

Memorandum

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Date: 6 January 2026, v.3
To: Nathan Dupes, Bodman Law
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Project: MASSEYLK

SUBJECT: Potential impacts of MMM Vella Pit dewatering on water quality in nearby wells

Overview

This memo provides an overview of potential impacts on water quality in residential drinking water wells in Ann Arbor Charter Township that may have been affected by aquifer drawdown from dewatering at the Vella Pit of Mid Michigan Materials (MMM pit). The period of active dewatering and discharge outside the MMM Pit was about 530 days from July 2022 to October 2023, with monthly average discharge rates of up to 3.85 million gallons per day over this time. Beyond problems with dry wells or reduced yields from wells during the active dewatering period, residents have also reported changes in well water quality during and after the dewatering period. Assessment of the available data and a basic literature review support the reasonableness of attributing these reported changes in well water quality to impacts on the aquifer or wells from gravel pit dewatering and aquifer drawdown and recovery (Xu et al., 2025).

Aquifer Drawdown and Recovery

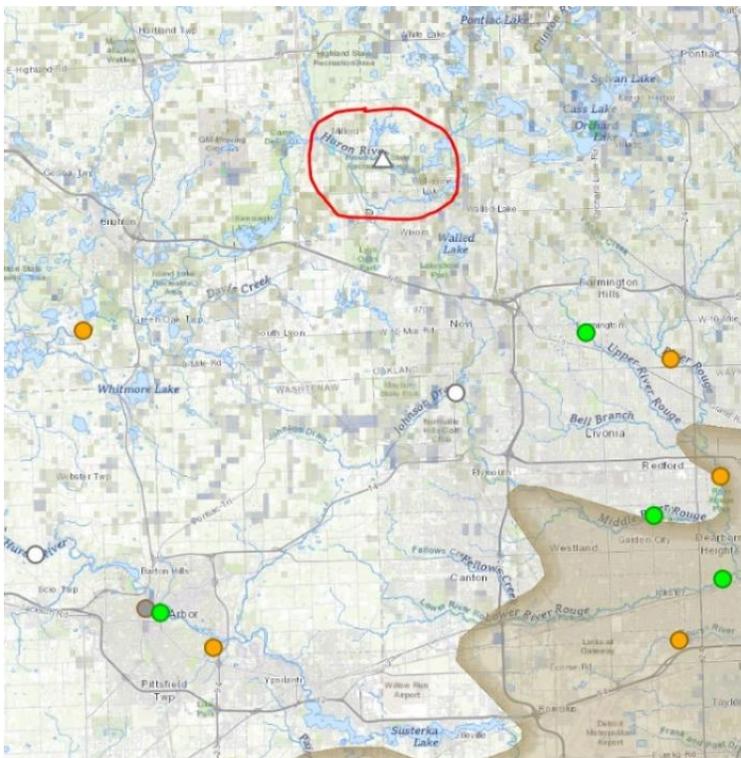
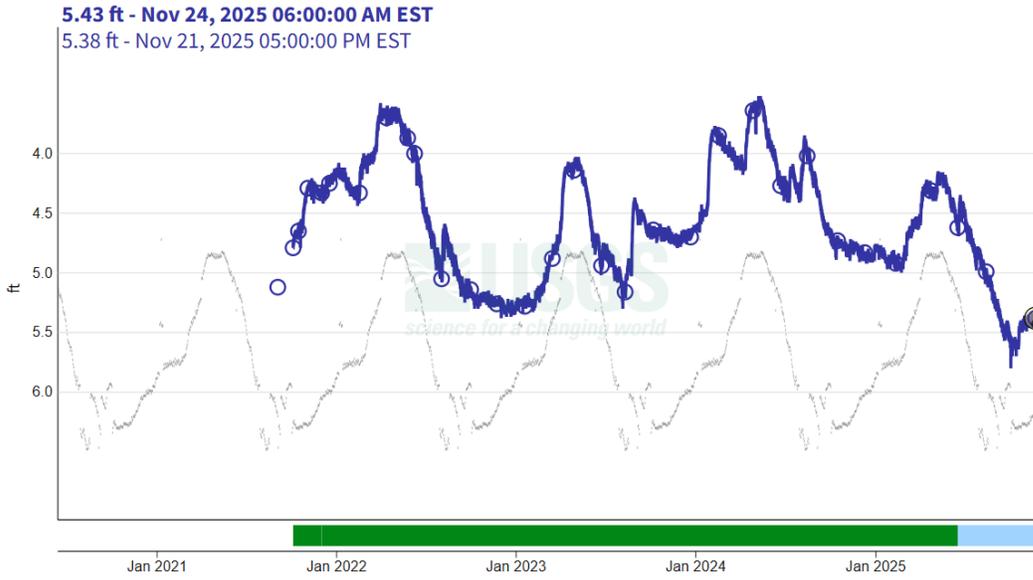
Water levels in impacted wells dropped by more than 12 feet near the MMM Pit and over 4 feet at a distance of more than 8,000 feet from the pit during the active dewatering period. This compares with a typical seasonal fluctuation of the water table of 2 to 4 feet. As an example, a water level record from an observation well northwest of Ann Arbor Charter Township that is maintained by the U.S. Geological Survey (USGS) in Oakland County, Michigan is shown below (Figure 1). The USGS well has logged the depth to water continuously from 2021 to the present. Electronic measurements were confirmed with manual measurements every one to two months. Note that the well is influenced by similar weather to that experienced in Ann Arbor Charter Township, but the geological and hydrological conditions at this site could be quite different from those in the vicinity of the MMM pit. Natural water level fluctuations over seasons or years may cause minor changes in well water quality (MEOEEA, n.d.).

