UNIVERSITY OF MINNESOTA
MINNESOTA GEOLOGICAL SURVEY
D.L. Southwick, Director

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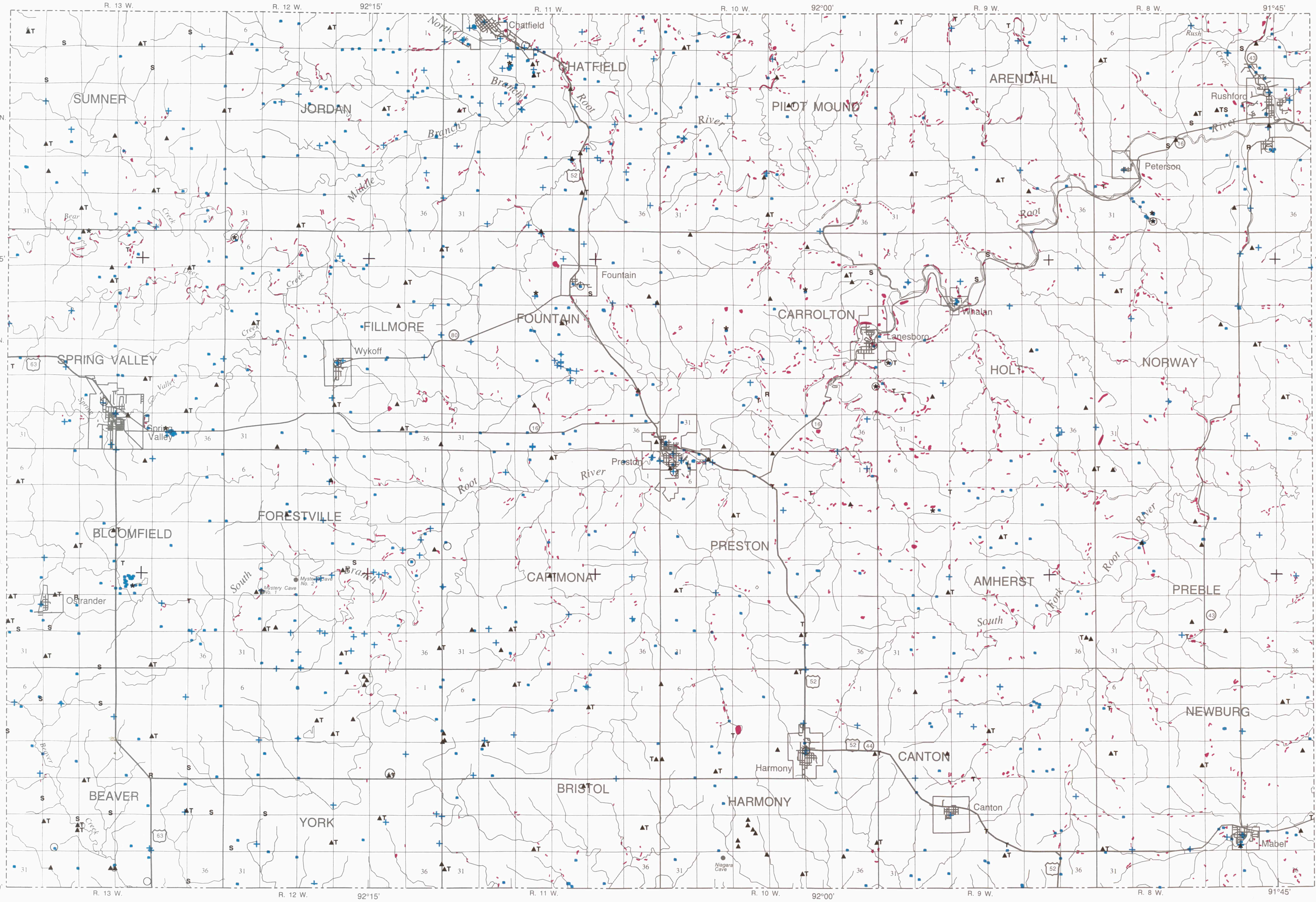
COUNTY ATLAS SERIES
ATLAS C-8, PART A
Plate 1—Data Base



