GROUNDWATER QUALITY REPORT

FOR

WATERTOWN CHARTER TOWNSHIP 2022

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Project Description

The major aquifer systems in Watertown Township, Clinton County Michigan, are made up of the Saginaw, Grand River, and Red Beds bedrock formations. A majority of people in Watertown Township obtain their water from wells which are completed in the Pennsylvanian-age Saginaw bedrock groundwater aquifer. Stratigraphically, the Saginaw is the oldest formation and overlain by the Grand River formation, and then the Red Beds. The Saginaw and Grand River formations form a continuous aquifer unit in the Township. The Jurassic age Red Beds formations, which consist of primarily clay, shale, and gypsum, acts as a confining layer. The Red Beds layer is not continuous across the Township but covers a large area.

From 1983 to 1987 a groundwater survey was conducted in Ingham County as part of a larger project that included 18 other counties. A total of 326 wells were sampled throughout the county to get a quality understanding of the groundwater. The wells were selected in a fashion to provide information about groundwater recharge and selected areas of interest. The purpose of this study was to establish a baseline of water chemistry to determine potential changes over time, (Rowe, Garry, 1986).

The 1983 study indicated some local concerns associated with activities such as road salting, levels of arsenic, nitrate, boron, and fluoride above drinking water standards and recommendations. Another concern was landfill sites that may be contaminating the groundwater. The results helped Ingham County start programs to protect ground water. An updated study for Ingham County was conducted from 2015 to 2020 to compare the data from the 1983 study to the new survey study.

Similar to the past work conducted in Ingham County, this 2022 survey project in Watertown Township established a baseline water chemistry database for the area. Both DeWitt and Bath Townships were also sampled in 2021. The information collected from these surveys should be useful for water quality information and groundwater management.

Benefits for Township

1. Provide the community with a report on the condition of their sole source of drinking water and if any Public Health concerns need to be addressed. This may include levels of important main drinking water parameters such as arsenic, nitrates, boron, fluoride, and chloride test results.

2. Participating homeowners will receive their own individual extensive water test report which can be used to help manage and plan their individual water treatment needs, such as the installation of water softener devices or filters.

3. A presentation of the results and what it means for the community would be provided during a meeting at the Township Hall. This information can be used for future planning and management associated with the future protection of this important and exclusive resource for drinking water. The information can also be used in connection with Well Head Protection projects currently being done in the County.

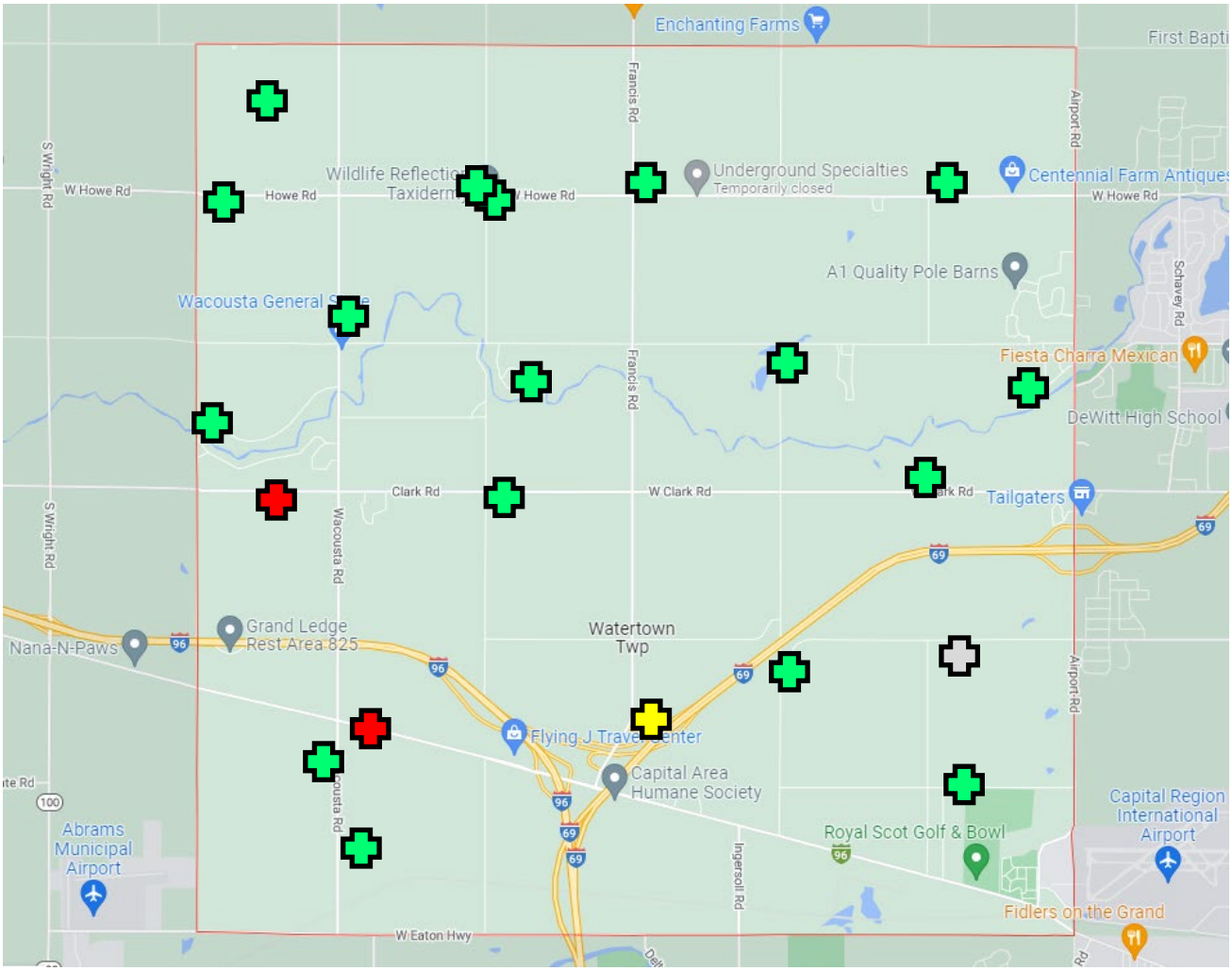
How sampled wells with problem drinking water test results were addressed

