5.4.10 Water Supply Contamination

The following sections provide the hazard profile (hazard description, extent, location, previous occurrences and losses, probability of future events, and climate change impacts) and vulnerability assessment for the water supply contamination hazard in Wyoming County.

5.4.10.1 Hazard Profile

Description

For the purpose of this Hazard Mitigation Plan (HMP) and as deemed appropriate by the Wyoming County Steering Committee, groundwater contamination and harmful algal blooms (HAB) are the main water supply contamination types of concern for the county. These types of water supply contamination are further discussed below.

Groundwater Contamination

Groundwater is a natural resource that is used for drinking water, recreation, industry, and crops. It is water found underground in the cracks and spaces in soil, sand, and rock. Groundwater is stored in and moves slowly through layers of soil, sand, and rocks called aquifers. Aquifers typically consist of gravel, sand, sandstone, or fractured rock, like limestone. These materials are permeable because they have large connected spaces that allow water to flow through. The speed of groundwater flow depends on the size of the spaces in the soil or rock and how well the spaces are connected. The area where water fills the aquifer is called the saturated zone (or saturation zone). The top of this zone is called the water table. The water table may be located only a foot below the ground's surface, or it can be hundreds of feet down.

According to the New York State Department of Environmental Conservation over 50 percent of Wyoming County's population relies on potable groundwater as their water source (NYSDEC 2004). The county population's dependence on groundwater provides the need to protect the quality of this vital resource.

Groundwater contamination is defined as the addition of elements, compounds, and/or pathogens to groundwater that alter its composition. It can be contaminated in many ways and through a variety of compounds, both natural and man-made. In general, shallow, permeable water table aquifers are the most susceptible to contamination, but susceptibility of all aquifers to contamination is determined largely by such site-specific characteristics as:

- Distance from the contamination source to the aquifer and residence time of the water in the unsaturated zone
- Presence of clay and organic matter in the unsaturated zone materials
- Potential of a particular contaminant to biodegrade and decompose
- Amount of precipitation, which affects recharge and the rate at which contaminants move downward
- Evapotranspiration, which in recharge areas may decrease the amount of water that moves downward to the aquifer

Contamination sources can be grouped into five main categories: natural, municipal, agricultural, industrial, and residential. Most concern over groundwater contamination has centered on pollution associated with human activities, including municipal, agricultural, industrial, and residential uses. Human groundwater contamination can be related to waste disposal [private sewage disposal systems (septic systems), land disposal of solid waste (landfills), municipal wastewater, wastewater impoundments, land spreading of sludge, brine disposal from the petroleum industry, mine wastes, deep-well disposal of liquid wastes, animal feedlot wastes, radioactive wastes] or not directly related to waste disposal (accidents, certain agricultural activities, mining, highway deicing, acid rain, improper well construction and maintenance, road salt). It can be caused by the improper handling, transporting, stockpiling, and storage of hazardous materials (e.g., underground or aboveground storage tanks), resulting in leaks or spills or poor housecleaning practices. Since groundwater contamination associated with human influence is not considered a natural hazard, only natural groundwater contamination is being assessed within this hazard profile for the purpose of this HMP.

Groundwater moving through sedimentary rocks and soils may pick up a wide range of inorganic compounds such as magnesium, calcium, and chlorides. Some aquifers have high natural concentrations of dissolved constituents such as arsenic, boron, and selenium. The effect of these natural sources of contamination of groundwater quality depends on the type of contaminant and its concentrations. Most inorganic compounds are harmless at the concentrations commonly found in unpolluted groundwater, and some are even beneficial to human health.

Naturally occurring pollutants of groundwater include, but are not limited to, the following:

- *Microorganisms*: Bacteria, viruses, parasites, and other microorganisms are sometimes found in water. Shallow wells, with water close to ground level, are at most risk. Runoff, or water flowing over the land surface, may pick up these pollutants from wildlife and soils. This is often the case after flooding. Some of these organisms can cause a variety of illnesses. Symptoms include nausea and diarrhea. These can occur shortly after drinking contaminated water. The effects could be short-term yet severe (similar to food poisoning) or might recur frequently or develop slowly over a long time. A common type of microorganism in groundwater is coliform bacteria. Coliform bacteria occur naturally in the environment and is associated with soils and plants and in the intestines of humans and other warm-blooded animals. This bacterium is used as an indicator for the presence of pathogenic bacteria, viruses, and parasites from domestic sewage, animal waste, or plant or soil material.
- *Dissolved Solids and Chlorides*: One of the most common water quality concerns is the presence of dissolved solids and chloride in concentrations that exceed the recommended maximum limits in federal secondary drinking water standards. The recommended limits are 500 mg/L (milligrams per liter or approximately equivalent to parts per million) for dissolved solids and 250 mg/L for chloride. Such concentrations are found at the seaward ends of all coastal aquifers and are quite common in aquifers at depths greater than a few hundred feet below the land surface in many parts of the United States.
- *Radionuclides*: Radionuclides are radioactive elements such as gross alpha particles, beta particles and photon emitters, Radium 226 and Radium 228 (combined), and uranium. They may be present in underlying rock and ground water and through erosion or decay of these natural deposits, groundwater contamination can occur. Most drinking water sources have very low levels of radioactive contaminants ("radionuclides"), which are not considered to be a public health concern. Of the small percentage of drinking water systems with radioactive contaminant levels high enough to be of concern, most of the radioactivity is naturally occurring.
- *Radon*: Radon is a gas that is a natural product of the breakdown of uranium in the soil and can also pose a threat. Radon is most dangerous when inhaled and contributes to lung cancer. Although soil is the primary source, using household water containing radon contributes to elevated indoor radon levels. Radon is less dangerous when consumed in water but remains a risk to health.
- *Nitrates and Nitrites*: Although high nitrate levels are usually due to human activities (see below), they may be found naturally in ground water. They come from the breakdown of nitrogen compounds in the soil. Flowing ground water picks them up from the soil. Drinking large amounts of nitrates and nitrites is particularly threatening to infants (for example, when mixed in formula). Most groundwater not affected by human activity contains less than 10 mg/L nitrate-nitrogen, the maximum concentration allowed by federal primary drinking water standards. Nationwide, nitrate-nitrogen concentrations of less than 0.2 mg/L generally represent natural conditions, whereas values greater than 3 mg/L may indicate the effects of human activities.
- *Heavy Metals*: Underground rocks and soils may contain inorganic chemicals, including arsenic, asbestos, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, and selenium. Erosion

of these natural deposits can lead to the contamination of groundwater sources. However, these contaminants are not often found in household wells at dangerous levels from natural sources.

