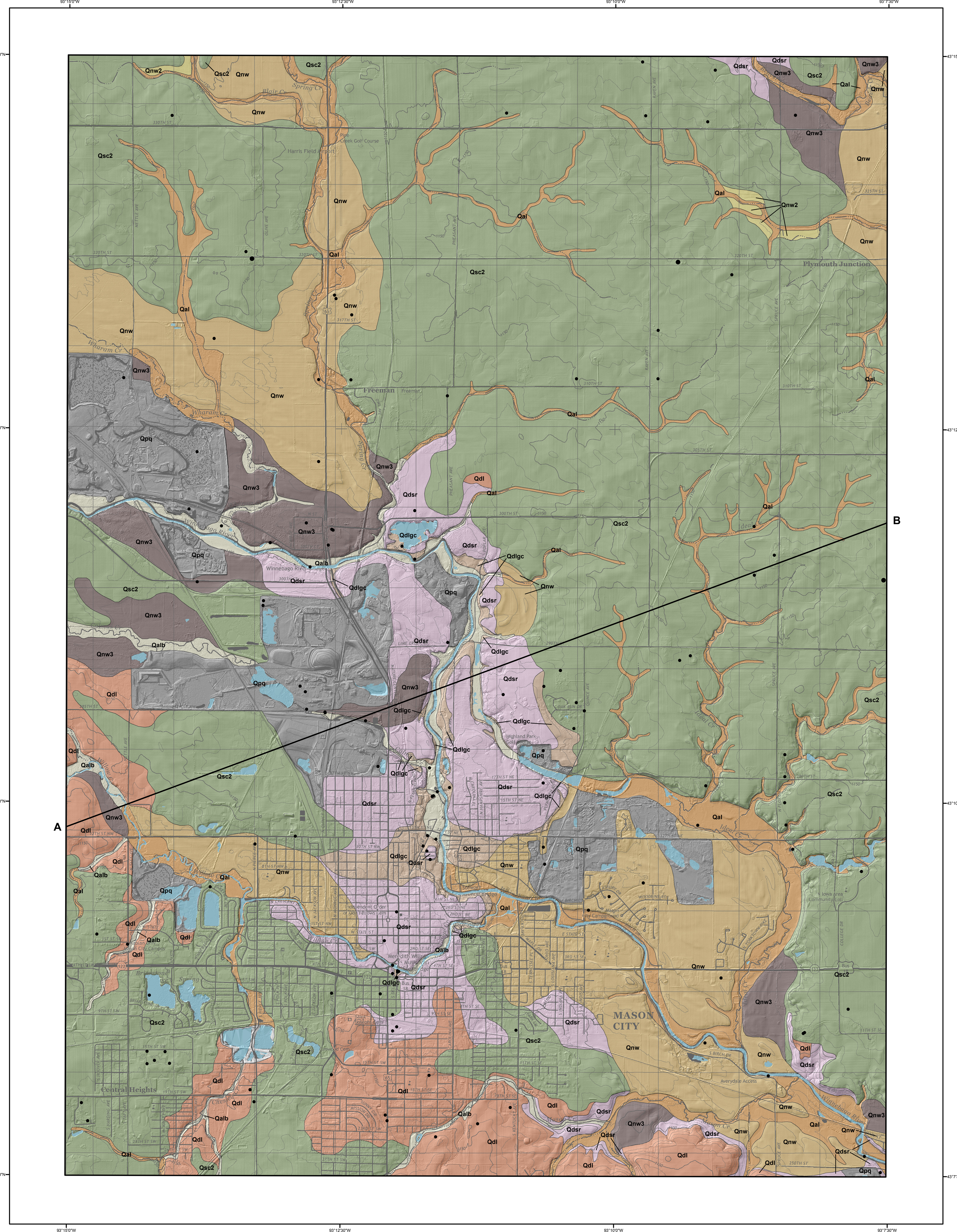
Surficial Geology of the Mason City (Iowa) 7.5' Quadrangle



