An Investigation of the Interlobate Area West of Three Rivers, Michigan and Its Relationship to the Late Wisconsinan Glaciation of Southwest Michigan

Kendzierski

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Scott Kendzierski
AN INVESTIGATION OF THE INTERLOBATE AREA WEST OF THREE RIVERS, MICHIGAN AND ITS RELATIONSHIP TO THE LATE WISCONSINAN GLACIATION OF SOUTHWEST MICHIGAN

Scott J. Kendzierski, M.S.

Western Michigan University, 2005

A detailed investigation of selected mineralogical and textural characteristics of glacial deposits was conducted in order to explore the complex relationships between the Lake Michigan and Saginaw Lobe ice-margins and associated depositional regimes during the deglaciation of southwest Michigan. Various analytical methodologies were applied to the characterization of glacial materials, glacial and post-glacial environments in order to infer a chronology of lobate activity.

The Sturgis Moraine, located in St. Joseph County, Michigan, is a major recessional moraine owing to the processes of both the Lake Michigan and Saginaw Lobes. Analysis of geologic materials and examination of subsurface data along with geomorphic evidence has shown that ice-margins of the Lake Michigan and Saginaw Lobes oscillated in southwest Michigan and contributed to the development of the Sturgis Moraine. As they did so, they left behind alternating deposits of glaciolacustrine and glaciofluvial materials separated by regionally significant units of glacial till.

The data gathered in this study demonstrates that the two sections of the Sturgis Moraine were developed by different glacial processes and subsequently display variability in deposits and associated geomorphic features.
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Deposition of Quaternary sediments in the Three Rivers, Michigan area occurred during the Pleistocene glaciation of North America. During several periods of extensive advance, the Laurentide Ice Sheet spread southward into areas of Indiana and Ohio, where it deposited large quantities of glacial material forming broad morainic systems and other glacial landforms. As the late Wisconsinan ice retreated from its maximum (21-20 ka B.P.), a series of stagnations or short-lived readvances left a pattern of recessional moraines across southern Michigan, Indiana and Ohio (Figure 1).

Figure 1 – Morainic Systems of Southwest Michigan and Northern Indiana (after Leverett and Taylor, 1915).
During the late Wisconsinan, three glacial lobes of the Laurentide Ice Sheet influenced southwestern Michigan (Figure 2). The Huron-Erie Lobe, which originated in the Lake Erie basin and traveled westward through areas of Michigan, Ohio and Indiana, reached as far as southeastern St. Joseph County (Figure 3).

Figure 2 – Ice-marginal Positions and Flow Lines in the Central Great Lakes (Keew, Nicks and Straw, 1999)
Figure 3 – Position of the Sturgis Moraine in St. Joseph County, Michigan
(Source: MDNR MIRIS Base Files – Transportation, Hydrology, Michigan Counties)
The Saginaw Lobe advanced southwesterly from Saginaw Bay; extending into Indiana, whereas the Lake Michigan Lobe spread from the Lake Michigan Basin eastward into St. Joseph County, Michigan. The extent and synchronicity of lobal relationships, however, has been debated in the literature and the subject of several studies (Leverett and Taylor, 1915; Monaghan et al., 1986; Monaghan and Larson, 1986; Dodson, 1993; Lovan, 1977; Rieck, 1994; Gardner, 1997; Flint, 1999; Kozlowski, 1999, Kehew et al. 1999).

The deposition of glacial material by the Lake Michigan and Saginaw Lobes was responsible for the creation of the Sturgis Moraine, a significant geomorphic feature in southwest Michigan (Figure 3). The Sturgis Moraine is a broad southeast-northwest trending ridge of upland topography that traverses St. Joseph County, from northwest to southeast. It is approximately 40 km NW-SE and 10 km SW-NE, separated into two halves by the Central Lowlands; an area underlain by fluvial and lacustrine deposits (Figure 3).

The interactions of the Lake Michigan and Saginaw Lobe ice margins, at the close of the Wisconsinan, created a highly complex and dynamic juxtaposition of sediments and sediment-landform assemblages. St. Joseph County was experiencing large influxes of water and glacial materials from these ice margins as they advanced, stagnated, readvanced and ultimately retreated from southwest Michigan. These factors make the general interpretation of glacial sediments and timing of events associated with the development of the Sturgis Moraine problematic.

The glacial geology of St. Joseph County was mapped as part of the STATEMAP project, a U.S. Geological Survey initiative, conducted collaboratively with the MDEQ
and Western Michigan University to produce a collection of large scale (1:24000) surficial geology maps of St. Joseph County (Kehew et al., 1999). Although Leverett and Taylor (1915) produced maps of the surficial geology of Michigan, they were made at a small scale and provide little detail for accurate investigations of local glacial deposits. The STATEMAP project addressed the need to produce surficial geologic information in St. Joseph County, but also demonstrated a need to explore the subsurface to apply a glacial model to the Sturgis Moraine and adjacent areas.

The purpose of this study is to employ field and analytical techniques to identify the distribution and composition of glacial materials and stratigraphic units, both on the surface and below the western section of the Sturgis Moraine in St. Joseph County.

Exploration of this area led to the discovery of a thin, enigmatic surface diamicton (till) that covers portions of the western section of the Sturgis Moraine. This surface “till” was sampled throughout the study area and analyzed to provide data regarding its occurrence and local significance. If this till could be attributed to the deposition of a single glacial lobe, conclusions could be drawn regarding the synchronicity of a late readvance by glacial ice over older deposits. Additionally, topographic surveys and the identification of cross-cutting relationships aided in defining the surface geology of the Sturgis Moraine.

Characterization of the subsurface and significant stratigraphic units was accomplished by using existing water well records and geophysical data to construct cross-sections transecting the western section of the Sturgis Moraine. This aided in the creation of a working model of subsurface deposits and relationships between various stratigraphic units. Analytical methods were used to provide information about glacial
sediments; such as textural analysis of surface and subsurface materials, and analysis of clay minerals from buried diamicton units.

Existing information regarding the last retreat of ice from St. Joseph County is very limited and thus knowledge of glacial events at the close of the Wisconsinan glaciation remains poorly constrained. It is the primary goal of this investigation to characterize various geologic sediments, their occurrence and significance with regard to the local and regional glacial history. It is anticipated that this study will aid future projects concerning geologic resources, the local geologic setting, the history of the development of the western section of the Sturgis Moraine and the influences of the Lake Michigan and Saginaw Lobes during the deglaciation of southwest Michigan.

LOCATION AND GEOLOGIC SETTING

The study area for this investigation is located along the western edge of St. Joseph County, Michigan, focusing primarily on the western section of the Sturgis Moraine. St. Joseph County lies in southwestern Michigan, bordering Kalamazoo, Cass and Branch Counties and is positioned along the northern Indiana border (Figure 4). St. Joseph County has twelve full civil townships in its northern reaches and four partial townships bordering Indiana.

The detailed study area consists of the area encompassed by the Three Rivers West USGS 7.5" Quadrangle and adjoining areas located within St. Joseph County and part of eastern Cass County, Michigan (Figure 4). The western section of the Sturgis Moraine, a large area of upland topography, lies in this area and is the primary topographic feature being investigated.
The Sturgis Moraine forms a broad ridge cresting at elevations above 1000 feet above mean sea level (MSL) and is separated into two sections by the St. Joseph River and the Central Lowland (Figure 3). High linear features on portions of the western section of the Sturgis Moraine mark ice-contact margins and the stagnation or retreat of Wisconsinan ice. This part of the Sturgis Moraine is hummocky, with lakes occupying many of the depressions that make up its current landscape and a thin surface diamicton is present in many areas covering older glacial materials.

The eastern section of the Sturgis Moraine has been well documented by Kehew et.al (1999), Gardner (1997), Flint (1999) and Nicks (2004) to contain glacial materials of Saginaw Lobe in origin. The western section, however, has characteristics of deposition by more than one glacial lobe. Determining the extent and influence of individual ice margins provides insight into the nature of interlobate deposition, paleoenvironments and their influence on the creation of the Sturgis Moraine.
Figure 4 – Study Area
(Source: MDNR MIRIS Base Files – Hydrology, Transportation, Michigan Counties and Political Boundaries)
FIELD SAMPLING

Bulk soil samples were collected with a six-foot hand auger from areas suspected of having the presence of a surface till (diamicton) or areas that exhibit geologic significance (Appendix A). Samples were collected from original grade to six feet below the surface, avoiding organic matter where possible. Most were collected below the level of carbonate leaching (the C horizon); however, several samples were taken above that zone due to sampling equipment limitations. Collection intervals were determined by soil texture, in the case of heavy soil profiles (clay-rich) or a representative composite sample was collected from soil sequences that consisted of homogenous unconsolidated materials. All samples were collected in plastic freezer bags, labeled and stored for analysis.

Seventy-three surface samples were collected and textural analysis was conducted using standard methodologies (Wray, 1986). Analytical results were then entered into a database and identified on maps giving sample locations a geographic context.

Sample locations were mapped using ArcView, a GIS (Geographic Information System), to convey relationships between topography, hydrology, sample location and textural characteristics. Figure 5 shows the sampling locations identified with their corresponding sample identification number.

Subsurface samples were recovered from a test boring (Test Boring 96-52) drilled at Robert’s Aggregates pit in southern Fabius Township. These samples were collected using standard split spoon sampling techniques at five-foot intervals. Bulk samples were recovered from the split spoon, placed in glass jars and labeled. All samples collected from this well were saved for textural and mineralogical analysis.
Figure 5 – Sample Locations of Surface Diamicton and Location of Test Boring 96-52
(Source: MNDR MIRIS Base Files- Hydrology and Transportation)
LABORATORY ANALYSIS

Standard investigative techniques and methods were used to describe glacial materials collected within the study area. During deglaciation of southwestern Michigan large sequences of glacial sediments were deposited within the study area, including several distinct diamicton (till) units. These units are characteristic of the parent materials from which they were derived and mark time-transgressive (diachronous) glacial events in the stratigraphic record. Throughout this investigation, textural and mineralogical analysis was conducted on till samples in an attempt to clearly identify physical characteristics of recovered glacial materials.

During previous investigations, it was noted that a brown surface diamicton (till) was identified throughout the study area. Kehew (2003) recently concluded that the occurrence of this diamicton over outwash deposits is more a function of soil genesis than of till deposition. Though discontinuous in nature, the surface diamicton has been observed from southern Fabius Township into parts of Cass County. This till has been observed to vary in texture from sandy to clay-rich and is often found interbedded with outwash and other glaciolacustrine sediments.

Regionally significant till units also exist below the surface, separated by large sequences of unconsolidated sands and gravels. Samples were collected from Test Boring 96-52 drilled at the Robert’s Aggregates gravel pit on M-60, Three Rivers, Michigan. Several field and laboratory tests were conducted to compare these till units. Clay fractions were separated and 7Å/10Å peak ratio analysis was conducted to correlate results to previous works. The occurrence of these units was also compared with water well records and gamma ray logs collected within the study area.
Textural Analysis Procedures

Sampled materials were sieved and compared using the USDA soil classification system. Six USA Standard Testing Sieves (ASTM E-11 Specification) were used throughout the analysis (Table 1). Textural analysis included the recording of percent retained and cumulative percent retained for each sample.

Table 1

<table>
<thead>
<tr>
<th>Sieve No.</th>
<th>Inches</th>
<th>Millimeters</th>
<th>Microns</th>
<th>Geological Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>0.132</td>
<td>3.327</td>
<td></td>
<td>very fine gravel</td>
</tr>
<tr>
<td>12</td>
<td>0.0661</td>
<td>1.651</td>
<td></td>
<td>very coarse sand</td>
</tr>
<tr>
<td>20</td>
<td>0.0331</td>
<td>0.833</td>
<td>850</td>
<td>coarse sand</td>
</tr>
<tr>
<td>40</td>
<td>0.0165</td>
<td>0.4174</td>
<td>425</td>
<td>medium sand</td>
</tr>
<tr>
<td>100</td>
<td>0.0059</td>
<td>0.147</td>
<td>150</td>
<td>fine sand</td>
</tr>
<tr>
<td>230</td>
<td>0.0024</td>
<td>0.061</td>
<td></td>
<td>clay &amp; silt</td>
</tr>
<tr>
<td>tray</td>
<td>0.0000</td>
<td>0.000</td>
<td></td>
<td>clay</td>
</tr>
</tbody>
</table>

The following procedures, modified from Wray (1986), were employed to prepare and analyze all surface till samples collected in this study:

1. Samples of 300 to 400 grams were collected at field moisture and broken by hand onto a sieve pan.

2. Samples were dried in an oven at 125 degrees Fahrenheit for a minimum of 6 hours to dehydrate materials.

3. Materials were transferred to a porcelain mortar and broken into pea-sized pieces with a porcelain pestle, taking care not to pulverize samples. Additional grinding was done with a rubber tipped pestle.

4. Samples were then transferred to a weighing tray and weighed to the nearest tenth of a gram (dry weight) and placed in a solution of Calgon and distilled
water (0.25g Calgon – 1 liter of distilled water) for a minimum of 24 hours. The Calgon solution satisfies the surface charges on clay materials and prevents flocculation.

5. The fine-grained material was washed from the sand and gravel through a #230 sieve and into a pan using tap water until runoff appears clear.

6. The remaining sample was then wet-sieved through a sieve tower comprised of sieves ranging from No.6 (3.35mm) to No.230 (.062mm), as indicated in Table 1, and were oven dried at 125 degrees Fahrenheit for a minimum of 6 hours or until no moisture content remained.

7. Sample separates were then weighed to the nearest tenth of a gram and percent retained and cumulative percent values were calculated and recorded (Appendix B).

In addition, grain size information was used to calculate a sand/(clay+silt) ratio for each sample and was subsequently added to the dataset (Appendix B). Lovan (1977) conducted similar analyses on till samples collected in southern Michigan. He reported sand%/mud% ratio calculations and obtained statistical means for Lake Michigan and Saginaw Lobe tills, 2.249 and 4.095 respectively. Lovan’s results were compared with results of this study in an attempt to ascertain provenance of sampled materials. However, because the surface till is subject to extensive weathering and erosion processes, textural differences between the Saginaw and Lake Michigan Lobe deposits may not be distinguishable.
X-Ray Diffraction of Clay Minerals

Samples collected from Test Boring 96-52 are representative of a series of sands and gravels separated by distinct clay-rich, poorly sorted materials. Two distinct till units were recovered for analysis. Six samples were collected from a hard, dark grey till (5YR 4/1) occurring between 61 and 63 feet below ground level and ten samples were collected from a thick sequence of hard, dark grey till (5YR 4/1 and 5YR 3/1) lying just above the surface of the Coldwater Shale (660’ above mean sea level), occurring between the depths of 153 and 190 feet. These units were analyzed by conducting X-ray diffraction (XRD) of their clay mineral separates in order to characterize their mineralogy and compare results to those of other investigations.

X-ray diffraction is based on the principal that the x-ray wavelength is equivalent to the atom spacing within a crystalline structure, including clay minerals. When x-rays are passed through a prepared clay sample, the atoms diffract the waves, developing consistent patterns of interference. These diffractions work constructively and are recorded by the detector as peaks at certain intervals, based on the machine settings.

The process involves rotating the sample to take advantage of the geometric relationships between the distances between parallel rows of atoms within crystalline structures. These relationships can be described by the following equation developed by Bragg (1913):

\[
2d \sin \theta = n \lambda
\]

where:

Equation 1

The Bragg Equation

\[
2d \sin \theta = n \lambda
\]
d = the spacing between rows of atoms (angstroms)

θ = angle between the x-ray source and sample (degrees)

λ = the wavelength of the x-ray beam (angstroms)

n = a whole integer

(Moore and Reynolds, 1997, modified from Bragg, 1913)

The spacing between parallel rows of atoms is referred to as the d-spacing. The d-spacing is one of the tools that identifies which clay minerals are present within a sample. The detector records diffracted energy producing a diffractogram that shows the angle of the detector on the x-axis and the x-ray intensity on the y-axis (Figure 6). The peak intensities (peak heights) are obtained by measuring from a determined base level.

For the purposes of this study, the 7Å and 10Å peaks were recorded and used to obtain a ratio between the two values. These were used for comparative analysis and are unique values. X-ray 7Å /10Å peak analysis is considered, however, a semi-quantitative analytical technique due, in part, to the fact that individual peaks may represent more than one type of clay mineral (Flint 1999). Even though this rudimentary comparison can only demonstrate basic similar mineralogical characteristics of sampled tills, they can be compared to the works of previous investigators (Monaghan and Larson, 1986, Gardner, 1997 and Flint, 1999).

Sample Preparation and X-Ray Diffraction Procedure

The following procedure was conducted to prepare and analyze till samples using X-ray diffraction of oriented mounts of clay-sized particles using a Phillips-Norelco XRD
diffractometer. The following methodologies for analysis of clay minerals was adapted from Moore and Reynolds (1997):

1. Individual samples were sieved, by the method described earlier for textural analysis, and their clay+silt-sized portions separated. The collected clay+silt portion was mixed with 25 ml of a 4% sodium hexa-metaphosphate solution and 50 ml of distilled water.

2. The contents were washed through a #230 sieve with 100 to 150 ml of distilled water and collected in a sieve pan below and then transferred to a glass beaker.

3. The beaker was then placed into an ultrasound bath for 5 to 10 minutes and the contents centrifuged at 1500RPMs to separate the clay and silt fractions. The centrifuge run time is based on the temperature of the sample (see Appendix C).

4. Suspended contents from the centrifuge cup are poured into a beaker and placed in an ultrasound bath for 5 minutes.

5. Slides were prepared by pipetting 0.5 to 2 ml of sample onto slide surface and allowing to dry for 12 to 24 hours. As the slide dries, suspended clay minerals align themselves parallel to the slide surface (Moore and Reynolds, 1997).

X-Ray Diffraction Procedure

1. The prepared slide was placed in the sample holder of the x-ray chamber of the Phillips-Norelco XRD unit.
2. The x-ray generator was allowed to warm up for 30 minutes in a slow stepwise manner starting at a low power and increasing to 30 mVolts and 20 mAmps.

3. The XRD unit was set up using the settings described in Table 2.

**Table 2**

<table>
<thead>
<tr>
<th>X-Ray Diffraction Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjustment</td>
</tr>
<tr>
<td>Volts</td>
</tr>
<tr>
<td>Amps</td>
</tr>
<tr>
<td>diversion slit</td>
</tr>
<tr>
<td>goniometer speed</td>
</tr>
<tr>
<td>proportional KV</td>
</tr>
<tr>
<td>gain</td>
</tr>
<tr>
<td>range</td>
</tr>
<tr>
<td>time constant</td>
</tr>
</tbody>
</table>

4. Samples were run from 7.5 to 14 degrees 20 then rotated 180 degrees in the sample chamber and x-rayed again.

5. The diffractograms produced were analyzed by measuring the height of peaks above an established baseline. Baselines were estimated from the natural path of the diffraction curve assuming the peaks were not present. Measurements were made to the nearest half-millimeter.
Diffractograms were used to differentiate till samples by their mineralogical characteristics. Diffractograms are interpreted by establishing a baseline on the plot and measuring the distance between the baseline and the peak intensities corresponding to the particular clays being examined (Figure 6). Diffractogram patterns were analyzed by recording and comparing the 7Å and 10Å peak intensities and by averaging them within each till unit (Appendix D).

Figure 6 – Example of an X-Ray Diffractogram
(Example: 7Å/10Å peak intensity=29mm/44.5mm=.65 (unitless))
The western section of the Sturgis Moraine is predominantly an interlobate area of hummocky terrain with many depressions occupied by lakes, swamps and marshes. Leverett and Taylor (1915) described an area on the moraine’s northwestern edge as having sharp choppy knobs, possibly owing to overriding by the Lake Michigan Lobe.

Most of Fabius Township is a pitted gravel plain, but also displaying characteristics of a rolling outwash plain. Glacial materials, ranging from 150 to 300 feet thick, cover the local bedrock (Coldwater Shale) within the study area. Though this area shows diversity in sediments and landforms, general environments can be interpreted by comparing field observations with analytical data.

A map produced by Farrand and Bell (1982) and the Michigan Department of Natural Resources, as part of their Spatial Data Library, shows Quaternary sediments and is provided to show the general setting of moraines and associated glacial sediments in southwest Michigan (Figure 7). Though very general, the classifications used to describe glacial sediments between the two sections of the Sturgis Moraine are distinctly different. The western section is classified as “ice contact outwash sand and gravel”, while the eastern section is identified as “end moraine of coarse textured till”. This distinction supports the idea that the moraine was developed by two separate sets of processes.

Many researchers have conducted glacial investigations in southwest Michigan, including Leverett and Taylor (1915), Travis (1964) and Shah (1971). These investigations suggest several scenarios of lobate advancement and retreat, but the timing of the various ice margin positions remains incomplete due to inadequate surface evidence and dating. In most cases, surficial evidence of prior glacial activity has been
Figure 7 – Quaternary Geology of Southwest Michigan
(Source: MDNR MIRIS Base Files- Michigan Counties and Michigan Quaternary Geology; Modified from Farrand and Bell, 1982)
masked, destroyed, modified or covered. In order to better understand the sequence of events that occurred during the Late Wisconsinan, attention must be paid to the surface relationships and occurrence of glacial materials that exist within the study area and their associated sediment-landform assemblages.

**Topography**

A review of topographic maps, aerial photography, Digital Line Graphs (DLG) and Digital Elevation Models (DEM) were used to analyze surface features and provide a glacial perspective to topographic trends or landforms. USGS 7.5 min topographic quadrangles and 30 meter DEMs were used for the purposes of evaluating topographic features and creating elevation profiles that transect the study area with orientations consistent with the flow paths of Lake Michigan and Saginaw Lobe ice.

The western section of the Sturgis Moraine exhibits elevations in excess of 1000 feet MSL dropping to elevations nearing 780 feet MSL near the St. Joseph River. Discontinuous ridges exist on upland areas of the western section of the Sturgis Moraine and topographic data were used to show patterns of high elevation and other geomorphic features that could be evidence of former ice-margin positions. Areas of high elevation were mapped using ArcView GIS software to demonstrate linear elevation patterns, which could be attributed to the actions of the Lake Michigan and Saginaw Lobes.

**Cross-cutting Relationships**

Large linear valleys are found within and proximal to the study area carving deeply through the hummocky landscape of the interior sections of the Sturgis Moraine. These valleys are well defined to the south, revealing themselves as long, steep-walled depressions that trend in a southwesterly direction. To the north, the continuity of these
features lessens and they become discontinuous valley chains, often occupied by lakes, with topographic expressions that suggest similar linear trends.

In addition, deep valleys and other depression features are observed within and west of the study area into Cass County. These valleys trend primarily in east-west orientations and are also frequently occupied by lakes, wetlands, streams and creeks.

U.S.G.S. 1:24,000 and 1:100,000 scale topographic quadrangles were employed to interpret the significance of surface features within the study area. Observations of depressions and truncated geomorphic features were used to evaluate stagnation topography and ultimately apply an interpretation to the glacial processes that created them and relevant ice-margin positions.

Cross-cutting relationships are observed as valleys of different orientations cut across each other at high angles while maintaining their continuity. They are also observed as deposits, such as outwash fans, that cross these valleys and continue with a lack of interruption. By examining the ways in which these relationships occur, one can show the types and directions of deposition from different sources. These can be defined by exploring their stratigraphic relationships and to observed glacial deposits.
Several investigative techniques were used to compile and analyze subsurface depositional data and to create cross-sections of significant stratigraphic units lying below the study area. Water well records were the most abundant source of subsurface information and were augmented by geophysical and exploratory data from gamma ray logging and analysis of subsurface materials recovered from Test Boring 96-52.

**Well Log Cross-sections**

As part of the investigation of the underlying glacial drift, water well records were obtained from the Branch-Hillsdale-St. Joseph District Health Department and the Michigan Department of Environmental Quality. In 1965, Michigan established requirements for water well records to be completed on all water wells drilled in the state. All well logs are required to be submitted to the Michigan Department of Environmental Quality (MDEQ), Geological Survey Division, and Local Health Departments. Well logs are then entered into the MDEQ Wellogic computer database.

Throughout the study, hundreds of well logs were reviewed and used for the creation of cross-sections based on their completeness, location and importance to the continuity of identified stratigraphic units and relationships. The well logs used for cross-sections can be found in Appendix E.

Numerous cross-sections were made and five were identified as being representative of the uniform stratigraphic relationships observed within the study area. Cross-sections were made transecting the study area in orientations that matched those of the flow directions of the Lake Michigan and Saginaw Lobes.
Test Drilling

In December of 1996, a test boring (Test Boring 96-52) was drilled in the Robert’s Aggregates gravel pit south of M-60, Fabius Township, Section 26. The boring was exploratory in nature and drilled until bedrock was encountered. Split spoon samples were collected at five-foot intervals for the entire length of the borehole, which terminated in the Coldwater Shale. Samples were evaluated for their textural and physical characteristics (Appendix F). All samples collected in this manner were assigned a Munsel color in the field and placed in labeled glass jars for further analysis. Textural characterizations were given for each interval and where applicable, 7Å/10Å peak data was given. A stratigraphic profile was then created and used in conjunction with both well logs and gamma ray data.

Examination of the profile created for this test boring show there to be large sequences of stratified sands and gravels separated unconformably by grey, clay-rich tills. Till units were identified and x-ray diffraction was conducted on the clay mineral separates to obtain 7Å/10Å peak data (Appendix D).

Geophysical Exploration

Several wells and boreholes, including Test Boring 96-52, were logged using a Keck gamma ray logger. Wells were logged after the casing was set and prior to the installation of a pump or other down-hole equipment. Gamma ray signatures were collected using the Keck Model SR-3000 set at two separate sensitivities and constantly collecting data from the entire casing length. Each log was assigned a Well ID number and information about the well and its location were recorded.
Gamma ray signatures reflect the differences in sediments based on amount of emitted gamma rays from Potassium (K\textsuperscript{40}), a radioactive potassium isotope. Potassium (K\textsuperscript{40}) is found in orthoclase feldspars and micas, which weather into clays. Clays emit more gamma rays than sands and gravels and, therefore, are discernable by the intensity of their signatures (Figure 8).

Figure 8 – Example of a Gamma Ray Signature and Interpretation (Modified from Kozlowski 1999)
For use in this study, the gamma ray logger was set at time constants equal to 200 and 100/division (sensitivity 2 and 1), 200 and 1000 cmpfs (counts measured per foot-second) and at a set velocity of 6 feet/minute. In addition to the Well ID number, well permit number, casing type, operator, address, township, quarter sections, drilling contractor, surface elevation, top of casing (TOC), logged depth, drilled depth, owner, and static water level were recorded when possible. Gamma ray signature records are provided in Appendix G.

Gamma ray signatures were collected, compared against each other and used to construct a profile across the study area. In addition, well logs were used to identify and confirm stratigraphic units observed from gamma ray signatures. When possible, well logs corresponding to gamma ray signatures were used for comparison, however, some well logs were not available, incomplete or had inadequate descriptions of subsurface materials. In cases where the well log was unavailable or incomplete, surrounding well logs were used to infer stratigraphic units.
CHAPTER II – GEOLOGY

BEDROCK GEOLOGY

Bedrock units subcropping in St. Joseph and surrounding counties are Paleozoic in age and consist primarily of the Coldwater Shale and Marshall Sandstone with small areas of Ellsworth Shale in the southern reaches of St. Joseph County (Figure 9). Because of a lack of local outcrops and the inadequate number of rock wells in the immediate area, knowledge of the subsurface bedrock geology is limited. Most information for this investigation was gathered from oil and gas well records, Test Boring 96-52, and commercial and residential well records that encountered bedrock. Other sources of information included the review of previous geologic investigations conducted in or near the study area and data obtained from the Michigan Department of Natural Resources.

Figure 9 – Bedrock of Southwestern Michigan
(Source: MDNR MIRIS Base Files – Bedrock Geology of Michigan, Michigan Counties)
Till composition in St. Joseph County, Michigan is influenced by both the local underlying bedrock and materials far removed from southwestern Michigan. However, Flint (1999) found that the till referred to as the “Sturgis Till” by Nicks (2004) and or the “Grey Marker” by Gardner (1997) is mineralogically very similar to the Coldwater Shale.

Beyond contributing to bedload sediment, bedrock played a large role in the control of movement of Wisconsinan ice and its control over depositional and erosional glacial regimes. Kehew (1999), Nicks (2004), Rieck (1976) and Dodson (1984) concluded that areas of morainal deposition in southwest Michigan are coincident with high bedrock elevations. Therefore, it is essential that bedrock geology be considered in the interpretation of surficial deposits relating to glacial environments and their geologic link to provenance of materials.

**Bedrock Control**

It is well documented that bedrock surfaces have a direct influence on how overlying materials are deposited, of which St. Joseph County was no exception. The bedrock surface in southwest Michigan is complex. The local bedrock was shaped by preglacial crustal deformation accompanied by other erosional processes such as fluvial, glacial, glacio-fluvial and post-glacial environments.

On a regional scale, bedrock topography can influence the patterns of ice margin advance and retreat. Therefore, the dipping bedrock topography toward the Lake Michigan Basin provided a bedrock trough for ice movement and likely promoted the advance of the Lake Michigan Lobe toward the southeast. This movement along bedrock surfaces resulted in the glacial plucking and erosional modification of the pre-glacial bedrock surface and the subsequent incorporation of these sediments into its bedload.
A strong correlation between bedrock surface topography and morainal development can be observed in southern Michigan and within the study area. Nicks (2004) produced a bedrock surface elevation contour map (Figure 10) which demonstrates the local bedrock topography. Areas of high bedrock elevations can be observed in the area of the Sturgis Moraine. It also becomes apparent that the tunnel valleys identified on the eastern section of the Sturgis Moraine by Kelew et al. (1999), Nicks (2004) and others are contiguous with channels eroded into the bedrock surface.

Areas west of Three Rivers show bedrock surfaces rising from the Lake Michigan basin as one moves southeastward into St. Joseph County. Local bedrock highs suggest that, in part, bedrock topography held some control over Lake Michigan Lobe glacial movement and the subsequent deposition of the Sturgis Moraine.

**Coldwater Shale**

Well log research and the Michigan Bedrock Geology Map (MDNR MIRIS Base Data, 1982) reveal that almost all of St. Joseph County is underlain by the Coldwater Shale. The Coldwater Shale is lower Mississippian in age and lies below the Quaternary glacial deposits that blanket the study area in thicknesses up to 300 feet.

These early Mississippian rocks are comprised of moderately deep offshore marine deposits. Coldwater Shale is blue-grey to greenish in color, texturally fine-grained and sometimes contains fossils, clay-ironstone concretions, cherts, and thin interspersed beds of limestone and dolomite (Shah 1971). Minerals present include galena, sphalerite and pyrite. It was suggested by Cohee (1965) and others that the Coldwater Shale was deposited in the early Mississippian as a result of massive uplift in the Wisconsin highlands on the western side of the Michigan Basin.
Figure 10 – Bedrock Topography, St. Joseph County, Michigan (after Nicks 2002)
Deposits from the Lake Michigan, Saginaw and Huron-Erie Lobes all contain a component of Coldwater Shale; however, logic leads to the assumption that local lobate deposits would be expressed by differences in shale quantities within sediments, as well as differing in degrees of erosion. St. Joseph County, however, is an area that has been affected by several independent glacial advances and retreats from different sources, thus making provenance interpretation complex.

Lower Marshall Sandstone

The Marshall Sandstone forms a broad low escarpment running northwest-southeast through the middle of Calhoun and adjacent counties. The close of the Mississippian was accompanied by a major marine regression, resulting in much of southern Michigan becoming a near-shore and beach zone environment. The overlying Marshall and Napoleon Formations are such deposits, consisting of marine and beach sediments. In contrast with the fine-grained shales of the underlying Coldwater Formation, the Marshall and Napoleon Formations consist of coarser grained sandstones, sometimes containing fragments of driftwood.

Winchell (1861) first described the Marshall Sandstone as white, grey, green and red in color, sometimes micaceous and fossiliferous. As ice moved over the areas northeast of the study area, the Saginaw Lobe plucked Marshall Sandstone from the northwest-southeast trending escarpment and incorporated this sandstone into its sediment load to be deposited farther to the south.

Ellsworth Shale

The Ellsworth Shale is Devonian in age and was formed from black muds that were the result of uplift in the Wisconsin Highland to the west. The Ellsworth Shale was
deposited at the same time as the Antrim Shale. Ellsworth Shale is reportedly a gray to gray-greenish shale, consisting of offshore muds of the Antrim Sea, rich in organic matter. The color suggests a chemically reducing depositional environment, in which the muds rested on the sea floor of a poorly oxygenated, acidic sea (Dorr and Eshman 1970).

Ellsworth Shale occurs on the western and southern edges of St. Joseph County and immediately to the west in Cass County.

GLACIAL GEOLOGY

The Pleistocene Epoch (10,000 to 2,000,000 yr BP) is the most significant time of deposition of unconsolidated materials in southwestern Michigan. The Pleistocene was marked in the northern hemisphere by alternating globally synchronous periods of cold climate and ice advance (glacials) and warmer climate and glacial retreat (deglacials). The glacial landscape of the study area is the result of a series of these oscillations in climate. Deposits consist of material derived from the processes of direct contact with glacial ice and those materials carried away from glacial ice margins by meltwaters and laid down in meltwater channels as outwash deposits, as lacustrine sediment in lakes and as loess downwind from ice margins.

Quaternary sediments are geochronologically divided into numerous glacial stages in order to provide a means for describing glacial materials. These stages include the Holocene, Wisconsinan, Sangamon and Illinoian Stages, with many earlier pre-Illinoian stages represented. It was during the Wisconsinan Stage that the Laurentide Ice
Sheet reached as far south as southern Indiana and resulted in the creation of the Sturgis Moraine and surrounding glaciated terrain.

Lying discontinuously below Wisconsinan deposits, is a geosol that marks the upper boundary of the Sangamon Stage. This geosol was developed during the ice-free period prior to the Wisconsinan Stage and is recognized by the Indiana Geological Survey as a paleosol or weathered zone below the Newberry till and is identified in St. Joseph County, Michigan by Chris Gardner (1997) and Flint (1999).

Below Sangamon deposits lie sediments of the Illinoian Stage. Illinoian drift occurs at the surface in southern Illinois and Indiana with its overall boundary following a similar pattern as Wisconsinan boundaries. Leverett and Taylor (1915), Gardner (1997), Nicks (2004) and Flint (1999) have all recorded finding Illinoian tills in southeast Michigan.

The Illinoian Stage was marked by multiple ice-margin fluctuations. It is likely that Illinoian materials were deposited in southwestern Michigan and are represented by bedrock valley fillings and in areas of compacted till on top of or close to local bedrock surfaces. However, some deposits of this glaciation would likely have been destroyed or reworked by later Wisconsinan ice. Southwest Michigan certainly experienced earlier glaciations, however little evidence remains to provide information about their occurrence.

In describing Lake Michigan Lobe deposits, Hansel and Johnson (1996) devised a dichronic classification of materials and glacial events. The current diachronic classification of time-transgressive stratigraphic boundaries of the Great Lakes region
(Figure 11) identifies two subepisodes of the Wisconsinan, the Michigan and Athens Subepisodes.

Figure 11 – Geochronologic Time Scale and Diachronic Model of Great Lakes Region (Modified from Hansel and Johnson, 1996)
Wisconsin Episode

During the Wisconsin Episode, southwest Michigan's current landscape was being formed by the Lake Michigan, Saginaw and Huron-Erie Lobes of the Laurentide Ice Sheet. During the majority of the Wisconsin Episode, the ice margin was far to the south of the Michigan border, terminating in areas of Illinois, Ohio and Indiana at the Late Glacial Maximum (21,000-18,200 yr BP).

As the Laurentide Ice Sheet retreated from the Late Glacial Maximum, it thinned and weakened until it took on a distinctly lobate form being controlled by its parent basins (Lake Michigan, Lake Huron and Lake Erie). As the ice sheet deteriorated, it formed three primary lobes in southwestern Michigan; these lobes were named after the basins or bays they originated from.

It is believed that both the Lake Michigan Lobe and Saginaw Lobe deposits contained materials from Huronian sources (Anderson 1957), differing significantly in quantity of selected Precambrian lithologies. Lake Michigan Lobe sediments were reported to contain larger amounts of granitic material, corresponding to granitic materials exposed farther to the northwest.

Saginaw Lobe materials, however, contain the presence of jasper conglomerate (pudding stone) and pebbles from the Gowganda Tillite. Due to the limited source of these materials, they are used as semi-qualitative indicator rocks. The source of these materials are from the area including Bruce Mines, Ontario, Canada. These materials traveled as fragments in the bed load of the Saginaw Lobe to southwest Michigan where they were deposited as the Saginaw Lobe retreated at the end of the Wisconsin Episode. The occurrence of jasper conglomerate cannot, however, be used conclusively as an
indicator of Saginaw Lobe provenance because of the complex nature of interlobate environments. Most of the materials present in St. Joseph County, Michigan have been reworked by the oscillation of ice-margins associated with both the Lake Michigan and Saginaw Lobes.

Lován (1977) examined the heavy mineral characteristics of lobate deposits. He concluded that the farther traveled Lake Michigan sediments exhibited a lower mean value percent heavy minerals within a given grain size. Lován (1977) found the Lake Michigan Lobe tills have 2.6% heavy minerals in the 120 plus 230 mesh sands, whereas the Saginaw Lobe tills have a mean of 3.1%. These results corroborate Anderson’s (1957) hypothesis and clearly show that the sediments of the Lake Michigan Lobe traveled a greater distance than did the Saginaw materials and were likely diluted with a greater quantity of local material.

Lake Michigan Lobe

Throughout the Wisconsin Episode, the Lake Michigan Lobe frequently fluctuated in marginal position and volume (Shah 1971). The Lake Michigan Lobe was fed by flowing ice from northern Canada, moving southward into the Lake Michigan lowlands of southern Michigan. Ice migrated along preglacial river valleys, eroding weak Middle and Lower Paleozoic rocks. The retreatal history of the Lake Michigan Lobe is directly related to the history of Lake Chicago and its high-low water stages.

Based on stratigraphic logs, geophysical data and materials obtained from split spoon samples collected from test borings in St. Joseph County, at least two till units separated by unconsolidated sands and gravels were identified below large amounts of interlobate outwash deposits.
Monaghan and Larson (1986) identified three major till units associated with the Lake Michigan Lobe. Provenance was based on grain size distribution, clay mineralogy and the correlation of exposed till units west of Glenn Shores in Allegan County, Michigan. Table 3 identifies these till units and their associated textural and mineralogical characteristics.

Table 3

<table>
<thead>
<tr>
<th>Till Unit</th>
<th>Textural Characteristics</th>
<th>Description</th>
<th>7Å/10Åmean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glenn Shores*</td>
<td>46% sand, 34% silt, 20% clay</td>
<td>silty-sand till</td>
<td>1.22</td>
</tr>
<tr>
<td></td>
<td>* may be pre-Wisconsinan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ganges</td>
<td>59% sand, 22% silt, 19% clay</td>
<td>blue-grey sandy till</td>
<td>0.85</td>
</tr>
<tr>
<td>Saugatuck</td>
<td>36% sand, 42% silt, 22% clay</td>
<td>blue-grey till</td>
<td>0.58</td>
</tr>
</tbody>
</table>

(Modified from Monaghan and Larson, 1986)

More recent classifications of the Wisconsin Episode have been proposed for Lake Michigan Lobe deposits. Hansel and Johnson (1996) have divided the Michigan and Athens Subepisodes into two inter-fingering groups, the Mason Group and the Wedron Group (Figure 11). The Mason and Wedron Groups are chiefly responsible for the materials found within the study area.

The Mason Group is divided into four major formations, the Roxana Silt, Peoria Silt, Henry and Equality Formations. These formations are made up of proglacial sorted deposits, including loess, eolian sand, lake sediments and outwash materials.

The Wedron Group is also divided into four formations, the Tiskilwa, Lemont, Wadsworth and Kewaunee Formations, which includes surficial materials in the study...
area. The Wedron Group formations are encountered as tills and diamictons associated with ice-margins.

These groups are further divided into phases representing the advance and retreat of glacial ice. Eight phases represent intervals of glacial activity, the Marengo, Shelby, Putnam, Livingston, Woodstock, Crown Point, Port Huron, and Two Rivers. Four phases represent deglacial intervals, the Worth, Mackinaw, Milwaukee and Two Creeks. These phases are characterized by glacigenic sequences of both the Wedron and Mason Groups, forming alternating deposits of diamicton and unconsolidated sorted material.

The Wedron and Mason Groups are representative of time-transgressive or diachronic units that use a system of temporal classification based on events that transgress time, unlike the ranking found in traditional chronostratigraphic or geochronologic classification systems.

Saginaw Lobe

At some point during the Wisconsin Glaciation, the Saginaw Lobe also advanced to a position south of the Michigan border. It moved in a southwesterly direction from Saginaw Bay and continued through southwest Michigan and into Indiana. Shah (1971) and Horberg and Anderson (1956) place the terminal position of the Saginaw Lobe ice in northern Indiana, represented by the Iroquois-Packerton moraines.

As the Laurentide Ice Sheet took on a lobate form, the lobes began to act independently of each other. Leverett and Taylor (1915) make reference to the out-of-phase relationships that existed during the Late Wisconsinan. They documented the retreat of the Saginaw Lobe as being prior to the Lake Michigan or Huron-Erie. This was attributed to Saginaw Lobe moving across more elevated terrain. In addition, the
Saginaw Lobe was reported by Leverett and Taylor (1915) to be thinner than the adjacent glacial lobes, with correspondingly weaker movement.

Because the Saginaw Lobe traveled a shorter distance than did the Lake Michigan Lobe, it may have had coarser-textured basal sediments. Monaghan and Larson (1986) also described two tills deposited by the Saginaw Lobe (Table 4).

Table 4

<table>
<thead>
<tr>
<th>Till Unit</th>
<th>Textural Characteristics</th>
<th>Description</th>
<th>7Å/10Åmean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bedford</td>
<td>51% sand, 41% silt, 8% clay</td>
<td>tan sandy till</td>
<td>0.72</td>
</tr>
<tr>
<td>Fulton</td>
<td>43% sand, 44% silt, 13% clay</td>
<td>dense blue sandy till</td>
<td>1.13</td>
</tr>
</tbody>
</table>

(Modified from Monahan and Larson 1986)

Huron-Erie Lobe

Deglaciation was described by Martin (1957) as occurring as a progressive withdrawal from the Tekonsha ice-margin east of the study area, interrupted only by a few minor readvances and some ice stagnation. The Huron-Erie Lobe, located east of the western section of the Sturgis Moraine, contributed large amounts of outwash sediments to areas proximal to its ice-margin. These sediments were deposited in the Central Lowlands and are combined with other materials from the north that were transported to St. Joseph County during the Late Wisconsinan. The Huron-Erie Lobe has very little influence on the creation of the moraine located west of Three Rivers and thus has little attention paid to it in this study.
Deglaciation of the Study Area

Several recent geologic investigations have been conducted concerning the deglaciation of southwest Michigan and surrounding areas. The focus of glacial investigations in southwest Michigan must be concerned with the interaction between the Lake Michigan, Saginaw and Huron-Erie Lobes as they developed and moved out of phase from each other.

Evidence from sediment-landform assemblages, cross-cutting relationships, and sediment provenance further supports the interlobate, non-synchronous ice-margin relationship model. Observance of moraine ridge patterns across Michigan and Indiana show that the lobes were independent from each other with the Saginaw retreating before the Lake Michigan or Huron-Erie (Leverett and Taylor 1915).

When the Saginaw Lobe retreated to the position of the Sturgis Moraine, Lovan (1977) indicated that the Lake Michigan Lobe was positioned at the Kalamazoo Moraine. As the Saginaw Lobe retreated to the position of the Tekonsha Moraine (Figure 1), the Lake Michigan Lobe began its advance over the Sturgis and Tekonsha Moraines, overriding earlier Saginaw Lobe deposits. These two moraines show evidence of deformation of Saginaw Lobe deposits, the presence of an ablation till covering the Kalamazoo Moraine (Lovan 1977), and the reported presence of thin tills over outwash sediments in Cooper and Prairie Ronde Townships of Kalamazoo County, Michigan (Shah 1981). Evidence of a readvance of the Saginaw Lobe exists as drumlins found in northwestern Branch County, Kalamazoo and Calhoun Counties and the presence of a thin ablation till capping the Tekonsha Moraine (Dodson, 1985,1993, Kozlowski, 1999).
As the Saginaw Lobe quickly retreated from the area, the Lake Michigan Lobe began its retreat. The Lake Michigan Lobe retreated slowly and was identified by several stagnation ridges. Thin linear features suspected of being stagnation ridges also exist in Prairie Ronde, Portage and Cooper Townships of Kalamazoo County, Michigan (Kehew et al. 1999). It is also suspected that the Lake Michigan Lobe advanced beyond the western section of the Sturgis Moraine with its maximum extent residing against the western part of the eastern section of the Sturgis Moraine. This is demonstrated by truncated Saginaw Lobe tunnel valleys of the eastern section of the Sturgis Moraine and the presence of a surface till that overrides Saginaw materials deforming them as they were deposited. Continued retreat was responsible for the development of the Kendall, Valparaiso, and Kalamazoo morainic systems.
CHAPTER III - RESULTS

TEXTURAL ANALYSIS OF SURFACE MATERIALS

The textural analysis of surface materials resulted in the identification of several areas of clay-rich, poorly sorted diamicton. The surface diamicton is discontinuous throughout the study area and seems coincident with upland areas. These materials occur as supraglacial sediments capping former glaciolacustrine and glaciofluvial sand and gravel deposits.

Though samples were analyzed for their individual textural characteristics (Appendix B), the study area was influenced by deposits from both the Lake Michigan and Saginaw Lobes, making the establishment of provenance inherently difficult. Textural considerations were applied to each sample by percent passing and by the calculation of a sand/(clay+silt) ratio. This ratio was used to differentiate between areas of sandy diamicton versus more clay-rich materials and mapped using ArcView GIS software (Figure 12).

Resulting high sand/(clay+silt) ratios show a predominance of sandy materials, as indicated by the largest graduated circles, near Pleasant Lake and areas south and eastward. There are other samples showing a high ratio outside the Pleasant Lake area. These samples were collected from areas that were lacking in a surface till and likely represent glaciofluvial deposits from former glacial activity.

Numerous samples were found to have low sand/(clay+silt) ratios, indicting a clay-rich matrix for these materials. These samples were generally collected from areas of high elevation and are indicative of supraglacial diamictons. The surface diamicton is
associated with deformation structures in some underlying unconsolidated materials. This is observed at the Robert's Aggregates pit as contorted bedding plains in materials underlying the surface diamicton. This supports the hypothesis that Late Wisconsinan ice overrode existing outwash materials and blanketed the area with supraglacial sediments before retreating from the Sturgis Moraine.

Figure 12 – Graduated Symbol Representation of Sand/(Clay+Silt) Ratios (Source: MDNR Base Files – Transportation, Hydrology, and Topography)
Many samples also contained a considerable amount of gravel-sized separates with respect to the overall composition of materials. These samples were scattered throughout the study area and were not present in enough of the analytical data to infer a correlation with landforms or lobe affiliation.

**TOPOGRAPHY**

By examining topographic data of the study area (Figure 13), several geomorphic features and trends can be observed which characterize the local glaciated terrain. The western section of the Sturgis Moraine is an upland area reaching elevations of over 1000 feet MSL. Several deep linear depressions can be seen cutting through the western section of the Sturgis Moraine and there are numerous depressions covering the landscape commonly occupied by lakes, streams or wetlands, some having irregular shapes and orientations. There are many indications of former drainageways interrupted by depressions and many distinguishable areas of hummocky terrain. All of the observed surface features are consistent with ice-contact environments and demonstrates a landscape occupied with numerous buried ice blocks overlain with large sequences of outwash and other glaciofluvial deposits.

