5 May 2014

Mary Beth Peranteau
Wheeler, Van Sickle & Anderson, SC
25 W. Main Street, Suite #801
Madison, WI 53703

RE: Hydrogeologic Review of Proposed Quarry Site in Albion

Dear Ms.Peranteau,

At your request, the following provides the findings of a technical evaluation of the potential hydrogeologic impacts of the proposed quarry site in Albion, Wisconsin.

GEOLOGY

Based on the WGNHS Dane County Preliminary Bedrock Map, the geology of the area is glacial overburden underlain by the Platteville Formation over St Peter Sandstone. The Wisconsin Geological and Natural History Survey (Preliminary Bedrock Geology of Dane County, Wisconsin; Open File Report 2013-01, Plate 1) identifies the bedrock of the area as Sinnipee Group consisting of the Galena, Decorah and Platteville formations. Underlying this is the Ancell Group consisting of the Glenwood and St. Peter formations.

SULFIDES AND ARSENIC CONCERNS

There is a significant potential for arsenic to be mobilized into groundwater from quarry operations. Sulfides and metal oxides within the lower section of the Platteville formation and upper section of the St Peter Sandstone are known to be intruded by sulfide deposits, and have been found to cause significant arsenic issues in several areas of the state.

As stated in the Report on the Preliminary Investigation of Arsenic in Groundwater near Lake Geneva, Wisconsin (Wisconsin Geological and Natural History Survey, Open File Report 2000-02, submitted to WDNR, 2002), "… the source of arsenic is believed to be a sulfide-rich horizon at the base of the Platteville Formation. A well-supported hypothesis for the release of arsenic from the sulfide horizon is oxidation via exposure of the sulfides to air where the air-water interface in wells intersects the sulfide-rich rock."

Documentation by the Department of Natural Resources indicates arsenic is commonly found in the Platteville formation at the St Peter Sandstone (Figure 1). Processes for release of arsenic include oxidation , reduction , changes in pH, and changes in phosphate and silica.

Oxidation of the arsenic-bearing layer from quarry processes can result in the release and resultant mobilization of arsenic into the groundwater. As material is exposed to air or increased dissolved oxygen, ferrous sulfide minerals are affected by oxidative dissolution, sulfides are oxidized to sulfates, and arsenic is released.

$$FeS\text{-}As(III) + 2\ O_2 >> Fe^{2+} + SO_4^{2-} + As(III), As(V)$$

As stated in the peer reviewed publication, Arsenic in Ground Water, "Several lines of evidence suggest that oxidation of sulfides is the cause of high (>100 µg/l) concentrations of arsenic in ground water, including 1) the presence of the arsenic-bearing sulfides in the aquifer; 2) water chemistry data that show a positive correlation between arsenic, iron, and sulfate and negative correlation between arsenic and pH; and 3) similar sulfur isotopic signatures in sulfides of the secondary cement horizon (SCH) and dissolved sulfate in ground water. We propose that atmospheric oxygen, introduced to the SCH through well boreholes, provides an oxidant to the system. This hypothesis is supported by the occurrence of high arsenic concentrations where water levels within the well intersect the SCH." (Schreiber et al, Mechanisms of Arsenic Release to Ground Water from Naturally Occurring Sources, Eastern Wisconsin, Arsenic in Ground Water, 2003). The oxidation is as significant from quarry operations as from oxidation from well installation.

ENVIRONMENTALLY SENSITIVE AREAS

Local wetlands are identified within and directly west and south of the proposed quarry. In addition, areas of wetland indicators are present. Records submitted with the proposed quarry application indicate mining operations within each of these wetland class areas. Revised boundaries of the proposed quarry include farmed wetland areas, and border sensitive areas of wetlands and wetland indicators to the west, southwest and south.

In order to protect environmentally sensitive areas, it is vital that a stable area of vegetation be maintained, separating the wetlands from the impervious surface area of the quarry. The proposed boundaries (both initial and revised) do not appear to allow for a vegetative separation.

