1. Natural Resources

1.1 Regional Setting

Polk County is located in central Iowa, in the fourth tier of Iowa counties north of the Missouri River and is the seventh county west of the Mississippi River. The County's land area totals 594 square miles, or 378,800 acres, of which approximately two-thirds consists of farmland and natural areas. The urban expansion of the metropolitan area surrounding Des Moines, the capital city, has been a significant source of land use change in Polk County.

1.2 Geology

The geology of Polk County has been studied and documented in detail in numerous publications. The intent of this narrative is not to add to this catalog of work, but to summarize its findings to provide a basic understanding of the geologic processes that have shaped Polk County. More detailed geologic information is readily available from the Iowa Geological Survey Bureau and Iowa Department of Natural Resources.

The geologic features of Polk County consist of a combination of surficial (Quaternary) and bedrock (Paleozoic) features formed over a great deal of time in a variety of environments. The composition and features of the surficial and bedrock geology have directly affected the present day topography and land use of Polk County. The information presented here provides an overview of geologic processes and the resulting resources.

Bedrock

The bedrock that underlies Polk County consists primarily of marine sedimentary rocks including shales, mudstones, limestones, dolomites, and sandstones deposited during the Carboniferous Period of the Paleozoic Era. The Carboniferous Period occurred from about 354 to 290 million years ago and is divided into the Mississippian (Lower Carboniferous) and Pennsylvanian (Upper Carboniferous).

During the Mississippian, shallow seas covered much of what is now the Midwest, depositing the sands, clays, and carbonate materials needed to form the sedimentary rocks that underlie the surface today. As the seas receded, wind and water eroded the surfaces of the exposed Mississippian rocks erasing much of them, as it were, from the geologic record. As the seas returned during the Pennsylvanian, the processes of sedimentation, rock formation, and erosion were repeated, as was erosion as the seas retreated.

The cycles of deposition and erosion resulted in unconformities between older rocks and the younger rocks that overlie them. The surficial deposits observed throughout most of Polk County typically overlie Pennsylvanian-aged bedrock of the Marmaton and Cherokee Groups. In some areas of northeastern Polk County, the Pennsylvanian-aged bedrock was eroded resulting in the deposition of surficial materials over Mississippian-aged bedrock of the Augusta Group and "St. Louis" and Pella formations.

Drainage patterns are greatly affected by the location and topography of bedrock. The more competent nature of bedrock materials, relative to surficial deposits, tends to direct water as it flows both above and below the ground surface.

The Midcontinent Rift System (MRS) is a 1450-kilometer long geological terrain that extends from eastern Lake Superior to southern Kansas. The MRS was formed during the Middle Proterozoic (1.6 billion to 900 million years ago) and consists of a massive uplifted block (called a horst) of basalt that follows the axis of the rift. The horst is regionally known as the Iowa Horst and extends from south-central Minnesota to southeastern Nebraska. The horst is flanked by deep sedimentary-rock filled basins that cover almost 150,000 square miles of Iowa. Rocks associated with the MRS are typically buried at depths of 1,200 to 5,500 feet below ground surface. Several large faults are associated with the MRS including the Thurman-Redfield Fault Zone that cuts through the northeastern corner of Polk County.

Surficial Deposits

The surficial geology and landscapes of Polk County are primarily the result of glacial activity that affected the North American continent during the Quaternary Period (2 million years ago to present). The majority of Quaternary glacial activity occurred during the Pleistocene Epoch (2 million to 10,000 years ago) and evidence of this activity is seen throughout Iowa, including Polk County. The glacial periods of the Pleistocene, from oldest to youngest, are known as the Nebraskan, Kansan, Illinoisan, and Wisconsinan glacial stages, named for the areas in which their most representative deposits are observed. In Polk County, surficial evidence of these periods of glacial activity are primarily found in the form of Wisconsinan-stage deposits (approximately 60,000 to 10,000 years ago), though deposits associated with older stages of glacial activity are observed in southern Polk County and at depth elsewhere.

As the glaciers pushed south, they amassed soil and rock. These materials were placed over the exposed bedrock by the ice as it advanced or retreated. Typically, these deposits consist of clays and unconsolidated sands and gravels, though cobbles and boulders are frequently encountered. Combined, these deposits are commonly referred to as glacial drift and are observed throughout Polk County. The areas north of the Raccoon River are associated with the Des Moines Lobe landform region. The Des Moines Lobe represents the depositional environments associated with late Wisconsinan glaciation.

