Wisconsin Geological and Natural History Survey
DIVISION OF EXTENSION
UNIVERSITY OF WISCONSIN–MADISON

Hydrogeologic atlas of Burnett County, Wisconsin

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Supplemental material

The data and accompanying materials for this publication are available for download from the WGNHS Publications Catalog at: https://doi.org/10.54915/wxef8967.

Dataset 1: GIS data

A file geodatabase (.gdb file format) with water-table map features and depth-to-bedrock points; raster datasets of depth to water, depth to bedrock, recharge, and groundwater susceptibility.

Plate 1: Map of water-table elevation

Map (.pdf file format) of Burnett County showing water-table elevation contours, direction of shallow groundwater flow, well locations, and areas where surface-water elevations are above well-water elevations.

Plate 2: Map of groundwater susceptibility to contamination

Map (.pdf file format) of Burnett County showing relative groundwater susceptibility to contamination from near-surface sources.

Abstract

This hydrogeologic atlas offers a comprehensive interpretation and analysis of groundwater resources across Burnett County, Wisconsin, primarily constructed from existing data sources. It encompasses assessments of the water-table elevation and groundwater flow directions (plate 1); depth to the water table (fig. 4); thickness of unconsolidated materials, or depth to bedrock (fig. 5); distribution of groundwater recharge (fig. 6); relative vulnerability of groundwater to contamination (plate 2); and hydrogeologic cross sections (figs. 8–10).

The primary aquifer supplying wells in Burnett County is composed of surficial sediments left by glaciers and modern streams. The glacial sediments, which consist of outwash, till, and lake sediments, are widespread across the county and were deposited by the Superior Lobe and the Grantsburg Sublobe during the Wisconsin Glaciation. Uplands with sandy outwash sediments are the dominant areas of groundwater recharge, where precipitation infiltrates with ease and travels past the soil root zone to the water table. Regions with coarse sands located at or near the surface are particularly susceptible to the rapid transport of contaminants from the surface. In contrast, the presence of clay at the surface restricts how quickly groundwater can recharge and may hinder the downward movement of contaminants to the water table. Therefore, the presence of clay-rich tills and lake sediments is essential for providing natural protection to the aquifers and wells in Burnett County.

The groundwater susceptibility map (plate 2) estimates the degree and distribution of areas that are naturally prone to contamination from pollutants at the land surface. Factors that enhance groundwater susceptibility include (1) high groundwater recharge, (2) high permeability of surficial geologic materials, (3) shallow depths to bedrock, and (4) shallow depths to the water table. In Burnett County, the areas most at risk to groundwater contamination are characterized by sand and gravel surficial sediments and a shallow depth to the water table. Groundwater is also vulnerable to contamination in several areas of southern Burnett County where surficial sediments are thin or absent and the bedrock is near the land surface. Hydrogeologic cross sections developed in three areas with concentrated agricultural activity demonstrate that groundwater susceptibility is also dependent on local hydrogeologic conditions and the variability of surficial sediments.

The susceptibility assessment offers a qualitative framework for identifying areas within the county that may require extra preventative actions or monitoring for groundwater protection initiatives. The information provided in this atlas can effectively guide the efforts of users interested in conservation strategies aimed at maintaining or enhancing groundwater quality.

Introduction

The purpose of this hydrogeologic atlas is to provide an inventory and summary of groundwater resources in Burnett County, Wisconsin. The atlas includes maps and other interpretative materials that provide county-scale information on groundwater levels, the direction of shallow groundwater flow, and the physical properties of the landscape that influence the susceptibility of Burnett County's groundwater and water-supply wells to contamination. This atlas can function as a technical resource for local officials and land conservation managers to evaluate the potential impacts of various activities on groundwater resources and take actions that help preserve groundwater quality.

Background

This work expands on a Wisconsin Geological and Natural History Survey (WGNHS) groundwater inventory conducted in Burnett County in the late 1990s. For the 1990s groundwater inventory, WGNHS compiled the available well construction reports, constructed a 1:100,000 scale water-table map (Muldoon and Dahl, 1998), and mapped the results of a homeowner well water-testing program. The county collected samples from over 200 wells and had water analyzed for nitrate-nitrogen, chloride, alkalinity, total hardness, electrical conductivity, and ferrous iron. These measurements were presented on 1:100,000 scale maps (Bridson, 1997). Since the 1990s, Burnett County has experienced changes in land use and an increase in agricultural activity. As a result, the Burnett County Board contracted the WGNHS to update the original groundwater inventory. The results of the update are summarized in this hydrogeologic atlas.

Scope

The WGNHS completed the mapping and analysis associated with this project during 2023 and 2024. This report summarizes all components of the hydrogeologic atlas:

- Water-well locations appended with information on well construction and geology,
- Water-table map (plate 1),
- Depth-to-water-table map (fig. 4),
- Depth-to-bedrock map (fig. 5),
- Mean annual groundwater-recharge map (fig. 6),
- Groundwater-susceptibility map (plate 2), and
- Hydrogeologic cross sections (figs. 8-10).

The maps listed above can be found in dataset 1. These maps are designed for use at a scale of 1:100,000 and should not be relied upon for detailed site-specific applications. Nonetheless, these broader interpretations may offer a valuable foundation for more focused site-specific assessments.

Project area and hydrogeologic setting

The study area covers all of Burnett County, located in northwest Wisconsin (fig. 1). Agricultural land use is concentrated in the southern region of the county. The Saint Croix National Scenic Riverway runs along the Saint Croix River at the western boundary of the county, and branches eastward along the Namekagon River in the northern part of the county. The St. Croix Chippewa Indians of Wisconsin have reservations divided across 11 separate communities over a four-county area. Eight of these communities are within Burnett County, including the community of Big Sand Lake where the St. Croix Tribal headquarters is located.

Surficial geology

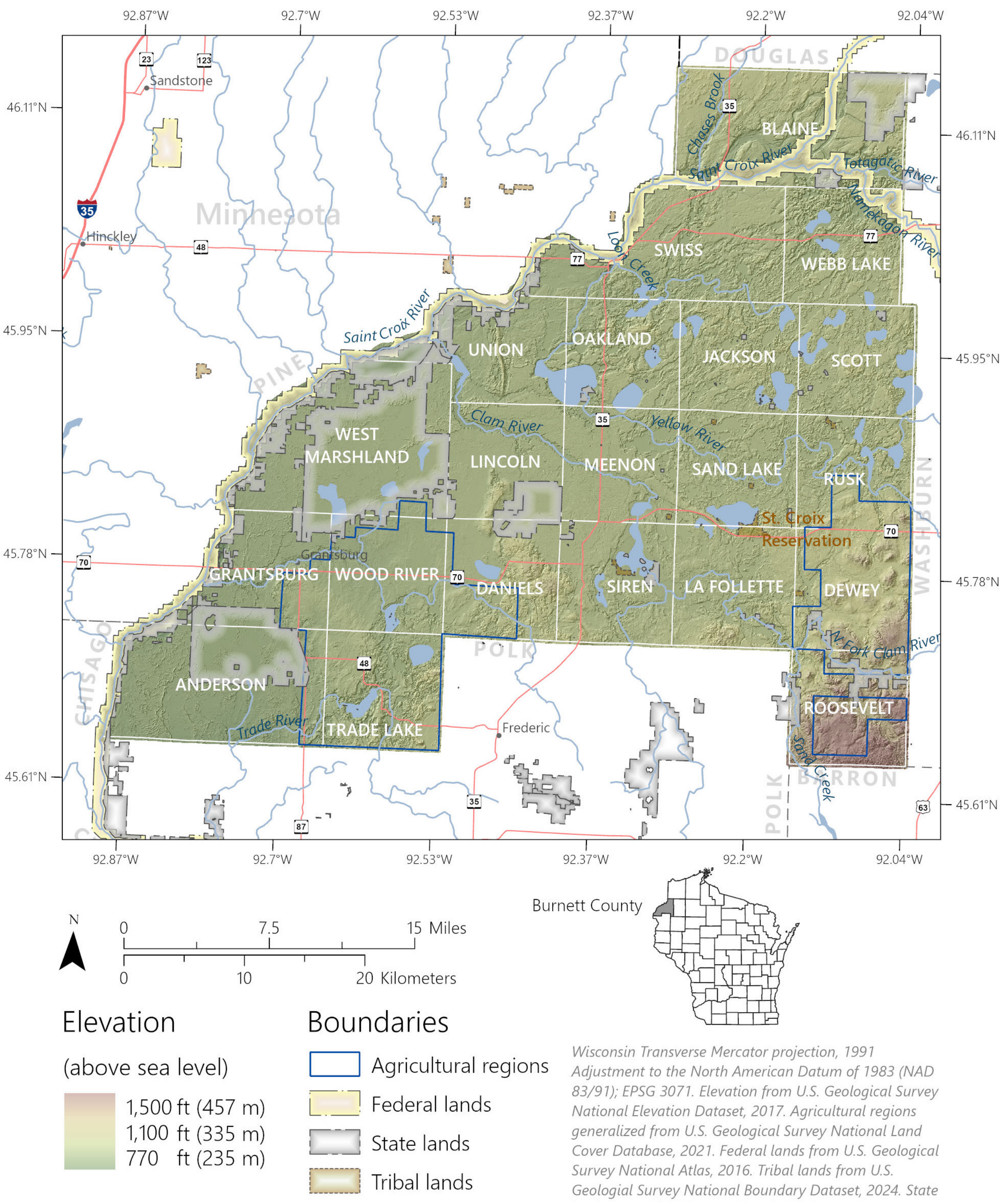
The surficial sediments in Burnett County were deposited by glaciers and modern surface water systems (fig. 2). A significant portion of Burnett County is covered by glacial sediments that were deposited by the Superior Lobe and Grantsburg Sublobe during the Wisconsin Glaciation. The Superior Lobe advanced into Burnett County from the north and northwest about 25,000 to 15,000 years ago and deposited the Copper Falls Formation (Johnson and Rawling, WGNHS, unpub. data, 2025; Muldoon and others, 1990). The Copper Falls Formation consists of sandy till, sand and gravel, and clay deposits (Syverson and others, 2011). In southeastern Burnett County and in adjacent Polk, Washburn, and Sawyer counties, there is a distinct area of high topographic relief informally referred to as the Spooner Hills (Johnson, 1999). The hills are composed of Copper Falls Formation till and meltwater stream sediments and are erosional remnants formed when the valleys were excavated by subglacial meltwater. In southwest Burnett County, the Copper Falls Formation includes a clay layer up to 30 meters thick that can be observed at the surface along the Saint Croix River. The clay is the preserved lake bottom of Glacial Lake Lind, which was formed during the retreat of the Superior Lobe along the former drainage of the Saint Croix River (Johnson and others, 1999). The spatial extent of Glacial Lake Lind sediments in the subsurface is described in Johnson and Hemstad (1998) and Johnson and others (1999).

