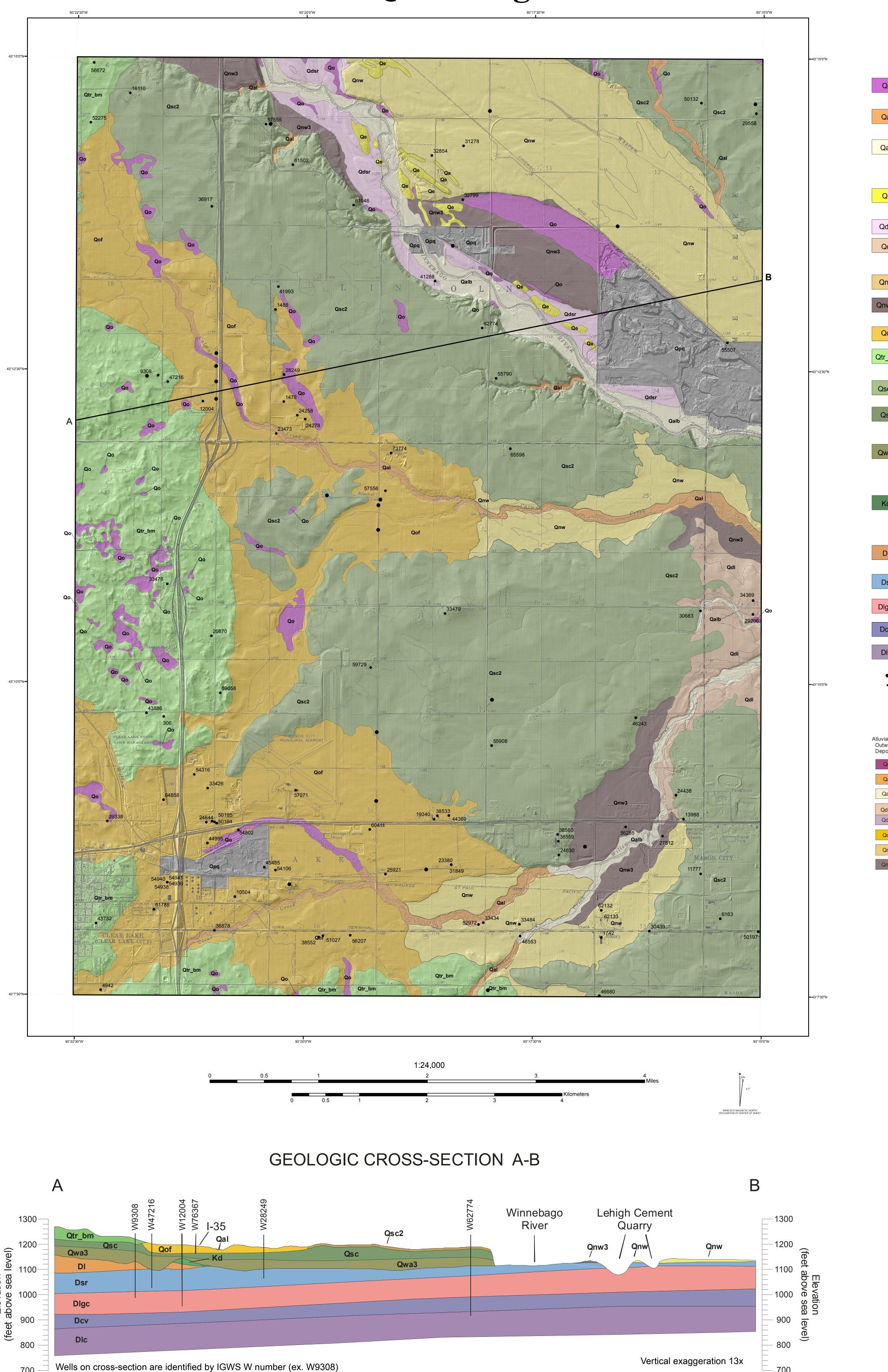
Surficial Geology of the Clear Lake East (Iowa) 7.5' Quadrangle



Records available at www.igsb.uiowa.edu\geosam

LEGEND CENOZOIC

QUATERNA RY SYSTEM HUDSON EPISOD E

Qo - Depressions (DeForest Formation-Woden Mbr.) - Generally 2.5 to 6 m (8-20 ft) of black to very dark gray, calcareous, muck, peat and silty clay bam colluvium and organic sediments in drained and undrained closed and semi-closed depressions. Overlies gray, calcareous, loam diamicton (Dows Fm.-Morgan/Alden Mbr.) or Noah Creek Fm. sand and gravel or Sheldon Creek Fm bam diamicton. Associated with low relief features that occupy depressions and low sags on the land scape. Supports wetland vegetation and can be permanently covered by water.

