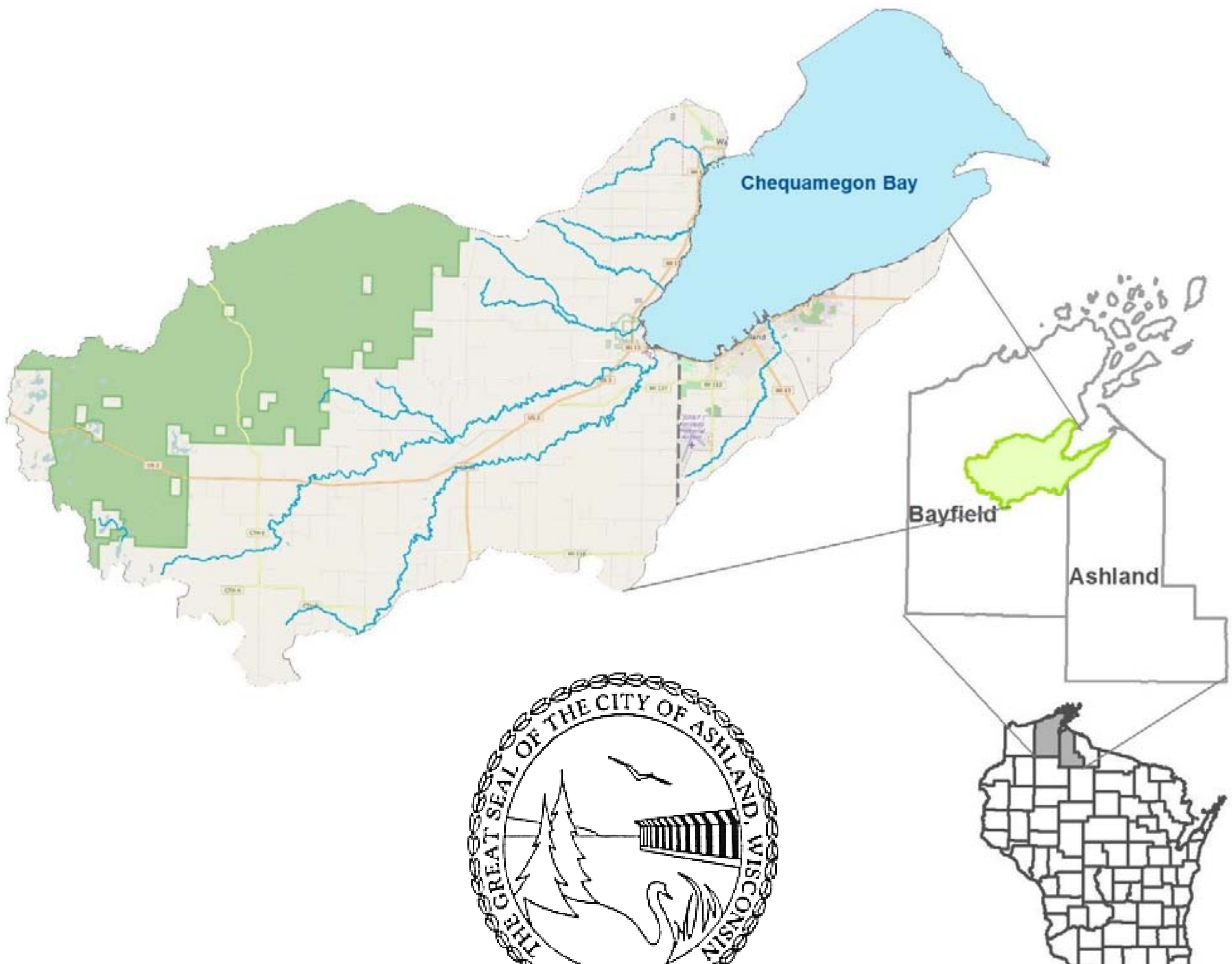
CITY OF ASHLAND
SOURCE WATER PROTECTION PLAN

August, 2021



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Additional Assistance from Wisconsin Department of Natural Resources

Acknowledgments

The Ashland City Council initiated the development of the source water protection committee in March, 2016. The committee consists of city staff and council members, Ashland and Bayfield County supervisors, Bad River Tribe and watershed association representatives, Northland College staff, and state Department of Natural Resources staff. Additional assistance was received from Wisconsin Rural Water Association, county and federal agency staff, and interested local citizens. Collaboration and input from these individuals has made this project possible. Thank you for the many hours spent working on the project, with particular recognition towards those who volunteered their time to help develop sections of the plan for which they have local knowledge of the issues.

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- Kevin Brewster–Superior Rivers Watershed Association–Advisory Role
- John Butler–Public Works Director
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- Mary Dougherty–Chair, Bayfield County Board of Supervisors
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1. INTRODUCTION

Source water is untreated water from streams, rivers, lakes, and groundwater aquifers. Source water protection is a watershed based approach to protecting drinking water sources and reducing treatment costs. A watershed is not limited to political boundaries such as township, county or state. Instead, it is simply an area of land that drains to a common point. Although we often manage land according to political boundaries, it makes more sense to plan and manage areas by the lay of the land, and all people living within a watershed play an important role in protecting their water.

Affordable, safe drinking water is essential to the health, development and stability of all communities. Treatment is used to maintain safe drinking water for surface water systems; however, the cost and quality of treated drinking water is a function of the pretreatment water quality. One of the best ways to ensure safe drinking water and reduce treatment costs is to develop a local source water protection program designed to protect the source of drinking water against potential contamination.

Source Water Protection (SWP) is the first line of defense in a multi-barrier approach to assure the availability and reduce the cost of clean safe drinking water. It focuses on protecting and improving water quality at the origin before reaching the drinking water intake and undergoing treatment. SWP is accomplished using four main steps: assessment, planning, implementation, and long-term management. For the City of Ashland, the first step, "assessment," was completed in March 2003 by the Wisconsin Department of Natural Resources (WDNR) and documented in the report *Source Water Assessment For Ashland Water Utility, Ashland, Wisconsin March 27, 2003* (A copy of Ashland's source water assessment is available by contacting the WDNR or the City of Ashland). The source water assessment for Ashland suggests that the next steps in protecting their drinking water is for the city to develop a SWP program by forming a SWP committee to plan and implement best management practices in the source water area. This source water protection program is intended to put in place the remaining steps of planning, implementation, and long term management of the city's source water.

In February 2016, due to an increase in public awareness about water quality concerns, city employees compiled a list of potential source water protection committee members who could collaboratively develop a SWP plan for the City of Ashland. In March 2016, the City Council voted to approve the formation of a SWP committee and development of the SWP plan. The city contacted the Wisconsin Rural Water Association (WRWA) for assistance with facilitating the SWP plan writing process. WRWA is a non-profit association of utilities that provides technical assistance to utilities. Ashland is a long time member of WRWA. SWP planning efforts began with an initial meeting of the SWP committee in August 2016. The committee started to develop the SWP plan and conducted several additional meetings throughout 2016 and 2017. Due to staff turnover at the city, the plan stalled before being completed. In early 2020, with new city staff in place and a refreshed SWP committee, the SWP planning efforts were renewed and the SWP plan was completed.

1.1 Integration With City Of Ashland Planning (Comprehensive Plan And Strategic Plan)

Integration of the Ashland Source Water Protection Plan with the City of Ashland is done two ways: through city operations and through ordinances. Two city council members and several city staff members sit on the SWP committee. These individuals are tasked with implementing the plan by revising and updating the city's operating procedures and developing ordinances that improve and protect water quality in the Chequamegon Bay and the tributaries leading to it.

1.2 Integration With Ashland And Bayfield Counties (Including Resource Management Plan)

Ashland and Bayfield Counties have Land & Water Resource Management (LWRM) Plans. Plans are approved for a 10-year term and work plans are updated every 5 years. LWRM plans address natural resource conservation and protection including surface water, groundwater, soils, forests, agriculture, and wildlife habitat. While these planning efforts are related, the Ashland Source Water Protection Plan takes a more focused look at surface water quality in Chequamegon Bay.

In Chapter VIII of the Ashland County plan, coordination with the City of Ashland is specifically listed. This includes the goal "Increase collaboration on Lake Superior waterfront issues, stormwater management, invasive species, and beach health." The Bayfield County plan lists the City of Washburn and the City of Bayfield as implementation partners. The City of Ashland should look for commonalities in the Ashland and Bayfield Counties' Land and Water Resource Management Plans and look for opportunities to participate in the regular planning cycle.

1.3 Integration With Other Planning Efforts (Tribal Governments And Entities And Non-Governmental Organizations)

Tribal government entities in the area include the Bad River Band of Lake Superior Chippewa, Red Cliff Band of Lake Superior Chippewa, and the Great Lakes Indian Fish and Wildlife Commission. Prominent non-governmental organizations in the area include the Superior Rivers Watershed Association, Chequamegon Bay Area Partnership, Mary Griggs Burke Center for Freshwater Innovation at Northland College, and others. The Ashland city staff and SWP committee members should seek opportunities to coordinate these tribal and non-governmental organizations to improve and protect water quality in the Chequamegon Bay and coordinate source water protection in planning efforts.

2. BACKGROUND

Source water refers to water from streams, rivers, lakes, or underground aquifers that provide water to an end user such as a municipal water supplier providing domestic drinking water. The City of Ashland is located in Northwest Wisconsin along the southern shore of Lake Superior, and the city water utility relies solely upon water from Lake Superior's Chequamegon Bay to provide drinking water to residents.

The first work done to protect Ashland's source of drinking water was the WDNR's Source Water Assessment completed in 2003. The Source Water Assessment delineated the *Source Water Area* for Ashland's municipal water intake. The source water area is defined as the area that contributes water to the public drinking water system. For Ashland that includes land drained by Bono Creek, Boyd Creek, Fish Creek, Bay City Creek, and multiple unnamed tributaries to Chequamegon Bay. Clay soils predominate throughout the watershed, which exacerbate erosion and runoff problems. Land cover consists of many naturally vegetated areas with some agriculture and urbanized land in the cities of Ashland and Washburn.

