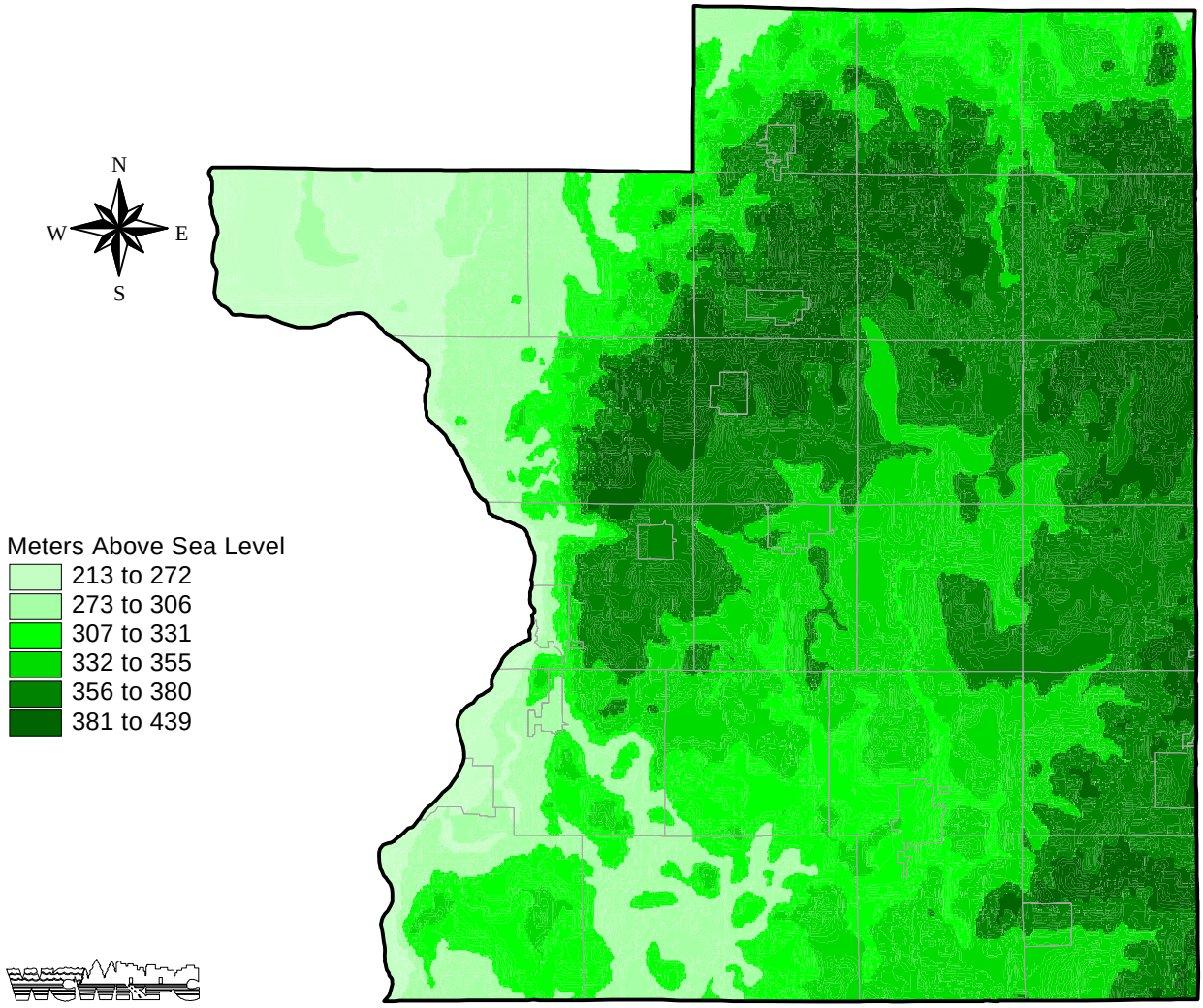
SECTION

# PHYSICAL FEATURES

# TOPOGRAPHY

Local areas of Polk County are part of larger geographic structures sharing some common characteristics or connections. Physically, the county is part of the “Central Plain” and "Western Upland" physiographic regions of Wisconsin. The Central Plain region extends southeasterly from northern Polk County to south-central Wisconsin and then northeasterly to Marinette County and the Michigan border. The Western Upland region extends parallel to the Mississippi and St. Croix Rivers from Polk County to the Illinois border and to the east from 30 to 75 miles.

**GENERAL TOPOGRAPHY**
**POLK COUNTY**



Generally, the topography of Polk County is moderately rolling, becoming increasingly more rugged in the western portion of the county, particularly in the St. Croix River valley. Surface features have been formed or modified by two distinct periods of glaciation. Pitted glacial outwash covers much of the county resulting in many lakes, wetlands, and areas of uneven topography. A series of glacial end moraines traverse the county from southwest to northeast. The area between the moraines is quite level and much of the County's best agricultural land is found here.

A band of trap rock (an intrusive igneous rock) is exposed at several points between Dresser and the Clam Falls area. Exposed dolomite limestone is found in the southwest part of the county and the exposed sandstone bedrock in the area known as the Dalles of the St. Croix is largely responsible for the scenic beauty in this area.

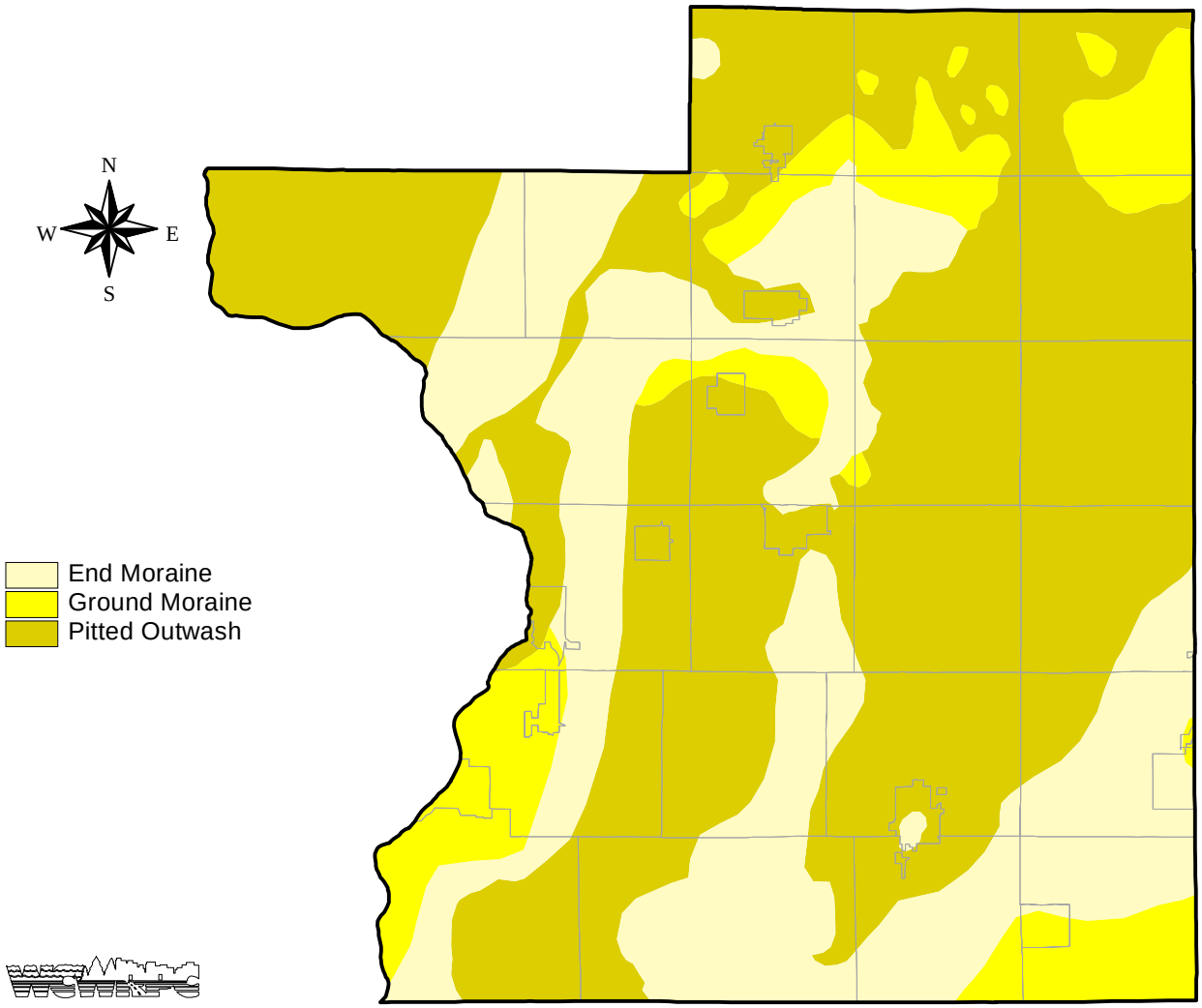
Local relief in Polk County is over 600 feet, ranging from 680 feet above mean sea level at the St. Croix River on the County's western extreme to over 1,400 feet in the north-central and eastern areas.

## GEOLOGY

# Surface Geology

The surface geology of Polk County is primarily the result of glacial deposition over bedrock. The modern landscape was most strongly influenced by the glaciers that invaded the county from about 25,000 to 15,000 years ago from the north and northwest, and by a glacier that moved into the county from the west about 12,300 years ago. Since the last period of glacial activity, the landscape has been further sculpted by naturally occurring and man-induced erosion and drainage activity.

**GLACIAL GEOLOGY**
**POLK COUNTY**


N
W
E
S
End Moraine
Ground Moraine
Pitted Outwash

During the last major glacial advance, the Wisconsin stage, ice covered all of Polk County except the southeast corner. This glacial activity has left thick glacial deposits that form the primary geologic characteristics of the County.

Landforms produced by glacial activity include a diverse landscape ranging from broad, nearly level glacial outwash plains to rough, broken glacial moraines and areas of pitted outwash. The moraines are rough and broken, having abrupt hills and short, steep ridges near depressions, many of which have no outlets. Between the moraines, the landscape is more nearly level, especially in the central part of the county. Large outwash plains, formed from material carried and deposited by glacial melt water, are mostly level or undulating but in some areas are also pitted with depressions. Lakes, ponds and bogs are common in the depressions in the moraines and areas of pitted outwash.

The most conspicuous glacial features of Polk County are two terminal moraines which extend from the southwest to the northeast. Terminal moraines mark the furthest advance of a lobe of glacial ice. Moraines are generally rough hills with numerous undrained depressions. These depressions, or kettles, were caused by voids left when ice blocks buried in the drift melted. Many of these kettles in Polk County are presently small lakes or swamps. The eastern-most terminal moraine extends from New Richmond through Clear Lake and on to Turtle Lake. The other terminal moraine extends from a point east of St. Croix Falls to the northeast corner of the county, near Indian Creek. Between these moraines, the surface is gently rolling to level with poorly developed drainage and many lakes.

The land southeast of the eastern terminal moraine is covered with drift from earlier glacial activity. Because this drift is older, it has been thinned out and leveled off by erosion over a longer period of time. Subsequently, this area is characterized by slopes that are long and gentle, and well developed drainage.

The northwestern portion of the County is level sand and gravel deposits. This area, which is mostly forested, is known as the "Pine Barrens".

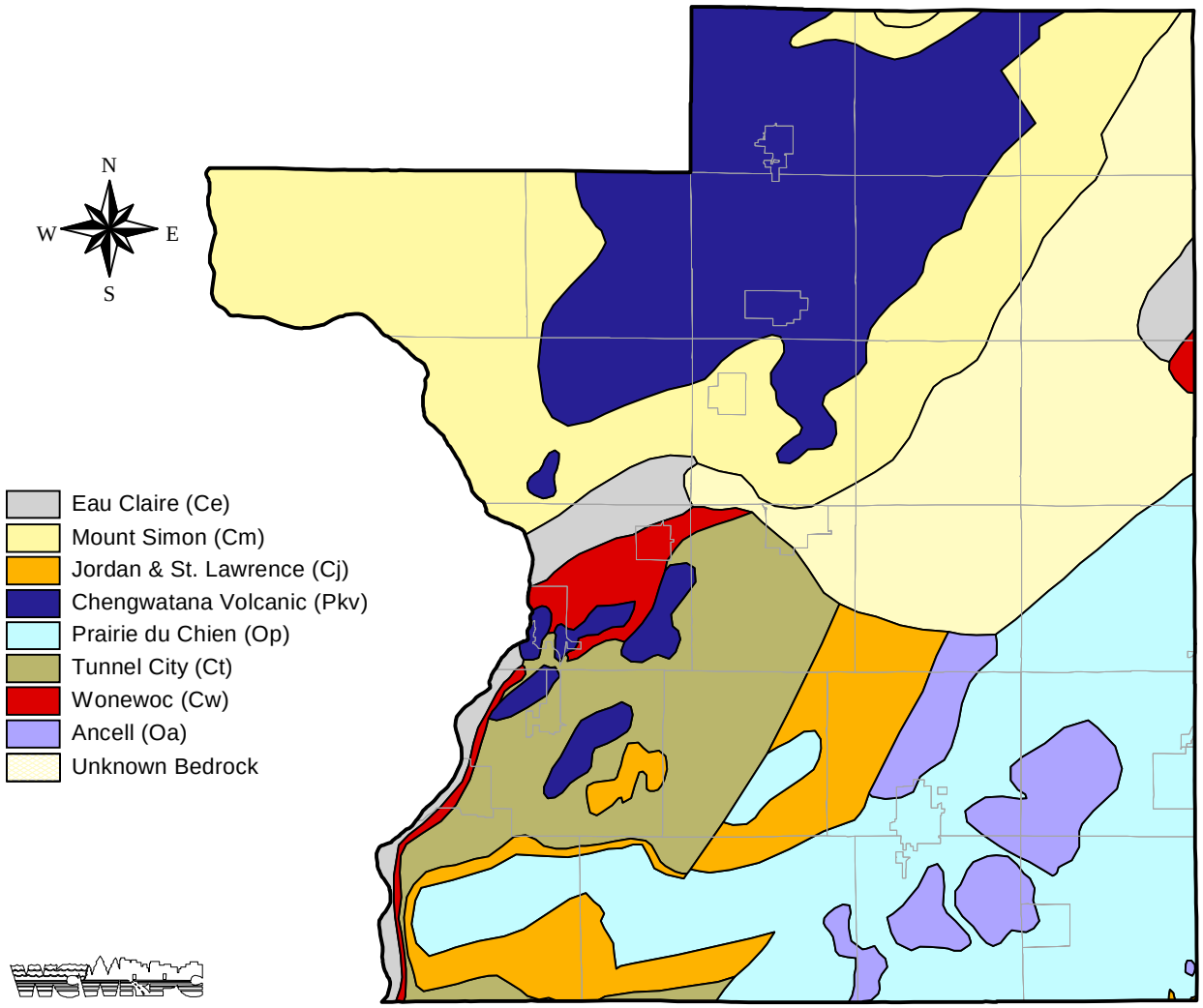
Throughout the eastern part of the county are scattered small areas of nearly level and gently sloping glacial lacustrine plains. This area was formed through the sedimentation of old glacial lakes.