Digital base modified from 1990 Census TIGER/Line Files of U.S. Bureau of the Census (source scale,1:100,000); digital base annotation by Minnesota Geological Survey

Universal Transverse Mercator Projection, grid zone 15
1927 North American Datum

SCALE 1:100 000

1 0 1 2 3 4 5 6 7 8 9 10 KILOMETERS

1 0 1 2 3 4 5 MILES

Map compiled Dec. 31, 1994

Cartography by Philip Heywood

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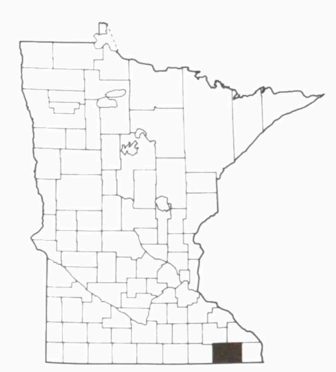

LOCATION DIAGRAM

Every reasonable effort has been made to ensure the accuracy of the factual data on which this map interpretation is based; however, the Minnesota Geological Survey does not warrant or guarantee that there are no errors. Users may wish to verify critical information; sources include both the references listed here and information on file at the offices of the Minnesota Geological Survey in St. Paul. In addition, effort has been made to ensure that the interpretation conforms to sound geologic and cartographic principles. No claim is made that the interpretation shown is rigorously correct, however, and it should not be used to guide engineering-scale decisions without site-specific verification.

DATA-BASE MAP

By

Jane M. Cleland and Robert G. Tipping

1995

MAP SYMBOLS

[Symbols for a single location may be combined or paired]

- ▪ Record of water-well construction (well driller's log)
- ○ Cutting sample
- ★ Borehole geophysical log
- T Texture analysis
- Bedrock exposure
- S Seismic sounding
- + Water-quality data
- ▲ Soil boring (Giddings probe or auger split spoon)—In places a single symbol represents several closely spaced borings
- R Soil boring (Rotasonic drill core)—The symbol also indicates geophysical log and textural analysis

INTRODUCTION

The public health and economic development of Fillmore County are directly dependent upon the wise use and management of its land and water resources. Geologic and hydrologic information is 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 at all if it is not available when it is needed, or if it is available only in a highly technical form or scattered in many different maps and reports.

County atlases 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. Digital versions of the maps are available for integration with other digital map products. Site-specific information also is available at a greater level of technical detail than shown on the maps. These 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. 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.

Whether to use the atlas alone, or to use data bases such as CWI, CWI/WL and CWI/WC, depends on the amount of detail needed. Generally, information in the data bases must be used to evaluate site-specific conditions, and test drilling may be necessary. The data bases and GIS products for Fillmore County are available on magnetic media.

THE DATA-BASE MAP

The types and locations of most of the information used to prepare this atlas are shown on the map, which was compiled at the end of 1994. The data are described below to aid the user in assessing which types of information may be useful for a particular need. The data-base map shows where data are sparse or lacking, and interpretation and extrapolation were required to prepare a map. Therefore, the data-base map is a guide to the precision of the other maps in the atlas.

Drill-Hole Information

A **record of water-well construction,** or well driller's log, is a water-well contractor's description of the geologic formations penetrated during drilling and the construction materials used to complete the well. 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. Drillers' logs are the primary source of subsurface geologic and hydrologic data for the county; about 2084 logs were reviewed during preparation of this atlas.

Cutting samples collected during drilling provide physical evidence of subsurface geologic materials and are the principal means of establishing the nature of the glacial materials and bedrock. They are collected at set depth intervals (usually every 5 feet) during drilling from wells selected by the Minnesota Geological Survey on the basis of the need for additional data.

Borehole geophysical logs are made by lowering instruments down the well or drill hole and measuring the physical and chemical properties of the geologic materials that the hole penetrates. 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 used mainly 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 another nearby geophysical log. Each bedrock formation has a characteristic geophysical "signature" that facilitates these correlations. Geophysical logs provide high-quality subsurface geologic and hydrologic information from wells for which little or no other information is available.

