

SURFICIAL GEOLOGY OF THE WAVERLY (IOWA) 7.5' QUADRANGLE,
BREMER COUNTY IOWA

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ABSTRACT

The main reason for developing the surficial geologic map of the Waverly Quadrangle is to obtain geologic data that can be used for county-specific land use planning tools for the city of Waverly, IA, the Natural Resources Conservation Service (NRCS), and the local farmers. The geologic findings will also assist the development of groundwater permeability maps that will be used in the planning of potential sites for urban and agricultural developments. The city of Waverly and the surrounding Cedar Falls/Waterloo metro area need this data to improve their water resources management plans, wetland protection programs, aggregate resource management programs, and the pollution potential from Iowa's growing confined animal farming operations (CAFOs). Sufficient data for our local natural resources is scarce for the production and interpretation of county specific land use planning tools. UNI's EDMAP program collaborated with Federal (NRCS, EPA), State (Iowa Geological and Water Survey), and local (Waverly Public Works Department, landowners) to address the need for sufficient geologic mapping data.

INTRODUCTION

The purpose for developing the surficial geologic map of the Waverly Quadrangle is to obtain geologic data that can be used for county-specific land use planning tools for the city of Waverly, IA, the Natural Resources Conservation Service (NRCS), and the local farmers. The study area was located in northeastern Iowa, in Bremer County and Black Hawk counties (Fig. 1). The Waverly 7.5' Quadrangle covered an area from 42°37'30" N to 42°45' latitude and 92°30' W to 92° 22.5' longitude. The Waverly Quadrangle lies in a terrain of dissected Pre-Illinoian glacial deposits that blanket a bedrock surface with significant relief. The study area also represents a portion of the Iowan Erosion Surface and exhibits Wisconsinan and Holocene alluvial surfaces, eolian landforms, and discontinuous outcrops of Paleozoic bedrock. Geologic units within the project area include Devonian carbonate bedrock, Pre-Illinoian glacial sediment and alluvium, Wisconsin outwash, loess, Holocene alluvium, and eolian sand.

