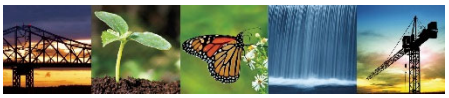

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December 21, 2023
File No. 20.0158210.00

Mr. Bryan Lindgren, Project Manager
Neumann Developments, Inc.
N27 W24025 Paul Court, Suite 100
Pewaukee, Wisconsin 53072-6239

Re: Groundwater Evaluation Summary
Proposed Thomas Farm Subdivision Development
Town of Delafield, Wisconsin

Dear Mr. Lindgren:

GZA GeoEnvironmental, Inc. (GZA), on behalf of Neumann Developments, Inc. (Neumann/"Client"), completed a groundwater evaluation for the Thomas Farm property in accordance with the Town of Delafield Ordinance. The purpose of GZA's services was to evaluate the potential for the proposed 183 domestic supply wells in the proposed development on the cumulative drawdown of groundwater. This document summarizes GZA's initial *Hydrogeologic Assessment Report*, dated March 24, 2023, and subsequent GZA correspondence with the Southeast Regional Planning Commission (SEWRPC), which are provided as **Attachments 1 through 4**, presenting the findings and conclusion of the evaluation. Detailed information about the evaluation completed by GZA can be referenced in the attached letters submitted to the Town of Delafield as part of the application process.

For the groundwater evaluation, GZA used an analytical solution to estimate the cumulative drawdown from groundwater pumping within the proposed development. For this evaluation, hydraulic properties of the aquifer were estimated using actual data from water wells in the area surrounding the Thomas Farm property, the number of people per household for Waukesha County as estimated from available demographic information, and water usage per capita as estimated based on the published range of per capita usage data. In addition, infiltration was estimated based on the actual stormwater modeling activities for the site, as confirmed by Waukesha County as part of the proposed development application review.

The cumulative drawdown of the wells was calculated using the Theis solution for Non-Leaky Confined Aquifers. The Theis solution is the most widely used and accepted solution for calculating drawdown. This analytical/mathematical solution was developed by Charles Theis in 1935, and is based on a set of generally accepted assumptions. While all of the assumptions in the equation may not be applicable to the aquifer in this area, GZA believes that the Theis solution is the most accurate option given both available and discoverable data, and should be used to evaluate the proposed development for the Thomas Farm property and to provide an estimate of the cumulative drawdown from pumping.

To estimate the groundwater drawdown from pumping at each well, GZA used available demographic information for the area and estimated the hydraulic aquifer properties from available well pumping data. The input parameters shown below were used in the Theis solution to calculate the drawdown from pumping wells:

- Number of People/Home = 3 people or 633 people in proposed development;
- Water Usage per Capita = 77 gallons/day or 231 gallons/home/day;

- Aquifer Transmissivity = 2,500 gallons per day per foot; and
- Duration = 50 years.

For the initial estimation of drawdown, GZA assumed there was a water well for each parcel in the proposed development and that there was no groundwater recharge. The well was assumed to be in a setback from roads and property lines and the estimated drawdown was calculated at the property line of each parcel. Based on these calculations, GZA concluded that an individual well serving the parcel would have an estimated drawdown at the property boundary of each parcel of approximately 0.25 to 0.8 feet. GZA concluded that this level of drawdown did not represent a significant drawdown that would affect the groundwater system.

Upon SEWRPC's review and recommendation, GZA completed further evaluation of the proposed development by calculating the cumulative impact to groundwater from water usage from the proposed development. The cumulative drawdown was evaluated using two scenarios: 1) no groundwater recharge; and 2) groundwater recharged based on infiltration estimates for the proposed development.

For the no groundwater recharge scenario of the cumulative drawdown evaluation, GZA grouped the individual parcels in the development into seven groupings based on their location. A well was assumed to be centrally located within each grouping and the amount of groundwater pumping at that hypothetical central well was based on the number of assumed people within that grouping. To evaluate the cumulative drawdown from the seven groupings at the boundary of the Thomas Farm property, 11 points were identified around the perimeter of the property. The drawdown from each well was calculated at each of the 11 points. The cumulative drawdown was calculated by summing the drawdowns at each point. Based on this method of calculating cumulative drawdown, the average drawdown was estimated to be approximately 17.80 feet at and decreasing from the property boundary. GZA and SEWRPC consider this drawdown to be a conservatively high estimate and should not be used for the proposed development because groundwater recharge in this scenario was assumed to be zero and it is agreed that there will be groundwater recharge in this area that limits the amount of drawdown.

GZA further evaluated cumulative drawdown assuming groundwater recharge. The recharge was estimated based on the amount of infiltration derived from stormwater modeling for the proposed development. The infiltration and stormwater modeling was completed by Trio Engineering and utilized actual soil boring data and included the preliminary recommendations made by the Senior Engineer for the Waukesha County Department of Parks and Land Use. The evaluation of cumulative drawdown when including groundwater recharge was performed using the same method described above. The estimated groundwater pumping was calculated for each well based on the number of people within the grouping and offset by the groundwater recharge of the area. The same 11 points around the boundary of the Thomas Farm property used above were then used to calculate cumulative drawdown. Based on this calculation, the average drawdown assuming infiltration and groundwater recharge was estimated to be approximately 4 to 5 feet at and decreasing from the property boundary.

To understand how the cumulative drawdown of the proposed development compared to the other existing developments around the Thomas Farm property, GZA evaluated the existing developments to the east and west and estimated the cumulative drawdown at the property boundary of those developments using the same methods. The hydraulic properties and a centrally located well for groundwater pumping were used along with information obtained from the WDNR Water Well Database and the demographic information. Based on this evaluation, the cumulative drawdown at the property boundary for the developments to the east and west is estimated to be approximately 7 to 14 feet. By comparison, the estimated cumulative drawdowns for the proposed Thomas Farm property, as presented above, are similar to or less than the adjacent developments.

Based on this groundwater evaluation, GZA concludes that the estimated cumulative drawdown at the property boundary of the Thomas Farm property is similar to the estimated cumulative drawdown for the existing surrounding developments. As such, the proposed development will have no further adverse impacts to the groundwater system than existing developments.

GZA appreciates the opportunity to provide this summary to Neumann. If you have questions or require additional information, please feel free to contact Kevin Hedinger at (262) 754-2578 or kevin.hedinger@gza.com.

Sincerely,

GZA GeoEnvironmental, Inc.

Kevin M. Hedinger
Senior Hydrogeologist

James F. Drought, P.H.
Principal Hydrogeologist

J:\158200to158299\158210 Town of Delafield\Report\GW Evaluation Summary\FINAL 20.0158210.00 GW Eval Summary_Town of Delafield WI 12-21-23.docx

Attached: *Hydrogeologic Assessment Report*, dated March 24, 2023
Response to SEWRPC Comments to GZA's Hydrogeologic Assessment Report, dated July 14, 2023
Response to SEWRPC Considerations, dated October 16, 2023
Email Response to SEWRPC Comments, dated November 28, 2023

ATTACHMENT 1

***Hydrogeologic Assessment Report*, dated March 24, 2023**

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March 24, 2023
File No. 20.0158210.00

Mr. Bryan Lindgren, Project Manager
Neumann Developments, Inc.
N27 W24025 Paul Court, Suite 100
Pewaukee, Wisconsin 53072-6239

Re: Hydrogeologic Assessment Report
Proposed Thomas Farm Subdivision Development
Town of Delafield, Wisconsin

Dear Mr. Lindgren:

In accordance with your request and authorization on February 27, 2023, GZA GeoEnvironmental, Inc. (GZA) is pleased to submit this Hydrogeologic Assessment Report to Neumann Developments, Inc. (Neumann/"Client") for the proposed Thomas Farm Subdivision Development ("Development") in the Town of Delafield, Waukesha County, Wisconsin. The proposed Development is located in the NE, SE, and SW ¼ of The United States Public Land Survey Section Number 23, Township 7 North, Range 18 East, Waukesha County, Wisconsin ("Site").

Neumann provided GZA with a proposed Development plan showing the layout and features of the Development, and the Town of Delafield Ordinance, Section 17.04 5. R., entitled "Planned Development District No. 1" ("Ordinance"), that is solely applicable to the Site and includes a requirement for a water study. It is understood that the Site covers an area of approximately 152 acres, which include 30.65 acres identified as a Primary Environmental Corridor (PEC) by the Southeastern Wisconsin Regional Planning Commission (SEWRPC), 10.11 acres identified as wetlands, and 111.24 acres available for development. The proposed Development plan includes 160 single-family, residential units and 28 condominium buildings with 56 individual units.

The objective of the water study identified in the Ordinance is to demonstrate that a private water supply will adequately serve the project and not adversely impact existing private wells in the area or other natural resources. The applicant also needs to demonstrate that the SEWRPC, Wisconsin Department of Natural Resources (WDNR), and the Lake Pewaukee Sanitary District were consulted on the anticipated water table impacts of the planned private water use. The Ordinance does not, however, provide means or methods for performing the water study or a specific minimum or maximum criteria for evaluating the impact to the water table.

The following sections of this report present information pertaining to the proposed subdivision, the geologic and hydrogeologic conditions of the Site, and an assessment of the impact to groundwater from the proposed subdivision. Note that Limitations to our evaluation are provided in **Attachment 1**.

BACKGROUND

As described above, the proposed Development is located in the NE, SE, and SW ¼ of The United States Public Land Survey Section Number 23, Township 7 North, Range 18 East, in the Town of Delafield, Waukesha County, Wisconsin. The Site covers approximately 152 acres on the northwest intersection of Golf Road and Elmhurst Road, which includes 30.65 acres identified as a PEC, 10.11 acres identified as wetlands, and 111.24 acres available for development. The

proposed Development plan includes 160 lots for single-family, residential units and 28 buildings with 56 duplex condominium units. The conceptual Development plan is provided as **Figure 1**.

The Site is located in a rural area with primarily single-family, residential properties immediately adjacent to the Site, a mixture of agricultural and limited commercial development south of the Site, and Pewaukee Lake to the north. Located north of the Site is East Glen Cove Road, beyond which are residential properties and Pewaukee Lake; located west of the Site are residential properties and Glen Cove Road, beyond which are additional residential properties; located south of the Site is Golf Road, beyond which is Wisconsin Veterans Memorial Highway (Interstate 94 [I-94]); and located east of the Site is Elmhurst Road, beyond which is Western Lakes Golf Course and residential properties.

TOPOGRAPHY AND HYDROLOGY

The Site is located in the center of Waukesha County within the southwestern extent of the Lake Michigan glacial lobe of the Laurentide Ice Sheet. Due to the glacial history, the region is characterized by various types of glacial deposits, including moraines, drumlins, kames, outwash plains, and lake basin deposits. Although there are small, internally-drained basins as a result of the kettles and pitted outwash across the undulating plain, the surface generally slopes eastward toward Lake Michigan.

Based on a review of the Hartland, Wisconsin Quadrangle of the United States Geological Survey (USGS) Topographic Map (1959), the elevation of the Site ranges from 880 feet above mean sea level (msl) along the north perimeter of the Site to 950 feet above msl on the southwest perimeter of the Site. The surface slope of the property is to the east and north. An unnamed, 0.5-acre pond is located on the center of the north Site boundary. Pewaukee Lake is located approximately 600 feet to the north side of East Glen Cove Road, Salow Lake is located approximately 0.4-mile south of the Site, Etter Lake is located approximately 1 mile southeast of the Site, Aubrey Creek is located approximately 0.5-mile west of the Site, and Zion Creek is located approximately 0.15-mile south of the Site. An unnamed pond exists approximately 230 feet northwest of the Site. Numerous unnamed ponds are located on the Western Lakes Golf Course property approximately 500 feet east of the Site, which are connected to Zion Creek. **Figure 2** is a map showing the topography of the Site and the surrounding area.

The Site is located within the 151 square-mile, Upper Fox River – Illinois watershed. Surface run-off and shallow percolating groundwater are expected to drain north toward and recharge Pewaukee Lake.

According to the Fish and Wildlife National Wetlands Inventory, Freshwater Forested/Shrub Wetlands are located on the Site, covering an area of approximately 18.54 acres. 11.05 acres of wetland, located in the center of the Site, are considered to be semi-permanently flooded, whereas 6.34 acres of wetlands along the northwest perimeter, and 1.15 acres oriented north-south along the northern area of the Site, are considered to be seasonally flooded.

Soil at the Site, as described by the Natural Resources Conservation Service (NRCS) on the Web Soil Survey website, consists of loam and silt loam from 0% to 30% slope. The specific soil classification units include the following:

Mapped Wetland on the Northeast Corner of the Site
(Fish and Wildlife NationalWetlands Invetory Mapper)

- BsA - Brookstone Silt Loam, 0% to 2% slopes, poorly-drained;
- HmB - Hochheim Loam, 2% to 6% slopes, well-drained;
- HmC2 - Hochheim Loam, 6% to 12% slopes, well-drained;
- KIA - Kendall Silt Loam, 1% to 3% slopes, somewhat poorly-drained;
- KwA - Knowles Silt Loam, 0% to 2% slopes, well-drained;
- KwB - Knowles Silt Loam, 2% to 6% slopes, well-drained;
- LmB - Lamartine Silt Loam, 0% to 3% slopes, somewhat poorly-drained;
- Lu - Loamy Land, moderately well-drained;
- MoB - Mayville Silt Loam, 2% to 6% slopes, moderately well-drained;
- RkB - Ritchey Silt Loam, 1% to 6% slopes, well-drained;
- RkE - Ritchey Silt Loam, 12% to 30% slopes, well-drained;
- ThA - Theresa Silt Loam, 0% to 2% slopes, well-drained;
- ThB - Theresa Silt Loam, 2% to 6% slopes, well-drained; and
- ThB2 - Theresa Silt Loam, 2% to 6% slopes, erode, well-drained.

Distribution of Soil Types Across the Site
(Well-drained Soils Shown in Yellow, Poorly-drained Soils Shown in Blue)
(NRCS Web Soil Survey).

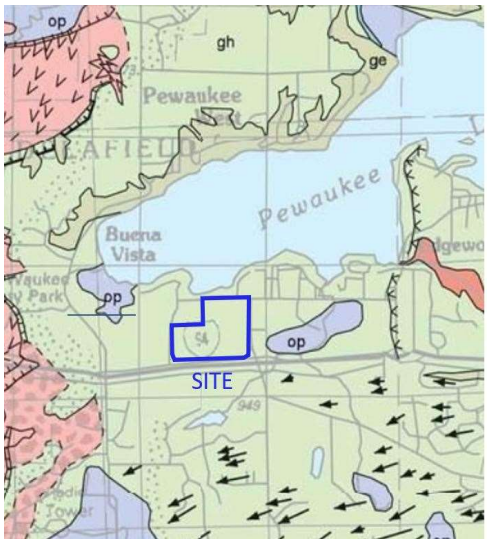
The majority of the soils are considered to be well-drained, indicating that water drains through the soils readily and free water is deep to very deep in the soil column. The soils on the central portion of the Site are considered poorly drained, indicating that the soils may exhibit frequent flooding or ponding.

REGIONAL GEOLOGIC AND HYDROGEOLOGIC CONDITIONS

Waukesha County is underlain by Precambrian-age crystalline rocks, Cambrian-age sandstone; Ordovician-age dolomite, sandstone, and shale; and Silurian-age dolomite. These consolidated deposits are overlain by quaternary-age glacial deposits deposited by the Green Bay and Lake Michigan glacial lobes during the last glacial period. Three principal aquifers are located in Waukesha County: 1) a shallow and locally discontinuous sand and gravel aquifer comprised of glacial deposits of Quaternary-age; 2) the Niagara Dolomite aquifer of Silurian-age; and 3) the Sandstone aquifer of Ordovician-Cambrian age. The Sandstone aquifer is hydrologically separated from the Niagara aquifer by the low-permeability Maquoketa Shale formation. The Sandstone aquifer is the primary water supply for municipal and industrial use and, to a lesser extent, residential use. The Sandstone aquifer incorporates the formations above the Pre-Cambrian crystalline rocks and below the Maquoketa Shale, which includes the Galena-Platteville unit, the St. Peter Sandstone, the Trempealeau Formation, and the Franconia, Galesville, Eau Claire, and Mount Simon Sandstones. The Sandstone aquifer coverage is continuous across the state; however, due to glacial erosion, the sand and gravel and Niagara aquifers do not exist in the central and southwestern portions of the County and the uppermost bedrock unit is the Maquoketa shale.

LOCAL GEOLOGIC AND HYDROGEOLOGIC CONDITIONS

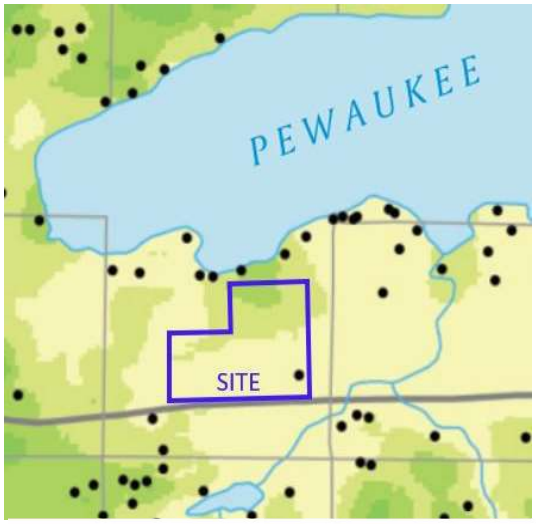
The USGS publication, Ground-Water Resources of Waukesha County (J. B. Gunther, 1975), identifies the glacial deposits in the vicinity of the Site as ground moraine. Ground moraine deposits predominantly consist of unsorted glacial till ranging in size from clay to boulders, but may contain lenses of stratified sand and gravel. Ground moraine deposits are characterized by gently undulating topography of low relief, with alternating small till mounds and depressions. Lee Clayton (2001) mapped the quaternary-age glacial deposits as sandy till of the Holy Hill Formation. The unconsolidated deposits at the Site are underlain by Ordovician-age Maquoketa Shale to the north and the Silurian-age Kankakee Dolomite to the south, as identified by K.M Massie-Ferch (2004). Massie-Ferch and R. M. Peters (2004) estimate the depth to bedrock in the proposed Development to be less than 50 feet below ground surface (bgs) on the south half of the Site and between 50 and 150 feet bgs on the north half of the Site.



Surface Geology Consisting of Sandy Till of the Holy Hill Formation (green)
(L. Clayton, 2001)

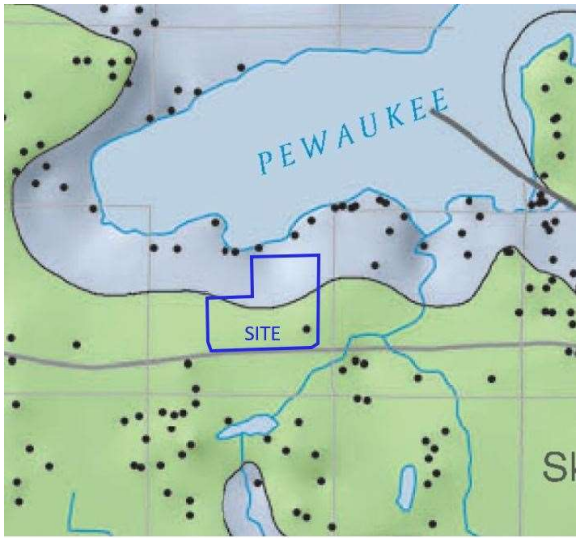
Based on a review of area well construction records, GZA prepared generalized geologic cross-section A-A' and B-B' oriented north-south and east-west, respectively. The approximate locations of the cross-sections are shown on Figure 3 and the geologic cross-sections are presented on Figures 4A and 4B. The well construction records used to prepare the cross-sections were obtained from the WDNR Water Well Database and are provided in **Attachment 2**. The Site is underlain by glacial till and isolated deposits of sand and gravel. Depth to bedrock is less than 10 feet on the northeastern and southeastern portions of the Site and more than 80 feet on the northwestern portion of the Site. According to the SEWRPC publication, A Lake Management Plan for Pewaukee Lake, Waukesha County, Wisconsin (2020), bedrock is exposed in an area east of Elmhurst Road, which borders the eastern perimeter of the proposed subdivision.

Due to the erosion of the Niagara Dolomite, the Maquoketa shale is the uppermost bedrock unit and is consistently encountered at depths between 3 and 81 feet bgs, which correspond to elevations between 939 and 791 feet above msl. The Maquoketa Shale is a low permeability shale formation that is fractured in the upper 100 feet and has interbedded limestone layers of the Fort Atkinson member up to 40 feet thick (Eaton et al., 2000; Gunther, 1975). Limestone is encountered on top of the Maquoketa Shale in wells located near the south end of the Site, consistent with Massie-Ferch (2004); however, GZA considers this overlying limestone to be part of the Maquoketa Shale due to the limestone's limited thickness, the absence of wells completed in the limestone, and the inability to distinguish the overlying limestone from interbedded limestone within the Maquoketa Shale. The Maquoketa Shale is not considered an aquifer in literature publications due to its low permeability, but is used for potable water supply in wells near the proposed development.



Depth to Bedrock Map of the Site Showing Increase From <50 ft (yellow) to 50-100 ft (light green) to 100-150 ft (dark green)
(Massie-Ferch and Peters, 2004).

The Galena-Platteville unit is the upper formation in the Sandstone aquifer and is encountered at depths between 145 and 269 feet bgs, which correspond to elevations between 750 and 629 feet above msl. The underlying St. Peter's sandstone is encountered at depths between 402 and 485 feet bgs, which correspond to elevations between 496 and 429 feet above msl. The geologic conditions and depth to bedrock obtained by GZA from available well logs are consistent with the published maps and descriptions noted above.



Bedrock Map of the Site Showing Silurian-age Kankakee Dolomite (green) and Ordovician-age Maquoketa Shale (blue)
(K.M. Massie-Ferch, 2004)

The depth to groundwater was recorded on the well logs within the Maquoketa Shale at depths between 5 and 125 feet bgs, corresponding to groundwater elevations between 922 and 791 feet above msl. Most private domestic wells in the area are completed within the Maquoketa Shale dolomite layers or in the deeper Sandstone aquifer.

WATER REQUIREMENTS OF THE SUBDIVISION

As shown on **Figure 1**, the proposed subdivision will consist of 28 condominium buildings and 155 single-family homes. For this assessment, GZA assumes that each single-family home will be serviced by a private water supply well; each home will be serviced by municipal sanitary sewer, not private septic systems; and there are limited stormwater controls within the proposed subdivision that could promote infiltration and recharge to the groundwater system. For the condominiums, the assumptions are the same as the single-family properties and that each building (two units) will be serviced by a single well. Based on the Development plan, it is assumed that there will be a total of 183 privately owned water supply wells.

Based on a review of the US Census' five-year estimate (2017-2021) demographics for the Town of Delafield, each home has an average of 2.75 individuals, which translates into a total population for the subdivision of approximately 580 individuals. The USGS estimated that in 2015, the water usage per capita for self-supplied domestic sources was 77 gallons per capita per day (gpcd). Using a water use of 77 gpcd, the average total daily groundwater withdrawal for the subdivision is estimated to be 44,660 gallons per day (gpd) or about 31 gallons per minute (gpm).

