Brown County

Wisconsin

Shaded Relief Map

Brown County's Landscape

does not have mountains or deep canyons.

However, there are plenty of interesting landforms.

A shaded relief map like this one will highlight features of the landscape that you may not have known existed. Study this map and you will find plenty of interesting landforms that have both natural and human origins.

Several noteable landforms are listed below, along with an index to the map. Use the letters and numbers found along the edge of this map (much like the 'battleship grid') to find the following features on the map:

Bedrock features

"The Ledge"

The Niagara Escarpment is one of the well-known landforms in Brown County. It is most prominent on this map near N-18 in the aptly-named Town of Ledgeview. The escarpment consists of bedrock called Niagara Dolomite that is more resistant to erosion than the surrounding rock types. This formation is essentially the same one that forms much of the Door Peninsula, and it arcs all the way around Georgian Bay on Lake Huron and back to the south-southeast between lakes Erie and Ontario--where Niagara Falls plummets from the escarpment (hence the name).

Ice Age features

Thousands of years ago, the great glaciers of the Ice Age left their marks all over Brown County with many different types of landforms. Ice flowed from the north, advancing and retreating many times. At least four major "episodes" of glacial advance and retreat are recorded in the land formations and deposits of the county.

Drumlins

One tell-tale sign of past glacial activity is a landform known as a "drumlin". These streamlined, elongated hills tell a lot about a glacier, including the direction of ice flow. There are many drumlins in Brown County but there is one particularly interesting "drumlin field" on this map at N-29 in the Town of Morrison. There are dozens of drumlins in this area, and they are part of the Wayside Member of the Horicon Formation, the oldest episode of glacial activity seen in Brown County from the last ice age. Note that the direction of these drumlins trends different than other drumlins from younger deposits to the north such as in Pittsfield at coordinate E-6 on this map.

Moraines

Ice sheets receded and again advanced. This next "episode" did not advance as far to the south as the previous; in fact, the prominent east-west trending "terminal moraine" along Park Road in Morrison (refer to coordinate N-27 on this map) marks the limit of this ice advance. When the ice stops moving, it leaves linear areas of hummocky terrain at the front edge of the glacier. These areas are known as "end" or "terminal" moraines.

Other moraines that can be seen in Holland and Wrightstown (look in the vicinity of J-28 on this map).

Wind-blown sand dunes

Large areas of thick windblown sand dunes up to 145 feet thick were deposited near the end of Reforestation Road (I-1) and are related to the second to last ice episode in in Brown County.

11,000 year old trees

Prior to the final advance of ice across Brown County and eastern Wisconsin (about 11,000 years ago), a coniferous forest grew and deposited a well- defined layer of forest materials.

The last advance of ice buried this forest under many feet of thick clay that prevented air from facilitating wood rot and decay. Through erosion and excavation, many intact pieces of this wood have been unearthed in Brown County--wood that looks and feels much younger than 11,000 years of age. This layer can be seen along quarry walls and other deep excavations in many parts of eastern and northeastern Brown County.This buried forest is very unique in it's formation, age, preservation, and what it tells us about the conditions of this area during the Ice Age. This layer is known as the "Two Creeks buried forest" and it has has been the subject of many studies and glacial geology textbooks worldwide.

Features left by the final advance of glacial ice

The last episode of ice advance deposited the Denmark Moraine-an east-west line of hummocky terrain near T-23 that begins to trend somewhat north-south through eastern Wrightstown and Holland Townships, north and west of the older terminal moraines.

Other features left by this youngest episode include the Duck Creek Ridge (near H-9) and Platton & Burton Hills in the same vicinity.

High water

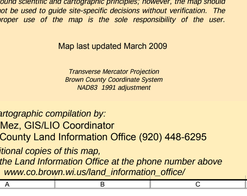
Liquid water also played a major role in shaping Brown County. In addition to the modern rivers, lakes and streams that erode or deposit landforms today, there are several interesting events in natural history that are evident on this map:

Glacial lakes and abandoned outflow channels

Whenever the natural drainage of water to the north was blocked by thick glaciers in the Bay, water ponded against the ice in the Fox River Lowland forming "proglacial lakes". "Glacial Lake Oshkosh" reached a depth of about 220 feet above the present level of the Bay, easily covering much of Brown County under water. At its maximum depth, this lake probably drained west and into the Wisconsin River near Portage and on to the Mississippi River. As the glacier retreated to the north, a lower part of the Niagara Escarpment at S-17 (near Hwy I-43, 29 and R) was exposed and water catastrophically burst through to create a new outlet to the southeast and on to Lake Michigan. Presently, the Neshota River flows through this valley but it is evident on this map that this much larger water source is responsible for cutting this channel. Other large glacial lake outflow channels can be seen on this map in the vicinity of X-6. Even lower elevations along the Escarpment exist to the north (such as the Ahnapee River valley) and these too became outlets to Glacial Lake Oshkosh as the glacier receded. By the time the ice retreated north of Sturgeon Bay, Glacial Lake Oshkosh ceased to exist.