Soil borings are 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 a geologist or an engineer using a variety of classification schemes based on particle size, penetration rate, moisture content, and color. Soil borings data are most useful in determining the composition of unconsolidated deposits. Some logs include the depth to bedrock and the lithology of the first bedrock encountered. Soil borings were completed using a variety of tools, including Giddings probe, auger-split spoon, and Rotasonic drill. The borings were obtained from several sources in addition to the Minnesota Geological Survey, including the Soil Conservation Service of the U.S. Department of Agriculture, the Minnesota Department of Transportation (bridge borings), and a master's thesis*.

Other Information

Bedrock outcrops are exposures of solid rock at the land surface. Most are natural outcrop; however, some are exposures created during construction. Outcrops are abundant in Fillmore County, except in the southwest. 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 excavations.

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, such as glacial deposits. The samples analyzed were taken from selected areas where other data were sparse or lacking.

Seismic soundings are a geophysical method that measures the time required for sound or pressure waves to travel from a source to a receiver. The density and rigidity of the material through which the waves must travel affects their travel time. Bedrock such as limestone or dolomite exhibits acoustic- or pressure-wave velocities three to four times those of much less dense sandstone and unconsolidated deposits. The spacing of the receivers (geophones) and the arrival times (measured in milliseconds) are used to calculate the depth to bedrock and the water level in Quaternary aquifers. Seismic soundings are labor intensive but can provide high-quality data when no other sources of subsurface information are available.

Water-quality data consist of information on bacteria and nitrates and were obtained from records at the Fillmore County Public Health Department, Olmsted County Health Department, the Minnesota departments of agriculture and health and some municipalities within the county. The data are incorporated in the CWI data base to pair water-quality values with information on aquifers and well construction. Only water-quality data matched with a well log were plotted on the map.

* Mason, J.A., 1992, Loess distribution and soil landscape evolution, southeastern Minnesota: Minneapolis, University of Minnesota M.S. thesis, 2 vols.

```
*****************************************************************
MINNESOTA COUNTY WELL INDEX

UN.NO./CO.  : 226624/23                         ENTERED: 1991/12/20
NAME        : OSTRANDER 1                       UPDATED: 1993/08/25

  COUNTY    : FILLMORE          USE   : MUNICIPAL  DRILLED: 1947/03/00
  T/R/SEC.  : 102/13/30ADAADA   DEPTH : 250 FT.    DEPTH D:  250 FT
  ELEVATION: 1343 FT.(TOPO)     CASED : 78 FT.     GROUT   :
  DIAM.     : 8 IN.             DRL/DS : 62012   :KEYS WELL CO.
  LOC.METH. : INFO.OWNER        LOC.BY : MGS       COORDS.:
  STATUS    : ACTIVE            WHPA   :           DNR PA#: 86-5072

  DPTH BDRK: 6 FT.              BEDROCK: CRETACEOUS, UNDIFF.
  OPEN HOLE: SPILLVILLE-MAQUOKETA-GALENA
  AQUIFER  : MULTIPLE

  ADDRESS   : OSTRANDER, MN
  QUAD(7.5): OSTRANDER                     CONTACT:
  CWI/WL: YES    CWI/WC: YES    CORE/CTTNGS/GP.:

    DATE       NITRATE  BACTERIA  SOURCE        SWL    ELEV   SOURCE
 ----------    -------  --------  ------        ---    ----   ------
 1947/03/00                                      55    1288   62012
*****************************************************************
```

