Miller Hydrogeologic Incorporated

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February 3, 2020

Barry Medenbach, P.E.
Medenbach and Eggers Civil Engineering and Land Surveying, PC
4305 US Hwy 209
Stone Ridge, NY 12484

Re: Addendum to Bedrock Well BW-1 Testing Final Report
850 Rt. 28, LLC
Town of Kinston
Ulster County, New York
MHI Project No. 151-019.1

Dear Mr. Medenbach:

Miller Hydrogeologic, Incorporated (**MHI**) is pleased to present this addendum to the final well testing report, dated May 28, 2019 related to the evaluation of the ground water supply at the referenced facility in the Town of Kingston, New York. All work for both the original report and this addendum were conducted according to the guidelines of the New York State Department of Health (NYSDOH), Part 5, Subpart 5-D.

INTRODUCTION

850 Rt. 28, LLC is currently evaluating the development of a parcel of property located at 850 Rt. 28 in the Town of Kingston, NY. An existing six inch diameter bedrock well, labeled BW-1, installed on the site in December of 2012 is planned to supply part of the project requirements. The total design flow average daily usage for the project's proposed warehouse facilities and employee's usage is 2900 gallons per day (gpd), or 2.01 gallons per minute (gpm). The average daily usage is proposed to occur at three individual proposed warehousing units. The proposed water usage distribution is BW-1, (existing tested well) 150 gpd, new bedrock well BW-2, 2375 gpd and new bedrock well BW-3, 375 gpd for a total site usage of 2900 gpd. Sheet 1 of 1 shows the locations of the existing well BW-1 and proposed locations for new wells BW-2 and BW-3.

It is our understanding that questions as to the affects the existing and proposed pumping wells will have on the local groundwater flow system have been raised during project review by the Town of Kingston Planning Board. The May 29, 2019 report only considered the potential drawdown within existing well BW-1 assuming it would supply all the water for the proposed project. This addendum to the May 28, 2019 report describes the potential effects on the local groundwater flow system based on all three wells pumping simultaneously at their individual proposed usage rates.

DETERMINATION OF AQUIFER PROPERTIES

In order to determine the potential effects of pumping on the local ground water levels it is necessary to determine the hydraulic characteristics of transmissivity and storage for the underlying aquifer. It is possible to determine the value of transmissivity from the single well test conducted on the existing BW-1 well.

The determination of aquifer properties has advanced significantly with the introduction of modern computing capacity. The selection of the traditional mathematical curve matching methods used to determine aquifer properties is based on comparing the general assumptions which are used to formulate the mathematical solution type curves describing the flow of ground water toward a discharging (or recharging) well and true field conditions. Because no mathematical solution can take into account exactly the true field conditions the results of the curve matching techniques are considered approximate.

Examination of the well log and water level elevation data from the BW-1 well indicates the well is constructed in a consolidated, fractured, sandstone formation with approximately 20 feet of unconsolidated till at land surface. With recorded water levels to be approximately 15 feet below land surface suggests that the water in the bedrock unit flows under confined flow conditions. Based on this analysis the method described by Theis (1935) for the determination of consolidated aquifer properties under confined flow conditions was selected for aquifer test analysis. In addition to assuming that groundwater flows under confined conditions the Theis (1935) solution also assumes the aquifer is homogeneous, isotropic and of uniform thickness over the area of test influence, the water level surface is horizontal prior to testing, the well is fully penetrating and pumps at a constant rate for the duration of the

test, water removed from storage is discharged instantaneously with a decline in head and that the well diameter is small and well bore storage is negligible.

The commercially available computer software *Aquifer Test Pro, Version 4.0*, by Waterloo Hydrogeologic was used to analyze the test data and determine aquifer properties according to the methods of Theis (1935). The software generates a type curve based on the hydraulic properties of transmissivity and storage for either a manual type curve fit to the data or an automated type curve fit. For the automatic type curve fit the software uses a "downhill simplex method" which is a minimizing algorithm for general non-linear functions (the solution to the Theis (1935) equation). All curve matching for the monitoring well data for both the pumping and recovery time periods were performed using the automatic curve fitting feature and then refined manually.

Figure 1 shows the curve match for the existing bedrock well BW-1 for both periods of pumping and recovery using data collected for the 24 hour aquifer test. A value of transmissivity was determined to be 50 feet squared per day (ft^2/day). Determination of the value of aquifer storage is not possible with data from a single well test. Lohman(1972) indicates that a good approximation for the storage term can be obtained by multiplying the thickness of the aquifer (or depth of test well), in feet, by 10^{-6}. For test well BW-1 with a depth of 273 feet this produces an aquifer storage coefficient of 2.73×10^{-4}.

DATA ANALYSIS

As described above water level data were collected as part of the test production well testing. Analysis of the data can be used to describe the ground water flow in the vicinity of the pumping well and aid in the determination of the consolidated aquifer's potential long term yield and effect on the local groundwater flow system.

To determine drawdown within the vicinity of site for all three proposed wells the Theis (1935) equation was solved for the distributed pumping rates described earlier. The values of transmissivity and storage of 50ft^2/day and 0.000273, respectively, were substituted into the Theis (1935) equation and solved for the proposed individual pumping rates. Image well theory and superposition were used to determine the well interference effects between the three proposed pumping wells and to determine drawdown at other locations across the site. The values of transmissivity and storage are assumed to

extend across the entire site and be infinite in any direction. The pumping of all three wells was assumed to be for a continuous 180 day period with no groundwater recharge, simulating a drought condition.