South of the Raccoon River in Polk County, surficial materials are often comprised of windblown silty clays known as loess. Loess deposition varies in depth, and underlying Kansan and Nebraskan-aged glacial tills are commonly observed in eroded areas, such as stream valleys. The areas in southern Polk County belong to the Southern Iowa Drift Plain landform region.

The periods during which glacial bodies were in retreat are referred to as "interglacial" periods. The Holocene Epoch (10,000 years ago to the present) is considered an interglacial period following the Wisconsinan glacial stage. During interglacial periods, meltwater associated with the retreat of the glaciers drained into valleys presently occupied by the Des Moines, Raccoon and Skunk Rivers.

Drainage patterns within Polk County were reshaped by the Wisconsinan glacial stage. Prior to that period, the Moingona River drained much of Iowa, running from northwest to southeast. The Des Moines Lobe of the glacier filled in the river valley and, as it melted, created a new drainage channel on its southern edge, the present-day course of the Raccoon River. The Des Moines River south of the Capitol follows the ancient river valley, while to the north of the city it flows in a more recent post-glacial channel. The presence of the buried Moingona River valley has caused drainage problems on the city's east side. Figure 1-2, Alluvial Deposits, shows these drainage patterns.

Geologic Hazards

Geologic hazards in Polk County consist primarily of earthquakes, the subsidence of abandoned mines, and flooding (discussed under Hydrology).

Earthquakes

The Iowa Department of Natural Resources reports only 12 recorded earthquakes with epicenters in Iowa in historic times, the first recorded incident being in 1867 and the most recent in 1948. None of the recorded earthquakes have been centered in Polk County nor have they had significant impacts on property or life. The most probable scenario in which Polk County would be affected by an earthquake would result from a major seismic event along the New Madrid Fault Zone located along the valley of the Mississippi River from the Ohio River south. The potential effects of an earthquake here on Polk County would likely be confined to low to moderate shaking similar to the effects of a large passing truck.

Mine Subsidence

Iowa's once-thriving coal industry was centered in the central and southeastern portions of the state, with many mines in Polk County and the greater Des Moines region. Most coal mining activity in Iowa occurred from 1840 to 1947, with production reaching its peak in 1918; the last mine closed in 1994. Coal seams are found in the Marmaton and Cherokee bedrock groups that underlie Polk County. The roughly horizontal seams are generally located 40 to 50 feet below ground level, and many are now flooded. The collapse of mine roofs, or subsidence, is the most significant potential hazard associated with these mines. There are documented cases of personal and property damage associated with mine subsidence in Polk County, and the potential exists for similar events in the future. Given the depth of most mines, however, the threat is most pronounced for large buildings with deep foundations. Potential for groundwater contamination also exists. A 1989 study by the Iowa Department of Natural Resources, Geological Survey Bureau, documents past mining activities in the Des Moines metro area and identifies areas potentially threatened by mine subsidence. A database of known and potential mine locations were mapped as part of this study, and these are shown in Figure 1-2.

Figure 1.3.A Iowa and Polk County Landforms

source: Iowa DNR

1.3 Physiography and Landforms

The topographic relief of Polk County is largely a function of the ages of surficial deposits and the presence of four watersheds within the County. The areas north of the Raccoon River belong to the Des Moines Lobe landform region, while the areas south of the Raccoon River are associated with the Southern Iowa Drift Plain.

The topography of the Des Moines Lobe landform region is that of a recently glaciated, poorly drained landscape, with expanses of level spaces punctuated by bands of knobby ridges. Numerous ponds and marshes are located in the areas between ridges with no drainage outlets. This glaciated area is part of the much larger Prairie Pothole Region that extends north and west into Canada. The southern boundary of the Des Moines Lobe is a glacial end moraine, the Bemis moraine, which marks the southernmost point of glacial movement during the Wisconsinan glacial stage. The Capitol Building sits on one of the moraine's ridges.

The absence of Wisconsinan glaciation in the Southern Iowa Drift Plain has resulted in topography characterized by steep rolling hills with areas of uniformly level wooded upland divides and level alluvial lowlands. The loess soils are highly erodible, and erosion has produced efficient dendritic drainage patterns, which in turn have produced the topography seen today.