During the deglaciation of southwestern Michigan, the glacial lobes of the Laurentide Ice Sheet left behind a record of their presence in the sediments that were deposited and the landforms that were left behind. As glacial ice moved across the study area, the various glacial ice-margin positions controlled the depositional and erosional environments and the subsequent formation of distinct sediment-landform assemblages.
Figure 13 – Regional Topography and Lake Michigan Ice Margin Positions
(Source: Part of USGS 1:100,000 Elkhart Quadrangle)
By using several forms of topographic data, the general landscape of the study area was scrutinized with respect to the deglaciation of the study area. Figure 13 demonstrates the regional topography of the western section of the Sturgis Moraine and surrounding areas.

Three Lake Michigan ice-margin positions are presented in Figure 13. Ice-margin positions LM#1 and LM#2 are described by Kehew et al. (1999), whereas LM#3 is inferred based on topography and occurrence of sediment-landform assemblages that are consistent with proglacial environments, such as the fan deposit located west of Corey and Long Lakes. LM#3 is also suggested by the occurrence of a subsurface glaciolacustrine and/or glaciofluvial unit, revealing that an ice-margin position likely existed coincident with the upland areas north and west of LM#2.

Figure 13 extends beyond the immediate study area and reveals the relationship and orientation of areas of higher elevation present within the western section of the Sturgis Moraine. These are presumed to be depositional areas close to the prominent ice-margin positions that created them upon stagnation or retreat from the area. When these areas were correlated with adjacent topographic uplands, elevation trends emerged that displayed dominant axial orientations for these features. The predominant orientation of the upland topography trends northeast-southwest, matching depositional environments for a glacier moving southeasterly across the study area and is labeled LM#3. LM#3 is interpreted to represent one of the final ice-margin positions of the Lake Michigan Lobe before retreating from southern Michigan permanently. Additionally, drainage channels, deeply entrenched valleys and outwash fans place the Lake Michigan Lobe at position LM#3 during the late Wisconsinan.
Several other topographic features can be observed from Figure 13. There are numerous steep walled valleys transecting the study area, sharing orientations with the flow directions of both the Lake Michigan and Saginaw Lobes. These valleys intersect the prevailing topography at high angles and are interpreted to represent tunnel valleys similar to those observed by Kehew et al. (1999) and discussed later in this Chapter.

Two outwash fans are identified in Figure 14, which provide strong geomorphic evidence of former ice-margin positions. The first, Fan 1, is represented by the long shallow contours directly West of the Cass County – St. Joseph County boundary and west of Corey Lake. This fan originates at very high elevations and slopes to the south and east revealing that glacial ice must have been present northwest of the apex of these fan deposits (LM#3), again demonstrating the influence of the Lake Michigan Lobe during the final stages of the deglaciation of southwestern Michigan.

The second fan deposit, Fan 2, exists farther to the south, located directly west and adjacent to two large tunnel valleys associated with the Lake Michigan Lobe. This fan also represents a former ice-margin position of the Lake Michigan Lobe and can be correlated with other geomorphic evidence to establish a boundary for position LM#2. It is also noted here that the predominant tunnel valley in this location (Figure 14) extends beyond the ice-margin boundary (Kehew et al. 1999), suggesting that the Lake Michigan Lobe advanced to position LM#1 near the eastern section of the Sturgis Moraine.

The topography also clearly demonstrates the characteristically pitted appearance of the study area. As Wisconsinan ice retreated from southwestern Michigan, its ice-margin disintegrated, spalling pieces of debris-laden ice and subsequently burying them under supraglacial material and outwash deposits. This is evident at several local gravel
Figure 14 – Geomorphic Features and Relationships to Former Lake Michigan Lobe Ice-margin Positions
(USGS 7.5 min 1:100,000 Elkhart Quadrangle)
pit locations by observing numerous fault and other melt-out features. Buried ice is primarily responsible for the many lakes and depressions present throughout the study area.

Furthermore, a broad relatively flat area (Lake Plain) exists in the area of Pleasant Lake and surrounding areas (Figure 14). This area is underlain by stratified sands and clays and is capped with a sandy diamicton, and may be a proglacial glaciolacustrine lake plain. The gravel pit located on the South side of Hoffman Road exposes sands and gravels with ripple cross-bedded units approximately 15 cm thick (Figure 15), as well as pockets of unsorted material interpreted to be deposits from debris-laden rafted ice.

![Figure 15 - Ripple Structures at the Hoffman Road Pit](image)

Figure 15 – Ripple Structures at the Hoffman Road Pit
Long steep-walled valleys, interpreted to be tunnel valleys, confine this area to the north, west and south and buried ice may have damned glacial meltwaters creating a proglacial environment proximal to position LM#3. This would also suggest that the eastern side of this area was damned by ice. This suggests that the Saginaw Lobe may have readvanced to a position near the Sturgis Moraine.

**CROSS-SECTIONS**

By utilizing the information gathered from well drilling records, five stratigraphic cross-sections (Plate I, II, III, IV and V) were generated transecting the study area (Figure 16). These cross-sections were used to gain a broad understanding of the subsurface geology, identify glacial materials based on descriptions retrieved from well logs and, where possible, sample drill cuttings during the installation of new water wells.

Other sources of data used to create the cross-sections included field observations in gravel pits, textural analysis of near surface soil samples and sample recovery from Test Boring 96-52. Test Boring 96-52 provided a great deal of information regarding subsurface materials and was used to correlate with materials described on collected water well records.

Subsurface stratigraphic units identified within the study area are time-transgressive and mark, by the nature of their composition and position in the stratigraphic profile, diachronous glacial events. As the Sturgis Moraine developed, glacial materials were eroded, deposited and modified by the movement of glacial ice-
margins. The materials remaining represent glacial events that can be regionally correlated and which also span a range of time.

These cross-sections provide information regarding subsurface materials, but were also created to identify topographic relationships and to profile elevations across the study area. Surface elevations were determined by using cross section intersections with topographic contours at ten-foot intervals.

Three cross-sections (M1, M2, M3) were constructed in the flow direction of the Lake Michigan Lobe, generally from the northwest to the southeast, and two were generated in the flow direction of the Saginaw Lobe (S1, S2), generally from the northeast to the southwest. They demonstrate the rough topography of the western section of the Sturgis Moraine and reveal the depositional and erosional characteristics of the local glaciated terrain.

Cross-sections M1, M2 and M3 (Plates I-III)

Moving from the northwest to southeast, with respect to the Lake Michigan Lobe cross-sections, M1 shows the greatest elevations to the northwest (approximately 980 feet MSL) and the most distinctive breaks in topography resulting in a very choppy appearance transecting the interior portions of the western section of the Sturgis Moraine. By comparing cross-section M1 with the Three Rivers West 7.5 minute USGS quadrangle, sharp breaks in topography are representative of depressions in or near existing lakes or drainage ways and are consistent with features associated with buried ice and ice-margin meltwater channels or tunnel valleys.
Figure 16 – Stratigraphic/Topographic Cross-sections
(Source: 7.5 Minute 1:24000 USGS Three Rivers West Quadrangle)
Near the St. Joseph River in Section 25 of Fabius Township and just west of US 131, a sharp drop in elevation (120 feet) occurs in cross-section M1. The drop in elevation starts at well 75000002391, with an elevation of around 900 feet MSL, and drops to the St. Joseph River (780 feet MSL). Compared with the current path of the St. Joseph and Prairie Rivers, it appears that this sharp drop in elevation may be due in part to the erosional forces of large amounts of glacial meltwater from the north and east down these relict drainage channels and which likely deposited large amounts of glaciolacustrine and glaciofluvial materials to areas of the Central Lowlands.

Cross-sections M2 and M3 both originate at the southwestern end of Corey Lake and terminate at the banks of the St. Joseph River. M2 cuts across the study area and terminates at Florence Bridge, about .5 miles east of US 131. M3 follows a more southerly route ending north of Constantine at the intersection of US 131 and Millers Mill Road. These cross-sections transect the Sturgis Moraine and drop down to the outwash deposits south of Three Rivers, Michigan.

Cross-sections M2 and M3 reveal topography consisting of numerous depressions and sharp breaks in slope, producing a choppy appearance to the western portions of their profiles. This is due largely to the numerous depressions that occupy this area. In cross section M2, high elevations crest above 940 feet MSL and drop sharply at first and then gently to the St. Joseph River suggesting the presence of an outwash fan originating from the western section of the Sturgis Moraine. In support, M3 gently declines in elevation from well 75000003879 (905 feet MSL) to the St. Joseph River (790 feet MSL) over a distance of more than three and a half miles.
Generally, the upland areas on the western edge of the study area show thick sequences of red to brown, clay-rich diamicton (Unit 1), ranging from 60 to 90 feet in thickness. As cross-sections M1, M2 and M3 move from west to east, the thickness of the surface diamicton diminishes and is only found as a thin layer capping upland areas to the eastern ends of the cross sections.

Unit 3, a blue-grey till, occurs beneath the thick surface diamicton on the western edge of St. Joseph County. The characteristics of this till vary across the study area, both horizontally and vertically, sometimes described as sandy, silty, hard or clayey and often accompanied by gravel. These changes may represent changing depositional environments over time, diachronic facies changes, or differences in driller’s descriptions of this unit. The thickness of this till varies from 20 to 100 feet and it is occasionally interbedded with thin sand lenses. Unit 3 provides an excellent aquitard and is regionally significant as a confining layer, separating the saturated materials of Units 2 and 4, where present.

As cross-sections M1, M2 and M3 traverse eastward from the western edge of St. Joseph County, Units 1 and 3 become separated by thick sequences of glaciofluvial and/or glaciolacustrine material identified as Unit 2. This unit consists predominantly of sands and gravels and is characterized by vertical and lateral variations in grain size and varies in thickness from 20 to 100 feet. Unit 2 is observed to generally increase in thickness with distance to the east and forms a broad outwash fan in M2 and M3, where it is steeply truncated in cross-section M1.

By determining the occurrence of Unit 2 on cross-sections M1, M2 and M3, it was observed that the apices of these deposits replicate the ice-margin orientations of the
Lake Michigan Lobe. Unit 2, in particular, does not occur on the western edges of cross-sections M1, M2 or M3. As we traverse eastward, Unit 2 appears separating the surface diamicton (Unit 1) from the grey till of Unit 3 below. The glaciolacustrine and/or glaciofluvial materials of Unit 2 are representative of proglacial outwash deposits and by their position along the cross-sections, may indicate the origin of these deposits and thus the leading edge of one of the last positions of the Lake Michigan Lobe ice-margin. Again, this would suggest that a source for Unit 2 materials existed to the north and west of LM#2 and are assumed the result of the Lake Michigan Lobe occupying the LM#3 position.

It is unclear what happens to Unit 2 as it moves into the Central Lowlands and the stratigraphic continuity of this unit cannot be extended beyond the LM#2 position. Outwash in the Central Lowlands may be the result of material transported from the north or from outwash associated with the activities of the Huron-Erie Lobe to the east.

Deformation structures were encountered in Unit 2, directly beneath the surface diamicton at Robert’s Aggregates pit south of M-60 in Section 26 of Fabius Township. This suggests that the observed deformation structures are due to the overriding of Unit 2 by glacial ice and subsequent deposition of the poorly sorted material identified as Unit 1. Unit 2 is a significant water producing aquifer that supplies domestic drinking water to residents in the eastern portions of Fabius Township.

Unit 4 consists primarily of sandy material often identified texturally as fine-grained and commonly interbedded with coarse and gravely material. These glaciofluvial deposits display thicknesses up to 75 feet (Test Boring 96-52) and taper to the southeast.
in Constantine Township. Numerous water wells are completed in Unit 4 and this unit is considered a highly productive drinking water aquifer.

Lying below the stratified materials of Unit 4, Unit 5 consists of a blue-grey till some 20 to 50 feet thick and ranging from a primarily hard, dense till with fine gravel, to soft and sandy till near the top and bottom of this unit. Unit 5 is found lying directly above the Coldwater Shale in Test Boring 96-52 from 155 to 200 feet below grade. In cross-section M3, Unit 5 is underlain by sands and gravels as observed in well records 75000002482 and 75000003884.

Cross-sections S1 and S2 (Plates IV-V)

Cross-sections S1 and S2 were created consistent with the flow direction of the Saginaw Lobe. The northern most cross-section (S1) transects an area from the southwestern end of Corey Lake to the northeast terminating west of US 131 North of Heimbach Road in Section 31 of Park Township. Again, many areas are characterized by sharp elevation highs accompanied by drops in elevation. Northeast of well 75000002174, located at the southern end of Pleasant Lake, the topography exhibits a series of broad flat areas that drop incrementally until finally crossing the Rocky River, one mile West of US 131 on Null Road, Fabius Township, Section 1.

Cross-section S2 starts near the Cass County - St. Joseph County border in Section 6 of Constantine Township, east of Corey Lake Road and south of Harder Road. From well location 75000006567 the cross section traverses northeasterly to Section 6 of Lockport Township, 0.5 miles east of US 131 on the south side of Lovers Lane. Several depressions and drainage ways, occupied by swamps and intermittent streams, cut
through the western portion of cross-section S2, again producing sharp rises and drops in elevation.

As cross-section S2 transects the study area eastward, elevations rise slightly with more gradual elevation gradients. They rise to elevations up to 930 feet MSL, before gently sloping toward the Rocky River, just north of Hoffman Road on US 131.

Stratigraphic units observed in cross-sections S1 and S2 are consistent with those identified from M1, M2 and M3. Unit 1 is representative of the red and brown surface diamicton found throughout the study area and covers portions of cross section S1, primarily west of Pleasant Lake capping areas of higher elevation. Two large zones of gravely materials are identified on upland areas between Corey and Clear Lakes and between Clear and Pleasant Lakes. These gravel deposits taper to the northeast extending to the eastern edge of Pleasant Lake and are identified as Unit 1A.

In cross-section S2, Unit 1 is identified in well logs southwest of well 7500002151 and is thickest west of the Rocky River, generally above elevations of 870 feet MSL. Cross section S2 reveals Unit 1 varying in thickness from 10 to 90 feet.

In cross-section S1, a unit of glaciolacustrine and/or glaciofluvial sands and gravels (Unit 2) starts to appear in the stratigraphic section east of Corey Lake. The occurrence of Unit 2 is indicative of an ice-margin position boundary and suggests that a source for these deposits was located west of the study area or of a Lake Michigan Lobe origin. Unit 2 stretches to the east and is encountered at the surface; infrequently capped by a surface diamicton. In cross section S2, Unit 2 varies from 15 to 100 feet thick.
The upper subsurface till unit, Unit 3, is often accompanied by gravel and is thickest in cross-section S1, west of well 75000005686. Unit 3 ranges from 20 to 115 feet thick, varying little in cross-section S2, from 15 to 40 feet at its thickest.

In both S1 and S2, wells used for the construction of the cross-sections were terminated in Unit 4. Unit 4 consists of glaciolacustrine and glaciofluvial deposits, primarily stratified sands and gravels, is found in thicknesses greater than 40 feet and is a productive drinking water aquifer. Unit 5 is not represented in either S1 or S2.

**TEST BORING 96-52**

Test Boring 96-52, located in Fabius Township, Section 26, was drilled to a depth of 208 feet, where the Coldwater Shale was encountered and provided split spoon sample recovery of glacial materials to bedrock (Appendix F). The boring started at grade from the floor of the gravel pit (elevation 890 feet MSL) and was drilled using a mud rotary drill rig. The purpose of the test boring was to attempt to describe subsurface materials and correlate observations with water well records, stratigraphic cross sections and gamma logging activities.

Since the top 50 to 80 feet of overburden had been excavated from the drill site, observations from the surrounding pit walls were recorded and assumed representative of materials overlying the test boring location. The walls of the gravel pit surrounding the drill site displayed materials dominated by yellow-brown (10YR 5/4) sands, silts and fine gravel, capped by a thin brown sandy diamicton. These observations are consistent with
those of the materials described as Unit 1 and Unit 2 from the cross-sections described previously.

Abundant deformation structures within materials were observed on pit walls, indicating that buried ice may have once occupied the drill site or that glacial readvance occurred, overriding existing materials. In addition, a thick, massive assemblage of silt was identified on the eastern pit wall and deformation structures appear on the gravel pit’s western edge directly below the surface diamicton (Unit 1).

From the pit floor, the first 50 feet of drilling produced the recovery of glaciolacustrine and/or glaciofluvial deposits. Sands and gravels dominate the interval and add to the surface observations to correlate with Unit 2. Combined with the observations above grade, Unit 2 was originally 90 feet thick at the drill site.

Between 48 and 65 feet below grade, a significant till unit was encountered. This till is grey (10YR 5/1) to dark grey (5YR 4/1) in color and varies vertically in density and composition. This unit correlates well with the water well records used to construct stratigraphic cross-sections and is representative of Unit 3. Overall, this unit is predominantly a soft till comprised of clay, silt, sand and gravel (sometimes up to 4 inches in diameter). Unit 3 represents a time-transgressive boundary between the glaciolacustrine and/or glaciofluvial sediments of Units 2 and 4 and is considered to be a significant regional stratigraphic unit, traversing the study area to the west.

Below Unit 3, a thick sequence of sand and gravel (Unit 4) is present to 145 feet below grade where a dense grey till is encountered. Unit 4 varies vertically in its textural characteristics, consisting of yellow-brown (10YR 5/4) fine sands to 115 feet below grade, where it grades to coarse sands and gravel (grey at depth). Overall, Unit 4 fines
upward in the stratigraphic profile, implying that this area was experiencing a glacial retreat and that over time, distance from the ice-margin was increasing.

Below the unconsolidated materials of Unit 4 lies a massive unit of dark grey till (5YR 4/1) to very dark grey (5YR 3/1) deposited directly above the crushed bedrock surface of the Coldwater Shale. This unit is correlative with Unit 5 and occurs across the study area in thicknesses up to 75 feet. This unit is a dense hard till to a depth of 190 feet below grade where it softens and becomes mixed with fragments of the Coldwater Shale to a depth of 208 feet where consolidated bedrock is encountered.

Test Boring 96-52 was fundamental in identifying and characterizing general subsurface materials by using this data to compare with surrounding water well records, and was also very useful in demonstrating the clay mineralogy of tills by conducting X-ray diffraction analysis on recovered materials.

**CLAY MINERALOGY OF SUBSURFACE MATERIALS**

The test boring at the Robert's Aggregates pit (Test Boring 96-52) produced a number of split spoon samples that contained clay-rich subsurface diamicton units, interpreted as till units (Appendix F). Till units collected from Test Boring 96-52 were differentiated from each other by 7Å/10Å peak intensity ratios (Appendix D) as described in Chapter I.

The primary clay minerals observed within the sample set included chlorite, illite, kaolinite and vermiculite. It is assumed, in accordance with the work of Lovan (1977), that the 10Å peak is represented by illite and that the 7Å peak is produced by chlorite,
kaolinite and/or vermiculite. Rieck (1976) found that though 7Å/10Å peak analysis is not a complete mineralogical characterization; it is a ratio of intensities that can be used for comparison without using an internal standard.

The open borehole of Test Boring 96-52 was also logged with a Keck gamma ray logger prior to plugging. The split spoon samples were compared with the gamma ray signature of Test Boring 96-52 to characterize encountered stratigraphic units. In order to maintain consistency with other data presented in this investigation (ie. gamma ray and well log cross-sections), the same stratigraphic units are used for this analysis. Detailed descriptions of units recovered from Test Boring 96-52 can be found in Appendix F.

Unit 1 and Unit 2

Unit 1 represents the surface diamicton. Test Boring 96-52 was drilled from the bottom of the gravel pit and thus Unit 1 was not present in samples recovered from this boring. Unit 1, however, was sampled using a hand auger from several locations in the adjacent area and observations of this diamicton were made around the rim of the gravel pit.

Unit 1 occurs at the surface and consists of a sandy diamicton. It is encountered above Unit 2, a thick sequence of stratified lacustrine material. Unit 2 is comprised of yellow-brown fine sands and gravels encountered between 10 and 46 feet below grade. Deformation structures can be observed in this unit, directly below the contact surface with Unit 1, which provides evidence of the overriding of Unit 2 by a late glacial advance. Some faulting can also be observed in the pit wall, indicating that the burial of ice blocks occurred in this area during glacial retreat and regional deglaciation of the
study area. Melt-out features are common throughout this area and can be observed by the numerous depressions giving the landscape a distinctly pitted appearance.

Also noteworthy is the presence of a massive light brown silt assemblage located on the eastern wall of the pit. Silt deposits generally indicate quiet water deposition or eolian deposits remote from ice-margin positions. Since the silt unit is found below Unit 1 and evidence shows the existence of several ice margin positions within the area, it is assumed that this deposit represents lacustrine deposition. The presence of this sediment assemblage may indicate a supraglacial or proglacial lake environment existed locally and is consistent with observations of glaciolacustrine deposits identified as the proglacial lake area near Pleasant Lake.

X-ray diffraction analysis was not conducted on Units 1 or 2.

**Unit 3**

Unit 3 is a thin till unit found between 60 and 65 feet below the surface of the gravel pit floor. This till is dark grey (5YR 4/1) and unconformably overlies the thick sand and gravel sequences of Unit 4. Initial results from two samples produced a mean 7Å/10Å peak height of 0.73 +/- 0.03, which is statistically similar to the Bedford Till identified by Monahan and Larson (1986). Further sampling produced a final mean for six samples to be 0.683 +/- 0.07 at a 95% confidence level. These results may be misleading, however, due to the limited degrees of freedom. This value does not compare with till units identified from the eastern section of the Sturgis Moraine by Gardner (1997) and Flint (1999) and likely is a till deposited by the Lake Michigan Lobe when it reached LM#1. Deposits of this till in the Central Lowlands were likely eroded by
meltwaters from the north and east. Figure 17 demonstrates a typical diffractogram for the till recovered from Unit 3.

![Diffractogram](image-url)

**Figure 17** - X-Ray Diffractogram for Unit 3 - 63'

\(7A / 10A = 5.4 / 8.2 = 0.658\)

**Unit 4**

Unit 4 is found between 65 and 150 feet below grade. This unit is comprised of coarse sands and gravels at depth and grading to finer materials upward. This is suggestive of deposition from an ice-margin that is retreating from the area. A thin layer of hard grey till was identified within this unit; however, recovery was so limited that proper analysis of this unit could not be achieved.
Unit 5

Unit 5 is found directly above the Coldwater Shale and is dark grey in color (5YR 4/1). This unit contains an abundance of dark meta-sediments close to the bedrock surface and is believed to contain soft fragments of the Coldwater Shale. As the boring bottomed in bedrock, a sample of shale fragments and gravel was recovered and believed to be lying between the Coldwater Shale and Unit 5. This would be consistent with the deposition of a lodgment till and may represent pre-Wisconsinan sediments smeared against the bedrock.

Unit 5 is found between 150 and 200 feet below the pit floor and varies from soft till near the bedrock, owing to saturated subsurface conditions, to hard sandy till further up the stratigraphic column. The mean 7Å/10Å peak height ratio for ten samples recovered from Unit 5 is 0.596 +/- .036. The results for Unit 5 are similar to the units described by Flint (1999) as Units 1 and 2 (2a – Sturgis Till). 7Å/10Å peak analysis and t-Tests confirm a similarity between these units.

X-ray diffraction of Unit 5 produced tall, slender peaks, similar to those of Unit 1 identified by Garner (1997), as demonstrated in Figure 18. Though the peak analysis generated results confirming the null hypothesis with respect to Gardner’s Unit 1, there was a strong similarity between diffractograms of Gardner’s Unit 1 and Unit 5 from this investigation.

The till unit known as the “Sturgis Till”, Nicks (2004), Gardner (1997) and Flint (1999), was not observed in Test Boring 96-52 and may be restricted to deposits characterized in the eastern section of the Sturgis Moraine and surrounding areas. Overall, the limited number of samples analyzed and the lack of comparative studies
from the western section of the Sturgis Moraine resulted in the inability to correlate x-ray diffraction results, thus making the data inconclusive.

Figure 18 -- X-Ray Diffractogram for Unit 5 - 153°

\(7A/10A = 9.7/17.4 = 0.557\)
Evidence of stagnation topography and the presence of deep linear valleys in southwest Michigan, suggest an environment similar to that of the Green Bay Lobe and the development of tunnel valleys in Wisconsin. Attig and others (1989) documented permafrost as late as 13 kyr BP, which is synchronous with the retreat of the glacial ice from the study area and implies the possible existence of a similar glacial environment in St. Joseph County during the Late Wisconsinan. The existence of permafrost during the deglaciation of the study area supports the hypothesis that as glacial ice retreated from the Sturgis Moraine, a frozen ice margin trapped subglacial meltwaters.

Wet-based conditions behind the frozen margin of a glacier force the erosion of underlying glacial drift and bedrock, producing long linear valleys parallel to flow directions of glacial ice and perpendicular to the ice-margin. As we consider the study area, similar valleys exist consistent with the orientations and flow directions of the Saginaw and Lake Michigan Lobes. It is hypothesized that subglacial meltwaters eroded valleys beneath the Saginaw and Lake Michigan Lobes, tunneling to the ice-margins where they released tremendous amounts of water and glacial materials. These events could have occurred as outbursts of subglacial meltwaters or more discretely as small surges. Evidence of this exists throughout the study area as drainage channels, sluiceways, outwash fans and other observable sediment-landform assemblages.

Several distinct linear valleys exist within the study area, cutting across valleys and surface deposits at high angles and are interpreted to be tunnel valleys similar to the ones identified by Attig and others (1989). Tunnel valleys are also observed and documented (Nicks, 2004) on the eastern section of the Sturgis Moraine near Coldwater,
Michigan. There they are most pronounced dissecting the leading outwash deposits of the eastern section of the Sturgis Moraine. Figure 19 identifies several tunnel valleys within the interior section of the western section of the Sturgis Moraine.

Lake Michigan Lobe Tunnel Valleys

Several tunnel valleys have been identified in the western section of the Sturgis Moraine (Kehew et al. 1999, Nicks, 2004). Deep valleys cut across the landscape south and west of Corey Lake and are frequently occupied by lakes and streams. These features are aligned in northwest-southeast and west-east orientations and are interpreted to be tunnel valleys associated with former ice-margin positions of the Lake Michigan Lobe.

Two large tunnel valleys associated with the Lake Michigan Lobe (T1 and T2) exist in Cass County, running nine miles from sections 17 and 18 of Porter Township to Section 15 of Washington Township, Elkhart County, Indiana. Numerous wetlands, streams and lakes occupy these steep-walled valleys, including Shavehead Lake, Carters Lake, Bellows Lake, Baldwins Lake, Long Lake, Indiana Lake, Coverdale Lake, Round Lake, Teesdale Lake, Robbins Lake, Mud Creek and Trout Creek.

These large tunnel valleys eventually end at the St. Joseph River and along with the fan deposits of Fan 2, serve to define an ice-margin position of the Lake Michigan Lobe during the deglaciation of the study area. T1 extends beyond the established ice-margin position of the Lake Michigan Lobe boundary, suggesting that the Lake Michigan Lobe stretched beyond the western section of the Sturgis Moraine.
Figure 19 - Tunnel Valleys of the Lake Michigan and Saginaw Lobes
(Source: USGS Elkhart 1:100,000 Quadrangle)
T3 is a series of steep-walled lake-filled depressions originating in Cass County, Penn Township, Section 35. This chain of lakes incises the landscape eastward and includes Donnell Lake, Lewis Lake, Lime Lakes, and Blair Lake. The outwash fan identified as Fan 1 (Figure 14) extends across this valley chain between Lime Lakes and Blair Lake. This demonstrates a chronology of events that includes an ice-filled tunnel valley prior to outwash deposition from the Lake Michigan Lobe when it was at the LM#3 position.

Another chain of lake-filled depressions (T4) exists from Corey Lake westward, to the point where it is truncated by the deposits of Fan 1. T4 includes both Corey Lake and Harwood Lake. The orientation of this valley chain extends westward and if buried by Fan 1 deposits, may include Forked Lake and Kirk Lake and possibly Belas Lake to the west.

Other Lake Michigan tunnel valleys exist to the west in Cass County. They generally trend west to east and are occupied by lakes, streams and wetlands. Two linear topographic trends exist within the study area that exhibit characteristics of tunnel valleys of the Lake Michigan Lobe. These features, however, are discontinuous and severely collapsed.

A series of depressions (Ta) dissects the study area, between areas of southwestern Flowerfield Township and moving southward across highway M-60. Lakes and wetlands occupy this topographic feature, including Little Pleasant Lake and Pleasant Lake. This valley chain is suspected of constraining the western edge of the lake plain described earlier.
West of Ta, a linear trend of lakes and depressions (Tb) extends through Corey, Long, and possibly Allen Lakes. The topography is generally consistent (900 to 950 feet MSL) except where interrupted by steep-walled depressions and water bodies.

Ta, and Tb are obscured by the nature of intelobate glacial deposits present in the study area and the collapsed nature of the interior sections of the western section of the Sturgis Moraine. Thus, for the purposes of this study, these features will not be treated as tunnel valleys, but considered linear topographic trends relating to the Lake Michigan Lobe.

Several other lakes and depressions exist within the interior portions of the western section of the Sturgis Moraine that may be attributed to the Lake Michigan Lobe. These features, however, are so obscured and demonstrate such weak continuity that they will not be included in the investigation at this time.

Saginaw Lobe Tunnel Valleys

Several tunnel valleys exist within the western section of the Sturgis Moraine that share orientations with the flow direction of the Saginaw Lobe. These features deeply incise the Sturgis Moraine and disrupt the nature of the postglacial topography.

In the northern sections of the study area, a long linear series of depressions (T5) cuts across the landscape from Section 34 of Flowerfield Township, St Joseph County to Section 13 of Newberg Township, Cass County. Numerous wetlands and lakes occupy segments of this linear valley system, including Lake Four and Long Lake. Several areas are buried by glacial material and are highly collapsed, but the overall aspect of this feature maintains a high degree of continuity. The steep walls of this feature truncate the
local surface topography, which is characteristic of several depressions within this tunnel valley system.

Figure 20 – Tunnel Valley T6 Intersecting with Ta
(Source: 7.5 Min USGS 1:24000 Three Rivers West Quadrangle)
Figure 20 shows a short steep-walled valley occurring (T6) west of Three Rivers, starting near the intersection of US 131 and Hoffman Road and running almost three miles southwest to Section 22 of Fabius Township. The valley diverges near the intersection of Ferguson and Coon Hollow Roads, Fabius Township, Section 14. At this point, tunnel valley T6 intersects with Ta. These tunnel valleys, if filled with ice, may be responsible for the damming of glacial meltwaters from both the Lake Michigan and Saginaw Lobes resulting in the formation of a proglacial lake plain.

The Robert’s gravel pit on West Broadway Road, Fabius Township, Section 22, is located on the western side of Ta. The near surface deposits observed in this pit are stratified sands, gravels with significant deposits of boulder-sized materials. The presence and quantity of boulders observed at this location suggest a catastrophic event occurred, enough to move a considerable amount of large material. This is consistent with large subglacial meltwater outburst events and is likely the result of a catastrophic outburst from either the Saginaw Lobe or Lake Michigan Lobe, carrying with it an abundant amount of bedload material.

In addition, deposits at the Robert’s gravel pit on West Broadway Road location are observed to contain numerous faults and melt-out features. This suggests that there was a great deal of buried ice in the immediate area and supports the hypothesis that Ta was an ice filled tunnel valley during the deglaciation of southwest Michigan.

Another valley (T7) (Figure 19) exists in the southern portions of the western section of the Sturgis Moraine. This steep-walled valley extends from Section 35 of Fabius Township, St. Joseph County to Section 14 of Porter Township, Cass County. This large trench contains several wetlands and small lakes and is the primary
drainageway for Mill Creek. Mill Creek runs almost the entire length of this feature where it eventually drains to the South and ultimately into the St. Joseph River. This tunnel valley incises numerous features of the postglacial topography, truncating natural drainage patterns of the current landscape.

The valleys described above are interpreted to be Saginaw Lobe tunnel valleys overridden by the Lake Michigan Lobe. The preservation of these valleys suggests that they contained significant amounts of buried ice and that the Lake Michigan Lobe overrode these ice channels as it deposited materials. As sediments were deposited over the filled tunnel valleys of the Saginaw Lobe, new drainage patterns and valleys were created cutting at high angles to the buried valleys. The buried ice remained long enough for the overlain deposits to establish its natural terrain before eventually melting to create the existing topography of the valleys in the postglacial landscape.

In addition to the identified tunnel valleys within the western section of the Sturgis Moraine, numerous depressions exist that are likely the result of ice blocks spalled from the leading edge of glacial ice as it retreated from the study area. These depressions demonstrate characteristics consistent with ice burial and are often occupied by lakes and wetlands.

**Geophysical Results**

Figure 21 shows the locations of wells that were logged using the Keck gamma ray logger. By connecting selected gamma ray signatures, a cross-section (G1-G1') was constructed transecting the study area from northwest to southeast (Plate VI). By
comparing all of the gamma ray logs with their corresponding and surrounding well records, the local stratigraphy was correlated between wells.

The gamma ray cross-section shows the presence of three distinct clay-rich, poorly sorted diamicton units. These diamictons are separated by thick sequences of glaciolacustrine and/or glaciofluvial sands and gravels and form lithologically significant units within the stratigraphic profile.

The first diamicton is a sandy surface till that is brown in color, occurs discontinuously throughout the study area and corresponds to Unit 1 as described earlier. This surface till ranges in thickness up to 30 feet. Gamma ray logs and well logs show that the thickness of Unit 1 generally increases to the northwest.

Below Unit 1 is a thick succession of stratified outwash and lacustrine deposits. Unit 2 is encountered below the surface till in thicknesses up to 80 feet. Gamma ray signatures and split spoon samples show that Unit 2 is unconsolidated glaciolacustrine and/or glaciofluvial stratified sands, silts, clays and gravels. These deposits are absent from logs taken along the north and west boundaries of the study area. This suggests that Lake Michigan Lobe ice was still present or close to this area, possibly stagnated, and contributing large amounts of meltwater and outwash materials to the south.

Gamma ray signatures also identified the presence of two buried till units (Unit 3 and 5), separated by stratified drift (Unit 4). Unit 3 was identified farther up in the stratigraphic profile. Within the gamma ray cross-section, Unit 3 varies in thickness from 3-15 feet across the study area and is described as grey to dark brown in color and sometimes sandy in texture. Unit 3 is thin and is suspected of being discontinuous due to erosional processes of the Lake Michigan Lobe.
Unit 5 is found directly above the bedrock and is dark grey in color and silty in texture. This till is observed in Test Boring 96-52 and is 40 feet thick, lying directly above the Coldwater Shale.

Figure 21 – Locations of Gamma Ray Log Collection Sites and Cross-section G1-G1’
(Source: MDNR MIRIS Base Data: Cities, Roads, Hydrology)
CHAPTER IV – DISCUSSION

INTRODUCTION

The late Wisconsinan brought about the end of glacially transported material to southern Michigan. As glacial ice retreated and readvanced, the over-deepened basins of Lakes Michigan, Lake Huron and Lake Erie exerted topographic control over advancing ice initiating the development of a distinctly lobate ice margin. The Sturgis moraine was formed as the thinning Laurentide Ice Sheet retreated from its maximum (21 to 20 kyr BP) and developed three separate glacial lobes in southwestern Michigan.

The Lake Michigan, Saginaw and Huron-Erie Lobes moved across southern Michigan and were primarily responsible for the creation of the Sturgis Moraine and other significant geomorphologic features in St. Joseph County, Michigan.

The Sturgis Moraine is the dominant topographic feature in St. Joseph County, separated into two sections by the glaciofluvial and glaciolacustrine deposits of the Central Lowlands. Though they are both part of the same morainic system, the formation of each section was brought about by different glacial processes. The eastern section of the Sturgis Moraine is directly associated with the processes of the Saginaw and Huron-Erie Lobes, whereas its western section represents an interlobate regime dominated by the Lake Michigan and Saginaw Lobes.

A large re-entrant formed along the ice margin in southwestern Michigan approximately 15 kyr BP as the Saginaw Lobe retreated to the northeast. It is unknown if only the Lake Michigan and Huron-Erie Lobes were advancing at this time or if the Saginaw ultimately moved south again during a synchronous readvance of all three lobes. In any case, it is certain that the advances of the Lake Michigan and Huron-Erie Lobes
were much stronger than that of the Saginaw Lobe. Drumlins identified in the Union Streamlined Plain (Dodson 1986 and Kozlowski 1997) demonstrate evidence of a Saginaw Lobe readvance beyond the Tekonsha Moraine.

The western section of the Sturgis Moraine was created during the retreat of the Saginaw Lobe and bears evidence of Saginaw Lobe materials and geomorphologic features. Once the Saginaw Lobe retreated from southwestern Michigan, the Lake Michigan Lobe readvanced into the area and extended at least to the western section of the Sturgis Moraine. There is a great deal of evidence to support the hypothesis that the Lake Michigan Lobe advanced to the western section of the Sturgis Moraine, ice-margin position LM#2, and that it overrode earlier Saginaw Lobe deposits.

This investigation has provided information in many forms that sheds light on the development and chronology of events that contributed to the interlobate moraine building activities of the Saginaw and Lake Michigan Lobes in St. Joseph County.

Several cross sections were presented that created a stratigraphic model for the study area and which can be used to put physical observations into a geologic context. By examining the relationships between analytical evidence, collected data and observed geomorphic features, a better understanding of the events surrounding the deglaciation of southwestern Michigan and the development of the Sturgis Moraine can be achieved.

TEXTURAL CONSIDERATIONS

The textural composition of surface materials within the study area represents the reworking of previously deposited materials and thus inference of provenance on textural characteristics alone cannot be accurately determined. However, by comparing samples
against each other, one can observe trends and compare with geomorphic features to obtain a regional interpretation of sample results.

After the identification of a discontinuous surface diamicton within the study area, an investigation commenced regarding the occurrence and character of this material, for it is the last evidence of glacial activity with respect to the creation of the Sturgis Moraine. The primary goal was to collect, analyze and identify the locations of samples where the surface diamicton was encountered.

The surface diamicton, identified as Unit 1, was found to be texturally diverse and widespread. Below the surface diamicton lie large sequences of sand and gravel. Fisher and Taylor (1999) hypothesize a subglacial flood origin for these deposits in eastern Calhoun County, based on the nature of their contacts, elevation of gravel and boulders within the landscape and the thin, weak, unconsolidated fabric of the surface diamicton.

The prevalence of Unit 1 throughout the study area acquires significance from its occurrence and textural character. The sand/(clay+silt) ratio mirrors the amount of diamicton encountered. The most massive sequences of Unit 1 are located to the northwest, are the most structurally competent and show the lowest sand/(clay+silt) ratios.

The sandier surface diamictons occur toward the outer margins of the western section of the moraine. Unit 1 is also more abundant at higher elevations, but rarely is present in topographic lows. This may be due to the massive amounts of meltwater accompanying glacial ice-margin advance and subsequent stagnation or retreat. Meltwaters flowing away from the ice margin would seek out natural drainage patterns that would serve to preserve materials at higher elevations.
Unit 1 is interpreted to be associated with the activities of the Lake Michigan Lobe. Several local gravel pits were examined and observed to show the surface diamicton coupled with deformation structures in the units lying directly below Unit 1. In addition, the largest sequences of this surface till are found coincident with upland areas in the northwestern portions of the study area and also with former positions of the Lake Michigan Lobe ice margin.

Field evidence suggests a late rapid ice advance of the Lake Michigan Lobe that moved at least to a position near the western edges of the Central Lowlands, deforming the existing deposits and covering the western section of the Sturgis Moraine with a thin ablation till. As the Lake Michigan Lobe retreated to ice-margin position LM#3, large amounts of glacial meltwater eroded and weathered this till, especially in areas that served as meltwater channels and drainageways. These deposits are also highly weathered and show evidence of illuviated clays in the lower profiles of the soil horizon.

Hummocky terrain is present in the northwest portions of the Sturgis Moraine. Hummocky terrain is usually associated with supraglacial processes (Bennett and Glasser 1996, Flint 1971, Attig, 1989, Mickelson and Clayton 1989) and is frequently observed throughout the internal portions of the western section of the Sturgis Moraine.

The surface diamicton is significant when placed in context with the glacial history of the Sturgis Moraine and the chronology of lobate influences, resulting in the deposition of glacial sediments and their stratigraphic expression. Combined with the other analyses provide in this study, the surface till can be linked to the Lake Michigan Lobe and the last presence of glacial ice influencing the western section of the Sturgis Moraine.
X-RAY DIFFRACTION

As with the surface deposits, subsurface tills are the result of reworked materials from different sources. Subsurface till units within the study area represent materials that have been eroded, mixed and incorporated into the bedload of the glacier. These sediments are typically deposited subglacially and have sharp erosional contacts with adjacent materials.

Subsurface exploration identified two distinct diamicton units that were differentiated by their stratigraphic position in the geologic column, their sharp contacts with adjacent units and their associated mineralogy of clay separates. One method for differentiating diamicton units was the application of x-ray diffraction analytical techniques and the relevance of ratios between 7Å d-spacing and 10 Å d-spacing between clay minerals. This method, however, is a semi-quantitative correlation and does not adequately and consistently describe the same mineralogical assemblages (Flint 1999).

By examining the clay mineralogy of the recovered samples from Test Boring 96-52, it becomes evident that the results are different from the results of the eastern half of the Sturgis Moraine (Gardner, 1997, Flint, 1999). This may be the result of differential weathering of deposited diamictons, the variability of depositional processes or facies relationships between the two sections of the Sturgis Moraine. The physical placement of these materials within the stratigraphic column correlates with eastern deposits and may, with further exploration, be related to subsurface tills from the eastern section of the Sturgis Moraine.
The correlation of x-ray diffraction results remains inconclusive due the limited number of samples analyzed, the ability to produce a range of results for individual units and the lack of mineralogical data from the western section of the Sturgis Moraine.

TOPOGRAPHY

By examining the topography and stratigraphy of the study area it becomes evident that the western half of the Sturgis Moraine was the result of processes of more than one glacial lobe. The general topography is of an upland area consistent with moraines and consisting of ridges, hummocky terrain, depression features, kames, and tunnel valleys. Most exposed terrain is supraglacial in origin and made up of a discontinuous sandy diamicton capping glaciolacustrine materials.

Many linear features are readily observable within the interior sections of the moraine. Areas of high relief present themselves as ridges displaying orientations consistent with the ice margin orientations of the Lake Michigan and Saginaw Lobes. Linear depressions are present trending in similar directions to the flow paths of the Lake Michigan and Saginaw Lobes, and are interpreted to be tunnel valleys. Cross-cutting relationships within glacial materials show that these valleys have been partially buried by materials generated from the Saginaw and Lake Michigan Lobes.

An area near and surrounding Pleasant Lake shows a relatively flat topography bounded by upland areas. It is proposed that this broad area represents the deposition of glaciolacustrine and glaciofluvial materials proximal to the ice-margin of the Lake Michigan and possibly the Saginaw Lobe. The area extends from Pleasant Lake
southward to Hoffman Road. The occurrence of lakes and depressions surrounding this area, suggest that the area may also have been walled by ice at the time of deposition.

Evidence of glaciolacustrine sediments is observed at several gravel pits within gravel-size materials. These deposits contain ripple cross-bedded sand and silt units, as well as ice rafted clasts.

SEDIMENT-LANDFORM ASSEMBLAGES

The focus on sediment-landform assemblages is consistent with recent glacial investigations in southern Michigan. Sediment-landform assemblages can be used as models to help interpret the thermal bed conditions of glacial ice and its subsequent erosional and depositional processes during the late Wisconsinan. Local ice-margin positions were established by combining analytical data with the occurrence of sediment-landform assemblages observed within the study area.

Several recent studies have focused on the sediment-landform assemblage link to glacial processes. Similar to the glacial processes of the Sturgis Moraine, the Green Bay Lobe produced abundant subglacial landforms including narrow zones of supraglacial sediments, which are suggestive of a stable deglaciation (Colgan 1996, Attig et al 1989).

The Green Bay Lobe experienced thawed bed conditions beneath its interior with a frozen marginal zone (Attig et al. 1989). Under these conditions, trapped meltwaters erode subglacially into previous deposits or bedrock until they excavate a channel under the ice margin and break out at the marginal zone. The tunnel valleys associated with the Sturgis Moraine, similar to the Green Bay Lobe, suggest a similar basal thermal regime.
The Des Moines Lobe in Iowa illustrates a different retreatal history with a dominance of supraglacial landform assemblages. Unsteady flow conditions experienced by the Des Moines Lobe during its final retreat resulted in an abundance of supraglacial sediments hypothesized to be the product of a surging glacier regime (Colgan 1996, Patterson 1997). Under these conditions, supraglacial sediments would have been deposited on top of earlier subglacial sediment-landform assemblages.

Both of these deglaciation models can be applied to the study area and the development of the western section of the Sturgis Moraine. The presence of numerous tunnel valleys across the Sturgis Moraine, striking in the direction of Saginaw ice flow and also of the Lake Michigan Lobe to the west, is consistent with the presence of a frozen margin and thawed bed conditions similar to the Green Bay Lobe. Attig and others (1989) report the presence of permafrost until 13 kyr BP. This would place permafrost in Michigan during the retreat of glacial ice from the study area and would account for the abundance of tunnel valleys identified in the study area and those identified on the eastern portions of the Sturgis Moraine (Nicks, 2004, Flint, 1999, Kehew et al., 1999).

The wet-based thermal regime could apply to the Saginaw Lobe when it was at the Sturgis Moraine (Kehew et al. 1999). Attig and others (1989) suggest that landform creation is a function of the distance from the ice margin position. With thawed bed conditions, the subglacial dynamics may also be responsible for the creation of drumlins identified in the Union Streamline Plain (Kozlowski 1999). In addition, the presence of large amounts of glaciofluvial and glaciolacustrine sediments along with the proglacial
lake area previously identified, support the hypothesis that the study area was largely the result of thawed bed conditions of late Wisconsinan glacial ice.

The presence of the enigmatic surface diamicton identified and sampled throughout the study area is consistent with the glacial dynamics of the Des Moines Lobe, with its dominance of supraglacial sediment-landform assemblages. As suggested by surface deformation and drainage features within the study area, there was a rapid ice advance of the Lake Michigan Lobe after Saginaw ice retreated farther to the north.

It is hypothesized that the Lake Michigan Lobe overrode earlier glacial deposits, deforming these materials and blanketing the area with the sandy diamicton observed capping the landscape. This readvance of the Michigan Lobe is hypothesized by others (Kehew et al. 1999; in press, 2006) to be responsible for the truncated western portion of the Tekonsha Moraine to the north.
CHAPTER V - CONCLUSIONS

The Sturgis Moraine is part of the overall retreatal history of the Laurentide Ice Sheet as it moved from its maximum about 21,000 yr B.P., leaving behind a series of recessional moraines across Indiana, Ohio and Michigan. As it did so, the ice sheet divided itself into separate lobes that acted independently of each other. The western half of the Sturgis Moraine is the result of the processes of both the Lake Michigan and Saginaw Lobes as they retreated southern Michigan.

The Coldwater Shale lies beneath 100 to 300 feet of unconsolidated glacial material in the study area. The bedrock topography in St. Joseph County is irregular due to the erosional processes of glacial activity in southern Michigan. The bedrock topographic map (Figure 10) produced by Nicks (2004) shows a strong relationship between tunnel valley locations, surface drainage patterns and bedrock lows. It is assumed that as trapped subglacial meltwaters excavated below the interior portions of the glacier, they eroded channels into the bedrock.

