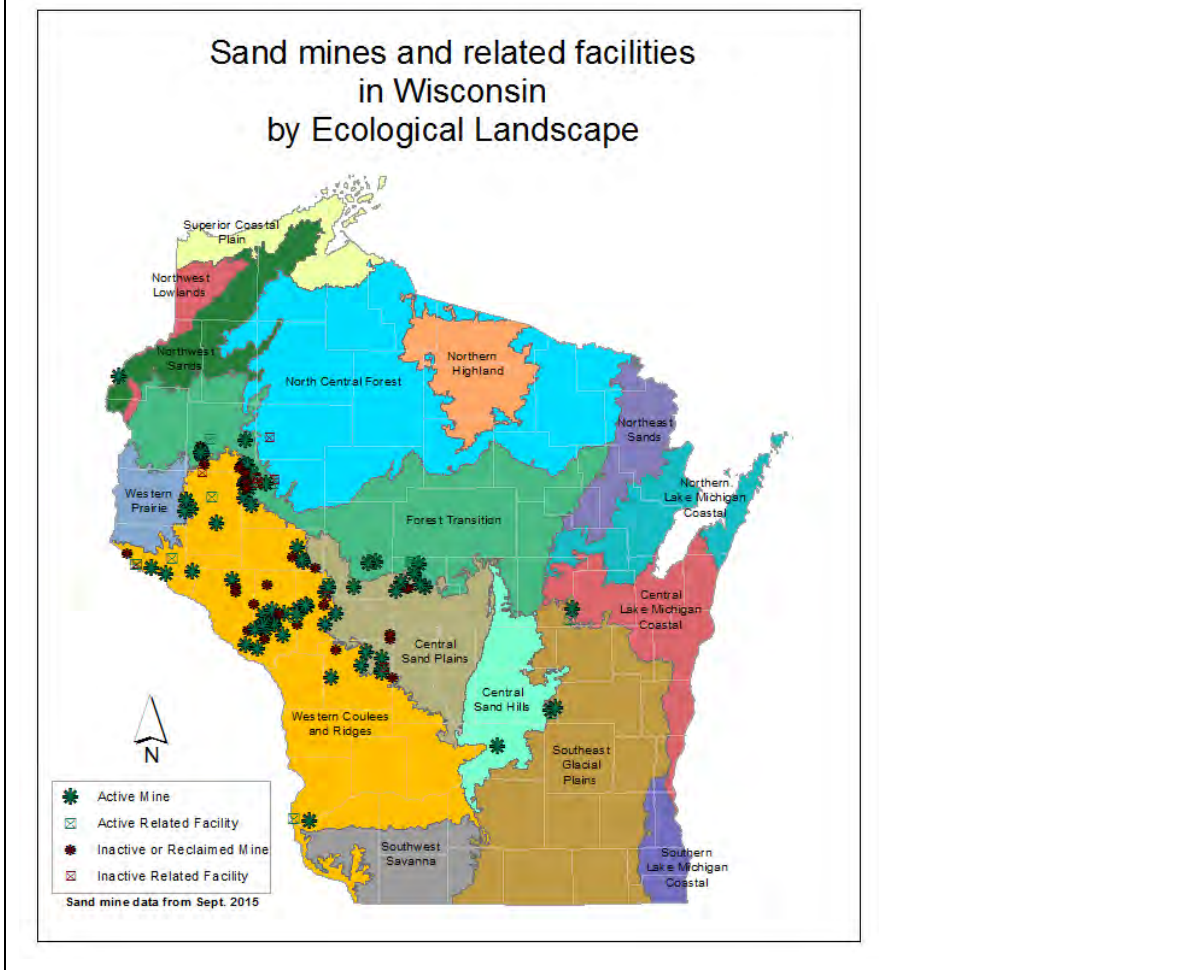
This section identifies regulations and policies for rare, endangered, and threatened species pertinent to ISM activities in Wisconsin. It also describes known and potential impacts of industrial sand mines to other sensitive wildlife, habitats, and natural communities within the three ecological landscapes of the state where ISM activities are most common (Figure 2-6).<sup>27</sup> Records of rare species' occurrences and their habitats were provided by the Wisconsin Natural Heritage Inventory. Although some of the information is gathered at a very specific level, it is described here at a landscape and statewide level, which is more suitable for this analysis.

The greatest potential for negative effects from ISMs, relative to this chapter, are the direct loss or destruction of rare plants, critical habitats and natural communities where these are present at a proposed ISM site. Potential indirect effects include changes to local hydrology and the proliferation of invasive plant species near ISMs. Specific negative effects from critical or sensitive habitat loss due to ISM operations have not been evaluated in Wisconsin or elsewhere in the upper Midwest. Consequently, we are not able to provide a complete evaluation of the potential impacts at this time.

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<sup>27</sup> For more information on ecological landscapes, see "Ecological Landscapes of Wisconsin" (<http://dnr.wi.gov/topic/landscapes/Book.html>).

Figure 2-6 Wisconsin Ecological Landscapes and current sand mines



### 2.7.1 Regulations and Policy

The Wisconsin Endangered Species Law (Ch. 29.604, Wis. Stats.) requires the protection of our State’s Endangered and Threatened species. The following protections are given to State and Federal listed or protected species:

- Federally-protected species include those federally-listed as endangered or threatened and their designated critical habitats. Federally-listed animals are protected on all lands and waters. Federally-listed plants are only protected on federal lands or where federal funding is being used. The current Federal Endangered and Threatened species list is available at [www.fws.gov/midwest/endangered/lists/wisc-spp.html](http://www.fws.gov/midwest/endangered/lists/wisc-spp.html). Additional federal protections are provided to all migratory birds, through the federal [Migratory Bird Treaty Act](#), and to bald eagle nest trees and adjacent habitats through the federal [Bald and Golden Eagle Protection Act](#).
- State-listed (Threatened and Endangered) animals are protected on all lands and waters of the state. State-listed plants are protected on public lands only, though the statute does not require protection on these public lands during the course of



forestry or agricultural practices, in the construction, operation, or maintenance of a utility facility, or as part of bulk sampling activities under [s. 295.45.stats](#). The current Wisconsin Endangered and Threatened species list is available at <http://dnr.wi.gov/topic/endangeredresources/ETList.html>.

In order to receive water, wetland, or other permits from the DNR, an Endangered Resources (ER) Review needs to be completed by the DNR. An ER Review is a screening of a proposed project area for potential impacts to endangered resources, including rare plants, animals, and natural communities. The Review includes follow-up actions to allow the project to comply with Wisconsin's Endangered Species Law, as well as other applicable laws and regulations protecting endangered resources. An ER Review is completed by using the Natural Heritage Inventory (NHI) database, which is the primary source for information on rare and declining species, habitat features, and natural community occurrences in our state. The NHI database is limited, especially for private lands. As such, the lack of occurrences within an area being reviewed does not mean rare species do not exist there. It could merely mean that no surveys have occurred in the area. If an ER Review indicates a state-listed species is present and the project can't avoid impact, the department can allow take under certain circumstances through an Incidental Take Permit or Authorization (ITP/A) (<http://dnr.wi.gov/topic/ERReview/ITApply.html>). In order receive an ITP/A, both a conservation plan and an implementing agreement must be submitted as part of the application. The conservation plan requires discussion of alternate actions, minimization and mitigation measures, responsible parties, and funding. The ITP/A will not be issued if the project impacts will put the existence of the particular species in Wisconsin in jeopardy.

### **2.7.2 Potential Impacts to Rare, Threatened and Endangered Species**

Typical ISM developments and operations would have a greater overall impact on terrestrial habitats and associated species because sand mines are located in upland habitats. As summarized in Table 2-5, occurrences of rare and listed species near existing ISMs and processing facilities in Wisconsin have included more records of aquatic species (64%) than terrestrial species (36%). This may be because data from the NHI database includes terrestrial and wetland species within 1 mile of an ISM and aquatic species within 2 miles. Sand mine operations that alter local hydrology or have erosion or waste material runoff could indirectly affect aquatic habitats and the sensitive species that utilize them. However, this potential appears to be low for operations away from water sources and given current protections.

Most ISMs are located within the Western Coulee and Ridges, Central Sand Plains, and Forest Transition ecological landscapes of the state (Figure 2-6). For the Western Coulee and Ridges landscape, 96 of the 140 individual species records near known ISMs within the NHI database, or 69%, were for aquatic species (Table 2-5). For the Central Sand Plains and Forest Transition landscapes, respectively, 14 of 38 (37%) and 6 of 8 (75%) of database records located near known ISMs were aquatic species (Table 2-5).

Karner blue butterflies (KBB) and cave bats are the listed species that can be impacted by ISM development and operations. KBB is a Federal endangered species. KBB caterpillars feed only on wild lupine (USFWS 2003), a sun-loving plant that grows in well-drained sandy soils within the ecological landscapes of central, west central and northwestern

Wisconsin. It is no coincidence that the KBB range almost perfectly overlaps with the sand mining range in Wisconsin. Essentially, KBBs may occur wherever there is wild lupine present in this region of the state. Thus, a survey for wild lupine on any potential sand mine site is a simple and efficient approach to determine the potential for presence of KBBs.

Potential negative impacts to the hibernacula (winter hibernation sites) of bats can only occur when industrial sand mines are below ground. This is because bats form large, vulnerable aggregations during the winter hibernation period in caves and mines. Any declines that may occur could have a significant effect on local and regional bat populations, since bats' low reproductive rates makes population recovery slow, particularly now that the infectious disease white-nose syndrome is present in hibernacula of the state. Negative effects on bats from ISMs and processing plants should be minimal for any surface mining operation.

**Table 2-5** *Natural Heritage Inventory occurrences near<sup>1</sup> industrial sand mine facilities by Ecological Landscape in Wisconsin*

<b>Taxonomic Group</b>	<b>Status<sup>2</sup></b>	<b>Ecological Landscapes with NHI Occurrences<sup>3</sup></b>	<b>Occurrences</b>
Amphibians/Reptiles	E/T	CSH; CSP; FT; WCR	9
Amphibians/Reptiles	SC	CSH; CSP; FT; WCR	14
Birds	E/T	CSH; CSP	4
Birds	SC	CSP; FT; NL; WCR	11
Fish	E/T	CSH; CSP; FT; NL; WCR	34
Fish	SC	CLMC; CSH; CSP; FT; WCR	31
Invertebrates	E/T	CLMC; CSH; CSP; NL; WCR	45
Invertebrates	SC	CLMC; CSP; FT; NCF; NL; WCR	38
Mammals	E/T	WCR	7
Mammals	SC	CSH	2
Natural Communities	none	CSH; CSP; FT; NCF; SGP; WCR	39
Plants	E/T	CLMC; CSP; WCR	8
Plants	SC	CSH; CSP; NCF; SGP; WCR	17
<b>Total</b>			<b>259</b>

<sup>1</sup> "near"= within 1 mile for wetland and terrestrial species and within 2 miles for aquatic species  
<sup>2</sup> Status Abbreviations: E/T = Endangered or Threatened Species; SC = Special Concern  
<sup>3</sup> Abbreviations: CLMC = Central Lake Michigan Coastal; CSH = Central Sand Hills; CSP = Central Sand Plains; FT = Forest Transition; NCF = North Central Forest; NL = Northwest Lowlands; SGP = Southeast Glacial Plains; WCR = Western Coulee and Ridges  
Source: WI DNR Natural Heritage Inventory database – January 2016

### 2.7.3 Potential Impacts to Environmentally Sensitive Habitats and Natural Communities

Ecological Landscapes are diverse geographic areas of physical, biological and social systems that interact with one another on a large scale. As of 2015, over 90% of proposed or active ISMs and processing plants occurred in the Western Coulee and Ridges, Forest Transition and Central Sand Plains Ecological Landscapes (Figure 2-6). In general, surface mining in ISMs directly eliminates habitats that exist within the mine's "footprint." This direct loss and additional indirect changes like habitat fragmentation

could diminish the quality and function of these habitats and natural communities. Because ISMs are highly associated with these landscapes, the likelihood of negative effects exists, but the overall impact is undeterminable at this time. Further, much of this habitat loss could potentially be restored if a sound reclamation plan is developed and implemented once the mining operations cease.

### **Western Coulee and Ridges Ecological Landscape**

Current vegetation within the Western Coulee and Ridges Ecological Landscape consists of a mix of forest (41%), agriculture (36%) and grassland (14%), with wetlands (5%) mostly in the river valleys. Primary upland forest cover is oak-hickory (51%) and maple-basswood (28%). Bottomland hardwoods (10%), which are dominated by silver maple, swamp white oak, river birch, ashes, elms, and cottonwood, are common in the floodplains of the larger rivers. Relict "northern" mesic conifer forests composed of hemlock, white pine, and associated hardwoods such as yellow birch are rare but do occur in areas with cool, moist microclimates. Dry, rocky bluffs may support xeric stands of native white pine, sometimes mixed with red or even jack pine. Prairies are typically dry and are now restricted to steep south- or west-facing bluffs, unplowed outwash terraces along the large rivers, and a few other sites. They occupy far less than 1% of the current landscape. Mesic tallgrass prairies are now virtually nonexistent except as very small remnants along rights-of-way or in cemeteries.

### **Forest Transition Ecological Landscape**

Current vegetation within the Forest Transition Ecological Landscape includes forested upland (37%), agriculture (31%), forested wetland (7%), non-forested wetland (6%) and grassland (14%), with the remaining 5% a mix of bare land, urban, shrubland, and open water. However, land cover in the Forest Transition landscape is highly variable by subsection, dominant landform, and major land use. The eastern part of the ecological landscape remains heavily forested, the central portion is dominated by agricultural uses (with most of the historically abundant mesic forest cleared), and the west end is a mixture of forest, lakes, and agricultural land.

### **Central Sand Plains**

Current vegetation within the Central Sand Plains is forested upland (42%), forested wetland (10%), non-forested wetland (13%), agriculture (16%) and grassland (12%), with the remaining 7% a mix of bare land, urban, open water, and shrubland.

### **Natural Communities**

Thirty-nine total natural community records currently exist within the NHI database within 1-mile of ISM operations and processing plants and 29 of these were located within the three main ecological landscapes. Specific natural communities identified by ecological landscape were:

- Western Coulee and Ridges landscape – dry prairies, dry and moist cliffs, floodplain forest, cold-water streams, emergent marsh, and southern sedge meadow.

- Central Sand Plains landscape – southern and northern dry forests, dry and moist cliffs, floodplain forest, cold-water streams, northern sedge meadow, and pine barrens.
- Forest Transition landscape – northern wet forest, open bog, northern sedge meadow, emergent marsh, and alder thicket.

### **Significant Ecological Places**

Significant ecological places have been identified within all ecological landscapes in Wisconsin. These areas represent geographic locations in the state that were identified using criteria from a number of sources or plans within their original source documents or maps. Specific types of places identified include Land Legacy Places, Important Bird Areas, State Natural Areas, and Aquatic and Terrestrial Conservation Opportunity Areas (see <http://worldcat.org/arcviewer/8/WIDAG/2014/06/20/H1403282580603/viewer/file6864.pdf>). In many cases, these ecological places have the greatest biological diversity of species and habitats in Wisconsin, which if altered or destroyed, could potentially have greater negative effects than the loss of other habitats. Significant ecological places in the three major ecological landscapes with the greatest concentration of ISM facilities are listed in Chapters 10, 11 and 22 of the Ecological Landscapes of Wisconsin (DNR 2016).<sup>28</sup>

#### **2.7.4 Potential Impacts to Wildlife**

Wisconsin supports a great diversity of wildlife including game, non-game, furbearer, bird, and invertebrate species. In total, Wisconsin is home to some 410 vertebrate wildlife species including 69 species of mammals, 284 species of birds, 57 species of herptiles (reptiles and amphibians), and numerous species of invertebrates (DNR 2012). With such a high level of species diversity, it is easy to understand the importance of Wisconsin's wildlife to our economic, ecological, cultural, and social principles.

There is limited information and virtually no published literature available from studies completed in Wisconsin or in the western Great Lakes region on the impacts of ISM on wildlife.

Although there is a great amount of variability in how sand is mined, this section describes potential direct and indirect impacts to wildlife and habitat from a typical dry mine and processing operation. Details of normal ISM processes are provided in section 1-6 of this document.

ISM has the potential to affect wildlife species through habitat conversion or loss, processing and transportation of the sand, and the reclamation of the mined site. Primary impacts to wildlife may occur by the direct killing of individuals through land clearing during the overburden/excavation process, as well as during the processing and transportation of mined sand, though the frequency of these occurrences is unknown. Secondary impacts could occur through degradation or loss of habitats and habitat features such as nesting or denning locations, host-plant or nectar sources, and/or through displaced or injured individuals.

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<sup>28</sup> <http://dnr.wi.gov/topic/landscapes/Book.html>

Habitat and associated wildlife may also be affected through the introduction or spread of invasive species (see section 2.9 of this document). The resources that will actually be affected by a specific project will depend on the specific areas and status of wildlife populations within the mining areas. The overall extent or “footprint” of ISMs across a given geographic area and temporal timeframe will determine the significance to sensitive wildlife populations.

The time of year, habitat quality/quantity, and habitat preference (specialist vs. generalist) are important considerations in evaluating potential impacts. For example, many birds migrate out of the state in the fall of the year and return in the spring to nest, or to rest when migrating north to nesting grounds. For these examples, the greatest direct impact to birds would occur if the overburden is removed during the nesting season. For existing agricultural habitats, removal of the overburden would have minimal impacts to wildlife if it occurs during winter. Conversely, in forested or prairie habitats, the direct impacts to wildlife could be greater if overburden surface was removed in the late spring or summer months or if limited specific habitat is reduced.

However, the overall negative impacts to wildlife associated with large industrial sand mines may be dynamic because many operations are designed to be mined in phases; typically, 30 to 40 acres of permitted mines are active at any given time. In most operations there will be reclamation projects in some areas of the mine while mining continues in others. Positive impacts could occur with reclamation. In some cases, tunnels and caves created from industrial sand mines have provided critical habitat for wintering bats. In other cases, companies may apply and become a [Wisconsin DNR Green Tier](#) participant (discussed in section 5.2.1 of this document) and reclamation activities may exceed minimum levels required. These are some examples that would help reduce any net negative impacts to wildlife and associated habitats.

## **Reclamation**

Chapter NR 135, Wis. Adm. Code requires all Wisconsin counties to implement a nonmetallic mining reclamation permit program. The purpose of this program is to ensure that mining sites are reclaimed to a post-mining land use, which can be agricultural, wildlife habitat, prairie, cranberry bog, or another use that the mining company and landowner agree upon (Orr and Krumenacher 2015). Nonmetallic mining permits are subject to uniform reclamation standards that are provided in NR 135.

Reclamation activities have the potential to benefit many species of wildlife, provided they focus on habitats appropriate for the ecological landscape where it occurs. Development of voluntary standards and best management practices for restoring or creating these critical habitats and natural community types would further increase positive impacts.

## **2.8 Forest Resources**

### **2.8.1 Introduction**

ISM will have impacts on forest resources. In the Western Coulee and Ridges Ecological Landscape in particular, where many industrial sand mines are proposed, forest resources are well represented and have outstanding oak resources identified.

## 2.8.2 Existing Forest Vegetation

Industrial sand mining predominately occurs in the Western Coulee and Ridges Ecological Landscape of southwestern and west-central Wisconsin. Substantial mining also occurs in adjacent ecological landscapes, including the Central Sands Plains, Forest Transition, and Central Sand Hills (see the Ecological Landscape map in Figure 2-6). The Western Coulee and Ridges Ecological Landscape is characterized by a lack of glacial features, with no known glacial deposits, although glacial outwash materials do occur in river valleys. Vegetation follows the area's landform features, including dissected ridges, steep-sided valleys and extensive stream networks with dendritic drainage patterns. This ecological landscape is more forested than others in southern Wisconsin.

Of the 6.1 million acres comprising the Western Coulee and Ridges Ecological Landscape, vegetated land cover is a mix of forest (the largest component, at over 40%), agriculture, and grassland, with wetlands restricted almost entirely to river valleys. Of the total forested area, 51% is oak-hickory forest, dominated by various oak species (*Quercus* spp.) and shagbark hickory (*Carya ovata*). Maple-basswood forests account for 28% of the total forested area and are dominated by sugar maple (*Acer saccharum*), American basswood (*Tilia americana*), and red maple (*Acer rubrum*). Bottomland hardwoods (10%) are restricted to the valley bottoms of the larger rivers and are dominated by silver maple (*Acer saccharinum*), ashes (*Fraxinus* spp.), elms (*Ulmus* spp.), and eastern cottonwood (*Populus deltoides*). Coniferous forests are few and contain stands of eastern white pine (*Pinus strobus*), red pine (*Pinus resinosa*), and (rarely) jack pine (*Pinus banksiana*) on dry sites and mesic stands of eastern hemlock (*Tsuga canadensis*).