For this evaluation, GZA used a conservative value of three individuals per single-family home and condominium unit, or a total population of 633 individuals, and water usage per capita of 125 gpcd. Using these assumptions, the total water usage of each single-family home well is 375 gpd or 0.26 gpm, and for each condominium building, 750 gpd or 0.52 gpm. In addition, this evaluation will assume that there is no infiltration or recharge to the bedrock aquifer system due to the low permeability (hydraulic conductivity) of the Maquoketa Shale. These assumptions will provide a conservatively high estimation of the influence from the groundwater pumping in the proposed subdivision on the groundwater system, which will reduce underestimating the calculated drawdown and will account for potential variation in the total population exceeding the average household size.

ESTIMATE OF POTENTIAL OF PUMPING IMPACT

It is GZA's understanding that there are no existing municipal codes relating to groundwater drawdown that are required to be met for this evaluation. To evaluate the potential hydrogeologic impact of the proposed residential subdivision on the local groundwater resources, GZA calculated the drawdown at the property boundary for the single-family and multi-family properties based on a continuous pumping scenario for each well over a 50-year period. The drawdown was calculated without considering the return of water to the groundwater system through stormwater retention or recharge.

For the single- and multi-family scenarios, the well locations were assumed based on typical setbacks from roads and the location of the buildings on the property. The wells were placed in locations to minimize the distance from the property boundary and maximize the calculated drawdown. For the single-family properties, the wells were assumed to be 30 feet from the property boundary, adjacent to the road in the center of the property boundary. For the condominiums, the wells were assumed to be between the buildings near the center of the building because the piping would need to service both units. In addition to calculating the drawdown at the setback distances above, the drawdown was also calculated at the midpoint between neighboring wells to determine the cumulative drawdown effect at the intersection of each well's cone of depression.

For the single-family homes, the lot sizes range from 0.22- to 0.38-acre and are generally rectangular in shape. The low-density lots in Zone 1 range from 0.47- to 0.54-acre. The actual location and size of the homes on each lot are unknown, therefore, a conservative well location close to the property boundary was assumed to be a location 30 feet from the road in the center of the property boundary adjacent to the road. By assuming the well at this location, the well will be at the minimum setback distance from the road; however, it is possible that the well could be placed at a distance greater than 30 feet from the closest property boundary based on the lot sizes and the side and rear setbacks. As shown on **Figure 5**, the distance from the well and the intersection of the neighboring property boundary is estimated to be approximately 40 feet. These same dimensions were applied to the larger lots in Zone 1, even though a greater distance could be assumed.

For the condominiums, the Site on the Development plan is not divided into individual parcels for each building, but rather, the condominiums are located within a single parcel. The well location was assumed to be between each building and the distance between the well location and the closest property boundary was assumed to be approximately 60 feet to the north or south. As shown on **Figure 5**, the distance from the well and the intersection of the neighboring property well is estimated to be approximately 50 feet, as they are approximately 100 to 110 feet apart. At the intersection of two neighboring wells, the drawdown is assumed to be cumulative.

The drawdown at the critical distance radius to the property line for each location was calculated using the Theis non-equilibrium well equation:

$$s = \frac{114.6 * Q}{T} * W(u) \qquad (1)$$

Where:

s = drawdown
Q = discharge, gpm
T = transmissivity, gallons per day per foot (gpd/ft)
W(u) = well function

The well function, W(u), is approximated by the following equations:

$$W(u) = -0.577216 \mp \ln u - \frac{u}{2 * 2!} + \frac{u}{3 * 3!} - \frac{u}{4 * 4!} \qquad (2)$$

and:

$$u = \frac{1.87 * r^2 * S}{T * t} \qquad (3)$$

Where:

r = distance from the discharging well, ft
t = length of pumping time, days
S = storage coefficient, unitless

The aquifer is assumed to be confined and, as such, the storage coefficient was determined based on the following equations:

$$S = b * Ss \qquad (4)$$

Where:

b = aquifer thickness, ft
Ss = specific storage, ft^{-1}

Specific storage values for the Maquoketa Shale range between 3.7 x 10^{-9} ft^{-1} and 8.5 x 10^{-7} ft^{-1} based on laboratory pulse-decay testing of unfractured rock core (Eaton et al., 2000). GZA calculated the average storage coefficient to be 7.13 x 10^{-5} ft^{-1}. This does not consider the likelihood of fractures within the upper 100 feet of the Maquoketa Shale; therefore, this is a conservatively low estimate of effective porosity to ensure the calculated drawdown is not underestimated. Based on WDNR well logs, the aquifer thickness is likely 167 feet, which aligns with literature values for average thickness of 160 to 215 feet (Foley et al., 1953).

Based on the Theis equation, the only variable that cannot be estimated from the literature review or development plan is transmissivity. GZA utilized the method described in the paper by Bradbury and Rothschild (1985) to estimate transmissivity from specific capacity data using an iterative spreadsheet method. The equation to calculate the transmissivity considering partial penetration and well loss is shown in equation 6 below.

$$T = \frac{Q}{4 * \pi * (s - s_w)} * \left[ln\left(\frac{2.25 * T * t}{{r_w}^2 * S}\right) + 2 * s_p \right] \qquad (6)$$

Where:

s_p = partial penetration factor
s_w = well loss

The equation for calculating the partial penetration factor is as follows:

$$s_p = \frac{1 - \frac{L}{b}}{\frac{L}{b}} * \left(ln\frac{b}{r_w} - G * \left\{\frac{L}{b}\right\} \right) \qquad (7)$$

Where:

L = length of open interval
b = aquifer thickness
G = a function of L/b defined by $G\left\{\frac{L}{b}\right\} = 2.948 - \left(7.363 * \frac{L}{b}\right) + \left(11.447 * \left\{\frac{L}{b}\right\}^2\right) - \left(4.675 * \left\{\frac{L}{b}\right\}^3\right)$

In equation 6, transmissivity is on both sides of the equation, so the transmissivity cannot be calculated directly. The value for transmissivity was estimated iteratively until the difference in calculated consecutive transmissivity values was less than 0.0001 or until a maximum of 1,000 iterative calculations were completed. The difference of 0.0001 was reached prior to 1,000 iterations for each well.

A total of 148 well construction logs were retrieved from the WDNR Well Driller Viewer for Section number 23, Township 7 North, Range 18 East of The United States Public Land Survey. Of the 148 well logs, 39 were disregarded due to lack of

drawdown information noted on the pumping test section of the well construction record. Of the 109 remaining records, seven wells (6.5%) were completed in surficial, isolated sand and gravel deposits, 80 wells (73%) were completed in the underlying Maquoketa Shale formation, 15 wells (14%) were completed in the underlying Galena-Platteville unit of the Sandstone aquifer, and seven (6.5%) wells were completed in the St. Peters sandstone unit of the Sandstone aquifer. For this evaluation, GZA assumed that the proposed subdivision wells will be completed within the Maquoketa Shale because: 1) the sand and gravel deposits are considered too sparse and isolated to support the water supply of the proposed subdivision; 2) 80 out of 109 wells in the vicinity of the Site are completed in the Maquoketa Shale; and 3) the depth of the underlying Sandstone aquifer may not be economical for the subdivision. The Maquoketa Shale is not considered an aquifer, however, can transmit considerable amounts of water from overlying formations where fractures and dolomite interbeds are present.

Of the remaining 109 well records, 80 wells were deemed representative for this analysis of hydraulic properties, which included wells within the immediate vicinity and those completed within the Maquoketa Shale. The specific capacity data from a total of 80 well construction records were reviewed, and the transmissivity was estimated. **Table 1** presents the well data reviewed and the estimated transmissivity calculated for each well.

The geometric mean of the estimated transmissivity values for the 80 wells was calculated to be approximately 7,920 gpd/ft. Over 50% of the transmissivity values are 7,500 gpd/ft or less and over 25% are 2,500 gpd/ft or less. For this evaluation, GZA used the lower transmissivity value of 2,500 gpd/ft as a conservative value. Using this value, the hydraulic conductivity can be calculated by dividing the transmissivity by the aquifer thickness. Based on the WDNR well logs, the average thickness of the Maquoketa Shale is approximately 167 feet. Dividing the transmissivity by 167 feet results in an estimated hydraulic conductivity of 1.39×10^{-3} feet per minute (ft/min) or 2.32×10^{-5} feet per second (ft/sec). This hydraulic conductivity value is consistent with and in the range for literature values for Maquoketa Shale (Eaton and Bradbury, 1998).

Using the values estimated in the discussion above, drawdown was calculated using the Theis equation presented in equations 1, 2, and 3 for the appropriate critical distances estimated for the single-family homes and condominiums. Below is a summary of the values used for each of the different drawdown scenarios.

Variable	Single-Family		Multi-Family Condominium Buildings	
	Drawdown at Nearest Property Boundary	**Drawdown With Neighboring Property Well Considering Cumulative Drawdown From Intersecting Cones of Depression**	**Drawdown at Nearest Property Boundary**	**Drawdown With Neighboring Property Well Considering Cumulative Drawdown From Intersecting Cones of Depression**
Per Capita Home	3	3	6	6
Daily Water Use, gpd	125	125	125	125
Well Discharge	375 gpd / 0.26 gpm	375 gpd / 0.26 gpm	750 gpd / 0.52 gpm	750 gpd / 0.52 gpm
Critical Distance, ft	**30**	**40**	**60**	**50**
Storage, unitless	0.0000713	0.0000713	0.0000713	0.0000713
Transmissivity, gpd/ft	2,500	2,500	2,500	2,500
50-Year Pumping Period, days	18,250	18,250	18,250	18,250
Aquifer Thickness, ft	167	167	167	167
Saturated Screen Length, ft	3	3	3	3
Well Radius, ft	0.25	0.25	0.25	0.25
Drawdown at Critical Distance	**0.23 feet 2.75 inches**	**0.44 feet 5.0 inches**	**0.42 feet 5.10 inches**	**0.87 feet 9.60 inches**

Based on GZA's review of the available information in the Ordinance that requires this groundwater study, it does not state an acceptable standard by which to evaluate the effect of the proposed development on the groundwater due to pumping. In GZA's experience, the Village of Richfield in Washington County has a Groundwater Protection Ordinance that specifically states that "…drawdown at the property boundary shall not exceed one foot…" and that "…the drawdown at any perennial stream, wetland or lake shall not exceed 1/2 foot." These criteria seem reasonable for evaluating the effect on groundwater and represented the criteria used to evaluate the effect of the proposed development on the groundwater and surface water due to pumping.

The calculated drawdown for the different types of proposed buildings indicates that the impact to the groundwater system by the proposed development at the property boundary of each lot is less than 1 foot and at the intersection of the cones of depression between adjacent wells where drawdown is cumulative. The calculated drawdown is considered a conservatively high value based on the assumptions presented above, including an increase in the per capita capacity of the household and the increase in the water usage per building per capita. In addition, the calculated drawdown assumed no groundwater recharge from surface water infiltration from stormwater features that would have the effect of minimizing the drawdown.

An evaluation of the surface water or natural resources indicates that these features are protected from the groundwater withdrawal. A review of the water well logs indicates that the water wells in this area are predominantly withdrawing water from the underlying bedrock, not the shallow glacial deposits. The shallow glacial deposits are classified as well-drained soils, indicating that the soils in this area have a moderate to high recharge potential. Although the shallow glacial deposits have a recharge potential, the underlying Maquoketa Shale act as an aquitard and the change in permeability between the overlying glacial deposits and the Maquoketa Shale limits the vertical hydraulic communication between perched water, such as wetland and ponds and the underlying aquifers. Therefore, the pumping in the Maquoketa Shale will not cause the water level in the surface water features to be affected. The surface water features are not in direct communication with the groundwater pumping, therefore, the proposed development will not impact the surface water features such as wetlands, ponds, and streams, and drawdown at these features due to groundwater pumping is considered to be negligible to non-existent.

CONCLUSIONS

Based on a review of the proposed subdivision, available published literature, and well construction records from the WDNR, GZA was able to gain an understanding of the water requirements and underlying aquifer conditions that form the basis of this evaluation. GZA used the Theis non-equilibrium well equation to determine drawdown at the nearest property boundary, as well as the cumulative drawdown at the intersection of each well's cone of depression for both the single-family and multi-family living scenarios. Based on calculations of drawdown over a 50-year pumping period, assuming no recharge to the groundwater system and using very conservative assumptions for water use, the maximum drawdown calculated at the closest property boundary is less than 3 inches and the cumulative drawdown at the intersection of each well's cone of depression is less than 10 inches. Based on GZA's interpretation of the calculated drawdown, it does not represent a significant drawdown that will affect the groundwater system. The proposed subdivision will not affect the local groundwater resources or recharge to Pewaukee Lake because the shallow groundwater in the glacial deposits has very limited hydraulic communication to the underlying bedrock aquifer due to the presence of Maquoketa Shale. The private well systems for this subdivision should be capable of supporting the subdivision without environmental impairment to groundwater or surface water features.

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CLOSING

GZA appreciates the opportunity to provide this professional evaluation to Neumann. If you have questions or require additional information, please feel free to contact Ms. Sheryl Stephenson at (262) 202-1716 or Mr. Kevin Hedinger at (262) 424-1761.

Sincerely,

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Attachments: Table 1
Figures 1 through 5
Limitations
Well Construction Records

TABLES

TABLE 1
WELL DATA
Town of Delafield, Wisconsin

Address	Install Date	Unique ID	Well Diameter (inches)	Well Depth (ft bgs)	Well Screen (Top) (ft bgs)	Well Screen (Bottom) (ft bgs)	Initial Water Level (ft bgs)	Pumping Water Level (ft bgs)	Pumping Rate (gpm)	Duration (hours)	Storage Coefficient (S)	Well Loss Coefficient (C)	Aquifer Thickness	Measured drawdown (ft)	Saturated Screen Length (ft)	Well Loss (Sw) (ft)	Partial Penetration Parameter (sp)	Specific Capacity (gpm/ft)	T0	Transmissivity (ft2/min)	1st term	2nd term	K (ft/sec)
MAQUOKETA																							
W296 N1926 GLEN COVE ROAD	5/22/1976	8KN577	6	143			43	48	10	3	7.1284E-05	4.38E-09	167	5	3	2.81783E-05	201.44	2	9.00840	9.00840	2.13E-02	423.40	0.000899042
N20W29612 GLEN COVE RD	1/30/1970	8NM374	6	80			21	26	10	9	7.1284E-05	4.38E-09	167	5	3	2.81783E-05	201.44	2	9.03183	9.03183	2.13E-02	424.51	0.00090138
N20W29536 GLEN COVE ROAD	10/12/1968	8NM376	6	265			5	100	8	8	7.1284E-05	4.38E-09	167	95	3	1.80341E-05	201.44	0.084211	0.37734	0.37734	8.96E-04	421.21	3.76582E-05
W92N2015 ELMHURST DRIVE	7/8/2021	AAK300	6	142			38	100	10	1	7.1284E-05	4.38E-09	167	62	3	2.81783E-05	201.44	0.16129	0.72026	0.72026	1.72E-03	419.78	7.18823E-05
N20 W29352 OAKTON RD	10/19/1993	GF227	6	68			11	18	20	18	7.1284E-05	4.38E-09	167	7	3	0.000112713	201.44	2.857143	12.93474	12.93474	3.04E-02	425.56	0.001290892
N18 W29022 GOLF RDG S	4/9/1993	GF527	6	245			90	200	10	4	7.1284E-05	4.38E-09	167	110	3	2.81783E-05	201.44	0.090909	0.40675	0.40675	9.67E-04	420.59	4.05941E-05
N18W28987 GOLF RIDGE SOURT	7/16/1993	GI594	6	221			40	160	7	1	7.1284E-05	4.38E-09	167	120	3	1.38074E-05	201.44	0.058333	0.25986	0.25986	6.21E-04	418.76	2.59343E-05
W299 N1848 WIND RIDGE CT	3/19/1994	GM165	6	191			65	78	11	1.3	7.1284E-05	4.38E-09	167	13	3	3.40958E-05	201.44	0.846154	3.79593	3.79593	9.00E-03	421.70	0.000378835
N18 W29926 CROOKED CREEK RD	12/17/1993	GM196	6	199			40	160	2	1.25	7.1284E-05	4.38E-09	167	120	3	1.12713E-06	201.44	0.016667	0.07406	0.07406	1.77E-04	417.73	7.39153E-06
N18 W29838 CROOKED CREEK RD	11/16/1993	GM199	6	192			33	160	3.5	1	7.1284E-05	4.38E-09	167	127	3	3.45185E-06	201.44	0.027559	0.12255	0.12255	2.93E-04	418.01	1.22304E-05
N18 W29845 CROOKED CREEK RD	8/14/1995	HD929	6	210			35	120	7	4	7.1284E-05	4.38E-09	167	85	3	1.38074E-05	201.44	0.082353	0.36838	0.36838	8.76E-04	420.50	3.67648E-05
N18 W29085 GOLF RIDGE S	12/10/1993	HM183	6	285			70	240	6	4	7.1284E-05	4.38E-09	167	170	3	1.01442E-05	201.44	0.035294	0.15756	0.15756	3.75E-04	419.65	1.57245E-05
N18 W29019 GOLF RIDGE S	12/7/1993	HM722	6	165			46	80	15	5	7.1284E-05	4.38E-09	167	34	3	6.34013E-05	201.44	0.441176	1.98243	1.98243	4.69E-03	422.40	0.000197848
N19 W28998 GOLF RIDGE N	12/9/1993	HM728	6	245			66	140	9	5	7.1284E-05	4.38E-09	167	74	3	2.28245E-05	201.44	0.121622	0.54484	0.54484	1.29E-03	421.11	5.43749E-05
N18 W29059 GOLF RDG S	5/2/1994	HR773	6	245			24	165	5	5	7.1284E-05	4.38E-09	167	141	3	7.04458E-06	201.44	0.035461	0.15839	0.15839	3.77E-04	419.87	1.58075E-05
W299 N1853 WINDRIDGE CT	5/27/1994	HR800	6	205			64	145	8	5	7.1284E-05	4.38E-09	167	81	3	1.80341E-05	201.44	0.098765	0.44223	0.44223	1.05E-03	420.90	4.41344E-05
W298 N1864 LOST TREE CT	7/27/1994	HT523	6	195			45	168	4.5	1.5	7.1284E-05	4.38E-09	167	123	3	5.70611E-06	201.44	0.036585	0.16296	0.16296	3.89E-04	418.70	1.6263E-05
N18 W29856 CROOKED CREEK RD	7/19/1994	HT524	6	196			33	55	12	1	7.1284E-05	4.38E-09	167	22	3	4.05768E-05	201.44	0.545455	2.44288	2.44288	5.80E-03	421.00	0.0002438
W299 N1828 WINDRIDGE CT	10/4/1994	HT561	6	190			55	90	10	1	7.1284E-05	4.38E-09	167	35	3	2.81783E-05	201.44	0.285714	1.27763	1.27763	3.04E-03	420.35	0.000127508
N18 W29925 CROOKED CREEK RD	8/29/1994	HT566	6	193			44	160	3	1.5	7.1284E-05	4.38E-09	167	116	3	2.53605E-06	201.44	0.025862	0.11510	0.11510	2.75E-04	418.35	1.14867E-05
W299 N1877 WINDRIDGE CT	10/3/1994	HT585	6	186			52	67	10	1	7.1284E-05	4.38E-09	167	15	3	2.81783E-05	201.44	0.666667	2.98717	2.98717	7.09E-03	421.20	0.000298121
N19 W29056 GOLF RDG N	6/6/1994	HT864	6	205			58	125	15	5	7.1284E-05	4.38E-09	167	67	3	6.34013E-05	201.44	0.223881	1.00439	1.00439	2.38E-03	421.72	0.000100239
N18W29054 GOLF RIDGE SOUTH	11/6/1995	HU441	6	192			58	120	15	72	7.1284E-05	4.38E-09	167	62	3	6.34013E-05	201.44	0.241935	1.09247	1.09247	2.57E-03	424.47	0.000109029
N20W29316 OAKTON RD	3/7/1995	HU445	6	85			18	40	20	30	7.1284E-05	4.38E-09	167	22	3	0.000112713	201.44	0.909091	4.10940	4.10940	9.67E-03	424.92	0.00041012
N18 W29822 CROOKED CREEK RD	7/18/1994	HW624	6	205			56	145	10	5	7.1284E-05	4.38E-09	167	89	3	2.81783E-05	201.44	0.11236	0.50325	0.50325	1.20E-03	421.03	5.02245E-05
W299 N1866 WINDRIDGE CT	4/11/1995	IE527	6	188			50	83	11	1	7.1284E-05	4.38E-09	167	33	3	3.40958E-05	201.44	0.333333	1.49112	1.49112	3.55E-03	420.51	0.000148814
N18 W29887 CROOKED CREEK RD	2/20/1995	IF101	6	345			108	280	10	4	7.1284E-05	4.38E-09	167	172	3	2.81783E-05	201.44	0.05814	0.25986	0.25986	6.18E-04	420.15	2.59337E-05
N19 W29015 GOLF RIDGE N	4/28/1995	II160	6	225			73	125	20	3	7.1284E-05	4.38E-09	167	52	3	0.000112713	201.44	0.384615	1.72562	1.72562	4.09E-03	421.75	0.000172217
N18 W 29582 CROOKED CREEK	12/6/1996	KB124	6	210			8	80	8	2	7.1284E-05	4.38E-09	167	72	3	1.80341E-05	201.44	0.111111	0.49656	0.49656	1.18E-03	420.10	4.95568E-05
N18 W29543 CROOKEN CREEK RD	10/29/1997	KB792	6	210			17	80	8	1.5	7.1284E-05	4.38E-09	167	63	3	1.80341E-05	201.44	0.126984	0.56729	0.56729	1.35E-03	419.95	5.66155E-05
N18 W29521 CROOKED CREEK RD	5/13/1996	KM561	6	188			21	91	10	1	7.1284E-05	4.38E-09	167	70	3	2.81783E-05	201.44	0.142857	0.63776	0.63776	1.52E-03	419.66	6.36487E-05
W298 N1857 LOST TREE CT	8/29/1996	KM594	6	191			45	82	10	1.5	7.1284E-05	4.38E-09	167	37	3	2.81783E-05	201.44	0.27027	1.20958	1.20958	2.88E-03	420.70	0.000120717
N18 W29082 S GOLF RIDGE	1/26/1996	KO745	6	145			57	80	20	4	7.1284E-05	4.38E-09	167	23	3	0.000112713	201.44	0.869565	3.91164	3.91164	9.25E-03	422.86	0.000390383
N19 W29079 GOLF RIDGE N	12/5/1995	KQ085	6	245			115	200	3.5	3	7.1284E-05	4.38E-09	167	85	3	3.45185E-06	201.44	0.041176	0.18376	0.18376	4.38E-04	419.51	1.83394E-05
N18 W29612 CROOKED CREEK RD	8/22/1996	KZ997	6	185			37	80	20	3	7.1284E-05	4.38E-09	167	43	3	0.000112713	201.44	0.465116	2.08774	2.08774	4.95E-03	421.94	0.000208357
W298 N1889 LOST TREE CT	11/4/1996	LJ614	6	190			54	148	9	2	7.1284E-05	4.38E-09	167	94	3	2.28245E-05	201.44	0.095745	0.42773	0.42773	1.02E-03	419.95	4.2688E-05
W296 N1734 HIDDEN CREEK CT	12/24/1997	LT222	6	203			20	105	12	2	7.1284E-05	4.38E-09	167	85	3	4.05768E-05	201.44	0.141176	0.63128	0.63128	1.50E-03	420.34	6.30023E-05
W299 N1884 WINDRIDGE CT	5/7/1997	LU761	6	185			51	80	30	3	7.1284E-05	4.38E-09	167	29	3	0.000253605	201.44	1.034483	4.65226	4.65226	1.10E-02	422.74	0.000464298
N19 W29028 GOLF RIDGE NORTH	6/11/1997	LV116	6	247			66	247	2	2.5	7.1284E-05	4.38E-09	167	181	3	1.12713E-06	201.44	0.01105	0.04914	0.04914	1.18E-04	418.01	4.90378E-06
N18 W29873 CROOKED CREEK RD	8/25/1997	LV163	6	207			33	145	5	1.5	7.1284E-05	4.38E-09	167	112	3	7.04458E-06	201.44	0.044643	0.19894	0.19894	4.75E-04	418.90	1.98542E-05
N20 W29624 E GLEN COVE RD	10/28/1997	LV188	6	183			23	125	6	2	7.1284E-05	4.38E-09	167	102	3	1.01442E-05	201.44	0.058824	0.26249	0.26249	6.26E-04	419.46	2.61961E-05
W295 N1738 PRAIRIE WOODS	7/18/1997	LW273	6	105			11	40	20	4	7.1284E-05	4.38E-09	167	29	3	0.000112713	201.44	0.689655	3.10063	3.10063	7.34E-03	422.63	0.000309444
W296 N1763 HIDDEN CREEK CT	7/11/1997	LW665	6	185			35	105	15	2	7.1284E-05	4.38E-09	167	70	3	6.34013E-05	201.44	0.214286	0.95915	0.95915	2.28E-03	420.76	9.57237E-05
W295 N1777 PRAIRIE WOOD CT	10/31/1997	MC482	6	125			33	60	15	4	7.1284E-05	4.38E-09	167	27	3	6.34013E-05	201.44	0.555556	2.49644	2.49644	5.91E-03	422.41	0.000249146
W295 N1806 PRAIRIE WOOD CT	6/30/1998	MK142	6	220			23	150	4.5	1	7.1284E-05	4.38E-09	167	127	3	5.70611E-06	201.44	0.035433	0.15766	0.15766	3.77E-04	418.26	1.57343E-05
N16 W29838 BROOKSTONE CIR	9/4/1998	MQ079	6	225			58	185	2	3	7.1284E-05	4.38E-09	167	127	3	1.12713E-06	201.44	0.015748	0.07012	0.07012	1.68E-04	418.55	6.99785E-06
N16 W29867 BROOKSTONE CIR	5/19/1999	MW364	6	219			42	131	10	2	7.1284E-05	4.38E-09	167	89	3	2.81783E-05	201.44	0.11236	0.50215	0.50215	1.20E-03	420.11	5.0115E-05
N16 W29926 BROOKSTONE DR	6/3/1999	MW380	6	221			52	70	15	2	7.1284E-05	4.38E-09	167	18	3	6.34013E-05	201.44	0.833333	3.74211	3.74211	8.87E-03	422.12	0.000373464
N16 W29816 BROOKSTONE CIR	8/12/1999	MW410	6	212			33	63	14	1	7.1284E-05	4.38E-09	167	30	3	5.52295E-05	201.44	0.466667	2.08924	2.08924	4.96E-03	420.84	0.000208507
W296 N1779 HIDDEN CREEK CT	2/4/1999	NC801	6	205			36	160	6	3	7.1284E-05	4.38E-09	167	124	3	1.01442E-05	201.44	0.048387	0.21602	0.21602	5.15E-04	419.67	2.15593E-05
N18 W29604 CROOKED CRK	2/26/1999	ND269	6	260			11	210	5	1	7.1284E-05	4.38E-09	167	199	3	7.04458E-06	201.44	0.025126	0.11170	0.11170	2.67E-04	417.92	1.1148E-05
W299 N1831 WINDRIDGE CT	6/11/1999	NI344	6	225			65	200	3.5	2	7.1284E-05	4.38E-09	167	135	3	3.45185E-06	201.44	0.025926	0.11546	0.11546	2.76E-04	418.64	1.15231E-05
N16 W29819 BROOKSTONE CIR	6/8/2004	NS844	6	205			96	165	10	4	7.1284E-05	4.38E-09	167	69	3	2.81783E-05	201.44	0.144928	0.64917	0.64917	1.54E-03	421.06	6.47872E-05
N18 W29609 CROOKED CRK	4/27/2000	NU070	6	100			26	58	40	12	7.1284E-05	4.38E-09	167	32	3	0.000450853	201.44	1.25	5.64251	5.64251	1.33E-02	424.32	0.000563125
N16 W29914 BROOKSTONE CIR	2/24/2000	NV795	6	225			50	165	4	2	7.1284E-05	4.38E-09	167	115	3	4.50853E-06	201.44	0.034783	0.15501	0.15501	3.70E-04	418.94	1.54704E-05
N16 W29883 BROOKSTONE CIR	3/28/2000	NW115	6	210			57	80	10	1	7.1284E-05	4.38E-09	167	23	3	2.81783E-05	201.44	0.434783	1.94617	1.94617	4.63E-03	420.77	0.000194229
N18 W29629 CROOKED CREEK RD	5/11/2000	NW137	6	190			14	190	7	1.5	7.1284E-05	4.38E-09	167	176	3	1.38074E-05	201.44	0.039773	0.17719	0.17719	4.23E-04	418.78	1.76834E-05