Qal - Alluvium (DeForest Formation-Undifferentiated) - Variable thickness of less than 1 to 5 m (3-16 ft) of very dark gray to brown, noncalcar cous to calcareous, massive to stratified silty clay loam, clay loam, loam to sand y loam alluvium and colluvium in stream valleys, on hillslopes and in closed depressions. May overlie Noah Creek Formation, Wolf Creek or Alburnett for mations or fractured Devon ian carbonate bedrock. Associated with low-relief modern floodplain, closed depressions, modern drainageways or toestope 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 be rown, noncalcareous to calcareous, stratified silty clay learn, clay learn, learn to sandy learn alluvium and colluvium in stream valleys, on hillslopes and in closed depressions. May overlie Noah Creek Formation or Devenian carbonate bedrock. Bedrock surface is within 5 m (16 ft) of the land surface. A speciated with low-relief modern floodplain, closed depressions, modern drainageways or toes lope 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 Winnebus of River.

HUDSON and WIS CONSIN EPIS ODE

Qdsr - Loamy Sediments Shallow to Limestone, Dolomite, and Shale (DeForest-Noah Creek-Shell Rock Formation) - 1 to 2 m (3-7 ft) of yellowish brown to gray, massive to weakly stratified, well to poorly screed loamy, sandy and silty alluvial sediment that over lies the Upper

Qe - S and D unes and Sand Sheets (Peoria Formation-sand facies) - Generally less than 3 m (10 ft) of yellowish brown, massive calcareous loamy sand to fine sand. It may overlie yellowish-brown coarse-grained sand and gravel (Noah Creek Fm.), or it may overlie yellowish to grayish brown, usually calcareous, stratified loam to silt loam to sandy loam diamicton (Dows Fm.-Morgan Mbr.). Usually restricted to a narrow belt along major river valley bottoms or adjacent uplands on the Des Moines Lobe. Off the Des Moines Lobe this unit is not restricted to dunes along valley areas and may occur as sand stringers overlying unnamed erosion sur face loamy sediments.

Devonian bedrock surface as described below (Dsr). This unit is too thin to be shown in the cross section area crossing the Winnebago River.

Qdl - Loa my Sediments Shallow to Dolomite, Limestone, and Shale (DeForest-Noah Creek- Lime Creek Formation) - 1 to 2 m (3-7 ft) of yellowish brown to gray, massive to weakly stratified, well to poorly scrited loamy, sandy and silty alluvial sediment that over lies the Upper Devonian bedrock surface as described below (D1).

WISCONSIN EPISODE

Qnw - Sand and Gravel (Noah Creek Formation) - Generally less than 8 m (26 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 middle Wiscon sin-age Sheldon Creek Fm. 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 £ldspathic quartz sand derived from wind reworking of the alluvium. Fractured car bon ate bedrock is less than 5 m (16 ft) below the land surface. The unit en compasses deposits that accumulated in river and stream valleys during the late Wisconsin as well as exhumed Pre-Illinois Epis ode deposits of the Wolf Creek and Alburnett formations.

Qof - Outwash fan (Noah Creek Formation) - Thickness can be quite variable from 3 to 12 m (10-39 ft) of yellowish-brown coarse-grain ed

relief apron that gently slopes away from the moraine front. Season all high water table.

Qtr_bm - Till ridge (Dows Formation-Morgan Mbr.) - Generally 3 to 15 m (10-49 ft) of yellowish to grayish brown, usually calcareous and fractured, stratified loam to silt loam; stratified sands and gravels to sandy loam diamicton; textures can be quite variable. Overlies gray, calcar eous, massive, dense loam diamicton (Dows Fm.-Alden Mbr.). The Alden Mbr. in thismapping unit rarely extends to depth's greater than 15 meters (49 ft); and overlies the Sheldon Creek Formation diamicton. At the DML margin, this landform may be mantled with a thin layer of Peoria Formation silt. Low to moderate relief hummocky landform features exceed 3 to 5 m (10-16 ft) of local relief. This landform is associated with the Bemis Moraine. The surface pattern is irregularly shaped patterns. Seasonal high water table.

sand and gravel. May over lie gray, calcareous, massive, dense loam diamicton (Dows Fm.- Alden Mbr. or Sheldon Creek Fm.). Broad low-

Qsc2 - Loamy Sediments Shallow to Glacial Till (Unnamed erosion surface sediment) - 1 to 3 m (3-10 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 σ sand facies). Overlies massive, fractured, slightly firm glacial till of the Sheldon Creek Formation.