The St. Croix River Valley, along the western extreme of the county, was a major glacial drainageway as the glaciers melted and receded.

## BEDROCK GEOLOGY

Sandstone, limestone, and basalt and andesite form Polk County's bedrock. Bedrock exposures are few, though bedrock is often close to the surface. Low ridges of Precambrian (Keweenanwan) basalts are interbedded with sandstone outcrop in the west central part of the County. This rock is commonly known as Traprock. Dolomitic limestone also outcrops in the southwest quarter of the County. The escarpment formed by this limestone separates the county into two recognized physiographic provinces. These provinces are the Central Plain, which covers most of the County, and the Western Upland, which covers the southwestern portion of the county.

**BEDROCK GEOLOGY**
**POLK COUNTY**




**Mount Simon Formation** - Sandstone; 18 to 52 meters thick.

**Chengwatana Volcanic Group** - Basalt; light to dark gray basalt flows; 5 to 30 meters thick.

**Eau Claire Formation** - Sandstone; light brown; 30 to 46 meters thick.

**Wonewoc Formation** - Sandstone; 5 to 18 meters thick.

**Tunnel City Group** - Sandstone; 30 to 56 meters thick.

**Jordan and St. Lawrence Formations** - Sandstone, quartzose, sandy dolomite, dolomite, and siltstone; 3 to 18 meters thick.

**Ancell Group** - Sandstone and quartzose; less than 25 meters thick.

**Prairie du Chien Group** - Dolomite and sandy dolomite; 2 to 27 meters thick.

The general bedrock geology has been mapped using the Bedrock Geology of Wisconsin map series produced in 1987 by the University of Wisconsin - Extension. Based on this map series, sandstone is shown to be the primary bedrock underlying the county. In addition there are significant amounts of basalts, located in the north-central part of the county, and dolomite, primarily located in south and southeastern Polk County. Both of the sandstone and dolomite types of bedrock are porous and have the ability serve as good natural groundwater aquifers depending on their thickness, degree of fracture, overlying soil characteristics, and proximity to the land surface. However, these types of bedrock are also susceptible to contamination in areas where this fractured rock occurs at or near the land surface, especially where there is little or no soil to attenuate groundwater contaminants.

# Soils

Soil properties are an important factor in how land is used. Soils characteristics can assist in the evaluation of the productivity of farmland and the type and amount of development that can be reasonably supported. Subsequently, the identification and review of soil suitability interpretations for specific urban and rural land uses are essential for physical development planning and determining the most suitable land use.

In November 1979, the Soil Conservation Service (SCS), now known as the Natural Resources Conservation Service (NRCS), completed the Soil Survey of Polk County, Wisconsin. This soil survey provides detailed soils mapping for the county, as well as, information on the physical, chemical and biological properties of the soils. Most importantly, the soil survey provides soil property interpretations for agricultural, engineering, planning and resource conservation activities.

This section will cover the general soil associations and the soil suitability interpretations for agricultural use, septic tank absorption fields, dwellings with basements, and small commercial buildings.

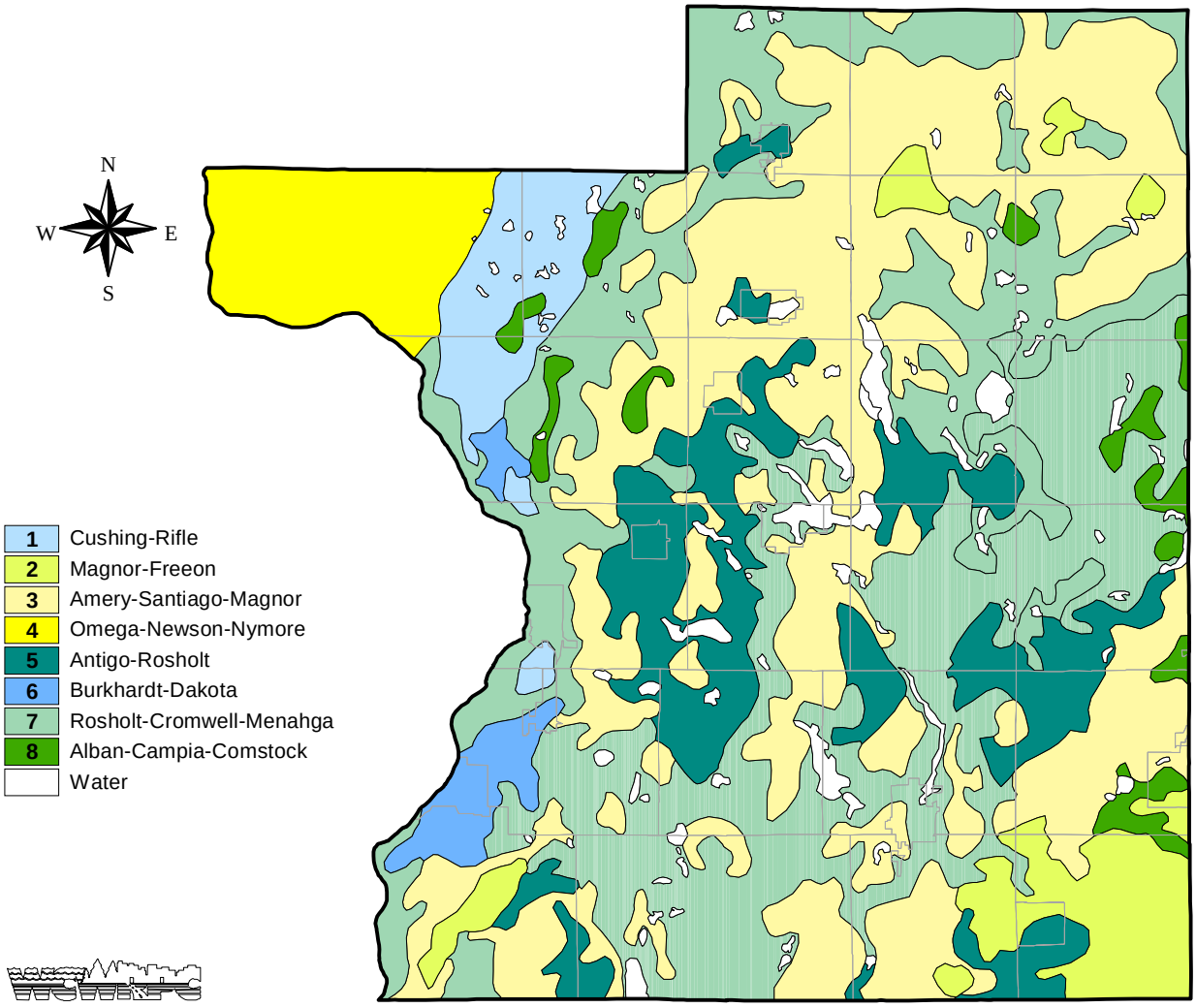
# General Soil Associations

The soils of Polk County were formed principally from glacial and alluvial deposits under northern hardwood and conifer forest cover. Portions of the southwestern towns were vegetated with prairie and savanna vegetation which affected the soil formation in those areas. The irregular topography of the County, with many depressions, accounts for much of the local variability in soils.

The following is a description of the generalized soils located in Polk County.

Each association contains several major and minor soils in a pattern that varies throughout the association. The soils within an association differ in many properties such as drainage, wetness, slope and depth to bedrock. These characteristics affect the suitability of the land for agriculture and for development. For these reasons, the generalized information provided in this report is intended to be used for general policy and planning purposes, and not to provide information for site specific applications.

**GENERAL SOIL ASSOCIATIONS**
**POLK COUNTY**




### 1. Cushing-Rifle Association

*Undulating to very hilly, well and moderately well drained, loamy and nearly level very poorly drained organic soils on till plains.*

Areas of these soils are on glacial moraines with short uneven slopes, short drainageways and common depressions and pothole lakes. The Cushing soils are used primarily for cultivated crops. Some of the hilly and very hilly areas are used for woodland or pasture. Erosion is the main limitation to the use of these soils for cultivated crops. The Rifle soils are used primarily for woodland and wildlife habitat. A few areas are pastured. Excess wetness and the frost hazard are the main limitations that generally prevent their use for cropland. Cushing soils, when adequately protected from erosion, have good potential for cultivated crops. This association has good potential for woodland. Potential for residential developments is because of severe limitations for septic tank absorption fields.

### 2. Magnor-Freeon Association

*Nearly level and gently sloping, somewhat poorly and moderately well drained silty soils on till plain plains.*

Areas of these soils are on broad ground moraines with long, even slopes. The soils in this unit are used primarily for cultivated crops. Wetness and erosion are the main limitations. This association, when adequately drained and protected from excess erosion, has good potential for cultivated crops. Potential for woodland is good. Potential for residential development is poor because of severe limitations for septic tank absorption fields.

**3. Amery-Santiago-Magnor Association**
*Nearly level to very hilly, well and somewhat poorly drained loamy and silty soils on till plains.*

Areas of these soils are glacial moraines with short, uneven slopes, short drainageways, and common depressions and pothole lakes. Much of this soil association is used for cultivated crops or pasture. However, a large acreage, primarily in the northern part of the county, is used for woodland. Erosion is the main limitation to the use of these soils for cultivated crops. Excess wetness and impoundment of water are additional problems on Magnor soils. The soils in this association, when adequately protected from erosion, have good potential for cultivated crops. They also have good potential for woodland. Potential for residential development is fair because of moderate or severe limitations for septic tank absorption fields.

**4. Omega-Newson-Nymore Association**
*Nearly level to hilly, somewhat excessively and poorly to very poorly drained sandy soils on outwash plains.*

Areas of these soils are on broad, nearly level to hilly outwash plains, with short uneven slopes. These outwash plains, locally known as the "Pine Barrens", consist primarily of fine sand glacial outwash that has been reworked by wind to give it a dune-like topography. This association is used primarily for woodland. Drouthiness and soil blowing are the main limitations for the use of these soils for cultivated crops. Excess wetness is an additional problem on Newson soils. This association is too droughty for cultivated crops, however, it does have the potential for irrigated cropland. It also has fair potential for woodland. Potential for residential development is good.

**5. Antigo-Rosholt Association**
*Nearly level to sloping well-drained silty and loamy soils on outwash plains.*

Areas of these soils are on broad, nearly level and gently sloping outwash plains with some sloping areas adjacent to drainageways and depressions. The soils in this group are use primarily for cultivated crops. Maintaining soil tilth and controlling erosion on sloping areas are the main limitations to the use of these soils for cultivated crops. This association has good potential for cultivated crops, woodland, and residential development.

**6. Burkhardt-Dakota Association**
*Nearly level to sloping, well and somewhat excessively drained loamy soils on outwash plains.*

Areas of these soils are on broad, nearly level to sloping outwash plains and stream terraces. The soils in this grouping are used primarily for cultivated crops. Maintaining

soil tilth and fertility, and controlling erosion on sloping areas are the main limitations to the use of these soils for cultivated crops. Drouthiness is an additional limitation on Burkhardt soils. This unit of soils has good potential for cultivated crops, woodland, and residential development.

7. **Rosholt-Cromwell-Menahga Association**
   *Nearly level to very hilly, well and somewhat excessively drained loamy and sandy soils on pitted outwash plains.*

   Areas of these soils are pitted glacial outwash plains with short uneven slopes, many closed drainageways, and common depressions and pothole lakes. Much of this association is used for cultivated crops; however, many areas, especially the more sloping areas, are used for pasture and woodland. Erosion and drouthiness are the main limitations to the use of these soils for cultivated crops. Soil blowing is an additional hazard on the Menahga soils. This soil association has poor potential for cultivated crops. Its potential for woodland and residential development is good.