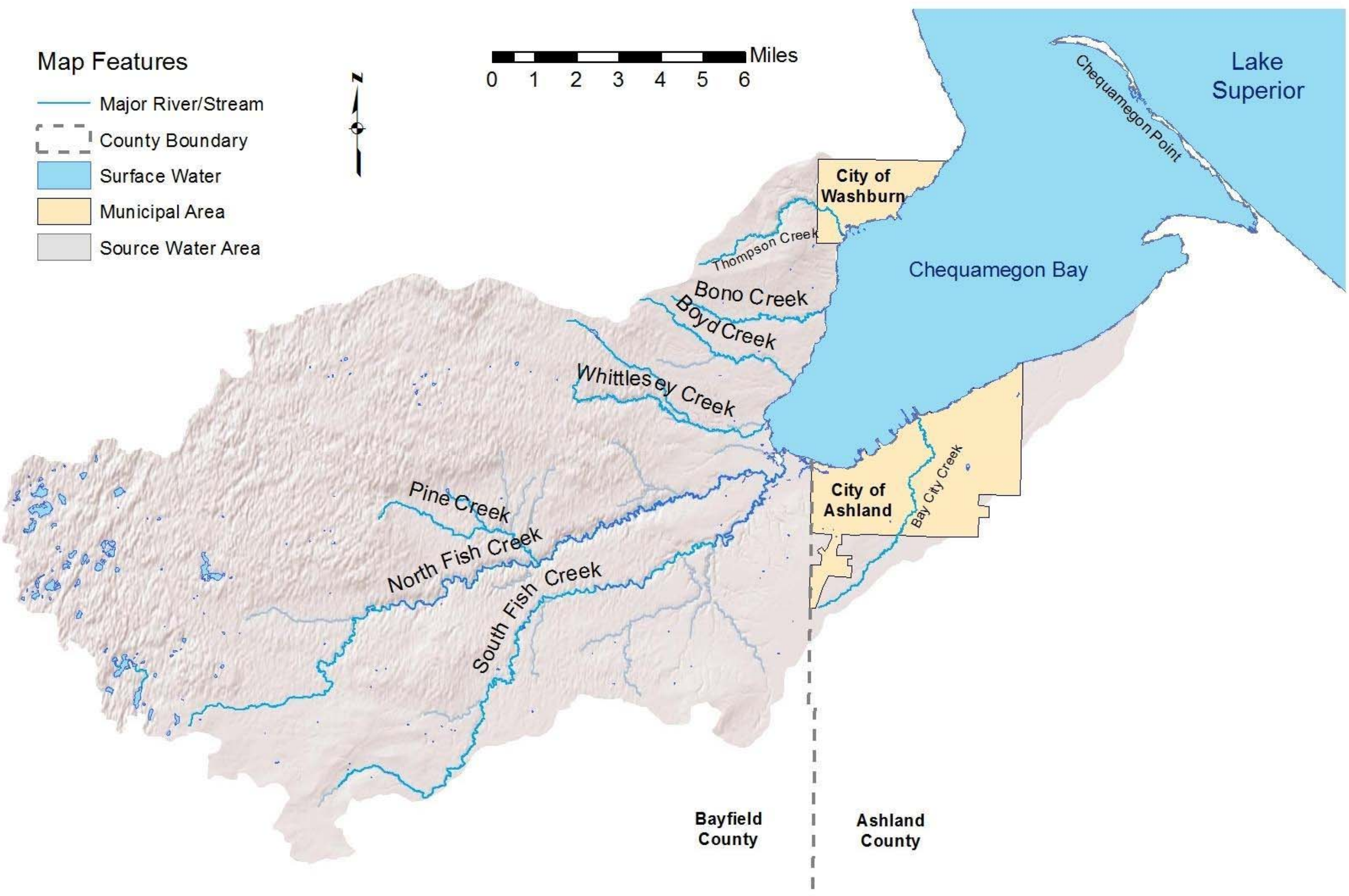


Figure 1: Watershed Overview

2.1 Source Water Assessment Overview

A source water assessment provides not only an understanding of current conditions but also serves as a predictive tool for management and protection efforts. This information can be used as a basis for voluntary, community-based barriers to drinking water contamination.

The 1996 amendments to the Safe Drinking Water Act required that states complete source water assessments for all public drinking water systems. The primary purpose of these assessments was to determine the relative susceptibility of each community's source water to contamination. Susceptibility is defined as the likelihood that a contaminant of concern will enter a public water supply at a level that may result in adversely impacting human health.

The source water assessment for the Ashland Water Utility was completed by the WI DNR in 2003. It states that, as with most surface water systems, "Ashland's source water is impacted by the source water area and highly susceptible to contamination". The assessment identifies the confined nature of the Chequamegon Bay, erodible soils, and land use as the biggest factors affecting source water susceptibility. It concludes that contaminants of particular concern to Ashland's source water include microbial, volatile organic, and synthetic organic contaminants as well as precursors of treatment by-products. It suggests that SWP efforts should focus on preventing contamination from agriculture and pasture land draining into Bono, Boyd, and Fish Creeks, urban development in the city of Ashland, and sites of historic contamination. The primary recommendation of the source water assessment is for the City of Ashland to develop a local source water protection program designed to protect Ashland's drinking water source from potential contamination. A copy of Ashland's source water assessment can be obtained by contacting the WDNR.
https://dnr.wisconsin.gov/topic/DrinkingWater/SWAP.html.

2.2 Source Water Protection Overview

Source water protection is the next step beyond the source water assessment. Source water protection begins when the local community decides to develop a program designed to protect the drinking water sources from potential contamination. A source water protection committee must be formed to plan and implement best management practices to prevent contamination. It is the first line of defense to reduce the chance that contamination will reach the end user. Additionally, SWP reduces potential health risks and minimizes the costs of treating drinking water. SWP consists of the following steps:

- **Delineate the source water protection area**: The source water protection area was delineated in the 2003 source water assessment and is described in section 3.1. This plan includes an additional "secondary" source water protection area, which is described in section 3.2.
- **Inventory known and potential source of contamination and determine susceptibility to contaminant source within the SWP area**: In order to protect the source water, it is necessary to know what potential sources of contamination threaten the water. Potential contaminant sources are evaluated in Sections 4 & 5.
- **Implement management measures to prevent, reduce, or eliminate risks to the source water**: The key to a successful plan is creating meaningful action. The implementation measures laid out in section 7 are designed to protect the drinking water source for the City of Ashland.
- **Develop contingency planning strategies that address water supply contamination or service interruption emergencies**: In the event of a contamination event or emergency, section 8

outlines what actions need to be taken and lays out communication procedures. Preparing for emergencies is a critical part of any drinking water protection program.

Protecting source water is everyone's responsibility. Some key contributors include federal, state, and local government entities, water and wastewater utilities, business and industry, non-governmental organizations, and individuals. More information about SWP can be found at the following Wisconsin DNR and EPA websites.
http://dnr.wi.gov/topic/drinkingwater/sourcewaterprotection.html
https://www.epa.gov/sourcewaterprotection/source-water-protection-basics

2.3 City Of Ashland Water System Overview

The Ashland Water Utility pumps an average of around 500,000 gallons of water per day and serves more than 9,115 people through more than 3,000 service connections. Raw water is collected from the Chequamegon Bay by a 24-inch diameter pipeline and single raw water intake, which extends approximately one half mile into the bay. Gravity feeds water through the intake pipe into the collection chamber. From there it is pumped to the microfiltration building on the east shore of the bay off Water Street.

The microfiltration building was constructed in 2001. Filtration starts with a 500-micron strainer to remove any large debris. Next, water flows through four membrane microfiltration units which remove particles as small as 0.2 microns in size. After filtration, finished water is treated with chlorine for disinfection and fluoride for dental health. Treated water flows to a ground storage reservoir which allows for sufficient contact time with the chlorine to completely disinfect the water. Additional treatment consists of adding small doses of Polyphosphate and Sodium Hydroxide. These chemicals have been successful at reducing the amount of lead that leaches into water if a home still has lead pipes.

From the ground reservoir, three high-lift service pumps, capable of pumping 840 gallons per minute each, discharge to the distribution system. The system contains 54 miles of main pipe that ranges from one inch to twenty-four inches in diameter. Storage for the water system is provided by a 1.4 million gallon standpipe and a half-million gallon elevated water tower. All facilities are continuously monitored by computer through a telemetry system and physically checked daily for proper operation.

3. HYDROGEOLOGIC SETTING

Lake Superior is the largest freshwater lake in the world by surface area and the third-largest by volume. It has 1,826 miles of shoreline and covers 31,700 square miles with a maximum depth of 1,332 feet. The lake's watershed drains approximately 49,300 square miles of land.

Chequamegon Bay is a shallow, sandy bay relatively isolated from Lake Superior by the Bayfield Peninsula to the northwest and Chequamegon Point to the northeast. The bay is connected to Lake Superior by a 2 mile stretch of open water between the tip of Chequamegon Point and Houghton Point on the Bayfield Peninsula. The Chequamegon Bay area watershed is a compilation of several watersheds that flow toward Lake Superior. The Chequamegon Bay watershed includes nearly 1,500 square miles of land in Ashland, Bayfield, and Iron counties. It contains more than 2,100 linear miles of tributaries that originate near the watershed divide created by the Penokee Range to the south and flow north towards Chequamegon Bay and Lake Superior.

The Superior region contains portions of two distinct geologic provinces: the Lake Superior Lowland along the lakeshore and the higher elevations of the Northern Highlands to the south. The geography of the region was shaped by glaciers that covered the area more than 20,000 years ago during the later portion of the most recent glacial period. The Northern Highlands consist of the sandy till of the Copper Falls Formation deposited by glacial meltwater. The sandy, coarse-grained till allows much precipitation and snowmelt to infiltrate and supports less surface runoff to streams. As the glaciers retreated to the north, they deposited till with much more silt and clay known as the Miller Creek Formation. The fine-grained, low permeability in these areas supports high surface runoff to streams (Clayton, 1984; Gotkowitz and Li, 2016). The old beach shoreline of Glacial Lake Duluth is composed of sand layers on top of clay layers as well as interwoven sand and clay layers. These transitional soils are highly susceptible to erosion, especially when undercut by water (Fitzpatrick et al., 1999). Surface runoff in the Fish Creek and Whittlesey Creek watersheds give the Chequamegon Bay a prominent cloudy red appearance during high runoff events such as during spring snowmelt and after heavy rains.

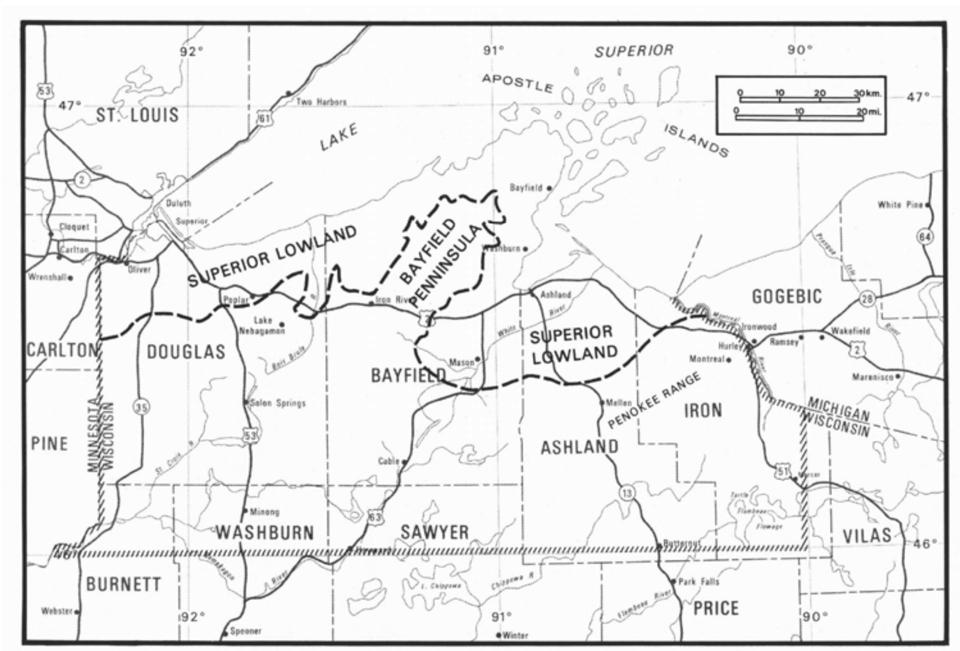


Figure 2: Superior Region (Clayton, 1984)

While the entire Chequamegon Bay area watershed and other factors such as lake-wide episodic events can affect water quality in the bay, implementing SWP in the entire Lake Superior Watershed is not practical. To protect and improve water quality at a more manageable scale, Ashland's source water area was delineated to include the local watersheds that discharge near Ashland's intake and have the most direct impact on water quality in Chequamegon Bay. The Source Water Protection (SWP) area for Ashland is divided into Primary and Secondary SWP areas which are described below.

3.1 Primary Source Water Protection (SWP) Area

The Primary SWP area is the land that contributes a majority of the surface water flowing into the Chequamegon Bay and most directly affects source water quality due to proximity. It covers more than

200 square miles and includes land drained by Bono Creek, Boyd Creek, Fish Creek, Bay City Creek and multiple unnamed tributaries to Chequamegon Bay. Ashland's source water is most directly affected by runoff from the Fish Creek 10 digit Hydraulic Unit Code (HUC 10) watershed and the Whittlesey Creek HUC 12 watershed. The primary SWP area is the main focus of this report and the efforts of the Ashland SWP program. The primary SWP area is mapped along with the secondary SWP area in Figure 3.

