MEMORANDUM

OTWELL MAWBY, P.C.

To: Eric Ritchie

From: Roger Mawby, P.E.

Date: 8/3/17

Re: Elmer's-Proposed Bear Creek Township Gravel Mine-Hydrogeologic Evaluation

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Otwell Mawby was requested to provide an evaluation of the hydrogeology at a property proposed to be developed as a gravel/sand mining operation. The site is comprised of three parcels located in Bear Creek Township. Our evaluation included discussion with regulators including the MDEQ-Water Resources Division, the MDEQ-Remediation and Redevelopment Division and the Health Department of Northwest Michigan, Emmet County Environmental Health Division. We also obtained and reviewed available potable well logs from the surrounding area and test pit logs completed on the site by Elmer's.

The site consists of three parcels of land located in Bear Creek Township, Emmet County, Michigan, Section 26, Town 35 N Range 5W. The total site area is approximately 55 acres. The site is currently undeveloped, is predominately wooded and contained a drainage course running south to the north across the property. Some evidence of potential wetland area is located in the northeast quadrant of the site.

Review of the test pit logs provided by Elmers indicates a complicated/variable geology across this site. The logs indicate a significant presence of sand soil but also encountered inclusions or

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stratifications of clay and significant gravel or rock deposits. Wet or saturated soil conditions were encountered in many of the test pits and evidence of water perched at the surface is evident by the potential wetland areas located in the northeast quadrant of this site.

Review of several well logs for wells located along Pickerel Lake Road in the vicinity of the proposed gravel pit, indicate a complicated geology described as clay and rocks, clay and gravel, limestone, water sand and hard pan. Some of the wells are rock wells, situated in the underlying limestone bedrock and some of the wells are screened in a water bearing sand strata above the bedrock. Depths of the wells range from 46 to 140 feet for the logs that we reviewed along Pickerel Lake Road.

Review of the USGS Topographic Map for the area indicates a topography sloping downward in a northerly direction with eventual drainage to Round Lake and then eventually to Little Traverse Bay. We did not review specific information with regard to groundwater flow in the area but regional groundwater flow is in a northwesterly direction towards Round Lake and Little Traverse Bay/Lake Michigan. There could be localized groundwater hydrologic flow scenarios in the upper soil profile due to the complicated geology but given the topography in the vicinity of the site and the location of Little Traverse Bay, the regional aquifer flow would be in the westerly direction away from Pickerel Lake Road. Gravel mining operations would be in a downgradient direction from Pickerel Lake Road and are not expected to affect the groundwater quality of the Pickerel Lake Road wells.

We also reviewed available well logs for wells that were located along US-31, in a northerly direction or downgradient of the proposed gravel extraction activities. The majority of these wells were deeper wells. Well depths ranged from 99 feet to 320 feet. The majority of the wells appeared to be screened in the limestone bedrock and are considered rock wells, extracting water from an aquifer significantly below the proposed gravel extraction activities.

Extraction of gravel and sand from this site would be predominately from unsaturated soils although given the wet soil conditions that were observed in some of the test pits, perched

groundwater would likely be encountered and would need to be managed. This water at higher elevations typically 15 to 30 feet below the ground surface would not be considered a potable aquifer and it is not likely that any wells with well logs we observed along Pickerel Lake, Road would be screened in this aquifer. The shallow wells (46 to 140 feet) that we observed along Pickerel Lake are also upgradient from any gravel extraction operation and even if the aquifer were encountered during extraction activities we would not anticipate any impact or influence on the adjacent Pickerel Lake Road wells by extraction activities. Downgradient wells located to the north and west, typically along US-31, were screened much deeper typically in the lower limestone aquifer, significantly below where any extraction activities might encounter groundwater. As a result, we would not anticipate impact to the well water quality in downgradient or northerly located wells due to the proposed gravel mining.

Surface water drains across this site generally in a northerly direction towards US-31. As with any development or project, surface water would need to be collected and managed appropriately to accommodate rainfall, snowmelt and surface water runoff. Appropriate county and state soil erosion permitting will be submitted for and obtained prior to commencement of any activity on the site.

Potential wetlands and a drainage course are also noted to be located on the property. We have contacted the MDEQ –Water Resources Division and they indicated there was no information pertinent to the onsite drainage course being regulated but further evaluation would be required prior to the initiation of site development activities. If the drainage course is determined to be unregulated the future operation will allow for continued surface water drainage across the property. If the drainage course is determined to be regulated measures will be implemented to protect the drainage feature. Appropriate wetland delineation, and MDEQ permitting of any regulated wetlands, if required, will be completed prior to work on the site.