Continuous data

02N 08E 18DBAD01 Oakland CO (Proud Lake Well) - USGS-423423083324001

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- using custom time span -
June 13, 2020 - December 4, 2025
Depth to water level, feet below land surface



Figures 1a and 1b. Plot of [USGS](#) groundwater observation well data for depth to water from 2021 to 2025 (1a, upper panel, vertical axis scale is reversed), and location map for the well (1b, map at left; white triangle symbol, circled in red).



General Well Construction and Water Quality Issues

Approximately 25-30 percent of Michigan residents get their drinking water from private wells, including many in Washtenaw County. The county health department (WCHD, n. d.) lists several common [issues](#) that can arise with well water including problems with color, odor, taste, and grit or sand. Drivers of these issues include changes in the aquifer or water table, changes in the [well and pump system](#) (EGLE, 2023), or changes within the water treatment and plumbing system inside the house. Most of these issues are due to natural seasonal variations or mechanical issues that can be addressed by maintenance or upgrades to the well, pump, or water treatment system. Color, odor, and taste issues can arise from dissolved or particulate minerals and natural substances in the water including iron (orange color, metallic taste; EGLE, 2020), manganese (black color, metallic taste; EGLE, 2025 and n. d.; Gounot, 1994; Ramachandran et al., 2021), sulfur compounds (rotten egg smell), and organic matter or bacteria (musty or earthy smell or taste).

Dissolved iron and manganese, which are present in most Washtenaw County groundwater, will often change their form when exposed to oxygen as they enter a filter or leave the tap in a house. This causes them to shift from an invisible dissolved state to a visible solid state, appearing as orange or black murky water or sediment precipitates in the bottom of a glass, sink, or tub. Wells, sumps, piping, and filters can be fouled by iron and manganese oxides (Figure 2), as well as by bacteria that extract energy from the oxidation reaction and form slimy deposits of precipitated iron and manganese mixed with bacterial filaments. Arsenic is present in some parts of deeper Washtenaw County aquifers but is not known to be an issue in the shallower glacial aquifer.



Figure 2. Iron oxides on filter media and suspended in water, compared with a clean filter and clear water (left), and a filter fouled with manganese oxides (right). Note that iron sulfides on filters can also appear black initially but then change to an orange color when exposed to air.

Dissolved iron at concentrations of 0.3 mg/L can change the taste, color and smell of the water, and concentrations over 2 mg/L can cause digestive issues for some people (MDHHS, 2023). Manganese guidelines include concentrations in drinking water of less than 0.05 mg/L for

aesthetic reasons, and 0.3 mg/L to 1.0 mg/L for health reasons (EGLE, 2025). The EGLE (2025) fact sheet for manganese states, “The [EPA health advisory levels of 0.3 mg/L and 1 mg/L](#) were set based upon typical daily dietary manganese intake levels not known to be associated with adverse health effects. This does not imply that intakes above these levels will necessarily cause health problems.”