8. **Alban-Campia-Comstock Association**
   *Nearly level to moderately steep, well to somewhat poorly drained loamy and silty soils on glacial lake plains.*

   Areas of these soils are on broad, nearly level and gently sloping old glacial lake beds, with some sloping and moderately steep areas adjacent to drainageways and depressions. This association is used primarily for cultivated crops. Maintaining soil tilth and fertility are the main limitations to the use of these soils for crops. The erosion hazard is a problem on the sloping areas and excess wetness is a problem on areas of Comstock soils. This soil association has good potential for cultivated crops and woodland. Potential for residential development is fair. Some areas have moderate or severe limitations for septic tank absorption fields because of slope or excess wetness.

## SOIL SUITABILITY INTERPRETATIONS

Soils and subsoil materials are the basis of agricultural production; foundations for roads and buildings; and, if properly used, the treatment of waste from homes, the production of livestock and poultry, and from municipal and industrial sewage-treatment plants. Soil and subsoil characteristics, such as thickness, texture, and permeability, are among the natural factors that help determine the degree of natural protection against groundwater contamination. This information, used in conjunction with other land characteristics such as slope, can help determine the overall potential of the environment to protect groundwater.

The Polk County Soil Survey provides important information about the suitability of land for different rural and urban uses. The interpretation of soils involves assessing the characteristics of soils and predicting the various limitations that those soils place on specific land uses.

The generalized soils in Polk County have been mapped, analyzed and categorized as to their suitability for development. For planning and development purposes, specific development limitation information can help decision-makers determine the suitability of certain areas for particular types of development. For example, soils which have slight limitations can be developed with few, if any, difficulties. However, problems may occur as development takes place in areas classified as having moderate to severe limitations. Some of these limitations can be overcome, or their undesirable effects minimized, if proper measures are taken. In the case of severe limitations, such as areas having shallow depths to bedrock and groundwater, questions regarding the economic and environmental feasibility of such developments should be posed.

The purpose of this section is to provide general information about the suitability of soils for the purposes of agriculture and building site development, including septic tank absorption fields, dwellings with basements, and small commercial buildings.

Evaluation of building site development will include the NRCS interpretations of development limitations. Based on the soil characteristics and the intended land use (i.e. septic tank absorption fields, dwellings with basements, or small commercial buildings), the NRCS has identified the degree to which the soil is limited in its capacity to sustain itself environmentally and functionally. The following is a description of the degrees of soil limitations that are used.

**SLIGHT Limitations**: Soil properties and site features generally are favorable for the indicated use and the limitations are easily overcome.

**MODERATE Limitations**: Soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations.

**SEVERE Limitations**: Soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. In the case of severe limitations, questions regarding the economic and environmental feasibility of such development should be seriously considered.

The information in this section will be general and is intended to be used for the purpose of broad-based planning and management activities. All of the maps produced for this section are at a small scale, and are not suitable for site specific planning or management activities.

## SUITABILITY FOR AGRICULTURE

The Natural Resource Conservation Service (NRCS), formerly known as the Soil Conservation Service (SCS), has established a system of soils classification in order to uniformly evaluate the potential suitability of soils for agriculture production. This system is known as the Capability Classification of Soils.

The capability classification is a grouping of soils that shows, in a general way, how suitable soils are for most kinds of farming. The capability classification system is intended to assist decision-makers in evaluating areas for their desirability for continued agricultural productivity. It does this by considering characteristics and suitability for supporting various crops and activities, and is based on the limitations of the soils, risk of damage as they are used, and the way they respond to treatment. Soils are classified in capability classes, subclasses and units in accordance with the degree and kind of their permanent limitations; but without consideration of major and generally expensive land-forming that would change the slope, depth, or other characteristics of the soil, and without consideration of possible but unlikely major reclamation projects.

The following are the eight classes in the soil capability classification system:

**Class I**
Soil that has few limitation that would restrict agriculture use. These soils are nearly level, generally well drained and have no significant problems relating to agriculture use.

**Class II**
These soils have some limitation which would require some conservation practices.

**Class III**
These soils have severe limitation that reduce the choice of plants or require special conservation practices or both. They can be cultivated safely with special precautions.

**Class IV**
Soils that are identified as soils with very severe limitations that require very careful management, restrict the choice of plants, or both.

**Class V**
These soils are suited mainly to pasture due to permanent limitations such as wetness, overflow or stoniness.

**Class VI**
These soils have severe limitation that make them generally unsuited for cultivation and limit use to pasture, woodland or wildlife.

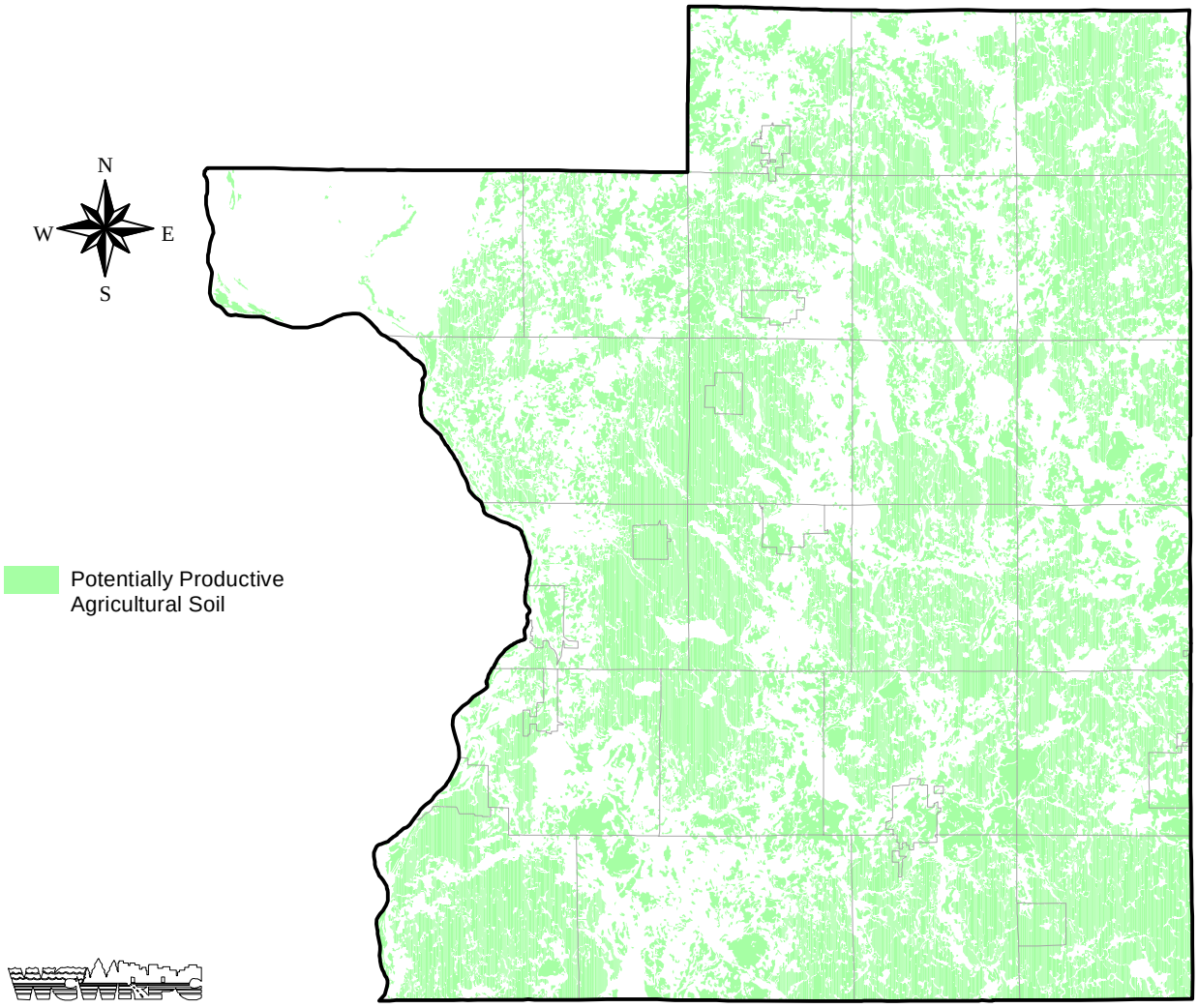
**Class VII**
The soils in this class have severe limitation that restrict their use to recreation and wildlife.

**Class VIII**
The soils in this class have very severe limitation that restrict their use to recreation and wildlife.

Prime agricultural land is the land that is best suited to food, feed, forage, fiber and oil seed crops. It may be cultivated land, pasture, woodland or other land, but it is not existing urban and developed land or water areas. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime agricultural land is able to produce the highest yields with the minimal inputs of energy and economic resources.

For the purposes of the Polk County Comprehensive Plan, the Polk County Farmland Preservation Plan, Polk County Soil Survey and Polk County Soil Survey Cropland Interpretations were used to identify potentially productive agricultural lands. The Farmland Preservation Plan, adopted in 1979, uses the soil capability classifications to identify general farmland preservation guidelines. As recognized in the Polk County Farmland Preservation Plan, generally, soils with the capability classifications I, II, and III are considered potentially productive agricultural lands.

**POTENTIALLY PRODUCTIVE AGRICULTURAL LANDS (CAPABILITY CLASS I, II & III)**
**POLK COUNTY**




**SOIL CAPABILITY CLASSIFICATION FOR POTENTIALLY PRODUCTIVE AGRICULTURAL LANDS**
**POLK COUNTY**

| Soils | Acres | Percent of Total Land Acreage |
|---|---|---|
| Class I | 2,000 | 0.3% |
| Class II | 202,890 | 34.1% |
| Class III | 120,840 | 20.3% |
| Total Classes I, II, & III | 325,730 | 54.7% |

***Source:*** ***Polk County Soil Survey, Soil Conservation Service, 1979; and Cropland Interpretations, Natural Resource Conservation Service, 1996***

For the purposes of this plan, potentially productive agricultural lands are those areas having a soil capability classification of I, II or III.

Of the total land acres in Polk County, 325,730 acres are classified as Class I, II, and III soils by the NRCS. These soils make up approximately 55% of the total land acres of the county. Of the total acres of Class I, II and III soils, over 62% are Class II, 37% are Class III soils, and 0.6% are Class I soils.

## SUITABILITY FOR SEPTIC TANK ABSORPTION FIELDS

Septic tank absorption fields are subsurface systems of perforated pipe which distribute effluent from septic tanks to the soil. Soil between 24 to 72 inches is evaluated for properties that affect absorption of effluent and construction and operation of the system. The main soil properties that affect absorption are soil permeability, soil depth to bedrock, soil depth to the water table, and susceptibility to flooding.

The layout and construction of a system is affected by soil conditions related to slope, erosion potential, lateral seepage, and downslope flow of effluent. Soils with characteristic large rocks and boulders present additional problems, and increase the costs of septic system construction.

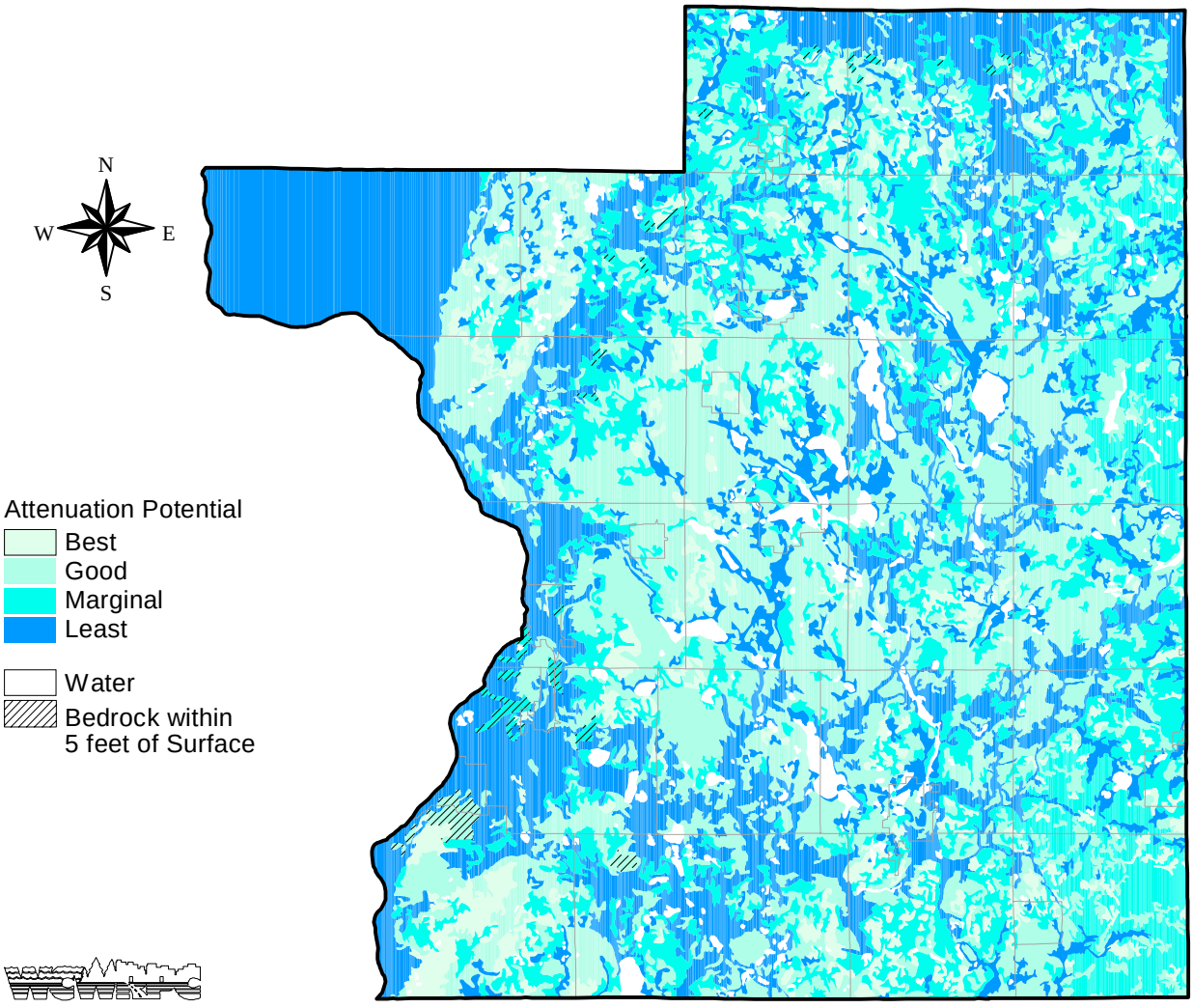
The state requirements for septic system siting are specified in Chapter ILHR 83 of the Wisconsin Administrative Code. This code relies heavily on the ability of the soil to efficiently absorb the effluent discharged from the septic system drainfield in order for the septic system to function properly. In addition, current septic system regulations only require a minimal soil depth, sufficient water infiltration into the soil, minimal separation between wells and soil absorption systems, and certain plumbing standards.