Sheet 1 of 1 shows plots of drawdown across the project site based on the proposed three well pumping scenario for 180 of continuous pumping assuming no groundwater recharge. The contours of drawdown would represent the worst case scenario for the proposed pumping scenario. In general the majority of drawdown occurs at the proposed new bedrock well BW-2 location which proposes to use the most water. Maximum predicted drawdown within the proposed BW-2 well at the end of the 180 day pumping period is 11.4 feet. Maximum predicted drawdown within the existing bedrock well BW-1 and proposed bedrock well BW-3 is 3.35 and 4.5 feet, respectively. The maximum predicted drawdown outside the property boundary is approximately 2.5 feet. None of the predicted drawdowns both within the project site and outside the project site are considered significant.

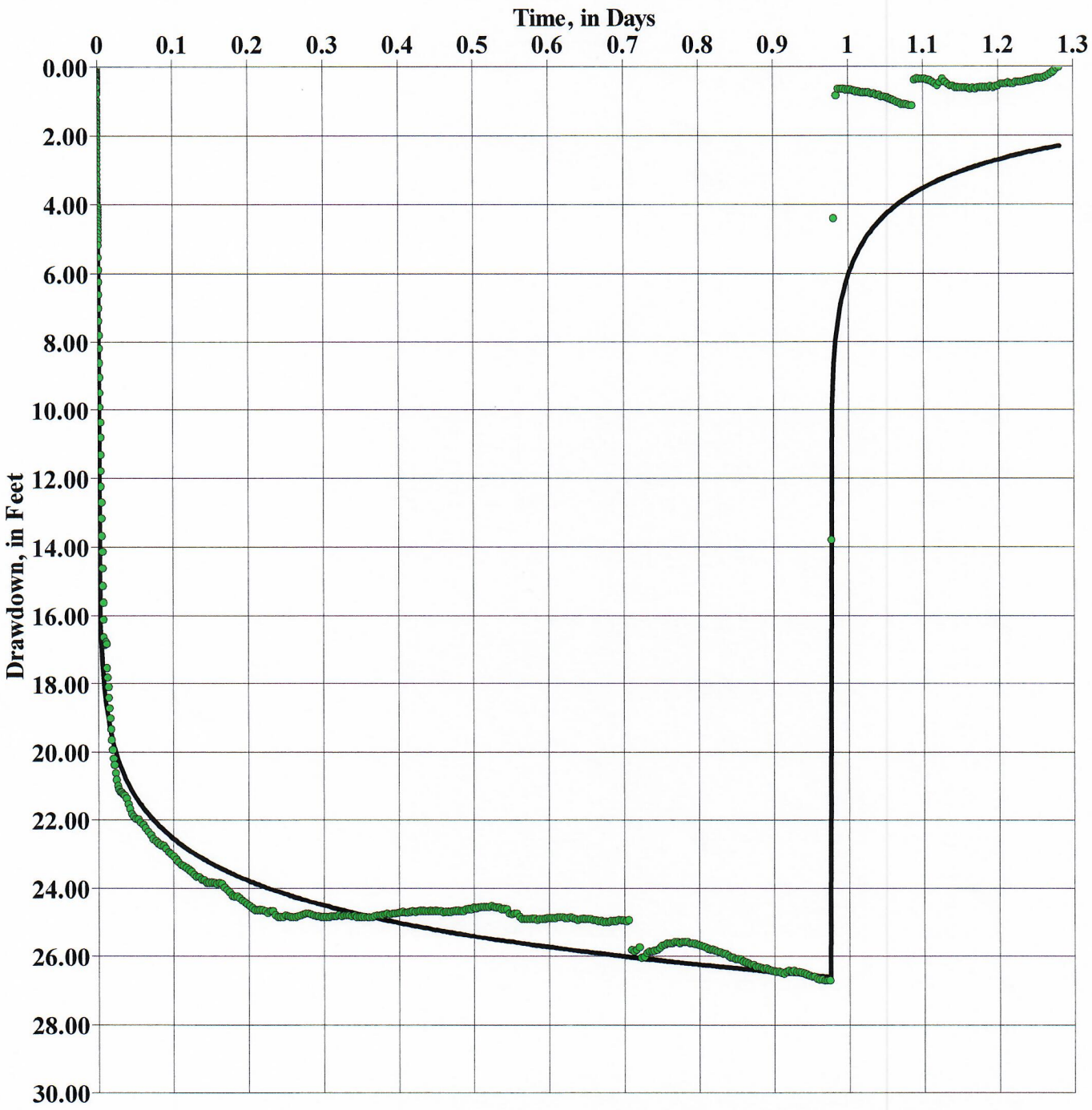
MHI thanks you for the opportunity to submit this addendum to our May 28, 2019 report. If you should have any questions concerning our report please do not hesitate to contact me.

Very truly yours,

Miller Hydrogeologic Incorporated

Robert T. Miller, PG
Hydrogeologist
President

Figure
Sheet



TRANSMISIVITY = 50.0 FT^2/DAY
STORAGE =0.000273(DIMENSIONLESS)

Miller Hydrogeologic, Incorporated

Project No. *151-019*	
Date: *1/24/20*	
Scale: *As Shown*	
Drawn By: *RTM*	

FIGURE 1

24 HOUR AQUFER TEST PUMPING AND RECOCERY TYPE CURVE ANALYSIS FOR BEDROCK WELL BW-1

850 ROUTE 28, LLC
TOWN OF KINSTON, ULSTER COUTY, NEW YORK