GROUNDWATER LEVELS

Water well records reviewed included the following:

WDNR Drinking Water System: High Capacity Wells
WDNR Drinking Water System: Well Construction Reports
DATCP Well Constructor's Reports (1936-1989)

Records for water supply wells within 2 miles of the property were reviewed, including residential wells, irrigation wells, and industrial wells. In addition, permit requests for new high capacity water wells were also evaluated.

The depths of wells within a mile of the proposed quarry site range from 75 feet bls to 200 feet bls. The majority of wells in the area are utilized for residential and farm use. Of the 338 water supply wells located within T5N R12E, there were 60 residential wells located within a mile radius of the proposed quarry site. Of these wells, 42 well construction reports indicated static water levels of twenty feet below land surface. The average depth to water in well reports reviewed is 22 feet bls.

Groundwater levels in well construction reports are consistent with the groundwater levels expected across the area, with depth to water greater north and east of the proposed quarry site. Water levels become more shallow south and southwest of the site. An illustration of the water levels is provided in Figure 2.

The application materials reviewed as part of this review identify the quarry floor to be estimated at 850 msl. This estimate puts the base of quarry operations at or near the water table. Water supply wells could be significantly impacted by the proposed quarry if quarry operations go beyond the current proposal of 850 msl.

HIGH CAPACITY WELLS IN THE VICINITY

There are 2 high capacity wells (defined as wells with a capacity greater than 100,000 gallons per day) identified within a mile of the proposed quarry site. These are both irrigation wells, and usage is expected to be significantly greater in summer months.

Two abandoned high capacity wells were formerly used for gravel wash approximately a mile northeast of the site; these are both recorded as having a depth of 305 feet bls, depth to bedrock of 24 feet bls, static water level of 42 feet bls, and a normal pumping rate of 216,000 gallons per day (gpd). No permit applications are pending in the vicinity of the proposed quarry site, as no applications for Dane County were submitted in the last 16 weeks.

IMPACTS FROM BLASTING

Blasting activities can negatively impact well water quality. Ground roll has been documented to flake iron off casing. A site in Little Chute, Wisconsin was found to have clogged pump intakes from rust particles that had flaked off a well from the driving of pilings nearby.

Blasting material may not be entirely combusted during blasting, which can release contaminants into the groundwater. Specifically, "Contamination of groundwater caused by the release or spillage of blasting chemicals has been occasionally associated with the detection of nitrate and nitrite. To a lesser extent, volatile organic compounds and semi-volatile organic compounds have been detected at blasting sites. It is likely that some substances associated with blasting may not be typically analyzed as part of standard laboratory drinking water analysis resulting in limited data describing the occurrence of these constituents within groundwater." (Rock Blasting and Water Quality Measures That Can Be Taken To Protect Water Quality and Mitigate Impacts, New Hampshire Department of Environmental Services/Water Source Protection Program, WD-10-12, 2010).

Blasting may also cause release of silt, sand, rock particles, and chemical precipitate which can cause increased turbidity in groundwater. The impact usually occurs until approximately a year after blasting ceases. A quarry in Lisbon, Wisconsin was found to be responsible for impacting water supply wells for over two dozen homes from blasting operations in 2007. "High turbidity can damage household equipment and fixtures, be aesthetically unpleasing to drink, and increase concentrations of various metals and other contaminants. Water samples with high turbidity may exhibit high metal concentrations. This is because metal ions on flocculants or colloidal particles (particles suspended in groundwater) that carry metals may release the metals as the pH of the water changes in the plumbing system of the home." (Rock Blasting and Water Quality Measures That Can Be Taken To Protect Water Quality and Mitigate Impacts, New Hampshire Department of Environmental Services/Water Source Protection Program, WD-10-12, 2010).

INCONSISTENCIES IN GROUNDWATER DEPTH LISTED IN APPLICATION MATERIALS

Application materials identify the depth to groundwater as 96 feet bls. Based on the technical evaluation conducted, it appears unlikely that the depth to groundwater in the area of the proposed quarry is this deep.

