

Mining Information Sheet

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Protecting Groundwater at Metallic Mining Sites

Introduction

Activities and processes that occur at metallic mining sites have the potential to affect the quantity and quality of groundwater surrounding the project area. At most surface or underground mines, groundwater will flow into excavated areas and must then be pumped out in order to dewater places where mining activities are intended to take place. Depending on the site's local hydrology, mining activities may affect groundwater *quantity* by lowering the water table elevation, which in turn may impact nearby lake levels and base flow in streams. Additionally, groundwater *quality* may be affected by the handling, storage, and disposal of mining wastes; the mine excavation itself; the water-table drawdown; the wastewater discharge; and the storage and handling of chemicals, reagents, and fuels.

As explicitly stated in Wisconsin's mining laws and regulations, the contamination of groundwater quality must be prevented through compliance with strict performance based standards. This mining information sheet summarizes the measures used to monitor and protect groundwater quality and quantity before mining begins, during site development, operations and closure, and following final reclamation.

Overview of Groundwater Protection Requirements

In Wisconsin, the environmental and permit review processes applicable to a proposed metallic mining site is comprehensive, and generally would require at least four years to complete. During the permit review process, a mining company must meet a number of requirements. Among these, the applicant must submit a detailed *Mining Permit Application*, which contains documentation on the proposed Mining Plan, Reclamation Plan, Monitoring and Quality Assurance Plan, Contingency Plan, as well as other ancillary information mandated by rule. The applicant for a metallic mining permit is required to design their mining operations and facilities to ensure protection of groundwater resources. The Wisconsin Department of Natural Resources is responsible for reviewing submitted plans, and verifying that groundwater resources would be adequately protected should the project be permitted and developed.

The regulations require that, among other things, the Mining Plan include a detailed explanation of the facility design and the operating procedures for groundwater and surface water management. It must also provide evidence that the facility, as designed, is adequate to prevent adverse impacts to groundwater resources. The Reclamation Plan must show that all underground and surface water runoff would be managed in order to prevent damage or contamination to surface waters and

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groundwater, or threats to public health and safety. The portion of the Monitoring Plan addressing groundwater is designed to assess groundwater quality (water chemistry) during mine operation, following final site reclamation, and during the 30-year or longer, long-term care period. This information supplements baseline monitoring data collected during the permitting process and during the construction phase of the project. The Quality Assurance Plan details the procedures for data collection, analysis, and verification. The Contingency Plan includes information on the resources to be available and the procedures to be followed should there be an accident or spill that results in a release of materials that could be potentially harmful to public health or the environment.

Groundwater quality and quantity would be monitored by the company and verified by the Department throughout the mine's operation and well after reclamation to reveal any mining-induced impacts to groundwater. Early detection of potential groundwater impacts would lead to intervention before the actual violation of specific environmental protection requirements.

Any waste disposal facility at a mining site must be carefully designed and engineered to protect groundwater quality. The applicant is required to submit a *Feasibility Report* and a *Plan of Operation* for any mining waste disposal facility for the Department's review, prior to initiation of construction activities. Most mining projects would require disposal of large volumes of waste rock and finely ground rock called tailings. Tailings, which are byproducts from the metallic mineral separation/recovery process, generally have minimal economic value. All mining waste produced from the operations of a metallic mineral mine must be disposed in an environmentally safe manner.

In order for the applicant to predict potential environmental impacts from a mining waste disposal facility, a detailed characterization of the wastes and an analysis of the waste's leaching potential must be completed, and verified by the Department. In addition, the applicant must collect information on the natural and physical environment surrounding the proposed facility location. Information on depth to groundwater and flow directions, existing groundwater quality, surface water drainage patterns, among other site-specific data, must be collected and submitted to the DNR for review.

As part of the permitting process, an applicant is required to demonstrate through predictive modeling that groundwater standards will not be violated in the area around the waste disposal facility and/or underground mine, indefinitely. Information from the waste characterization tests, facility design, hydrogeologic studies, and baseline groundwater conditions are used to predict impacts to groundwater quality. If impacts were found to exceed the standards prescribed in State mining and groundwater quality regulations, the proposed disposal site would be found unfeasible for development. Such studies would be conducted by technical consultants hired by the applicant, and reviewed by the Department.

