Aqua Terra Tech

Silver River Watershed, Lanse, Michigan

Residential Well Report

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Submitted To:

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Executive Summary

Aqua Terra Tech is currently in its third year of working with Keweenaw Bay Indian Community in order to characterize the Silver River Watershed. Aqua Terra Tech is a unique enterprise at Michigan Technological University. The enterprise resembles the actions of a real engineering firm rather than performing as a competitive group like some other enterprises at MTU. Aqua Terra Tech has existed for three years and has concentrated efforts on two clients, the most time and energy being spent working on characterizing the watershed for Keweenaw Bay Indian Community. The enterprise works to gather subsurface data, surface data, and characteristics on the behavior of water flow through the region.

The main goal of the enterprise is to create an extensive computer model that can simulate changes in the aquifer behavior and changes in the amount of water that is drawn from the aquifer. This involves spending a great time in the field collecting data from geophysical surveys, residential wells, and pump tests. Then, this data is compiled into the computer model that can be used to simulate changes in the aquifer.

The analysis of well data from well logs, compiled from the when the well was drilled and from conducted well measurements are important to the computer model. Using well logs, subsurface characteristics can be acquired. For groundwater measurements, the depth to the water table and stratum formation can be found. Also, the location of the well is given on the well log. This is in the form of a section, township, and range numbers. Well measurements, conducted on a seasonal basis, can show how groundwater levels fluctuate throughout the year and from year to year. Since, geophysical surveys have also been conducted in the area well measurements can be used to validate the surveys. By comparing the depth of the water table taken at a well and the depth of the water table given by a geophysical survey, the accuracy of the survey can be checked.

Aqua Terra Tech is working on gathering well information that will show the seasonal changes in the aquifer characteristics. In order to show these fluctuations, data must be collected form given wells over an extended time period. Thus far, data has been collected for two and-a-half years. Data will continue to be collected for the duration of the project. Over the past year and a half, a few residential wells within the region have been selected to conduct spring and fall water level measurements for the duration of the project. As ATT continues to grow, more wells could conceivably be surveyed. These selected wells were surveyed during the fall of 2001 and the spring and fall of 2002.

Beginning this fall semester at MTU, ATT has recruited seven new sophomore students who have joined ATT for three years of study. ATT has given these recruits the task of collecting well data within the watershed. This involves acquiring background information from the ATT advisor, Dr. Gierke and myself, Matt Hieshetter. Next, well owners were notified by mail and by personal contact to gain permission to conduct the water table measurements. Team members must then drive to the watershed in Lanse, Michigan. Well measurements are then taken at specific wells and data is recorded for

further analysis. A Global Positioning System was used to locate the well to input location data into the computer model. Collected data was then compared to previously collected data to ensure the measurements were consistent. Finally, data was put into the model and a subsurface contour map was created.