Abandoned Shorelines

Long after the glaciers retreated back into Canada, there were other natural processes that caused the water levels of Lake Michigan and the Bay to fluctuate. One particularly long period of high water occurred between 5000 and 6000 years ago. This "stage" of the Great Lakes is known as the "Lake Nipissing" level and was about 27 feet higher than the present level of Lake Michigan and the Bay. This elevated shoreline is evident on this map in the form of wave-out shoreline terraces at N-12 (near Crooks St in downtown Green Bay) as well as the ridge near Mason & Gross that angles northeast to Shawano and Oneida streets (K-11). Other shoreline features from this elevated lake level can be found along Nicolet Drive (S-9) and many other areas.



"Nipissing" level of Lake Michigan and Green Bay. This elevated lake stage existed about 5000 to 6000 years ago, long after the glaciers receded.

It covered much of modern-day areas of Suamico, Howard Green Bay, Allouez Bellevue & Ledgeview

Human impacts to the landscape

Humans have also impacted the landscape features of the County:

Quarries

Quarries are visible at U-9, P-19 and several other places where people have mined the bedrock of the Niagara Escarpment or the sand & gravel left behind by the glaciers and actions of water.

Waterborne Commerce

Coal piles at M-13, M-10 and N-13 made it onto this map. These large coal piles help to fuel the paper industry and are left by ships between 600-800 feet in length. These huge freighters require water depths of more than 20 feet to traverse the Bay and Fox River. Dredging of the shipping channel to this depth can be clearly seen on the deep blue "bathymetric" color shading on this map. Commercial shipping no longer occurs south of Georgia-Pacific (M-13,) but the remnants of the system of locks, dams, and canals that once connected the Green Bay and the Great Lakes to the Fox-Wisconsin-Mississippi waterways are still seen at J-16, H-21 and D-25.

Airport

The runways of Austin Straubel International Airport can be seen as built-up, flat, linear features near G-13.

Portions of the above text were paraphrased from these sources:

Need, Edward, 1985, "Pleistocene Geology of Brown County, Wisconsin" UW-Extension: Wisconsin Geological and Natural History Survey

Farrand, William, 1988 Bulletin 4: "The Glacial Lakes around Michigan" University of Michigan

Legend

- Municipal Boundaries
- Major Highway
- Other Highway
- Local Road or Street
- Multi-Use Trail
- Private Road or Street
- Railroad
- Unofficial Road or Street

LANDMARKS

- Airport
- Campground
- Cemetery
- Church
- School / College
- Golf
- Government
- Hospital
- Mall
- Marina
- Mile Marker
- Navigational Aid
- Hamlet
- Summit

- Lakes, Ponds, & Rivers
- Rivers & Streams
- Wetland

High: 1022 feet — Surface Elevation* (referenced to NGVD)

Low: 579 feet — Low-water datum of the Bay of Green Bay

Shallow: 1' foot

Bathymetry** (depth below the surface of the water)

Deep: 32 feet

Woodlands, wetlands, parks and other natural areas are shown as "blocky" shades of green on top of the elevation surface.

*An exaggerated "hillshade" effect has been added to the Digital Elevation Model (DEM) to provide a 3-D "relief" appearance.

**Bathymetry is the depth below the surface of the water.

Map/GIS Data Sources include:
Brown County LiO consortium (elevation data)
Brown County Planning Department (land use & streets)
Wisconsin Department of Natural Resources (hydrography)
Wisconsin Dot (roads & land use)
National Oceanic & Atmospheric Administration (NOAA)

N

0 0.5 1 2 Miles

This map and corresponding text are a compilation and interpretation of the data available at the time of preparation. Every reasonable effort has been made to ensure that this interpretation conforms to sound scientific and cartographic principles; however, the map should not be used to guide site-specific decisions without verification. The proper use of the map is the sole responsibility of the user.