The Hydrogeology of Dane County (Open File 1999-04, Wisconsin Natural History and Geological Survey, Plate 1) provides a summary of water levels and groundwater flow within Dane County based on an evaluation of well construction reports. The study indicates shallow groundwater flow beneath the proposed quarry area toward the southeast. Water level elevations in the area range from less than 840 mean sea level (msl) in the southwest quadrant of the proposed quarry to 860 msl north of Craig Road.

Well construction logs within the immediate area of the project site indicate water levels in Section 15 to be between 35 feet bls and 64 feet bls. Specifically, these are described below:

- A well was drilled for Bussey in 1991 indicating a depth of 195 feet bls and a depth to groundwater of 60 feet bls. This well is located at 893 Highway 73, directly east and on property adjacent to the proposed quarry (Unique Well Number CO291).
- A Bussey well construction report indicates that the residential water supply well was drilled in 1964, was located in Albion within Section 15, had a well depth of 120 feet bls and a depth to water of 64 feet bls (DN4054).
- A Bosbon well construction report indicates that the residential water supply well was drilled in 1962, was located in Albion within Section 15, had a well depth of 106 feet bls and a depth to water of 35 feet bls (DN4055).

ADDITIONAL POTENTIAL IMPACTS

Potential impacts from quarry operations within or adjacent to this area include the following:

- Reduction in surface water levels in streams and wetlands
- Reduction in surface water quality
- Reduction in groundwater quality
- Impact on local water supply wells due to decreased groundwater levels
- Disruption of groundwater recharge

Reduction in surface water levels in streams and wetlands

Groundwater discharge from the area is important for stabilization of stream flows and maintaining surface water quality, particularly in dry months.

Reduction in surface water quality

Runoff from the proposed quarry could significantly impact the surface water and wetlands on the same parcel, as well as surface water and environmentally sensitive areas adjacent to the site. Negative impacts may also result from blasting charges that may not completely combust, as well as particulate dust.

The surface of the open water within the wetland area adjacent to the southern boundary of the proposed quarry appears to be at the level of the water table, indicating that it functions as a groundwater monitoring point; for this reason, it may be subject to more stringent groundwater quality rules as found in Wisconsin Administrative Code NR140.

Impact on local water supply wells due to decreased groundwater levels

If dewatering activities occur, or if the quarry operations extend beneath the groundwater level, there is potential to impact local water supply wells.

Disruption of groundwater recharge

The lowlying wetlands area within the parcel, including portions within the mapped area of the proposed quarry, provide a sensitive network of plants and substrates that allow filtering and recharge of the aquifer, replenishing valuable groundwater supply.

Photos (Figures 3 and 4) provide views of the environmentally sensitive areas located adjacent to, and within, the proposed quarry site. Figure 3 captures a view of the lower elevation, including the surface water and environmentally sensitive areas to the southeast of the property. The photo in Figure 4 provides a view of the area southwest of the site, showing the higher elevation and vegetation proposed to be removed.

I trust that the information provided above, in addition to the attached figures and photos, summarize the potential issues associated with the proposed quarry. Please feel free to contact me at 608-886-7245 with any questions or if you are in need of additional information.