Homeowners will each receive a copy of their individual test results. If a test result, or test results, indicate a drinking water concern and or exceed an established drinking water standard that represents a public health issue, the homeowner will be notified as soon as possible by phone or email. The homeowner will be consulted about the test results and options for correcting the drinking water concern.

For example, if the test results indicate an arsenic level above the drinking water standard of 10 ppb, they will be informed of the risks involved with drinking water with levels this high and the possible filtration devices available to treat the water. The goal is to inform the homeowner of the conditions of their drinking water resource. This would be analogous to having a blood test done by your family doctor and they find your cholesterol levels are too high. The doctor will then consult with the patient on the steps they should take to correct this concern. This will also be explained in a cover letter to the homeowner which will include some educational material on the test results. If homeowners still have further questions about the test results, there will be phone numbers and resources available for them to discuss the results with.

The educational material was important to share with homeowners to help them better understand how their water well system works. It was determined from sampling several wells during the past surveys that homeowners lack a basic understanding about water well systems and how to properly maintain them.

WATERTOWN CHARTER TOWNSHIP WATER WELL SAMPLING SITES



N

SCALE

1 MILE

- AVERAGE WATER CHEMISTRY
- ABOVE AVERAGE CHLORIDE LEVELS
- ABOVE AVERAGE BORON LEVELS
- ARSENIC LEVELS AT OR ABOVE EPA DRINKING WATER STANDARD OF 10 PPB

Results of the 2022 Survey

A total of 21 wells were sampled over the duration of this 2022 study. Coliform Bacteria presence was tested and found in only two of the wells. E. Coli bacteria was not present in any of the wells. Various water chemistry parameters were also tested from the samples collected in order to access the groundwater quality. Average mean values of the *primary parameters* tested were calculated.

Table 1: Mean values of 2022 *primary* water chemistry data with a comparison to the neighbor township of DeWitt to the east. All mean values are shown in parts per million (ppm) except pH and conductivity, which is shown in units of micro-Siemens per centimeter. A red *P Value* indicates a statistical significant difference between the mean values.