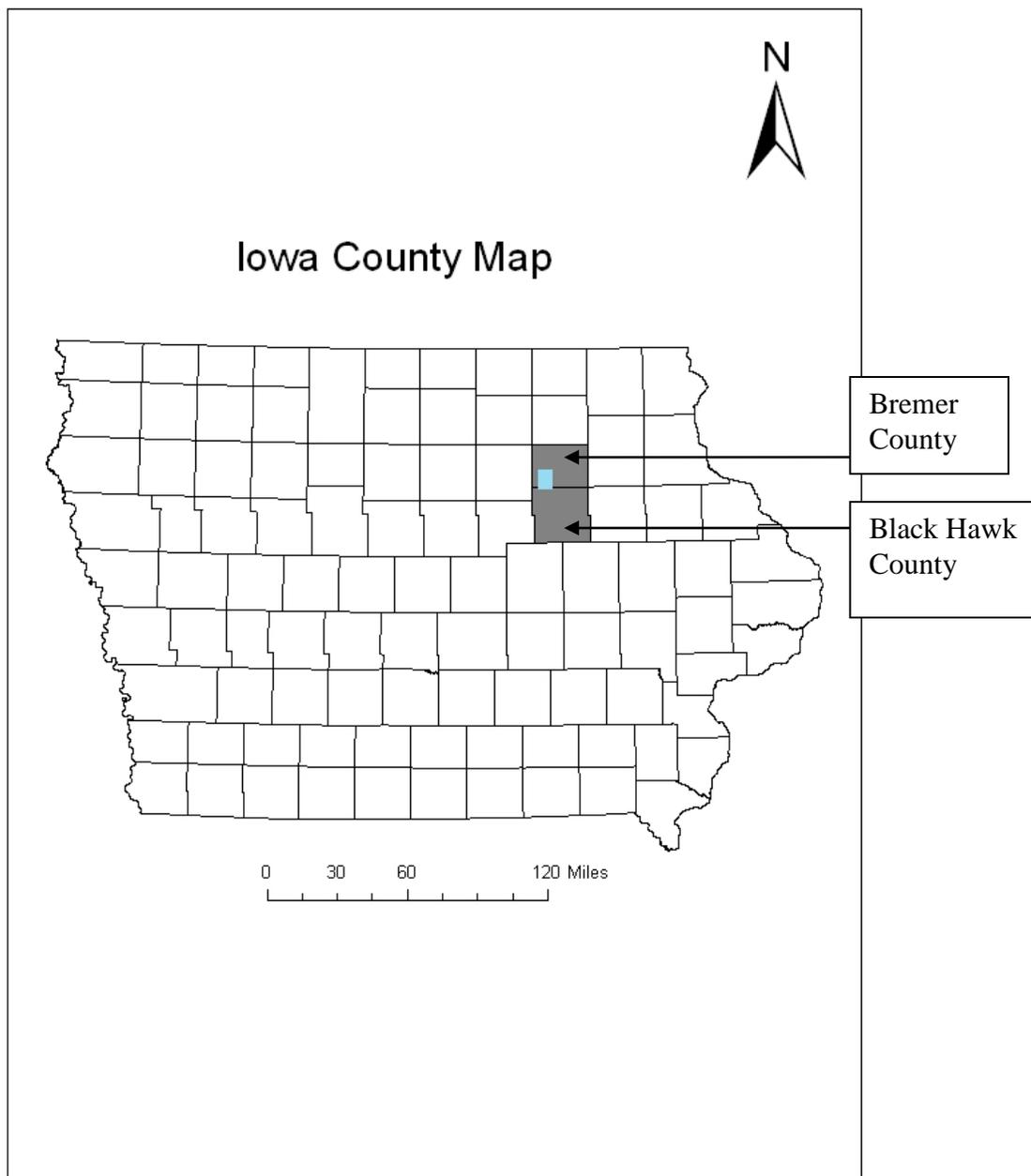


Figure. 1 Locality Map of Waverly Quadrangle (highlighted in blue)

REGIONAL SETTING

During the Pleistocene, continental glaciers advanced over Iowa, depositing sediments during and after ice contact. The main glacial stages from oldest to youngest were the Pre-Illinoian, Illinoian, and Wisconsinan (Fig. 2). The Waverly Quadrangle lies on the lowan Surface (Fig. 3). The lowan Surface (Figure) displays sweeping, relaxed, open topography. The surface usually appears slightly inclined to gently rolling with long slopes, low relief, and open views to the horizon (Prior, 1991). This region of Iowa has no constructional features associated with glaciations. There are no moraines, eskers, kames, or outwash plains. The lowan Erosion Surface was previously known as the lowan Drift Region. A considerable amount of this region is covered by loess, but the major part of the region is covered by a thin loam sediment that overlies a stone line on the till (Ruhe, 1969). Within the Waverly Quadrangle there exist loess-capped, elongated elliptical ridges known as pahas. Paha are aligned in a northwest-southeast direction (Fig. 4). The stratigraphy of these pahas are known to be very similar to that of the Kansan drift region. The lowan Drift does not exist in northeastern Iowa. The lowan Drift Region is actually an erosion surface (Ruhe, 1969).