However, these regulations may not fully address the potential environmental impacts of unsewered development in Polk County. Additional consideration should be given to the characteristics of the soil and the underlying geology. These factors relate to the environments ability to limit the exposure of contaminants to the groundwater. The NRCS soil interpretations for septic tank absorption fields, not only consider the soils ability to maintain a properly functioning septic system, but also consider the soil's ability to attenuate (reduce) contaminants from septic effluent before it reaches the groundwater. This interpretation is based on the various soil characteristics and geology of an area. For example, the NRCS soil interpretations would consider most excessively drained soils, occurring over fractured bedrock or high water tables, a limitation to septic system development. This is due to the fact that effluent in these situations can be readily transported to the groundwater. Subsequently, even though the siting of septic systems in some areas may be allowed by state code, doing so has the potential for threatening groundwater quality.

Based on the Polk County Soil Survey, and the NRCS's most recent interpretation of soil limitations, all land area in Polk County, 595,840 acres, has either moderate (8,890 acres) or severe (586,950 acres) limitations for septic tank absorption fields.

## SOIL ATTENUATION POTENTIAL

**SOIL ATTENUATION POTENTIAL**
**POLK COUNTY**




The soil is an important part of the natural protection of groundwater from contaminants. Soils have the ability to attenuate contaminants through a series of complex physical, chemical, and biological processes. During attenuation, the soil can store essential plant nutrients, immobilize metals that might be contained in municipal sewage sludge, or remove bacteria contained in animal or human wastes. Since this is such an important step in the natural protection of groundwater, the location of septic systems should not only be determined based on the ability of the system to function, but also the potential exposure the effluent may have to the groundwater.

The Soil Attenuation Potential map for Polk County, as developed by University of Wisconsin-Extension, was developed for the purpose of identifying areas of Polk County that are sensitive to the impacts of normal land-use activities. This is determined by evaluating the soil and subsoil's ability to reduce the exposure of contaminants to the groundwater. This map is intended to be used as a planning tool only, and does not replace the need for detailed on-site investigations.

## SUITABILITY FOR DWELLINGS WITH BASEMENTS

Another consideration with regard to residential development is the suitability of soils for dwellings with basements. For this interpretation, dwellings are no taller than three stories and are supported by foundation footings in undisturbed soil.

The capacity to support load and resist settling under load, and the ease of excavation affect the soil rating for dwellings. Wetness, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential are soil properties that affect the capacity to support load. Soil properties which affect excavation are wetness, slope, depth to bedrock, and the content of stones and rocks. Soils with severe limitations preclude basements in most instances. Soils with moderate limitations may preclude basement development in some instances. However, it is more likely that these soils will result in an increased cost for basement construction.

In Polk County, approximately 68%, 405,240 acres, of the total land area possess either moderate (139,640 acres) or severe (265,600 acres) limitations to the development of dwellings with basements.

## SUITABILITY FOR SMALL COMMERCIAL BUILDINGS

Single story, small commercial building development is limited by soil factors related to steep slope, wetness, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential. These are the same factors which affect the construction of dwellings without basements, and as such can be used to evaluate these dwellings as well. Small commercial buildings are typical where commercial development is allowed in rural areas.

In Polk County, approximately 86%, 513,040 acres, of the total land area possess either moderate (128,840 acres) or severe (384,200 acres) limitations to the development of small commercial buildings.

# WATER RESOURCES

Polk County's water resources are very important to the economic, aesthetic, social, and recreational interests of its residents, businesses and visitors. The following characteristics generally describe the various water resources available in the County.

## Groundwater Resources

Groundwater is an important natural resource in Polk County. Understanding how groundwater is used in the county and how it can become contaminated is important to understanding the relationship between land use and groundwater quality.

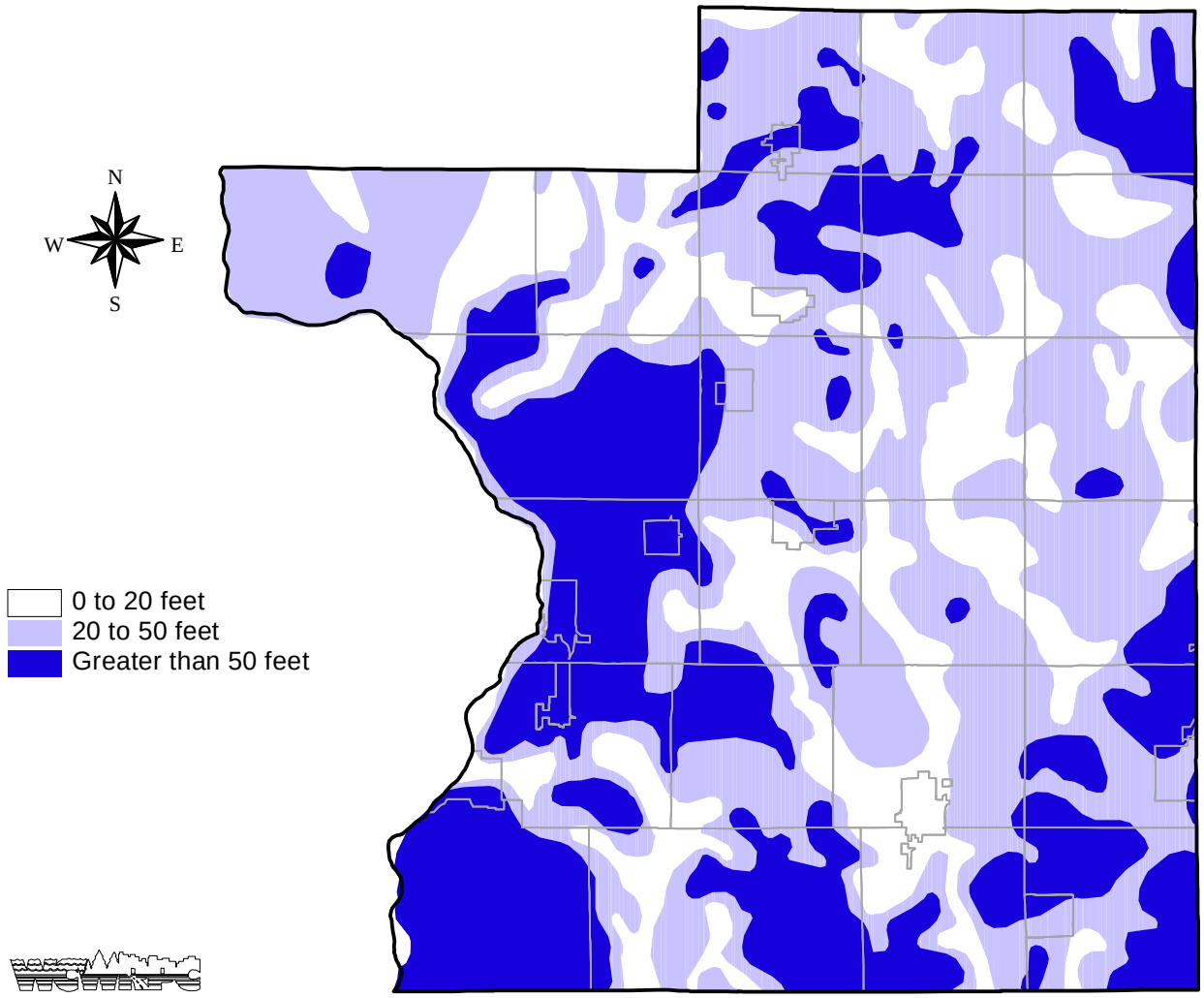
The first step in this process is to understand the source of groundwater. As rain and snow fall to the ground, some runs off into the lakes, rivers and streams; some evaporates; and plants use some. The rest trickles down through the soil and subsoil material. This water eventually reaches a saturated zone that comprises groundwater. These saturated zones, called aquifers, are geologic formations that can store and transmit water. The concept of water moving from the land's surface into groundwater is the starting point for thinking about the relationship between land use and groundwater quality. Nearly anything that is dumped, spilled, or spread on the ground can seep down to groundwater. This groundwater is then used by residents for drinking, farming and other activities. Groundwater can also return to the surface as springs or as discharge to lakes, river and streams.

Protecting groundwater means modifying or even prohibiting certain activities in areas where contaminants can easily enter the groundwater. This can mean changing the type of septic system required to be installed, or limiting the concentration of development in areas that are most susceptible to contamination.

In Polk County, the principal sources of potable water supplies are the sand and gravel aquifer and the sandstone aquifer. The sand and gravel aquifer consists of unconsolidated sand and gravel in glacial drift and alluvium. These deposits occur throughout the entire county. Sandstone generally yields enough water for domestic use. The sandstone aquifer includes all sedimentary bedrock younger than the Precambrian age. Precambrian rocks generally have low permeability and mark the lower limit of groundwater movement. The sandstone aquifer covers the southeastern half of the county as well as a portion of northwestern Polk County. Due to the abundance of water and depth of the sandstone, the aquifer is typically used for wells that require large amounts of water, such as municipal water supplies and industries.

In those areas underlain by basaltic rocks, preservation of the quality of the water in the sand and gravel aquifer is extremely important. Although the basalt (also known as Traprock) does contain water, it generally does not yield sufficient water for domestic use unless a well happens to hit a large fissure or crack. Subsequently, if the groundwater in the sand and gravel aquifer becomes contaminated, alternative sources of water are limited.

**DEPTH TO GROUNDWATER**
**POLK COUNTY**




- The principle sources of groundwater in Polk County are the Sand and Gravel Aquifer and the Sandstone Aquifer.
- The Sand and Gravel Aquifer underlies all of Polk County, while the Sandstone Aquifer underlies about two-thirds of the County.
- Approximately 97% of all the water used in Polk County is groundwater. 3% is surface water.
- The quality of groundwater in Polk County is generally good.