PARAMETER	*WATERTOWN (mean)*	*DEWITT (mean)*	*MANN-WHITNEY Z*	*P VALUE*
ALKALINITY	**359.7**	**298.2**	**4.506**	**< 0.00001**
ARSENIC	**0.003**	**0.005**	**0.484**	**0.631**
BORON	**0.185**	**0.283**	**-2.070**	**0.038**
CALCIUM	**81.2**	**77.5**	**1.174**	**0.242**
CHLORIDE	**7.27**	**12.70**	**-2.613**	**0.009**
CONDUCTIVITY	**638**	**571**	**2.393**	**0.017**
HARDNESS	**326.9**	**307.0**	**1.233**	**0.219**
IRON	**1.34**	**0.89**	**2.995**	**0.003**
MAGNESIUM	**30.1**	**27.9**	**1.761**	**0.078**
NITRATE	**<0.40**	**<0.10**	**-**	**-**
pH	**7.35**	**7.48**	**-2.877**	**0.004**
POTASSIUM	**2.0**	**2.5**	**-2.011**	**0.044**
SODIUM	**8.9**	**13.3**	**-1.908**	**0.056**
SULFATE	**18.5**	**23.4**	**0.088**	**0.928**
FLUORIDE	**0.40**	**0.44**	**-0.088**	**0.928**
SILICA	**14.5**	**12.8**	**1.512**	**0.131**

Table 2: Mean values of 2022 *primary* water chemistry data with a comparison to the northwest quadrant of Ingham County. All mean values are shown in parts per million (ppm) except pH and conductivity which is shown in units of micro-Siemens per centimeter. A red *P Value* indicates a statistical significant difference between the mean values.

PARAMETER	*WATERTOWN (mean)*	*INGHAM NW (mean)*	*MANN-WHITNEY Z*	*P VALUE*
ALKALINITY	**359.7**	**347.8**	**-1.187**	**0.234**
ARSENIC	**0.003**	**0.003**	**1.117**	**0.263**
BORON	**0.185**	**0.406**	**-0.237**	**0.810**
CALCIUM	**81.2**	**113.0**	**3.729**	**<0.00001**
CHLORIDE	**7.27**	**56.49**	**5.067**	**<0.00001**
CONDUCTIVITY	**638**	**921**	**3.917**	**<0.00001**
HARDNESS	**326.9**	**436.0**	**3.454**	**0.001**
IRON	**1.344**	**1.314**	**-0.467**	**0.638**
MAGNESIUM	**30.1**	**33.4**	**1.506**	**0.131**
NITRATE	**<0.40**	**<0.10**	**-**	**-**
pH	**7.35**	**7.17**	**-3.082**	**0.002**
POTASSIUM	**2.0**	**2.6**	**1.915**	**0.055**
SODIUM	**8.88**	**39.65**	**4.187**	**<0.0001**
SULFATE	**18.46**	**89.21**	**4.486**	**<0.0001**
FLUORIDE	**0.40**	**0.34**	**-1.768**	**0.077**
SILICA	**14.5**	**13.6**	**-0.413**	**0.682**

For these major parameter results that were non-detectable, the value inputted to calculate the average was estimated to be one third of the reporting limit for all reported non-detectable levels for a given parameter. This was done because parameter results reported as non-detectable don't guarantee the parameter is completely absent from the sample. In the study, nitrate was non-detectable in all well samples and therefore the mean was less than the reporting limit of 0.40 ppm.

Of the 21 wells sampled, 12 wells were tested for bromide. The range seen was 0.013 – 0.067 ppm, or 13 – 67 ppb. The average value was 0.022 ppm or 22 ppb. Bromide was used to help determine the source of chloride in the wells using a Cl/Br ratio.

Outside the primary parameters analyzed, other water chemistry parameters were tested to ensure safe drinking water based on the National Primary Drinking Water Regulations, (United States Environmental Protection Agency (EPA), 2021).

Table 3: Comparison of 2022 survey data with parameters regulated by the EPA as part of the National Primary Drinking Water Regulations. All values are in parts per million (ppm).

Parameter	National Primary Drinking Water Regulations	2022 Mean
Arsenic	0.010	0.003
Barium	2.00	0.14
Cadmium	0.005	<0.001
Chromium	0.10	<0.01
Copper	*TT action level =1.30	<0.05
Fluoride	4.00	0.40
Lead	*TT action level =0.015	<0.001
Mercury	0.002	<0.001
Nitrate	10.00	<0.40
Selenium	0.050	<0.001
Nitrite	1.00	<0.05

*Lead and Copper are monitored through Treatment Techniques (TT) set by the Lead and Copper Rule (LCR). LCR requires action if more than 10% of customers taps sampled exceed the action level, (United States Environmental Protection Agency (EPA), 2021).

Parameters were non-detectable for all wells sampled for cadmium, chromium, copper, mercury, nitrate, nitrite, selenium, and lead. All other parameters tested, though detectable, had levels under the Primary and Recommended EPA Drinking Water Standards. The average arsenic level in the township was below the EPA standard; however, arsenic was at or above the standard in two of the wells tested. These

homeowners were contacted and provided information to address these levels of arsenic.