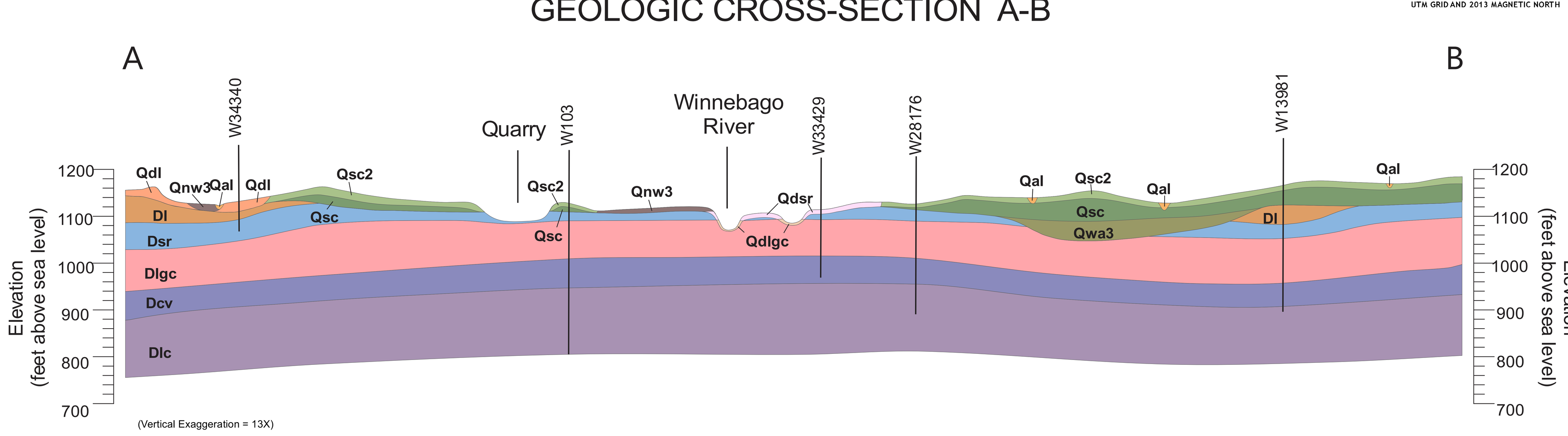
1:24,000

0 0.5 1 2 3 4 Miles

0 0.5 1 2 3 4 Kilometers

UTM GRID AND 2013 MAGNETIC NORTH

GEOLOGIC CROSS-SECTION A-B



LEGEND

CENOZOIC

QUATERNARY SYSTEM

HUDSON EPISODE

Qal - Alluvium (DeForest Formation-Undifferentiated) - Variable thickness of less than 1 to 5 m (3-16 ft) of very dark gray to brown, noncalcareous to calcareous, massive to stratified silty clay loam, clay loam, loam to sandy loam alluvium and colluvium in stream valleys, on hillslopes and in closed depressions. May overlie the Noah Creek, Sheldon Creek, Wolf Creek or Alburnett formations or fractured Devonian carbonate bedrock. Associated with low-relief modern floodplain, closed depressions, modern drainageways or toeslope positions on the landscape. Seasonal high water table and potential for frequent flooding.

Qalb - Alluvium Shallow to Bedrock (DeForest Formation-Undifferentiated) - Variable thickness of less than 1 to 5 m (3-16 ft) of very dark gray to brown, noncalcareous to calcareous, stratified silty clay loam, clay loam, loam to sandy loam alluvium and colluvium in stream valleys, on hillslopes and in closed depressions. May overlie the Noah Creek Formation or Devonian carbonate bedrock. Bedrock surface is within 5 m (16 ft) of the land surface. Associated with low-relief modern floodplain, closed depressions, modern drainageways or toeslope positions on the landscape. Seasonal high water table and potential for frequent flooding. *This unit is too thin to be shown in the cross section area crossing the Winnebago River and Willow Creek.*

