Analysis of the Litchfield, Minnesota Well 2 (607420) Aquifer Test

CONDUCTED ON JUNE 29, 2017 CONFINED QUATERNARY GLACIAL-FLUVIAL SAND AQUIFER



Analysis of the Litchfield, Minnesota Well 2 (607420) Aquifer Test Conducted on June 29, 2017

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Contents

Analysis of the Litchfield, Minnesota Well 2 (607420) Aquifer Test 1
Data Collection and Analysis7
Description7
Purpose of Test7
Well Inventory7
Hydrogeologic Setting7
Other Interfering Wells
Test Setup8
Weather Conditions
Discharge Monitoring8
Data Collection9
Qualitative Aquifer Hydraulic Response9
Quantitative Analysis 11
Conceptual Model11
Pumped Aquifer
Aquitard (Confining) Layer12
Conclusion13
Acknowledgements13
References
Tables and Figures

List of Tables

Table 1. Summary of Results for Leaky Confined - Radial Porous Media Flow	15
Table 2. Aquifer Test Information	16
Table 3. Well Information	17
Table 4. Data Collection	18
Table 5. Transient Analysis Results	19
Table 6. Steady-state Analysis Results	19

List of Figures

Figure 1. Adjustments for pumping-phase data 20
Figure 2. Theis (1935) analysis of pumping and recovery data from Litchfield 2 (607420) 21
Figure 3. Theis (1935) analysis of pumping and recovery data from Litchfield MW (607417) 22
Figure 4. Theis (1935) analysis of pumping and recovery data from USGS 2-F (773051) 23
Figure 5. Theis (1935) analysis of pumping and recovery data from USGS 1-F (773057) 24
Figure 6. Theis (1935) analysis of pumping and recovery data from Desens (800011)
Figure 7. Theis (1935) composite (t/r ²) analysis of recovery data
Figure 8. Projected recovery to 10,000 minutes for steady-state analysis
Figure 9. Cooper-Jacob (1946) transient and Hantush-Jacob (1955) steady-state analyses 28
Figure 10. de Glee (1930) steady-state analysis 29
Figure 11. Difference in water level at USGS Nest-1 during pumping and recovery
Figure 12. Aqtesolv composite (t/r2). Hantush-Jacob (1955) model
Figure 13. Aqtesolv analysis of data from Nest 1 wells, Neuman-Witherspoon (1969) model. Till thickness 63 feet
Figure 14. Aqtesolv analysis of data from Nest 1 wells, Neuman-Witherspoon (1969) model. Till thickness 50 feet
Figure 15. Aqtesolv analysis of data from Nest 1 wells, Neuman-Witherspoon (1969) model. Drawdown from unknown pumping wells
Figure 16. Well Location Map: well name and Minnesota unique well number
Figure 17. Schematic Section
Figure 18. Depth to Water from Top of Casing at Litchfield 2 (607417), Both Manual and Electronic Measurements
Figure 19. Depth to Water from Top of Casing at Litchfield MW (607420), Both Manual and Electronic Measurements

Figure 20. Depth to Water from Top of Casing at Litchfield 3 (632077), Manual Measurements
Figure 21. Depth to Water from Top of Casing at Litchfield 4 (632078), Manual Measurements
Figure 22. Depth to Water from Top of Casing at Litchfield 5 (764258), Manual Measurements
Figure 23. Depth to Water from Top of Casing at USGS 1-B (773062), Both Manual and Electronic Measurements
Figure 24. Depth to Water from Top of Casing at USGS 1-C (773060), Both Manual and Electronic Measurements
Figure 25. Depth to Water from Top of Casing at USGS 1-D (773059), Both Manual and Electronic Measurements
Figure 26. Depth to Water from Top of Casing at USGS 1-E (773058), Both Manual and Electronic Measurements
Figure 27. Depth to Water from Top of Casing at USGS 1-F (773057), Both Manual and Electronic Measurements
Figure 28. Depth to Water from Top of Casing at USGS 2-A (773056), Both Manual and Electronic Measurements
Figure 29. Depth to Water from Top of Casing at USGS 2-B (773055), Both Manual and Electronic Measurements
Figure 30. Depth to Water from Top of Casing at USGS 2-C (773054), Both Manual and Electronic Measurements
Figure 31. Depth to Water from Top of Casing at USGS 2-D (773053), Both Manual and Electronic Measurements
Figure 32. Depth to Water from Top of Casing at USGS 2-F (773051), Both Manual and Electronic Measurements
Figure 33. Depth to Water from Top of Casing at Desens Observation (800011), Both Manual and Electronic Measurements
Figure 34. Groundwater elevation at Litchfield-2 and Nest 1
Figure 35. Groundwater elevation at Litchfield-2 and Nest 2
Figure 36. Groundwater elevation at Litchfield-2 and Observation Wells Constructed in Aquifer, All Data
Figure 37. Groundwater elevation at Litchfield-2 and Observation Wells, Test Period
Figure 38. Groundwater elevation at Litchfield-2 and Nest 1, Test Period
Figure 39. Groundwater elevation at Litchfield-2 and Nest 2, Test Period
Figure 40. Groundwater Elevation in Aquifer Compared to Barometric Pressure, Test Period 59

Figure 41.	Depth to Water in Water-Table Wells Compared to Rainfall Events	60
Figure 42.	Daily Pumping Volume from Community Supply Wells, June 1, to July 10, 2017	61
Figure 43. 2017	Expanded View of Groundwater Elevation in Aquifer Wells from July 2 to July 11,	62
Figure 44.	Local Effects of Community Supply Wells from July 5 to July 11, 2017	63
Figure 45. of 2016	Groundwater Elevation at USGS 2-F (773051) Compared to Rainfall Events, Summe	r 64
Figure 46.	Well and Boring Report - Litchfield 2 (607420)	65
Figure 47.	Well and Boring Report - Litchfield 3 (632077)	66
Figure 48.	Well and Boring Report - Litchfield 4 (632078)	67
Figure 49.	Well and Boring Report - Litchfield 5 (764258)	68
Figure 50.	Well and Boring Report - Litchfield-MW (607417)	69
Figure 51.	Well and Boring Report - USGS 1-B (773062)	70
Figure 52.	Well and Boring Report - USGS 1-C (773060)	71
Figure 53.	Well and Boring Report - USGS 1-D (773059)	72
Figure 54.	Well and Boring Report - USGS 1-E (773058)	73
Figure 55.	Well and Boring Report - USGS 1-F (773057)	74
Figure 56.	Well and Boring Report - USGS 2-A (773056)	75
Figure 57.	Well and Boring Report - USGS 1-F (773057)	76
Figure 58.	Well and Boring Report - USGS 2-C (773054)	77
Figure 59.	Well and Boring Report - USGS 2-D (773053)	78
Figure 60.	Well and Boring Report - USGS 2-E (773052)	79
Figure 61.	Well and Boring Report - USGS 2-F (773051)	80
Figure 62.	Well and Boring Report - Desens Observation (800011)	81

Data Collection and Analysis

The constant-rate pumping test of Litchfield 2 (607420) was conducted as described below. The representative aquifer properties are summarized in Table 1. The specifics of test location, scope, and timing are presented in Table 2 and Table 3. The associated data files and a comparison of manual and transducer measurements are presented in Table 4. The results of analyses are presented in Appendix 1 and are summarized in Table 5. The analyses used standard methods, cited in references. The figures include maps, field notes, other documentation, and records of well construction.

Description

Purpose of Test

The test of Litchfield 2 was conducted by the Minnesota Department of Health (MDH) Source Water Protection Unit as a small part of a long-term project that was led by the United States Geological Survey (USGS). The overall purpose of the study was to assess the rates of groundwater recharge through low-conductivity glacial sediments (till) at various sites in Minnesota.

Specific to Litchfield, nine observation wells were installed by the USGS in 2015. Water elevations were recorded on a one-hour interval in seven of these wells for approximately one-year. The USGS had completed its data collection and was preparing to seal the observation wells. Prior to sealing the wells, notification was provided to the partner agencies relative to the completion of the work. At that time, staff in the Source Water Protection Unit recognized that this configuration of observation wells is nearly ideal for conducting short-term constant-rate aquifer tests on Public Water Supply (PWS) wells so as to estimate vertical groundwater flow. Therefore prior to sealing the wells, MDH proposed to conduct tests that would complement the USGS data collection efforts.

Well Inventory

The well records are presented in Figures 46-62 and the well construction is summarized in Table 22. The site plan is shown in Figure 16.

Hydrogeologic Setting

A schematic section (geologic cross-section) through the test site is shown on Figure 17 to illustrate the three layers that comprise the flow system; water table, aquitard, aquifer, and the construction of wells within these layers.

Other Interfering Wells

Other high capacity wells exist in the area that may cause interference. These wells are associated with the First District dairy processing in the center of Litchfield (to the south of the wellfield), and the Desens crop irrigation well (to the east of the wellfield). Several smaller domestic and non-community supply wells exist in the area. However, based on previous testing these smaller wells are not judged to present significant interference. Mr. Desens was contacted prior to the test to gain access to the observation well on his property. This well contains a transducer and water level data over the test period was obtained with the assistance of Minnesota Department of Natural Resources (MDNR).

Test Setup

The USGS provided the pressure transducers and data loggers used for long-term monitoring, re-programmed to a one-minute interval. MDH hydrologists, Justin Blum and Luke Pickman, traveled to Litchfield on June 13, 2017 to assess site conditions and re-install the transducers to collect background water level and barometric data. Transducers were placed in all existing observation wells, with the exception of USGS 2-E.

Access to Litchfield 2 is provided by a 0.75-inch polyethylene tube. The restricted diameter of this tube did not allow a transducer to be placed in the well to monitor water levels even though manual measurements were easily made. The three additional PWS wells in the wellfield; 3, 4 and 5, are similarly constructed and equipped. A prior test of Litchfield 2 was conducted by a geotechnical consultant (ECAD, 1998) and the observation well from that testing still exists a short distance from Well 2. Because of these factors; access to the wells, prior tests, and the relative distance of the observation wells, Litchfield 2 was selected to be the pumping well for this test.

The water operator, Mr. Herb Watry, was not comfortable with a standard test schedule; 24-hours of rest, 24-hours of pumping and 24-hours of recovery, because of system water demand and the limitations of the city water treatment plant. Extensive discussions with the operator indicated that an abbreviated pumping and recovery period of 4 to 6 hours each was possible and would still provide sufficient capacity. On that basis, the test was tentatively scheduled to begin on June 23, 2017. However, a major storm event on June 22, 2017 and various other public works projects caused the start of testing to be put off for a week. Other preparations for the test continued; on June 22, 2017 an acoustic water level sensor was installed in Litchfield 2, and the transducer in the Desens observation well was set up on a five-minute interval with the assistance of MDNR staff.

Weather Conditions

Conditions were warm and mostly dry during background data collection. Rain events greater 0.2-inches were recorded on June 22th and 27th at the Litchfield Waste Water Treatment Plant. No appreciable precipitation occurred during the pumping and recovery periods of June 29th to June 30th, 2017.

Discharge Monitoring

The pumping rates of the wells were reported by the Litchfield water treatment plant SCADA system. This was supplemented by manual readings of the totalizing flow meter on the Well 2 discharge line.

Data Collection

MDH personnel mobilized for the test on 6/29/2017, arriving on-site at 11:00. Upon arrival, the system was not in a 'rest' state; Litchfield Wells 3 and 5 were pumping, and Wells 2 and 4 were off. [Well 4 remained out of service for repairs until 7/6.] Wells 3 and 5 were turned off at 12:16:30 to place the wellfield into a limited recovery. The Litchfield 2 pump was started at 6/29/2017 14:03:30 by hand control through the SCADA system. Water levels were collected manually from Litchfield Wells 3, 4, and 5 from 12:00 until 15:00. The operator turned off the Litchfield 2 pump at 20:00 and all city wells remained off until 6/30/2017 06:00. At that time the system was critically short of water and Wells 2, 3, and 5 were pumped intensively over the next day to restore reserve capacity.

The USGS transducers remained in the wells until 7/10/2017 when static levels were measured and all equipment was removed. Data were attempted to be downloaded from the transducers at Nest 2 prior to equipment removal but difficulties connecting to the data loggers caused the equipment to be pulled before downloading. Data from the Desens obwell was downloaded on 7/13/2017 by MDNR staff. (personal communication, Ari Berland, MDNR)

The comparisons of manual and transducer measurements are presented in Figures 15 through 33. Only one well saw a decline in water level below the transducer setting, USGS 1-E, Figure 26, affecting data collection after 7/6/2017. The batteries of the acoustic transducer in Litchfield 2 failed during the extended recovery period and data after 7/7/2017 were not recorded. However, the MDH transducer in the Litchfield monitoring well continued to function over the monitoring period to provide a continuous record at that location.

Time signatures of the data files were checked against the computer clock after the equipment was removed from the wells. It was found that the USGS data logger clocks lost between 40 and 58 seconds, an average of 50 seconds, over the 28-day data collection period. This small and nearly uniform time shift was judged to not strongly affect data over the short, 14-hour, test period. Otherwise, the USGS loggers performed as expected and the equipment was returned to the USGS Mounds View office on 7/11/2017.

After the test was complete, precipitation records from the WWTP were obtained and the operator generated reports from the SCADA system for daily pumping from the wells. The daily pumping totals were compared to readings from the totalizing flowmeter on Well 2. There is a significant difference in flow volume between these two sources. The SCADA average cumulative volume reported for Well 2 was 710 gpm. The reading from totalizer, 46 minutes after the start of pumping, was 787 gpm. The appropriate value to use for the analysis was evaluated by comparison to results from the 1998 test of Litchfield 2, ECAD - test 2209. The larger rate produced comparable transmissivity values to the earlier test and is considered to be more accurate.