The youngest glacial sediments in the county belong to the Trade River Formation. The Grantsburg Sublobe advanced into Burnett County from the west about 12,300 years ago and deposited the Trade River Formation (Muldoon and others, 1990; Johnson and Rawling, WGNHS, unpub. data, 2025). The Trade River Formation is composed of silty till and clay (Syverson and others, 2011). The clay, present at the surface in southwest Burnett County, is the preserved lake bottom of Glacial Lake Grantsburg and ranges in thickness from approximately one to five meters. Glacial Lake Grantsburg was created when the glacier reached its maximum extent and blocked the Saint Croix drainageway (Johnson and Hemstad, 1998). The spatial extent of Glacial Lake Grantsburg sediments in the subsurface is described in Johnson and Hemstad (1998) and Johnson and others (1999). Post-glacial sediments deposited less than 10,000 years ago include sand and gravel deposited by modern rivers and lakes, and peat formed in low-lying areas.

Bedrock geology

The bedrock of Burnett County consists of Precambrian igneous and sedimentary rocks and Cambrian sedimentary rock (fig. 3). The oldest rock underlying the entire county is Precambrian basalt of the Chengwatana Volcanic Group (Mudrey and others, 1987). The Precambrian basalt, formed by volcanic activity approximately 1.1 billion years ago and locally referred to as traprock, forms a prominent topographic high extending from west-central Polk County into southern Burnett County. Typically, the depth to bedrock over this area is 50 feet or less, and exposed rock formations are prevalent (Muldoon and Dahl, 1998). In northern Burnett County, the basalt is overlain by Precambrian sandstone and shales of the Oronto Group. Cambrian sandstones of the Elk Mound Group overlie Precambrian basalt in southwest and southeast

Figure 1. Shaded topographic relief map of Burnett County showing towns, boundaries of agricultural regions, federal lands, state lands, and tribal lands. Town boundaries (Wisconsin State Legislature, 2024) and tribal land boundaries (U.S. Geological Survey National Boundary Dataset, 2024) are included for geographic reference in subsequent figures.



Wisconsin Transverse Mercator projection, 1991 Adjustment to the North American Datum of 1983 (NAD 83/91); EPSG 3071. Elevation from U.S. Geological Survey National Elevation Dataset, 2017. Agricultural regions generalized from U.S. Geological Survey National Land Cover Database, 2021. Federal lands from U.S. Geological Survey National Atlas, 2016. Tribal lands from U.S. Geologial Survey National Boundary Dataset, 2024. State lands from DNR Managed Land, 2025.

Figure 2. Generalized map showing the surficial geology of Burnett County (modified from Johnson and Rawling, WGNHS, unpub. data, 2025).

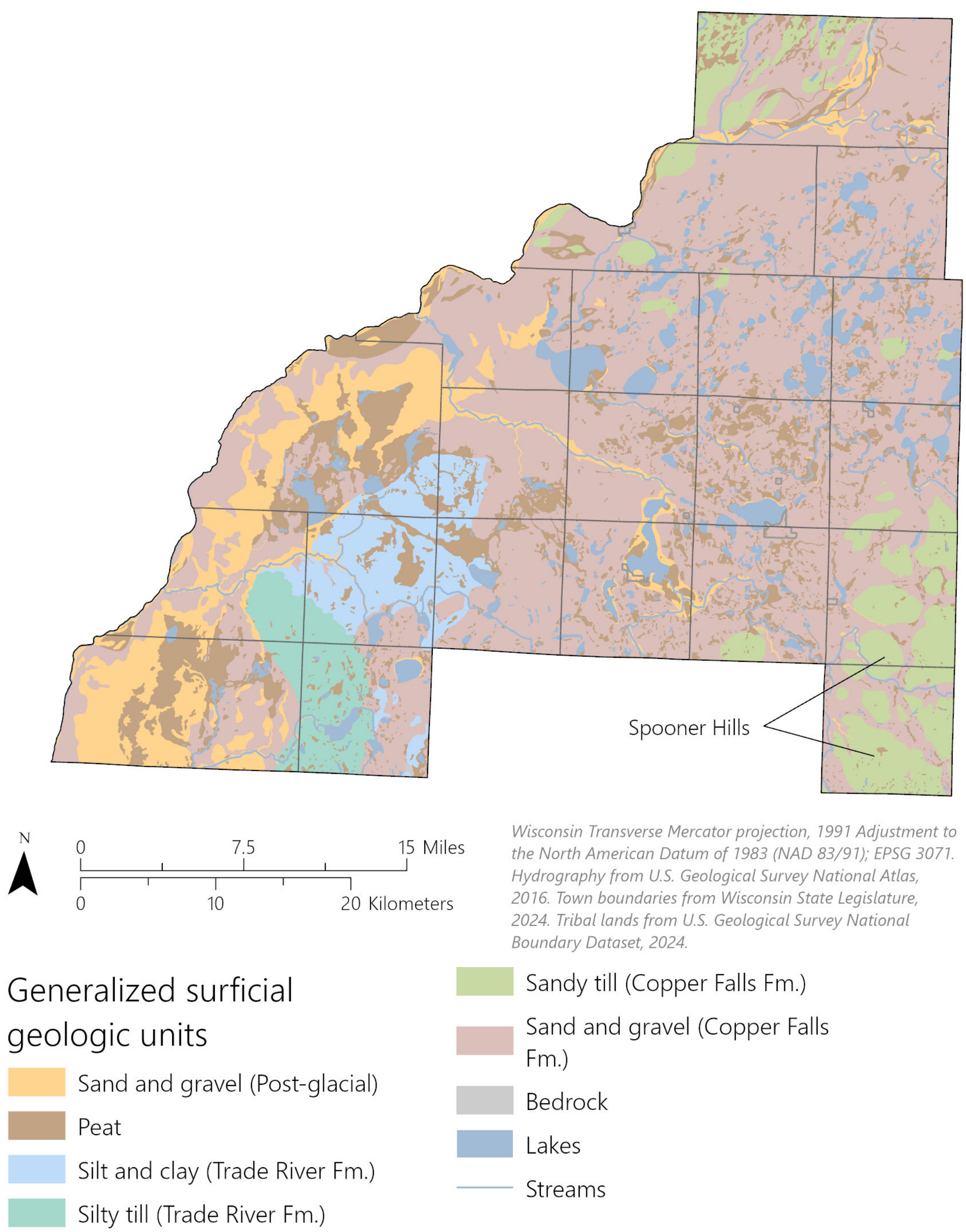
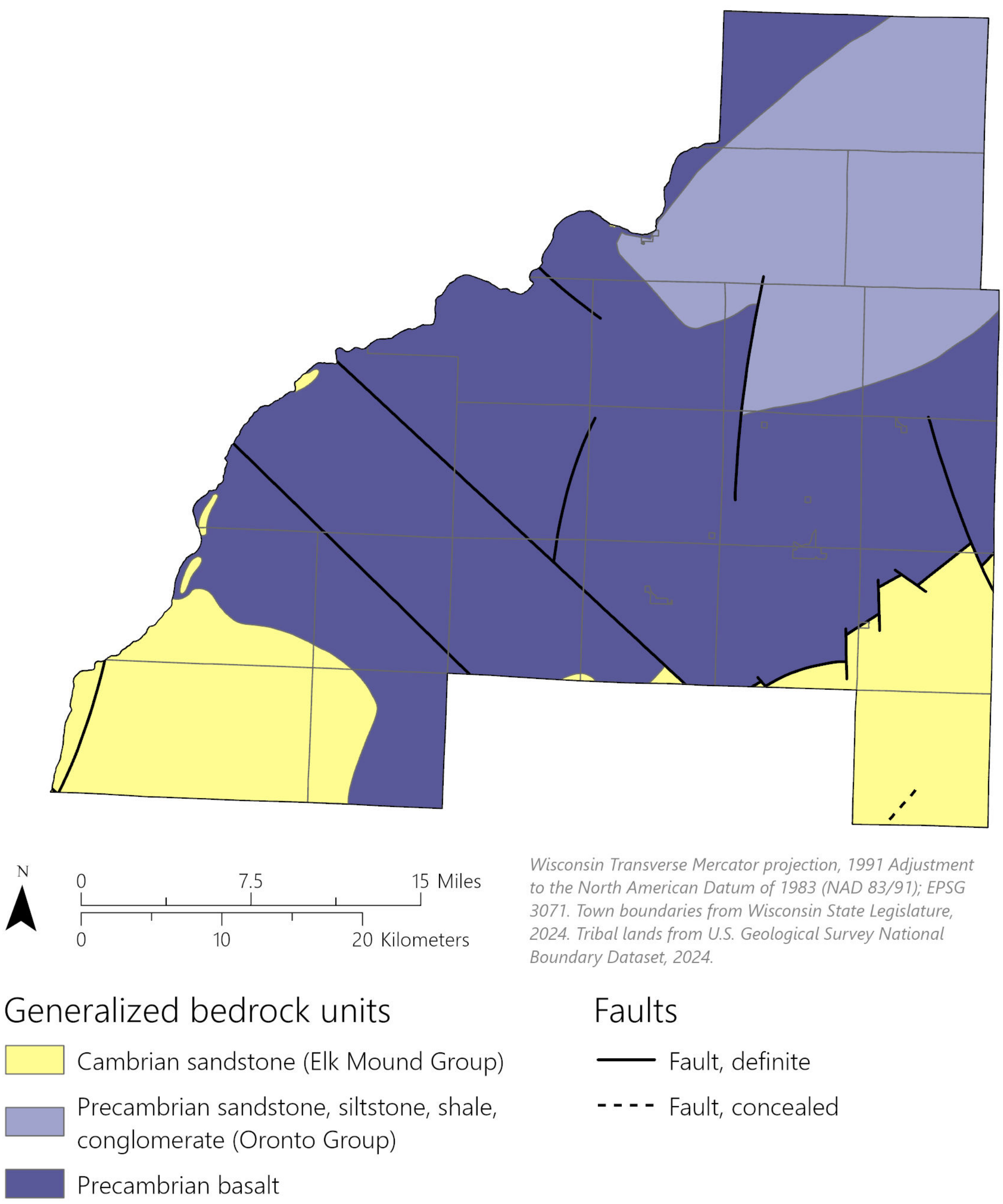


Figure 3. Generalized map showing the bedrock geology of Burnett County (modified from Cannon and others, 1997; Mudrey and others, 1987; Nicholson and others, 2004).



Burnett County. These sandstones were formed approximately 523 to 505 million years ago when the region was covered by shallow seas. The elevation of the bedrock surface is influenced to some extent by the faulting and folding that occurred due to tectonic stresses in this region.