The [Wisconsin Wildlife Action Plan](#) (DNR 2015) highlights outstanding forested communities in this ecological landscape. Occurring on both public and private lands, these forest communities include Southern hardwood forest, oak ecosystems (including the best examples of the oak continuum: oak forest, oak woodland and oak savanna), and forested floodplain – with complex terraces and surrounding blufflands that support a wealth of plant and animal diversity. Outstanding examples of these forest types, such as the Fort McCoy Barrens and Oak Savanna, Buffalo County Oak Forests, Coulee Forests, and Lower Chippewa Savannas, overlap areas with potential for sand mining as mapped by the Wisconsin Geological and Natural History Survey (see Figure 1-2).

Sand mines could potentially be located within a forested area. Given the nature of ISM operations, this would change the area's ecological structure, composition and function from its existing state. Although there are forested areas within the Western Coulee and Ridges Ecological Landscape that are fragmented by agriculture, even small woodlots could potentially be deforested. Depending on reclamation land use agreements, mined areas can be returned to a forested landscape.

## 2.8.3 Effects

Industrial sand mines located and constructed within forested landscapes can result in forest clearing (deforestation), which in turn can lead to increased soil erosion and the deposition of nutrients in nearby streams and waterbodies. Deforested areas are also subject to the loss of long-term productivity for forest species, through changes in soil depth, soil profile, topography, depth to groundwater, etc.

During the construction phase, forest products may be recovered and marketed. After mining operations have concluded, mine sites must be reclaimed to a post-mining land use (see sections 1.3.7 and 4.1.6). Many former mine sites have been planted to grasses and forbs (i.e., prairie); however, trees may also be planted. Reestablishment of forest can take many years. Given the changes in soil characteristics and productivity, it is unlikely that forest reestablished on mine sites will be similar to pre-mining forest. As such, appropriate soil and site preparation are recommended before tree planting.

## **2.8.4 Regulation**

Regulation of forest land depends on the property owner and jurisdiction. On designated county forest land, areas proposed for industrial sand mining would need to be withdrawn from the county forest program. Ch. NR 48, Wis. Adm. Code, and s. 28.11(11) Wis. Stats. establish requirements and procedures for such withdrawals. These include a resolution adopted by at least two-thirds of the County Board followed by an investigation and findings by the DNR, including whether the land will be put to a better or higher use and whether the county and statewide benefits of withdrawal outweigh the benefits of continued inclusion in the county forest program.

Within the Western Coulee and Ridges Ecological Landscape, there are approximately 670,000 acres of private land enrolled in the Managed Forest Law (MFL) and Forest Crop Law (FCL) programs. Wisconsin enacted the MFL in 1985 to allow private landowners to obtain tax benefits by enrolling their forested land as MFL land. Similar to the federal Conservation Reserve Program, MFL is a voluntary program with specific criteria required for enrollment. The FLC is the predecessor to the MFL. Enacted in 1927, this landowner-incentive program encourages long-term, sustainable management of private woodlands by reducing and deferring property taxes. Wisconsin closed enrollment in the FLC program on January 1, 1986.

Both the MFL and FCL programs require enrollees to either keep their forest land in a forested state or to no longer be enrolled. If a proposed industrial sand mine is located on MFL or FCL property, the landowner will not be able to remain enrolled in the program since the activity would change the forested state of the lands. Chapter NR 46, Wis. Adm. Code, and s. 77, Subchapters I and VI, Wis. Stats. establish requirements and procedures for withdrawing lands designated under the FLC program (subchapter I) and the MFL program (subchapter VI) before such lands can be used for purposes contrary to the law, which include ISM. Withdrawal taxes and fees are assessed to the owner of record at the time of withdrawal.

## **2.9 Invasive Species**

### **2.9.1 Introduction**

Invasive species have emerged as a significant concern among Wisconsin citizens, businesses and visitors, with a legislative and regulatory framework intended to prevent their introduction and curb their spread. This section describes possible ways in which ISM could contribute to the introduction and spread of invasive species and suggests steps and best practices that can be taken to minimize such impacts.



## 2.9.2 Overview of Wisconsin’s Invasive Species Laws and Regulations

Wisconsin’s legislative and regulatory framework for preventing and controlling invasive species consists of various state statutes and administrative rules, as well as a number of applicable federal laws. These include laws specific to the prevention and control of aquatic and terrestrial invasive species, respectively, as well as those dealing with noxious weeds, nuisance animals, pests and diseases. Appendix A concisely summarizes the principal state laws and regulations that are most applicable to ISM operations.

Information on the state’s invasive species rule (ch. NR 40, Wis. Admin. Code), including steps that can be taken to ensure compliance, is available at <http://dnr.wi.gov/topic/Invasives/classification.html>.

### Definition and Classification of Invasive Species

Invasive species are defined in s.23.22(1)(c), Stats, as “nonindigenous species whose introduction causes or is likely to cause economic or environmental harm or harm to human health.” For regulatory purposes, these can include “seeds, propagules and individual living specimens, eggs, larvae, and any other viable life-stages of such species” (s. NR 40.02(48), Wis. Admin. Code).

NR 40 classifies invasive species into two categories: prohibited and restricted:

- “Prohibited invasive species” are not yet found in the state or are in small pioneer stands of terrestrial species, or in the case of aquatic species, that are isolated to a specific watershed or the Great Lakes, and for which statewide or regional eradication or containment may be feasible.
- “Restricted invasive species” are already established in the state

The list of species regulated under NR 40 – including those classified as “restricted” and “prohibited” – can be found at <http://dnr.wi.gov/topic/invasives/documents/nr40lists.pdf>. Due to their distribution at the time of regulation, a few species of terrestrial plants are split-listed; that is, classified as restricted in some counties and prohibited in others (see: [http://dnr.wi.gov/topic/invasives/documents/nr40\\_handout\\_rd2\\_final\\_vcs5.pdf](http://dnr.wi.gov/topic/invasives/documents/nr40_handout_rd2_final_vcs5.pdf)).

### Regulation of Prohibited and Restricted Species

With limited exceptions, no person may transport, possess, transfer, or introduce a prohibited species. Similarly, with limited exceptions, no person may 1) transport, possess, transfer or introduce a restricted invasive fish or crayfish species, or 2) transport, transfer or introduce any other restricted species.

### Preventive Measures

One exception to the prohibition of transporting regulated invasive species is if the DNR determines that the transportation, possession, transfer, or introduction was incidental or unknowing, and was not due to the person’s failure to take reasonable precautions. NR 40 defines “reasonable precautions” as “intentional actions that prevent or minimize the transport, introduction, possession, or transfer of invasive species” and include but are not limited to best management practices (BMPs) approved by the DNR, practices recommended by the “Wisconsin Clean Boats, Clean Waters” program and “Stop Aquatic Hitchhikers” campaign, and compliance with plant and plant pest quarantine

regulations imposed by the DATCP or United States Department of Agriculture Animal and Plant Health Inspection Service (USDA-APHIS). These BMPs may be found on the DNR's NR 40 webpage at <http://dnr.wi.gov/topic/Invasives/prevention.html>.

### **Decontamination Protocols**

Chs. NR 320, 323, 328, 329, 341, 343 and 345, Wis. Adm. Code, which relate to general navigable waters permit criteria, set out equipment decontamination requirements to stop the spread of invasive species from one waterway to another and require removal of all plants, animals, mud, debris, etc., before and after use. More details can be found at <http://dnr.wi.gov/lakes/invasives/boatdisinfection.aspx>.

### **Applicable Federal Laws**

In addition to Wisconsin statutes and codes, the following federal laws also regulate invasive species management:

- 16 U.S. Code § 4724 – State aquatic nuisance species management plans.
- 16 U.S. Code § 4722 – Aquatic nuisance species program.
- 7 USC section 7714 or 7715 – plant pest quarantines.

## **2.9.3 Potential Impacts on the Spread of Invasive Species**

### **Invasive Forest Insects and Diseases**

The harvest and removal of trees at a mine site is unlikely to pose a threat to the spread of invasive forest pests and diseases any greater than a normal harvest. Prior to sale, it must be determined whether the county that the site is located in is quarantined for a forest pest or disease. At the time of this writing, Wisconsin had counties quarantined for two forest pests: gypsy moth and emerald ash borer (EAB). Information on location of quarantine and regulations for loggers and mills can be found at <http://gypsymoth.wi.gov> and <http://emeraldashborer.wi.gov>, or by contacting the Plant Protection Section at the Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP).

DATCP determines which counties are quarantined. Their staff work with businesses that move regulated items, such as logs, from quarantined to non-quarantined areas, as well as mills in non-quarantined areas that receive logs from quarantined counties, in order to ensure compliance at minimal cost to the business. If logs are being moved out of state, the shipper and receiving mill should contact the USDA Animal and Plant Health Inspection Service (APHIS), which serves a role similar to DATCP for interstate trade. Logs and woody debris staying within the quarantine for processing don't require any special treatment, even if they contain the quarantined pest.

Gypsy moth and EAB are listed under NR 40 as 'Restricted' pests statewide. Required precautions are the same as those for the quarantine within the quarantine area. Outside of the quarantined areas for these pests, persons should be aware of the appearance of these pests and report any suspected individuals to DATCP. Forest pests and diseases listed as 'Prohibited' in NR 40 have not been found in Wisconsin as of 2015. For this reason, no precautions are currently required for sites in Wisconsin. This could change in the future if a prohibited species were to become established in the state.

## Terrestrial and Wetland Invasive Plants

### *Siting and Construction*

Mining work that disturbs ground or changes hydrology has a high potential to result in the establishment of invasive plants on site, especially if such species are in the area prior to the disturbance. Seeds are often moved easily by wind and water. Other viable parts, such as roots, rhizomes, and live stem fragments can easily be spread around sites or brought in through vehicular traffic. Once onsite, many of these species spread rapidly in suitable habitat. Identification and control of these species with herbicide prior to construction may greatly reduce their spread.

As existing vegetation and topsoil are removed, seeds and reproductive plant parts are moved about. If topsoil is stockpiled in berms for more than a few years, it is likely that many seeds deep within the pile will no longer be viable; however, the surface of the berms and other waste areas are likely to become dominated by weedy and invasive plants. These large areas of highly disturbed soil in full sun will fill-in with weedy species. Temporary drawdowns of surface waters also create ideal settings for invasion.

Table 2-6 lists invasive plants reported to occur within 1 mile of existing mine sites. See also Appendix B for lists invasive plants reported to occur within 2.5 and 5 miles of existing mine sites. Species most likely to become established and spread on upland disturbed sites include spotted knapweed (*Centaurea maculosa/stoebe*) and Canada thistle (*Cirsium vulgare*). In wet soils, likely invaders include reed canary grass (*Phalaris arundinacea*), tall manna grass (*Glyceria maxima*), hybrid cattail (*Typha x glauca*) and phragmites (*Phragmites australis*). Intensive work began in 2015 to eliminate non-native phragmites from the western half of the state where there are few known stands. Jackson County is an area of special concern for this species since a large population at a reclaimed mine site has been dispersing satellite stands into nearby wet areas.

**Table 2-6** Invasive plants reported to occur within one mile of existing mine sites

<b>Scientific Name</b>	<b>Common name(s)</b>
<i>Arctium minus</i>	Lesser burdock, Burweed, Louse-bur, Common burdock, Button-bur, Cuckoo-button or Wild rhubarb
<i>Centaurea stoebe</i>	Spotted knapweed
<i>Centaurea stoebe ssp. micranthos</i>	Spotted knapweed
<i>Cirsium spp.</i>	Thistle
<i>Cirsium spp.</i>	Thistle
<i>Cirsium vulgare</i>	Spear thistle
<i>Dipsacus laciniatus</i>	Cut-leaved teasel
<i>Dipsacus sylvestris</i>	Common teasel
<i>Glyceria maxima</i>	Tall or reed mannagrass
<i>Lonicera maackii</i>	Amur honeysuckle
<i>Lonicera x bella</i>	Bell's or showy bush honeysuckle
<i>Phalaris arundinacea</i>	Reed Canary Grass
<i>Phragmites australis</i>	Phragmites or Common reed non-native ecotype
<i>Potamogeton crispus</i>	Curly-leaf pondweed
<i>Rhamnus cathartica</i>	Common buckthorn
<i>Rosa multiflora</i>	Multiflora rose
<i>Rumex acetosella</i>	Garden sorrel
<i>Vincetoxicum nigrum</i>	Black or Louise's swallow-wort

### *Transport*

Mining operations have vehicles constantly moving around the site, as well as to and from other sites, railroad depots, construction areas, etc. As such, the potential for unintentionally dispersing invasive plants from contaminated mine sites, and the establishment of any viable plant parts brought into a highly disturbed mine site is very high. NR40 requires that reasonable precautions be taken to minimize the spread of any listed species. Mine operators, trucking firms, and others involved are responsible for making sure the rule is followed. BMPs have been developed to help people minimize the accidental transportation of invasive species. These consist of actions such as cleaning off earth-moving equipment before leaving the site and only using native or non-invasive plants when seeding for reclamation work. If BMPs are followed, mining activities and the transportation of materials to-and-from and between mine sites can be done with limited risk of spreading invasive species. Invasive species BMPs for terrestrial, wetland and aquatic species can be found at: <http://dnr.wi.gov/topic/Invasives/prevention.html>

### *Reclamation*

The reclamation of mine sites once mining operations have ceased is another potential point of introduction of invasive plant species, through the introduction of materials brought in for re-grading, vegetative re-seeding, and accidental spread by vehicles. NR 40 prohibits the purchase or planting of regulated invasive plants, or the use of mulch containing invasive species. Seed mixes should be made up of native species and/or non-invasive cover crops and species known to not be invasive. Mulch should be weed-free. Once reclamation is completed, local monitoring to detect and remove invasives will prevent establishment of the unwanted species.

### **Aquatic Invasive Species (AIS)**

Sand mining and processing facilities may include surface water ponds and waterways that can store and/or convey stormwater or industrial process water. These may be constructed in ways that discharge stormwater or process water to natural streams. To date, ISM facilities have not been located on flow-through stream systems.

Constructed ponds and waterways provide potential habitat for aquatic invasive species. The value or suitability of the habitat created can vary greatly. The risk of introduction of non-native and invasive species into these ponds and waterways is considered low, in part because general access to the public is prohibited.

Mine sites that are dewatered during the mining season provide poor habitat for both native and non-native species since the pond or lake is dry for nine or more months out of the year. Mine sites that hydraulic dredge material, resulting in a permanent waterbody, provide potential habitat for both native and non-native vertebrate and invertebrate species. During active mining operations, mechanical and flow disturbances within the pond/lake will likely restrict the survival of non-native species. In some instances, the reclamation plan shows these larger water bodies will be managed as natural lakes with created littoral zones, public access and shoreline development and public parks. These larger ponds and lakes could provide suitable habitat for the introduction and survival of invasive species. Introductions could occur through natural vectors (e.g., birds) or by humans, if public or private access exists.

## **Management to Decrease Potential Environmental Effects**

State waterway and wetland permits include conditions that require construction machinery to be decontaminated and inspected for invasive species. ISM companies could put in place similar conditions for contractor work and their own machinery that operates within ponds and waterways on their property. Lakes and larger ponds proposed as part of the final reclamation plans could include an invasive species monitoring and management plan. A targeted public information and education program could help prevent the introduction and spread of invasive species.

All prohibited species should be reported to [Invasive.Species@wi.gov](mailto:Invasive.Species@wi.gov).

### **2.10 Reclamation**

The nonmetallic mining reclamation regulations are established by the State in Ch. 295, subchapter I, Wisconsin Statutes and Ch. NR 135, Wis. Admin. Code. Section 295.13, Wisconsin Statutes requires a county to enact and administer a nonmetallic mining reclamation ordinance. In addition, s. 295.14, Wisconsin Statutes allows a city, village or town to enact and administer a nonmetallic mining reclamation ordinance.

#### **2.10.1 Permits, Fees, and Financial Assurance**

NR 135 requires reclamation of nonmetallic mining sites that have been actively mined after August 2001. All active mines must have valid reclamation permits, issued by the county or local regulatory authority (RA) with jurisdiction for the mine site, unless exempt from NR 135. New mines must apply for and receive a reclamation permit prior to beginning operations. The rules provide reasonable exemptions, such as for sites less than one acre, a pit on a farmer's land for personal use or excavations incidental to building construction.

A reclamation plan is the basis for granting a reclamation permit. It is a blueprint describing the steps that are necessary to reclaim the site to achieve a post-mining land use. The reclamation plan must demonstrate compliance with the uniform reclamation standards provided in NR 135 and provides environmental protection during and after the mining process.

RAs are responsible for permitting and overseeing the reclamation of nonmetallic mining sites within their jurisdiction, including reviewing mine operators' reclamation plans. The reclamation permit application requires the mine operator to submit information regarding land ownership or leasing information, mine location and description, the first year's annual fees, and a complete reclamation plan. The permit, once approved, also requires operators to provide financial assurance in an amount sufficient for the RA to reclaim the mine in the event that the operator is unable to do so. The reclamation permit, a complete reclamation plan, and financial assurance must all be in place prior to the commencement of mining.

RAs administering NR 135 reclamation programs may set and collect annual reclamation fees on unreclaimed acres of active mining operations. By law, the RA administering a nonmetallic mining reclamation program sets and collects fees from mine operators that represent, as closely as possible, their administrative costs. These costs include

permitting, plan review, and administrative and inspection costs. The RA also forwards a portion of the fees to the DNR to cover statewide administrative costs.

RAs are responsible for transferring fees and providing reports to the DNR's Nonmetallic Mining Program. These fees allow the DNR to provide technical assistance and oversight to the nonmetallic mining reclamation RA programs, including periodic audits to ensure they are administering reclamation programs in a consistent and reasonable manner across the state.

### **2.10.2 Cross-Programmatic Jurisdictions**

Under s. NR 135.06(5): Reclamation of nonmetallic mining sites shall comply with any other applicable federal, state and local laws including those related to environmental protection, zoning and land use control.

Multiple DNR programs may cover elements of mine site reclamation. Examples include the Stormwater Management Program, which requires that all nonmetallic mines have a Wisconsin Pollutant Discharge Elimination System (WPDES) permit in place through the lifetime of the mine, and the Waterways and Wetlands program, which permits operations with proposed waterway dredging activities, grading, or the construction of ponds in close proximity to waterways.

Where zoning has been adopted at the county or local level, zoning administrators are responsible for all mine siting requirements, including the issuance of zoning Conditional Use Permits and the regulation of operations, as allowed under the specific ordinance. When zoning is in place, these bodies may also be responsible for regulating reclamation activities. See also section 4.1.3.

### **2.10.3 Reclamation Processes and Standards**

County and local RAs are responsible for the review and approval of reclamation plans for mine sites in their jurisdiction, and for ensuring that mine operators adhere to those reclamation plans. The purpose of the reclamation plan is to achieve acceptable final site reclamation to an approved post-mining land use in compliance with the uniform reclamation standards outlined in NR 135. The reclamation standards address environmental protection measures including topsoil salvage and storage, surface and groundwater protection, final grading and slopes, and contemporaneous reclamation to minimize the acreage exposed to wind and water erosion.

While the overall reclamation programs are consistent, there is some variation in what counties require for site stabilization, but generally sites will be graded so that slopes do not exceed a 3:1 slope gradient. 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 engineering analyses show it to be safe and stable, or if the highwall was in existence before NR 135 came into effect. Once grading is complete the site will have topsoil applied, and then be seeded and mulched.

Common post-mining land uses include:

- Passive wildlife habitat

- Lakes or ponds
- Agriculture and silviculture
- Industrial development
- Recreation facilities

Reclamation activities should be conducted contemporaneously as practicable with the development of new mining phases. The department believes contemporaneous reclamation is a program requirement. However, for smaller mine sites, contemporaneous reclamation may be difficult either due to the size of the mine or when a small amount of material is extracted. The department does expect mine operators and RAs to ensure that reclamation is conducted on a timely basis at 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 RA and guaranteed through the posting of a financial assurance instrument payable exclusively to the county or local RA.

Because sand mines are designed to be mined and reclaimed in phases, the department believes RAs should direct these large mines to conduct contemporaneous reclamation to reduce open acreage. Once the supply of sand at the mine site has been exhausted, the mine owner / permittee is required to reclaim the mine area.