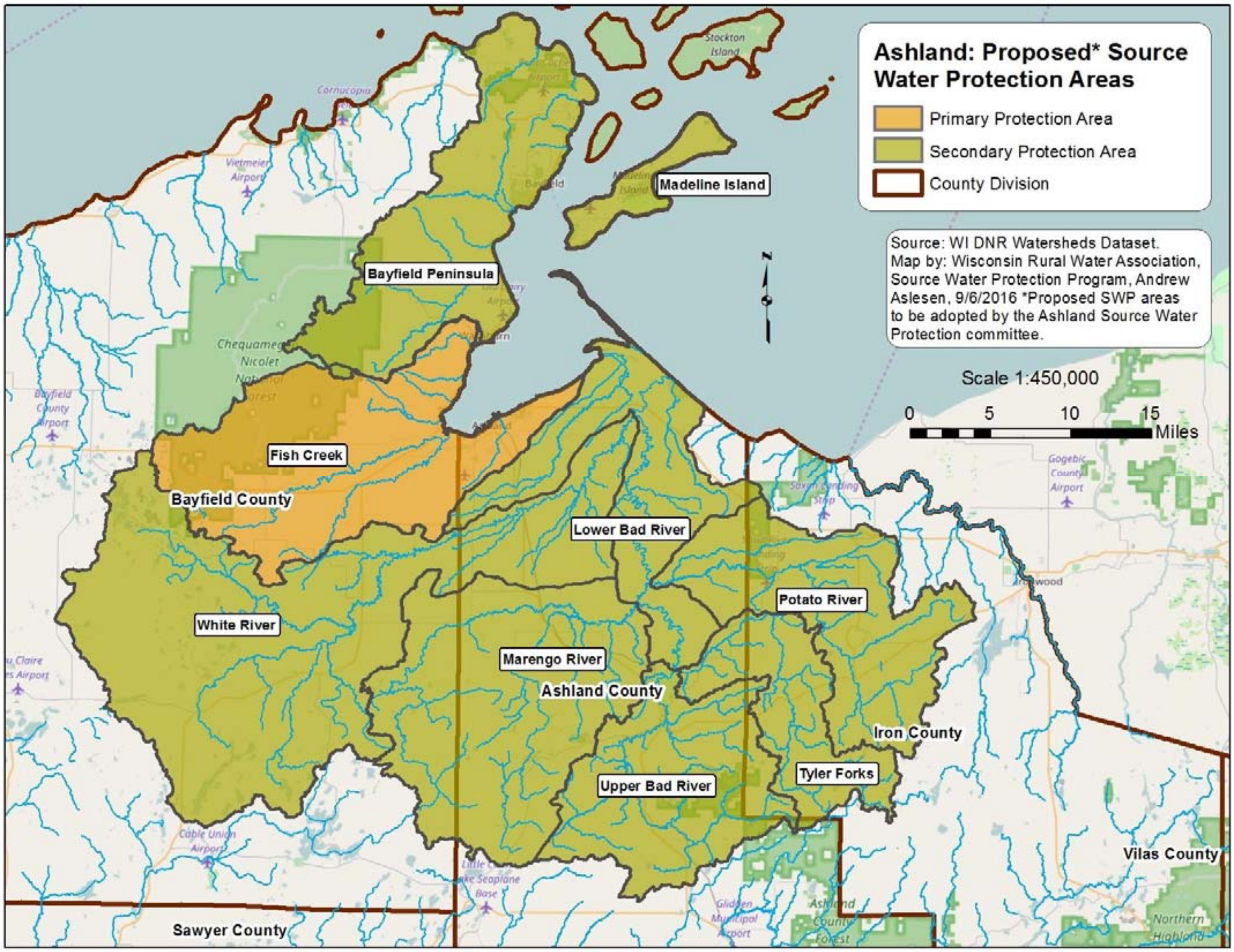


Figure 3: Ashland Source Water Protection Area

3.2 Secondary Source Water Protection (SWP) Area

The Secondary SWP area includes adjoining subwatersheds outside of the primary SWP area that contribute less directly to the surface flow and water quality of Chequamegon Bay and Ashland's source water quality. The area is much larger than the primary SWP area and includes the following HUC 10 Watersheds: Bayfield Peninsula, Beartrap Creek, Lower Bad River, Marengo River, Potato River, Tyler Forks, Upper Bad River, and White River. Due to the large size of the secondary SWP area, Ashland's SWP program does not directly address issues and implementation measures in the secondary SWP area; however, it is important to acknowledge that these surrounding watersheds do have some impact on Ashland's source water quality, particularly when certain variables such as wind direction or circulation patterns in the bay are just right.

The Source Water Protection Committee includes representatives from primary and secondary SWP areas and recognizes the importance of working with all local units of government, tribes, organizations, and individuals in implementation of the Source Water Protection Program in both the primary and secondary SWP areas.

3.3 Impaired Waters List

Every two years, Section 303(d) of the Clean Water Act requires states to publish a list of all waters that do not meet water quality standards known as the Impaired Waters List. As of 2020, the water bodies in the primary SWP area listed as impaired are South Fish Creek, an unnamed tributary to South Fish Creek, Bay City Creek, and Maslowski Beach. Bayview Park Beach was listed previously but has been removed. The streams are impaired because of total phosphorus from rural and/or urban nonpoint source runoff. Maslowski Beach is impaired for E. coli. Additionally, Lake Superior is listed as impaired for PCBs and Mercury. Below is a table and a map of the listed impaired waters in the primary source water protection area. https://dnr.wisconsin.gov/topic/SurfaceWater/ConditionLists.html

County	Local Waterbody	Water Type	Waterbody Condition	Date Listed	Source Category	Pollutant	Impairment	Listings Status	TMDL Priority	Listing Condition
Ashland	Bay City Creek	RIVER	Category 5A	4/1/2016	PS/NPS	Total Phosphorus	Degraded Biological Community	303d Listed	Low	TMDL Needed (5A)
Ashland	Chequamegon Bay (Ashland Coal Tar Site)	BAY/HARBOR	Category 5A	4/1/1998	Contam. Sed.	PAHs	Chronic Aquatic Toxicity, PAHs	303d Listed	Low	TMDL Needed (5A)
Ashland	Maslowski Beach, Lake Superior	GREAT LAKES BEACH	Category 5A	4/1/2016	PS/NPS	E. coli	Recreational Restrictions - Pathogens	303d Listed	Low	TMDL Needed (5A)
Bayfield	South Fish Creek	RIVER	Category 5P	4/1/2016	PS/NPS	Total Phosphorus	Impairment Unknown	303d Listed	Low	Phosphorus Listed (5P)
Bayfield	Unnamed Trib to S Fish Creek	RIVER	Category 5P	4/1/2016	PS/NPS	Total Phosphorus	Impairment Unknown	303d Listed	Low	Phosphorus Listed (5P)

Table 1: Impaired Waters 2020

CATEGORY 5 (IMPAIRED WATERS) SUBCATEGORIES

Sub-category	Description	Key Defining Factor
5A	Available information indicates that at least one designated use is not met or is threatened, and/or the anti-degradation policy is not supported, and one or more TMDLs are still needed. This is the default category for impaired waters.	TMDL needed. Default subcategory.
5B	Available information indicates that atmospheric deposition of mercury has caused the impairment and no other sources have been identified.	Mercury only.
5C	Available information indicates that non-attainment of water quality standards may be caused by naturally occurring or irreversible human-induced conditions.	Natural or irreversible conditions.
5P	Available information indicates that the applicable total phosphorus criteria are exceeded; however, biological impairment has not been demonstrated (either because bioassessment shows no impairment or because data are not available).	Phosphorus only.
5W	Pollutant/impairment a low priority for a TMDL because the impaired water is included in a watershed area addressed by at least one of the following WDNR-approved watershed plans: adaptive management plan, adaptive management pilot project, lake management plan, or Clean Water Act Section 319-funded watershed plan (i.e., nine key elements plan).	Alternative cleanup plan.

Table 2: Breakdown Of Impaired Waters Subcategories

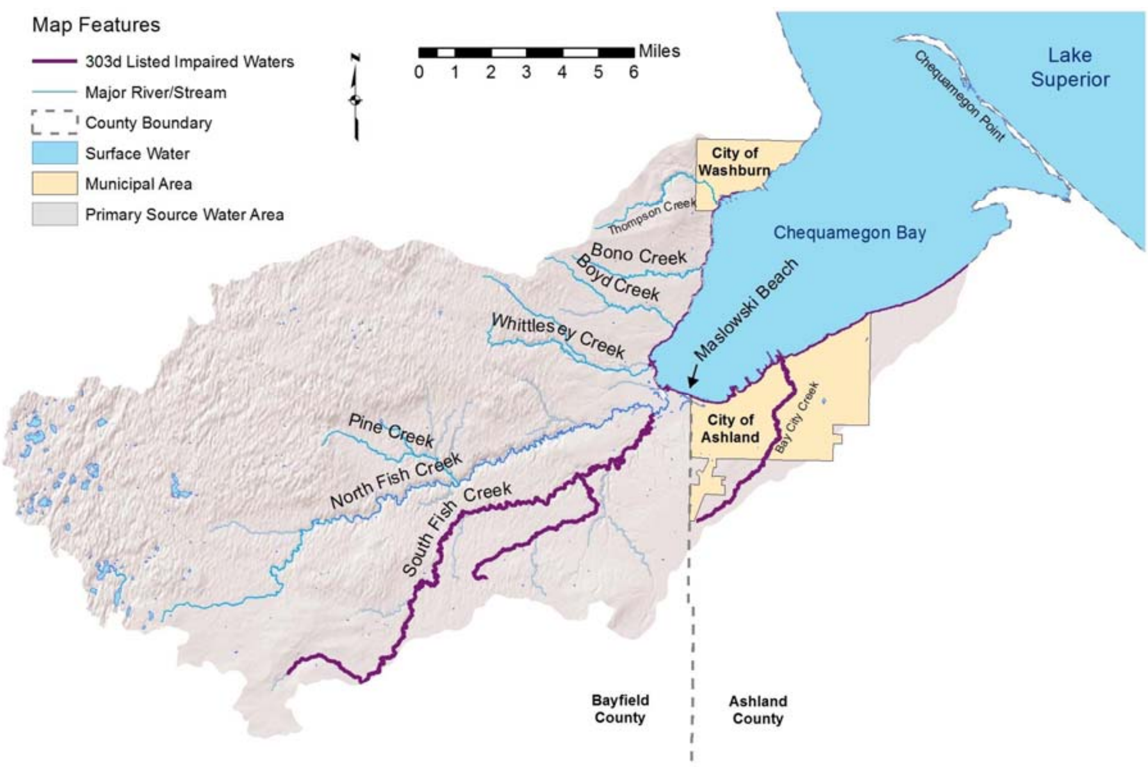


Figure 4: Map Of Listed Impaired Waters

4. WATER SYSTEM SUSCEPTIBILITY ASSESSMENT

Surface water quality can change rapidly and is affected by various things such as weather and human inputs. Ashland's water system is susceptible to changes in a variety of different water quality parameters. The major parameters of concern are discussed below and include things such as sediment load, harmful algal blooms, and chemical compounds. Additionally, a major risk to the water system is the loss of the single water intake used to draw raw water into the filter plant. The addition of a second "redundant" intake would greatly reduce this risk.

4.1 Susceptibility To Elevated Turbidity From Excess Sediment Load

Turbidity is a measure of the cloudiness of water due to the presence of suspended particles. When storm events flush large amounts of sediment into the Chequamegon Bay, turbidity increases, which has several impacts on the city's water system. Turbidity is treated by the water system using coagulation and filtration. Elevated turbidity comes from suspended solid particles which have a negative surface charge and thus repel one another. This keeps them small in size and makes it easier for them to stay in suspension. The first step in treating turbidity in water is the addition of a coagulant solution. The coagulant solution is a chemical with a positive charge that neutralizes the particles, allowing them to clump together, or "coagulate", and thus be removed by the filters. The high percentage of fine clay particles in the soils surrounding Ashland makes the addition of the coagulation solution particularly important for the city's treatment system. When turbidity in the bay increases, coagulant solution usage increases as well.

The filters used to remove suspended particles are cleaned in place (CIP) by backwashing at regular intervals. The plant design interval for backwash cleaning is once per week using only water and the 4th week of every month using water with the addition of heat, chlorine, and two types of acid. The backwash solution from the 4th cleaning needs to be disposed of into the sanitary system which increases the load to the wastewater treatment plant. The filters have a design life of 10 years. An increased suspended sediment load causes the backwash cycle frequency to increase. This results in increased energy use, water use, and backwash water load, all of which increase cost. Additionally, the City of Ashland has found a reduced filter lifespan from the projected 10-year lifespan to and average of around 7 years. With a replacement cost of $415K, the filter replacement capital cost is increased from $42K/year for a 10-year lifespan to $59K/year for a 7-year lifespan (an increase of $17K/year). These costs are inevitably passed on to every rate payer utilizing the water utility.