Aquifers and aquitards

The geologic materials present in Burnett County form various aquifers and aquitards. An *aquifer* is a geologic unit that holds or transmits significant quantities of groundwater that are economically or environmentally beneficial. Typically, aquifers are made up of permeable geological materials like sand, gravel, or sandstone, which allows them to deliver groundwater quickly enough to supply wells or springs. *Aquitards* are geologic units that can also store groundwater but have low permeability, which means groundwater flows through them very slowly. These aquitards generally consist of materials such as clay or shale and typically do not provide enough water for wells. Nevertheless, due to their low permeability, aquitards can serve as protective layers for underlying aquifers.

Over 95 percent of the wells in Burnett County are completed in surficial sediments, often referred to as the "sand and gravel" aquifer (Muldoon and Dahl, 1998). Although the compositions of these sediments vary, they usually contain enough coarse-grained sand and gravel to provide adequate water supply for residential wells. In areas where surficial sediments are thin or absent and the depth to bedrock is shallow, wells are completed in the bedrock. The near-surface bedrock present in southern Burnett County consists of Precambrian basalt and some overlying Cambrian sandstone. The sandstone aquifer typically offers dependable water supplies where present, whereas the basalt tends to be a low-yielding aquifer that is only used when the overlying surficial sediments are unable to provide adequate water supplies. Aquitards in Burnett County may include clay lenses within the sand and gravel aquifer. Glacial Lake Lind clay may also act as an aquitard where present in Burnett County. The spatial extent of Glacial Lake Lind clay at depth in Burnett County is described in Johnson and Hemstad (1998) and Johnson and others (1999). The potential importance of Glacial Lake Lind clay is discussed in the results and discussion section of this report.

Water table and local water-table conditions

Below the land surface, the soil, sediment, and rock are separated into an upper unsaturated zone and a lower saturated zone. In the *unsaturated zone*, the pore spaces and fractures in sediments or rocks are filled with air and water. In the *saturated zone*, all pore spaces and fractures are completely filled with water. The *water table* is the top of the saturated zone and is also the elevation to which water rises to in a shallow well. Streams, lakes, and springs occur where the water table elevation is at the land surface. Similar to how surface water moves downhill, shallow groundwater flows from higher to lower water-table elevation.

The source of groundwater is precipitation that infiltrates the ground surface and reaches the water table in a process called groundwater *recharge*. Accordingly, the elevation of the water table varies with the seasons and is usually at its peak during periods of high precipitation and in the spring after snowmelt. Generally, the changes in the water table tend to be more pronounced at higher elevations and locations far from surface water features. In certain wells, especially those that are deeper, there may be a lag of weeks to months between periods of recharge and the resulting changes in water-table elevation. The local water-table elevation can differ from the regional water-table elevation in areas where the water table is perched or steeply-sloping. A *perched water table* occurs when the local water table sits above the elevation of the regional water table. A *perched aquifer* typically forms when an aquitard or a layer of fine-grained sediment is situated within an aquifer and is positioned above the regional water table. This low permeability layer retains water, causing it to be held (or perched) above the regional water table. An unsaturated zone separates the perched aquifer from the regional aquifer. The presence of such an unsaturated zone needs to be confirmed with field data. A *steeply-sloping water table* occurs when the water table is locally mounded, and a continuous zone of saturation exists in the subsurface. Perched and steeply-sloping water-table conditions in northern Wisconsin have been identified in field studies (Muldoon, 2000).

Methods

This atlas was created from existing data sources, including water-well information and other subsurface data, outcrop descriptions, and previous reports and studies. Limited field data were collected to verify locations.

Approach

A water-well database was created to include details on well construction, geology, and groundwater levels. This database was the primary data source for the development of the water-table elevation map, depth-to-bedrock map, and hydrogeologic cross sections. The water-table map was developed to determine the direction of groundwater flow at a regional scale. The water-table map was used to develop a map of depth to the water table (or thickness of the unsaturated zone), which is one of the key factors influencing the vulnerability of groundwater to contamination from near-surface sources. Additional factors include depth to the bedrock (or the thickness of the unconsolidated material) and the distribution of the groundwater recharge. Maps illustrating each of these factors were produced and combined to assess the susceptibility, or relative vulnerability, of groundwater to contamination from near-surface sources throughout the county. Hydrogeologic cross sections were created for three towns to illustrate significant aquifers and confining units, allowing for an enhanced assessment of groundwater susceptibility to contamination.

Water-well database

Well construction reports document important information about local geology and depth to the water table and serve as the primary data source for the maps associated with this inventory. In addition, the hydrogeologic setting and design of a water well are crucial elements to evaluate when determining a well's vulnerability to contamination and creating a well-monitoring or protection strategy. The water-well database for Burnett County created by WGNHS contains 7,743 well records obtained from the Wisconsin Department of Natural Resources (WDNR). The water-well database was updated by Burnett County to verify the locations of these wells in a process called *well geolocation*. During the well geolocation process, historic land records and air photos were used to move wells to a more accurate location so that the data recorded on a well construction report is associated with the correct position and elevation on the landscape.

Map development

Water table

Water-table elevation contours in Burnett County were constructed manually, resulting in a contour map showing the elevation of the water-table surface. Water-table elevations were interpolated using point observations of water-table elevation derived from well construction reports and elevations of surface water features including lakes, streams, and wetlands. Well construction reports state the depth to static water at the time when the well was drilled. Depending on well construction, this water level may not represent the water table. Preference was given to measurements from the shallowest wells as they are more likely to indicate the water-table elevation than water levels in deeper wells, which may reflect upward or downward hydraulic gradients. Well-water elevations were used for interpolation in areas where surface-water elevations did not agree with well-water elevations so that the map is representative of the regional water-table elevation and not where the water table may be locally perched or steeply sloping.

Depth to water table

The map showing the depth to the water table was created by subtracting a surface of water-table elevation from the land-surface elevation derived from a 10-m resolution digital elevation model (U.S. Geological Survey, 2017). The water-table elevation surface was generated by interpolating between the mapped water-table elevation contours. The final depth-to-water-table map was then resampled to a 30-m resolution.

Depth to bedrock

The depth-to-bedrock map was developed by interpolation of various data sources, including (1) existing well construction reports, (2) geologic logs, (3) observed and previously mapped bedrock-outcrop locations (Clayton, 1984; Mudrey and others, 1987; Johnson, 2000), (4) soils data from the Natural Resources Conservation Service (NRCS) (Soil Survey Staff, 2023), and (5) the Minnesota depth-to-bedrock map (Jirsa and others, 2010; Minnesota Geological Survey, 2021) (table 1). Datapoints from the Minnesota depth-to-bedrock map were used to better constrain the bedrock-elevation surface along the county's western border.

A bedrock-elevation surface was interpolated from point elevation data using the Topo to Raster tool. The depth-to-bedrock map was then derived by subtracting the bedrock elevation from the ground-surface elevation. The National Elevation Dataset ⅓-arc second Digital Elevation Model (U.S. Geological Survey, 2017) was used as the ground-surface elevation datum and resampled to 100-m resolution. Measurements from well construction reports that did not agree with neighboring bedrock elevation values created isolated high or low points in the bedrock-elevation surface. These values were investigated and either corrected or removed from the dataset. Some of these datapoints were mislocated and moved to their proper locations or had incorrectly coded stratigraphy that was rectified.

Table 1. Data used to construct the depth-to-bedrock map.

Data type	Description	Source
Well construction reports	Wells geolocated by Burnett County in 2023 and 2024. Locations verified to the parcel level. Includes 445 wells completed in bedrock.	Well database provided by Burnett County Land Services/Zoning office.
Additional well construction reports	Additional data from 440 wells that reached bedrock in Polk, Douglas, Barron, and Washburn counties. Records archived at the WGNHS. Wells geolocated to the parcel using plat books and online property information.	WGNHS (unpub. data, 2024).
Geologic logs	7 geologic logs archived at the WGNHS.	WGNHS (unpub. data, 2024).
Outcrops	30 previously-mapped outcrops.	Mudrey and others (1987).
Soils data and shallow bedrock observations	3,673 shallow depth-to-bedrock measurements from the NRCS and 3,829 shallow bedrock observations indicated on published WGNHS bedrock maps.	Soil Survey Staff (2023), Clayton (1984), Johnson (2000).
Minnesota depth-to-bedrock data	1,042 datapoints derived from the Minnesota depth-to-bedrock dataset.	Jirsa and others (2010), MGS (2021).

Abbreviations: WGNHS, Wisconsin Geological and Natural History Survey; NRCS, Natural Resources Conservation Service; MGS, Minnesota Geological Survey.

Groundwater recharge

Groundwater-recharge values were calculated using the Soil-Water-Balance (SWB) computer model, which incorporates various factors affecting recharge in an iterative, daily simulation (Westenbroek and others, 2018). This model was developed by the U.S. Geological Survey (USGS) in collaboration with WGNHS (Dripps and Bradbury, 2007; Westenbroek and others, 2010) and has been applied in other regions throughout Wisconsin (e.g., Hart and Schoephoester, 2011; Hart and others, 2012). The model tracks the movement of precipitation on the land surface and within the soil root zone using the following equation (from Westenbroek and others, 2018):

Net infiltration = (precipitation + snowmelt + inflow) − (interception + outflow + ET) − Δ soil moisture

Where,

Net infiltration = water that has escaped the evapotranspiration sinks of the root zone, some portion of which will eventually find its way to the water table;

Precipitation = rainfall;

Snowmelt = water derived from snowmelt, calculated by tracking snow accumulation and atmospheric temperature;

Inflow = water routed from an adjacent upslope cell as surface runoff (*outflow*);

Interception = water trapped by vegetation that is transpired or evaporated from plant surfaces;

ET = water evaporated or transpired by plants, estimated using the Thornthwaite and Mather (1957) method; and

Δ soil moisture = the change in amount of soil moisture held in storage; soil moisture is capped at the maximum amount of water the type of soil can hold.

The SWB model does not simulate unsaturated-zone processes beneath the soil root zone and therefore provides an estimate of net infiltration rather than groundwater recharge (water that actually reaches the water table). For this report, it is assumed that net infiltration is equal to groundwater recharge. The SWB model also does not simulate recharge in areas of open water; therefore, surface waters are assigned null values. Inputs to the SWB model include daily climate records (Thornton and others, 2022) and map layers representing land elevation (U.S. Geological Survey, 2017), land cover (U.S. Geological Survey, 2021), and soil properties (Soil Survey Staff, 2023). The inputs allow the SWB model to calculate the terms described in the above equation, resulting in daily estimates for groundwater recharge.