#### **2.10.4 Monitoring**

NR 135 does not prescribe monitoring requirements for nonmetallic mining sites. However, sections NR 135.07 and NR 135.08 require that surface water quality standards detailed in chapters NR 102 through 105, Wis. Adm. Code, and groundwater quality standards detailed in Ch. NR 140, Wis. Adm. Code standards are not exceeded by reclamation activities. Reclamation plan conditions, including monitoring requirements, can be negotiated as part of the reclamation plan approval and permit issuance. An operator can seek to reduce or remove monitoring parameters or frequency by submitting a request to the RA for a modification to the reclamation permit under NR 135.24(2) to modify the permit or reclamation plan.

## **3 Socioeconomic Topics**

The construction and operation of industrial sand mines and processing facilities, along with the transportation of mined sands, has the potential to generate sizable direct and indirect impacts on Wisconsin's economy, its people and communities. These include impacts on employment, wages, and tax revenues, as well as property values, tourism, public parks and recreation, transportation systems, agriculture, human health and safety, quality of life, and cultural resources. While it is difficult to put exact figures on all of these impacts, this chapter will provide the most current information available and provide resources for follow-up analyses.

### **3.1 Public Parks and Recreational Lands**

#### **3.1.1 Introduction**

Publicly-owned lands are an important component of Wisconsin's supply of outdoor recreation. Federal, state, and local units of government provide access to over 5.7 million acres of natural and recreational land in Wisconsin. Sand mining operations have the potential to impact public outdoor recreation in the west central part of the state.

#### **3.1.2 Regional Physical and Recreational Characteristics**

The first step to evaluating the potential impacts of ISM on public parks and recreation is to understand the physical and recreational characteristics of west central Wisconsin. The 2005-10 Wisconsin Statewide Comprehensive Outdoor Recreation Plan (SCORP) divides the state into eight recreational regions, roughly equivalent in size, that represent different demographic trends, tourism influences, and environment types.

Two SCORP regions – the Western Sands Region and the Mississippi River Corridor – are home to the vast majority of sand mining operations within the state. The Western Sands Region encompasses Adams, Chippewa, Clark, Eau Claire, Jackson, Juneau, Marathon, Monroe, Portage, and Wood Counties. This region has more public recreation land and water resources than any other region outside of the Northwoods, and includes the Black River State Forest, Jackson County Forests, Necedah National Wildlife Refuge, the Wisconsin River, Chippewa River, Black River, and numerous other smaller state and county parks. Although the region remains largely rural, it is heavily influenced by tourism from the Chicago and Twin Cities metropolitan areas. Easy highway access and relatively cheap land have made it a popular location for seasonal home development. Adams and Juneau Counties in particular have experienced high growth in housing, especially along rivers flowages.

The Mississippi River Corridor is located in the southwestern portion of the state and encompasses St. Croix, Dunn, Pierce, Pepin, Buffalo, Trempealeau, La Crosse, Vernon, Crawford, and Grant Counties. The Mississippi River itself is the primary recreational resource in the region. The river and its backwaters are used for a variety of nature- and water-based recreational activities such as boating and swimming. Streams extending off the Mississippi support an excellent coldwater fishery. Although most public lands within the region are fishery or wildlife areas, there are also a number of state parks. The Great River Road, a thoroughfare that follows the Mississippi for 250 miles, connects over 50



local parks and beaches. Increased tourism from the nearby Twin Cities Metropolitan Area, as well as suburban development in St. Croix and Pierce Counties, influences both the supply and demand for outdoor recreation across the region.

### 3.1.3 Recreation Prioritization of Land Legacy Areas

Published by the DNR in 2006, the Wisconsin Land Legacy Report provided an initial inventory of areas thought to be critical in meeting the state’s recreation and conservation needs over a fifty-year time horizon. Developed over a three-year period, with input from citizens and nonprofit organizations, the report identified 229 “Legacy Places.” As part of the 2005-2010 SCORP, these Legacy Places were further evaluated according to their potential visitation, population/development pressure, cost of land acquisition, conservation significance, and recreational potential, resulting in a ranked inventory of “Recreational Land Legacy Areas.” Of the top fifteen of these areas, six are located in the principal sand mining regions of the state (Table 3-1).

**Table 3-1** Recreation Land Legacy Areas in the sand mining regions of the state

Area	Ranking	County
Baraboo Hills	5	Sauk
Lower Wisconsin River	7	Sauk, Iowa, Richland, Grant, Crawford
Baraboo River	9	Sauk
Balsam Branch Creek and Woodlands	11	St. Croix
Kickapoo River	13	Vernon and Crawford
Lower Chippewa River and Prairies	14	Dunn and Pepin

### 3.1.4 Regional Recreation Land Legacy Areas

The 2010-2015 SCORP further evaluated and ranked the Recreational Land Legacy Areas according to recreation needs within each of the eight SCORP Regions. The top five areas within the Western Sands Region and Mississippi Corridor are listed below. These rankings are a separate subset of the statewide rankings and represent a regional perspective on recreational supply and demand.

#### Western Sands Region

1. Black River
2. Upper Chippewa River
3. Central Wisconsin Grasslands
4. Robinson Creek Barrens
5. Yellow (Chippewa) River

#### Mississippi River Corridor

1. Kickapoo River
2. Upper Mississippi River National Fish and Wildlife Refuge
3. Lower Chippewa River and Prairies
4. Coulee Coldwater Riparian Resources
5. Black River

### **3.1.5 Rail Trails and Sand Mining**

Rail-trails are subject to a unique, and occasionally complex, mix of federal and state law. Many rail-trail conversions are “railbanked” under Section 8(d) of the National Trails Systems Act, often called “the Railbanking Act” or the “Rails-to-Trails Act.” This federal law, enacted by Congress in 1983 to preserve established railroad corridors for interim trail and future rail use, preempts state or local laws that are inconsistent with these goals. Wisconsin has been a part of this program to create a network of trails that utilize former railroad corridors.

Within the core sand mining area, a number of state trails exist as shown below:

- 400 State Trail
- Buffalo River State Trail
- Cattail State Trail
- Chippewa River State Trail
- Elroy-Sparta State Trail
- Great River State Trail
- La Crosse River State Trail
- Old Abe State Trail
- Red Cedar State Trail
- Stower Seven Lakes State Trail
- Tuscobia State Trail

As sand mines are developed, many look to rail lines as the most economical shipping method. Rail patterns dictate that most frac sand mined in the region goes to shale oil and gas fields in the eastern and southern United States, rather than to the Bakken. For example, mines in Chippewa and Barron counties ship sand on small, rural rail lines to connect to the networks of Canadian National, BNSF and other continental railroads.

If sand mining continues to expand, the “railbanked” corridors may once again become an important transportation corridor for these operations. A handful of state trails may fit this need if they offer a less expensive option than other shipping methods. In the past, the DNR has had inquiries from ethanol producers about state rail lines being reestablished for shipping.

A fundamental premise of the railbanking program was that once a rail corridor is placed in railbanking status, the railroad is entitled to reinstitute rail service on the line. At the time of the initial rail-trail conversion, the possibility of rail service reactivation is, by definition, remote, since the corridor would not have been proposed for railbanking if there had been a foreseeable future need for rail service on the line. To date, there are no proposals being considered to convert State Trails back to railroads.

### **3.1.6 Public Recreation Lands Next to Sand Mines**

Impacts to public recreation lands have the potential to occur if a mine is located adjacent to or near public property. An notable example outside of Wisconsin was a proposal to develop a sand mine next to Illinois’s Starved Rock State Park. In January 2012, the LaSalle County Board approved the purchase of 80 acres by a mining company. The land

bordered the eastern entrance of Starved Rock State Park and had conservation groups concerned about the effects mining could have on the park. In 2013, LaSalle County placed a moratorium on new sand mines, which was subsequently extended until 2016. The purpose of the moratorium was to allow time to review the impact of sand mining next to the state park.<sup>29</sup> It is possible that similar scenarios could play out in Wisconsin.

While sand mining operations have expanded and contracted in recent years in response to changes in oil prices, outdoor recreation on public land has continued to increase. At a statewide and regional level, special attention should be given to the Recreational Land Legacy Places discussed in the 2005-2010 SCORP (see sections 3.1.3 and 3.1.4. above). Protections should also be considered at the level of individual public properties.

## **3.2 Transportation**

Industrial sand is transported in bulk by multiple modes, which can vary from operation to operation, as described in section 1.3.6 of this document. For transport purposes, industrial sand is classified as a common non-metallic mineral that is handled as a dry bulk, non-hazardous commodity. Once it leaves the state, sand transport is largely rail-dependent; however, trucks are used to transport sand between mines, processing facilities and rail-loading facilities. Rail and in some cases barges are necessary for the cost-effective transport of large quantities of industrial sand out of the state.

The transport of sand can have impacts on local economies, public safety, and the environment. The creation of new transportation infrastructure for industrial sand mining operations, such as roads and rail spurs, must comply with regulations described in chapter 2 of this document, as well as local regulations administered by the appropriate county as applicable. Covered loads can reduce the loss of visibility and deposition of sand onto roads that could be washed into rivers, streams and wetlands.

### **3.2.1 Effects on Local Road Systems**

The increased use of public roads by heavy sand trucks can cause road damage, as well as traffic safety concerns. These issues are outside the authority of the DNR, and are regulated by local units of government, and Wisconsin Department of Transportation (WisDOT). In general, any trucking that occurs is for short distances and is likely to be on local routes. As such, most of the impacts seen are on local, non-state system roadways. In some cases, the local road may have been already designed to accommodate heavy truck traffic, thereby limiting any impacts the sand industry may have.

If a local authority determines that a roadway design cannot accommodate regular heavy truck traffic, Wisconsin Statutes § 349.16 allows local units of government to enter into road upgrade maintenance agreements (RUMAs) with trucking operators. These agreements vary across the state, but allow for mitigation of the roadway impacts created by a mining facility's trucking operations. RUMAs can help local governments to recover the cost of road damages, fund maintenance of area roads, and help pay for at-grade rail crossing improvements. In some cases, local units of government can also negotiate

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<sup>29</sup> <https://gsa.confex.com/gsa/2015NC/webprogram/Paper255812.html>

routes, weight limits, and hours of transport. These tools help address safety issues by improving intersections and limiting hours of operation to avoid conflicts with school bus traffic, etc. A RUMA can also help to alleviate local tax burdens, by requiring the industry to pay for the road maintenance in the area (WisDOT 2013).<sup>30</sup>

The Wisconsin Towns Association, Wisconsin Counties Association, and Wisconsin County Highway Association can offer training and information to local units of government on using these statutory authorities. For more information, see:

- <http://www.wisctowns.com/education/frac-sand>
- <http://dnr.wi.gov/topic/EIA/documents/ISMSA/FracSandHandbookWCA.pdf>

The WisDOT Facility Development Manual also provides guidance to local municipalities (see <http://wisconsinstate.gov/Pages/doing-bus/eng-consultants/cnslt-rsrces/rdwy/fdm.aspx>). WisDOT regional planning staff work cooperatively with local units of government on developing these RUMAs, as well.

For a more detailed case study of the transportation impacts of the industry, and a sample RUMA for Chippewa County, see <http://midamericafreight.org/wp-content/uploads/FracSandWhitePaperDRAFT.pdf>.

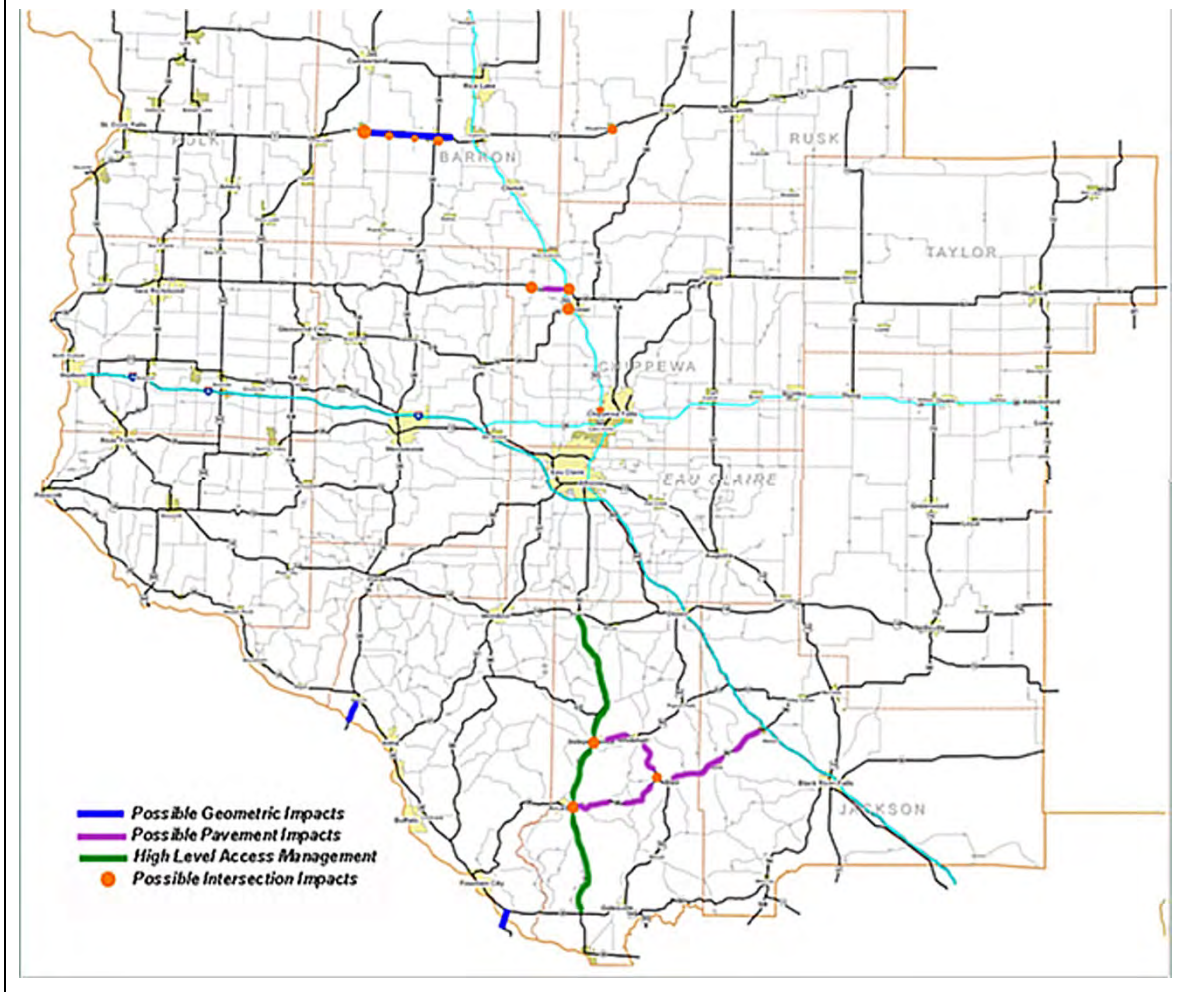
### **3.2.2 Effects on State Highways**

State highway systems are under the authority of WisDOT. One of WisDOT's main functions is to ensure the safe movement of commerce via the State's Highway System that it maintains. For this reason, many state highways were designed to accommodate heavy truck traffic. Unlike local governments, WisDOT does not have the statutory authority to enter into road use maintenance agreements discussed in the section 3.2.1 above. WisDOT does, however, have authority over the direct access (driveway) to their state highway systems. As such, they can address safety issues by requiring the addition of turn lanes, and locating the driveway in a safe area along the system. The impacts to the State's Highway System are minimal, and localized. WisDOT (2013) has monitored the industry to account for the cumulative impacts to roadways, and has identified the location of specific areas of concern (see <http://dnr.wi.gov/topic/EIA/documents/ISMSA/DOT2013TransImpactsWisFracSandIndFinal.pdf>).

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<sup>30</sup> <http://dnr.wi.gov/topic/EIA/documents/ISMSA/DOT2013TransImpactsWisFracSandIndFinal.pdf>

**Figure 3-1** Areas with high potential highway impact  
(source: WisDOT Frac sand report update)



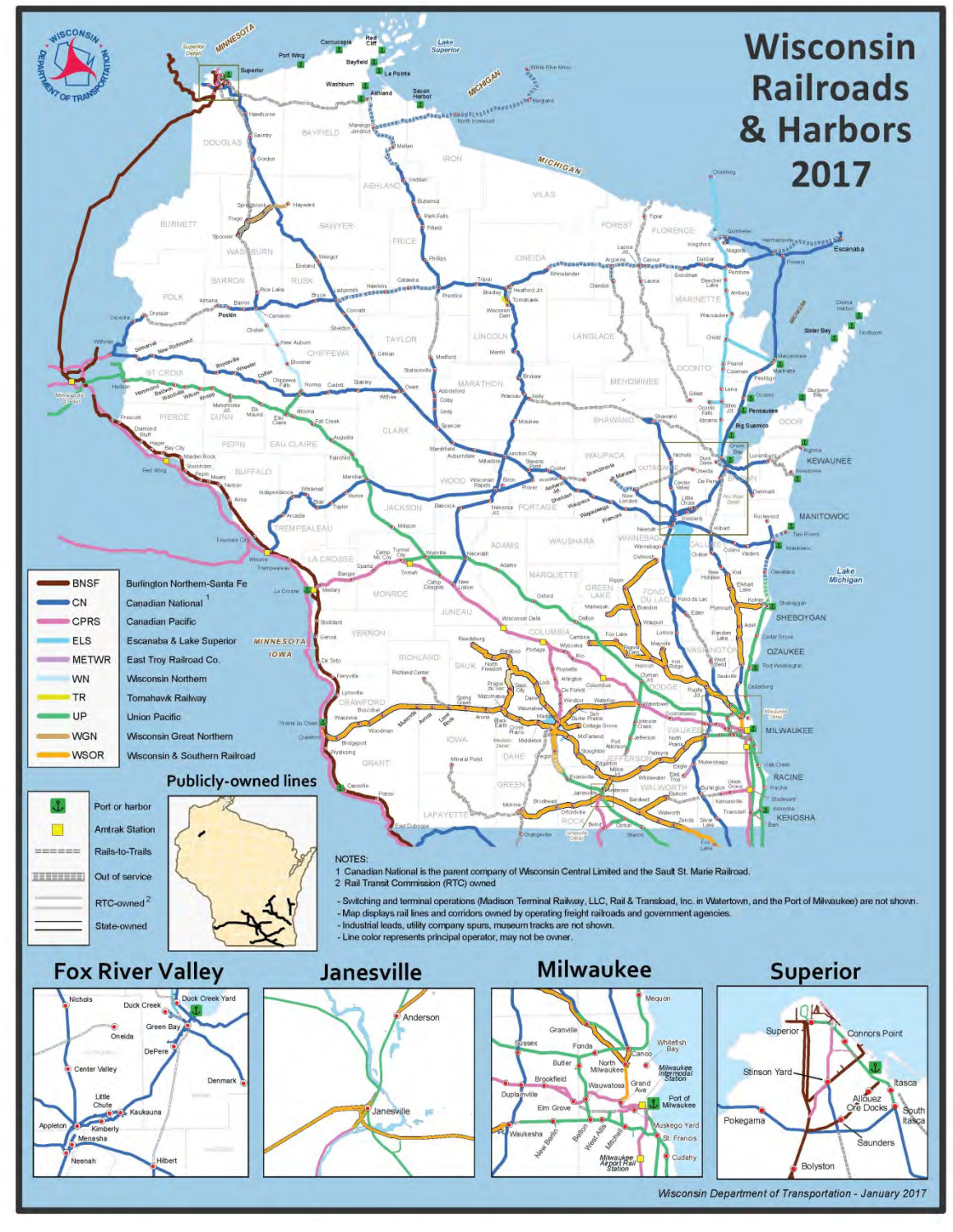
### 3.2.3 Rail Systems

The preferred and most economical method of transporting industrial sand is by rail. Increased rail traffic has raised concerns about noise, delays and at-grade rail crossing safety. Rail traffic is regulated by the Federal Railroad Administration (FRA), along with the Wisconsin State Office of the Commissioner of Railroads and WisDOT. These authorities are in charge of safety inspections, highway overpass and grade-crossing construction.

There are four Class I railroads in Wisconsin, and two short line rails in West Central Wisconsin. All have invested significantly in upgrading their infrastructure to handle the increased loads and frequency of both industrial sand going out of the state, and crude oil coming back through the state.



**Figure 3-2 Wisconsin railroads**  
(source: WisDOT)



The increase in rail traffic throughout the state raises concerns about safety issues associated with at-grade rail crossings of roadways, as well as concerns of increased noise levels and potential derailments.

The FRA tracks all train accidents across the nation. In Wisconsin the number of accidents fluctuates annually.

**Table 3-2** Highway-rail crossing incident casualties in Wisconsin (2015 preliminary)  
 (source: <http://safetydata.fra.dot.gov/OfficeofSafety/publicsite/summary.aspx>)

Fatal				Nonfatal			
2012	2013	2014	2015	2012	2013	2014	2015
4	2	10	3	12	22	17	11

### Delays to Emergency Vehicles

In recent years, drivers have experienced more frequent and longer delays at at-grade rail crossings. This has raised concerns of delays to emergency service vehicles (Kottke 2014).

