UNIVERSITY OF MINNESOTA
MINNESOTA GEOLOGICAL SURVEY
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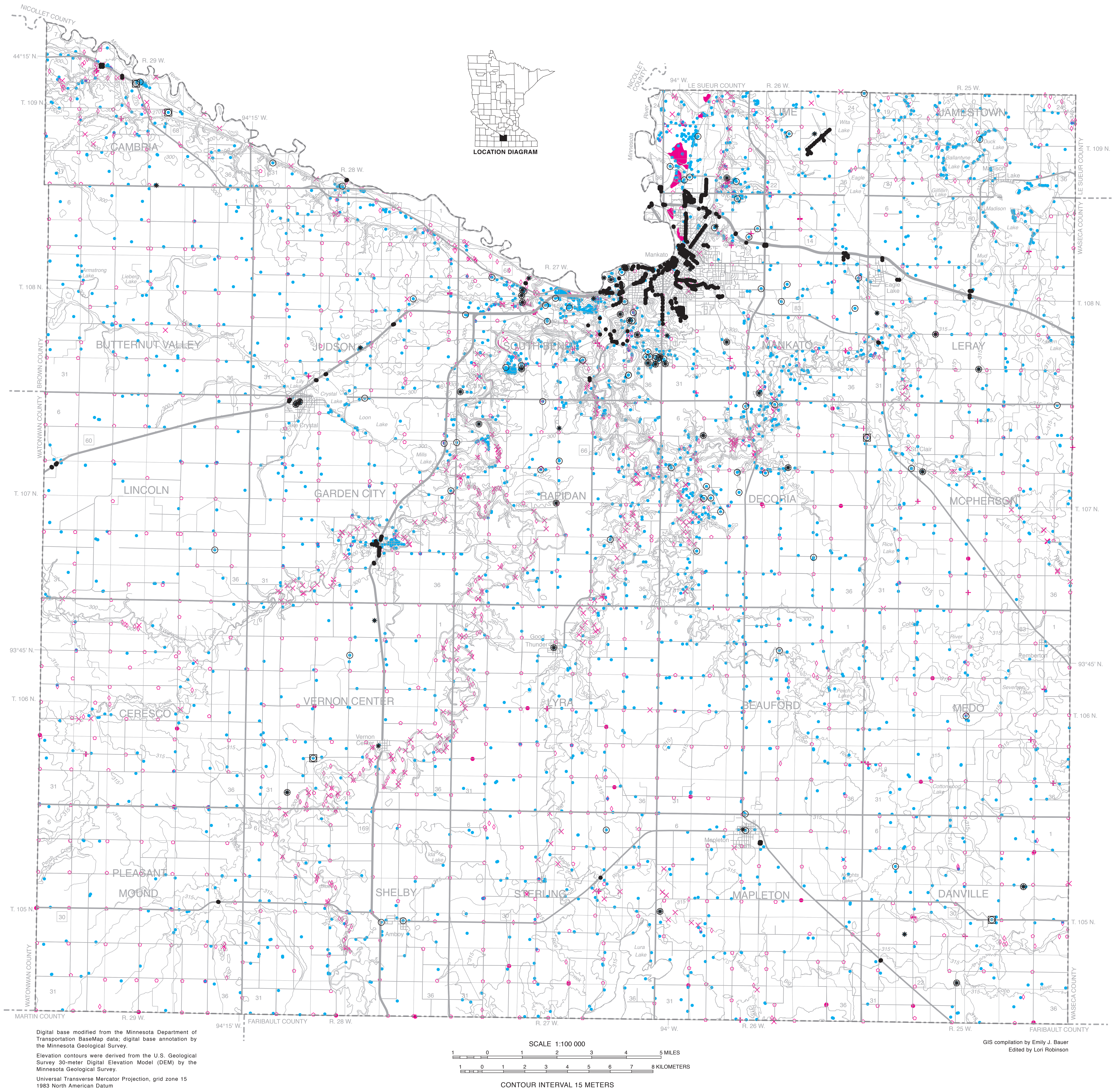
DATA-BASE MAP

By
Emily J. Bauer
2012



Digital base modified from the Minnesota Department of Transportation BaseMap data; digital base annotation by the Minnesota Geological Survey.