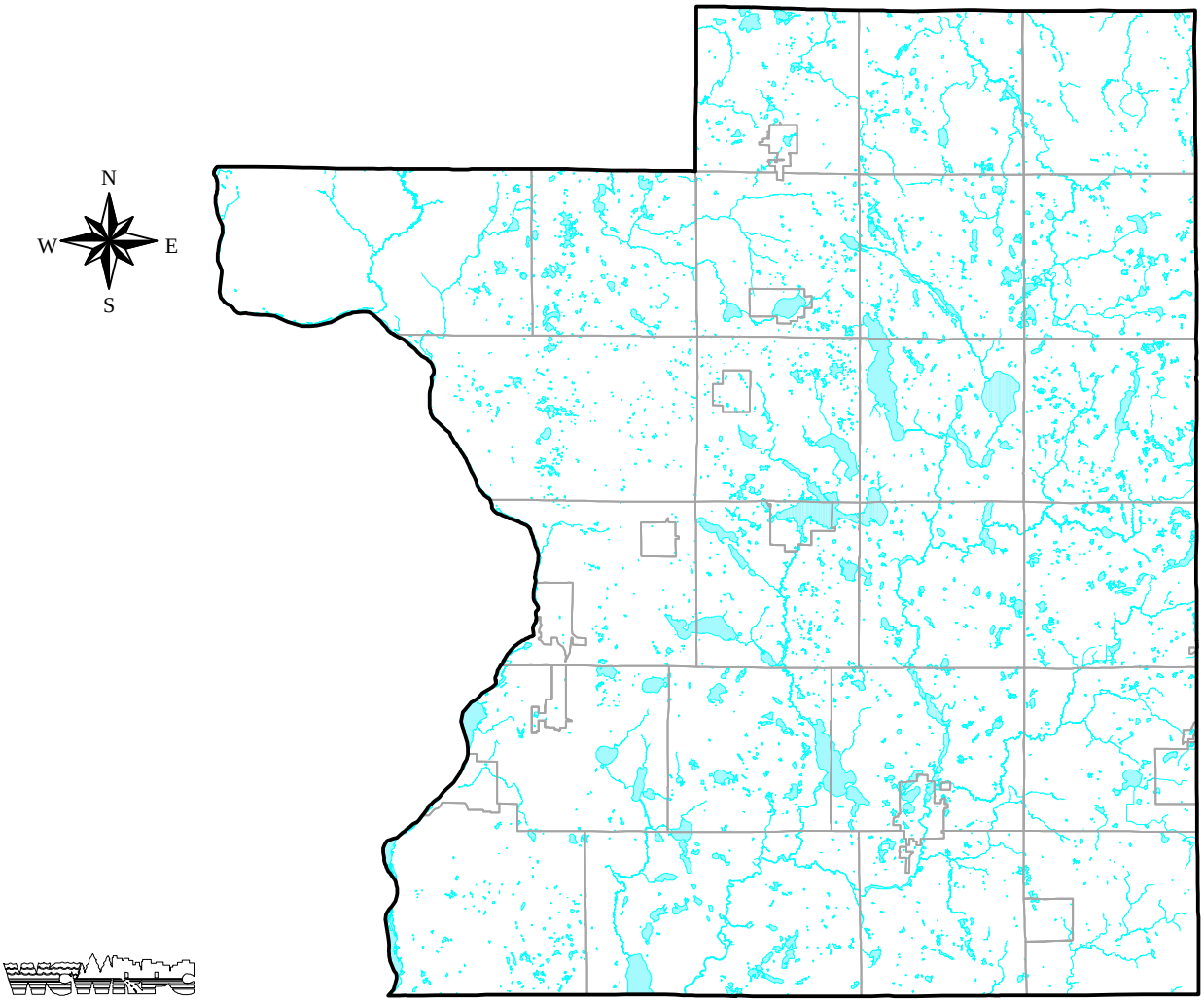
## SURFACE WATER RESOURCES

Lakes, ponds, rivers, streams, intermittent waterways and natural drainageways make up the surface waters of Polk County. These resources are all waterbodies, standing still or flowing, navigable and intermittent, including natural drainageways that collect and channel overland rainwater or snowmelt runoff. Natural drainageways are characterized by intermittent streams, threads, rills, gullies and drywashes which

periodically contribute water to first-order streams. There are also many artificial drainageways where the natural drainageways have been altered by human activity. All of these features have the ability to transport sediment and pollutants, and are affected by their watersheds, the land that surrounds them.

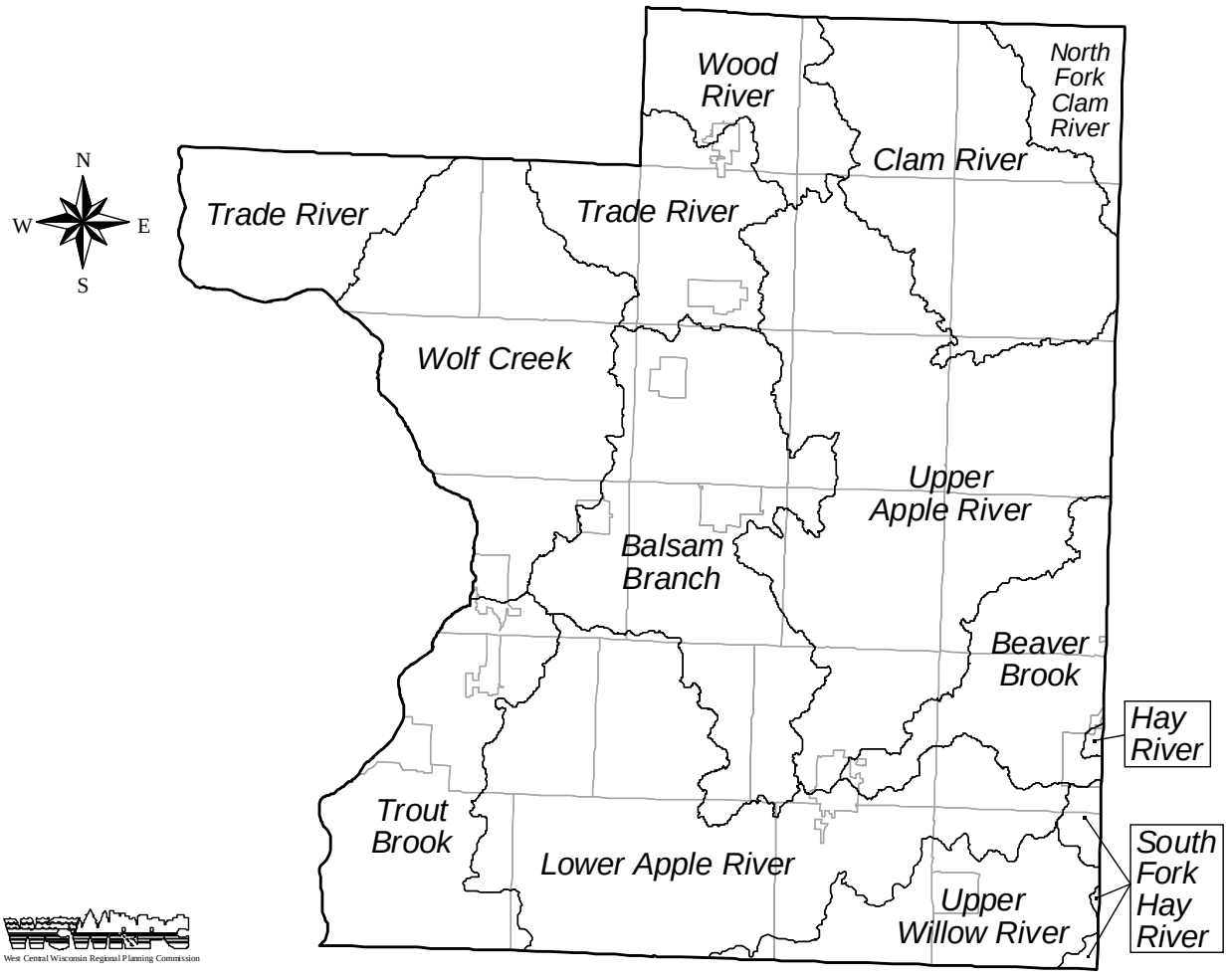
Similar to surrounding counties, the source of nearly all potable water is groundwater. However, surface water can be a major source of groundwater recharge, and in the case of Polk County, a major factor in maintaining the county's natural and recreational values. Consequently, there is also significant concern for understanding the impacts of development on the surface water resources in the County.

**SURFACE WATER RESOURCES**
**POLK COUNTY**



- Polk County is almost entirely in the St. Croix River Basin. A small part of the southeast corner of the County lies within the Chippewa River Basin.
- In general, the water quality in the St. Croix River and Chippewa River Basins is good.
- Polk County has a total surface water area of 22,626 acres. This is comprised of 437 lakes (20,900 acres) and 200 miles (1,726 acres) of rivers and streams.
- The St. Croix River is the county's most significant surface water feature. As such it has been designated by Congress as the Lower St. Croix National Scenic Riverway under the National Wild and Scenic Rivers Act.
- The current quality of the lakes, rivers and streams in the County enable them to support various aquatic life and recreation activities.
- Over 26 miles of steams in the County are Class I trout streams.

**WATERSHEDS**
**POLK COUNTY**



## WATER QUALITY

Water quality can be affected by many different natural and man-made activities. However, for the purposes of this plan, the following discussion will focus on land use and development activities, and the potential water quality impacts of those activities.

The following is a summary of Polk County's water quality conditions by watershed, major lakes by watershed, and issues affecting water quality.

# Conditions by Watershed

A watershed is an area of land that drains or "sheds" its water to a stream, lake or wetland. Some watersheds encompass several hundred square miles, while others may be small covering only a few square miles that drain into a lake. This is important to understand since the effects of development in one area can have an impact on the surface waters in other areas.

Polk County is comprised of all of parts of 13 watersheds, 11 watersheds from the St. Croix River Basin and small portions of 2 watersheds from the Chippewa River Basin. The following are general descriptions of the water quality conditions in each of these watersheds.

### Upper Willow River

- Issues in the Upper Willow River watershed include the reduction of sedimentation, protection of groundwater from contamination by surface water entering through sink holes, and livestock waste entering the streams.

### Lower Apple River

- The Lower Apple River watershed should be considered a high priority for protection from water quality degradation by non-point source water pollution.
- The Apple River is a high value, warm water stream. The river is affected by non-point source pollution primarily from agriculture, although residential development is increasing.

### Balsam Branch

- The Balsam Branch watershed should be considered a high priority for protection from water quality degradation by non-point source water pollution.
- Water quality in the Balsam Branch watershed would have an effect on two of the County's larger lakes, Balsam and Wapogasset.

## Upper Apple River

- The Upper Apple River watershed should be considered a medium priority for protection from water quality degradation by non-point source water pollution.
- The Apple River has moderate water quality impacts as a result of agricultural and stormwater runoff.

## Beaver Brook

- The Beaver Brook watershed should be considered a high priority for protection from water quality degradation by non-point source water pollution.

## Trout Brook

- The St. Croix River is classified as an outstanding resource water for 14 miles within this watershed, and as an exceptional resource water for 7 miles.
- Osceola Creek, commonly called Trout Brook, is a cold water fishery with 3 miles listed as Class III trout water and 0.5 miles classified as Class II. However, this water resource is being degraded by cropland erosion.

## Wolf Creek

- This watershed lacks any substantial surface drainage pattern. This is due to the high permeability of the glacial outwash and the drainage to kettle lakes.

## Trade River

- The Trade River watershed should be considered a medium priority for protection from water quality degradation by non-point source water pollution.
- The St. Croix River is classified as an outstanding resource water in this watershed.
- In order to maintain the water quality at the Trade River Class III trout fishery, the eastern half of this watershed should be included in any non-point source pollution control programs.

## Wood River

- The St. Croix River in this watershed is classified as an outstanding resource water, and should be protected from the delivery of nutrients and sediment from its tributaries.

## Clam River

- The Clam River is classified as an outstanding resource water. Parts of the river are also classified as Class I and Class III trout waters.

## North Fork Clam River

- The North and South Forks of the Clam River are classified as outstanding resource waters. Six additional trout streams in the watershed were designated as outstanding resource waters in 1993.

## Hay River (CHIPPEWA RIVER BASIN)

- The Hay River watershed should be studied to determine point sources and acceptable limits for phosphorus.

## South Fork Hay River (CHIPPEWA RIVER BASIN)

- The South Fork Hay River watershed should be considered a high priority for protection from water quality degradation by non-point source water pollution.
- The South Fork Hay River habitat is limited by severe streambank erosion caused from livestock pasturing the streambanks.

## MAJOR POLK COUNTY LAKES BY WATERSHED

Polk County includes 437 lakes, of which 222 are named lakes and 215 are unnamed lakes. The following are general descriptions of the major lakes, by watershed.

## Lower Apple River

- Cedar Lake has a long history of algae blooms due to the high concentration of nutrients from internal and external (watershed) sources.
- Big, Church Pine and Round Lakes are a series of connected lakes that are affected by runoff.
- Lower Pine Lake is a seepage lake with excellent water quality.
- Sand Lake is a 187 acre seepage lake that experiences water-level fluctuations with variances in the precipitation and groundwater cycles.

## Balsam Branch

- Balsam Lake is the largest lake in the watershed, 2,054 acres, and fifth largest in the St. Croix River Basin. The lake is a densely developed, high quality, high value, multiple use water resource which is experiencing water quality degradation due to the fertility contribution from the Rice Lake subwatershed.
- Deer Lake is a densely developed 807 acre seepage lake. The lake is a high quality water resource.
- Half Moon Lake is a 579 acre lake with reasonably good water quality. There are concerns about the degradation of water quality from nutrient sources in the watershed.
- Long Lake is a 272 acre waterbody with an intermittent outlet during high water periods. This is a eutrophic lake in which the water quality is significantly impacted by the nutrient loading from the watershed.
- Rice Lake is a small lake that has been severely affected by runoff and the Village of Milltown's wastewater treatment facility. This lake is a major contributor to Balsam Lake's fertility problems.
- Wapogasset and Beartrap Lakes are in the process of completing a comprehensive water quality assessment study of the lakes and incoming stream.

## Upper Apple River

- Amery Lakes (which include North Twin, South Twin and Pike Lakes) lie mostly within the City of Amery. These lakes have experienced problems associated with the stormwater runoff from the City.
- Apple River Flowage is a eutrophic impoundment that has lead to abundant aquatic vegetation growth.
- Big Round Lake is a eutrophic lake mainly influenced by in-lake recycling of phosphorus from sediments. The lake is experiencing algae blooms and other eutrophic symptoms.
- Blake Lake (Big) is a eutrophic lake subject to large algae blooms and excessive vegetation growth.
- Bone Lake is a large 1,781 acre lake which has experienced abundant vegetation growths and algae blooms for years. This eutrophic condition is due to

the in-lake recycling of phosphorus from deep-water sediments.