HUDSON and WISCONSIN EPISODES

Qdl – Loamy Sediments Shallow to Shale, Limestone, and Dolomite (DeForest, Noah Creek, and Lime Creek formations) - 1 to 2 m (3-7 ft) of yellowish brown to gray, massive to weakly stratified, well to poorly sorted loamy, sandy and silty alluvial sediments that overlie the Upper Devonian bedrock surface. The Lime Creek Formation occurs on the bedrock surface in the southern part of the mapping area, especially in the southwest portion of the quadrangle. The thickness of this unit varies between 0 and 25 m (0-83 ft), but is usually less than 15 m (50 ft) in the mapping area. The unit can be subdivided into three parts: a lower unfossiliferous green-gray to gray calcareous shale, a middle fossiliferous calcareous shale, and an upper fossiliferous limestone, dolomitic limestone, and dolomite. Only lower and middle shaley parts of the unit occur in the quadrangle. *This unit is too thin to be shown in the cross section area crossing Willow Creek.*

Qdsr - Loamy Sediments Shallow to Limestone, Dolomite, and Shale (DeForest, Noah Creek, and Shell Rock formations) - 1 to 2 m (3-7 ft) of yellowish brown to gray, massive to weakly stratified, well to poorly sorted loamy, sandy and silty alluvial sediment that overlies the Upper Devonian bedrock surface. The Shell Rock Formation forms most of the bedrock surface in the mapping area. Thickness of this unit is about 12 to 21 m (40-70 ft), but can be less than 9 m (30 ft). The unit is characterized by fossiliferous limestone, dolomitic limestone and dolomite, with some grey to light green shale and/or argillaceous carbonates. Layers containing abundant subspherical and tabular stromatoporoids commonly occur in the lower part of the unit. Brachiopods, bryozoans, corals, and crinoids are abundant in some intervals, especially in the upper part of the unit.

Qdlgc – Loamy Sediments Shallow to Limestone, Dolomite, and Shale (DeForest, Noah Creek, and Lithograph City formations) - 1 to 2 m (3-7 ft) of yellowish brown to gray, massive to weakly stratified, well to poorly sorted loamy, sandy and silty alluvial sediments that overlie the Middle to Upper Devonian bedrock surface. The Lithograph City Formation occurs only along the Winnebago River and Willow Creek, and in a bedrock valley through the quad. The maximum thickness of this unit is about 34 m (110 ft) in the mapping area. It consists of dolomite and dolomitic limestone, usually characterized by interbeds of laminated lithographic and sublithographic limestone and dolomitic limestone, in part argillaceous or with minor shale. "Birdseye," vugs and calcite vug-fills are common. Some intervals are fossiliferous and stromatoporoid-rich. *This unit is too thin to be shown in the cross section area crossing the Winnebago River.*

Qnw2 - Sand and Gravel (Noah Creek Formation) - 2 to 12 m (7-40 ft) of yellowish brown to gray, poorly to well sorted, massive to well stratified, coarse to fine feldspathic quartz sand, pebbly sand and gravel with few intervening layers of silty clay. Along many valleys a thin mantle of loess, reworked loess, or fine-grained alluvium (Qal) may be present. This unit includes silty colluvial deposits derived from the adjacent map units. In places this unit is mantled with 1 to 3 m (3-10 ft) of fine to medium, well sorted medium to fine sand derived from wind reworking of the alluvium. This unit encompasses deposits that accumulated in low-relief stream valleys during the Wisconsin and Hudson episodes. Seasonal high water table and some potential for flooding.

WISCONSIN EPISODE

Qnw - Sand and Gravel (Noah Creek Formation) - Generally less than 10 m (33 ft), but there may be significantly thinner coarse-grained deposits in smaller stream valleys. Yellowish brown to gray, poorly to well sorted, massive to well stratified, coarse to fine feldspathic quartz sand, pebbly sand and gravel. In the map area the unit overlies the middle Wisconsin-age Sheldon Creek Formation. This unit encompasses outwash deposits that accumulated in valley trains during the Wisconsin Episode.