Map last updated March 2009

Transverse Mercator Projection
Brown County Coordinate System
NAD83 1991 adjustment

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For additional copies of this map, contact the Land Information Office at the phone number above or visit: www.co.brown.wi.us/land_information_office/

This map has its root in an aerial photo project that was conducted in April, 2000. From the aerial photos, "photogrammetry" was used to extract detailed elevation values to create a "Digital Terrain Model (DTM)". This DTM is the most comprehensive, accurate and detailed terrain mapping that was ever conducted in Brown County. This DTM was used for a variety of purposes ranging 2-foot contour mapping in various communities. The DTM was also used to remove distortion from the aerial photography to make a map-accurate "orthophoto" image, as well as other projects ranging from flood mapping, stormwater management planning, utility design, area development planning, road planning (cut and fill problems, cost estimation, line of sight) as well as environmental protection (runoff and soil erosion modeling) and many other purposes. It saves money by providing the people who need this kind of information with readily-accessible data and greatly reduces the need to perform costly field surveys for each and every project.

However, not all areas of the County were mapped with the same level of elevation detail. Most of the metropolitan areas of Green Bay had a DTM that supports 2-foot contours; while most of the rural areas do not have as much precision. If you look closely, you may see that the terrain appears a little "sharper" and crisper in the metro area, while rural areas like Glenmore have a slightly softer appearance. This is due to the elevation mapping precision and methodology differences, not necessarily to the actual terrain. Despite these differences in mapping techniques and precision, this elevation product is still the most detailed elevation map ever produced for Brown County. Even in the rural areas, there is more elevation precision than what the 1:24,000 scale USGS "Quad" maps provide.

This particular map is called a "shaded relief map" that was created using GIS and related technologies. The GIS was used to combine various geographic data sets such as elevation data, streets, land use, and other "layers" of data and quickly turn it into easy-to-use information that can be readily visualized and used. To create this map, the elevation data was imported into a grid surface with a 20 foot cell size. Each grid cell was then color coded based on its elevation. A hillshade effect was then applied in order to highlight ridges and hills using a shadowing effect. GIS layering was then used to add streets, wetlands, streams, and other features onto this elevation base map. Certain layers such as land use and land cover were given a slightly transparent setting so that the elevations would show behind them.

The software used to create this map included the ArcGIS 8.3 suite of products: *ArcSDE database with Microsoft SQL Server as the RDBMS to manage several gigabytes of data; ArcMap for display and cartography; 3-D Analyst Extension was used to create an elevation TIN from the DTM data, as well as to mosaic it into a countwide 20 foot Digital Elevation Model (DEM); Spatial Analyst extension was used to input the DEM and export the "hillshade" effect. Also, the NOAA Bathymetric data was converted to a GRID using Spatial Analyst.

This map highlights just a few of the facets of Brown County's Geographic Information System (GIS)

What is GIS?

"A GIS is a tool for mapping and analyzing things that exist and events that happen on earth. GIS technology integrates common database operations such as query and statistical analysis with the unique visualization and geographic analysis benefits offered by maps." Well, that's one book definition anyway. Read on.

Why use GIS?

It has been estimated that as much as 90% of the information that local governments require on a day-to-day basis is geographic or land-related in nature: tax parcels, addresses, real estate documents, roads, zoning, utilities, land use, and emergency response areas are just a handful of examples. GIS has the unique ability to tie these and other information together in a common system that can be easily visualized, used, and shared. Most of the County's basic services rely directly or indirectly on complete, accurate, and up-to-date land records.

Brown County's land records system is not new. When Wisconsin's governmental units were organized in the early-mid 1800's, Wisconsin and Brown County's surveying, real estate, and record/keeping systems were among the best in the world, given the technology of the time. However, over the next 100+ years, the paper-based land records system grew unwieldy, outdated, and inefficient to use.

By the 1970's, there were several initiatives to "modernize" land records at all levels of government through the use of computer technology. In 1978, the Wisconsin Department of Administration, in cooperation with the University of Wisconsin, inventoried and analyzed the technical and institutional impediments that limited the access and use of various public records. In this report, the inefficiencies of the existing system were translated into higher costs to taxpayers. Pressures to modernize also came from the private sector, such real estate, assessment, engineering, surveying, and other businesses that rely on land records for day-to-day business transactions.