The elevation of Polk County ranges from 730 to 1,044 feet above mean sea level (msl). Elevation generally decreases from the northwest to southeast, with the highest elevations near the town of Sheldahl and the lowest elevations in the Des Moines River floodplain in the southeast corner of the county.

1.4 Climate

Polk County's climate reflects Iowa's mid-continental location, with hot summers and cold winters. The winter is a season of cold dry air interrupted by occasional storms of short duration. Snowfall is light compared with the amount received in states to the east and north, but still significant, and drifting snow can impede transportation. The growing season lasts from early May to early October. It is characterized by prevailing southerly winds and precipitation falling primarily as showers and thunder-storms, some of which can be severe. The autumn is characteristically sunny with diminishing precipitation, favorable for drying and harvesting crops.

Average monthly temperatures in the Des Moines area vary from 19 degrees F in January to 76 °F in July. High and low average temperatures for the Des Moines area are shown in Table X. Total annual precipitation is almost 32 inches, of which 72 percent usually falls from April through September. Average seasonal snowfall is 25.6 inches, and an average of 10 days per year has at least one inch of snow on the ground. The sun shines an average of 70 percent of the time possible in summer and about 50 percent in winter. The prevailing wind is from the northwest, with the highest average wind speed, 13 mph, in April. [1]

Table 1-1: Average Temperatures and Precipitation for Des Moines

Month	Low (°F)	High (°F)	Average Precipitation (inches)
Jan	11.7°F	29.1°F	1.03
Feb	17.8°F	35.4°F	1.19
Mar	28.7°F	48.2°F	2.21
Apr	39.9°F	61.3°F	3.58
May	51.4°F	72.3°F	4.25
Jun	61.0°F	81.8°F	4.57
Jul	66.1°F	86.0°F	4.18
Aug	63.9°F	83.9°F	4.51
Sept	54.3°F	75.9°F	3.15
Oct	42.2°F	63.5°F	2.62
Nov	29.0°F	46.7°F	2.10
Dec	16.7°F	33.1°F	1.33

1.5 Air Quality

Air quality within Polk County is generally good compared to other urban areas, and shows substantial improvement

[1] Sources: *Soil Survey of Polk County*, www.rss.weather.com, climate-zone.com, Iowa Climatology Bureau

over conditions in the past. Historically, the Des Moines region was “non-attainment” for particulates and carbon monoxide during the 1970s and early 1980s. Attainment with these national standards was demonstrated in 1986-87. Since that time, the Des Moines region has remained an “attainment” area under the Clean Air Act, meaning that it meets national standards for acceptable air quality for all criteria pollutants: ozone, fine particulate, very fine particulate, lead, carbon monoxide, nitrogen oxides, and sulfur oxides. The Air Quality Division of the Public Works Department is responsible for regulating air pollution sources within the County, and has performed that function since establishment of the U.S. EPA in 1973. Its mission is to improve the quality of the air by reducing the amount of pollutants such as ozone, carbon monoxide, fine particulates and hazardous air pollutants.

Air quality is measured by EPA’s Air Quality Index, a uniform national standard for reporting a variety of air quality measures. The Index provides information on pollutant concentrations for ground-level ozone, particulate matter, carbon monoxide, sulfur dioxide, and nitrogen dioxide. The Index is "normalized" across pollutants so that an Index value of 100 represents a “moderate” level of health protection and an Index value of 500 represents the significant harm level.

In 2003, air quality, as measured by the Air Quality Index, was “good” (AQI of 50 or less) on 71 percent of days recorded, “moderate” on 28 percent, and “unhealthful for sensitive populations” (AQI of 100-200) on only 1 percent. The median AQI value for the year was 39. The significant pollutants present in the Polk County airshed are ozone, carbon monoxide, nitrogen dioxide, particulates and toxic compounds.