Another impact of increased turbidity is an increase in the use of chlorine, which can lead to the development of disinfection byproducts. As turbidity increases, some of the solids causing the turbidity are composed of dissolved organic material. While the city's filtration system is effective at removing turbidity, some dissolved organic materials remain in the finished water. This means that an increase in the turbidity of raw water leads to an increase in organic matter in finished water pumped to the system. The city utilizes chlorine for disinfection of finished water. When chlorine is added to water, it is consumed by any organic matter found in the water over time. The DNR requires the water utility to maintain a detectable level of disinfectant (chlorine) throughout the distribution system to maintain bacteriological protection. This is known as a "chlorine residual". Since some of the chlorine is being consumed by organic matter as it flows through the distribution system, an increase in organic matter means the utility has to add more chlorine at the point of treatment to maintain an appropriate chlorine residual. As the chlorine is consumed, the reaction creates byproducts known as “disinfection byproducts” DBPs. DBPs are known to be carcinogenic and are regulated by the DNR. As turbidity levels in raw water increase, maintaining safe levels of disinfection byproducts becomes more challenging.

4.2 Susceptibility To Harmful Algal Blooms

Freshwater harmful Algal blooms (HABs) are a growing concern in the United States. Cyanobacteria, sometimes referred to as blue-green algae, are found naturally in surface water and can be capable of producing cyanotoxins that pose a health risk to humans as well as creating taste and odor problems in drinking water. When toxins are produced, the algal bloom is considered “harmful”. For further information on the processes that drive HABs and local conditions in the Chequamegon Bay see section 5.5.2 below.

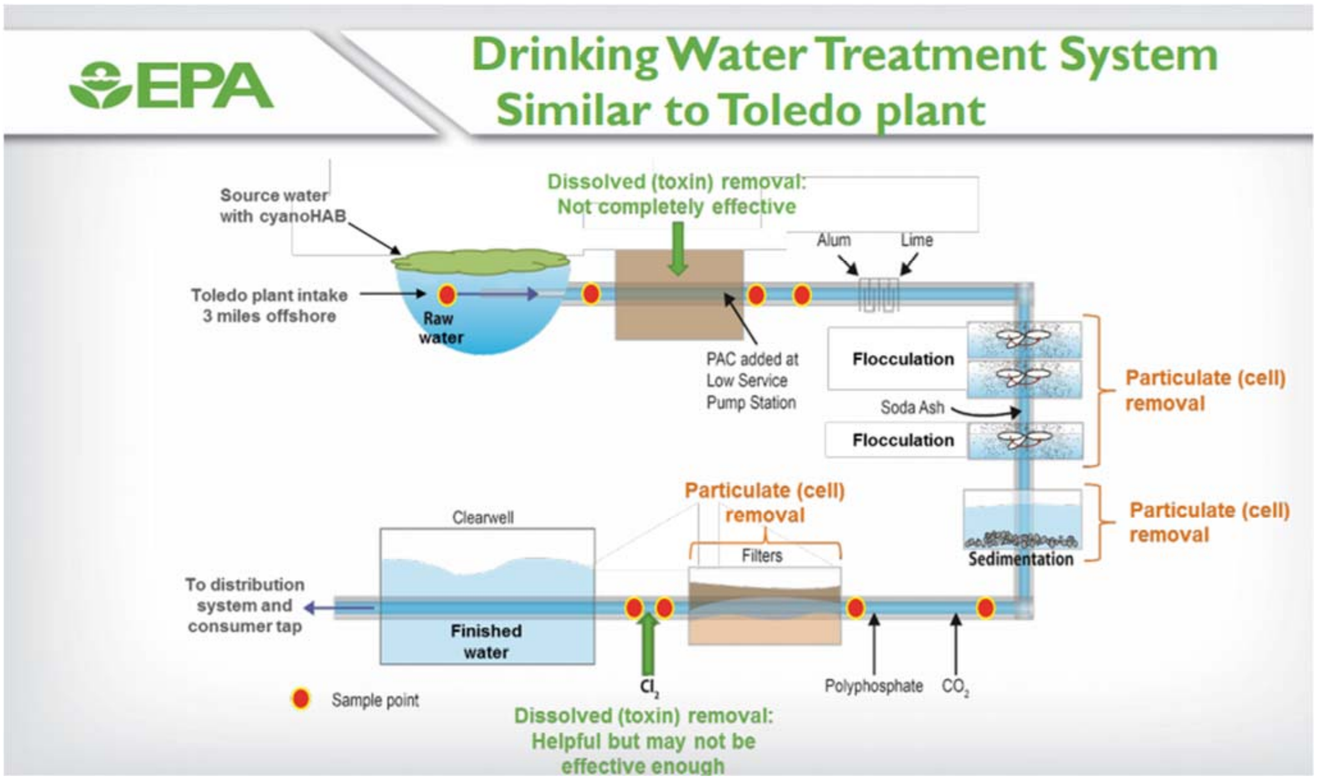
HABs can produce over 80 known toxins that can affect the liver, nervous system, and/or skin, but data are insufficient for many of the toxins. The U.S. EPA and the World Health Organization have developed guidelines for some HAB toxins, and drinking water health advisories have been established for two of the toxins: microcystins and cylindrospermopsin. However, there are no federal regulations under the Clean Water Act or enforceable standards under the Safe Drinking Water Act. Under the EPA’s Fourth Unregulated Contaminant Monitoring Rule, water utilities serving greater than 10,000 customers and 800 randomly selected smaller utilities were required to monitor for 30 chemical contaminants in finished water including 10 cyanotoxins from 2018-2020. This list identifies contaminants that may require regulation under the Safe Drinking Water Act. As of January 2020, about 20,283 microcystin samples were taken through this program, and only 6 samples exceeded the advisory standards for small children, and 0 samples exceeded the advisory levels for adults. Cylindrospermopsin had 11 instances of advisory exceedance. This shows the risk of cyanotoxins being found in finished water is low, but the cyanobacteria situation is constantly evolving, so it is important to continue to monitor the situation.

When HABs occur in a drinking water source, the financial burden of water treatment increases. In 2014, an algal bloom on Lake Erie caused toxins in Toledo’s drinking water to spike to unsafe levels, causing the city to prohibit tap water usage for drinking, cooking, and bathing for 2 days. At low to moderate levels, Ashland’s drinking water microfiltration is capable of removing bloom materials, and chlorination is effective at treating toxins such as microcystins. There is potential for more significant incidents, particularly following storms, to require the plant to go beyond normal standard operating procedures. If this were to happen and the treatment system was to be overwhelmed, the city would be facing a similar scenario to Toledo.

Figure 5: Breakdown Of How Cyanobacteria Can Potentially Enter The Water Distribution System

4.3 Susceptibility To Chemical Compounds

Chemical compounds in relation to drinking water systems are divided into three primary categories: Inorganic Chemicals (IOCs), Synthetic Organic Compounds (SOCs), and Volatile Organic Compounds



(VOCs). Concentrations of these chemicals are regulated in drinking water under the Safe Drinking Water Act which sets Maximum Contaminant Levels (MCLs) for a variety of chemicals known to be harmful if consumed. Surface water systems are required to sample for these chemicals annually. The MCLs for these chemicals can be found in the National Primary Drinking Water Regulations 40 CFR § 141.11.

IOCs

IOCs are elements or compounds that may be naturally found in the environment or geology, or caused by human activities such as mining, industry or agriculture. Regulated IOCs typically include metals, fluoride, and nitrate.

SOCs

SOCs are man-made, carbon-based compounds used for a variety of industrial and agricultural purposes. This group of compounds includes pesticides, polychlorinated biphenyls (PCBs) and dioxin. Pesticides are used in agricultural operations and reach surface water through runoff. PCBs were widely used in the US for hundreds of industrial and commercial applications from 1929 to 1979 and reach surface water discharge from spills or industrial discharge. Dioxin refers to a group of toxic chemical compounds that share certain chemical structures and biological characteristics. Dioxin is not produced or used commercially in the US, but it is formed during the production of some chlorinated organic compounds, including some herbicides. The EPA and industry have been working to dramatically reduce the production of dioxin and its release to the environment, and environmental levels of dioxins have decreased in the last 30 years (EPA, 2021).

VOCs

VOCs are man made compounds used for fuel additives and a variety of industrial and manufacturing purposes. Fuel components are chemicals found in gasoline, kerosene, and heating oil as octane boosters or oxygenators. Common fuel components are benzene, MTBE, toluene, and xylenes. Chlorinated solvents are widely used in industry and common household products. They are used to make degreasing fluids, solvents, dry-cleaning chemicals, and in plastics manufacturing. VOCs tend to evaporate quickly, so they are not often found in surface water such as lakes or rivers.

Potential sources of chemical compounds within Ashland's source water protection area include petroleum pipelines, gas stations, manufacturing operations, and transportation. Known historic sources of chemical contamination have been or are being cleaned up under the supervision of the DNR or EPA. Given the distance of current potential sources of chemical compounds from the city's intake and the percentage of the watershed that it undeveloped, the susceptibility of the city's water supply to chemical compounds is considered low. In the unlikely event that chemical compounds do reach Ashland's intake, the water filtration system would not be equipped to handle them since it relies on physical treatment processes (settlement and filtration). Additional treatment such as granulated activated carbon filtration or air stripping would be required to remove chemical compounds.

4.4 Susceptibility To Water Intake Loss (Lack Of Redundant Water Intake)

The city's water system is served by a single water intake that is more than 100 years old. In the event of an intake failure or other issue preventing the intake from being used, the city would be without water until the issue could be fixed. One condition that has been observed during the winter months, which could potentially be an issue is frazil ice formation on the intake. Frazil ice consists of loose, randomly oriented, needle-like ice crystals that do not float like solid ice. They can adhere to objects in the water, like intake structures, and quickly multiply. The buildup can restrict or fully block water flow to the intake. Frazil ice typically forms in open, calm water on clear nights when the water and air temperatures plunge to very cold levels. During the winter months the utility must monitor water temperatures and watch for frazil ice formation.

5. WATERSHED ASSESSMENT

The focus of the Watershed Assessment portion of the Source Water Protection Plan is to provide an overview of the causes and sources of pollution that can negatively impact water quality in the

Chequamegon Bay and the municipal water supply. This includes naturally occurring pollution sources as well as human caused pollution sources in both rural and urban areas.

5.1 Historic Sources Of Pollution

A legacy of environmentally harmful industrial pollutants persists today at several sites in the source water protection area. These known sites are being managed for the purpose of mitigating environmental contaminants. The sites along with their potential effects on the city's source water are outlined below.

5.1.1 Ashland/Xcel/Northern States Power Lakefront Gas Plant, Marina Lagoon (Superfund Remediation Site), City Of Ashland

Over a period of approximately 145 years (1845-1989), a portion of the Ashland waterfront between Ellis Avenue and 7th Avenue East was the site of various industrial activities. Those activities included a manufactured gas plant (used to heat and light homes), a lumber mill, railroad car facilities, a municipal landfill, and a community wastewater treatment plant.

Soil and groundwater contamination was detected in 1989. Specific contaminants include tar, oil, and other waste consisting of polyaromatic hydrocarbons (PAHs), volatile organic compounds (VOCs), and metals. Identified contamination extends to the site of the gas plant landward and 10 acres of lakebed on Chequamegon Bay. Site investigations and remediation work were ongoing from 1994 to 2020, and a long-term water monitoring system continues to treat water at the site (Kaeding, 2020).

Removal of contaminated soils at the site of the gas plant and nearby Kreher Park was completed in 2016, and wet dredging clean up was completed in 2018 (EPA Superfund Website).