Qnw3 - Sand and Gravel Shallow to Bedrock (Noah Creek Formation) - 1 to 3 m (3-10 ft) of yellowish brown to gray, poorly to well sorted, massive to well stratified, coarse to fine feldspathic quartz sand, pebbly sand and gravel. May be overlain by up to 2 m (7 ft) of silty alluvial material. In places mantled with fine to medium well-sorted feldspathic quartz sand derived from wind reworking of the alluvium. Fractured carbonate bedrock is less than 5 m (16 ft) below the land surface. The unit encompasses deposits that accumulated in river and stream valleys during the late Wisconsin as well as exhumed Pre-Illinois Episode deposits of the Wolf Creek and Alburnett Formations.

Qsc2 - Loamy Sediments Shallow to Glacial Till (Unnamed erosion surface sediment) - 1 to 6 m (3-20 ft) of yellowish brown to gray, massive to weakly stratified, well to poorly sorted loamy, sandy and silty erosion surface sediment. Map unit includes some areas mantled with less than 1 m (3 ft) of Peoria Formation (silt or sand facies). Overlies massive, fractured, slightly firm glacial till of the Sheldon Creek Formation.

Qsc - Glacial Till (Sheldon Creek Formation-Undifferentiated) - Generally 3 to 15 m (10-50 ft) of yellowish brown to gray, calcareous fractured to massive clay loam; at depth this unit can be variably textured and contain significant sand and gravel bodies. The upper 3 to 6 meters (10-20 ft) may be periglacially altered. This unit overlies Pre-Illinois diamicton or Devonian carbonate bedrock and is only shown on the cross-section.

PRE-ILLINOIS EPISODE

Qwa3 - Till (Wolf Creek or Alburnett formations) - Generally 3 to 23 m (10-75 ft) of very dense, massive, fractured, loamy glacial till of the Wolf Creek or Alburnett formations. This mapping unit can be buried by glacial sediments (Sheldon Creek Formation), unnamed erosion surface sediments, loess or alluvium and is shown only on the cross-section.

PALEOZOIC

DEVONIAN SYSTEM

Dl – Shale, Limestone, and Dolomite (Lime Creek Formation) Upper Devonian. This map unit occurs on the bedrock surface in the southwestern part of the mapping area and bedrock highs. The thickness of this unit varies between 0 and 25 m (0-83 ft), but is usually less than 15 m (50 ft) in the mapping area. The unit can be subdivided into three parts: a lower unfossiliferous green-gray to gray calcareous shale, a middle fossiliferous calcareous shale, and an upper fossiliferous limestone, dolomitic limestone, and dolomite. Only lower and middle shaley parts of the unit occur in the quadrangle. This unit is shown only on the cross-section, not on the map.

Dsr - Limestone, Dolomite, and Shale (Shell Rock Formation) Upper Devonian. This map unit forms most of the bedrock surface in the mapping area. Thickness of this unit is about 12 to 21 m (40-70 ft), but can be less than 9 m (30 ft). The unit is characterized by fossiliferous limestone, dolomitic limestone and dolomite, with some grey to light green shale and/or argillaceous carbonates. Layers containing abundant subspherical and tabular stromatoporoids commonly occur in the lower part of the unit. Brachiopods, bryozoans, corals, and crinoids are abundant in some intervals, especially in the upper part of the unit. This unit is shown only on the cross-section, not on the map.

Dlgc - Dolomite, Limestone, and Shale (Lithograph City Formation) Middle to Upper Devonian. This map unit occurs only along the Winnebago River and Willow Creek, and in a bedrock valley through the quadrangle. The maximum thickness of this unit is about 34 m (110 ft) in the mapping area. It consists of dolomite and dolomitic limestone, usually characterized by interbeds of laminated lithographic and sublithographic limestone and dolomitic limestone, in part argillaceous or with minor shale. "Birdseye," vugs and calcite vug-fills are common. Some intervals are fossiliferous and stromatoporoid-rich. This unit is shown only on the cross-section, not on the map.