FIGURE 1. ***Example of output from CWI.***

```
*****************************************************************
MINNESOTA COUNTY WELL INDEX/WELL LOG.
UN.NO./CO. : 226624/23           NAME    : OSTRANDER 1

   COUNTY     : FILLMORE         QUAD    : OSTRANDER
   T/R/SEC. : 102/13/30ADAADA    ELEV    : 1343 FT     DEPTH D:  250 FT
   BDRK ELEV: 1337 FT.           BEDROCK: CRETACEOUS,UNDIFF.
   OPEN INT.: SPILLVILLE-MAQUOKETA-GALENA
   AQUIFER    : MULTIPLE
   GEO.INTRP: MGS                GEOLGST: JM    METHOD : GEO.STUDY<1:100K
---------------------------------------------------------------------
  WELL CONSTRUCTION.
   DRILLER'S NAME: LEDBETTER          DRV.SH.:
   DRILLNG METHOD: CABLE TOOL         FLUID   :
   CASNG MATERIAL: STEEL              JOINTNG:               TOP:        FT
                                                  [GROUT------------------]
                 DIAM(IN)  FROM(FT)   TO(FT)      MATERIAL      AMNT   UNITS
                 --------  --------   ------      --------      ----   -----
   CASING 1   :     8         0         78

  SCREEN.
   PRESENT?: NO         OPEN HOLE FROM:   78 FT    TO:  250FT

  PUMP   : DATA UNAVAILABLE
---------------------------------------------------------------------
  PUMPAGE TEST(S)
   STATIC WATER LEVEL:      55 FT          DATE: 1947/03/00
              LEVEL(FT)   HOURS     GPM    DRAWDOWN(FT)
              ---------   -----     ---    ------------
   TEST 1:       57         3       284        2.0
---------------------------------------------------------------------

                         DRILLER'S/GEOLOGIC LOG
---------------------------------------------------------------------
 DEPTH
INTERVAL  DRILLER'S DESCRIPTION                  COLOR     HARDNESS
[EL. TOP] [INTERPRETED LITHOLOGY      ][CODE][STRATIGRAPHIC UNIT(S)  ]  [AGE]
---------                                                               -----
   0    6 SANDY LOAM
[   1343] [LOAM, SAND, ORGANIC DEPOSI][QLUU][CLAY+SAND              ]  [QUA]
   6   10 COARSE SAND                        WHITE
[   1337] [SAND                       ][QFUU][SAND                   ]  [QUA]
  10   64 CLAY SAND GRAVEL                   RUSTY
[   1333] [SANDSTONE, CONGLOMERATE    ][KWND][WINDROW                ]  [CRE]
  64   76 LIMEROCK                                     SOFT
[   1279] [DOLOMITE                   ][DSPL][SPILLVILLE             ]  [DEV]
  76  115 LIMEROCK                                     HARD
[   1267] [DOLOMITE                   ][DSOM][SPILLVILLE-MAQUOKETA   ]  [DEV]
 115  143 SAND & SANDROCK & LIMEROCK STREAK S
[   1228] [DOLOMITE, LIMESTONE, SHALE][OMAQ][MAQUOKETA              ]  [ORD]
 143  169 ROCK                               BLUE
[   1200] [LIMESTONE, DOLOMITE        ][ODGL][DUBUQUE-GALENA         ]  [ORD]
 169  225 ROCK & SHALE                       BLUE
[   1174] [LIMESTONE, SHALE           ][OGAL][GALENA                 ]  [ORD]
 225  250 SHAKOPEE DOLOMITE
[   1118] [LIMESTONE                  ][OGAL][GALENA                 ]  [ORD]
---------------------------------------------------------------------
*****************************************************************
```