- *Arsenic*: Arsenic occurs naturally in sedimentary and hard rocks and soil, water, air, plants, and animals. Natural arsenic is also found in thermal and mineral waters, which reach the earth's surface either by natural discharge in springs or by geothermal exploitation, which may affect the environment if not treated or not reinjected. It can be further released into the environment through natural activities such as volcanic action, erosion of rocks, and forest fires.
- *Cadmium*: Cadmium occurs naturally in zinc, lead, copper, and other ores, which can serve as sources to ground and surface waters, especially when in contact with soft, acidic waters.
- *Iron and Manganese*: Although not particularly toxic, iron and manganese in concentrations greater than the limits for federal secondary drinking water standards (0.3 mg/L for iron and 0.05 mg/L for manganese) can impair the taste of water; stain plumbing fixtures, glassware and laundry; and form encrustations on well screens, thereby reducing well-pumping efficiency.
- *Fluoride*: Fluoride is helpful in dental health, so many water systems add small amounts to drinking water. However, excessive consumption of naturally occurring fluoride can damage bone tissue. High levels of fluoride occur naturally in some areas. It may discolor teeth, but generally, levels are not high enough to present a health risk (USEPA 2020).

Harmful Algal Bloom

Algae can be found in a wide range of environments, including fresh water, oceans, hot springs, and even on land. Algae are a diverse group of species ranging from single-celled organisms to kelp seaweeds that can grow to be over 50 yards long. Algae can be found in symbiotic relationships with other organisms, the most common being corals and lichens. Large species of algae that appear to grow off the lake or sea floor are referred to as macroalgae while smaller, microscopic species are referred to as microalgae. Microalgae can be free floating in the water column as phytoplankton or can rest on the bottom of the water body as periphyton.

As the base of the food chain in aquatic systems, phytoplankton populations are under constant threat of being eaten by herbivores. Phytoplankton species employ a variety of natural defenses to limit the amount of population destruction that unabated grazing by herbivores can cause. These may include regulation of population size and seasonal occurrence, growth of spiny exteriors, and the creation of toxins. More than 40 cyanobacterial species are confirmed or suspected to produce toxins (Inside Climate News 2018).

Traditional methods of in-home treatment systems such as boiling, disinfecting with chlorine/ultraviolet (UV), and water filtration units are not effective in removing HABs and their toxins. Public water is always the best option for drinking, preparing food, cooking, washing, and bathing because water suppliers are required to treat, disinfect, and monitor their water supplies. Even after a HAB abates, toxins released by algae can remain in the water column for weeks. Water treatment plants remove variable amounts of microcystin from drinking water; however, as much as 20 percent may escape the treatment process (NYSDOH 2017), sometimes leading to plant and water system closures.

The NYSDEC Lake Classification and Inventory Program, Citizen Statewide Lake Assessment Program volunteers, public reporting, and partnered HAB monitoring programs collect information about the status of waterbodies in New York that may be impacted by HABs (NYSDEC n.d. [b]).

The NYSDEC use visual observations, photographs, and laboratory sampling results to determine if blooms are composed of cyanobacteria or other types of algae. NYS DEC staff will set bloom statuses for waterbodies that are being investigated for HABs:

- **Suspicious Bloom**: NYSDEC staff have determined that conditions fit the description of a cyanobacteria HAB based on visual observations and/or digital photographs. Laboratory analysis has not been conducted to confirm whether this suspicious bloom is a HAB. It is not known if toxins are present in the water.

- **Confirmed Bloom**: Water sampling results have confirmed the presence of a cyanobacteria HAB, which may produce toxins or other harmful compounds.
- **Confirmed with High Toxins Bloom**: Water sampling results have confirmed that toxins are present in enough quantities to potentially cause health effects if people and animals come in contact with the water through swimming or drinking (NYSDEC n.d. [b]).

Suspicious blooms are reported to NYSDEC, local health departments, or the NYSDOH and are also available on the NYSDEC Division of Water Quality Portal website found here: https://www.waterqualitydata.us/ (NYSDEC n.d. [b]).

Extent

Groundwater Contamination

Although the USEPA does not regulate private wells or provide recommended criteria or standards for individual wells, it does offer information on private well testing and guidance regarding technologies that may be used to treat or remove contaminants (USEPA 2020e).