Before implementing the Soil-Water-Balance model, the county was divided into a grid of 30-m × 30-m cells, with the resolution ultimately dictated by the coarsest model input (land cover). All other input layers were resampled to align with this grid. Gridded daily climate data from the years 2012 to

2022, comprising both observed and simulated values for precipitation and temperature, were applied across the entire model area (Thornton and others, 2022). This timespan was selected because it was the most recent 10-year period of data available at the time of model creation. Digital elevation data from the National Elevation Dataset (U.S. Geological Survey, 2017) were used to create a flow-direction grid, establishing the surface over which surface-water runoff was routed. Closed depressions were filled to avoid the unrealistically high recharge estimates that occur due to pooling in the model. This method of filling closed depressions has consistently been employed by the WGNHS for other SWB recharge estimates across Wisconsin, such as Bayfield County and east-central Wisconsin (Hart and Schoephoester, 2014; Graham and others, 2019). Information about land cover is incorporated into the calculations for interception, runoff, evapotranspiration, and determining the depth of the root zone.

The soil characteristics considered include the hydrologic group and the available water storage capacity. The hydrologic group is a categorization of how well a soil map unit can infiltrate water and is used in the input for the recharge model to estimate runoff. The main categories are labeled A through D, signifying a range from minimal runoff potential to significant runoff potential. In the model area, several map units were assigned dual classifications, such as "A/D," where the lower runoff classification typically signifies land that has been artificially drained. Since any infiltration that happens in this context would not contribute to groundwater recharge, all soil map units with dual designations were reclassified into the higher-runoff category for the recharge model input. The available water storage, which quantifies the volume of water contained in a defined soil thickness, is used by the model for managing root zone moisture.

Groundwater susceptibility

A groundwater susceptibility map shows the relative susceptibility of different areas to groundwater contamination originating from surface or near-surface sources. Potential sources of contamination include landfills, chemical spills, manure spreading, fertilizer and pesticide application, septic systems, and leaking underground storage tanks. The groundwater susceptibility assessment was conducted using an overlay method that integrated four environmental or geologic factors known to affect the vulnerability of shallow aquifers to contamination from the land surface. The factors analyzed included (1) the depth to the water table, (2) the depth to the bedrock, (3) the groundwater recharge, and (4) the type of surficial geological material. Each factor's classifications were ranked from 1 to 5 based on their ability to protect the aquifer (with '1' representing low susceptibility) or how easily they allow contamination to reach the water table (with '5' indicating high susceptibility), according to the framework detailed in table 2. These rankings were derived from other maps in this atlas series

Table 2. Factors ranked for the groundwater susceptibility model.

Rank	Depth to regional water table	Depth to bedrock	Annual groundwater recharge	Surficial material*
5	0–25 ft (0–7.6 m)	0–10 ft (0–3.1 m)	>10 in/yr (>254 mm/yr)	Post-glacial stream sediments, windblown sand, and shoreline lake sediments; Copper Falls Fm. stream sediments; shallow bedrock
4	25–50 ft (7.6–15.2 m)	10–25 ft (3.1–7.6 m)	8–10 in/yr (203–254 mm/yr)	Copper Falls Fm. stream sediments composed of stratified sand and gravelly sand with thin (~20 cm) bedded to massive clay in patches; Copper Falls Fm. nearshore lake sediments
3	50–75 ft (15.2–22.9 m)	25–50 (7.6–15.2 m)	6–8 in/yr (152–203 mm/yr)	Copper Falls Fm. tills, Copper Falls Fm. stream sediments composed of sand overlying 1 m of clay
2	75–100 ft (22.9–30.5 m)	50–100 ft (15.2–30.5 m)	4–6 in/yr (102-152 mm/yr)	Trade River Fm. tills
1	>100 ft (>30.5 m)	>100 ft (>30.5 m)	<4 in/yr (<102 mm/yr)	Peat; Trade River Fm. offshore lake sediments

* surficial material units mapped by Johnson and Rawling, WGNHS, unpub. data, 2025 Abbreviations: Fm., Formation

Table 3. Score ranges for overall groundwater susceptibility classifications.

Overall susceptibility	Total score
High	>3.3-5
Moderate	>2.5-3.3
Low	1-2.5

and the mapping of surficial geologic materials conducted by Johnson and Rawling (WGNHS, unpub. data, 2025).

The rankings of the four factors were summed and divided by four (for a maximum possible score of 5) to assess groundwater susceptibility. Areas with the highest overall score are deemed highly susceptible to groundwater contamination originating at the surface. The index totals were categorized into three classes based on natural breaks, where the susceptibility scores naturally cluster together (table 3). The calculated numerical values are semi-quantitative and convey only relative levels of vulnerability. The resulting susceptibility map does not show areas where groundwater will or will not become contaminated but rather conveys the relative ability for contaminants released at the land surface to reach the water table. Groundwater contamination can still occur in areas delineated as low susceptibility.

A manual sensitivity analysis was performed to investigate the influence of different factor classification schemes and factor weighting on model results. The classification schemes tested included custom ranges, ranges defined by natural breaks, and ranges defined by the DRASTIC method (Aller and others, 1987). The resulting maps had similar spatial trends with only subtle differences. Therefore, custom ranges were used in the final map to be consistent with previous WGNHS susceptibility maps (Parsen and others, 2017; Graham and others, 2019). Factor weighting refers to the assignment of different levels of importance, or weight, to the factors used in the analysis. The depth to the water table was initially considered as an important factor for groundwater susceptibility in Burnett County due to the prevalence of a shallow water table. Therefore, the weight for the depth to the water table was progressively increased to evaluate the influence on model results. As the weight of the depth-to-water factor increased, the overall area on the map indicated as moderate or high susceptibility increased. This resulted in a less useful map with only a very small portion of the county indicated as low susceptibility. Since there are few areas of Burnett County where depth to bedrock is shallow, the depth to bedrock factor was removed as a factor to evaluate its influence on model results. When depth to bedrock was not considered, the map did not convey notable areas of shallow bedrock as highly susceptible, including southern Burnett County and along the Saint Croix River. Therefore, the final susceptibility model used equal weights for all factors.

Hydrogeologic cross sections

A hydrogeologic cross section is a diagram that depicts the subsurface sediments, rocks, and hydrogeologic conditions as if the earth was cut along a slice and visualized from the side. Hydrogeologic cross sections were constructed using multiple sources of information, including: (1) a digital elevation model of the land surface (U.S. Geological Survey, 2017), (2) the Quaternary geology map of Burnett County (Johnson and Rawling, WGNHS, unpub. data, 2025), (2) soils data from the NRCS (Soil Survey Staff, 2023), (3) the modeled bedrock-elevation surface used to derive the depth-to-bedrock map for Burnett County, (4) geologic descriptions on well construction reports available at the time of preparation and located within 1,000 m (0.62 miles) of the line of cross section, and (5) one 300-ft (91 m) deep rotosonic core. The profiles of regional water-table elevation depicted on the cross sections were derived from the water-table elevation map of Burnett County. The data were visualized along the lines of cross section in ESRI ArcGIS Pro using the Cross Section Toolbox developed by the Minnesota Geological Survey (Minnesota Geological Survey, 2024).

Results and discussion

Water table

The water-table map (plate 1) illustrates the average elevation of the regional water table in Burnett County and may be used to determine the direction of shallow groundwater flow. The map also shows areas where groundwater contributes to streams or lakes.

The contour lines on the map represent the elevation of the regional water table in feet above mean sea level. The water-table elevation ranges from less than 780 ft (238 m) along the Saint Croix River in southwestern Burnett County to more than 1,220 ft (372 m) in southeastern Burnett County. The shape of the water table and the resulting groundwater flow directions are an expression of the regional hydrogeologic setting and topography. The arrows on the map signify that groundwater moves from areas of higher water-table elevation to those of lower elevation, typically at a right angle to the water-table-elevation contours.

Groundwater flows away from groundwater divides. A groundwater divide is similar to a ridge on a topographic map; just like the surface of the land slopes away from a ridgetop, the water table slopes away from a groundwater divide. Groundwater flows away from a divide and eventually discharges into wells, streams, and lakes. There are no county-scale groundwater divides, but the flow direction arrows on the water-table map (plate 1) show areas in Burnett County with local groundwater divides. In much of the county, groundwater flows along short paths and discharges into lakes and streams that ultimately flow toward the Saint Croix River to the west. Although a water-table map does not show it, groundwater also moves vertically within the flow system. For example, downward flow occurs in upland areas where groundwater recharges and upward flow occurs in lowland areas where groundwater discharges into streams.

In several areas of Burnett County, the surface-water elevations are 20 to 220 ft (6.1 to 67 m) above well-water elevations. These areas primarily occur in southeastern Burnett County in the Spooner Hills region and in southwestern Burnett County where the Trade River Formation till is present. The Spooner Hills are high-relief hills characterized by broad upland plains and separated by step-side valleys (Johnson, 1999). The uplands contain numerous lakes and wetlands with surface-water elevations significantly above both well-water elevations and surface-water elevations in the valleys. Previous field investigations in adjacent Barron County indicate the presence of a perched aquifer above the regional water-table (Muldoon and others, 1990; Muldoon and Dahl, 1998; Muldoon, 2000). We were not able to target these features in field investigations for this study, but based on the previous work, we chose to interpret the discrepancies in upland surface-water elevations and well-water elevations in the Spooner Hills region as an indication of a similar perched aquifer. The map of water-table elevation (plate 1) represents the regional water table consistent with well-water elevations in this region, rather than the locally perched water table.

In the southwestern portion of the county, a hummocky till plain contains numerous lakes and wetlands, where the Trade River till is the surficial unit (fig. 2). In adjacent Polk County, fieldwork around Bass Lake (Muldoon, 2000; fig. 3) indicated that the water table was strongly mounded under that lake. Since the geology in the southwestern portion of Burnett County is similar to that around Bass lake in Polk County, we assume that similar steeply-mounded water-table conditions exist around lakes in southwestern Burnett County. However, the connection between small upland lakes and the regional flow system in this region has not been confirmed with field work. The water table elevation depicted on plate 1 represents the regional water table, which is consistent with well-water elevations and the elevation of larger lakes in the region.

The distribution and density of data depicted on the map help convey relative levels of confidence in the water-table elevation interpretations. The areas with the highest certainty are those where there is a greater concentration of wells and surface waters, which supply information about the elevation of the water table. The areas with highest uncertainty on the water-table map are locations with little to no wells or surface waters, such as the northeast portion of the town of Swiss and the western portion of the town of Anderson.

Depth to water table

Figure 4 illustrates the depth from the land surface to the regional water table (in feet). The depth to the water table ranges from 0 to nearly 245 ft (74.7 m) in Burnett County and is greatest in the Spooner Hills region of the southeastern part of the county. About 35 percent of the county has a depth to the water table of less than 25 ft (7.6 m).