- Pipe Lake is a high quality seepage lake that has been nominated for classification as an "Outstanding Water Resource". However, the lake has been listed on the fish consumption advisory for walleye.
- Staple Lake is a 305 acre lake that is affected by non-point source pollution in the watershed.
- White Ash Lakes is comprised of White Ash Lake and North White Ash Lake. The lakes are shallow, sediment-filled basins that are eutrophic.

## Beaver Brook

- Echo Lake appears to have good water quality.
- Magnor Lake has signs of excess fertility which have been chemically treated for years.

## Trout Brook

- Lake of the Dalles is a shallow lake with limited fishery habitat, although the fish population is likely resupplied periodically from the intermittent connection with the St. Croix River.
- Poplar Lake is a intensely developed, 125 acre seepage lake.

## Wolf Creek

- Indianhead Flowage is part of the St. Croix River and as such is accorded "Outstanding Resource Water" status.

## Trade River

- Big Butternut Lake is a shallow eutrophic lake that is receiving an excessive phosphorus loading from both external sources and in-lake recycling.
- Long Trade, Round, and Big and Little Trade Lakes have all exhibited signs of excess fertility for decades.

## Wood River

- Mud Hen Lake is a 563 acre, hard water, drainage lake. The lake is mesotrophic, with good water quality and relatively few trophic problems.
- Spirit Lake is a 593-acre, hard water, drainage lake. The lake exhibits many of the symptoms of a eutrophic lake.
- Big Wood Lake shows some signs of trophic stress and experiences algae blooms and excessive aquatic plant growth.

## Clam River

- Crooked Lake is a shallow seepage lake that experiences periodic winterkill. Drastic water level fluctuations are also a problem.
- Ward Lake is a 91 acre seepage lake. The lake has been listed on the fish consumption advisory for walleye, and suffers from non-point source water pollution from the watershed.

## ISSUES AFFECTING WATER QUALITY

# GENERAL DEVELOPMENT IMPACTS AND ISSUES

Urbanization, development and other human activities can disrupt the natural course of water as it moves across the land. Removing vegetation and constructing impervious surfaces such as roads, parking lots, driveways, sidewalks, and rooftops, greatly increases the amount and rate of stormwater runoff. As this increased stormwater runoff crosses the urbanized or developed landscape, it picks up contaminants and sediments. As that water unites with other surface waters, or begins to infiltrate down to groundwater, these contaminants can be transported across, and affect, additional water resources in other areas.

Rivers and streams can be greatly affected by land use and development. Changes brought about by development can include increased water level fluctuations manifested by lower base flow and increased stormwater flow. This can lead to flooding, decreased oxygen levels, increased water temperatures, greater channel erosion, muddying of waters from increase sediments and pollution from fertilizers, pesticides, debris, salt, oil, grease, and other toxic substances.

Lakes, ponds, and reservoirs can also be impacted by development. All lakes decline in water quality over time if left in their natural state. However, development can accelerate the decline in lake water quality. As with rivers and streams, the detrimental impacts from development to lakes are mainly caused by stormwater runoff, erosion and pollution.

Shorelands and the vegetation they contain are the natural buffers that help protect surface waters from overland runoff and contaminants. When shorelands are

disturbed, their ability to slow runoff and filter contaminants is reduced.

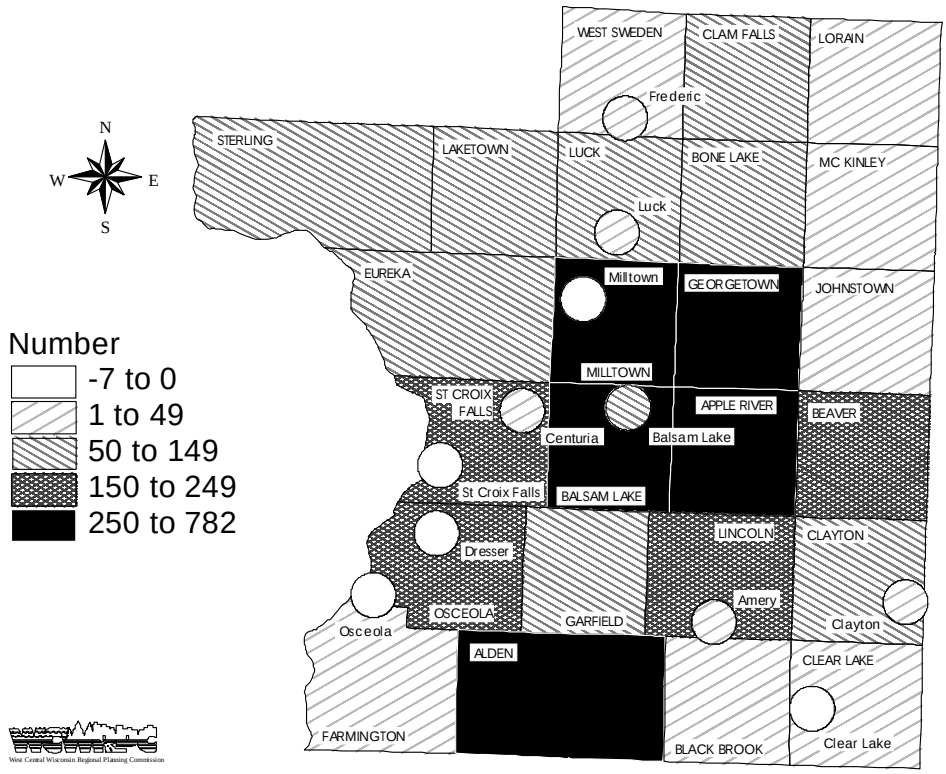
Development in areas that are prone to flooding can also have adverse impacts on water quality and the development itself. Altering the floodplain landscape by filling or building levees or structures can exacerbate flooding conditions. The filling of wetlands in flood-prone areas has also been proven to increase the likelihood of flooding. These alterations can divert water from where it once moved, or was stored, during spring runoff or storm events. The accumulation of development in floodplains and wetlands can cause more severe flooding in other areas within the floodplain or create new areas that are flood-prone.

Development on steep slopes can cause erosion by introducing impervious surfaces to areas where water does not infiltrate readily. Increased erosion impacts surface waters by increasing runoff quantity and the sediment it carries. Development on these slopes can result in high construction costs as special construction techniques may be employed.

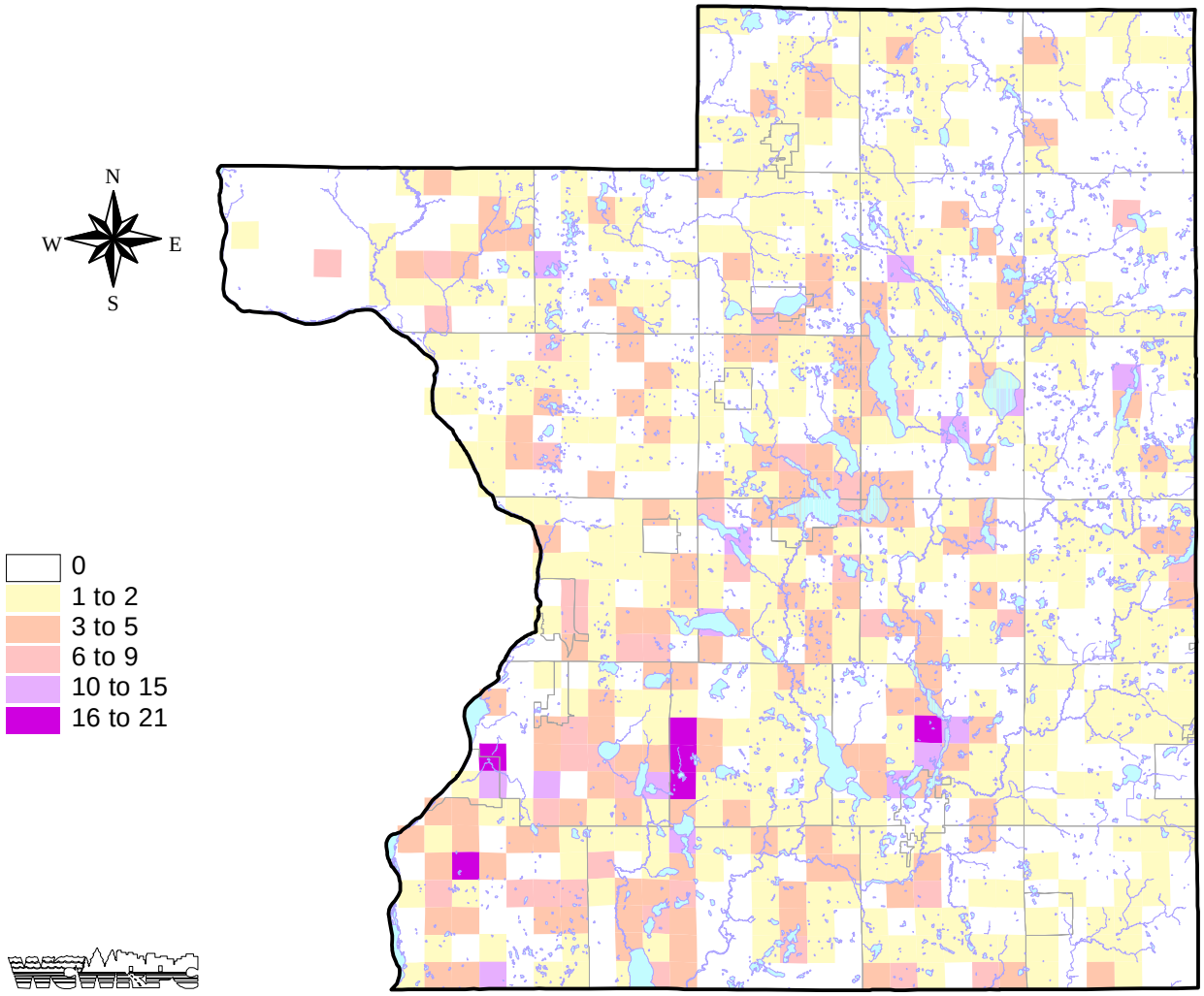
## PRIVATE SEPTIC SYSTEMS

Another development issue that can affect water quality is the siting of private septic systems. The following is a summary of private septic system issues and trends affecting Polk County.

**CHANGE IN THE NUMBER OF PRIVATE SEPTIC SYSTEMS BY MINOR CIVIL DIVISION • 1980 TO 1990**
**POLK COUNTY**




**NUMBER OF NEW SANITARY PERMITS ISSUED FOR PRIVATE SYSTEMS BY SECTION • 1990 TO 1997**
**POLK COUNTY**

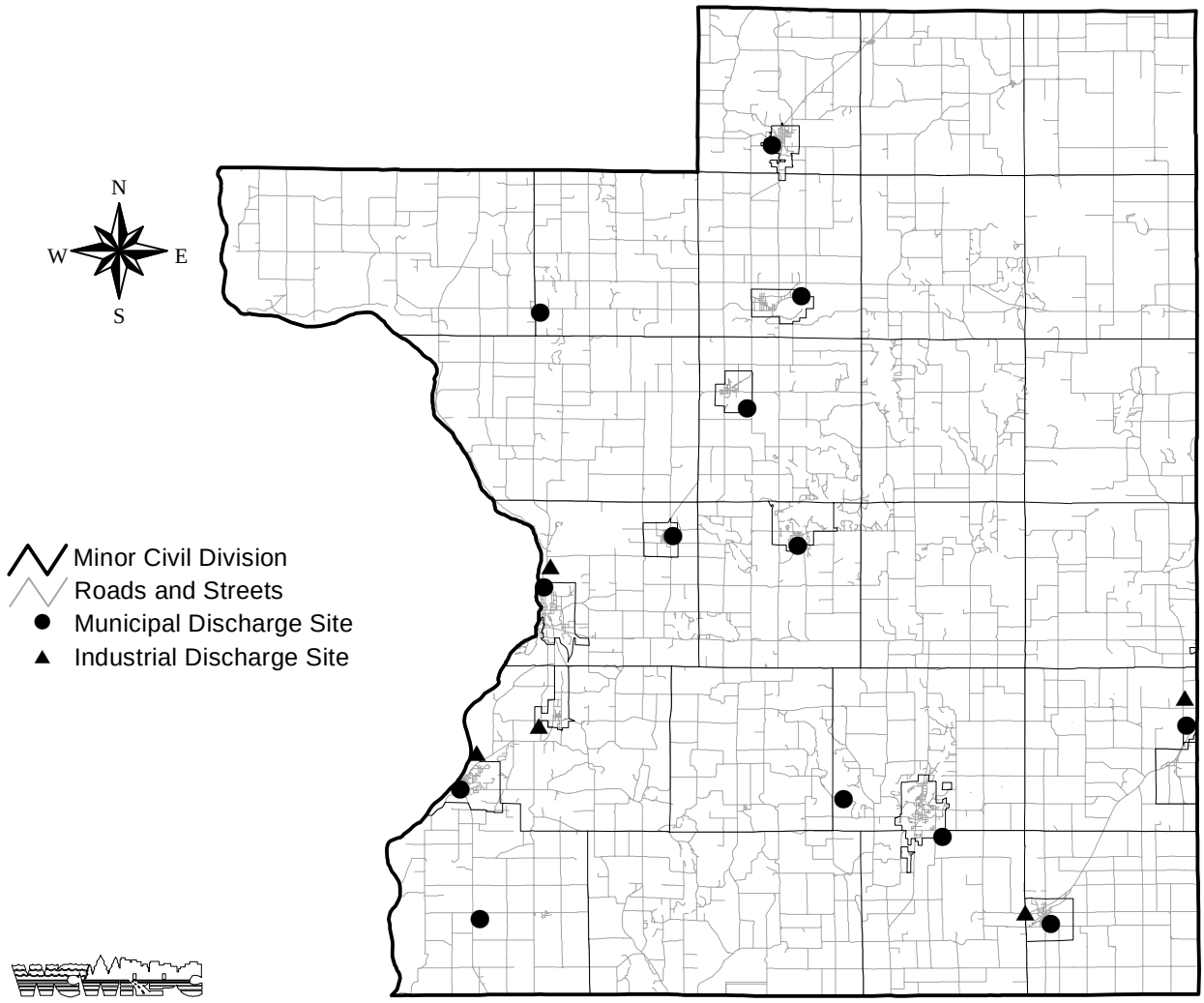



- In 1990, there were a total of 12,292 (570 in incorporated areas) private sewage systems in Polk County. This was an increase of 4,275, or 53.3%, from 1980.

