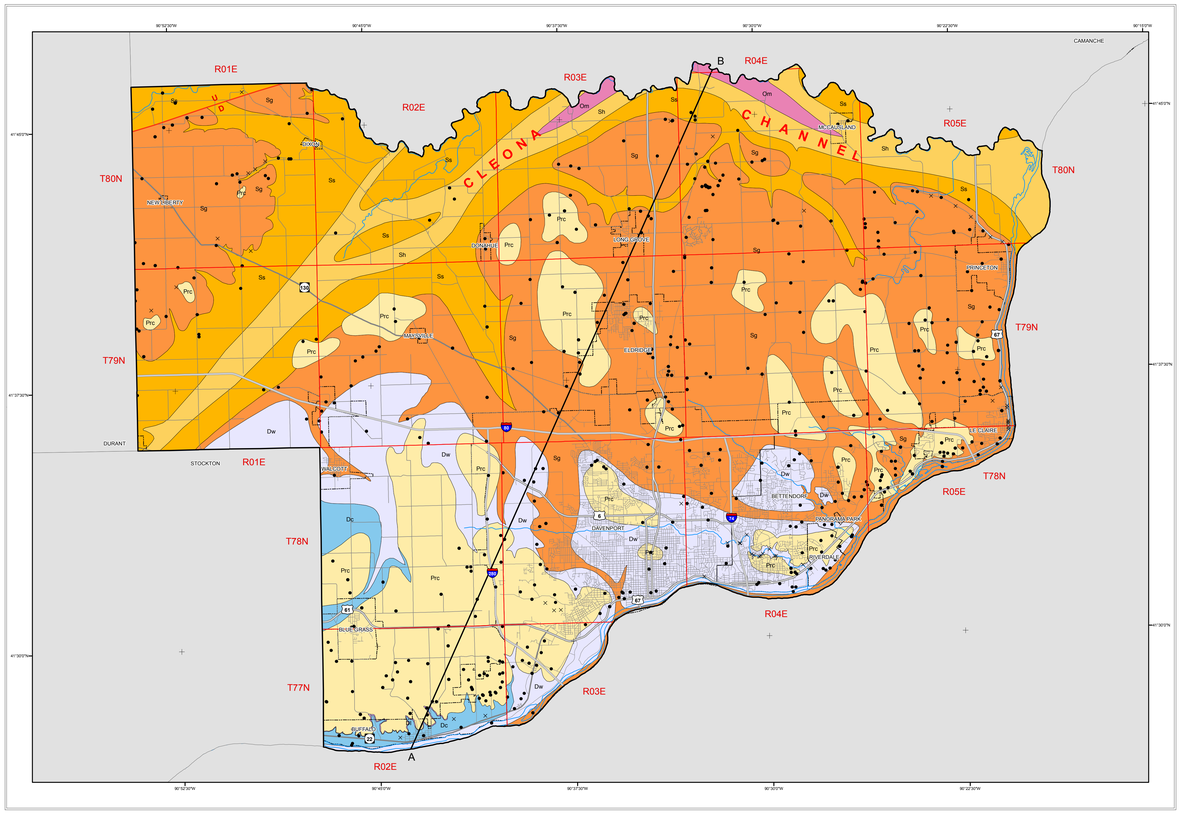
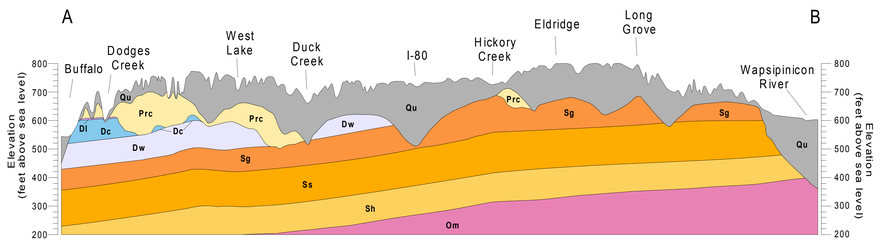
Bedrock Geology of Scott County, Iowa