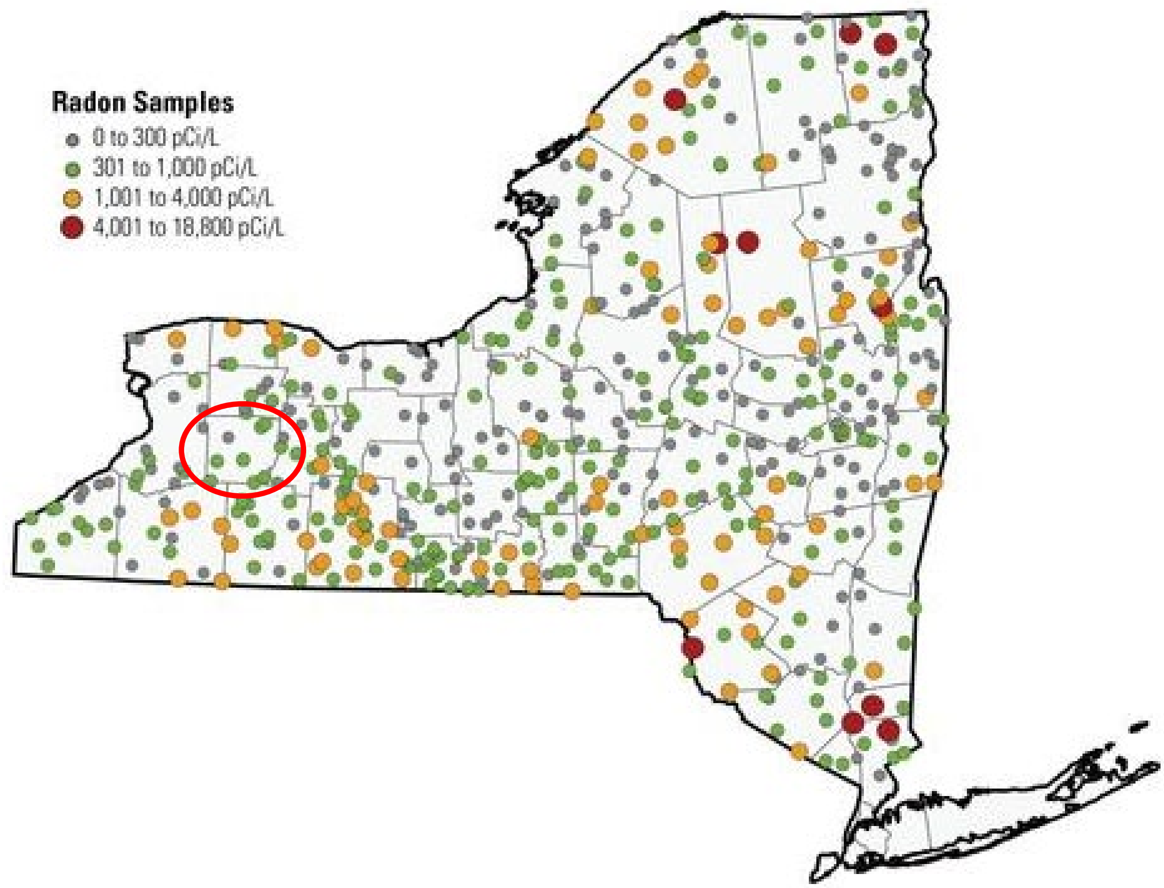
The USEPA does regulate drinking water standards that apply to public water systems, which provide water for human consumption through at least 15 service connections, or regularly serve at least 25 individuals. Public water systems include municipal water companies, homeowner associations, schools, businesses, campgrounds, and shopping malls. The 1974 Safe Drinking Water Act (SWDA) and its 1986 and 1996 amendments require the USEPA set standards for contaminants in drinking water that may pose health risks to humans. The USEPA standard for lifetime exposures in drinking water, the maximum contaminant level (MCL), is the highest amount of a contaminant allowed in drinking water supplied by municipal water systems. Regulators use the reference dose to establish a MCL for a contaminant, assuming that the exposure comes from drinking 2 liters of contaminated water per day for 70 years (USEPA 2020d).

Radon

Currently, there is no federally enforced drinking water standard for radon. The USEPA has proposed to regulate radon in drinking water from community water suppliers (water systems that serve 25 or more year-round residents); however, they do not regulate private wells. The USEPA has proposed to require community water suppliers to provide water with radon levels no higher than 4,000 pCi/L, which contributes to approximately 0.4 pCi/L of radon to the air in a home. Under the proposed regulation, states that choose not to develop enhanced indoor air programs, community water systems in the state would be required to reduce radon levels in drinking water to 300 pCi/L. Even if a state does not develop an enhanced indoor air program, water systems may choose to develop their own local indoor radon program and meet a radon standard for drinking water of 4,000 pCi/L (USEPA 2014).

According to a groundwater well study of groundwater systems in New York State, Wyoming County was identified as having 0 to 1,000 pCi/L regarding radon levels in its groundwater supply. See Figure 5.4.10-1; however, this study is not dated and may not represent all water systems and may not represent the present-day radon conditions (USGS, n.d.).

Figure 5.4.10-1. Radon Samples in New York Groundwater Wells



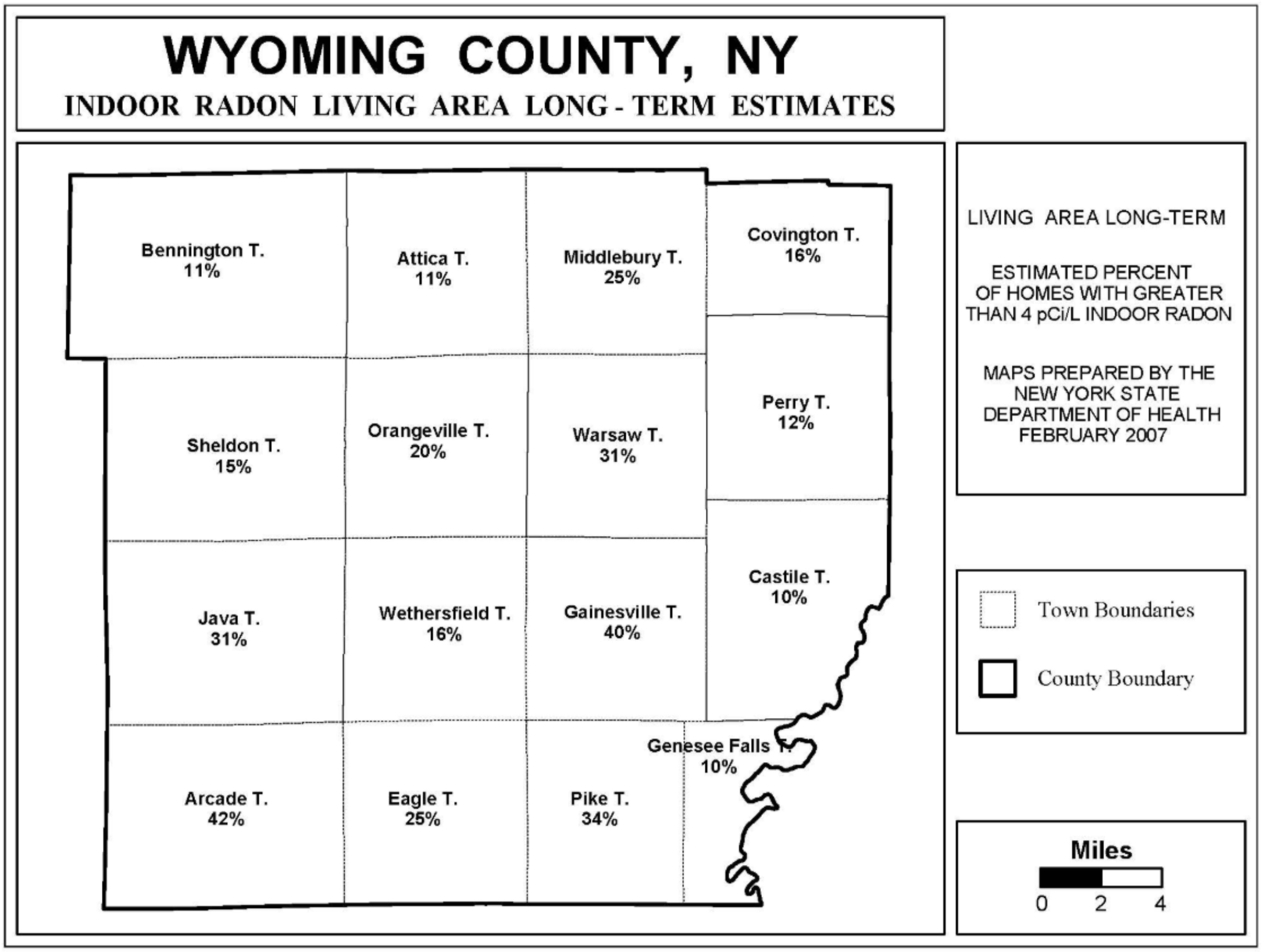
Source: *USGS, Date Unknown*
Note: *Wyoming County is located within the red circle;*
Wyoming County's radon samples were 0 to 1,000 pCi/L.