TABLE 1
WELL DATA
Town of Delafield, Wisconsin

Address	Install Date	Unique ID	Well Diameter (inches)	Well Depth (ft bgs)	Well Screen (Top) (ft bgs)	Well Screen (Bottom) (ft bgs)	Initial Water Level (ft bgs)	Pumping Water Level (ft bgs)	Pumping Rate (gpm)	Duration (hours)	Storage Coefficient (S)	Well Loss Coefficient (C)	Aquifer Thickness	Measured drawdown (ft)	Saturated Screen Length (ft)	Well Loss (Sw) (ft)	Partial Penetration Parameter (sp)	Specific Capacity (gpm/ft)	T0	Transmissivity (ft2/min)	1st term	2nd term	K (ft/sec)
N16 W29959 BROOKSTONE CIR	3/29/2000	NZ343	6	165			75	125	15	2	7.1284E-05	4.38E-09	167	50	3	6.34013E-05	201.44	0.3	1.34389	1.34389	3.19E-03	421.10	0.000134121
N15 W29981 BROOKSTONE CIR	3/28/2000	NZ349	6	145			40	65	15	2	7.1284E-05	4.38E-09	167	25	3	6.34013E-05	201.44	0.6	2.69222	2.69222	6.38E-03	421.79	0.000268684
N16 W29973 BROOKSTONE CIR	6/27/2000	OG103	6	207			31	56	12	2.5	7.1284E-05	4.38E-09	167	25	3	4.05768E-05	201.44	0.48	2.15377	2.15377	5.11E-03	421.79	0.000214947
N15 W29874 BROOKSTONE CIR	3/7/2001	OG175	6	205			42	60	15	1.5	7.1284E-05	4.38E-09	167	18	3	6.34013E-05	201.44	0.833333	3.73955	3.73955	8.87E-03	421.83	0.000373209
N16 W29966 BROOKSTONE CIR	8/24/2000	OG933	6	245			79	180	7.5	2	7.1284E-05	4.38E-09	167	101	3	1.58503E-05	201.44	0.074257	0.33154	0.33154	7.90E-04	419.70	3.30878E-05
N15 W29992 BROOKSTONE CT	11/14/2000	OH372	6	165			55	80	40	4	7.1284E-05	4.38E-09	167	25	3	0.000450853	201.44	1.6	7.20791	7.20791	1.70E-02	423.47	0.000719353
N16 W29835 BROOKSTONE CIR	1/11/2001	ON816	6	205			65	120	18	4	7.1284E-05	4.38E-09	167	55	3	9.12978E-05	201.44	0.327273	1.46878	1.46878	3.48E-03	421.88	0.000146585
N15 W29814 BROOKSTONE CIR	7/3/2001	OT151	6	225			125	185	5	3	7.1284E-05	4.38E-09	167	60	3	7.04458E-06	201.44	0.083333	0.37252	0.37252	8.86E-04	420.22	3.7178E-05
N16 W29886 BROOKSTONE CIR	4/25/2001	OV202	6	208			47	188	5	3	7.1284E-05	4.38E-09	167	141	3	7.04458E-06	201.44	0.035461	0.15820	0.15820	3.77E-04	419.36	1.57882E-05
N16 W29864 BROOKSTONE CIR	4/30/2001	OV203	6	215			39	97	11	2	7.1284E-05	4.38E-09	167	58	3	3.40958E-05	201.44	0.189655	0.84866	0.84866	2.02E-03	420.64	8.46963E-05
N16 W29942 BROOKSTONE CIR	2/27/2003	RK737	6	225			100	185	4	4	7.1284E-05	4.38E-09	167	85	3	4.50853E-06	201.44	0.047059	0.21022	0.21022	5.01E-04	419.93	2.09804E-05
N15 W29852 BROOKSTONE CIR.	11/23/2001	RW617	6	172			48	90	14	2	7.1284E-05	4.38E-09	167	42	3	5.52295E-05	201.44	0.333333	1.49358	1.49358	3.55E-03	421.20	0.00014906
N16 W29803 BROOKSTONE CIR	2/18/2002	RX509	6	210			43	60	14	2.5	7.1284E-05	4.38E-09	167	17	3	5.52295E-05	201.44	0.823529	3.69994	3.69994	8.76E-03	422.33	0.000369256
W292 N2010 ELMHURST RD	12/1/2003	SB120	6	223			44	100	15	5.5	7.1284E-05	4.38E-09	167	56	3	6.34013E-05	201.44	0.267857	1.20247	1.20247	2.85E-03	422.00	0.000120007
N20 W29538 E GLEN COVE RD	9/27/2005	TE643	6	385			80	345	1.5	5	7.1284E-05	4.38E-09	167	265	3	6.34013E-07	201.44	0.00566	0.02517	0.02517	6.02E-05	418.04	2.51218E-06
W297 N1915 GLEN COVE RD	5/31/2006	TI985	6	145			41	80	30	4	7.1284E-05	4.38E-09	167	39	3	0.000253605	201.44	0.769231	3.45930	3.45930	8.18E-03	422.74	0.000345239
N20 W29636 E GLEN COVE RD	7/25/2006	TW102	6	182			25	120	10	3	7.1284E-05	4.38E-09	167	95	3	2.81783E-05	201.44	0.105263	0.47082	0.47082	1.12E-03	420.45	4.69879E-05
W297 N2007 GLEN COVE RD	3/14/2012	WW715	6	146			32	105	8	1	7.1284E-05	4.38E-09	167	73	3	1.80341E-05	201.44	0.109589	0.48893	0.48893	1.17E-03	419.39	4.87955E-05
W299 N1831 WINDRIDGE CT	9/11/2012	WZ922	6	245			65	200	3.5	4	7.1284E-05	4.38E-09	167	135	3	3.45185E-06	201.44	0.025926	0.11565	0.11565	2.76E-04	419.34	1.15422E-05
N16 W2 BROOKSTONE CIRCLE	12/5/2012	YI525	6	262			70	230	5	1	7.1284E-05	4.38E-09	167	160	3	7.04458E-06	201.44	0.03125	0.13900	0.13900	3.32E-04	418.13	1.38726E-05
N12 W295888 S HAMPTON DR	11/1/2004	SN045	6	200			65	80	20	2	7.1284E-05	4.38E-09	167	15	3	0.000112713	201.44	1.333333	5.99408	5.99408	1.42E-02	422.59	0.000598212
SOUTHHAMPTON DR	8/14/2019	ZW994	6	165			65	105	20	3	7.1284E-05	4.38E-09	167	40	3	0.000112713	201.44	0.5	2.24470	2.24470	5.32E-03	422.02	0.000224022
N20 W29254 ELMHURST DRIVE	10/29/1986	8KO526	6	202			13	35	15	3	7.1284E-05	4.38E-09	167	22	3	6.34013E-05	201.44	0.681818	3.06321	3.06321	7.25E-03	422.33	0.00030571

Notes:

1. ft bgs = feet below ground surface.
2. gpm = gallons per minute.
3. gpm/ft = gallons per minute per foot.
4. gpd/ft = gallons per day per foot.

FIGURES

SITE DATA SUMMARY

- TOTAL AREA =	152.0 acres
- WETLAND AREA =	10.11 acres
- UPLAND PEC AREA =	30.65 acres
- SUB-TOTAL EC =	40.76 acres
- DEVELOPMENT AREA =	111.24 acres
- ZONE 1: Low Density Single Family Residenital =	8 lots
- ZONE 2: Medium Density Single Family Residential =	29 lots
-ZONE 3: Single Family = & Condominium =	37 lots 56 units
- ZONE 4: Medium Density Single Family Residential =	81 lots
- TOTAL DEVELOPMENT =	211 units
- NET DENSITY = 211 un/111.24 ac =	1.90 un/ac
- Total Street Length = 10,700 lf (50.7 lf/unit)	

Low Density
Single Family Residential
Zone 1
20,000 sf, 100' wide
8 lots

Single Family & Condominium
Zone 3
- Duplex Ranch = 56 units
- 10,000 sf Single Family Lots = 37 units
Total = 93 units

Medium Density
Single Family Residential
Zone 2
15,000 sf, 90' wide
29 lots

Medium Density
Single Family Residential
Zone 4
10,000 sf, 75' wide
81 lots

Zone 1 24 ac
Zone 2 32 ac
Zone 3 51 ac
Zone 4 45 ac

EXISTING WETLAND
EXISTING PEC
PRIMARY ENVIRONMENTAL CORRIDOR
SHORELAND ZONING
WETLAND
Landscape Berm
ACTIVE RECREATION AREA
EXISTING FARMHOUSE TO REMAIN

CROOKED CREEK RD
BROOKSTONE CIR
GLEN COVE ROAD
GOLF ROAD
GOLF RDG S
ELMHURST ROAD
I-94

TRIO DESIGN · LAND SURVEYING · CIVIL ENGINEERING
4100 N. CALHOUN ROAD
BROOKFIELD, WI 53005
PHONE: (262) 790-1480
FAX: (262) 790-1481
EMAIL: jpudelko@trioeng.com

PROPOSED SITE PLAN -UPDATE-

Thomas Farm Development (152 acres)

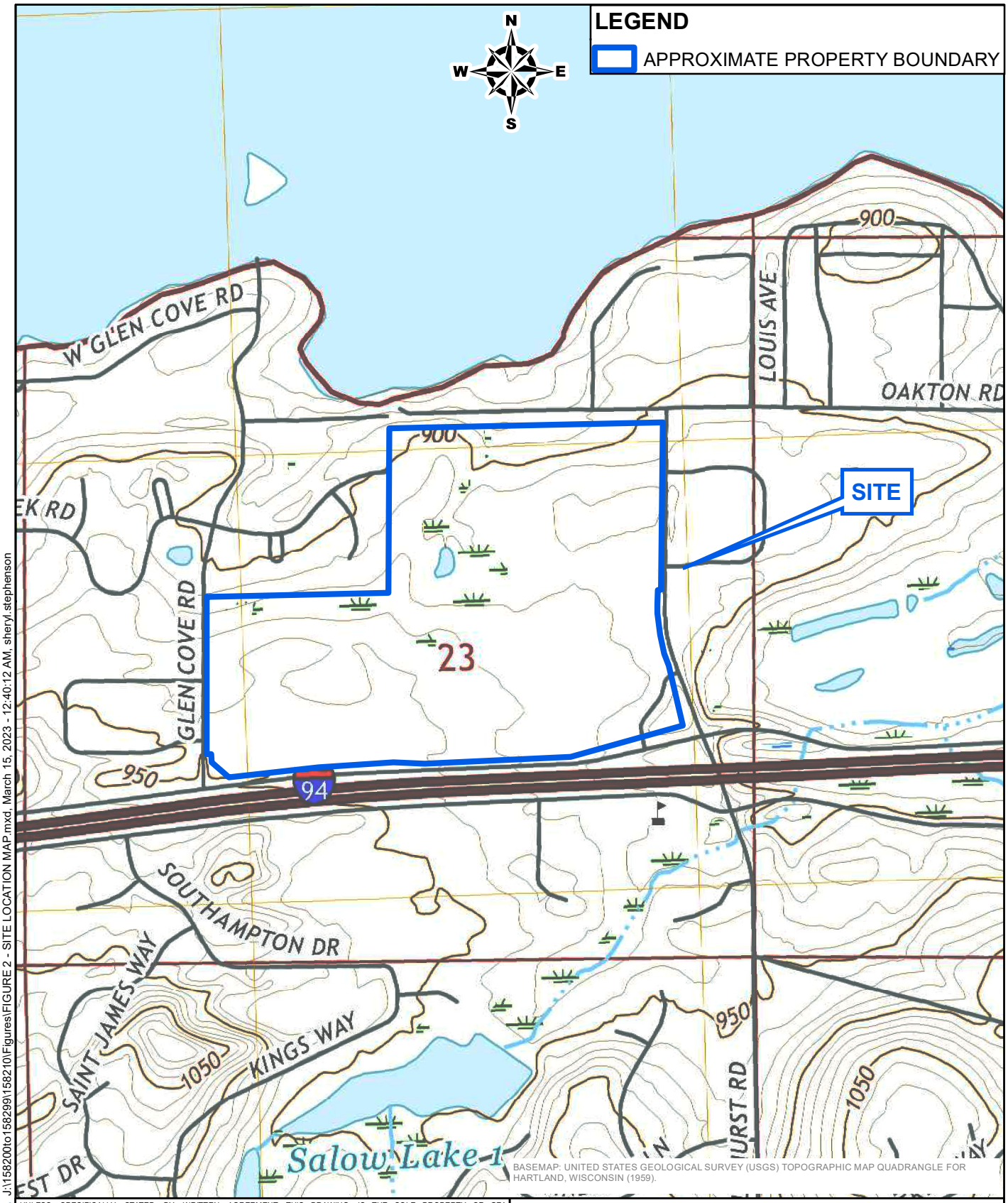
Town of Delafield, WI

NEUMANN DEVELOPMENTS, INC.

0 75 150 300

Scale: 1" = 150' (22"X34")
Scale: 1" = 300' (11"X17")
DATE: 02/19/2023

K:\2021\21-071-1013 thomas property delafield\drawings\concepts\site plan-rdl thomas farm_2023-02-19.dwg



BASEMAP: UNITED STATES GEOLOGICAL SURVEY (USGS) TOPOGRAPHIC MAP QUADRANGLE FOR HARTLAND, WISCONSIN (1959).

0 500 1,000 2,000
SCALE IN FEET

PROPOSED THOMAS FARM
SUBDIVISION DEVELOPMENT
TOWN OF DELAFIELD
WISCONSIN

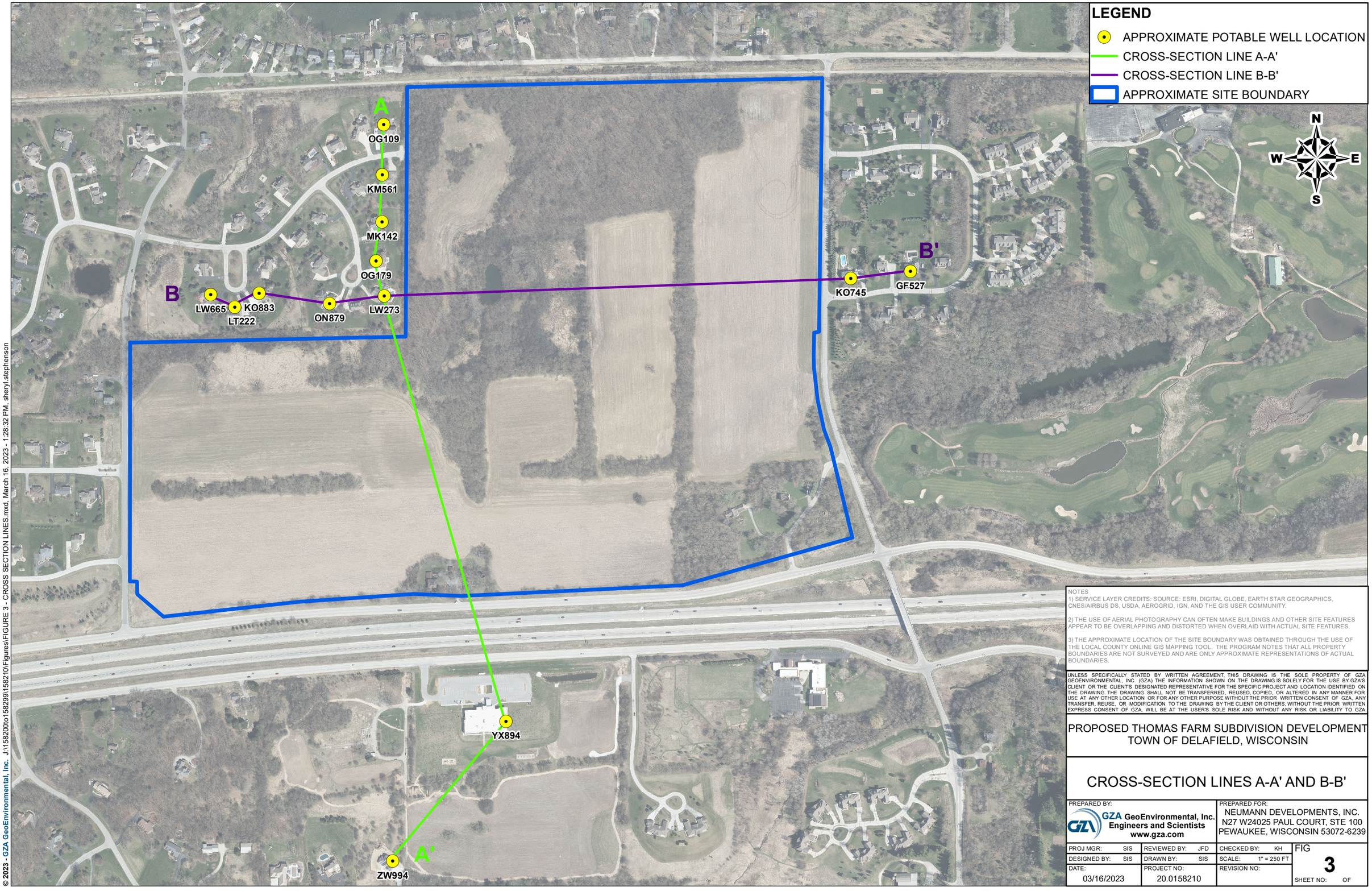
SITE LOCATION MAP

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
NEUMANN DEVELOPMENTS, INC.
N27 W24025 PAUL COURT, STE 100
PEWAUKEE, WISCONSIN, 53072-6239

PROJ MGR:	SIS	REVIEWED BY:	KMH	CHECKED BY:	JFD
DESIGNED BY:	SIS	DRAWN BY:	SIS	SCALE:	SEE ABOVE
DATE:	03/15/2023	PROJECT NO:	20.0158210.00	REVISION NO:	

FIG 2
SHEET NO: OF



NOTES
1) SERVICE LAYER CREDITS: SOURCE: ESRI, DIGITAL GLOBE, EARTH STAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, AEROGRID, IGN, AND THE GIS USER COMMUNITY.