- Ozone is a major element of urban smog, and is produced by the interaction of volatile organic compounds, such as gasoline vapors, with nitrogen oxides along with the presence of sunlight. Ozone is primarily generated (and measured) from May to October. Ozone can cause coughing, throat irritation, and breathing discomfort, and there is evidence that exposure can aggravate chronic lung disease such as asthma or bronchitis. The Air Quality Division works to limit emissions from manufacturing and cleaning processes that can contribute to ozone.
- Carbon monoxide is produced in nature through the oxidation of methane, but its primary man-made source is the incomplete combustion of fuel. Short-term exposure can result in fatigue, while long-term effects

may increase one's chances of developing heart and lung disease.

- Nitrogen dioxide belongs to a family of highly reactive gases called nitrogen oxides (NOx). These gases form when fuel is burned at high temperatures, and come principally from motor vehicle exhaust and stationary sources such as electric utilities and industrial boilers. Nitrogen dioxide is a strong oxidizing agent that reacts in the air to form corrosive nitric acid, contributing to "acid rain." It also plays a major role in the atmospheric reactions that produce ground-level ozone (or smog).
- Particulate matter is measured at two scales: very fine (less than 2.5 micrometers) and fine (larger than 2.5 mm and smaller than 10.0 mm). Very fine particles result from fuel combustion from vehicles, industrial plants, fireplaces and other sources, while coarse particles generally result from windblown dust, materials handling, and crushing and grinding operations. Even the fine particles (10-mm) are almost invisible – about one-seventh the diameter of a human hair – but both types can affect respiratory health, especially in children and the elderly.
- Examples of toxic air pollutants include benzene, which is found in gasoline; perchlorethlyene, which is emitted from some dry cleaning facilities; and methylene chloride, which is used as a solvent and paint stripper by a number of industries.

1.6 Vegetation

Historical Vegetation

The Government Land Office conducted the original public land survey of Iowa from 1832 to 1897, providing a richly detailed picture of the landscape of pre-settlement Polk County, now available digitally (Figure D.2). Fully 79 percent of the County was classified as prairie with a substantial component of "timber" (20%) located along the various watercourses. Surveyors mapped nine vegetation types along with three other land cover types (city, lake, and pond). "Wetland" was a category used by the surveyors, with variations such as "marsh," "slough," and "swamp."

The land that was mapped as "timber" has been determined to most likely be oak savanna. Much of this forest type was lost to homesteads or towns, or, depending on the soil type,

was converted to row crops. Savannas are park-like communities of bur oak, hickory, and walnut trees that occurred within the expanse of prairie. "A carpet of wildflowers and shorter grasses accompanied the outstretched trees, as did a specific collection of animals including elk, shrikes, fox squirrels, and redheaded woodpeckers. The savannas were considered an oasis to travelers of the lonely prairie landscape. Today, oak savannas are as rare as their tallgrass prairie counterpart."[2] (One example in Polk County is in Yellow Banks Park, on steep bluffs above the Des Moines River.)

The surveyors' maps appear to underestimate the extent of the wetlands that were once common in the Des Moines Lobe landform region. This area was sometimes called the "thousand-lake" region by pioneers, due to the thousands of prairie pothole wetlands, many of which were only seasonally wet.[3] These once numerous wetland marshes left by the glaciers are called **palustrine** wetlands.

Contemporary Vegetation

It is well known that 99% of Iowa's original prairie has been converted to other types of land cover. Polk County is no exception to this statistic. The prairie lands that were recorded in the original public land survey have been converted to row crops and pasture/grassland (Figure D.1). Forest lands occur today in a similar pattern to the historic land survey pattern, though to a lesser extent. The forest vegetation is divided into three categories: bottomland, deciduous, and coniferous. Those these three classes have been combined into one "Forest" category in Figure D.1, since it appears that only a very small portion of the forests in Polk County are not 'deciduous.' The deciduous forest occurs along the rivers and streams ("bottomland") of Polk County, with the exception of the Skunk River, where much of the wide river valley has been converted to row crops.

Tallgrass prairie vegetation exists today only in small remnants throughout Polk County, such as the Sand Hill Prairie in the Chichaqua Bottoms Greenbelt. The Neal Smith National Wildlife Refuge – Prairie Learning Center in neighboring Jasper County was established to reconstruct tallgrass prairie and restore oak savanna on 8,654 acres of the Walnut Creek watershed.

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[2] Neal Smith National Wildlife Refuge-Prairie Learning Center, midwest.fws.gov/nealsmith

[3] Iowa Association of Naturalists, *Iowa's Biological Communities (IAN-201)*, 2001.