Dcv - Limestone and Dolomite (Coralville Formation) Middle Devonian. The thickness of this map unit varies between 11 and 18 m (35-60 ft). It is dominated by limestone, dolomitic limestone, and dolomite, in part, laminated and argillaceous. Brachiopods, echinoderm debris and corals usually occur in the limestone facies. This unit is shown only on the cross-section, not on the map.

Dlc - Dolomite and Limestone (Little Cedar Formation) Middle Devonian. The thickness of this formation ranges from 27 to 46 m (90-150 ft) in the study area. The unit is dominated by slightly argillaceous to argillaceous dolomite and dolomitic limestone, usually vuggy and partially laminated and/or cherty. This unit is commonly fossiliferous, especially in the lower portion. This unit is shown only on the cross-section, not on the map.

OTHER FEATURES

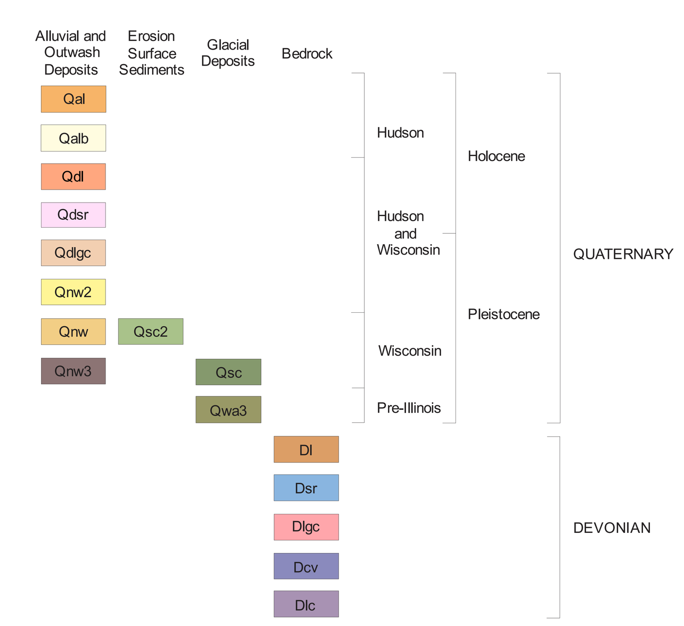
Qpq – Pits and Quarries Sand and gravel pits and rock quarries. Extent mapped as shown in county soil surveys and as identified on aerial imagery.

Water Features - Rivers, lakes, and small ponds. Extent mapped as shown in county soil surveys and as identified on aerial imagery.

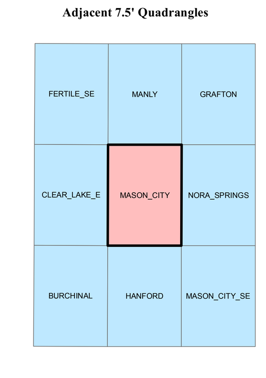
New Drill Holes for this map project

IGS GEOSAM Data Points- records available at www.iowageologicalsurvey.com

CORRELATION CHART



Adjacent 7.5' Quadrangles



SURFICIAL GEOLOGY OF THE MASON CITY 7.5' QUADRANGLE, CERRO GORDO COUNTY, IOWA

Iowa Geological Survey
Open File Map OFM-14-2
September 2014

Stephanie Tassier-Surine[1], Deborah Quade[2], Matthew T. Streeter[1], Phil Kerr[1], Robert Rowden[2], Robert McKay[2], Huaibao Liu[1], Ryan Clark[1] and Rochelle Galer[1]

Iowa Geological Survey, IIHR-Hydroscience & Engineering, University of Iowa, Iowa City, Iowa