2) THE USE OF AERIAL PHOTOGRAPHY CAN OFTEN MAKE BUILDINGS AND OTHER SITE FEATURES APPEAR TO BE OVERLAPPING AND DISTORTED WHEN OVERLAID WITH ACTUAL SITE FEATURES.

3) THE APPROXIMATE LOCATION OF THE SITE BOUNDARY WAS OBTAINED THROUGH THE USE OF THE LOCAL COUNTY ONLINE GIS MAPPING TOOL. THE PROGRAM NOTES THAT ALL PROPERTY BOUNDARIES ARE NOT SURVEYED AND ARE ONLY APPROXIMATE REPRESENTATIONS OF ACTUAL BOUNDARIES.

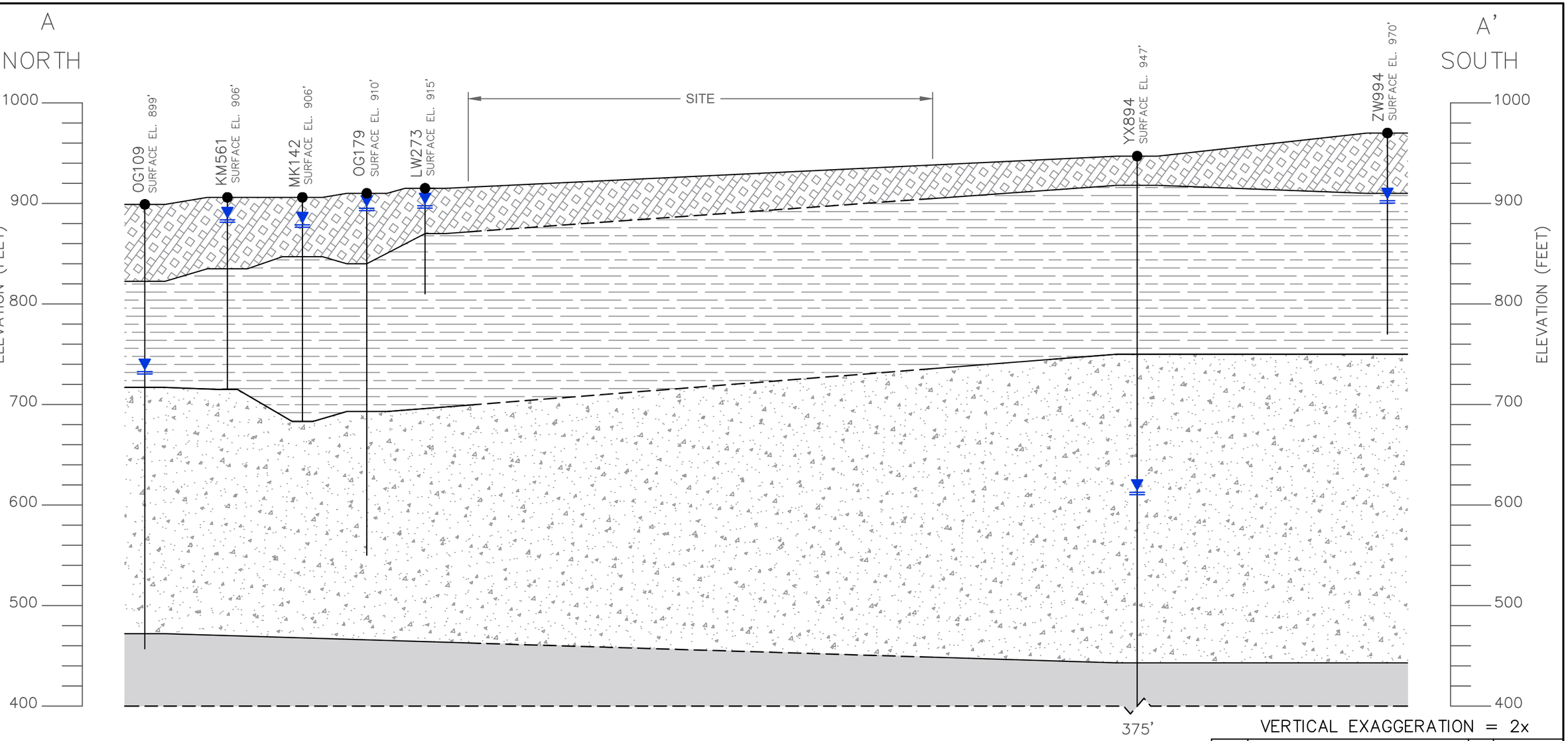
PROPOSED THOMAS FARM SUBDIVISION DEVELOPMENT
TOWN OF DELAFIELD, WISCONSIN

CROSS-SECTION LINES A-A' AND B-B'

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
NEUMANN DEVELOPMENTS, INC.
N27 W24025 PAUL COURT, STE 100
PEWAUKEE, WISCONSIN 53072-6239

PROJ MGR: SIS	REVIEWED BY: JFD	CHECKED BY: KH	FIG 3
DESIGNED BY: SIS	DRAWN BY: SIS	SCALE: 1" = 250 FT	
DATE: 03/16/2023	PROJECT NO: 20.0158210	REVISION NO:	SHEET NO: OF



LEGEND

- GLACIAL DEPOSITS
- MAQUOKETA SHALE
- GALENA–PLATEVILLE UNIT
- ST. PETERS SANDSTONE UNIT
- DOMESTIC WATER WELL
- APPROXIMATE WATER TABLE
- OG109 — WDNR WELL ID

NOTES

1. ELEVATIONS SHOWN ARE ESTIMATED FROM WAUKESHA COUNTY TOPOGRAPHY (1 FT. INTERVALS).
2. THE STRATIFICATION LINES ARE BASED ON INTERPOLATIONS BETWEEN WIDELY SPACED BORING LOCATIONS AND THUS REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN DEPOSIT TYPES. ACTUAL TRANSITIONS MAY VARY FROM THOSE SHOWN.
3. MAGNIFICATION OF VERTICAL SCALE FOR PURPOSES OF PRESENTATION CAUSES TRENDS IN SOIL STRATA TO APPEAR MORE PRONOUNCED THAN THAT WHICH ACTUALLY EXISTS.
4. WELL YX894 EXTENDS TO 202' ABOVE MSL BUT IS NOT SHOWN ON CROSS SECTION.
5. GEOLOGICAL AND WATER LEVEL DATA ARE OBTAINED FROM WDNR WELL CONSTRUCTION RECORDS.
6. WELL LOCATIONS WERE OBTAINED FROM ADDRESSES PROVIDED ON THE WDNR WELL CONSTRUCTION RECORDS, HOWEVER, EXACT WELL LOCATIONS ARE ESTIMATED.

NO.	ISSUE/DESCRIPTION	BY	DATE

PROPOSED THOMAS FARM SUBDIVISION DEVELOPMENT
TOWN OF DELAFIELD, WISCONSIN

GEOLOGIC CROSS SECTION (A-A')

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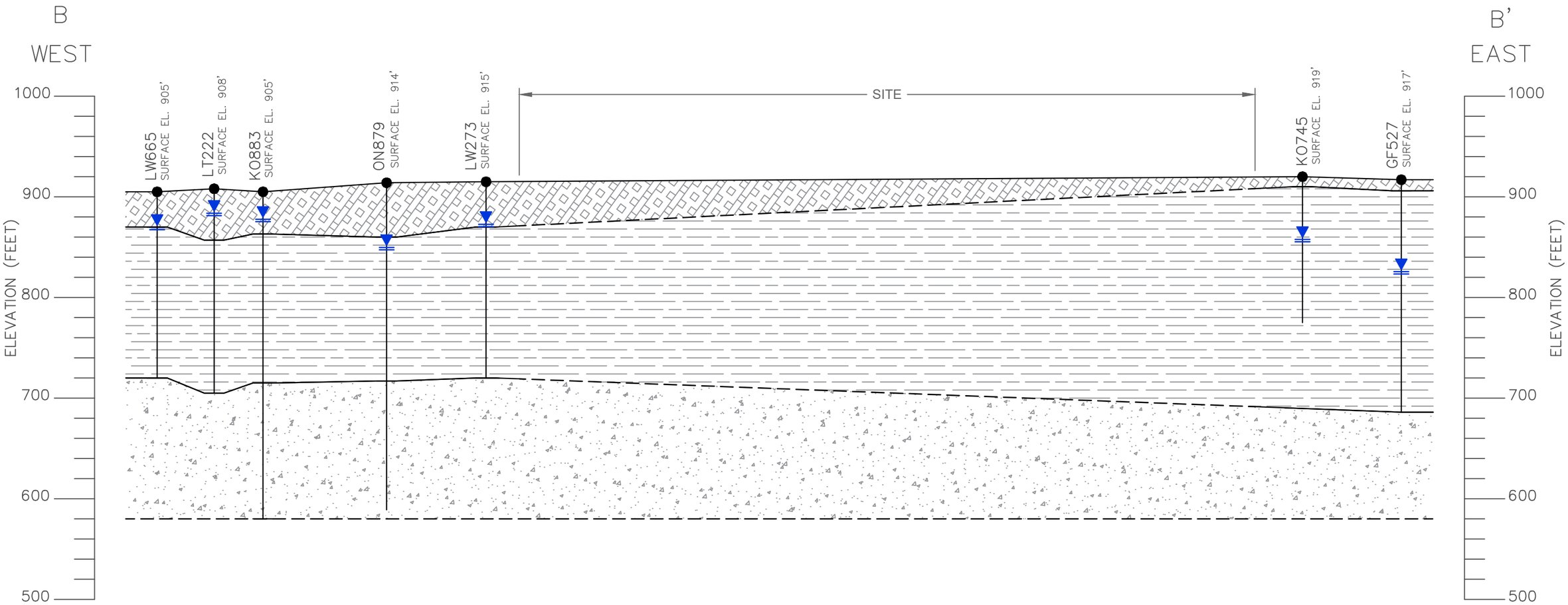
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
NEUMANN DEVELOPMENTS, INC.
N27 W24025 PAUL COURT, STE 100
PEWAUKEE, WISCONSIN 53072-6239

PROJ MGR: KMH	REVIEWED BY: KMH	CHECKED BY: SIS	FIG 4A
DESIGNED BY: SIS	DRAWN BY: HKP	SCALE: 1" = 50'	
DATE: 03/16/2023	PROJECT NO. 20.0158210.00	REVISION NO.	SHEET NO. OF



VERTICAL EXAGGERATION = 2x

LEGEND

- GLACIAL DEPOSITS
- MAQUOKETA SHALE
- GALENA–PLATEVILLE UNIT
- LW665 WDNR WELL ID
- DOMESTIC WATER WELL
- APPROXIMATE WATER TABLE

NOTES

1. ELEVATIONS SHOWN ARE ESTIMATED FROM WAUKESHA COUNTY TOPOGRAPHY (1 FT. INTERVALS).
2. THE STRATIFICATION LINES ARE BASED ON INTERPOLATIONS BETWEEN WIDELY SPACED BORING LOCATIONS AND THUS REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN DEPOSIT TYPES. ACTUAL TRANSITIONS MAY VARY FROM THOSE SHOWN.
3. MAGNIFICATION OF VERTICAL SCALE FOR PURPOSES OF PRESENTATION CAUSES TRENDS IN SOIL STRATA TO APPEAR MORE PRONOUNCED THAN THAT WHICH ACTUALLY EXISTS.
4. WELL YX894 EXTENDS TO 202' ABOVE MSL BUT IS NOT SHOWN ON CROSS SECTION.
5. GEOLOGICAL AND WATER LEVEL DATA ARE OBTAINED FROM WDNR WELL CONSTRUCTION RECORDS.
6. WELL LOCATIONS WERE OBTAINED FROM ADDRESSES PROVIDED ON THE WDNR WELL CONSTRUCTION RECORDS, HOWEVER, EXACT WELL LOCATIONS ARE ESTIMATED.

NO.	ISSUE/DESCRIPTION	BY	DATE

PROPOSED THOMAS FARM SUBDIVISION DEVELOPMENT
TOWN OF DELAFIELD, WISCONSIN

GEOLOGIC CROSS SECTION (B-B')

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GZA GeoEnvironmental, Inc.
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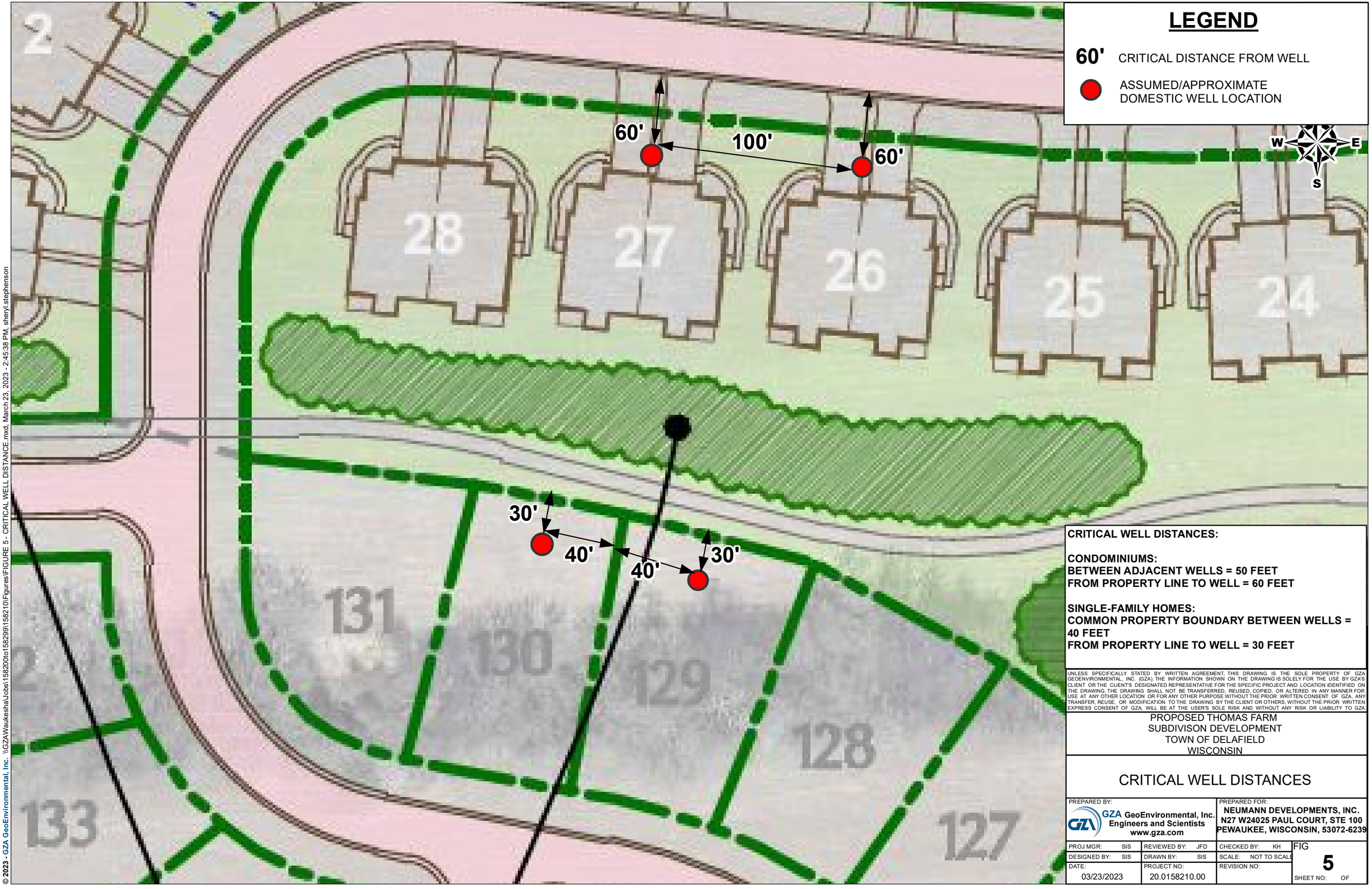
PREPARED FOR:
NEUMANN DEVELOPMENTS, INC.
N27 W24025 PAUL COURT, STE 100
PEWAUKEE, WISCONSIN 53072-6239

PROJ MGR: KMH	REVIEWED BY: KMH	CHECKED BY: SIS	FIG 4B
DESIGNED BY: SIS	DRAWN BY: HKP	SCALE: 1" = 50'	
DATE: 03/16/2023	PROJECT NO. 20.0158210.00	REVISION NO.	SHEET NO. OF



CRITICAL WELL DISTANCES:

CONDOMINIUMS:
BETWEEN ADJACENT WELLS = 50 FEET
FROM PROPERTY LINE TO WELL = 60 FEET

SINGLE-FAMILY HOMES:
COMMON PROPERTY BOUNDARY BETWEEN WELLS = 40 FEET
FROM PROPERTY LINE TO WELL = 30 FEET

PROPOSED THOMAS FARM
SUBDIVISON DEVELOPMENT
TOWN OF DELAFIELD
WISCONSIN

CRITICAL WELL DISTANCES

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N27 W24025 PAUL COURT, STE 100
PEWAUKEE, WISCONSIN, 53072-6239

PROJ MGR: SIS	REVIEWED BY: JFD	CHECKED BY: KH	FIG 5
DESIGNED BY: SIS	DRAWN BY: SIS	SCALE: NOT TO SCALE	
DATE: 03/23/2023	PROJECT NO: 20.0158210.00	REVISION NO:	SHEET NO: OF

ATTACHMENT 1

Limitations

LIMITATIONS

1. In performing this assessment, GZA has relied on certain information provided by other parties referenced herein. GZA completed the evaluation in accordance with generally accepted practices of other consultants undertaking similar studies at the same time, in the same geographical areas. GZA observed the degree of care and skill generally exercised by other consultants under similar circumstances and conditions. GZA's findings and conclusions must be considered not as scientific certainties, but rather as our professional opinion concerning the significance of the data available at the time of the evaluation. No warranty, expressed or implied, is made.

2. The conclusions submitted in this report are based in part on data obtained from a limited number of well logs from widely spaced subsurface explorations. The nature and extent of variations between these explorations may not become evident until further investigation. If variations or other latent conditions then appear evident, it will be necessary to reevaluate the recommendations of this report.

3. The generalized geologic profile described in the text is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized and have been developed by interpretations of widely spaced explorations and samples; actual soil transitions are probably more gradual. For specific information, refer to the boring logs.

4. Water level elevations have been derived from well construction reports made in the test pits, borings and/or wells at times and under conditions encountered at the time of installation. It must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall and other factors different from those prevailing at the time measurements were made.

5. In preparing this report, GZA has relied on certain information provided by state and local officials and other parties referenced therein, and on information contained in the files of state and/or local agencies available to GZA at the time of the site assessment. Although there may have been some degree of overlap in the information provided by these various sources, GZA did not attempt to independently verify the accuracy or completeness of all information reviewed or received during the course of this site assessment.

ATTACHMENT 2

Well Construction Records

Well Construction Report
WISCONSIN UNIQUE WELL NUMBER GF527

Drinking Water and Groundwater - DG/5
Department of Natural Resources, Box 7921
Madison WI 53707

Form 3300-077A

Property Owner: SIGNATURE BUILDERS			Phone #
Mailing Address: N18 W29022 GLF RDG S			
City: PEWAUKEE	State: WI	Zip Code: 53072	
County: Waukesha	Co. Permit #	Notification #	Completed: 04-09-1993

Well Constructor (Business Name): MICHAEL HARTMAN	Lic. #: 436	Facility ID # (Public Wells)	
Address: W82 N28280 MARSHALL HARTLAND WI 53029		Well Plan Approval #	
		Approval Date (mm-dd-yyyy)	
Hicap Permanent Well #	Common Well #	Specific Capacity: 0.1	

3. Well serves 1 # of
Private,potable
Heat Exchange____# of drillholes

Hicap Well ? No
Hicap Property ? No
Hicap Potable ?

1. Well Location
Town of DELAFIELD

Fire # (if avail.)

Street Address or Road Name and Number: N18 W29022 GOLF RDG S

Subdivision Name: GOLF RIDGE	Lot #: 12	Block #

Latitude / Longitude in Decimal Degree (DD): 43.0551 °N -88.3252 °W			Method Code: GCD013
SE NE or Govt Lot #	Section: 23	Township: 7 N	Range: 18 E

2. Well Type New Well
of previous unique well # constructed in

Reason for replaced or reconstructed well ?
HOME

Construction Type: Drilled

4. Potential Contamination Sources - ON REVERSE SIDE

5. Drillhole Dimensions and Construction Method

Dia. (in.)	From (ft.)	To (ft.)
10	Surface	42
6	42	245

Upper Enlarged Drillhole — Lower Open Bedrock

Yes — Rotary - Mud Circulation .....
Rotary - Air .....
Rotary - Air & Foam .....
Drill-Through Casing Hammer
Reverse Rotary
Cable-tool Bit ____in. dia...
Dual Rotary .....
Temp. Outer Casing ____in. dia
Removed? ____depth ft. (If NO explain on back side)

8. Geology

Geology Codes	8. Geology Type, Caving/Noncaving, Color, Hardness, etc...	From (ft.)	To (ft.)
P	HARDPAN	Surface	10
L	LIMESTONE	10	25
H	SHALE	25	35
L	LIMESTONE	35	46
H	SHALE	46	245

6. Casing, Liner, Screen

Dia. (in.)	Material, Weight, Specification Manufacturer & Method of Assembly	From (ft.)	To (ft.)
6	0.280 A-53 GR.B SAWHILL STEEL WELDED	Surface	41
Dia. (in.)	Screen type, material & slot size	From (ft.)	To (ft.)