Common genera of iron oxidizing bacteria that can be present in wells include *Gallionella*, *Leptothrix* and *Crenothrix* (Gounot et al., 1994; Houben et al., 2003). They are found naturally in surface water and soil. If water from the surface leaks into a well, the bacteria may come along with it and begin to thrive if the right conditions are present. Iron bacteria and other naturally occurring groundwater bacteria can produce problematic slime or biofilms. This is a byproduct of the iron and manganese oxidation by bacteria. Biofilm deposits can clog pump intakes, well screens, filters, and water pipes. Biofouling can also occur in the aquifer near the well. Such fouling can occur rapidly if conditions change that favor bacterial growth and oxide precipitation.

Water Quality Impacts from Unnatural Aquifer Drawdown and Recovery

Drinking water wells are lined cylindrical penetrations from above into layers of saturated sand and gravel, or into bedrock that contains fractures and pore spaces (EGLE, 2023). Drilled wells are cased with steel or PVC, and water enters the well through slots or perforations in the saturated zone. Typically, a submerged pump lifts water from the well into the residence where it is treated in a variety of ways prior to entering the plumbing system. Most of the wells in Ann Arbor Charter Township near the MMM pit tap into saturated parts of the same glacial sand and gravel deposit that host the target material for the pit. This means that some of the groundwater that naturally flowed from the west and southwest toward Massey Lake and the tributaries that flow into and out of it would be intercepted by the pit, and then subsequently flow back into the aquifer on the east and northeast sides of the pit. Recent dewatering of the pit accelerated the flow of groundwater from the adjacent aquifer, dropping the water table and impacting upgradient wells. Subsequent termination of discharge from the pit in October 2023 began a period of slow aquifer recovery and rising water table conditions. Similar issues arise in the operations of pits, quarries, and mines more broadly ((Green et al., 2005; Muellegger et al., 2013; Karlović et al., 2023).

Figures 3 and 4 below are schematic representations of how the interactions between a drinking water well and the surrounding aquifer would change during periods of aquifer drawdown and recovery, assuming a consistent well pumping rate. Note that as the water level and aquifer thickness change, the horizontal distances and orientations of the flow paths from the aquifer to the well would also change. This means that the water entering the well and being pumped to the surface would be drawn from different aquifer areas with different sediment properties (e.g., more silt, more dissolved iron) that were not previously in equilibrium with well pumping conditions. If the pump had also been exposed to air periodically, it could have injected oxygen into the groundwater that it was pumping to the surface.



In addition to aquifer changes, the shifting water table could also impact the well itself. Sediment and debris that had built up in the bottom of the well over time could be mixed up into the pumping zone by the shifting water flow from the aquifer. Exposure of the well casing to air could cause steel elements to rust and rust flakes or sloughed coatings on the inside of the well to fall down the formerly submerged part of the well to the pumping zone. Shifting conditions could alter the well screen and the aquifer materials immediately adjacent to it, introducing new fine sediment or sand to the well. Drilling new wells or lowering pumps in existing wells would also change conditions such that a new equilibration period is necessary until water quality stabilizes in the new well and pump system.

Any of these changes in raw water quality can impact existing water treatment systems in homes, which may have been designed for different groundwater conditions or overwhelmed by sudden increases in dissolved constituents. This could require more frequent filter and media changes or possibly upgrading or replacement of treatment system components. Treatment systems consist of one or more of the following elements: water filtration, water softening, cation exchange, activated carbon adsorption, reverse osmosis, ozone treatment, and ultraviolet (UV) light treatment. Some components deal with the dissolved metals (e.g., iron and manganese), while others remove dissolved minerals (e.g., calcium carbonate), organic pollutants, and bacteria.