FIGURE 2. ***Example of output from CWI/WL (County Well Index/Well Log).***

```
*****************************************************************
MINNESOTA COUNTY WELL INDEX/WATER CHEMISTRY
UN.NO./CO.   : 226624/23                        UPDATED: 1993/08/25

   NAME      : OSTRANDER 1
   COUNTY    : FILLMORE          QUAD   : OSTRANDER
   T/R/SEC.  : 102/13/30ADAADA   ELEV   : 1343 FT.     DEPTH D:  250 FT.
   OPEN INT. : SPILLVILLE-MAQUOKETA-GALENA
   AQUIFER   : MULTIPLE
-----------------------------------------------------------------
 UN.NO./CO.: 226624/23           SAMPLE NO.:    4

   SAMP.DATE: 1982/06/01         SAMPLED BY: MDH
   SAMP.DPTH:                    SAMP.PROG:
   SAMPLE ID:
   LAB.CODE :                    LAB.REF.#:

   SWL  :       70 FT    TEMP(C):         PH:    6.9    COLOR:
   DIS.OX(MG/L):              SP.COND.:           UMHOS/CM
   ALKALINITY(TOT.AS CACO3):       180 MG/L

   PARAMETER                  VALUE UNITS Q*1 T*2  CODE
   ----------------------     ------ ----- --- ---  -----
   HARDNESS(AS CACO3)-T         240 MG/L            00900
   ALKALINITY(AS CACO3)-T       180 MG/L            00410
   CALCIUM-T                    140 MG/L            00916
   MAGNESIUM-T                  100 MG/L            00927
   FLUORIDE-T                  <0.1 MG/L            00951
   NITRATE(AS NO3)-T            9.9 MG/L            71850
   IRON-T                      0.05 UG/L            01045
   MANGANESE-T                <0.02 UG/L            01055
   CHLORIDE(AS CL)               21 MG/L            00940
   SULFATE(AS SO4)-T             25 MG/L            00945
-----------------------------------------------------------------
*****************************************************************
```

FIGURE 3. ***Example of output from CWI/WC (County Well Index/Water Chemistry).***

```
*******************************************************************
MINNESOTA GEOLOGICAL SURVEY
FILLMORE COUNTY TESTHOLE DATA BASE.

  UNIQUE NO.     : 004110              UTM EASTING   : 589124
  COUNTY         : FILLMORE            UTM NORTHING  : 4842080
  DATA SOURCE    : MHD                 UTM ZONE      : 15
  PROJECT NO.    : 2304-1              LATITUDE      : 43:43:42 N
  BRIDGE NO.     :                     LONGITUDE     : 91:53:36 W

  DATE BORED     : 64/10/15            WATER LEVEL   : 16 FT
  ELEVATION      :                     DRY HOLE      :
  DEPTH          : 63.0                HAMMER        :
  TWP/RNG/SECT   : 103/09/03           SOIL CLASS.   : M
  SUBSEC         :
-------------------------------------------------------------------
DEPTH                 BORING LOG                      TESTS
INTERVAL ----------------------------------------------------------
(IN FEET)       LITHOLOGY         STRATIGRAPHY    MS C CR MC  DRILLER'S DESCRP.
-------------------------------------------------------------------
 0.0            LOAM              PLEISTOCENE     M           LOAM BROWN
 4.0            CLAY LOAM         PLEISTOCENE     M           CLAY LOAM DK. BRN
 5.0            LOAMY SAND/GRVL   PLEISTOCENE     D           LOAMY SAND & GRVL
 7.0            SAND              PLEISTOCENE     M           SAND DK. BROWN
11.0            SAND              PLEISTOCENE     M           SAND DK. BROWN
14.5            CLAY LOAM         PLEISTOCENE     M           CLAY LOAM GRAY
17.0            SAND              PLEISTOCENE     W           SAND BROWN
29.0            SAND              PLEISTOCENE     W           SAND BROWN
40.0            SAND              PLEISTOCENE     W           SAND BROWN
42.0            SAND              PLEISTOCENE     W           SAND BROWN
-------------------------------------------------------------------
 ABBREVIATED COLUMN HEADINGS (TESTS)   COLUMN VALUES

  MS=MOISTURE                          D=DRY,M=MOIST,W=WET
  C =CONE TEST                         A=0-4,B=5-9,C=10-15,D=16-30
  CR=CORE RECOVERED                    PER CENT RECOVERED X10
  MC=MOISTURE CONTENT                  PERCENT
```

FIGURE 4. ***Example of output from TESTHOLE (Test Borings Data Base).***

DATA-BASE MANAGEMENT

All of the data shown on the map were plotted on 7.5-minute topographic quadrangle maps, half-section maps, or highway alignment maps; inventory numbers were assigned to all except bedrock exposures and some soil borings. Manual files and automated data bases 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. Automated geologic data bases may 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.