GEOLOGIC CROSS-SECTION A-B



LEGEND

CENOZOIC

QUATERNARY SYSTEM

Qu – Undifferentiated unconsolidated sediment Consists of loamy soils developed in loess and glacial till of variable thickness, and alluvial clay, silt, sand, and gravel. Maximum thickness can be up to 390 ft (119 m) in the western part of the county where Qu fills the deeply buried bedrock valley of the Cleona Channel. This unit is shown only on the cross-section and not on the map.

PALEOZOIC

PENNSYLVANIAN SYSTEM

Prc - RACCOON CREEK GROUP (primarily Morrowan; locally includes Atokan-lower Desmoinesian Tradewater Formation in upper part). Recognized only in eastern Iowa in Scott and Muscatine counties; includes in ascending order the "Caseyville" and Tradewater formations. Rests unconformably on older map units in the county and fills paleovalleys and paleokarst developed in underlying Silurian and Devonian carbonate rocks. Primary lithologies are: shale/mudstone, light to dark gray, partly silty to sandy; sandstone, very fine to medium-grained; siltstone, gray. Secondary lithologies are: carbonaceous shale/mudstone, gray to black; phosphatic black shale; limestone, dense, partly fossiliferous, partly sandy; coal (beds locally > 2 ft). Minor lithologies are: sandstone, coarse-grained to granular, partly conglomeratic; mudstone, red to pink; limestone concretions (may be septarian); cone-in-cone limestone; siderite/ironstone concretions and pellets; pyritic. Maximum thicknesses: 195 ft (59 m).

DEVONIAN SYSTEM

Dl - LIME CREEK FORMATION (Upper Devonian, upper Frasnian). The formation is comprised entirely of the Sweetland Creek Shale in the southwest portion of the county. Primary lithologies are light green to brown shale and green siltstone containing an abundant and diverse fossil conodont fauna. Maximum thickness up to 12 ft (4 m).

Dc – CEDAR VALLEY GROUP (Middle-Upper Devonian, middle Givetian-lower Frasnian). The group includes in ascending order the Little Cedar, Coralville, and Lithograph City formations. Primary lithologies are: fossiliferous limestone, with an abundant and diverse invertebrate fauna, variably argillaceous, partly biostromal; and dolomite, partly fossil-moldic to vuggy, variably argillaceous. Maximum thickness of 85-90 ft (26-27 m) occurs in the southwest portion of the county near Buffalo.

Dw - WAPSIPINICON GROUP (Middle Devonian, upper Eifelian-middle Givetian). The group includes in ascending order the Bertram, Otis, and Pinicon Ridge formations. Primary lithologies are: dolomite, partly laminated, variably argillaceous, part fetid; and limestone, dense, "sublithographic," partly laminated to intraclastic; dolomite, fossil-moldic to vuggy (lower Otis Fm). Secondary lithologies are: limestone/dolomite breccia (evaporite collapse, upper limestone, Pinicon Ridge Fm); dolomitic shale and shaly dolomite, gray to green-gray, partly silty-sandy; limestone, partly peloidal-oolitic to fossiliferous (Otis Fm). Minor lithologies are: chert and chalcedony nodules (Pinicon Ridge Fm); and sandstone, fine to medium with larger dolomite clasts (Bertram Fm). Maximum thicknesses of 112 ft (34 m).