The State of Wisconsin has established a framework for protecting groundwater quality at regulated facilities. Under this framework, facilities must not exceed numerical standards at specified distances from the edge of the facility. This zone in which compliance must be maintained is called

the design management zone or DMZ. The DMZ is a three-dimensional boundary set at a specified distance surrounding the regulated facility. For metallic mining facilities (mining waste disposal sites, and underground or surface mines), the maximum distance to the boundary of the DMZ would be 1,200 feet from the outside edge of the waste disposal facility or the outer edge of the mine workings, extending vertically through all saturated geologic strata. In addition, for these facilities there is an intermediate intervention boundary set at 150 feet from the facility. If standards are exceeded at the mandatory intervention boundary, operators must take remedial action. Other facilities at a mining site, such as wastewater basins, are also subject to the groundwater regulations. The distance to the DMZ for those facilities are established in the groundwater regulations, or if the facility is not specifically mentioned there, the distance to the DMZ is set at 150 feet.

Groundwater Modeling

As part of the mine permitting process, application of Wisconsin's mining regulations necessitates the preparation of numerical groundwater models by an applicant. The groundwater model is used to:

- (1) Develop a more complete understanding of the groundwater system;
- (2) Predict the amount of water expected to be pumped from the mine (mine inflow);
- (3) Predict the changes to the groundwater system from mine pumping, including water table drawdown;
- (4) Predict changes to surface waters in response to the drawdown;
- (5) Predict potential changes in groundwater quality as a result of project development;
- (6) Assist with project design; and
- (7) Provide an additional tool for monitoring and project assessment during site operation.

The applicant for a proposed mine must develop both a groundwater flow model and a solute transport model to provide the necessary predictive capabilities. These models would be developed in concert with the collection and interpretation of groundwater and surface water monitoring data and geologic information. They are, in effect, simplified representations of the hydrologic system at the proposed site. The Department reviews the applicant's models in detail to ensure that they reasonably represent the natural system before using them to develop impact predictions.

Monitoring Groundwater at Mining Sites

Groundwater monitoring at mining sites has five primary purposes:

- (1) Identify baseline (pre-mining) groundwater quality, water table elevations, and flow patterns;
- (2) Measure water table levels and flow patterns during mining to quantify effects from mine pumping and dewatering;
- (3) Discover if spills or accidental discharges have contaminated groundwater;
- (4) Determine the effectiveness of various design and operational aspects of the project intended to

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- prevent or minimize the generation and/or migration of contaminants; and
(5) Determine the extent of any contaminant migration from project facilities.

Groundwater must be monitored by the applicant during permitting to determine baseline conditions. The applicant must also monitor on a monthly basis for 1 year during initial site development, prior to operation of the waste disposal facility, in order to determine background (pre-mining) groundwater quality. The characteristics of the proposed waste site, proposed site design, nature of the waste material, and hydrologic setting would be used to determine the number and placement of groundwater monitoring wells and the parameters to be analyzed. This monitoring is designed to produce adequate numbers of samples representative of the groundwater quality up- and down-gradient from the proposed facilities.

Monitoring of groundwater in the vicinity of the mine and mine waste disposal facilities would continue throughout operation and closure. Locations selected for waste facility monitoring would be situated around, directly beneath, and within the waste site. After construction and initiation of waste disposal, monitoring would be used to determine whether contaminants (from reacting waste products) are exiting the facility and entering the aquifer.

If analysis of groundwater collected following the initiation of waste disposal indicated significant differences from the background water quality, the mine operator and the Department would work to determine the cause of the difference. Possible causes might include a spill, design failure, or improper operational procedure. The operator would have to evaluate the extent of any groundwater problem and implement the applicable portion of the Contingency Plan to respond to the problem and prevent further impacts.