In order to maintain uniformity in regulations across the nation, federal law and the FRA limit state and local regulations of train crossings and train traffic (49 U.S. Code § 20106 – Preemption):

1. Laws, regulations, and orders related to railroad safety and laws, regulations, and orders related to railroad security shall be nationally uniform to the extent practicable.
2. A State may adopt or continue in force a law, regulation, or order related to railroad safety or security until the Secretary of Transportation (with respect to railroad safety matters), or the Secretary of Homeland Security (with respect to railroad security matters), prescribes a regulation or issues an order covering the subject matter of the State requirement. A State may adopt or continue in force an additional or more stringent law, regulation, or order related to railroad safety or security when the law, regulation, or order—
  - A. is necessary to eliminate or reduce an essentially local safety or security hazard;
  - B. is not incompatible with a law, regulation, or order of the United States Government; and
  - C. does not unreasonably burden interstate commerce.

Wisconsin Stat. 192.292 makes it unlawful to stop a train longer than 10 minutes across any highway or street crossing outside of a city, except in cases of accident. According to a 2008 opinion of the Wisconsin Attorney General, however, this authority would likely be preempted by federal law (see <https://www.doj.state.wi.us/sites/default/files/informal/20081014-blank.pdf>).

Emergency services need to be aware of these potential conflicts with delays at at-grade rail crossings and know alternate routes that are available to them.

## **Train Noise**

With the increase in train traffic in the state, there are increased concerns about noise from trains blowing horns in or near residential areas. Under the federal [train horn rule](#) (49 CFR Part 222), locomotive engineers must begin to sound train horns at least 15 seconds, and no more than 20 seconds, in advance of all public grade crossings. There are also required minimum and maximum decibel levels and a standardized pattern which must be repeated or prolonged until the lead locomotive or lead cab car occupies the grade crossing.

While state and local governments do not have the authority to order trains to cease blowing their horns, the federal train horn rule does provide an opportunity for localities to mitigate the effects of horn noise by establishing “quiet zones.” Within these zones, railroads are directed to cease routine sounding of horns when approaching at-grade intersections with public highways. Train horns may still be used in emergency situations or to comply with other federal regulations or railroad operating rules. Localities desiring to establish a quiet zone are first required to mitigate the increased risk caused by the absence of a horn ([www.fra.dot.gov/Page/P0889](http://www.fra.dot.gov/Page/P0889)).

## **Train Derailments**

Increased train traffic in the state has also raised concerns of derailments of trains carrying materials that could spill into the environment and cause hazardous conditions for nearby residents. According to the FRA, track and infrastructure failure is a cause of train derailments in the U.S. Incorrect interaction between moving vehicles and the track is a common cause of derailments. The FRA is developing track inspection technologies, computer modeling capabilities, expanding recording methods, and monitoring to detect safety issues ([www.fra.dot.gov/Page/P0065](http://www.fra.dot.gov/Page/P0065)).

### **3.2.4 Barge Systems**

The Port of Winona, Minnesota, is the only port near Wisconsin that transports industrial sand. The twin ports of Duluth/Superior are not currently used, due to distance from the mines in west-central Wisconsin. There have not been significant concerns raised about this particular transportation method in Wisconsin. The port has limited capacity for offloading the commodity at this particular site, as well as a limitation for winter transport due to ice on the river. Industrial sand was not shipped out of the Port of Winona in 2015, due to the fall of demand for the industry.

Along with rail, and in some cases commercial trucking, barge transport falls under interstate commerce, thereby limiting local and state authority.

## **3.3 Agricultural Lands**

Concerns have been raised about the impact of industrial sand mining on agriculture within the state. Some of this concern is related to the fact that sand mining often occurs in and around prime farmland, resulting in the loss of agricultural production as mining competes for land. An additional concern relates to mine reclamation, and whether or not reclaimed mines will be suitable for crop production in the future.



While the DNR does not have regulatory authority over land use (see section 2.10 and section 4 of this document) the Department of Agriculture, Trade and Consumer Protection (DATCP) has some influence over industrial sand mining under the farmland preservation program (FPP). Nonmetallic mines are allowed as a conditional use under local zoning ordinances certified for the FPP under Ch. 91, Wis. Stats. This conditional use requires that mined lands be reclaimed to an agricultural use, which under Chapter 91 can include managed forest, as well as pasture or cropland.

The ability to return reclaimed land to pasture or cropland depends on a number of factors. These include: the remaining slope (side slopes of 3:1 or 4:1 may be too steep for cropland), the depth of the topsoil reclaimed and returned to the mined areas, the characteristics of the reclaimed or remaining subsoil (including the ability to return an adequate A soil horizon for root development), and other soil characteristics, such as pH, organic matter, and available nutrients. Returning reclaimed sites to agricultural productivity may take decades, as opposed to years. Unless extensive measures are taken, it is unlikely that soil properties will “catch up” meaning productivity may always be lower than it was before mining.

DATCP has identified the size of industrial sand mines as relevant to its special-use approvals under farmland preservation agreements entered into prior to the revision of Chapter 91 in 2009. A DATCP analysis of these older agreements in Trempealeau County found that 13 special uses had been granted for non-metallic mining between 2001 and 2011, totaling 364 acres or an average of 28 acres per mine. In 2012, DATCP received applications for three industrial sand operations on land under FPP agreements in the county, totaling 409 acres or an average of 136 acres per mine. Based on its analysis of special uses granted during the previous decade, DATCP determined that the scale of these mines was not consistent with agricultural use.

Before 2009, farmland owners could “buy out” of FPP agreements by paying back the previous ten years of FPP tax credits. This option was utilized by several farmland owners in Trempealeau County to open industrial sand mines (personal communication, Keith Foye, Director Bureau of Land and Water Resources, DATCP).

In agricultural communities, a critical mass of productive cropland is necessary to sustain related businesses essential to farming operations, such as equipment dealers, seed/feed/chemical distributors, and veterinary services. According to the USDA’s 2014 Wisconsin State Overview Survey (Quick Stats), the state has approximately 14.5 million acres in agricultural use. Permitted industrial sand mines cover 34,000 acres. Table 3-3 reports the acreage of land in agricultural use in 2007 and 2012 within the five counties with the highest number of permitted ISM facilities in the state, including the percent change during that time. Table 3-4 reports the acreage of currently permitted industrial sand facilities in the same counties.

**Table 3-3** County agricultural acreage in the top five counties with the highest number of permitted mines  
(source: USDA 5 year census 2007 and 2012)

County	2007 Farm Acres	2012 Farm Acres	Percent Change	Percentage of County Area in Farmland
Barron	324,196	309,750	-4 %	56.1 %
Chippewa	353,491	384,621	+9 %	59.6 %
Jackson	238,978	239,936	+0.4 %	37.0 %
Trempealeau	341,370	323,157	-5 %	68.9 %
Wood	221,962	222,730	+0.3 %	43.9 %
<b>Total</b>	<b>1,479,997</b>	<b>1,480,194</b>	<b>+0.01 %</b>	<b>52.7 %</b>

**Table 3-4** Sand facility acreage in the top five counties with the highest number of permitted mines

County	Permitted Sand Facility Acres	Percentage of County Area in Permitted Industrial Sand Facilities
Barron	2,922	0.5 %
Chippewa	2,922	0.4 %
Jackson	8,226	1.3 %
Trempealeau	4,278	0.9 %
Wood	963	0.2 %
<b>Total</b>	<b>19,825</b>	<b>0.7 %</b>

source: <http://dnr.wi.gov/topic/Mines/documents/ISMSpreadsheet20160523.xlsx>

### 3.3.1 Transportation Logistics

A final issue of concern with respect to ISM and agriculture is the competition between the two industries for rail transport during the fall harvest. Industrial sand is often shipped by unit trains (100 rail cars) using the same type of cars that are used to ship grain. As such, there can be shortages of rail cars during harvest season, although this conflict subsided with the drop off in ISM activity in 2015. It should be noted that increased rail traffic has made this a national issue (see the FRA Freight Railroads Background report, April 2015: [www.fra.dot.gov/Elib/Document/14497](http://www.fra.dot.gov/Elib/Document/14497)).

## 3.4 Local and State Economy

### 3.4.1 Direct Employment and Income

In 2012, the Wisconsin Economic Development Corporation (WEDC) reported that, on average, a new industrial sand mine would create 10 jobs, while a processing facility would create 50 to 80 jobs.<sup>31</sup> According to the Bureau of Labor Statistics (BLS), there were just over 900 people employed at 40 Wisconsin establishments<sup>32</sup> reporting industrial sand mining or processing as their primary business in 2016. This represents an increase of 700 employees or 450% from 2007, when there were only seven such establishments. These figures do not, however, reflect of the full extent of ISM expansion during that period, since there were actually 92 DNR-permitted facilities actively engaged in industrial sand mining or processing in 2016. Recent estimates of the number of people directly employed in ISM in Wisconsin range from 2,300<sup>33</sup> to 4,300,<sup>34</sup> representing a roughly ten- to twenty-fold increase over the previous decade. Neither the BLS data nor these estimates include workers employed by establishments that support ISM, such as truck drivers working for sand-hauling companies.

Jobs in industrial sand mining and processing are comparatively high-paying. Among the 40 self-identified ISM establishments reporting to BLS, the average weekly wage during the first quarter of 2016 was \$1,095, the equivalent of \$57,000 a year. By comparison, the average wage among all workers in Wisconsin in 2014 was \$44,000. The median wage among all ISM workers is not available; however, the Wisconsin Department of Workforce Development (DWD) reports cross-sector median wages for job-types that are associated with ISM. For 2015, the median wage among “Operating Engineers and Other Construction Equipment Operators” was \$53,150, while the median wage among “Excavating and Loading Machine and Dragline Operators” was \$45,900. The median wage among “Heavy and Tractor-Trailer Truck Drivers” was \$39,200.

### 3.4.2 Indirect and Induced Impacts

The indirect impacts of industrial sand mining include increased employment and income in sectors that provide goods and services to ISM establishments, beginning with the construction of new facilities and the purchase of necessary machinery and heavy equipment. In 2012, WEDC estimated that the average sand processing plant required an investment of between \$20 and \$40 million to cover these costs, while facilities that

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<sup>31</sup> As reported in the DNR’s 2012 study on Silica Sand Mining Wisconsin: <http://dnr.wi.gov/topic/Mines/documents/SilicaSandMiningFinal.pdf>.

<sup>32</sup> According to BLS, an “establishment” is commonly understood as a single economic unit, such as a mine, a factory, or a store, that produces goods or services at one physical location, and is engaged in one, or predominantly one, type of economic activity.

<sup>33</sup> From IHS Markit’s 2012 report “America’s New Energy Future: The Unconventional Oil and Gas Revolution and the US Economy, Volume 2 – State Economic Contributions.”

<sup>34</sup> From the Heartland Institute’s 2015 policy study on “Economic Impacts of Industrial Silica Sand (Frac Sand) Mining” [www.heartland.org/template-assets/documents/publications/05-29-15\\_orr\\_and\\_krumenacher\\_on\\_frac\\_sand\\_economics.pdf](http://www.heartland.org/template-assets/documents/publications/05-29-15_orr_and_krumenacher_on_frac_sand_economics.pdf). The authors present a range of estimates, from 2,880 to 4,230, according to the number of DNR-permitted active facilities at the time (108) multiplied by WEDC’s 2012 estimates of the number of workers per sand mine and sand processing facility, respectively.

include resin coating require investments of upwards of \$100 million.<sup>35</sup> Induced impacts include employment and income in other sectors, such as retail sales and professional services, in response to consumer spending on the part of newly-hired workers.

Several economists have projected the total (direct + indirect + induced) impacts of proposed ISM facilities using regional “multipliers” derived from input-output (I-O) models.<sup>36</sup> As described below, these studies vary in their geographic focus, approach, and assumptions. Taken as a whole, however, their results reveal a general pattern: While the construction and operation of ISM facilities generates considerable employment and income in multiple sectors, some locales are better suited than others to capture these benefits. In particular, rural communities with limited commercial infrastructure may lose some of the ISM-generated benefits. This issue is also discussed in section 3.4.4 below.

In 2011, the City of Marshfield and the Centergy economic development corporation hired Economic Modeling Specialists, Inc. (EMSI) to project the impact of a large-scale expansion of sand processing, mining, and rail transport in Wood County (Robison and Nadreau 2012). The proposal included the construction and expansion of four processing plants in Marshfield (at an initial cost of \$65 million) along with associated mines and rail facilities. The projected impacts generated during the construction phase (Year 1) included 480 jobs in construction and utilities (earning \$56,700 on average) plus 136 jobs in other industries (earning \$44,700 on average), for a total of 616 jobs. The projected impacts of long-term operation (Year 8 and beyond) included 486 jobs in sand mining and processing (earning \$73,500 on average), 112 jobs in sand hauling (earning \$81,600 on average), and 331 jobs in other industries (earning \$42,000 on average), for a total of 929 jobs. Since 2012, three of the four processing plants have actually been built. Preliminary data suggest that the initial employment impacts are within range of the early-year projections by EMSI: [www.economicmodeling.com/2015/01/27/a-spot-on-assessment-ems-measures-impact-of-frac-sand-mining-in-wisconsin](http://www.economicmodeling.com/2015/01/27/a-spot-on-assessment-ems-measures-impact-of-frac-sand-mining-in-wisconsin).

In 2012, an economist with University of Wisconsin Extension projected the impact of a hypothetical 30-employee sand mine in Buffalo County, as part of a larger study requested by the Buffalo County Board (Duley and Deller 2012). For the sake of simplicity, this study did not consider the initial impacts of mine construction and assumed all other impacts would accrue to Buffalo County. These included the 30 employees of the sand mine itself (earning \$40,800 on average<sup>37</sup>) plus 11 new jobs in other industries (earning \$24,600 on average) for a total of 41 jobs across the county.

In 2013, an economic consulting firm hired by the Wisconsin Farmers Union, Wisconsin Towns Association, and the Institute for Agriculture and Trade Policy reviewed the Wood County and Buffalo County studies and attributed the wide disparities in their indirect + induced impacts to differences in the two counties’ underlying economic

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<sup>35</sup> As reported in the DNR’s 2012 study on Silica Sand Mining in Wisconsin: <http://dnr.wi.gov/topic/Mines/documents/SilicaSandMiningFinal.pdf>.

<sup>36</sup> A brief overview of the I-O method is provided in the appendix to a University of Wisconsin study on the economic activity of cooperative businesses in the U.S.: <http://reic.uwcc.wisc.edu/implan>

<sup>37</sup> The authors assume that 10 of the 30 mine employees will earn a wage of \$50,000 a year, while the other 20 employees will earn \$30,000 a year.

conditions (Power and Power 2013). The reviewers suggested that the more urbanized Wood County, including the cities of Marshfield and Wisconsin Rapids, “would be expected to support a more extensive business infrastructure [and therefore] capture and hold more of the purchases associated with frac-sand production” than rural Buffalo County (pg. 34). The authors of the University of Wisconsin Extension study similarly noted that Buffalo County “does not have the retail and service businesses [necessary] to capture the economic benefits of industry” (Duley and Deller 2012, pg. 25).

A 2014 study by an economist at the University of Wisconsin-River Falls reflects the challenge rural communities may face in capturing ISM-generated benefits (Kelly 2014). Using the I-O modeling software IMPLAN, the author projected both county and statewide impacts of a proposed sand mine and processing facility in rural Trempealeau County. Construction of the joint facility (estimated to cost \$47.6 million) was projected to generate more jobs outside of Trempealeau County than within it (95 non-local jobs vs. 65 local jobs). Moreover, non-local construction workers were projected to earn considerably more in average annual income (\$75,900 vs. \$39,530 for local workers). During its operational phase, however, the proposed facility was projected to employ more people within Trempealeau County than outside of it (38 local vs. 7 non-local jobs). Yet, while these local workers constitute nearly 85% of ISM employment, they were projected to earn just 57% of the total income (\$51,400 a year, on average). The remaining 43% (a combined \$1.5 million a year) was projected to accrue to the seven non-local workers.<sup>38</sup> Projected employment in all other industries was evenly split (57 local vs. 59 non-local jobs), although here again non-local workers were projected to earn more in average annual income (\$54,070 vs. \$45,240 for local workers).

### **3.4.3 Fiscal Impacts**

The fiscal impacts of industrial sand mining include changes in local and state tax revenues, as well as expenses. Sand mines and processing facilities are taxed at manufacturing rates and are assessed according to land and improvements (utilities, buildings, and infrastructure) plus company property such as silos, excavation equipment, and generators. New facilities are often located on former agricultural lands, generating substantial increases in tax revenues, as farmland is typically assessed at between one and three-hundred dollars per acre, whereas sand mining facilities can range from thousands to tens-of-thousands of dollars per acre. The assessed values of individual ISM facilities can be searched at <https://ww2.revenue.wi.gov/RETRWebRolls/>.

Revenues generated by ISM facilities also include taxes on indirect and induced sales and income, as well as property values. Such projections were included in the economic impact studies for Wood, Buffalo, and Trempealeau Counties (summarized in section 3.4.2). The EMSI study of Wood County projected that the construction of a \$65 million processing plant would generate \$1.5 million a year in county and local taxes in Year 1.

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<sup>38</sup> Disaggregating the projections of ISM employment and earnings into their local and non-local components produces a split whereby non-local workers are projected to earn, on average, \$212,500 a year vs. \$51,400 for local workers. While the assumptions underlying this split are not given, it would appear that either the facility’s proprietors are assumed to be among the 7 non-local workers, or a large portion of the combined non-local income represents annual profits flowing out of the county.

By Year 8, the operation of the facility, together with several associated sand mines and rail facilities constructed in the interim, was projected to generate \$2.6 million a year in county and local taxes (Robison and Nadreau 2012). The University of Wisconsin study of Buffalo County projected that the annual operation of one 30-employee mine would generate a total of \$243,500 a year in county and local taxes (Duley and Deller 2012). The University of Wisconsin-River Falls study of Trempealeau County projected that the construction of a \$47.6 million mining and processing facility would generate \$1.53 million a year in state and local taxes. Full operation of the combined facility was projected to generate \$1.3 million a year in state and local taxes (Kelly 2014).

None of the above projections account for increased expenses for road maintenance (addressed in section 3.2 of this document) or the loss of tax revenues caused by the depreciation of nearby residential property values (section 3.5).

#### **3.4.4 Economic Sustainability**

As part of a temporary moratorium on new ISM facilities issued in 2012, the Buffalo County Board requested that the University of Wisconsin Cooperative Extension Office identify and explore economic issues for decision-makers to consider when evaluating ISM proposals (Duley and Deller 2012). Issues were identified based on a review of the economic literature on mining, feedback from a series of community meetings, and interviews with business owners, as well as a county-level impact analysis (described in section 3.4.2 above). In general, the issues explored by the authors focus on the sustainability of ISM-generated economic benefits. These include the possibility that some of the benefits may be lost from communities that lack commercial infrastructure or are unattractive to employees commuting from other areas; the potential for intermittent mining shutdowns and layoffs in response to market volatility (referred to as “flickering”); and the potential for ISM facilities to negatively impact other local businesses, including those related to tourism, and the amenities that support them.

The potential for ISM-generated benefits to leak from certain communities, particularly those in rural areas, is reflected in the results of the separate impact studies of Buffalo and Trempealeau Counties (described in section 3.4.2 above). Similarly, the potential for mining operations and their associated businesses to “flicker” in response to fluctuations in oil and gas prices is reflected in information on business closings and mass layoffs reported to the Department of Workforce Development (DWD). Following a decline in oil prices that began in 2014, layoffs were reported at three ISM facilities and one sand hauling company in 2015, affecting nearly 150 workers. Reports for 2016 included 124 layoffs across 10 sand mining facilities. (For more information see the DWD website: <http://worknet.wisconsin.gov/worknet/downloads.aspx?menuselection=da&pgm=pcml>.)

While there have been no empirical studies to date on the negative impacts of sand mining on local businesses and amenities, a number of studies have shown that counties with higher concentrations of surface mining have lower rates of population growth than counties that are otherwise similar (e.g., Deller and Schreiber 2012). These findings suggest that “disamenities” associated with surface mining, such as noise, dust and truck traffic, may make communities with high concentrations of mines less desirable to reside in, or relocate to. Interviews with people living next to sand mines, processing plants, and hauling routes in several townships in Barron and Chippewa Counties provide anecdotal

evidence that this may be the case (Pearson 2016). In response to a general lack of data, the authors of a study on the potential impacts of ISM on “amenity-rich” communities in Pepin County recommended that future investigations include surveys of business owners, real estate professionals, and residents (Parker and Phaneuf 2013).