SILURIAN SYSTEM

Sg - GOWER FORMATION (Lower-?Upper Silurian, Wenlock-?Ludlow). The formation includes Anamosa and LeClaire members; LeClaire Member can be a fossiliferous carbonate mound facies or a horizontally stratified fossil-moldic facies. Erosionally beveled and truncated beneath Dw. Primary lithologies are: laminated to stromatolitic dolomite (Anamosa Mbr), part fetid/organic; dolomite mudstone, dense, featureless. Secondary lithologies are: dolomite, fossiliferous to vuggy, moldic,; dolomite, partly coarsely crystalline, vuggy, fossiliferous to sparsely fossiliferous, part crinoidal and coralline (LeClaire Mbr). Minor lithologies are: chert; intraclastic dolomite. Maximum thickness occurs at LeClaire, 150 ft (46 m); thins to the southwest to 70 ft (21 m) at Blue Grass.

Ss - SCOTCH GROVE FORMATION (Lower Silurian, upper Llandovery-lower Wenlock). The formation includes the Johns Creek Quarry, Welton, Buck Creek Quarry, Waubeek, and Palisades-Kepler members. The bulk of the formation is comprised of the finely fossil-moldic Welton Member. Carbonate mound facies of the Palisades-Kepler Member are replaced laterally by inter-mound strata of the Waubeek Member. Everywhere overlain by the Gower Formation. Primarily lithologies are: dolomite, porous, fossil-moldic to vuggy, part very crinoidal (includes Welton Mbr); dolomite, cherty to very cherty, dense (Buck Creek Quarry Mbr). Secondary lithologies are: dolomite, sparsely fossil-moldic, dense, part vuggy (includes Waubeek Mbr); dolomite, coarsely crystalline, part very crinoidal (within Johns Creek Quarry and Palisades-Kepler mbrs); dolomite mudstone, dense. Minor lithologies are: dolomite, slightly argillaceous; quartz druse, chalcedony, silicified fossils. Maximum thicknesses of 150 ft (46 m).

Sh – HOPKINTON AND BLANDING formations (Lower Silurian, ?Rhuddanian, Aeronian-upper Llandovery. The Blanding Formation marks the base of the Silurian in the county and is overlain by the substantially thicker Hopkinton Formation. The map unit is at the bedrock surface only within the deeply buried bedrock valley (Cleona Channel) in the northern and western part of county. Primary lithologies are: dolomite, fossil-moldic to vuggy, fine to coarse crystalline; dolomite, dense to porous, cherty to very cherty, nodular to bedded chert (especially Blanding Fm). Maximum map-unit thicknesses of 110 ft (35 m); Hopkinton 95 ft (30 m); Blanding 15 ft (5 m).

ORDOVICIAN SYSTEM

Om - MAQUOKETA FORMATION (Upper Ordovician; Richmondian [upper Katian]). The formation includes in ascending order the Elgin, Clermont, Fort Atkinson, and Brainard members. The map unit is at the bedrock surface only within the deeply buried bedrock valley (Cleona Channel) in the northern part of county. Primary lithologies are: shale, green-gray, variably dolomitic, mostly unfossiliferous; dolomite, argillaceous, partly shaly, variably fossiliferous; dolomite, partly argillaceous, partly cherty. Secondary lithologies are: shale, brown to brown-gray, organic, partly graptolitic, partly finely laminated (lower strata); interbedded dolomite and shale, partly fossiliferous. Minor lithologies are: dolomite, phosphatic, argillaceous (Elgin Mbr). Maximum thicknesses of 210 ft (64 m).

IOWA CITY - CLINTON FAULT ZONE A normal, probably near vertical fault zone, trending through the northwest corner of the county with relative movement up on the north side and down on the south side. Although not exposed, the fault has approximately 100-150 ft (30-45 m) of stratigraphic offset.

Drill Holes to Bedrock

Outcrop

Base map from iowa DOT Road Map Layers 2009.

Iowa Geological and Water Survey digital cartographic file ScottCounty_BedrockGeology2011.mxd, version 9/28/11 (ArcGIS 10.0)
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.