Operators of mining facilities must also monitor groundwater levels in the vicinity of the mining operation. This information is critical in assessing possible impacts to private wells and surface water bodies in the area as a result of groundwater drawdown. If the monitoring indicates that significant adverse impacts are developing, the operator would be required to implement the applicable provisions of the surface water mitigation plan, developed and approved as a part of the permitting process. This plan establishes procedures to maintain minimum elevations and flows in area lakes and streams and could include such measures as addition of water to the affected water body or construction of artificial water flow structures.

The owner of a mine site or mine waste disposal facility is responsible for the care and environmental performance of the site in perpetuity. Detailed groundwater monitoring must be conducted and provisions for long-term care must be developed. **The owner's long-term care responsibility never ends.** If another company was to acquire ownership of the project, a new license would be issued, and the long-term care responsibility would be transferred to the new owner.

Establishing Groundwater Standards for Metallic Mining Sites

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The specific guidelines for protecting groundwater quality at a mining site are contained in Chapters NR 140 (Groundwater Quality), NR 182 (Metallic Mining Wastes), and NR 132 (Metallic Mineral Mining), Wisconsin Administrative Codes. Before 1998, the groundwater quality rules for mining sites were contained primarily in Chapter NR 182. However, the administrative rules were revised in 1998 and now specify that mining sites must conform to the State's general groundwater quality code (Chapter NR 140). This rule change means that the Department regulates groundwater quality protection at mining sites in a similar fashion to other facilities where the protection of groundwater quality has regulatory restrictions.

The State's groundwater laws and groundwater quality protection rules incorporate specific numerical standards in order to protect groundwater quality. The rules identify substances that are related to *public health* and *public welfare*. Public health related substances include such inorganic elements as arsenic, copper, cyanide, lead, and mercury, and a myriad organic compounds. Public welfare related substances are those parameters that may impart objectionable characteristics to groundwater quality. Examples of public welfare substances include iron, manganese, sulfate, zinc, chloride, color, and odor.

Numerical groundwater standards for over 120 substances are specified in Tables 1 (public health substances) and 2 (public welfare substances) in Chapter NR 140, and are established on a two-tiered system comprised of *Enforcement Standards* and *Preventive Action Limits*. Enforcement Standards are set at levels adequate to protect public health and welfare, are based on scientific studies of potential health and toxicological impacts of each substance, and represent concentrations that are assumed to be safe to consume without causing adverse health or aesthetic concerns. Preventive Action Limits are specified for the same parameters, but are established at lower concentrations than the Enforcement Standard and can be used as triggers for early evaluation of potential groundwater contamination.

For example, for public health concern substances with carcinogenic, mutagenic, or teratogenic properties, the Preventive Action Limits are set as 10% of the Enforcement Standard. For all other public health concern substances, the Preventive Action Limit is set as 20% of the Enforcement Standard. For example, the Enforcement Standard for cyanide is 200 micrograms per liter (parts per billion), whereas the Preventive Action Limit is 40 micrograms per liter. The Preventive Action Limit for substances of public welfare concern is generally 50% of the Enforcement Standard. For example, the sulfate Enforcement Standard is 250 milligrams per liter (parts per million) whereas the Preventive Action Limit is 125 milligrams per liter.

If monitoring shows that an Enforcement Standard is reached or exceeded at a monitoring point within the DMZ, or any point within the property boundary, the Department would require immediate action necessary to limit the release of additional contaminants. The range of responses for an exceedance of an Enforcement Standard is specified in Chapter NR 140 and include actions such as additional monitoring, design or operational revisions, early closure and abandonment of the facility, and remedial action to prevent or minimize the further releases into the environment. There is no allowance for a "no action" response.

If groundwater monitoring indicated that a Preventive Action Limit is reached or exceeded at any of these points, the Department and the site operator must evaluate the situation to determine the appropriate level of response. By conducting this evaluation when the contaminant concentrations are at the relatively low-level of the Preventive Action Limit, the Department and the operator are afforded adequate time in which to intervene before the concentrations reach the level of the Enforcement Standard. The range of responses for exceeding a Preventive Action Limit is specified in Chapter NR 140. Selection of an applicable response is dependent on specific site conditions and ensuring continued compliance with the Enforcement Standard.