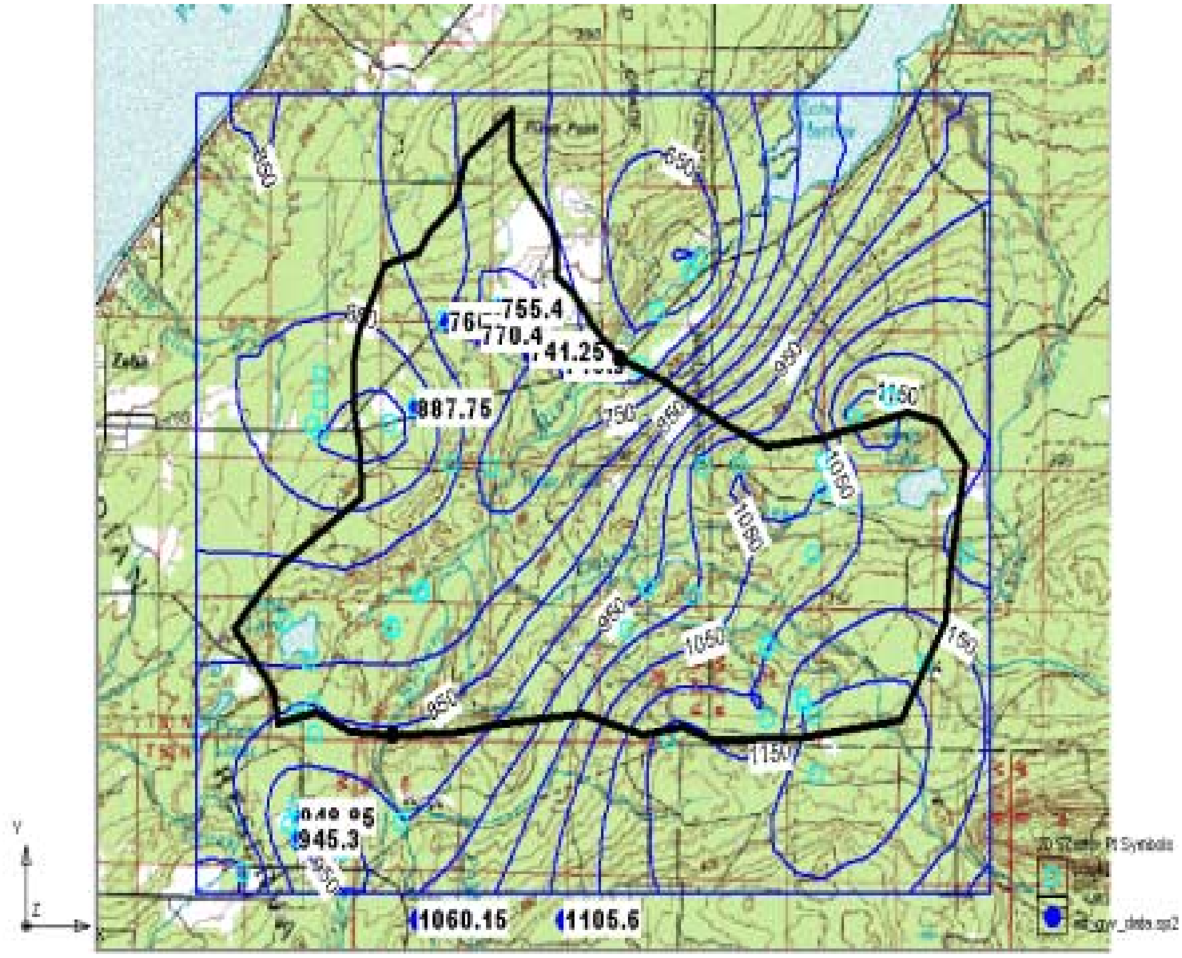


Figure 1: Ground water topography map for Silver River Watershed as of 12/02.

Introduction

Groundwater measurements have been collected for the fall of 2002. These results are compared to previously collected data to show any fluctuations in the water table. Depths to the water table at residential wells were collected using a Solinst Water Level Meter Model 101. The method to acquire data was to lower the probe in the well and record the measured distance to the surface. Locations of the wells were found by using a GPS device. Residential wells were chosen in the northern and southern regions of the watershed. These wells have been previously measured in the past and the fall of 2002 measurements are a continuation of the ongoing project. All data was recorded in a field book. A map was created using previous data from well logs and measurements along with newly collected data for this fall.

Data collected this semester will be used to provide a framework for the computer model. Next semester will be spent working on producing a more complete and accurate model. Also, wells will be measured to collect data that will show any changes in the aquifer system from fall to spring.

Previous Work

Aqua Terra Tech has continued to survey and model the KBIC watersheds since the fall of 2000. During the academic school year of 2000 and 2001, Little Silver River Watershed (Zeba Creek) was the focus of the project. Since then, the project has evolved to characterizing the silver river watershed. Characterizing the larger silver river watershed began in the fall of 2001.