- The increased number and density of private sewage systems can lead to nitrates in the groundwater.

# MUNICIPAL AND INDUSTRIAL DISCHARGE SITES

**MUNICIPAL AND INDUSTRIAL DISCHARGE SITES**
**POLK COUNTY**



- There are thirteen (13) municipal and sanitary district wastewater treatment plants that discharge to either surface or ground water in the County.

There are five permitted industrial discharges in Polk County.

## SENSITIVE LANDS

In addition to the more distinct physical land features, there are other environmentally sensitive and valued land resources that should be considered for the potential impacts of growth and development activities. These areas, referred to as sensitive lands, should be identified and evaluated for their significance as a valued resource in the county. In addition, growth and development policies and management techniques will need to be established in order to affect the desired impacts on these resources.

The following are the Sensitive Lands that are briefly reviewed and discussed in this section.

- Wetlands
- Shorelands
- Floodplains
- Closed Depressions
- Steep Slopes
- Woodlands
- Grasslands
- Wildlife, Fishery, Natural and Scientific Areas

# Wetlands

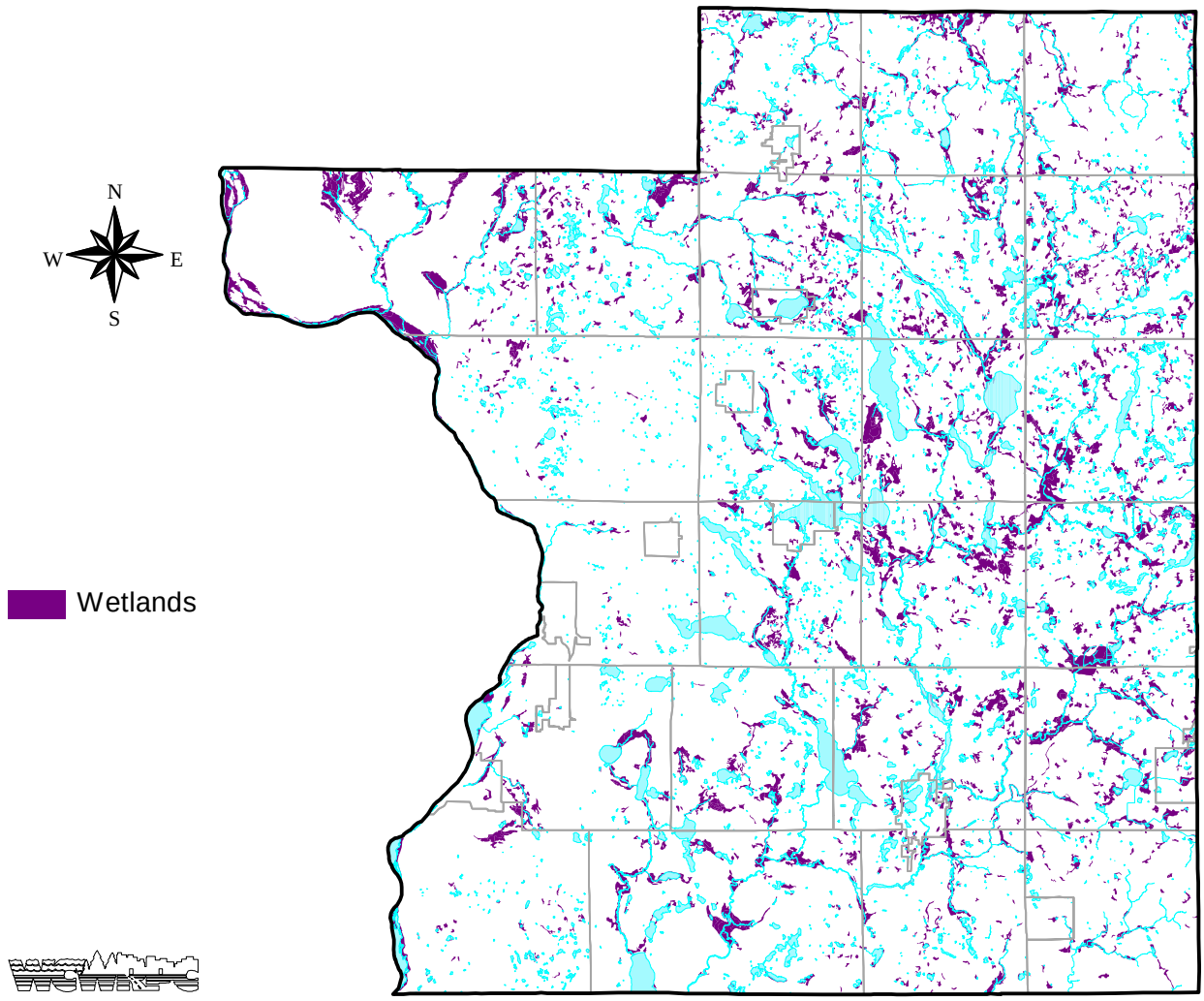
Wetlands are defined by Wisconsin State Statute as "an area where water is at, near, or above the land surface long enough to be capable of supporting aquatic or hydrophytic (water-loving) vegetation and which has soils indicative of wet conditions." Wetlands may be seasonal or permanent and are commonly referred to as swamps, marshes, or bogs. Wetland plants and soils have the capacity to store and filter pollutants ranging from pesticides to animal wastes. Wetlands can make lakes, rivers and streams cleaner, drinking water safer and also provide valuable habitat for both aquatic and terrestrial animals and vegetation. In addition, some wetlands can also provide the replenishment of groundwater supplies. Groundwater discharge is common from wetlands and can be important in maintaining stream flows, especially during dry months. Groundwater discharged through wetlands can contribute to high quality water in lakes and streams.

The federal government and the DNR restrict development in wetlands through Section 404 of the Clean Water Act and NR103, respectively. Local governments often fail to notify landowners and developers of these restrictions, subsequently, wetlands can be damaged, resulting in costly fines and/or restoration.

Even though the DNR has an inventory of wetlands of two acres and larger, all wetlands, no matter how small, which meet the state definition are subject to DNR regulations. Even if state regulations do not apply, federal regulations may, making it necessary to review all wetlands against these regulations before their disturbance. Particular attention must be given to wetlands within shorelands to ensure protection from development.

The following map shows the identified wetlands for Polk County. This map is general in nature and should not be used for site specific determinations. Site investigation is required to ensure compliance with federal and state regulations.

**WETLANDS**
**POLK COUNTY**




## SHORELANDS

Shorelands provide valuable habitat for both aquatic and terrestrial animals and vegetation. Shorelands also act as buffers and thus serve to protect water quality. However, shorelands are also considered prime residential building areas because of their scenic beauty.

Recognizing this conflict, and in order to maintain the environmental, recreational, and economical quality of our water resources, the State of Wisconsin requires counties to adopt and enforce a shoreland ordinance.

As required by the State, shorelands are defined as:

- all land within 1,000 feet of the ordinary high water mark of a lake, pond or flowage; or
- all land within 300 feet of the ordinary high water mark of a river or stream or to the landward side of the floodplain, whichever is greater.

Each county must meet or exceed the minimum state standards for shoreland protection. The identified shoreland areas are based on the standards as defined in the Polk County Shoreland Ordinance.

## FLOODPLAINS

Another sensitive land feature that most residents are aware of is the floodplain, the flood-prone lands adjacent to waterbodies. Floodplains can be desirable development areas due to the proximity to lakes, rivers and streams, but pose additional problems by possibly putting residents and property at risk. Development in floodplains can also effect the environmental quality of the waterway.

In order better protect the residents of Polk County, and to minimize the loss of property, the State of Wisconsin, under Wisconsin Statute 87.30(1), requires counties, cities and villages to adopt and enforce Floodplain zoning. In addition, Wisconsin Administrative Code NR116, Floodplain Management Program, has been promulgated for the protection of property and public investments from the effects of flooding.

Development within the floodplain is usually assessed through the use of the Flood Insurance Rate Maps (FIRM) developed by the Federal Emergency Management Agency (FEMA).

The following floodplains have been identified for Polk County based on the FEMA flood insurance maps.

It is important to remember that this map is no substitute for site specific analysis. Natural and man-made changes in the landscape, and the age and accuracy of the flood insurance maps has in some cases limited their reliability for the identification and designation of floodplains.

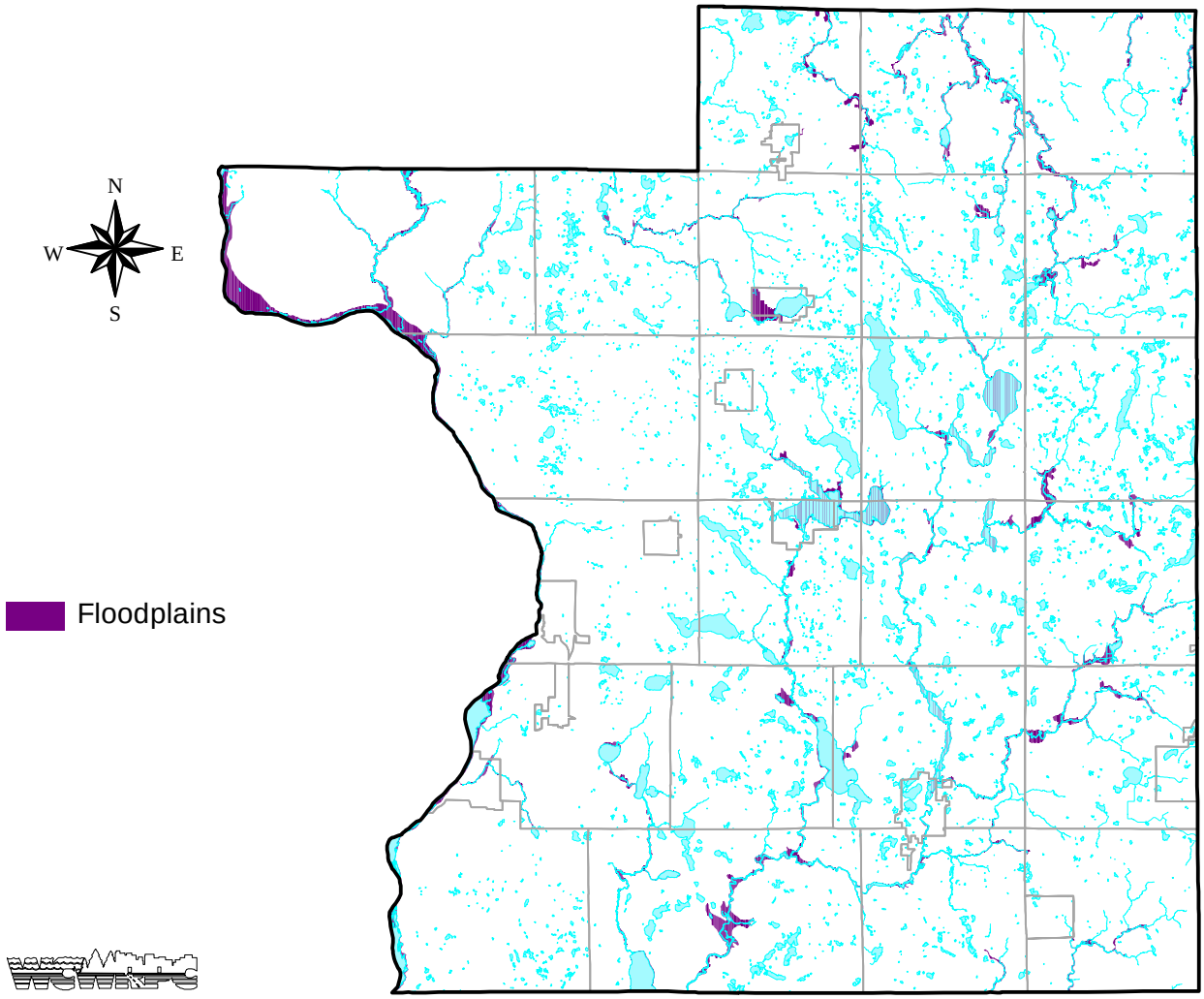
## CLOSED DEPRESSIONS

Another topographic feature found in Polk County is closed depressions. Although closed depressions can be formed through different geological processes, kettles or kettleholes formed by glacial action are the primary feature in Polk County.