Qsc - Glacial Till (Sheldon Creek Formation-undiff.) - Generally 3 to 15 m (10-50 ft) of a 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 7 meters (10-20 ft) may be periglacially altered. It is not un common to see few Pierre Shale clasts in core samples. The presence of unaltered Sheldon Creek till in the eastern portion of the county is questionable. This unit overlies Pre-Illinois diamicton and is only shown on the cross-section.

Qwa3 - Till (Wolf Creek or Alburn ett 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 Fm.), unnamed erosion surface sediments, loess or alluvium and is shown only in the cross-section.

PRE-ILLINOIS EPISODE

MESOZOIC

y in the α oss-s ection.

CRETAC EOUS SYSTEM

Kd – S ands tone, Mudstone, and Siderite Pellets (Windrow Formation) "Mid"-Cretaceous. This map unit occurs as erosional outliers and is only found occasionally in well materials in the mapping area. The formation is characterized by reddish shaly sandstone and mudstone or siderite pellets. Its thickness is variable, but usually less than 6 m (20 ft).

PALEOZOIC DEVONIAN SYSTEM

DI – Shale, Limestone, and Dolomite (Lime C reek Formation) Upper Devon ian. This map unit comprises most of the bedrock surface in the southern part of the mapping area. Because of erosion, the thick ness of this unit varies between 0 to 42 m (0-140 ft). The unit can be subdivided into three parts: a lower unfossilifer ous green-gray to gray calcareous shale, a middle fossiliferous calcar cous shale, and an upper fossiliferous limestone, dolomitic limestone, and dolomite. The middle and upper parts of the unit are characterized by extremely abundant brachicpods and other fossils.

Dsr - Limestone, Dolomite, and Shale (Shell Rock Formation) Upper Devonian. This map unit usually has a thickness of 12 to 18 m (40-60 ft), and occurs in the southern part of the quad. The unit is characterized by fossiliferous carbonates, with some grey to light green shale. 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.

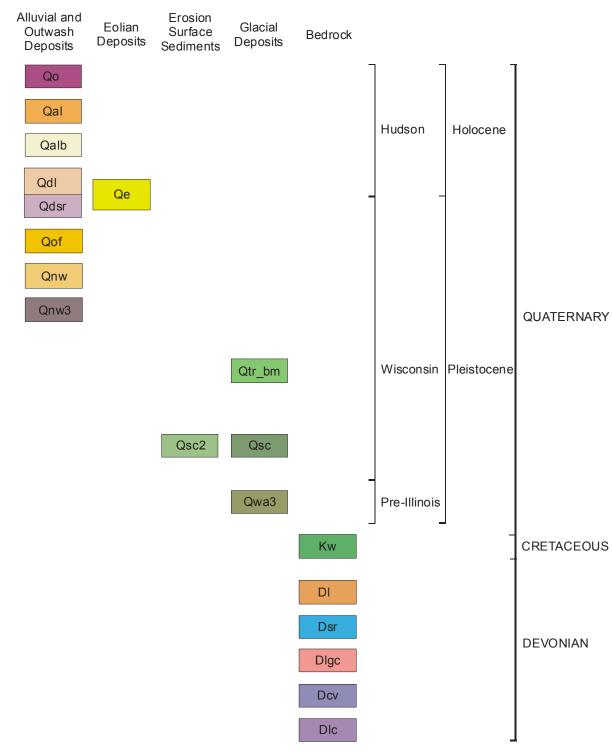
Digc - Dolomite, Limest one, and Shale (Lithograph City Formation) Middle to Upper Devonian. This map unit forms the major upper most bedrock in the quad, with a maximum thickness of up to 33 m (110 ft). This unit consists of dolomite and dolomitic limestone, partially characterized by interbeds of laminated lithographic and sublithographic limestone and dolomitic limestone, in part argillaceous or with slight shale "Birdseye" structures are common. Some intervals are fossiliferous and stromatoporoid-rich.

Dev - Limestone and Dolomite (Coralville Formation) Middle Devonian. The thickness of this map unit varies between 10 and 18 m (35-60 ft), and it is dominated by limestone, dolomitic limestone, and dolomite, in part laminated and argillaceous. Brachiopods and corals usually

Dic - Dolomite and Limestone (Little Cedar Formation) Middle Devenian. The thickness of this map unit ranges from 27 to 35 m (90-115 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, and brachique are especially abundant in the lower per tion. This unit is shown only on the cross-section, not on the map.