Computerized data bases were developed for the major point-source data sets for Fillmore County. They use Public Land Survey descriptions, and/or Universal Transverse Mercator (UTM) coordinates as location criteria and are compatible with the natural-resource data bases housed at the Minnesota Land Management Information Center (LMIC). The automated data bases for Fillmore County are County Well Index (CWI) and Test Borings Data Base (TESTHOLE).

County Well Index

The County Well Index (CWI) is a PC-compatible data base of information related to water wells. Each well is assigned a six-digit unique number that is used to reference all data concerning the well. The unique number is used by local, state, and federal agencies, as well as drillers and consultants, to refer unambiguously to a specific well. The location of each well was digitized from topographic maps. Elevations, expressed in feet above sea level, of the land surface at well sites were also determined from these maps. These data are included with the well driller's log and any other available information in CWI. The street address of each well is also included to provide data users with a well-location system that is compatible with local programs. The CWI software, which runs on almost any IBM-compatible PC, provides easy access to the data through flexible, interactive browsing and report generation.

The County Well Index has three components: CWI, CWI/WL and CWI/WC. CWI contains basic data on the well, such as location, owner's name, depth, and date drilled, as well as aquifer usage and basic ground-water quality data, and serves as an index to data that are available in the other CWI components (Fig. 1). Most of the information in CWI comes from the well drillers' records. Some basic well data, however, originate from community testing programs and the Minnesota Department of Health data collections on ground-water quality (mostly nitrate measurements and coliform bacteria counts). These data, though very limited in subsurface information, are stored in CWI, as are historic static water-level measurements.

CWI/WL, or County Well Index/Well Log, contains well-construction information, such as casing, screen, and pump installation, pumpage test data, and the driller's log of subsurface materials. It also contains the geologic interpretation of the materials described in the drillers' logs (Fig. 2).

CWI/WC, or County Well Index/Water Chemistry, provides storage for the results of analyses of water samples from wells (Fig. 3). This component is intended for results from more detailed or rigorous sampling than the basic bacteria and nitrate data contained in the CWI component. Basic water-chemistry parameters recorded in CWI/WC include temperature, pH, conductivity, dissolved oxygen, alkalinity, major anions and cations, stable isotopes, and tritium. Additional parameters may be recorded as encountered. Most chemical data were obtained through the Department of Natural Resources, Division of Waters, as part of the hydrogeologic component of this atlas.

Test Borings Data Base (TESTHOLE)

Information from soil borings and engineering test holes is stored in the TESTHOLE data base (Fig. 4). Descriptions of the types of geologic materials penetrated and the soils classification system used are entered, together with specific field and laboratory tests. The most common tests are blow counts, liquid and plastic limits, water content, and dry density. The depth to the water table is entered if available. Each test hole receives a unique number, and the location is digitized from the site plan.

DIGITAL MAP DATA

Geographical Information System (GIS) technology played an important role in the development and production of this atlas. Point data from CWI and other sources were incorporated into the Minnesota Geological Survey GIS. Working data maps were produced as aids for geologic and hydrologic interpretation and mapping. The maps and cross sections compiled by the geologists were digitized into the GIS, which was then used to generate the map and cross section portions of the final printed plates. The coverages, or digital map layers, in the GIS are included as part of the atlas and may be obtained in digital form from the Minnesota Geological Survey. Details describing the GIS products are included with the digital media.

FUTURE DATA COLLECTION

The map on this plate was compiled at the end of 1994. 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 another well is tested for water quality. The library of geologic information prepared for Fillmore 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.

ACKNOWLEDGMENTS

Staff members of the Minnesota Geological Survey who contributed to the development of the data bases include Susan Benson, Richard Christopher, Bart Jensen, Amy Nuutinen, and Dean Schemenauer. We thank local water-well contractors and landowners for their valuable assistance.

GEOLOGIC ATLAS OF FILLMORE COUNTY, MINNESOTA

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