Well levels at residential wells have been recorded at determined well locations since fall, 2001. Wells were selected in the throughout the watershed where available. Contact with the well owner and well surveys have continued. Well owners have begun to know some members of Aqua Terra Tech by name and face and a good relationship with most of the well owners has been obtained.

Objectives

The overall objective of the well measurements for Aqua Terra Tech is to obtain data to be entered in the computer model. This data shows the effect of seasonal changes on the aquifer system. Yearly water level trends may also be studied from obtaining measurements on a yearly basis. Static water levels measured at residential wells can be compared to static water levels obtained from geophysical surveys. Thus, the accuracy of the geophysical survey can be tested. This data can be used in future surveys. By testing such surveys as resistivity and seismic refraction surveys against actual data from wells, the best survey method for the region can be realized.

Scope

Since the Silver River Watershed is a rural area, residential homes are only located in a few areas. Because of this, well level measurements can only be taken for a small percentage of the entire watershed. Residential wells within the watershed are primarily located in two regions. The northern section of the watershed contains a number of residential wells on Skanee and Ford Farm Roads. The southern section contains a few wells along Pinery Road. Because most wells are located in these areas, measuring static water levels through wells is restricted to these areas.

Collecting sample data of static water levels was governed by a few factors. Time and residential permission were the most influential factors. Time is needed to contact the resident and set up a time and day to run the measurement. Also, since the watershed is located in Lanse, Michigan, drive time was a factor. Most measurements were taken during the weekend. Weather also played a factor in the amount of time spent in the field and the comfort of team members working in the field.

Approach

In order to measure static water levels a few pieces of equipment are needed. Equipment pieces required at the well site are:

- Solinst Water Level Meter Model 101 (Appendix D)
- Disinfectant solution
- Socket and wrench set
- Paper towels
- Map of the area
- Field book
- Trimble GPS system

Residents were contacted and a set time to measure the water levels was made. This time worked best the specific survey team and the resident. On a few cases we were given permission to test the well while the owner was not home. First, the well cap was removed using a wrench and socket set. Any debris and wiring was cleared away from the well opening. Next, the level meter probe was disinfected using a 10% bleach solution. The bleach solution was then washed off the probe using a water spray bottle to remove any bleach from the probe. The probe was then wiped off with the paper towel. . The level meter turned on and tested to insure measurements would be recorded. The Trimble GPS backpack unit was then set up. The height of the antenna was measured and the entered into the unit. The unit was turned on and initial data was collected.

The level meter was lowered down the casing of the well. When the probe reached the static water level, the meter gave tone. Then, the exact distance was measured from the top of the casing. The measuring tape was moved vertically to measure the exact distance. This process was performed twice to check the initial measurement. The probe was reeled up and cleaned off and the well cap was fitted back on the well casing. The distance from the surface to the top of the well was also recorded. All data was recorded in a field book along with the address and a sketch of the well location. Figure 1 shows an example well similar to the wells surveyed in the region.

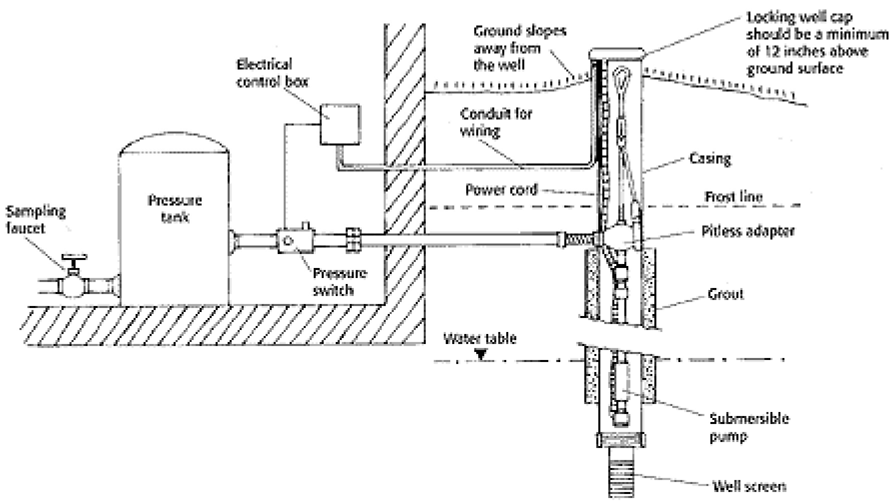


Figure 2: Typical well diagram (http://clallam.wsu.edu/waterquality/diagramprop.html)