Expanding on these issues, a 2013 report commissioned by the Wisconsin Farmers Union, Wisconsin Towns Association, and the Institute for Agriculture and Trade Policy evaluated whether ISM can provide “the basis for sustained economic vitality” in west-central Wisconsin (Power and Power 2013, pg. 11). Noting that most of the region’s recent economic growth has been in medical- and other professional services, as opposed to land-based exports, the authors contend that the overall impact of ISM will be comparatively small, while potentially detrimental to the social, cultural, and natural amenities that attract and retain a variety of businesses, entrepreneurs, and professionals. Citing historical trends among other types of mining in Wisconsin and elsewhere, the authors further contend that communities that become heavily dependent on ISM will be vulnerable to “boom-and-bust” cycles, whereby the eventual cessation of mining activity (whether due to market forces or local depletion) will leave their economies in worse condition than they were prior to mining.

By contrast, a 2015 policy paper from the Heartland Institute suggests that ISM provides rural counties in western Wisconsin, which are heavily-dependent on agriculture, with an opportunity to diversify their economies while having little or no measurable effect on either agriculture or tourism (Orr and Krumenacher 2015). The authors contend that economic comparisons between industrial sand mining and other types of mining are problematic based on the fact that silica sand reserves are more abundant and less spatially-concentrated, and that even those counties with the most sand mines in Wisconsin are far less dependent on mining than their counterparts in the coal country of Appalachia or the Iron Range of Minnesota. As noted by the authors of the Buffalo County impact study, most research on the boom-and-bust phenomenon has focused on large mining operations located in remote areas, whereas sand mining in western Wisconsin is characterized by relatively small, dispersed operations (Duley and Deller 2012).

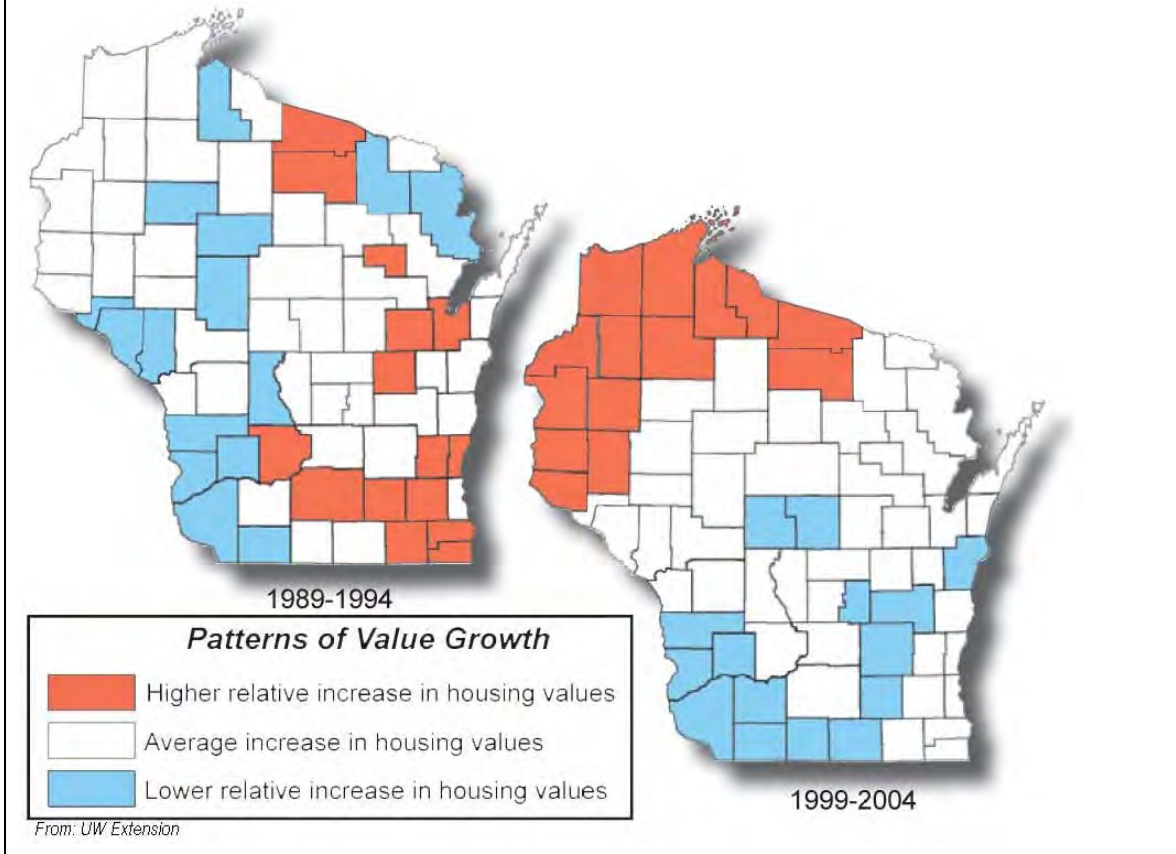
### **3.5 Property Values**

According to the Wisconsin Department of Revenue, the total assessed value of properties with industrial sand mines was \$455,236,900 in 2015. These properties cover over 8,000 acres of land, the total value of which is \$66.2 million (\$8,255 per acre), not including improvements. Barron County has the highest total property value for industrial sand mines at \$105 million, including 13 facilities on approximately 1,600 acres (see section 3.4). Among individual properties, EOG’s processing facility in Chippewa Falls has the highest assessed value, at nearly \$51 million in 2015.

Wisconsin’s trends in residential property are generally consistent with national trends, including increases associated with larger house sizes. Between 1940 and 2000, median residential property values in Wisconsin increased from \$33,600 to \$112,000. In certain areas of the state, a growing demand for vacation homes has caused property values to rise more rapidly than typical rural areas (University of Wisconsin Extension 2009). Figure 3-3 shows the recent geographical shift in increasing housing values from the eastern half of the state to the northwest.



**Figure 3-3** Patterns of housing value growth  
(Source: <http://learningstore.uwex.edu/Assets/pdfs/G3995-05.pdf>)



To date, only one study has investigated the impact of ISM on residential property values in Wisconsin (Parker and Phaneuf 2013). Citing studies from other parts of the country on the effect of increased traffic, noise, air pollution and other externalities commonly associated with ISM, the authors concluded that the establishment of ISM facilities in the vicinity of Lake Pepin (along the Mississippi River) would lower the property values in the amenity-rich towns of Pepin and Stockholm. The lack of data on ISM-specific impacts prevented the researchers from projecting the magnitude of the impact in these communities; however, they noted that the results of the separate studies they reviewed, involving high-traffic roadways, rail lines, landfills, and other “locally-undesirable land uses,” showed that nearby property values typically decrease by 3% to 8%.

These studies used a method known as hedonic evaluation to estimate the impact of “disamenities” on property values. Using data on sale prices across a given area, a hedonic model can estimate the percent change in property values resulting from changes in some environmental condition, controlling for variables such as house size, distance to retail, the performance of nearby schools, etc. Using this method, Hite (2006) evaluated the effect of 250-acre gravel mine in Delaware County, Ohio on the value of residential properties within five miles of the mine. Controlling for other attributes, property values were found to increase by 1% with each 10% increase in distance from the mine. Erickcek (2006) used these findings to simulate the impact of a proposed gravel mine in



Kalamazoo County, Michigan, predicting that the value of 1,400 properties within three miles of the mine would decline by a total of \$31.5 million. This result was not validated, however, since the mine was never constructed. In the absence of detailed case studies, it is difficult to estimate or predict the net effect of ISM facilities on the overall property value of a given jurisdiction.

### 3.6 Population

Of the 45 Wisconsin counties with sandstone deposits, 21 have industrial sand mining facilities. Of these, five have more than 60% of the state’s ISM facilities: Barron, Trempealeau, Jackson, Wood, and Chippewa. Table 3-5 lists the change in population between 2000 and 2014 among these counties, ranging from –1.5% (Wood County) to +2.3% (Trempealeau County). During the same period, the total population of Wisconsin increased by 1.2%. Based on historical data from counties that experienced booms in other types of mining, Power and Power (2013) suggest that the current expansion in ISM will have little or no effect on population trends. Deller and Schreiber (2012) analyzed data across all non-metropolitan counties of the U.S. and found that those counties that are more heavily dependent on non-metallic mining (in general, not just ISM) have had lower rates of population growth, on average, than counties that are otherwise similar.

**Table 3-5** *Top counties with active industrial sand mines*

<b>County</b>	<b>Number of Operating Industrial Sand Facilities</b>	<b>Estimated 2014 population</b>	<b>% Change in population 2010 to 2014</b>
Barron	17	45,455	- 0.9
Trempealeau	12	29,509	+ 2.3
Jackson	11	20,652	+1.0
Wood	9	73,608	- 1.5
Chippewa	8	63,460	+1.6
Total/Ave	57	232,684	+0.5

Source: ISM spreadsheet download DNR website: <http://dnr.wi.gov/topic/Mines/ISMMap.html> (population data from U.S. Census Bureau)

In general, stand-alone sand mines and those with onsite processing and rail facilities have tended to be sited in rural areas. Conversely, stand-alone sand processing and rail facilities are more commonly located in or near more densely-populated areas. As the number of both types of facilities has increased, potentially affected residents and local authorities have become interested in the impacts that proposed operations may have on local development and population growth. A number of counties, cities, and towns have developed ISM ordinances with a range of restrictions and requirements. In 2013, the Wisconsin Counties Association developed a Best Practices Handbook to provide guidance for this process.<sup>39</sup> Some individual counties and towns have developed their own recommendations and guidelines, as have several health studies (see references in section 3.8, Human Health and Safety).

<sup>39</sup> <http://dnr.wi.gov/topic/EIA/documents/ISMSA/FracSandHandbookWCA.pdf>

### 3.7 Tourism

Little research has been conducted on the potential impacts of industrial sand mining on tourism. Duley and Deller (2012) of the University of Wisconsin Cooperative Extension including a section on potential impacts on current businesses as part of their study on the economics of sand mining in Buffalo County. The authors reported that the county has a small but steadily growing tourism sector along with a strong agriculture industry. Based on community meetings and interviews with a sample of business owners, concerns were raised about the potential for expanded sand mining and increased truck traffic to negatively impact tourism. A study by the Heartland Institute also considered potential impacts on tourism, such as increased traffic, noise and lost scenery. However, the authors reported that they could find no tourism data or other empirical evidence supporting these concerns (Orr and Krumenacher 2015).

**Table 3-6** Statewide and county tourism statistics  
 (source: Wisconsin Department of Tourism: County Total Impact (Excel),  
<http://industry.travelwisconsin.com/research/economic-impact>)

County	Direct Visitor Spending			Total Business Sales			Employment			Total Labor Income			State and Local Taxes		
	Millions \$		%	Millions \$		%	Total		%	Millions \$		%	Millions \$		%
	2013	2014	Change	2013	2014	Change	2013	2014	Change	2013	2014	Change	2013	2014	Change
Wisconsin	10,840	11,419	5.34	17,517	18,475	5.47	185,495	187,643	1.16	4,657	4,829	3.70	1,356	1,412	4.13
Barron	87.7	94.7	8.05	131.1	140.6	7.26	1,357	1,407	3.68	28.3	30.4	7.30	10.0	10.7	6.76
Buffalo	10.4	10.8	3.81	17.7	18.5	4.58	185	189	2.16	3.5	3.7	5.91	1.2	1.3	3.02
Burnett	21.4	22.4	4.45	31.8	33.3	4.85	368	366	-0.54	6.2	6.6	5.78	2.8	2.9	2.82
Chippewa	77.5	77.6	0.12	124.3	127.0	2.21	1,329	1,313	-1.20	28.5	29.3	2.97	8.8	8.9	0.67
Clark	26.4	27.1	2.98	45.5	47.3	4.11	353	356	0.85	6.2	6.5	4.97	2.8	2.9	2.76
Columbia	110.5	115.4	4.39	161.8	169.5	4.80	1,724	1,700	-1.39	33.6	33.9	0.79	13.4	13.6	1.74
Crawford	39.1	41.2	5.36	56.4	59.4	5.46	713	714	0.14	11.3	11.7	3.60	5.4	5.5	2.77
Dunn	42.6	46.4	8.80	73.6	79.1	7.49	837	864	3.23	16.2	17.2	5.91	5.6	6.0	6.50
Eau Claire	195.7	214.8	9.75	320.0	346.2	8.16	3,972	4,055	2.09	87.0	90.9	4.43	25.5	27.1	6.58
Green Lake	34.7	35.3	1.59	52.4	54.0	2.97	753	763	1.33	14.3	15.3	6.90	5.2	5.4	3.41
Jackson	32.2	36.1	11.81	48.8	53.6	9.73	532	545	2.44	8.7	9.2	5.57	4.2	4.5	7.04
Monroe	75.3	79.6	5.70	114.4	120.9	5.69	1,198	1,203	0.42	23.8	24.6	3.35	9.5	9.8	4.08
Outagamie	300.0	315.8	5.26	521.7	550.1	5.44	6,275	6,287	0.19	147.9	154.0	4.11	39.4	40.7	3.22
Pepin	5.4	5.7	5.24	9.6	10.1	5.43	100	101	1.00	1.8	1.8	1.71	0.7	0.7	3.53
Pierce	24.5	25.0	1.89	45.4	47.0	3.63	409	416	1.71	7.7	8.2	6.00	2.9	3.0	2.63
Portage	104.3	111.6	7.07	186.6	198.7	6.45	2,041	2,073	1.57	40.06	42.4	4.54	14.0	14.7	4.75
Rusk	24.5	26.7	8.66	36.1	38.9	7.70	410	416	1.46	7.7	7.9	3.11	3.0	3.2	5.84
St. Croix	88.0	93.8	6.54	148.8	158.0	6.18	1,691	1,748	3.37	35.1	38.0	8.32	11.2	12.0	6.50
Trempealeau	22.2	24.2	8.65	44.2	47.4	7.17	365	371	1.64	7.2	7.3	1.14	2.6	2.8	6.66
Waupaca	81.7	87.4	6.98	125.8	134.0	6.52	1,266	1,303	2.92	22.9	23.9	4.14	9.9	10.5	5.56
Wood	81.5	86.6	6.28	157.0	166.4	5.99	2,093	2,166	3.49	52.9	57.3	8.40	10.6	11.1	4.69

Data from the Wisconsin Department of Tourism (Table 3-6) shows overall tourism up in all counties across the state through 2014, including Buffalo County. Four of the five

counties containing the majority of active ISM facilities (Barron, Jackson, Trempealeau, and Wood) experienced tourism increases above the state average.

## **3.8 Human Health and Safety**

### **3.8.1 Air Quality**

Questions about public air quality have been raised by those living near industrial sand mines. Section 2.1.2 of this document addresses sources of air emissions at mining facilities. Multiple studies have been conducted to determine what if any concern there may be with respect to air quality outside of mines. A health impact assessment (HIA) conducted by the Institute for Wisconsin's Health, Inc. (2016) looked at these studies in depth (see: <http://www.pewtrusts.org/en/multimedia/data-visualizations/2015/hia-map/state/wisconsin/silica-sand-mining-in-western-wisconsin>). Section 2.1.9 of this document also addresses sand mining impacts on air quality and health.

### **3.8.2 Water Quality**

Questions about public water quality (surface and groundwater) have also been raised by those living near industrial sand mines. Concerns about polyacrylamides used to treat process wash water as well as the potential for metal migration in the materials separated from the sand have been presented by the public as well. Section 2.4.2 of this document addresses pollutant discharges and the potential for impacts to water resources and 2.3.8 addresses polyacrylamides. Section 2.3.7 addresses the potential for metal migration to occur where naturally occurring concentrations of metals occur. Several independent studies are just getting underway to look at certain background levels of metals, to measure groundwater and surface water for metals, and ascertain whether reclamation practices affect the potential impacts. For more information about these studies, see section 5.2 (Non Regulatory Activities). The HIA conducted by the Institute for Wisconsin's Health (2016) looked at the potential impacts of polymers as part of their review (see: <http://www.pewtrusts.org/en/multimedia/data-visualizations/2015/hia-map/state/wisconsin/silica-sand-mining-in-western-wisconsin>).

### **3.8.3 Worker Safety**

#### **Federal Mine Safety and Health Administration**

Mineworker safety has been a part of the federal regulations since 1978. The Mine Safety and Health Administration (MSHA) was formed to reduce illnesses, injuries, and death due to mine related activities in the US. According to MSHA, mine-related deaths peaked in 1979 with over 250 deaths nationally. By 2014, the death toll had dropped to less than 50, and was further reduced in 2015 with 28 deaths, the lowest in recorded history. Of the reported deaths, 11 were in coal mining and none were in Wisconsin.<sup>40</sup> A wide range of topics on mineworker safety can be found at [www.msha.gov/S&Htopics.htm](http://www.msha.gov/S&Htopics.htm).

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<sup>40</sup> <http://www.msha.gov/media/press/2016/nr-0105-mining-deaths-drop-to-new-lows.asp>;  
<http://www.msha.gov/MSHAINFO/FactSheets/MSHAFCT10.asp>

With respect to mineworker health, MSHA's illness prevention focuses on environmental conditions, as well as typical work place hazards similar to OSHA standards.<sup>41</sup>

MSHA provides extensive information on hazards of dust inhalation which includes silica dust. The following are excerpts from the MSHA website:<sup>42</sup>

*The main hazard of exposure to mineral dusts is pneumoconiosis. When very fine dust particles are breathed, they can accumulate in the lungs, and this can result in disease. Tissue reactions such as fibrosis, or scarring, of lung tissue can result from the inhalation of certain dusts.*

*Respirable dust consists of particles which are very fine in size, such that they can enter the inner most parts of the lungs. Respirable dust is not visible to the naked eye. The hazard of breathing mineral dust depends greatly on the composition of the dust, the concentration, particle size and duration of exposure.*

*Personal respirable dust sampling is carried out to determine the concentration of respirable dust in the breathing zone of the worker.*

*MSHA regulations require that exposures for airborne contaminants including respirable dust and total dust be controlled insofar as feasible, by prevention of contamination, removal by exhaust ventilation, or by dilution with uncontaminated air. Personal respirator protection is not acceptable except when engineering controls are being developed or for occasional entry into hazardous atmospheres to perform maintenance or investigation.*

### **Wisconsin Department of Safety and Professional Services**

Additional work place regulations in Wisconsin are regulated by the Department of Safety and Professional Services (DSPS). Chapter SPS 308, Wis. Adm. Code contains provisions for operations and safety requirements on mine, pits, and quarries, including industrial sand mines.<sup>43</sup> DSPS also provides worker safety training.<sup>44</sup>

In addition to meeting DSPS operation requirements, DSPS also regulates blasting activities under the state's explosives code Ch. SPS 307, Wis. Adm. Code.<sup>45</sup>

SPS 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 industrial sand mine sites

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<sup>41</sup> [http://www.msha.gov/Illness\\_Prevention/minetype/surfnm.htm](http://www.msha.gov/Illness_Prevention/minetype/surfnm.htm)

<sup>42</sup> [https://arlweb.msha.gov/illness\\_prevention/healthtopics/HHICM06.HTM](https://arlweb.msha.gov/illness_prevention/healthtopics/HHICM06.HTM)

<sup>43</sup>

[http://docs.legis.wisconsin.gov/code/admin\\_code/sps/safety\\_and\\_buildings\\_and\\_environment/301\\_319/308](http://docs.legis.wisconsin.gov/code/admin_code/sps/safety_and_buildings_and_environment/301_319/308)

<sup>44</sup> <http://dsps.wi.gov/Programs/Industry-Services/Industry-Services-Programs/Mine-Safety/>

<sup>45</sup> <http://dsps.wi.gov/Programs/Industry-Services/Industry-Services-Programs/Explosives/>

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

### **3.9 Quality of Life**

A community or region's quality of life is often conceived of as a combination of factors such as the quality of its schools, employment opportunities and health care, as well as recreational, cultural and scenic amenities centered around natural features like rivers and forests. The potential loss of such amenities was a contentious issue during the 2013 permitting of the Pattison Sand Bridgeport mine in Crawford County, along the Wisconsin River. The Lower Wisconsin State Riverway (LWSR) Board denied permits to mine certain areas of the property. This decision, however, was challenged and overturned in a court ruling that found that the Board stepped outside its legal authorities. Information about the process can be found on the LWSR website (<http://lwr.state.wi.us/section.asp?linkid=1793&locid=50>).