Kettles develop when large blocks of glacier ice are buried within glacial deposits and subsequently melt. Closed depressions are primarily located in the western and southern portions of Polk County, and were the result of glacial activity that took place during the Wisconsin stage.

Closed depressions are extremely sensitive land features because of their close association with the groundwater. The release of pollutants into or near closed depressions is almost certain to reach the groundwater immediately.

**FLOODPLAINS**
**POLK COUNTY**




## STEEP SLOPES

It is generally more desirable, both environmentally and economically, to avoid steep slopes and disrupting natural drainageways with construction and land development. Problems with erosion and runoff pollution can occur with development on steep slopes, and flooding and wet basements can occur with drainageway disruptions.

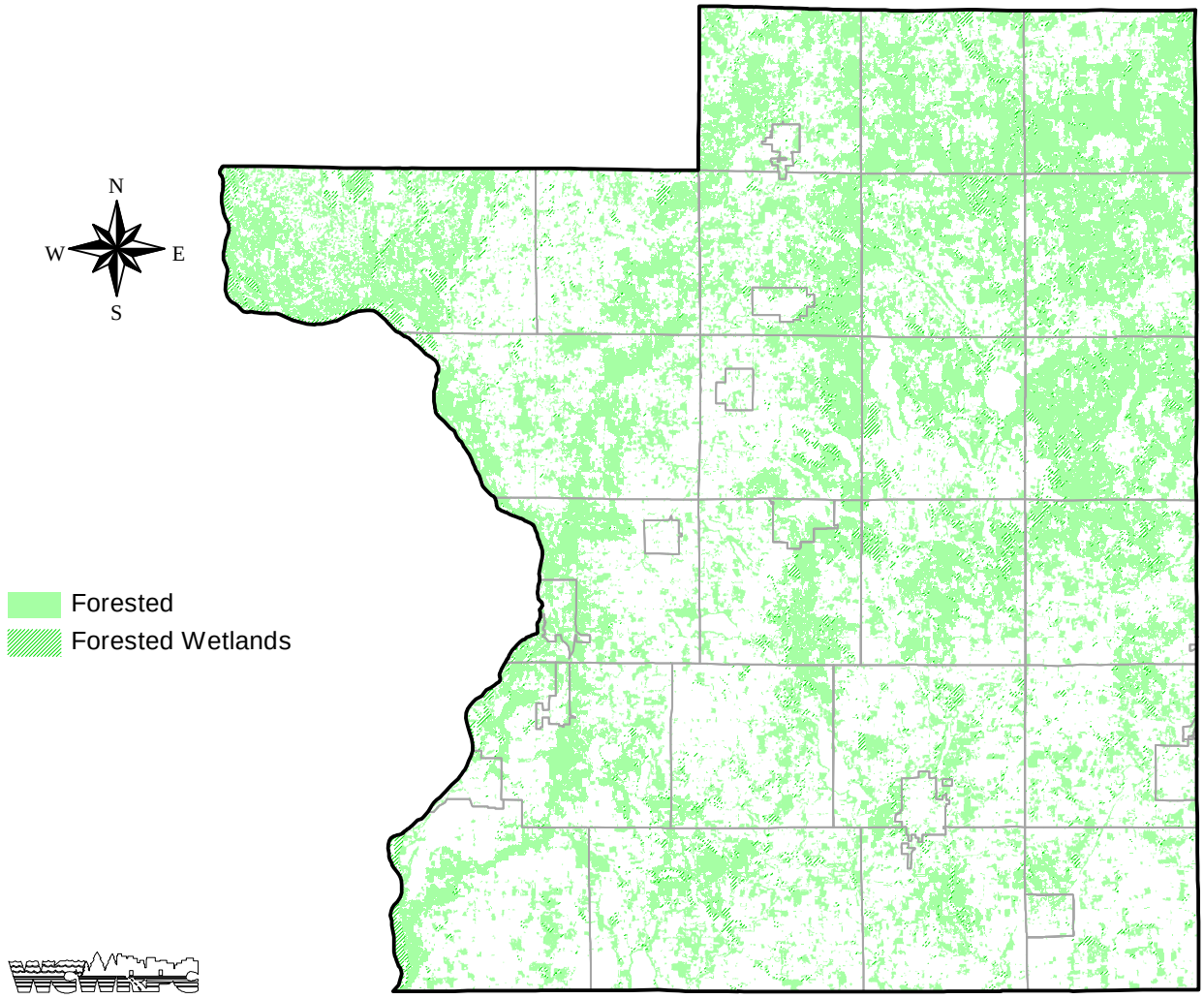
Steep slopes are any area where the gradient of the land is 12 percent or greater (each percent of slope is measured as one unit in elevation for every 100 horizontal units). Areas having steep slopes can be categorized into two levels, 12%-19% slope and 20% and greater.

Development on slopes of 12% to 19% should consider direct runoff into lakes, rivers or streams; follow state approved construction site erosion control standards; and institute best management practices to control on-site runoff and pollution. Land with slopes of 20% or greater represent a definite limiting environmental condition.

Development on these slopes results in high construction costs and severe erosion with resultant negative impacts to surface and ground waters. Therefore, development on slopes of 20% or greater is highly discouraged.

Based on the Soil Survey for Polk County, there are 135,560 acres, 22.7% of the total land area, having a slope of 12% or greater. Based on this, it is apparent that past glacial activity has created some topography in Polk County that is scenic, but may also be very sensitive to development activities.

**FORESTED AREAS**
**POLK COUNTY**



## WOODLANDS

Woodlands are an important feature of Polk County. In fact, the forests of Polk County are the second most extensive land use and land cover in the county, after agriculture. The largest concentrations of woodlands occur in the northwest and northeast corners of the county. Other large woodland areas are scattered throughout the county.

In Polk County, woodlands are a valuable part of the environment, aesthetics and economy. Woodlands provide:

- habitat for a variety of plants and animals;
- the basic resource for many wood-based industries;
- resources for the agricultural community;
- an environment for recreational activities; and
- for the scenic beauty of the landscape and the rural character of the county.

Woodlands managed according to approved forest management practices can support varying and sometimes complementary objectives, such as timber production or wildlife habitat. On the other hand, strict preservation of a woodland would be unusual and reserved for the most rare and unique stands in the county.

Unmanaged development can diminish or eliminate a woodlands capacity to provide wood products, habitat for plants and animals, and aesthetic quality. Because woodlands are considered a valued resource for these reasons, significant woodlands should be protected from conversion to other uses or properly managed in order to retain their desirable characteristics. For example, residential development in woodland areas could use conservation design techniques in order to allow for development and preserve the environmental and aesthetic value.

## GRASSLANDS

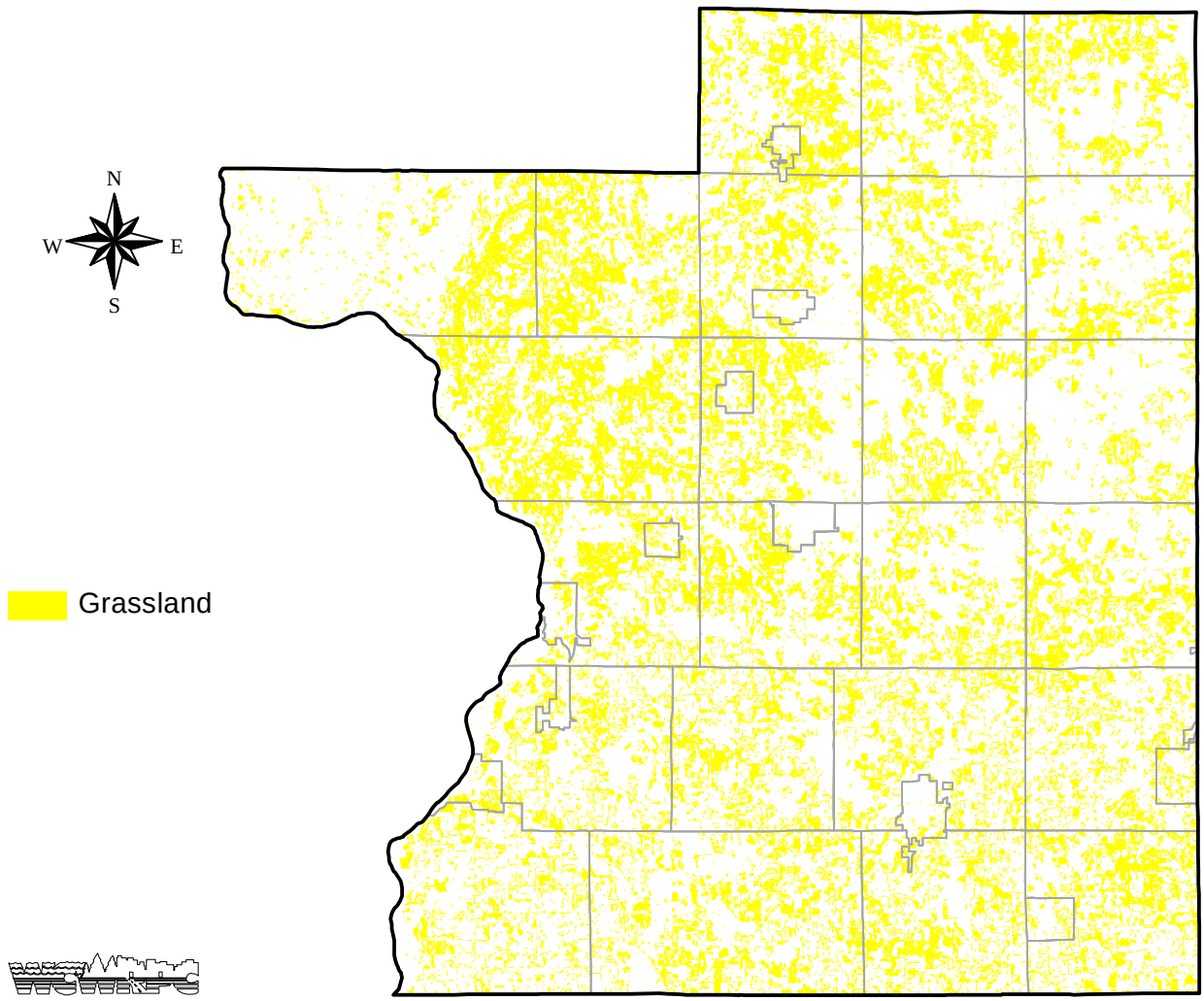
Much of southern Polk County was originally covered by prairie, most of which does not remain today. Prairie is the term used to describe the grassland type which predominated Wisconsin prior to Euro-American settlement. Prairies are dominated by grasses and sedges, lack trees and tall shrubs, and are home to a rich variety of plants and animals. Within the prairie designation there are variations due to soils and climate.

Prairies continue to be a threatened plant community in Wisconsin. The reduction of prairie in the state means that an estimated 20% of the original grassland plants are considered rare in the state. Consequently, many species of plants and animals associated with Wisconsin prairies are endangered, threatened or of special concern.

There are few high quality prairie remnants remaining. However, it will take more than the preservation of these remnants to recover or retain the biodiversity this ecosystem can offer. Degraded areas that were once prairie can often be restored with moderate effort to yield a habitat suitable for most of the associated plant and animal species. Even certain managed agricultural and livestock practices can accommodate the maintenance of the open habitats needed by many grassland species. Grasslands can be restored and maintained through preserving a certain amount of open space for this type of cover as development occurs. Hence, development

can occur in such a way that it can maintain sufficient grasslands for its habitat value while preserving the rural character of the landscape.

**GRASSLANDS**
**POLK COUNTY**




## OAK SAVANNA

Portions of Polk County were originally covered by oak savanna. Only scant remnants of the complete ecosystem exist today. Oak savanna is the ecosystem that historically was a part of a larger complex bordered by the prairies of the west and the forests of the east. Savannas, considered to be the middle of the continuum between prairie and forest, were a mosaic of plant types maintained by wildfire and possibly large ungulates such as bison and elk.

Oak savanna was home to an abundant variety of plants and animals, and was probably optimum habitat for many game species, as well as songbirds. However, presently oak savanna is one of the most threatened plant communities in the world. Less than 500 acres are listed in Wisconsin's Natural Heritage Inventory as having a mix of plants similar to original oak savanna.

Any identified oak savanna remnants should be protected. There has been no inventory of oak savanna remnants in Polk County. However, some of the identified grasslands have the potential for savanna restoration by the Department of Natural Resources and conservation groups. Certain marginal agricultural lands which were once oak savanna can be restored economically and often still accommodate light to moderate cattle grazing.

## WILDLIFE, FISHERY, NATURAL AND SCIENTIFIC AREAS

Scattered throughout Polk County are various federal, state and local wildlife, fishery, natural and scientific areas, including private conservancy areas. These areas are managed to provide important feeding, breeding, nesting, cover and other habitat values to a wide variety of plant and animal species.

The Wisconsin Department of Natural Resources - Bureau of Endangered Resources conducts data searches for natural and scientific areas of national, state or local significance. The Bureau urges special notice be taken to protect any and all natural or scientific areas from development.