Elevation contours were derived from the U.S. Geological Survey 30-meter Digital Elevation Model (DEM) by the Minnesota Geological Survey.

Universal Transverse Mercator Projection, grid zone 15
1983 North American Datum

SCALE 1:100 000

CONTOUR INTERVAL 15 METERS

GIS compilation by Emily J. Bauer
Edited by Lori Robinson

THE DATA-BASE MAP

The types, locations, and density of information used to prepare the Blue Earth County atlas are shown on this map. The data are described below to aid the user in assessing what types may be useful for a particular information need. The Data-Base Map serves as a guide to the precision of the other maps in the atlas. It shows where data are sparse or lacking and interpretation and extrapolation were required to prepare the maps. All data were collected by Minnesota Geological Survey staff unless otherwise specified.

DRILL-HOLE INFORMATION

A **record of water-well construction (well driller's log)** is a water-well contractor's description of the geologic materials penetrated during drilling and the construction materials used to complete the well. Not all wells extend to bedrock. In areas of thick, unconsolidated Quaternary deposits, drillers commonly do not need to drill through the entire thickness of overburden to find sufficient ground water. Hydrologic data, such as the static water level and test-pumping results, are commonly included. Before any driller's log can be used, the location of the well must be verified, and a geologist must interpret the log. Driller's logs are the primary source of subsurface geologic and hydrologic data for Blue Earth County; about 2,775 logs were used for this atlas; they can be found in the County Well Index (CWI).

Cutting samples collected during drilling provide physical evidence of subsurface geologic materials. Cuttings are the samples generated as the drill bit cuts through the subsurface material and are used to interpret and verify driller's logs. They are logged and stored at the Minnesota Geological Survey.

Borehole geophysical logs are created by lowering instruments down a well or drill hole and measuring the physical and chemical properties of the geologic materials through which the hole passes. Different logging techniques measure naturally occurring gamma radiation, spontaneous potential, and resistivity. Gamma logs characterize in graphic form the geologic formations penetrated. Spontaneous potential and resistivity are mainly used to locate water levels in wells and the depth of the well casing. An interpretive log is prepared from the geophysical log and correlated with drilling samples from the same hole, information obtained from nearby outcrops, or a geophysical log from a nearby drill hole. Geophysical logs can provide high-quality subsurface geologic and hydrologic information for wells that have little or no other information available. The information obtained from a geophysical log is added to the County Well Index (CWI) and the paper log is on file at the Minnesota Geological Survey.

Soil borings are test holes drilled to obtain information about the physical properties of subsurface materials for engineering, mapping, or exploration purposes. Most terminate at very shallow depths or where bedrock is encountered They are logged by an engineer or a geologist using a variety of classification schemes based on particle sizes, penetration rate, moisture content, and color. Soil-boring data were collected from the Minnesota Department of Transportation, the U.S. Army Corps of Engineers, and the City of Mankato. They are limited in distribution; in Blue Earth County they are concentrated in the City of Mankato and along the U.S. Highway 169 and Minnesota Highway 60 corridors. These data are most useful in determining the composition of unconsolidated deposits. The geologic materials penetrated are entered into the Quaternary Samples Data Base (QBASE); all other information collected is contained in paper files.

Rotary-sonic cores were collected at five sites in Blue Earth County as a means to help establish the nature of the subsurface material. The coring technique enables recovery of a continuous core, 3.5 inches (8.9 centimeters) in diameter, from glacial deposits and bedrock (if intersected). It provides excellent subsurface samples for detailed study and comparison with cuttings, geophysical logs, and driller's logs from surrounding sites. A detailed geologist's log is entered into the County Well Index (CWI) and any sampling results are entered into the Quaternary Samples Data Base (QBASE). The core is available for inspection at the Minnesota Department of Natural Resources, Division of Lands and Minerals offices.

OTHER INFORMATION

Giddings probe holes are continuous cores of glacial materials, 2 inches (5.1 centimeters) in diameter, collected by a truck-mounted hydraulic auger. A description was generated at every site and almost always a sample or samples were taken for textural analyses. Samples were generally taken about every 5 feet (1.5 meters), at unit contacts, or where the geologist believed it was important.