#### **3.9.1 Light**

Impacts of the industrial sand mining may include light disturbance from night mining. Regulation of impacts due to light from nighttime operations is not under the DNR jurisdiction. Several counties and towns have chosen to adopt ordinances to restrict hours of operations to limit impacts of light disturbance. The Institute for Wisconsin's Health, Inc. (2016) also addressed impacts of light from operations in its Health Impact Assessment (HIA).<sup>46</sup>

#### **3.9.2 Noise**

Impacts of the industry may include noise from mining and transport operations. Regulation of impacts due to noise from ISM operations is not under DNR's jurisdiction. Some counties and towns have adopted ordinances addressing hours of operations and decibel limits at the perimeter of facilities to limit impacts of noise disturbance. The Institute for Wisconsin's Health, Inc. (2016) also addressed noise impacts in its HIA.

Blasting, which is regulated by the DSPS, lists provisions where noise is concerned and allows for additional local controls (Ref SPS 307 SubCh IV).<sup>47</sup>

### **3.10 Archaeological, Historic and Cultural Resources**

#### **3.10.1 Regulation**

Under provisions of Wisconsin statutes, state agencies (including the DNR) 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 that may be adversely impacted by agency actions such as permitting. Protection of these

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<sup>46</sup> <http://www.pewtrusts.org/en/multimedia/data-visualizations/2015/hia-map/state/wisconsin/silica-sand-mining-in-western-wisconsin>

<sup>47</sup> [http://docs.legis.wisconsin.gov/code/admin\\_code/sps/safety\\_and\\_buildings\\_and\\_environment/301\\_319/307](http://docs.legis.wisconsin.gov/code/admin_code/sps/safety_and_buildings_and_environment/301_319/307)

resources may be accomplished through avoidance or required field investigations (as directed by DNR after internal review).

Human burial sites, whether they occur on public or private lands (and irrespective of state agency actions), are afforded additional protection by WHS from unauthorized disturbance under separate provisions of Wisconsin statutes.

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

### **3.10.2 Tribal Lands**

The DNR is committed to government-to-government relations with the sovereign Tribal Nations located within the state. Wisconsin has eleven federally recognized Tribes with elected or appointed Tribal governments. Protocol, policies and Executive Order #39 are followed and revisited for consistency and accuracy purposes. The DNR maintains a Tribal Liaison to ensure staff are informed of their unique relationship and partnerships with the Tribes, to provide guidance to programs, and to support requests and relay information between the State and the Tribes.

Executive Order #39 affirms the government-to-government relationship between the State of Wisconsin and Indian Tribal Governments, allowing for frequent and high-level coordination. The DNR strives to work proactively with the Tribes on environmental concerns, fish and wildlife management, and other natural resource matters. A consultation policy exists to guide the DNR on respectful and cooperative communication designed to occur prior to a decision being made or an action being taken. The DNR recognizes that each Tribe has their own laws and ordinances for both on-reservation and off-reservation concerns. This creates a unique legal relationship as affirmed in federal law, state law, court decisions and treaties.

Several Tribes have raised concerns with the DNR regarding industrial sand mining, including the location of mine sites, air and water pollution, and concerns brought to them by tribal members who live near mine sites. Dust and noise are common complaints. As sovereign nations, each Tribe has the ability to regulate their tribal lands. When an activity such as industrial sand mining is located on non-tribal lands, however, Tribes have limited influence on the activity or its location. While Tribal governments can request formal consultation with the DNR, such consultation is not required at the local government level where such decisions are made.

### **3.10.3 Ethics and Community Relations**

The increase in ISM in Wisconsin has led to an increase in disputes between property owners near proposed facilities and their local officials. In addition to environmental and economic considerations, disputes have centered on ethical issues, including perceived conflicts of interest and a sense that local residents have little or no influence (Pearson 2013). In 2013, the Wisconsin Counties Association assembled a Frac Sand Task Force to develop recommendations regarding counties' role in regulating ISM, including ethical and procedural considerations (WCA 2013). The Task Force noted that both common law and State Statute 946.13 prohibit public officials from engaging in official activities that

produce a private benefit, while the state ethics code for local officials (under State Statute 19) lists specific prohibitions and enforcement penalties. The Task Force, however, recommended that local governments go further, stating that:

*Counties should carefully review any possible conflicts of interest that may involve decision makers at any level of the decision making process. Any appearance of impropriety, regardless of whether it truly exists, will have the effect of eroding public confidence... (WCA 2013, pg. 16).*

Established in 2012, the Wisconsin Industrial Sand Association (WISA) has its own Code of Conduct ([www.wisconsinsand.org/code-of-conduct](http://www.wisconsinsand.org/code-of-conduct)) including Guiding Principles and a series of Performance Standards covering several topics. For example, under “Environmental,” WISA members are expected to be Tier I participants in the DNR’s Green Tier program (see <http://dnr.wi.gov/topic/GreenTier/Participants> and section 5.2.1 of this document). Under “Community,” WISA members are expected to adhere to the following standards:

- Dialog with stakeholders, and action as appropriate, to minimize the community impacts of industrial sand operations, e.g., tangible efforts to reduce noise, light pollution, blasting impacts, visual impacts, impact of truck and rail traffic;
- Establish a program to communicate relevant information concerning Wisconsin facilities to local communities;
- Engage local communities to identify and promote local community education projects, e.g., facility open houses, tours;
- Develop and manage wildlife habitat;
- Engage the local community to identify and promote local environmental projects.

## 4 Regulatory Framework

The following information is a brief overview of regulations that may apply to ISM at the various levels of government in the State of Wisconsin.

### 4.1 Local

Local governments play a central role in regulating industrial sand mining. Part of this role involves the review and approval of mine reclamation plans and permits by county governments (discussed in section 4.1.6 below). More broadly, local governments can address ISM through comprehensive planning and land-use regulation (i.e., zoning). In Wisconsin, the authority to regulate land use lies not with the DNR, or other state agencies, but rather with local units of government. Additional authorities and regulatory tools include shoreland zoning, floodplain ordinances, annexation, moratoriums, licensing ordinances, developer's agreements, and road use agreements.

A number of informational resources and tools have been developed to help local governments address ISM through planning, zoning, and other types of local ordinances and agreements. The Center for Land Use Education (2012) at UW-Stevens Point has produced a series of papers on planning and zoning for sand mining:

- [www.uwsp.edu/cnr-ap/clue/Documents/Mining/FracSand1.pdf](http://www.uwsp.edu/cnr-ap/clue/Documents/Mining/FracSand1.pdf)
- [www.uwsp.edu/cnr-ap/clue/Documents/Mining/FracSand2.pdf](http://www.uwsp.edu/cnr-ap/clue/Documents/Mining/FracSand2.pdf)
- [www.uwsp.edu/cnr-ap/clue/Documents/Mining/FracSand3.pdf](http://www.uwsp.edu/cnr-ap/clue/Documents/Mining/FracSand3.pdf)
- [www.uwsp.edu/cnr-ap/clue/Documents/Mining/FracSand4.pdf](http://www.uwsp.edu/cnr-ap/clue/Documents/Mining/FracSand4.pdf)

The Wisconsin Counties Association (2013) formed a Frac Sand Task Force to provide county officials with guidance on the practical and legal considerations of zoning, local agreements and moratoria, as well as the procedural and ethical issues surrounding ISM regulation in general. The Task Force's Best Practices Handbook can be accessed from: <http://dnr.wi.gov/topic/EIA/documents/ISMSA/FracSandHandbookWCA.pdf>.

In Minnesota, the Environmental Quality Board (2014) published "Tools to Assist Local Governments in Planning for and Regulating Silica Sand Projects" (see [https://www.eqb.state.mn.us/sites/default/files/documents/Tools for Local Govt approved March 19 with Errata.pdf](https://www.eqb.state.mn.us/sites/default/files/documents/Tools%20for%20Local%20Govt%20approved%20March%2019%20with%20Errata.pdf), as well as section 4.4 of this document).

#### 4.1.1 Planning

Cities, villages, counties and towns that choose to adopt general zoning ordinances (see section 4.1.2 below) must develop comprehensive plans that among other things identify desired land uses for future development and redevelopment. Prepared by a planning commission or committee – with public input – and adopted by the governing body, a jurisdiction's comprehensive plan provides guidance for its zoning ordinance, which in turn regulates land use. Comprehensive plans must include objectives, goals, policies, maps, and programs across nine or more "elements." The nine required elements include:

1. Issues and Opportunities
2. Housing
3. Transportation



4. Utilities and Community Facilities
5. Agricultural, Natural and Cultural Resources
6. Economic Development
7. Intergovernmental Cooperation
8. Land Use
9. Implementation

Non-metallic mining may be addressed in multiple plan elements, including Transportation, Economic Development and Land Use, but is most commonly highlighted within the combined Agricultural, Natural and Cultural Resources Element, including maps of mineral resources and possible mining locations. Extensive guidance on the development of comprehensive plans has been developed by the Wisconsin Department of Administration's Division of Intergovernmental Relations ([www.doa.state.wi.us/Divisions/Intergovernmental-Relations/Comprehensive-Planning](http://www.doa.state.wi.us/Divisions/Intergovernmental-Relations/Comprehensive-Planning)) and the Center for Land Use Education at UW-Stevens Point (see: [www.uwsp.edu/cnr-ap/clue/Pages/publications-resources/ComprehensivePlanning.aspx](http://www.uwsp.edu/cnr-ap/clue/Pages/publications-resources/ComprehensivePlanning.aspx)).

#### 4.1.2 Zoning

Zoning refers to the exercise of local authority to control how land is used and may be developed within different areas of a city, village, county or town – in order to balance individual property rights with the public's right to a safe and healthy community. Zoning ordinances identify districts (i.e., residential, agricultural, commercial, and industrial) and the specific types of use permitted within each district. According to the Zoning Board Handbook (Markham and Roberts 2006, pg. 7):

*Generally, two categories of allowable uses are listed for each zoning district: permitted uses and conditional uses. **Permitted uses** are allowed as a matter of right in all locations in a zoning district and may be authorized by the zoning administrator or building inspector with a simple permit. Authorization is nondiscretionary provided the project complies with general standards for the zoning district, any overlay district or design standards, and related building or construction codes. **Conditional uses** [including special exemptions] are listed in the zoning ordinance for each district but are subject to an additional layer of scrutiny... [Such] uses are authorized on a discretionary basis, meaning they are only authorized if found to be compatible with neighboring land uses, if they can be tailored to meet the limitations of the site, and if they do not violate the objectives of the zoning ordinance.*

If non-metallic mining is not listed as a permitted or conditional use within a particular district, it is prohibited and would require an amendment to the zoning ordinance following all required approval processes. If, however, non-metallic mining is listed as a conditional use, property owners may apply for conditional use permits (CUPs) for specific mining operations. CUPs allow local governments to consider whether or not proposed operations meet the express standards of their zoning ordinances, and to attach specific conditions, such as restrictions on truck traffic, blasting, lighting, hours of operation, noise levels, and dust. The Center for Land Use Education's (2012) paper on Planning and Zoning for "Frac Sand" Mining includes examples of zoning ordinances, amendments, and CUPs that address industrial sand mining.

Under s. 66.1001(3), Wis. Stats., local zoning ordinances must be consistent with their jurisdictions' comprehensive plans (see section 4.1.1 above). If the zoning ordinance or related zoning decisions are not consistent with the plan, resulting actions may be subject to legal challenge.

### **4.1.3 Shoreland**

Shoreland zoning ordinances, adopted by each county in Wisconsin, provide development standards for shorelands in unincorporated areas to limit impacts on water quality, fish and wildlife habitat, recreation, navigation and natural scenic beauty. Chapter 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. While counties' development standards may vary, a permit or variance is generally required for any structure within the shoreland zone; for the removal of shoreline vegetation that exceeds certain limits; or for filling, grading, lagooning, dredging, ditching or excavating within a shoreland zone. Any of these may apply to ISM facilities developed near public waterways. (For more information, see: <http://dnr.wi.gov/topic/shorelandzoning>.)

### **4.1.4 Floodplain**

A floodplain is an area of low-lying ground adjacent to a stream, river, or flowage that is subject to flooding. Development within a floodplain is managed through local floodplain ordinances, the enforcement of which is the responsibility of local officials. For most communities, the responsible official is the Zoning Administrator. All local floodplain ordinances must meet the minimum requirements of the National Flood Insurance Program (NFIP) found in 44 CFR 59-72 and Ch. NR 116, Wis. Adm. Code. Communities that do not adequately enforce the local floodplain ordinance can be penalized by FEMA through probation or suspension from the NFIP. Violations of the minimum requirements of NR 116 can result in enforcement action by the DNR.

Wisconsin floodplain ordinances include the NFIP minimums along with higher state standards to ensure the health and safety of people living in or near the floodplain. These higher standards include the prohibition of residential, commercial or industrial structures in the floodway and the creation of flood storage districts, as well as the following requirements: that the lowest floor a structure be elevated on fill two feet or more above the regional flood elevation (basement floor can be at regional flood elevation); that fill must be one foot or more above the regional flood elevation; that structures must have dryland access. (For more information, see: <http://dnr.wi.gov/topic/floodplains>).

Industrial sand mines developing infrastructure within mapped floodplains can fall under floodplain regulations. This can include the placement of culverts or bridges over streams for access to mine sites or processing plants, as well as stream realignments for developing rail load-out facilities. The owner must demonstrate that these activities do not impact base flood elevation (100-year flood elevation) of the waterbody. If their proposal does raise or lower the base flood elevation, the facility must purchase flood

easements, submit a letter of map revision to FEMA for approval, and the local authority must adopt the revised mapped floodplain in their ordinance.

#### **4.1.5 Reclamation**

As authorized by Ch. 295, Wis. Stats., all counties in the state of Wisconsin are required under Ch. NR 135, Wis. Adm. Code to implement a nonmetallic mining reclamation permit program. The purpose of the program is to ensure that mining sites are reclaimed to a post-mining land use. This program includes the adoption of a nonmetallic mining ordinance and the administration of the reclamation program including permitting, collection of fees, mine inspection, and management of financial assurance. The administration of the programs is conducted by either county or local regulatory authorities (RAs). These RAs are designated under the authority of NR 135, and are regulated by the DNR's Nonmetallic Mining Program. DNR audits the delegated regulatory authority to ensure that standards are being met.

The DNR's Nonmetallic Mining Program is responsible for ensuring consistent statewide implementation of nonmetallic mining reclamation requirements and compliance with uniform statewide reclamation standards. A stakeholder group, the [Nonmetallic Mining Advisory Committee](#), advises the DNR on its administration of the statewide reclamation program, and consults with the DNR on the reasonableness of fees with respect to the administrative expenses incurred by local reclamation programs. A report on revenues and expenses is submitted periodically to the Wisconsin Natural Resources Board. (For more information, see: <http://dnr.wi.gov/topic/Mines/Nonmetallic.html>).

#### **4.1.6 Annexation**

Annexation transfers territory from unincorporated towns to cities and villages. Landowners seek to annex property to obtain sewer and water or other city or village services not available in the town, but they may annex for other reasons as well. Wisconsin statutes authorize a number of different Annexation Methods. Annexations are sometimes contentious; however, annexations can also be a catalyst to bring communities together to talk about disagreements, shared goals and visions for the area, and future intergovernmental cooperation such as Boundary Agreements. The Department of Administration (DOA) maintains a Roster of Trained Mediators who help communities resolve disputes and can facilitate boundary agreement discussions. (For more information, see: <http://doa.wi.gov/Divisions/Intergovernmental-Relations/Municipal-Boundary-Review>.)

An industrial sand facility may seek annexation if there is a moratorium in place in the county or town that the facility is proposed in. They may also seek annexation, because the city or town have different operational requirements under their ordinances. A city or village may see annexation as an opportunity to increase their tax base, by having the industry within their boundaries.

#### **4.1.7 Moratoriums**

Under secs. 62.23(7)(da) and 66.1002, Wis. Stats., cities, villages and towns have the ability to enact, by ordinance, a development moratorium in order to prevent the development of industrial sand mines for a set period of time, while the unit of

government works to prepare or revise its comprehensive plan and/or zoning ordinance, in response to new or changing circumstances. The Wisconsin Towns Association has developed a sample moratorium ordinance for non-metallic mining, which is available at: [http://wisctowns.com/uploads/ckfiles/files/Moratorium Ordinance for Nonmetallic Mining.pdf](http://wisctowns.com/uploads/ckfiles/files/Moratorium_Ordinance_for_Nonmetallic_Mining.pdf).

According to the Wisconsin Counties Association's Frac Sand Task Force (WCA 2013, pg. 46), counties have "the implied authority to adopt development moratoria and more specific statutory authority to do so under Section 59.69 of the Wisconsin Statutes" (see <http://dnr.wi.gov/topic/EIA/documents/ISMSA/FracSandHandbookWCA.pdf>) To avoid legal challenge, the Task Force suggests the following best practice:

*When counties consider enacting a moratorium on nonmetallic mining, they must also determine whether the temporary freeze on mining is of a reasonable duration. Factors that may be considered in determining the length of the moratorium may include the number of mine applications pending, studies to be conducted, specific community and environmental concerns, and the time it may take to draft or amend existing zoning ordinances. In most circumstances, a moratorium should last no longer than six (6) months with the possibility of a short extension in the event further evaluation is necessary. (WCA 2013, pg. 48)*

#### **4.1.8 Other Local Ordinances and Agreements**

Additional means have been used by local governments to address industrial sand mining within their jurisdictions. These include licensing ordinances, development agreements and road upgrade maintenance agreements (RUMAs). Licensing ordinances regulate allowable activities associated with the use of property without regard to the location of the property. Licensing ordinances may be used by counties to regulate industrial sand mining in the absence of zoning. The Wisconsin Counties Association Frac Sand Task Force (2013, pg. 39) does not recommend this approach outside of the following areas: "financial assurance, restrictions on hours of operation, restrictions on truck routes, reclamation plan[s], restrictions on truck and traffic volume into and out of the mine site, restrictions to protect groundwater, wells, and to control air emission and dust."

Development agreements are contracts between local units of government and land owners or developers. These agreements can be used to set bonding requirements for ISM operations and place limitations on local nuisances such as noise and blasting. While there is no statutory process for municipalities or counties to follow when entering into development agreements, it is important that they follow all applicable local rules and enable public involvement. Examples of development agreements are included in The Center for Land Use Education's (2012) paper on Planning and Zoning for "Frac Sand." Similar to development agreements, RUMAs are contracts between local governments and private trucking operations that allow for mitigation of the roadway impacts created by a mining facility's trucking operations (see section 3.2.1 of this document).

## **4.2 State of Wisconsin**

### **4.2.1 Department of Natural Resources**

The DNR is the primary state agency responsible for regulating the environmental impacts that the ISM industry may have. Section 2 of this document discusses all of the applicable regulations in detail.

#### **Enforcement**

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 stormwater 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.

Enforcement options for the agency on violations can include use of the DNR's stepped enforcement process, the issuance of civil citations, or a combination of the two. The list of DNR regulations, below, describes DNR enforcement authority. A list of enforcement cases from November 2011 through January 2016 is provided in Table 4-1.

**Table 4-1 Sand mine enforcement cases (November 30, 2011 - January 27, 2016)**

Company	Program Violated	NOV/EC/Citation/Referral	Date Case Accepted	Status of Enforcement
Bear Creek Cranberry	Water	NOV/EC/Citation	03/30/2012	Closed
Chieftain Sand and Proppant	Water	NOV/EC	06/20/2012	Closed
Chippewa Sand	Water	NOV/EC/Citation	06/19/2012	Closed
Copper Road Minerals	Water	NOV/EC/Citation	04/25/2012	Open
Croell Redi-Mix	Water	NOV/EC	06/29/2012	Closed
Smart Sand	Air	NOV/EC	11/07/2012	Closed
Hi-Crush / Thein Well Drilling	Water	NOV/EC/Referral	12/11/2012	Settled 6-4-14 / Closed
Interstate Energy Partners / Tiller Corp	Water	NOV/EC/Referral	05/09/2012	Settled 1-6-14 / Closed
Mid Wisconsin Con Ex	Water	NOV/EC	11/30/2012	Open
Northern Frac Sand LLC	Water	NOV/EC	11/07/2012	Closed
Panther Creek Sand	Water	NOV/EC/Citation	03/02/2012	Closed
Pattison Sand	Water	NOV/EC	12/18/2012	Closed
Preferred Sands	Water / Air	NOV/EC/Referral	11/30/2011	Settled 12-16-2013 / Closed
Procore Technologies	Water	NOV/EC	01/09/2012	Closed
Completion Industrial Minerals	Air	NOV/EC/Referral	02/16/2012	Settled 12-26-2013 / Closed
Arcadia Sand	Water	NOV/EC/Referral	05/23/2013	Settled 8-25-24 / Closed
Alpine Sand	Water	NOV/EC/Referral	06/05/2013	Settled 10-9-14 / Closed
Sierra Frac – Patzner Pit	Water	NOV/EC	05/30/2013	Open
Sierra Frac – Suchla Pit	Water	NOV/EC	06/03/2013	Closed
Superior Silica	Water	NOV/EC	05/30/2013	Closed
Great Northern Sand	Water	NOV/EC	05/30/2013	Closed
Brann Valley Excavating-Guza	Water	NOV/EC, 3 citations/bench warrant	08/05/2013	Closed
Sand Technology	Water	NOV/EC	08/05/2013	Open
Source Energy Services – Processing	Water	NOV/EC	06/04/2014	Open
Source Energy Services – Mine Site	Water	NOV/EC	10/07/2015	Open
EOG / Kraemer Company	Water	NOV/EC	09/25/2014	Closed
Northern Sands/Ahlgrimm Explosives	Water	NOV/EC	08/08/2014	Open
Chieftain Sand	Air	NOV/EC/Referral	01/16/2015	Settled / Closed
Hi-Crush Whitehall	Air Permit	NOV/EC	09/04/2015	Open

NOV = Notice of Violation

EC = Enforcement Conference

Referral = Request for prosecution by the Wisconsin Department of Justice

## Green Tier

The Green Tier law ([s. 299.83, Wis. Stats](#)) created a program in which qualified businesses and associations make legal commitments to superior environmental performance through contracts negotiated with the DNR. In exchange, these businesses may seek flexibility in how they achieve their goals. See section 5.2.1 of this document for a list of Green Tier companies and examples of their work within this program.