Introduction to the Bedrock Geology of Scott County, Iowa

Scott County lies mostly within the Southern Iowa Drift landform region of eastern Iowa, an area of moderate topographic relief developed on eroded Illinoian and Pre-Illinoian glacial deposits, Wisconsinan loess, and Paleozoic bedrock formations (Prior, 1991). Norton (1899) first described and mapped the Quaternary and Paleozoic bedrock geology of the county and discussed the stratigraphy of the Pennsylvanian, Devonian and Silurian strata that comprise the county's bedrock units. Statewide bedrock geologic maps by Hershey (1969) and, most recently, by Witzke, Anderson, and Pope (2010) depict the increased understanding of the distribution of geologic units at the bedrock surface across this region, including Scott County.

Bedrock exposed at the land surface is restricted to small areas in the eastern, north-central, southern, and northwestern portions of the county. All rock outcrops and quarries are located in close proximity to surface topographic lows coincident with the modern drainages of the Mississippi and Wapsipinicon rivers and their tributaries Duck Creek, Walnut Creek, McDonald Creek, and Dodges Creek. Throughout the remainder of the county bedrock is covered by moderately thick deposits of glacial sediments and bedrock formation distribution is known solely from water well drilling samples and rock cores.

The distribution of bedrock map units is dominantly influenced by the extremely gentle south to southwest dip of bedrock strata, approximately 12 feet per mile, in combination with the bedrock topography and the large-scale unconformity between Pennsylvanian strata and older Devonian and Silurian formations. In the eastern part of the county the topography of the bedrock surface is controlled by a network of Pleistocene-age bedrock valleys and uplands. In the western and northern part of the county the bedrock surface is deeply incised by a major bedrock valley called the Cleona Channel (Norton, 1899). The Cleona Channel is filled with Pre-Illinoian glacial tills and possibly represents a former channel of an ancestral Mississippi River.

The oldest unit at the bedrock surface is the Maquoketa Formation, a thick sequence of shale and dolomite. The Maquoketa is not exposed in outcrop; it subcrops over a small area along the axis of the Cleona Channel and is covered by several hundred feet of Quaternary deposits.

Silurian strata comprise the largest area of the bedrock surface across the county. Witzke (1994) provides the best discussion of the Silurian stratigraphy for the county. The oldest Silurian map unit, the combined Hopkinton and Blanding formations, is restricted in subcrop to the deeper portions of the Cleona Channel. This unit, composed of cherty and moderately fossiliferous dolomite, is reached by the deeper Silurian water wells across the county. Witzke (ibid.), using drill cuttings, logs and core, provided a brief characterization of the Hopkinton and Blanding formations in Scott County and neighboring Clinton County. The Scotch Grove Formation, primarily a moderately to abundantly fossil-moldic dolomite, occurs across the county above the Hopkinton-Blanding except where it is truncated within the Cleona Channel system. The Scotch Grove is an important aquifer, and its upper portion is quarried for construction aggregate. The Gower Formation overlies the Scotch Grove Formation and is the most widespread surfacal bedrock map unit across the county. It is a laminated (Anamosa Member) to moderately fossiliferous (LeClaire Member) dolomite that attains maximum thickness in the eastern portion of the county at LeClaire. The LeClaire Member may be horizontally bedded but also may exhibit prominent "mounding" where fossiliferous beds may dip up to 45 degrees; horizontally bedded and laminated Anamosa Member may occur laterally to the mounded LeClaire Member. Construction aggregate is produced from several large quarries in the Gower Formation from the northern half of the county.