The areas with highest uncertainty on the depth-to-water-table map are the same as those on the water-table elevation map, because the depth-to-water map is a derivative map of the water-table elevation map.

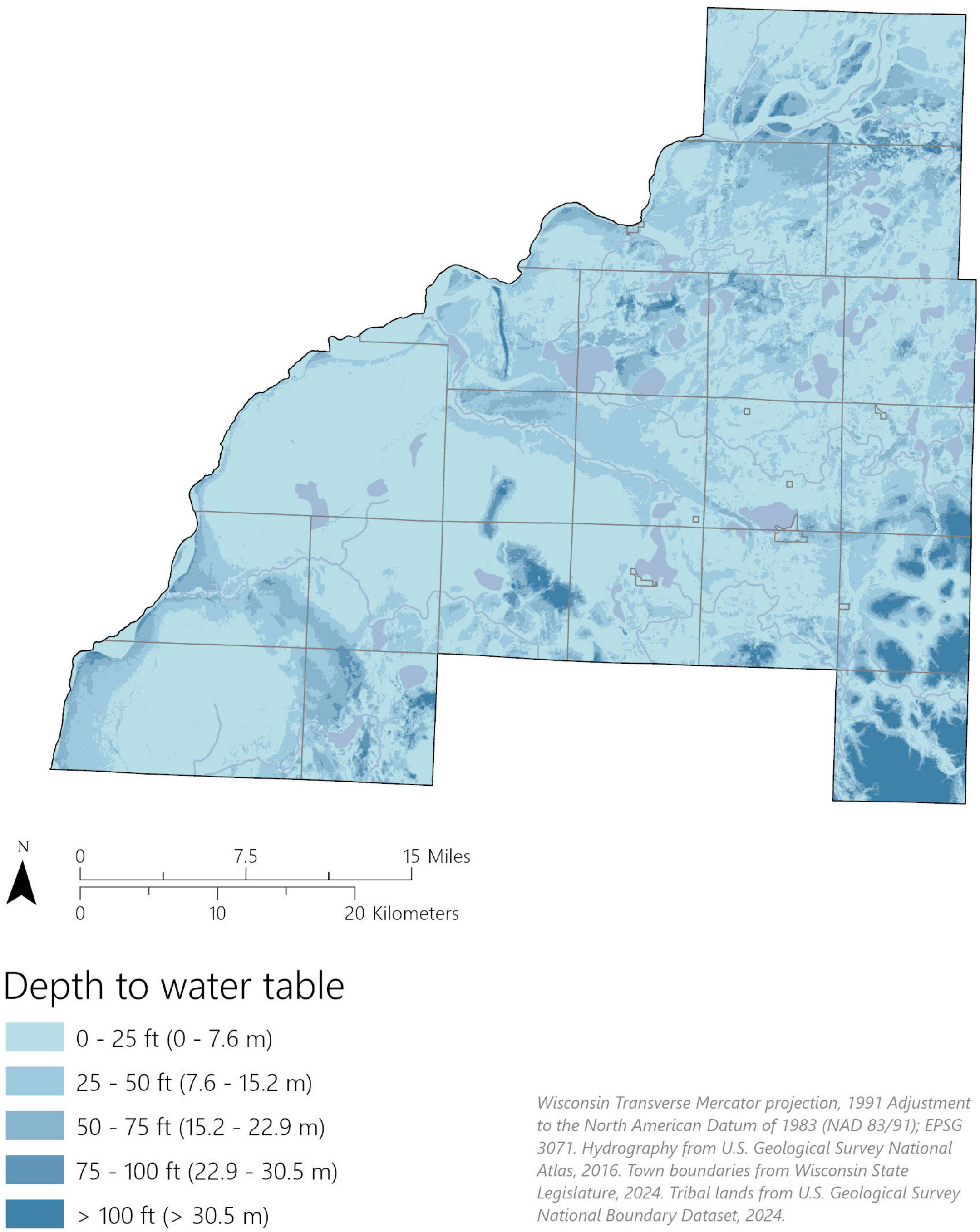
Depth to bedrock

Figure 5 shows the estimated depth from the land surface to the top of the bedrock surface, also representing the thickness of the unconsolidated aquifer materials above the bedrock in Burnett County. Sediments are thickest in the middle of the county. In contrast, sediments are thinnest along the Saint Croix River and in areas along the county's southern border, such as near Rice Lake in the town of Trade Lake and Little Deer Lake in the town of Siren. The interpolated depth-to-bedrock surface varies significantly, ranging from 0 (where bedrock is exposed at the land surface) to more than 400 ft (122 m). A well construction report from the Yellow Lake area notes approximately 350 ft (107 m) of sediment overlying the bedrock.

The significant variation in bedrock depths found in Burnett County is characteristic of northwest Wisconsin (Rehwald and Rawling, 2026). This variation stems from a complex geological history shaped by factors such as continental rifting, movement and folding along faults, glaciation, and erosion caused by surface water.

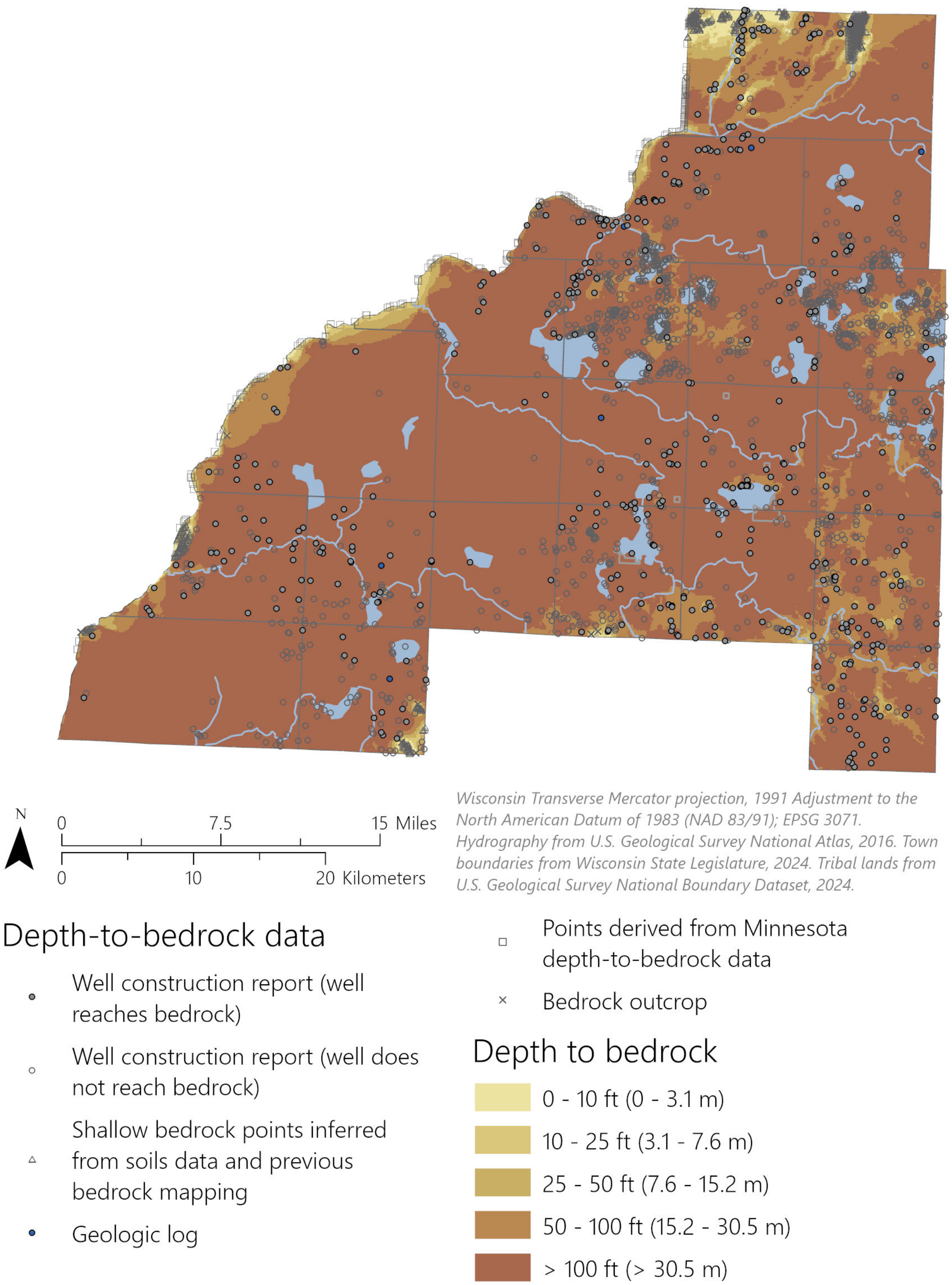
The distribution and density of control data depicted on the map help convey relative levels of confidence in the bedrock depth interpretations. The areas with the highest certainty are those where there is a greater concentration of wells, geologic logs, or outcrops, which supply information about bedrock depth. Wells that fail to reach bedrock provide a minimum value for bedrock depth; however, they do not limit the depth to a specific value or range. The areas of the map with the greatest uncertainty are located within large wetlands where there are few wells. Furthermore, most wells in Burnett County are completed in the surficial aquifer and do not reach bedrock. There is more certainty in the depth-to-bedrock interpretation in shallow bedrock areas, such as in northern Burnett County and several areas in southern Burnett County.

Figure 4. Map showing depth to the water table in Burnett County. The data classification ranges are the same as the groundwater susceptibility attribute ranges shown in table 2.



Wisconsin Transverse Mercator projection, 1991 Adjustment to the North American Datum of 1983 (NAD 83/91); EPSG 3071. Hydrography from U.S. Geological Survey National Atlas, 2016. Town boundaries from Wisconsin State Legislature, 2024. Tribal lands from U.S. Geological Survey National Boundary Dataset, 2024.

Figure 5. Map showing depth to bedrock in Burnett County and the location of data used to interpolate the bedrock elevation surface. The data classification ranges are the same as the groundwater susceptibility attribute ranges shown in table 2.



There is still potential error in areas of high data density (Haas and others, 2025). This is due to the potential for inaccuracies or uncertainty in data point location or the accuracy of the depth-to-bedrock measurements considered in the interpolation.

Groundwater recharge

The top panel of figure 6 shows the distribution of the average annual net infiltration in Burnett County estimated by the SWB model, assumed to be equal to groundwater recharge. The values represent the mean annual groundwater recharge between 2012 and 2022, a timespan where annual precipitation ranged from 27.7 to 43.7 inches (in) (704 to 1110 millimeters/mm) (fig. 7). The average recharge rate from 2012–2022 ranges from <1 to 66 in/yr (<25 to 1676 mm/yr), with a county-wide average of 7.4 in/yr (188 mm/yr).