If indoor radon gas levels are high and groundwater is consumed in a household, it is advised that groundwater should be tested. If the radon level is low in the air, there is generally no need to test the groundwater. In general, 10,000 pCi/l of radon in water contributes roughly 1 pCi/l of airborne radon throughout the house. The USEPA currently advises consumers to take action if the total household air level is above 4 pCi/l (CDC 2020).

Between 1986 and 2007, over 45,000 basement screening measurements and over 11,000 long-term living area measurements were collected through the New York State Department of Health's ongoing detector distribution program. According to the NYSDOH, this type of data does not scientifically change over time, thus is still valuable today.

Figure 5.4.10-2 shows the percentage of homes greater than 4 pCi/L based on long-term tests with the detectors placed in a primary living area of the home. Approximately 90 percent of the detectors were placed in living rooms, family rooms, and bedrooms. Wyoming County ranges from 10 percent to 42 percent of the homes within the county to be greater than 4 pCi/L. Statewide, the long-term living area estimate for homes above 4 pCi/L is 5 percent (NYSDOH 2007).

Figure 5.4.10-2. Wyoming County Indoor Radon Levels by Municipality



Source: NYSDOH 2007

Harmful Algal Bloom

The NYSDEC has identified HABs in Java, Silver, Akron, and South Sandy Lakes; however, it is possible that other waterbodies may have been impacted as well but were not identified in monitoring programs. The extent of a harmful algal bloom is an estimate of the area of the waterbody that is impacted. The NYSDEC has four categories to classify extent within their monitoring program (NYSDEC 2017b):

- **Small Localized**: Bloom affects a small area of the waterbody, limited from one to several neighboring properties.
- **Large Localized**: Bloom affects many properties within an entire cove, along a large segment of the shoreline, or in a specific region of the waterbody.
- **Widespread/Lake-wide**: Bloom affects the entire waterbody, a large portion of the lake, or most to all of the shoreline.

- **Open Water**: Sample was collected near the center of the lake and may indicate that the bloom is widespread, and conditions may be worse along shorelines or within recreational areas. Special precautions should be taken in situations when a "Confirmed with High Toxins Bloom" is reported with an open water extent because toxins are likely to be even higher in shoreline areas.

Wind currents can play a large role in the concentrations of algae that float at or near the water surface. Consistent winds can accumulate algae at downwind shorelines. Shorelines containing coves or other features that could capture floating algae may be more susceptible to HABs. In instances where freshwater intakes are impacted by these blooms, the extent may also include the area that is serviced by the impacted water utility.

According to NYSDOH, the statewide Water Quality Rapid Response Team was created by New York's Governor Cuomo in 2016 to strengthen the state's existing drinking water, ground water, and surface water protection programs and conduct enhanced testing of them. The team also monitors HABs in lakes that serve sources of drinking water for communities. This response team will be valuable to control the extent of HABs in the future (NYSDOH 2017).

Location

Groundwater Contamination

Sand and gravel aquifers of the glacial aquifer system are found in the northern contiguous United States. Glacial aquifer systems consist of permeable, unconsolidated sediments left behind by continental glaciers in the northern United States.

The most productive aquifers in New York consist of unconsolidated deposits of sand and gravel that occupy major river and stream valleys or lake plains and terraces. Due to the land's typically flat formations and ample groundwater supply in these areas, they are suitable for development. Because of development, high permeability of these deposits, and shallow depth to the water table, these aquifers are particularly susceptible to contamination from point sources. These point sources are typically landfills, oil and gas wells, and tire stockpiles over primary and/or principal source aquifers.