The Trimble GPS unit recorded the exact location of the well. Criteria required for complete data was the following:

- Minimum number of Satellites of six
- Radio link with system
- PDOP of 40

This data was then later downloaded and recorded. The location units are in the form of Easting and Northing UTM coordinates. Well locations were ultimately entered into the computer model.

Results and Discussion

As stated, well measurements were recorded for the northern region of the watershed, along Form Farm and Skanee roads, and in the southern region, along Pinery road. Please refer to Appendix A for well locations on a zoomed in map of the region. These regions have the highest concentration of wells within the watershed. Thus, these regions of the watershed were focused on. Also, previous results form surveyed wells are given in Appendix B for the southern and northern wells

Depths to the static water level in the northern section taken during the fall of 2002 are given in a table 1 below.

Table 1: Measured static water levels for the fall of 2002 (Northern)

Owner	Address	Depth (ft)	Date
Catola	Box 422 Ford Farm Rd., Lanse MI	10.85	10/12/02
Elamblad	L-3221 Ford Farm Rd., Lanse MI	9.9	10/15/02
Fish	Skanee Rd.	5.75	10/15/02
Hansen	L-3349 N. Skanee Rd., Lanse MI	8.3	10/20/02
Jorgensen	L-3352 N. Skanee Rd., Lanse MI	9.6	10/12/02
P. Lahti	L-3272 Ford Farm Rd., Lanse MI	13.5	10/12/02
Nevela	Box 401 Skanee Rd., Lanse MI	32.25	10/12/02
Retaskie	Box 401 Skanee Rd., Lanse MI	2.1	10/12/02

Depths to static water level for the southern section are given in Table 2 below.

Table 2: Measured static water levels for the fall of 2002 (Southern)

Owner	Address	Depth (ft)	Date
B. Lahti	L-2900 E. Pinery Rd., Lanse MI	12.55	10/15/02
G. Lahti	L-2950 E. Pinery Rd., Lanse MI	32.2	10/12/02
Mayo	L-4480 E. Pinery Rd., Lanse MI	60.1	10/20/02
Reid	L-4520 E. Pinery Rd., Lanse MI	29.85	10/20/02

Comparisons can be made between values measure during the fall of 2001 and the fall of 2002. These comparisons are given in the following figures.