Details about the site's history and ongoing remediation efforts can be reviewed at EPA's Superfund web site: https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0507952

5.1.2 Historic Land Use Changes From Forest To Clear Cut Timber Harvesting To Agriculture

The forests surrounding Ashland underwent a period of heavy logging from 1882 to 1889. In 1887, Ashland and Bayfield counties produced more than 263 million board feet of lumber (Bro and Fratt, 2011). As the logging era slowed, immigrant laborers bought much of the cut-over land with hopes of establishing farms. Much of the agricultural development occurred from 1895 to 1920. The sandy soils in the headwaters of the watershed turned out to be unsuitable for growing crops, and in the early 1930s, much of the land in the headwaters was purchased by the US government, who established the Chequamegon-Nicolet National Forest. Additionally, the Wisconsin legislature passed a Forest Crop Law that enabled tax benefits for long-term management of private forest lands.

The 1999 USGS study of the North Fish Creek watershed, which makes up about 20% of the primary SWP area, examined how flooding and sedimentation has changed in response to human-caused land cover changes. The study looked at field evidence as well as hydrologic and sediment transport models to show how the transition from forest to clear cutting to agriculture significantly altered the conditions of the watershed. The removal of forest cover increased surface runoff, leading to increased peak discharge and frequency of floods. In areas where the natural forest vegetation was permanently converted to agriculture (like much of the Fish Creek watershed) substantial long term changes in flooding and sedimentation occurred. Peak flood flows during peak agricultural land use (around 1928) were about 3 times greater (and under current conditions 2 times greater) than under pre-settlement forest cover.

Channel characteristics were also affected by the land use change. Post-settlement channel width has narrowed in the upper main stem and widened in the lower main stem. Higher peak discharge has led to faster channel bed incision in the upper main stem, creating eroding bluffs that contribute large amounts of sediment into Chequamegon Bay. The lower main stem has seen higher rates of deposition.

5.1.3 DuPont Munitions Plant, Town Of Barksdale

On the west side of Chequamegon Bay, in the Town of Barksdale, is the site of the former DuPont Munitions plant. The property is bordered on the north by Nolander Road and the west by Ondossagon Road. State Highway 13 runs northeast across the eastern edge of the property and Boyd Creek runs west to east through the center of the property. E.I. du Pont de Nemours and Company (DuPont) manufactured explosives, primarily dynamite, TNT and Nitroglycerin on the 1,800-acre facility from 1905-1971. While in operation, waste was stored at various locations on site and went into Boyd Creek which flows through the property. During operation, contamination levels in the creek were likely much higher, probably at levels harmful to wildlife and people, unfortunately sampling data from the time is limited.

DuPont has been investigating the site under state authority since 1997, when DNT contamination was found in one of three private wells sampled by DNR. To date, the site investigation has included the installation and sampling of 116 monitoring wells and sampling over 100 private wells, screening-level sampling of Boyd Creek and soil, surface water and sediment sampling of various areas on site. Site-related contaminants have been detected in seventeen private wells and minimally in on-site portions of Boyd Creek and other intermittent drainages downstream of the facility property. In 2004-2005 DuPont established municipal water supply connections to 57 properties north and east of the site, including the 17 properties with private well impacts. Treatment systems were installed on some private wells to provide safe, clean drinking water.

A superfund site reassessment report was prepared by the WI DNR in November 2016. Contamination from the site appears to have had the biggest impact on groundwater. Based on the limited surface water and stream sediment sampling, it is believed that the site poses a minimal threat to surface water in Chequamegon Bay. The site remains an active remediation investigation and more information on the site is located at the following link:
https://dnr.wi.gov/botw/GetActivityDetail.do?detailSeqNo=33361

5.1.4 Early Development Of Ashland Waterfront (Through ~1950's)

Settlement in the City of Ashland began around 1855, and the first railroad to Ashland was completed in 1877. The city was incorporated in March of 1887. The lumber and iron ore industries were the dominant industries during the late 1800's to the early 1900's. Modification of the shoreline began almost immediately, with a total of four ore docks built along the city's waterfront to accommodate loading of iron ore from the Gogebic range onto ships. The first ore dock in Ashland was built by the Milwaukee, Lake Shore and Western Railway in 1884. The second dock was built in 1888, but it burned down in 1924 and was dismantled in 1948. The largest ore dock was the Wisconsin Central ore dock built in 1916. It was 1,800 feet long, 80 feet high, and 59 feet wide and was located 1,000 feet southwest of where Bay City creek empties into Chequamegon Bay. By 1965, shipping of ore from the City of Ashland ended.

The Wisconsin Central dock was demolished in 2013 with only the concrete base left behind. The city has plans to redevelop the dock into a public space with initial construction of public access completed in 2020. Subsequent phases are planned to provide public access to additional sections of the dock along with seating, lighting, bike trail facilities, and other park amenities. Related developments and infrastructure upgrades in the adjacent City neighborhoods are expected to result in significant redevelopment of the ore dock area.

5.2 Point Sources Of Pollution

A point source of pollution is pollution originating from an easily identifiable, singular source such as a chemical spill or a pipe that discharges to the land surface or into a waterway. Any residential, commercial or industrial facility or activity that stores, uses or produces contaminants of concern which could find their way into a source of drinking water is a potential point source of pollution. These contaminants could find their way into Ashland's source water through intentional or unintentional discharges. This section reviews a variety of known current or potential point sources of pollution that could affect Ashland's source water. Below is a map of potential contaminant point sources identified by records review and field reconnaissance. Contaminant type is identified on the map by the DNR's 3 digit code. A table with the code values is listed in Appendix A.

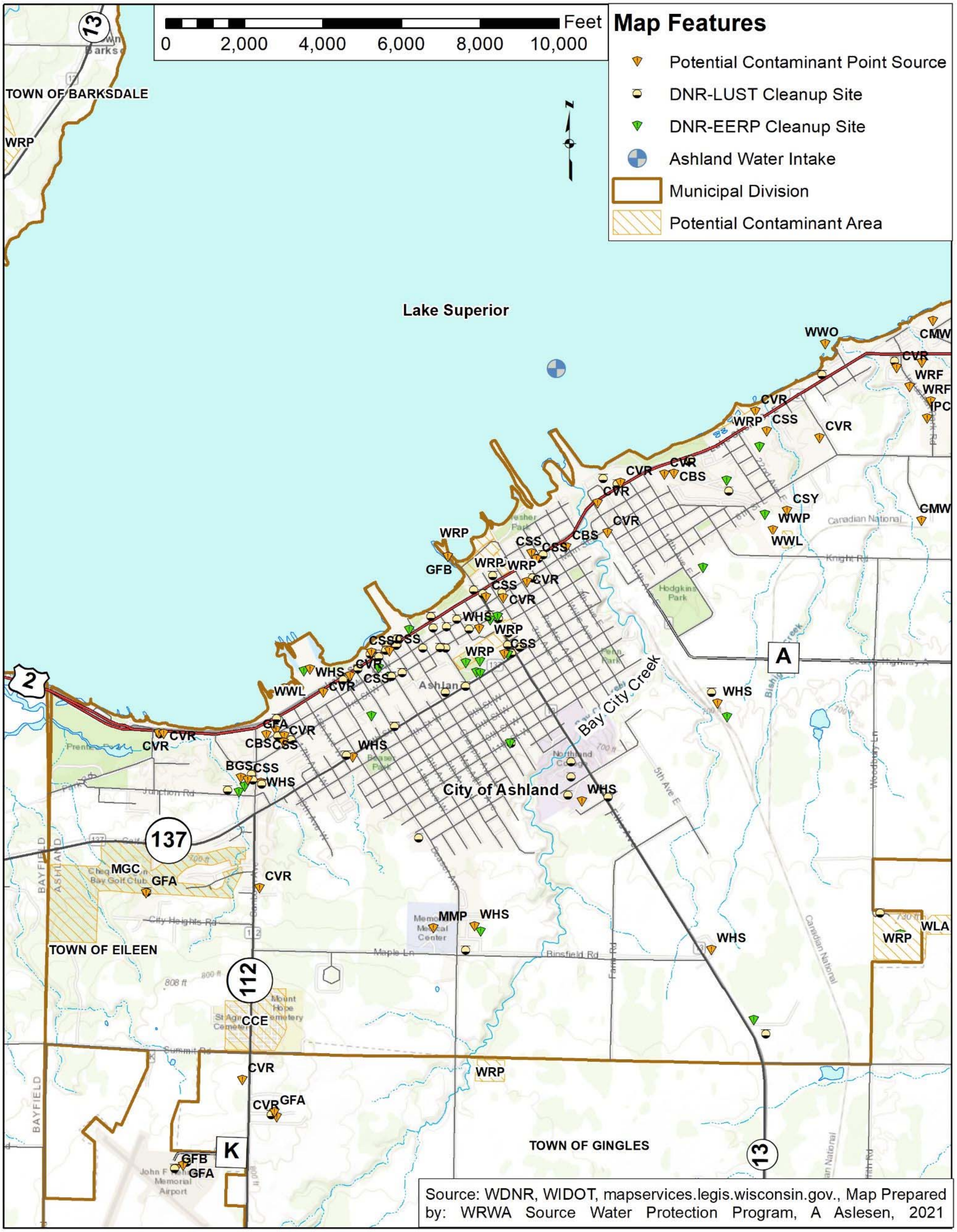

Map Features
Potential Contaminant Point Source
DNR-LUST Cleanup Site
DNR-EERP Cleanup Site
Ashland Water Intake
Municipal Division
Potential Contaminant Area
Feet
0 2,000 4,000 6,000 8,000 10,000
Lake Superior
TOWN OF BARKSDALE
TOWN OF EILEEN
TOWN OF GINGLES
City of Ashland
Bay City Creek
Source: WDNR, WIDOT, mapservices.legis.wisconsin.gov., Map Prepared by: WRWA Source Water Protection Program, A Aslesen, 2021

Figure 6: Map Of Known Point Sources Of Pollution In The City Of Ashland

5.2.1 Municipal Wastewater Treatment Plant Effluent

Three municipalities discharge treated wastewater effluent into the Chequamegon Bay area: the City of Ashland, City of Washburn, and the Greater Bayfield facilities.

The required parameters and frequency of monitoring effluent differs among facilities, with specific requirements identified on the Wisconsin Pollution Discharge Elimination System (WPDES), which requires each facility to report effluent testing results to the WI DNR for regulatory oversight. Effluent testing requirements of Ashland's WPDES permit (# WI-0030767-09-0) are summarized below, including maximum effluent concentrations and associated sample frequency.

Parameter	Limit Type	Limit and Units	Sample Frequency	Sample Type	Notes
Flow Rate		mgd	Daily	Total Daily	Monitoring only
BOD_5, Total	Monthly Average	30 mg/L	Daily	24-Hr Flow Prop. Comp.	
BOD_5, Total	Weekly Average	45 mg/L	Daily	24-Hr Flow Prop. Comp.	
Suspended Solids, Total	Monthly Average	30 mg/L	Daily	24-Hr Flow Prop. Comp.	
Suspended Solids, Total	Weekly Average	45 mg/L	Daily	24-Hr Flow Prop. Comp.	
pH Field	Daily Maximum	9.0 su	Daily	Grab	
pH Field	Daily Minimum	6.0 su	Daily	Grab	
Fecal Coliform	Geometric Mean–Monthly	400#/100 ml	Weekly	Grab	
Fecal Coliform	Geometric Mean–Weekly	656#/100 ml	Weekly	Grab	Limit added to July 1, 2016 Draft Permit
E. coli		#/100 ml	Weekly	Grab	Monitoring only
Phosphorus, Total	Monthly Average	1.0 mg/L	Weekly	24-Hr Flow Prop. Comp.	
Nitrogen, Ammonia (NH_3-N) Total		mg/L	Quarterly	24-Hr Flow Prop. Comp.	Monitoring only; July 1, 2016 Draft Permit changed sample frequency from "Monthly" to "Quarterly" and notes monitoring required in 2018
Mercury, Total Recoverable	Daily Maximum	11 ng/L	Quarterly	Grab	Limit added to July 1, 2016 Draft Permit; previously monitoring only with mercury reduction program
Temperature Maximum		deg F	3 per week	Measure	Limit and monitoring removed from July 1, 2016 Draft Permit; monitored previously

Table 1.02-6 WPDES Permit Effluent Monitoring Requirements and Limits Volume 2

Table 3: WPDES Permit Effluent Monitoring Requirements And Limits

Review of Ashland's effluent testing results show that there were no exceedances of allowable BOD, TSS, mercury, fecal coliforms, or phosphorus limits from 2012-2016. Some minor instances of pH levels below the allowable range have been recorded by not for significant periods of time.