Iowa Geological Survey, Robert D. Libra, State Geologist

Supported in part by the U.S. Geological Survey
Cooperative Agreement Number G13AC00175
National Cooperative Geologic Mapping Program (STATEMAP)

ACKNOWLEDGMENTS

Special thanks to Greene Limestone Co., Heartland Asphalt Inc., Holcim Cement Inc., L. R. Falk Construction Co., Lehigh Cement Co. and Martin Marietta Co. for allowing us to work in their quarries or gravel pits. New subsurface geologic data was mostly generated by Michael Bounk of the Iowa Department of Natural Resources (IDNR) by producing descriptive logs of water well drilling samples. Jason Vogelgesang and Zachary Demanett of the Iowa Geological Survey (IGS) prepared well cutting samples for stratigraphic logging. Ray Anderson and Brian Witzke (IDNR) provided valued information concerning the bedrock topography and Devonian stratigraphy of the mapping area. Mary Howes and Casey Kohrt (IDNR) provided GIS technical help. Special thanks to the landowners who allowed access to their properties: Beverly Butler, Geraldine Schwarz, Marty Sturges, and Merel Wharam. Also, a special thanks to the Natural Resources Conservation Service staff for collaboration and providing drilling assistance: James Johnson, driller, and Joe Thompson and Kathy Woida, geologists.

[1]Iowa Geological Survey, IIHR-Hydroscience & Engineering, University of Iowa, Iowa City, Iowa
[2]Iowa Department of Natural Resources, Des Moines, Iowa

Introduction to the Surficial Geology of the Mason City 7.5' Quadrangle, Cerro Gordo County, Iowa

The Mason City Quadrangle is located in Cerro Gordo County in north-central Iowa. The quadrangle is located on the Wisconsin-age Iowan Surface Landform Region (Prior and Kohrt, 2006). Quaternary deposits in this quadrangle generally vary in thickness from 0 to 24 m (0 to 80 ft), with thicker deposits to the north. The map area is dominated by unnamed loamy sediments (unnamed erosion surface sediment) of variable thickness overlying Wisconsin-age Sheldon Creek Formation glacial sediments, Pre-Illinoian glacial sediments, or shallow rock. These deposits are regionally extensive as shown by the Des Moines 4 ° x 6 ° Quadrangle at a scale of 1:1,000,000 (Hallberg et al., 1991). Significant areas of bedrock outcrop or areas with less than 5 m (16 ft) of loamy material over rock are present, especially along the Winnebago River, as well as Plymouth, Calmus, Willow, and Mason creeks.

Calvin (1896) described and mapped the Quaternary and Paleozoic bedrock geology of Cerro Gordo County. He noted the extreme variability of the till units in Cerro Gordo County and also the presence of significant sand and gravel bodies. Statewide bedrock geologic maps by Hershey (1969), and most recently by Witzke et al. (2010), depict the increased understanding of the complex distribution of geologic units at the bedrock surface across north-central Iowa, including Cerro Gordo County. Previous surficial geologic mapping completed as part of the STATEMAP program adjacent to the project area includes Surficial Geology of Worth County, Iowa (Quade et al., 2012) and Surficial Geology of the Clear Lake East Quadrangle (Quade et al., 2013).

The map area has a rich and complex geologic history punctuated by at least seven periods of glaciation between 2.6 million to 500,000 years ago (Boellstorff, 1978a,b; Hallberg, 1980, 1986). In this area, Pre-Illinois Episode glacial deposits and associated buried soils are overlain by much younger Wisconsin-age glacial deposits. During the earlier and mid Wisconsin-age, ice advances dating from approximately 40,000 to 26,000 years before present were deposited throughout the map area. In Iowa, this glacial deposit is formally recognized as the Sheldon Creek Formation (Bettis et al., 1996, Bettis, 1997) and in earlier literature is referred to as the "Tazewell till" (Ruhe, 1950). Results from this mapping program and others in Worth, Cerro Gordo, and Mitchell counties indicate that the Sheldon Creek glacial materials extend much farther east than was previously thought.