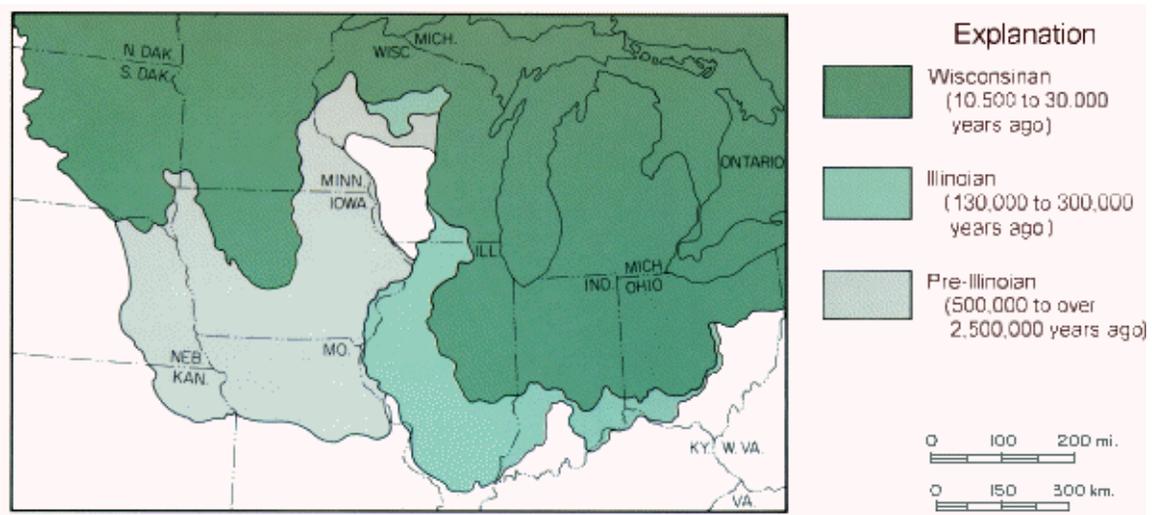


Fig. 2 Limits of major Pleistocene glacial advances into the Midwest

The edge of the erosion surface extends under the thick loess, so the erosion surface itself cannot be the primary source for the loess (Hallberg, 1979). It is postulated that much of the lowan Erosion Surface must have been created before the loess began to be deposited. Radiocarbon ages indicated that loess deposition began on the erosion surface approximately 18,000-23,000 radiocarbon years ago and between 21,000-29,000 radiocarbon years ago on the areas with paleosols. This aging indicates that erosion and loess deposition were occurring simultaneously (Zanner, 1999). The lowan Surface was last inhabited by glaciers in Pre-Illinoian time and since then has lain exposed to various episodes of weathering and soil development, erosion, and loess deposition (Prior, 1991).