Qualitative Aquifer Hydraulic Response

A general site plan is shown in Figure 16, identifying the wells monitored for this test. Distances between the pumping and observation wells are presented in Table 3. A schematic cross section is provided for visual context of the test conditions, Figure 17. Comparison of manual and transducer data are shown in, Figures 18 through 33, documenting the proper functioning of the equipment.

The differences between pre and post-test manual and transducer water levels from wells completed in the pumped aquifer were consistent, indicating little effect of cable stretch, transducer 'drift,' or other common problems. This was not the case for observation wells constructed in till, particularly in Nest 2, where static water levels were disturbed by

installation of the transducers. The instrumentation displaced water in the well casings similar to a 'slug' injection. This disturbance dissipated over a time interval that varied according to the hydraulic conductivity of the materials in which the wells are constructed; from seconds to greater than 20 days. The USGS had analyzed these 'slug' tests during earlier parts of this study; therefore, additional slug analyses were not performed on this dataset.

The groundwater elevations in both nests showed a downward gradient, as expected, Figure 34 and Figure 35. There was a clear signal in all wells completed in the aquifer caused by the pumping of Litchfield 2, Figure 36 and Figure 37. As for the response in the till observation wells, the effects of pumping of Litchfield 2 was seen only at Nest 1, Figure 34. No response was seen in any of the till observation wells at Nest 2, Figure 35.

The possible influence on groundwater elevation from barometric pressure changes was evaluated, Figure 40. Barometric pressure varied little over the pumping test period. The range around the mean pressure was +/- 0.03 psi with a small upward trend of 0.05 psi. This variation is considered to have a negligible effect on water elevation and the data were not corrected for barometric efficiency.

Long-term trends in groundwater elevation were evaluated. The groundwater elevation in the shallow water-table observation well, USGS 1-B declined about 0.5 foot over the monitoring period, Figure 23. At Nest-2, the decline in well USGS 2-A was about 2 feet, Figure 28. The declines differed between the well nests; at Nest 1 the decline was linear, whereas Nest 2 saw a curvilinear decline – similar to a stream recession curve. The overall decrease in groundwater elevation at the water table appears to be an area-wide trend.

The vertical groundwater gradient is uniformly downward over the test area. At Nest 1, to the south of the wellfield, the ambient groundwater elevation difference is approximately 25 feet. During the test this difference increased by about 1 foot. Therefore, the incremental difference in the volume of leakage through the till as the result of this test is small relative to the ambient leakage.

Precipitation events are associated with small increases in groundwater elevation at both Nests 1 and 2, Figure 41. At Nest 2, the changes in elevation are seen to propagate downward, decreasing in magnitude with depth, in wells 2-B, 2-C, and 2-D, Figure 29, Figure 30, and Figure 31. This relationship holds true for Nest 1 also but is less pronounced, Figure 24 and Figure 25. The trend in the pumped aquifer is less clear because of the cycling of many pumping wells; but, groundwater elevation was relatively stable until 7/5/2017.

During the extended monitoring period, between 7/5 and 7/8/2017, groundwater elevation in the aquifer declined up to 10 feet, starting to recover on 7/9/2017, Figure 36. This event affected all wells constructed in the aquifer nearly equally. It was not associated with a marked increase in pumping from the Litchfield wellfield, Figure 42. The SCADA system reported an increase in total pumping volume over that period of about ten percent above average. Nor was it associated with any changes in flow from the First District dairy processing; as the waste water flow from that facility to the Litchfield WWTP was within the normal range over that time and no additional pumping was reported from First District wells. (personal communication, M. Geers, city of Litchfield and R. Albrecht, First District, Inc.) It was clearly not associated with pumping of the Desens irrigation well as that well remained off until about 7/12, after the time that water elevations had started to recover, Figure 33. The small differences in the response of the Desens obwell relative to other wells in the aquifer are probably associated with the return to service of Well 4, Figure 43 and Figure 44. Because of the magnitude and uniform effect of this change in water elevation, it can only be caused by a large discharge located at a large distance; greater than 2000 gpm, and at one mile or greater distance. During this analysis, the mystery of the source of this disturbance was referred to MDNR as it clearly has area-wide significance.

Subsequent discussions with the USGS verified that similar declines had occurred the previous year, Figure 45. In 2016, three episodes of water elevation decline similar in magnitude to that observed during this test occurred during the summer months, June, July and August. Comparison of these declines in water elevation to records of precipitation showed that they only occurred during dry times and on two occasions the recovery coincided with rain events. The declines are not strongly related to local pumping because the magnitude of the cycling of local wells is consistent throughout the year. Because these declines 1) regularly occur only in the summer months, 2) start during dry periods, and 3) recover after significant rainfall events, leads to the conclusion that they are the result of cumulative effects of area-wide irrigation pumping.

Quantitative Analysis

Traditional aquifer test analysis utilizes two main types of simple inverse models, transient and steady-state, see: selected references. When both types of models are used for the analysis (data permitting) - the aquifer hydraulic response may be proved consistent from the two perspectives and uncertainty in hydraulic properties is reduced.

Conceptual Model

The conceptual model for this test is of a layered leaky aquifer system with the majority of wells completed in two of three layers, as per the schematic section, Figure 17. The layers have distinctly different hydraulic characteristics. The first layer is composed of glacial drift and alluvium, which contains the water table. The second layer is the till which provides hydraulic confinement and recharge by leakage to the third layer. The third layer is the hydraulically-confined glacial outwash aquifer in which the production wells are constructed.

For the analysis of the confining layer data, it is preferred initially to use the simplest approach so as to introduce as few degrees of freedom as possible. The conceptual model of flow through the till is each well nest is analogous to a column of permeable material in the laboratory and flow is steady-state. For analysis of aquifer properties, the steady-state conceptual model leakage of a two-layer system is used [de Glee (1930) and Hantush-Jacob (1955)]. There is assumed to be no change in storage in these steady-state models. Transient analysis by the Neuman-Witherspoon (1969) method was also done for comparison, as data permitted.

Pumped Aquifer

Analyses are presented in Figures 1 through 10. Adjustments to the data were made prior to analysis to account for the effects of the short rest period before the start of pumping and the abbreviated duration of the test. The first adjustment is made to estimate the impact of previous pumping/recovery cycles by superposition, Figure 16. This correction was applied to the drawdown of each well for the composite transient analyses, Figures 17 through 21.

The recovery period was 10-hours in length and therefore is a bit higher quality. The transient distance drawdown analysis (t/r^2) , Figure 7, used recovery data. However, the duration of the 10-hour recovery was not long enough for steady-state conditions to develop. Therefore, recovery data were projected to 10,000 minutes, Figure A1-8, for the steady-state analyses, Figure 9 and Figure 10.

Aquifer transmissivity is best represented by the distance-drawdown analyses between 8,800 to 11,000 ft2/day. The storativity (dimensionless) is in the range of 5.5e-5 at the Nest 2 site to as large as 2.0e-4 at nest 1, to the south of the wellfield. This variation in storativity corresponds to the relative conductivity of the till at the well nests. No wells showed a leaky response, as expected, and the corresponding leakage factor from the steady-state analyses is quite large, approximately 22,000 feet. Comparison of these results to those of the earlier aquifer test shows that the transmissivity and storativity are within the same range but the characteristic leakage factor from the earlier test was significantly smaller. [This may be due in part to a bias in the earlier analysis which used drawdown values after only 1440 minutes of pumping. It also was the result of choices to weight proximal wells more heavily to the fit rather than more distant wells. The uncertainty of the leakage factor from that analysis was quite large.]

There are differences between the response to pumping and recovery for USGS 1-F and Desens Obwell, Figure 5 and Figure 6, that are not seen in the response of wells located within the wellfield. It is believed that these differences are the result of interference from other, more distant, pumping wells. The effect of the differences causes an increase in uncertainty of hydraulic properties at these wells, +/- 30% of the nominal values which are presented on the figures and Table 5.

Aquitard (Confining) Layer

Analyses are presented in Figures 11 - 15. The assessment of the vertical hydraulic conductivity of the till at Nests 1 and 2 depends on the observed response to pumping. There was no observed response to pumping at Nest 2 and the analysis is therefore limited. The observed response to pumping at Nest 1 is shown on Figure 11as four series:

- 1) pumping,
- 2) recovery,
- 3) recovery projected to 1000 minutes, and
- 4) that caused by the 'unknown pumping.'

The short-term differences in water level caused by pumping are best fit by a log function. As the well nest is expected to react linearly, as a hydraulic column in the laboratory; this indicates that the duration of pumping was insufficient for the system to reach equilibrium. The recovery data projected to 10,000 minutes may be used, as that response was linear, but limited to only two wells. The strongest linear signal was caused by the `unknown pumping' 7/5 through 7/8/2017. These data indicate that only the deeper observation wells; USGS 1-E, 1-D, and possibly 1-C, may provide a reasonably linear relationship of clay thickness vs. water level change. As water levels drew down below the transducer in USGS 1-E, an estimate of the water level was made from the consistent difference between USGS 1-E and 1-F of 0.6 feet, Figure 26.

Note that on Figure 11, the intersection of all regressions at ~ 0 feet of drawdown is much less than the full thickness of the till. Therefore, the true thickness of competent till as a confining layer is not its full lithological thickness at the Nest 1 site. It appears that the effective thickness is approximately 48 to 50 feet.

The composite leaky analysis, Figure 12, used the parameter estimation tool in Aqtesolv for the data from the wellfield area. The data from wells 1-F and Desens Obwell plot significantly below the other wells. This indicates that the transmissivity and/or leakage is different for the wells not matched. This is additional confirmation that the aquitard is more permeable in the area near Nest 1.

The Neuman-Witherspoon analysis of recovery data from Nest 1, Figure 13, produces a kV of the aquitard of 1.8e-2 ft/day. However, the match is poor because the test was not conducted long enough to generate a strong signal. Also, this initial analysis assumed that

the thickness of the aquitard is 63 feet rather than that from the well records (114 feet). The smaller effective aquitard thickness from Figure 11 can be verified with this model. On Figure 14, the match to data from well 1-E is much improved if an aquitard thickness of 50 feet is used, with no other change in parameters.

The analysis of the data associated with this abbreviated constant-rate test is limited because of the relatively small signal that only affected wells 1-E and 1-D. However, a very strong signal was generated by the disturbance after 7/5/2017 19:00, Figure 43. Unfortunately, no facts are available to verify the well location(s) or pumping rate(s) that may have caused the disturbance. Modeling the impact of the observed response has inherent uncertainties but is a worthwhile check on the aquitard properties, if only because of the strength of the signal.

If aquifer properties are reasonably consistent in this area, the effects of the 'unknown pumping' well at Nest 1 may be modeled in Aqtesolv. Assuming a well located approximately 8000 feet from Nest 1 and discharging at a rate of 2300 gpm for 5000 minutes, a steady-state model provides similar aquifer properties: T - 9,000 ft2/day, S - 5e-5, and L - 20,000 feet. These assumptions were then used as the basis for a Neuman-Witherspoon analysis of the data after 7/5/2017 19:00, Figure 15. The match was quite good to data from all observation wells in the till: 1-E (estimated), 1-D, and 1-C. The k_V of the aquitard was smaller, 1.0e-3 ft/day, than that calculated from the test of Litchfield 2, Figure 14, but not out of the reasonable range. For comparison, this value is essentially the same as than that from the steady-state analyses, Figure 9 and Figure 10.

Because no response was observed at the Nest 2 site, the k_V of the aquitard is at least one order of magnitude smaller than that at Nest 1, at most 1.0e-4 ft/day or smaller.

Conclusion

The hydraulic properties of the two-layer aquifer and aquitard system are shown in Table 1. These values are a summary of the analyses listed on Table 5. The large range of estimated aquifer properties shown are the result of both the sub-set of the data to which an analysis method was applied and natural lithological variation - particularly within the till.

The bulk aquifer properties were within the expected range given the prior test of Litchfield 2 in 1998. The leakage factor from this test was larger (a lower rate of leakage) than that from the earlier test, with better documentation and a much more robust analysis.

The interesting aspect of these data is that the more conductive portion of the aquitard (Nest 1) appears to dominate the bulk hydraulic response, as represented by the steady-state analyses.

Acknowledgements

There have been few opportunities to collect this level of detailed hydraulic information for the analysis of rates of leakage through till. The test conducted at the Litchfield municipal wellfield described here was successful not simply because of the efforts of MDH but also for the work of many, over decades. This analysis drew heavily on previous testing of Litchfield Well 2 in 1998, data collected by the USGS in 2015 and 2016, the work of MDNR with irrigators in the area, as well as other sources. It is an example of how success may sometimes result from being there to gather information, taking advantage of coincidental and uncontrolled field conditions, rather than the 'proper conduct' of an aquifer test.