1.7 Soils

Soils provide one of the underlying keys to the opportunities and constraints for site development. These constraints range from high water tables that limit on-site sewage treatment to erosive conditions that require intensive management during site development. Soils data are used for establishing general patterns of soil suitability and limitations for land uses.

Polk County contains eight major soil associations (Figure 1.7.A), each containing several major soils and two or more minor soils. These associations define a unique natural landscape with distinctive patterns, relief and drainage. The associations are intended to be used for planning the use and management of large areas, not for specific parcels of land. There are other ways of characterizing a particular soil's capabilities or limitations for specific land uses.

Patterns emerge when viewing the soil associations map. One is the division of the County into glacial and non-glaciated areas. The north three-quarters of the County consists of glacial till parent material (Soil Association Groups 1-3) on flat to gently rolling terrain. The southern quarter of the County is predominantly loess (wind-transported) in origin and is dissected by river and stream valleys (Soil Association Groups 4, 6, 7 and 8) resulting in rougher terrain.

The second pattern the map reveals is the general southeasterly drainage direction of watercourses in the County. Two major deposits of alluvial soils (Groups 3 and 5) underlie the Skunk River and Des Moines River stream corridors. Smaller alluvial deposits are found in the Four Mile Creek and Walnut Creek valleys.

Corn Suitability Rating (CSR) is a measure of a soil's suitability for modern intensive row-crop agriculture. CSR, developed at Iowa State University, is expressed as an index from 0 to100. Corn suitability ratings provide a relative ranking of all soils mapped in the state of Iowa. Ratings range from 100 for soils that have no physical limitations, occur on minimal slopes, and can be continuously row-cropped, to as low as 5 for soils with severe limitations for row crops.

The highest CSR indexes (81 to 100) generally correspond with the soils in the Group 1 Association on level terrain, primarily in the northern half of the County (Figure 1.7.B). These soils range from well drained to poorly drained, with many soils in the 'hydric' category. High CSR indexes also apply to the silty soils of the southern loess areas located on level areas with slopes of seven percent or less.

Soils that are well-suited for agricultural use are generally also well-suited for development. Such soils are typically well-drained and found on moderate slopes with good bearing capacity, shear strength and compressibility. The hydric nature of many of the best agricultural soils in Polk County has been remedied by ditching and draining. A mosaic of small drainage districts across the County took responsibility for maintenance of drainage systems in the past; about 30 of these are still active. When agricultural lands in these districts are converted to urban use, the drainage districts often are turned over to city control; however, the need for artificial drainage remains.

Soils on slopes within the southern loess areas are considered highly erodible (Groups 4 and 8), as is typical for silty, wind-blown material. Much of the loess on side slopes has been removed by erosion, exposing glacial till. Erodible soils have limitations for construction and on-site wastewater disposal.

Hydric soils, as mentioned above, make up many of the soils with the highest CSR indexes, in the Group 1 association, formed on glacial till. As discussed below under Hydrology, the extensive ditching and draining of this wet "Prairie Pothole" region has changed the surface drainage patterns but not the underlying soil qualities.

1.8 Hydrology

Surface Water

Polk County is drained by the Skunk River and the Des Moines River, and its major tributary, the Raccoon River. General flow across the county is towards the southeast. The Des Moines River runs from the northwest to southeast corners of the County, with flood control provided by Saylorville Lake. The Raccoon River is a primary tributary of the Des Moines River and flows from the southwestern corner of the County to its confluence with the Des Moines River in the City of Des Moines. Flood control on the Raccoon River consists of a series of levees constructed along the river. Walnut Creek is a primary tributary to the Raccoon River. The Skunk River, a tributary of the Mississippi, cuts diagonally across the northeast corner of the County, passing to the east of Elkhart and north of Mitchellville. Four Mile Creek flows roughly north-south from Alleman along the eastern border of Ankeny, joining the Des Moines River near the Des Moines-Pleasant Hill boundary.

The major bodies of water in Polk County include Saylorville Reservoir, the northern edge of the Red Rock

Reservoir (primarily within Warren County), Big Creek Lake, Maffitt Reservoir, Easter Lake and Grays Lake.