7. Grout or Other Sealing Material

Method PUMP

Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
PORTLAND	Surface	41.15	

9. Static Water Level
90 ft. below ground surface

10. Pump Test
Pumping level 200 ft. below surface
Pumping at 10 GP M for 4 Hrs.
Pumping Method ?

11. Well Is
12 in. above grade
Developed ? Yes
Disinfected ? Yes
Capped ? Yes

12. Notified Owner of need to fill & seal ?

Filled & Sealed Well(s) as needed? No
NO WELLS

13. Constructor / Supervisory Driller	Lic #	Date Signed
MH		04-21-1993
Drill Rig Operator	Lic or Reg #	Date Signed

4a. Potential Contamination Sources Is the well located in floodplain ? No

Type	Qualifier	Distance	Type	Qualifier	Distance
Building Overhang		10	Collector Sewer - San or Storm		90
Clearwater Sump		15	Foundation Drain to Clearwater		11
			Sewer - Building Sanitary		40

Comment:

Water Quality Text:

Water Quantity Text:

Difficulty Text:

Created On: 08-06-1993 Created by: HFRC LOAD Updated On: 07-09-2019 Updated by: PARCEL_MATCH

Well Construction Report
WISCONSIN UNIQUE WELL NUMBER KM561

Drinking Water and Groundwater - DG/5
Department of Natural Resources, Box 7921
Madison WI 53707

Form 3300-077A

Property Owner: ROGERS, LEONARD			Phone #: (414)242-5316
Mailing Address: 11649 N ANNETTE 45 W			
City: MEQUON	State: WI	Zip Code: 53092	
County: Waukesha	Co. Permit #:	Notification #:	Completed: 05-13-1996

1. Well Location

Town of DELAFIELD

Fire # (if avail.):

Street Address or Road Name and Number: N18 W29521 CROOKED CREEK RD

Subdivision Name	Lot #	Block #
HIGH RIDGE EAST 1	40	

Well Constructor (Business Name)	Lic. #	Facility ID # (Public Wells)
ROSCHI BROS WELL DRLG @ PUMP INC	435	

Address: N10W28210 NORTHVIEW
WAUKESHA WI 53188-9401

Well Plan Approval #:

Approval Date (mm-dd-yyyy):

Latitude / Longitude in Decimal Degree (DD): 43.0561 °N -88.3347 °W

Method Code: GCD013

SE NW or Govt Lot #	Section	Township	Range
	23	7 N	18 E

2. Well Type New Well

of previous unique well #: constructed in

Reason for replaced or reconstructed well ?: NEW CONSTRUCTION

Hicap Permanent Well #	Common Well #	Specific Capacity
		0.1

3. Well serves 1 # of

Private,potable

Heat Exchange____# of drillholes

Hicap Well ? No

Hicap Property ? No

Hicap Potable ?

Construction Type: Drilled

4. Potential Contamination Sources - ON REVERSE SIDE

5. Drillhole Dimensions and Construction Method

Dia. (in.)	From (ft.)	To (ft.)
8.75	Surface	69
6	69	188

Upper Enlarged Drillhole — Lower Open Bedrock

Yes Rotary - Mud Circulation .....

Rotary - Air .....

Rotary - Air & Foam .....

Drill-Through Casing Hammer

Reverse Rotary

Cable-tool Bit ____in. dia...

Dual Rotary .....

Temp. Outer Casing ____in. dia

Removed? ____depth ft. (If NO explain on back side)

8. Geology

Geology Codes				8. Geology Type, Caving/Noncaving, Color, Hardness, etc...	From (ft.)	To (ft.)
		C	G	STONEY CLAY	Surface	15
		P		HARDPAN	15	69
		H	L	SHALE W STREAKS OF LIMESTONE	69	188

6. Casing, Liner, Screen

Dia. (in.)	Material, Weight, Specification Manufacturer & Method of Assembly	From (ft.)	To (ft.)
6	BLACK STEEL PIPE WELDED JOINTS 1897 LB ASTM B531780 PSI IPSCO	Surface	69
Dia. (in.)	Screen type, material & slot size	From (ft.)	To (ft.)

9. Static Water Level

21 ft. below ground surface

10. Pump Test

Pumping level 91 ft. below surface

Pumping at 10 GP M for 1 Hrs.

Pumping Method ?

11. Well Is

12 in. above grade

Developed ? Yes

Disinfected ? Yes

Capped ? Yes

7. Grout or Other Sealing Material

Method

Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
BENTONITE DRILLING FLUID	Surface	69	

12. Notified Owner of need to fill & seal ?

Filled & Sealed Well(s) as needed?

13. Constructor / Supervisory Driller	Lic #	Date Signed
RR		05-13-1996
Drill Rig Operator	**Lic or Reg #**	**Date Signed**
TDK		05-13-1996

4a. Potential Contamination Sources Is the well located in floodplain ? No

Type	Qualifier	Distance	Type	Qualifier	Distance
Building Overhang		10	Collector Sewer - San or Storm	>	50
			Foundation Drain to Clearwater		11

Comment:

Water Quality Text:

Water Quantity Text:

Difficulty Text:

Created On: 07-02-1996 Created by: HFRC LOAD Updated On: 07-12-2019 Updated by: PARCEL_MATCH

Well Construction Report
WISCONSIN UNIQUE WELL NUMBER KO745

Drinking Water and Groundwater - DG/5
Department of Natural Resources, Box 7921
Madison WI 53707

Form 3300-077A

Property Owner: COVENTRY HOMES			Phone #
Mailing Address: 16735 W GREENFIELD			
City: NEW BERLIN	State: WI	Zip Code: 53151	
County: Waukesha	Co. Permit #	Notification #	Completed: 01-26-1996

Well Constructor (Business Name): MICHAEL HARTMAN	Lic. #: 436	Facility ID # (Public Wells)	
Address: W82 N28280 MARSHALL HARTLAND WI 53029		Well Plan Approval #	
		Approval Date (mm-dd-yyyy)	
Hicap Permanent Well #	Common Well #	Specific Capacity: 0.9	

1. Well Location

Town of DELAFIELD

Fire # (if avail.)

Street Address or Road Name and Number: N18 W29082 S GOLF RIDGE

Subdivision Name: GOLF RIDGE	Lot #: 10	Block #

Latitude / Longitude in Decimal Degree (DD): 43.055 °N -88.3264 °W				Method Code: GCD013
SW NW or Govt Lot #	Section: 23	Township: 7 N	Range: 18 E	

2. Well Type New Well

of previous unique well # constructed in

Reason for replaced or reconstructed well ?: NEW HOME

Construction Type: Drilled

3. Well serves 1 # of

Private,potable

Heat Exchange____# of drillholes

Hicap Well ? No

Hicap Property ? No

Hicap Potable ?

4. Potential Contamination Sources - ON REVERSE SIDE

5. Drillhole Dimensions and Construction Method

Dia. (in.)	From (ft.)	To (ft.)
10	Surface	8
8.75	8	61
6	61	145

Upper Enlarged Drillhole / Lower Open Bedrock

- Rotary - Mud Circulation .....
- Yes — Rotary - Air .....
- Rotary - Air & Foam .....
- Drill-Through Casing Hammer
- Reverse Rotary
- Cable-tool Bit ____in. dia...
- Dual Rotary .....
- Temp. Outer Casing ____in. dia
- Yes — Removed? ____depth ft. (If NO explain on back side)

8. Geology

Geology Codes				8. Geology Type, Caving/Noncaving, Color, Hardness, etc...	From (ft.)	To (ft.)
		X		CLAY SAND	Surface	8
		L	H	LIMESTONE SHALE	8	70
		H		SHALE	70	145

6. Casing, Liner, Screen

Dia. (in.)	Material, Weight, Specification Manufacturer & Method of Assembly	From (ft.)	To (ft.)
6	0 280 A 53 GRB SAWHILL STEEL WELDED	Surface	63
Dia. (in.)	Screen type, material & slot size	From (ft.)	To (ft.)

9. Static Water Level

57 ft. below ground surface

10. Pump Test

Pumping level 80 ft. below surface

Pumping at 20 GP M for 4 Hrs.

Pumping Method ?

11. Well Is

18 in. above grade

Developed ? Yes

Disinfected ? Yes

Capped ? Yes

7. Grout or Other Sealing Material

Method PUMPED TREMIE

Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
PORTLAND CEMENT GROUT C 150	Surface	61	18 S

12. Notified Owner of need to fill & seal ?

Filled & Sealed Well(s) as needed? No

NO WELL

13. Constructor / Supervisory Driller	Lic #	Date Signed
MH		01-29-1996
Drill Rig Operator	**Lic or Reg #**	**Date Signed**
TW		04-24-1996

4a. Potential Contamination Sources Is the well located in floodplain ? No

Type	Qualifier	Distance	Type	Qualifier	Distance
Building Overhang		12	Collector Sewer - San or Storm		75
Clearwater Sump		35	Foundation Drain to Clearwater		13
			Sewer - Building Sanitary		40

Comment:

Water Quality Text:

Water Quantity Text:

Difficulty Text:

Created On: 06-04-1996 Created by: HFRC LOAD Updated On: 07-12-2019 Updated by: PARCEL_MATCH

Well Construction Report
WISCONSIN UNIQUE WELL NUMBER KO883

Drinking Water and Groundwater - DG/5
Department of Natural Resources, Box 7921
Madison WI 53707

Form 3300-077A

Property Owner: MURPHY, DAN		Phone #	
Mailing Address: W296 N1742 HIDDEN CR			
City: PEWAUKEE	State: WI	Zip Code: 53072	
County: Waukesha	Co. Permit #	Notification #	Completed: 08-13-1996

Well Constructor (Business Name): RICHARD L DANECKI	Lic. #: 124	Facility ID # (Public Wells)	
Address: PO BOX 94 NORTH PRAIRIE WI 53153-0094		Well Plan Approval #	
		Approval Date (mm-dd-yyyy)	
Hicap Permanent Well #	Common Well #	Specific Capacity	

3. Well serves 1 # of
Private,potable
Heat Exchange____# of drillholes

Hicap Well ? No
Hicap Property ? No
Hicap Potable ?

1. Well Location
Town of DELAFIELD

Fire # (if avail.)

Street Address or Road Name and Number
W296 N1742 HIDDEN CREEK CT

Subdivision Name: HIGH RIDGE	Lot #	Block #

Latitude / Longitude in Decimal Degree (DD): 43.0546 °N -88.3369 °W	Method Code: GCD013			
SE NW or Govt Lot #	Section: 23	Township: 7 N	Range: 18 E	

2. Well Type New Well
of previous unique well # constructed in

Reason for replaced or reconstructed well ?
NEW HOME

Construction Type Drilled

4. Potential Contamination Sources - ON REVERSE SIDE

5. Drillhole Dimensions and Construction Method

Dia. (in.)	From (ft.)	To (ft.)
6	Surface	325

Upper Enlarged Drillhole
Lower Open Bedrock
Rotary - Mud Circulation .....
Rotary - Air .....
Rotary - Air & Foam .....
Drill-Through Casing Hammer
Reverse Rotary
Cable-tool Bit ____in. dia...
Dual Rotary .....
Temp. Outer Casing ____in. dia
Removed? ____depth ft. (If NO explain on back side)

8. Geology

Geology Codes	8. Geology Type, Caving/Noncaving, Color, Hardness, etc...	From (ft.)	To (ft.)
C	CLAY	Surface	41
H H	HARD SHALE	41	190
L	LIMESTONE	190	325

6. Casing, Liner, Screen

Dia. (in.)	Material, Weight, Specification Manufacturer & Method of Assembly	From (ft.)	To (ft.)
6	SAW HILL USA STD ERW A53 90 GR BBLACK PLAIN END6 625 OD X 280 WALL	Surface	41
Dia. (in.)	Screen type, material & slot size	From (ft.)	To (ft.)

9. Static Water Level
10 ft. below ground surface

10. Pump Test
Pumping level 280 ft. below surface
Pumping at 6 GP M for 4 Hrs.
Pumping Method ?

11. Well Is
14 in. above grade
Developed ? Yes
Disinfected ? Yes
Capped ? Yes

7. Grout or Other Sealing Material
Method

Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
8 MESH BENTONITE	Surface	41	

12. Notified Owner of need to fill & seal ?

Filled & Sealed Well(s) as needed? No
NONE

13. Constructor / Supervisory Driller	Lic #	Date Signed
RLD		08-15-1996
Drill Rig Operator	**Lic or Reg #**	**Date Signed**
SH		08-15-1996

4a. Potential Contamination Sources Is the well located in floodplain ? No

Type	Qualifier	Distance	Type	Qualifier	Distance
Building Overhang		23	Downspout/Yard Hydrant		24
Clearwater Sump		32	Foundation Drain to Clearwater		30
Collector Sewer - San or Storm		150	Sewer - Building Sanitary		60

Comment:

Water Quality Text:

Water Quantity Text:

Difficulty Text:

Created On: 01-28-1997 Created by: HFRC LOAD Updated On: 07-12-2019 Updated by: PARCEL_MATCH

Well Construction Report
WISCONSIN UNIQUE WELL NUMBER LT222

Drinking Water and Groundwater - DG/5
Department of Natural Resources, Box 7921
Madison WI 53707

Form 3300-077A

Property Owner: LIEN, JEFFREY			Phone #
Mailing Address: W296 N1734 HIDDEN CR			
City: PEWAUKEE	State: WI	Zip Code: 53072	
County: Waukesha	Co. Permit #	Notification #	Completed: 12-24-1997

Well Constructor (Business Name): GROTH WATER WELLS INC	Lic. #: 639	Facility ID # (Public Wells)	
Address: W69 N949 WASHINGTON CEDARBURG WI 53012		Well Plan Approval #	
		Approval Date (mm-dd-yyyy)	
Hicap Permanent Well #	Common Well #	Specific Capacity: 0.1	

3. Well serves 1 # of
Private,potable
Heat Exchange____# of drillholes

Hicap Well ? No
Hicap Property ? No
Hicap Potable ?

1. Well Location
Town of DELEFIELD

Fire # (if avail.)

Street Address or Road Name and Number: W296 N1734 HIDDEN CREEK CT

Subdivision Name: HIGH RDG E	Lot #: 28	Block #

Latitude / Longitude in Decimal Degree (DD) °N °W			Method Code: GPS008
SE NW or Govt Lot #	Section: 23	Township: 7 N	Range: 18 E

2. Well Type New Well
of previous unique well # constructed in

Reason for replaced or reconstructed well ?

Construction Type: Drilled

4. Potential Contamination Sources - ON REVERSE SIDE

5. Drillhole Dimensions and Construction Method

Dia. (in.)	From (ft.)	To (ft.)
8	Surface	52
6	52	203

Upper Enlarged Drillhole — Lower Open Bedrock

Yes Rotary - Mud Circulation .....
Rotary - Air .....
Rotary - Air & Foam .....
Drill-Through Casing Hammer
Reverse Rotary
Cable-tool Bit ____in. dia...
Dual Rotary .....
Temp. Outer Casing ____in. dia
Removed? ____depth ft. (If NO explain on back side)

8. Geology

Geology Codes				8. Geology Type, Caving/Noncaving, Color, Hardness, etc...	From (ft.)	To (ft.)
		Z	S	SANDY CLAY @ GRAVEL	Surface	16
		C	S	SANDY CLAY	16	43
		Z	S	SANDY CLAY W STONES	43	50
		H		SHALE	50	203

6. Casing, Liner, Screen

Dia. (in.)	Material, Weight, Specification Manufacturer & Method of Assembly	From (ft.)	To (ft.)
6	18 97# ASTM A53 PE SAWHILL	Surface	52
Dia. (in.)	Screen type, material & slot size	From (ft.)	To (ft.)

7. Grout or Other Sealing Material

Method

Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
DRILLING MUD	Surface	52	

9. Static Water Level
20 ft. below ground surface

10. Pump Test
Pumping level 105 ft. below surface
Pumping at 12 GP M for 2 Hrs.
Pumping Method ?

11. Well Is
12 in. above grade
Developed ? Yes
Disinfected ? Yes
Capped ? Yes

12. Notified Owner of need to fill & seal ?

Filled & Sealed Well(s) as needed?

13. Constructor / Supervisory Driller	Lic #	Date Signed
HG		12-27-1997
Drill Rig Operator	Lic or Reg #	Date Signed

4a. Potential Contamination Sources Is the well located in floodplain ? No

Type	Qualifier	Distance	Type	Qualifier	Distance
Building Drain - Sanitary		29	Collector Sewer - San or Storm		150
Building Overhang		12	Foundation Drain to Clearwater		13
Clearwater Sump		15	Sewer - Building Sanitary		85

Comment:

Water Quality Text:

Water Quantity Text:

Difficulty Text:

Created On: 03-04-1998 Created by: HFRC LOAD Updated On: 03-04-1998 Updated by: MIGRATION

Well Construction Report
WISCONSIN UNIQUE WELL NUMBER LW273

Drinking Water and Groundwater - DG/5
Department of Natural Resources, Box 7921
Madison WI 53707
Form 3300-077A

Property Owner: KUZMINSKI MARK	Phone #: (414)695-8454
Mailing Address: W295 N1738 PRAIRIE W	
City: PEWAUKEE	State: WI — Zip Code: 53072
County: Waukesha	Co. Permit #: — Notification #: — Completed: 07-18-1997
Well Constructor (Business Name): MICHAEL HARTMAN	Lic. #: 436 — Facility ID # (Public Wells):
Address: PO BOX 218 NORTH LAKE WI 53064-0218	Well Plan Approval #: — Approval Date (mm-dd-yyyy):
Hicap Permanent Well #:	Common Well #: — Specific Capacity: 0.7

1. Well Location
Town of DELAFIELD
Fire # (if avail.):
Street Address or Road Name and Number: W295 N1738 PRAIRIE WOODS
Subdivision Name: HIGH RIDGE — Lot #: 36 — Block #:
Latitude / Longitude in Decimal Degree (DD): 43.0546 °N -88.3348 °W — Method Code: GCD013
SE NW or Govt Lot #: — Section: 23 — Township: 7 N — Range: 18 E

2. Well Type New Well
of previous unique well #: — constructed in:
Reason for replaced or reconstructed well ?: NEW HOME
Construction Type: Drilled

3. Well serves 1 # of
Private,potable
Heat Exchange____# of drillholes
Hicap Well ? No
Hicap Property ? No
Hicap Potable ?

4. Potential Contamination Sources - ON REVERSE SIDE

5. Drillhole Dimensions and Construction Method

Dia. (in.)	From (ft.)	To (ft.)
6	Surface	105

Upper Enlarged Drillhole — Lower Open Bedrock
Rotary - Mud Circulation .....
Rotary - Air .....
Rotary - Air & Foam .....
Drill-Through Casing Hammer
Reverse Rotary
Cable-tool Bit ____in. dia...
Dual Rotary .....
Temp. Outer Casing ____in. dia
Removed? ____depth ft. (If NO explain on back side)

8. Geology

Geology Codes	8. Geology Type, Caving/Noncaving, Color, Hardness, etc...	From (ft.)	To (ft.)
C	CLAY	Surface	8
P	HARDPAN	8	44
H	SHALE	44	92
L	LIMESTONE	92	100
H	SHALE	100	105

6. Casing, Liner, Screen

Dia. (in.)	Material, Weight, Specification Manufacturer & Method of Assembly	From (ft.)	To (ft.)
6	280 A53 GRB SAWHILL STEEL WELDED	Surface	72
Dia. (in.)	Screen type, material & slot size	From (ft.)	To (ft.)

9. Static Water Level
11 ft. below ground surface

10. Pump Test
Pumping level 40 ft. below surface
Pumping at 20 GP M for 4 Hrs.
Pumping Method ?

11. Well Is
18 in. above grade
Developed ? Yes
Disinfected ? Yes
Capped ? Yes

7. Grout or Other Sealing Material
Method MOUNDED

Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
CRUMBLES	Surface	0	

12. Notified Owner of need to fill & seal ?
Filled & Sealed Well(s) as needed? No
NO WELL

13. Constructor / Supervisory Driller	Lic #	Date Signed
MH		07-21-1997
Drill Rig Operator	**Lic or Reg #**	**Date Signed**
TA		

4a. Potential Contamination Sources Is the well located in floodplain ? No

Type	Qualifier	Distance	Type	Qualifier	Distance
Building Overhang		13	Collector Sewer - San or Storm		85
Clearwater Sump		40	Foundation Drain to Clearwater		15
			Sewer - Building Sanitary		35

Comment:

Water Quality Text:

Water Quantity Text:

Difficulty Text:

Created On: 10-10-1997 Created by: HFRC LOAD Updated On: 07-12-2019 Updated by: PARCEL_MATCH

Well Construction Report
WISCONSIN UNIQUE WELL NUMBER LW665

Drinking Water and Groundwater - DG/5
Department of Natural Resources, Box 7921
Madison WI 53707

Form 3300-077A

Property Owner: FAIRWAY HOMES INC AMIDEI	Phone #: (414)965-2020
Mailing Address: 575 DOUSMAN RD	
City: OCONOMOWOC	State: WI — Zip Code: 53066
County: Waukesha	Co. Permit #: — Notification #: — Completed: 07-11-1997
Well Constructor (Business Name): HERR WELL DRILLING INC	Lic. #: 672 — Facility ID # (Public Wells):
Address: W295 HERR RD DOUSMAN WI 53118-9407	Well Plan Approval #: — Approval Date (mm-dd-yyyy):
Hicap Permanent Well #:	Common Well #: — Specific Capacity: 0.2

1. Well Location

Town of DELAFIELD

Fire # (if avail.):

Street Address or Road Name and Number: W296 N1763 HIDDEN CREEK CT

Subdivision Name	Lot #	Block #
HIGH RIDGE E	27	

Latitude / Longitude in Decimal Degree (DD): 43.0546 °N -88.3381 °W — Method Code: GCD013

SE	NW	Section	Township	Range
or Govt Lot #		23	7 N	18 E

2. Well Type New Well

of previous unique well # — constructed in

Reason for replaced or reconstructed well ?: WATER SUPPLY FOR A NEW HO

Construction Type: Drilled

3. Well serves 1 # of

Private,potable

Heat Exchange____# of drillholes

Hicap Well ? No

Hicap Property ? No

Hicap Potable ?

4. Potential Contamination Sources - ON REVERSE SIDE

5. Drillhole Dimensions and Construction Method

Dia. (in.)	From (ft.)	To (ft.)
10	Surface	49
6	49	185

Upper Enlarged Drillhole — Lower Open Bedrock

Yes — Rotary - Mud Circulation .....

Rotary - Air .....

Rotary - Air & Foam .....

Drill-Through Casing Hammer

Reverse Rotary

Cable-tool Bit ____in. dia...

Dual Rotary .....

Temp. Outer Casing ____in. dia

Removed? ____depth ft. (If NO explain on back side)

8. Geology

Geology Codes	8. Geology Type, Caving/Noncaving, Color, Hardness, etc...	From (ft.)	To (ft.)
Z	GRAVEL @ CLAY	Surface	19
Y	SAND @ GRAVEL	19	26
C	CLAY	26	33
H	SHALE	33	185

6. Casing, Liner, Screen

Dia. (in.)	Material, Weight, Specification Manufacturer & Method of Assembly	From (ft.)	To (ft.)
6	B SAWHILL TUBULAR 2660 LBS PSI	49	49
6	1897 LBS PER FOOT NEW STEEL PLAIN END ASTM A53 GR	Surface	49
Dia. (in.)	Screen type, material & slot size	From (ft.)	To (ft.)