The comparison of Watertown and DeWitt township water indicated Watertown township groundwater to contain slightly more calcium, magnesium and iron making the well water much harder. DeWitt township groundwater contained a higher level of chloride perhaps from more road salting in winter, but both townships indicated low levels of chloride compared to the northwest area of Ingham County. In Ingham County the significant higher levels of chloride was determined by a Chloride/Bromide ratio to be primarily caused by road salting, and to a lesser extent from water softener wastewater discharges too close to the well, (Rowe, Garry, 1986, Davis, S.D., Whittemore, D.O, and Fabryka-Martin, J., 1998, Panno, S.V., Hackley, K.C., Hwang, H.H., Greenberg, S.E., Krapac, I.G., Landsberger, S., and O'Kelly, D.J., 2006).

One well in Watertown township showed an elevated chloride level of 107 ppm which is above the average of 7.27 for the township. A chloride/bromide ratio for this well came to 3595.24. This high ratio value suggests a salt source such as road salt or water softener waste water. This well was unique compared to the other wells tested which indicated very low levels of chloride in the township.

Two wells had arsenic levels of 0.010 ppm or 10 ppb and 0.022ppm or 22 ppb, which are at and above the EPA drinking water standard of 0.010 ppm or 10 ppb. These arsenic levels are probably natural in origin and not associated with a pollution source. One of the wells is just south and near the Granger Landfill site, but since chloride and sulfate levels were low and in the range of average for the township, the landfill was not considered the source of the arsenic.

One well had a boron test result of 1.7 ppm, which is also much higher than the township average of 0.185. This level of boron is also within the range of naturally soft water wells seen in Ingham County. This naturally soft water is usually seen with wells that have a high percentage, (often greater than 50%), of shale bedrock, (Slayton, D.E., 1982). This well in Watertown Township is unique in that it does not follow the same pattern of naturally soft water, but has a hardness value of 236 ppm.

This level of boron is above the drinking water standard or guideline found in several other states including California, Florida, Maine, Minnesota, New Hampshire, and Wisconsin, (Office of Water, Environmental Protection Agency, 1996). Presently, the EPA and the State of Michigan do not regulate boron in drinking water. The EPA does provide a Health Advisory for boron with a long-term health advisory limit of 2.0 ppm for children and 5.0 ppm for adults. Other research indicates that boron may be important with postmenopausal women, (Nielson, F.H., et al, 1987). Updated information from the World Health Organization, (World Health Organization, 2009), also provides a guideline of 2.4 ppm. Boron is also important in agricultural applications, (Sprague, R.W., 1972).

Results of the study reveal very hard groundwater in the area with an average hardness level of 326.9 ppm. Water is considered very hard when levels are above 180 ppm. Extreme hardness in the area is most likely a result of high levels of magnesium and calcium present in surrounding soil and rock in the area that dissolve into the groundwater, (United States Geological Survey (USGS), Hardness of Water, Accessed August 6, 2021). High levels of hardness are not a health concern but can be an inconvenience as it could cause mineral build up in piping or affect the efficacy of soaps. Similarly, iron concentrations in all 21 of the wells sampled were above the recommended limit of 0.30 ppm. This is also not a health concern but could affect the taste and odor of the water and cause discoloration and staining.

Conductivity levels are reflective of the concentration of ions in the groundwater. Elevated levels of conductivity can potentially be attributed to the use of road salt or water softener discharges. Home water softeners are often installed in houses in the area because of hard well water. Water softeners discharge wastewater containing calcium, magnesium and iron removed from the hard water as well as excess sodium and chloride from the resin tank of the water softener. If this wastewater is discharged too close to the water supply well, it may impact the well water concentrations of chloride, sodium, iron, magnesium or calcium.

Recommendations

Homeowners need to routinely check the physical condition of their well, such as the well cap and casing. Wells that are abandoned or are no longer in use, should be properly sealed by a licensed well drilling company.

Wells should also be routinely tested for a bacteriological and partial chemical analysis. Tests for both arsenic and boron should be considered. A survey of private water wells around the landfill site in the township should also be considered.

The use of de-icing salt products should be reviewed for possible effects on both surface and groundwater resources. Homeowners need to manage wastewater from water treatment devices properly so that wells and groundwater are not adversely impacted. Alternatives for road treatment should also be explored.

Resources should be made available to conduct a survey of the groundwater/drinking water every 10 years.

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