Surface hydrology in Polk County and the Des Moines region today is best understood in the context of changes in the land since the mid-1800s. Much of the "wet prairie" of the Des Moines Lobe landform was drastically altered for agricultural use.

> Although estimates vary, it is generally agreed that approximately 99 percent of the original wetlands, marshes, and small streams of north-central Iowa were drained and plowed, while the larger streams and rivers were dredged and straightened to facilitate removal of surface water.
>
> Today, artificial stream systems replace the more absorbent wetlands and marshes, and these streams flow in direct contact with Iowa's vast agricultural landscape. Further, we have eliminated many natural stream meanders through straightening and channelization. Drainage of wetlands and channelization of streams and rivers have promoted a hydrological imbalance. Today, in the upstream or headwater portion of small streams, water moves off the land much faster, allowing greater stream bank and bed erosion, creating increased transport and deposition of materials (including soil and agricultural chemicals), along with more severe flooding downstream. Draining of wetlands has lowered the water table, causing natural underground springs and small streams to cease flowing and shallow wells to be deepened. Most of these changes in surface and subsurface hydrology have occurred within a human lifetime.[4]

Flooding

Large portions of Polk County, including the Des Moines metro area, are susceptible to the effects of floodwaters. The most severe floods recorded within the Des Moines region and the state occurred in 1993.

"The Flood of 1993 was the costliest, most devastating flood in U.S. history according to the U.S. Geological Survey. Floodwaters covered as many as 23 million acres of agricultural and urban lands in the Upper Midwest for weeks. The unusual duration and magnitude of this event was triggered by a wet-weather pattern that had persisted since early in the year, followed by a series of intense

[4] Andersen, Kathy L. "Historic Alteration of Surface Hydrology on the Des Moines Lobe, article at Iowa Geological Survey, Iowa DNR website: www.igsb.uiowa.edu/Browse/

rainstorms in late June and early July. Iowa found itself in the center of the catastrophic flooding that resulted."[5]

A total of 47.5 inches of rain fell across Iowa from November 1, 1992 through August 1993 – 20.74 inches more than average and an incredible 11.92 inches more than the previous record. Heavy rains in the upper watershed of the Raccoon River in early July set the stage for the flood event. By July 11, much of downtown Des Moines was inundated, including the Des Moines Water Works water supply facility, leaving the entire city and much of the region without water for 12 days.

Flooding is a common occurrence in Des Moines, but the Flood of '93 set records. Prior to that year, the highest recorded crest on the Raccoon River was 18 feet and the highest flow rate was 41,200 cubic feet per second (cfs). During the Flood of '93, the Raccoon River crested at 28 feet above normal river stage and had a flow rate of 68,900 cfs.

Following the flood, physical changes were made in downtown Des Moines and at Des Moines Water Works facilities: levees were raised, flood gates were installed at the Fleur Drive water treatment plant, and a second treatment facility at Maffitt Reservoir was constructed, reducing the likelihood of a complete loss of water service during a major flood.

Groundwater

The recent DNR publication *Iowa's Groundwater Basics* defines three groundwater provinces within the state. Polk County lies within the Southern groundwater province, and is underlain entirely by Pennsylvania-era bedrock (see above under Bedrock Geology). The Pennsylvanian strata is generally considered an "aquitard" (a barrier to groundwater), and lower-lying aquifers are more frequently used for domestic, municipal and industrial supplies.

"The upper (Mississippian) and middle (Silurian-Devonian) bedrock aquifers contain about 17 trillion gallons of water in storage. However, not all water in these aquifers is of a quality suited for domestic use. In some areas, neither aquifer will yield water of a satisfactory quality for domestic supplies; whereas, in other areas, good water may be obtained by both aquifers."

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[5] "Flood of 1993 Uncovers Devonian Sea Floor" – article at Iowa Geological Survey, Iowa DNR website: www.igsb.uiowa.edu/Browse/

The lower (Cambrian) bedrock aquifer differs from other bedrock aquifers in that it contains relatively good water throughout most of central Iowa. However, in most areas, wells penetrating this aquifer will need to be more than 2,000 feet deep and, in many areas, will need 1,000 feet or more of casing to seal out the poorer quality water in the overlying rocks."[6]

Shallower wells in glacial till are easily contaminated by agricultural and industrial chemicals, and tend to dry up during periods of drought. Therefore, there are relatively few private wells in Polk County that supply water for household consumption, although some supply water for agricultural and industrial uses.