7. Grout or Other Sealing Material

Method BRADEN HEAD

Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
NEAT CEMENT GROUT	Surface	49	16 S

9. Static Water Level

35 ft. below ground surface

10. Pump Test

Pumping level 105 ft. below surface

Pumping at 15 GP M for 2 Hrs.

Pumping Method ?

11. Well Is

12 in. above grade

Developed ? Yes

Disinfected ? Yes

Capped ? Yes

12. Notified Owner of need to fill & seal ?

Filled & Sealed Well(s) as needed?

13. Constructor / Supervisory Driller	Lic #	Date Signed
JH		07-25-1997
Drill Rig Operator	**Lic or Reg #**	**Date Signed**
DK		07-27-1997

4a. Potential Contamination Sources Is the well located in floodplain ? No

Type	Qualifier	Distance	Type	Qualifier	Distance
Building Overhang		13	Other Contamination Sources		119

Comment:

Water Quality Text:

Water Quantity Text:

Difficulty Text:

Created On: 09-09-1997 Created by: HFRC LOAD Updated On: 07-12-2019 Updated by: PARCEL_MATCH

Well Construction Report
WISCONSIN UNIQUE WELL NUMBER MK142

Drinking Water and Groundwater - DG/5
Department of Natural Resources, Box 7921
Madison WI 53707
Form 3300-077A

Property Owner: BELLA BUILDING CO	Phone #: (414)305-2350
Mailing Address: W231 N7047 HOMESTEAD	
City: SUSSEX	State: WI — Zip Code: 53089
County: Waukesha	Co. Permit #: — Notification #: — Completed: 06-30-1998
Well Constructor (Business Name): ROSCHI BROS WELL DRLG @ PUMP INC	Lic. #: 435 — Facility ID # (Public Wells):
Address: N10W28210 NORTHVIEW WAUKESHA WI 53188-9401	Well Plan Approval #: — Approval Date (mm-dd-yyyy):
Hicap Permanent Well #:	Common Well #: — Specific Capacity:

1. Well Location

Town of DELAFIELD

Fire # (if avail.):

Street Address or Road Name and Number: W295 N1806 PRAIRIE WOOD CT

Subdivision Name	Lot #	Block #
HIGH RIDGE E		

Latitude / Longitude in Decimal Degree (DD)	Method Code
43.0556 °N -88.3348 °W	GCD013

SE NW or Govt Lot #	Section	Township	Range
	23	7 N	18 E

2. Well Type New Well

of previous unique well # — constructed in

Reason for replaced or reconstructed well ?: NEW CONSTRUCTION

Construction Type: Drilled

3. Well serves 1 # of

Private,potable

Heat Exchange____# of drillholes

Hicap Well ? No

Hicap Property ? No

Hicap Potable ?

4. Potential Contamination Sources - ON REVERSE SIDE

5. Drillhole Dimensions and Construction Method

Dia. (in.)	From (ft.)	To (ft.)
6	Surface	220

Upper Enlarged Drillhole — Lower Open Bedrock

Yes — Rotary - Mud Circulation .....

Rotary - Air .....

Rotary - Air & Foam .....

Drill-Through Casing Hammer

Reverse Rotary

Cable-tool Bit ____in. dia...

Dual Rotary .....

Temp. Outer Casing ____in. dia

Removed? ____depth ft. (If NO explain on back side)

8. Geology

Geology Codes				8. Geology Type, Caving/Noncaving, Color, Hardness, etc...	From (ft.)	To (ft.)
		I		TOPSOIL	Surface	3
		C	G	STONEY CLAY	3	16
		P		HARDPAN	16	54
		H		SHALE	54	189
		H	L	SHALE W STREAKS LIMESTONE	189	220

6. Casing, Liner, Screen

Dia. (in.)	Material, Weight, Specification Manufacturer & Method of Assembly	From (ft.)	To (ft.)
6	BLACK STEEL PIPE WELDED JOINTS 18 97# ASTM A531780 PSI SAWHILL TUBULAR	Surface	58
Dia. (in.)	Screen type, material & slot size	From (ft.)	To (ft.)

9. Static Water Level

23 ft. below ground surface

10. Pump Test

Pumping level 150 ft. below surface

Pumping at 4.5 GP M for 1 Hrs.

Pumping Method ?

11. Well Is

12 in. above grade

Developed ? Yes

Disinfected ? Yes

Capped ? Yes

7. Grout or Other Sealing Material

Method

Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
BENTONITE CRUMBLES	Surface	25	

12. Notified Owner of need to fill & seal ?

Filled & Sealed Well(s) as needed?

13. Constructor / Supervisory Driller	Lic #	Date Signed
RR		06-30-1998
Drill Rig Operator	**Lic or Reg #**	**Date Signed**
KL		06-30-1998

4a. Potential Contamination Sources Is the well located in floodplain ? No

Type	Qualifier	Distance	Type	Qualifier	Distance
Building Overhang		12	Foundation Drain to Clearwater		12

Comment:

Water Quality Text:

Water Quantity Text:

Difficulty Text:

Created On: 09-21-1998 Created by: HFRC LOAD Updated On: 07-12-2019 Updated by: PARCEL_MATCH

Well Construction Report
WISCONSIN UNIQUE WELL NUMBER OG109

Drinking Water and Groundwater - DG/5
Department of Natural Resources, Box 7921
Madison WI 53707
Form 3300-077A

Property Owner: BARENZ BUILDERS		Phone #: (262)253-2282
Mailing Address: N112 W16700 MEQUON R		
City: GERMANTOWN	State: WI	Zip Code: 53022

County	Co. Permit #	Notification #	Completed
Waukesha			07-14-2000

Well Constructor (Business Name)	Lic. #	Facility ID # (Public Wells)
ROSCHI BROS WELL DRLG & PUMP INC	435	

Address: N10W28210 NORTHVIEW RD
WAUKESHA WI 53188-9401

Well Plan Approval #:

Approval Date (mm-dd-yyyy):

Hicap Permanent Well #	Common Well #	Specific Capacity
		0.1

3. Well serves 1 # of
Private,potable
Heat Exchange____# of drillholes

Hicap Well ? No
Hicap Property ? No
Hicap Potable ?

1. Well Location
Town of DELAFIELD

Fire # (if avail.):

Street Address or Road Name and Number
N18 W29534 CROOKED CREEK RD

Subdivision Name	Lot #	Block #
HIGH RIDGE E	41	

Latitude / Longitude in Decimal Degree (DD)				Method Code
43.0569	°N	-88.3347	°W	GCD013

SE NW or Govt Lot #	Section	Township	Range
	23	7 N	18 E

2. Well Type New Well
of previous unique well # constructed in

Reason for replaced or reconstructed well ?
NEW CONSTRUCTION

Construction Type: Drilled

4. Potential Contamination Sources - ON REVERSE SIDE

5. Drillhole Dimensions and Construction Method

Dia. (in.)	From (ft.)	To (ft.)
6	Surface	441

Upper Enlarged Drillhole / Lower Open Bedrock

Yes — Rotary - Air .....
Rotary - Mud Circulation .....
Rotary - Air & Foam .....
Drill-Through Casing Hammer
Reverse Rotary
Cable-tool Bit ____in. dia...
Dual Rotary .....
Temp. Outer Casing ____in. dia
Removed? ____depth ft. (If NO explain on back side)

8. Geology

Geology Codes				8. Geology Type, Caving/Noncaving, Color, Hardness, etc...	From (ft.)	To (ft.)
		C	G	STONEY CLAY	Surface	57
		C	S	SANDY CLAY	57	77
		H		SHALE	77	183
		L		LIMESTONE	183	428
		N		SANDSTONE	428	441

6. Casing, Liner, Screen

Dia. (in.)	Material, Weight, Specification Manufacturer & Method of Assembly	From (ft.)	To (ft.)
6	BLACK STEEL PIPE, WELDED JOINTS, 18.97 LB. ASTM A53 1780 PSI SAWHILL	Surface	77
Dia. (in.)	Screen type, material & slot size	From (ft.)	To (ft.)

7. Grout or Other Sealing Material
Method

Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
BENTONITE CRUMBLES	Surface	77	

9. Static Water Level
165 ft. below ground surface

10. Pump Test
Pumping level 335 ft. below surface
Pumping at 11 GP M for 5 Hrs.
Pumping Method ?

11. Well Is
12 in. above grade
Developed ? Yes
Disinfected ? Yes
Capped ? Yes

12. Notified Owner of need to fill & seal ?

Filled & Sealed Well(s) as needed?

13. Constructor / Supervisory Driller	Lic #	Date Signed
RR		07-14-2000
Drill Rig Operator	**Lic or Reg #**	**Date Signed**
TDK		07-14-2000

4a. Potential Contamination Sources Is the well located in floodplain ? No

Type	Qualifier	Distance	Type	Qualifier	Distance
Building Overhang		16	Collector Sewer - San or Storm	>	50
			Foundation Drain to Clearwater		17

Comment:

Water Quality Text:

Water Quantity Text:

Difficulty Text:

Created On: 09-11-2000 Created by: WELL CONST LOAD Updated On: 07-11-2019 Updated by: PARCEL_MATCH

Well Construction Report
WISCONSIN UNIQUE WELL NUMBER OG179

Drinking Water and Groundwater - DG/5
Department of Natural Resources, Box 7921
Madison WI 53707

Form 3300-077A

Property Owner: PIEKARSKI, JAMES			Phone #: 8960140
Mailing Address: 2538 PEBBLE VALLE RD			
City: WAUKESHA	State: WI	Zip Code: 53188	
County: Waukesha	Co. Permit #:	Notification #:	Completed: 04-09-2001

Well Constructor (Business Name): ROSCHI BROS WELL DRLG & PUMP INC	Lic. #: 435	Facility ID # (Public Wells):
Address: N10W28210 NORTHVIEW RD WAUKESHA WI 53188-9401		Well Plan Approval #:
		Approval Date (mm-dd-yyyy):
Hicap Permanent Well #:	Common Well #:	Specific Capacity:

3. Well serves 1 # of
Private,potable
Heat Exchange____# of drillholes

Hicap Well ? No
Hicap Property ? No
Hicap Potable ?

1. Well Location
Town of DELAFIELD

Fire # (if avail.):

Street Address or Road Name and Number: W295 N1774 PRAIRIE WOOD CT

Subdivision Name: HIGH RIDGE E	Lot #:	Block #:

Latitude / Longitude in Decimal Degree (DD): 43.0551 °N -88.3348 °W				Method Code: GCD013
NE NE or Govt Lot #	Section: 23	Township: 7 N	Range: 18 E	

2. Well Type New Well
of previous unique well # constructed in

Reason for replaced or reconstructed well ?
NEW CONSTRUCTION

Construction Type Drilled

4. Potential Contamination Sources - ON REVERSE SIDE

5. Drillhole Dimensions and Construction Method

Dia. (in.)	From (ft.)	To (ft.)
6	Surface	360

Upper Enlarged Drillhole / Lower Open Bedrock

Yes Rotary - Air ..... No

Rotary - Mud Circulation .....
Rotary - Air & Foam .....
Drill-Through Casing Hammer
Reverse Rotary
Cable-tool Bit ____in. dia...
Dual Rotary .....
Temp. Outer Casing ____in. dia
Removed? ____depth ft. (If NO explain on back side)

8. Geology

Geology Codes				8. Geology Type, Caving/Noncaving, Color, Hardness, etc...	From (ft.)	To (ft.)
-	-	C	G	STONEY CLAY	Surface	69
-	-	H	-	SHALE	69	217
-	-	C	G	STONEY CLAY	217	360

6. Casing, Liner, Screen

Dia. (in.)	Material, Weight, Specification Manufacturer & Method of Assembly	From (ft.)	To (ft.)
6	BLACK STEEL PIPE, WELDED JOINTS, 18.97 LB. ASTM A53 1780 PSI SAWHILL	Surface	69
Dia. (in.)	Screen type, material & slot size	From (ft.)	To (ft.)

9. Static Water Level
12 ft. below ground surface

10. Pump Test
Pumping level 300 ft. below surface
Pumping at 6 GP M for 2.5 Hrs.
Pumping Method ?

11. Well Is
12 in. above grade
Developed ? Yes
Disinfected ? Yes
Capped ? Yes

7. Grout or Other Sealing Material
Method

Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
BENTONITE CRUMBLES	Surface	24	

12. Notified Owner of need to fill & seal ?

Filled & Sealed Well(s) as needed?

13. Constructor / Supervisory Driller	Lic #	Date Signed
RR		04-09-2001
Drill Rig Operator	**Lic or Reg #**	**Date Signed**
KL		04-09-2001

4a. Potential Contamination Sources Is the well located in floodplain ? No

Type	Qualifier	Distance	Type	Qualifier	Distance
Building Overhang		14	Foundation Drain to Clearwater		18

Comment:

Water Quality Text:

Water Quantity Text:

Difficulty Text:

Created On: 10-02-2001 Created by: WELL CONST LOAD Updated On: 07-11-2019 Updated by: PARCEL_MATCH

Well Construction Report
WISCONSIN UNIQUE WELL NUMBER ON879

Drinking Water and Groundwater - DG/5
Department of Natural Resources, Box 7921
Madison WI 53707
Form 3300-077A

Property Owner: SIGNATURE BUILDERS			Phone #: (262)691-4440
Mailing Address: N18 W29022 GOLF RIDG			
City: PEWAUKEE	State: WI	Zip Code: 53072	
County: Waukesha	Co. Permit #:	Notification #:	Completed: 03-12-2001

1. Well Location
Town of DELAFIELD
Fire # (if avail.):
Street Address or Road Name and Number: W295 N1765 PRAIRIE WOOD CT

Subdivision Name	Lot #	Block #
HIGH RIDGE E	34	

Well Constructor (Business Name)	Lic. #	Facility ID # (Public Wells)
MICHAEL HARTMAN	436	

Latitude / Longitude in Decimal Degree (DD): 43.0546 °N -88.3359 °W
Method Code: GCD013

Well Plan Approval #:
Address: PO BOX 218, NORTH LAKE WI 53064-0218
Approval Date (mm-dd-yyyy):

SE	NW	Section	Township	Range
or Govt Lot #		23	7 N	18 E

2. Well Type New Well
of previous unique well #: constructed in

Hicap Permanent Well #	Common Well #	Specific Capacity
		0.1

Reason for replaced or reconstructed well ?
NEW HOME

3. Well serves 1 # of HOME
Private,potable
Heat Exchange____# of drillholes

Hicap Well ? No
Hicap Property ? No
Hicap Potable ?

Construction Type: Drilled

4. Potential Contamination Sources - ON REVERSE SIDE

5. Drillhole Dimensions and Construction Method

Dia. (in.)	From (ft.)	To (ft.)
6	Surface	325

Upper Enlarged Drillhole / Lower Open Bedrock
- Rotary - Mud Circulation .....
- Rotary - Air .....
- Rotary - Air & Foam .....
- Drill-Through Casing Hammer
- Reverse Rotary
- Cable-tool Bit ____in. dia...
- Dual Rotary .....
- Temp. Outer Casing ____in. dia
  - Removed? ____depth ft. (If NO explain on back side)

8. Geology

Geology Codes				8. Geology Type, Caving/Noncaving, Color, Hardness, etc...	From (ft.)	To (ft.)
-	-	C	-	SURFACE CLAY	Surface	7
-	-	Y	-	SAND, GRAVEL	7	15
-	-	P	-	HARDPAN	15	53
-	-	H	-	SHALE	53	195
-	-	L	-	LIMESTONE	195	325

6. Casing, Liner, Screen

Dia. (in.)	Material, Weight, Specification Manufacturer & Method of Assembly	From (ft.)	To (ft.)
6	0.280 A 53 GRB SAWHILL STEEL WELDED	Surface	60
Dia. (in.)	Screen type, material & slot size	From (ft.)	To (ft.)

9. Static Water Level
60 ft. below ground surface

10. Pump Test
Pumping level 180 ft. below surface
Pumping at 11 GP M for 4 Hrs.
Pumping Method ?

11. Well Is
18 in. above grade
Developed ? Yes
Disinfected ? Yes
Capped ? Yes

7. Grout or Other Sealing Material
Method: MOUNDED

Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
CRUMBLES	Surface		

12. Notified Owner of need to fill & seal ?

Filled & Sealed Well(s) as needed? No
NO WELL

13. Constructor / Supervisory Driller	Lic #	Date Signed
MH		03-13-2001
Drill Rig Operator	**Lic or Reg #**	**Date Signed**
JB		07-10-2001

4a. Potential Contamination Sources Is the well located in floodplain ? No

Type	Qualifier	Distance	Type	Qualifier	Distance
Building Overhang		8	Collector Sewer - San or Storm		148
Clearwater Sump		25	Foundation Drain to Clearwater		10
			Sewer - Building Sanitary		22

Comment:

Water Quality Text:

Water Quantity Text:

Difficulty Text:

Created On: 08-23-2001 Created by: WELL CONST LOAD Updated On: 07-12-2019 Updated by: PARCEL_MATCH

Well Construction Report
WISCONSIN UNIQUE WELL NUMBER YX894

Drinking Water and Groundwater - DG/5
Department of Natural Resources, Box 7921
Madison WI 53707

Form 3300-077A

Property Owner: DAYSPRING BAPTIST CHURCH	Phone #
Mailing Address: N14 W79503 SILVERNAIL RD	
City: DELAFIELD	State: WI — Zip Code: 53018
County: Waukesha	Co. Permit #: — Notification #: — Completed: 05-18-2018
Well Constructor (Business Name): D & D WELL & PUMPS LLC	Lic. #: 7181 — Facility ID # (Public Wells): 268680280
Address: N6331 COUNTY F, OCONOMOWOC WI 53118	Well Plan Approval #: 685014362 — Approval Date (mm-dd-yyyy): 04-03-2018
Hicap Permanent Well #: 92243	Common Well # — Specific Capacity: 0.4

1. Well Location

Town of DELAFIELD				Fire # (if avail.): N14 W29503
Street Address or Road Name and Number: SILVERNAIL RD				
Subdivision Name		Lot #		Block #
Latitude / Longitude in Decimal Degree (DD): 43.0491 °N -88.3334 °W				Method Code: GPS008
SW SE or Govt Lot #	Section: 23	Township: 7 N	Range: 18 E	

2. Well Type New Well

of previous unique well # — constructed in

Reason for replaced or reconstructed well ?

Construction Type: Drilled

3. Well serves 1 # of CHURCH SCHOOL

Non-community — School

Heat Exchange____# of drillholes

Hicap Well ? Yes
Hicap Property ? Yes
Hicap Potable ? No

4. Potential Contamination Sources - ON REVERSE SIDE

5. Drillhole Dimensions and Construction Method

Dia. (in.)	From (ft.)	To (ft.)
12.25	Surface	26
12	26	241
8	241	745

Upper Enlarged Drillhole		Lower Open Bedrock
Yes	Rotary - Mud Circulation	No
No	Rotary - Air	Yes
No	Rotary - Air & Foam	No
No	Drill-Through Casing Hammer	
No	Reverse Rotary	
No	Cable-tool Bit ____in. dia...	No
No	Dual Rotary	No
Yes	Temp. Outer Casing 12in. dia	
No	Removed? 26depth ft. (If NO explain on back side)	

6. Casing, Liner, Screen

Dia. (in.)	Material, Weight, Specification Manufacturer & Method of Assembly	From (ft.)	To (ft.)
8	STEEL 28.55 # A53-B IPSCO WELDED	Surface	241
Dia. (in.)	Screen type, material & slot size	From (ft.)	To (ft.)

7. Grout or Other Sealing Material

Method

Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
PORTLAND CEMENT	Surface	241	200 S

8. Geology

Geology Codes				8. Geology Type, Caving/Noncaving, Color, Hardness, etc...	From (ft.)	To (ft.)
		Y	G	Y-SAND & GRAVEL G-W/GRAVEL/COBBLES/BOULDERS/STONES	Surface	26
		L		L-LIMESTONE/DOLOMITE	26	60
		H	L	H-SHALE L-LIMEY OR DOLOMITIC	60	195
		L		L-LIMESTONE/DOLOMITE	195	505
		N		N-SANDSTONE	505	745

9. Static Water Level

318 ft. below ground surface

10. Pump Test

Pumping level 505 ft. below surface

Pumping at 75 GP M for 2 Hrs.

Pumping Method ? Airlift

11. Well Is

18 in. above grade

Developed ? Yes
Disinfected ? Yes
Capped ? Yes

12. Notified Owner of need to fill & seal ? No

NO WELL

Filled & Sealed Well(s) as needed? No

NO WELL

13. Constructor / Supervisory Driller	Lic #	Date Signed
DJ	5694	05-18-2018
Drill Rig Operator	Lic or Reg #	Date Signed

4a. Potential Contamination Sources Is the well located in floodplain ? No

Type	Qualifier	Distance	Type	Qualifier	Distance
Grease Trap		72	Sewer - Building Sanitary		40
POWTS dispersal component (soil absorption unit or mound)	>	600	Septic or Holding, or POWTS Tank	>	600

Comment:

Water Quality Text:

Water Quantity Text:

Difficulty Text:

Created On: 07-13-2018 Created by: CHARMCAFEE Updated On: 07-12-2019 Updated by: PARCEL_MATCH_LL_OK

Well Construction Report
WISCONSIN UNIQUE WELL NUMBER ZW994

Drinking Water and Groundwater - DG/5
Department of Natural Resources, Box 7921
Madison WI 53707
Form 3300-077A

Property Owner: KINGS WAY HOMES / CRAMER, GARTH & KIM		Phone #: (414)303-8638
Mailing Address: 700 PILGRIM PARKWAY		
City: ELM GROVE	State: WI	Zip Code: 53122
County: Waukesha	Co. Permit #:	Notification #: 7719574802 / Completed: 08-14-2019

Well Constructor (Business Name): HERR WELL DRILLING INC	Lic. #: 672	Facility ID # (Public Wells):
Address: W295 HERR RD DOUSMAN WI 53118-9407		Well Plan Approval #: Approval Date (mm-dd-yyyy):
Hicap Permanent Well #:	Common Well #:	Specific Capacity: 0

3. Well serves 1 # of HOME
Private,potable
Heat Exchange____# of drillholes

Hicap Well ? No
Hicap Property ? No
Hicap Potable ? No

1. Well Location
Town of DELAFIELD
Fire # (if avail.): N12 W29556
Street Address or Road Name and Number: SOUTHAMPTON DRIVE
Subdivision Name:
Lot #:
Block #:
Latitude / Longitude in Decimal Degree (DD): 43.0471 °N -88.3348 °W
Method Code: GPS008

SE	SW	Section	Township	Range
or Govt Lot #		23	7 N	18 E

2. Well Type New Well
of previous unique well # constructed in
Reason for replaced or reconstructed well ?
Construction Type: Drilled

4. Potential Contamination Sources - ON REVERSE SIDE

5. Drillhole Dimensions and Construction Method

Dia. (in.)	From (ft.)	To (ft.)
8.75	Surface	62
6	62	165

Upper Enlarged Drillhole		Lower Open Bedrock
Yes	Rotary - Mud Circulation	Yes
No	Rotary - Air	No
No	Rotary - Air & Foam	No
No	Drill-Through Casing Hammer	
No	Reverse Rotary	
No	Cable-tool Bit ____in. dia...	No
No	Dual Rotary	No
No	Temp. Outer Casing ____in. dia	
No	Removed? ____depth ft. (If NO explain on back side)	

8. Geology

Geology Codes				8. Geology Type, Caving/Noncaving, Color, Hardness, etc...	From (ft.)	To (ft.)
		C		C-CLAY	Surface	15
		X	G	X-SAND & CLAY G-W/GRAVEL/STONES	15	45
		L		L-LIMESTONE/DOLOMITE	45	50
		H		H-SHALE	50	60
		L	H	L-LIMESTONE/DOLOMITE H-SHALEY	60	140
	B	L		B-BROKEN L-LIMESTONE/DOLOMITE	140	153
		H		H-SHALE	153	165

6. Casing, Liner, Screen

Dia. (in.)	Material, Weight, Specification Manufacturer & Method of Assembly	From (ft.)	To (ft.)
6	18.97 LBS PER FT, NEW STEEL PLAIN END, ASTM A53 GRADE B, IPSCO TUBULAR, 2660 PSI	Surface	62
Dia. (in.)	Screen type, material & slot size	From (ft.)	To (ft.)