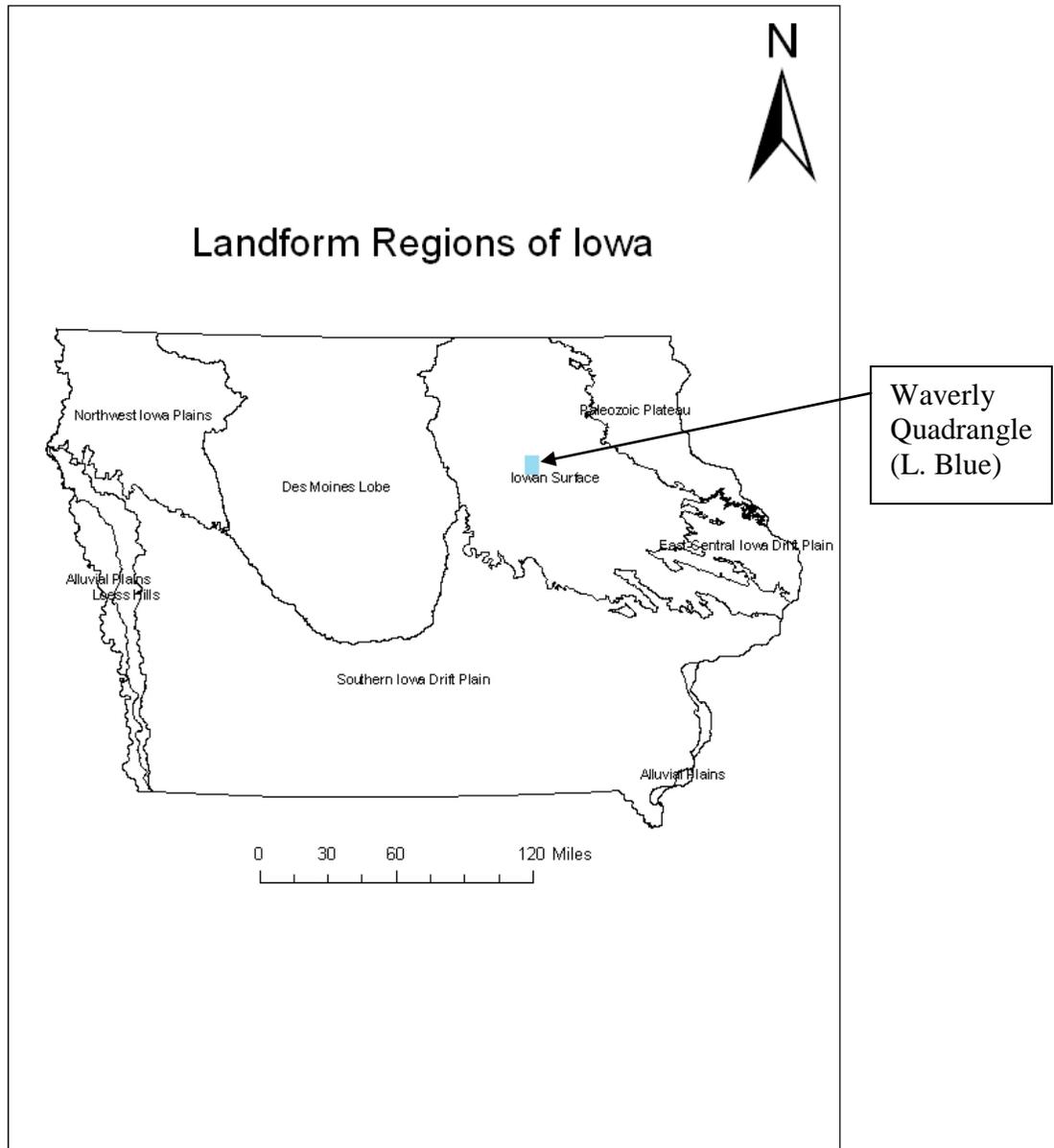


Fig. 3 Landform Regions of Iowa

Surficial Geology of the Waverly Quadrangle

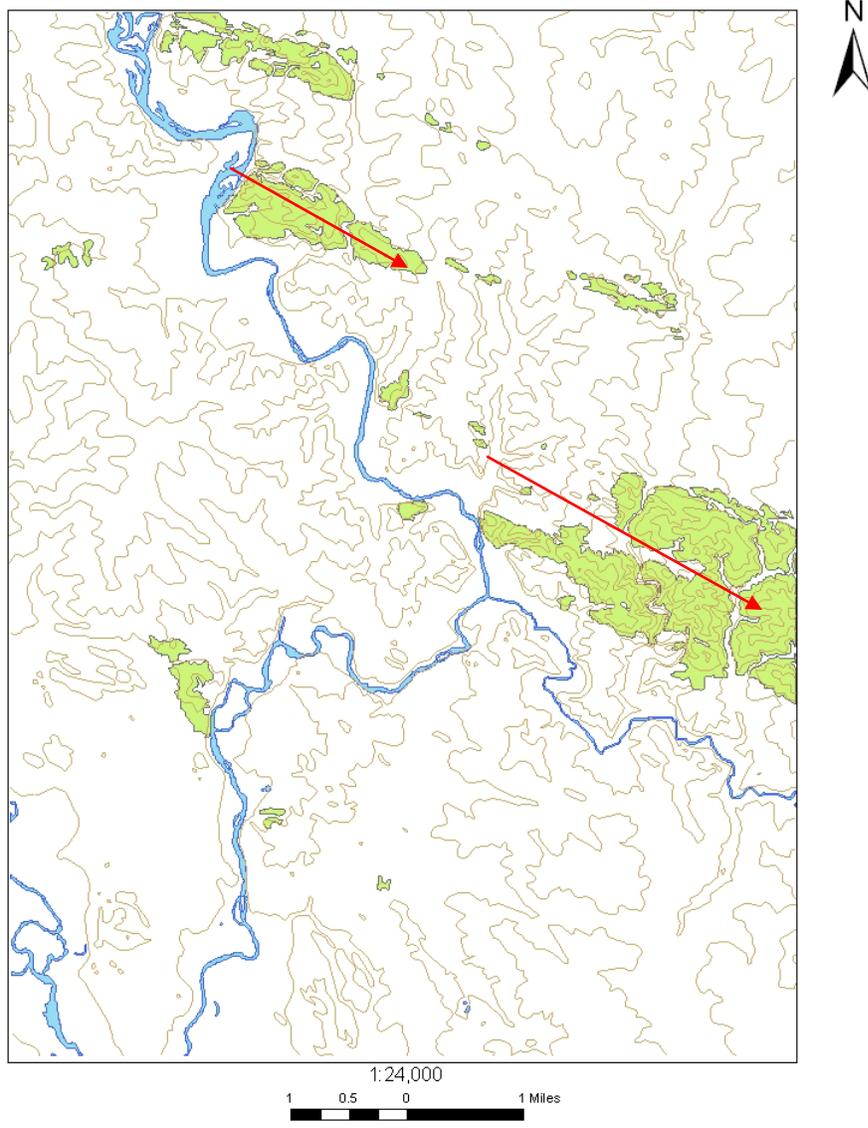


Fig. 4 Lineation of Pahas within the Waverly Quadrangle

METHODS

Data Collection

Geographically referenced data were necessary for this mapping project. This project required obtaining geospatial data from the Iowa Natural Resources Geographic Information Systems Library (<http://www.igsb.uiowa.edu/nrgislibx/gishome.htm>). Spatial data were also obtained from Robert McKay from the Iowa Geological Survey. The spatial data were in the form of GIS layers.

GEOSAM data were needed to acquire information related to Iowa's bedrock. GEOSAM (<http://gsbdata.igsb.uiowa.edu/geosam/>) is Iowa's geologic site and sample cores tracking program. GEOSAM was developed by the Iowa DNR and IGWS around a digital database that provides location, identification, and other key information about every available well, exposure, or site geologic information in Iowa. This information is made available to anyone who has the internet. To access Geosam, go to the IGS website at www.igsb.uiowa.edu. Clicking GEOSAM brings up the homepage. GEOSAM data were obtained from the Iowa DNR website. Spatial data were also collected in the field using Trimble GeoXH units. These GPS units have GIS capabilities. This allowed the EDMAP team to collect geospatial data from other sources rather than the internet. This mobile mapping enables the collection of field data to lessen the possibility of error in identifying geologic units.

Field Methods

Soil samples were taken from the field using a bucket-auger and shovel. Soil samples were described in the field notebook on the basis of soil identification methods. The soil samples were collected for lab analysis. Soil samples are being analyzed through a particle size analysis method. This particle size analysis is