Of the regulated effluent parameters, phosphorus has the most direct correlation to water quality. All three wastewater facilities discharging into Chequamegon Bay monitor phosphorus at least weekly. Estimates of annual phosphorus loading as P mass (as pounds per year or lbs/yr) are calculated using mean daily flow of effluent (million gallons per day or MGD) and mean concentration of total P (milligrams per liter or mg/L). Phosphorus loading differs among years and among facilities (Figure 7). It should be noted that estimated phosphorus loading presented here represents discharges from current facilities for years in which data are available (1993-2015). Discharges did occur prior to the first year noted in Figure 7. For the Ashland and Washburn facilities, permits did not require regular phosphorus measurements needed to make the calculations. The Greater Bayfield facility was constructed in 2005; data from 2006 on represent effluent from the new facility.

Ashland's annual phosphorus effluent has ranged from 1,493 to 2,547 lbs/year for the period of record. Washburn's annual phosphorus effluent ranges from 926 to 2,419 lbs/year; however, the highest estimated load occurred in 2011 when the biological processing was not functioning. During all other years, effluent from Washburn was below 1,600 lbs/year. The existing Greater Bayfield wastewater treatment plant treats wastewater from the City of Bayfield and the Pike's Bay Sanitary district. Estimated phosphorus loading from Bayfield ranges from 96 to 275 lbs/year. However, effluent volume varies greatly throughout the year, correlating with the seasonal nature of the population. More people live in the area in the summer months; therefore, the volume of wastewater treated is much higher during summer months.

At the Ashland Facility, phosphorus removal is accomplished by the addition of alum to the waste stream.

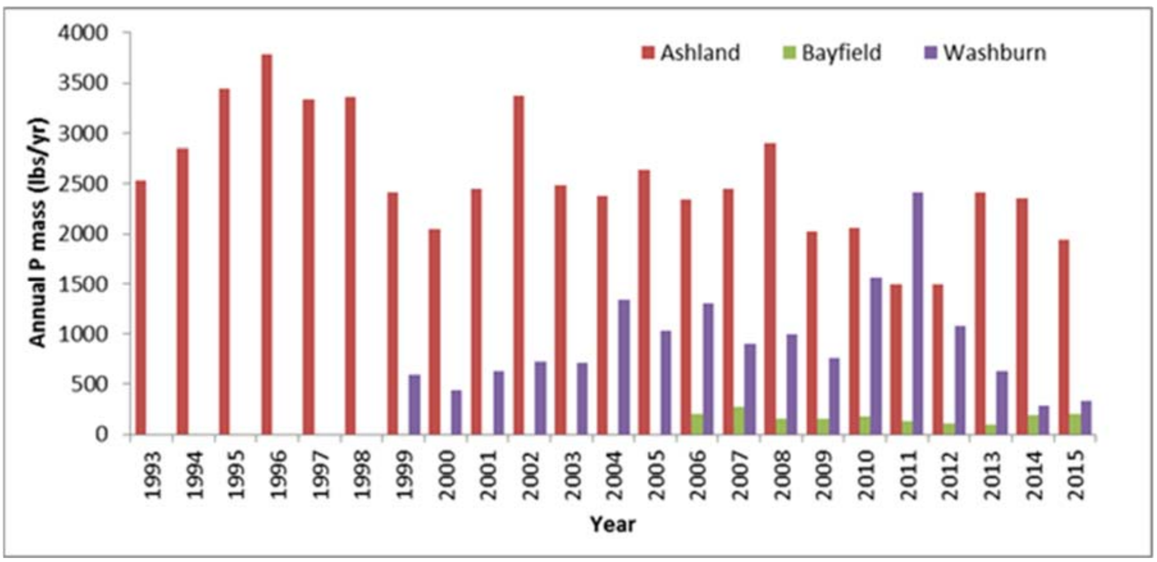


Figure 7: Estimated Phosphorus Load From Ashland, Washburn, And Greater Bayfield Wastewater Treatment Plants

5.2.2 Sanitary Sewer Overflow Events/Inflow And Infiltration

Inflow and Infiltration, or I&I, is a term used to describe the ways that stormwater and groundwater enter into the sanitary sewer systems. I&I water is called "clear water" (although it may be dirty) to distinguish it from normal sanitary sewage in the sanitary sewer system. Sanitary sewer systems are designed to carry wastewater from sanitary fixtures and drains such as toilets, dishwashers, sinks, and showers. A stormwater sewer is a pipe system designed to convey rainwater and snowmelt. Stormwater sewers are larger than sanitary sewers because they are designed to carry larger amounts of water. When clear water enters sanitary sewer systems, it must be transported and treated like sanitary wastewater. During dry weather, the impact of I&I can vary from minimal to a significant portion of the sewer flow. Wet weather magnifies I&I. As rain or snowmelt events begin, I&I starts filling the sanitary sewer systems with clear water, eventually reaching or exceeding the sanitary sewer system's capacity. Once it becomes overloaded, wastewater can flow backward through sanitary sewer pipes, sanitary fixtures, or drains that are below the overload flow level. This can cause flooding to basements or households and can cause manholes to pop open, releasing wastewater onto the street. When sanitary sewer flow at the wastewater treatment plant exceeds excess storage capacity, excess water is released. This is called a sanitary sewer overflow event.

Inflow is stormwater that enters into sanitary sewer systems at points of direct connection to the systems. Sources of inflow include footing/foundation drains, roof drains, downspouts, window well drains, outdoor basement stairwell drains, driveway drains, basement sump pumps, and even streams. These sources are typically improperly or illegally connected to the sanitary sewer systems by direct connections or discharge into sinks or tubs that are directly connected. These improper connections let water from sources other than sanitary fixtures and drains enter the sanitary sewer system that should be going to the storm sewer system. Improper connections can be made in any type of building and contribute a significant amount of water to sanitary sewer systems. For example, an eight inch sanitary sewer pipe can adequately move domestic wastewater flow from up to 200 homes, but only eight sump pumps operating at full capacity or six homes with downspouts connected to the sanitary sewer pipe will overload the same eight inch sewer pipe. A single sump pump can pump over 7,000 gallons of water to the sanitary sewer system in a 24 hour period, which is the equivalent of the average daily flow from 26 homes.

Infiltration is groundwater that enters sanitary sewer systems through cracks and/or leaks in the sanitary sewer pipes or manholes. This may be caused by age related deterioration, loose joints, poor design, installation or maintenance errors, damage, or root intrusion. Groundwater can enter these cracks wherever sanitary sewer systems lie beneath water tables or when the soil above the sewer systems becomes saturated. On average, sanitary sewer pipes are designed to last up to 50 years depending on the type of material being used. Often sanitary sewer system pipes, along with the lateral pipes attached to a building, have gone much longer without inspection or repair and are likely to be damaged. The city has a large percentage of pipes beyond the 50 year lifespan, including some that are 130 years old.

All water entering a water treatment facility must be treated as sanitary wastewater, which increases operating costs proportionally to the amount of I&I entering the sanitary sewer system. The City of Ashland spent $95,000 just to handle the additional rain water collected during the July 2016 flood event. By reducing I&I, operating costs can be lowered significantly, and the lifetime-capacity of a treatment facility can be increased. Pumping systems involved with wastewater treatment and transport operate 24/7; I&I puts an unneeded strain and shortens the life expectancy of these expensive pumping systems.

I&I problems are difficult to resolve because of the enormous amount of aging infrastructure still in place. The city has almost 60 miles of underground sanitary piping, with most pre-dating World War II, and many pipes over 100 years old. Many of these pipes were created from materials that are well beyond their expected service lives and used methods of construction that are not state of the art by today's standards. Treating clear water introduced by I&I is not economically feasible because of the treatment plant operating cost and expense of wastewater treatment plant infrastructure. To reduce I&I, sanitary sewer system maintenance and capital projects to repair failing infrastructure will require significant investments. The reduction and control of I&I in sanitary sewer systems should be considered with regard to a disciplined, annual, long-term monitoring and maintenance program. The first step to resolving any I&I problems is determining how significant the problem is. An evaluation of the sewer system will determine the quantity of I&I, determine sources, and provide guidance to determine a cost effective corrective action plan. The City of Ashland has undertaken several of these steps already.

Periodically, the city must monitor and measure their sanitary sewer system to maintain its integrity and determine sources of I&I. Continuous monitoring is also beneficial so appropriate cost increases can be applied to sources that are heavy contributors of inflow and infiltration. Monitoring provides a justification to develop plans that will require council approval to have new developments pay their fair share of the infrastructure already in place for them. The city has taken significant steps to help reduce I&I and better manage excess flows. A large project was completed in 2008 that helped to reroute flows, significantly reducing the frequency of sanitary sewer overflows along the lakeshore. In 2009, a city-wide study was completed to identify and prioritize areas contributing the largest amounts of I&I. In 2011, nearly 8 miles of sewer were televised, and 231 manholes were inspected in sewer districts 7 and 8 (the two districts with the greatest amount of I&I). In 2013, nearly $550,000 of grant money was used to rehabilitate and replace 3,830 linear feet of public sewer and 72 manholes in the two districts, significantly reducing I&I. In 2020, another $882,000 of the wastewater utility's funds were used to rehabilitate and replace 12,200 linear feet of public sewer and 9 manholes in districts 2, 7, and 8. In 2021, the City will receive funds from the WI Department of Natural Resources (WI DNR) Clean Water Loan Program (CWLP) for a $1.3 million project to rehabilitate 22,700 linear feet of public sewer main and 40 manholes in districts 1, 7 and 8. All of these projects include the use of cure in place pipe (CIPP) technologies, which offer an opportunity for the City to make swift and cost effective progress in addressing the need for improvements to the sanitary sewer system.

Although these projects should result in significant reductions in overall I&I, focusing only on the publicly-owned components of the system will likely not reduce I&I to acceptable levels due to failed infrastructure on the property owner's portion of the sanitary sewer system. I&I reduction in the privately owned portions of the sewer system will be pivotal to the overall success of the I&I removal program. In March 2021, the City Council approved an interim policy requiring replacement of the portion of any private sewer lateral not conforming to city specifications when replacement of the public sewer main occurs. Additional policy is needed to encourage similar upgrades to private sewer laterals when CIPP is used to rehabilitate a sewer main while significant enforcement, coordination, and assistance to property owners is necessary to address the contribution to I&I from sources like cross connected roof drains, downspouts, and sump pumps in commercial and resident locations. A planned project for complete replacement of the city's existing water meter system presents an opportunity to implement a program to systematically address these sources of I&I to the system.

5.2.3 City Of Ashland Sanitary System

The City of Ashland's original wastewater treatment plant (WWTP) was constructed in 1954 near the city marina on Chequamegon Bay. In 1992, a new wastewater treatment plant was constructed in the eastern part of the city on the north side of Knight Road. Wastewater is conveyed through the sanitary sewer system to the city's main lift station located at the edge of Chequamegon Bay at 12th Avenue East. From there, six 150-horsepower pumps convey wastewater through a 24-inch force main to the treatment plant. Under normal conditions, one or two pumps operate simultaneously; however, during high flow events all six pumps can operate. Once wastewater enters the treatment facility, it undergoes pre-treatment to remove large particles. From there it undergoes biological treatment in the plant's two oxidation ditches. Raw wastewater is mixed with microorganisms that feed on bacteria and organic material. The microorganisms clump together to form a biological floc. Air and alum, a chemical that reduces phosphorus in wastewater, are added at this point. From the oxidation ditches, water enters the final clarifiers. Water comes through the center and slowly moves to the outside of the clarifier. This movement allows the biological floc to settle out and return to the oxidation ditches to continue the biological treatment process. Excess sludge is pumped to the sludge storage basin. Clean treated water flows over the outside edge of the clarifiers and is sent through a disinfection process using ultraviolet light. Finally, clean water is conveyed through the outfall line and is discharged to Chequamegon Bay near 29^{th} Avenue East.