Bedrock topography underneath the western section of the Sturgis Moraine is poorly described and very little information exists to correlate with surrounding areas. There are a limited number of well records encountering bedrock and few oil and gas wells were drilled in the areas immediately west of Three Rivers. There is evidence, however, that suggests that the study area experienced similar glacial dynamics to those of the eastern section of the Sturgis Moraine, including thawed bed conditions and a frozen ice-margin. These conditions are consistent with the occurrence of tunnel valleys in the study area and suggest that analogous erosional forces existed within the western
section of the Sturgis Moraine and likely excavated valleys into the Coldwater Shale below.

As the glacial lobes of the Laurentide Ice Sheet carved the current landscape of southern Michigan and the Sturgis Moraine, they left a complex of subglacial and supraglacial sediment-landform assemblages sharing similarity with both the Des Moines and Green Bay Lobes (Attig et al. 1989). Numerous tunnel valleys, streamlined features, outwash fans and ice-walled lake plains are readily observable throughout areas of the Sturgis Moraine, as well as, hummocky terrain and other elements of collapsed topography.

As the Saginaw Lobe retreated from the Sturgis Moraine, it left debris-laden ice occupying valleys eroded into the bedrock and overlying materials. Subsequently, as the Lake Michigan Lobe advanced into St. Joseph County from the position of the Kalamazoo Moraine, it overrode and deposited glacial materials over the existing ice-filled valleys. These materials were deposited as till, glaciolacustrine and glaciofluvial units, marking diachronic glacial events in the stratigraphic record, which are correlative with established ice-margin positions.

Geomorphic features are associated with the Lake Michigan Lobe and its advance to the position of the eastern section of the Sturgis Moraine (LM#1) (Figure 22) and the western Tekonsha Moraine (Kehew et al., 1999). During this stage of deglaciation, the Saginaw Lobe was positioned at the Tekonsha Moraine (Kozlowski, 1999), at which time, the Lake Michigan Lobe tunnel valleys were being formed. Lake Michigan Lobe tunnel valleys are observed to extend beyond the LM#2 position, suggesting that a frozen
ice-margin existed, similar to the Green Bay Lobe (Attig et al. 1989), when the Lake Michigan Lobe was at position LM#1.

It is likely that as the Lake Michigan Lobe retreated from LM#1, it deposited the grey to brown till described earlier as Unit 3. This till is encountered within the interior portions of the western section of the Sturgis Moraine as identified on numerous water well records and gamma ray logs. Unit 3 shares similar 7Å/10Å peak ratios with lower till units from the eastern section of the Sturgis Moraine, but is not assumed to be correlative due to its position in the stratigraphic column. Unit 3 is not known to extend beyond the LM#2 position and is likely absent from the Central Lowlands due to the successive erosion by meltwaters from a variety of sources, including the Lake Michigan and Saginaw Lobes.

As retreat continued, the Lake Michigan Lobe occupied position LM#2 generating an outwash fan identified as Fan 2, with its apex coinciding with the ice-margin position. When the Lake Michigan Lobe occupied position LM#2, it was still experiencing thawed bed conditions and a frozen margin. Tunnel valleys T4 and T5 were likely excavated during this stage of retreat. The tunnel valleys do not extend completely to position LM#2 and are likely buried under glaciolacustrine and glaciofluvial deposits.

Based on the occurrence of Unit 2 in the stratigraphic cross-sections, a fourth Lake Michigan Lobe position, LM#3A, is proposed (Figure 22). This position may be the expression of a fluctuating ice-margin between LM#3 and LM#2. The position of LM#3A is established by identifying the first occurrence of Unit 2 in cross-sections M1,
Figure 22 – Lake Michigan Ice-margin Positions Including LM#3A
(Source: Part of USGS 1:100,00 Elkhart Quadrangle)
M2 and M3. By interpolating between these points, an ice-margin position consistent with the Lake Michigan Lobe was established and is identified in Figure 22.

Ice-margin position LM#3A is consistent with the development of an ice-walled proglacial lake, identified near Pleasant Lake. Numerous gravel pits surrounding this area display lacustrine stratified sand, silt and gravel, cross-bedded ripple structures and units of ice-rafted debris. This lake plain, however, must have been dammed on its eastern side. It is suggested here that as the Saginaw Lobe advanced from the position of the Tekonsha Moraine, it may have moved southward as far as the Sturgis Moraine.

Streamlined features, including drumlins, are documented in the Union Streamlined Plain (Kozlowski, 1999, Dodson, 1986, Kehew et al., 1999) demonstrating that the Saginaw Lobe readvanced beyond the Tekonsha Moraine.

It is suggested that the Lake Michigan Lobe, residing at position LM#3A, and the Saginaw Lobe positioned somewhere immediately east of LM#2, combined with ice-filled tunnel valleys were responsible for the lake plain observed adjacent to and including Pleasant Lake. Large influxes of meltwater from both the Saginaw and Lake Michigan Lobes would also be responsible for the lacustrine deposits observed in the Hoffman, Roberts Broadway and Roberts M-60 pits.

Finally, both the Saginaw and Lake Michigan Lobes retreated; the Saginaw Lobe retreating northeastward from the Sturgis Moraine and the Lake Michigan Lobe to ice-margin position LM#3. Geomorphic features, such as Fan 1 and local drainage channels, place the Lake Michigan Lobe at position LM#3.

It is uncertain when the Lake Michigan Lobe readvanced across the western section of the Sturgis Moraine, but a great deal of evidence supports the hypothesis that a
rapid ice advance coupled with the supraglacial deposition of a surface diamicton occurred during the final retreat of ice from southwest Michigan. A surface diamicton, identified as Unit 1, discontinuously covers much of the study area and is associated with the deformation of lower units.

The intent of this investigation was to gather and assess glacial data from numerous sources to gain and improve on the understanding of events at the close of the Wisconsinan and the relative timing of glacial lobe positions and their influence on the development of the Sturgis Moraine. Techniques utilized by others conducting glacial studies in southern Michigan were employed and compared to construct a glacial history for the western section of the Sturgis Moraine.

Based on the data gathered through this investigation, it is evident that Sturgis Moraine was created by two distinctly different sets of processes. The Lake Michigan Lobe was much more influential in the final development of the western section of the Sturgis Moraine than was the Saginaw Lobe. Thus the western section of the Sturgis Moraine continued to be transformed by the processes of the Lake Michigan Lobe, long after the Saginaw Lobe had retreated from St. Joseph County.

This project demonstrates the importance of subsurface exploration of glacial deposits in southern Michigan. Combined with surface observations and insight into local geomorphic relationships, a geologic model was created to understand the local geology and the relative timing of glacial events and deposition of materials during the deglaciation of southern Michigan. The information provided from this study and other similar studies in southwestern Michigan will hopefully provide a local and regional
framework for future geologic investigations of the Sturgis Moraine and surrounding areas.
APPENDIX A

Surface Sample Locations
<table>
<thead>
<tr>
<th>IDN</th>
<th>LOCATION</th>
<th>X coord.</th>
<th>Y coord.</th>
</tr>
</thead>
<tbody>
<tr>
<td>96-004</td>
<td>Drummond Road</td>
<td></td>
<td></td>
</tr>
<tr>
<td>97-001</td>
<td>Robert's Gravel Pit, Broadway Road, .5 - 1m thick sandy diamicton, *found coal *grey clay floor in pit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>97-002</td>
<td>Pit at Clear Lake Road and Reed Road, surface tills and red sands</td>
<td></td>
<td></td>
</tr>
<tr>
<td>97-003</td>
<td>Hoffman Road near Clear Lake 0-4&quot;surface till</td>
<td></td>
<td></td>
</tr>
<tr>
<td>97-004</td>
<td>#2 Sandy Till</td>
<td></td>
<td></td>
</tr>
<tr>
<td>97-005</td>
<td>Hoffman Pit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>97-006</td>
<td>#4 Mt. Zion Road</td>
<td></td>
<td></td>
</tr>
<tr>
<td>97-007</td>
<td>#3 Dutch Settlement Road</td>
<td></td>
<td></td>
</tr>
<tr>
<td>97-008</td>
<td>Reed Road and RC-1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>97-009-1</td>
<td>Corey Lake Road, Camp Eberheart 24&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>98-001</td>
<td>Dutch Settlement W. edge of Fabius Twp. (920')</td>
<td></td>
<td></td>
</tr>
<tr>
<td>98-002</td>
<td>Day Road and Treman's Road (1000')</td>
<td></td>
<td></td>
</tr>
<tr>
<td>98-003</td>
<td>Abby Road and Hoffman Road, NE corner (914')</td>
<td></td>
<td></td>
</tr>
<tr>
<td>98-004</td>
<td>Mohoney Lake Road and Day Road (950')</td>
<td></td>
<td></td>
</tr>
<tr>
<td>98-005</td>
<td>Stoldt Road (915')</td>
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<td></td>
</tr>
<tr>
<td>98-006</td>
<td>Day Road, South of Dutch Settlement Road</td>
<td></td>
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<tr>
<td>98-007</td>
<td>Mt. Zion Road, East of Day Road</td>
<td></td>
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</tr>
<tr>
<td>98-008</td>
<td>NE corner of Cranberry Lake Road and Bent Road</td>
<td></td>
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<tr>
<td>98-009</td>
<td>Bent Road, South of Cranberry Lake Road</td>
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<td></td>
</tr>
<tr>
<td>98-010</td>
<td>Dutch Settlement and Day Road to west</td>
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<td></td>
</tr>
<tr>
<td>98-011</td>
<td>Mt. Zion Road, West of Bent Road</td>
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<tr>
<td>98-012</td>
<td>Hoffman Road and Stoldt Road</td>
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<tr>
<td>98-013</td>
<td>Stoldt Road and Coon Hollow Road</td>
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<tr>
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<td>Coon Hollow Road, West of Stoldt Road</td>
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<tr>
<td>98-015</td>
<td>Coon Hollow Road, Between Clear Lake Road and Mud Lake Road</td>
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<tr>
<td>98-016</td>
<td>Coon Hollow Road and Schafer Brothers Road</td>
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<td>Rumsey Road, West of County Line Road</td>
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</tr>
<tr>
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<td>Rumsey Road</td>
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<tr>
<td>98-019</td>
<td>Rumsey Road</td>
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<td>North of Broadway Road, South of Coon Hollow Road, East side of road</td>
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<td></td>
</tr>
<tr>
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<td>Corner of Broadway Road and Stoldt Road</td>
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<tr>
<td>98-023</td>
<td>Jones Road, South of Broadway Road</td>
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<tr>
<td>98-024</td>
<td>Jones Road, South of Broadway Road</td>
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<td></td>
</tr>
<tr>
<td>98-025</td>
<td>Van Selos Road, East of Jones Road</td>
<td></td>
<td></td>
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<tr>
<td>Codes</td>
<td>Description</td>
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</tr>
<tr>
<td>98-026</td>
<td>Van Selos Road, West of Krull Road</td>
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</tr>
<tr>
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<td>Krull Road, South of Van Selos Road</td>
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<td>North side of South Corey Lake Road, 3.5 ft.</td>
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<tr>
<td>98-029</td>
<td>New England Road, sandy till</td>
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<td></td>
</tr>
<tr>
<td>98-030</td>
<td>New England Road, South side</td>
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<td></td>
</tr>
<tr>
<td>99-002</td>
<td>South of Coon Hollow Road on Leo Road (Stoldt to West)</td>
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<td></td>
</tr>
<tr>
<td>99-003</td>
<td>South of Coon Hollow Road on Leo Road (Subdivision)</td>
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<td>Coon Hollow Road, West of Stoldt Road, North of Jennie Drive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>99-005</td>
<td>?</td>
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<tr>
<td>99-006</td>
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</tr>
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<td>99-008</td>
<td>North side of Coon Hollow Road, West of Pulver Road</td>
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<td>South side of Spence Road, West of Hoffman Road</td>
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<td>South side of Bullock Road</td>
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<td>99-011</td>
<td>South side of Bullock Road, West of Pulver Road</td>
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<td></td>
</tr>
<tr>
<td>99-012</td>
<td>South Side of Mahoney Lake Road, East of Ruggles Road</td>
<td></td>
<td></td>
</tr>
<tr>
<td>99-013</td>
<td>East Side of Ruggles Road, just North of Mahoney Lake Road</td>
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<td></td>
</tr>
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<td>99-014</td>
<td>West side of Ruggles Road, South of Mt. Zion Road</td>
<td></td>
<td></td>
</tr>
<tr>
<td>99-015</td>
<td>(no sample) South of Mt. Zion Road, West of Dutch Settlement Road</td>
<td></td>
<td></td>
</tr>
<tr>
<td>99-016</td>
<td>(no sample) SE corner of Lucas Road</td>
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Puddingstone Glacial Erratic - Floating Bridge Road

N42.00.535 W85.45.703
APPENDIX B

Textural Analysis of Recovered Surface Materials
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| 01-199 | 1.83 | 2.11 | 2.83 | 8.57 | 19.28 | 3.63 | 61.75 | 1.83 | 3.94 | 6.77 | 15.34 | 34.62 | 38.25 | 100.00 | 0.50152952 | 38.25 | 41.75 |
| 01-200 | 0.35 | 0.79 | 1.66 | 4.77 | 11.79 | 3.39 | 77.26 | 0.35 | 1.14 | 2.80 | 7.57 | 19.35 | 22.74 | 100.00 | 0.235708857 | 22.74 | 77.26 |
| 01-211 | 10.66 | 2.12 | 3.71 | 12.05 | 30.42 | 6.49 | 34.56 | 10.66 | 12.78 | 16.49 | 28.53 | 58.96 | 65.44 | 100.00 | 1.176613886 | 65.44 | 34.56 |
| 01-222 | 12.14 | 5.29 | 7.32 | 20.22 | 42.26 | 3.59 | 9.17 | 12.14 | 17.43 | 24.76 | 44.98 | 87.24 | 90.83 | 100.00 | 5.884796238 | 90.83 | 9.17 |
APPENDIX C

Centrifuge Spin Duration Calculations
Determining the centrifuge spin duration to extract clay-sized particles is based on four considerations:

1. The temperature of the solution.
2. The distance of the top and bottom of the solution from the center of rotation while rotating the centrifuge cup.
3. The maximum revolutions per minute.
4. The length of time to accelerate to maximum revolutions per minute (RPM) and decelerate to zero RPM.

Considerations 2, 3, and 4 are determined for the specific centrifuge device being used. Once these have been determined, only the temperature of the solution impacts the spin duration of the sample. The following formula was used to calculate spin duration for this study (Starkey 1984).

**Equation 2**

Centrifuge Spin Duration

\[ T = \frac{h \log_{10}(R_2/R_1) + 3.81 r^2 N^2 (\rho - \rho_o)}{3} + \frac{2(t_a + t_d)}{3} \]

where:

- \( h \) = viscosity of solution based on temperature
- \( R_1 \) = distance (cm) of top of solution from the center of rotation
- \( R_2 \) = distance (cm) of bottom of solution from the center of rotation
- \( r \) = largest diameter (cm) particle to remain in solution (<2µm = 10^{-4} cm)
- \( N \) = maximum RPM/60
- \( (\rho - \rho_o) \) = change in specific gravity of particles in water (1.65g/cm³)
- \( (t_a + t_d) \) = centrifuge acceleration and deceleration time in seconds

(Starkey 1984)
The centrifuge used in this study is located at the Western Michigan Soil Lab and the following equation represents the specific parameters for that device:

\[
T = \left[ h \log \left( \frac{9.8}{3.8} \right) \frac{3.81 \times 10^8 \times 25^2 \times 1.65}{3.8} \right] + 40
\]

\[
= h (10,471.77) + 40
\]

The following table was created by Gardner (1997) and used to determine spin durations for sample solutions of different temperatures:

**Table 5**

<table>
<thead>
<tr>
<th>Temp (°C)</th>
<th>h</th>
<th>Time (sec.)</th>
<th>Spin Time (min., sec.)</th>
<th>Deceleration (sec.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>0.01005</td>
<td>145.2</td>
<td>1 min., 55 sec.</td>
<td>30 sec.</td>
</tr>
<tr>
<td>21</td>
<td>0.00981</td>
<td>142.7</td>
<td>1 min., 53 sec.</td>
<td>30 sec.</td>
</tr>
<tr>
<td>22</td>
<td>0.00958</td>
<td>140.3</td>
<td>1 min., 50 sec.</td>
<td>30 sec.</td>
</tr>
<tr>
<td>23</td>
<td>0.00936</td>
<td>138.0</td>
<td>1 min., 48 sec.</td>
<td>30 sec.</td>
</tr>
<tr>
<td>24</td>
<td>0.00914</td>
<td>135.7</td>
<td>1 min., 46 sec.</td>
<td>30 sec.</td>
</tr>
<tr>
<td>25</td>
<td>0.00894</td>
<td>133.6</td>
<td>1 min., 43.5 sec.</td>
<td>30 sec.</td>
</tr>
<tr>
<td>26</td>
<td>0.00874</td>
<td>131.5</td>
<td>1 min., 41.5 sec.</td>
<td>30 sec.</td>
</tr>
<tr>
<td>27</td>
<td>0.00855</td>
<td>129.5</td>
<td>1 min., 39.5 sec.</td>
<td>30 sec.</td>
</tr>
<tr>
<td>28</td>
<td>0.00836</td>
<td>126.3</td>
<td>1 min., 36 sec.</td>
<td>30 sec.</td>
</tr>
</tbody>
</table>

(Modified from Gardner 1997)
APPENDIX D

X-Ray Diffraction of Clay Minerals
in Subsurface Diamictons
<table>
<thead>
<tr>
<th>Sample #</th>
<th>7A peak</th>
<th>10A peak</th>
<th>7A/10A</th>
</tr>
</thead>
<tbody>
<tr>
<td>62'</td>
<td>1</td>
<td>6.3</td>
<td>8.6</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>9.9</td>
<td>12.7</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>5.7</td>
<td>8.5</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>5.4</td>
<td>8.2</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>4.3</td>
<td>6.1</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>4.1</td>
<td>6.4</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avg.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sample #</th>
<th>7A peak</th>
<th>10A peak</th>
<th>7A/10A</th>
</tr>
</thead>
<tbody>
<tr>
<td>153'</td>
<td>1</td>
<td>9.7</td>
<td>17.4</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>10.3</td>
<td>18.8</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>9.2</td>
<td>15.0</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>9.5</td>
<td>15.5</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>3.3</td>
<td>5.5</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>5.0</td>
<td>7.5</td>
</tr>
<tr>
<td>188'</td>
<td>7</td>
<td>9.2</td>
<td>15.1</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>10.1</td>
<td>18.2</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>7.2</td>
<td>12.3</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avg.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------</td>
<td>----------</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td>0.683167</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Standard Error</strong></td>
<td>0.030164</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Median</strong></td>
<td>0.688</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mode</strong></td>
<td>#N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Standard Deviation</strong></td>
<td>0.073888</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sample Variance</strong></td>
<td>0.005459</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Kurtosis</strong></td>
<td>0.02989</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Skewness</strong></td>
<td>-0.38873</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td>0.211</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Minimum</strong></td>
<td>0.569</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Maximum</strong></td>
<td>0.78</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sum</strong></td>
<td>4.099</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Count</strong></td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Confidence Level (95.0%)</strong></td>
<td>0.07754</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX E

Water Well Records Used to Construct
Stratigraphic Cross-sections
Cross-section M1 – M1′
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978. Failure to comply is a misdemeanor.

<table>
<thead>
<tr>
<th>Well ID: 75000001879</th>
</tr>
</thead>
<tbody>
<tr>
<td>County: St. Joseph</td>
</tr>
<tr>
<td>Township: Fabius</td>
</tr>
<tr>
<td>Tax No: 004-006-004-01</td>
</tr>
<tr>
<td>Permit No:</td>
</tr>
</tbody>
</table>

**Import ID: 75761206007**

<table>
<thead>
<tr>
<th>Well ID: 75000001879</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failure to comply is a misdemeanor.</td>
</tr>
</tbody>
</table>

**Well Name:**

<table>
<thead>
<tr>
<th>Well Owner: David And Susan Salvat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well Address: 10556 MOHNEY LAKE ROAD</td>
</tr>
<tr>
<td>Owner Address: 10556 MOHNEY LAKE ROAD 3 RIVERS MI 49093</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drilling Method: Rotary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well Depth: 153.00 ft.</td>
</tr>
<tr>
<td>Well Use: Household</td>
</tr>
</tbody>
</table>

| Well Type: New |
| Date Completed: 5/26/1992 |

| Casing Type: PVC plastic |
| Diameter: 5.00 in. to 148.00 ft. depth |
| 3.00 in. to 153.00 ft. depth |

| Bore Diameter 1: 8.00 in. to 20.00 ft. depth |
| Bore Diameter 2: |
| Bore Diameter 3: Height: 1.00 ft. above grade |
| Casing Fitting: None |

| Static Water Level: 90.00 ft. Below Grade(Not Flowing) |
| Yield Test Method: Unknown |
| Measurement Taken During Pump Test: 93.00 ft. after 1.00 hrs. pumping at 30.00 GPM |

| Abandoned Well Plugged: Yes |
| Reason for not plugging Well: |

| Screen Installed: Yes |
| Filter Packed: No |
| Screen Diameter: 3.00 in. |
| Length: 5.00 ft. |
| Screen Material Type: Slot: 12.00 in. Set Between 148.00 ft. and 153.00 ft. |
| Blank: 1.00 ft. Above |
| Fittings: Neoprene packer |

| Well Grouted: Yes |
| Grouting Method: Unknown |

| No. of Bags: |
| Grouting Materials: Bentonite slurry From 0.00 ft. to 25.00 ft. |

| Well Head Completion: Pitless adapter |

| Nearest source of possible contamination: Type: 60.00 ft. East |

| Drilling Machine Operator Name: RICK CLARK |
| Employment: Unknown |

| Other Remarks: WP13411 |
| EQP 2017C (2/2000) |

**WATER WELL CONTRACTOR’S CERTIFICATION:**

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

| Contractor Type: Unknown |
| Registration Number: 1794 |
| Business Name: |
| Business Address: |

Signature of Registered Representative Date

**ATTENTION WELL OWNER: FILE WITH DEED**

2/19/2000 17:43
### WATER WELL AND PUMP RECORD

**Well ID:** 75000001972  
**Completion is required under authority of Part 127 Act 368 PA 1978.**

**Import ID:** 75761209035  
**Failure to comply is a misdemeanor.**

<table>
<thead>
<tr>
<th>Tax No:</th>
<th>004-009-007-00</th>
<th>Permit No:</th>
<th>County: St. Joseph</th>
<th>Township: Fabius</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Well ID:** 75000001972  
**Elevation:** 985 ft  
**Latitude:** 41.9651485226  
**Longitude:** -85.7177173101

**Drilling Method:** Jetted  
**Well Type:** Replacement  
**Date Completed:** 7/10/1969  
**Well Use:** Household

**Casing Type:** Unknown  
**Casing Joint:** Threaded & coupled  
**Diameter:** 2.00 in. to 149.00 ft. depth

**Bore Diameter 1:**  
**Bore Diameter 2:**  
**Bore Diameter 3:**  
**Height:** 1.00 ft. above grade  
**Casing Fitting:** Drive shoe

**Static Water Level:** 999.99 ft. Below Grade (Not Flowing)  
**Yield Test Method:** Unknown  
**Measurement Taken During Pump Test:**

**Abandoned Well Plugged:** No  
**Reason for not plugging Well:**

**Screen Installed:** Yes  
**Well Intake:**

**Screen Diameter:** 1.25 in.  
**Length:** 4.00 ft.  
**Screen Material Type:**

**Slot:** 10.00 in. Set Between 149.00 ft. and 153.00 ft.  
**Blank:** 0.00 ft. Above  
**Fittings:** None

**Well Grouted:** No  
**Grouting Method:**

**No. of Bags:** Additives:

**Grouting Materials:**

**Well Head Completion:** Pitless adapter

**Nearest source of possible contamination:**

**Type:** Septic tank  
**Distance:** 50.00 ft.  
**Direction:** West

**Drilling Machine Operator Name:**

**Employment:** Unknown

**General Remarks:**

**OTHER REMARKS**


**ATTENTION WELL OWNER: FILE WITH DEED**

<table>
<thead>
<tr>
<th>Formation Description</th>
<th>Thickness</th>
<th>Depth to Bottom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Clay</td>
<td>8.00</td>
<td>8.00</td>
</tr>
<tr>
<td>Clay &amp; Sand</td>
<td>30.00</td>
<td>38.00</td>
</tr>
<tr>
<td>Blue Clay</td>
<td>15.00</td>
<td>53.00</td>
</tr>
<tr>
<td>Blue Clay &amp; Sand</td>
<td>42.00</td>
<td>95.00</td>
</tr>
<tr>
<td>Sand Very Fine Wett/Moist</td>
<td>35.00</td>
<td>130.00</td>
</tr>
<tr>
<td>Sand Coarse</td>
<td>23.00</td>
<td>153.00</td>
</tr>
</tbody>
</table>

**Geology Remarks:** 1. [RED CLAY] [8] 2. [CLAY & SAND] [38] [30] 3. [BLUE CLAY] [15] 4. [BLUE CLAY & SAND] [65] [42] 5. [WATER SAND VERY FINE] [130] [35] 6. [COARSE SAND] [153] [23]

**Contractor Type:** Unknown  
**Registration Number:** 205  
**Business Name:**

**Business Address:**

**WATER WELL CONTRACTOR'S CERTIFICATION:**

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

**Signature of Registered Representative:**

**Date:** 2/18/2000 17:44

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**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978.

**Failure to comply is a misdemeanor.**

---

**Well ID: 75000001958**

- **Well ID:** 75000001958
- **Elevation:** 890 ft
- **Latitude:** 41.9621583491
- **Longitude:** -85.7161486617

**Well Name:**
- **Owner:** Paula Vanvalkenburoh
- **Address:** 57437 STOLDT ROAD
- **City:** 3 RIVERS MI 49093

**Drilling Method:** Cable tool

**Well Depth:** 100.00 ft
**Well Type:** New
**Date Completed:** 8/12/1987

**Casing Type:** Steel - black
**Casing Joint:** Threaded & coupled
**Diameter:** 4.00 in. to 94.00 ft. depth

**Bore Diameter 1:**
**Height:** 1.00 ft. above grade
**Casing Fitting:** Drive shoe

**Static Water Level:** 41.00 ft. Below Grade (Not Flowing)
**Yield Test Method:** Unknown
**Measurement Taken During Pump Test:** 41.00 ft. after 1.00 hrs. pumping at 50.00 GPM

**Abandoned Well Plugged:** No
**Reason for not plugging Well:**

**Screen Installed:** Yes
**Well Intake:**
**Filter Packed:** No
**Screen Diameter:** 4.00 in.
**Length:** 6.00 ft.
**Screen Material Type:**
**Slot:** 10.00 in. Set Between 94.00 ft. and 100.00 ft.
**Blank:** 1.00 ft. Above
**Fittings:** Neoprene packer

**Well Grouted:** Yes
**Grouting Method:** Unknown
**No. of Bags:** Additives: None
**Grouting Materials:** Bentonite slurry From 0.00 ft. to 35.00 ft.

**Well Head Completion:** Pitless adapter

**Nearest source of possible contamination:**
**Type:** Septic tank
**Distance:** 120.00 ft. South

**Drilling Machine Operator Name:** CHARLIE JR.
**Employment:** Unknown

**General Remarks:** WP8786

---

**ATTENTION WELL OWNER: FILE WITH DEED**

---

**Geology Remarks:**
1. [BROWN CLAY & GRAVEL] [15] [15]
2. [BROWN CLAY & GRAVEL] [35] [20]
3. [SOFT GRAY CLAY] [90] [65]
4. [COARSE SAND] [100] [10]

**Well Data:**
- **Well ID:** 7500001958
- **Failure to comply is a misdemeanor.**

---

**Contractor Type:** Unknown
**Registration Number:** 112
**Business Name:**
**Business Address:**
**WATER WELL CONTRACTOR’S CERTIFICATION:**
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

**Signature of Registered Representative**

---

**ATTENTION WELL OWNER: FILE WITH DEED**

---

**Printed by:**

---

**PAGE 126**
WATER WELL AND PUMP RECORD

Well ID: 75000002174

Completion is required under authority of Part 127 Act 368 PA 1978.

Failure to comply is a misdemeanor.

Import ID: 75761216014

Tax No: 004-016-001-30

Permit No:

County: St. Joseph

Township: Fabius

Fraction:

Section: 16

Town/Range: 06S 12W

French Claim: WSSN:

Distance and Direction from Road Intersection: E. SIDE OF AVERY ROAD, .2 MILE N. OF COON HOLLOW ROAD

Well ID: 75000002174

Failure to comply is a misdemeanor.

Elevation: 890 ft

Latitude: 41.94999325

Longitude: -85.7036260998

Well Name:

Well Owner: Russell & Hope Gearhart

Well Address:

58265 AVERY ROAD

3 RIVERS, MI 49093

Owner Address:

58265 AVERY ROAD

3 RIVERS, MI 49093

Drilling Method: Rotary

Well Depth: 119.00 ft.

Well Use: Household

Well Type: New

Date Completed: 2/2/1991

Casing Type: PVC plastic

Casing Joint: Welded

Diameter: 5.00 in. to 114.00 ft. depth

Bore Diameter 1: 8.00 in. to 28.00 ft. depth

Bore Diameter 2:

Bore Diameter 3:

Height: 1.00 ft. above grade

Casing Fitting: None

Static Water Level: 35.00 ft. Below Grade(Not Flowing)

Yield Test Method: Unknown

Measurement Taken During Pump Test:

38.00 ft. after 1.00 hrs. pumping at 50.00 GPM

Abandoned Well Plugged: No

Reason for not plugging Well:

Abandoned well ID:

Screen Installed: Yes

Well Intake:

Filter Packed: No

Screen Diameter: 3.00 in.

Length: 5.00 ft.

Screen Material Type:

Slot: 15.00 in.

Blank: 1.00 ft. Above

Fittings:

Neoprene packer

Well Grouted: Yes

Grouting Method: Unknown

No. of Bags: Additives: None

Grouting Materials:

Bentonite slurry: From 0.00 ft. to 28.00 ft.

Well Head Completion: Pilless adapter

Nearest source of possible contamination:

Type: Septic tank

Distance: 50.00 ft.

Direction: North

Drilling Machine Operator Name:

Employment: Unknown

General Remarks: WP11370

WATER WELL CONTRACTOR'S CERTIFICATION:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Contractor Type: Unknown

Registration Number: 1794

Business Name: WP11370

Business Address:

ATTENTION WELL OWNER: FILE WITH DEED

2/18/2000 17:47
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978.

Failure to comply is a misdemeanor.

**Well ID:** 75000002314

**Well Name:**

Well Owner: Phillio Dufour

**Well Address:**

13603 BROADWAY ROAD
3 RIVERS Ml 49093

**Owner Address:**

3 RIVERS Ml 49093

**Drilling Method:** Jetted

**Well Depth:** 135.00 ft.

**Well Use:** Household

**Well Type:** New

**Date Completed:** 2/19/1991

**Casing Type:** Steel - black

**Casing Joint:** Threaded & coupled

**Diameter:** 4.00 in. to 130.00 ft. depth

**Bore Diameter 1:**

**Bore Diameter 2:**

**Bore Diameter 3:**

**Height:** 1.00 ft. above grade

**Casing Fitting:** Drive shoe

**Static Water Level:** 72.00 ft. Below Grade

**Yield Test Method:** Unknown

**Measurement Taken During Pump Test:**

72.00 ft. after 1.00 hrs. pumping at 60.00 GPM

**Abandoned Well Plugged:** No

**Reason for not plugging Well:**

**Abandoned well ID:**

**Screen Installed:** Yes

**Filter Packed:** No

**Screen Diameter:** 3.50 in.

**Length:** 5.00 ft.

**Screen Material Type:**

**Slot:** 12.00 in. Set Between 130.00 ft. and 135.00 ft.

**Blank:** 2.00 ft. Above

**Fittings:** Neoprene packer

**Well Grouled:** Yes

**Grouting Method:** Unknown

**No. of Bags:** Additives: None

**Grouting Materials:** Other From 0.00 ft. to 0.00 ft.

**Well Head Completion:** Pitless adapter

**Nearest source of possible contamination:**

**Type:** Distance Direction

**Septic tank:** 50.00 ft. South

**Drilling Machine Operator Name:** JON LEWIS

**Employment:** Unknown

**General Remarks:** WP12023

**OTHER REMARKS**

**Grouting Material 1:** Listed as other in Wellkey


**ATTENTION WELL OWNER: FILE WITH DEED**

2/18/2000 17:50

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### Water Well and Pump Record

**Well ID:** 75000002395  
**Completion is required under authority of Part 127 Act 368 PA 1978.**

**Import ID:** 75761226004  
**Failure to comply is a misdemeanor.**

**Well ID:** 75000002395  
**Failure to comply is a misdemeanor.**

**Well Name:**  
**Well Owner:** Roberts Aggregates  
**Well Address:** 14571 M-60 3 RIVERS MI 49093  
**Owner Address:** 14571 M-60 3 RIVERS MI 49093

**Tax No:** 004-026-004-10  
**Permit No:** I  
**County:** St. Joseph  
**Township:** Fabius  
**Fraction:** I  
**Section:** 26  
**Town/Range:** 06S 12W  
**French Claim:** WSSN:  
**Distance and Direction from Road Intersection:** 25 MILE E. OF ROBERTS RD., ON THE S. SIDE OF M-60

**Well Elevation:** 850 ft  
**Latitude:** 41.9202417452  
**Longitude:** -85.668477629

**Drilling Method:** Cable tool  
**Well Type:** New  
**Date Completed:** 2/23/1990  
**Well Depth:** 130.00 ft  
**Well Use:** Industrial  
**Casing Type:** Steel - black  
**Casing Joint:** Welded  
**Diameter:** 12.00 in. to 110.00 ft. depth

**Bore Diameter 1:**  
**Bore Diameter 2:**  
**Bore Diameter 3:**  
**Height:** 1.00 ft. above grade  
**Casing Fitting:** Drive shoe

**Static Water Level:** 28.00 ft. Below Grade (Not Flowing)  
**Yield Test Method:** Unknown  
**Measurement Taken During Pump Test:** 70.00 ft. after 1.00 hrs. pumping at 850.00 GPM  
**Well Used:** Industrial  
**Screen Installed:** Yes  
**Well Intake:**  
**Screen Diameter:** 11.75 in.  
**Length:** 20.00 ft.  
**Screen Material Type:**  
**Slot:** 15.00 in.  
**Blank:** 0.00 ft. Above

**Well Grouted:** Yes  
**Grouting Method:** Unknown  
**No. of Bags:** Additives: None  
**Grouting Materials:** Neoprene packer  
**Neat cement:** From 0.00 ft. to 0.00 ft.  
**Well Head Completion:** 12 inches above grade, Other

**Nearest source of possible contamination:**  
**Type:** Distance Direction  
**Unknown:** 0.00 ft.  
**Unknown:**

**Well Head Completion:** 12 inches above grade

**Drilling Machine Operator Name:** JON LEWIS  
**Employment:** Unknown

**Contractor Type:** Unknown  
**Registration Number:** 187  
**Business Name:**  
**Business Address:**

**Geology Remarks:** 1. [SAND & GRAVEL] [20] [20] 2. [FINE SAND] [56] [36] 3. [BLUE CLAY & FINE SAND] [76] [20] 4. [BLUE CLAY] [108] [32] 5. [FINE SAND] [118] [10] 6. [COARSE SAND & GRAVEL] [130] [12]

**WATER WELL CONTRACTOR'S CERTIFICATION:** This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

**Signature of Registered Representative**

**Drilling Machine Operator Name:** JON LEWIS  
**Employment:** Unknown

**General Remarks:** LINE SHAFT TURBINE PUMP. SCREEN HAS TOP .015 SLOT ON TOP 12 FEET AND .040 SLOT ON BOTTOM 8 FEET. WELL IS FOR SAND AND GRAVEL WASHING

**Attention Well Owner:** FILE WITH DEED

**ATTENTION WELL OWNER:** FILE WITH DEED

**Date:** 2/18/2000 17:51
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978. Failure to comply is a misdemeanor.

**Import ID:** 75761225008

---

**Well ID:** 75000002386

- **Tax No:** 004-025-010-00  
- **Well Name:** Jeffrey Williams  
- **County:** St. Joseph  
- **Township:** Fabius  
- **Well Address:** 15220 GLEASON ROAD  
  3 RIVERS MI 49093

---

**Drilling Method:** Jetted

- **Well Depth:** 152.00 ft.  
- **Well Type:** Replacement  
- **Date Completed:** 11/30/1974

**Casing Type:** Steel - black  
**Casing Joint:** Threaded & coupled  
**Diameter:** 4.00 in. to 0.00 ft. depth

**Bore Diameter 1:**  
**Bore Diameter 2:**  
**Bore Diameter 3:**  
**Height:** 0.00 ft. above grade  
**Casing Fitting:** Drive shoe

---

**Well Use:** Household  
**Pump Installed:** Yes

**Manufacturer:** Flint & Walling  
**Model Number:**  
**Pump Type:** Submersible  
**Pump Capacity:** 0.00 GPM

**Length of Drop Pipe:** 140.00 ft.  
**Diameter of Drop Pipe:**  
**Draw Down Seal Used:** No

**Pressure Tank Installed:** No  
**Pressure Tank Type:**  
**Model Number:**  
**Tank Capacity:** Gallons

**Topsoil WC**  
**Sand & Gravel**  
**Sand**  
**Red Clay**  
**Blue Clay**  
**Topsoil Well Moist**  
**Blue Clay**  
**Topsoil Well Moist**

---

**Screen Installed:** Yes  
**Screen Diameter:** 3.00 in.  
**Length:** 0.00 ft.  
**Slot:** 8.00 in. Set Between 0.00 ft. and 0.00 ft.  
**Blank:** 0.00 ft. Above  
**Fittings:** Neoprene packer

**Well Grouted:** No  
**Grouting Method:**  
**No. of Bags:**  
**Grouting Materials:**

**Well Head Completion:** Pitless adapter

---

**Nearest source of possible contamination:**

- **Type:** Septic tank  
  **Distance Direction:** 80.00 ft. East

**Drilling Machine Operator Name:**  
**Employment:** Unknown

---

**General Remarks:** FORMATION DESCRIPTION IS THE SAME AS WELL # 75761225009 FOR 15185 GLEASON ACROSS THE ROAD

**OTHER REMARKS**

**ATTENTION WELL OWNER: FILE WITH DEED**

---

**Contractor Type:** Unknown  
**Registration Number:** 205

**Business Name:**  
**Business Address:**

**WATER WELL CONTRACTOR’S CERTIFICATION:**  
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

**Signature of Registered Representative:**  
**Date:**

---


---

**Employment:** Unknown

---

**General Remarks:** FORMATION DESCRIPTION IS THE SAME AS WELL # 75761225009 FOR 15185 GLEASON ACROSS THE ROAD

**OTHER REMARKS**

**ATTENTION WELL OWNER: FILE WITH DEED**

---

**Signature of Registered Representative:**  
**Date:**

---

**General Remarks:** FORMATION DESCRIPTION IS THE SAME AS WELL # 75761225009 FOR 15185 GLEASON ACROSS THE ROAD

---

**OTHER REMARKS**

**ATTENTION WELL OWNER: FILE WITH DEED**
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978.

Failure to comply is a misdemeanor.

**Well ID: 75000002391**

- **Well Owner:** Steven Stuckey
- **Well Address:** 15131 GLEASON ROAD 3 RIVERS MI 49093
- **Owner Address:** 3 RIVERS MI 49093

---

**Drilling Method:** Jetted

- **Well Depth:** 204.00 ft.
- **Well Type:** Replacement
- **Date Completed:** 6/21/1994

**Casing Type:** Steel - black

- **Diameter:** 4.00 in. to 200.00 ft. depth

**Bore Diameter 1:**

- **Height:** 0.00 ft. above grade
- **Casing Fitting:** None

**Static Water Level:** 90.00 ft. Below Grade (Not Flowing)

**Yield Test Method:** Unknown

**Measurement Taken During Pump Test:**

- 0.00 ft. after 0.00 hrs. pumping at 50.00 GPM

**Abandoned Well Plugged:** No

**Reason for not plugging Well:**

- Abandoned well ID:

- **Screen Installed:** Yes
- **Well Intake:**
- **Screen Diameter:** 3.75 in.
- **Length:** 4.00 ft.
- **Screen Material Type:**
- **Slot:** 12.00 in. Set Between 200.00 ft. and 204.00 ft.
- **Blank:** 9.90 ft. Above
- **Fittings:** Neoprene packer

- **Well Grouted:** Yes
- **Grouting Method:** Unknown
- **No. of Bags:**
- **Additives:** None
- **Grouting Materials:** Bentonite slurry From 0.00 ft. to 0.00 ft.

- **Well Head Completion:** Pitless adapter

- **Nearest source of possible contamination:**
- **Type:** Unknown
- **Distance Direction:** 0.00 ft.

- **Drilling Machine Operator Name:** TODD GOTSHALL
- **Employment:** Unknown

**General Remarks:** WP15231 BLANK ABOVE SCREEN = 15.0 FEET

**OTHER REMARKS**


---

**ATTENTION WELL OWNER: FILE WITH DEED**

2/18/2000 17:51
**WATER WELL AND PUMP RECORD**

**Completion is required under authority of Part 127 Act 368 PA 1978.**

Failure to comply is a misdemeanor.

---

**Well ID:** 75000006454

**Tax No:** 00-02-4935

**County:** St Joseph

**Township:** Lockport

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<td>06S 11W</td>
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**Distance and Direction from Road Intersection:** 1/10 MILE W OF CONSTANTINE RD ON S SIDE OF SHOREWOOD DR

**Well Name:**

- **Well Owner:** Donald Thibos
- **Well Address:** 61096 SHOREWOOD DR
- **Owner Address:** 61096 SHOREWOOD DR
- **THREE RIVERS MI 49093**
- **THREE RIVERS MI 49093**

**Drilling Method:** Rotary

**Well Depth:** 81.00 ft.

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 6/7/2002

**Casing Type:** PVC plastic

**Casing Joint:** Unknown

**Diameter:** 5.00 in. to 81.00 ft. depth

**Bore Diameter 1:** 8.00 in. to 81.00 ft. depth

**Bore Diameter 2:**

**Bore Diameter 3:**

**Height:** 1.00 ft. above grade

**Casing Fitting:** None

**Static Water Level:** 14.00 ft. Below Grade (Not Flowing)

**Yield Test Method:** Air

**Measurement Taken During Pump Test:**

- **16.00 ft. after 1.00 hrs. pumping at 25.00 GPM**

**Abandoned Well Plugged:** Yes

**Reason for not plugging Well:**

**Abandoned well ID:**

**Screen Installed:** Yes

**Well Intake:**

**Filter Packed:** No

**Screen Diameter:** 5.00 in.

**Length:** 5.00 ft.

**Screen Material Type:** PVC slotted

**Slot:** 20.00 in. Set Between 76.00 ft. and 81.00 ft.

**Blank:** 0.00 ft. Above

**Fittings:**

- **None**

**Well Grouded:** Yes

**Grouting Method:** Unknown

**No. of Bags:** 4

**Additives:** None

**Grouting Materials:**

- **Bentonite slurry**
  - From 0.00 ft. to 75.00 ft.

**Well Head Completion:**

- **12 inches above grade. Pitless adapter**

**Nearest source of possible contamination:**

- **Type:**
- **Distance:** 60.00 ft.
- **Direction:** North

**Drilling Machine Operator Name:** RICK CLARK

**Employment:** Employee

**General Remarks:**

**OTHER REMARKS**


---

**ATTENTION WELL OWNER: FILE WITH DEED**

11/15/2002 09:31
Cross-section M2 – M2'
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978.

**Well ID:** 7500002461

**Tax No:** 004-030-006-00  **Permit No:** 

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<td>NW½ NW½ NE¼</td>
<td>30</td>
<td>06S 12W</td>
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**Distance and Direction from Road Intersection:** ON HILL BEHIND SITE 39, 5 MILE E. OF COUNTY LINE ROAD

**Well Name:**

**Well Owner:** Corey Lake Recreation Area

**Well Address:**

10705 COREY LAKE ROAD 3 RIVERS MI 49093

**Owner Address:**

10705 COREY LAKE ROAD 3 RIVERS MI 49093

**Well ID:** 75000002461

**Elevation:** 920 ft

**Latitude:** 41.9250827141  **Longitude:** -85.7499837022

**Drilling Method:** Unknown

**Well Depth:** 112.00 ft  **Well Use:** Other

**Well Type:** Replacement  **Date Completed:** 6/14/1974

**Casing Type:** Unknown  **Casing Joint:** Unknown

**Diameter:** 2.00 in. to 100.00 ft. depth

**Bore Diameter 1:**

**Bore Diameter 2:**

**Bore Diameter 3:**

**Casing Fitting:** Drive shoe

**Static Water Level:** 65.00 ft. Below Grade (Not Flowing)

**Yield Test Method:** Unknown

**Measurement Taken During Pump Test:**

**Abandoned Well Plugged:** No  **Reason for not plugging Well:**

**Abandoned well ID:**

**Screen Installed:** No  **Well Intake:** Unknown

**Filter Packed:**

**Screen Diameter:**

**Screen Material Type:**

**Slot:**

**Blank:**

**Fittings:**

**Well Grouted:** Yes  **Grouting Method:** Unknown

**No. of Bags:**

**Grouting Materials:**

**Unknown**

**Well Head Completion:** Unknown

**Nearest source of possible contamination:**

**Type:**

**Distance Direction:**

**Unknown**

**Unknown**

**Drilling Machine Operator Name:** Unknown

**Employment:** Unknown

**General Remarks:** NORTHWEST WELL BY CAMPSITE 39 (CAMP AREA #3)

**Contractor Type:** Unknown  **Registration Number:** 834

**Business Name:**

**Business Address:**

**WATER WELL CONTRACTOR'S CERTIFICATION:**

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

**Signature of Registered Representative**

**Date**

**ATTENTION WELL OWNER: FILE WITH DEED**

2/18/2000 17:52
WATER WELL AND PUMP RECORD

Completion is required under authority of Part 127 Act 368 PA 1978.

Failure to comply is a misdemeanor.

Import ID: 75761229014

Well ID: 75000002455

Well ID: 75000002455

Well Name: George Myers

Well Address: 11540 COREY LAKE ROAD

Owner Address: 3 RIVERS MI 49093

Tax No: 004-140-020-00

Permit No: 75761229014

Fraction: SE 1/4 NW 1/4

Section: 29

Town/Range: 06S 12W

French Claim: WSSN:

Distance and Direction from Road Intersection: N. SIDE OF CORY LAKE RD., E. OF DUDD

Well Owner: George Myers

Well Address: 11540 COREY LAKE ROAD

Owner Address: 3 RIVERS MI 49093

Drilling Method: Hollow rod

Well Depth: 81.00 ft. Well Use: Household

Well Type: New Date Completed: 8/4/1967

Casing Type: Steel - back

Casing Joint: Threaded & coupled Diameter: 2.00 in. to 77.00 ft. depth

Bore Diameter 1:

Bore Diameter 2:

Bore Diameter 3:

Height: 1.00 ft. above grade

Casing Fitting: Drive shoe

Static Water Level: 50.00 ft. Below Grade(Not Flowing)

Yield Test Method: Unknown

Measurement Taken During Pump Test:

Abandoned Well Plugged: No

Reason for not plugging Well:

Abandoned well ID:

Screen Installed: Yes Well Intake:

Filter Packed: No Length: 4.00 ft.

Screen Material Type:

Slot: 10.00 in. Set Between 77.00 ft. and 81.00 ft.