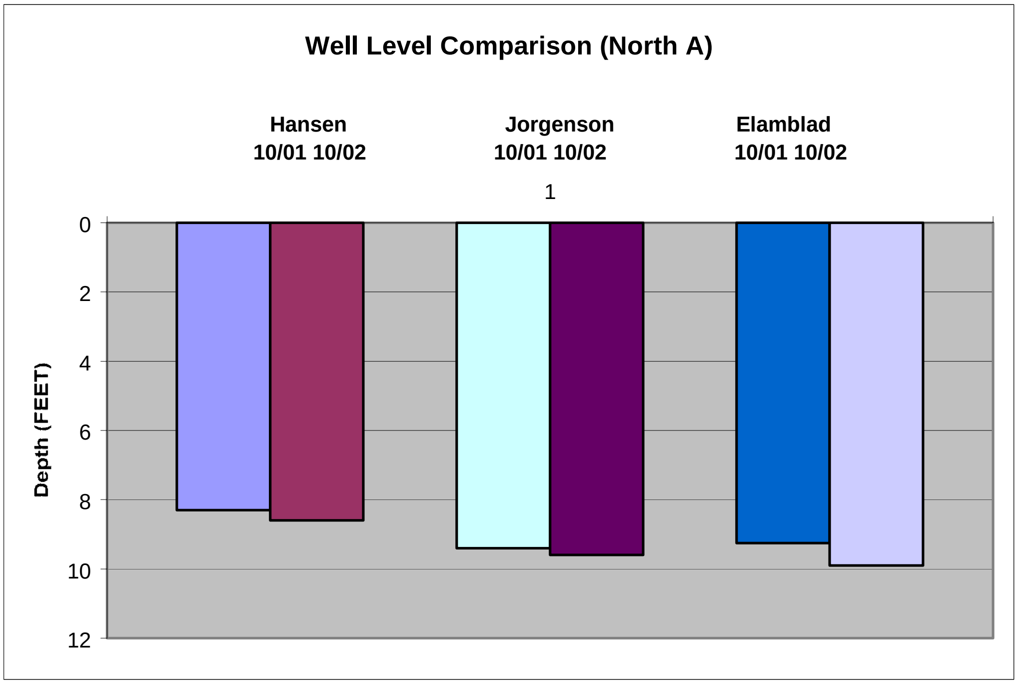


Figure 3: Well level comparison between fall of '01 and fall of '02

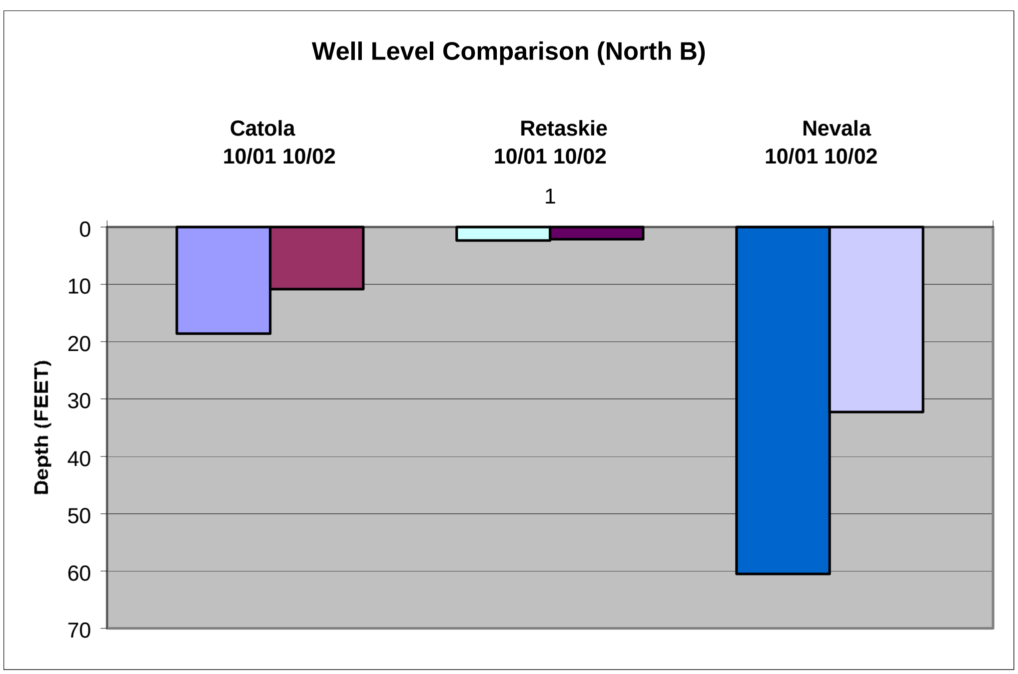


Figure 4: Well level comparison