used specifically for the determination of size classes according to the "Wentworth Geometric Progression" scale. This procedure is determined on samples after all organic matter is removed. This procedure allowed for the testing of 18 different soil samples at one time. A standard reference sample is placed in bottle 19 and bottle 20 is used to determine the salt factor for each run.

GIS Data Processing

All geospatial data needed were added to a new ArcMap document. Geospatial data were obtained for both Bremer and Black Hawk counties from the Iowa Natural Resources Geographic Information Systems Library, because the Waverly Quadrangle splits these two Iowa counties. Coverages in the form of shapefiles were obtained from the GIS Library. Shapefiles needed were soil maps from both Bremer and Black Hawk counties. A bedrock shapefile was also used for the completion of the map. The bedrock layer was clipped using the extent of the soils that represented bedrock near the surface. When querying the

soils layer, the select by attributes feature was used to identify only the soils that were contained within the surficial geologic unit that were being queried. Surficial geologic units were identified from the surficial geologic map of the Bremer Quadrangle, just one quadrangle north of the Waverly Quadrangle. Once all geologic units were identified by the description of the soil, the Select tool (Fig. 5) within the Analysis Tools toolbox was used. All new data layers were created from the results of the Selection tool. The new data layers represented each surficial geologic unit within the mapping area. Now the new data layers needed to be combined into one general layer, so the Append feature (Fig. 6) was used within the Data Management Tools. The Append feature appends multiple input datasets into an already existing target dataset. The appended feature was labeled Waverly_Quadrangle.