The lower panel in figure 6 shows annual mean groundwater-recharge rates for the years 2014 and 2021, which are the model years with the highest and lowest estimated mean recharge rates, respectively. The mean recharge rates modeled in 2014 and 2021 are 12.9 and 4.1 in/yr (328 and 104 mm/yr), respectively. While the SWB model outputs from these years show different absolute groundwater recharge rates, the spatial distribution across the county remains consistent.

The distribution of modeled recharge is controlled by topography, soil type, vegetation, and land use. The soil type is one of the most influential factors; the type of soil that develops is a function of the geologic parent material. Regions covered by windblown sand and sandy sediments from glacial meltwater streams are regarded as the primary locations in the county for higher groundwater recharge. These sediments have high hydraulic conductivity and low available water storage capacity, leading to average annual recharge rates between 5 and 16 in/yr (127 and 406 mm/yr). The highest average annual recharge rates of 12–14 in/yr (305–356 mm/yr) over the past decade are found in a northeastern area of Burnett County characterized by sandy glacial meltwater-stream sediments, elevated terrain, and a land cover of shrub/scrub. Locations with moderate to low recharge rates align with areas underlain by till from the Trade River and Copper Falls Formations. These regions, situated in the southwest and southeast parts of the county, have average annual recharge rates ranging from 3 to 10 in/yr (76.2 to 254 mm/yr). The lowest recharge rates occur in low-lying, wet areas with organic-rich soil and in regions comprising fine-grained lake sediments, averaging between 2 and 8 in/yr (51 and 203 mm/yr). This reduced rate is due to the runoff from precipitation that falls on clayey soil with low permeability but high available water storage capacity. In these locations, the infiltration to the water table is hampered by the low permeability of the soils, and surface-water runoff primarily feeds the headwater streams rather than groundwater.

The results of the SWB recharge model were compared to U.S. Geological Survey (USGS) recharge estimates derived from baseflow measurements (Gebert and others, 2011). Since the SWB model lacks direct flow measurements within the hydrologic system, comparing its results with the USGS estimates is a crucial step in validating the model output. USGS average recharge estimates reported for the streamflow-gaging station covering Burnett County is 8–8.9 in (203–226 mm), while the average recharge reported for partial-record sites in Burnett County ranges from < 1 to 8–8.9 in (<25 to 203–226 mm). Although the USGS estimates are not comprehensive for the whole county and are evaluated over broader areas, the general spatial patterns in recharge identified by the SWB model align with those indicated by the USGS measurements. For instance, both the USGS estimates and the SWB results indicate that average recharge rates are greater in eastern Burnett County than in the western part. This similarity provides additional confidence to the SWB model results for the county.

There are several limitations associated with the SWB model. First, the SWB model does not explicitly consider surface-water bodies such as lakes and streams. As a result, the model does not provide recharge rate estimates for regions of open water as specified by the land cover dataset. Another limitation is that the SWB model may not provide reasonable estimates for regions of complex hydrology, such as wetlands and other areas with a shallow water table. Groundwater recharge may be overestimated and have higher uncertainty in areas with a shallow water table because the model does not consider evapotranspiration following the day of a rain event or thickness of the unsaturated zone. Lastly, the SWB model can yield some cells with unreasonably high recharge values (e.g., >50 in/yr), but nonetheless captures the relative spatial distribution of recharge across the county.

Groundwater susceptibility

The groundwater-susceptibility map (plate 2) provides an estimation of the varying degrees and distribution of groundwater vulnerability in Burnett County. This susceptibility map does not identify or take into account current or potential contamination locations. Therefore, it does not indicate that contamination has occurred or will occur. Instead, the susceptibility of an aquifer to pollution is determined by how easily contaminants from the surface can reach the water table. This evaluation is often termed "intrinsic susceptibility" (Focazio and others, 2002) because it assesses the inherent properties of the subsurface. Factors that contribute to increased groundwater susceptibility include (1) elevated groundwater-recharge rates,

Figure 6. **Map showing the mean annual groundwater-recharge rate in Burnett County for 2012-2022 (top), 2021 (bottom left), and 2014 (bottom right). Areas with no data are areas designated as open water in the U.S. Geological Survey National Land Cover Database. The data classification ranges are the same as the groundwater susceptibility attribute ranges shown in table 2.**

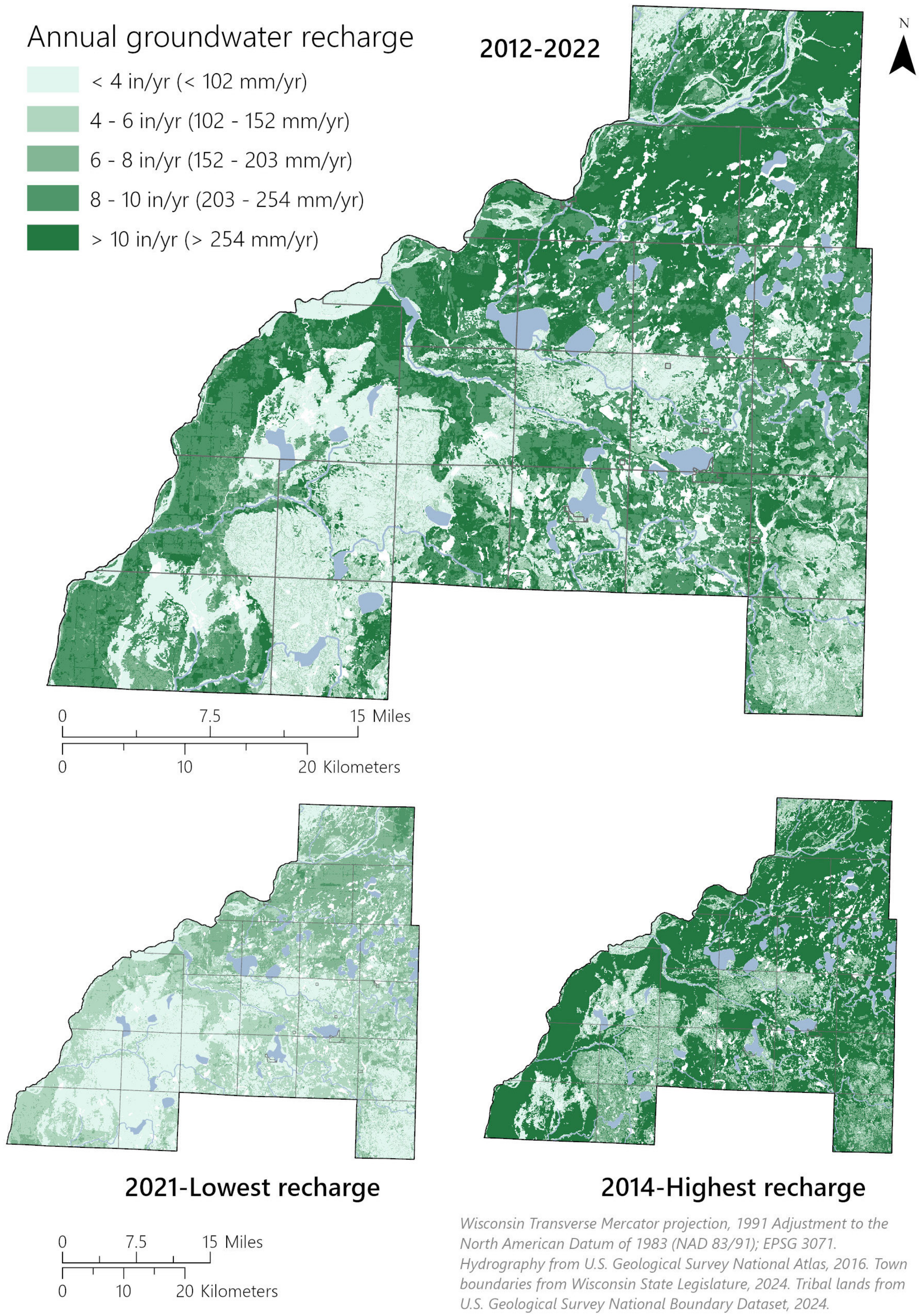
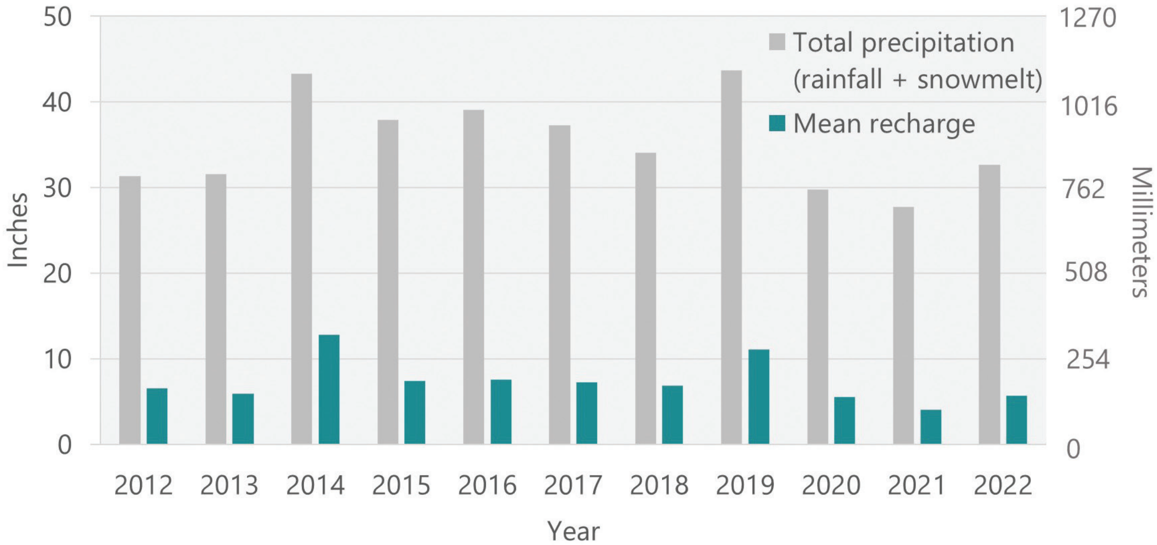


Figure 7. Annual precipitation and the mean annual groundwater-recharge rate in Burnett County from 2012 to 2022.



(2) high permeability of geological materials, (3) shallow bedrock depths, and (4) a thin unsaturated zone. Areas that exhibit a combination of these traits are deemed most susceptible to contamination and are marked in dark red on the map.

Why do these physical characteristics matter?

Each of the four evaluated physical factors affects groundwater susceptibility in distinct ways, which are elaborated upon below. Comprehending how these characteristics impact the protection and vulnerability of aquifers is essential for interpreting the map.

The spatial variability of groundwater recharge is a significant element influencing groundwater susceptibility, as contaminants can be carried to the water table along with the recharge. Consequently, the groundwater system is more prone to contamination in areas where groundwater-recharge rates are high (table 2).