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Tables and Figures

Table 1. Summary of Results for Leaky Confined - Radial Porous Media Flow

Parameter	Value	Unit	Range Minimum	Range Maximum	+/- % variation
Top Stratigraphic Elev.	1015	feet (MSL)	1008	1022	
Bottom Stratigraphic Elev.	986	feet (MSL)	978	986	
Transmissivity (T)	9,000	ft2/day	7,000	14,500	
Aquifer Thickness (b)	29	feet	30	44	
Hydraulic Conductivity (k)	310	ft/day	155	310	
Ratio Vertical/Horizontal k (k _v /K _R)	1	0.00 %			
Primary Porosity (ep)	0.25	0.00 %			
Storativity (S)	7.5e-5	dimensionless	5.5e-5	3.3e-4	
Characteristic Leakage (L)	21,000	feet	5,000	24,100	
Hydraulic Resistance (c)	44,400	days	2,800	63,500	
Thickness of till (b')	50	feet	48	130	
Hydraulic Conductivity of till (k_v)	1.0e-3	ft/day	< 1.0e-4	2.0e-2	

TEST 2617, LITCHFIELD 2 (607420) JUNE 29, 2017

Information Type	Information Recorded
Aquifer Test Number	2617
Test Location	Litchfield 2 (607420)
Well Owner	City of Litchfield
Test Conducted By	MDH - J. Blum and J. Woodside
Aquifer	QBAA
Confined / Unconfined	Confined
Date/Time Monitoring Start	06/13/2017 12:10
Date/Time Pump off Before Test	06/29/2017 12:16:30
Date/Time Pumping Start	06/29/2017 14:03:30
Date/Time Recovery Start	06/29/2017 20:00:00
Date/Time Test Finish	7/13/2017 14:35
Pumping time (minutes)	1454.93
Totalizer – end reading	not recorded
Totalizer – start reading	122,434,800
Total volume (gallons)	280,060 gallons
Nominal Flow Rate	787 (gallon per minute)
Number of Observation Wells	8 (see Table 3)

Table 2. Aquifer Test Information

Well Name (Unique Number)	Easting Location, X ¹ (meter)	Northing Location, Y ¹ (meter)	Radial Distance (feet)	Ground Surface Elevation, GSE ² (feet, MSL)	Measuring Point Description GSE+(stick-up) (feet, MSL)	Open Interval Top (feet, MSL)	Open Interval Bottom (feet, MSL)	Aquifer
Wellfield								
Litchfield 2 (607420)	613	481.6	1	1120	1124.35 e	1013	988	QBAA
L-MW (607417)	607.8	496.1	51	1120	1123.7	1001.2	996.2	QBAA
Litchfield 3 (632077)	674.4	711.6	781	1123.2	1127.2	1018	990	QBAA
Litchfield 4 (632078)	538.4	1129.6	2140	1126	1130	1026	1002	QBAA
Litchfield 5 (764258)	466.1	1014.9	1815	1149	1153	1015.5	990.5	QBAA
Desens, D. (800011)	1384.7	947.7	2958	1128.4	1129.4 e	980.4	970.4	QBAA
Nest 1								
USGS 1-B (773062)	1021.8	265.5	1517	1114.5	1118.23	1092.1	1089.2	QWTA
USGS 1-C (773060)	1019.2	267.5	1506	1114.8	1118.35	1064.6	1061.7	Till
USGS 1-D (773059)	1020.4	267.5	1510	1114.7	1118.25	1042.3	1039.4	Till
USGS 1-E (773058)	1021.8	267.5	1514	1114.5	1118.07	1022.1	1019.2	Till
USGS 1-F (773057)	1020.4	265.6	1513	1114.7	1118.1	996.7	987.2	QBAA
Nest 2								
USGS 2-A (773056)	559.8	844	1202	1139.6	1142.82	1122.5	1119.6	QWTA
USGS 2-B (773055)	559.8	842.9	1198	1139.2	1142.24	1106.9	1104.1	Till
USGS 2-C (773054)	561.3	844	1201	1139.4	1142.41	1082.4	1079.6	Till
USGS 2-D (773053)	559.7	841.6	1194	1139.2	1142.15	1058.1	1058.1	Till
USGS 2-E (773052)	561.4	842.9	1197	1139.3	1142.46	1028.3	1025.5	QBAA
USGS 2-F (773051)	561.4	841.6	1193	1139.3	1142.37	986.8	976.9	QBAA

Table 3. Well Information

¹ Local Datum

² Vertical Datum: NAV88

Table 4. I	Data C	ollection
------------	--------	-----------

Data File Name: Well Name_Unique Number	Data Logger Type, SN:	Probe Id., Range (psi)	Install 1. Static WL ³	Install 2. XD ⁴ Setting	Remove 3. Static WL	Remove 4. XD Setting	Diff. Static WL (1-3)	Diff. XD Setting (4-2)
L-2_(607420)	Acoustic transducer		50.29	49.64	71.04 ⁵			
Baro_data	Hermit 3000 45333	6, 15 psia						
L-Ob(607417)	Troll 500 145815	17, 30 psi	46.50	61.59	59.70	48.54	-13.2	-13.04
USGS-1-B(773062)	OTT 382929		13.55	12.96	14.17	12.33	-0.62	-0.63
USGS-1-C(773060)	OTT 382931		14.61	13.97	15.46	14.83	0.78	0.79
USGS-1-D(773059)	OTT 382935		28.77	28.30	32.75	32.34	-3.98	4.04
USGS-1-E(773058)	OTT 382934		38.04	37.52	45.29	39.60 ⁶	-0.21	
USGS-1-F(773057)	OTT 382937		38.20	37.11	45.45	44.88	7.25	7.77
USGS-2-A(773056)	OTT 382927		13.99	14.19	16.09	16.23	-2.1	2.04
USGS-2-B(773055)	OTT 382932		14.99	16.09	16.39	18.72	1.4	0.35
USGS-2-C(773054)	OTT 382930		17.87	16.06	19.02	18.59	-2.15	2.52
USGS-2-D(773053)	OTT 382933		35.19	34.07	35.90	35.38	-0.71	1.31
USGS-2-E(773052)	None installed		64.36		71.33			
USGS-2-F(773051)	OTT 382938		65.43	64.88	70.88	70.01	-5.45	5.13

³ WL = water level below measuring point, feet.

⁴ XD = pressure transducer depth below water surface, feet.

⁵ Pump running

⁶ Transducer set above water surface in well at removal

Well Name (Unique Well No.)	Transmissivity, T (ft2/day)	Storativity, S (dimensionless)	Leakage Factor, L (feet)	Hydraulic Conductivity of Aquitard, kV (ft/day)	Analysis Method	Figure No. Remarks
L-2 (607420)	3,440	NA ⁷	NA	NA	Theis	2. poor match, T not credible
L-MW (607417)	8,600	2.5e-4	NA	NA	Theis	3. good match
USGS 2-F (773051)	14,700	5.5e-5	NA	NA	Theis	4. good match to pumping data
USGS 1-F (773057)	14,700	3.3e-4	NA	NA	Theis	5. divergence between pumping and recovery data – uncertainty in T & S values +/- 30%
Desens (800011)	14,300	1.5e-4	NA	NA	Theis	6. divergence between pumping and recovery data – uncertainty in T & S values +/- 30%
Aquifer, composite	10,000	1.1e-4	NA	NA	Theis - t/r2	7. good match, inefficiency of pumped well causes divergence from Theis-curve
Aquifer, composite	9,170	2.0e-4			Cooper – Jacob	9. representative bulk aquifer properties
Aquifer, composite	11,000	9.5e-4	20,000	1.4e-3	Hantush-Jacob - t/r2	12. Aqtesolv solution - match to L-MW and USGS 2-F
Nest 1, composite	14,000	1.0e-4	6,700	2.0e-2	Neuman- Witherspoon	13. aquitard thickness of 63 feet - poor match
Nest 1, composite	10,800	1.2e-4	5,500	1.8e-3	Neuman- Witherspoon	14. aquitard thickness of 50 feet - better match to USGS 1-E
Nest 1, composite	8,000	7.4e-5	10,800	1.0e-3	Neuman- Witherspoon	15. aquitard thickness of 50 feet - good match to all till wells

Table 5. Transient Analysis Results

Table 6. Steady-state Analysis Results

Transmissivity, T (ft²/day)	Leakage Factor, L (feet)	Hydraulic Resistance, c (days)	Hydraulic Conductivity of Aquitard, k _v (ft/day)	Analysis Method	Plot No. Remarks
9,170	24,100	63,500	7.9e-4	Hantush- Jacob	9. representative bulk aquifer properties
8,830	22,000	54,800	9.0e-4	De Glee	10. representative bulk aquifer properties

⁷ Not Applicable







Figure 2. Theis (1935) analysis of pumping and recovery data from Litchfield 2 (607420)



Figure 3. Theis (1935) analysis of pumping and recovery data from Litchfield MW (607417)

TEST 2617, LITCHFIELD 2 (607420) JUNE 29, 2017



Figure 4. Theis (1935) analysis of pumping and recovery data from USGS 2-F (773051)



Figure 5. Theis (1935) analysis of pumping and recovery data from USGS 1-F (773057)

TEST 2617, LITCHFIELD 2 (607420) JUNE 29, 2017



Figure 6. Theis (1935) analysis of pumping and recovery data from Desens (800011)



Figure 7. Theis (1935) composite (t/r^2) analysis of recovery data



Figure 8. Projected recovery to 10,000 minutes for steady-state analysis



Figure 9. Cooper-Jacob (1946) transient and Hantush-Jacob (1955) steady-state analyses



Figure 10. de Glee (1930) steady-state analysis



Figure 11. Difference in water level at USGS Nest-1 during pumping and recovery



Figure 12. Aqtesolv composite (t/r2). Hantush-Jacob (1955) model

L = 20,000 feet kV = 0.00005 * 11,000 * 50 = 0.0014 ft/day Figure 13. Aqtesolv analysis of data from Nest 1 wells, Neuman-Witherspoon (1969) model. Till thickness 63 feet.



L = 5,000 feet kV = 0.0002 * 10,000 * 50 = 0.02 ft/day Figure 14. Aqtesolv analysis of data from Nest 1 wells, Neuman-Witherspoon (1969) model. Till thickness 50 feet



L = 5,500 feet

 $k_V = 0.0001825 * 10,800 * 50 = 0.018 \text{ ft/day}$

Figure 15. Aqtesolv analysis of data from Nest 1 wells, Neuman-Witherspoon (1969) model. Drawdown from unknown pumping wells.



L = 20,000 feet

 $k_V = 0.00005 * 8000 * 50 = 0.001 \text{ ft/day}$

TEST 2617, LITCHFIELD 2 (607420) JUNE 29, 2017



Figure 16. Well Location Map: well name and Minnesota unique well number



Figure 17. Schematic Section


Figure 18. Depth to Water from Top of Casing at Litchfield 2 (607417), Both Manual and Electronic Measurements





Figure 20. Depth to Water from Top of Casing at Litchfield 3 (632077), Manual Measurements



Figure 21. Depth to Water from Top of Casing at Litchfield 4 (632078), Manual Measurements



Figure 22. Depth to Water from Top of Casing at Litchfield 5 (764258), Manual Measurements



Figure 23. Depth to Water from Top of Casing at USGS 1-B (773062), Both Manual and Electronic Measurements



Figure 24. Depth to Water from Top of Casing at USGS 1-C (773060), Both Manual and Electronic Measurements



Figure 25. Depth to Water from Top of Casing at USGS 1-D (773059), Both Manual and Electronic Measurements



Figure 26. Depth to Water from Top of Casing at USGS 1-E (773058), Both Manual and Electronic Measurements



Figure 27. Depth to Water from Top of Casing at USGS 1-F (773057), Both Manual and Electronic Measurements



Figure 28. Depth to Water from Top of Casing at USGS 2-A (773056), Both Manual and Electronic Measurements



Figure 29. Depth to Water from Top of Casing at USGS 2-B (773055), Both Manual and Electronic Measurements

Test No: 2617 Pumped Well: Litchfield 2 (607420) Obwell: USGS 2-C (773054) Test Date: 6/29/2017 Data Series: Comparison of manual and transducer data Radial Distance (feet): 1201 16 Measurement \oplus manual Ο transducer 17 Ð 18

19 20 6/12/17 6/16/17 6/20/17 6/24/17 6/28/17 7/2/17 7/6/17 7/10/17 7/14/17 Date - Time of Reading

Depth to Water from Top of Casing [feet]



Figure 31. Depth to Water from Top of Casing at USGS 2-D (773053), Both Manual and Electronic Measurements

Date - Time of Reading



Figure 32. Depth to Water from Top of Casing at USGS 2-F (773051), Both Manual and Electronic Measurements



Figure 33. Depth to Water from Top of Casing at Desens Observation (800011), Both Manual and Electronic Measurements







Figure 35. Groundwater elevation at Litchfield-2 and Nest 2



Figure 36. Groundwater elevation at Litchfield-2 and Observation Wells Constructed in Aquifer, All Data



Figure 37. Groundwater elevation at Litchfield-2 and Observation Wells, Test Period







Figure 39. Groundwater elevation at Litchfield-2 and Nest 2, Test Period



Figure 40. Groundwater Elevation in Aquifer Compared to Barometric Pressure, Test Period



Figure 41. Depth to Water in Water-Table Wells Compared to Rainfall Events



Figure 42. Daily Pumping Volume from Community Supply Wells, June 1, to July 10, 2017



Figure 43. Expanded View of Groundwater Elevation in Aquifer Wells from July 2 to July 11, 2017



Figure 44. Local Effects of Community Supply Wells from July 5 to July 11, 2017

Figure 45. Groundwater Elevation at USGS 2-F (773051) Compared to Rainfall Events, Summer of 2016





Figure 46. Well and Boring Report - Litchfield 2 (607420)