Field sites are natural and artificial exposures of unconsolidated Quaternary deposits that were described in detail; some sites were texturally analyzed. Sites include gravel pits, road cuts, and stream or river cuts.

Textural analyses express the proportion of sand-, silt-, and clay-size particles that make up a sample. They are helpful in identifying and mapping unconsolidated materials like Quaternary glacial deposits. The samples analyzed were taken from natural and artificial exposures, Giddings holes, and the rotary-sonic cores.

Soil auger holes are shallow borings collected with a hand auger to generate a description of the subsurface material. They are generally less than 5 feet (1.5 meters) in depth.

Gravity data in Blue Earth County were primarily used to help map structures within the Precambrian bedrock. Although Precambrian rocks do not subcrop in Blue Earth County, they may still be pertinent to mapping the overlying Paleozoic bedrock. This is because some structures that are observed in the Paleozoic bedrock are related to minor re-activation of Precambrian structures.

Minnesota Department of Natural Resources sites are the locations of field observations made by Minnesota Department of Natural Resources staff that were used for mapping the aggregate resources of Blue Earth County. The data and maps are available from the Minnesota Department of Natural Resources, Division of Land Minerals Aggregate Resource Mapping webpage (http://www.dnr.state.mn.us/lands_minerals/aggregate_maps/index.html).

Bedrock outcrops are exposures of rock at the land surface. Most are natural outcrop; however, some are exposures created during construction. They serve as reference points for mapping and for checking the accuracy of subsurface data. Bedrock at or near the surface must be considered in land-use planning decisions such as pipeline routing, sewage-system design, and excavation.

INTRODUCTION

The public health and economic development of Blue Earth County are directly dependent on the wise use and management of its land and water resources. Geologic and hydrologic information are essential before decisions are made that affect natural resources. Although the amount of geologic information required for making specific decisions can vary, the information will not be used if it is unavailable when needed, or if it is available only in a highly technical form, or scattered in many different maps and reports.

County atlases, prepared jointly by the Minnesota Geological Survey and the Minnesota Department of Natural Resources, Division of Waters, present detailed geologic and hydrologic information in an interpretive as well as descriptive form. Maps and texts either summarize basic geologic and hydrologic conditions at a county scale, or interpret these conditions in terms of the impacts of possible land- and water-use decisions. Site-specific information is also available at a greater level of technical detail than shown on the maps of this atlas. The data are too voluminous to present in the atlas, but have been incorporated into readily accessible files housed at the Minnesota Geological Survey.

Several sources commonly provide information about an area or an individual property, but they may use different classification schemes to describe the same geologic materials. As a result, discrepancies in interpreting the data may arise or the different sources may appear to contradict each other. For example, water-well drillers may describe glacial till as "clay," but engineering records will describe it as "clayey sand." Both descriptions are acceptable for their original purpose of describing the physical attributes of the material. "Clay," the term used by well drillers, defines the general inability of the till to yield ground water to a well. "Clayey sand," the term from the engineering record, defines the physical composition of the till relative to particle size and engineering properties. The geologist must take the analysis one step further and define the material in terms of how it formed rather than how it is to be used. In this example, till consists of an unsorted mixture of rock fragments ranging in size from clay to cobbles and boulders, and it is interpreted by the geologist as having been deposited directly by glacial ice.

All of the types of data described on this plate had to be interpreted by geologists or hydrogeologists before they were meaningful for mapping purposes. The 1:100,000 scale of the maps in this atlas was chosen because it can show the geologic and topical studies of the county while keeping the physical size of each plate to a manageable level. As a result, some detailed information that was gained by data interpretation and mapping cannot be shown on these maps or discussed in the texts.

Whether to use the atlas alone, or in combination with the data bases, depends on the amount of detail needed. Generally, data-base information must be used to evaluate site-specific conditions.

DATA-BASE MANAGEMENT

All of the data shown on the maps were plotted on 7.5-minute topographic quadrangle maps or highway alignment maps and assigned inventory numbers. Automated data bases and a few manual files were developed to provide easy access and rapid retrieval of these site-specific data. The data may be obtained from the Minnesota Geological Survey.

Computer storage and retrieval systems are better than manual files for manipulating large amounts of data because automated geologic data bases can be designed to interact with other computer files, such as land-use data. Such interaction permits more efficient assessment of cause-and-effect relationships concerning natural resources than is commonly possible with manual files.