The hydrologic properties (e.g., texture and permeability) of glacial or other shallow materials affect the speed at which water and contaminants percolate down into the ground and reach the water table (Stephenson and others, 1988; Arnaud and others, 2025). For instance, regions with sandy sediments from meltwater streams of the Copper Falls Formation or other coarse-grained materials at the surface are more vulnerable compared to regions covered by Trade River Formation clay or fine-grained till.

Depth to bedrock contributes to how susceptible an area is to contamination because the loose materials above the bedrock help to inhibit the downward flow of pollutants. Thicker sediments provide more surface area and sorption sites for contaminant attenuation and more time for contaminant degradation. In regions where the unconsolidated materials are thin, and the bedrock is near the surface, precipitation and snowmelt can quickly percolate into the bedrock. Shallow bedrock areas in Burnett County include areas along the Saint Croix River and in areas along the county's southern border, such as near Rice Lake in the town of Trade Lake and Little Deer Lake in the town of Siren. Groundwater can travel especially fast through extensive fracture networks, which may be present in basalt underlying Burnett County.

The depth to the water table, or the thickness of the unsaturated zone, influences the natural protection of aquifers and the likelihood of groundwater contamination from surface activities. Based on the composition and hydrologic characteristics of the materials, a thicker unsaturated zone allows for a longer period for water and potential pollutants to reach the water table. Throughout this zone, microbiological and chemical processes can attenuate the concentrations of certain contaminants. In contrast, regions with shallow water tables or thinner unsaturated zones face a higher risk of contamination. The water table is relatively shallow over a significant portion of Burnett County, resulting in high groundwater vulnerability to contamination.

Groundwater susceptibility in Burnett County

The areas in Burnett County most susceptible to groundwater contamination are characterized by sand and gravel at the surface. For example, the areas indicated as highly susceptible along the Saint Croix River and throughout the towns of Swiss, Webb Lake, Scott, and Jackson, result from a combination of sandy soil and a shallow water table.

In Burnett County, the occurrence of clays and silty tills, such as those of the Trade River Formation, plays a vital role in naturally protecting groundwater. The existence of fine-grained sediments on the surface ultimately decreases the rate of groundwater recharge and may hinder the downward movement of pollutants into shallow groundwater. Regions identified as "least susceptible" in the southwestern and southeastern parts of Burnett County are characterized by clay or till layers which result in more runoff and slower infiltration of water to the water table.

The uncertainty associated with the susceptibility map is higher than the other maps included in this atlas because it is dictated by the combined uncertainty of the four inputs. Therefore, it is recommended that the susceptibility map be used as a qualitative and educational resource to understand how the inherent properties of the landscape can have an impact on groundwater quality.

Although not considered in the development of the susceptibility model, land use and well construction can be important in determining the risk of groundwater contamination. Land use and human activities have an influence on potential sources of contamination and can change over time. The way in which an individual well is constructed can also influence the risk of contamination. For example, a well with a casing extended past an aquitard or fine-grained layer will have less risk of becoming contaminated with pollutants released at the land surface than a well cased above the aquitard. Abandoned or unused wells that are not properly filled and sealed can provide a direct path for contaminants to reach groundwater.

Hydrogeologic cross sections

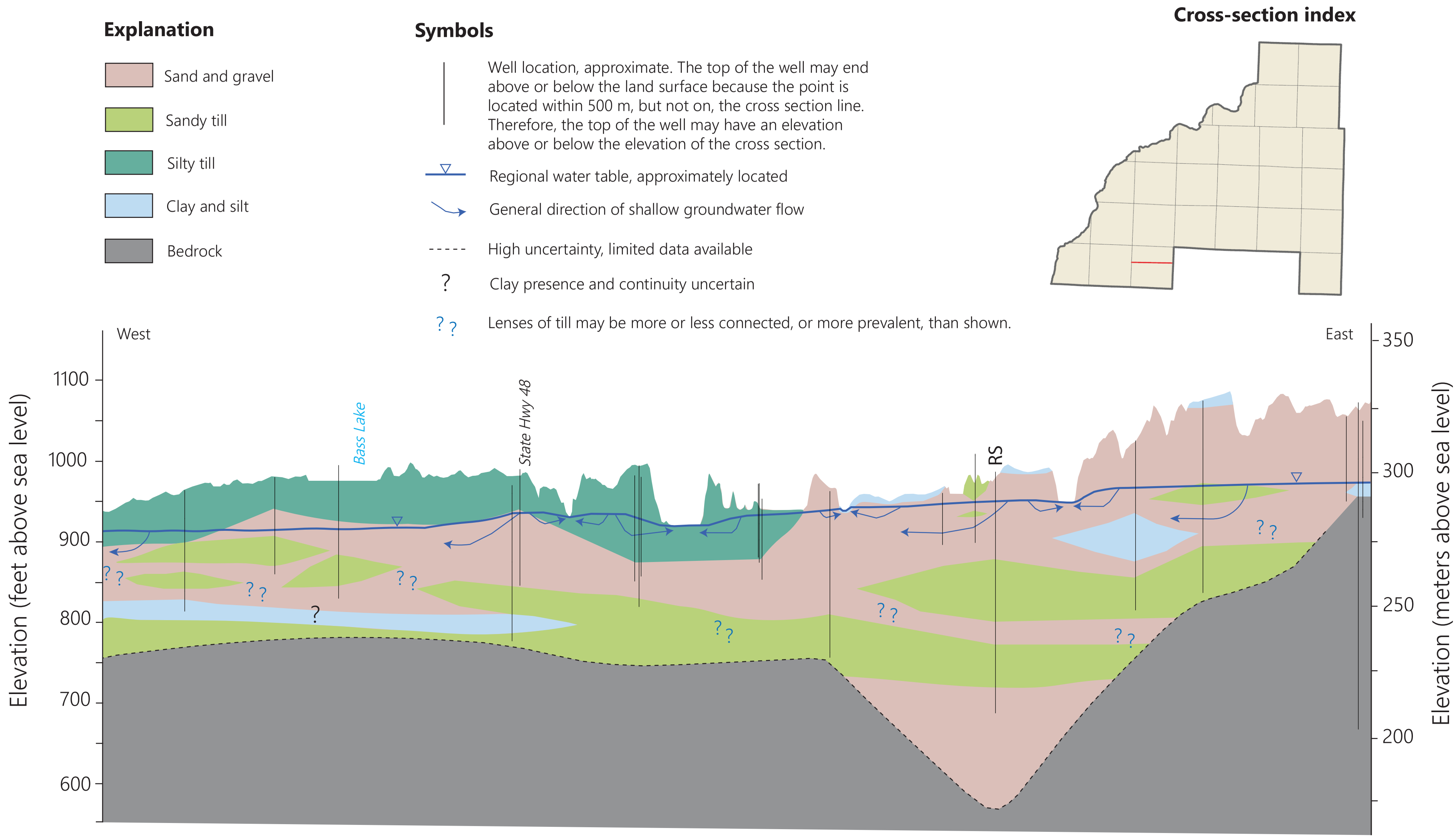
The hydrogeologic cross sections developed for three towns in Burnett County provide a generalized interpretation of geologic and hydrogeologic conditions in the subsurface based on the available information at the time of preparation (figs. 8–10). The final cross sections are derived from multiple iterations in consultation with Quaternary geologists actively mapping the surficial geology of Burnett County (Johnson and Rawling, WGNHS, unpub. data, 2025). In some instances, there are differences between the surficial sediment type indicated on the cross section and the surficial geology map. These differences are attributed to the additional consideration of NRCS soil parent material descriptions in the interpretation, which are mapped at a finer scale than the surficial geology.

High uncertainty due to limited data is conveyed on several areas of the cross sections. The bedrock elevation has high uncertainty indicated by dashed lines on the bedrock surface due to the low number of wells that reach bedrock along these cross sections. Question marks indicate that the lenses of till or clay may be more or less connected than shown. This uncertainty associated with the stratigraphy is due to the low density of well records. In general, less confidence should be placed in areas with few well records. The cross sections are based on interpretation of well records within 1,000 m (0.62 miles) of the line of cross section; therefore, the cross sections represent generalized conditions and should not be used to guide site-specific decisions without further data collection and verification.

The hydrogeologic cross sections provide additional information about relative hydrogeologic conditions and groundwater susceptibility to contamination. The cross sections are located within the two primary agricultural regions in Burnett County (fig. 1). In the town of Trade Lake, groundwater is more vulnerable to contamination in the east than in the west due to the absence of the silty till of the Trade River Formation at the surface and the shallow depth to bedrock (fig. 8). The silty till provides protection of the underlying sand and gravel aquifer in western Trade Lake. Lake Lind clay depicted at depth in western Trade Lake may serve as a confining unit, but its presence and continuity is uncertain at this location due to limited data. The eastern extent of Lake Lind clay in Burnett County is interpreted to be where the topography transitions from non-pitted in the west to pitted in the east (Johnson and others, 1999). The absence of Lake Lind clay in eastern Trade Lake was confirmed with the rotosonic drillhole labeled on the cross section. The sediments underlying Lake Lind clays have unknown composition and thickness at this location, but are depicted as tills to be consistent with observations from other locations in Burnett County (Johnson, M., oral commun., 2025). These deeper sediments are not currently widely used as an aquifer but could be further characterized as a potential resource. If these sediments were used as an aquifer in the future, the Lake Lind clays could provide protection of the underlying aquifer from contaminants released at the land surface.