Minnesota Unique Well Numb	er County Ma	ooker	MINNESOTA DEI	PARTMENT (OF HEALTH	I	Entry Date	03/23/1000
607420	Ored Lit	chfield	WELL AND	BORIN	G REPO	DRT	Ladata Data	05/15/2017
00/420	Qual 12	54	Minnesota St	atutes Chap	ter 1031		Update Date	00/10/2017
	Quad ID 12	JA .					Keceived Date	
Well Name To	waship Range	Dir Section	Subsection	Well Depth	1	Depth Completed	Date W	ell Completed
LITCHFIELD 2 11	9 31	W 2	CDCDAA	134 ft.	1	32 ft.	02/19/1	998
Elevation 1120	Elev. Method	7.5 minute topogr	aphic map (+/- 5 feet)	Drill Method	Non-specif	fied Rotary	Drill Fluid Ben	tonite
Address				Use comm	unity supply()	municipal)		Status Active
Contact 126	MARSHALL AV	N LITCHFIELD	MN 55355	Well Hydrofra	ctured?	Ves No	X From	Te
Well LIT	CHFIELD MN 553	55		Casing Type	Single ca	sing	Joint	10
Stratigraphy Informa	tion			Drive Shoe?	Yes	No X	Above/Below	
Geological Material	From	To(ft.) Co	lor Hardness	Casing Diamo	ter We	isht		Hole Diameter
CLAY	0	24 BF	OWN	12 in To	107 ft.	Ibs/ft.		18 in. To 134 ft.
CLAY	24	29 GI	AY					
SAND & GRAVEL	29	35 BF	OWN					
CLAY	35	65 G3	LAY					
SAND & GRAVEL	65	71 BF	OWN	Onen Hole	-		-	
CLAY	71	105 GI	AY	Screen? R	From	II. Type stainless	10 Make	II. IOHNSON
SAND & GRAVEL	105	134 BF	IOWN	Diameter	Slot/Gauze	Length	Set	
CLAY	134	134 GI	CAY	12 in.	115	25 ft.	107 ft .	132 ft .
				Static Water	Level			
				42 ft.	land surfa	ce	Measure	02/19/1998
				Pumping Le	vel (below las	ad surface)		
				132 ft.	7.5 hrs.	Pumping at	1000 g	ip.m.
				Wellhead Co	mpletion			
				Pittess adapter	manufacturer Destaction	X 12 in	N above made	lodel
				At-grad	e (Environme	ntal Wells and Bor	ings ONLY)	
				Grouting Int	ormation	Well Grouted?	Yes N	o Not Specified
				Material		Amo	ruat	From To
				neat cement		85	Sacks	0 ft. 87 ft.
				high solids b	entonite	50	Sacks	87 ft. 132 ft.
								ft. ft.
				Nearest Kno	wa Source of	Contamination		-
				Well disinfe	et cted unon cor	mletion?	Yes	No Iype
				Pump	Not 1	Installed D	ato Installed	
				Manufacturer	's name			
				Model Numb	er	HP	Vo	lt
				Length of dro	p pipe	ft Capacity	S-P-	Тур
				Abandoned				
				Does property	have any not i	n use and not sealed v	well(s)?	Yes X No
				Variance Was a variant	e granted from	the MDH for this we	er [Yes X No
				Miscellaneou	15			
				First Bedrock			Aquifer	Quat. buried
				Last Strat	clay-gray		Depth to Be	drock ft
Remarks				Located by	Minn	esota Department	of Health	
MDH AQUIFER TEST, 2	20017			Locate Metho System	a Digiti ITM - NAT	ization (Screen) - N 183 Zone 15 Marrie	viap (1:24,000) X 2000	47 Y 4000549
				Unique Numb	er Verification	Informatic	unfrom li	and Date 09/19/2000
				Angled Drill	Hole			
				Well Contra	ctor		71676	ROBBIT DON
				Licensee B	well Co. usiness	Lie	or Reg. No.	Name of Driller
			60	7420				Drived Achapters
Minnesota Well	Index Repor	rt -						Printed on 06/19/2017 HE-01205-15

Figure 47. Well and Boring Report - Litchfield 3 (632077)

Minnesota Unique Well Number	County Ma	ooker	MINN	ESOTA DEP.	ARTMENT (OF HEALTH		Fatry Data	02/02/0000
C20077 Orad Litchfield WELL AN					BORIN	G REPO	DRT	Eastly Date	03/22/2000
632077	Quad La		M	innesota Sta	tutes Chap	ter 1031		Update Date	03/10/2014
	Quad ID 12	AC						Received Date	
Well Name Town	ship Range	Dir Secti	on Subsectio	10	Well Depth	1	epth Completed	Date We	I Completed
LITCHFIELD 3 119	31	W 2	CDABDO		140 ft.	1	36 ft.	12/09/19	99
Elevation 1126 Ele	rv. Method	7.5 minute to	ographic map (+	- 5 feet)	Drill Method	Non-specif	ied Rotary	Drill Fluid Bent	atite
Address					Ura				Status Activo
					Car Comm	annis safibistr	numcibath		June -
Contact 126 M/	ARSHALL AV 1	N LITCHFIE	LD MN 55355		Well Hydrofra	ctured?	Yes No	From	To
Well LITCH	FIELD MN 553	55			Casing Type	Single ca	sing	Joint	Welded
Stratigraphy Informatio	0				Drive Shoe?	Yes	No	Above/Below	
Geological Material	From	To (ft.)	Color H	lardness	Casing Diamo	ter Wei	ght		Hole Diameter
TOPSOIL	0	2	BLACK		12 in To	108 ft. 49	5 Ibs/ft.		18 in.To 140 ft.
CLAY	2	18	YELLOW						
CLAY	18	98	GRAY						
DIRTY SAND	98	106	GRAY						
SAND	106	117	GRAY						
SAND COARSER	117	130	GRAY		Open Hole	From	ft.	То	ft.
SAND FINER	130	136	GRAY		Screen? p	C I	Type stainless	Make J	OHNSON
CLAY	136	140	GRAY		Diameter	Slot/Gauge	Length	Set	
			0.011		12 in.	70	28 ft.	108 ft .	136 ft.
					Static Water	Level			
					43.6 ft.	mill		Measure	11/22/1999
					Pumping Le	vel (below laz	d surface)		
					65.5 ft.	20 hrs.	Pumping at	750 g	p.m.
					Wellhead Co	mpletion			
					Pittess adapter	manufacturer	MONITOR		odel 7PS1214WBW
					At-grad	e (Fristianited	ntal Wells and Bor	ings ONLY)	
					Cronting Int	internation	Well Geoster?		Not Specified
					Citoning In	Of manon	weil Grouter/		
					Material		Amo		From To
					neat cement		,	Cubic yarus	12 п.96 п.
					Neuro		Cartonia		
					Nearest Mile	WE SOURCE OF	Direction		T
					II Well disinfo	et ctud unon con	mission?	VI Vot I	I No.
						case upon con			
					rump	K Not	nstalled Da	te installed	
					Manufacturer	8 Itanic	100		
					Model Numb	er 	A Courts	vo	t Tum
					Length of dro	b hite	II Capacity	8-P-	Typ
					Demonster	have an extension			
					Tools property	nave any not it	a use and not seared a	real(s):	
					Variance				Var 1971 11
					Was a variant	e granted from	ine MDH for this we	ar .	INS A NO
					Miscellaneou				
					First Bedrock			returpA	Quat. buried
					Last Strat	ciay-gray	Deret D	Depth to Bed	III III
Remarks					Locate Marke	A CDC C	A Off (according to	or riearn	
GAMMA LOGGED 10-5-19	99 BY SUMMIT.				System	UTM-NAD	83. Zone 15 Marcon	¥ 3702	NS Y 4000778
					Unique North	er Verification	as, some 15, maleis		aut Date 09/19/2000
					Angled Deill	Hole			03/13/2000
					Aligies Drill	11000			
					Well Contra	ctor			
					L.t.p. Enter	prises, Inc.		91686	VERDECK, D.
					Licensee B	usmoss	Lic. (or Rog. No.	Name of Driller
10	1 2			632	077				Printed on 06/12/2017
Minnesota Well I	ndex Kepor	rt -							HE-01205-15
L				1					10-01203-13

Figure 48. Well and Boring Report - Litchfield 4 (632078)

Minnesota Unique Well N	lumber	County M	ooker	MIN	NESOTA DEP	ARTMENT O	F HEALTH		Entry Date		2000
(22070 Orad Litchfold				WEL	L AND 1	BORIN	Undets Date 03/10/2014				
632078	5	Quad La	SA	A	linnesota Sta	itutes Chapt	er 1031		Update Da	te 03/10/	2014
	_	Quad ID 12	JA.			-			Received D	ate	
Well Name	Townsh	ip Range	Dir Sect	ion Subsect	08	Well Depth	1	Depth Completed	Date	Well Complet	ed
LITCHFIELD 4	119	31	W 2	CABAC	в	159 ft .	1	47 ft.	12/09	9/1999	
Elevation 1149	Elev.	Method	7.5 minute to	pographic map (*	+/- 5 feet)	Drill Method	Non-specif	fied Rotary	Drill Fluid B	entonite	
Address						Use comm	unity supply()	municipal)		Status	Active
Contact	126 MAR	SHALL AV	NUTCHED	TLD MN 5535	5	Well Hydrofes	ctured?	Ver 🗌 Ne		-	
Well	ITCHE	FLD MN 553	55		-	Caring Type	Single ca		Toint	Walara	0
Stratigraphy Infor	rmation					Drive Shoe?	Yes 🗌	No 🗆	Ahove/Belo	Welded	
Goological Materia	1	From	To (ft.)	Color	Hardness	Casing Diama	tor We			Hale Diem	at an
TOP SOIL SILTY		0	1	BLACK		12 in To	123 8 44	lgan }5 ∐hs/ft		18 in Te	147 ft
SANDY CLAY/GE	RAVEL	1	10	BROWN						6.2 in To	159 ft.
CLAY SANDY/PE	BBLES	10	42	GRAY							
SANDY CLAY/SA	IND	42	48	GRAY							
SANDY CLAY/PE	BBLES	48	97	GRAY							
SANDY CLAY		97	113	BROWN	V.SOFT	Open Hole	From	£.	To	£.	
SANDY CLAY/PE	BBLES	113	121	GRAY		Screen?		Type stamless	S-4	JOHNSON	
SAND & GRAVEI	L	121	128	GRAY		12 in	70	24 0	103 0	147 8	
SAND & GRAVEI	L	128	136	GRAY			<i>/v</i>	24 11.	125 11		-
SAND & GRAVEI	L	136	146	GRAY		Static Water	Laval				
SANDY CLAY/PE	BBLES	146	150	GRAY		61.2 0	land surfa		Measure	12/08/19	00
CLAY		150	159	GRAY							
						Pumping Lev	vel (below la	ad surface)			
						77.8 ft.	21 hrs.	Pumping at	750	g.p.m.	
						Wellhead Co	moletion				
						Pidess adapter	manufacturer	MONITOR		Model 7PS	1214WBW
						Casing]	rotection	X 12 in	above grade		
						At-grad	e (Environme	ntal Wells and Bor	ings ONLY)		
						Grouting Inf	ormation	Well Grouted?	X Yes	No No	t Specified
						Material		Amo	0000	From	То
						neat coment		4.5	Cubic yards	:8 ft.	113 ft .
						Nearest Kno	wn Source of	Contamination			-
						19 Well disinfo	et stad unon cor	Direction moletion?	Ver.		Туре
						Deser		apressa.			
						Manufactured	NOL NOL	installed La	tte installed		
						Model Numbe	*	HP		Volt	
						Length of dro	pipe	ft Capacity	g.p.	Тур	
						Abandoned					
						Does property	have any not i	n use and not sealed v	vell(s)?	Y	es X No
						Variance					
						Was a variance	e granted from	the MDH for this we	17	Yes	X No
						Miscellaneou	8				
						First Bedrock			Aquif	er Quat. burie	d
						Last Strat	clay-brow	m	Depth to	Bedrock	ft
Remarks						Located by	Minn	esota Department	of Health		
BOTTON 12 FT. OF	HOLE GR	OUTED W/HI	GH SOLIDS.			Locate Metho	GPS:	SA Off (averaged)		w.	
						Unione Month	UIM - NAL	AS, Zone 15, Meters	A 3	/91/2 1	000196
						Angled Deill	Hale			mpar trate	09/19/2000
						Angled Drill	nose				
						Well Contra	ctor				
						L.tp. Enter	prises, Inc.		91686	VERD	ECK, D.
						Licensee B	usiness	Lic. (or Rog. No.	Name of	t Driller
						070					
Minnesota W	all Ind	lay Renov			632	0/8				Print	ed on 06/19/2017
Minnesota W	en mo	ter repoi									HE-01205-15

Figure 49. Well and Boring Report - Litchfield 5 (764258)