Blank: 0.00 ft. Above

Fittings: Bremer check valve

Well Grouted: No Grouting Method:

No. of Bags: Additives:

Grouting Materials:

Well Head Completion: Other

Contractor Type: Unknown

Registration Number: 18

Business Name: 

Business Address: 

Nearest source of possible contamination:

Type: Distance Direction

Septic tank: 60.00 ft. Southeast

Well Drilling Machine Operator Name: 

Employment: Unknown

Geology Remarks: 1. [CLAY RED] [20] [20] 2. [CLAY & GRAVEL] [60] [40] 3. [WHITE SAND] [81] [21]

Formation Description Thickness Depth to Bottom

Red Clay 20.00 20.00

Clay & Gravel 40.00 50.00

White Sand 21.00 81.00

WATER WELL CONTRACTOR'S CERTIFICATION:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Driller: 

Signature of Registered Representative Date

General Remarks: LOT 20, DUDD SUB., TAX RECORDS SHOW ADDRESS AS 11420 HARMON COURT, OWNERS USE COREY LAKE ROAD ADDRESS

OTHER REMARKS: Well Head Completion: Approved Pit Pump Manufacturer: RAPID DAYTON

ECP 2017C (2/2000) ATTENTION WELL OWNER: FILE WITH DEED

2/18/2000 17.52
DEY WATER WELL AND PUMP RECORD
Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.
Import ID: 75761229012

Well ID: 75000002453

Well Name: Don Winne

Well ID: 75000002453

Distance and Direction from Road Intersection: N. SIDE OF OAK AVE., E. OF KING ST.

Well Elevation: 890 ft
Latitude: 41.9242444114
Longitude: -85.7355795123

Well Depth: 82.00 ft
Well Use: Household

Well Type: Replacement
Date Completed: 8/19/1974

Casing Type: Steel - black
Casing Joint: Threaded & coupled
Diameter: 2.00 in. to 78.00 ft. depth

Bore Diameter 1:
Bore Diameter 2:
Bore Diameter 3:
Height: 1.00 ft. above grade
Casing Fitting: Drive shoe

Drilling Method: Auger/Bored

Well Installed: Yes
Pump Installation date: HP:
Manufacturer: Tait
Model Number: 
Length of Drop Pipe: 36.00 ft.

Pressure Tank Installed: No
Pressure Tank Type: 
Manufacturer: 
Model Number:

Pressure Relief Valve Installed: No
Tank Capacity: Gallons

Abandoned Well Plugged: No
Reason for not plugging Well:

Well Grouted: Yes
Grouting Method: Unknown
No. of Bags: 
Additives: None
Grouting Materials:

Well Head Completion: Pitless adapter

Well intakes:

Screen Installed: Yes
Screen Diameter: 1.25 in.
Length: 4.00 ft.
Screen Material Type:
Slot: 70.00 in.
Set Between 78.00 ft. and 82.00 ft.
Blank: 0.00 ft. above
Fittings:

Well retrieved:

Well Head Completion: Pitless adapter

Nearest source of possible contamination:

Type: Septic tank
Distance Direction:
50.00 ft. South

Well depth:
20.00 ft.

Formation Description:
Red Clay
Red Clay & Sand Red
Blue Clay
White Sand & Gravel

Thickness:
20.00
20.00
36.00
6.00

Depth to Bottom:
20.00
40.00
76.00
82.00

Geology Remarks:
1. [RED CLAY] [20] [20] [RED CLAY & RED SAND] [40]
20.3 [BLUE CLAY] [76] [36] 4, [WHITE SAND & GRAVEL] [82] [6]

Well completed:

General Remarks:

ATTENTION WELL OWNER: FILE WITH DEED

EQP 2017C (2/2000)

WATER WELL CONTRACTOR'S CERTIFICATION:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Signature of Registered Representative

Date

2/18/2000 17:52

136
## Water Well and Pump Record

**Well ID:** 750000006537  
**Completion is required under authority of Part 127 Act 368 PA 1978. Failure to comply is a misdemeanor.**

### General Information
- **Well ID:** 750000006537  
- **Tax No:**  
- **Permit No:** W24697  
- **County:** St. Joseph  
- **Township:** Fabius  
- **Distance and Direction from Road Intersection:** 3/8 MILE EAST OF SHAFER BROS ON COREY LAKE RD, SOUTH SIDE

### Well Specifications
- **Well Name:**  
- **Well Owner:** David & Chari Hubbard
- **Well Address:** 11857 COREY LAKE ROAD THREE RIVERS, MI
- **Owner Address:** 11857 COREY LAKE ROAD THREE RIVERS, MI

### Drilling Method
- **Drilling Method:** Rotary  
- **Well Depth:** 72.00 ft.
- **Well Use:** Household
- **Well Type:** New  
- **Date Completed:** 10/21/2002

### Casing and Pipe Information
- **Casing Type:** PVC plastic  
- **Casing Joint:** Unknown
- **Diameter:** 5.00 in. to 67.00 ft. depth
- **Bore Diameter 1:** 8.50 in. to 72.00 ft. depth
- **Bore Diameter 2:**  
- **Bore Diameter 3:** Height: 1.00 ft. above grade
- **Casing Fitting:** None

### Static Water Level
- **Static Water Level:** 21.00 ft. Below Grade (Not Flowing)

### Yield Test Method
- **Yield Test Method:** Air
- **Measurement Taken During Pump Test:** 27.00 ft. after 0.50 hrs pumping at 30.00 GPM

### Abandoned Well Plugged
- **Abandoned Well Plugged:** No
- **Reason for not plugging Well:**

### Screen Information
- **Screen Installed:** Yes  
- **Well Intake:**
- **Screen Diameter:** 4.00 in.
- **Length:** 5.00 ft.
- **Screen Material Type:** PVC - slotted
- **Slot:** 18.00 in. Set Between 67.00 ft. and 72.00 ft.
- **Blank:**
- **Fittings:** Unknown

### Geology Remarks
- **Well Grouted:** Yes
- **Grouting Method:** Unknown
- **No. of Bags:** 5
- **Additives:** None
- **Bentonite slurry:** From 0.00 ft. to 62.00 ft.
- **Well Head Completion:** 12 inches above grade, Pitless adapter

### Nearest Source of Possible Contamination
- **Type:** Septic tank
- **Distance:** 50.00 ft.
- **Direction:** Southeast

### Contractor Information
- **Contractor Type:** Water well drilling contractor
- **Registration Number:** 1996
- **Business Name:** GRAHL & SON WELL DRLG

### Water Well Contractor's Certification
- **Signature of Registered Representative:**
  - **Date:**

---

**ATTENTION WELL OWNER: FILE WITH DEED**
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978.

Failure to comply is a misdemeanor.

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<td>Distance and Direction from Road Intersection:</td>
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<td>Diameter:</td>
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<td>Slot:</td>
<td>10.00 in. Set Between 60.00 ft. and 66.00 ft.</td>
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<td>Blank:</td>
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<td>Well Grouted:</td>
<td>No</td>
<td>Grouting Method:</td>
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<tr>
<td>No. of Bags:</td>
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<td>Additives:</td>
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<tr>
<td>Contractor Type:</td>
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<td>Registration Number:</td>
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<td>Business Name:</td>
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<td>Well Head Completion:</td>
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<td>WATER WELL CONTRACTOR'S CERTIFICATION:</td>
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<td>Nearest source of possible contamination:</td>
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<td>Drilling Machine Operator Name:</td>
<td>TERRY DAVIS</td>
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<tr>
<td>General Remarks:</td>
<td>TEST WELL WAS PULLED BACK TO 66 FEET AND LEFT AS A PERMANENT INSTALLATION</td>
<td>OTHER REMARKS:</td>
<td>Screen Fittings:</td>
<td>Type Unknown</td>
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</table>

**ATTENTION WELL OWNER: FILE WITH DEED**

2/18/2000 17:51
WATER WELL AND PUMP RECORD

Completion is required under authority of Part 127 Act 368 PA 1978.

Import ID: 75761227002

Well ID: 75000002426

Well ID: 75000002426
Elevation: 900 ft

Latitude: 41.9128925624
Longitude: -85.6977657614

Well Name: Robert Zerfas
Well Address: 60852 KRULL ROAD
Township: Fabius
County: St. Joseph
Tax No: 004-155-017-00
Permit No: I Permit No: I

Distance and Direction from Road Intersection: .1 MILE S. OF M-60, W. SIDE KRULL
LOT 17 FABIUS FARMS

Well Name: Robert Zerfas
Well Address: 60852 KRULL ROAD
Owner Address: 3 RIVERS MI 49093

Fraction: NE¼ SW¼ SW¼ 27
Town/Range: 06S 12W
French Claim: WSSN:

Well depth: 180.00 ft
Well Use: Household

Pump Installed: No
Pump installation only: No

Manufacturer: Pump Type:
Model Number: Pump Capacity:
Length of Drop Pipe: Id of Well:
Diameter of Drop Pipe:
Diameter of Drop Pipe:

Pressure Tank Installed: No
Pressure Tank Type:

Well Type: Replacement
Date Completed: 8/22/1972

Well Grouted: Yes
Grouting Method: Unknown

No. of Bags: Additives: None


Well Head Completion: Pitless adapter

General Remarks: VERIFIED BY CURRENT OWNER RICHARD HAGENBUCH

OTHER REMARKS

ATTENTION WELL OWNER: FILE WITH DEED

2/18/2000 17:51
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978.

**Well ID:** 75000002496

**Elevation:** 900 ft

**Latitude:** 41.90177877

**Longitude:** -85.6782850933

---

**Drilling Method:** Jelled

**Well Depth:** 156.00 ft

**Well Type:** Replacement

**Well Use:** Household

**Date Completed:** 1/18/1968

**Casing Type:** Steel - black

**Diameter:** 2.00 in. to 152.00 ft. depth

**Bore Diameter 1:**

**Bore Diameter 2:**

**Bore Diameter 3:**

**Height:** 2.00 ft. above grade

**Casing Fitting:** Drive shoe

---

**Distance and Direction from Road Intersection:** 6 MILE S. OF GLEASON ON THE W. SIDE OF ROBERTS

**Well Name:** Evelyn Velie

**Well ID:** 75000002496

**Distance and Direction from Road Intersection:** .6 MILE S. OF GLEASON ON THE W. SIDE OF ROBERTS

**Elevation:** 900 ft

**Latitude:** 41.90177877

**Longitude:** -85.6782850933

**Well Name:** Evelyn Velie

**Well Address:** 61620 ROBERTS ROAD

**Owner Address:** 61620 ROBERTS ROAD

**Well Driller:** OTTO BICKEL

**Signature:**

---

**Pump Installed:** Yes

**Pump Installation date:** HP

**Manufacturer:** Flint & Walling

**Pump Type:** Jet

**Model Number:**

**Pump Capacity:** 0.00 GPM

---

**Formation Description**

<table>
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<tr>
<th>Thickness</th>
<th>Depth to Bottom</th>
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<tbody>
<tr>
<td>3.00</td>
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<td>152.00</td>
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**Geology Remarks:**


**Contractor Type:** Unknown

**Registration Number:** 88

**Business Name:**

**Business Address:**

---

**WATER WELL CONTRACTOR'S CERTIFICATION:**

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

**Signature of Registered Representative:**

**Date:** 2/18/2000 17:52

---

**ATTENTION WELL OWNER: FILE WITH DEED**
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978.

Failure to comply is a misdemeanor.

<table>
<thead>
<tr>
<th>Permit No:</th>
<th>County: St. Joseph</th>
<th>Township: Fabius</th>
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<tbody>
<tr>
<td>004-035-013-01</td>
<td>14878 DRUMMOND ROAD</td>
<td>3 RIVERS, MI 49093</td>
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</table>

**Well ID: 75000002501**

- **Elevation:** 900 ft
- **Latitude:** 41.8970077335
- **Longitude:** 85.6659227546

**Well Name:** Donald King

**Well Address:** 14878 DRUMMOND ROAD 3 RIVERS, MI 49093

**Owner Address:** 14878 DRUMMOND ROAD 3 RIVERS, MI 49093

**Well ID:** 75000002501

**Distance and Direction from Road Intersection:** 1 MILE W. OF 131 ON THE N. SIDE OF DRUMMOND

**Well Name:** PF DRUMMOND

**Elevation:** 900 ft

**Well Name:** Latitude: 41.8970077335

**Longitude:** -85.6659227546

**Drilling Method:** Jetted

**Well Depth:** 123.00 ft

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 10/30/1975

**Casing Type:** Steel - black

**Casing Joint:** Threaded & coupled

**Diameter:** 2.00 in. to 119.00 ft. depth

**Bore Diameter 1:**

**Bore Diameter 2:**

**Bore Diameter 3:**

**Casing Fitting:** Drive shoe

**Static Water Level:** 70.00 ft. Below Grade (Not Flowing)

**Yield Test Method:** Unknown

**Measurement Taken During Pump Test:**

**Abandoned Well Plugged:** No

**Reason for not plugging Well:**

**Abandoned well ID:**

**Screen Installed:** Yes

**Filter Packed:** No

**Screen Diameter:** 1.25 in.

**Length:** 4.00 ft.

**Screen Material Type:**

**Slot:** 70.00 in. Set Between 115.00 ft. and 119.00 ft.

**Blank:** 0.00 ft. Above

**Fittings:** Neoprene packer

**Well Grouted:** No

**Grouting Method:**

**No. of Bags:**

**Grouting Materials:**

**Well Head Completion:** Fliteless adapter

**Nearest source of possible contamination:**

**Type:** Septic tank

**Distance Direction:** 60.00 ft. North

**Pump Installed:** No

**Pump Installation date:** HP

**Manufacturer:**

**Pump Type:**

**Model Number:**

**Pump Capacity:**

**Length of Drop Pipe:**

**Diameter of Drop Pipe:**

**Draw Down Seal Used:** No

**Pressure Tank Installed:** No

**Pressure Tank Type:**

**Manufacturer:**

**Model Number:**

**Tank Capacity:** Gallons

**Formation Description:**

| Sand & Clay | 10.00 | 10.00 |
| Sand | 67.00 | 77.00 |
| Gravel | 23.00 | 100.00 |
| Blue Clay | 13.00 | 113.00 |
| Sand Water Bearing | 10.00 | 123.00 |

**Pressure Relief Valve Installed:** No

**Bore Diameter 1:**

**Bore Diameter 2:**

**Bore Diameter 3:**

**Casing Filling:**

**Drive shoe**

**Model Number:**

**Manufacturer:**

**Height:** 0.00 ft. above grade

**Casing Joint:** Threaded & coupled

**Length of Drop Pipe:**

**Depth:** 119.00 ft.

**Diameter of Drop Pipe:**

**Depth:** 123.00 ft.

**Grouting Materials:** GRAVEL | 100 | 23 |

**Grouting Materials:**

**Geology Remarks:** 1. (SAND & CLAY) [10] [10] 2. (SAND) [77] [67] 3. (GRAVEL) [100] [23] 4. (BLUE CLAY) [113] [13] 5. (SAND & WATER) [123] [10]

**Contractor Type:** Unknown

**Registration Number:** 205

**Business Name:**

**Business Address:**

**WATER WELL CONTRACTOR'S CERTIFICATION:**

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

**Signature of Registered Representative:**

**Date:** 2/18/2000 17:52

**ATTENTION WELL OWNER: FILE WITH DEED**
Cross-section M3 – M3’
<table>
<thead>
<tr>
<th>well id: 75000002461</th>
<th>completion is required under authority of part 127 act 368 pa 1978. failure to comply is a misdemeanor.</th>
<th>tax no: 004-030-006-00</th>
<th>permit no:</th>
<th>county: st. joseph</th>
<th>township: fabius</th>
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<tbody>
<tr>
<td>well id: 75000002461</td>
<td>elevation: 920 ft.</td>
<td>well depth: 112.00 ft.</td>
<td>well use: other</td>
<td>well type: replacement</td>
<td>date completed: 6/14/1974</td>
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<tr>
<td>casing type: unknown</td>
<td>casing joint: unknown</td>
<td>diameter: 2.00 in. to 100.00 ft. depth</td>
<td>bore diameter 1:</td>
<td>bore diameter 2:</td>
<td>bore diameter 3:</td>
</tr>
<tr>
<td>static water level: 65.00 ft. below grade (not flowing)</td>
<td>yield test method: unknown</td>
<td>measurement taken during pump test:</td>
<td>abandoned well plugged: no</td>
<td>reason for not plugging well:</td>
<td>abandoned well id:</td>
</tr>
<tr>
<td>screen installed: no</td>
<td>well intake: unknown</td>
<td>filter packed:</td>
<td>screen diameter:</td>
<td>screen material type:</td>
<td>slot:</td>
</tr>
<tr>
<td>well grouted: yes</td>
<td>grouting method: unknown</td>
<td>additives: none</td>
<td>grouting materials: unknown</td>
<td>from 0.00 ft. to 0.00 ft.</td>
<td>blank:</td>
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<tr>
<td>well head completion: unknown</td>
<td>contractor type: unknown</td>
<td>registration number: 834</td>
<td>business name:</td>
<td>business address:</td>
<td>water well contractor's certification: this well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.</td>
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<td>nearest source of possible contamination: type: unknown</td>
<td>distance direction: 0.00 ft.</td>
<td>unknown</td>
<td>drilling machine operator name: unknown</td>
<td>employment: unknown</td>
<td>signature of registered representative: date</td>
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<tr>
<td>general remarks: northwest well by campsite 39 (camp area #3)</td>
<td>other remarks: well use: public well type unknown</td>
<td>eqp 2017c (2/2000)</td>
<td>attention well owner: file with deed</td>
<td>2/18/2000 17:52</td>
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</table>
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978.

**Import ID:** 75761229003

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<th>WSSN:</th>
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</table>

Distance and Direction from Road Intersection: S. SIDE OF DUDD, .4 MILE N. AND E. OF M-60

**Well Name:**

Well Owner: Koehler Farm - C. Morton

Well Address:

60725 DUDD ROAD

3 RIVERS MI 49093

**Owner Address:**

407 S. WHITLOCK

BREMEN IN

**Drilling Method:** Jetted

**Well Depth:** 91.00 ft. **Well Use:** Household

**Well Type:** Replacement **Date Completed:** 9/19/1968

**Casing Type:** Steel - black **Casing Joint:** Threaded & coupled

**Diameter:** 2.00 in. to 87.00 ft. depth

**Bore Diameter 1:** **Bore Diameter 2:** **Bore Diameter 3:**

**Height:** 1.00 ft. above grade **Casing Fitting:** Drive shoe

**Static Water Level:** 30.00 ft. Below Grade (Not Flowing)

**Yield Test Method:** Unknown **Measurement Taken During Pump Test:**

**Abandoned Well Plugged:** No **Reason for not plugging Well:**

**Screen Installed:** Yes **Well Intake:**

**Filter Packed:** No **Screen Diameter:** 1.25 in. **Length:** 4.00 ft.

**Screen Material Type:** Slot: 10.00 in. **Set Between:** 87.00 ft. and 91.00 ft.

**Blank:** 0.00 ft. Above **Fittings:** Bremer check valve

**Well Grounted:** No **Grouting Method:**

**No. of Bags:** Additives:**

**Well Grouted Material:**

**Well Head Completion:** Pitless adapter

**Nearest source of possible contamination:**

**Type:** Septic tank **Distance:** 50.00 ft. West

**Contractor Type:** Unknown **Registration Number:** 18

**Business Name:** **Business Address:**

WATER WELL CONTRACTOR'S CERTIFICATION:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Drilling Machine Operator Name: Employment: Unknown

**General Remarks:** WELL EAST SIDE OF HOUSE, 1ST HOUSE S. OF COREY LAKE RD ON DUDD. ORIGINAL HOUSE IS NO LONGER THERE BUT NEW HOUSE IS AT THIS ADDRESS

OTHER REMARKS: Pump Manufacturer: USED

**ATTENTION WELL OWNER: FILE WITH DEED**

2/19/2000 17:52

144
Well ID: 75000002473

Well Completion under authority of Part 127 Act 368 PA 1978.

<table>
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<th>Fraction:</th>
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Distance and Direction from Road Intersection: 3.3 MILE S. OF M-60 ON THE W. SIDE OF YOUNGS PRAIRIE RD

Well Name: Don Rentfrow
Well Address: 61346 YOUNGS PRAIRIE ROAD 3 RIVERS MI 49093
Owner Address: 61366 YOUNGS PRAIRIE ROAD 3 RIVERS MI 49093

Drilling Method: Jetted
Well Type: New
Well Use: Household
Well Depth: 96.00 ft.
Well Installed Completed: 7/26/1974

Casing Type: Steel - black
Casing Joint: Threaded & coupled
Diameter: 4.00 in. to 91.00 ft. depth

Bore Diameter 1:
Bore Diameter 2:
Bore Diameter 3:
Casing Fitting: None

Static Water Level: 55.00 ft. Below Grade (Not Flowing)
Yield Test Method: Unknown
Measurement Taken During Pump Test:

Abandoned Well Plugged: No
Reason for not plugging Well:

Screen Installed: Yes
Filter Packed: No
Screen Diameter: 3.00 in.
Length: 5.00 ft.

Screen Material Type:
Slot: 10.00 in. Set Between 91.00 ft. and 96.00 ft.
Blank: 1.50 ft. Above
Fittings:
Neoprene packer

Well Grouted: Yes
Grouting Method: Unknown
No. of Bags: Additives: None
Grouting Materials: Unknown
From 0.00 ft. to 0.00 ft.

Well Head Completion: Pitless adapter

Nearest source of possible contamination:
Type: Distance Direction
Septic tank: 100.00 ft. North

Drilling Machine Operator Name: Unknown
Employment: Unknown

General Remarks:
OTHER REMARKS

ATTENTION WELL OWNER: FILE WITH DEED 2/18/2000 17:52

145
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978.

**Failure to comply is a misdemeanor.**

**Import ID:** 75761223007

**Well ID:** 75000002482

**Well ID:** 75000002482

**Elevation:** 890 ft

**Latitude:** 41.8999174059

**Longitude:** -85.7073942421

**Well Name:** Gerald Glass

**Well Address:**
- 61750 YOUNGMAN ROAD
- 3 RIVERS, MI 49093

**Owner Address:**
- 61750 YOUNGMAN ROAD
- 3 RIVERS, MI 49093

**Drilling Method:** Jetted

**Well Depth:** 166.00 ft

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 11/4/1991

**Casing Type:** Steel - black

**Casing Joint:** Threaded & coupled

**Diameter:** 2.00 in. to 163.00 ft. depth

**Bore Diameter 1:**
- 12.50 in.
- Length: 3.00 ft.

**Screen Installed:** Yes

**Filter Packed:** No

**Screen Diameter:** 1.25 in.

**Screen Material Type:** Neoprene packer

**Well Grouted:** Yes

**Grouting Method:** Unknown

**No. of Bags:** Additives: None

**Grouting Materials:** Bentonite slurry

**Well Head Completion:** Pitless adapter

**Nearest source of possible contamination:**
- Type: Unknown
  - Distance: 0.00 ft.
- Unknown
  - Unknown

**Drilling Machine Operator Name:** WILLIAM REED

**Employment:** Unknown

**General Remarks:** WP13419

**OTHER REMARKS**

**ATTENTION WELL OWNER: FILE WITH DEED**

**2/18/2000 17:52**

**146**
## WATER WELL AND PUMP RECORD

**Well ID:** 75000002477  
**Completion is required under authority of Part 127 Act 368 PA 1978.**

### General Information
- **Tax No.:** 004-033-012-60  
- **Well ID:** 75000002477  
- **Well Name:** Merle Pollitt  
- **Well Address:** 12859 HARDER ROAD  
  3 RIVERS MI 49093
- **Permit No.:**  
- **County:** St. Joseph  
- **Township:** Fabius  
- **Fraction:**  
  - S6  
  - E5  
  - S6  
- **Section:** 33  
- **Town/Range:** 06S 12W  
- **WSSN:**  
- **Distance and Direction from Road Intersection:** 1/8 MILE W. OF BRICK CHAPEL ON S. SIDE OF HARDER ROAD  
- **Failure to comply is a misdemeanor.**

### Well Details
- **Well ID:** 75000002477  
- **Elevation:** 900 ft  
- **Latitude:** 41.897047964  
- **Longitude:** -85.7048388834  
- **Well Name:** Merle Pollitt  
- **Well Address:** 12859 HARDER ROAD  
  3 RIVERS MI 49093
- **Owner Address:**  
  - 12859 HARDER ROAD  
  - 3 RIVERS MI 49093
- **Permit No.:**  
- **County:** St. Joseph  
- **Township:** Fabius  
- **Fraction:**  
  - S6  
  - E5  
  - S6  
- **Section:** 33  
- **Town/Range:** 06S 12W  
- **WSSN:**  
- **Distance and Direction from Road Intersection:** 1/8 MILE W. OF BRICK CHAPEL ON S. SIDE OF HARDER ROAD

### Well Drilling Details
- **Drilling Method:** Jetted  
- **Well Depth:** 107.00 ft  
- **Well Use:** Household  
- **Well Type:** New  
- **Date Completed:** 3/27/1979  
- **Casing Type:** Steel - black  
- **Casing Diameter:** 2.00 in. to 104.00 ft. depth  
- **Bore Diameter 1:**  
- **Bore Diameter 2:**  
- **Bore Diameter 3:**  
- **Height:** 0.00 ft. above grade  
- **Casing Fitting:** Drive shoe

### Static Water Level
- **Static Water Level:** 50.00 ft. below grade (Not Flowing)

### Yield Test Details
- **Yield Test Method:** Unknown  
- **Measurement Taken During Pump Test:** 0.00 ft. after 0.00 hrs. pumping at 15.00 GPM

### Well Abandonment
- **Abandoned Well Plugged:** No  
- **Reason for not plugging Well:**  

### Well Construction Details
- **Screen Installed:** Yes  
- **Well Intake:**  
- **Screen Diameter:** 1.25 in.  
- **Length:** 3.00 ft.  
- **Screen Material Type:**  
- **Slot:** 10.00 in. Set Between 104.00 ft. and 107.00 ft.  
- **Blank:** 2.00 ft. Above  
- **Fittings:** Neoprene packer

### Well Grouting Details
- **Well Grouted:** No  
- **Grouting Method:**  
- **No. of Bags:**  
- **Grouting Materials:**  

### Well Completion Details
- **Well Head Completion:** 12 inches above grade, Other

### Nearest Source of Possible Contamination
- **Type:** Septic tank  
- **Distance:** 50.00 ft.

### Geology Remarks
- **Geology Remarks:** 1. [BROWN CLAY, GRAVEL] [25] [25] 2. [YELLOW & WHITE SAND, GRAVEL] [73] [48] [3]. [GREY CLAY, GRAVEL] [95] [22] 4. [BROWN CLAY & SAND] [100] [5] [5]. [YELLOW & WHITE SAND, GRAVEL] [107] [7]

### Water Well Contractor's Certification
- **Contractor Type:** Unknown  
- **Registration Number:** 369  
- **Business Name:**  
- **Business Address:**  

---

**ATTENTION WELL OWNER: FILE WITH DEED**

---

**General Remarks:** WP3609  
**OTHER REMARKS** Well Head Completion: 12 inch Above Grade

---


---

2/18/2000 17:52
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978. Failure to comply is a misdemeanor.

Well ID: 750000000003880

Import ID: 75771203002

<table>
<thead>
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<th>Tax No:</th>
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<th>County: St. Joseph</th>
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<td>003-003-009-10</td>
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</table>

**Distance and Direction from Road Intersection:** E. SIDE OF BRICK CHAPEL RD., 1000' S. OF HARDER RD.

**Well Name:**

Well Owner: John Avila

**Well Address:**

62101 BRICK CHAPEL ROAD
THREE RIVERS, MI 49093

Owner Address: RR#5 BOX 98
THREE RIVERS, MI 49093

<table>
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<tr>
<th>Drilling Method:</th>
<th>Well ID:</th>
<th>Distance and Direction from Road Intersection:</th>
<th>Fraction:</th>
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<td>Jetted</td>
<td>7500000003880</td>
<td>E. SIDE OF BRICK CHAPEL RD., 1000' S. OF HARDER RD.</td>
<td>NW1/4 NW1/4 NW1/4</td>
</tr>
</tbody>
</table>

**Well Completion:**

Pitless adapter

**Nearest source of possible contamination:**

Type: Distance Direction

**Septic tank:** 58.00 ft. Southeast

**Pump Installed:** Yes

Pump Installation only: No

**Model Number:**

Manufacturer: Flint & Walling

Pump Type: Jet

Pump Capacity: 0.00 GPM

Pressure Tank Installed: No

Pressure Relief Valve Installed: No

**Formation Description:**

<table>
<thead>
<tr>
<th>Formation Description</th>
<th>Thickness</th>
<th>Depth to Bottom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Clay</td>
<td>4.00</td>
<td>4.00</td>
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<tr>
<td>Sand &amp; Gravel</td>
<td>80.00</td>
<td>84.00</td>
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<td>Blue Clay</td>
<td>20.00</td>
<td>104.00</td>
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<tr>
<td>Gravel Coarse</td>
<td>12.00</td>
<td>116.00</td>
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</table>

**Geology Remarks:**

1. [RED CLAY] [4] [4] [RED CLAY] [4]
2. [SAND & GRAVEL] [84] [80]
3. [BLUE CLAY] [104] [20] [COARSE GRAVEL] [116] [12]

**Grouting Materials:**

**Well Head Completion:** Pitless adapter

**Attention Well Owner:** File with Deed 2/18/2000 18:14
WATER WELL AND PUMP RECORD

Completion is required under authority of Part 127 Act 368 PA 1978.

Failure to comply is a misdemeanor.

Import ID: 75771203001

Well ID: 75000003879

Distance and Direction from Road Intersection: 1250' E. OF BRICK CHAPEL RD., 1200' S. OF HARDER RD.

Well Name: Albert Simeri

Well Address: 62059 BRICK CHAPEL ROAD
THREE RIVERS MI 49093

Owner Address: 2020 E. JACKSON BLVD.
ELKHART IN 46515

Drilling Method: Rotary

Well Depth: 115.00 ft.

Well Use: Household

Well Type: New

Date Completed: 9/24/1992

Casing Type: PVC plastic

Casing Joint: Welded

Diameter: 5.00 in. to 109.00 ft. depth

4.00 in. to 115.00 ft. depth

Bore Diameter 1: 8.00 in. to 115.00 ft. depth

Bore Diameter 2: None

Bore Diameter 3:

Height: 1.00 ft. above grade

Casing Fitting: None

Elevation: 900 ft

Latituide: 41.8943195162

Longitude: -85.697811679

Well Name: Albert Simeri

Well ID: 75000003879

Distance and Direction from Road Intersection: 1250' E. OF BRICK CHAPEL RD., 1200' S. OF HARDER RD.

Well Name: Albert Simeri

Well Address: 62059 BRICK CHAPEL ROAD
THREE RIVERS MI 49093

Owner Address: 2020 E. JACKSON BLVD.
ELKHART IN 46515

Drilling Method: Rotary

Well Depth: 115.00 ft.

Well Use: Household

Well Type: New

Date Completed: 9/24/1992

Casing Type: PVC plastic

Casing Joint: Welded

Diameter: 5.00 in. to 109.00 ft. depth

4.00 in. to 115.00 ft. depth

Bore Diameter 1: 8.00 in. to 115.00 ft. depth

Bore Diameter 2: None

Bore Diameter 3:

Height: 1.00 ft. above grade

Casing Fitting: None

Static Water Level: 60.00 ft. Below Grade (Not Flowing)

Measurement Taken During Pump Test:

0.00 ft. after 1.00 hrs. pumping at 26.00 GPM

Abandoned Well Plugged: No

Reason for not plugging Well:unknown

Screen Installed: Yes

Filter Packed: No

Screen Diameter: 4.00 in.

Length: 6.00 ft.

Screen Material Type:

Slot: 12.00 in. Sel Between 109.00 ft. and 115.00 ft.

Blank: 0.00 ft. Above

Fittings: None

Well Grouted: Yes

Grouting Method: Unknown

No. of Bags: unknown

Additives: None

Grouting Materials:

Bentonite slurry

From 0.00 ft. to 55.00 ft.

Well Head Completion: Pitless adapter

Nearest source of possible contamination:

Type: Unknown

Distance: 0.00 ft.

Unknown

Well Drilling Machine Operator Name: FLOYD MARTIN

Employment: Unknown

General Remarks: WP14155

OTHER REMARKS

ECP 2017C (2/2000)

ATTENTION WELL OWNER: FILE WITH DEED

2/18/2000 18:14
WATER WELL AND PUMP RECORD

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

**Well ID:** 75000003884

**Elevation:** 860 ft
**Latitude:** 41.8819500404
**Longitude:** -85.6972002504

**Well Name:** Clyde Pearson
**Owner Address:** 13260 GARBER ROAD
**Owner Address:** CONSTANTINE MI 49042

**Drilling Method:** Jetted
**Well Type:** Replacement
**Well Use:** Household
**Date Completed:** 9/2/1983

**WELL ID:** 75000003884

**Distance and Direction from Road Intersection:** N. SIDE OF GARBER RD., 1400' E. OF BRICK CHAPEL RD.

**Tax No:** 003-003-013-00
**Import ID:** 75771203006
**Fraction:** SW¼ SE¼ SW¼
**Section:** 3
**Town/Range:** 07S 12W
**French Claim:** WSSN:

**Well ID:** 75000003884

**Well Depth:** 138.00 ft
**Well Use:** Household

**Casing Type:** Steel - black
**Casing Diameter 1:** 2.00 in. to 135.00 ft. depth
**Casing Diameter 2:** 1.25 in. to 138.00 ft. depth

**Bore Diameter 1:** 2.00 in.
**Bore Diameter 2:** 1.25 in.
**Bore Diameter 3:** 1.00 ft. above grade
**Casing Fitting:** None

**Static Water Level:** 42.00 ft. Below Grade (Not Flowing)
**Yield Test Method:** Unknown
**Measurement Taken During Pump Test:** 0.00 ft. after 0.00 hrs. pumping at 15.00 GPM

**Abandoned Well Plugged:** No
**Reason for not plugging Well:**

**Screen Installed:** Yes
**Screen Diameter:** 1.25 in.
**Screen Material:** Slotted: 1.00 in. Set Between 135.00 ft. and 138.00 ft.
**Blank:** 0.00 ft. Above
**Fittings:** Bremer check valve Neoprene packer

**Screen Diameter Length:** 3.00 ft.
**Well Intake:**

**Screen Diameter Length:** 3.00 ft.
**Fittings:**

**Well Grouted:** No
**Grouting Method:**

**Well Grouted:** No
**Grouting Materials:** Additives:

**Well Head Completion:** Pitless adapter

**Well Head Completion:** Pitless adapter

**Nearest source of possible contamination:**
**Type:** Sand
**Distance Direction:** 0.00 ft.

**Nearest source of possible contamination:**
**Type:** Sand
**Distance Direction:** 0.00 ft.

**Drilling Machine Operator Name:** WP6666
**Employment:** Unknown

**General Remarks:** WP6666

**WATER WELL CONTRACTOR'S CERTIFICATION:**
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

**Signature of Registered Representative:** 

**Registration Number:** 369
**Business Address:**

**Business Name:** WATER WELL CONTRACTOR'S CERTIFICATION:

**Other Remarks:** EQP 2017C (2/2000)

**ATTENTION WELL OWNER:** FILE WITH DEED

2/18/2000 18:14

150
### WATER WELL AND PUMP RECORD

Completion is required under authority of Part 127 Act 368 PA 1978. Failure to comply is a misdemeanor.

<table>
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<tr>
<th>Tax No: 003-010-010-00</th>
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<th>County: St. Joseph</th>
<th>Township: Constantine</th>
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<tbody>
<tr>
<td><strong>Well ID:</strong> 75000003916</td>
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<tr>
<td>Elevation: 818 ft</td>
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<td>Latitude: 41.8676718401</td>
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<td></td>
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<tr>
<td>Longitude: -85.684577851</td>
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<td></td>
<td></td>
</tr>
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</table>

#### Well ID: 75000003916

- **Well Owner:** Gale Kline Farm
- **Owner Address:** ZERBE ROAD, CONSTANTINE MI 49042

#### Drilling Method:
- **Rotation**
- **Well Use:** Irrigation
- **Well Depth:** 110.00 ft.
- **Well Type:** Replacement
- **Date Completed:** 2/28/1975
- **Casing Type:** Steel - black
- **Casing Joint:** Welded
- **Diameter:** 12.00 in. to 90.00 ft. depth
- **Well Depth:** 12.00 in. to 110.00 ft. depth

- **Bore Diameter 1:**
- **Bore Diameter 2:**
- **Bore Diameter 3:**
- **Height:** 1.00 ft. above grade
- **Casing Fitting:** None

#### Static Water Level:
- **23.00 ft. Below Grade (Not Flowing)**

#### Yield Test Method:
- **Unknown**

#### Measurement Taken During Pump Test:
- 96.00 ft. after 8.00 hrs. pumping at 1,000.00 GPM

#### Abandoned Well Plugged:
- No

#### Reason for not plugging Well:
- Abandoned well ID:

#### Screen Installed:
- **Yes**
- **Well Intake:**
- **Screen Diameter:** 12.00 in.
- **Length:** 20.00 ft.
- **Screen Material Type:**
- **Slot:** 25.00 in. Set Between 90.00 ft. and 110.00 ft.
- **Blank:** 0.00 Ft. Above
- **Fittings:** None

#### Well Grouted:
- **Yes**
- **Grouting Method:** Unknown
- **No. of Bags:**
- **Additives:** None
- **Grouting Materials:**
- **Bentonite slurry** From 0.00 ft. to 80.00 ft.

#### Well Head Completion:
- **12 inches above grade, Other**

- **Nearest source of possible contamination:**
  - **Type:**
  - **Unknown**
  - **Distance:** 0.00 ft.

- **Drilling Machine Operator Name:** Unknown
- **Employment:** Unknown

---

**ATTENTION WELL OWNER: FILE WITH DEED**

2/18/2000 18:14
Cross-section S1 – S1’
# WATER WELL AND PUMP RECORD

**Well ID**: 75000002461

**Completion is required under authority of Part 127 Act 368 PA 1978.**

Failure to comply is a misdemeanor.

**Import ID**: 75761230003

---

**Well ID**: 75000002461

**Distance and Direction from Road Intersection**: ON HILL BEHIND SITE 39, 5 MILE E. OF COUNTY LINE ROAD

**Well Name**: Core Lake Recreation Area

**Well Address**: 10705 COREY LAKE ROAD, 3 RIVERS MI 49093

**Owner Address**: 10705 COREY LAKE ROAD, 3 RIVERS MI 49093

---

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<th>Township</th>
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</table>

**Drilling Method**: Unknown

**Well Depth**: 112.00 ft.

**Well Use**: Other

**Well Type**: Replacement

**Date Completed**: 6/14/1974

**Casing Type**: Unknown

**Casing Joint**: Unknown

**Diameter**: 2.00 in. to 100.00 ft. depth

**Bore Diameter 1**:

**Bore Diameter 2**:

**Bore Diameter 3**: Height: 0.00 ft. above grade

**Casing Fitting**: Drive shoe

**Static Water Level**: 65.00 ft. Below Grade(Not Flowing)

**Yield Test Method**: Unknown

**Measurement Taken During Pump Test**: Unknown

**Abandoned Well Plugged**: No

**Reason for not plugging Well**: Unknown

**Abandoned well ID**:

**Screen Installed**: No

**Filter Packed**: No

**Screen Diameter**: unknown

**Screen Material Type**: unknown

**Slot**: Blank

**Blank**:

**Fittings**:

**Well Grouted**: Yes

**Grouting Method**: Unknown

**No. of Bags**: Additives: None

**Grouting Materials**: Unknown From 0.00 ft. to 0.00 ft.

**Well Head Completion**: Unknown

**Nearest source of possible contamination**:

**Type**: Unknown Distance Direction

**Unknown**: 0.00 ft.

**Unknown**:

**Drilling Machine Operator Name**: Unknown

**Employment**: Unknown

**General Remarks**: NORTHWEST WELL BY CAMPSITE 39 (CAMP AREA #3)

**OTHER REMARKS**: Well Use: Public Well Type Unknown


**ATTENTION WELL OWNER: FILE WITH DEED** 2/18/2000 17:52

---

**Geology Remarks**: 1. [GRAVEL & CLAY] [50] [50] 2. [COARSE GRAVEL] [50] [54] 3. [GRAVEL & CLAY] [80] [26] 4. [SILT W/CLAY] [100] [20] 5. [MED. GRAVEL (WATER)] [112] [12]

**WATER WELL CONTRACTOR’S CERTIFICATION**: This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978.

Failure to comply is a misdemeanor.

---

**Well ID:** 75000002256

**Completion is required under authority of Part 127 Act 368 PA 1978.**

Failure to comply is a misdemeanor.

**Import ID:** 75761220002

**Tax No:** 004-340-005-00

**Well ID:** 75000002256

**Failure to comply is a misdemeanor.**

**Import ID:** 75761220002

**Well Name:**

**Well Address:** 11441 Middle Road

**Owner Address:** 11441 Middle Road

**Owner:** Blanche McCawley

**County:** St. Joseph

**Township:** Fabius

**Fraction:** W

**Section:** 20

**Town/Range:** 06S 12W

**French Claim:**

**Well Site:** SE¼ SE¼ NW¼ 20 06S 12W

**Distance and Direction from Road Intersection:** NW CORNER OF MIDDLE RD AND SHAFER BROS. RD.

**Well Elevation:** 920 ft

**Latitude:** 41.9330269557

**Longitude:** -85.7321234591

**Well Address:** 11441 MIDDLE ROAD

**Owner Address:** 11441 MIDDLE ROAD

**Drilling Machine Operator Name:**

**Employment:**

**General Remarks:** WP7744 BUILDER - BILL HARTZELL

**Other Remarks:**

---

**Drilling Method:** Jetted

**Well Depth:** 160.00 ft

**Well Use:** Household

**Well Type:** New

**Date Completed:** 3/25/1986

**Casing Joint:** Threaded & coupled

**Casing Diameter:** 4.00 in. to 156.00 ft. depth

**Bore Diameter 1:**

**Bore Diameter 2:**

**Bore Diameter 3:**

**Height:** 0.00 ft. above grade

**Casing Fitting:** None

**Static Water Level:** 43.00 ft. Below Grade (Not Flowing)

**Measurement Taken During Pump Test:**

**Test Method:** Unknown

**0.00 ft. after 0.00 hrs. pumping at 60.00 GPM**

**Abandoned Well Plugged:** No

**Reason for not plugging Well:**

**Abandoned Well ID:**

**Screen Installed:** Yes

**Well Intake:**

**Filter Packed:** No

**Screen Diameter:** 3.75 in.

**Length:** 4.00 ft.

**Screen Material Type:**

**Slot:** 12.00 in.

**Set Between 156.00 ft. and 160.00 ft.**

**Blank:** 2.00 ft. Above

**Fittings:**

**Neoprene packer**

**Well Grouted:** No

**Grouting Method:**

**No. of Bags:**

**Additives:**

**Grouting Materials:**

**Well Head Completion:** Pitless adapter

**Nearest source of possible contamination:**

**Type:** Unknown

**Distance Direction:** 0.00 ft.

---

**Formation Description**

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<tr>
<th>Formation Description</th>
<th>Thickness</th>
<th>Depth to Bottom</th>
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<tbody>
<tr>
<td>Gravel Fill W/Gravel</td>
<td>25.00</td>
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<tr>
<td>Sand Fine W/Clay</td>
<td>115.00</td>
<td>140.00</td>
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<tr>
<td>Clay</td>
<td>10.00</td>
<td>150.00</td>
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<tr>
<td>Sand &amp; Gravel</td>
<td>10.00</td>
<td>160.00</td>
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</table>

**Geology Remarks:** 1. [FILL GRAVEL] [25] [25] 2. [FINE SAND, TR. CLAY] [140] [115] 3. [CLAY] [150] [10] 4. [SAND & GRAVEL] [160] [10]

**Contractor Type:** Unknown

**Registration Number:** 369

**Business Name:**

**Business Address:**

**WATER WELL CONTRACTOR'S CERTIFICATION:**

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

**Signature of Registered Representative:**

**Date:**

---

**General Remarks:** WP7744 BUILDER - BILL HARTZELL

**Other Remarks:**

---

**ATTENTION WELL OWNER: FILE WITH DEED**

---

2/18/2000 17:49
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978.

**Well ID: 75000002165**

- **Tax No:** 004-016-009-20
- **Legislative ID:** 75761216005
- **Import ID:** 75761216005

**Well ID:** 75000002165

**Well Owner:** John Stevenson

**Well Address:** 58740 STOLDT ROAD

**County:** St. Joseph

**Township:** Fabius

**District and Direction from Road Intersection:** SW CORNER OF STOLDT AND COON HOLLOW

**Elevation:** 950 ft

**Latitude:** 41.9433690515

**Longitude:** -85.7173386166

**Well Depth:** 134.00 ft

**Well Use:** Household

**Drilling Method:** Cable tool

**Well Type:** New

**Casing Type:** Unknown

**Casing Diameter:** 4.00 in. to 129.00 ft. depth

**Bore Diameter 1:**

**Bore Diameter 2:**

**Bore Diameter 3:**

**Height:** 1.00 ft. above grade

**Casing Fitting:** Drive shoe

**Static Water Level:** 80.00 ft. below ground (Not Flowing)

**Yield Test Method:** Unknown

**Measurement Taken During Pump Test:**

**Abandoned Well Plugged:** No

**Reason for not plugging Well:**

**Abandoned well ID:**

**Screen Installed:** Yes

**Filter Packaged:** No

**Screen Diameter:** 3.00 in.

**Length:** 5.00 ft.

**Screen Material Type:**

**Slot:** 15.00 in. Set Between 129.00 ft. and 134.00 ft.

**Blank:** 0.00 ft. Above

**Fittings:** Neoprene packer

**Well Grouted:** Yes

**Grouting Method:** Unknown

**No. of Bags:**

**Grouting Materials:**

**Unknown**

**From 0.00 ft. to 0.00 ft.**

**Well Head Completion:** Pitless adapter

**Nearest Source of possible contamination:**

- **Type:**

- **Distance Direction:** 70.00 ft. South

**Drilling Machine Operator Name:** LYLE GRAHAM

**Employment:** Unknown

**General Remarks:** WP5340

**Other Remarks:**

EQP 2017C (2/2000)

**ATTENTION WELL OWNER: FILE WITH DEED**

2/18/2000 17:47

---

**Formation Description**

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<tr>
<td>Gravel</td>
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<td>Sand</td>
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<td>Blue Clay</td>
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<tr>
<td>Sand</td>
<td>6.00</td>
<td>134.00</td>
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</table>

**Geology Remarks:**

1. [GRAVEL] [70] [70] 2. [SAND] [76] [6] 3. [BLUE CLAY] [128] [52] 4. [SAND] [134] [6]

**Contractor Type:** Unknown

**Registration Number:** 1638

**Business Name:**

**Business Address:**

**WATER WELL CONTRACTOR'S CERTIFICATION**

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

**Signature of Registered Representative:**

**Date:**

---
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978.

Failure to comply is a misdemeanor.