Sincerely,

Lori Huntoon, PG
Principal Hydrogeologist
HydroGeoLogic Consulting, llc

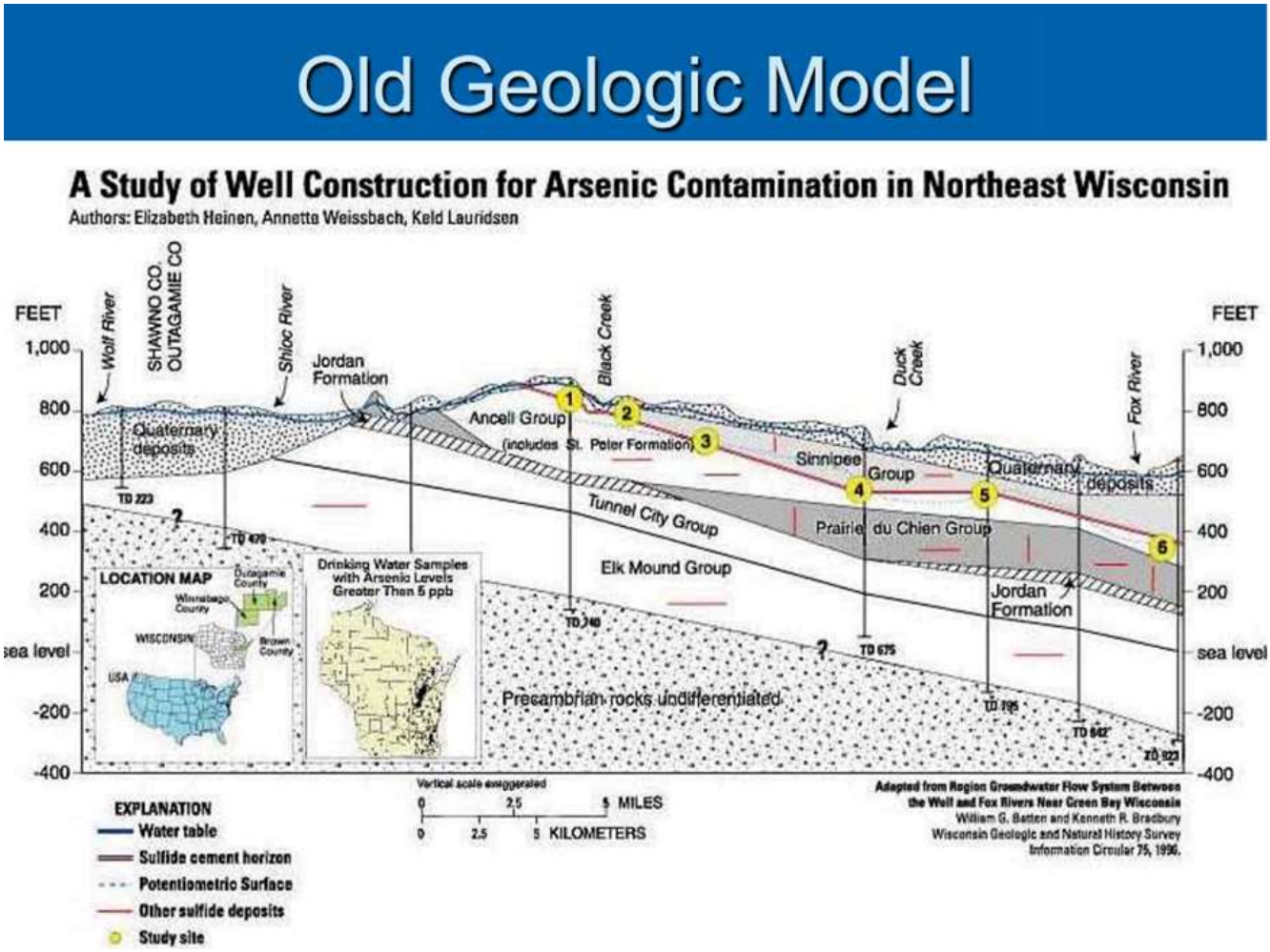

FIGURE 1.
Arsenic issues at contact between Platteville Formation and St.Peter Formation