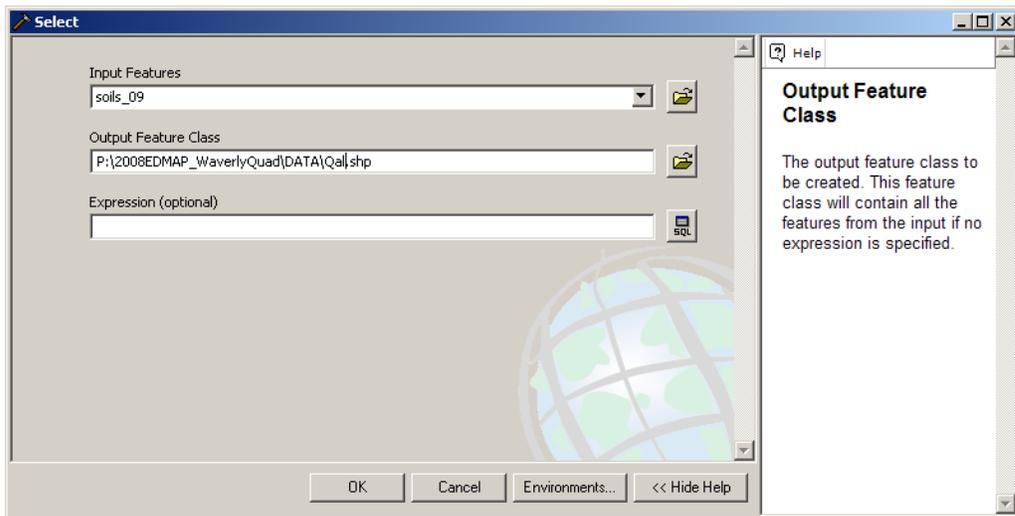


Fig. 5 Select Feature

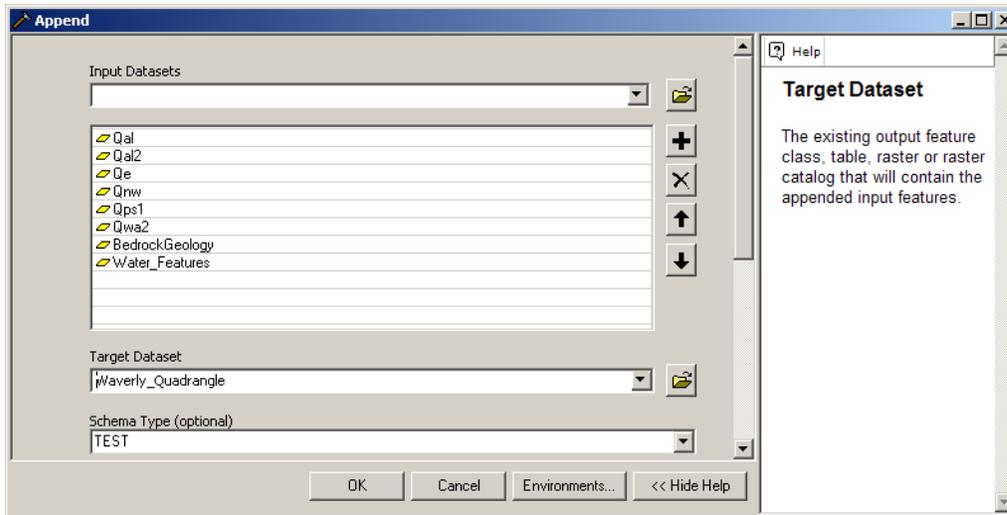


Fig. 6 Append Feature

Data

8/30

92°27'54.767"W 42°45'1.378"N

Color: 2.5y 6/4 (light yellowish brown)

New Church Construction Site

9/2

92°24'58.115"W 42°41'16.827"N

Sample 1 taken SE of Camp Director's House

Color: 7.5YR 4/4

Depth of hole: 2 ft

92°24'58.67"W 42°41'16.258"N

Sample 2 taken on top of a hill.

0-1 ft - soils medium brown. Soil getting lighter and more orange.

1-1.5 ft - Soils then progress to a lighter brown. Clay starting to accumulate.

1.5-3 ft - Large clumps of clay around 3 ft down.

Color: 10YR 5/6 (yellowish brown)

Depth of hole: 4 ft

9/16

92°24'27.267"W 42°41'33.136"N

Color: 10YR 6/8 (brownish yellow)

Depth of hole: 50 cm

10/21/08

92°23'8.937"W 42°40'18.618"N

Samples were taken on the North side of the road. Cut bank was sampled mid-slope.