Surface Water Quality

Non-point source pollution (NPSP) refers to pollutants that come from a widespread area and cannot be tracked to a single point or source. Soil erosion, chemical runoff, and animal waste pollution are examples of NPSP. NPSP is Iowa's major water quality problem by sheer volume and in terms of current and future economic costs to the state. In Iowa, the number one source of surface water pollution by volume is soil erosion. Soil erodes into nearby streams, rivers, and lakes, causing many problems. The causes of soil erosion are numerous. Row crop farming, planting crops too close to rivers and streams without the benefits of filter strips, and allowing grazing livestock access to waterways are primary sources of soil erosion, but erosion is not limited to agriculture. Road construction and building sites in towns are often sources of heavy runoff.

Point source pollution (PSP) – also known as "the end of the pipe pollution" – can be traced to a specific source, such as a leaking chemical tank, effluents coming from a waste treatment or industrial plant, or a manure spill from a hog confinement lagoon.

The Department of Natural Resources maintains the state's list of "impaired waters" – those for which effluent limits will not be sufficient to meet all state water quality standards – as required by the Section 303(d) of the Clean Water Act. The most current final list was compiled in 2002. Within Polk County, the following impaired waters were identified:

[6] *Iowa Geological Survey Water Atlas Series*, 1965, from http://www.seta.iastate.edu/publicservices/water/county/polk.aspx

Table 1-2: Impaired Waters Within Polk County, 2002

Water Body	Location	Impairment	Impaired Use	Priority
Part One: Waters impaired by one or more pollutants				
Big Creek Lake	near Polk City	nutrients and siltation		high
Des Moines River	throughout County	indicator bacteria, nitrate	primary contact, drinking water	high
Easter Lake	SE edge of Des Moines	nutrients and siltation		medium
Raccoon River	throughout County	indicator bacteria, nitrate	primary contact, drinking water	high
Yeader Creek	Easter Lake to Fleur Drive	priority organics	general uses	medium
Part Two: Waters impaired by pollution				
Camp Creek	Beaver & Camp townships	habitat alterations	aquatic life	NA
Walnut Creek	mouth to I-80	habitat alterations	aquatic life	NA
Part Five Biologically-impaired water bodies with no identified cause of impairment				
Four Mile Creek	mouth to First St., Ankeny	unknown	aquatic life	low
Walnut Creek (same as in Part Two)	mouth to I-80	unknown	aquatic life	low

Source: Iowa's Final 2002 Impaired Waters List, www.iowadnr.com/water/tmdlwqa/index.html

The failure to meet water quality standards might be due to an individual pollutant, multiple pollutants, "pollution," or an unknown cause of impairment. The listing process includes waters impaired by point sources and nonpoint sources of pollutants. States must also establish a priority ranking for the listed waters, taking into account the severity of pollution and uses.

One listed water body, Easter Lake, has had problems with water quality in the past, due to erosion from construction sites and de-icing chemicals used at the Des Moines Airport. The city of Des Moines and Polk County have spent thousands of dollars building sediment ponds to reduce the amount of soil that enters the water.

For each pollutant that causes a water body to fail to meet state water quality standards, the federal Clean Water Act requires the states to conduct a TMDL study. A TMDL (Total Minimum Daily Load) is a calculation of the greatest amount of a pollutant that a water body can receive without violating water quality standards, and assigns the amount of pollution that can be contributed by the pollutant

sources. A TMDL study identifies both point and nonpoint sources of each pollutant that fails to meet water quality standards. Water quality sampling, biological and habitat monitoring, and computer modeling determine how much each pollutant source must reduce its contribution to assure the water quality standard is met. No TDML studies have been prepared to date for the impaired water bodies within Polk County.