Minnesota Unique Well Number Manker MINNESOTA D							ARTMENT O	F HEALTH		Entry Data	01/20/2000
			Out I	it-bfield	WELL AND BORING REPORT					Endy Date	01/29/2009
70-	4258	- 1	Quad 1	254	1	Ainnesota Sta	itutes Chapt	er 1031		Update Date	04/16/2015
_		_	Quad ID	2.74			-			Kecewed Dat	e 01/21/2009
Well Name	1	ownshi	ip Rang	 Dir Sect 	ion Subsec	tion	Well Depth	1	Depth Completed	Date W	ell Completed
LITCHFIEL	D5 1	19	31	W 2	CABCO	CA	165 ft.	1	61.5 ft.	10/30/2	008
Elevation	1152	Elev.	Method	7.5 minute to	pographic map	(+/- 5 feet)	Drill Method	Non-specif	fied Rotary	Drill Fluid Ben	tonite
Address							Use comm	unity supply()	municipal)		Status Active
Contact	12	6 MAR	SHALL AV	NE LITCHE	TELD MN 55	355	Well Hydrofra	ctured?	Yes No.	X From	T .
Well	LI	TCHED	ELD MN 55	355			Casing Type	Single ca	sing	Joint	10
Stratigraphy	v Inform	ation					Drive Shoe?	Yes 🗌	No X	Above/Below	
Goological M	laterial		From	To (ft.)	Color	Hardness	Casing Diame	er We	isht		Hole Diameter
TOP SOIL			0	1	BLACK		12 in To	136. ft . 0	Ibs./ft.		18 in. To 165 ft.
SANDY CL	AY		1	2	BROWN						
SANDY CL	AY WIT	н	2	7	YELLOW						
SANDY CL	AY		7	11	TAN						
SANDY CL	AY WIT	н	11	14	GRAY		Onen Hole	-		-	
SANDY CL	AY-SAN	D &	14	20	GRAY		Screen? 70	From	Type stainless	10 Make	II. IOHNSON
SANDY CL	AY		20	36	GRAY		Diameter	Slot/Gauze	Length	Set	
SANDY CL	AY WIT	н	36	47	GRAY		12 in.	60	25 ft.	136.5 ft.	161.5 ft.
SANDY CL	AY WIT	н	47	121	GRAY						
SOFT SAND	Y CLA	Y	121	123	BROWN	SOFT	Static Water	Level			
SANDY CL	AY WIT	н	123	125	GRAY		70.4 ft.	land surfa	ce	Measure	08/12/2008
COARSE SA	AND AN	D	125	128	VARIED		Description I and	-1 /h -l l	1		
SANDY CLA	AY A CT AV		128	131	GRAY		Pumping Lev	et (Detow 1st	Developed		
SAND WITH	TUEAT	000	121	133	CRAV	MEDITIM	88.J II.	24 85.	Pumping at	900 8	çp.m.
ENTER CAM	E PEA I	UUCK	133	147	CRAV	MEDIOM	Wellhead Co	mpletion			
COARSE SA	ND-		147	158	VARIED		Pidess adapter	manufacturer	MONITOR	. N	fodel 9PS1214
GRAVEL			158	162	VARIED		At-grade	Totection (Environme	ntal Wells and Bor	ings ONLY)	
SANDY CL	AY		162	165	GRAY		Grouting Inf	ormation	Well Grouted?	X Yes N	o Not Specified
	-						Material		Ame		From To
							neat cement		4.5	Cubic yards	10 ft. 126.5 ft.
										-	
							Nearest Kno	wa Source o	Contamination		
							Q fe	et	Direction		Туре
							Well disinfe	ted upon cor	mpletion?	Y Yes	<mark>N₀</mark>
							Pump	Not	Installed Da	te Installed	10/30/2008
							Manufacturer	s name	GRUNDFOS		
							Model Numbe	* <u>80054</u>	<u>0-</u>	<u>10</u> Vo	It <u>400</u>
							Abandoned	pipe 12	I Capacity	200 S-P-	Typ Submersible
							Does property	have any not i	a use and not scaled a	vell(s)?	Yes X No
							Variance				
							Was a variance	e granted from	the MDH for this we	17	Yes X No
							Miscellaneou	5			
							First Bedrock			Aquifer	Quat. buried
							Last Strat	clay+sand	l-gray	Depth to Be	drock ft
Famarla							Located by	Minn	esota Department (of Health	
Acting the							Locate Method	GPS	SA Off (averaged)		
							System University	UTM - NAL	983, Zone 15, Meters	X 379	100 I 5000084
							Angled Deill	Hele			ipa bac 11/15/2008
							Augue Dim	11000			
							Well Contra	tor			
							LTP Enterp	rises, Inc.	1	2157	THEISEN, R.
							Latensee D		1.30.0	a rag. no.	Partie of Diffier
<u> </u>						764	258				
Minneso	ta We	ll Ind	lex Repo	rt		/04	200				Printed on 06/12/2017
											HE-01205-15

Figure 50. Well and Boring Report - Litchfield-MW (607417)

Minnesota Unique Well Number	County 1	Mooker	MIN WFI	NESOTA DEP.	ARTMENT	F HEALTH	DRT	Entry Date	04/22/2003
607417	Quad 1	litchfield	WEL	fumerate Sta	buter Chem	3 INEF	JKI	Update Date	08/18/2014
	Quad ID	25A	<u>л</u>	unnesota sta	uuus Chup	WF 1031		Received Ds	te
Well Name Townsh	ip Rang	e Dir Sect	ion Subsect	ion	Well Depth	1	Depth Completed	Date	Vell Completed
LITCHFIELD MW 119	31	W 2	CDCAD	в	130 ft .	1	27 ft.	12/18/	1997
Elevation 1123.2 Elev.	Method	Surveyed			Drill Method	Auger (nor	-specified)	Drill Fluid Be	etizate
Address					Use monito	r well			Status Active
					Well Hydrofes	ctured?	Ver 🗆 Ne	V Room	-
					Casing Type	Single ca	tes 100	Joint	10
Stratigraphy Information					Drive Shoe?	Yes 🗌	No X	Above/Below	
Geological Material	From	n To(ft.)	Color	Hardness	Casing Diame	ter We	inter (CC)		Hale Diameter
SANDY CLAY	0	22	BROWN		2 in To	122 ft.	lbs/ft.		6.5 in To 130 ft.
CLAY	22	29	GRAY						
SAND & GRAVEL	29	37	BROWN						
CLAY	37	40	GRAY						
SAND	40	45	BROWN		Onen Hale	-		-	
ROCK	45	47	BLK/WHT		Serman? R	From	II. Type stainlass	To Make	TOHNSON
CLAY	47	72	GRAY		Diameter	Slot/Gauze	Length	Set	
SAND & GRAVEL	72	76	BROWN		2 in.	10	10 ft.	122 ft.	127 ft.
CLAY	76	107	GRAY						
SAND & GRAVEL	107	130	BROWN		Static Water	Level			
					40 ft.	land surfa	ce	Measure	12/18/1997
					Density Ter		1		
					Pumping Let	er (perow rat	id surrace)		
					Wellhead Co	mpletion			
					Pidess adapter	manufacturer			Model
					At-grad	Totection (Environme	ntal Wells and Bor	ings ONLY)	
					Grouting Inf	ormation	Well Grouted?	X Yes	No Not Specified
					Material		Ame		From To
					high solids b	entonite	7	Sacks	3 ft 120 ft
					Nearest Kno	wa Source of	Contamination		
					fe	et	Direction		Туре
					Well disinfe	cted upon cor	mpletion?	X Yes	No No
					Pump	Not 1	Installed Da	ste Installed	
					Manufacturer	s name	100		
					Model Number	# 		`	olt T
					Abandoned	b hite:	If Capacity	8-P-	Typ
					Does property	have any not it	n use and not scaled y	vell(s)?	Yes X No
					Variance				
					Was a variance	e granted from	the MDH for this we	17	Yes X No
					Miscellaneou	5			
					First Bedrock			Aquife	Quat. buried
					Last Strat	sand +lar	ger-brown	Depth to I	Bedrock ft
Remarks					Located by	Minn	esota Geological S	lurvey	
WELL OBS #1					Locate Metho	1 Digiti	nation (Screen) - N	dap (1:24,000)	
					Justice Month	UTM - NAL er Verification	Terfs/CDS	A 3/	22/ 1 4999393 Issue Date 10/23/1008
					Angled Drill	Hole	LLLO GFS		Inpla Date 10/22/1996
					August Dim	11000			
					Well Contra	ctor			
					Traut M.J.	Well Co.	1	71536 or Rog No.	Norma of Dollar
					Latensee D		Lac. (or rong, reo.	Name of Littler
				607	417				
Minnesota Well Inc	lex Repo	ort		007	11/				Printed on 06/19/20
1	-								HE-01205-

Minnesota Unique Well Number	County Meeker	MINNESO	OTA DEPARTMENT O	F HEALTH	Entry Date	08/14/2015
773062	Ouad Litchfield	WELL A	AND BORIN	G REPORT	Undate Date	10/20/2015
115002	Quad ID 125A	Minne	esota Statutes Chapi	ter 1031	Received Date	10202013
Torrest Torrest	in Passa Dis Car	tion Calculation	Bell Deeth	Denth Complet	Data Mal	Completed
LFOI-B 119	31 W 11	ABACBB	25.27 ft.	25.27 ft.	06/12/201	5
Elevation 1114.5 Elev.	Method LiDAR Im	DEM (MNDNR)	Drill Method	Auger (non-specified)	Drill Fluid	
Address			Use monito	r well		Status Active
Contact 126 MAR	SHALL AV N LITCHE	ELD MN 55355	Well Hydrofra	ctured? Yes 7	No X From	То
Well 982 MILL	ER AV N LITCHFIELI	D MIN 55355	Casing Type	Single casing	Joint G	lued
Statigraphy Info2060MiO	ODALE DR MOUNDS	VIEW MN 55112	Drive Shoe?	Yes No X	Above/Below	
Geological Material	From To (ft.)	Color Hards	Dess Casing Diame	ter Weight		Hole Diameter
SAND, WELL SORTED	0 12	GRAY SOFT	1.2 in.To	22.4 ft. 0.74 Ibs/ft.		8.2 in.To 25.2 ft.
SAND WELLSORTED	12 14	GRAY SOFT				
SAND, WELL SORIED,	14 19	GRAY SOFT				
SAND, MED. TO	19 25	GAAT SOFT				
			Open Hole	From ft.	То	ft.
			Screen?	Type slotts	ed pipe Make El	WIRONMENTAL
			1.2 in.	10 2.7 ft.	22.4 ft.	25 ft .
			Static Water	Level		
			11 ft .	land surface	Measure	08/17/2015
			Pumping Lev	el (below land surface)		
			£.	3.7 hrs. Pumping at	0.21 g.p.	m .
			Wellhead Co	mpletion		
			Pidess adapter	manufacturer	Moo Moo	lel
			At-grad	e (Environmental Wells and	Borings ONLY)	
			Grouting Inf	ormation Well Grouted	7 X Yes No	Not Specified
			Material	A	Imount	From To
			bentonite	1	.67 Sacks	4.5 ft. 19.2 ft.
			concrete	2	Sacks	ft. 4.5 ft.
			Nearest Kno	wn Source of Contaminatio	n	
			fe	et Direction		Туре
			Well disinfe	cted upon completion?	Yes X	No
			Pump	Not Installed	Date Installed	
			Manufacturer	s name HD	Train	
			Length of dra	anine fi Canaci	voit v en T	w.
			Abandoned	ttt. • offer	v 917°*.	/r
			Does property	have any not in use and not seal	ied well(s)?	Yes X No
			Was a variance	e granted from the MDH for this	well?	Yes X No
			Miscellaneou	6		
			First Bedrock	11-7h -	Aquifer Q	Juat. Water
			Last Strat	Minnesota Geologic	al Survey	AA II
Remarks			Locate Metho	1 Digitization (Screen)) - Map (1:24,000)	
SEE DRILLERS LOG FOR DE	TAILED INFORMATION.		System	UTM - NAD83, Zone 15, Me	ters X 37965	5 Y 4999332
			Unique Numb	er Verification Inform	ation from Inpu	a Date 08/14/2015
			Angled Drill	Hole		
			Well Contra	ctor		
			US Geolog	ical Survey	1548	HUCKABY, J.
			Licensee B	usiness L	ic. or Rog. No.	Name of Driller
			773062			
Minnesota Well Ind	lex Report					Printed on 06/19/2017 HE-01205-15

Figure 51. Well and Boring Report - USGS 1-B (773062)

Figure 52. Well and Boring Report - USGS 1-C (773060)

Minnesota Uniqu	se Well Numb	er	County M	ooker	MIN	NESOTA DEP	ARTMENT O	F HEALTH		Fater Data	08/14/001	
	772060 Ored Litchfield WELL AND				BORIN	G REPO	DRT	Early Date 00/14/2015				
	3000		Quad 14	CA.	1	Minnesota Sta	itutes Chapt	er 1031		Update Date 10/20/2015		2
		-	Quad ID 1	DA						Received Date		
Well Name	To	wash	ip Range	Dir Sect	ion Subsec	tion	Well Depth	1	Oepth Completed	Date W	ell Completed	
LFO1-C	119	9	31	W 11	ABACE	BB	53.1 ft.	5	3.1 ft.	06/12/2	015	
Elevation	1114.8	Elev.	Method	LiDAR 1mI	EM (MNDNR)		Drill Method	Auger (nor	i-specified)	Drill Fluid		
Address							Use monito	r wall			Status	Active
_										_		
Contact	126	MAK	SHALL AV	N LITCHFI	ELD MN 3333	35	Well Hydrofra	ctured?	Yes No	X From	To	
Well	982	MILL	ER AV N L	TCHFIELD	MN 55355		Casing Type	Single ca	sing	Joint	Glued	
Statigraph	ry Infoliatio	NHO	ODALE DR	MOUNDS	/IEW MIN 551	112	Drive Shoe?	Yes	No X	Above/Below		
Geological I	Material	_	From	To (ft.)	Color	Hardness	Casing Diame	ter We	ight		Hole Diameter	r
SAND, WE	LL SORTE	Ð	0	12	GRAY	SOFT	1.2 in To	50.2 ft. 0.	74 Ibs./ft.		8.2 in To	53 ft.
SAND WEI	LL SORT		12	14	GRAY	SOFT						
SAND, WE	LL SORTE	D,	14	19	GRAY	SOFT						
SAND, MEI	D. TO		19	22	GRAY	SOFT						
SAND, MEI	DIUM WE	LL	22	43	GRAY	SOFT	Onen Hele	-		-		
SILT & CL/	AY WITH		43	53	GRAY	MEDIUM	Copen Hote	From	II. Tame slatted a	To Make	II.	
							Diameter	Slot/Gauge	Longth	Sar Sar	ENVIRONME!	1.72
							1.2 in	10	27 0	50.2 0	52.8 0	
							Cardia Western	Tanal				
							125 0	land corfs	~	Manura	08/17/2015	
								THE PARTY			001//2015	
							Pumping Lev	el (below la	ud surface)			
							ft.	1.9 hrs.	Pumping at	0.21	p.m.	
							Wellhead Co	mpietton				
							Pittess adapter	manufacturer	X 12 in	about made	LOGIEL	
							At-grad	- (Environme	ntal Wells and Bor	ings ONLY)		
							Grouting Inf	ormation	Well Grouted?	X Yes N	o 🗆 Not St	recified
							Material		Ame		Error To	
							bontonito		3.5	Sacks	35 0 43	
							concrete		2.5	Sacks	£ 31	. .
										Course of the second se		· •
							Nearest Kno	Source of	Contamination			
							6		Direction			Trees
							Well disinfe	w. ctad unon cor	mletion?	Yes	No No	1.750
							Dump	Not Not	Installed De	to Too to Had		
							Manufactured	NOL NOL	installed La	ine installed		
							Madel Number		HP	Ve		
							Length of day	n nine	ft Cenerity		Tvp	
							Abandoned	1.1.1.1	- othern)	8 2 .	-//r	
							Does nonests	have any not it	a use and put scaled a	vell(s)?	Ver.	X No
							Variance	and any state				
							Was a various	e enanted from	the MDH for this wel	IP [Yes	X No
							Miscellance	- grande ridin	and the set of the west	L		
							First Badarch	-		Amifer	Oust huring	
							Last Street	nabhbran	nd/silt/class-mass	Death to Be	quar. ouried drock	÷
							Located by	Minn	esota Geological S	and the second s		-
Remarks							Locate Metho	1 Digit	zation (Screen) - M	dap (1:24.000)		
SEE DRILLE	ERS LOG FO	RDE	TAILED INFO	RMATION			System	UTM - NAL	83, Zone 15, Meters	X 3796	53 Y 499	9334
							Unique Numb	er Verification	Informatio	n from li	put Date 08/	14/2015
							Angled Drill	Hole				
1							-					
							Well Contra	ctor				
							US Goolog	ical Survey		1548	HUCKAE	SY, J.
							Lacensee B	USER SS	Lác. (or Keg. No.	Name of D	niller
L												
Minner	ata Well	Ind	or Rene			773	060				Printed o	a 06/19/2017
And the st	a neu	100	ica itepo									HE-01205-15