Sample 1

Color: 10YR 7/3 (very pale brown)

Sample 2

Color: 10YR 6/4 (light yellowish brown)

Sample 3

Color: 2.5 Y 6/4 (light yellowish brown)

Geologic Units

Qal

Qal2

Qe

Qnw

Qps1

Qwa2

Bedrock

Soil Descriptions

(Not)Alluvial Land, Alluvium, Local Alluvium, Local Alluvium/till

Alluvial Land, Loamy Sediments, S&G, organic materials

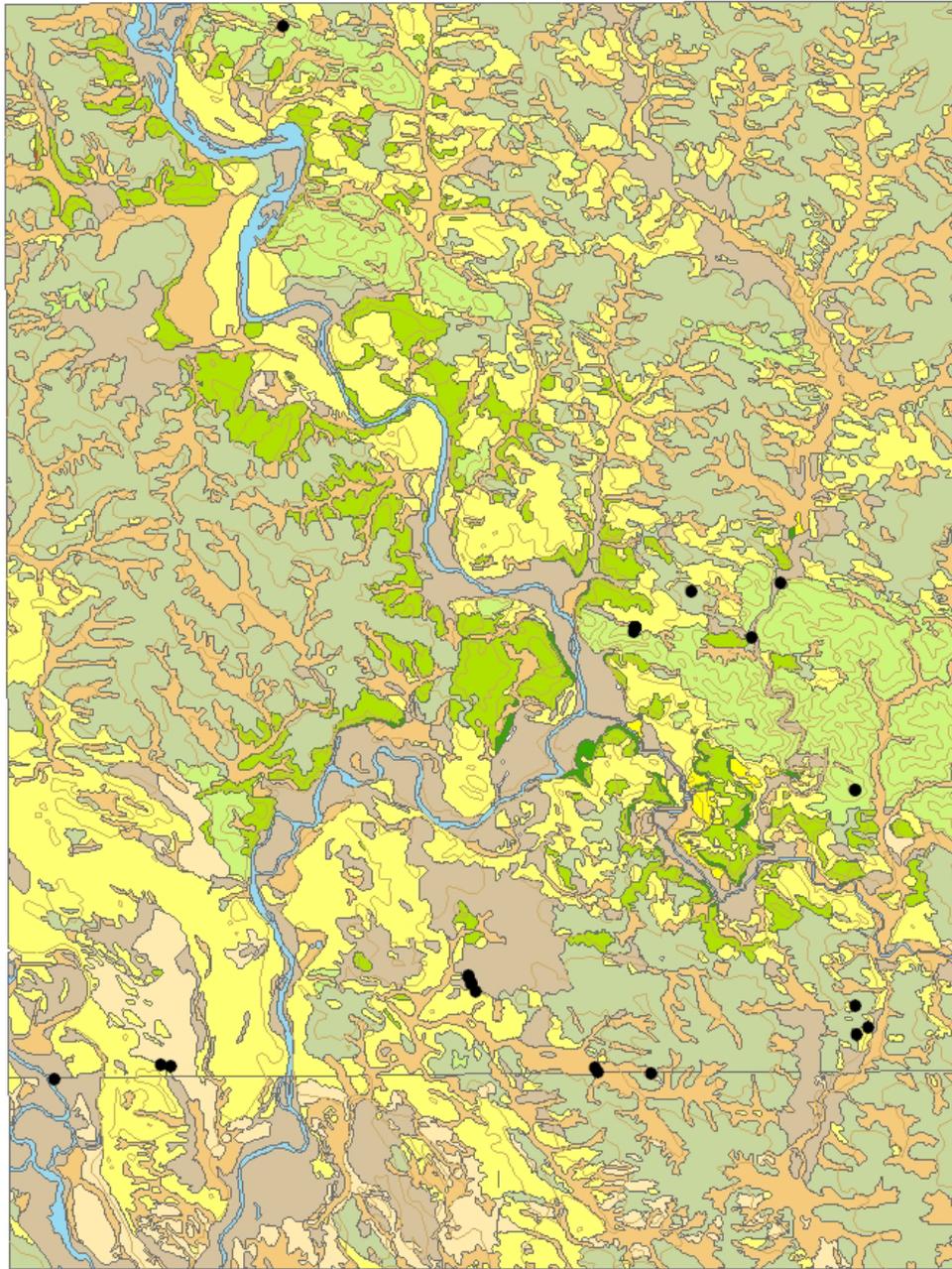
Eolian Sand

Silty Sed., S & G

Loess, Loess/till

Loam or clay loam/till, Loamy sediments/till, Orthents Loamy
Loamy Sed./Rock Limestone, Till/Rock Limestone, Sand/Rock
Limestone

Surficial Geology of the Waverly Quadrangle



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