In 1985, Governor Anthony Earl created the Wisconsin Land Records Committee by Executive Order #79. The conceptual model for a "land records modernization" program was developed by the WLRC and synthesized in their final report to the governor in 1987. The report recommended implementation of a Wisconsin Land Information Program for modernizing the land records at all levels of government.

Wisconsin Land Information Program

In 1989, the Wisconsin Legislature and the Governor created with assistance from the land information community began a collective journey to transform land information from a 150-year old, non-integrated, paper-based institution into a digital world reflective of, and in step with, the Information Age. Wisconsin Act 31 established the Wisconsin Land Information Board (WLIB) and created the Wisconsin Land Information Program (WLIP). Under this program, all 72 counties established a local Land Information Office as defined in State Statutes 59.72 and 59.43. One of the WLIB's charges was to fund the WLIP entirely through user fees on real estate documents recorded in the County Register of Deeds office rather than the general tax levy.

The goal of this program is to help reduce or eliminate the operating expenses that would otherwise be incurred by other departments and the tax levy due to duplication of effort as well as inefficient storage, access, and use of land information (maps, databases, etc).

Brown County Land Information Office (LIO)

The Brown County Board established a county Land Information Office (LIO) in 1990. The objective included the facilitation of the development of a fully integrated geographic information system. With an established Land Information Office, the County became eligible to retain a portion of the fees collected with real estate document recordings. Additionally, the establishment of a County LIO became eligible under the WLIP to apply for grants on behalf of itself or on behalf of municipalities within the county.

LIO Committee

The County Board also established an LIO Committee under the Planning, Development, and Transportation Committee of the Board.

The LIO Committee is comprised of individuals from County offices that use or maintain the land records that are part of the overall GIS system.

The LIO Committee also has a County Board member from the PDT Committee, as well as two County Executive appointments, currently these appointments are filled by one member of a Brown County Municipality and one person from the Private sector.

GIS/LIO Coordinator

The GIS/LIO Coordinator was originally located in the Planning Department, but moved to the Information Services Department in 1999.

This position is fully funded by the Land Information Program revenues.

The GIS/LIO Coordinator is charged with coordinating and implementing land records modernization & GIS activities within and between County departments, local municipalities, utilities, the private sector and the general public.

Every county in the State now has a Land Information Officer performing similar duties.

Benefits & Successes of the program

The success of the Land Records Modernization (LRM) and LIO Programs is significant and measurable . For example, over the last 18 years, the workload of the Brown County Register of Deeds office increased by 300% – but there has been no increase in staffing during this time! This kind of efficiency is a direct benefit of the LRM program. Improved technology provided through the program has made the County staff more productive, and a tremendous amount of information is being offered on the Internet so customers can help themselves.

As the program has grown and expanded, the use of information generated as a result has increased greatly. Today current, modernized geographic information is being used in applications ranging from emergency management and E-911 support to land conservation, comprehensive land use planning, and transportation analysis.

The benefits of the program are not limited to internal efficiencies within County government; the private sector and the general public have benefited as well. Each year in Brown County, the LIO group processes thousands of requests for modernized base maps, document images, GIS databases and other modernized land records from private business such as real estate, engineering, architecture, and utility companies.

The program has vastly improved upon Wisconsin's rich tradition in openness in government by giving businesses and citizens the means to view open records from the comfort of their home or office rather than having to make a trip downtown. The program has increased accessibility to public information not only in terms of reducing trips to government offices, but also by allowing users to query a centralized, integrated, up-to-date computer database, thus shortening the time spent searching the data. County records that are available on the Internet are accessible at any time to the public, not just working hours Monday through Friday.

The use of new technologies has greatly improved the accuracy and completeness of many records. Brown County now routinely uses modern technology in the form of global positioning system (GPS) receivers for land surveying and digital orthophoto images for base mapping. Geographic Information System (GIS) software has the unique ability to collect, store, connect, and integrate all sorts of geographically-referenced information. We can now link land ownership, address, tax, and assessment records with zoning, soils, wetlands and more into a single system.

Several other significant accomplishments of the program are starting to be realized. A more complete list of noteworthy accomplishments can be obtained by request to the Land Information Office (920-448-6295) or by visiting: www.co.brown.wi.us/Land_Information_Office/

"Portions of this text were paraphrased from the "Wisconsin Land Council & the Wisconsin Land Information Board: Report to the Governor and Legislature: An evaluation of the Functions, Activities, and Future Directions" September 2002 and from Environmental Systems Research Institute (ESRI.com)