Devonian strata of the Wapsipinicon Group, the Cedar Valley Group, and the Lime Creek Formation comprise Mid-Paleozoic bedrock map units across the southern half of the county. The Wapsipinicon Group outcrops at numerous points in Davenport and Bettendorf along the Duck Creek drainage, and the group's uppermost division, the Davenport Member, is named for those exposures. The group contains limestone, dolomite, and minor shale; is partly brecciated; and is underground mined at Buffalo where it is an important source of high-calcium limestone, high-quality aggregate, and portland cement feedstock. Day (2006) and Witzke and Bunker (2006) summarize the stratigraphy and paleontology of the Wapsipinicon Group in the area. The overlying Cedar Valley Group is restricted to the southwest part of the county. Near the town of Buffalo a thick succession of fossiliferous Cedar Valley limestones are quarried for portland cement production, and several investigations of the excellent exposures at the LaFarge Corporation quarry describe numerous aspects of the group (Day, 2006; Witzke and Bunker, 2006). The youngest Devonian map unit is the Lime Creek Formation, a thin shale unit that lies unconformably above the Cedar Valley Group in the southwest corner of the county. In southeast Iowa, the Lime Creek is comprised entirely of the Sweetland Creek Shale. Bunker and Witzke (1992) discuss the regional stratigraphy of the Lime Creek and Sweetland Creek, and Over (2006) provides a recent description of the type section in adjacent Muscatine County.

Pennsylvanian System strata of the Raccoon Creek Group comprise the youngest bedrock map unit in the county. Raccoon Creek strata rest unconformably on Silurian Scotch Grove and Gower formations, and all Devonian groups and formations. The lower portions of the Raccoon Creek Group fill paleokarst and paleovalleys developed on the underlying Silurian and Devonian carbonate rocks and contain, at certain localities, superb fossil plant assemblages (Leary, 1994). The name Raccoon Creek Group has recently been introduced into Iowa by Pope and Anderson (2009) and Pope (2011); their revised nomenclature is employed by Witzke, Anderson, and Pope (2010). The Raccoon Creek Group, comprised of the Caseyville and Tradewater formations, is dominated by shale, mudstone, and sandstone with subordinate coal and minor limestone. Historic coal and clay production came from underground mines and surface pits within the Raccoon Creek group.

References

Bunker, B. J., and Witzke, B.J., 1992, An upper Middle through lower Upper Devonian lithostratigraphic and conodont biostratigraphic framework of the Midcontinent Carbonate Shelf area, Iowa, *in* Day, J. and Bunker, B. J. (eds.), The stratigraphy, paleontology, depositional and diagenetic history of the Middle-Upper Devonian Cedar Valley Group of Central and eastern Iowa: Iowa Department of Natural Resources, Geological Survey Bureau, Guidebook Series No. 16, p. 3-25.

Day, J., 2006, Overview of the Middle-Upper Devonian sea-level history of the Wapsipinicon and Cedar Valley groups, with discussion of new conodont data from the subsurface Cedar Valley Group of southeastern Iowa, *in* Day, J., Luczaj, J., and Anderson, R. (eds.), New perspectives and advances in the understanding of lower and middle Paleozoic epeiric carbonate depositional systems of the Iowa and Illinois basins: Iowa Geological Survey Guidebook Series No. 26, p.3-21.

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

Leary, R. L., 1994, Paleobotany of Pennsylvanian channel fills at Allied Quarry, *in* Bunker, B.J. (ed.), Paleozoic Stratigraphy of the Quad-Cities Region East-Central Iowa, Northwestern Illinois: Geological Society of Iowa Guidebook 59, p. 85-98.

Norton, W. H., 1899, Geology of Scott County: Iowa Geological Survey, Annual Report, v. 9, p. 389-520.

Over, D.J., 2006, Frasnian-Famennian boundary at the type Sweetland Creek Shale locality, *in* Day, J., Luczaj, J., and Anderson, R. (eds.), New perspectives and advances in the understanding of lower and middle Paleozoic epeiric carbonate depositional systems of the Iowa and Illinois basins: Iowa Geological Survey Guidebook Series No. 26, p.75-79.

Pope, J.P. and Anderson, R. A., 2009, Revision of stratigraphic nomenclature and reclassification of the Morrowan, Atokan, Desmoinesian, Missourian, and Virgilian stages in Iowa: Geological Society of America Abstracts with Programs, v. 41, No. 2, p. 33.