BLUE EARTH COUNTY DATA BASES

Computerized files were developed for point-source data such as wells and borings in Blue Earth County. They use Public Land Survey descriptions, Universal Transverse Mercator (UTM), and latitude-longitude coordinates as location criteria; thus, they are compatible with the natural-resource data bases housed at the Minnesota Land Management Information Center (LMIC). The computerized data bases developed for Blue Earth County by the Minnesota Geological Survey are County Well Index (CWI) and Quaternary Samples Data Base (QBASE).

County Well Index (CWI)—Information from water-well records and exploration holes is entered into this statewide data base. Each well log is assigned a six-digit unique number and each exploration drill hole is assigned either a five- or six-digit unique number. These reference numbers are also used by state agencies and the Water Resources Division of the U.S. Geological Survey. Elevations, expressed in feet above sea level, were determined from topographic maps (see the index to 7.5-minute quadrangles) and are generally accurate to plus or minus five feet. The street address of each well is also included wherever possible to provide data users with a well-location system that is compatible with local regulatory programs. Software at the Minnesota Geological Survey is used to display and tabulate many of the data elements contained on the original well log.

The County Well Index is currently stored in a data base that consists of nine related tables. These tables contain information such as well depths, well construction, addresses, aquifers, dates drilled, static water levels, and pumping test data. They also contain alternate well identifiers such as permit numbers or emergency-service numbers, and the well stratigraphy (the geologic materials encountered during drilling).

CWI application software developed by the Minnesota Department of Health provides two types of reports:

- WELL LOG contains all the information about the well as it was reported by the contractor (Fig. 1). There may also be additional location information, land-surface elevation, aquifer designation, and remarks about the drill holes.
- WELL STRATIGRAPHY contains the geologic log with a geologist's stratigraphic interpretations, which are based on her or his knowledge and understanding of the geology of Blue Earth County (Fig. 2). Only those drill holes with verified locations have stratigraphy assigned to them.

Quaternary Samples Data Base (QBASE)—Information from Quaternary samples collected and analyzed is entered into this data base. QBASE contains locations, the name of the sample collector, elevations, depths from where the samples were collected, proportions of sand, silt, and clay, and proportions of crystalline, carbonate, and shale. Information pertaining to borings obtained from the Minnesota Department of Transportation, the U.S. Army Corps of Engineers, and the City of Mankato also can be found in this database.