• 1938 Water Well Logs with IGWS well number (records available at www.igsb.uiowa.edu\geosam)

CORRELATION CHART



SURFICIAL GEOLOGY OF THE CLEAR LAKE EAST 7.5' QUADRANGLE, CERRO GORDO COUNTY, IOWA

Iowa Geological and Water Survey Open File Map OFM-13-2 September 2013

prepared by

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Introduction to the Surficial Geology of Clear Lake East 7.5' Quadrangle,

Cerro Gordo County, Iowa

The Clear Lake East Quadrangle is located in Cerro Gordo County in north-central Iowa. The quad straddles the eastern margin of the Late Wisconsin-age Des Moines Lobe Landform (DML), the most recently glaciated region of the state; and the Wisconsin-age Iowan Erosion Surface (IES) Landform Region (Prior and Kohrt, 2006). The western part of the map area, consists of a complex suite of depositional landforms and sediment sequences related to supraglacial, subglacial, and proglacial sedimentation associated with the initial advance of the DML. Within the quadrangle, Quaternary deposits on the DML can reach a maximum thickness of 43 m (140 ft) and are significantly thicker than on the IES landform where deposits vary in thickness from 5 to 18m (15 to 60 ft). The Des Moines Lobe is characterized by hummocky terrain that forms arcuate belts of moraine complexes and undulating plains with thick increments of supraglacial sediment (>3 m). In the map area, the most noteable feature of the DML is the Bemis Moraine, the terminal moraine of the DML which is dated at approximately 14,500 to 14,000 years before present. Supraglacial and proglacial sediments (coarse-grained glaciofluvial, ice-contact sediments associated with outwash fans and channel deposits) encompass a large area of the eastern flank of the DML and are extensively mapped at the former ice margin and in the Winnebago River, Calmus, Wharam and Willow Creek valleys. The eastern portion of the map area is dominated by unnamed loamy sediments (IES materials) of variable thickness overlying Wisconsin-age Sheldon Creek Fm. glacial sediments, Pre-Illinoian glacial sediments or shallow rock. These deposits are regionally extensive and in this quadrangle, on average are less than 18 m (60 ft) in thickness. Significant areas of bedrock outcrop or areas with less than 15 feet of loamy material over rock are present, especially along the Winnebago River and the lower reach of Willow Creek. Bisecting the northeastern section of the map area is the Winnebago River valley. The valley is younger than the Bemis Moraine and was cut approximately 12,500 years before present during the catastrophic drainage of the younger Algona Moraine. The valley is dominated by a variable thickness 1 to 10 m (3 to 32 ft) of coarse grained outwash associated with the "last-gasp" drainage of the DML.

Williams (1899) described and mapped the Quaternary and Paleozoic bedrock geology of Worth County and made mention of similar geologic units in Cerro Gordo county. He also noted the extreme thinness of the "drift" along the Winnebago River and the remarkable difference in surface features between the eastern and western portions of Worth and Cerro Gordo counties. Statewide bedrock geologic maps by Hershey (1969), and most recently by Witzke, Anderson, and Pope (2010), depict the increased understanding of the complex distribution of geologic units at the bedrock surface across this region, including Worth County. The only regional surficial map of the area consists of the Des Moines 4 ° x 6° Quadrangle at a scale of 1:1,000,000 (Hallberg et al., 1991). In addition, Kemmis (1991) undertook a systematic study of glacial landforms, sedimentology and depositional environments of the northern Des Moines Lobe. This study served as the foundation for the development of a lithostratigraphic framework for DML deposits in Iowa.

Surficial deposits of the map area are composed of seven formations: DeForest, Dows, Noah Creek, Peoria, Sheldon Creek, Wolf Creek, and Alburnett formations, as well as unnamed erosion surface sediments (see map discussion for further detail). 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 Dows Formation consists of upland glacial deposits and is subdivided into the Alden, Lake Mills, Morgan and Pilot Knob Members. The Noah Creek Formation includes coarse sand and gravel associated with outwash from the Des Moines Lobe. The Noah Creek Formation includes 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 present along the Winnebago River valley. Eolian materials may also be 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 full 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) are exposed as outcrop or quarries in the map area. Bedrock outcrops occur primarily along the Winnebago River and to some extent along Willow Creek. The Devonian rocks are dominated by carbonates varying between limestone and dolomite, accompanied with minor shale.

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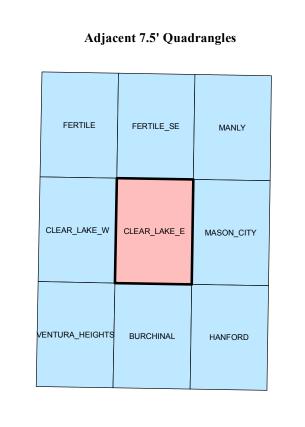
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Base map from USGS Clear Lake East 7.5' Digital Raster Graphic (IGS GIS file DRGD28c.TIF) which was scanned from the Clear Lake East 7.5' Topographic Quadrangle map, published by US Geological Survey in 1972 Land elevation contours (10' interval).

lowa Geological and Water Survey digital cartographic file ClearLakeE_SurficialGeology.mxd, version 9/16/13 (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.