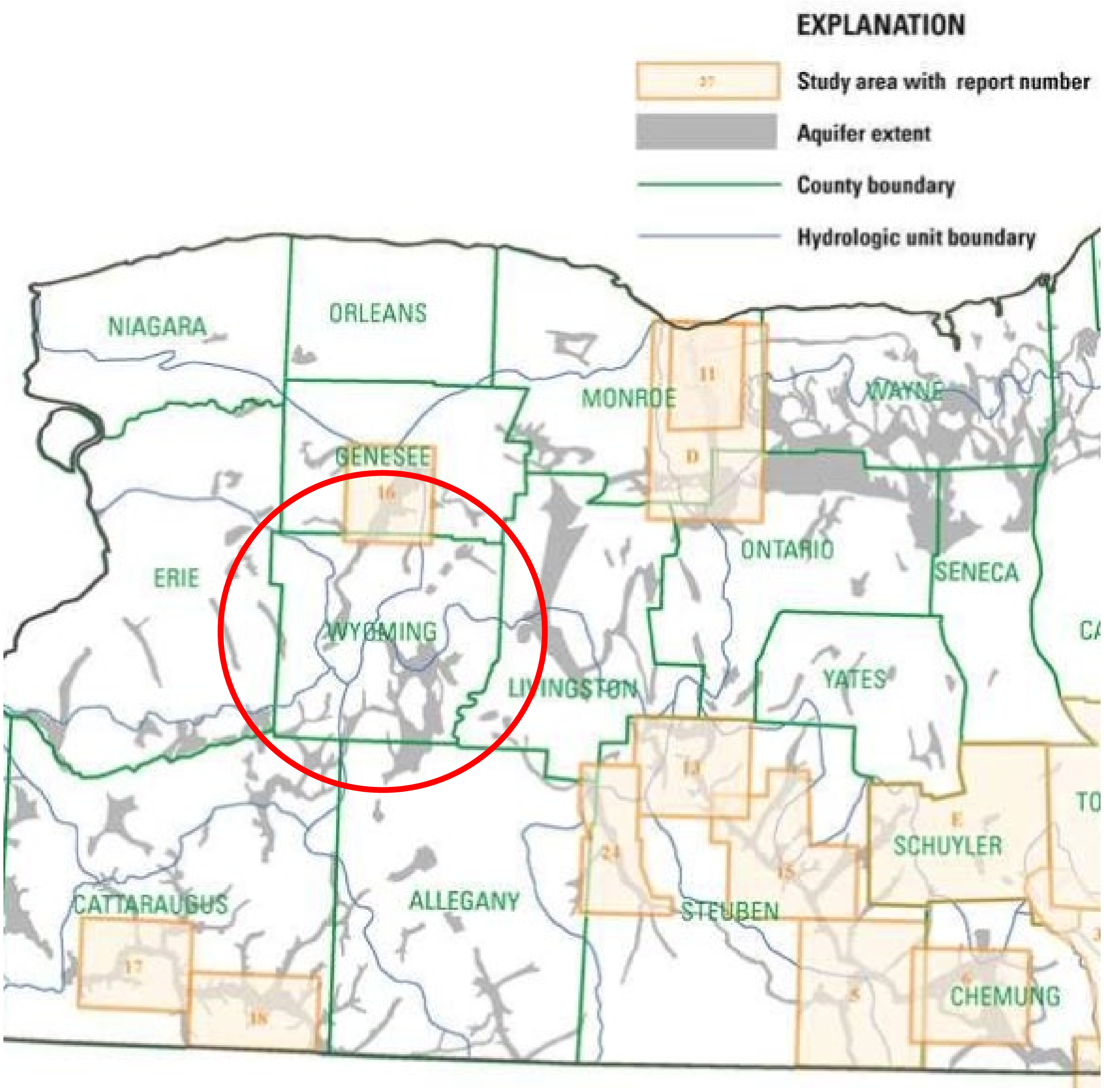
In 1988 (newest information available as of this HMP update) the New York Department of Environmental Conservation (NYDEC) partnered with the United States Geological Survey (USGS) to research and publish reports on groundwater resources across the state. Figure 5.4.10-3 shows the regions of unconsolidated aquifer systems in New York State. Wyoming County is in Region 5: Niagara region.

Figure 5.4.10-3. Unconsolidated Aquifer Areas in New York State

Source: USGS 1988
Note: The approximate location of Wyoming County is within the red circle.

Since 1980, the USGS has partnered with NYSDEC and other agencies to produce hydrogeologic map reports for the aquifer systems throughout New York State. Wyoming County has aquifers that extend the entire county. The Figure 5.4.10-4 below shows the map report and various study areas of the region. Study area 16 straddles the border of Genesee and Wyoming Counties and the geohydrology of the aquifer is that of glacial outwash.