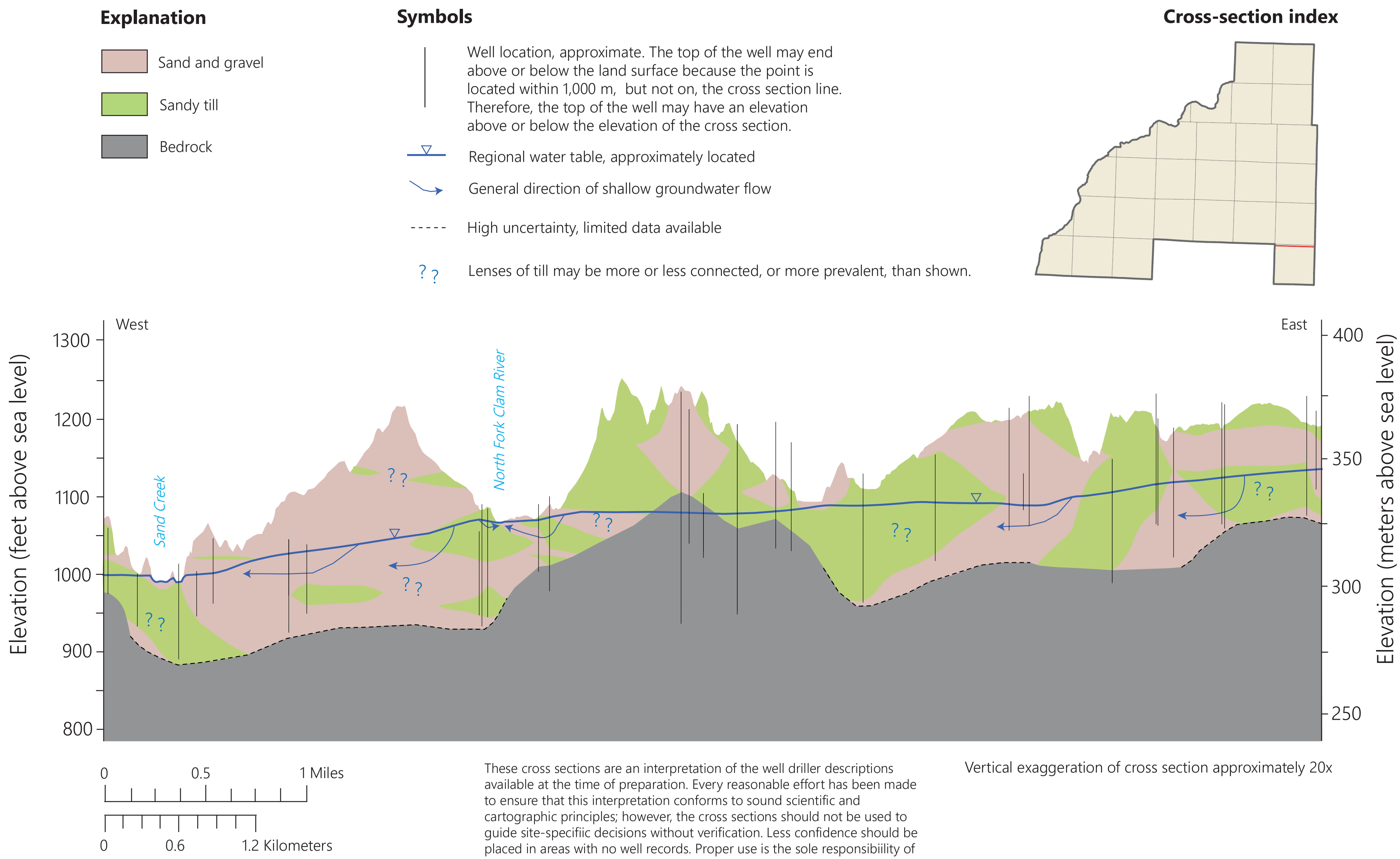
The towns of Roosevelt and Dewey are located within the Spooner Hills. In this region, the distribution of till and sand and gravel is highly heterogenous and dictates groundwater vulnerability to contamination (figs. 9–10). Groundwater is highly susceptible to contamination along stream valleys with sandy sediments and where hilltops are capped by sand and gravel, and less susceptible where the hilltops are capped by Copper Falls till.

Figure 8. Hydrogeologic cross section depicting subsurface conditions in the town of Trade Lake, Burnett County, Wisconsin. The clay layer depicted in the west represents Glacial Lake Lind clay, but there is high uncertainty in its presence and continuity at this location due to a lack of data. The absence of Lake Lind clays was confirmed in the east by the rotosonic drill hole (labeled RS). Note that the regional water table elevation is shown, but the local water table elevation may be steeply mounded under Bass Lake.



These cross sections are an interpretation of the well driller descriptions 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 cross sections should not be used to guide site-specifiic decisions without verification. Less confidence should be placed in areas with no well records. Proper use is the sole responsibiility of the user.

Figure 9. Hydrogeologic cross section depicting subsurface conditions in the town of Roosevelt, Burnett County, Wisconsin.



These cross sections are an interpretation of the well driller descriptions 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 cross sections should not be used to guide site-specifiic decisions without verification. Less confidence should be placed in areas with no well records. Proper use is the sole responsibiility of the user.

Figure 10. Hydrogeologic cross section depicting subsurface conditions in the town of Dewey, Burnett County, Wisconsin.

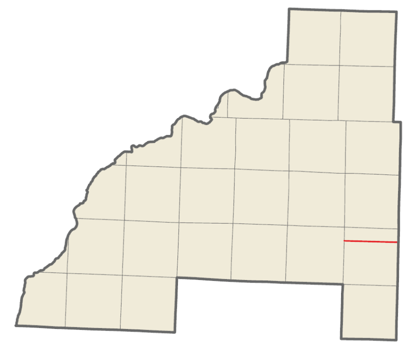
Explanation

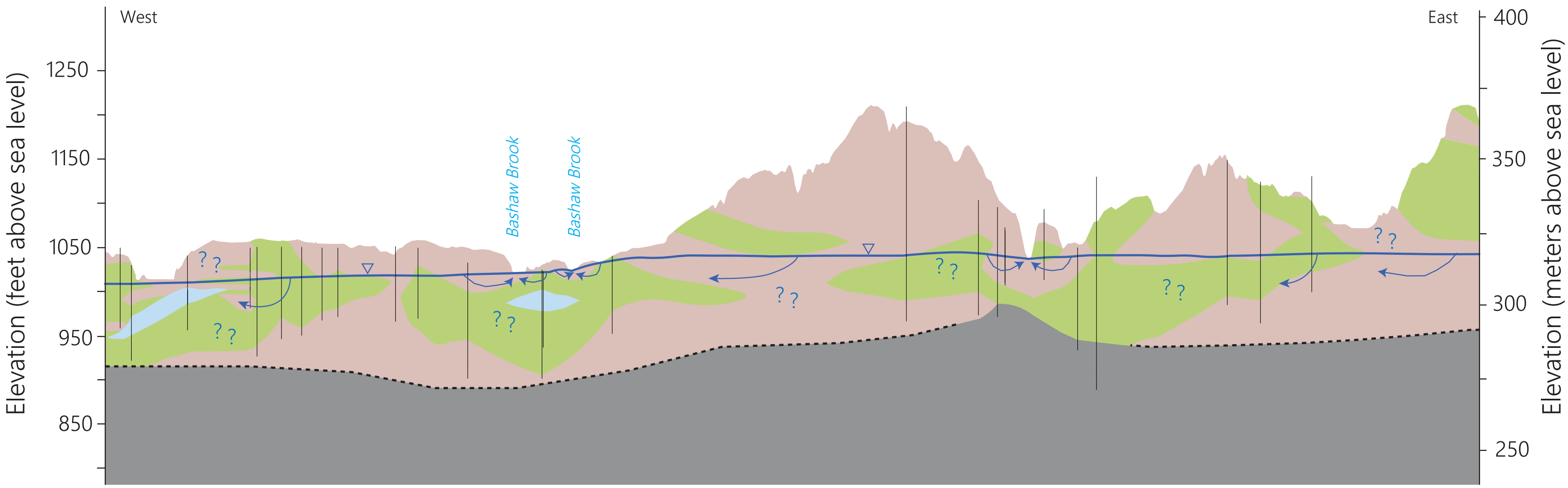
- Sand and gravel
- Sandy till
- Clay and silt
- Bedrock

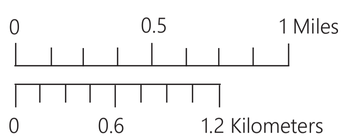
Symbols

- Well location, approximate. The top of the well may end above or below the land surface because the point is located within 1,000 m, but not on, the cross section line. Therefore, the top of the well may have an elevation above or below the elevation of the cross section.
- Regional water table, approximately located
- General direction of shallow groundwater flow
- High uncertainty, limited data available
- ? ? Lenses of till may be more or less connected, or more prevalent, than shown.

Cross-section index







These cross sections are an interpretation of the well driller descriptions 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 cross sections should not be used to guide site-specifiic decisions without verification. Less confidence should be placed in areas with no well records. Proper use is the sole responsibility of the user.

Vertical exaggeration of cross section approximately 20x

Using this atlas

This atlas provides baseline information on groundwater resources in Burnett County, including a series of maps and hydrogeologic cross sections. These resources provide a framework for stakeholders to understand the regional hydrogeology before engaging in groundwater and surface water quality projects or efforts to protect groundwater resources. This information can be used to answer questions related to groundwater, including:

- What are the aquifers in Burnett County composed of?
- What direction is groundwater flowing?
- How much precipitation makes it to the water table each year?
- How far beneath the land surface is the water table?
- In what areas is groundwater most vulnerable to contamination from activities performed on the land surface?

Potential contaminant sources in Burnett County include fertilizer application, manure storage and application, landfills, and industrial facilities. Knowledge of groundwater flow directions (plate 1) may be used to help remediate wells and surface-water bodies downgradient of a contaminated site. Groundwater quality information paired with knowledge of groundwater flow directions may also be useful in targeting areas for conservation practices that improve groundwater quality. The susceptibility map (plate 2) identifies areas where groundwater is most vulnerable to contamination and may be used as an educational tool for understanding how the intrinsic properties of the land can influence groundwater quality. Additionally, the map may be used to initiate conversations about land use decisions or delineating areas for additional groundwater monitoring.

The maps associated with this publication are intended to be used at the county scale (1:100,000) but may provide useful context for site-scale investigations. For site-scale investigations, it is recommended that the user consults hydrogeologic information from individual well construction reports in the area of interest and collect additional data on site as necessary.

Recommendations for future work

The results presented in this atlas should be revised and improved as new data become available. There are two suggestions for future work that could enhance the understanding of groundwater resources and susceptibility in Burnett County. The first suggestion is to characterize the extent and thickness of glacial Lake Lind clay and sediments underlying glacial Lake Lind clay across the county. Improving understanding of the distribution and thickness of Lake Lind clays would help determine if and where it serves as a confining unit to the underlying sediments. Although these underlying sediments are not currently widely used as an aquifer in Burnett County, they may be considered an important resource after further characterization. Another suggestion for future work is to conduct field work to confirm the mechanisms responsible for the discrepancies between surface-water and well-water elevations outlined on the water-table map. Current interpretations of these local water table conditions are based on field work from adjacent counties. Installation of monitoring wells at various depths within areas of water-level disagreement would help determine if the water table is locally perched above an unsaturated zone and the regional water table or steeply mounded with a continuous saturated zone in the subsurface. An enhanced understanding of the configuration of the water table in these areas would be useful for siting water supply wells.

Acknowledgments

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The Survey conducts earth-science surveys, field studies, and research. We provide objective scientic information about the geology, mineral resources, water resources, soil, and biology of Wisconsin. We collect, interpret, disseminate, and archive natural resource information. We communicate the results of our activities through publications, technical talks, and responses to inquiries from the public. These activities support informed decision making by government, industry, business, and individual citizens of Wisconsin.