The normal sanitary flow for the City of Ashland is about 1 million gallons per day (MGD). The wastewater treatment facility has a maximum capacity of 3.84 MGD, so the system will handle approximately 4 times the normal flow of the city. This allows most minor rain events to be processed through the wastewater treatment facility. Additionally, the system is complete with an 8 million gallon outdoor overflow basin where the heavy solids settle out and five floating aeration units provide an increase in oxygen levels to help the digestive process. This outdoor overflow basin absorbs most of the heavy rain events, and the stored diluted sanitary water (since it is mixed with a significant amount of rain or snow melt) is metered back through the plant over the days following an event. All processed treated water is released to Chequamegon Bay per the DNR approved permit.

In Ashland, like many other cities, most of the sanitary collection system has exceeded its lifetime. There are cracks in sanitary sewer pipes where groundwater can infiltrate into the sanitary system, which contribute to spikes in flow during major storm or snowmelt events. This increase in sanitary sewer flow is known as Inflow and Infiltration (I&I). During these events, sanitary flow can spike to 5 or 6 times above the wastewater treatment facility's capacity. When the amount of water exceeds the outdoor overflow basin's storage capacity, it bypasses treatment and is released directly to surface water. This is called a "sanitary sewer overflow," and these releases are very infrequent. When they happen, the city is required to notify the DNR and public within specified timeframes and monitor the quality of the release. The monitoring during these events as required by the DNR includes the following: TSS (total suspended solids), BOD (biochemical oxygen demand), E. coli, and pH. I&I is the biggest issue facing the City of Ashland wastewater system and is the primary contributor to overflow releases.

The WWTP requires significant upgrades, repairs, and replacement of existing components such as the clarifiers, aeration equipment, sludge management components, and electrical system in the coming years. These upgrades must be completed to allow the sanitary sewer system to comply with applicable water quality standards for wastewater discharge. However, additional system upgrades are likely to be necessary in the future in response to increased regulatory standards.

5.2.4 Rural Sanitary Waste (Septic Systems, Holding Tanks)

Private, on-site wastewater treatment systems or septic systems are used when public sewage service is not available. Septic systems dispose of domestic wastewater effluent, including that which is produced in homes and businesses by bathrooms, kitchens, and laundry. Wastewater effluent may contain disease-causing pathogens and pollutants that must be treated to protect human health and the environment. When properly operating, a septic system safely treats wastewater effluent by storing sludge and solids in the septic tank and treating and dispersing wastewater in a soil absorption field. Septic systems must be properly used, operated, and maintained by the owner to assure the long-term performance of the system and protection of public health and the environment.

In facilities served by septic systems, all of the wastewater from the building should flow into the septic tank. Even water from the shower, bathtub, and washing machine can contain disease-causing pathogens and environmental pollutants. As wastewater flows into the tank, the heavier solid materials settle to the bottom (forming a sludge layer), and the lighter greases and fats float to the top (forming a scum layer). The tank's primary purpose is to retain the solids. After a retention time of about two days, the liquid portion (the sewage effluent) flows out of the tank through the outlet pipe. The retention time is necessary for separation of the solids from the liquid and for anaerobic digestion of the solids to begin in the septic tank.

The liquid portion of the effluent flows out of the tank into a series of perforated pipes to the soil absorption field or drainfield. Effluent flows through the buried perforated pipes where it is discharged through holes in the pipe onto porous surfaces that allow the wastewater to filter through the soil. Treatment of the effluent occurs in the soil beneath the drainfield. The soil absorbs some of the smaller pathogens such as viruses, and it retains certain chemicals including phosphorus and some forms of nitrogen. Living organisms in the soil remove harmful bacteria, viruses, and nutrients. After percolating through the soil, the treated water is ultimately discharged to groundwater.

Both the septic tank and the drainfield must be properly maintained to allow the system to work correctly for many years. Proper maintenance begins by utilizing good water use and waste disposal habits. Efficient water use reduces the amount of effluent entering the drain field which improves the operation of the system and reduces risk of failure. System owners are responsible for what materials enter the system. Best practices include never flushing anything besides human waste and toilet paper down the toilet, avoiding pouring toxins down sink drains, and limiting the use of garbage disposals. Toxins such as chemical cleaners, solvents, and paints can kill the living organisms that treat effluent in the drain field. Fats and solid wastes that enter a septic system can clog the drainfield.

Much of the land in the SWP area outside of the cities of Ashland and Washburn is not served by municipal sewers. Residents and businesses in unsewered areas rely on septic systems. State law requires sanitary permits for any structure that has water receptacles (i.e. sinks, faucets, showers, toilets, washing machines). Additionally, the state requires that a licensed master plumber perform the installation. Types of septic systems include conventional in-ground systems, at grade or mound systems, Aerobic Treatment Systems (ATU), and holding tanks.

Sewage effluent handled by septic systems typically includes contaminants such as nitrates, phosphorus, bacteria, viruses, dissolved metals, detergents, and solvents. When working properly, soils bind up a majority of the metals and phosphorus. Nitrate is diluted in groundwater, and pathogens and solvents die off or are degraded in the soil. However, improperly functioning systems can be a source of pollution to groundwater, which can then make its way to surface water. Improperly functioning septic systems can be caused by poor design or construction, overloading, misuse, or inadequate maintenance.

5.2.5 Incidental Spills Of Hazardous Materials

Incidental spills of hazardous materials could potentially reach the water supply. While such risks cannot be entirely eliminated, they can be reduced and managed. Sources of hazardous material spills can be divided into fixed and mobile (transportation) sources. Within each group, events can be further distinguished as posing a major or a minor risk. Major risks have the potential to release large quantities of material of significant toxicity directly into water sources.

Major fixed sources include gas stations, agricultural co-ops, or manufacturing operations that handle or store large quantities of hazardous materials. Spill prevention and control measures for such facilities are enforced by the City of Ashland, Wisconsin Department of Safety and Professional Services, Wisconsin Department of Agriculture Trade and Consumer Protection, and the Bureau of Weights and Measures. Minor fixed sources involve small quantity releases of things like herbicides, gasoline, waste oil, or other chemicals that may occur at residences, farms, or commercial properties. While a single event may be a minor concern, the cumulative effect of many small releases throughout the watershed could result in problems for the water supply. Minor releases can be addressed through landowner education, provision of convenient hazardous waste disposal options, and disconnecting paved area drainage from streams.

Major mobile sources are associated with highways, railways, and pipelines. US Highway 2 crosses the source water protection area and goes through the City of Ashland, and Enbridge Line #5 traverses west-east across the source water protection area; however, a planned re-route is scheduled to begin in summer 2021. A catastrophic accident involving a chemical tanker truck on a bridge over a stream that drains to Chequamegon bay is considered a low probability threat, but it could have major impacts on the water supply. Mitigating these risks is done several ways: 1) ensuring that there is adequate emergency response capability; 2) limiting hazardous material transport on highways closest to the bay; 3) Retrofit bridges and drainage ditches on bridge approaches to provide spill containment. This option is expensive and risk vs. cost considerations likely make it a low priority option.

Built in 1953, the 645-mile, 30-inch-diameter Enbridge #5 pipeline carries up to 540,000 barrels per day of petroleum products to eastern Canada from Superior. It traverses west/east across Bayfield and Ashland Counties and crosses many major tributaries to Lake Superior. A 2017 article by The National Wildlife Federation obtained records from the federal Pipeline Hazardous Materials Safety Administration that show Line 5 has spilled more than 1 million gallons of oil and gas liquids in at least 29 incidents since 1968. From the records, only one of the 29 recorded incidents was detected by a remote pipeline detection system. By contrast, 15 releases were detected by local personnel or the public. An online mapping system found here shows the location, cause, date, and amount released from each incident. The spill nearest to Ashland was near Saxon in 1972, when around 14,700 gallons were released due to an equipment failure. The planned re-route will move the line south of Mellen which will eliminate a majority of the direct risk to Ashland’s water system from Line 5, although the secondary source water protection area will still be at risk.

5.3 Nonpoint Sources Of Pollution Overview - Watershed Contributions To Chequamegon Bay

Nonpoint-source (NPS) pollution is a term used to describe pollution resulting from many diffuse sources as opposed to a single, identifiable source. NPS pollution comes from everyday land use activities throughout a watershed. It is caused by runoff moving over and through the ground picking up and transporting sediment, nutrients, and other pollutants to receiving water bodies.

NPS pollution has generally been identified as originating from “urban” or “rural” activities. It is important to note, however, that those distinctions are blurred by the large land base and small population of the City of Ashland and the profound effects that rural development can have on the delivery of NPS pollution to surface waters. For instance, runoff from rural roads or rural construction sites may be of equal importance to the runoff from city streets, city construction sites, and other urban impervious surfaces. With that being said, the easiest way to differentiate the issue remains to divide NPS pollution into urban and rural categories for management purposes. For this plan, the term “urban” refers to the developed portions of the City of Ashland and other municipalities within the source water protection area, and “rural” is defined, by exclusion, as the area that is not-urban (this can include undeveloped areas within the corporate limits of a city or village).

For decades, land management initiatives have recognized that accelerated runoff is a major concern for water quality in the region, and the mantra “slow the flow” has guided conservation efforts since the late 1990’s. This approach recognizes that the runoff rate and quantity, and resulting stream discharge as overland flow, is influenced by conditions throughout contributing watersheds including soils, topography, and land use. The heavy clay soils that comprise the Wisconsin portion of the Lake Superior coast allow little infiltration and provide for substantial runoff. Steep slopes increase the rate of runoff. Additionally, open pasture, crop, harvested forest, and urban/residential lands contribute to and accelerate overland flow. Wetlands, lakes, and constructed stormwater retention in a watershed influence runoff and stream discharge, with greater storage capacity reducing runoff impacts.

Land use in the Primary Source Water Protection Area is summarized in Figure 6 using WisCLAND2 dataset that was completed in August of 2016 (WDNR and WSCO 2016). This dataset describes land cover throughout the state using a combination of remotely sensed imagery and field verification ground-truthing. The primary source water protection area is primarily forested, with a greater proportion of development in lower reaches of the watersheds along Chequamegon Bay. Agricultural and pasture land cover is most concentrated in the South Fish Creek watershed.

Figure 8: WISCLAND 2 Land Cover In The Primary Source Water Protection Area.