A period of intense cold occurred during the Wisconsin full glacial episode from 21,000 to 16,500 years ago (Bettis, 1989). This cold episode and ensuing upland erosion led to the development of the distinctive landform recognized as the Iowan Surface (Prior, 1976). A periglacial environment prevailed during this period with intensive freeze-thaw action, solifluction, strong winds, and a host of other periglacial processes (Walters, 1996). The result was that surface soils were removed from the Iowan Surface, and the Sheldon Creek and Pre-Illinois till surface was significantly eroded, resulting in the development of a region-wide colluvial lag deposit referred to as a "stone line." Thick packages of stratified loamy and sandy sediments located low in the upland landscape and adjacent to streams are remnants of solifluction lobes associated with the formation of the Iowan Surface. These materials can be found along tributaries of the Winnebago and Shell Rock rivers.

Surficial deposits of the map area are composed of six formations: DeForest, Noah Creek, Peoria, Sheldon Creek, Wolf Creek, and Alburnett formations, as well as unnamed erosion surface sediments. Hudson age deposits associated with fine-grained alluvial, organic, and colluvial sediments include the DeForest Formation which is subdivided into the Camp Creek, Roberts Creek, Gunder, Corrington, Flack, and Woden members. The Noah Creek Formation includes coarse sand and gravel associated with outwash from the Des Moines Lobe, as well as coarse to finer grained fluvial deposits associated with local stream and river valleys. Unnamed erosion surface sediments consist of reworked till and slopewash deposits associated with periglacial activity during the Wisconsin ice advance. Areas of Peoria Formation eolian materials are intermittently present mantling most other mapping units, and are more abundant near stream valleys. Sheldon Creek Formation glacial deposits are undifferentiated and occur in northwest and north-central Iowa. The maximum extent of these deposits is still not fully understood. Pre-Illinoian glacial deposits in Iowa consist of two formations: the younger Wolf Creek Formation and the Alburnett Formation. The Wolf Creek is divided into the Winthrop, Aurora, and Hickory Hills members (oldest to youngest). The Alburnett Formation consists of several "undifferentiated" members.

Three bedrock mapping units (Devonian Lime Creek, Shell Rock, and Lithograph City formations) are exposed at the surface in the quadrangle, with the Shell Rock Formation occurring at the bedrock surface over most of the mapping area. More than 40 rock outcrops and several quarries are located in the map area. The Devonian rocks are dominated by carbonates varying between limestone and dolomite, accompanied with minor shale.

References

Bettis, E.A., III, 1989, Late Quaternary history of the Iowa River Valley in the Coralville Lake area *in* Plocher, O.W., Geologic Reconnaissance of the Coralville Lake area: Geological Society of Iowa Guidebook 51, p. 93-100.

Bettis, E.A. III, Quade, D.J., and Kemmis, T.J., 1996, *in* Hogs, bogs, and logs: Quaternary deposits and environmental geology of the Des Moines lobe: Bettis, E.A., III, Quade, D.J., and Kemmis, D.J. (eds.): Iowa Department of Natural Resources-Geological Survey Bureau, Guidebook Series No. 18, 170 p.

Bettis, E.A. III, 1997, Late-Middle and Early-Late Wisconsin Glaciation in North Central Iowa: Geological Society of America North-Central Section Meeting Abstracts with Programs 29, Issue 4, p. 5.

Boellstorff, J., 1978a, North American Pleistocene Stages reconsidered in light of probable Pliocene-Pleistocene continental glaciation: Science, v. 202, p. 305-307.

Boellstorff, J., 1978b, Chronology of some late Cenozoic deposits from the central United States and the ice ages: Transactions of the Nebraska Academy of Science, v. 6, p. 35-49.

Calvin, S., 1896, Geology of Cerro Gordo County: Iowa Geological Survey Annual Report, v. 7, p. 117-195.