Figure 5.4.10-4. Aquifers in Wyoming County

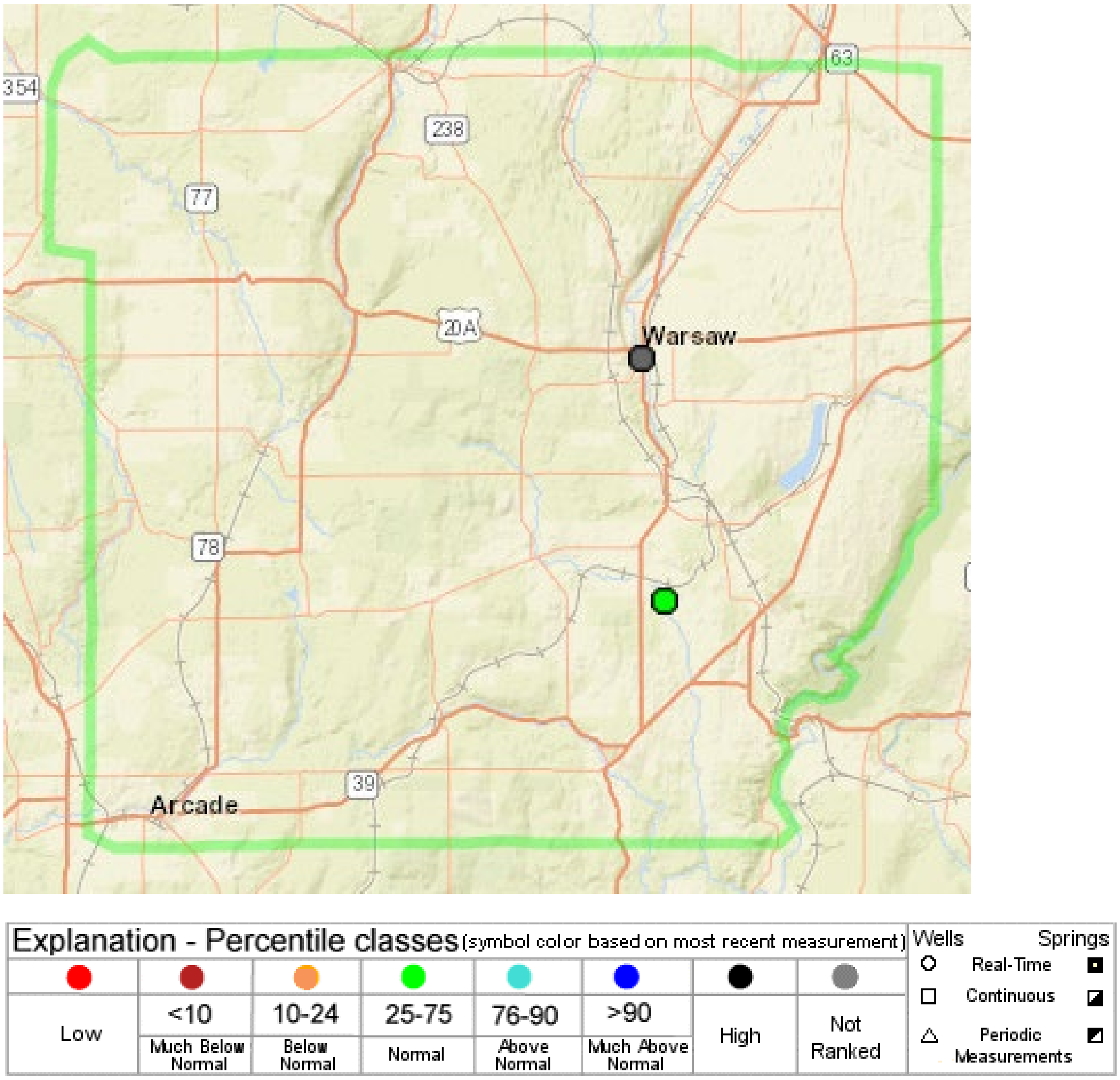


Source: NYSDEC n.d.
Note: Wyoming County is located within the red circle.

According to USGS the public water systems affecting Wyoming County along Cattaraugus Creek (located in Cattaraugus County) draw from local groundwater resources and serve about 5,500 people. The remainder of the population obtains water from domestic wells, with many of them completed in glacial aquifers. USGS is actively studying these aquifers to define the extent and hydrogeologic framework of the glacial aquifers in this Erie County, Cattaraugus County and Wyoming County region. The objective is to present the results as a digital map and summary report. The study does not provide for an estimated completion date (USGS n.d.)

The Wyoming County aquifer has two well sites, one located in Gainesville and the other in Warsaw. The Gainesville well has a depth of 20.3 feet, and the Warsaw well has a depth of 380 feet (USGS 2020).

Figure 5.4.10-5. Wyoming County Well Sites



Source: *USGS 2020*
Note: *Wyoming County is outlined in green highlight.*

The aquifer system of Wyoming County is vulnerable to contamination. Most commonly documented contamination is primarily associated with human influences (e.g., pesticides, nitrates, heavy metals, hazardous releases and/or wastes) and not with natural contamination sources. Although there are many natural contaminants, those contaminants are likely to include radon and arsenic. Other natural pollutants may impact the county; however, resources and documented cases regarding the location of natural contamination impacts are limited.

According to USGS (1998), the contamination of shallow groundwater by sewage effluent typically contains chemicals that consume dissolved oxygen, creating a lower oxygenated environment, thus contaminating the water.

The Wyoming County Health Department employs an Individual Wastewater Program, the Private Water Program, and the Public Water Program, whose goals are to minimize contamination of surface and groundwater, private well water sources, and public water supplies by ensuring wastewater treatment systems are designed and follows the Sanitary Code of the Wyoming County Health District and the NYS Sanitary Code (Wyoming n.d.).

Harmful Algal Bloom

The population of Wyoming County has significant exposure to water and vulnerability to the water supply contamination hazard, as shown below.

- Shorelines of the Wyoming County lakes with documented HABs may be easily accessible.
- Any surface water can experience HABs, but blooms are primarily limited to lakes, ponds, and reservoirs within the county.
- Locations that rely on surface water intake for drinking water are most exposed to the impacts of HABs; however, for security reasons, details on water intakes (e.g., exact location, depth, etc.) were not made available during the planning process, so specific vulnerability could not be assessed.

Java Lake, Silver Lake, Akron Reservoir, and the South Sandy Pond each have had documented HABs in recent years. Combined, these lakes have a total of 1,369 acres of water. Table 5.4.10-1 breaks down the total acres per lake within Wyoming County, providing to be a potential source for additional HAB contamination locations (Lake Link New York 2020).

Table 5.4.10-1. Acreage of Major Water Bodies in Wyoming County

Water Body	Acres
Akron Reservoir	57
Attica Reservoir	181
Dream Lake	35
Faun Lake	46
Gouinlocks Pond	30
Hiram Lake	20
Java Lake	54
Jenkins Pond	10
Lake Le Roy	63
Lake Willene	11
Silver Lake	862
TOTAL	**1,369**

Source: Lake Link NY 2020

Figure 5.4.10-6 and Figure 5.4.10-7 show maps of prominent lakes within Wyoming County that frequently contain HAB's: Java Lake and Silver Lake.

Figure 5.4.10-6. Java Lake

Figure 5.4.10-7. Silver Lake

Previous Occurrences and Losses

Between 1954 and 2019, the Federal Emergency Management Agency (FEMA) included New York State in one emergency declaration (EM-3066 - New York Chemical Waste, Love Canal in 1978) classified as a toxic substance release in Rensselaer County. Wyoming County was not included in this declaration (FEMA 2020).

For this 2021 HMP update, known harmful algal bloom events that have impacted Wyoming County between 2014 and 2019 are identified in Table 5.4.10-2. Because information regarding specific details of groundwater supply contamination in the county is scarce, knowledge of previous occurrences and losses associated with these events is limited. Therefore, Table 5.4.10-2 may not include all events that have occurred in the county.