1.9 Land Quality

Contaminated Sites

A number of sites affected by soil and groundwater contamination are located in Polk County. The extent and nature of the sites varies greatly, however there are two sites within the County identified on the United States Environmental Protection Agency's (EPA) National Priority List (NPL). NPL sites, also referred to as CERCLA or Superfund sites, represent facilities or areas where significant groundwater and/or soil contamination is known to exist. The NPL sites identified in Polk County include:

- **Railroad Avenue Groundwater Contamination Site** (EPA ID# IA0001032556) – According to the EPA, the Railroad Avenue site consists of an area of groundwater contamination that includes 22 municipal water supply wells, which historically or currently supply water to the residents of West Des Moines, and the potential source areas of the contamination. The site is being addressed through Federal Action, and is currently in the Remedial Investigation phase.
- **Des Moines TCE Site** (EPA ID# IAD980687933) – According to the EPA, the Des Moines TCE site is an area of contaminated groundwater located southwest of downtown Des Moines, in the flood plain of the Raccoon River. The surrounding area is industrial and commercial, with some recreational parklands. The site is also commonly referred to as the Tuttle Street Landfill, Des Moines Vocational School, Dichem, and Dico Company. The site is being addressed through Federal, state, and potentially responsible parties' actions. The third five-year review for the site was completed in February 2003 and indicated that the actions being taken at the site remain protective.

Iowa DNR cooperates with the US EPA in the administration and preliminary site evaluation for the CERCLA program.

Two state programs, Chapter 133 and Chapter 137 (also known as the Land Recycling Program) are administered by Iowa DNR to address sites that are contaminated by hazardous materials or wastes. These programs focus on assessing the severity of such problems and on identifying and carrying out the appropriate remedial measures. In addition, the Land Recycling Program provides for limited liability protection from further regulatory action relative to the problem(s) addressed. The DNR has identified the following contaminated sites in Polk County.

Table 1-3: Registered Contaminated Sites

Site	Priority	Date Added	Primary contaminant
Ankeny Landfill/Lagoon	B	1990	Metals
Aratex Services – Des Moines	D	1991	VOCs* (dry cleaning solvents)
Dico Company (see above under "Des Moines TCE site")	D	1984	VOCs
North High School	E	1994	VOCs
Williams Pipe Line Company	B	1990	BTEX (petroleum fuels)

*VOCs: Volatile Organic Compounds

Source: Iowa DNR Contaminated Sites, www.iowadnr.com/land/consites/hwregistry/conregistry/county.html

Threatened and Endangered Species

Endangered species include any species of fish, plant life or wildlife, which is in danger of extinction throughout all, or a significant part of its range. Threatened species include any species which is likely to become endangered within the foreseeable future throughout all or a significant portion of its range. Both endangered and threatened species are protected by law. Species "of special concern" have no protection status but are tracked by the Iowa DNR for research purposes. Species within each category found within Polk County are listed in Table 1-__.

Polk County Conservation Board (PCCB) parks and wildlife areas are home to several rare species. The plains pocket mouse, a state endangered species, was recently discovered at Sandhill Prairie. In 1997, PCCB purchased 10 river otters, a state threatened species, from Louisiana and released them at Chichaqua Bottoms Greenbelt in hopes to repopulate the Skunk River. The state endangered ornate box turtle,has also been introduced in hopes of returning the turtle to central Iowa.

Table 1-4: Protected Species and Species of Concern

Species	Scientific Name	Common Name	Status	Number of Records
Fish	Ammocrypta Clara	Western Sand Darter	T	1
Reptile	Emydoidea Blandingii	Blanding's Turtle	T	3
Fish	Esox Americanus	Grass Pickerel	T	1
Fish	Notropis Heterolepis	Blacknose Shiner	T	1
Reptile	Ophisaurus Attenuatus	Slender Glass Lizard	T	1
Mammal	Perognathus Flavescens	Plains Pocket Mouse	E	1
Butterfly	Poanes Zabulon	Zabulon Skipper	SC	1
Mammal	Spilogale Putorius	Spotted Skunk	E	3
Plant	Cirsium Hillii	Hill's Thistle	SC	1
Plant	Cypripedium Candidum	Small White Lady's Slipper	SC	1
Plant	Opuntia Fragilis	Brittle Prickly Pear	T	1
Plant	Plantathera Praeclara	Western Prairie Fringed Orchid	T	1
Plant	Spiranthes Magnicamporum	Great Plains Lady's Tresses	SC	1
Plant	Spiranthes Ovalis	Oval Lady's Tresses	T	7

E: Endangered
T: Threatened
SC: Special Concern (no protection status)
Source: Iowa Department of Natural Resources, Conservation and Recreation Division

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