7. Grout or Other Sealing Material
Method BRADENHEAD

Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
NEAT CEMENT GROUT	Surface	62	20 S

9. Static Water Level
65 ft. below ground surface

10. Pump Test
Pumping level 105 ft. below surface
Pumping at 20 GP M for 3 Hrs.
Pumping Method ? Airlift

11. Well Is
16 in. above grade
Developed ? Yes
Disinfected ? Yes
Capped ? Yes

12. Notified Owner of need to fill & seal ? No
NONE

Filled & Sealed Well(s) as needed? No
NONE

13. Constructor / Supervisory Driller	Lic #	Date Signed
GSD	6676	08-15-2019
Drill Rig Operator	**Lic or Reg #**	**Date Signed**
DJD	8131	08-15-2019

4a. Potential Contamination Sources Is the well located in floodplain ? No

Type	Qualifier	Distance	Type	Qualifier	Distance
POWTS dispersal component (soil absorption unit or mound)		135	Septic or Holding, or POWTS Tank		120

Comment:

Water Quality Text:

Water Quantity Text:

Difficulty Text:

Created On: 08-15-2019 Created by: JohnCHerr Updated On: 08-21-2019 Updated by: WELL PROCESS

ATTACHMENT 2

***Response to Southeastern Wisconsin Regional Planning Commission Comments to GZA's Hydrogeologic Assessment Report*, dated July 14, 2023**

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www.gza.com

July 14, 2023
File No. 20.0158210.00

Mr. Bryan Lindgren
Neumann Developments, Inc.
N27W24025 Paul Court, Suite 100
Pewaukee, Wisconsin 53072-6329

Re: Response to Southeastern Wisconsin Regional Planning Commission Comments to GZA's Hydrogeologic Assessment Report
Proposed Thomas Farms Subdivision Development
Town of Delafield, Wisconsin

Dear Mr. Lindgren:

GZA GeoEnvironmental, Inc. (GZA), at the request of Neumann Developments, Inc. (Neumann Developments), prepared a Hydrogeologic Assessment Report, dated March 24, 2023,[1] for the Proposed Thomas Farms Subdivision Development ("Development") in the Town of Delafield, Wisconsin. The purpose of the hydrogeologic assessment was to evaluate the effects of the proposed Development on the groundwater levels due to pumping. This assessment included a review of the geologic and hydrogeologic information available for this area, and the details about the proposed Development, including the number and locations of the new dwellings. As part of this assessment, GZA estimated the drawdown of each well at the individual property boundaries using a Theis analytic solution for pumping wells.

In an electronic mail message, dated April 25, 2023, Ms. Laura K. Herrick, Chief Environmental Engineer at the Southeastern Wisconsin Regional Planning Commission (SEWRPC), provided comments regarding GZA's Hydrogeologic Assessment Report to both Waukesha County and Neumann Developments. GZA reviewed these comments and is providing further clarification to and evaluation of the comments. SEWRPC's comments included general statements regarding the assumptions used in the Hydrogeologic Assessment Report and specific comments for further evaluation. The specific SEWRPC comments to GZA's Hydrogeologic Assessment Report for further evaluation are summarized below.

1. The report alternately identifies the Maquoketa Shale as permeable for well purposes, but impermeable for influence on near surface aquifers - it cannot be both. Typically, the Maquoketa Shale is not considered an aquifer in our Region. If it is permeable via fracturing and an acceptable residential water supply, then it can pull water from the overlying glacial deposits, is likely easily contaminated, and has significant potential impact to surface water resources. If it is impermeable, then it would not be a reliable water supply to the new homes.

2. The GZA report does not evaluate the cumulative impact of all 183 wells at the proposed Development parcel boundaries as is done in Richfield; it is not possible to determine or comment on the overall potential for pumping impact of this proposed Development on neighboring parcels.

[1] *Hydrogeologic Assessment Report, Proposed Thomas Farm Subdivision Development, Town of Delafield, Wisconsin*, dated March 24, 2023, GZA File No. 20.0158210.00.

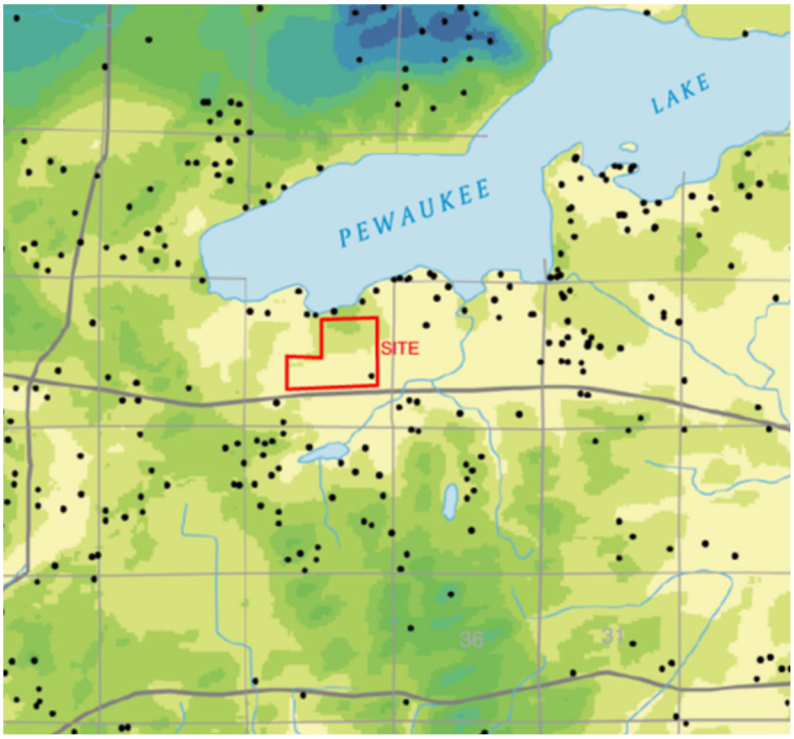
The following sections of this letter are intended to provide GZA's response to SEWRPC's comments and provide clarification of the information in GZA's Hydrogeologic Assessment Report.

BEDROCK GEOLOGY AND HYDRAULIC PROPERTIES

Bedrock formations in southeastern Wisconsin dip to the east at approximately 45 feet per mile. The bedrock has been eroded by the glacial and fluvial processes. As shown on the Preliminary Bedrock Geologic Map of Waukesha County, Wisconsin[2] below, in the site area, the youngest bedrock units encountered consist of Silurian-age dolomite (light green color) underlain by the Ordovician-age Maquoketa Shale (gray color). The Silurian-age dolomite has been eroded in the portion of Waukesha County in the vicinity of the Proposed Thomas Farms Subdivision Development and consists of a thin layer over the Maquoketa Shale or is completely eroded. As shown on the map below, the Silurian dolomite is completely eroded beneath Pewaukee Lake to the north and, therefore, the Maquoketa shale is the first bedrock unit encountered.

In the area of Thomas Farms, surficial deposits overlay the bedrock. A review of the depth to bedrock map for this area, as provided below, indicates the thickness of the unconsolidated deposits is less than 50 feet (yellow color) with increasing thickness to the south (green colors) across the highway up to 50 to 150 feet in thickness.[3] Due to the limited saturated thickness in the area of the Thomas Farms property, the unconsolidated deposits are not considered to be used for drinking water purposes.

[2] Massie-Ferch, K.M. and Peters, R.M., *Preliminary Bedrock Geologic Map of Waukesha County, Wisconsin*, Wisconsin Geological and Natural History Survey, Open-File Report-2004-15A, 2004.
[3] Ibid.



GZA reviewed water well drilling logs for 20 potable drinking water wells in the area of the proposed Development that extend through the Maquoketa Shale to evaluate the thickness of the Maquoketa Shale and the underlying bedrock. The well logs obtained and reviewed by GZA were immediately adjacent to the site to the east, north, west, and south. Based on a review of the drilling logs, the lithology consists of:

- Varying thicknesses of unconsolidated deposits were encountered over the bedrock. The thickness of these deposits varied with location. To the south of the site, the elevation increases due to a thickening of the unconsolidated deposits. The thickness of the unconsolidated deposits northeast of the site is less than 15 feet and generally between 3 and 8 feet thick. The thicknesses of the unconsolidated deposits northwest and southwest of the site generally range from 20 to 50 feet.
- A thin layer of Silurian dolomite appears to be present in wells east of the site at a thickness of 10 to 30 feet, but is not present in wells west of the site. As confirmed on the bedrock map above, it appears that the site overlies the transition area in which the Silurian dolomite is completely eroded and the Maquoketa Shale is the first bedrock encountered.
- The drilling logs reviewed indicate that the transition from Silurian dolomite to Maquoketa Shale is represented as an alternating and interbedded sequence of shale and dolomite. The thickness of the Maquoketa Shale was evaluated in drilling logs that indicated the presence of the overlying Silurian dolomite and the underlying Ordovician dolomite so that the entire Maquoketa Shale sequence was reasonably present in the drilling logs. These criteria were present in eight of 20 drilling logs and the Maquoketa Shale ranged in thickness from 160 to 220 feet.
- The Ordovician-age Sinnipee Group dolomite was present in 12 of 20 drilling logs and the thicknesses ranged from 195 to 310 feet. However, the thickness in most wells where the Sinnipee Group dolomite was encountered ranged between 203 and 249 feet.

A review of the drilling logs for 40 potable drinking water wells in the immediate area surrounding the site indicates that these wells are generally constructed to depths of approximately 200 to 250 feet below ground surface (bgs). The wells are cased with steel pipe from ground surface into the bedrock at which depth the wells are completed as open boreholes. Most of the wells are cased to a depth at which the bedrock is described as shale and limestone or shale. For the purposes of this study, these units were interpreted as the Maquoketa Shale.

In a report prepared for the University of Wisconsin Water Institute, Eaton et al. (2000)[4] evaluated the hydraulic conductivity and specific storage of the Maquoketa Shale in Waukesha County. The conclusion of this study identified that the upper 100 feet of the Maquoketa Shale is a dolomitic shale with significant bedding plane fractures and vertical fractures that are well connected to the Silurian dolomite. These fractures increase the transmissivity of the bedrock. This study also concluded that the lower portion of the Maquoketa Shale contains more shale and does act as a confining unit over the low hydraulic conductivity Ordovician dolomite and the underlying sandstone, which is a major aquifer. The upper portion is not considered an aquifer for municipal water supplies, but is sufficient to support individual households, as evidenced by the depth of the existing potable wells in the area. Residential developments are located to the east, west, and north with wells completed in the Maquoketa Shale.

UNCONSOLIDATED DEPOSITS

GZA reviewed well drillers' logs to evaluate the static water levels, as recorded by the driller, to determine if the surface water on the property is in contact with the regional aquifer or aquifer within the upper portion of the Maquoketa Shale. Based on the static water levels recorded by the well drillers, the depth to groundwater appears to be within the Maquoketa Shale to the north, west, and east of the Thomas Farms property. The groundwater in the potable wells is generally reported to be at a depth of 20 to 30 feet bgs, or deeper, which confirms separation between surface water and the upper Maquoketa Shale aquifer.

Surface water in this area is recharged from overland flow of stormwater runoff and is generally not recharged from groundwater unless there are stratified unconsolidated deposits that cause infiltrating water to be perched and discharged to surface water. As previously noted, the perched groundwater in the unconsolidated deposits is not used for potable drinking water purposes in this area. Groundwater in this area will also be recharged through infiltration and the underlying bedrock aquifer will be recharged, to some degree, through the vertical fractures. In addition, Pewaukee Lake is a constant head boundary that recharges the bedrock upper Maquoketa Shale through bedding plane fractures and unconsolidated deposits in the area.

POTABLE WELL CONSTRUCTION

A review of the well drillers' logs indicates that the potable drinking water wells are generally completed in the Maquoketa Shale for the subdivisions that are adjacent to the Thomas Farms property. These wells have steel casing that extends from the surface into the bedrock which eliminates direct communication of the wells with the surface water. As indicated above, the static water levels reported are generally within the bedrock indicating that there is not groundwater perched on the bedrock. The wells are completed as open borehole completions allowing water from the entire thickness of bedrock to flow into the well.

There is residential development to the east, west, and north of the proposed Development. Potable water for each of the residential properties is supplied by a potable drinking water well. There is a higher density of development north of the Thomas Farms property along Pewaukee Lake, with lower density residential development to the east and west. The properties to the north, along Pewaukee Lake, have been developed for more than 50 years, while the developments to

[4] Eaton, Timothy, Hart, D., Bradbury, Ken, and Wang, Herbert, 2000, *Hydraulic conductivity and specific storage of the Maquoketa shale*.

the east and west have been developed within the last 20 years. The long-term use of groundwater on the properties has not had a detrimental effect on the groundwater levels in this area.

Based on review of the available information, and as presented herein, GZA believes:

- The Maquoketa Shale is used as a drinking water source in this area;
- Pumping from the Maquoketa Shale will not adversely affect the surface water in this area; and
- Construction of wells that have casing into bedrock allows for protection of shallow perched groundwater.

Therefore, this Development will not adversely affect the groundwater in this area.

CUMULATIVE DRAWDOWN EVALUATION

SEWRPC's comments included that the cumulative impacts of the pumping for this subdivision be evaluated to understand the drawdown at the subdivision boundaries. GZA completed this evaluation, as described in this section.

For this evaluation, GZA divided the subdivision into 11 separate areas, designated as Areas A through K, each with a central well. The water usage for each lot within the respective area was assigned to the central well. To evaluate the cumulative drawdown for the proposed development, GZA also established 11 points, designated as 1 through 11, around the perimeter. The attached **Figure 1** shows the areas and the point around the perimeter. The details of each well are summarized in the table below.

Group	No. of Single-Family Homes Per Group	No. of Condominium Buildings Per Group	No. of People Per Group	Well Discharge (gpm) Per Group (assuming 77 gpcd)	Well Discharge (gpm) Per Group (assuming 125 gpcd)
A	0	9	54	2.89	4.69
B	0	11	66	3.53	5.73
C	5	8	63	3.37	5.47
D	10	0	30	1.60	2.60
E	11	0	33	1.76	2.86
F	11	0	33	1.76	2.86
G	40	0	120	6.42	10.42
H	30	0	90	4.81	7.81
I	32	0	96	5.13	8.33
J	8	0	24	1.28	2.08
K	8	0	24	1.28	2.08

The aquifer properties used for this evaluation were the same as the properties used in the Hydrogeologic Assessment Report. Each well was assumed to pump at a constant rate based on the number of people and the average water usage per capita per day and the pumping scenario was assumed to be over a 50-year period.

As discussed in our Hydrogeologic Assessment Report, GZA calculated a transmissivity value of 2,500 gallons per day per foot (gpd/ft), used an aquifer thickness value of 167 feet, and used a storage coefficient value of 7.13×10^{-5} ft^{-1}. Based on a review of the US Census' five-year estimate (2017-2021) demographics for the Town of Delafield, each home has an average of 2.75 individuals; however, for this evaluation, GZA used a conservative value of three individuals per single-family home and condominium unit or six individuals per condominium building. To calculate the drawdown, GZA assessed cumulative drawdown at the property boundary using a water usage per capita of 77 gpd/person.

The drawdown was conservatively calculated without considering the return of water to the groundwater system through stormwater retention or recharge.

The drawdown was calculated at each of the 11 perimeter points for each well. The cumulative drawdown was calculated at each point by summing the drawdowns for each well. The cumulative drawdown calculated at each point is summarized in the table below.

Point	Cumulative Drawdown (assuming 77 gpd/Capita [feet])
1	18.06
2	17.81
3	17.65
4	17.77
5	18.48
6	18.38
7	17.71
8	17.89
9	17.51
10	16.95
11	17.53
Average	**17.80**

GZA believes this a conservatively high estimate for cumulative drawdown because of the assumptions used in this evaluation for per capita water usage and no groundwater recharge. In the proposed Development plan, there are approximately 74 acres of open space that will not be developed, which will promote groundwater recharge. Any recharge from infiltration will result in a lower cumulative drawdown.

Based on the conservative cumulative drawdown over a 50-year period, the proposed Development will not adversely affect either the groundwater or surface waters in the area of the proposed Development.

We trust this supplemental information will meet your needs. Should you, however, have any further questions regarding this information, please feel free to contact the undersigned below.

Sincerely,

GZA GeoEnvironmental, Inc.

Kevin M. Hedinger
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Attachment: Figure 1

OPEN SPACE DATA TABLE - Welshire Farm — Date: 3/17/2023

Proposed Zoning = PLANNED DEVELOPMENT DISTRICT #1

ZONE	Total Area (acres)	Lowland Area (acres)	Upland PEC (acres)	SUB-TOTAL Development Area (non-EC) (acres)	*Incremental Development Area (non-EC) (acres)*	PROPOSED USE	Required Open Space (% of site*)	REQUIRED NET OPEN SPACE* (acres)	NET OPEN SPACE PROVIDED * (acres)	(%)
1	23.20	3.98	11.72	7.50		Single-Family Low Density	30.0%	6.96	15.31	66.0%
2	29.94	0.90	9.94	19.10		Residential Single-Family Low-Medium Density (15,000)	30.0%	8.98	16.04	53.6%
3	50.08	3.77	5.85	40.46	22.97	Condominium (4 un/ac) **	60.0%	19.56	19.56	60.0%
					17.49	Single-Family Medium Density (10,000)	35.0%	6.12	6.16	35.2%
4	47.83	1.45	3.09	43.30		Single-Family Medium Density (10,000)	35.0%	16.74	17.00	35.6%
SUBTOTAL	151.05	10.09	30.60	110.36			38.6%	58.36	74.07	49.0%

* Net Open Space for whole development site. Accounts for Lowland Area multiplied by 0.2. Single family open space is in Outlots. Condo open space is common area.

** Condo Net Open Space based on: Gross Area = 50.08 ac - 17.49 ac = 32.59 ac. Open Space includes (3.77 ac lowland x 0.2) + 18.19 ac of common area + a portion of OL 4 (0.5 ac) + a portion of OL 8 (0.12 ac) within Zone 3 - said OL areas flanking entry area at Clubhouse and provided for common use, to satisfy Net Open Space requirements.

Open Space Plan Legend

- **Wetlands** (Heartland Ecological Group Inc, July 2022)
- **Primary Environmental Corridor (PEC)** (Heartland Ecological Group Inc, July 2022)
- Treelines & Other wooded areas to be preserved (OS)
- **Landscape Buffer (LB)**
- Open Space Areas for Development Site Calculations
  - Single family in Outlot
  - Condo is common area

Treeline Preservation Area (30' wide Outlot)

OS 1

Zone 1 23.2 ac

Zone 2 29.94 ac

Zone 3 50.08 ac

Zone 4 47.83 ac

OS 3

OS 4

OS 5

EXISTING WETLAND

EXISTING PEC

PRIMARY ENVIRONMENTAL CORRIDOR

SHORELAND ZONING

OAKTON RD

Lake Country Recreation Trail

CROOKED CREEK RD

PRAIRIE WOOD CT

HIDDEN CREEK CT

GLEN COVE ROAD

BROOKSTONE CIR

BROOKSTONE CIR

Landscape Berm

Landscape Buffer

LB 1 100' wide

LB 2 50' wide

LB 3 100' wide

Treeline Replacement landscape area

GOLF ROAD

CTH 'DR'

I-94

ELMHURST ROAD

GOLF RDG S

SILO

WETLAND

TRIO DESIGN + LAND SURVEYING CIVIL ENGINEERING
4100 N. CALHOUN ROAD
BROOKFIELD, WI 53005
(262) 790-1480
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Map 2
OPEN SPACE AND NATURAL RESOURCE PROTECTION PLAN
Welshire Farm Development
Town of Delafield, Waukesha County, Wisconsin

NEUMANN DEVELOPMENTS, INC.

0 75 150 300

Scale: 1" = 150' (22"X34")

Scale: 1" = 300' (11"X17")

DATE: 03/17/2023

ATTACHMENT 3

Response to Southeastern Wisconsin Regional Planning Commission Considerations,
dated October 16, 2023

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www.gza.com

October 16, 2023
File No. 20.0158210.00

Mr. Bryan Lindgren
Neumann Developments, Inc.
N27W24025 Paul Court, Suite 100
Pewaukee, Wisconsin 53072-6329

Re: Response to Southeastern Wisconsin Regional Planning Commission Considerations
Proposed Thomas Farm Subdivision Development
Town of Delafield, Wisconsin

Dear Mr. Lindgren:

GZA GeoEnvironmental, Inc. (GZA) is submitting this letter as clarification to considerations provided by the Southeastern Wisconsin Regional Planning Commission (SEWRPC) regarding the groundwater evaluation for the proposed Thomas Farm property in the Town of Delafield, Wisconsin. The SEWRPC considerations were in response to GZA's letter dated July 14, 2023 ("July 2023 Letter"), which presented the results of a cumulative impacts evaluation and the estimated drawdown calculated at points along the development boundary.

The SEWRPC considerations provided concurrence on certain conclusions in GZA's July 2023 Letter, and identified areas of suggested further evaluation that could be considered. SEWRPC's comments were prepared and transmitted in an August 3, 2023 email from Mr. Dale Buser of SEWRPC to Mr. Jason Fruth of Waukesha County. The email contained 11 considerations. These considerations were discussed in a meeting on September 7, 2023 with Waukesha County, Neumann Development, Inc., GZA, Town of Delafield, representatives of the property owner, and SEWRPC. This letter provides clarification and addresses the considerations identified in the email.

The considerations can be categorized into three broad areas, including the cumulative drawdown at the property boundary and its influence on regional groundwater elevations, well construction and groundwater volume, stormwater planning and influence of groundwater on the shallow surface water features on and around the Thomas Farm property.