## **DNR Regulations List**

The following is a list, by category, of some of the Wisconsin Administrative Codes and State Statutes that are administered by the DNR. The list is not comprehensive, but represents some of the more common DNR regulations that may apply to industry.

### *Nonmetallic Mining*

- NR 135: Requires reclamation of nonmetallic mining sites. Reclamation is controlled through a reclamation permit issued by the county, or local unit of government.

### *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 DNR to implement and enforce standards for new stationary sources promulgated by the U.S. EPA.
- NR 445: Establishes emission limitations for hazardous contaminants from stationary sources.

### *Groundwater and Drinking Water*

- NR 135: Reclamation standards in s. NR 135.08, Wis. Adm. Code, 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 DNR response. Provides exemptions.
- 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

#### *Navigable Waters*

- NR 340: Establishes consistency in the application of state statute chapter 30 to nonmetallic mining. 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

#### *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.

#### *Stormwater*

- NR 216: Regulates stormwater by controlling erosion and sedimentation.
- State Statute Chapter 283: Pollution Discharge Elimination

#### *Wastewater*

- NR 200: Sets forth the requirements for filing applications for the discharge permits.
- NR 205: Sets forth permit general conditions for all WPDES permits, effluent limitations applicable to non-POTW's where pH is continuously monitored and procedures to be used for issuing general WPDES permits.
- NR 216: Also regulates discharge of other wastewaters from a nonmetallic mining operation through the General Non Metallic Mining WPDES permit. These wastewaters include waters generated from washing the sand, equipment washing and any noncontact cooling waters.
- State Statute Chapter 283: Pollution Discharge Elimination



### *Endangered Resources*

- State Statute Chapter 29: Wild Animals and Plants

### *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.

### *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.

### *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: Remedial Action ( Hazardous substances spill law).

### *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.

## **4.2.2 Department of Safety and Professional Services**

The Department of Safety and Professional Services (DSPS) is responsible for ensuring the safe and competent practice of licensed professionals in Wisconsin. The DSPS has jurisdiction on building construction and any fuel storage tanks located on mine or processing plant property, as well as blasting. The DSPS also administers and enforces laws to ensure safe and sanitary conditions in public and private buildings. It provides administrative services to the state authorities responsible for the regulation of occupations and offers policy assistance in such areas as evaluating and establishing new professional licensing programs, creating routine procedures for legal proceedings, and adjusting policies in response to public needs. (See <http://dsps.wi.gov>.)

### **4.2.3 Department of Transportation**

WisDOT has authority on licensing truck drivers transporting industrial sand, as well as truck safety, road and load limits, and vehicle size restrictions. (See <http://wisconsindot.gov> and section 3.2 of this document.)

### **4.2.4 The Office of the Commissioner of Railroads**

The Office of the Commissioner of Railroads has the primary responsibility for making determinations of the adequacy of warning devices at railroad crossings, along with other railroad and water carrier related regulations. These duties include: installation, alteration, and repair of new or existing highway/rail crossings; determining adequate railroad fences; exemptions from railroad track clearance laws; and assistance with rail safety initiatives and participate in community outreach. (See <http://ocr.wi.gov>.)

### **4.2.5 Department of Health Services**

The Department of Health Services (DHS) exercises multiple roles in the protection and promotion of the health and safety of the people of Wisconsin. DHS is responsible for maintaining public health. It administers a wide range of services in the state and at state institutions, regulates hospitals and care providers, and supervises and consults with local public health agencies. (See [www.dhs.wisconsin.gov](http://www.dhs.wisconsin.gov) and section 3.8 of this document.)

### **4.2.6 Department of Agriculture, Trade and Consumer Protection**

The Department of Agriculture, Trade and Consumer Protection (DATCP) partners with the citizens of Wisconsin to grow the economy by promoting quality food, healthy plants and animals, sound use of land and water resources, and a fair marketplace. While DATCP does regulate sand mining, it has some influence under the farmland preservation program (FPP), which allows nonmetallic mining as a conditional use under local zoning ordinances certified for the FPP. (See <https://datcp.wi.gov> and section 3.3 of this document.)

## **4.3 Federal**

### **4.3.1 Environmental Protection Agency**

#### **Clean Air Act**

The Clean Air Act is the comprehensive federal law that regulates air emissions from stationary and mobile sources. Among other things, the Clean Air Act authorizes EPA to establish National Ambient Air Quality Standards (NAAQS) to protect public health and public welfare and to regulate emissions of hazardous air pollutants. The state implements the CAA. If enforcement actions are necessary, however, the federal government may take its own action, or work in conjunction with the state.

One of the goals of the Clean Air Act was to set and achieve NAAQS in every state by 1975 in order to address the public health and welfare risks posed by certain widespread air pollutants. The setting of these pollutant standards was coupled with directing the states to develop state implementation plans (SIPs) applicable to appropriate industrial sources in the state, in order to achieve these standards. The Clean Air Act was amended

in 1977 and 1990, primarily to set new goals (dates) for achieving attainment of NAAQS, since many areas of the country had failed to meet the deadlines.

Section 112 of the Clean Air Act addresses emissions of hazardous air pollutants. Prior to 1990, the Act established a risk-based program under which only a few standards were developed. The 1990 Clean Air Act Amendments revised Section 112 to require issuance of technology-based standards for major sources and certain area sources. "Major sources" are defined as a stationary source or group of stationary sources that emit or have the potential to emit 10 tons per year or more of a hazardous air pollutant or 25 tons per year or more of a combination of hazardous air pollutants. An "area source" is any stationary source that is not a major source.

For major sources, Section 112 requires that EPA establish emission standards that require the maximum degree of reduction in emissions of hazardous air pollutants. These emission standards are commonly referred to as "maximum achievable control technology" (MACT) standards. Eight years after the technology-based MACT standards are issued for a source category, EPA is required to review those standards to determine whether any residual risk exists for that source category and, if necessary, revise the standards to address such risk. (See [www.epa.gov/clean-air-act-overview](http://www.epa.gov/clean-air-act-overview).)

### **Clean Water Act**

The Clean Water Act (CWA) establishes the basic structure for regulating discharges of pollutants into the waters of the U.S. and for regulating quality standards for surface waters. Under the CWA, EPA administers pollution control programs, such as setting wastewater standards for industry, and sets water quality standards for contaminants in surface waters. As with the Clean Air Act, the state is responsible for implementing the CWA, with the exception of wetlands (which are jointly regulated by the DNR and the U.S. 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.

Under the CWA, it is unlawful to discharge any pollutant from a point source into navigable waters, unless a permit is obtained. EPA's [National Pollutant Discharge Elimination System \(NPDES\)](#) permit program controls discharges. Point sources are discrete conveyances, such as pipes or man-made ditches. Industrial facilities must obtain permits if they discharge directly to surface waters. (See [www.epa.gov/laws-regulations/summary-clean-water-act](http://www.epa.gov/laws-regulations/summary-clean-water-act).)

### **Safe Drinking Water Act**

The Safe Drinking Water Act (SDWA) was established to protect the quality of drinking water in the U.S. This law focuses on all waters actually or potentially designed for drinking use, whether from above ground or underground sources. The Act authorizes EPA to establish minimum standards to protect tap water and requires all owners or operators of public water systems to comply with these primary (health-related) standards. As with the Clean Air Act and the CWA, the state is responsible for implementing the SDWA. If enforcement actions are necessary, the federal government may take its own action, or may work in conjunction with the state.

The 1996 amendments to SDWA require that EPA consider a detailed risk and cost assessment, and best available peer-reviewed science, when developing these standards.

State governments, which can be approved to implement these rules for EPA, also encourage attainment of secondary standards (nuisance-related). Under the Act, EPA also establishes minimum standards for state programs to protect underground sources of drinking water from endangerment by underground injection of fluids. (See [www.epa.gov/sdwa](http://www.epa.gov/sdwa).)

#### **4.3.2 United States Army Corps of Engineers**

The Regulatory Program of the United States of Army Corps of Engineers (USACE) is committed to protecting aquatic resources and navigation capacity, while allowing reasonable development through fair and balanced decisions. USACE evaluates permit applications for construction activities that occur in the Nation's waters, including wetlands. (See [www.usace.army.mil](http://www.usace.army.mil).)

#### **4.3.3 United States Fish and Wildlife Service**

##### **Endangered Species Act**

The Endangered Species Act (ESA) of 1973 provides a program for the conservation of threatened and endangered plants and animals and the habitats in which they are found. The U.S. Fish and Wildlife Service (FWS) maintains a [worldwide list of endangered species](#), including birds, insects, fish, reptiles, mammals, crustaceans, flowers, grasses, and trees. The ESA prohibits any action that causes a "taking" of a listed species of endangered fish or wildlife. The Act is jointly administered by the DNR and the FWS through a formalized cooperative agreement. (See [www.fws.gov/endangered](http://www.fws.gov/endangered) and section 2.7 of this document.)

#### **4.3.4 Mine Safety and Health Administration**

The Mine Safety and Health Administration (MSHA) is an agency of the U.S. Department of Labor which administers the provisions of the Mine Safety and Health Act (Mine Act) of 1973 to enforce compliance with mandatory safety and health standards as a means to eliminate fatal accidents, to reduce the frequency and severity of nonfatal accidents, to minimize health hazards, and to promote improved safety and health conditions in the nation's mines. MSHA carries out the mandates of the Mine Act at all mining and mineral processing operations in the U.S. regardless of size, number of employees, commodity mined, or method of extraction. (See [www.msha.gov](http://www.msha.gov) and section 3.8.3 of this document.)

#### **4.3.5 Occupational Safety and Health Administration**

The Occupational Safety and Health Administration (OSHA) is an agency of the United States Department of Labor which administers the provisions of the Occupational Safety and Health (OSH) Act of 1970. OSHA ensures safe and healthy conditions for workers by setting and enforcing standards and by providing training, outreach, education and assistance. The OSH Act covers most private sector employers and their workers. OSHA has issued a final rule to curb lung cancer, silicosis, chronic obstructive pulmonary disease and kidney disease in America's workers by limiting their exposure to respirable crystalline silica. OSHA also provides information on the occupational risks of silica exposure and measures to reduce those risks. (See [www.osha.gov/silica](http://www.osha.gov/silica).)

### **4.3.6 U.S. Department of Transportation**

#### **Federal Rail Administration**

The Federal Rail Administration's Office of Railroad Safety promotes and regulates safety throughout the nation's railroad industry. The office executes its regulatory and inspection responsibilities through a diverse staff, including 400 federal safety inspectors who operate out of eight regional offices. Each regional administrator is supported by two deputy regional administrators, chief inspectors, supervisory specialists, grade crossing safety managers and safety inspectors for five of the safety disciplines focusing on compliance and enforcement in: hazardous materials; motive power and equipment; operating practices; signal and train control; railroad safety and customer training (including state safety inspectors); accident and employee fatality investigations and reporting; partnerships between labor, management, and the agency that address systemic initiatives; development and implementation of safety rules and standards. (See [www.fra.dot.gov](http://www.fra.dot.gov).)

#### **Federal Highway Administration**

The Federal Highway Administration (FHWA) is an agency within the U.S. Department of Transportation that supports state and local governments in the design, construction, and maintenance of the nation's highway system (Federal Aid Highway Program) and various federally and tribal owned lands (Federal Lands Highway Program). Through financial and technical assistance to state and local governments, the FHWA is responsible for ensuring that America's roads and highways continue to be among the safest and most technologically sound in the world. (See [www.fhwa.dot.gov](http://www.fhwa.dot.gov) and section 3.2 of this document.)

### **4.3.7 Tribal**

See section 3.10.2 of this document for discussion on tribal authorities.

## 5 Alternative Approaches

### 5.1 Regulatory

Wisconsin could consider regulatory changes such as those adopted in Minnesota. Legislation enacted in that state in 2013 directs state agencies to provide local units of government with technical assistance on regulation and permitting, sets new thresholds for environmental review of sand related operations, and requires the development of a number of new regulations (see [www.revisor.leg.state.mn.us/laws/?id=114&year=2013](http://www.revisor.leg.state.mn.us/laws/?id=114&year=2013).)

Specifically, the legislation requires the Minnesota Environmental Quality Board (EQB) to do the following:

- Develop model standards and criteria for mining, processing, and transporting silica sand. (See “Tools to Assist Local Governments in Planning for and Regulating Silica Sand Projects,” available at: [www.eqb.state.mn.us/sites/default/files/documents/Tools for Local Govt approved March 19 with Errata.pdf](http://www.eqb.state.mn.us/sites/default/files/documents/Tools%20for%20Local%20Govt%20approved%20March%2019%20with%20Errata.pdf).)
- Assemble a Silica Sand Technical Assistance Team to provide local units of government, at their request, with assistance in developing ordinances development, zoning, environmental review and permitting, monitoring, or other issues arising from silica sand mining and processing operations. (See [www.eqb.state.mn.us/content/silica-sand-technical-assistance-team](http://www.eqb.state.mn.us/content/silica-sand-technical-assistance-team).)
- Amend its rules for environmental review for silica sand mining and processing to take into account the increased activity in the state and concerns over the size of specific operations. EQB will consider whether the requirements of Minnesota Statutes, section 116C.991 (see section 4.4.1 below) should remain part of the environmental review requirements, and whether those requirements should be different for different geographic areas of the state. (See “Silica Sand Rulemaking,” available at [www.eqb.state.mn.us/silica-sand-rulemaking](http://www.eqb.state.mn.us/silica-sand-rulemaking).)

In addition, the legislation directed the Minnesota Pollution Control Agency to adopt rules for the control of particulate emissions from silica sand mining, processing and transportation ([www.pca.state.mn.us/air/mpca-rulemaking-silica-sand](http://www.pca.state.mn.us/air/mpca-rulemaking-silica-sand)).

Lastly, the legislation directed the Minnesota DNR to create rules pertaining to the reclamation of sand mines, and to develop and administer a setback permit for mining within one mile of a designated trout stream (see [www.dnr.state.mn.us/silicasand](http://www.dnr.state.mn.us/silicasand)).

### 5.2 Non-Regulatory

In addition to the many local, state and federal regulations that may apply to industrial sand facilities in Wisconsin (see section 4 of this document), a number of non-regulatory efforts have been initiated to better understand and manage the effects of ISM in the state. These include activities conducted by the DNR, academia and the ISM industry.

#### 5.2.1 Green Tier

Although the DNR is largely a regulatory agency, Ch. 299.83, Wis. Stats. established a non-regulatory program by which the agency can promote, reward, and sustain superior



environmental performance. Known as Green Tier, this DNR program seeks to promote voluntary performance with incentives to address un-regulated environmental challenges. The Green Tier program encourages companies to go beyond compliance in their environmental efforts while supporting their work to develop innovative solutions.

There are currently six companies with 12 separate ISM facilities participating in the Green Tier program. These and other participating companies are required to submit an annual report summarizing their activities and to conduct an audit every year where every third year is done by a certified third-party auditor. Green Tier participants must implement an Environmental Management System (EMS) that is either ISO 14001-certified or functionally equivalent. Reports are available on each company's Green Tier web page: <http://dnr.wi.gov/topic/GreenTier/Participants>.

In addition to meeting all of the criteria of their EMS, Green Tier businesses engage in beyond-compliance efforts to enhance the environment, improve relationships with local communities, and increase trust with regulators. Listed below is a sample of the wide range of activities that have been reported by ISM companies currently participating in the Green Tier program.

- **Badger Mining** – Badger Mining has developed a method of reclamation called Geomorphic Reclamation, which reduces erosion and post-reclamation maintenance by mimicking pre-mining topographic formations and drainage patterns. Since initiating mining at its Taylor facility over 35 years ago, Badger has reclaimed 72 acres in this fashion. Badger has also been involved with fish and wildlife habitat efforts in reclaimed areas at their Fairwater plant, which has provided sport fish and wood duck habitat. In addition, the company has partnered with the U.S. Fish and Wildlife Service and the DNR to enhance Jonah's Coulee Creek for fish habitat and flood control on this Jackson County trout stream.
- **Eden Stone** – This mainly rock and dimension stone company also produces sand. The company has worked to enhance their community by addressing flooding and stormwater runoff in the village of Valders. This includes alleviating flood issues for the village's elementary school and providing flood storage through the creation of a wetland, which also provides wildlife habitat.
- **Fairmount Santrol** – This company's diverse operations include two underground sand mines, which provide extensive habitat for the state's four species of cave-dwelling bats. Fairmount has made a strong commitment to programs of the Wildlife Habitat Council and has partnered with the DNR, U.S. Fish and Wildlife Service and other stakeholders to foster research and monitoring of bats frequenting portions of their underground mines. This has included research on population dynamics and surveys to evaluate bats for the presence of "White Nose Syndrome," a fungal disease that threatens bat populations across the U.S. Recognized as a Green Master by the Wisconsin Sustainable Business Council, the company is engaged in habitat and stream restoration along with many community projects at their locations in Wisconsin.
- **Smart Sand** – As the newest Green Tier facility, Smart Sand has set goals in environmental commitment. A recently submitted plan to restore Bear Creek as a trout stream on their property is a large undertaking that will be beneficial to the traditional farming area. As the project comes to fruition, Smart Sand has



- partnered with the DNR in monitoring stocked trout for gill lice disease that was recently observed in the area and regularly report conditions back to the DNR.
- **U.S. Silica** – This company has committed to a community approach that seeks input via meetings to identify and address issues that arise. The company supports and is involved in a number of community improvement efforts in the City of Sparta including local food pantries, Habitat for Humanity building projects, donating to local sports programs, providing scholarships for local high school students, and supporting the local chapter of Ducks Unlimited.
  - **Unimin** – Also a member of the Wildlife Habitat Council, Unimin has put work into a bluebird habitat trail near its Portage facility and has partnered with the U.S. Fish and Wildlife service to enter the Wisconsin Statewide Karner Blue Butterfly (KBB) Conservation Plan for its Tunnel City facility. At Tunnel City, 108 acres have been restored to KBB habitat, while the property’s historic train tunnels have been preserved and serve as bat habitat. The DNR is monitoring these bats for “White Nose Syndrome,” a fungal disease that threatens U.S. bat populations. The Portage facility undertook a local project that cleaned up a scrap dump and restored it to native grasslands.

### 5.2.2 Academia

Researchers at several academic institutions have conducted applied research on the potential impacts of ISM facilities in the state. These projects include the following:

- **University of Iowa** – *Exposure Assessment and Outreach to Engage the Public on Health Risks from Frac Sand Mining*. Funded by the National Institute of Environmental Health Sciences, this project has focused on fine particulate matter and potential air quality impacts on the health of residents near active sand mining operations in Wisconsin, as well as Iowa and Minnesota, based on air sampling, dispersion models, toxicology studies, and community engagement. The project is complete and is in the process of publication review. (For more information, see <https://cph.uiowa.edu/ehsrc/fracsand.html>.)
- **University of Wisconsin–Eau Claire** – *PM2.5 Airborne Particulates Near Frac Sand Operations*. Funded by UW-Eau Claire Office of Research and Sponsored Programs, this study also focused on fine particulate matter and air quality on the perimeter of active mines. Although this study has been published (Walters, Jacobson and Kroening 2015), work is still being conducted. The publication is available from [https://www.heartland.org/template-assets/documents/publications/pm2.5\\_airborne\\_particulates\\_near\\_frac\\_sand\\_operations\\_pierce.pdf](https://www.heartland.org/template-assets/documents/publications/pm2.5_airborne_particulates_near_frac_sand_operations_pierce.pdf).
- **University of Wisconsin–Eau Claire** – *Surface Water and Groundwater Chemistry of Western Wisconsin: Establishing An Environmental Baseline*. Also funded by UW-Eau Claire Office of Research and Sponsored Programs, this project represents the first comprehensive analysis of surface water and groundwater chemistry throughout western Wisconsin. The study is expected to conclude in 2017 and provide baseline data of dissolved metals and regional background variations in surface water and groundwater chemistry in western

Wisconsin. (For more information, see the poster by Wiest et. al (2017), which can be accessed from <http://digital.library.wisc.edu/1793/75776>.)