**Import ID: 75761216014**

<table>
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<tr>
<th>Tax No: 004-016-001-30</th>
<th>Permit No:</th>
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</thead>
</table>

**Well ID: 75000002174**

Elevation: 890 ft
Latitude: 41.94999325
Longitude: -85.7036260998

Distance and Direction from Road Intersection: E. SIDE OF AVERY ROAD, .2 MILE N. OF COON HOLLOW ROAD

**Well Name:**

**Well Owner:** Russell & Hope Gearhart

**Well Address:**

58265 AVERY ROAD
3 RIVERS MI 49093

**Owner Address:**

58265 AVERY ROAD
3 RIVERS MI 49093

**Drilling Method:** Rotary

**Well Depth:** 119.00 ft
**Well Use:** Household

**Well Type:** New
**Date Completed:** 2/2/1991

**Casing Type:** PVC plastic
**Casing Joint:** Welded
**Diameter:** 5.00 in. to 114.00 ft. depth

**Bore Diameter 1:** 8.00 in. to 28.00 ft. depth
**Bore Diameter 2:**
**Bore Diameter 3:** Height: 1.00 ft. above grade
**Casing Fitting:** None

**Static Water Level:** 35.00 ft. Below Grade (Not Flowing)

**Yield Test Method:** Unknown
**Measurement Taken During Pump Test:** 38.00 ft. after 1.00 hrs. pumping at 50.00 GPM

**Abandoned Well Plugged:** No
**Reason for not plugging Well:**

**Abandoned well ID:**

**Screen Installed:** Yes
**Well Intake:**
**Screen Diameter:** 3.00 in.
**Length:** 5.00 ft.

**Screen Material Type:**
**Slot:** 15.00 in. Set Between 114.00 ft. and 119.00 ft.
**Filtings:** Neoprene packer

**Well Grouted:** Yes
**Grouting Method:** Unknown
**No. of Bags:** Additives: None
**Grouting Materials:** Bentonite slurry From 0.00 ft. to 28.00 ft.

**Well Head Completion:** Pitless adapter

**Nearest source of possible contamination:**

**Type**
**Distance Direction**
Septic tank 50.00 ft. North

**Drilling Machine Operator Name:**

**Employment:** Unknown

**General Remarks:** WP11370

**OTHER REMARKS**


**ATTENTION WELL OWNER: FILE WITH DEED** 2/18/2000 17:47
WATER WELL AND PUMP RECORD
Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Well ID: 75000005686
Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

<table>
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<tr>
<th>Tax No:</th>
<th>Permit No: W22986</th>
<th>County: St. Joseph</th>
<th>Township: Fabius</th>
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<tbody>
<tr>
<td>Well ID: 75000005686</td>
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Well Name:
Well Owner: Kevin & Virginia Griffin
Well Address: 13104 SPENCE ROAD THREE RIVERS MI
Owner Address: 13104 SPENCE ROAD THREE RIVERS MI

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<tr>
<th>Elevation:</th>
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<tr>
<td>Longitude:</td>
<td>-85.69389193</td>
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</table>

Drilling Method: Rotary
Well Depth: 70.00 ft.
Well Type: New
Date Completed: 10/6/2000
Casing Type: PVC plastic
Casing Joint: Unknown
Diameter: 5.00 in. to 65.00 ft. depth
Bore Diameter 1: 7.88 in. to 70.00 ft. depth
Bore Diameter 2: 
Bore Diameter 3: 
Height: 1.00 ft. above grade
Casing Fitting: None

Abandoned Well Plugged: No
Reason for not plugging Well: 
Abandoned well ID:

Screen Installed: Yes
Filter Packed: Yes
Screen Diameter: 4.00 in.
Length: 5.00 ft.
Screen Material Type: PVC - slotted
Slot: 16.00 in. Set Between 65.00 ft. and 70.00 ft.
Blank:
Fittings: Unknown

Well Grouted: Yes
Grouting Method: Unknown
No. of Bags: 4
Additives: None

Bentonite slurry
From 4.00 ft. to 60.00 ft.
Well Head Completion: Basement offset, Pinless adapter

Contractor Type: Water well drilling contractor
Registration Number: 1849
Business Name: MOBIER DRLG
Business Address: 

Well Head Completion: Basement offset, Pinless adapter

Nearest source of possible contamination:
Type: Sepic tank
Distance Direction: 75.00 ft. North

Drilling Machine Operator Name: Unknown
Employment: Unknown

General Remarks:
OTHER REMARKS
EQP 2017C (2/2000)


<table>
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<td>Well Name:</td>
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<td>Well Owner:</td>
<td>Kevin &amp; Virginia Griffin</td>
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<td>Well Address:</td>
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<td>Owner Address:</td>
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<tr>
<td>Elevation:</td>
<td>41.95420856</td>
</tr>
<tr>
<td>Longitude:</td>
<td>-85.69389193</td>
</tr>
<tr>
<td>Drilling Method:</td>
<td>Rotary</td>
</tr>
<tr>
<td>Well Depth:</td>
<td>70.00 ft.</td>
</tr>
<tr>
<td>Well Type:</td>
<td>New</td>
</tr>
<tr>
<td>Date Completed:</td>
<td>10/6/2000</td>
</tr>
<tr>
<td>Casing Type:</td>
<td>PVC plastic</td>
</tr>
<tr>
<td>Casing Joint:</td>
<td>Unknown</td>
</tr>
<tr>
<td>Diameter:</td>
<td>5.00 in. to 65.00 ft. depth</td>
</tr>
<tr>
<td>Bore Diameter 1:</td>
<td>7.88 in. to 70.00 ft. depth</td>
</tr>
<tr>
<td>Bore Diameter 2:</td>
<td></td>
</tr>
<tr>
<td>Bore Diameter 3:</td>
<td></td>
</tr>
<tr>
<td>Height:</td>
<td>1.00 ft. above grade</td>
</tr>
<tr>
<td>Casing Fitting:</td>
<td>None</td>
</tr>
<tr>
<td>Abandoned Well Plugged:</td>
<td>No</td>
</tr>
<tr>
<td>Reason for not plugging Well:</td>
<td></td>
</tr>
<tr>
<td>Screen Installed:</td>
<td>Yes</td>
</tr>
<tr>
<td>Filter Packed:</td>
<td>Yes</td>
</tr>
<tr>
<td>Screen Diameter:</td>
<td>4.00 in.</td>
</tr>
<tr>
<td>Length:</td>
<td>5.00 ft.</td>
</tr>
<tr>
<td>Screen Material Type:</td>
<td>PVC - slotted</td>
</tr>
<tr>
<td>Slot:</td>
<td>16.00 in. Set Between 65.00 ft. and 70.00 ft.</td>
</tr>
<tr>
<td>Blank:</td>
<td></td>
</tr>
<tr>
<td>Fittings:</td>
<td>Unknown</td>
</tr>
<tr>
<td>Well Grouted:</td>
<td>Yes</td>
</tr>
<tr>
<td>Grouting Method:</td>
<td>Unknown</td>
</tr>
<tr>
<td>No. of Bags:</td>
<td>4</td>
</tr>
<tr>
<td>Additives:</td>
<td>None</td>
</tr>
<tr>
<td>Bentonite slurry:</td>
<td>From 4.00 ft. to 60.00 ft.</td>
</tr>
<tr>
<td>Contractor Type:</td>
<td>Water well drilling contractor</td>
</tr>
<tr>
<td>Registration Number:</td>
<td>1849</td>
</tr>
<tr>
<td>Business Name:</td>
<td>MOBIER DRLG</td>
</tr>
<tr>
<td>Business Address:</td>
<td></td>
</tr>
</tbody>
</table>

WATER WELL CONTRACTOR'S CERTIFICATION:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Signature of Registered Representative: 
Date: 

157
**WATER WELL AND PUMP RECORD**
Completion is required under authority of Part 127 Act 368 PA 1978.

**Well ID: 7500002160**

**Elevation:** 860 ft  
**Latitude:** 41.9534299618  
**Longitude:** -85.6953767476

**Well Name:**  
**Well Owner:** Pleasantview Christian Church

**Well Address:**  
13403 SPENCE ROAD
2 RIVERS MI 49093

**Owner Address:**  
13403 SPENCE ROAD
2 RIVERS MI 49093

**Drilling Method:** Cable tool
**Well Depth:** 81.00 ft.  
**Well Use:** Type II public

**Casing Type:** Unknown  
**Casing Joint:** Threaded & coupled  
**Diameter:** 4.00 in. to 77.00 ft. depth

**Bore Diameter 1:**  
**Bore Diameter 2:**  
**Bore Diameter 3:** Height: 6.00 ft. above grade  
**Casing Fitting:** Drive shoe

**Static Water Level:** 14.00 ft. Below Grade (Not Flowing)

**Yield Test Method:** Unknown  
**Measurement Taken During Pump Test:** 30.00 ft. after 1.00 hrs. pumping at 20.00 GPM

**Abandoned Well Plugged:** No  
**Reason for not plugging Well:**

**Screen Material Type:**  
**Screen Diameter:** 4.00 ft.  
**Screen Length:** 4.00 ft.  
**Screen Type:** Slot: 10.00 in. Set Between 77.00 ft. and 81.00 ft. Blank: 0.00 ft. Above  
**Fittings:** Neoprene packer

**Well Grouted:** Yes  
**Grouting Method:** Unknown  
**No. of Bags:**  
**Additives:** None  
**Grouting Materials:** Bentonite slurry From 0.00 ft. to 30.00 ft.

**Well Head Completion:** Pitless adapter

**Nearest source of possible contamination:**  
**Type:**  
**Distance:** 75.00 ft.  
**Direction:** North

**Drilling Machine Operator Name:**  
**Employment:** Unknown

**General Remarks:** WP15216 WELL SUPPLIES COTTAGES AND REC. BUILDING
**OTHER REMARKS**

**ATTENTION WELL OWNER: FILE WITH DEED**

---

**Pump Installed:** Yes  
**Pump Installation only:** No  
**Manufacturer:** Red Jacket  
**Model Number:**  
**Pump Type:** Submersible

**Well Depth:** 81.00 ft.  
**Well Use:** Type II public

**Manufacturer:**  
**Model Number:**  
**Pump Type:** Submersible

**Well Depth:** 81.00 ft.  
**Well Use:** Type II public

**Length of Drop Pipe:** 40.00 ft.  
**Diameter of Drop Pipe:**  
**Draw Down Seal Used:** No

**Pressure Tank Installed:** No  
**Pressure Tank Type:**  
**Manufacturer:**  
**Model Number:**  
**Tank Capacity:** galons

**Formation Description**  
**Thickness**  
**Depth to Bottom**

<table>
<thead>
<tr>
<th>Formation Description</th>
<th>Thickness</th>
<th>Depth to Bottom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topsoil</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Brown Clay Sandy</td>
<td>13.00</td>
<td>14.00</td>
</tr>
<tr>
<td>Brown Sand Water Bearing</td>
<td>18.00</td>
<td>32.00</td>
</tr>
<tr>
<td>Clay Sandy</td>
<td>2.00</td>
<td>34.00</td>
</tr>
<tr>
<td>Brown Sand Water Bearing</td>
<td>6.00</td>
<td>40.00</td>
</tr>
<tr>
<td>Clay Sandy</td>
<td>17.00</td>
<td>57.00</td>
</tr>
<tr>
<td>Gravel Medium</td>
<td>2.00</td>
<td>59.00</td>
</tr>
<tr>
<td>Gray Clay</td>
<td>15.00</td>
<td>74.00</td>
</tr>
<tr>
<td>Gray Sand Fine Water Sand</td>
<td>7.00</td>
<td>81.00</td>
</tr>
<tr>
<td>Gray Clay</td>
<td>1.00</td>
<td>82.00</td>
</tr>
</tbody>
</table>

**Geology Remarks:**  
1. [TOP SOIL] [1]  
2. [SANDY BROWN CLAY] [14]  
3. [BROWN WATER SAND] [32]  
4. [SANDY CLAY] [34]  
5. [BROWN WATER SAND] [40]  
6. [SANDY CLAY] [57]  
7. [MEDIUM GRAVEL] [59]

**Contractor Type:** Unknown  
**Registration Number:** 2085  
**Business Name:**  
**Business Address:**

---

**WATER WELL CONTRACTOR'S CERTIFICATION:**
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

**Signature of Registered Representative:**

**Date:**

---

**ATTENTION WELL OWNER: FILE WITH DEED**

---

158
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978.

**Failure to comply is a misdemeanor.**

**Well ID:** 75000001829

**Elevation:** 825 ft

**Latitude:** 41.9739662529

**Longitude:** -85.663544551

**Drilling Method:** Jetted

**Well Type:** Replacement

**Well Use:** Household

**Well Depth:** 66.00 ft

**Well ID:** 75000001829

<table>
<thead>
<tr>
<th>Depth</th>
<th>Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>66.00 ft</td>
<td>2.00 in. to 62.00 ft. depth</td>
</tr>
</tbody>
</table>

**Casing Type:** Unknown

**Casing Joint:** Threaded & coupled

**Bore Diameter 1:**

**Bore Diameter 2:**

**Bore Diameter 3:** 1.00 ft. above grade

**Casing Fitting:** Drive shoe

**Static Water Level:** 13.00 ft. Below Grade (Not Flowing)

**Yield Test Method:** Unknown

**Measurement Taken During Pump Test:**

<table>
<thead>
<tr>
<th>Formation Description</th>
<th>Thickness</th>
<th>Depth to Bottom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Clay</td>
<td>2.00</td>
<td>2.00</td>
</tr>
<tr>
<td>Sand</td>
<td>34.00</td>
<td>36.00</td>
</tr>
<tr>
<td>Blue Clay</td>
<td>25.00</td>
<td>61.00</td>
</tr>
<tr>
<td>Sand</td>
<td>5.00</td>
<td>66.00</td>
</tr>
</tbody>
</table>

**Abandoned Well Plugged:** No

**Reason for not plugging Well:**

**Screen installed:** Yes

**Filter Packed:** No

**Screen Diameter:** 1.25 in.

**Length:** 4.00 ft.

**Screen Material Type:**

**Slot:** 7.00 in. Sel Between 62.00 ft. and 66.00 ft.

**Blank:** 0.00 ft. Above

**Fittings:** Bremer check valve

**Well Drilled:** Yes

**Grouting Method:** Unknown

**No. of Bags:** Additives: None

**Grouting Materials:**

**Unknown**

**From 0.00 ft. to 0.00 ft.**

**Well Head Completion:** Pitless adapter

**Nearest source of possible contamination:**

<table>
<thead>
<tr>
<th>Type</th>
<th>Distance</th>
<th>Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Septic tank</td>
<td>50.00 ft. South</td>
<td></td>
</tr>
</tbody>
</table>

**Drilling Machine Operator Name:** LYLE GRAHAM

**Employment:** Unknown

**General Remarks:** WP 7340

**OTHER REMARKS**

Pump Manufacturer: WAYNE

**ATTENTION WELL OWNER: FILE WITH DEED**

2/18/2000 17:42

---

**ATTENTION WELL OWNER: FILE WITH DEED**

2/18/2000 17:42

---

159
WATER WELL AND PUMP RECORD

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Well ID: 75000006014

Tax No: 000 02 3830
Permit No: County: St. Joseph
Section: 31
Town/Range: 055 11W
French Claim: WSSN:

Well ID: 75000006014
Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Well Name: 001
Well Owner: American Metal Fab
Well Address: 55515 FRANKLIN DR
THREE RIVERS MI 49093
Owner Address: 55515 FRANKLIN DR
THREE RIVERS MI 49093

Drilling Method: Rotary
Well Depth: 73.00 ft. Well Use: Type II public
Well Type: Replacement Date Completed: 6/18/2001
Casing Type: PVC plastic Casing Joint: Unknown Diameter: 5.00 in. to 73.00 ft. depth
Bore Diameter 1: 8.00 in. to 73.00 ft. depth Bore Diameter 2: Bore Diameter 3: Height: 1.00 ft. above grade Casing Fitting: None

Static Water Level: 15.00 ft. Below Grade (Not Flowing)
Yield Test Method: Air
Measurement Taken During Pump Test: 18.00 ft. after 1.00 hrs. pumping at 30.00 GPM

Abandoned Well Plugged: Yes Reason for not plugging Well:
Abandoned well ID:

Screen Installed: Yes Well Intake: Filter Packed: No Screen Diameter: 5.00 in. Length: 5.00 ft. Screen Material Type: PVC-slotted Slot: 20.00 in. Blank: Fittings: Unknown

Well Grouted: Yes Grouting Method: Unknown No. of Bags: 3 Additives: None Grouting Materials: Bentonite slurry From 0.00 ft. to 65.00 ft.

Well Head Completion: 12 inches above grade, Pitless adapter

Nearest source of possible contamination:
Type Distance Direction
Septic tank 100.00 ft. Northwest

Drilling Machine Operator Name: RICK CLARK Employment: Employee

Geology Remarks:

Contractor Type: Water well drilling contractor
Registration Number: 1794
Business Name: CLARK WELL DRILLING
Business Address:

WATER WELL CONTRACTOR'S CERTIFICATION:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Signature of Registered Representative Date

ATTENTION WELL OWNER: FILE WITH DEED
7/28/2002 13:51

160
Cross-section S2 – S2’
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978.

Failure to comply is a misdemeanor.

<table>
<thead>
<tr>
<th>Tax No.</th>
<th>Permit No.</th>
<th>County: St. Joseph</th>
<th>Township: Constantine</th>
</tr>
</thead>
</table>

**Well ID:** 75000006567

**Completion is required under authority of Part 127 Act 368 PA 1978.**

Failure to comply is a misdemeanor.

**Elevation:** 883 ft
**Latitude:** 41.89661264
**Longitude:** -85.75892635

- **Well Name:** Doreen Sweitzer Remertv
- **Well Address:** 10037 HARDER ROAD
  - **Owner Address:** THREE RIVERS MI 49093
  - **Owner Address:** THREE RIVERS MI 49093

- **Drilling Method:** Rotary
- **Well Depth:** 125.00 ft
- **Well Use:** Household
- **Well Type:** New
- **Date Completed:** 9/30/2002

- **Casing Type:** PVC plastic
- **Casing Diameter:** 5.00 in. to 125.00 ft. depth
- **Bore Diameter 1:** 8.00 in. to 125.00 ft. depth
- **Bore Diameter 2:**
- **Bore Diameter 3:** Height: 1.00 ft. above grade
- **Casing Fitting:** None

- **Static Water Level:** 15.00 ft. Below Grade (Not Flowing)
- **Yield Test Method:** Air
- **Measurement Taken During Pump Test:** 18.00 ft. after 1.00 hrs. pumping at 50.00 GPM

- **Abandoned Well Plugged:** No
- **Reason for not plugging Well:**

- **Abandoned well ID:**

- **Screen Installed:** Yes
- **Filter Packed:** No
- **Screen Diameter:** 5.00 in.
- **Screen Length:** 5.00 ft.
- **Screen Material Type:** PVC -slotted
- **Slot:** 20.00 in. Set Between 120.00 ft. and 125.00 ft.
- **Blank:**
- **Fittings:** Unknown

- **Well Grouded:** Yes
- **Grouting Method:** Unknown
- **No. of Bags:** 6
- **Additives:** None
- **Grouting Materials:** Bentonite slurry
  - **From:** 0.00 ft. to 115.00 ft.

- **Well Head Completion:** 12 inches above grade, Pitless adapter

- **Nearest source of possible contamination:**
  - **Type:** Unknown
  - **Distance:** Unknown

- **Drilling Machine Operator Name:** RICK CLARK
- **Employment:** Employee

- **General Remarks:**

**ATTENTION WELL OWNER: FILE WITH DEED**

1/14/2003 15:01
WATER WELL AND PUMP RECORD

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 7576123001

<table>
<thead>
<tr>
<th>Well ID:</th>
<th>75000002472</th>
</tr>
</thead>
</table>

**Well ID:** 75000002472

**Elevation:** 900 ft

**Latitude:** 41.9069639406

**Longitude:** -85.7253616373

**Well Name:** Donald Rentfrow

**Well Address:** 61346 YOUNGS PRAIRIE ROAD 61346 YOUNGS PRAIRIE ROAD 3 RIVERS MI 49093

**Owner Address:** 61346 YOUNGS PRAIRIE ROAD 61346 YOUNGS PRAIRIE ROAD 3 RIVERS MI 49093

**Drilling Method:** Rotary

**Well Depth:** 133.00 ft

**Well Use:** Irrigation

**Well Type:** New

**Date Completed:** 10/31/1978

**Casing Type:** Steel - black

**Casing Joint:** Welded

**Diameter:** 14.00 in. to 108.00 ft. depth

**Bore Diameter 1:** 

**Bore Diameter 2:** 

**Bore Diameter 3:** 

**Bore Fitting:** None

**Casing Fitting:** None

**Static Water Level:** 47.00 ft. Below Grade (Not Flowing)

**Yield Test Method:** Unknown

**Measurement Taken During Pump Test:**

- 85.00 ft. after 1.00 hrs pumping at 1,470.00 GPM
- 87.00 ft. after 2.00 hrs pumping at 1,560.00 GPM

**Abandoned Well Plugged:** No

**Reason for not plugging Well:**

**Abandoned well ID:**

**Screen Installed:** Yes

**Well Intake:**

**Filter Packed:** No

**Screen Diameter:** 10.00 in.

**Screen Length:** 25.00 ft.

**Screen Material Type:**

- Slot: 25.00 in. Set Between 108.00 ft. and 133.00 ft.
- Blank: 0.00 ft. Above

**Fittings:** Other

**Well Grouted:** Yes

**Grouting Method:** Unknown

**No. of Bags:** Additives: None

**Grouting Materials:**

- Bentonite slurry: From 1.00 ft. to 10.00 ft.

**Well Head Completion:** 12 inches above grade, Other

**Nearest source of possible contamination:**

- Type: Septic tank
  - Distance: 800.00 ft. South

**Drilling Machine Operator Name:** JOHNIE WYATT

**Employment:** Unknown

**General Remarks:** WP3510 38" X 14" GRAVEL WALL WELL, 3/8 STEEL WELD PLATE BOTH ENDS, VERTICAL TURBINE PUMP

**Other Remarks:** Screen Fittings: Type Unknown

**Well Head Completion:** 12 inch Above Grade

**Pump Type:** Type Unknown

**Manufacturer:** WESTERN LAND ROLLER

**Other Remarks:**

- ATTENTION WELL OWNER: FILE WITH DEED

**WATER WELL CONTRACTOR’S CERTIFICATION:**

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

**Contractor Type:** Unknown

**Registration Number:** 550

**Business Name:**

**Business Address:**

**Signature of Registered Representative:**

**Date:** 2/18/2000

**ATTENTION WELL OWNER: FILE WITH DEED**

163
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978.

Failure to comply is a misdemeanor.

**Well ID: 75000002473**

**Completion is required under authority of Part 127 Act 368 PA 1978.**

**Failure to comply is a misdemeanor.**

**Import ID: 75761232002**

<table>
<thead>
<tr>
<th>Tax No.</th>
<th>004-032-001-00</th>
<th>Permit No.</th>
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<tbody>
<tr>
<td>County</td>
<td>St. Joseph</td>
<td>Township: Fabius</td>
</tr>
</tbody>
</table>

**Well Name:**

**Well Owner:** Don Rentfrow

**Well Address:**

61346 YOUNGS PRAIRIE ROAD
3 RIVERS MI 49093

**Owner Address:**

61346 YOUNGS PRAIRIE ROAD
3 RIVERS MI 49093

**Well ID:** 75000002473

**Distance and Direction from Road Intersection:** 33 MILE S. OF M-60 ON THE W. SIDE OF YOUNGS PRAIRIE RD

**Elevation:** 905 ft

**Latitude:** 41.9061129052

**Longitude:** -85.7220728674

**Well Depth:** 96.00 ft

**Well Use:** Household

**Well Type:** New

**Date Completed:** 7/26/1974

**Drilling Method:** Jetted

**Pump Installed:** Yes

**Pump Installation only:** No

**Well Name:**

**Well Owner:** Don Rentfrow

**Well Address:**

61346 YOUNGS PRAIRIE ROAD
3 RIVERS MI 49093

**Owner Address:**

61346 YOUNGS PRAIRIE ROAD
3 RIVERS MI 49093

**Casing Type:** Steel - black

**Casing Joint:** Threaded & coupled

**Diameter:** 4.00 in. to 91.00 ft. depth

<table>
<thead>
<tr>
<th>Bore Diameter 1</th>
<th>Bore Diameter 2</th>
<th>Bore Diameter 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height: 1.00 ft. above grade</td>
<td>Height: 1.00 ft. above grade</td>
<td>Height: 1.00 ft. above grade</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Casing Fitting:</th>
<th>None</th>
</tr>
</thead>
</table>

**Static Water Level:** 55.00 ft. Below Grade(Not Flowing)

**Yield Test Method:** Unknown

**Measurement Taken During Pump Test:**

Abandoned Well Plugged: No

Reason for not plugging Well:

Abandoned well ID:

<table>
<thead>
<tr>
<th>Screen Installed:</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filter Packed:</td>
<td>No</td>
</tr>
<tr>
<td>Screen Diameter:</td>
<td>3.00 in.</td>
</tr>
<tr>
<td>Length:</td>
<td>5.00 ft.</td>
</tr>
<tr>
<td>Screen Material Type:</td>
<td></td>
</tr>
<tr>
<td>Slot:</td>
<td>10.00 in. Set Between 91.00 ft. and 95.00 ft.</td>
</tr>
<tr>
<td>Blank:</td>
<td>1.50 ft. Above</td>
</tr>
<tr>
<td>Fittings:</td>
<td>Neoprene packer</td>
</tr>
</tbody>
</table>

| Well Grouted: | Yes |
| Grouting Method: | Unknown |
| No. of Bags: | Additives: None |
| Grouting Materials: | Unknown |
| Unknown: From 0.00 ft. to 0.00 ft. |

| Well Head Completion: | Pilotless adapter |

<table>
<thead>
<tr>
<th>Nearest source of possible contamination:</th>
<th>Type</th>
<th>Distance Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Septic tank: 100.00 ft. North</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Drilling Machine Operator Name: | Employment: Unknown |

<table>
<thead>
<tr>
<th>General Remarks:</th>
<th>OTHER REMARKS</th>
</tr>
</thead>
</table>

**ATTENTION WELL OWNER: FILE WITH DEED**

2/19/2000 17:52
WATER WELL AND PUMP RECORD
Completion is required under authority of Part 127 Act 368 PA 1978. Failure to comply is a misdemeanor.

Well ID: 75000002437

Well Name: Dayton Hubbard
Well Address: A.L. JONES ROAD
3 RIVERS MI 49093
Owner Address: 12147 COREY LAKE ROAD
3 RIVERS MI 49093

Well ID: 75000002437

Distance and Direction from Road Intersection: .5 MILE N. OF M-60 ON W. SIDE OF A.L. JONES

Well ID: 75000002437

Well Depth: 122.00 ft.  Well Use: Household
Well Type: Replacement  Date Completed: 3/20/1979

Casing Type: Steel - black  Casing Joint: Threaded & coupled
Casing Diameter: 4.00 in. to 122.00 ft. depth

Bore Diameter 1:
Bore Diameter 2:
Bore Diameter 3:
Height: 2.00 ft. above grade
Casing Fitting: Drive shoe

Static Water Level: 37.00 ft. Below Grade(Not Flowing)
Yield Test Method: Unknown
Measurement Taken During Pump Test: 0.00 ft. after 1.00 hrs. pumping at 60.00 GPM

Abandoned Well Plugged: No
Reason for not plugging Well:
Abandoned well ID:

Screen Installed: Yes  Well Intake: Blue Clay
Filter Packed: No  Screen Diameter: 3.75 in  Length: 6.00 ft.
Screen Material Type: Slot: 10.00 in. Set Between 60.00 ft. and 66.00 ft.
Blank: 0.00 ft. Above Fittings: Other

Well Grouted: No  Grouting Method: Unknown
No. of Bags:  Grouting Materials:  Additives: 0

Well Head Completion: Unknown

Nearest source of possible contamination:
Type  Direction  Distance
Unknown  50.00 ft.

Drilling Machine Operator Name: TERRY DAVIS
Employment: Unknown

Contractor Type: Unknown  Registration Number: 88
Business Name:
Business Address:


Well Head Completion: Unknown

Contractor Type: Unknown  Registration Number: 88
Business Name:
Business Address:


Drilling Machine Operator Name: TERRY DAVIS
Employment: Unknown

General Remarks: TEST WELL WAS PULLED BACK TO 66 FEET AND LEFT AS A PERMANENT INSTALLATION

Other Remarks: Screen Fittings: Type Unknown

ATTENTION WELL OWNER: FILE WITH DEED

2/16/2000 17.51

165
<table>
<thead>
<tr>
<th><strong>WATER WELL AND PUMP RECORD</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Completion is required under authority of Part 127 Act 368 PA 1978.</td>
</tr>
</tbody>
</table>

**Well ID: 75000002134**

Elevation: 910 ft
Latitude: 41.9471375725
Longitude: -85.6814998686

**Well Name:**

**Well ID:** 75000002134

**Distance and Direction from Road Intersection:** W. SIDE OF FERGUSON ROAD, 2 MILE N. OF COON HOLLOW

**Well Owner:** Larry & Tonya Hale

**Well Address:**

58489 FERGUSON ROAD 58489 FERGUSON ROAD
3 RIVERS MI 49093 3 RIVERS MI 49093

**Owner Address:**

58489 FERGUSON ROAD 58489 FERGUSON ROAD
3 RIVERS MI 49093 3 RIVERS MI 49093

**Well Type:** New

**Date Completed:** 11/12/1985

**Drilling Method:** Cable tool

**Well Depth:** 114.00 ft

**Well Use:** Household

**Casing Type:** Unknown

**Casing Joint:** Threaded & coupled

**Diameter:** 4.00 in. to 110.00 ft. depth

**Bore Diameter 1:**

**Bore Diameter 2:**

**Bore Diameter 3:**

**Height:** 1.00 ft. above grade

**Casing Fitting:** None

**Static Water Level:** 80.00 ft. below grade

**Measurement Taken During Pump Test:** 80.00 ft. after 1.00 hrs. pumping at 50.00 GPM

**Well Intake:**

**Filter Packed:** No

**Screen Diameter:** 4.00 in.

**Length:** 4.00 ft.

**Screen Material Type:**

**Slot:** 15.00 in.

**Blank:** 0.00 ft. Above

**Fittings:** Neoprene packer

**Screen Installed:** Yes

**Grouting Method:** Unknown

**No. of Bags:**

**Grouting Materials:**

**Well Grouted:** Yes

**Grouting Additives:** None

**Well Head Completion:** Pitless adapter

**Nearest source of possible contamination:**

**Type:** Septic tank

**Distance Direction:** 75.00 ft. East

**Drilling Machine Operator Name:**

**Employment:** Unknown

**General Remarks:** WP743B

**OTHER REMARKS**

**ATTENTION WELL OWNER: FILE WITH DEED**
**Well ID:** 75000002151  
**Elevation:** 870 ft  
**Well Address:** 14912 MILLARD ROAD  
**Owner Address:** 14912 MILLARD ROAD  
**Owner Address:** 3 RIVERS MI 49093  
**Well Name:** Ken Bradke  
**Well Address:** 14912 MILLARD ROAD  
**Owner Address:** 3 RIVERS MI 49093  

**Drilling Method:** Rotary  
**Well Depth:** 146.00 ft.  
**Well Type:** New  
**Date Completed:** 4/19/1994  
**Casing Type:** PVC plastic  
**Casing Joint:** Welded  
**Diameter:** 5.00 in. to 136.00 ft. depth  
**Bore Diameter 1:** 8.00 in. to 136.00 ft. depth  
**Bore Diameter 2:** 1.00 ft. above grade  
**Casing Fitting:** None  
**Static Water Level:** 47.00 ft. Below Grade(Not Flowing)  
**Measurement During Pump Test:** 0.00 ft. after 1.00 hrs. pumping at 100.00 GPM  

**Abandoned Well Plugged:** No  
**Reason for not plugging Well:**  

**Screen Installed:** Yes  
**Filter Packed:** No  
**Screen Diameter:** 4.00 in.  
**Length:** 10.00 ft.  
**Screen Material Type:** Slot: 12.00 in. Sel Between 136.00 ft. and 146.00 ft. Blank: 0.00 ft. Above  
**Fittings:** Neoprene packer  
**Well Grouted:** Yes  
**Grouting Method:** Unknown  
**No. of Bags:**  
**Grouting Materials:** Bentonite slurry From 0.00 ft. to 30.00 ft.  
**Well Head Completion:** Pitless adapter  

**Nearest source of possible contamination:**  
**Type:** Distance Direction  
**Septic tank:** 50.00 ft. North  

**Drilling Machine Operator Name:** FLOYD MARTIN  
**Employment:** Unknown  

**General Remarks:**  

**Water Well Contractor's Certification:**  
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.  

**Signature of Registered Representative:**  
**Date:**  

---  

**ATTENTION WELL OWNER: FILE WITH DEED**  
2/18/2000 17:47
WATER WELL AND PUMP RECORD

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Well ID: 75000001478

Well Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Tax No: 009-006-034-00
Permit No: 009-006-034-00

Well ID: 75000001478

Fraction: SE SE SE
Section: 6
Town/Range: 06S 11W
French Claim: WSSN:

Distance and Direction from Road Intersection: N. SIDE OF LOVERS LN RD., 150 W. OF CHERRY LN.

Well Name: Don Tinnerv

Well Address: 16940 LOVERS LANE ROAD
THREE RIVERS MI 49093
Owner Address: 3227 S. WESTNEDGE
KALAMAZOO MI 49006

Drilllnq Method: Cable tool
Well Depth: 82.00 ft.
Well Use: Household

Well Type: Replacement
Date Completed: 2/19/1992

Casing Type: Steel - black
Casing Joint: Threaded & coupled
Diameter: 4.00 in. to 78.00 ft. depth

Bore Diameter 1:
Bore Diameter 2:
Bore Diameter 3:
Height: 1.00 ft. above grade
Casing Fitting: Drive shoe

Static Water Level: 19.00 ft. Below Grade(Not Flowing)
Yield Test Method: Unknown
Measurement Taken During Pump Test:
19.00 ft. after 1.00 hrs. pumping at 50.00 GPM

Abandoned Well Plugged: Yes
Reason for not plugging Well:
Abandoned well ID:

Screen Installed: Yes
Screen Diameter: 4.00 in.
Length: 4.00 ft.
Screen Material Type:
Slot: 15.00 in. Set Between 78.00 ft. and 82.00 ft.
Blank: 1.00 ft. Above
Fittings:
Neoprene packer

Well Grouted: Yes
Grouting Method: Unknown
No. of Bags: Additives: None
Grouting Materials:
Bentonite slurry: From 0.00 ft. to 25.00 ft.

Well Head Completion: Pitless adapter

Nearest source of possible contamination:
Type: Distance Direction
Septic tank: 65.00 ft. North

Drilllnq Machine Operator Name: RICK
Employment: Unknown

General Remarks: WP13446

ATTENTION WELL OWNER: FILE WITH DEED 2/18/2000 17.37
APPENDIX F

Description of Materials Recovered from Test Boring 96-52
<table>
<thead>
<tr>
<th>Interval</th>
<th>Munsell Color</th>
<th>Color Description</th>
<th>Material</th>
<th>Avg.</th>
<th>Till</th>
</tr>
</thead>
<tbody>
<tr>
<td>10'-12'</td>
<td>10yr 5/4</td>
<td>yellow brown</td>
<td>fine sand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20'-22'</td>
<td>10yr 4/3</td>
<td>dk. Yellow brown</td>
<td>fn. Sand w/ gravel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30'-32'</td>
<td>10yr 5/3</td>
<td>brown</td>
<td>fn. Sand and gravel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40'-42'</td>
<td>10r 5/4</td>
<td>yellow brown</td>
<td>fn. Sand w/ gravel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>46'-48'</td>
<td>10yr 5/1</td>
<td>grey</td>
<td>fn. Silty clay</td>
<td></td>
<td></td>
</tr>
<tr>
<td>53'-56'</td>
<td>10yr 4/2 (5yr 5/1)</td>
<td>grey</td>
<td>soft clay sand &amp; gravel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>58'-60'</td>
<td>5yr 4/1</td>
<td>dk. Grey</td>
<td>soft till - lg. Gravel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>61'-63'</td>
<td>5yr 4/1</td>
<td>dk. Grey</td>
<td>hard till</td>
<td></td>
<td></td>
</tr>
<tr>
<td>63'-65'</td>
<td>10yr 3/2 (10yr 5/4)</td>
<td>dk. Grey brown (yellowish brown)</td>
<td>soft till (poss. Lacustrian clay) (fine sand)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>76'-78'</td>
<td>10yr 5/4</td>
<td>yellow brown</td>
<td>fine-med sand (some coarse)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>86'-88'</td>
<td>10yr 5/3</td>
<td>brown</td>
<td>fine sand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>93'-95'</td>
<td>10yr 3/1</td>
<td>very dk. Grey</td>
<td>hard till</td>
<td></td>
<td></td>
</tr>
<tr>
<td>95'-97'</td>
<td>10yr 5/4</td>
<td>yellow brown</td>
<td>fine sand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>113'-115'</td>
<td>10yr 5/3</td>
<td>brown</td>
<td>fine sand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>123'-124'</td>
<td>10yr 4/4</td>
<td>dk. Yellow brown</td>
<td>med-coarse sand w/ gravel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>124'-125'</td>
<td>10yr 4/6</td>
<td>dk. Yellow brown</td>
<td>fine sand and fn. Gravel</td>
<td></td>
<td></td>
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<tr>
<td>133'-135'</td>
<td>10yr 3/1</td>
<td>grey</td>
<td>fine gravel w/ coarse gravel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>143'-145'</td>
<td></td>
<td>grey</td>
<td>fine gravel w/ coarse gravel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>153'-155'</td>
<td>5yr 4/1</td>
<td>dk. Grey</td>
<td>soft sandy till</td>
<td></td>
<td></td>
</tr>
<tr>
<td>163'-165'</td>
<td>5yr 3/1</td>
<td>very dk. Grey</td>
<td>hard till</td>
<td></td>
<td></td>
</tr>
<tr>
<td>165'-167'</td>
<td>5yr 3/1</td>
<td>very dk. Grey</td>
<td>hard till</td>
<td></td>
<td></td>
</tr>
<tr>
<td>167'-169'</td>
<td>5yr 3/1</td>
<td>very dk. Grey</td>
<td>hard till</td>
<td></td>
<td></td>
</tr>
<tr>
<td>173'-173.5'</td>
<td>5yr 4/1</td>
<td>dk. Grey</td>
<td>hard till (sandy)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>178'-178.5'</td>
<td>5yr 4/1</td>
<td>dk. Grey</td>
<td>hard till (sandy)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>183'-183.5'</td>
<td>5yr 4/1</td>
<td>dk. Grey</td>
<td>hard till (sandy)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depth</td>
<td>Color</td>
<td>Description</td>
<td>Hardness</td>
<td>Softness</td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>--------</td>
<td>---------------------</td>
<td>----------</td>
<td>----------</td>
<td></td>
</tr>
<tr>
<td>188'-190'</td>
<td>5yr 3/1</td>
<td>very dk. Grey</td>
<td>hard till</td>
<td></td>
<td></td>
</tr>
<tr>
<td>193'-194'</td>
<td>5yr 5/1</td>
<td>grey</td>
<td>soft till - shale</td>
<td></td>
<td></td>
</tr>
<tr>
<td>194'-195'</td>
<td>5yr 4/1</td>
<td>dk. Grey</td>
<td>soft till - shale</td>
<td></td>
<td></td>
</tr>
<tr>
<td>198'-200'</td>
<td>5yr 4/1</td>
<td>dk. Grey</td>
<td>soft sandy till - shale</td>
<td>till?</td>
<td></td>
</tr>
<tr>
<td>208'-210'</td>
<td></td>
<td></td>
<td></td>
<td>SHALE</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.586</td>
</tr>
</tbody>
</table>
APPENDIX G

Gamma Ray Signatures and Water Well Records
GAMMA RAY LOG

WELL: St. Joseph #34
DATE: 11/1/74

EQUIP: Kelt Model SR-3000
UPPER: Neta

TIME: 100 div. Sens. 1
VLL: 5.0 min
SCALP: 1000 cpm sx

SUBURBAN: 10770 Floating Bridge Rd. 1.7 mi. W of Hwy Rd
TOWNSHIP: Flatsfield Rd Section 19

DRILLING CO: Tom Mosier Drilling
GROUND ELEVATION: approx. feet
USER: 8 inches ground level
Drilled Depth: feet
Red mark to ground: 10 inches

CONTACT: Tom Mosier, owner
STAKE: 24 ft TEC

Note: Started logging 29'. 10/-19 inches below surface. At surface 0 ft. 2.2 feet. Therefore actual logged depth is 99 to 101 feet.
WATER WELL AND PUMP RECORD

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

<table>
<thead>
<tr>
<th>Field</th>
<th>Details</th>
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<tbody>
<tr>
<td>Well ID</td>
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<tr>
<td>County</td>
<td>St. Joseph</td>
</tr>
<tr>
<td>Township</td>
<td>Flowerfield</td>
</tr>
<tr>
<td>Well Name</td>
<td></td>
</tr>
<tr>
<td>Well Owner</td>
<td>Joe Bell</td>
</tr>
<tr>
<td>Well Address</td>
<td>54978 DAY ROAD MARCELLUS MI 49067</td>
</tr>
<tr>
<td>Eleviation</td>
<td>935 ft</td>
</tr>
<tr>
<td>Latitude</td>
<td>41.998362054</td>
</tr>
<tr>
<td>Longitude</td>
<td>-85.742784854</td>
</tr>
<tr>
<td>Distance and Direction from Road Intersection</td>
<td>NW CORNER OF DAY RD. &amp; CRANBERRY LAKE RD.</td>
</tr>
<tr>
<td>Permit No.</td>
<td></td>
</tr>
<tr>
<td>County</td>
<td>St. Joseph</td>
</tr>
<tr>
<td>Township</td>
<td>Flowerfield</td>
</tr>
<tr>
<td>Well Name</td>
<td></td>
</tr>
<tr>
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</tr>
<tr>
<td>Permit No.</td>
<td></td>
</tr>
<tr>
<td>County</td>
<td>St. Joseph</td>
</tr>
<tr>
<td>Township</td>
<td>Flowerfield</td>
</tr>
<tr>
<td>Well Name</td>
<td></td>
</tr>
<tr>
<td>Well Owner</td>
<td>Joe Bell</td>
</tr>
<tr>
<td>Well Address</td>
<td>54978 DAY ROAD MARCELLUS MI 49067</td>
</tr>
<tr>
<td>Eleviation</td>
<td>935 ft</td>
</tr>
<tr>
<td>Latitude</td>
<td>41.998362054</td>
</tr>
<tr>
<td>Longitude</td>
<td>-85.742784854</td>
</tr>
<tr>
<td>Distance and Direction from Road Intersection</td>
<td>NW CORNER OF DAY RD. &amp; CRANBERRY LAKE RD.</td>
</tr>
</tbody>
</table>

Drilling Method: Jetted
Well Type: Replacement
Well Use: Household
DrillilnQ Method: Jetted
Pump Installed: No
Well Completed: 9/25/1979

Bore Diameter 1:
Bore Diameter 2:
Bore Diameter 3:
Height: 1.50 ft. above grade
Casing Fitting: Drive shoe

Formation Description
- Red Clay Sand Gravel: 10.00 ft. below grade
- Sand & Gravel: 67.00 ft.
- Clay: 2.00 ft.
- Gravel & Clay: 70.00 ft.
- Stones: 2.00 ft.
- Gravel Sand Clay: 23.00 ft.

Screen Installed: Yes
Filter Packed: No
Screen Diameter: 1.25 in.
Slot: 70.00 in.
Blank: 0.00 ft.
Fittings: Bremer check valve

Well Head Completion: 12 inches above grade

Contractor Type: Unknown
Business Name: 205
Business Address:

WATER WELL CONTRACTOR'S CERTIFICATION:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Signature of Registered Representative

OTHER REMARKS
Well Head Completion: 12 inch Above Grade

ATTENTION WELL OWNER: FILE WITH DEED

EQP 2017C (2/2000)

2/18/2000 17:27
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

**Well ID: 75000006271**

Elevation:
Latitude: 42.00902476
Longitude: -85.75887953

**Drilling Method:** Jetted

**Well Depth:** 90.00 ft.
**Well Use:** Household
**Well Type:** New
**Date Completed:** 1/28/2002

**Casing Type:** Steel - black
**Casing Joint:** Threaded & coupled
**Diameter:** 4.00 in. to 80.00 ft. depth

**Bore Diameter 1:** 9.999.00 in. to
**Bore Diameter 2:**
**Bore Diameter 3:**
**Height:** 1.00 ft. above grade
**Casing Fitting:** Drive shoe

**Static Water Level:** 24.00 ft. Below Grade (Not Flowing)
**Yield Test Method:** Plunger
**Measurement Taken During Pump Test:** 26.00 ft. after 1.00 hrs. pumping at 60.00 GPM

**Abandoned Well Plugged:** No
**Reason for not plugging Well:**

**Screen Installed:** Yes
**Well Intake:**
**Filter Packed:** No
**Screen Diameter:** 3.50 in.
**Length:** 10.00 ft.
**Screen Material Type:** PVC - slotted
**Slot:** 14.00 in. Set Between 80.00 ft. and 90.00 ft.
**Blank:** 2.00 ft. Above
**Fittings:** Neoprene packer

**Well Grouted:** Yes
**Grouting Method:** Unknown
**No. of Bags:** 1
**Additives:** None
**Grouting Materials:** Bentonite dry granular

**Well Head Completion:** Pittless adapter

**Nearest source of possible contamination:**
**Type:** Septic tank
**Distance Direction:** 50.00 ft. Northwest

**Drilling Machine Operator Name:** LEWIS
**Employment:** Employee

**General Remarks:**

**Contractor Type:** Water well drilling contractor
**Registration Number:** 187
**Business Name:** JON LEWIS WELL DRILLING
**Business Address:**

**WATER WELL CONTRACTOR’S CERTIFICATION:**
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

**Signature of Registered Representative:**

**ATTENTION WELL OWNER: FILE WITH DEED** 9/23/2002 12:31
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978.

Failure to comply is a misdemeanor.

---

**Well ID: 75000005908**

**Well ID:** 75000005908

**Elevation:**

- **Latitude:** 42.00853713
- **Longitude:** -85.7571376

**Distance and Direction from Road Intersection:** 2.2 miles east.

**Well Name:**

- **Well Owner:** Northstar Builders
- **Well Address:** 10221 Floating Bridge
- **Howardsville**

**Owner Address:**

- **10221 Floating Bridge**
- **429 N. Main**
- **Middlebury, MI 46540**

**Drilling Method:** Rotary

**Well Depth:** 125.00 ft.

**Well Use:** Household

**Well Type:** New

**Date Completed:** 6/6/2000

**Casing Type:** PVC plastic

**Casing Joint:** Unknown

**Diameter:** 5.00 in. to 120.00 ft. depth

**Bore Diameter 1:** 8.00 in. to 115.00 ft. depth

**Bore Diameter 2:**

**Bore Diameter 3:**

**Height:** 1.00 ft. above grade

**Casing Fitting:** None

**Static Water Level:** 45.00 ft. Below Grade (Not Flowing)

**Yield Test Method:** Air

**Measurement Taken During Pump Test:**

- **47.00 ft. after 1.00 hrs. pumping at 12.00 GPM**

**Abandoned Well Plugged:** No

**Reason for not plugging Well:**

**Abandoned well ID:**

- **Screen Installed:** Yes
- **Filter Packed:** No
- **Screen Diameter:** 4.00 in.
- **Screen Material Type:** PVC-wire wrapped
- **Slot:** 12.00 in. Set Between 120.00 ft. and 125.00 ft.
- **Blank:** Unknown
- **Fittings:** Other

**Well Grouted:** Yes

**Grouting Method:** Unknown

**No. of Bags:** 5

**Grouting Materials:** Bentonite slurry

From 5.00 ft. to 115.00 ft.