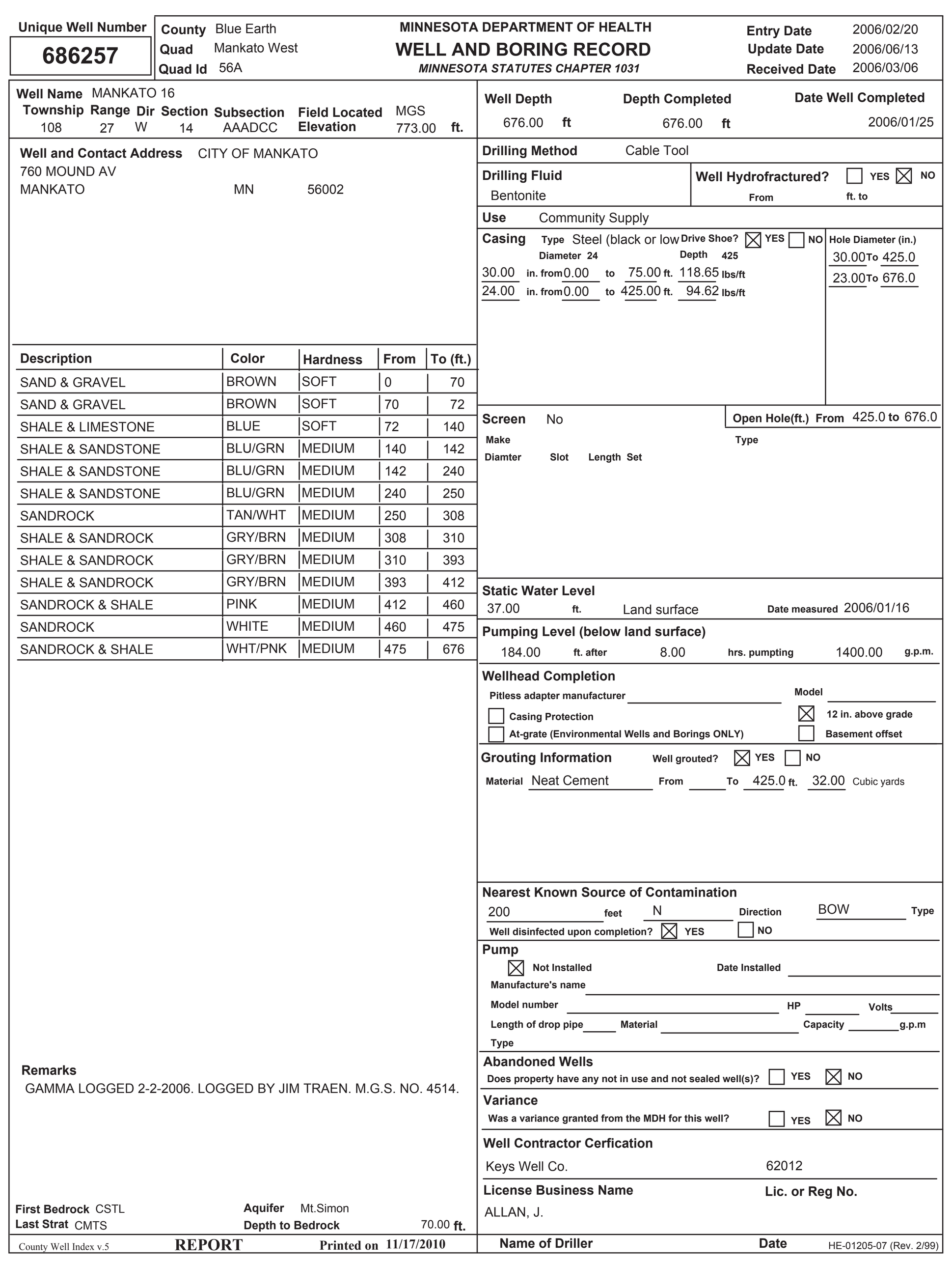
FUTURE DATA COLLECTION

A data-base map is out of date even before it is printed because additional information is continually generated as new water wells are drilled, construction activities expose more bedrock, or additional wells are tested for water quality. The library of geologic information prepared for Blue Earth County is flexible so that old data can be reevaluated in light of new information, and new forms of data can be added if required. The need to manage ground water and other natural resources wisely will never become outdated. Future demands on these resources will require current data to assess the impacts.

MAP SYMBOLS

- Record of water-well construction (well driller's log)
- Cutting sample
- Borehole geophysical log
- Soil boring
- Rotary-sonic core sample
- Giddings probe hole
- Field site
- Soil auger boring
- Gravity reading
- Minnesota Department of Natural Resources site
- Bedrock outcrop