- **University of Wisconsin–River Falls – Frac Sand Mining Reclamation Project.** Funded in part by Chippewa County and conducted by faculty and students from the UW-River Falls Department of Plant and Earth Science, this five-year project is evaluating the impacts of reclamation efforts on soil properties and vegetation at reclaimed mine sites in the county. The study is also evaluating the effects of fertility amendments and fine-material byproducts from sand processing. (See <https://www.uwrf.edu/PES/FracSandMineReclamationProject>.)
- **Wisconsin Geologic and Natural History Survey UW-Extension – Chippewa County Groundwater Study.** Conducted in partnership with the U.S. Geological Survey, this project has developed two modeling tools: a soil-water-balance model and a groundwater flow model, to evaluate the current and potential future impacts of industrial sand mining and irrigated agriculture on the groundwater resources of western Chippewa County. The five-year project is scheduled to be completed in 2017. (For more information, see the project factsheet by Parsen and Gotkowitz (2013) at <http://wgnhs.uwex.edu/pubs/000922>.)
- **Wisconsin Geologic and Natural History Survey, UW-Extension –The Wonewoc and Tunnel City: A Potential Natural Source of Groundwater Contamination in Western & Central Wisconsin.** Funded by the UW Water Resources Institute, this project seeks to characterize the interface between the Wonewoc and Tunnel City geologic layers. This sandstone interface may be a natural source of metals and sulfides that have been found in elevated levels in some private wells. Data collected through this study will provide a baseline for future research and possible regulations to mitigate potential health risks. (See [www.wri.wisc.edu/Default.aspx?tabid=120&ctl=Details&mid=604&ProjectID=98562596](http://www.wri.wisc.edu/Default.aspx?tabid=120&ctl=Details&mid=604&ProjectID=98562596).)

### 5.2.3 Industry

Members of the ISM industry in Wisconsin have participated in and led efforts to better understand and minimize potential impacts of mining operations on the surrounding environment. Several facilities participated in the air-quality research conducted by Air Control Techniques, P.C. (Richards and Brozell 2015). That study looked at particulate matter parameters beyond state standards, including PM<sub>4</sub>, which does not have an established standard by EPA but has been identified as a health concern in California. Section 2.1.5 includes more detailed information about this study.

In addition, members of the ISM industry participate in associations and groups that have an environmental or health focus as part of their mission, such as the National Industrial Sand Association ([www.sand.org](http://www.sand.org)) and the Wisconsin Industrial Sand Association, or WISA ([www.wisconsinsand.org](http://www.wisconsinsand.org)). WISA members are expected to adhere to a Code of Conduct ([www.wisconsinsand.org/code-of-conduct](http://www.wisconsinsand.org/code-of-conduct)) that includes Guiding Principles and a series of Performance Measures, including participation in the DNR's Green Tier program (described in section 5.2.1 above). ISM companies also participate in the Wildlife Habitat Council, National Institute for Occupational Safety and Health, and the Wisconsin Non-Metallic Mining Advisory Committee, among others.

Sand mining companies have also worked locally to address other types of concerns. In some counties, for example, companies with mines on agricultural lands have taken on additional work to address failing/leaking manure storage tanks and ponds that remain on the properties. Whether under agreement with the landowner or the local authority, this environmental work is neither mandated nor regulated, but nevertheless provides much needed action on unmaintained manure storages.

### **5.3 Alternatives to Sand**

Industrial Sand is used as a readily-available raw material for many products. In most cases, alternatives to sand are either not available or are considerably more expensive. The following is a list of alternatives for the top three uses of industrial sand, according to the U.S. Geological Survey's (USGS) most recent Mineral Commodity Summaries:<sup>48</sup>

- For Hydraulic Fracturing – Alternative proppants include kaolin-based ceramic and sintered Bauxite. These alternatives, though more costly, are mostly used in deeper wells. The only other known alternative is the use of resin-coated materials; however, this product uses industrial sand as the main raw ingredient.
- For Glass Production – Some glasses that do not include silica as a major constituent may have physio-chemical properties useful for their application in fiber optics and other specialized technical applications. These include fluoride glasses, aluminosilicates, phosphate glasses, borate glasses, and chalcogenide glasses. These glasses are more expensive to produce, and reduce, but not eliminate, the need for industrial sand. Other types of glass are also more expensive and require very controlled conditions to make.
- For Foundry Casting – Alternative materials to industrial sand that can be used for foundry casting and molding are chromite, olivine, staurolite, and zircon sands. Similar to silica sand, olivine is a relatively common mineral that also is mined from the earth, but is subject to weathering more than silica sand.

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<sup>48</sup> U.S. Geological Survey (USGS). 2016. Mineral Commodity Summaries 2016. Reston, VA: USGS. <http://minerals.usgs.gov/minerals/pubs/mcs/2016/mcs2016.pdf>.

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## 7 Glossary

*Annular Space (annulus)* – The space between two concentric cylinders or circular objects, such as the space between an upper enlarged drillhole and a well casing pipe.

*Aquifer* – Geological layer of either unconsolidated material, usually sand or gravel or both, or bedrock lying below the ground surface, that is all or partially saturated with water and permeable enough to allow water to be extracted as from a well.

*Best management practices (BMP)* –

From NR216.002: “[S]tructural or non-structural measures, practices, techniques or devices employed to avoid or minimize soil, sediment or pollutants carried in runoff to waters of the state.”

From Statute 281.65: “[A] practice, technique or measure, except for dredging, which is determined to be an effective means of preventing or reducing pollutants generated from nonpoint sources, or from the sediments of inland lakes polluted by nonpoint sources, to a level compatible with water quality objectives established under this chapter and which does not have an adverse impact on fish and wildlife habitat. The practices, techniques or measures include land acquisition, storm sewer rerouting and the removal of structures necessary to install urban structural practices, facilities for the handling and treatment of milkhouse wastewater, repair of fences built using grants under this chapter and measures to prevent or reduce pollutants generated from mine tailings disposal sites for which the department has not approved a plan of operation under s. 289.30, Stats.”

*Cambrian* – Geologic time period ranging from 540 to 485 million years ago.

*Certified Operator* – A state certified operator who is responsible for ensuring that a public water supply system provides safe, clean water.

*Colloid* – A solution that has particles ranging between 1 and 1000 nanometers in diameter, yet are still able to remain evenly distributed throughout the solution. These are also known as colloidal dispersions because the substances remain dispersed and do not settle to the bottom of the container.

*Community Water System* – A public water system which serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents. Any water system serving 7 or more single family homes, 10 or more mobile homes, 10 or more apartment units, 10 or more duplex living units or 10 or more condominium units shall be considered a community water system unless information satisfactory to the DNR is provided by the owner indicating that 25 year-round residents will not be served.

*Concentration* – The relative amount of a given substance contained within a solution or in a particular volume of space; the amount of solute per unit volume of solution.

*Consumptive Use* – A use of waters of the state, other than an interbasin diversion, that results in a failure to return any or all of the water to the basin from which it is withdrawn. "Consumptive uses" include, but are not limited to, evaporation and incorporation of water into a product or agricultural crop.

*Contaminant* – Any physical, chemical, biological or radiological substance or matter in water.

*De-minimus quantity* – Lacking significance or importance; so minor as to merit disregard.

*Dewatering* – The pumping of groundwater so that work (typically construction, excavation or utility work) can be done at a depth that is below the water table.

*Dredging* – An excavation activity carried out underwater.

*Drillhole (borehole)* – An excavation, opening or driven point well deeper than it is wide that extends more than 10 feet below the ground surface.

*Flocculant* – (Also known as flocking agents or flocculating agents). Chemicals that promote flocculation by causing colloids and other suspended particles in liquids to aggregate, forming a floc. Flocculants are used in water treatment processes to improve the sedimentation or filterability of small particles.

*Fugitive dust* – From NR 415.02: "Solid airborne particles emitted from any source other than a flue or stack."

*High Capacity Well* – One or more wells, drillholes, or mine shafts used or to be used to withdraw water for any purpose on one property, if the total pumping or flowing capacity of all wells, drillholes, or mine shafts on one property is 70 or more gallons per minute based on the pump curve at the lowest system pressure setting, or based on the highest flow rate from a flowing well or wells.

*Hydrogeology* – The science of groundwater, its movement, abundance, chemistry and distribution.

*Infiltration* – The movement of surface water downwards into porous soil or rock.

*ISM* – Industrial sand mining.

*Model* – Computer model of a groundwater flow system used by hydrogeologists to simulate and predict aquifer behavior and conditions.

*Monomer* – A molecule that may bind chemically to other molecules to form a polymer.

*Non-Metallic Mine* – A mine site where extraction of material other than metallic resources takes place. They are regulated differently than metallic mines. For legal definition see [https://docs.legis.wisconsin.gov/code/admin\\_code/nr/100/135/I/03/11](https://docs.legis.wisconsin.gov/code/admin_code/nr/100/135/I/03/11).

*Ordovician* – Geologic time period ranging from 485 to 444 million years ago.

*Overburden* – Material overlying a deposit of useful geological materials or bedrock

*pH* – A numeric scale used to quantify the acidity or alkalinity of an aqueous solution. More specifically it is a logarithmic measure of hydrogen ion concentration.

*Polymer* – A molecule that has a structure consisting chiefly or entirely of a large number of similar units (monomers) bonded together.

*Proppant* – A solid material, typically sand, treated sand or man-made ceramic materials, designed to keep an induced hydraulic fracture open, during or following a fracturing treatment.

*Pump Capacity* – The maximum rate that a well can produce water based on the physical limitations of the pump and other construction details.

*Quaternary* – Geologic time period ranging from 2.6 million years ago to present time.

*Reclamation* – From NR 135.01: “To rehabilitate sites where nonmetallic mining takes place after the effective date of an applicable reclamation ordinance, in order to promote the removal or reuse of nonmetallic mining refuse, removal of roads no longer in use, grading of the nonmetallic mining site, replacement of topsoil, stabilization of soil conditions, establishment of vegetative cover, control of surface water flow and groundwater withdrawal, prevention of environmental pollution, development and reclamation of existing nonmetallic mining sites, and development and restoration of plant, fish and wildlife habitat if needed to comply with an approved reclamation plan.”

*Redox* – shorthand for reduction-oxidation reaction, redox reactions involve the transfer of electrons from one chemical species to another, which results in a change of oxidation state.

*Reserve* – That part of an identified resource that meets specified minimum physical and chemical criteria related to current mining and production practices, including those for grade, quality, thickness and depth.

*Resource* – A concentration of naturally occurring solid, liquid or gaseous material in or on the Earth’s crust in such a form and amount that economic extraction of a commodity from the concentration is currently or potentially feasible.

*Sandstone* – A sedimentary rock composed mainly of sand-sized minerals or rock grains. Most sandstone is composed of quartz and/or feldspar because these are the most common minerals in the Earth’s crust, although composition of sandstone varies. Sandstone also contains a cementing material that binds the grains together.

*Silica* – SiO<sub>2</sub> or quartz is the chemical composition of sand mined for industrial purposes in Wisconsin.

*Stormwater* – Runoff from precipitation including rain, snow, ice melt or similar water that moves on the land surface via sheet or channelized flow.

*Target Formation* – geologic unit containing desired resources, in the case of industrial sand mines this is typically sandstone.

*Wastewater* – From ch. 281.01: ““Wastewater” means all sewage.” And ““Sewage” means the water-carried wastes created in and to be conducted away from residences, industrial establishments, and public buildings as defined in s. 101.01 (12), with such surface water or groundwater as may be present.”

*Water table* – The upper-most surface of groundwater-below is saturated, above is unsaturated.

*Water loss* – The amount of water that is withheld or not returned to the basin from which it is withdrawn as a result of a diversion or consumptive use or both.

*Wetland* – From ch. 23.32: “[A]n 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.”

*WGNHS* – Wisconsin Geologic and Natural History Survey.

*Withdrawal* – The taking of water from surface water or groundwater.

*Wisconsin Pollution Discharge Elimination System (WPDES)* – From ch. 28.001: “[The] authority necessary to establish, administer and maintain a state pollutant discharge elimination system to effectuate the policy set forth under sub. (1) and consistent with all the requirements of the federal water pollution control act amendments of 1972, P.L. 92-500; 86 Stat. 816.”

# Appendices

## Appendix A - Summary of Principal Invasive Species Laws and Regulations Applicable to Industrial Sand Mining

Wisconsin Statutes	
Chapter 23	Defines “invasive species;” requires the DNR to develop a statewide management plan, promulgate classification and control rules, and undertake invasive species outreach, education, and research; requires the DNR to establish an aquatic plant management program; prohibits distribution of invasive aquatic plants; on stream bank easements, allows control measures to comply with noxious weed laws, to control pests on an emergency basis, or for DNR-approved purposes; allows the DNR and DATCP to promulgate rules for granting federal funds for the control or eradication of noxious weeds
Chapter 26	Establishes policies for control of forest pests; defines “forest pests;” provides authority for the DNR to monitor and control forest pests; provides authority for the DNR to designate “infestation control zones;” requires control measures for forest pests
Chapter 27	Authorizes local park boards to manage urban forestry programs; provides authority for park boards to manage trees to prevent the spread of diseases and pests and eliminate dangerous conditions
Chapter 29	Includes laws related to the management of wild animals and plants; prohibits introductions of non-native fishes; allows for control of rough fish and other undesirable fish; authorizes the DNR to identify and control “detrimental” fish; authorizes the DNR to control nuisance wildlife; provides for nuisance wildlife grants
Chapter 30	Establishes regulations to protect and manage navigable waters; prohibits placing or operating vehicles or other objects with aquatic plants or animals attached; includes permitted activities that may consider risks of invasive species introductions
Chapter 59	Establishes general county law; authorizes county boards to appropriate money for the control of insect and worm pests, weeds, or plant or animal diseases; authorizes committees which may take steps to suppress and control pests; requires the state entomologist and DATCP to cooperate with county committees in suppression and control of pests; allows county boards to acquire tractors, bulldozers, and other equipment for controlling weeds
Chapter 60	Establishes general town law; allows a town chairperson to appoint one or more commissioners of noxious weeds under s.

	66.0517, <i>Wis. Stats.</i> ; authorizes town boards to appropriate money for the control of insects, weeds, or plant or animal diseases if an emergency arises within the town due to insects, weeds, or plant or animal diseases
Chapter 61	Establishes general village law; allows a village board to appropriate money for the control of insect pests, weeds, or plant or animal diseases; requires the DATCP to cooperate with the village if requested and to provide technical assistance
Chapter 66	Establishes general municipal law; defines “noxious weed;” authorizes local officials to require removal of noxious weeds within their boundaries; see also s. 84.07 (3), <i>Wis. Stats.</i>
Chapter 93	Outlines responsibilities of the DATCP, including provisions for plant pest and animal disease prevention and control; authorizes the DATCP to enact quarantines
Chapter 94	Establishes the DATCP’s plant inspection and control authorities, including quarantine and biological control authorities; establishes seed and nursery inspection and certification programs
Chapter 95	Establishes the DATCP’s animal disease control responsibilities, including quarantine authorities
Chapter 146	Regulates the release of a genetically engineered organisms into the environment; requires prior notification of the DATCP and DNR, regardless of whether the genetically engineered organism is a pest or biological control agent
Chapter 236	Requires plantings in public stormwater facilities are adequate, well-established, and reasonably free of invasive species
Chapter 281	Establishes regulations for the protection and management of water quality and quantity; requires the DNR to supervise chemical control treatments for aquatic plants and animals
Chapter 287	Establishes regulations for solid waste landfills; allows the disposal of invasive plants and their seeds, if the plants or seeds are not commingled with other yard waste
Chapter 443	Regulates various professional fields including land surveyors and landscape architects; exempts individuals performing invasive species control activities from certain requirements related to maps and mapping
<b>Wisconsin Administrative Code</b>	
Chapter ATCP 10	Establishes regulations to implement animal health provisions of Chapter 95, <i>Wis. Stats.</i> ; regulates wild animal imports; regulates release, importation, and transportation of



	fish; requires fish health certificates
Chapter ATCP 20	Establishes regulations for plant seed labeling and sale; defines “prohibited noxious weed seeds” and “restricted noxious weed seeds;” prohibits sale of prohibited noxious weed seeds
Chapter ATCP 21	Regulates the importation, movement, distribution, and release of a plant pests and biological control agents; provides for DATCP inspection and certification services; establishes import controls and quarantine measures for gypsy moth, pineshoot beetle, Hemlock woolly adelgid, emerald ash borer, Asian longhorned beetle, <i>Phytophthora ramorum</i> , and thousand cankers disease of walnut trees.; regulates firewood movement
Chapter ATCP 29	Regulates pesticide registration and labeling; regulates manufacturers and labelers, distributors and dealers, and commercial applicators; regulates sales, transportation, handling, use, and disposal of pesticides; see also ch. NR 80, Wis. Admin. Code
Chapter NR 16	Designates “harmful wild animals”
Chapter NR 19	Regulates release, importation, and transportation of fish; prohibits placing or operating vehicles or other objects with aquatic plants or animals attached; requires draining of boats, boat trailers, boating equipment, and fishing equipment
Chapters NR 20 & NR 21	Establishes fishing regulations; regulates use of bait, including restrictions on species used, sources of bait, and release of bait
Chapter NR 40	Establishes regulations for invasive species identification, classification, and control; defines “invasive species;” classifies invasive species into “prohibited” and “restricted” categories; regulates possession, transfer, sale, transport, introduction of invasive species through prohibitions and DNR-issued permits; outlines required control measures; includes preventive measures
Chapter NR 47	Contains rules for the DNR’s cost-sharing program to suppress gypsy moth populations; contains rules for the DNR’s Weed Management Area Private Forest Grant Program
Chapter NR 80	Regulates the use of pesticides on land and water areas; establishes requirements for use of pesticides and permitting; see also ch. ATCP 29, Wis. Admin. Code
Chapter NR 107	Establishes procedures for permitting and regulating chemical treatments for aquatic plant and animal

	management pursuant to ch. 281, <i>Wis. Stats.</i> ; see also ch. NR 109, Wis. Admin. Code
Chapter NR 109	Establishes procedures for protection and regulation of aquatic plants pursuant to chs. 23 and 30, <i>Wis. Stats.</i> ; prohibits distribution and introduction of invasive aquatic plants; prohibits placing or operating vehicles or other objects with aquatic plants or animals attached; see also ch. NR 107, Wis. Admin. Code
Chapter NR 198	Establishes procedures for awarding cost-sharing grants for the prevention and control of aquatic invasive species

## Appendix B - Invasive Plants Reported to Occur within 2.5 and 5 miles of Existing Mine Sites

**Table 8-0-1** *Invasive plants reported to occur within 2.5 miles of existing mine sites*

<b>Scientific Name</b>
<i>Nasturtium officinale</i>
<i>Orconectes rusticus</i>
<i>Persicaria maculosa</i>
<i>Phalaris arundinacea</i>
<i>Polygonum cuspidatum</i>
<i>Potamogeton crispus</i>
<i>Reynoutria japonica</i>
<i>Rhamnus cathartica</i>
<i>Rosa multiflora</i>
<i>Rumex acetosella</i>
<i>Rumex obtusifolius</i>
<i>Saponaria officinalis</i>
<i>Solanum dulcamara</i>
<i>Tanacetum vulgare</i>
<i>Veronica officinalis</i>
<i>Vincetoxicum nigrum</i>

**Table 8-0-2** *Invasive plants reported to occur within 5 miles of existing mine sites*

<b>Scientific Name</b>
<i>Rhamnus frangula</i>
<i>Robinia pseudoacacia</i>
<i>Rosa multiflora</i>
<i>Rumex acetosella</i>
<i>Rumex obtusifolius</i>
<i>Saponaria officinalis</i>
<i>Solanum dulcamara</i>
<i>Tanacetum vulgare</i>
<i>Torilis japonica</i>
<i>Typha angustifolia</i>
<i>Ulmus pumila</i>
<i>Veronica officinalis</i>
<i>Vicia villosa</i>
<i>Vincetoxicum nigrum</i>