between fall of '01 and fall of '02

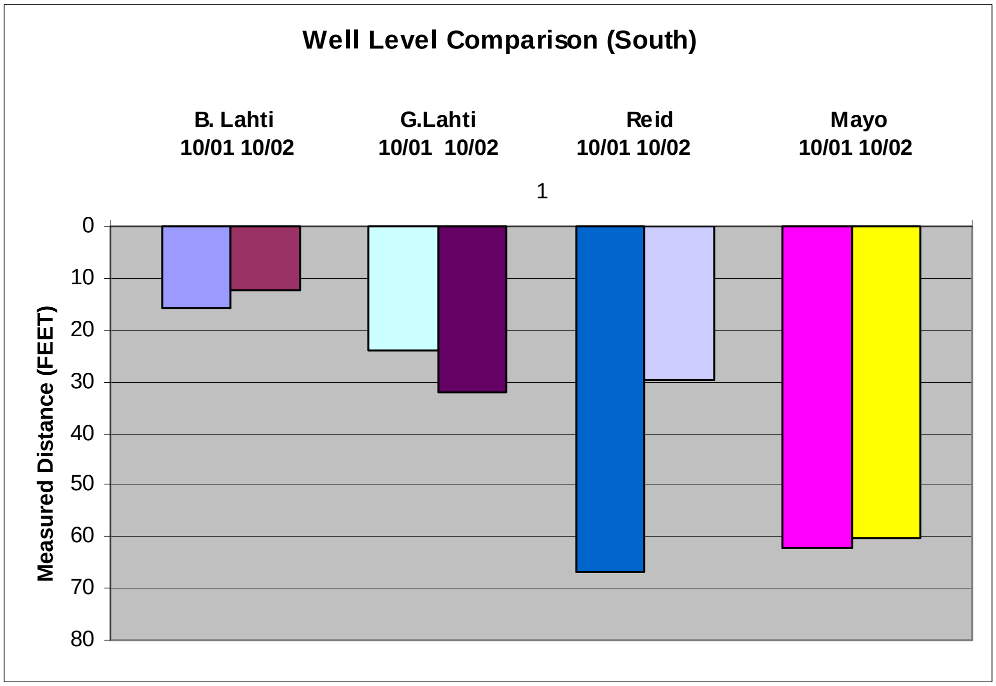


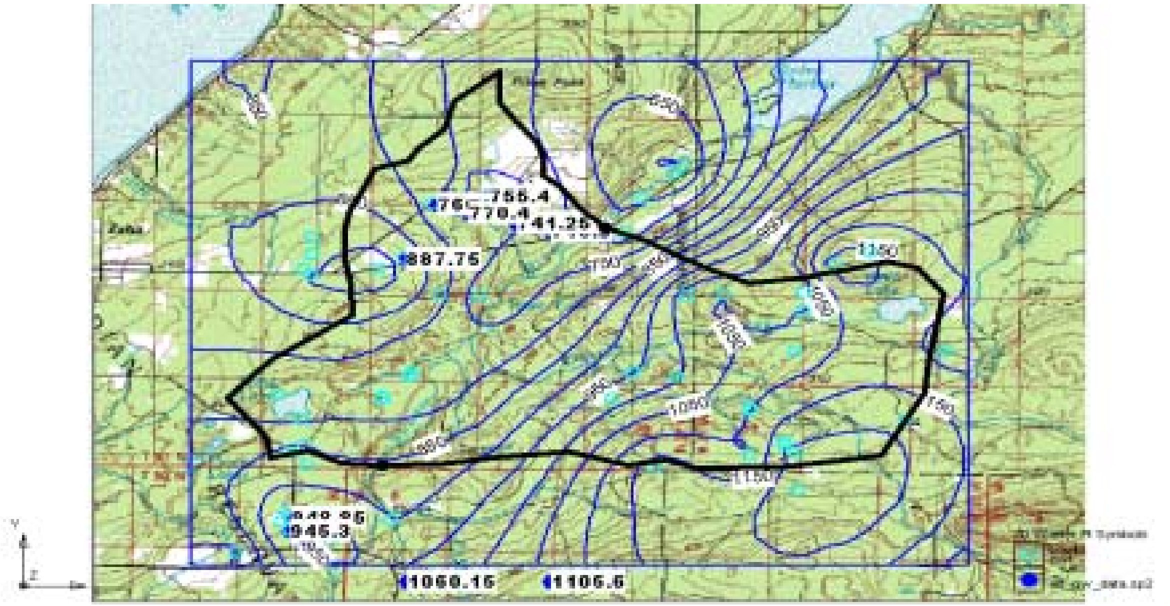
Figure 5: Well level comparison between fall of '01 and fall of '02