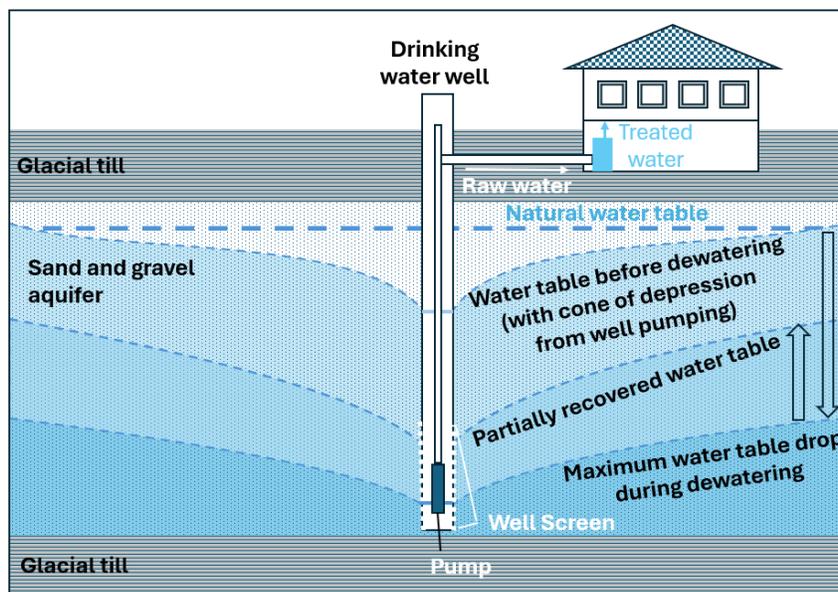


Figure 3. Schematic diagram of dewatering impacts on the aquifer water table and a drinking water well from aquifer drawdown associated with gravel pit dewatering, and subsequent recovery. The rapid drawdown would disturb the equilibrium conditions in the aquifer and well.



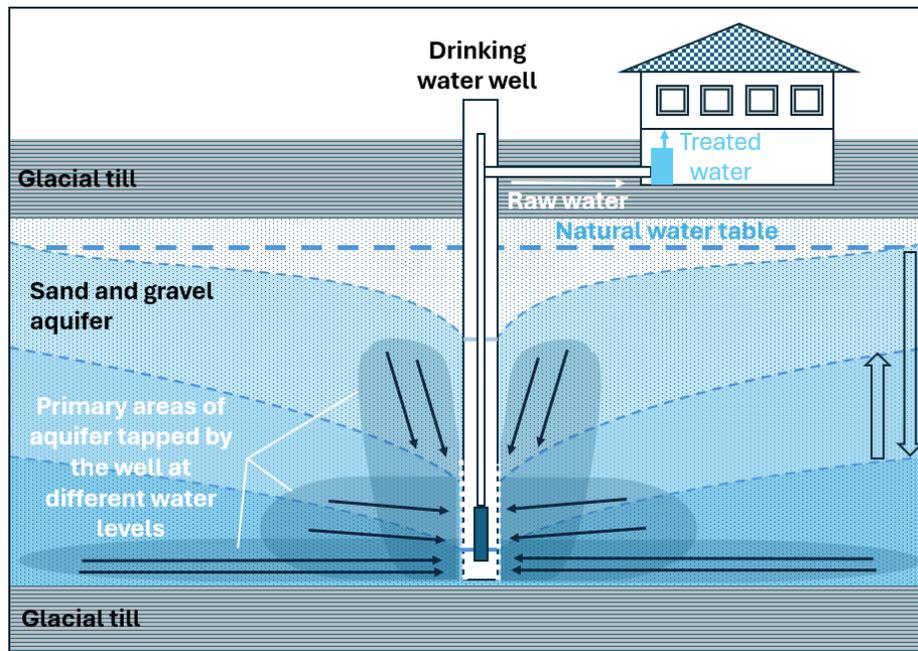


Figure 4. Modified version of Figure 3 showing changes in the aquifer areas from which the drinking water well draws water at different water table elevations.

Mitigation of Well Water Quality Impacts

Owners of wells and water treatment systems that potentially have been impacted by water quality changes associated with water table drawdown and extended recovery have several options to deal with their degraded well water quality. The first step would be to retain a water system professional to test the untreated well water for iron, manganese, and sulfur, among other constituents, in order to diagnose the source and nature of the existing problems. As described above, the ongoing problems may lie in the aquifer itself, in the well and pump system, or in the in-home water treatment system, even if the aquifer changes were the original source. As the aquifer recovers, it will take time for the aquifer, well, and treatment system to reach a new equilibrium. In the interim, it may be necessary to modify some or all parts of the system. Examples of mitigation actions could include one or more of the following:

- Temporarily removing the well pump, flushing out and sanitizing the well casing and well screen, cleaning the pump and piping, and replacing the pump in the well.
- Drilling and thoroughly developing a deeper well with a longer well screen and installing a new pump and piping.
- Increasing the frequency of replacement or backflushing of filter media and cation exchange media in the water treatment system.
- Upgrading or increasing the capacity of components of the water treatment system that deal with iron, manganese, and sediment (e.g., add multiple parallel filter chambers to the intake plumbing).

Individual homeowners should contact water treatment specialists who can diagnose the particular water quality issues at their home and propose solutions.



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