Table 5.4.10-2. Water Supply Contamination Events in Wyoming County, 2014 to 2019

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts
2019	HAB Growth	N/A	N/A	Java Lake was closed from July to September 2019 due to blue green algae blooms.
2019	HAB Growth	N/A	N/A	Silver Lake was closed from May to August 2019 due to blue green algae blooms.
2018	HAB Growth	N/A	N/A	During the annual water quality testing of Java Lake, located in the Town of Java, findings indicated the lake's use of swimming, aquatic life and aesthetics were "stressed/poor" due to algae levels and invasive plants. The lake's general habitat was "threatened/ fair" and the lake's use of recreation was "impaired" due to algae blooms.
2018	HAB Growth	N/A	N/A	Wyomoco Pond was closed for 7 weeks from August to September 2018 due to blue green algae blooms.
2018	HAB Growth	N/A	N/A	Silver Lake was closed for 3 weeks from August to September 2018 due to blue green algae blooms.
2018	HAB Growth	N/A	N/A	Java Lake was closed for 10 weeks from July to September 2018 due to blue green algae blooms.
2018	HAB Growth	N/A	N/A	During the annual water quality testing of Silver Lake, located in the Towns of Perry and Castile, findings indicated the lake's use of swimming and aesthetics were "stressed/ poor" due to algae blooms and invasive plants. The lake's general habitat was "threatened/ fair", and the lake's use of recreation and potable water was "impaired" due to algae blooms, algae levels, and invasive plants present.
2017	HAB Growth	N/A	N/A	Wyomoco Pond was closed for 1 week in August 2017 due to blue green algae blooms.
2017	HAB Growth	N/A	N/A	Silver Lake was closed for 12 weeks from August to October 2017 due to blue green algae blooms.
2017	HAB Growth	N/A	N/A	Java Lake was closed for 14 weeks from July to October 2017 due to blue green algae blooms.
2016	HAB Growth	N/A	N/A	During the annual water quality testing of the Akron Reservoir located in the Towns of Darien (Genesee County) and Bennington (Wyoming County), findings indicated the reservoir's use of potable water and recreation to be "stressed/ poor" due to potential presence of disinfection-by-products (DBPs) and algae levels. The reservoir's use of swimming, aquatic life, aesthetics, and general habitat were "threatened/ fair" due to algae levels, surface oxygen, poor perception and invasive plants.

Table 5.4.10-2. Water Supply Contamination Events in Wyoming County, 2014 to 2019

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts
2016	HAB Growth	N/A	N/A	Java Lake was closed for 9 weeks from July to September 2016 due to blue green algae blooms.
2016	HAB Growth	N/A	N/A	During the annual water quality testing of the South Sandy Pond, located in the Towns of Darien (Genesee County) and Bennington (Wyoming County), findings indicated the pond's aesthetics were "stressed/ poor" due to algae levels. The pond's aquatic life and general habitat were "threatened/ fair" due to surface oxygen and invasive plants.
2015	HAB Growth	N/A	N/A	During the annual water quality testing of Java Lake findings indicated the lake's use of swimming and aquatic life were "stressed/poor" due to algae levels. The lake's use of recreation was "impaired" due to algae blooms algae levels.
2015	HAB Growth	N/A	N/A	Silver Lake was closed for 5 weeks from July to August 2015 due to blue green algae blooms.
2015	HAB Growth	N/A	N/A	Java Lake was closed for 9 weeks from July to September 2015 due to blue green algae blooms.
2015	HAB Growth	N/A	N/A	During the annual water quality testing of Silver Lake, located in the Towns of Perry and Castile, findings indicated the lake's use of potable water, swimming, aquatic life and aesthetics to be "stressed/ poor" due to algae levels, bottom oxygen and excessive nutrients. The lake's recreation use was "impaired" due to algae blooms.
2014	HAB Growth	N/A	N/A	Java Lake was closed was closed for 7 weeks, August to September 2014 due to blue green algae blooms.
2014	HAB Growth	N/A	N/A	Silver Lake was closed was closed for 1 week in August 2014 due to blue green algae blooms.

Source: NOAA-NCEI 2020; FEMA 2020; NYSDEC 2020; NYSDEC 2018a; NYSDEC 2018b; NYSDEC 2018c

Probability of Future Events

Groundwater quality will naturally continue to be disrupted from a variety of natural and human factors. While the probability of future water supply contamination incidents in Wyoming County is difficult to predict, the historical record indicates that since previous HABs have occurred, they will likely continue to occur in the future. In addition, future changes in climate may also impact the frequency and probability of future water supply contamination occurrences.

Section 5.3 of this HMP lists the ranking of all identified hazards of concern for Wyoming County. Probability of occurrence, or likelihood of the event, is one parameter used for hazard rankings. Based on historical records and input from the Planning Partnership, probability of occurrence of utility failures in the county is considered "frequent" (likely to occur within 25 years).

Climate Change Impacts

Climate change is beginning to affect both people and resources in New York State, and these impacts are projected to continue and become more significant. Impacts related to increasing temperatures and sea-level rise are already evident in the state. The Integrated Assessment for Effective Climate Change in New York State (ClimAID) was undertaken to provide decision makers with information on the state's vulnerability to climate change, and to facilitate development of adaptation strategies informed by both local experience and scientific knowledge (New York State Energy Research and Development Authority [NYSERDA] 2014).

Each region in New York State, as defined by ClimAID, has attributes that will be affected by climate change. Wyoming County is part of Region 1, Western New York and Great Lakes Plain. Some characteristics of and issues affecting this region associated with climate change include the highest agricultural revenue in the state, relatively low rainfall, increased summer drought risk, high-value crops requiring irrigation, and projected improved condition for grapes (NYSERDA 2014).

Temperatures are expected to increase throughout the state by 2º F to 3.4º F by the 2020s, 4.1° F to 6.8° F by the 2050s, and 5.3° F to 10.1° F by the 2080s. The lower ends of these ranges assume lower greenhouse gas emissions scenarios, and the higher ends assume higher greenhouse gas emissions scenarios. Annual average precipitation is projected to increase by up to 1 to 8 percent by the 2020s, up to 3 to 12 percent by the 2050s, and up to 4 to 15 percent by the 2080s. By the end of the century, the greatest increases in precipitation are projected to be in the northern parts of the state. Although seasonal projections are less certain than annual results, this additional precipitation will most likely occur during the winter months, with the possibility of slightly reduced precipitation projected for the late summer and early fall. Table 5.4.10-3 lists projected precipitation changes within the Western New York Great Lakes ClimAID Region (NYSERDA 2014).