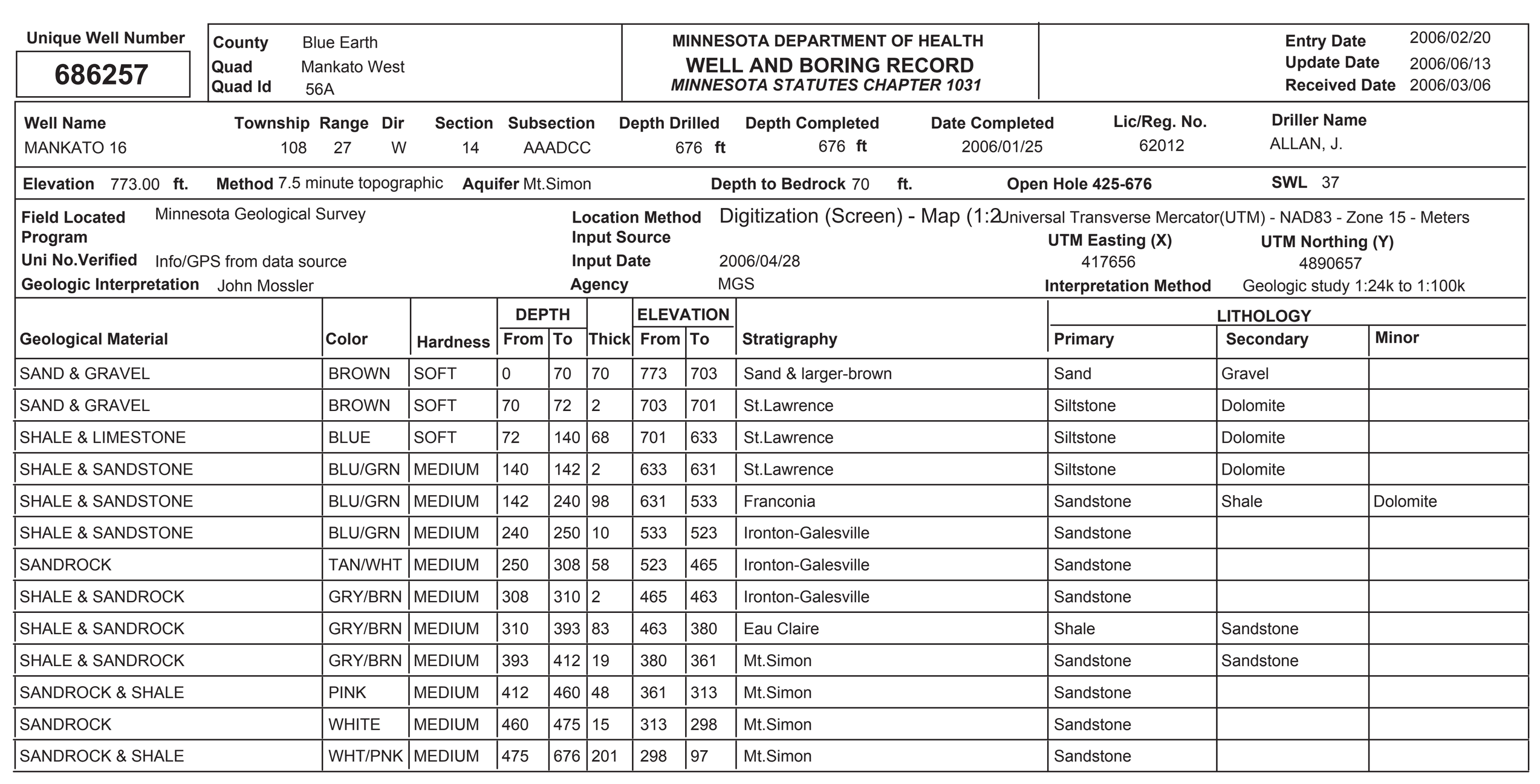
Note: More than one symbol can occur at the same location


Unique Well Number 686257
County Blue Earth
Quad Mankato West
Quad Id 56A
MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
MINNESOTA STATUTES CHAPTER 1031
Entry Date 2006/02/20
Update Date 2006/06/13
Received Date 2006/03/06
Well Name MANKATO 16
Township 108 Range 27 Dir W Section 14 Subsection AAADCC Field Located MGS Elevation 773.00 ft.
Well Depth 676.00 ft Depth Completed 676.00 ft Date Well Completed 2006/01/25
Well and Contact Address CITY OF MANKATO
760 MOUND AV
MANKATO MN 56002
Drilling Method Cable Tool
Drilling Fluid Bentonite
Well Hydrofractured? YES ☐ NO ☒ From ft. to
Use Community Supply
Casing Type Steel (black or low Drive Shoe? YES ☒ NO ☐ Hole Diameter (in.)
Diameter 24 Depth 425
30.00 in. from 0.00 to 75.00 ft. 118.65 lbs/ft
24.00 in. from 0.00 to 425.00 ft. 94.62 lbs/ft
30.00 To 425.0
23.00 To 676.0

Description	Color	Hardness	From	To (ft.)
SAND & GRAVEL	BROWN	SOFT	0	70
SAND & GRAVEL	BROWN	SOFT	70	72
SHALE & LIMESTONE	BLUE	SOFT	72	140
SHALE & SANDSTONE	BLU/GRN	MEDIUM	140	142
SHALE & SANDSTONE	BLU/GRN	MEDIUM	142	240
SHALE & SANDSTONE	BLU/GRN	MEDIUM	240	250
SANDROCK	TAN/WHT	MEDIUM	250	308
SHALE & SANDROCK	GRY/BRN	MEDIUM	308	310
SHALE & SANDROCK	GRY/BRN	MEDIUM	310	393
SHALE & SANDROCK	GRY/BRN	MEDIUM	393	412
SANDROCK & SHALE	PINK	MEDIUM	412	460
SANDROCK	WHITE	MEDIUM	460	475
SANDROCK & SHALE	WHT/PNK	MEDIUM	475	676