**Well Head Completion:** Pitless adapter

**Nearest source of possible contamination:**

- **Septic tank**

50.00 ft. South

**Drilling Machine Operator Name:** T. Maurer

**Employment:** Employee

**General Remarks:** Well log # 00490

**OTHER REMARKS:** Screen Fittings: Glue


---

**WATER WELL CONTRACTOR’S CERTIFICATION:**

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

**Contractor Type:** Water well drilling contractor

**Registration Number:** 2013

**Business Name:** Maurer Well Drilling, Inc.

**Business Address:**

**WATER WELL CONTRACTOR’S CERTIFICATION:**

Signature of Registered Representative

**Date**

---

**ATTENTION WELL OWNER: FILE WITH DEED**

7/8/2002 15:21
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978.

Failure to comply is a misdemeanor.

**Well ID:** 75000005573

**Completion** is required under authority of Part 127 Act 368 PA 1978.

Failure to comply is a misdemeanor.

**Well Name:** Chad Hackenburg

**Well Address:**

10811 FLOATING BRIDGE RD.

THREE RIVERS MI 49071

**Drilling Method:** Cable tool

**Well Depth:** 75.00 ft.

**Well Use:** Household

**Well Type:** New

**Date Completed:** 6/6/2000

**Casing Type:** Steel - black

**Casing Joint:** Unknown

**Diameter:** 4.00 in. to 71.00 ft. depth

**Bore Diameter 1:** 9.999.00 in. to 9.999.00 ft. depth

**Bore Diameter 2:**

**Bore Diameter 3:**

**Height:** 1.00 ft. above grade

**Casing Fitting:** Drive shoe

**Static Water Level:** 23.00 ft. Below Grade (Not Flowing)

**Measurement Taken During Pump Test:**

23.00 ft. after 1.00 hrs. pumping at 35.00 GPM

**Screen Installed:** Yes

**Filter Packed:** No

**Screen Diameter:** 4.00 in.

**Length:** 4.00 ft.

**Screen Material Type:** PVC - slotted

**Slot:** 18.00 in.

**Set Between:** 71.00 ft. and 75.00 ft.

**Blank:** 1.00 ft. Above

**Fittings:** Neoprene packer

**Well Grouted:** Yes

**Grouting Method:** Unknown

**No. of Bags:** 4

**Bentonite slurry:** From 0.00 ft. to 25.00 ft.

**Well Head Completion:** Pitless adapter

**Nearest source of possible contamination:**

**Type:** Septic tank

**Distance Direction:**

**Well Use:** Household

**Date Completed:** 6/6/2000

**Manufacturer:** Sta-Rite

**Model Number:** WM-9

**Tank Capacity:** 9 Gallons

**Pressure Relief Valve Installed:** No

**Formation Description**

<table>
<thead>
<tr>
<th>Description</th>
<th>Thickness</th>
<th>Depth to Bottom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown Clay &amp; Gravel Hard</td>
<td>45.00</td>
<td>45.00</td>
</tr>
<tr>
<td>Sand &amp; Gravel Coarse Wet/Moist</td>
<td>30.00</td>
<td>75.00</td>
</tr>
</tbody>
</table>

**Geology Remarks:**

**Contractor Type:** Water well drilling contractor

**Registration Number:** 112

**Business Name:** EARL SANDERS & SON

**Business Address:**

WATER WELL CONTRACTOR'S CERTIFICATION:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

**Signature of Registered Representative:**

**Date:**

**General Remarks:**

**ATTENTION WELL OWNER: FILE WITH DEED**

1/2/2002 08.41
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978.

Failure to comply is a misdemeanor.

<table>
<thead>
<tr>
<th>Tax No.</th>
<th>Permit No.</th>
<th>County</th>
<th>Township</th>
<th>French Claim</th>
<th>WSSN:</th>
</tr>
</thead>
<tbody>
<tr>
<td>007-030-012-10</td>
<td></td>
<td>St. Joseph</td>
<td>Flowerfield</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Well ID:** 75000000818

- **Elevation:** 870 ft
- **Latitude:** 42.0090119836
- **Longitude:** -85.758633007

<table>
<thead>
<tr>
<th>Well ID: 75000000818</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance and Direction from Road Intersection: N. SIDE OF FLOATING BRIDGE RD., 8 MILE E. OF DAY RD.</td>
</tr>
</tbody>
</table>

**Well Name:** Vine Martin

**Well Address:**

- **Owner Address:** 10160 FLOATING BRIDGE ROAD
  - **County:** SI. Joseph
  - **Township:** Flowerfield
  - **Fraction:** SE¼ NW¼ NW¼ 05S 12W
  - **Section:** 30
  - **Town/Range:** 05S 12W
  - **WSSN:**

<table>
<thead>
<tr>
<th>Drilling Method: Auger/Bored</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well Depth: 100.00 ft</td>
</tr>
<tr>
<td>Well Type: Replacement</td>
</tr>
<tr>
<td>Date Completed: 2/7/1979</td>
</tr>
<tr>
<td>Casing Type: Steel - black</td>
</tr>
<tr>
<td>Casing Joint: Threaded &amp; coupled</td>
</tr>
<tr>
<td>Diameter: 2.00 in. to 96.00 ft. depth</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bore Diameter 1:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bore Diameter 2:</td>
</tr>
<tr>
<td>Bore Diameter 3:</td>
</tr>
<tr>
<td>Height: 1.00 ft. above grade</td>
</tr>
<tr>
<td>Casing Fitting: Drive shoe</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Static Water Level: 26.00 ft. Below Grade (Not Flowing)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield Test Method: Unknown</td>
</tr>
<tr>
<td>Measurement Taken During Pump Test:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Abandoned Well Plugged: No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reason for not plugging Well:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Well Head Completion:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grouting Method: Unknown</td>
</tr>
<tr>
<td>No. of Bags:</td>
</tr>
<tr>
<td>Grouting Materials:</td>
</tr>
<tr>
<td>Additives: None</td>
</tr>
<tr>
<td>Unknown</td>
</tr>
<tr>
<td>From 0.00 ft. to 0.00 ft.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Screen Installed: Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well Intake:</td>
</tr>
<tr>
<td>Screen Diameter: 1.25 in.</td>
</tr>
<tr>
<td>Length: 4.00 ft.</td>
</tr>
<tr>
<td>Screen Material Type:</td>
</tr>
<tr>
<td>Slot: 70.00 in. Set Between 96.00 ft. and 100.00 ft.</td>
</tr>
<tr>
<td>Blank: 0.00 ft. Above</td>
</tr>
<tr>
<td>Fittings:</td>
</tr>
<tr>
<td>Bremer check valve</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Well Greated: Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grouting Method: Unknown</td>
</tr>
<tr>
<td>No. of Bags:</td>
</tr>
<tr>
<td>Grouting Materials:</td>
</tr>
<tr>
<td>Additives: None</td>
</tr>
<tr>
<td>Unknown</td>
</tr>
<tr>
<td>From 0.00 ft. to 0.00 ft.</td>
</tr>
</tbody>
</table>

| No. of Bags: |
| Grouting Materials: |
| Additives: None |
| Unknown |
| Flowing adapter |

<table>
<thead>
<tr>
<th>Nearest source of possible contamination:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type:</td>
</tr>
<tr>
<td>Distance Direction: 50.00 ft. Northwest</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drilling Machine Operator Name:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employment: Unknown</td>
</tr>
</tbody>
</table>

| General Remarks: WP3594 |

**ATTENTION WELL OWNER: FILE WITH DEED**

2/18/2000 17:27
WATER WELL AND PUMP RECORD
Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Well ID: 75000007383

Tax No: 02-7387 Permit No: County: St. Joseph Township: Flowerfield

Well Name: Well Owner: Albert & Nancy Jo Ruggles

Well Address: 10262 FLOATING BRIDGE RD MARCELUS MI 49067 Owner Address: 10262 FLOATING BRIDGE RD MARCELUS MI 49067

Well ID: 75000007383

Drilling Method: Rotary
Well Use: Household

Well Depth: 65.00 ft. Well Use: Household
Well Type: Replacement Date Completed: 5/14/2004

Casing Type: PVC plastic
Casing Joint: Unknown Diameter: 5.00 in. to 65.00 ft. depth

Bore Diameter 1: 8.00 in. to 65.00 ft. depth
Bore Diameter 2: Bore Diameter 3:
Height: 1.00 ft. above grade
Casing Fitting: None

Static Water Level: 14.00 ft. Below Grade (Not Flowing)
Yield Test Method: Air
Measurement Taken During Pump Test: 16.00 ft. after 12.00 hrs. pumping at 20.00 GPM

Abandoned Well Plugged: No Reason for not plugging Well: Other
Abandoned well ID:

Screen Installed: Yes Well Intake: Light Brown Gravel Coarse
Filter Packed: No Screen Diameter: 5.00 in.
Length: 5.00 ft.
Screen Material Type: PVC - slotted Slot: 20.00 in. Set Between 60.00 ft. and 65.00 ft.
Blank: Fittings: Unknown

Well Grouted: Yes Grouting Method: Unknown
No. of Bags: 3 Additives: None
Grouting Materials:
Bentonite slurry From 0.00 ft. to 60.00 ft.

Well Head Completion: 12 inches above grade

Nearest source of possible contamination:
Type: Septic tank Distance Direction: 60.00 ft. North

Drilling Machine Operator Name: RICK CLARK Employment: Employee

Other Remarks: Reason For Not Plugging Well: WELL ONLY

General Remarks:

Attention Well Owner: File with Deed

1/5/2005 14:14
### Gamma Ray Log

<table>
<thead>
<tr>
<th>WELL CD: St. Joseph 65-3</th>
<th>DATE: 11-07-66</th>
</tr>
</thead>
<tbody>
<tr>
<td>PERMIT:</td>
<td></td>
</tr>
<tr>
<td>COUNT: Kock Model 5R-3000</td>
<td></td>
</tr>
<tr>
<td>UPG: Nick</td>
<td></td>
</tr>
<tr>
<td>TIME CONSUMED: 100 div.</td>
<td></td>
</tr>
<tr>
<td>SENS: 1</td>
<td></td>
</tr>
<tr>
<td>SCALE: 1000 c.p.m. f.x.</td>
<td></td>
</tr>
<tr>
<td>LOCATION: Floatingbridge Rd.</td>
<td>First house west of Day road</td>
</tr>
<tr>
<td>TOWNSHIP: Flowerfield Section 30 NW corner</td>
<td></td>
</tr>
<tr>
<td>DRILLING CO: Tom Mosier Drilling</td>
<td></td>
</tr>
<tr>
<td>GROUND ELEVATION: approx.</td>
<td></td>
</tr>
<tr>
<td>RISER: 13 inch ground level</td>
<td></td>
</tr>
<tr>
<td>DRILLED Depth: feet</td>
<td></td>
</tr>
<tr>
<td>RED MARK in ground: 13 inches</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
- Started logging 29'-15"=14 inches below ground level. Actual logged depth is 63 feet. Note there was a lot of granular bentonite around the well. Mud rotary usually do not see granular bentonite. This may in part account for the high gamma values at this well.
TAX NO: 67-000-030-06-12

MIchIGAN DEPARTMENT OF PUBLIC HEALTH
WATER WELL AND PUMP RECORD

OWNER OF WELL
Address

3. WELL DEPTH:
Date Completed

4. USE:

5. CASING:

6. SCREEN:

7. Fittings:

8. PLUGGING MATERIAL:

9. STATIC WATER LEVEL:

10. PUMPING LEVEL:

11. WELL HEAD COMPLETION:

12. WELL GROUTED?

13. NEAREST SOURCE OF POSSIBLE CONTAMINATION:

14. PUMP:

15. WATER WELL CONTRACTOR'S CERTIFICATION:

This well was drilled under my jurisdiction and this report is true to the best of my

knowledge and belief.

Signature

17. DRILLING MACHINE OPERATOR:

18. REMARKS:

USE A 2ND SHEET IF NEEDED

19. 2ND SHEET OF PUMP RECORD

LOCAL HEALTH DEPT. COPY

181
**GAMMA RAY LOG**

**WELL NO.:** St. Joseph 96-33  
**DATE:** Oct. 1, 1996

**PERMIT #:**  
**GROUP:** Reck Model SR-3000

**Casing:** 4" G.S.

**OPPER:** Nicks

**TIME:** 1000 hrs.  
**CONS:** 1000 hrs.  
**SCALE:** 6 rpm

**Logging up**

**ADDRESS:** Camp Fiberart 10300 Corey Drive T.R.

**TOWNSHIP:** Fabius Section 19

**DRILLING CO.:** Tom Mosier Drilling

**GROUND ELEVATION:** approx. 800 feet

**RDBR:** 12 inches ground level

**Logged depth:** 65 feet

**Contractor:** owner: XARCA

**STATUS:** 5.81 ft TOC

Existing 2 story wooden house adjacent to lake.

*Logged depth starts 29' (red marker to crystal) 13' (red marker to ground) = 16' below the ground surface. Red marker is +1.2 ft when logged up. Actual logged depth is 65 feet.*

|Logged depth 46-48 |
**LOCATION OF WELL**

- County: [County Name]
- Township: [Township Name]
- Section: [Section Number]
- Range: [Range Number]
- Town: [Town Name]
- Range: [Range Number]

**Distance and Direction from Road Intersection**

Locate with 'x' in Section Below - Sketch Map

**WELL DEPTH**

- Street Address & City of Well Location: [Address] [City]
- Use Well Address: [Same as Well Location] Yes [Yes] No [No]

**WELL DEPTH**

- Distance: [Distance]
- Direction: [Direction]

**USE**

- Household: [Yes] [No]
- Type I Public: [Yes] [No]
- Type II Public: [Yes] [No]
- Type III Public: [Yes] [No]
- Irrigation: [Yes] [No]
- Heat Pump: [Yes] [No]

**CASING**

- Size: [Size]
- Material: [Material]
- Length: [Length]

**SCREEN**

- Diameter: [Diameter]
- Flow Rating: [Flow Rating]
- Screen Length: [Screen Length]

**FITTINGS**

- Type: [Type]

**PUMPING LEVEL**

- Below Land Surface: [Yes] [No]
- Above Grade: [Yes] [No]

**WELLHEAD COMPLETION**

- Pressure Tank: [Yes] [No]
- Submersible Pump: [Yes] [No]

**WATER WELL CONTRACTOR’S CERTIFICATION**

- This well was drilled under my jurisdiction and the report is true to the best of my knowledge and belief.

**STORAGE**

- Capacity: [Capacity]
- G.P.M.: [G.P.M.]

**PRESSURE TANK**

- Type: [Type]
- Capacity: [Capacity]
- G.P.M.: [G.P.M.]

**REGISTRATION NO.**

- Business Name: [Business Name]
- Registration No.: [Registration No.]

**Signature**

- Drilling Machine Operator: [Signature]
- Date: [Date]

**MICHIGAN DEPARTMENT OF PUBLIC HEALTH**

- WATER WELL AND PUMP RECORD

**PERMIT NO.**

- Permit No.: [Permit No.]

**LOCAL HEALTH DEPT. COPY**

- Authority: Act 136 PA 1975
- Commission: [Commission]
- Form: [Form]
- Date: [Date]
**WELL**
St. Joseph 97-13

**DATE**
4-22-97

**LUBRI**
Kock Model SR-3000

**LUBRICANT**
Nicks Kenzierski

**TIME/CONSUM**
100 div. Sens 1

**CABLE**
1000 cpsi ex

**ADDRESS**
15663 Crown Hollow Road, Three Rivers

**TOWNSHIP**
Fabius Section 13

**DRILL RIGS**
Tom Master Drilling

**HOLE DEPT**
65 ft

**HORZ RLR**
33 inches ground level

**LOGGED DEPT**
63 3 ft

**LOGGED**
32-29"+3" above ground level, driller collected samples every 5 ft.
WATER WELL AND PUMP RECORD

Completion is required under authority of Part 127 Act 368 PA 1978. Failure to comply is a misdemeanor.

Well ID: 75000006583

Elevation: 814 ft
Latitude: 41.94906375
Longitude: -85.65357995

Distance and Direction from Road Intersection: 300FT WEST OF KERR CREEK

Well Name: Louis Baima
Well Address: 15568 COONHOLLOW RD
THREE RIVERS MI 49093

Drilling Method: Rotary
Well Depth: 65.00 ft
Well Use: Household
Well Type: Replacement
Date Completed: 12/16/2002

Casing Type: PVC plastic
Casing Joint: Solvent welded/ glued
Diameter: 5.00 in. to 60.00 ft depth

Bore Diameter 1: 8.75 in. to 60.00 ft depth
Bore Diameter 2:
Bore Diameter 3:
Height: 1.00 ft. above grade
Casing Fitting: Shale packer/trap

Static Water Level: 30.00 ft. Below Grade (Not Flowing)
Yield Test Method: Air
Measurement Taken During Pump Test:
65.00 ft. after 1.00 hrs. pumping at 50.00 GPM

Abandoned Well Plugged: No
Reason for not plugging: Well being plugged by another driller

Abandoned well ID:
Screen Installed: Yes
Filter Packed: No
Screen Diameter: 4.00 in.
Screen Material Type: Stainless steel-sloated
Slot: 15.00 in. Set Between 60.00 ft. and 65.00 ft.
Blank: 1.00 ft. Above
Fittings: Blank above screen

Well Grouted: Yes
Grouting Method: Grout pipe outside casing
No. of Bags: 4
Additives: None
Grouting Materials:
Bentonite slurry
From 0.00 ft. to 57.00 ft.

Well Head Completion: 12 inches above grade

Nearest source of possible contamination:
Type: Distance Direction
Septic tank
50.00 ft. East

Drilling Machine Operator Name: RYAN KATZ
Employment: Employee

General Remarks:

Geology Remarks:

Contractor Type: Water well drilling contractor
Registration Number: 1953
Business Name: Katz Well Drilling Inc
Business Address: 1429 E Mich Ave Battle Creek 49014

WATER WELL CONTRACTOR’S CERTIFICATION:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Signature of Registered Representative

ATTENTION WELL OWNER: FILE WITH DEED

1/17/2003 13:52
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978.

Failure to comply is a misdemeanor.

<table>
<thead>
<tr>
<th>Tax No: 004-410-025-00</th>
<th>Permit No:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Well ID:</strong> 75000002044</td>
<td><strong>County:</strong> St. Joseph</td>
</tr>
<tr>
<td><strong>Well ID:</strong> 75000002044</td>
<td><strong>Township:</strong> Fabius</td>
</tr>
</tbody>
</table>

**Well Name:**

- **Well ID:** 75000002044
- **Failure to comply is a misdemeanor.**
- **Well Address:** 15491 COON HOLLOW ROAD
- **Owner Address:** 15491 COON HOLLOW ROAD
- **Owner:** Wayne Johnson
- **Owner Address:** 15491 COON HOLLOW ROAD
- **Owner:** Wayne Johnson
- **Owner Address:** 15491 COON HOLLOW ROAD

**Drilling Method:** Jetted

- **Well Depth:** 45.00 ft.
- **Well Use:** Household
- **Well Type:** Replacement
- **Date Completed:** 11/3/1988

- **Casing Type:** Steel - black
- **Casing Joint:** Threaded & coupled
- **Diameter:** 4.00 in. to 40.00 ft. depth

- **Bore Diameter 1:**
- **Bore Diameter 2:**
- **Bore Diameter 3:**
- **Height:** 1.00 ft. above grade
- **Casing Fitting:** Drive shoe

- **Well Intake:**
- **Water Use:** Household

**Screen Installed:** Yes

- **Filter Packed:** No
- **Screen Diameter:** 3.00 in.
- **Length:** 5.00 ft.
- **Screen Material Type:**
- **Slot:** 12.00 in.
- **Set Between:** 40.00 ft. and 45.00 ft.
- **Blank:** 2.00 ft.
- **Above:**
- **Fittings:** Neoprene packer

**Well Grouted:** Yes

- **Grouting Method:** Unknown
- **No. of Bags:**
- **Additives:** None
- **Grouting Materials:** Bentonite slurry
- **From:** 0.00 ft. to 0.00 ft.

**Well Head Completion:** Pillar adapter

**Nearest source of possible contamination:**

- **Type:**
- **Distance Direction:** Septic tank
- **Distance:** 50.00 ft.
- **South:**

**Pump Installed:** Yes

- **Pump Installation only:** No
- **HP:**
- **Manufacturer:** Grundfos
- **Model Number:**
- **Pump Type:** Submersible
- **Pump Capacity:** 0.00 GPM
- **Well ID:**
- **Length of Drop Pipe:** 30.00 ft.
- **Diameter of Drop Pipe:**
- **Draw Down Seal Used:** No
- **Pressure Tank Installed:** No
- **Pressure Tank Type:**
- **Manufacturer:**
- **Model Number:**
- **Pressure Relief Valve Installed:** No
- **Tank Capacity:** Gallons

**Formation Description:**

- **Thickness:**
- **Depth to Bottom:**

- **Topsoil:** 2.00
- **Brown Clay:** 6.00
- **Sand & Gravel:** 18.00
- **Sand & Clay:** 10.00
- **Sand Coarse:** 9.00

**Geology Remarks:**

- **1. [TOP SOIL]**
- **2. [BROWN CLAY]**
- **3. [SAND & GRAVEL]**
- **4. [SAND & CLAY MIXED]**
- **5. [COARSE SAND]**

**Contractor Type:** Unknown

- **Registration Number:** 187

**WATER WELL CONTRACTOR’S CERTIFICATION:**

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

**Special Remarks:**

- **General Remarks:**
- **Drilling Machine Operator Name:** Unknown
- **Employment:** Unknown

**OTHER REMARKS**

**ATTENTION WELL OWNER: FILE WITH DEED**

2/19/2000 17:46

186
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978. Failure to comply is a misdemeanor.

**Well ID:** 750000002047

<table>
<thead>
<tr>
<th>Tax No:</th>
<th>004-420-062-00</th>
<th>Permit No:</th>
</tr>
</thead>
<tbody>
<tr>
<td>County:</td>
<td>St. Joseph</td>
<td>Township:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fabius</td>
</tr>
<tr>
<td>Elevation:</td>
<td>830 ft</td>
<td></td>
</tr>
<tr>
<td>Latitude:</td>
<td>41.9483701558</td>
<td></td>
</tr>
<tr>
<td>Longitude:</td>
<td>-85.6591731736</td>
<td></td>
</tr>
</tbody>
</table>

**Well ID:** 750000002047

**Completion** is required under authority of Part 127 Act 368 PA 1978. Failure to comply is a misdemeanor.

**Well Name:** Chippewa Homes Inc.

**Well Address:**
- 15225 COON HOLLOW ROAD
- 3 RIVERS MI 49093

**Well ID:** 75000002047

**Distance and Direction from Road Intersection:** S. SIDE OF COON HOLLOW ROAD, 5 MILE W. OF US 131

**Elevation:** 830 ft

**Well Name:** Chippewa Homes Inc.

**Well Address:**
- 15225 COON HOLLOW ROAD
- 3 RIVERS MI 49093

**Drilling Method:** Jetted

**Well Depth:** 60.00 ft

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 12/1/1972

**Casing Type:** Unknown

**Casing Joint:** Threaded & coupled

**Diameter:** 2.00 in. to 56.00 ft. depth

**Bore Diameter 1:**

**Bore Diameter 2:**

**Bore Diameter 3:**

**Height:** 0.00 ft. above grade

**Casing Fitting:** Drive shoe

**Static Water Level:** 28.00 ft. Below Grade (Not Flowing)

**Yield Test Method:** Unknown

**Measurement Taken During Pump Test:**

**Abandoned Well Plugged:** No

**Reason for not plugging Well:**

**Abandoned well ID:**

**Screen Installed:** Yes

**Well Intake:**

**Screen Diameter:** 1.25 in.

**Length:** 4.00 ft.

**Screen Material Type:**

**Slot:** 10.00 in.

**Length:** 56.00 ft. and 60.00 ft.

**Blank:** 0.00 ft. Above

**Fitting:** Neoprene packer

**Well Grouted:** No

**Grouting Method:**

**No. of Bags:** Additives:

**Grouting Materials:**

**Well Head Completion:** Pitless adapter

**Nearest source of possible contamination:**

**Type:**

**Distance:** 80.00 ft.

**Direction:** West

**Geology Remarks:** 1. [RED CLAY] [2] [2] 2. [SAND & GRavel] [51] [49] 3. [BLUE CLAY] [54] [3] 4. [WATER SOIL] [60] [6]

**Contractor Type:** Unknown

**Registration Number:** 205

**Business Name:**

**Business Address:**

**WATER WELL CONTRACTOR’S CERTIFICATION:**

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

**Signature of Registered Representative:**

**Date:**

**General Remarks:**

**OTHER REMARKS:**

**ATTENTION WELL OWNER: FILE WITH DEED**

2/18/2000 17:46
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978.

**Well ID:** 75000002042

<table>
<thead>
<tr>
<th>Tax No: 051-360-001-00</th>
<th>Permit No:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Well ID:</strong> 75000002042</td>
<td><strong>Failure to comply is a misdemeanor.</strong></td>
</tr>
<tr>
<td><strong>Well ID:</strong> 75000002042</td>
<td><strong>Import ID:</strong> 75761213022</td>
</tr>
<tr>
<td><strong>Tax No:</strong> 051-360-001-00</td>
<td><strong>Well #:</strong> 75000002042</td>
</tr>
<tr>
<td><strong>Well #:</strong> 75000002042</td>
<td><strong>Elevation:</strong> 830 ft</td>
</tr>
<tr>
<td><strong>Latitude:</strong> 41.946680072</td>
<td><strong>Longitude:</strong> -85.6506467836</td>
</tr>
<tr>
<td><strong>Drilling Method:</strong> Jetted</td>
<td><strong>Well Depth:</strong> 66.00 ft</td>
</tr>
<tr>
<td><strong>Well Type:</strong> Replacement</td>
<td><strong>Well Use:</strong> Other</td>
</tr>
<tr>
<td><strong>Casing Type:</strong> Unknown</td>
<td><strong>Casing Joint:</strong> Threaded &amp; coupled</td>
</tr>
<tr>
<td><strong>Diameter:</strong> 4.00 in. to 60.00 ft. depth</td>
<td><strong>Bore Diameter 1:</strong></td>
</tr>
<tr>
<td><strong>Bore Diameter 2:</strong></td>
<td><strong>Bore Diameter 3:</strong></td>
</tr>
<tr>
<td><strong>Height:</strong> 2.00 ft. above grade</td>
<td><strong>Casing Fitting:</strong> Drive shoe</td>
</tr>
<tr>
<td><strong>Casing Fitting:</strong> Drive shoe</td>
<td><strong>Screen Installed:</strong> Yes</td>
</tr>
<tr>
<td><strong>Filter Packed:</strong> No</td>
<td><strong>Screen Diameter:</strong> 3.75 in</td>
</tr>
<tr>
<td><strong>Slot:</strong> 8.00 in.</td>
<td><strong>Length:</strong> 6.00 ft</td>
</tr>
<tr>
<td><strong>Blank:</strong> 0.00 ft. Above</td>
<td><strong>Fittings:</strong></td>
</tr>
<tr>
<td><strong>Geology Remarks:</strong></td>
<td><strong>Contractor Type:</strong> Unknown</td>
</tr>
<tr>
<td><strong>Fittings:</strong></td>
<td><strong>Registration Number:</strong> 88</td>
</tr>
<tr>
<td><strong>Wells Grouted:</strong> No</td>
<td><strong>Business Name:</strong></td>
</tr>
<tr>
<td><strong>Grouting Method:</strong></td>
<td><strong>Business Address:</strong></td>
</tr>
<tr>
<td><strong>No. of Bags:</strong></td>
<td><strong>WATER WELL CONTRACTOR’S CERTIFICATION:</strong></td>
</tr>
<tr>
<td><strong>Additives:</strong></td>
<td>This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.</td>
</tr>
<tr>
<td><strong>Grouting Materials:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Well Head Completion:</strong> Pitless adapter</td>
<td></td>
</tr>
<tr>
<td><strong>Nearest source of possible contamination:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Type:</strong> Unknown</td>
<td></td>
</tr>
<tr>
<td><strong>Distance Direction:</strong> 0.00 ft</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Drilling Machine Operator Name:</strong> ROBERT BICKEL</td>
<td></td>
</tr>
<tr>
<td><strong>Employment:</strong> Unknown</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>General Remarks:</strong> WP2291 (BURIED TANK)</td>
<td><strong>OTHER REMARKS</strong> Well Use: Public Well Type Unknown</td>
</tr>
<tr>
<td></td>
<td></td>
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<tr>
<td>**EQP 2017C (2/2000)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ATTENTION WELL OWNER: FILE WITH DEED</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Pump Installed:** Yes | **Well Intake:** |
| | **Pump Installation only:** No |
| **Pump Installation Date:** 10/31/1977 | **Well Head Completion:** |
| **Manufacturer:** Flint & Walling | **Contractor Type:** Unknown |
| **Model Number:** | **Registration Number:** 88 |
| **Pump Type:** Submersible | **Business Name:** |
| **Pump Capacity:** 0.00 GPM | **Business Address:** |
| **Diameter of Drop Pipe:** | **WATER WELL CONTRACTOR’S CERTIFICATION:** |
| **Draw Down Seal Used:** No | This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief. |

**Formation Description**

| Topsoil | 1.00 | 1.00 |
| Red Clay & Sand | 14.00 | 15.00 |
| Sand & Gravel | 16.00 | 31.00 |
| Blue Clay | 23.00 | 54.00 |
| Sand & Gravel | 12.00 | 66.00 |

**Nearest source of possible contamination:** Type Distance Direction | **Geology Remarks:** 1. [SURFACE] (1) (1) 2. [RED CLAY & SAND] (15) (14) 3. [SAND & GRAVEL] (31) (16) 4. [BLUE CLAY] (54) (23) 5. [SAND & GRAVEL] (66) (12) |
WELL: ID: St. Joseph 96-14
DRILLER: J. 1.11
PUR: Kick Model SR-3400
FOR: Nick's Ranch
TH: CONSULT 109-00-498 S 1
SLIDE: 1000 rpm 5' 
ADDRESS: 50844 A 1, Jones Rd
TOWNSHIP: Fairview Section 31 southwest quarter
DRILLER: Reed's Drilling
DIA: 34" FILLER 2"
VOL: 4" ground level
DIAM: 5" ground level
Notes: North of Corey Lake Rd but before school on Jones Rd. Take exit off north 200 feet, the well is located behind brown pole building, 1st past house, east side of tennis court.
Owner: Campcress
Drilled: Depth: 152 feet
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

<table>
<thead>
<tr>
<th>Tax No:</th>
<th>Permit No:</th>
<th>County:</th>
<th>Township:</th>
</tr>
</thead>
<tbody>
<tr>
<td>17143</td>
<td></td>
<td>St. Joseph</td>
<td>Fabius</td>
</tr>
</tbody>
</table>

### Well ID: 75000006003

- **Well Name:** 001
- **Well Owner:** Habonim Camp Tavor
- **Well Address:** 59884 AL Jones Rd
- **Owner Address:** 59884 AL Jones Rd
- **Township:** Fabius

#### Drilling Details

- **Drilling Method:** Jetted
- **Well Depth:** 152.00 ft.
- **Well Type:** Replacement
- **Date Completed:** 6/5/1996
- **Casing Type:** Steel - galvanized
- **Casing Joint:** Threaded & coupled
- **Diameter:** 4.00 in. to 142.00 ft. depth
- **Bore Diameter 1:** 4.00 in. to 152.00 ft. depth
- **Bore Diameter 2:**
- **Bore Diameter 3:**
- **Height:** 1.00 ft. above grade
- **Casing Fitting:** None

#### Water Level

- **Static Water Level:** 27.00 ft. Below Grade (Not Flowing)

#### Yield Test

- **Measurement Taken During Pump Test:**
  - 1.00 hrs. pumping at 65.00 GPM

#### Screen and Grouting

- **Screen Installed:** Yes
- **Screen Diameter:** 3.75 in.
- **Screen Material Type:** Stainless steel-slotted
- **Slot:** 12.00 in. Set Between 142.00 ft. and 152.00 ft.
- **Blank:** 3.00 ft. Above
- **Fittings:** Blank above screen

#### Well Head

- **Well Head Completion:** 12 inches above grade

#### Geology

<table>
<thead>
<tr>
<th>Formation Description</th>
<th>Thickness</th>
<th>Depth to Bottom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown Clay &amp; Gravel</td>
<td>36.00</td>
<td>36.00</td>
</tr>
<tr>
<td>Blue Sand &amp; Gravel</td>
<td>64.00</td>
<td>100.00</td>
</tr>
<tr>
<td>Blue Clay</td>
<td>26.00</td>
<td>126.00</td>
</tr>
<tr>
<td>Blue Sand &amp; Gravel</td>
<td>26.00</td>
<td>152.00</td>
</tr>
</tbody>
</table>

#### Contractor Information

- **Contractor Type:** Water well drilling contractor
- **Registration Number:** 369
- **Business Name:** reid & son
- **Business Address:** P.O. Box 10 Howe, IN 46746

**WATER WELL CONTRACTOR’S CERTIFICATION:**

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

**Signature of Registered Representative:**

**Date:**

---

**General Remarks:**

**ATTENTION WELL OWNER: FILE WITH DEED**

7/22/2002 11:29
FEARON 4: Irrigation well
DRILL: Rock Model NR-3000
UPPER: Nochard
TIME: 10 HR. 46 MINS.
SCALE: 1/2" = 100 ft.
LOGGING UP
ADDRESS: 790 ft. S of Knoll, 475 N of 1110
TOWNSHIP: Franklin Section 37
DRILLING CO: Peerless Drilling
GROUND ELEVATION: approx. 900 feet
Drilled Depth: 111 ft.
Notes: Entrance is west of Tool & Dye building
Contractor: Memor Faber
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978.

Failure to comply is a misdemeanor. Import ID: 75761227002

<table>
<thead>
<tr>
<th>Tax No.</th>
<th>004-155-017-00</th>
<th>Permit No.</th>
<th>Clay</th>
<th>Section: 27</th>
<th>TownRange: 005 12W</th>
<th>French Claim</th>
<th>WSSN:</th>
</tr>
</thead>
</table>

**Well ID: 75000002426**

**Elevation:** 900 ft  
**Latitude:** 41.9128925624  
**Longitude:** -85.6977657614

**Well Name:**  
**Well Owner:** Robert Zerfas  
**Well Address:** 60852 KRULL ROAD  
**Owner Address:** 60852 KRULL ROAD 3 RIVERS MI 49093

**Drilling Method:** Auger/Bored  
**Well Depth:** 160.00 ft.  
**Well Type:** Replacement  
**Date Completed:** 8/22/1972  
**Casing Type:** Steel - black  
**Casing Joint:** Threaded & coupled  
**Diameter:** 2.00 in. to 156.00 ft. depth

**Bore Diameter 1:**  
**Bore Diameter 2:**  
**Bore Diameter 3:**  
**Bore Height:** 1.00 ft. above grade  
**Casing Fitting:** Drive shoe

**Static Water Level:** 60.00 ft. Below Grade (Not Flowing)  
**Yield Test Method:** Unknown  
**Measurement Taken During Pump Test:**

<table>
<thead>
<tr>
<th>Formation Description</th>
<th>Thickness</th>
<th>Depth to Bottom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Clay</td>
<td>5.00</td>
<td>10.00</td>
</tr>
<tr>
<td>Red Sand</td>
<td>10.00</td>
<td>15.00</td>
</tr>
<tr>
<td>Red Clay &amp; Gravel</td>
<td>24.00</td>
<td>39.00</td>
</tr>
<tr>
<td>White Sand</td>
<td>10.00</td>
<td>49.00</td>
</tr>
<tr>
<td>Blue Clay</td>
<td>101.00</td>
<td>150.00</td>
</tr>
<tr>
<td>Gravel &amp; Sand Fine</td>
<td>10.00</td>
<td>160.00</td>
</tr>
</tbody>
</table>

**Abandoned Well Plugged:** No  
**Reason for not plugging Well:**

**Screen Installed:** Yes  
**Well Intake:**

**Filter Packed:** No  
**Screen Diameter:** 1.25 in.  
**Length:** 4.00 ft.  
**Screen Material Type:**

**Slot:** 10.00 in. Set Between 156.00 ft. and 160.00 ft.  
**Blank:** 0.00 ft. Above  
**Fittings:** Bremer check valve

**Well Grouted:** Yes  
**Grouting Method:** Unknown  
<table>
<thead>
<tr>
<th>Grouting Materials:</th>
<th>Additives: None</th>
<th>No. of Bags:</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unknown</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Well Head Completion:** Pitless adapter

**Nearest source of possible contamination:**

<table>
<thead>
<tr>
<th>Type</th>
<th>Distance Direction</th>
<th>Septic tank</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>75.00 ft. Southwest</td>
<td></td>
</tr>
</tbody>
</table>

**Drilling Machine Operator Name:**

**Employment:** Unknown

**Well Government Certification:**  
**Drilling Machine Operator Name:**

**Employment:** Unknown

**General Remarks:** VERIFIED BY CURRENT OWNER RICHARD HAGENBUCH

**OTHER REMARKS**

**ATTENTION WELL OWNER: FILE WITH DEED**

2/18/2000 17:51

192
WATER WELL AND PUMP RECORD

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

**Tax No:** 004-027-006-00  **Well ID:** 75000002430

**Well Name:**
**Well Owner:** Phil Dufour
**Well Address:** 60345 KRULL ROAD 3 RIVERS MI 49093
**Owner Address:** 13262 M-60 3 RIVERS MI 49093

**Distance and Direction from Road Intersection:** N. SIDE OF KRULL RD., .5 MILE N. OF M-60
**County:** St. Joseph  **Township:** Fabius
**Fraction:** NE¼ SW¼ NW¼  **Section:** 27  **Town Range:** 06S 12W  **French Claim:** WSSN:

**Well ID:** 75000002430  **Elevation:** 870 ft  **Longitude:** -85.6979392472
**Latitude:** 41.9207178713  **Well Depth:** 40.00 ft.

**Location:**
- **Distance from Road:** N. SIDE OF KRULL RD., .5 MILE N. OF M-60
- **Height:** 1.00 ft. above grade
- **Casing Fitting:** Drive shoe

**Drilling Method:** Jetted  **Well Type:** New  **Well Use:** Household
**Date Completed:** 7/18/1983

**Casing:**
- Type: Steel - black
- Joint: Threaded & coupled
- Diameter: 2.00 in. to 36.00 ft. depth

**Bore Diameter:**
- Diameter 1:
- Diameter 2:
- Diameter 3:

**Casing:**
- Diameter: 2.00 in. to 36.00 ft. depth

**Screen:**
- Installed: Yes
- Diameter: 1.25 in.
- Material Type: Between 36.00 ft. and 40.00 ft.
- Length: 4.00 ft.
- Blank: 0.00 ft. Above
- Fittings: None

**Well Grouted:** No  **Grouting Method:**
**No. of Bags:** Additives:
**Grouting Materials:**

**Well Head Completion:**
- Well Head Completion: 12 inches above grade. Other

**Well Grouted:** No  **Grouting Method:**
**No. of Bags:** Additives:
**Grouting Materials:**

**Static Water Level:** 15.00 ft. Below Grade(Not Flowing)

**Yield Test Method:** Unknown
**Measurement Taken During Pump Test:**
- 15.00 ft. after 1.00 hrs. pumping at 15.00 GPM

**Abandoned Well Plugged:** No  **Reason for not plugging Well:**
**Abandoned well ID:**
- Screen Installed: Yes  **Well Intake:**
- Filter Packed: No
- Diameter: 1.25 in.
- Length: 4.00 ft.
- Material Type: Between 36.00 ft. and 40.00 ft.
- Blank: 0.00 ft. Above
- Fittings: None

**Well Grouted:** No  **Grouting Method:**
**No. of Bags:** Additives:
**Grouting Materials:**

**Well Head Completion:**
- Well Head Completion: 12 inches above grade. Other

**Nearest source of possible contamination:**
- Type: Septic tank
- Distance Direction: 50.00 ft. North

**Drilling Machine Operator Name:**  **Employment:** Unknown  **General Remarks:** WP6289
**ATTENTION WELL OWNER: FILE WITH DEED**

2/19/2000 17:51

193
WATER WELL AND PUMP RECORD

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Well ID: 75000005413
Tax No: 000 02 2506
County: St. Joseph
Township: Fabius
Distance and Direction from Road Intersection: SW CORNER OF INTERSECTION OF M-60 & KRULL RD.

<table>
<thead>
<tr>
<th>Fraction</th>
<th>Section</th>
<th>Town/Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>US US US</td>
<td>27</td>
<td>06S 12W</td>
</tr>
</tbody>
</table>

Failure to comply is a misdemeanor.

Well Name: Norm Mevers
Well Address: 13180 M-60
Three Rivers Mi 49093

Well ID: 75000005413
Failure to comply is a misdemeanor.

- Well ID: 75000005413
- Well Name: Norm Mevers
- Well Address: 13180 M-60
  Three Rivers Mi 49093
- County: St. Joseph
- Township: Fabius
- Well Tax No: 000 02 2506
- Permit No: 000 02 2506

### Drilling Method: Rotary
- Well Depth: 103.00 ft.
- Well Use: Household
- Well Type: Replacement
- Date Completed: 2/9/2000
- Casing Joint: Unknown
- Diameter: 5.00 in. to 103.00 ft. depth
- Bore Diameter 1: 8.00 in. to 103.00 ft. depth
- Bore Diameter 2:
- Bore Diameter 3:
- Height: 1.00 ft. above grade
- Casing Fitting: None
- Static Water Level: 50.00 ft. Below Grade (Not flowing)
- Measurement Taken During Pump Test:
  - 53.00 ft. after 1.00 hrs. pumping at 25.00 GPM
- Abandoned Well Plugged: Yes
- Reason for not plugging Well:
- Abandoned well ID:
- Screen Installed: Yes
- Well Intake: Light Gray Gravel Fine
- Filter Packed: No
- Screen Diameter: 5.00 in.
- Length: 5.00 ft.
- Screen Material Type:
  - Slot: 20.00 in. Set Between 98.00 ft. and 103.00 ft.
  - Blank: None
- Well Grouted: Yes
- Grouting Method: Unknown
- No. of Bags: 5
- Additives: None
- Grouting Materials:
  - Bentonite slurry From 0.00 ft. to 95.00 ft.
- Well Head Completion: 12 inches above grade, Pitless adapter
- Nearest source of possible contamination:
  - Type: Distance Direction
    - Septic tank: 55.00 ft. Southwest

### Pump Installed: Yes
- Pump Installed only: No
- Pump Installation date: HP: 0.50
- Manufacturer: Flint & Walling
- Pump Type: Submersible
- Model Number: 4F10G0535
- Pump Capacity: 10.00 GPM
- Id of Well: 103.00 ft.
- Diameter of Drop Pipe: Draw Down Seal Used: No
- Pressure Tank Installed: Yes
- Pressure Tank Type: Unknown
- Manufacturer: Well-X-Trol
- Model Number: 203
- Tank Capacity: 32 Gallons
- Pressure Relief Valve Installed: No

### Formation Description
- Topsoil
  - Thickness: 2.00 ft.
  - Depth to Bottom: 2.00
- Brown Gravel Medium W/Clay
  - Thickness: 4.00 ft.
  - Depth to Bottom: 6.00
- Light Brown Gravel Medium
  - Thickness: 48.00 ft.
  - Depth to Bottom: 54.00
- Light Brown Gravel Fine W/Clay
  - Thickness: 2.00 ft.
  - Depth to Bottom: 56.00
- Light Brown Sand Coarse
  - Thickness: 12.00 ft.
  - Depth to Bottom: 68.00
- Light Brown Sand Coarse W/Clay
  - Thickness: 3.00 ft.
  - Depth to Bottom: 71.00
- Gray Clay
  - Thickness: 7.00 ft.
  - Depth to Bottom: 78.00
- Light Gray Gravel Fine
  - Thickness: 3.00 ft.
  - Depth to Bottom: 81.00
- Gray Clay
  - Thickness: 15.00 ft.
  - Depth to Bottom: 90.00
- Light Brown Gravel Fine
  - Thickness: 7.00 ft.
  - Depth to Bottom: 103.00

### Geology Remarks:
- Contractor Type: Water well drilling contractor
- Registration Number: 1784
- Business Name: CLARK WELL DRILLING
- Business Address: 51833 N NOTTAWA RD MENDON MI 49072

### WATER WELL CONTRACTOR’S CERTIFICATION:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Drilling Machine Operator Name: RICK CLARK
Employment: Employee
Signature of Registered Representative: Date

General Remarks: SCREEN TYPE: PVC

OTHER REMARKS:
EQP 2017C (2/2000)

ATTENTION WELL OWNER: FILE WITH DEED

10/19/2000 14:57

194
## WATER WELL AND PUMP RECORD

**Completion is required under authority of Part 127 Act 368 PA 1978.**

Failure to comply is a misdemeanor.

**Well ID:** 75000007340

<table>
<thead>
<tr>
<th>Tax No.:</th>
<th>Permit No.: 000027443</th>
<th>County: St. Joseph</th>
<th>Township: Fabius</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well ID:</td>
<td>75000007340</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elevation:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Latitude:</td>
<td>41.914311</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Longitude:</td>
<td>-85.697703</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance and Direction from Road Intersection:</td>
<td>NORTHWEST CORNER OF KRULL ROAD AND GLEASON ROAD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Well Name:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Well Owner: Martha Peebles</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Well Address: 60976 KRULL ROAD</td>
<td></td>
<td>Owner Address: 60976 KRULL ROAD</td>
<td></td>
</tr>
<tr>
<td>Township: Fabius</td>
<td>THREE RIVERS MI 49093</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drilling Method: Rotary</th>
<th>Pump Installed: Yes</th>
<th>Pump Installation date: HP: 0.50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well Depth: 110.00 ft.</td>
<td>Well Use: Household</td>
<td>Only</td>
</tr>
<tr>
<td>Well Type: Replacement</td>
<td>Date Completed: 7/18/2004</td>
<td></td>
</tr>
<tr>
<td>Casing Type: PVC plastic</td>
<td>Manufacturer: Flint &amp; Walling</td>
<td></td>
</tr>
<tr>
<td>Casing Joint: Unknown</td>
<td>Pump Type: Submersible</td>
<td></td>
</tr>
<tr>
<td>Diameter: 5.00 in. to 110.00 ft. depth</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bore Diameter 1: 8.00 in. to 110.00 ft. depth</td>
<td>Model Number: 4F10G05305</td>
<td></td>
</tr>
<tr>
<td>Bore Diameter 2:</td>
<td>Pump Capacity: 10.00 GPM</td>
<td></td>
</tr>
<tr>
<td>Bore Diameter 3:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Height: 1.00 ft. above grade</td>
<td>Diameter of Drop Pipe:</td>
<td></td>
</tr>
<tr>
<td>Casing Fitting: None</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Static Water Level: 60.00 ft. Below Grade(Not Flowing)</td>
<td>Draw Down Seal Used: No</td>
<td></td>
</tr>
<tr>
<td>Yield Test Method: Air</td>
<td>Pressure Tank Installed: No</td>
<td></td>
</tr>
<tr>
<td>Measurement Taken During Pump Test: 62.00 ft. after 1.00 hrs. pumping at 20.00 GPM</td>
<td>Pressure Tank Type:</td>
<td></td>
</tr>
<tr>
<td>Abandoned Well Plugged: Yes</td>
<td>Model Number:</td>
<td></td>
</tr>
<tr>
<td>Reason for not plugging Well:</td>
<td>Tank Capacity: Gallons</td>
<td></td>
</tr>
<tr>
<td>Abandoned well ID:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Screen Installed: Yes</td>
<td>Topsoil 1.00</td>
<td></td>
</tr>
<tr>
<td>Well Intake:</td>
<td>Brown Clay &amp; Sand 2.00</td>
<td></td>
</tr>
<tr>
<td>Screen Diameter: 5.00 in.</td>
<td>Brown Gravel Medium 12.00</td>
<td></td>
</tr>
<tr>
<td>Length: 5.00 ft.</td>
<td>Brown Sand Medium 57.00</td>
<td></td>
</tr>
<tr>
<td>Screen Material Type: PVC slotted</td>
<td>Gray Clay 28.00</td>
<td></td>
</tr>
<tr>
<td>Slot: 20.00 in. set between 105.00 ft. and 110.00 ft.</td>
<td>Brown Gravel Fine 10.00</td>
<td></td>
</tr>
<tr>
<td>Blank: Unknown</td>
<td>110.00</td>
<td></td>
</tr>
<tr>
<td>Fittings: None</td>
<td>Geology Remarks:</td>
<td></td>
</tr>
<tr>
<td>Well Grouted: Yes</td>
<td>Abandonment Details</td>
<td></td>
</tr>
<tr>
<td>Grouting Method: Unknown</td>
<td>Well Depth: 80 ft</td>
<td></td>
</tr>
<tr>
<td>No. of Bags: 4</td>
<td>Casing Diameter: 5</td>
<td></td>
</tr>
<tr>
<td>Additives: None</td>
<td>Plugging Material: Bentonite slurry</td>
<td></td>
</tr>
<tr>
<td>Bentonite slurry</td>
<td>No. of Bags: 5</td>
<td></td>
</tr>
<tr>
<td>From 0.00 ft. to 95.00 ft.</td>
<td>Casing Removed: No</td>
<td></td>
</tr>
<tr>
<td>Well Head Completion: 12 inches above grade, Pitless adapter</td>
<td>Contractor Type: Water well drilling contractor</td>
<td></td>
</tr>
<tr>
<td>Nearest source of possible contamination: Type</td>
<td>Registration Number: 1794</td>
<td></td>
</tr>
<tr>
<td>Distance Direction: Septic tank 60.00 ft. West</td>
<td>Business Name: CLARK WELL DRILLING</td>
<td></td>
</tr>
<tr>
<td>Drilling Machine Operator Name: RICK CLARK</td>
<td>Business Address:</td>
<td></td>
</tr>
<tr>
<td>Employment: Employee</td>
<td>WATER WELL CONTRACTOR'S CERTIFICATION:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Signature of Registered Representative</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Date</td>
<td></td>
</tr>
<tr>
<td>General Remarks:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OTHER REMARKS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**ATTENTION WELL OWNER: FILE WITH DEED**

12/27/2004 10:01
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978.