Table 5.4.10-3. Projected Seasonal Precipitation Change in Region 1, 2020-2100 (% change)

Baseline (1971-2000) 34.0 inches	Low Estimate (10th Percentile)	Middle Range (25th to 75th Percentile)	High Estimate (90th Percentile)
2020s	0 percent	+ 2 to + 7 percent	+ 8 percent
2050s	+ 2 percent	+ 4 to + 10 percent	+ 12 percent
2080s	+ 1 percent	+ 4 to + 13 percent	+ 17 percent
2100	- 3 percent	+ 4 to + 19 percent	+ 24 percent

Source: NYSERDA 2014

The projected increase in precipitation is expected to occur via heavy downpours and less in the form of light rains. Increases in heavy downpours could affect drinking water; heighten the risk of riverine flooding; flood key rail lines, roadways, and transportation hubs; and increase delays and hazards related to extreme weather events. Rising air temperatures intensify the water cycle by increasing evaporation and precipitation, which can cause an increase in rain totals during storm events, with longer dry periods between those events. Alternating periods of drought and heavy rainfall increase the likelihood of nutrient runoff into waterways, which can fuel algal blooms (EPA 2017a).

Climatologists predict an increase in the number and intensity of extreme temperatures events. During the hot summer months, potential for algal growth will increase. In addition to warmer temperatures and heavy precipitation events, carbon dioxide levels are forecast to continue to increase. Higher levels of carbon dioxide in the atmosphere and water can lead to increased algal growth, particularly for cyanobacteria that float at the surface (EPA 2017a).

Droughts can cause deficits in surface and groundwater used for drinking water. The New York State Water Resources Institute at Cornell University conducted a vulnerability assessment of drinking water supplies and climate change. To assess water supplies in New York State, it was assumed that long-term average supply will remain the same, but the duration and/or frequency of dry periods may increase. Both types of water supplies, surface water and groundwater, were divided into three categories: sensitive to short droughts (two to three months), sensitive to moderate and longer droughts (greater than six months), and relatively sensitive to any droughts. Major reservoir systems are presumed to have moderate sensitivity to drought because there is a likelihood of decreases in summer and fall water availability (Cornell University College of Agriculture and Life Sciences, 2011). The greatest likelihood of future water shortages is likely to occur on small water systems (Cornell University College of Agriculture and Life Sciences, 2011).

5.4.10.2 Vulnerability Assessment

To understand risk, a community must evaluate the assets that are exposed or vulnerable within the identified hazard area. For the utility failure hazard, all of Wyoming County has been identified as the hazard area. Therefore, all assets in the county (population, structures, critical facilities, and lifelines), as described in the County Profile are vulnerable to a utility failure. This section discusses the potential impact of the utility failure hazard on the county. Specifically, this section addresses:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impacts on (1) life, health, and safety of residents; (2) general building stock; (3) critical facilities; and (4) future growth and development
- Change of vulnerability as compared to that presented in the 2015 Wyoming County HMP
- Further data collections that will increase understanding of this hazard over time.

Overview of Vulnerability

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. For natural groundwater contamination, all of Wyoming County has been identified as the hazard area. Therefore, all assets, particularly the county's population, as described in the County Profile section, are vulnerable to this hazard.

Data and Methodology

Data were collected from Wyoming County and the Planning Partnership.

Impacts on Life, Health, and Safety

In general, private well owners/users are more vulnerable to natural groundwater contamination. USEPA regulates public water system and sets standards for contaminants in drinking water that may pose health risks. However, USEPA does not have the authority to regulate private drinking water wells. Private well water quality testing and water treatment is the responsibility of the well owner. In general, private well water quality is not tested as frequently as required by public water suppliers. Additionally, areas that rely on private wells for drinking water often use septic systems for sanitary wastewater disposal, which may be another source of contamination.

In areas that lack public water supply, the Wyoming County Water Resource Agency (WCWRA) operates a comprehensive water quality testing program. The program provides a comprehensive water quality analysis and recommendations if necessary. If the monitoring discovers significant water quality problems that may affect other nearby wells, a survey is conducted by testing adjacent wells (Wyoming County 2020). Proper water testing, well construction, and continued maintenance are keys to the safety of private water supply.

People who consume contaminated water (either contaminated groundwater or HAB-contaminated water bodies) may, immediately or over time, suffer from a variety of health problems depending upon the type of contamination. Depending upon the contaminant of concern, infants, young children, and individuals with compromised immune systems may be more susceptible to illnesses from contaminated groundwater. It is difficult to measure and quantify the health costs that might be incurred due to natural groundwater contamination.

Impacts on General Building Stock

No structures are anticipated to be directly affected by water supply contamination.

Impacts on Critical Facilities

No structures are anticipated to be directly affected by water supply contamination.

Future Growth and Development that May Impact Vulnerability

Understanding future changes that impact vulnerability in the county can assist in planning for future development and ensuring that appropriate mitigation, planning, and preparedness measures are in place. The county considered the following factors to examine potential conditions that may affect hazard vulnerability:

- Potential or projected development
- Projected changes in population
- Other identified conditions as relevant and appropriate, including the impacts of climate change

As discussed in the County Profile section of this HMP, areas targeted for future growth and development have been identified across Wyoming County. Any areas of growth could be impacted by the water supply contamination hazard because the entire county is exposed and vulnerable. Specific areas of development are indicated in tabular form and/or on the hazard maps included in the jurisdictional annexes in Volume II of this plan.

Any growth can create changes in density throughout the county, which can have an impact on the concentration of groundwater contamination sources. These sources include household lawns, household hazardous products, sewer lines, swimming pools, septic systems, and fuel oils (EPA 2015). Refer to Section 4 (County Profile), which includes a discussion on population trends for the County.

Groundwater contamination's impact on the future growth and development and estimated dollar losses are difficult to measure. Where groundwater becomes polluted, property values can drop, and land may become unsellable. The price to remediate contaminated groundwater can be high, and tax-payers may be burdened with this cost. Clean-up costs depend on many factors, including the type of contaminant, its concentrations and extent. In many cases, the full cost of remediation is not realized, even after years have passed. Industries that rely on water for business may also be impacted (e.g., agriculture).

Additional Data and Next Steps

For future plan updates, Wyoming County can track data on water supply contamination events and obtain additional information on past and future events, particularly in terms of any illnesses, deaths, shelter needs, and other impacts. These data will help to identify any concerns or trends for which mitigation measures should be developed or refined.