Hallberg, G.R., 1980, Pleistocene stratigraphy in east-central Iowa: Iowa Geological Survey Technical Information Series, v. 10, 168 p.

Hallberg, G.R., 1986, Pre-Wisconsin glacial stratigraphy of the central plains region in Iowa, Nebraska, Kansas, and Missouri: *in* Sibrava, V., Bowen, D.Q., and Richmond, G.M., eds., Quaternary Glaciations in the Northern Hemisphere, Quaternary Science Reviews, v. 5, p. 11-15.

Hallberg, G.R., Lineback, J.A., Mickelson, D.M., Knox, J.C., Goebel, J.E., Hobbs, H.C., Whitfield, J.W., Ward, R.A., Boellstorf, J.D., and Swinehart, J.B., 1991, Quaternary geologic map of the Des Moines 4° x 6° quadrangle, United States: U.S. Geological Survey, Miscellaneous Investigations Series, Map I-1420, 1:100,000 scale map sheet.

Hershey, H. G., 1969, Geologic map of Iowa: Iowa Geological Survey, scale 1:500,000.

Prior, J.C., 1976, Landforms of Iowa: Iowa City, Iowa, University of Iowa Press, 154 p.

Prior, J.C. and Kohrt, C.J., 2006, The Landform Regions of Iowa, Iowa Geological Survey, digital map, available on IDNR NRGIS Library.

Quade, D., Tassier-Surine, S., Liu, H., McKay, R.M., and Giglierano, J.D., 2012, Surficial Geology of Worth County, Iowa, scale 1:100,000: Iowa Geological and Water Survey, Open File Map OFM-12-2.

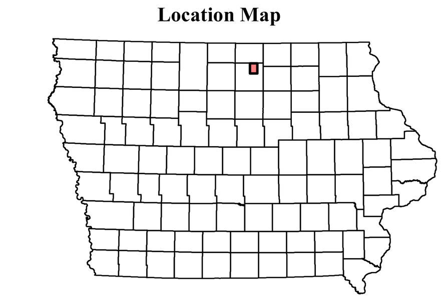
Quade, D., Tassier-Surine, S., Liu, H., McKay, R.M., Rowden, R., and Giglierano, J.D., 2013, Surficial Geology of the Clear Lake East 7.5' Quadrangle, Cerro Gordo County, Iowa, scale 1:24,000: Iowa Geological and Water Survey, Open File Map OFM-13-2.

Ruhe, R.V., 1950, Reclassification and correlation of the glacial drifts of northwestern Iowa and adjacent areas: University of Iowa Department of Geology, Iowa City, unpublished Ph.D. thesis, 124 p.

Walters, J.C., 1996, General and environmental geology of the Cedar Falls/Waterloo Area, The Iowan Surface, *in* general and environmental geology of Cedar Falls/Waterloo and surrounding area, Northeast Iowa: Iowa Geological Survey Guidebook Series No. 22, p. 7-9.

Witzke, B.J., Anderson, R.R. and Pope, J.P., 2010, Bedrock Geologic Map of Iowa, scale: 1:500,000, Iowa Geological and Water Survey, Open File Digital Map OFM-10-1.

Location Map



Base map from USGS Mason City 7.5' Digital Raster Graphic (IGS GIS file DRGC29C.tif) which was scanned from the Mason City 7.5' Topographic Quadrangle map, published by US Geological Survey in 2013 Land elevation contours (10' interval).

Iowa Geological Survey digital cartographic file MasonCity_SurficialGeology.mxd, version 9/15/14 (ArcGIS 10.1) Map projection and coordinate system based on Universal Transverse Mercator (UTM) Zone 15, datum NAD83.

The map and cross section are based on interpretations of the best available information at the time of mapping. Map interpretations are not a substitute for detailed site specific studies.

Research supported by the U. S. Geological Survey, National Cooperative Geologic Mapping Program, under USGS award number G13AC00175. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U. S. Government.