Figure 53. Well and Boring Report - USGS 1-D (773059)

Minnesota Unique Well Number	C	Maakar	MIN	ESOTA DEP	ARTMENT O	F HEALTH	I				
WELL AND				L AND I	BORIN	G REP	ORT	Entry Date	08/14/20	15	
773059	Quad	Lincameid	M	innesota Sta	tutes Chapt	ter 1031		Update Date	10/20/20	15	
	Quad ID	1204						Received Da	te		
Well Name Townsh	ip Rang	e Dir Sect	ion Subsecti	0B	Well Depth	1	Depth Completed	Date	Vell Completed		
LFO1-D 119	31	W 11	ABACB	В	75.5 ft.	1	75.27 ft.	06/11/	2015		
Elevation 1114.7 Elev.	Method	LiDAR 1m1	DEM (MNDNR)		Drill Method	Auger (no	n-specified)	Drill Fluid			
Address					Use monito	or well			Status	Active	
Contact 126 MAR	SHALL AV	V N LITCHFI	ELD MN 55355		Well Hydrofra	ctured?	Yes No	X From	Те		
Well 982 MILL	ERAVN	LITCHFIELD	MN 55355		Casing Type	Single o	asing	Joint	Ghad		
Strattigraphy InfoRitiGhild	ODALE D	R MOUNDS	VIEW MN 5511	2	Drive Shoe?	Yes 🗌	No X	Above/Below			
Geological Material	From	n To(ft.)	Color H	lardness	Casing Diame	ter We	right		Hole Diamete	r	
SAND, WELL SORTED	0	12	GRAY S	OFT	1.2 in To	72.4 ft. 0	.74 Ibs/ft.		8.2 in To	75.5 ft.	
SAND WELL SORT	12	14	GRAY S	OFT							
SAND, MEDIUM WELL	14	19	GRAY S	OFT							
SAND, MED. TO	19	22	GRAY S	OFT							
SAND, MEDIUM WELL	22	45	GRAY S	OFT	Open Hole	From	A	То			
SILT & CLAY WITH	45	76	GKAY	MEDIUM	Screen? 5	0	Type slotted p	ipe Make	ENVIRONME	NTAL	
					Diameter	Slot/Gauzo	Length	Set			
					1.2 in.	10	2.7 ft.	73.4 ft.	75 ft.		
					Static Water	Level		Maxim	08/17/2015		
					23.8 H.	NOT STOP	ace.	Measure	08/1//2013		
					Pumping Lev	rel (below la	nd surface)				
					ft.	3.6 hrs.	Pumping at	0.2	g.p.m.		
					Wellhead Co	moletion					
					Pidess adapter	manufacturer		1	Model		
					X Casing	Protection	X 12 in	above grade			
					At-grad	e (Environne	antal Wells and Bor	ings ONLY)			
					Grouting Inf	ormation	Well Grouted?	X Yes	No Not S	pecified	
					Material		Amo	nant.	From T	•	
					cuttings		5		4 ft.7	0.2 ft.	
					concrete		2.3		ш. 4	п.	
					Nearest Kno	wa Source o	f Contamination				
					feet Direction Type						
					Well disinfe	cted upon co	mpletion?	Yes	X No	- 11-	
					Pump	Not	Installed Da	ate Installed			
					Manufacturer	s name					
					Model Numb	cr.	HP	v	olt		
					Length of dro	p pipe	ft Capacity	8-P-	Тур		
					Abandoned				— ••	1971 •••	
					Does property	nave any not	in use and not sealed v	ecil(s)7	Ies	A NO	
					Was a marine	e organized for or	the MDH for this cost		Ver Ver	X No	
					Miscellencer	A granicu non	THE PROPERTY OF LIES WE	-	L -••	AL 110	
					First Bedrock	-		Amife	Ouat huried		
					Last Strat	pebbly sa	and/silt/clay-gray	Depth to E	ledrock	ft	
					Located by	Min	nesota Geological S	arvey			
SEE DRILLERS LOG DOD DE	TAILED DO	ORMATION!			Locate Metho	d Digit	ization (Screen) - M	dap (1:24,000)			
SEE DRILLERS LOG FOR DE	TAILED IN	CIONATION.			System	UTM - NAI	D83, Zone 15, Meters	X 379	654 Y 499	99334	
					Unique Numb	er Ventication	Informatio	n from	Input Date 08	/14/2015	
					Angled Drill	riole					
					Well Contra	ctor					
					US Goolog	ical Survey		1548	HUCKA	BY, J.	
					Licensee B	usmess	Lic. (or Reg. No.	Name of D	niler	
					050						
Minnesota Well Ind	lex Ren	ort		773	059				Printed	on 06/19/2017	
in the source of the										HE-01205-15	
Figure 54. Well and Boring Report - USGS 1-E (773058)

Minnesota Unique Well Number County Mooker	MINNESOTA DES WELL AND	PARTMENT O	F HEALTH	IRT	Entry Date 08/14/2015		
773058 Quad Litchfield	773058 Quad Litchheld Minnesota Sti				Update Date	10/20/2015	
Quad ID 125A					Received Date		
Well Name Township Range Dir S	ection Subsection	Well Depth	D	epth Completed	Date We	ell Completed	
LF01-E 119 31 W 1	1 ABACBB	95.3 ft.	93	5.28 ft.	06/10/20	15	
Elevation 1114.5 Elev. Method LiDAR 1:	m DEM (MNDNR)	Drill Method	Auger (non	-specified)	Drill Fluid		
Address		Use monito	or well			Status Active	
Contact 126 MARSHALL AV N LITCH	FIELD MN 55355	Well Hydrofra	ctured?	Yes No	From	To	
Well 982 MILLER AV N LITCHFIE	LD MN 55355	Casing Type	Single car	uing	Joint		
Statigraphy Information ODALE DR MOUND	S VIEW MN 55112	Drive Shoe?	Yes	No X	Above/Below		
Geological Material Prom 10 (P	CRAV SOFT	Casing Diame	ter Wei	ght .		Hole Diameter	
SAND WELL SORTED 12 14	GRAY SOFT	1.2 m. To	92.4 ft. 0.1	/4 Jbs/ft.		8.2 m. 10 95 ff.	
SAND, MEDIUM WELL 14 19	GRAY SOFT						
SAND, MED. TO 19 22	GRAY SOFT						
SAND, MEDIUM WELL 22 43	GRAY SOFT						
SILT & CLAY WITH 43 95	GRAY SFT-HRD	Open Hole	From	£.	To	ft.	
		Diameter	Slot/Gauza	Length	sor Sor	INVIRONMENTAL	
		1.2 in.	10	2.7 ft.	92.4 ft.	95 ft.	
		Static Water	Level				
		36.3 ft.	land surfac		Measure	08/17/2015	
		Pumping Lev	rel (below lan	d surface)			
		£.	11. hrs.	Pumping at	0.28 g	p.m.	
		Wellhead Co	mpletion				
		Pidess adapter	manufacturer		M	odel	
		At-grad	Protection e (Environmer	ital Wells and Bor	ings ONLY)		
		Grouting Inf	ormation	Well Grouted?	Yes No	Not Specified	
		Material		Ame	runt	From To	
		bentonite		7	Sacks	4 ft. 89.5 ft.	
		concrete		2.5	Sacks	£1.4 £1.	
		Nearest Kno	wa Source of	Contamination			
		fe	et	Direction		Туре	
		Well disinfe	cted upon con	pletion?	Yes	X No	
		Pump	Not I	nstalled Da	ate Installed		
		Manufacturer	s name	нр	17-1		
		Length of drop	a nine	ft Canacity	ED	Typ	
		Abandoned		- capital		-76	
		Does property	have any not in	use and not sealed w	vell(s)?	Yes X No	
		Variance			_		
		Was a variance	e granted from t	the MDH for this wel	17	Yes X No	
		First Bedrock	-		Amifer	Ouat, buried	
		Last Strat	pebbly sar	ad/silt/clay-gray	Depth to Bed	irock ft	
Permeter		Located by	Minne	sota Geological S	urvey		
SEE DRILLER LOG FOR DETAILED INFORMATION		Locate Metho	d Digitiz	zation (Screen) - N	dap (1:24,000)		
		Unique Numb	UTM - NAD	83, Zone 15, Meters	x 3796	00 1 4999334	
		Angled Drill	Hole	11101111400			
		Well Contra	ctor		1.6.0		
		US Goolog	usiness	De a	1048 or Reg. No.	Name of Driller	
		Land Land Land		Lab.		Contract of Lot live	
	77.	3058				Printed on 06/10/201	
Minnesota Well Index Keport						HE-01205-1	

Figure 55. Well and Boring Report - USGS 1-F (773057)

Minnesota Unique Well Number		Masher	MIN	NESOTA DEP	ARTMENT O	F HEALTH	r			
	County	NIGGER	WEL	L AND	BORINO	REP	ORT	Entry Date	08/14/20	015
773057	Quad	Latchfield	1.22	linnesota Sta	tutes Chapt	er 1031		Update Date	10/22/20	015
	Quad ID	120A						Received Da	te	
Well Name Towns	ip Ran	e Dir Sec	tion Subsect	ion	Well Depth	1	Depth Completed	Date	Well Completed	
LF01-F 119	31	W 11	ABACB	В	130 ft .	1	27.46 ft.	06/15/	2015	
Elevation 1114.7 Elev.	Method	LiDAR 1ml	DEM (MNDNR)		Drill Method	Auger (no	n-specified)	Drill Fluid		
Address					Use monito	r well			Status	Active
Contact 126 MAX	SHALL A	V N LITCHFI	ELD MN 5535	5	Well Hydrofrac	tured?	Yes No	X From	To	
Well 982 MIL	LER AV N	LITCHFIELD	MN 55355		Casing Type	Single ca	sing	Joint	Glued	
Summersphy Information	ODALE D	R MOUNDS	VIEW MN 551	12	Drive Shoe?	Yes 🗌	No X	Above/Below		
Geological Material	Fro	n To(ft.)	Color	Hardness	Casing Diamet	er We	ight		Hole Diamet	ier
WELL SORT, SAND,	0	12	GRAY	SOFT	2 in.To	118 ft. 1	.02 Ibs/ft.		8.2 in To	130 ft.
SAND WELL SORT	12	14	GRAY	SOFT						
SAND, MEDIUM WELL	14	19	GRAY	SOFT						
SAND, MED. TO	19	42	CRAV	SOFT						
STIND, MEDIUM WELL	43		CRAV	SULL SET HED	Open Hole	From	£.	To	ft.	
SAND & GRAVEL	98	130	GRAY	MEDIUM	Screen?]	Type slotted p	ipo Make	ENVIRONME	INTAL
and the construction of the second seco					Diameter	Slot/Gauze	Length	Set		
					1.9 m.	20	9.6 ff.	118 ft.	127.4 ft.	
					Castle Wester 1					
					366 A	land corfs	-	Maxim	08/17/2015	
					30.0 11.	1400 90014		Need state	00/1//2013	,
					Pumping Lev	el (below la	ad surface)			
					£.	2.9 hrs.	Pumping at	1.11	g.p.m.	
					Wellhead Co	mpletion				
					Pitless adapter	manufacturer		1	Model	
					X Casing P	rotection	X 12 in	above grade		
					At-grade	(Environme	intal Wells and Bor	ings ONLY)		
					Grouting Info	rmation	Well Grouted?	X Yes	No Not	Specified
					Material		Amo	vunt	From 1	To
					bentonite		9	Sacks	3.4 11.9	
					COLLINIO		20	Secas		
					Nearest Know	m Source o	f Contamination			
					fee	at a second s	Direction			Type
					Well disinfec	ted upon cor	mpletion?	Yes	X No	
					Pump	Not Not	Installed Da	te Installed		
					Manufacturer's	name				
					Model Number	r	HP	v	olt	
					Length of drop	pipe	ft Capacity	g-p.	Тур	
					Abandoned				— •	
					Does property	have any not i	in use and not sealed v	vell(s)?	Yes	X No
					Variance	constal from	the MOM for this real		Ves.	No.
					Was a variance	- granted from	The MUM for this we	ar -		
					First Bedrock	•		Amife	Oust huriad	
					Last Strat	sand +lar	POT-STAV	Depth to E	edrock	ft
					Located by	Minn	assota Geological S	arvey		
Kemarks					Locate Method	Digit	ization (Screen) - M	dap (1:24,000)		
GAMMA & EM DUDUCTION	LOGGED 6	24-2015 LOCC	ED EOR 119/25		System	UTM - NAI	D83, Zone 15, Meters	X 379	9654 Y 49	99332
GAMMA & EM INDUCTION	LOGGED	24-2013. 10030	ED FOR USOS.		Unique Numbe	r Verification	Informatio	n from	Input Date 0	8/14/2015
					Angled Drill	Hole				
					Well Contrac	tor				
					US Goologi	cal Survey		1548	HUCKA	BY, J.
					Licensee Bu	1910095	Lic.	or Reg. No.	Name of I	Driller
					057					
Minnesota Well In	dex Ren	ort		773	0057				Printed	on 06/19/2017
					I					HE-01205-15