**Well ID:** 75000002395

- **Failure to comply is a misdemeanor.**
- **Import ID:** 75761226004
- **Tax No:** 004-026-004-10
- **County:** St. Joseph
- **Township:** Fabius
- **Well ID:** 75000002395
- **Distance and Direction from Road Intersection:** 0.25 MILE E. OF ROBERTS RD., ON THE S. SIDE OF M-60
- **Well Name:**
- **Well Owner:** Roberts Aggregates
- **Well Address:** 14571 M-60, 3 RIVERS MI 49093
- **Owner Address:** 14571 M-60, 3 RIVERS MI 49093
- **Fraction:** NE ¼
- **Section:** 26
- **Town/Range:** French Claim
- **French Claim:** WSSN:
- **Well Name:**
- **Well Owner:** Roberts Aggregates
- **Well Address:** 14571 M-60, 3 RIVERS MI 49093
- **Owner Address:** 14571 M-60, 3 RIVERS MI 49093

### Drilling Method:
- **Method:** Cable tool
- **Well Depth:** 130.00 ft.
- **Well Use:** Industrial
- **Well Type:** New
- **Date Completed:** 2/23/1990

### Casing Type:
- **Type:** Steel - black
- **Joint:** Welded
- **Diameter:** 12.00 in. to 110.00 ft. depth

### Bore Diameter:
1. **1:**
2. **2:**
3. **3:**

### Casing Fitting:
- Drive shoe

### Static Water Level:
- **Depth:** 26.00 ft. Below Grade (Not Flowing)
- **Measurement Taken During Pump Test:** 70.00 ft. after 1.00 hrs. pumping at 850.00 GPM

### Abandoned Well Plugged:
- **No**

### Reason for not plugging Well:
- **Abandoned well ID:**

### Screen installed:
- **Yes**
- **Well Intake:**
- **Filter Packed:** No
- **Screen Diameter:** 11.75 in.
- **Length:** 20.00 ft.
- **Screen Material Type:** Slot: 15.00 in. Set Between 110.00 ft. and 130.00 ft.
- **Blank:** 0.00 ft. Above
- **Fitting:** Neoprene packer

### Well Grouted:
- **Yes**
- **Grouting Method:** Unknown
- **No. of Bags:**
- **Grouting Materials:**
- **Additives:** None
- **Neat cement From 0.00 ft. to 0.00 ft.**

### Well Head Completion:
- **12 inches above grade.**
- **Other**

### Nearest source of possible contamination:
- **Type:** Unknown
- **Distance Direction:** 0.00 ft.

### Contractor Type:
- **Unknown**
- **Registration Number:** 187
- **Business Name:**
- **Business Address:**

### WATER WELL CONTRACTOR'S CERTIFICATION:
- **This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.**
- **Drilling Machine Operator Name:** JON LEWIS
- **Employment:**
- **General Remarks:** LINE SHAFT TURBINE PUMP. SCREEN HAS TOP .015 SLOT ON TOP 12 FEET AND .040 SLOT ON BOTTOM 8 FEET. WELL S FOR SAND AND GRAVEL WASHING
- **OTHER REMARKS:** Well Head Completion: 12 inch Above Grade Pump Manufacturer: PEERLESS


**ATTENTION WELL OWNER: FILE WITH DEED**

**Import ID:** 75761226004

**Well ID:** 75000002395

**Completion is required under authority of Part 127 Act 368 PA 1978.**

Failure to comply is a misdemeanor.

**Import ID:** 75761226004

**Tax No:** 004-026-004-10

**County:** St. Joseph

**Well ID:** 75000002395

- **Distance and Direction from Road Intersection:** 0.25 MILE E. OF ROBERTS RD., ON THE S. SIDE OF M-60

**Well Name:**

**Well Owner:** Roberts Aggregates

**Well Address:** 14571 M-60, 3 RIVERS MI 49093

**Owner Address:** 14571 M-60, 3 RIVERS MI 49093

**Fraction:** NE ¼

**Section:** 26

**Town/Range:** French Claim

**French Claim:** WSSN:

<table>
<thead>
<tr>
<th>Formation Description</th>
<th>Thickness</th>
<th>Depth to Bottom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand &amp; Gravel</td>
<td>20.00</td>
<td>20.00</td>
</tr>
<tr>
<td>Sand Fine</td>
<td>36.00</td>
<td>56.00</td>
</tr>
<tr>
<td>Blue Clay &amp; Sand Fine</td>
<td>20.00</td>
<td>76.00</td>
</tr>
<tr>
<td>Blue Clay</td>
<td>32.00</td>
<td>106.00</td>
</tr>
<tr>
<td>Sand Fine</td>
<td>10.00</td>
<td>118.00</td>
</tr>
<tr>
<td>Sand &amp; Gravel Coarse</td>
<td>12.00</td>
<td>130.00</td>
</tr>
</tbody>
</table>

**Geology Remarks:**
1. [SAND & GRAVEL] [20] [20]
2. [FINE SAND] [56] [36]
3. [BLUE CLAY & FINE SAND] [76] [20]
4. [BLUE CLAY] [108] [32]
5. [FINE SAND] [118] [10]
6. [COARSE SAND & GRAVEL] [130] [12]

**Well Head Completion:** 12 inches above grade. Other

**Contractor Type:** Unknown

**Registration Number:** 187

**Business Name:**

**Business Address:**

**WATER WELL CONTRACTOR'S CERTIFICATION:**

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

**Drilling Machine Operator Name:** JON LEWIS

**Employment:**

**General Remarks:** LINE SHAFT TURBINE PUMP. SCREEN HAS TOP .015 SLOT ON TOP 12 FEET AND .040 SLOT ON BOTTOM 8 FEET. WELL S FOR SAND AND GRAVEL WASHING

**OTHER REMARKS:** Well Head Completion: 12 inch Above Grade Pump Manufacturer: PEERLESS


**ATTENTION WELL OWNER: FILE WITH DEED**

**Import ID:** 75761226004

**Well ID:** 75000002395

**Completion is required under authority of Part 127 Act 368 PA 1978.**

Failure to comply is a misdemeanor.

**Import ID:** 75761226004

**Tax No:** 004-026-004-10

**County:** St. Joseph

**Well ID:** 75000002395

- **Distance and Direction from Road Intersection:** 0.25 MILE E. OF ROBERTS RD., ON THE S. SIDE OF M-60

**Well Name:**

**Well Owner:** Roberts Aggregates

**Well Address:** 14571 M-60, 3 RIVERS MI 49093

**Owner Address:** 14571 M-60, 3 RIVERS MI 49093

**Fraction:** NE ¼

**Section:** 26

**Town/Range:** French Claim

**French Claim:** WSSN:

<table>
<thead>
<tr>
<th>Formation Description</th>
<th>Thickness</th>
<th>Depth to Bottom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand &amp; Gravel</td>
<td>20.00</td>
<td>20.00</td>
</tr>
<tr>
<td>Sand Fine</td>
<td>36.00</td>
<td>56.00</td>
</tr>
<tr>
<td>Blue Clay &amp; Sand Fine</td>
<td>20.00</td>
<td>76.00</td>
</tr>
<tr>
<td>Blue Clay</td>
<td>32.00</td>
<td>106.00</td>
</tr>
<tr>
<td>Sand Fine</td>
<td>10.00</td>
<td>118.00</td>
</tr>
<tr>
<td>Sand &amp; Gravel Coarse</td>
<td>12.00</td>
<td>130.00</td>
</tr>
</tbody>
</table>

**Geology Remarks:**
1. [SAND & GRAVEL] [20] [20]
2. [FINE SAND] [56] [36]
3. [BLUE CLAY & FINE SAND] [76] [20]
4. [BLUE CLAY] [108] [32]
5. [FINE SAND] [118] [10]
6. [COARSE SAND & GRAVEL] [130] [12]

**Well Head Completion:** 12 inches above grade. Other

**Contractor Type:** Unknown

**Registration Number:** 187

**Business Name:**

**Business Address:**

**WATER WELL CONTRACTOR'S CERTIFICATION:**

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

**Drilling Machine Operator Name:** JON LEWIS

**Employment:**

**General Remarks:** LINE SHAFT TURBINE PUMP. SCREEN HAS TOP .015 SLOT ON TOP 12 FEET AND .040 SLOT ON BOTTOM 8 FEET. WELL S FOR SAND AND GRAVEL WASHING

**OTHER REMARKS:** Well Head Completion: 12 inch Above Grade Pump Manufacturer: PEERLESS


**ATTENTION WELL OWNER: FILE WITH DEED**
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978. Failure to comply is a misdemeanor.

**Well ID:** 75000002394

<table>
<thead>
<tr>
<th>Fraction: NW 1/4 SW 1/4 NE 1/4</th>
<th>Section: 26</th>
<th>Township/Range: OES 12W</th>
<th>French Claim:</th>
<th>WSSN:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Distance and Direction from Road Intersection:** MILE E. OF ROBERTS RD. ON THE S. SIDE OF M-60

**Well Name:**

<table>
<thead>
<tr>
<th>Well Owner: Jack Roberts</th>
</tr>
</thead>
</table>

**Well Address:** 14571 M-60

<table>
<thead>
<tr>
<th>Owner Address: 14571 M-60</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Rivers MI 49093</td>
</tr>
</tbody>
</table>

---

**Drilling Method:** Jetted

**Well Depth:** 104.00 ft.

**Well Type:** New

**Date Completed:** 8/30/1973

**Casing Type:** Steel - black

**Casing Joint:** Threaded & coupled

**Diameter:** 4.00 in. to 96.00 ft. depth

**Bore Diameter 1:**

<table>
<thead>
<tr>
<th>Diameter:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

**Bore Diameter 2:**

<table>
<thead>
<tr>
<th>Diameter:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

**Bore Diameter 3:**

<table>
<thead>
<tr>
<th>Diameter:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

**Casing Fitting:** Drive shoe

---

**Static Water Level:** 70.00 ft. Below Grade (Not Flowing)

**Yield Test Method:** Unknown

**Measurement Taken During Pump Test:**

- 70.00 ft. after 0.00 hrs. pumping at 0.00 GPM

**Abandoned Well Plugged:** No

**Reason for not plugging Well:**

**Abandoned well ID:**

---

**Screen Installed:** Yes

**Well Intake:**

- Filter Packed: No
- Screen Diameter: 3.00 in.
- Length: 8.00 ft.
- Screen Material Type: Slot: 8.00 in. Set Between 96.00 ft. and 104.00 ft.
- Blank: 0.00 ft. Above
- Fittings: Neoprene packer

**Well Grouted:** No

**No. of Bags:**

**Grouting Materials:**

**Well Head Completion:** Pitless adapter

---

**Nearest source of possible contamination:**

- Type: Septic tank
- Distance Direction: 100.00 ft. East

---

**Drilling Machine Operator Name:**

**Employment:** Unknown

---

**Pump Installed:** Yes

**Pump Installation date:** HP:

**Manufacturer:** Flint & Walling

**Model Number:**

**Pump Capacity:** 0.00 GPM

**Length of Drop Pipe:** 79.00 ft.

**Diameter of Drop Pipe:**

**Draw Down Seal Used:** No

**Pressure Tank Installed:** No

**Pressure Tank Type:**

**Manufacturer:**

**Model Number:**

**Tank Capacity:** Gallons

**Formation Description**

<table>
<thead>
<tr>
<th>Description</th>
<th>Thickness</th>
<th>Depth to Bottom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Clay &amp; Sand</td>
<td>20.00</td>
<td>20.00</td>
</tr>
<tr>
<td>Red Clay &amp; Gravel</td>
<td>10.00</td>
<td>30.00</td>
</tr>
<tr>
<td>Gravel</td>
<td>14.00</td>
<td>44.00</td>
</tr>
<tr>
<td>Sand</td>
<td>10.00</td>
<td>54.00</td>
</tr>
<tr>
<td>Brown Clay &amp; Sand</td>
<td>8.00</td>
<td>62.00</td>
</tr>
<tr>
<td>Sand</td>
<td>13.00</td>
<td>75.00</td>
</tr>
<tr>
<td>Blue Clay</td>
<td>15.00</td>
<td>90.00</td>
</tr>
<tr>
<td>Sand</td>
<td>14.00</td>
<td>104.00</td>
</tr>
</tbody>
</table>

**Well Grouted:** No

**Grouting Method:**

**No. of Bags:**

**Grouting Materials:**

**Well Head Completion:** Pitless adapter

**Contractor Type:** Unknown

**Registration Number:** 205

**Business Name:**

**Business Address:**

**WATER WELL CONTRACTOR'S CERTIFICATION:**

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

**Signature of Registered Representative**

**Date**

---

**General Remarks:** DRAWDOWN SEAL FITTING

**OTHER REMARKS**


**ATTENTION WELL OWNER: FILE WITH DEED**

2/18/2000 17.51
WELL NO. St. Joseph 97-21  DATE: 12-97

PERMIT:

UNIT: Keck Model SR-3000

OPER: Krabicki

TIME:呈现: 2000 psi Screen: 2

SCALE: 2000 cpm 1.2

ADDRESS: 14 Drummond Rd.

TOWNSHIP: Fabius Section 3 SE 1/4, SE 1/4, SW 1/4

DRILLING CO: Grah Drilling

GROUND ELEVATION: approx. 913 feet

FIER: 7 inches ground level Layed depth: 76 ft

Drilled Depth: 7 feet Red marker: around 7 inches

Contractor/owner: owner: Kenneth Carey

STATE: NE

Area: New Home
### LOCATION OF WELL

<table>
<thead>
<tr>
<th>County</th>
<th>St. Joseph</th>
</tr>
</thead>
<tbody>
<tr>
<td>Township</td>
<td>Fabius</td>
</tr>
</tbody>
</table>

Distance and Direction from Road Intersections: ½ mile S of Old M-60 on W side of Roberts #2

### OWNER OF WELL

- **Address:** Evelyn Veile
- **Street Address & City of Well Location:** RR 4, Three Rivers, Michigan

### FORMATION

<table>
<thead>
<tr>
<th>Name</th>
<th>Thickness of Stratum (ft)</th>
<th>Depth to Bottom of Stratum (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface dirt</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Sand &amp; gravel</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Red clay &amp; sand</td>
<td>5</td>
<td>83</td>
</tr>
<tr>
<td>Sand &amp; gravel</td>
<td>35</td>
<td>50</td>
</tr>
<tr>
<td>Gravel &amp; blue clay</td>
<td>28</td>
<td>78</td>
</tr>
<tr>
<td>Blue clay</td>
<td>5</td>
<td>83</td>
</tr>
<tr>
<td>Gravel &amp; blue clay</td>
<td>60</td>
<td>143</td>
</tr>
<tr>
<td>Gravel, sand &amp; blue clay</td>
<td>5</td>
<td>143</td>
</tr>
<tr>
<td>Sand &amp; blue clay</td>
<td>4</td>
<td>152</td>
</tr>
<tr>
<td>Fine sand filter</td>
<td>4</td>
<td>156</td>
</tr>
</tbody>
</table>

### WELL DEPTH

- **Date of Completion:** Jan. 18, 1968
- **Completed:** 156 ft.

### USE

- Domestic
- Public Supply
- Irrigation
- Air Conditioning
- Commercial
- Agriculture

### CASING

- **Diameter:** 8 in. to 10 in.
- **Height Above Grade:** 100 ft.

### SCREEN

- **Type:** Coarse
- **Dia.:** 1½ in.
- **Length:** 40 ft.

### STATIC WATER LEVEL

- **Depth:** 100 ft. below land surface

### PUMPING LEVEL

- **Tests:**
  - Plunger: 4 ft. after 1 hour pumping
  - Jetted: 45 ft. after 1 hour pumping

### WATER QUALITY

- **Iron (Fe):**
- **Chlorides (Cl):**
- **Hardness:**

### SANITARY

- **Nearest Source of Possible Contamination:** Unknown
- **Well Disinfected Upon Completion:** Yes

### PUMP

- **Manufacturer's Name:** Flint & Walling
- **Model Number:** C 6779
- **Length of Drop Pipe:** 115 ft.
- **Capacity:** 5 g.p.m.

### WATER WELL CONTRACTOR'S CERTIFICATION

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

- **Name:** B. J. Lewis & Sons
- **Address:** M-60 East, Cassopolis, Michigan

**Authorized Representative:**

**Date:** 3/19/68

---

**Source of data, well & pump:** Otto Bickel

**Remarks, elevation, source of data, etc.:**

Source of data, well & pump: Otto Bickel
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978.

**Well ID:** 75000002500

<table>
<thead>
<tr>
<th>Tax No.</th>
<th>004-035-009-00</th>
<th>Permit No.</th>
<th>County: St. Joseph</th>
<th>Township: Fabius</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well Depth: 99.00 ft.</td>
<td>Well Use: Household</td>
<td>Date Completed: 11/14/1979</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Casing Type: Steel - black</td>
<td>Casing Joint: Threaded &amp; coupled</td>
<td>Diameter: 2.00 in. to 95.00 ft. depth</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bore Diameter 1:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bore Diameter 2:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bore Diameter 3:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Height: 200 ft. above grade</td>
<td>Casing Fitting: Drive shoe</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Static Water Level: 81.00 ft. Below Grade (Not Flowing)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Test Method: Unknown</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measurement Taken During Pump Test: 0.00 ft. after 1.00 hrs. pumping at 15.00 GPM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abandoned Well Plugged: No</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reason for not plugging Well:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abandoned well ID:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Screen Installed: Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Filter Packed: No</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Screen Diameter: 1.25 in.</td>
<td>Length: 4.00 ft.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Screen Material Type: Shot: 10.00 in. Set Between 95.00 ft. and 99.00 ft.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blank: 0.00 ft. Above</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fittings: Bremer check valve</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Well Grouted: No</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of Bags:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grouting Materials:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Well Head Completion: Unknown</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nearest source of possible contamination: Type: Unknown</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance Direction: 0.00 ft.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drilling Machine Operator Name: BUD BICKEL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employment: Unknown</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Remarks: WP4727</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WATER WELL CONTRACTOR'S CERTIFICATION:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contractor Type: Unknown</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Registration Number: 88</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business Name:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business Address:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Signature of Registered Representative: Date</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Pump Installed:** Yes

| Pump Installation only: No |
| Pump Installation date: HP: |
| Pump Type: Jet |
| Model Number: |
| Length of Drop Pipe: 90.00 ft. |
| Diameter of Drop Pipe: |
| Draw Down Seal Used: No |
| Pressure Tank Installed: No |
| Pressure Tank Type: |
| Manufacturer: |
| Model Number: |
| Tank Capacity: Gallons |

**Formation Description**

| Topsoil | 1.00 | 1.00 |
| Red Clay | 4.00 | 5.00 |
| Sand | 15.00 | 20.00 |
| Sand & Gravel Coarse | 15.00 | 35.00 |
| Sand Fine | 15.00 | 50.00 |
| Sand | 25.00 | 75.00 |
| Blue Clay & Sand | 15.00 | 90.00 |
| Sand Coarse | 9.00 | 99.00 |

**Geology Remarks:**

| [SURFACE] [1] | [RED CLAY] [5] [4] [3] [SAND] [20] [15] | [COARSE SAND & GRAVEL] [35] [15] [FINE SAND] [50] [15] [SAND] [75] [25] | [BLUE CLAY & SAND] [90] [15] [COARSE SAND] [99] [9] |

**ATTENTION WELL OWNER: FILE WITH DEED**
WATER WELL AND PUMP RECORD

Completion is required under authority of Part 127 Act 368 PA 1978.

Failure to comply is a misdemeanor.

Well ID: 75000002426

**Well ID:** 75000002426

**Well Name:** Robert Zerfas

**Well Address:** 60852 KRULL ROAD

**Owner Address:** 3 RIVERS MI 49093

**Distance and Direction from Road Intersection:** 1 MILE S. OF M-60, W. SIDE KRULL, OT 17 FABIUS FARMS

**Elevation:** 900 ft

**Latitude:** 41.9128925624

**Longitude:** -85.6977657614

---

**Well ID:** 75000002426

**Well Use:** Household

**Well Type:** Replacement

**Well Installed:** No

**Pump Installed:** No

**Model Number:**

**Manufacturer:**

**Pump Capacity:**

**Id of Well:**

**Diameter:** 2.00 in. to 156.00 ft. depth

**Screen Material Type:**

**Screen Diameter:** 1.25 in.

**Slot:** 10.00 in. Set Between 156.00 ft. and 160.00 ft.

**Blank:** 0.00 ft Above

**Filter Packed:** No

**Bore Diameter 1:**

**Bore Diameter 2:**

**Bore Diameter 3:**

**Height:** 1.00 ft. above grade

**Casing Fitting:** Drive shoe

**Screen Installed:** Yes

**Grouting Method:** Unknown

**No. of Bags:**

**Grouting Materials:**

**Unknown**

**From 0.00 ft. to 0.00 ft.**

**Well Head Completion:** Pitless adapter

**Nearest source of possible contamination:**

**Type:**

**Red Clay**

**Red Sand**

**Red Clay & Gravel**

**White Sand**

**Blue Clay**

**Gravel & Sand Fine White**

**Grouting Materials:**

**CLAY & GRAVEL**

**FINE GRAVEL, WHITE SAND**

**Geology Remarks:**


**动静水位：** 60.00 ft. Below Grade(Not Flowing)

**Yield Test Method:** Unknown

**Measurement Taken During Pump Test:**

---

**ATTENTION WELL OWNER: FILE WITH DEED**

2/18/2000 17:51
## WATER WELL AND PUMP RECORD

Completion is required under authority of Part 127 Act 368 PA 1978.

**Well ID: 75000002501**

**Elevation:** 900 ft

**Latitude:** 41.8970077335

**Longitude:** -85.6659227546

**Well ID:** 75000002501

**Distance and Direction from Road Intersection:** 1 MILE W. OF 131 ON THE N. SIDE OF DRUMMOND

**Well Name:**

**Well Owner:** Donald King

**Well Address:** 14878 DRUMMOND ROAD

3 RIVERS MI 49093

**Owner Address:**

**County:** St. Joseph

**Township:** Fabus

**Text No:** 004-035-013-01

**Tax No:** Import ID: 75761235007

**Permit No:**

**Well ID:** 75000002501

**Well Type:** Replacement

**Well Use:** Household

**Well Depth:** 123.00 ft.

**Casing Type:** Steel - black

**Casing Joint:** Threaded & coupled

**Diameter:** 2.00 in. to 119.00 ft. depth

**Bore Diameter 1:**

**Bore Diameter 2:**

**Height:** 0.00 ft. above grade

**Casing Fitting:** Drive shoe

**Static Water Level:** 70.00 ft. below grade (Not Flowing)

**Yield Test Method:** Unknown

**Measurement Taken During Pump Test:**

**Abandoned Well Plugged:** No

**Reason for not plugging Well:**

**Screen Installed:** Yes

**Filter Packed:** No

**Screen Diameter:** 1.25 in.

**Length:** 4.00 ft.

**Screen Material Type:**

**Slot:** 7.00 in.

**Set Between:** 115.00 ft. and 119.00 ft.

**Blank:** 0.00 ft. Above

**Fittings:** Neoprene packer

**Well Liner:**

**Well Intake:**

**Well Head Completion:** Pitless adapter

**Nearest source of possible contamination:**

**Type:** Sand Water Bearing

**Distance Direction:** 60.00 ft. North

**Well Head Completion:** Pitless adapter

**Type:** Sand & Clay

**Formation Description:**

<table>
<thead>
<tr>
<th>Formation</th>
<th>Description</th>
<th>Thickness</th>
<th>Depth to Bottom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand &amp; Clay</td>
<td>10.00</td>
<td>10.00</td>
<td></td>
</tr>
<tr>
<td>Sand</td>
<td>67.00</td>
<td>77.00</td>
<td></td>
</tr>
<tr>
<td>Gravel</td>
<td>23.00</td>
<td>100.00</td>
<td></td>
</tr>
<tr>
<td>Blue Clay</td>
<td>13.00</td>
<td>113.00</td>
<td></td>
</tr>
<tr>
<td>Sand Water Bearing</td>
<td>10.00</td>
<td>123.00</td>
<td></td>
</tr>
</tbody>
</table>


**Contractor Type:** Unknown

**Registration Number:** 205

**Business Name:**

**Business Address:**

**WATER WELL CONTRACTOR'S CERTIFICATION:**

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

**Drilling Machine Operator Name:**

**Employment:** Unknown

**Signature of Registered Representative:**

**Date:**

---

**OTHER REMARKS**

EQP 2017C (2/2000)

**ATTENTION WELL OWNER: FILE WITH DEED**

2/18/2000 17.52
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978.

Failure to comply is a misdemeanor.

<table>
<thead>
<tr>
<th>Tax No:</th>
<th>004-035-009-00</th>
<th>Permit No:</th>
</tr>
</thead>
<tbody>
<tr>
<td>County:</td>
<td>St. Joseph</td>
<td>Township:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fabus</td>
</tr>
</tbody>
</table>

**Well ID: 75000002500**

Elevation: 860 ft.
Latitude: 41.896810683
Longitude: -85.6816833276

**Well Owner:** Luke Hololy

**Well Address:** 14058 DRUMMOND ROAD
3 RIVERS MI 49093

**Well Name:**

**Well Owner:** Luke Hololy

**Well Address:** 14058 DRUMMOND ROAD
3 RIVERS MI 49093

**Well ID:** 75000002500

**Distance and Direction from Road Intersection:** 2 MILE W. OF ROBERTS, N. SIDE OF DRUMMOND

**Well Name:**

**Well Owner:** Luke Hololy

**Well Address:** 14058 DRUMMOND ROAD
3 RIVERS MI 49093

**Fraction:**

**Section:** 35

**Town/Range:** 06S 12W

**French Claim:** WSSN:

Import 10: 75761235006

Tax No: 004-035-009-00

**Well ID:** 75000002500

**Well Depth:** 99.00 ft.

**Well Type:** New

**Date Completed:** 11/14/1979

**Casing Type:** Steel - black

**Casing Joint:** Threaded & coupled

**Diameter:** 2.00 in. to 95.00 ft. depth

**Bore Diameter 1:**

**Bore Diameter 2:**

**Bore Diameter 3:**

**Height:** 2.00 ft. above grade

**Casing Fitting:** Drive shoe

**Drilling Method:** Jetted

**Well Use:** Household

**Well Installed:** Yes

**Well Installed only:** No

**Manufacturer:** Flint & Walling

**Model Number:** Pump Capacity: 0.00 GPM

**Length of Drop Pipe:** 90.00 ft.

**Diameter of Drop Pipe:**

**Draw Down Seal Used:** No

**Pressure Tank Installed:** No

**Pressure Tank Type:**

**Manufacturer:**

**Model Number:**

**Tank Capacity:** Gallons

**Pressure Relief Valve Installed:** No

**Static Water Level:** 81.00 ft. Below Grade (Not Flowing)

**Yield Test Method:** Unknown

**Measurement Taken During Pump Test:** 0.00 ft. after 1.00 hrs. pumping at 15.00 GPM

**Abandoned Well Plugged:** No

**Reason for not plugging Well:**

**Abandoned well ID:**

**Screen Installed:** Yes

**Filter Packed:** No

**Screen Diameter:** 1.25 in.

**Screen Material Type:** Slot: 10.00 in. Set Between 95.00 ft. and 99.00 ft.

**Blank:** 0.00 ft. Above

**Fittings:** Bremer check valve

**Well Grouted:** No

**Grouting Method:**

**No. of Bags:**

**Additives:**

**Grouting Materials:**

**Well Head Completion:** Unknown

**Nearest source of possible contamination:**

**Type:** Distance Direction

**Unknown**

**Unknown**

**Drilling Machine Operator Name:** BUD BICKEL

**Employment:** Unknown

**General Remarks:** WP4727

**OTHER REMARKS**


**ATTENTION WELL OWNER: FILE WITH DEED**

218/2000 17.52

204
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978.

Failure to comply is a misdemeanor.

<table>
<thead>
<tr>
<th>Tax No: 3087028</th>
<th>Permit No: 20558</th>
<th>County: St. Joseph</th>
<th>Township: Fabius</th>
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<tbody>
<tr>
<td><strong>Well ID: 75000006495</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elevation: 876 ft</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Well ID: 75000006495</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance and Direction from Road Intersection: TAKE 131 NORTH TO DRUMMOND ROAD GO EAST ON DRUMMOND FOR APPROX. 1/2 OF A MILE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Well Name:</strong> Luke Hotory</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Well Address:</strong> 14058 DRUMMOND ROAD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Owner Address:</strong> 14058 DRUMMOND ROAD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Owner:</strong> Luke Hotory</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Well Driller:</strong> Robert Farwell</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Employment:</strong> Subcontractor</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Drilling Method:** Rotary
**Well Depth:** 180.00 ft.  
**Well Use:** Household
**Date Completed:** 12/1/2002

**Casing:** PVC plastic  
**Casing Depth:** 5.00 in. to 175.00 ft. depth

**Bore Diameter 1:** 5.00 in. to 175.00 ft. depth
**Bore Diameter 2:**
**Bore Diameter 3:**
**Height:** 1.00 ft. above grade  
**Casing Fitting:** None

**Screen:** Yes  
**Filter Packed:** No  
**Screen Diameter:** 3.00 in.  
**Screen Material Type:** Stainless steel-wire wrapped
**Slot:** 12.00 in. Set Between 175.00 ft. and 180.00 ft.
**Blank:** 1.00 ft. Above
**Fitting:** Neoprene packer

**Well Grouted:** Yes  
**Grouting Method:** Grout pipe outside casing
**No. of Bags:** 8  
**Additives:** None

**Bentonite slurry**

**Well Head Completion:** Pitless adapter

**Nearest source of possible contamination:**
**Type:** Distance Direction
**Septic tank:** 60.00 ft. South

**Well Head Completion:** Pitless adapter

**Drilling Machine Operator Name:** Robert Farwell

**General Remarks:**

**OTHER REMARKS**

---

**ATTENTION WELL OWNER: FILE WITH DEED**

12/9/2002 09:26

205
## WATER WELL AND PUMP RECORD

Completion is required under authority of Part 127 Act 368 PA 1978. Failure to comply is a misdemeanor.

### Well ID: 75000007278

**Tax No:** 27435  **County:** St. Joseph  
**Permit No:**  **Township:** Fabius

### Elevation:

**Latitude:** 41.8964185  **Longitude:** -85.66574264

### Well Name:

**Owner Address:** 14878 DRUMMOND RD  
**Owner Address:** THREE RIVERS MI 49093

### Drilling Method:

- **Drilling Method:** Rotary
- **Well Depth:** 128.00 ft.
- **Well Use:** Household
- **Well Type:** Replacement
- **Date Completed:** 6/18/2004

### Casing Information:

- **Casing Type:** PVC plastic
- **Casing Joint:** Unknown
- **Diameter:** 5.00 in. to 121.00 ft. depth

### Bore Diameter:

- **Bore Diameter 1:** 8.00 in. to 128.00 ft. depth
- **Bore Diameter 2:**  
- **Bore Diameter 3:**  
- **Height:**  
- **Casing Fitting:** None

### Static Water Level:

- **Static Water Level:** 106.00 ft. Below Grade (Not Flowing)

### Yield Test Method:

- **Yield Test Method:** Air
- **Measurement Taken During Pump Test:** 120.00 ft. after 1.00 hrs. pumping at 30.00 GPM

### Abandoned Well Plugged:

- **Abandoned Well Plugged:** Yes
- **Reason for not plugging Well:**  
- **Abandoned well ID:**

### Screen Information:

- **Screen Installed:** Yes
- **Screen Diameter:** 5.00 in.
- **Length:** 7.00 ft.
- **Screen Material Type:** PVC-saw cut
- **Slot:** 12.00 in.  
- **Fittings:** Unknown

### Well Head Completion:

- **Well Head Completion:** PIJUessor adapter

### Nearest source of possible contamination:

- **Type:** Septic tank  
- **Distance Direction:** 50.00 ft.

### Drilling Machine Operator Name:

**Drilling Machine Operator Name:** ROBERT PLETCHER

### Geology Remarls:

**Geology Remarks:**

### Abandonment Details:

- **Abandonment Details:**  
- **Well Depth:** 123 ft.
- **Plugging Material:** Bentonite chips/pellets  
- **No.of Bags:** 4

### Contractor Information:

- **Contractor Type:** Water well drilling contractor
- **Registration Number:** 2289
- **Business Name:** C&L WELL DRLG
- **Business Address:**

### General Remarks:

**WATER WELL CONTRACTOR'S CERTIFICATION:**

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

**Signature of Registered Representative:**  
**Date:**

### OTHER REMARKS:


**ATTENTION WELL OWNER: FILE WITH DEED**

9/21/2004 12:38
WELL NO. N. Joseph 99-49

FORMER: Klock Model SR-3000

OIL: Niets

TIME: DATE: 1000 div. 40 sec. 1

SCALE: 1000 rpm. 6.8

ADDRESS: 4211 Schaefer Rd

TOWNSHIP: Constantine Section 3 NE corner

DRILLING CO: Tom Mosier Drilling

GROUND ELEVATION: approx. 900 feet

RIG: 18 inches ground level

Labeled depth: 131 ft.

Drilled Depth: feet

Construction: Contractor CRF homes

STATIC: not measured

Notes: The well was excavated to approximately 4 ft for the pilings adapter. This was a difficult well to log because I could not get in approximately 50 feet from the well due to the mud.
TAX NO: 96-49

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER WELL AND PUMP RECORD

PERMIT NO: 18524

1. LOCATION OF WELL
   County: St. Joseph
   Township Name: Constantine
   Section No: 33
   Range No: 15

   Distance and Direction from Road Intersection

   Street Address & City of Well Location
   Locate with 'x' in Section Below

   Sketch Map

2. FORMATION DESCRIPTION

<table>
<thead>
<tr>
<th>THICKNESS</th>
<th>DEPTH TO BOTTOM OF STRATUM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

   3. OWNER OF WELL
   Address: 6727 Shively Pl.
   Address Same as Well Location: Yes

4. WELL DEPTH:
   140 ft
   Data Completed: New Well
   Replacement Well: No

5. USE:
   Household: Yes
   Type I Public: No
   Type II Public: No
   Test Well: No

6. CASING:
   Steel: No
   Threaded: No
   Plastic: No

   Diameter: 6 in
   Height: 14 ft

7. SCREEN:
   Not Installed: Yes
   Gravel-Packed: No
   Type: Sand & Gravel
   Length: 40 ft

8. FITTINGS:
   K-Packer: Yes
   Pressure Tank: No

9. STATIC WATER LEVEL:
   Below Land Surface: Yes
   Flowing: No

10. PUMPING LEVEL:
    Below Land Surface: Yes
    h After: 1 hr
    Pumping at: 1 G.P.M

11. WELL HEAD COMPLETION:
    12" Above Grade: Yes
    Basement Offset: No
    Well House: No

12. WELL GROUTED?
    No: Yes
    Yes: No
    From: 15 ft
    To: 150 ft

13. NEAREST SOURCE OF POSSIBLE CONTAMINATION:
    Type: Sand & Gravel
    Distance: 500 ft
    Direction: W

14. PUMP:
    Not Installed: Yes
    Pump Installation Only: No

    Manufacturer's Name: John Pump
    Model Number: J-100
    Capacity: 15 ft³

    PRESSURE TANK:
    Manufacturer's Name: ABC
    Model Number: XYZ
    Capacity: 100 gallons

15. ABANDONED WELL PLUGGED?
    Yes: No
    No: Yes

    PLUGGING MATERIAL:
    Cement/Bentonite Slurry: Yes
    Bentonite Chips: No

    No. of Bags: 15
    Casing Removed: No

16. REMARKS:
    Elevation, Source of Data, etc.

17. DRILLING MACHINE OPERATOR:
    Employee: Yes
    Subcontractor: No

    Name: John Doe

18. WATER WELL CONTRACTOR'S CERTIFICATION:
    This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

    Water Well Contractor: John Doe
    Date: 10-26-95

LOCAL HEALTH DEPT. COPY
**TAX NO:**

**MICHIGAN DEPARTMENT OF PUBLIC HEALTH**

**WATER WELL AND PUMP RECORD**

**PERMIT NO:** 19667

1. **LOCATION OF WELL**
   - County: [Name]
   - Township Name: [Name]
   - Section: [Section]
   - Town No.: [Town]
   - Range No.: [Range]

2. **FORMAT ON DESCRIPTION**
   - Thickness: [Thickness]
   - Stratigraphic Position: [Position]

3. **OWNER OF WELL**
   - Address: [Address]
   - Phone: [Phone]

4. **WELL DEPTH**
   - Date Completed: [Date]
   - New Well: [New]
   - Replacement Well: [Replacement]

5. **USE**
   - Household: [Household]
   - Type I Public: [Type I]
   - Type II Public: [Type II]
   - Heat Pump: [Heat Pump]
   - Test Well: [Test]
   - Type III Public: [Type III]

6. **CASING**
   - Steel: [Steel]
   - Plastic: [Plastic]
   - Weight: [Weight]
   - Surface: [Surface]

7. **BORE HOLE**
   - Diameter: [Diameter]
   - Height: [Height]

8. **SCREEN**
   - Not Installed: [Not Installed]
   - Gravel-Pack: [Gravel-Pack]

9. **STATIC WATER LEVEL**
   - Flowing: [Flowing]

10. **PUMPING LEVEL**
    - Below Land Surface: [Below]
    - Flowing: [Flowing]

11. **WELL HEAD COMPLETION**
    - Bottom: [Bottom]
    - Top: [Top]

12. **WELL/GRouted?**
    - Yes: [Yes]
    - No: [No]

13. **NEAREST SOURCE OF POSSIBLE CONTAMINATION**
    - Distance:

14. **PUMP**
    - Not Installed: [Not Installed]
    - Pump, Installation Only: [Installation]

15. **ABANDONED WELL PLUGGED?**
    - Yes: [Yes]
    - No: [No]

16. **PLUGGING MATERIAL**
    - Neat Cement: [Cement]
    - Bentonite Slurry: [Slurry]

17. **REMARKS**
    - Source of Detecting Pumping

18. **DRILLING MACHINE OPERATOR**
    - Employee: [Employee]
    - Subcontractor: [Subcontractor]

19. **AUTHORIZED REPRESENTATIVE**
    - Name: [Name]
    - Address: [Address]

**RECEIVED OCT 10, 1995**

LOCAL HEALTH DEPT. COPY
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978.

Failure to comply is a misdemeanor.

**Well ID: 75000006285**

**Completion is required under authority of Part 127 Act 368 PA 1978.**

**Well ID:** 75000006285

**Failure to comply is a misdemeanor.**

**Tax No:**

**Permit No:** W24196

**County:** St. Joseph

**Township:** Constantine

**French Claim:** WSN:

**Completion is required under authority of Part 127 Act 368 PA 1978.**

**Failure to comply is a misdemeanor.**

**Well Name:**

**Well Owner:** Hickory Hills Homes

**Tax No:**

**Permit No:** W24196

**County:** St. Joseph

**Township:** Constantine

**County:** St. Joseph

**Township:** Constantine

**Fraction:**

**Section:** 3

**Town/Range:** 075 12N

**Well ID:** 75000006285

**Distance and Direction from Road Intersection:** S. ON ROBERTS RD. TO DRUMMOND RD., TURN W. AND GO 1/4 MILE TO SHAFFER RD., TURN S. AND GO 1/4 MILE TO DRIVE ON W. SIDE AND GO 500' TO HOME ON S. SIDE

**Well Name:**

**Well Owner:** Hickory Hills Homes

**Well Address:** 62124 SHAFFER RD., LOT 2

**Constantine, MI 49042**

**Owner Address:** 62124 SHAFFER RD., LOT 2

**Constantine, MI 49042**

**Drilling Method:** Rotary

**Well Depth:** 150.00 ft.

**Well Use:** Household

**Date Completed:** 3/14/2002

**Casing Type:** PVC plastic

**Casing Joint:** Unknown

**Diameter:** 5.00 in. to 140.00 ft. depth

**Bore Diameter 1:** 7.88 in. to 150.00 ft. depth

**Bore Diameter 2:**

**Bore Diameter 3:**

**Height:** 1.00 ft. above grade

**Casing Fitting:** None

**Screen Installed:** Yes

**Filter Packed:** Yes

**Screen Diameter:** 4.00 in.

**Length:** 10.00 ft.

**Screen Material Type:** PVC-slotted

**Slot:** 16.00 in. Set Between 140.00 ft. and 150.00 ft. blank.

**Fittings:** Others

**Well Grouted:** Yes

**Grouting Method:** Unknown

**No. of Bags:** 6

**Additives:** None

**Grouting Materials:** Bentonite slurry

**From:** 0.00 ft. to 140.00 ft.

**Well Head Completion:** Pvcless adapter

**Nearest source of possible contamination:**

**Type:**

**Distance Direction:**

**Septic tank:** 81.00 ft. North

**Drilling Machine Operator Name:** WILLIAM C. SCHOENFLED

**Employment:** Employee

**Well Head Completion:** Pvcless adapter

**Nearest source of possible contamination:**

**Type:**

**Distance Direction:**

**Septic tank:** 81.00 ft. North

**Drilling Machine Operator Name:** WILLIAM C. SCHOENFLED

**Employment:** Employee

**General Remarks:**

**OTHER REMARKS** Screen Fittings: GLUED

**ATTENTION WELL OWNER: FILE WITH DEED**

9/27/2002 09:13
### WATER WELL AND PUMP RECORD

**Completion is required under authority of Part 127 Act 368 PA 1978.**

Failure to comply is a misdemeanor.

---

**De**

**Well ID:** 75000005540

**Completion is required under authority of Part 127 Act 368 PA 1978.**

Failure to comply is a misdemeanor.

---

**Well ID:** 75000005540

**Tax No:**

**Permit No:**

**County:** St. Joseph

**Township:** Constantine

---

**Distance and Direction from Road Intersection:**

Going West on Drummond Rd., turn South onto Shaffer & go 400’ to Private Dr. on West. Follow back 350’ to home on North side.

---

**Well Name:**

**Well Owner:** Hickory Hill Homes

**Well Address:**

**Owner Address:**

---

**Drilling Method:** Rotary

**Well Depth:** 140.00 ft.

**Well Use:** Household

**Well Type:** New

**Date Completed:** 9/6/2000

**Casing Type:** PVC plastic

**Casing Joint:** Solvent welded/glued

**Diameter:** 5.00 in. to 125.00 ft. depth

**Bore Diameter 1:** 7.88 in. to 140.00 ft. depth

**Bore Diameter 2:**

**Bore Diameter 3:**

**Height:** 1.00 ft. above grade

**Casing Fitting:** None

---

**Static Water Level:** 80.00 ft. Below Grade (Not Flowing)

**Yield Test Method:** Air

**Measurement Taken During Pump Test:**

120.00 ft. after 1.00 hrs. pumping at 45.00 GPM

---

**Abandoned Well Plugged:** No

**Reason for not plugging Well:**

---

**Screen Installed:** Yes

**Filter Packed:** Yes

**Screen Diameter:** 4.00 in.

**Length:** 15.00 ft.

**Screen Material Type:** PVC -slotted

**Slot:** 16.00 in. Set Between 125.00 ft. and 140.00 ft.

**Blank:** Unknown

**Fittings:** None

---

**Well Grouted:** Yes

**Grouting Method:** Unknown

**No. of Bags:** 4

**Additives:** None

**Grouting Materials:**

**Unknown** From 0.00 ft. to 125.00 ft.

---

**Well Head Completion:** 12 inches above grade, Pitless adapter

---

**Nearest source of possible contamination:**

**Type:** None

**Distance Direction:** 68.00 ft. East

---

**Drilling Machine Operator Name:** William Schoenfeld

**Employment:** Employee

**General Remarks:** screen glued onto casing

---

**Other Remarks:** Pressure Tank Manufacturer: Perma Air

---

**Contractor Type:** Water well drilling contractor

**Registration Number:** 1699

**Business Name:** J.W. Bowles Well Drilling

**Business Address:**

---

**WATER WELL CONTRACTOR’S CERTIFICATION:**

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

---

**Signature of Registered Representative:**

**Date:** 8/13/2001 10:29

---

**ATTENTION WELL OWNER: FILE WITH DEED**
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978.

Failure to comply is a misdemeanor.