Source: WDNR, Sulfide Minerals, Wells and Water Quality

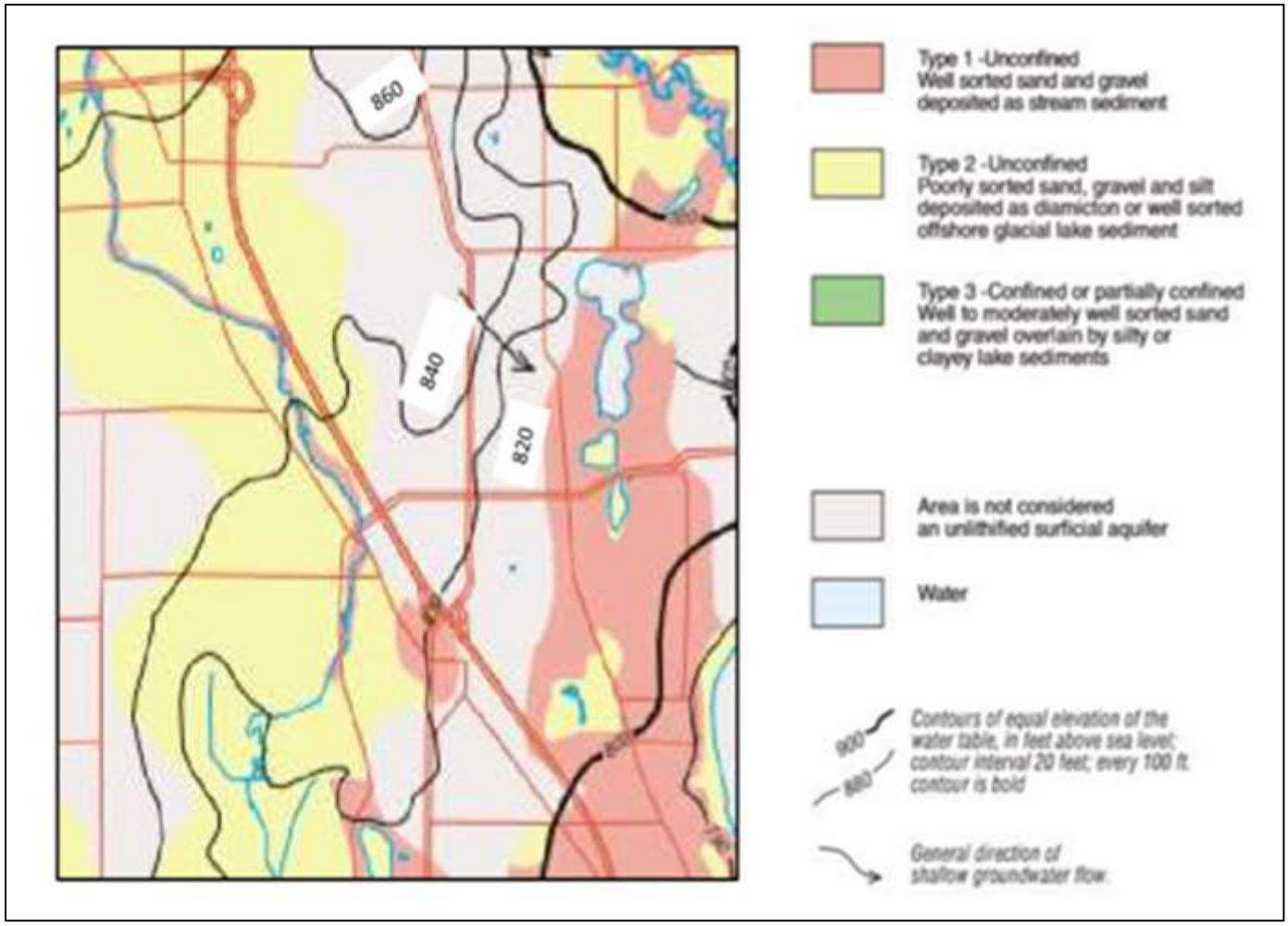

FIGURE 2.
Water Table Elevations and Unlithified Aquifers
Dane County, Wisconsin
Source: Hydrogeology of Dane County, Wisconsin, Wisconsin Natural History and Geological Survey, 1999.

FIGURE 3.

View of the lower elevation directly adjacent to the proposed quarry site, including the surface water and environmentally sensitive areas located south of the property (view looking south).

FIGURE 4.

Southwest area of the higher elevation of the site, including vegetation located adjacent to revised boundaries of the proposed quarry site (view looking south/south).