Figure 56. Well and Boring Report - USGS 2-A (773056)

Minnesota Unique Well	- Maakar	MINNESOTA DEI	PARTMENT O	OF HEALTH	1	Entry Date 00/00/0015			
77205	C Ored	Litchfield	WELL AND	LL AND BORIN		NG REPORT		Latry Date 09/09/2015	
7/305	D Quad	125A	Minnesota St	atutes Chapt	utes Chapter 1031			Update Date 10/20/2015	
	Quad II	J 1234					Keceived Ds	ite	
Well Name	Township R	ange Dir Section	Subsection	Well Depth	1	Jepth Completed	Date	Well Completed	
LFO2-A	119 31	1 W 2	CACDBD	20 ft .	1	9.99 ft.	06/24/	2015	
Elevation 1139	6 Elev. Metho	LiDAR 1m DEM ((NDNR)	Drill Method	Auger (nor	1-specified)	Drill Fluid		
Address				Use monito	or well			Status	Active
Well	61656 270TH ST	LITCHFIELD MN 553	55	Well Hydrofra	ctured?	Yes No	From	To	
Contact	126 MARSHALL	AV N LITCHFIELD 1	@N 55355	Casing Type	Single ca	sing	Joint	Glued	
Statigraphy Info	CONTRACTOR	DR MOUNDS VIEW	MN 55112	Drive Shoe?	Yes	No	Above/Below	r	
Geological Materi	al P	rom To(ft.) Col	ar Hardness	Casing Diame	ter We	ight		Hole Diameter	
SILIBOLAT W/	MND,	0 <u>2</u> 0 GAU	AT MEDIUM	1.2 in To	17.1 ft. 0.	74 Ibs/ft.		8.2 in To 2	20 ft .
				Open Hole	From	Ĥ.	То	£.	
				Screen?	(Type slotted p	ipe Make	ENVIRONMEN	TAL
				Diameter 1.2 in.	Slot/Gamze 10	Langth 2.7 ft.	Set 17.1 ft.	19.7 ft .	
				Static Water 17.3 ft.	Level land surfa	C9	Measure	08/17/2015	
				Pumping Lev ft.	vel (below lau 1.2 hrs.	ad surface) Pumping at	0.08	g.p.m.	
				Wellhead Co	ompletion				
				Pidess adapter	manufacturer	_	1	Model	
				X Casing At-grad	Protection e (Environme	12 in. ntal Wells and Bor	. above grade ings ONLY)		
				Grouting Inf	ormation	Well Grouted?	X Yes	No Not Spo	scified
				Material		Amo	sunt Coulor	From To	
				concrete		15	Sacks	5 H I) £ 3	ft.
									_
				Nearest Kno	wa Source of	f Contamination			
				fe Woll divinfo	et stad upon cor	Direction	- Ver	NOT No.	Туре
				Parmo	Not	Installed Dr	to Installed	A NO	
				Manufacturer	's name	installed Lia	ine inistanied		
				Model Numb	er	HP	v	Volt	
				Length of dro	p pipe	ft Capacity	8-P-	Тур	
				Abandoned Does property	have any not i	n use and not sealed v	vell(s)?	Yes	X No
				Variance					-
				Was a variant	e granted from	the Marrisor thas well	ar -	M	1 200
				First Bedrock			Aquife	Cuat, huriad	
				Last Strat	pebbly sa	nd/silt/clay-gray	Depth to F	Bedrock	ft
Preset				Located by	Minn	esota Geological S	urvey		
SEE DRULERS LO	G FOR DETAILED	INFORMATION		Locate Metho	d Digiti	ization (Screen) - N	(ap (1:24,000)		
				Unique North	UTM - NAD	Tas, Zone 15, Meters	x 379	7195 I 4999 Input Date 00/0	910
				Angled Drill	Hole	1010100000		- 1910 - 1910	5/2013
				Well Contra	ctor				
				US Goolog	ical Survey		1548	HUCKAB	Y, J.
				Lacensee B		Lac. (a neg. No.	name of Dri	1941
Minnesota V	Vell Index R	eport	77.	3056				Printed on	06/12/2017

Figure 57. Well and Boring Report - USGS 1-F (773057)

Minnesota Unique	Well Number	County Quad	Meeker Litchfield 125A	MINN WELI Mi	MINNESOTA DEPARTMENT OF HEALTH WELL AND BORING REPORT Minnesota Statutes Chapter 1031				Entry Date 09/09/2015 Update Date 10/20/2015 Received Date		
		Quanto							Received Da	ite	
Well Name	Towns	hip Ra	age Dir Sec	tion Subsectio		Well Depth	1	Depth Completed	Date	Well Completed	
LPO2-B	119	31	W 2	CACDBL	,	50.0 ff.		0.13 11.	06/24	2015	
Elevation	1139.2 Elev	Method	LiDAR 1m	DEM (MNDNR)		Drill Method	Auger (no	a-specified)	Drill Fluid		
Address						Use monito	r well			Status	Active
Well	61656 27	OTH ST L	ITCHFIELD N	EN 55355		Well Hydrofra	ctured?	Yes No	X From	Те	
Contact	126 MAI	RSHALL /	AV N LITCHF	ELD MN 55355		Casing Type	Single ca	sing	Joint	Ghad	
Stratigraphy	Information	ODALE	DR MOUNDS	VIEW MN 55112	2	Drive Shoe?	Yes	No 🗌	Above/Below		
Geological M	faterial	Fn	om To (ft.)	Color H	lardness	Casing Diame	ter We	isht		Hale Diamete	
SILT&CLAY	Y W/SAND,	0	36	GRAY N	(EDIUM	1.2 in. To	32.3 ft. 0.	74 Ibs/ft.		8.2 in. To	35.5 ft.
						Open Hole	From	£.	То	£.	
						Screen? 5	(Type slotted p	ipe Make	ENVIRONME	NTAL
						Diameter	Slot/Gauze	Length	Set		
						1.2 in.	10	2.7 ft.	32.2 ft.	34.9 ft.	
						Static Water	Level				
						23.8 ft.	land surfa	C 9	Measure	08/17/2015	
						Pumping Lev	el (below la	ad surface)			
						£.	1.4 hrs.	Pumping at	1.43	g.p.m.	
						Wellhead Co	mpletion				
						Pitless adapter	manufacturer			Model	
						X Casing I	Protection	X 12 in Real Wells and Ber	above grade		
						Granting Inf	ormation	Well Grouted?		No. 🗆 Not S	necified
						Material		Ame		From T	-
						bentonite		4	Sacks	3 ft. 30	0.5 ft.
						concrete		1.5	Sacks	ft. 3	ft.
						Name Van	Same a	Contomination			
						fo	at Source o	Direction			Tune
						Well disinfe	cted upon con	mpletion?	Yes	X No	- //
						Pump	Not Not	Installed Da	ate Installed		
						Manufacturer	s name				
						Model Numbe	a	HP	1	Volt	
						Length of drop	p pipe	ft Capacity	S-P-	Тур	
						Abandoned			-110.05		V N
						Does property	nave any not i	n use and not sealed v	well(s)7	105	N0
						Was a variance	e granted from	the MDH for this we	17	Yes	X No
						Miscellaneon	15				
						First Bedrock			Aquifa	Quat. buried	
						Last Strat	pebbly sa	nd/silt/clay-gray	Depth to I	Bedrock	ft
Remeric						Located by	Minn	esota Geological S	hurvey		
SEE DRILLES	IS LOG FOR DA	TAILED	NEORMATION			Locate Methor	1 Digit	ization (Screen) - M	dap (1:24,000)		
						Unique Numb	UTM - NAI er Verification	Jas, Zone 15, Meters	x 37	9195 I 495 Input Date 00	99909 09/2015
						Angled Drill	Hole	mormatic		operiose Va	
						Well Control	ctor				
						US Geologi	ical Survey		1548	HUCKAI	BY, J.
						Licensee B	usiness	Lic. (or Rog. No.	Name of D	riller
Minnere	ta Well In	dar Re-	nort		773	3055				Printed	on 06/12/2017
Atmines0	ta wen m	uer ve	port								HE-01205-15

Figure 58. Well and Boring Report - USGS 2-C (773054)

Minnesota Unique Well Number Committy Manker MINN	ESOTA DEP	EPARTMENT OF HEALTH							
WEL	L AND H	D BORING REPORT			Latry Date	08/14/2015			
773054 Quad Litensia M	4 Quad Encland Minnesota Statutes C				tutes Chapter 1031 Update Date 10/				
Quad ID 125A					Received Ds	te			
Well Name Township Range Dir Section Subsection	08	Well Depth	1	Depth Completed	Date	Well Completed			
LF02-C 119 31 W 2 CACDB	D	70 £.	5	9.84 ft.	06/22/	2015			
Elevation 1139.4 Elev. Method LiDAR 1m DEM (MNDNR)		Drill Method	Auger (nor	a-specified)	Drill Fluid				
Address		Use monito	r well			Status Active			
Well 61656 270TH ST LITCHETELD MN 55355		Well Hydrofra	tured?	Ver 🗆 No	V P	-			
Contect 126 MARSHALL AV N LITCHETELD MN 55355		Caring Trees	Single co		A From	To			
Statistanter Info@00010000 ALE DR MOUNDS VIEW MOUSSI	2	Drive Shoe?	Ves 🗌	No 🗆	Above Below	Gritted			
Geological Material From To (ft.) Color H	Tardness	Contra Minera			ADOVE DOWN	H-L Blooster			
SILT & CLAY W/SAND, 0 70 GRAY D	MEDIUM	1.2 in To	er we 57 ft. 0.	igne 74 Ibs/ft.		8.2 in To 70 ft.			
		Open Hole Screen? X Diamoter 1.2 in.	From] Slot/Gauze 10	ft. Type slotted Langth 2.7 ft.	To pipo Make Set 56.9 ft.	ft. ENVIRONMENTAL 39.6 ft.			
		Static Water 31.8 ft.	Level land surfa	C 0	Measure	06/22/2015			
		Pumping Lev	el (below las	ad surface)					
		ft.	1.2 hrs.	Pumping at	0.14	g.p.m.			
		Wellhead Co	mpletion						
		Pitless adapter	manufacturer		1	Model			
		X Casing P At-grade	Totection (Environme	ntal Wells and Be	n. above grade prings ONLY)				
		Grouting Info	rmation	Well Grouted?	X Yes	No 🔲 Not Specified			
		Material		An		From To			
		bentonite		7	Sacks	3 ft. 54.7 ft.			
		concrete		2	Sacks	£1.3 £1.			
		Nearest Know	an Source of	f Contamination		_			
		for Wall divinfor	at and among come	Direction		Туре			
		Well distilled	and upon con	mpiedon/	1es	X No			
		Manufactum	Not.	Installed 1	Jate Installed				
		Model Numbe		HP		[olt			
		Length of drop	pipe	ft Capacity	8.P	Тур			
		Abandoned							
		Does property	have any not it	n use and not sealed	well(s)?	Yes X No			
		Variance							
		Was a variance	e granted from	the MDH for this w	ell?	Yes X No			
		Miscellaneou	5						
		First Bedrock	mahhha	nd/silt/slav	Aquite Death to 5	v Quat. burned.			
		Located by	Minn	esota Geological	Survey	44			
Remarks		Locate Method	Digiti	ization (Screen) -	Map (1:24,000)				
SEE DRILLERS LOG FOR DETAILED INFORMATION.		System	UTM - NAD	083, Zone 15, Meter	s X 37	9195 Y 4999910			
		Unique Numbe	er Verification	Informat	ion from	Input Date 08/14/2015			
		Angled Drill	Hole						
		Well Contrac US Geologi Licensee Br	tor cal Survey isiness	Lic	1548 . or Reg. No.	HUCKABY, J. Name of Driller			
Minnesota Well Index Report	773	054				Printed on 06/12/2017 HE-01205-15			

Figure 59. Well and Boring Report - USGS 2-D (773053)

Minnesota Unique Well Number Manker MINNE	SOTA DEPARTMENT	OF HEALTH
County Monte WELL	AND BORIN	GREPORT Entry Date 08/14/2015
773053 Quad Lincaneid Min	nesota Statutes Chai	Update Date 10/20/2015
Quad ID 125A		Received Date
Well Name Township Range Dir Section Subsection	Well Depth	Depth Completed Date Well Completed
LF02-D 119 31 W 2 CACDBD	85.5 ft.	81.14 ft. 06/23/2015
Elevation 1139.2 Elev. Method LiDAR 1m DEM (MNDNR)	Drill Method	Auger (non-specified) Drill Fluid
Address	Use moni	itor well Status Activ
Wall 61656 220TH ST LITCHETELD MN 55355	Well Hedred	
Contrat 126 MARCHAIL AUXILITYCHURELD MIL S255	wear nyuron	ractured: 1es No X From To
CONSCIENCE AND	Casing Typ Drive Sheet	e Single casing Joint Ghied
Geological Material From To (ft.) Color Ha	rdness Contraction	Les No Above beau
SILT& CLAY W/SAND 0 80 GRAY M	DIUM 1.2 in To	eter Weight Hole Diameter
SAND& CLAY W/SAND 80 86 GRAY HA	RD 1.2 m. 10	81.1 H. 0.74 105/H. 8.2 H. 10 83.5
	Open Hole	From ft. To ft.
	Screen?	Type slotted pipe Make ENVIRONMENTAL
	Diameter	Slot/Gauze Length Set
	1.2 m.	10 2.7 ft. \$1.1 ft. \$1.1 ft.
	Static Wate	er Level
	/8 IL	iand surface Measure 06/1//2013
	Pumping L	evel (below land surface)
	£	1.4 hrs. Pumping at 0.1 g.p.m.
	TT: 10 - 16	Provide and the second s
	Weilbead C	-ompienon Madal
	Y Casing	er manaracturer Diodes
	At-gra	de (Environmental Wells and Borings ONLY)
	Grouting In	aformation Well Grouted? X Yes No Not Specifie
	Material	Amount From To
	bentonite	6.5 Sacks 3 ft. 78.5 ft
	concrete	1.5 Sacks ft. 3 ft
	Nearest Kn	nown Source of Contamination
	1	feet Direction Ty
	Well disinf	fected upon completion? Yes X No
	Pump	Not Installed Date Installed
	Manufacture	er's name
	Model Num	iber HP Volt
	Length of di	roppipe n Capacity g.p. Typ
	Does proper	ty have any not in use and not sealed well(s)?
	Variance	in the any net in the and the states wenty?
	Was a varia	nce cranted from the MDH for this well? Yes X 1
	Miscellane	
	First Bedroc	k Antifer Oust huriad
	Last Strat	pebbly sand/silt/clay-gray Depth to Bedrock ft
	Located by	Minnesota Geological Survey
Remarks	Locate Meth	hod Digitization (Screen) - Map (1:24,000)
SEE DRILLERS LOG FOR DETAILED INFORMATION.	System	UTM - NAD83, Zone 15, Meters X 379193 Y 4999908
	Unique Nun	aber Verification Information from Input Date 08/14/201
	Angled Dri	ill Hole
	Well Contr	ractor
	US Geolo	ogical Survey 1548 HUCKABY, J.
	Licensee	Business Lic. or Reg. No. Name of Driller
		-
	773053	
Minnesota Well Index Report		Printed on 06/12