CUMULATIVE IMPACT OF GROUNDWATER PUMPING WITH INFILTRATION

GZA evaluated the cumulative drawdown from 11 pumping wells on the Thomas Farm property at 11 points around the perimeter of the property. In the original evaluation, GZA assumed no groundwater recharge across the proposed development, which resulted in a conservatively high estimate for drawdown. Based on a review of the proposed development and site surface water features, there is likely significant groundwater recharge across the site due to the presence of stormwater features and natural surface water retention features such as wetlands.

Based on stormwater calculations developed as part of the development plan, the total post-development infiltration volume is estimated to be 13,398,000 cubic feet annually. This volume is approximately 90% of the pre-development infiltration volume. The post-development infiltration volume was used to re-evaluate the drawdown at the perimeter of the proposed development.

The same methodology used in previous calculations of drawdown was used in this evaluation. Hydrogeologic parameters were estimated from available information or publicly available sources and were used as variables in the Theis analytical solution. The Theis analytical solution provides an estimate of the drawdown at a given point at a distance from the pumping well for a given pumping rate over a specified time. The cumulative drawdown at the proposed development property boundary was estimated at 11 points by adding the drawdown calculated for each well at that point. **Figure 1** shows the proposed development, cumulative impact well locations, and property boundary drawdown measurement points.

To apply the infiltration volume to the Theis solution, the volume was divided among the 11 pumping wells and applied to each pumping well. Applying the appropriate volume of water to each well, in gallons per minute, resulted in a reduction in the pumping rate in each well.

The calculated drawdown, if considering infiltration, indicates that the drawdown at the property boundary would be approximately 4 to 5 feet. As previously stated, this drawdown is in comparison to 17 to 18 feet of drawdown when groundwater recharge is not considered. This evaluation including infiltration is considered to be an estimate of the conditions based on the hydrologic conditions at the Thomas Farm property. A summary table of the calculated drawdown at each point around the perimeter of the property is included in **Attachment 1**.

This evaluation confirms that groundwater recharge at the property reduces the potential for drawdown in the aquifer. The drawdown calculated from this evaluation indicates that the development will not adversely affect the groundwater elevations and resources in the area. The water supply for the proposed development can be from individual wells completed in the Maquoketa Shale and does not require a community well completed in the deeper sandstone. The proposed development is similar to other developments that were previously constructed in the area and that have not had a detrimental impact on the groundwater elevation or groundwater quality.

The groundwater elevation on the Thomas Farm property is estimated to be at approximately 860 feet above mean sea level (amsl) on the northern portion of the property and an elevation of 852.5 feet amsl for Pewaukee Lake. Since groundwater flow is toward Pewaukee Lake to the north, the groundwater elevation on the southern portion of the property is likely higher than the northern portion. An evaluation of the drawdown at the property boundary indicates that even with a drawdown of 4 to 5 feet, the groundwater elevation is approximately 855 feet amsl. This elevation maintains groundwater flow to the north toward Pewaukee Lake, therefore, it is unlikely that water will flow out of Pewaukee Lake to the proposed development. A review of United States Geological Survey (USGS) monitoring well 425535088131701 in the Silurian-Devonian aquifer indicates the monitoring well has natural groundwater fluctuations up to 10 feet and USGS monitoring wells 430416088144301 and 430416088144301 in the sand and gravel aquifer have natural groundwater fluctuations up to 6 feet. These wells are located east and south of the proposed Thomas Farm development in the Waukesha area. The estimated cumulative drawdown is within this same range of natural groundwater fluctuations measured at the existing wells.

The calculated drawdown for the development including infiltration is limited and the groundwater in bedrock is not in communication with the shallow groundwater. As such, the pumping is not anticipated to affect surface water features such as wetlands, seeps, and springs. In its considerations, SEWRPC identified features on the Pewaukee Golf Club property that could be in communication with groundwater based on an evaluation of the topographic and groundwater elevations. The closest of these features is located approximately 1,600 feet east of wells H, I, and J in GZA's cumulative impact evaluation. Assuming the pumping rate for these wells for the proposed development, GZA calculated the drawdown from these wells at a distance of 1,600 feet. The cumulative drawdown is less than 1 foot at the closest surface water feature on the Pewaukee Golf Club property. Based on this evaluation, when infiltration is included in the cumulative impact evaluation, the impact to surface water features on the Pewaukee Golf Club property is minimal. This evaluation assumes that the groundwater pumping in the proposed wells is in communication with and affects groundwater on the Pewaukee Golf Club property.

COMPARATIVE ANALYSIS OF CUMULATIVE DRAWDOWN FOR EXISTING SUBDIVISION

To evaluate the influence of the proposed Thomas Farm development on the groundwater, an estimate of the cumulative drawdown was calculated for the existing developments east and west of the Thomas Farm property. This cumulative drawdown estimate was calculated using the same methodology that was used for the Thomas Farm site. An estimate of infiltration was not included because it was not available. The calculated cumulative drawdown for these developments is comparable to the cumulative drawdown calculated for the proposed Thomas Farm development without infiltration. For each of these developments, the hydraulic conductivity or transmissivity was estimated from specific capacity tests from an existing well in the development. These estimated values were applied to the respective developments.

For the development to the east, the development was divided into two separate areas and a well was assumed at the center of the area. The water use for the homes in each area were applied to the well and the drawdown was calculated. For the development to the west, the development was divided into four separate areas and a well was assumed at the center of each area. The water use for the homes in each area were applied to the well and the drawdown was calculated. Water use was calculated based on three persons per home at a daily water use of 75 gallons and 125 gallons. This provides a range of water use to estimate drawdown.

For each, development points were identified along the perimeter of the development and the drawdown for each well at the points was calculated. To calculate the cumulative drawdown, the drawdown for each well at the point was summed together.

Based on the estimated aquifer properties and the methodology, the calculated cumulative drawdown for the developments to the east and west were as follows:

Development	Cumulative Drawdown
East	14 to 24 feet
West	7 to 12 feet

As with the calculated cumulative drawdown for the proposed Thomas Farm development, it is assumed that when a similar level of infiltration is used in the calculation, the drawdown will be limited to 4 to 5 feet. However, due to the age of the adjacent developments and changes in stormwater management regulations, it should be assumed that infiltration in the proposed development will be higher than adjacent developments where infiltration practices were not applied. A comparison of the calculated cumulative drawdown for these developments to the proposed Thomas Farm development indicates that, as anticipated, the proposed Thomas Farm development will have a similar influence on the groundwater as the existing developments.

PROPOSED WELL CONSTRUCTION AND WATER SUPPLY

The water supply wells proposed for the proposed development would be completed in accordance with the Wis. Adm. Code NR 812 for the construction of the wells. A review of the potable wells in the area surrounding the Thomas Farm property indicates that most of the wells are completed with 60 feet of well casing. NR 812.14 requires 60 feet of well casing if limestone or dolomite bedrock is encountered at a depth less than 20 feet from the ground surface. It is anticipated and assumed that the wells constructed for the proposed development would be constructed in the same manner. The construction of the wells will be performed by a licensed well driller who will be responsible for conformance to the applicable regulations.

A review of the surrounding wells indicates that these wells are capable of producing an adequate volume of water to support the residential properties. There are residential properties north, west, and east of the Thomas Farm properties that have wells that are constructed similar to the wells proposed for the development. The wells to the north, along Pewaukee Lake, are more closely spaced than the wells for the proposed development.

STORMWATER PLANNING AND GROUNDWATER INFLUENCE

Neumann Developments, Inc. developed a stormwater plan to control and direct stormwater flow with the property. This stormwater plan promotes controlled movement of surface water, reduction in suspended sediment load, promote infiltration, and maintain protective areas. This plan is being prepared in coordination with Waukesha County to meet the requirement of stormwater management for the proposed development. The implementation of this plan will provide protection of groundwater from contaminants.

CONCLUSIONS

Overall, the groundwater evaluation completed for the Thomas Farm property in this letter indicates that the proposed development will have a similar impact on the groundwater elevation as other developments in the area. The drawdown calculated will maintain groundwater flow toward Pewaukee Lake and will not influence surface water on the Thomas Farm property and this evaluation indicates that the proposed development will not affect the surface water on the Pewaukee Golf Club property. The drawdown calculated when including infiltration does not require a community water supply well completed in the deeper sandstone aquifer. The stormwater planning proposed for the property will promote removal of sediment load from stormwater and will promote infiltration of stormwater.

This supplemental information is intended to provide clarification and reevaluation of the considerations presented by SEWRPC. Please review this information and contact Kevin Hedinger at (262) 754-2578 or via email at kevin.hedinger@gza.com with questions.

Sincerely,

GZA GeoEnvironmental, Inc.

Kevin M. Hedinger
Senior Hydrogeologist

James F. Drought, P.H.
Principal Hydrogeologist

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Attachment: Figure 1
Calculated Drawdown Summary Table

FIGURES

OPEN SPACE DATA TABLE - Welshire Farm — Date: 3/17/2023

Proposed Zoning = PLANNED DEVELOPMENT DISTRICT #1

ZONE	Total Area (acres)	Lowland Area (acres)	Upland PEC (acres)	SUB-TOTAL Development Area (non-EC) (acres)	*Incremental Development Area (non-EC) (acres)*	PROPOSED USE	Required Open Space (% of site*)	REQUIRED NET OPEN SPACE* (acres)	NET OPEN SPACE PROVIDED * (acres)	(%)
1	23.20	3.98	11.72	7.50		Single-Family Low Density	30.0%	6.96	15.31	66.0%
2	29.94	0.90	9.94	19.10		Residential Single-Family Low-Medium Density (15,000)	30.0%	8.98	16.04	53.6%
3	50.08	3.77	5.85	40.46	22.97	Condominimum (4 un/ac) **	60.0%	19.56	19.56	60.0%
					17.49	Single-Family Medium Density (10,000)	35.0%	6.12	6.16	35.2%
4	47.83	1.45	3.09	43.30		Single-Family Medium Density (10,000)	35.0%	16.74	17.00	35.6%
SUBTOTAL	151.05	10.09	30.60	110.36			38.6%	58.36	74.07	49.0%

* Net Open Space for whole development site. Accounts for Lowland Area multiplied by 0.2. Single family open space is in Outlots. Condo open space is common area.

** Condo Net Open Space based on: Gross Area = 50.08 ac - 17.49 ac = 32.59 ac. Open Space includes (3.77 ac lowland x 0.2) + 18.19 ac of common area + a portion of OL 4 (0.5 ac) + a portion of OL 8 (0.12 ac) within Zone 3 - said OL areas flanking entry area at Clubhouse and provided for common use, to satisfy Net Open Space requirements.

Open Space Plan Legend

- **Wetlands** (Heartland Ecological Group Inc, July 2022)
- **Primary Environmental Corridor (PEC)** (Heartland Ecological Group Inc, July 2022)
- Treelines & Other wooded areas to be preserved (OS)
- **Landscape Buffer (LB)**
- Open Space Areas for Development Site Calculations
  - Single family in Outlot
  - Condo is common area

OAKTON RD
Lake Country Recreation Trail
Treeline Preservation Area (30' wide Outlot)
OS 1
EXISTING WETLAND
EXISTING PEC
PRIMARY ENVIRONMENTAL CORRIDOR
Zone 2 29.94 ac
SHORELAND ZONING
Zone 1 23.2 ac
CROOKED CREEK RD
PRAIRIE WOOD CT
HIDDEN CREEK CT
Landscape Buffer
LB 2 50' wide
GOLF RDG S
Zone 3 50.08 ac
OS 3
OS 4
EXISTING PEC
Zone 4 47.83 ac
WETLAND
ELMHURST ROAD
GLEN COVE ROAD
Landscape Berm
BROOKSTONE CIR
LB 1 100' wide
OS 5
Treeline Replacement landscape area
SILO
GOLF ROAD
CTH 'DR'
LB 3 100' wide
I-94

TRIO DESIGN + LAND SURVEYING CIVIL ENGINEERING
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info@trioeng.com

Map 2
OPEN SPACE AND NATURAL RESOURCE PROTECTION PLAN
Welshire Farm Development
Town of Delafield, Waukesha County, Wisconsin

Figure 1

NEUMANN DEVELOPMENTS, INC.

0 75 150 300
Scale: 1" = 150' (22"X34")
Scale: 1" = 300' (11"X17")
DATE: 03/17/2023

ATTACHMENT 1

Calculated Drawdown Summary

CALCULATIONS OF DRAWDOWN AT POINT 1											
	Well Group										
Variables	A	B	C	D	E	F	G	H	I	J	K
Well Discharge (gpm)	0.71	0.87	0.83	0.40	0.44	0.44	1.58	1.19	1.27	0.32	0.32
Distance to Point 1	625	515	985	1335	1075	1040	2775	1635	1585	1995	900
Storage	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713
Transmissivity (gpd/ft)	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500
50 year pumping period (days)	18250	18250	18250	18250	18250	18250	18250	18250	18250	18250	18250
Drawdown at Point 1 (feet)	0.43	0.54	0.47	0.21	0.24	0.24	0.74	0.61	0.65	0.16	0.18
										Cumulative drawdown at point 1 (feet):	**4.46**

CALCULATIONS OF DRAWDOWN AT POINT 2											
	Well Group										
Variables	A	B	C	D	E	F	G	H	I	J	K
Well Discharge (gpm)	0.71	0.87	0.83	0.40	0.44	0.44	1.58	1.19	1.27	0.32	0.32
Distance to Point 2	1175	635	515	1005	1010	1295	1890	2420	2385	2765	1430
Storage	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713
Transmissivity (gpd/ft)	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500
50 year pumping period (days)	18250	18250	18250	18250	18250	18250	18250	18250	18250	18250	18250
Drawdown at Point 2 (feet)	0.39	0.52	0.51	0.22	0.24	0.23	0.79	0.57	0.61	0.15	0.17
										Cumulative drawdown at point 2 (feet):	**4.40**

CALCULATIONS OF DRAWDOWN AT POINT 3											
	Well Group										
Variables	A	B	C	D	E	F	G	H	I	J	K
Well Discharge (gpm)	0.71	0.87	0.83	0.40	0.44	0.44	1.58	1.19	1.27	0.32	0.32
Distance to Point 3	1395	885	345	490	775	1230	2145	2755	2865	3320	2110
Storage	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713
Transmissivity (gpd/ft)	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500
50 year pumping period (days)	18250	18250	18250	18250	18250	18250	18250	18250	18250	18250	18250
Drawdown at Point 3 (feet)	0.38	0.50	0.55	0.25	0.25	0.23	0.77	0.55	0.58	0.14	0.16
										Cumulative drawdown at point 3 (feet):	**4.36**

CALCULATIONS OF DRAWDOWN AT POINT 4											
	Well Group										
Variables	A	B	C	D	E	F	G	H	I	J	K
Well Discharge (gpm)	0.71	0.87	0.83	0.40	0.44	0.44	1.58	1.19	1.27	0.32	0.32
Distance to Point 4	1215	995	775	295	440	790	1850	2495	2770	3315	2400
Storage	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713
Transmissivity (gpd/ft)	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500
50 year pumping period (days)	18250	18250	18250	18250	18250	18250	18250	18250	18250	18250	18250
Drawdown at Point 4 (feet)	0.38	0.49	0.48	0.27	0.28	0.25	0.79	0.56	0.59	0.14	0.15
										Cumulative drawdown at point 4 (feet):	**4.39**

CALCULATIONS OF DRAWDOWN AT POINT 5											
	Well Group										
Variables	A	B	C	D	E	F	G	H	I	J	K
Well Discharge (gpm)	0.71	0.87	0.83	0.40	0.44	0.44	1.58	1.19	1.27	0.32	0.32
Distance to Point 5	700	865	1055	850	510	195	1165	1815	2165	2740	2105
Storage	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713
Transmissivity (gpd/ft)	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500
50 year pumping period (days)	18250	18250	18250	18250	18250	18250	18250	18250	18250	18250	18250
Drawdown at Point 5 (feet)	0.42	0.50	0.46	0.23	0.27	0.31	0.86	0.60	0.62	0.15	0.16
										Cumulative drawdown at point 5 (feet):	**4.56**

CALCULATIONS OF DRAWDOWN AT POINT 6											
	Well Group										
Variables	A	B	C	D	E	F	G	H	I	J	K
Well Discharge (gpm)	0.71	0.87	0.83	0.40	0.44	0.44	1.58	1.19	1.27	0.32	0.32
Distance to Point 6	925	1515	1935	1850	1470	1005	550	985	1535	2145	2120
Storage	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713
Transmissivity (gpd/ft)	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500
50 year pumping period (days)	18250	18250	18250	18250	18250	18250	18250	18250	18250	18250	18250
Drawdown at Point 6 (feet)	0.40	0.45	0.41	0.20	0.23	0.24	0.97	0.66	0.66	0.15	0.15
										Cumulative drawdown at point 6 (feet):	**4.54**

CALCULATIONS OF DRAWDOWN AT POINT 7											
	Well Group										
Variables	A	B	C	D	E	F	G	H	I	J	K
Well Discharge (gpm)	0.71	0.87	0.83	0.40	0.44	0.44	1.58	1.19	1.27	0.32	0.32
Distance to Point 7	1635	2285	2675	2650	2260	1795	915	695	1320	1840	2390
Storage	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713
Transmissivity (gpd/ft)	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500
50 year pumping period (days)	18250	18250	18250	18250	18250	18250	18250	18250	18250	18250	18250
Drawdown at Point 7 (feet)	0.37	0.42	0.39	0.19	0.21	0.22	0.90	0.70	0.67	0.16	0.15
										Cumulative drawdown at point 7 (feet):	**4.37**

CALCULATIONS OF DRAWDOWN AT POINT 8											
	Well Group										
Variables	A	B	C	D	E	F	G	H	I	J	K
Well Discharge (gpm)	0.71	0.87	0.83	0.40	0.44	0.44	1.58	1.19	1.27	0.32	0.32
Distance to Point 8	1905	2415	2940	3065	2670	2260	1195	545	680	1000	2020
Storage	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713
Transmissivity (gpd/ft)	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500
50 year pumping period (days)	18250	18250	18250	18250	18250	18250	18250	18250	18250	18250	18250
Drawdown at Point 8 (feet)	0.36	0.42	0.38	0.18	0.20	0.21	0.86	0.73	0.75	0.18	0.16
										Cumulative drawdown at point 8 (feet):	**4.42**

CALCULATIONS OF DRAWDOWN AT POINT 9											
	Well Group										
Variables	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**
Well Discharge (gpm)	0.71	0.87	0.83	0.40	0.44	0.44	1.58	1.19	1.27	0.32	0.32
Distance to Point 9	2155	2575	3110	3225	2950	2610	1595	1035	600	375	1760
Storage	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713
Transmissivity (gpd/ft)	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500
50 year pumping period (days)	18250	18250	18250	18250	18250	18250	18250	18250	18250	18250	18250
Drawdown at Point 9 (feet)	0.35	0.41	0.38	0.18	0.20	0.20	0.82	0.66	0.77	0.21	0.16
										Cumulative drawdown at point 9 (feet):	**4.32**

CALCULATIONS OF DRAWDOWN AT POINT 10											
	Well Group										
Variables	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**
Well Discharge (gpm)	0.71	0.87	0.83	0.40	0.44	0.44	1.58	1.19	1.27	0.32	0.32
Distance to Point 10	2220	2450	2935	3265	2955	2730	1965	1645	1010	580	1215
Storage	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713
Transmissivity (gpd/ft)	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500
50 year pumping period (days)	18250	18250	18250	18250	18250	18250	18250	18250	18250	18250	18250
Drawdown at Point 10 (feet)	0.35	0.41	0.38	0.18	0.20	0.20	0.79	0.61	0.71	0.19	0.17
										Cumulative drawdown at point 10 (feet):	**4.19**

CALCULATIONS OF DRAWDOWN AT POINT 11											
	Well Group										
Variables	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**
Well Discharge (gpm)	0.71	0.87	0.83	0.40	0.44	0.44	1.58	1.19	1.27	0.32	0.32
Distance to Point 11	1425	1315	1675	2096	1985	1860	1695	1905	1545	1710	215
Storage	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713	0.0000713
Transmissivity (gpd/ft)	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500
50 year pumping period (days)	18250	18250	18250	18250	18250	18250	18250	18250	18250	18250	18250
Drawdown at Point 11 (feet)	0.37	0.46	0.42	0.19	0.22	0.22	0.81	0.59	0.66	0.16	0.22
										Cumulative drawdown at point 11 (feet):	**4.33**

ATTACHMENT 4

Email Response to SEWRPC Comments, dated November 28, 2023

From: Kevin Hedinger
Sent: Tuesday, November 28, 2023 2:45 PM
To: Bryan Lindgren <blindgren@neumanncompanies.com>
Subject: RE: Thomas Property Development, Town of Delafield

Bryan:

I reviewed the information and have a few comments about the information contained in the Waukesha County Memo dated November 20, 2023.

In the memo, SEWRPC indicates that to maintain pre-development groundwater elevations and flow paths that groundwater recharge should strive to increase from 63.3 acre-feet to 117.8 acre-feet. This is a 46% increase in groundwater recharge.

It is not a reasonable standard for the development that it should have no impact on the groundwater elevations. Groundwater will be used in the development that cannot be returned to groundwater because it is consumed by residents. A more reasonable approach for this evaluation is to minimize the impact to groundwater elevations by maximizing infiltration which also increases the potential for groundwater recharge.

I confirmed the calculations for groundwater recharge and well pumping in the SEWERPC portion of the memo. The groundwater recharge number assumed by SEWRPC is from a modeling document that was performed and compared several methods of estimating groundwater recharge. The estimated groundwater recharge used by SEWERPC is 5 inches/year which seems on the low end for this area given that there are wetland and vegetated area in and around the Thomas Farms site. In the SEWERPC document referenced for groundwater recharge, it appears that there is a range of 5 to 7 inches/year of recharge in this area. The groundwater recharge, using 5 inches/year for the Thomas Farms site is 63.3 acre-feet. The pumping results in a withdrawal of 54.5 acre-feet. There is a net recharge of about 8 acre-feet to the groundwater.

If the recharge is increased to the upper limit of the estimated recharge, 7 inches/year, there is 88.6 acre-feet of groundwater recharge and still 54.5 acre-feet of groundwater pumping. This results in a net groundwater recharge of 34 acre-feet.

The infiltration, as estimated for the post-development, is approximately 94% of the pre-development infiltration.

Based on this review, it appears that the development is designed to minimize the impact to the groundwater elevations by maximizing the infiltration, and thus the potential for groundwater recharge. The previous evaluation by GZA calculated the drawdown to be 4 to 5 feet at the property boundary when considering infiltration. Groundwater will be consumed by the residents of the development and will not be returned to the groundwater therefore, the groundwater elevations cannot be maintained at pre-development elevations.

Let me know if you have any questions.

Thanks!

Kevin M. Hedinger
Senior Project Manager/ Hydrogeologist
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Cell: 262-424-1761