Pope, J.P., 2011, Description of units, revision of stratigraphic nomenclature, and reclassification of the Morrowan, Atokan, Desmoinesian, Missourian, and Virgilian stages (Cherokee, Marmaton, Bronson, Kansas City, Lansing, Douglas, Shawnee, and Wabaunsee groups) in Iowa: manuscript submitted and under review, Iowa Geological and Water Survey, 131p.

Prior, J. C., 1991, Landforms of Iowa: University of Iowa Press, 153 p.

Witzke, B. J., 1994, Silurian Stratigraphy in the Quad Cities Area, Iowa-Illinois, *in* Bunker, B.J. (ed.), Paleozoic Stratigraphy of the Quad-Cities Region East-Central Iowa, Northwestern Illinois: Geological Society of Iowa Guidebook 59, p. 3-15.

Witzke, B. J., and Bunker, B.J., 2006, Stratigraphy of the Wapsipinicon Group (Middle Devonian) in southeastern Iowa, *in* Day, J., Luczaj, J., and Anderson, R. (eds.), New perspectives and advances in the understanding of lower and middle Paleozoic epeiric carbonate depositional systems of the Iowa and Illinois basins: Iowa Geological Survey Guidebook Series No. 26, p.47-58.

Witzke, B. J., and Bunker, B.J., 2006, Middle shelf facies of the Cedar Valley Group (Devonian) and their stratigraphic relationships in eastern Iowa, *in* Day, J., Luczaj, J., and Anderson, R. (eds.), New perspectives and advances in the understanding of lower and middle Paleozoic epeiric carbonate depositional systems of the Iowa and Illinois basins: Iowa Geological Survey Guidebook Series No. 26, p.23-46.

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 or printed Map Series, no. M-22.

Location Map

BEDROCK GEOLOGY OF SCOTT COUNTY, IOWA

Iowa Geological and Water Survey
Open File Map OFM-11-04
September 2011

prepared by

Robert M. McKay, Huaibao Liu, Stephanie Tassier-Surine, and James Giglierano

Iowa Geological and Water Survey, Iowa City, Iowa

Iowa Department of Natural Resources, Roger Lande, Director
Iowa Geological and Water Survey, Robert D. Libra, State Geologist

Supported in part by the U.S. Geological Survey
Cooperative Agreement Number G10AC00423
National Cooperative Geologic Mapping Program (STATEMAP)

ACKNOWLEDGMENTS

New subsurface geologic data was partly generated by University of Iowa student Kyle Bracken who produced descriptive logs of water well drilling samples. Thanks to Riverstone Group Inc., Linwood Mining and Minerals Corp., and LaFarge Corporation for access to and information about quarries in the county. Deborah Quade (IGWS) lent support with Quaternary field and office expertise; Jason Vogelgesang (IGWS) prepared well samples for stratigraphic logging; Ray Anderson and Brian Witzke (IGWS) provided valued information concerning the bedrock topography, geology, and Paleozoic stratigraphy of the area; and Bill Bunker and Andy Ausell (IGWS) provided GIS mapping technical help.

Correlation of Map Units

AGE (Ma)	SYSTEM	SERIES	STAGE	MAP UNIT
2.58	QUATERNARY	Pleistocene		Qu
	major unconformity			
307	PENNSYLVANIAN	Middle	Desmoinesian	
			Atokan	Prc
312		Lower	Morrowan	
318	major unconformity			
375	DEVONIAN	Upper	Frasnian	Dl
385			Givetian	Dc
390		Middle		Dw
395			Eifelian	
	major unconformity			
423	SILURIAN	Upper	Ludlo	Gorstian	
			Wenlockian	Homerian	Sg
428				Sheinwoodian	Ss
436		Lower	Llandoverian	Telychian	Sh
439				Aeronian	
				Rhuddanian	
445	ORDOVICIAN	Upper	Cincinnatian	Gamachian	
450				Richmondian	Om
				Maysvillian	
				Edenian	