Figure 60. Well and Boring Report - USGS 2-E (773052)

Minnesota Unique Well Number County Meeker MINNY	SOTA DEPARTMENT O	F HEALTH	Fater Data 02/14/0015				
773052 Ored Litchfield WELL	AND BORIN	G REPORT	Undets Date 10/20/2015				
//3052 Quild Internation Min	mesota Statutes Chap	er 1031	Provinced Date 10/20/2015				
Quarter 12			Received Date				
Well Name Township Range Dir Section Subsection	Well Depth	Depth Completed	Date Well Completed				
LF02-E 119 51 W 2 CACDBD	115.9 п.	115.82 ft.	08/20/2013				
Elevation 1139-3 Elev. Method LiDAR 1m DEM (MNDNR)	Drill Method	Auger (non-specified) D	rill Fluid				
Address .	Use monit	r well	Status Active				
Well 61656 270TH ST LITCHFIELD MN 55355	Well Hydrofra	ctured? Yes No	X From To				
Contact 126 MARSHALL AV N LITCHFIELD MN 55355	Casing Type	Single casing	Joint Glued				
Statigraphy Info21601WeOODALE DR MOUNDS VIEW MN 55112	Drive Shoe?	Yes No	Above Below				
Geological Material From To (ff.) Color Ha	Casing Diame	ter Weight	Hole Diameter				
SILISCLAT WAAND, 0 80 GRAT ME	LDIUM 1.2 in To	111 ft. 0.74 Ibs/ft.	8.2 in. To 113. ft.				
SILTECLAT WARNE, SU 114 GRAT HE							
	Open Hole	From ft. 1	fo ft.				
	Screen?	Type slotted pip	 Make ENVIRONMENTAL 				
	Diameter 1.2 in	Slot/Gauze Length	Set 1126 A				
	1.2 m.	10 2.7 H.	110.9 H. 115.0 H.				
	Static Water	Level					
	95.6 ft.	land surface	Measure 08/17/2015				
	Pumping Le	el (below land surface)					
	£	0.6 hrs. Pumping at	0.47 g.p.m.				
	Wellhead Co	mpletion					
	Pitless adapter	manufacturer	Model				
	X Casing	Protection X 12 in a	bove grade				
	Cronting Int	crimetion Well Grouted?	Ver No Not Specified				
	Material	Amon	Tes I to I her operated				
	bentonite		Sacks 3 ft 108.6 ft.				
	concrete		Sacks ft. 3 ft.				
	Nearest Kno	wn Source of Contamination					
	fr	et Direction	Туре				
	Well disinfe	cted upon completion?	Yes X No				
	Pump	Not Installed Date	Installed				
	Manufacturer	s name HD	V-la				
	Length of dro	a nine 🛱 Canacity	en Tun				
	Abandoned	here a caland	61/F				
	Does property	have any not in use and not sealed we	fl(s)? Yes X No				
	Variance	Variance					
	Was a variant	e granted from the MDH for this well?	Yes X No				
	Miscellaneou	5					
	First Bedrock		Aquifer Quat. buried				
	Last Strat	pebbly sand/silt/clay-gray	Depth to Bedrock ft				
Remarks	Located by	Minnesota Geological Sur Displayers (Server) - Ma	may (1.24.000)				
SEE DRILLERS LOG FOR DETAILED INFORMATION.	System	UTM - NAD83, Zone 15, Meters	X 370105 Y 4000000				
	Unique Numb	er Verification Information	from Input Date 08/14/2015				
	Angled Drill	Hole					
	-						
	Well Control	ctor					
	US Geolog	ical Survey	1548 HUCKABY, J.				
	Licensee B	usiness Lic. or	Reg. No. Name of Driller				
	773052		Delevel on Octobolis				
Minnesota Well Index Keport			HE-01205-15				

Figure 61. Well and Boring Report - USGS 2-F (773051)

Minnesota Uniq	Minnesota Unique Well Number Munhar Minnesota D							F HEALTH	I	E		
	WELL AND				L AND	BORIN	REP	ORT	Entry Date	08/14/	2015	
71	73051	- 1	Quad	Latchfield		finnesota Sta	tutes Chapt	er 1031		Update Dat	e 10/23/	2015
_		_	Quad ID	125A						Received D	ste	
Well Name	To To	weshi	ip Ran	ge Dir Sec	tion Subsect	ion	Well Depth		Depth Completed	Date	Well Complet	ed
LFO2-F	119	9	31	W 2	CACDE	BD .	162.5 ft.	1	162.42 ft.	06/18	/2015	
Elevation	1139.3	Elev. 1	Method	LiDAR 1m	DEM (MNDNR)		Drill Method	Auger (no	n-specified)	Drill Fluid		
Address							Use monito	r well			Status	s Active
Wall	6165	6 270	THATL	TCHEFTLD N	N 55355		Well Hydrofes	chured?	Ver 🗆 No			
Contact	1261	MAR	CHATT A	VNITCHE	ET D MOU 5535	•	Casing Trees	Ciarle a	ies No	X From	T	0
Contact	La Ta 6-9960		DALED	PMOIDINE	LITER AGAINST	12	Drive Shoe?	Ver 🗌	No 🗆	Joint About Ralas	Glued	
Geological	Material		Fro	m To(ft)	Color	Hardness	Codes Bloom			Above beau		
SILTACLA	AY W/SAND	D.	0	80	GRAY	MEDIUM	Casing Diame	152 A 1	nght 02 The / D			
SILT&CLA	AY W/SAND	D.	80	117	GRAY	HARD	2 11.10	1.72. 11. 1	.02 105/10			
SAND & G	RAVEL		11	7 161	GRAY	HARD						
SILT&CLA	AY W/SAND	D.	16	1 163	GRAY	HARD						
							Open Hole	From	ft.	То	ft.	
							Screen?	9	Type slotted p	nipe Make	ENVIRONA	IENTAL
							Diameter	Slot/Gauze	Length	Set		
							1.9 m.	20	9.6 ff.	152.4 ft.	162 #	Ł
							Static Water	Level			00/17/00	
							ог п.	land sure	100	Measure	08/17/20	D
							Pumping Lev	el (below la	nd surface)			
							÷.	6.4 hrs.	Pumping at	0.86	g.p.m.	
							Wellhead Co	mpletion			Madal	
							Carine I	manufacturer Instruction	X 12 m	abovo orado	NICOSI	
							At-grade	(Environme	antal Wells and Bo	rings ONLY)		
							Grouting Inf	ormation	Well Grouted?	X Yes	No 🗆 No	t Specified
							Material		Ame		From	То
							bentonite		10	Sacks	2 ft.	137 ft.
							concrete		2	Sacks	ft.	2 ft.
							Nearest Kno	wn Source o	f Contamination			
							fe	et	Direction			Туре
							Well disinfe	cted upon co	mpletion?	Yes	X No	
							Pump	X Not	Installed D	ate Installed		
							Manufacturer	s name				
							Model Numbe	a.	HP		Volt	
							Length of drop	p pipe	ft Capacity	g.p.	Тур	
							Abandoned					
							Does property	have any not	in use and not scaled	well(s)?	Y	es X No
							Variance			_		N N
							Was a variance	e granted from	the MDH for this we	1 7	195	X No
							Miscellaneou	5				
							First Bedrock			Aquit	r Quat burie	d _
							Last strat	peccity so	ma/sin/ciay-gray	Depth to	Dourock.	
Remarks							Locate Method	1 Dieit	initia (Secondical a	Man (1-24 000)		
SEE DRILLI	ERS LOG FO	R DET	TAILED IN	FORMATION.			System	UTM - NAI	D83, Zone 15, Meters	X 37	9195 Y	4999908
GAMMA &	INDUCTION	LOG	GED 8-19-3	2015. LOGGED	FOR USGS.		Unique Numb	er Verification	Informatio	on from	Input Date	08/14/2015
							Angled Drill	Hole				
							•					
							_					
							Well Contra	ctor				
							US Goolog	ical Survey		1048	HUCK	ABY, J.
							Lacensee D		Lac.	or neg. Ivo.	reame of	
<u> </u>						993	051					
Minnes	ota Well	Ind	ex Ren	ort			051				Print	ed on 06/19/2017
		-										HE-01205-15

Figure 62. Well and Boring Report - Desens Observation (800011)

Minnesota Unique Well Number	Course Ma	oker	MIN	ESOTA DEP	EPARTMENT OF HEALTH					
000011	-h6ald	WEL	L AND I	BORIN	G REPO	ORT	Entry Date	01/13/201	4	
800011	Quad Lin		M	innesota Sta	tutes Chapt	er 1031		Update Date	08/26/201	•
	Quad ID 12.	a.			-			Keceived Date	10/02/201	3
Well Name Townshi	ip Range	Dir Sect	ion Subsecti	on	Well Depth	1	epth Completed	Date We	ll Completed	
DESEN, DOUG 119	31	W 2	DACAA	C	158 ft.	1	58 ff.	07/29/201	13	
Elevation 1128.4 Elev.	Method	Surveyed			Drill Method	Non-specif	ed Kotary	Drill Fluid Bento	aite	
Address					Use monito	r well			Status	Active
Contact 28003 620	TH AV LITC	HFIELD M	IN 55355		Well Hydrofra	ctured?	Yes No	X From	To	
Well 620TH AV	LITCHFIEL	.D MN 553	55		Casing Type	Single ca	sing	Joint G	Hued	
Stratigraphy Information	F	T- (A)	C-1	T	Drive Shoe?	Yes	No X	Above/Below		
TOP SOT	nom	3	BLACK S	OFT	Casing Diame	ter Wei	ght .		Hole Diameter	
CLAY	3	5	BROWN	OFT	2 m. 10	148 п.	JDS/IL		0.2 m. 10	138 ff.
GRAVEL	5	9	BROWN	OFT						
CLAY	9	112	GRAY 1	ED-HRD						
DIRTY GRAVEL	112	117	GRAY S	OFT						
CLAY	117	120	GRAY S	FT-MED	Open Hole	From	£.	To	fi.	
SAND/GRAVEL	120	158	GRAY S	OFT	Diameter	Slot/Gauze	Length	Set Set	JUNSON	
CLAY/GRAVEL	158	158	GRAY S	OFT	2 in.	10	10 ft.	148 ft.	158 ft.	
					Static Water	Level				
					59.8 ft.	land surfa		Measure	07/29/2013	
					Pumping Let	el (below las	d surface)			
					•••					
					Wellbard Co	moletion				
					Pitless adapter	manufacturer		Mo	del	
					X Casing 1	Protection	12 in	above grade		
					At-grad	e (Environme	atal Wells and Bor	ings ONLY)		
					Grouting Inf	ormation	Well Grouted?	X Yes No	Not Sp	pecified
					Material		Ame	time:	From To	,
					bentonite		2	Carlo	4 ff. 14	2 ff.
					neat cement		-	oduas	<u>11.</u> 4	
					Nearest Kno	wn Source of	Contamination			
					900 fe	et We	st Direction	Septi	ic tank/drain fi	eld Type
					Well disinfe	cted upon con	pletion?	Yes	No	
					Pump	Not 1	nstalled Da	te Installed		
					Manufacturer	s name				
					Model Number	ar An airea	A Crowitz	Volt	-	
					Abandoned	b hihe	in Capacity	8P. 1	3P	
					Does property	have any not in	use and not scaled y	vell(s)?	Yes	X No
					Variance					
					Was a variance	e granted from	the MDH for this we	17	Yes	X No
					Miscellaneou	5				
					First Bedrock			Aquifer (Quat. buried	
					Last Strat	pebbly sat	nd/silt/clay-gray	Depth to Bedr	rock	Ħ
Remarks					Locate Metho	Munn 1 Digiti	nota Geological S	fan (1:12.000)		
DRILLERS: STEVE WEISBRIG	H & DREW B	ATES.			System	UTM - NAD	83, Zone 15, Meters	X 38001	8 Y 500	0014
					Unique Numb	er Verification	Info/GPS f	from data Inp	ut Date 08/	18/2014
					Angled Drill	Hole				
					Well Contra	ctor				
					Mark J Tra	ut Wells, Inc.		1404	STEVE/D	REW
					Licensee B	usimoss	Lic. (or Reg. No.	Name of Dr	iller
Minnesota Well Ind	ar Renor			800	011				Printed o	a 06/12/2017
The source of th	cx repor	•							1	HE-01205-15