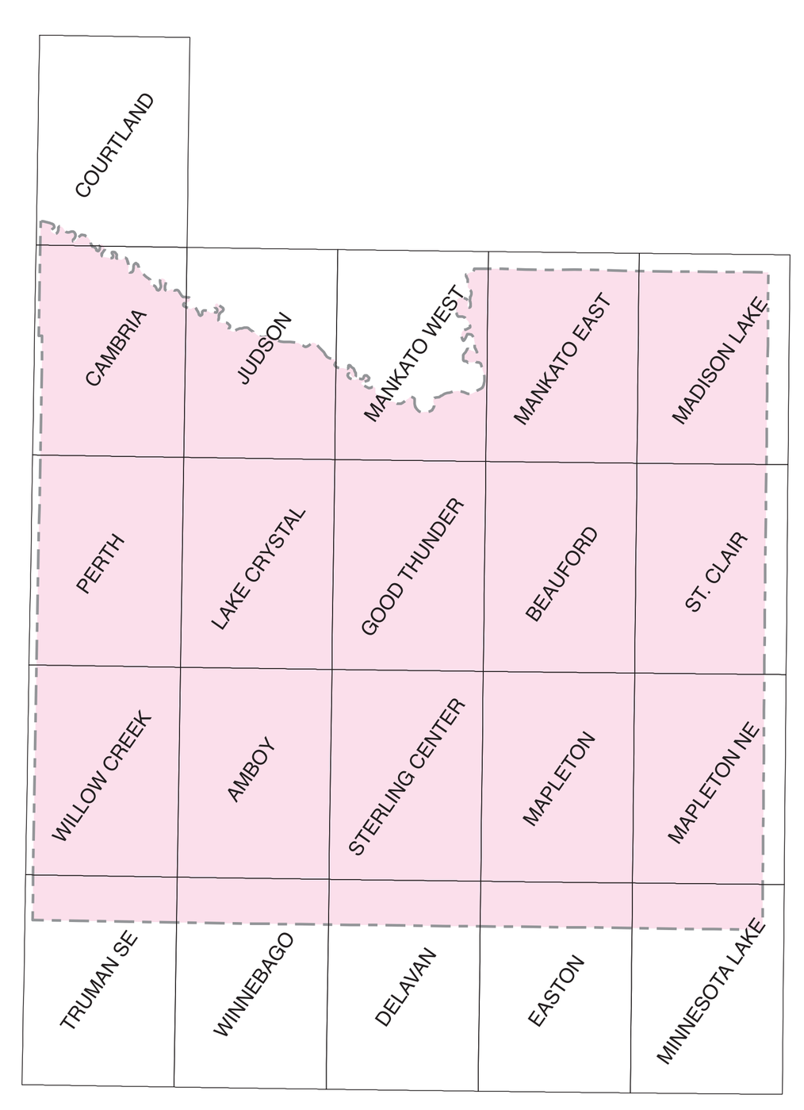
Screen No
Make Type
Diamter Slot Length Set
Open Hole(ft.) From 425.0 to 676.0
Static Water Level
37.00 ft. Land surface Date measured 2006/01/16
Pumping Level (below land surface)
184.00 ft. after 8.00 hrs. pumping 1400.00 g.p.m.
Wellhead Completion
Pitless adapter manufacturer Model
☐ Casing Protection ☒ 12 in. above grade
☐ At-grate (Environmental Wells and Borings ONLY) ☐ Basement offset
Grouting Information Well grouted? ☒ YES ☐ NO
Material Neat Cement From To 425.0 ft. 32.00 Cubic yards
Nearest Known Source of Contamination
200 feet N Direction BOW Type
Well disinfected upon completion? ☒ YES ☐ NO
Pump
☒ Not Installed Date Installed
Manufacture's name
Model number HP Volts
Length of drop pipe Material Capacity g.p.m
Type
Abandoned Wells
Does property have any not in use and not sealed well(s)? ☐ YES ☒ NO
Variance
Was a variance granted from the MDH for this well? ☐ YES ☒ NO
Well Contractor Cerfication
Keys Well Co. 62012
License Business Name Lic. or Reg No.
ALLAN, J.
Name of Driller Date
Remarks
GAMMA LOGGED 2-2-2006. LOGGED BY JIM TRAEN. M.G.S. NO. 4514.
First Bedrock CSTL Aquifer Mt.Simon
Last Strat CMTS Depth to Bedrock 70.00 ft.
County Well Index v.5 REPORT Printed on 11/17/2010
HE-01205-07 (Rev. 2/99)