**Well ID:** 75000003890

- **Elevation:** 900 ft
- **Latitude:** 41.8906189023
- **Longitude:** -85.683482781

**Well Owner:** Luke Hotory

**Well Address:** 62400 SHAFFER ROAD, CONSTANTINE MI 49042

**Owner Address:** CONSTANTINE MI 49042

---

**Well Drilling and Installation Details:**

- **Drilling Method:** Auger/Bored
- **Well Depth:** 120.00 ft
- **Well Use:** Household
- **Well Type:** Replacement
- **Date Completed:** 10/27/1973
- **Casing Type:** Steel - black
- **Casing Joint:** Threaded & coupled
- **Diameter:** 2.00 in. to 116.00 ft. depth; 1.25 in. to 120.00 ft. depth.
- **Bore Diameter 1:**
- **Bore Diameter 2:**
- **Bore Diameter 3:**
- **Height:** 1.00 ft. above grade
- **Casing Fitting:** Drive shoe
- **Draw Down Seal Used:** No
- **Bore Diameter 3:**

---

**Well Completion and Material Details:**

- **Screen Installed:** Yes
- **Filter Packed:** No
- **Screen Diameter:** 1.20 in.
- **Screen Length:** 4.00 ft.
- **Screen Material Type:** Slot: 70.00 in. Set Between 116.00 ft. and 120.00 ft.
- **Blank:** 0.00 ft. Above
- **Fittings:** Bremer check valve
- **Well Grouted:** Yes
- **Grouting Method:** Unknown
- **No. of Bags:**
- **Additives:** None
- **Grouting Materials:** Unknown
- **Geology Remarks:**

---

**Well Head Details:**

- **Well Head Completion:** 12 inches above grade, Other

---

**Well Head Completion Details:**

- **Nearest source of possible contamination:**
- **Type:** Distance Direction
- **Septic tank:** 60.00 ft. West

---

**Well Machine Operator Details:**

- **Employment:** Unknown

---

**General Remarks:**

**OTHER REMARKS**

**Well Head Completion:** 12 inch Above Grade

---

**WATER WELL CONTRACTOR'S CERTIFICATION:**

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

**Contractor Type:** Unknown

**Registration Number:** 18

**Business Name:**

**Business Address:**

**Signature of Registered Representative:**

**Date:**

---

**ATTENTION WELL OWNER: FILE WITH DEED**

EQP 2017C (2/2000)

212
### WATER WELL AND PUMP RECORD

**Well ID:** 75000003889

**Completion** is required under authority of Part 127 Act 368 PA 1978. Failure to comply is a misdemeanor.

<table>
<thead>
<tr>
<th>Tax No</th>
<th>Permit No</th>
<th>County</th>
<th>Township</th>
<th>WSSN</th>
</tr>
</thead>
<tbody>
<tr>
<td>003-003-002-00</td>
<td></td>
<td>St. Joseph</td>
<td>Constantine</td>
<td></td>
</tr>
</tbody>
</table>

**Distance and Direction from Road Intersection:** E. SIDE OF SHAFFER RD., 1700' S. OF DRUMMOND RD.

**Well Name:**

**Well Owner:** Paul Kline

**Well Address:**

**Owner Address:** 62334 SHAFFER ROAD RR#2 CONSTANTINE MI 49042

**Owner Address:** CONSTANTINE MI 49042

**Drilling Method:** Jetted

**Well Depth:** 154.00 ft. **Well Use:** Household

**Well Type:** Replacement **Date Completed:** 8/1/1978

**Casing Type:** Steel - black

**Casing Joint:** Threaded & coupled

**Diameter:**

- 4.00 in. to 144.00 ft. depth
- 3.75 in. to 154.00 ft. depth

**Bore Diameter 1:**

**Bore Diameter 2:**

**Bore Diameter 3:**

**Height:** 2.00 ft. above grade

**Casing Fitting:** Drive shoe

**Static Water Level:** 95.00 ft. Below Grade(Not Flowing)

**Yield Test Method:** Unknown

**Measurement Taken During Pump Test:**

- 0.00 ft. after 1.00 hrs. pumping at 60.00 GPM

**Abandoned Well Plugged:** No

**Reason for not plugging Well:**

**Abandoned well ID:**

**Screen Installed:** Yes

**Filter Packed:** No

**Screen Diameter:** 3.75 in. **Length:** 10.00 ft.

**Screen Material Type:**

**Slot:** 8.00 in. **Set Between:** 144.00 ft. and 154.00 ft.

**Blank:** 0.00 ft. **Above Fittings:**

**Well Diameter 1:**

**Well Diameter 2:**

**Well Diameter 3:**

**Well Diameter 4:**

**Geology Remarks:**

1. [SURFACE] [1] [11]
2. [RED CLAY & GRAVEL] [36] [35]
3. [SAND & GRAVEL] [130] [94] [143]
4. [BLUE CLAY] [143] [13]
5. [COARSE SAND] [154] [11]

**Abandoned Well Plugged:** No

**Grouting Method:**

**Grouting Materials:**

**Well Head Completion:** 12 inches above grade, Other

**Contractor Type:** Unknown

**Registration Number:** 88

**General Remarks:** WP3102

**Water Well Contractor's Certification:**

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

**Employment:** Unknown

**General Remarks:** WP3102

**Other Remarks:** Well Head Completion: 12 inch Above Grade

**EQP 2017C (2/2000) ATTENTION WELL OWNER: FILE WITH DEED**

2/18/2000 18:14
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978.

Failure to comply is a misdemeanor.

---

**Well ID: 75000003888**

- **Elevation**: 900 ft
- **Latitude**: 41.8924125904
- **Longitude**: -85.6841881792

---

**Well Information**

- **Name**: James Sheror
- **Address**: 62262 SHAFFER ROAD, CONSTANTINE MI 49042
- **County**: St. Joseph
- **Township**: Constantine

---

**Drilling Method**: Jetted
**Well Depth**: 129.00 ft
**Well Use**: Household

- **Casing Type**: Steel - black
- **Diameter**: 2.00 in. to 125.00 ft. depth
- **Casing Joint**: Threaded & coupled
- **Height**: 1.00 ft. above grade
- **Casing Fitting**: Drive shoe

**Static Water Level**: 90.00 ft. Below Grade (Not Flowing)
**Yield Test Method**: Unknown
**Measurement Taken During Pump Test**: Unknown

**Abandoned Well Plugged**: No
**Reason for not plugging Well**: Abandoned well ID:

- **Screen Installed**: Yes
- **Filter Packed**: No
- **Screen Diameter**: 1.20 in.
- **Slot**: 10.00 in. Set Between 125.00 ft. and 129.00 ft.
- **Blank**: 0.00 ft. Above
- **Fittings**: Bremer check valve

**Well Grouted**: Yes
**Grouting Method**: Unknown
**No. of Bags**: Additives: None
**Grouting Materials**: From 0.00 ft. to 0.00 ft.
**Well Head Completion**: 12 inches above grade. Other

**Nearest source of possible contamination**:
- **Type**: Distance Direction
- **Unknown**: 0.00 ft.
- **Unknown**: Unknown

**Drilling Machine Operator Name**: Unknown
**Employment**: Unknown

**Geology Remarks**: 1. [SAND & GRAVEL] [90] [90] 2. [BLUE CLAY] [125] [35] 3. [SAND] [129] [4]

**Contractor Type**: Unknown
**Registration Number**: 1638
**Business Name**: Unknown
**Business Address**: Unknown

**WATER WELL CONTRACTOR'S CERTIFICATION**: This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

**Signature of Registered Representative**: Yes
**Date**: 2/18/2000 18:14
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978.

**Failure to comply is a misdemeanor.**

---

**Well ID:** 75000003886

**Well Completion is required under authority of Part 127 Act 368 PA 1978.**

**Import ID:** 75771203008

---

**Well ID:** 75000003886

**Failure to comply is a misdemeanor.**

**Import ID:** 75771203008

---

**Well Name:**

**Well Owner:** James L. Baker

**Well Address:**

62172 SHAFFER ROAD

CONSTANTINE MI 49042

**Owner Address:**

62172 SHAFFER ROAD RR#1

CONSTANTINE MI 49042

---

**Drilling Method:** Jetted

**Well Depth:** 118.00 ft.

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 7/14/1966

**Casing Type:** Steel - black

**Casing Joint:** Threaded & coupled

**Diameter:**

- 2.00 in. to 114.00 ft. depth
- 1.25 in. to 118.00 ft. depth

**Bore Diameter 1:**

**Bore Diameter 2:**

**Bore Diameter 3:**

**Height:** 4.00 ft. above grade

**Casing Fitting:**

**Static Water Level:** 96.00 ft. Below Grade (Not Flowing)

**Yield Test Method:** Unknown

**Measurement Taken During Pump Test:**

**Abandoned Well Plugged:** No

**Reason for not plugging Well:**

**Abandoned well ID:**

**Screen Installed:** Yes

**Well Intake:**

**Screen Diameter:** 1.25 in.

**Length:** 4.00 ft.

**Screen Material Type:**

**Slot:** 10.00 in. Set Between 114.00 ft. and 118.00 ft.

**Blank:** 0.00 ft. Above

**Fittings:**

**Briemer check valve**

**Well Grouted:** Yes

**Grouting Method:** Unknown

**No. of Bags:**

**Grouting Materials:**

**Filter Packed:** No

**From 0.00 ft. to 0.00 ft.**

**Well Head Completion:**

**Geology Remarks:**

1. [SAND] [25] [25] 2. [GRAVEL] [75] [50] 3. [CLAY] [80] [5] 4. [CLAY, SAND & GRAVEL] [97] [17] 5. [HEAVY SAND] [118] [21]

---

**Nearest source of possible contamination:**

**Type:**

**Distance Direction:**

**Unknown**

**Distance Direction:**

**Unknown**

**Unknown**

**Unknown**

**Unknown**

**Unknown**

---

**Drilling Machine Operator Name:** DICK WILLARD

**Employment:** Unknown

**General Remarks:**

---

**WATER WELL CONTRACTOR’S CERTIFICATION:**

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

**Signature of Registered Representative**

**Date**

---

**ATTENTION WELL OWNER: FILE WITH DEED**

---


---

**2/18/2000 18.14**

---

215
PERMIT #: 46-46

LOCATION: Kick Island SSW-3000

IMPLOSION: 100 s/d sec.

SCALE: 1:100 open 10

ADDRESS: 13324 Millers Mill Rd

TOWNSHIP: Constantine Section 22 NW corner

DRILLING CO: Tom Mercer Drilling

GROUND ELEVATION: approx. 818 feet

RISER: 25 inches ground level

Logged depth: 34.5 ft.

Drilled Depth: 45 feet TOC* Red mark to ground: 27 inches

Contractor/Owner: contractor C&F Homes

STATIC: 18 ft

Note: *Started logging 25"-27"=2 inches below ground level, 0 ft after logging down is 0 ft. Collected samples from this well. Drilled well 145 feet and sampled but set well at 42 ft.
DATE: Feb 28 '97

WELL: St. Joseph 97-8

FORMER #:

 LIQUID: Kbrk Model SK-3000

 OPER. Nicks

 TIME CONST: 1000 div. Sel 1

 SCALE: 1000 rpm f.s.

 ADDRESS: 12164 (Oaker Rd 10 ml W of Xkrt Rd)

 TOWNSHIP: Constanine NW corner of Section 28

 DRILLING CO: William's Drilling

 GROUND ELEVATION: approx. 798 feet

 RISER: 11 inches ground level

 Drilled Depth: 7 feet Red mark to ground: 13 inches

 Notes: Started logging 29-13-76 below ground level. Only a small amount of bentonic seen in ground.

 Contagous owner: owner

 STAT: 10.11 ft TOC
DATE: 11-25-08

PUMP: Keck Model SR-2371

Casing: 5" PVC

Upper: Nicks

Time: 100+ days since 1

WATER: 6 ft/min

Scale: 1000 gpm 6s

Address: 12018 Chalker Rd

Township: Constance Section 28 NW corner

Drilling Co: Tom Allen Drilling

Ground elevation: approx. 785 feet

Riser: 28 inches ground level

Logged depth: 57.5 ft.

Drilled depth: 63 feet TIC

Real mark in ground: 70 inches

Liner: 18" x 18" contractor: Hockchester

Static: 8.64 ft when logged (6.6 ft when drilled)

Notes: Started legging at ground level. There is a strong

sulfur smell in the water when pumped. In back yard there

was a garbage pit with a 3 ft. exposure.
**Michigan Water-Well and Pump Record**

<table>
<thead>
<tr>
<th>Field</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permit No.</td>
<td>16719</td>
</tr>
<tr>
<td>Tax No.</td>
<td>97-23</td>
</tr>
<tr>
<td>Location of Well</td>
<td>Township Name: FABUS</td>
</tr>
<tr>
<td>County</td>
<td>ST JOSEPH</td>
</tr>
<tr>
<td>Township</td>
<td>FABUS</td>
</tr>
<tr>
<td>Distance and Direction from Road Intersection</td>
<td>11230 OAK AVE., THREE RIVERS</td>
</tr>
</tbody>
</table>

**Street Address and City of Well Location**

<table>
<thead>
<tr>
<th>Field</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sketch Map</td>
<td></td>
</tr>
</tbody>
</table>

**Owner of Well**

<table>
<thead>
<tr>
<th>Field</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>DEWAGE &amp; UNERHOLDT INC.</td>
</tr>
<tr>
<td>Address</td>
<td>5225 LANDSEND, KALAMAZOO, MI 49004-</td>
</tr>
</tbody>
</table>

**Well Depth (Completed)**

<table>
<thead>
<tr>
<th>Field</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth</td>
<td>87 ft.</td>
</tr>
<tr>
<td>Date of Completion</td>
<td>7/24/96</td>
</tr>
</tbody>
</table>

**Drilling Method**

- CABLE TOOL

**Proposed Use**

- DOMESTIC

**Formation Description**

- **DRIY SAND GRAVEL**
- **COARSE SAND GRAVEL (WET)**
- **SOFT GRAY CLAY**
- **COARSE SAND GRAVEL (WET)**

**Casing**

<table>
<thead>
<tr>
<th>Field</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness</td>
<td>4 in. to 81 ft. depth</td>
</tr>
<tr>
<td>Depth to Bottom of Stratum</td>
<td>87 ft.</td>
</tr>
<tr>
<td>Type</td>
<td>SLOTTED</td>
</tr>
<tr>
<td>Diameter</td>
<td>4</td>
</tr>
<tr>
<td>Slot/Gauze</td>
<td>12</td>
</tr>
<tr>
<td>Length</td>
<td>6</td>
</tr>
<tr>
<td>Set Between</td>
<td>81 ft. and 87 ft.</td>
</tr>
<tr>
<td>Fittings</td>
<td>K-PACKER</td>
</tr>
<tr>
<td>1.00 Blank ft. above screen</td>
<td></td>
</tr>
</tbody>
</table>

**Static Water Level**

- 38 ft. below land surface

**Abandoned Well Plugged?**

- No

**Casing Diameter**

<table>
<thead>
<tr>
<th>Field</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>In.</td>
<td>11/2</td>
</tr>
<tr>
<td>Ft.</td>
<td>65</td>
</tr>
</tbody>
</table>

**Casing removed?**

- No

**Remarks, elevation, source of data, etc.**

- Water Well Contractor's Certification:

  This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

  Registered business name: EARL SANDERS & SON
  Registration number: 0112
  Address: 7281 S H-40 HIGHWAY, LAWTON, MI 49065
  Signed: 12/10/96 (Authorized representative)
WELL LOG, St. Joseph 47,135

DATE: 05-12-87

PERMIT #: 112105

STTJP: Keck Model SR-3000

CVR: Nicki

TIME/CUR/SP: 104.0 div. Size 1 VVR, 5 in. min.

SCALE: 1000 cpm. ft

ADDRESS: 38021 County Line Rd.

TIME/PRED: Fabson Section 18 SW corner

DRILLING: Co., Tom Miner Drilling

GROUND ELEVATION: approx. 900 feet

BASE: 11 inches ground level

LOGGED: 22 ft.

DUG/BLE: 77 feet

CONSTRUCTION/owner:

STATIC: 23.5 TPC

Notes: started logging 29'-13.5"-15.5". New modular home in front of older mobile home/shed. Well located in front yard (west side of house).
WATER WELL AND PUMP RECORD

Completion is required under authority of Part 127 Act 368 PA 1978.

Failure to comply is a misdemeanor.

Import ID: 75761218003

Well ID: 75000002228

Well Name: Terry McLaughlin

Well Address: 58479 COUNTY LINE ROAD
3 RIVERS MI 49093

Owner Address: 58479 COUNTY LINE ROAD
3 RIVERS MI 49093

Drilling Method: Auger/Bored

Well Depth: 57.00 ft. Well Use: Household

Well Type: Replacement Date Completed: 8/3/1976

Casing Type: Unknown Casing Joint: Threaded & coupled

Diameter: 2.00 in. to 54.00 ft. depth

Bore Diameter 1: Bore Diameter 2:
Bore Diameter 3: Height: 1.00 ft. above grade
Casing Fitting: Drive shoe

Bore Diameter 1:
Bore Diameter 2:
Bore Diameter 3: Height 1.00 fl. above grade
Casing Fitting: Drive shoe

Screen Installed: Yes Well Intake: Unknown
Filter Packed: No Screen Diameter: 1.25 in. Length: 3.00 ft.
Screen Material Type: Slot: 70.00 in. Set Between 54.00 ft. and 57.00 ft.
Blank: 0.00 ft. Above Fittings:
Bore Diameter 1:
Bore Diameter 2:
Bore Diameter 3: Height 1.00 fl. above grade
Casing Fitting: Drive shoe

Well Grouted: Yes Grouting Method: Unknown

No. of Bags: Additives: None
Grouting Materials: Unknown From 0.00 ft. to 0.00 ft.

Well Head Completion: Pitless adapter

Nearest source of possible contamination:
Type Septic tank Distance Direction
50.00 ft. South

Drilling Machine Operator Name: Employment: Unknown

General Remarks: WP000882

OTHER REMARKS Pump Manufacturer: USED SEARS


ATTENTION WELL OWNER: FILE WITH DEED

2/18/2000 17:48
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978.

Failure to comply is a misdemeanor.

---

**Well ID:** 75000002229

**Elevation:** 920 ft

**Latitude:** 41.9480908308

**Longitude:** -85.7601822406

**Well Name:** George Brown

**Well Address:** 58437 COUNTY LINE ROAD, 3 RIVERS MI 49093

**Owner Address:** 58437 COUNTY LINE ROAD, 3 RIVERS MI 49093

**Well ID:** 75000002229

**Distance and Direction from Road Intersection:** E. SIDE OF COUNTY LINE ROAD, 25 MILE N. OF COON HOLLOW R

**Well Type:** Replacement

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 6/8/1973

**Drillina Method:** Jetted

**Well Depth:** 66.00 ft

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 6/8/1973

**Drillina Method:** Jetted

**Well Depth:** 66.00 ft

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 6/8/1973

**Drillina Method:** Jetted

**Well Depth:** 66.00 ft

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 6/8/1973

**Drillina Method:** Jetted

**Well Depth:** 66.00 ft

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 6/8/1973

**Drillina Method:** Jetted

**Well Depth:** 66.00 ft

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 6/8/1973

**Drillina Method:** Jetted

**Well Depth:** 66.00 ft

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 6/8/1973

**Drillina Method:** Jetted

**Well Depth:** 66.00 ft

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 6/8/1973

**Drillina Method:** Jetted

**Well Depth:** 66.00 ft

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 6/8/1973

**Drillina Method:** Jetted

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**Well Type:** Replacement

**Date Completed:** 6/8/1973

**Drillina Method:** Jetted

**Well Depth:** 66.00 ft

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 6/8/1973

**Drillina Method:** Jetted

**Well Depth:** 66.00 ft

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 6/8/1973

**Drillina Method:** Jetted

**Well Depth:** 66.00 ft

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 6/8/1973

**Drillina Method:** Jetted

**Well Depth:** 66.00 ft

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 6/8/1973

**Drillina Method:** Jetted

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**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 6/8/1973

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**Well Type:** Replacement

**Date Completed:** 6/8/1973

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**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 6/8/1973

**Drillina Method:** Jetted

**Well Depth:** 66.00 ft

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 6/8/1973

**Drillina Method:** Jetted

**Well Depth:** 66.00 ft

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 6/8/1973

**Drillina Method:** Jetted

**Well Depth:** 66.00 ft

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 6/8/1973

**Drillina Method:** Jetted

**Well Depth:** 66.00 ft

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 6/8/1973

**Drillina Method:** Jetted

**Well Depth:** 66.00 ft

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 6/8/1973

**Drillina Method:** Jetted

**Well Depth:** 66.00 ft

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 6/8/1973

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**Well Depth:** 66.00 ft

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 6/8/1973

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**Well Type:** Replacement

**Date Completed:** 6/8/1973

**Drillina Method:** Jetted

**Well Depth:** 66.00 ft

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**Well Type:** Replacement

**Date Completed:** 6/8/1973

**Drillina Method:** Jetted

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**Well Type:** Replacement

**Date Completed:** 6/8/1973

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**Well Depth:** 66.00 ft

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 6/8/1973

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**Well Depth:** 66.00 ft

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 6/8/1973

**Drillina Method:** Jetted

**Well Depth:** 66.00 ft

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 6/8/1973

**Drillina Method:** Jetted

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**Well Type:** Replacement

**Date Completed:** 6/8/1973

**Drillina Method:** Jetted

**Well Depth:** 66.00 ft

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 6/8/1973

**Drillina Method:** Jetted

**Well Depth:** 66.00 ft

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 6/8/1973

**Drillina Method:** Jetted

**Well Depth:** 66.00 ft

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 6/8/1973

**Drillina Method:** Jetted

**Well Depth:** 66.00 ft

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 6/8/1973

**Drillina Method:** Jetted

**Well Depth:** 66.00 ft

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 6/8/1973

**Drillina Method:** Jetted

**Well Depth:** 66.00 ft

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 6/8/1973

**Drillina Method:** Jetted

**Well Depth:** 66.00 ft

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 6/8/1973

**Drillina Method:** Jetted

**Well Depth:** 66.00 ft

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 6/8/1973

**Drillina Method:** Jetted

**Well Depth:** 66.00 ft

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 6/8/1973
WATER WELL AND PUMP RECORD

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Well ID: 75000005802

<table>
<thead>
<tr>
<th>Fraction:</th>
<th>Section:</th>
<th>Township:</th>
<th>Well ID:</th>
<th>Permit No:</th>
<th>County:</th>
<th>Township:</th>
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<tbody>
<tr>
<td>SW 1/4 SW 1/4 NW 1/4</td>
<td>18</td>
<td>St. Joseph</td>
<td>75000005802</td>
<td>000 02 1826</td>
<td>St. Joseph</td>
<td>Fabius</td>
</tr>
</tbody>
</table>

Distance and Direction From Road Intersection: 0.75 miles north of Coon Hollow Rd.

Well Name: William & Gloria Borton
Well Address: 58271 County Line Rd.
Owner Address: 58271 County Line Rd.
Three Rivers MI 49093
Three Rivers MI 49093

Drilling Method: Rotary
Well Depth: 57.00 ft.
Well Use: Household
Well Type: Replacement
Date Completed: 10/14/1999
Casing Type: PVC plastic
Casing Joint: Unknown
Diameter: 5.00 in. to 57.00 ft. depth

Bore Diameter 1: 8.00 in. to 57.00 ft. depth
Bore Diameter 2:
Bore Diameter 3:
Height: 1.00 ft. above grade
Casing Fitting: None

Static Water Level: 25.00 ft. Below Grade(Not Flowing)
Yield Test Method: Air
Measurement Taken During Pump Test:
27.00 ft. after 1.00 hrs. pumping at 20.00 GPM

Abandoned Well Plugged: Yes
Reason for not plugging Well:
Abandoned well ID:
Screen Installed: Yes
Well Intake:
Filter Packed: No
Screen Diameter: 5.00 in.
Length: 5.00 ft.
Screen Material Type: PVC - slotted
Slot: 18.00 in. Set Between 52.00 ft. and 57.00 ft.
Blank:
Fittings:
Unknown

Well Grouted: Yes
Grouting Method: Unknown
No. of Bags: 3
Additives: None
Grouting Materials:
Bentonite slurry From 0.00 ft. to 52.00 ft.

Well Head Completion: 12 inches above grade. Pitless adapter

Nearest source of possible contamination:
Type: Distance Direction
Septic tank: 55.00 ft. Northeast
None

Drilling Machine Operator Name: Rick Clark
Employment: Employee

WATER WELL CONTRACTOR'S CERTIFICATION:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
Contractor Type: Water well drilling contractor
Registration Number: 1794
Business Name: Clark Well Drilling
Business Address:

ATTENTION WELL OWNER: FILE WITH DEED
6/24/2002 13:10

224
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978.

**Well ID:** 75000002230

**Import ID:** 75761218005

- **Tax No:** 004-018-003-08
- **Permit No:**
- **County:** St. Joseph
- **Township:** Fabius
- **Well ID:** 75000002230
- **Distance and Direction from Road Intersection:** E. SIDE OF COUNTY LINE RD, .3 MILE N. OF COON HOLLOW RD

**Well Name:** Tracy Bainbridge

**Well Address:** 58335 COUNTY LINE ROAD 3 RIVERS MI 49093

**Owner Address:** 3 RIVERS MI 49093

**Well Owner:** Tracy Bainbridge

**Well Address:** 58335 COUNTY LINE ROAD 3 RIVERS MI 49093

**Owner Address:** 3 RIVERS MI 49093

**Well ID:** 75000002230

**Location:**
- **Elevation:** 920 ft
- **Latitude:** 41.9487466143
- **Longitude:** -85.7592157193

**Drilling Method:** Jetted

**Well Depth:** 60.00 ft

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 9/15/1976

**Casing Type:** Unknown

**Casing Joint:** Threaded & coupled

**Diameter:** 2.00 in. to 56.00 ft. depth

**Bore Diameter 1:**

**Bore Diameter 2:**

**Bore Diameter 3:**

**Height:** 2.00 ft. above grade

**Casing Fitting:** Drive shoe

**Static Water Level:** 44.00 ft. Below Grade (Not Flowing)

**Yield Test Method:** Unknown

**Measurement Taken During Pump Test:** 0.00 ft. after 1.00 hrs. pumping at 15.00 GPM

**Abandoned Well Plugged:** No

**Reason for not plugging Well:** Abandoned well ID:

**Screen Installed:** Yes

**Well Intake:**

**Screen Diameter:** 1.25 in.

**Length:** 4.00 ft.

**Screen Material Type:**

**Slot:** 10.00 in. Set Between 56.00 ft. and 60.00 ft.

**Blank:** 0.00 ft. Above

**Fittings:** Bremer check valve

**Well Grouted:** No

**Grouting Method:**

**No. of Bags:**

**Grouting Materials:**

**Well Head Completion:**

**Nearest source of possible contamination:**

**Type:** Unknown

**Distance Direction:** 0.00 ft.

**Drilling Machine Operator Name:** CHARLES YORDY

**Employment:**

**General Remarks:** WP000936

**WATER WELL CONTRACTOR'S CERTIFICATION:**

- **Drilling Machine Operator Name:** CHARLES YORDY
- **Employment:**

- **General Remarks:** WP000936

**OTHER REMARKS**

**ATTENTION WELL OWNER: FILE WITH DEED**

2/18/2000 17:48
DATE: 4-24-27

HOLE: St. Joseph 97-14

MACHINE: Drill Head Model SR-3000

MILL: 100 GPM, Sens 1

F.L.: 6 ft/min

LUG: 10,000 ccf

DIRS.: 11335 North Horsethief Drive

PURITY: Finish section 20 FW

BILLING: V.P. Head's Drilling

GROUND ELEVATION: approx. 906 feet

S.G.: 12 inches ground level

LUGGED: Depth: 145 ft

LUGGED: No. feet; Rod mark in ground: 13.5 inches

Drilled started drilling 20' 13.5" below ground. Well is

cased at west end of existing house.

TRANSMISSION: owner:

F.A.T. to top of casing

226
WATER WELL AND PUMP RECORD

Completion is required under authority of Part 127 Act 368 PA 1978.

Well ID: 75000002277

Tax No: 004-500-045-00  Permit No:  
County: St. Joseph  Township: Fabius

Well ID: 75000002277  Failure to comply is a misdemeanor.
Import ID: 75761220024  

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Well ID</td>
<td>75000002277</td>
</tr>
<tr>
<td>Elevation</td>
<td>915 ft</td>
</tr>
<tr>
<td>Latitude</td>
<td>41.9341538915</td>
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<tr>
<td>Longitude</td>
<td>-85.733831737</td>
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<tr>
<td>County</td>
<td>St. Joseph</td>
</tr>
<tr>
<td>Township</td>
<td>Fabius</td>
</tr>
</tbody>
</table>

**Drilling Method:** Auger/Bored  
**Well Depth:** 81.00 ft  
**Well Use:** Household  
**Well Type:** New  
**Date Completed:** 8/19/1976  
**Casing Type:** Unknown  
**Casing Joint:** Threaded & coupled  
**Diameter:** 2.00 in. to 77.00 ft. depth  
**Bore Diameter 1:**  
**Bore Diameter 2:**  
**Bore Diameter 3:**  
**Height:** 1.00 ft. above grade  
**Casing Fitting:** Drive shoe  
**Static Water Level:** 47.00 ft. Below Grade (Not Flowing)  
**Yield Test Method:** Unknown  
**Measurement Taken During Pump Test:**  
**Abandoned Well Plugged:** No  
**Reason for not plugging Well:**  
**Abandoned well ID:**  
**Screen Installed:** Yes  
**Well Intake:**  
**Screen Diameter:** 1.25 in.  
**Length:** 4.00 ft.  
**Screen Material Type:**  
**Slot:** 0.00 in.  
**Blank:** 0.00 ft. Above  
**Fittings:** Neoprene packer  
**Well Grouted:** Yes  
**Grouting Method:** Unknown  
**No. of Bags:**  
**Grouting Materials:** Unknown  
**Additives:** None  
**Well Head Completion:** Pitless adapter  
**Nearest source of possible contamination:**  
**Type:** Septic tank  
**Distance Direction:** 50.00 ft. South  
**Drilling Machine Operator Name:**  
**Employment:** Unknown  
**General Remarks:** SCREEN SIZE = 100  
**Other Remarks:** EQP 2017C (2/2000)  

**WATER WELL CONTRACTOR'S CERTIFICATION:**  
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

**Contractor Type:** Unknown  
**Registration Number:** 18  
**Business Name:**  
**Business Address:**  

**Signature of Registered Representative:**  
**Date:** 2/18/2000 17:49  

ATTENTION WELL OWNER: FILE WITH DEED
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978.

**Failure to comply is a misdemeanor.**

**Well ID:** 75000002278

**Well Location:**
- **Elevation:** 900 ft
- **Latitude:** 41.934735973
- **Longitude:** -85.7349777153

**Well Information:**
- **Well ID:** 75000002278
- **Distance and Direction from Road Intersection:** INSIDE CURVE OF HORSESHOE DR. W. OF SHAFER BROS. ROAD

**Well Details:**
- **Well Name:**
  - **Well Owner:** H. Beuscher
  - **Well Address:** 11299 NORTH HORSESHOE DRIVE
  - **Owner Address:** 11299 NORTH HORSESHOE DRIVE
  - **3 RIVERS MI 49093**

**Drilling Method:** Jetted

**Well Depth:** 58.00 ft

**Well Type:** Replacement

**Casing Type:** Steel - black
**Casing Diameter:** 2.00 in. to 54.00 ft. depth

**Bore Diameter:**
- **Bore Diameter 1:**
- **Bore Diameter 2:**
- **Bore Diameter 3:**
  - **Height:** 0.00 ft. above grade
  - **Casing Fitting:** None

**Static Water Level:** 25.00 ft. Below Grade (Not Flowing)

**Yield Test Method:** Unknown

**Measurement Taken During Pump Test:**

**Abandoned Well Plugged:** No

**Reason for not plugging Well:**

**Abandoned well ID:**

**Screen Installed:** Yes

**Filter Packed:** No

**Screen Diameter:** 1.25 in.
**Screen Material Type:**
- **Slot:** 10.00 in.
  - **Set Between 54.00 ft. and 58.00 ft.
- **Blank:** 0.00 ft. Above

**Fittings:** Bremer check valve

**Well Grouted:** Yes

**Grouting Method:** Unknown

**No. of Bags:**

**Grouting Materials:**
- **Additives:** None
- **Unknown:** From 0.00 ft. to 0.00 ft.

**Well Head Completion:** Pitless adapter

**Nearest source of possible contamination:**
- **Type:**
  - **Distance Direction:**
  - **Unknown:** 0.00 ft.
  - **Unknown:**

**Drilling Machine Operator Name:** RICHARD GRAHL

**Employment:** Unknown

**General Remarks:** WP7632

**WATER WELL CONTRACTOR'S CERTIFICATION:**

**This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.**

**Drilling Machine Operator Name:** RICHARD GRAHL

**Employment:** Unknown

**General Remarks:** WP7632

**WATER WELL CONTRACTOR'S CERTIFICATION:**

**Signature of Registered Representative:** Date

**ATTENTION WELL OWNER: FILE WITH DEED**

2/18/2000 17:49
**WATER WELL AND PUMP RECORD**

Completion is required under authority of Part 127 Act 368 PA 1978.

**Well ID:** 75000002283

**Well Owner:** Frances J. O’Shea

**Well Address:** 11319 NORTH HORSESHOE DRIVE 3 RIVERS MI 49093

**Owner Address:** 11319 NORTH HORSESHOE DRIVE 3 RIVERS MI 49093

---

**Drilling Method:** Jetted

**Well Depth:** 65.00 ft

**Well Use:** Household

**Well Type:** Replacement

**Date Completed:** 6/24/1970

**Casing Type:** Unknown

**Casing Joint:** Threaded & coupled

**Diameter:** 2.00 in. to 61.00 ft. depth

**Bore Diameter 1:**

**Bore Diameter 2:**

**Bore Diameter 3:**

**Height:** 0.00 ft. above grade

**Casing Fitting:** Drive shoe

**Static Water Level:** 40.00 ft. Below Grade (Not Flowing)

**Yield Test Method:** Unknown

**Measurement Taken During Pump Test:**

---

<table>
<thead>
<tr>
<th>Formation Description</th>
<th>Thickness</th>
<th>Depth to Bottom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Sand</td>
<td>10.00</td>
<td>10.00</td>
</tr>
<tr>
<td>Red Clay</td>
<td>10.00</td>
<td>20.00</td>
</tr>
<tr>
<td>Gravel &amp; Clay</td>
<td>30.00</td>
<td>50.00</td>
</tr>
<tr>
<td>White Sand</td>
<td>15.00</td>
<td>65.00</td>
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</tbody>
</table>

**Abandoned Well Plugged:** No

**Reason for not plugging Well:**

**Abandoned well ID:**

**Screen Installed:** Yes

**Filter Packed:** No

**Screen Diameter:** 1.25 in.

**Length:** 4.00 ft.

**Screen Material Type:**

**Slot:** 70.00 in. Set Between 61.00 ft. and 65.00 ft.

**Blank:** 4.00 ft. Above

**Fittings:**

**Bremer check valve**

**Well Grouted:** No

**Grouting Method:**

**No. of Bags:**

**Additives:**

**Grouting Materials:**

**Well Head Completion:** Other

---

**Geology Remarks:**

**Contractor Type:** Unknown

**Registration Number:** 18

**Business Name:**

**Business Address:**

---

**Well Grouted:** No

**Grouting Method:**

**No. of Bags:**

**Additives:**

**Grouting Materials:**

**Well Head Completion:** Other

---

**Attention Well Owner:** FILE WITH DEED

---


---

**Signature of Registered Representative**

**Date**

---

229
WATER WELL AND PUMP RECORD

Completion is required under authority of Part 127 Act 368 PA 1978.

Failure to comply is a misdemeanor.

Well ID: 75000005424

Tax No: Permit No: W22501
County: St. Joseph Township: Fabius
Section: 20 Township Range: 06S 12W
French Claim: WSSN:

Distance and Direction from Road Intersection: 1/8 MILE WEST OF SHAFFER BROS RD, 100' NORTH OF NORTH HORSESHOE DR.

Well Name: Well Owner: John Tnvkum
Well Address: 11420 N. HORSESHOE DR. THREE RIVERS MI
Owner Address: 11420 N. HORSESHOE DR. THREE RIVERS MI

Drilling Method: Jetted
Well Depth: 67.00 ft Well Use: Household
Well Type: Replacement Date Completed: 1/26/2000

Well ID: 75000005424 Failure to comply is a misdemeanor.

Well Name: Well Owner: John Tnvkum
Well Address: 11420 N. HORSESHOE DR. THREE RIVERS MI
Owner Address: 11420 N. HORSESHOE DR. THREE RIVERS MI

Pump Installed: Yes Pump Installation only: No
Pump Installation date: HP: 0.50
Manufacturer: Webtrol Pump Type: Submersible
Model Number: 102558B Pump Capacity: 10.00 GPM

Length of Drop Pipe: 42.00 ft Diameter of Drop Pipe:
Draw Down Seal Used: No

Pressure Tank Installed: Yes Pressure Tank Type: Unknown
Manufacturer: Other Model Number: 202 Tank Capacity: 9999 Gallons
Pressure Relief Valve Installed: No

Topsoil 1.00 1.00
Red Gravel & Sand 11.00 12.00
Red Clay & Sand W/Gravel 8.00 20.00
Red Sand & Gravel 12.00 32.00
See Comments 29.00 61.00
Sand & Gravel 6.00 67.00

Abandoned Well Plugged: Yes Reason for not plugging Well:
Abandoned well ID:

Filter Packed: No Screen Diameter: 3.88 in.
Screen Material Type: Slot: 10.00 in.
Blank: 1.00 ft. Above Fittings:
Blank above screen Neoprene packer

Well Grouted: Yes Grouting Method: Unknown
No. of Bags: 2 Additives: None
Grouting Materials: Bentonite slurry From 0.00 ft. to 25.00 ft.

Well Head Completion: 12 inches above grade, Pitless adapter

Nearest source of possible contamination:
Type Distance Direction
Septic tank 60.00 ft. North

Drilling Machine Operator Name: CHUCK YORDY
Employment: Employee

General Remarks: SCREEN TYPE: S.S.; PRESSURE TANK CAPACITY: 30; GALLONS: 5; 1.25
OTHER REMARKS: Pressure Tank Manufacturer: AMTROL

EQP 2017C (2/2000)

ATTENTION WELL OWNER: FILE WITH DEED

10/24/2000 10.29

230
WATER WELL AND PUMP RECORD

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Well ID: 75000006279

<table>
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<tr>
<th>Tax No:</th>
<th>Permit No:</th>
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<th>Township:</th>
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<tr>
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<td>W24619</td>
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<td>Fabius</td>
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<tr>
<th>Fraction:</th>
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<th>French Claim</th>
<th>WSSN:</th>
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<tr>
<td></td>
<td>20</td>
<td>06S 12W</td>
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</tr>
</tbody>
</table>

Distance and Direction from Road Intersection: SHAFER BROS RD TO S HORSESHOE DR TO SECOND HOUSE ON LEFT

<table>
<thead>
<tr>
<th>Well Name:</th>
<th>Well Owner:</th>
<th>Tax No:</th>
<th>Permit No:</th>
<th>County:</th>
<th>Township:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Marv Dillivan</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Well ID:</th>
<th>Well Address:</th>
<th>Owner Address:</th>
</tr>
</thead>
<tbody>
<tr>
<td>75000006279</td>
<td>11391 S HORSESHOE DR</td>
<td>11391 S HORSESHOE DR</td>
</tr>
<tr>
<td></td>
<td>THREE RIVERS MI</td>
<td>THREE RIVERS MI</td>
</tr>
</tbody>
</table>

Drilling Method: Rotary
Well Depth: 73.00 ft.
Well Type: Replacement
Date Completed: 1/28/2002

Well Casing:
- Casing Type: PVC plastic
- Diameter: 5.00 in. to 68.00 ft. depth
- Bore Diameter 1: 8.50 in. to 73.00 ft. depth
- Bore Diameter 2: Unknown
- Height: 1.00 ft. above grade
- Casing Fitting: None

Static Water Level: 48.00 ft. Below Grade (Not Flowing)

Yield Test Method: Air
Measurement Taken During Pump Test:
55.00 ft. after 1.00 hrs. pumping at 25.00 GPM

Abandoned Well Plugged: Yes
Reason for not plugging Well: Unknown

Screen Installed: Yes
Filter Packed: Yes
Screen Diameter: 4.00 in.
Screen Material Type: PVC - slotted
Slot: 18.00 in. Set Between 68.00 ft. and 73.00 ft.
Blank: Unknown
Fittings: None

Well Grouted: Yes
Grouting Method: Unknown
No. of Bags: 3
Additives: None
Grouting Materials:
- Bentonite slurry: From 0.00 ft. to 63.00 ft.

Well Head Completion:
12 inches above grade, Pitless adapter

Nearest source of possible contamination:
Type: Septic tank
Distance: 50.00 ft.

Drilling Machine Operator Name: RICHARD GRAHL
Employment: Employee

WATER WELL CONTRACTOR’S CERTIFICATION:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Driller: RICHARD GRAHL

General Remarks:
OTHER REMARKS:

ATTENTION WELL OWNER: FILE WITH DEED

WELL NO. St Joseph 97-21  DATE: May 27, 1997
DRILLER: Keel Model SK-3000  CASING: 5" PVC
UPPER: Niska  WATER WELL
TIME CONSUME: 1100 cpm  Logging up
SCALE: 1000 cpm -fix
ADDRESS: 608 SW US 131, south of Three Rivers
TOWNSHIP: Fabius SW corner of Section 25
DRILLER: Clarks Drilling
GROUND ELEVATION: approx 810 feet
WATER: 15 inches ground level  Located depth: 6.8 ft
Drilled Depth: feet  red mark is ground: 16.5 in
STAGES: well was gently flowing out of top of casing
Noting: Started logging 24.165" = 1.5 inches below ground
level. Enter drive hedie blue bunglow, drive goes back in
woods. The well was well graduated.
**MICHIGAN WATER WELL AND FOUNT RECORD**

<table>
<thead>
<tr>
<th>Permit No.:</th>
<th>1 &amp; 7, 29</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1 Location of Well</strong></td>
<td></td>
</tr>
<tr>
<td>County: ST. JOSEPH</td>
<td></td>
</tr>
<tr>
<td>Township Name: PARDES</td>
<td></td>
</tr>
<tr>
<td>Fraction: 7/10</td>
<td></td>
</tr>
<tr>
<td>Section Number: 1/4</td>
<td></td>
</tr>
<tr>
<td>Township: 1/4</td>
<td></td>
</tr>
<tr>
<td>Range Number: 1/4</td>
<td></td>
</tr>
<tr>
<td>7/10 OF A MILE SOUTH OF GLEASON</td>
<td></td>
</tr>
<tr>
<td><strong>2 Formation Description</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Thickness</strong>: Depth to Bottom of Stratum</td>
<td></td>
</tr>
<tr>
<td>BLACK DIET: 4 in. to 4 ft.</td>
<td></td>
</tr>
<tr>
<td>RED SAND GRAVEL: 46 in. to 50 ft.</td>
<td></td>
</tr>
<tr>
<td>GRAY CLAY: 43 in. to 43 ft.</td>
<td></td>
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<tr>
<td>MEDIUM SAND: 24 in. to 117 ft.</td>
<td></td>
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<tr>
<td>GRAY CLAY: 1 in. to 118 ft.</td>
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<tr>
<td><strong>3 Owner of Well</strong>: GEERHEART, DAVE</td>
<td></td>
</tr>
<tr>
<td><strong>Address</strong>: 500 CONSTANT STREET, TERRI RIVERS, MI 49093-</td>
<td></td>
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<tr>
<td><strong>4 Well Depth (Completed)</strong>: 115 ft.</td>
<td></td>
</tr>
<tr>
<td><strong>5 Drilling Method</strong>: HDD ROTARY</td>
<td></td>
</tr>
<tr>
<td><strong>6 Proposed Use</strong>: DOMESTIC</td>
<td></td>
</tr>
<tr>
<td><strong>7 Casing 5(^{\circ}) PVC</strong>: Height Above Surface 1 ft.</td>
<td></td>
</tr>
<tr>
<td><strong>8 Bore Hole Diameter</strong>: 8 in. to 110 ft. deep; Drive Shoe No</td>
<td></td>
</tr>
<tr>
<td><strong>9 Static Water Level</strong>: 80 ft. below land surface</td>
<td></td>
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<tr>
<td><strong>10 Pumping Level</strong>: 62 ft. after 1 hr. pumping at 12 G.P.M.</td>
<td></td>
</tr>
<tr>
<td><strong>11 Well End Completion</strong>: FITLESS ADAPTOR</td>
<td></td>
</tr>
<tr>
<td><strong>12 Well Grouted</strong>: Yes from 105 to 30 ft.</td>
<td></td>
</tr>
<tr>
<td><strong>13 Nearest Source of Possible Contamination</strong>: SEDIMENT</td>
<td></td>
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<tr>
<td><strong>14 Pressure Tank</strong>: Manufacturer's Name HYRUS</td>
<td></td>
</tr>
<tr>
<td><strong>15 Abandoned well plugged</strong>: No</td>
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<tr>
<td><strong>Casing Diameter</strong>: in.</td>
<td></td>
</tr>
<tr>
<td>Depth: ft.</td>
<td></td>
</tr>
<tr>
<td><strong>16 Remarks, elevation, source of data, etc.</strong></td>
<td></td>
</tr>
<tr>
<td><strong>17 Drilling machine operator</strong>: Employee</td>
<td></td>
</tr>
<tr>
<td>Name: R. DEPPERT</td>
<td></td>
</tr>
<tr>
<td>Authority: Act 368 PA 1978</td>
<td></td>
</tr>
<tr>
<td>Completion: Required</td>
<td></td>
</tr>
<tr>
<td>Penalty: Conviction of violation of any provision is a misdemeanor.</td>
<td></td>
</tr>
<tr>
<td>Important: File with deed.</td>
<td></td>
</tr>
<tr>
<td><strong>18 Water Well Contractor's Certification</strong>: This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.</td>
<td></td>
</tr>
<tr>
<td>Registered business name: MADDER WELL DRILLING</td>
<td></td>
</tr>
<tr>
<td>Registration number: 2013 (219) 272-7524</td>
<td></td>
</tr>
<tr>
<td>Address: 57711 EKHONS RD., SOUTH BEND, IN 46637</td>
<td></td>
</tr>
<tr>
<td>Signed: (Authorized representative)</td>
<td></td>
</tr>
</tbody>
</table>

**RECEIVED MAY 5 1996**
APPENDIX H

Student t-Test
The t-Test

The t-test is a parametric hypothesis test. The t-test is used to determine if two populations that are normal probability distribution functions are different at a given confidence level. If the hypothesis is rejected, the two populations are significantly different beyond the expectations from normal sampling variability. If the null hypothesis is not rejected, it is implied that the population means are statistically similar. The t-test was performed on 7A/10A results from Units 3 and 5 using Equation X.

**Equation 3**

t-Test

\[ t = \frac{(X_A - X_B)}{(S_A^2/I_A + S_B^2/I_B)^{0.5}} \]

where:

\( X_A \) and \( X_B \) = means of populations A and B

\( S_A \) and \( S_B \) = the variances of populations A and B

\( I_A \) and \( I_B \) = number members of populations A and B

(Jensen et al., 1997)

**Equation 4**

Degrees of Freedom

\[ df = \left[ \frac{(S_A^2/I_A + S_B^2/I_B)^2}{[(S_A^4/I_A (I_A-1) + S_B^4/I_B (I_B-1))]} \right] \]

(Jensen et al., 1997)
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PLATE I – Cross-section M1 – M1’
(Figure 16 – Stratigraphic/Topographic Cross-Sections (page 52) identifies the cross-section transects; description of cross sections and stratigraphic units can be found on pages 51-56)
PLATE II– Cross-section M2 – M2'

(Figure 16 – Stratigraphic/Topographic Cross-Sections (page 52) identifies the cross-section transects; description of cross sections and stratigraphic units can be found on pages 51-56)
PLATE III - Cross-section M3 – M3’
(Figure 16 – Stratigraphic/Topographic Cross-Sections (page 52) identifies the cross-section transects; description of cross sections and stratigraphic units can be found on pages 51-56)
PLATE IV– Cross-section S1 – S1’
(Figure 16 – Stratigraphic/Topographic Cross-Sections (page 52) identifies the cross-section transects; description of cross sections and stratigraphic units can be found on pages 56-58)
PLATE V– Cross-section S2 – S2’
(Figure 16 – Stratigraphic/Topographic Cross-Sections (page 52) identifies the cross-section transects; description of cross sections and stratigraphic units can be found on pages 56-58)
PLATE VI - Cross-section G1 – G1’
(Figure 21 - Locations of Gamma Ray Log Collection Sites and Cross-section (page 75) identifies the cross-section transect; description of cross sections and stratigraphic units can be found on pages 73-75)