Damage to Private Water Supplies

Because metallic mining activities have the potential to negatively affect groundwater, the Legislature has established a damage claims process for individuals whose private water supply might be damaged by mining activities. Individuals may file a complaint with the Department, or with a local municipality if an alternate source of water is needed. After the complaint is filed, the Department is required to investigate the problem, and after a hearing, determine whether or not the mining activity caused the change in water quality and/or quantity. The local municipality would be responsible for providing an adequate water supply while the alleged damage is being investigated.

If the mining activity is found to be the cause of the damage, the mining operator must provide an adequate supply of water and reimburse the municipality responsible for supplying water during the evaluation process. If the mining operation is found not to be responsible, the person that filed the complaint is responsible for reimbursing the municipality for costs of providing the temporary replacement water supply. The local agreement process for metallic mines may also address the provision of water rights by further defining the applicant's responsibilities. The perpetual Irrevocable Trust requirement also indicates that one use of its funds would be to provide for replacement of water supplies in the event that either the mining company is no longer financially liable, or does not have the financial ability to do so.

Contingency Plan

To prepare for the possible risk of groundwater contamination, a mining company must develop a Contingency Plan, which specifies intervention steps and remedial actions that would be taken if an analysis of groundwater samples showed a developing problem. If a potential groundwater contamination problem is indicated or a problem becomes evident, the company and the Department would determine the severity of the problem and the source of contamination. Additional monitoring wells could be placed down-gradient from a possible contaminant source to evaluate the horizontal and vertical extent of the contamination. Groundwater modeling would likely be employed to further evaluate impacts. Once the contamination source and extent are determined, the mining company would be required to implement remedial actions designed to abate and correct the problem.

Waste Disposal Fees and Groundwater Protection

By law, companies that dispose of solid waste, including mining wastes, are required to pay various fees on a per ton of waste basis to help fund a number of environmental protection programs. However, materials used in construction or as backfill in an underground mine are exempt from these fees.

There are four different fees: groundwater (1.0¢ per ton), environmental repair (1.0¢ per ton), recycling (30.0¢ per ton), and solid waste facility siting board (1.7¢ per ton). The groundwater fee is used for management and protection of groundwater resources throughout the state. The environmental repair fee is used to fund investigations and remedial actions at any solid or hazardous waste facilities causing environmental contamination. The recycling fee is used to establish and fund solid waste recycling programs throughout the state. The solid waste facility siting board fee is used to fund the Wisconsin Waste Facility Siting Board, which is responsible for administering the siting process for non-mining related solid and hazardous waste disposal facilities.

Regulatory Exemptions

The mining and groundwater regulations provide for exemptions under certain conditions, should the mining company be able to meet the applicable criteria. However, in no case shall any exemption authorize contaminant concentrations in the groundwater that would exceed the levels required to protect health, safety, or welfare.

For More Information

If you would like additional information or want to discuss any mining-related issues, please contact:

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This mining information sheet is one in a series prepared by the Department of Natural Resources to explain how metallic mining in Wisconsin is regulated and to explore other aspects of mining. Copies of the following mining information sheets are available from Department offices in Madison and Rhinelander, and the Internet:

- *The Permitting Process for a Metallic Mineral Mine*
- *How the Department of Natural Resources Regulates Metallic Mining*
- *Protecting Groundwater at Metallic Mining Sites*
- *Reclamation and Long-Term Care Requirements for Metallic Mining Sites in Wisconsin*
- *Local Decisions in Metallic Mining Projects*
- *Addressing Public Concerns With Wisconsin's Laws Governing Metallic Mining*
- *Wisconsin's Net Proceeds Tax on Metallic Mining and Distribution of Funds to Municipalities*
- *Cumulative Impacts of Metallic Mining Development in Northern Wisconsin*
- *Potential Metallic Mining Development in Northern Wisconsin*

Copies of the mining information sheets and regulations (administrative code) can be obtained at the Department's Mining Web site: <http://www.dnr.state.wi.us/org/aw/wm/mining/metallic/>.