Figure 1. An example of a WELL LOG record, showing all the information about the well as reported by the well driller.


Unique Well Number 686257
County Blue Earth
Quad Mankato West
Quad Id 56A
MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
MINNESOTA STATUTES CHAPTER 1031
Entry Date 2006/02/20
Update Date 2006/06/13
Received Date 2006/03/06
Well Name MANKATO 16
Township 108 Range 27 Dir W Section 14 Subsection AAADCC Depth Drilled 676 ft Depth Completed 676 ft Date Completed 2006/01/25 Lic/Reg. No. 62012 Driller Name ALLAN, J.
Elevation 773.00 ft. Method 7.5 minute topographic Aquifer Mt.Simon Depth to Bedrock 70 ft. Open Hole 425-676 SWL 37
Field Located Program Minnesota Geological Survey
Uni No.Verified Info/GPS from data source
Geologic Interpretation John Mossler
Location Method Digitization (Screen) - Map (1:2
Input Source
Input Date 2006/04/28
Agency MGS
Universal Transverse Mercator(UTM) - NAD83 - Zone 15 - Meters
UTM Easting (X) 417656
UTM Northing (Y) 4890657
Interpretation Method Geologic study 1:24k to 1:100k

Geological Material	Color	Hardness	DEPTH From	DEPTH To	Thick	ELEVATION From	ELEVATION To	Stratigraphy	LITHOLOGY Primary	LITHOLOGY Secondary	LITHOLOGY Minor
SAND & GRAVEL	BROWN	SOFT	0	70	70	773	703	Sand & larger-brown	Sand	Gravel	
SAND & GRAVEL	BROWN	SOFT	70	72	2	703	701	St.Lawrence	Siltstone	Dolomite	
SHALE & LIMESTONE	BLUE	SOFT	72	140	68	701	633	St.Lawrence	Siltstone	Dolomite	
SHALE & SANDSTONE	BLU/GRN	MEDIUM	140	142	2	633	631	St.Lawrence	Siltstone	Dolomite	
SHALE & SANDSTONE	BLU/GRN	MEDIUM	142	240	98	631	533	Franconia	Sandstone	Shale	Dolomite
SHALE & SANDSTONE	BLU/GRN	MEDIUM	240	250	10	533	523	Ironton-Galesville	Sandstone		
SANDROCK	TAN/WHT	MEDIUM	250	308	58	523	465	Ironton-Galesville	Sandstone		
SHALE & SANDROCK	GRY/BRN	MEDIUM	308	310	2	465	463	Ironton-Galesville	Sandstone		
SHALE & SANDROCK	GRY/BRN	MEDIUM	310	393	83	463	380	Eau Claire	Shale	Sandstone	
SHALE & SANDROCK	GRY/BRN	MEDIUM	393	412	19	380	361	Mt.Simon	Sandstone	Sandstone	
SANDROCK & SHALE	PINK	MEDIUM	412	460	48	361	313	Mt.Simon	Sandstone		
SANDROCK	WHITE	MEDIUM	460	475	15	313	298	Mt.Simon	Sandstone		
SANDROCK & SHALE	WHT/PNK	MEDIUM	475	676	201	298	97	Mt.Simon	Sandstone		

Figure 2. Example of a WELL STRATIGRAPHY record, which contains a geologist's interpretation of the geologic materials listed by the driller in the WELL LOG record (Fig. 1).



INDEX TO 7.5-MINUTE QUADRANGLES