Final data that was used as input into the model was also compiled. This data was used to generate a subsurface contour map of the watershed. Included in this map is data from well logs and geophysical surveys that were used to collect depths to water table. Locations of the wells are given in UTM coordinates. This data is shown in the table below.

Table 3: Computer Model Data

Owner	Northing	Easting	Surface Altitude (ft)	Fall 2001 Depth (ft)	Spring 2002 Depth (ft)	Fall 2002 Depth (ft)
Elamblad	17008973	1304607	780.3	9.25	7.65	9.9
Fish	17008361	1306908	747	-	-	5.75
Retaskie	17009492	1303049	769	2.35	2.4	2.1
Hansen	17007870	1308617	727.5	8.3	-	8.6
Lahti P.	17009967	1305584	787.6	13.1	18.2	-
Lahti G	16990066	1295896	977.5	24.05	-	32.2
Lahti B	16990833	1295948	961.4	15.7	-	12.55
Mayo	16987037	1308617	1165.7	62.25	-	60.1
Nevala	17006234	1301509	920	60.54	-	32.25
Reid	16987037	1301581	1090	67	-	29.85
Thorensen	17009393	1304607	777	-	10	-

This data was incorporated into the computer model and a contour map of the water table was created and was presented earlier as Figure 1 and is shown below.



A version of this map that shows a zoomed picture of Skanee and Ford Farm roads is shown as Figure 6 below.

Figure 6: Groundwater Topography for Ford Farm and Skanee roads

Conclusions

Based on the data collected some of the measured results can be used to provide some insight on how the aquifer behaves. Shown in table 1, it could be said that the depth to the water table increased slightly in the northeastern section of the watershed. However, some results are inconclusive. There are depths to the water table that are clearly different from previous measurements. This is most likely due to the well having some water discharged from it by the owner. Since most of our measurements took place during the weekend, it is likely that water was used for showers and other daily uses. Thus, more measurements would give better statistical data.

These wells will continue to be measured in the upcoming months to provide a clearer picture on the water table within the watershed. Wells that have well logs provide the best measure of accurate results. A few of the wells surveyed were compared to their respected well log. These results are shown in Appendix C. In the future, well owners that Aqua Terra Tech has access to will be contacted for measuring depths to the water table.

Recommendations

In order to improve the results collected thus far a few step should be taken. To eliminate unusable data a number of depths to the water table should be taken for each resident at different days. While this will cause time conflicts with a number of team members the results would be beneficial. As the size of the team grows and our goals become more defined, this task should be accomplished. If the resident is at home for the survey, ATT members should refer to the resident on the amount of water that they have used recently. Ideally, to achieve the best results a time should be set up with the resident when the well pump has been inactive for a set period of time. For example, if measurements could be taken early in the morning the pump would have been off for at least nine hours. This proposal presents a difficult problem in coordinating a time with the resident and the availability of ATT team members, but would give the best results.

References

Groundwater Topography Maps, Model output, assisted by: John S. Gierke, Ph.D., P.E., Associate Professor, Aqua Terra Tech Advisor.

Michigan Department of Environmental Quality, *Viewer maps*, (Wysiwyg://0/http://dwrp.deq.state.mi.us/website/imaps/MapFrame.htm).

Typical Well Diagram, (Figure 2) (http://clallam.wsu.edu/waterquality/diagramprop.html).