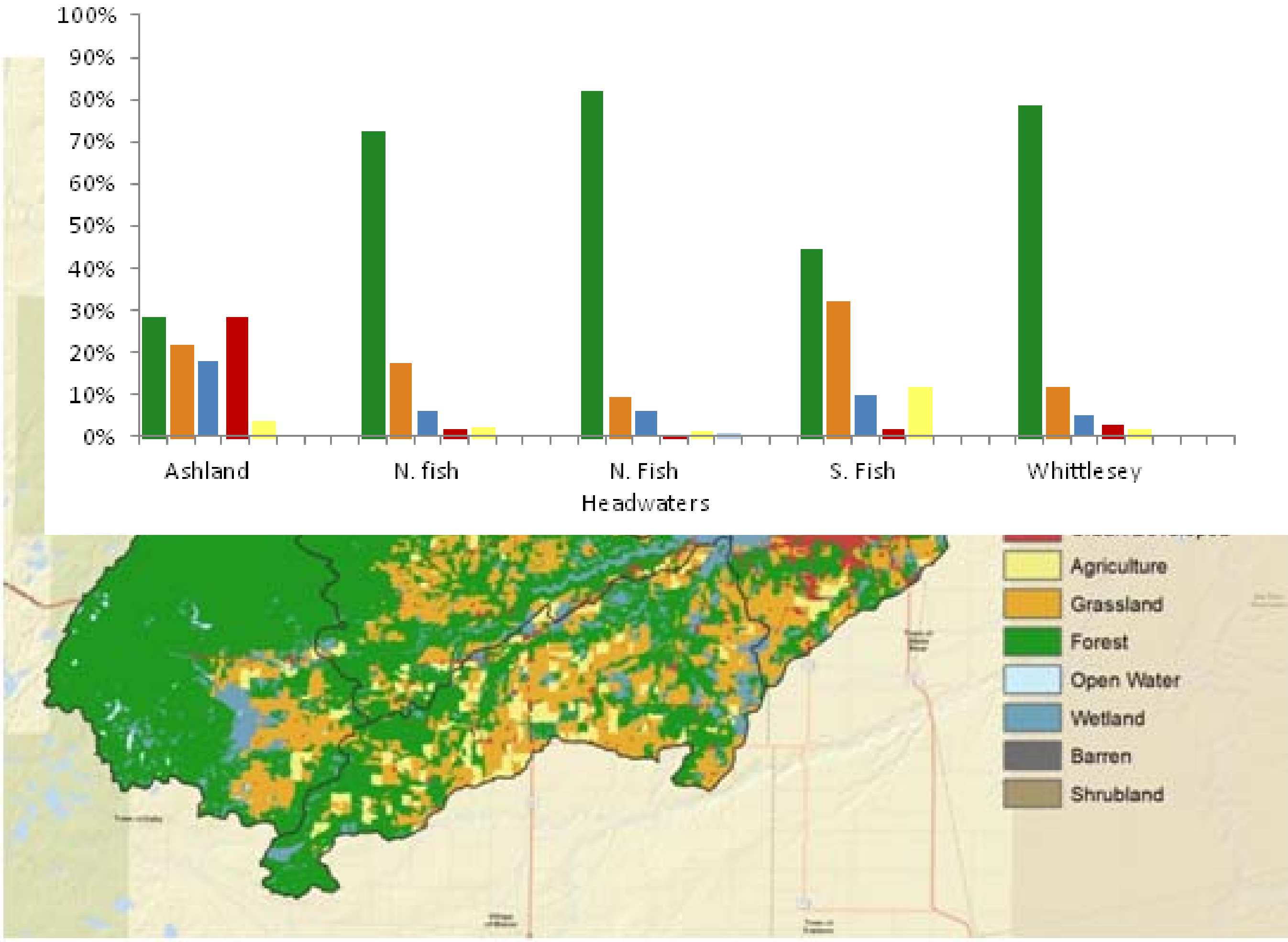


Figure 9: WISCLAND 2 Percentage Of Land Cover In The Primary Source Water Area By Watershed.

5.4 Urban Nonpoint Sources Of Pollution

The City of Ashland is the largest urban area in the primary SWP area and has the most significant urban NPS impact on water quality, with the City of Washburn being the second largest. Stormwater in urban areas is conveyed to Chequamegon Bay through storm sewer infrastructure and numerous ravines and streams that flow to the bay. In Ashland, about 25% of the urbanized area discharges to the lower three miles of Bay City Creek, with the rest of the storm sewers discharging directly to Chequamegon Bay or ravines that flow to the bay or Fish Creek Slough (Bro et. al., 2011).

Effective stormwater management often occurs by using a holistic system management approach. This approach takes into account the effectiveness of each stormwater practice, the costs of each practice, and the resulting overall cost and effectiveness rather than looking at each practice in isolation. Some individual practices may not be effective alone, but in combination with others, may provide a key function in highly effective systems.

Stormwater runoff is generated from many different land surfaces and is impacted by the behaviors and activities of individuals, households, and the public. These common individual behaviors have the potential to generate stormwater pollution including:

- littering
- disposing of trash and recyclables
- disposing of pet-waste
- applying lawn-chemicals
- washing vehicles
- changing motor-oil
- disposing leftover household chemicals or paint

Convincing people to change their behaviors and properly dispose of materials can minimise such pollution. It is important that the public be aware of the significance of their behavior and that their actions can either pollute or protect our waterways. The benefits of public education efforts cannot be understated, especially for urban stormwater pollution.

Encouraging community participation, forming partnerships, and combining efforts of other groups in the community will encourage everyone to work towards the same stormwater goals. Public involvement builds on community capital-—the wealth of interested citizens and groups—to help spread the message to:

- prevent stormwater pollution
- undertake group activities that highlight storm drain pollution
- contribute volunteer community actions to restore and protect local water resources

Phase II MS4s are required to follow all state, tribal, and local public notice requirements when implementing their stormwater program. Public involvement also includes creating opportunities for direct action, educational, and volunteer programs such as tree planting days, volunteer monitoring programs, storm drain marking, or stream clean-up programs.

Preventing pollutants from entering a waterway is less expensive than restoring a waterway after it has been polluted. Therefore, programs should first focus on preventing pollution before it happens. BMPs under each of the minimum measures, but especially under this pollution prevention category, focus on preventing pollutants from contacting stormwater.

Municipal activities such as winter road maintenance, minor road repairs and other infrastructure work, automobile fleet maintenance, landscaping and park maintenance, and building maintenance can release pollutants into MS4s that ultimately discharge to nearby water bodies. Municipal facilities can also be sources of stormwater pollutants if BMPs are not in place to contain spills, manage trash, and handle non-stormwater discharges. Sweeping parking lots and streets and cleaning storm drains can prevent pollutants from entering nearby waterways.

Further information on urban stormwater management can be found at the EPA's website: **https://www.epa.gov/npdes/national-menu-best-management-practices-bmps-stormwater#edu**

5.4.1 Urban Runoff Entering The City's Storm Sewer System

The storm sewer system is most impacted by runoff from impervious surfaces such as roofs and pavement. Water flows off these surfaces and into sewer inlets and drainage ways, rapidly carrying pollutants and sediment with it. An effective approach to reduce nonpoint source pollution in the city's storm sewer system should include efforts to reduce the volume and speed of runoff entering the system, a concept known as "slow the flow." Implementing stormwater Best Management Practices (BMPs) will help reduce both the volume and the speed of stormwater.

As new development or redevelopment occurs, conservation considerations should be made to reduce stormwater runoff. The city should create runoff-reduction requirements or incentives, such as minimizing the amount of impervious surfaces and/or adding filter strips, swales, or bioretention areas to filter runoff from paved surfaces and rooftops before it enters storm sewers, ditches, and/or waterways.

Consideration should also be given to practices, in the residential, commercial and industrial sectors, that result in the reduction of chemicals associated with yard fertilizer, herbicides, and pesticides within the city. Fertilizer, herbicide, and pesticides are used on lawns and gardens for the purpose of growing green grass and weed control. These lawn chemicals can runoff lawns and gardens into waterways though the urban stormwater system. The extent to which fertilizer and lawn chemicals are applied is not known; however, it is important to recognize the excess use could be an important threat to water quality in the bay.

Controlling excess fertilizer and lawn chemicals from commercial and industrial development focuses on BMPs for reducing over application and minimizing the amount that reaches surface water through good stormwater management practices, as described above. The City is in a good position to promote these practices through the Sustainability Committee.

5.4.2 Streambank Erosion Along Open Channels Within The City (Bay City Creek, Other Streams And Ravines Leading To The Bay)

A number of streams within the Ashland city limits experience problems with stream bank erosion. To examine the extent of this issue, it is important to put the hydrology of the watershed in context. A curve number is a number that indicates a land's propensity for infiltration into the ground or runoff into surface waters, with values ranging from 30-100. The lower the number, the better the infiltration and the less runoff occurs. According to the Natural Resources Conservation Service report on Urban Hydrology for Small Watersheds, commonly known as the TR-55 manual, historical conditions in Ashland (Forested area with good cover on clay soil) would have resulted in a curve number of 77, which indicates that the soil had a high runoff potential in its natural state. The addition of impervious surfaces brings this number up to 98, with virtually none of the water being infiltrated into the ground. Developed areas of the city that do not have bioretention infrastructure have a curve number of 98 and produce a high amount of stormwater runoff.

Stormwater runoff from impervious surfaces is often funneled directly into water bodies. In Ashland's case, this would be the tributaries that wind through the city. The added water increases the peak flow of these streams, which increases their erosive capabilities, thus leading to streambank erosion and increased pollutant loads. Stormwater outfalls are an additional source of streambank erosion since they deposit water onto streambanks at a smaller area with higher velocity. This causes erosion to the streambank as well as increases the peak flow of the stream.

Another component of the effective reduction of sediment and pollution loading to Chequamegon Bay is prevention of streambank erosion. The environmental consulting firm, MSA Professional Services Inc., studied the issue of stream bank erosion along open channels within the City of Ashland (McClure, 2008). The study identified 107 locations of significant stream bank erosion contributing approximately 242 tons/year of sediment and some level of phosphorus to the bay. McClure identified 5 major sites (3 sites on Bay City Creek, 1 site on Industrial Park Creek, and 1 on Mack Road Creek) that combined contribute approximately 40% of the total sediment load from urban streams. The study recommended that the city prioritize and implement repairs to those 5 sites.

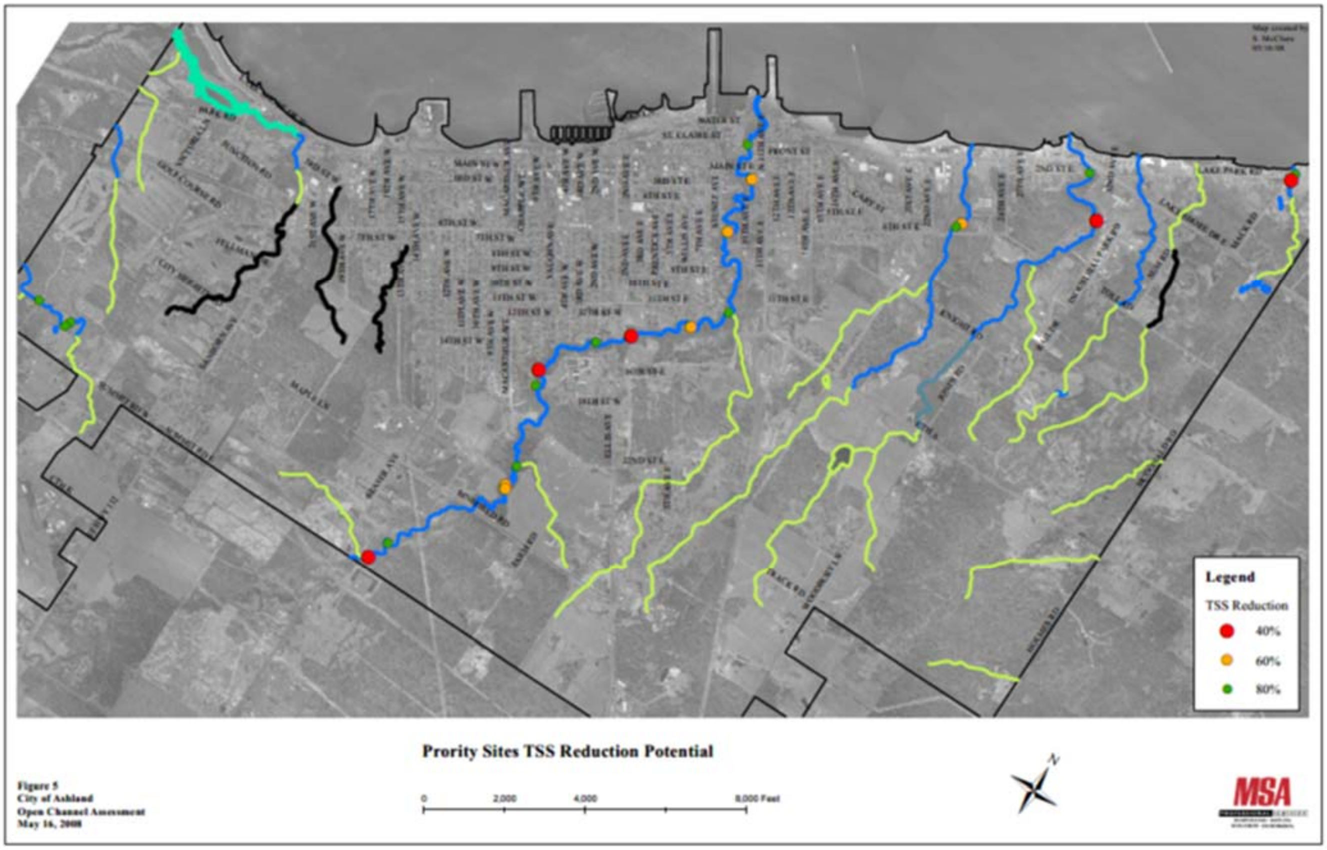


Figure 10: Map Highlighting Areas Of TSS Reduction Potential.

Areas of high erosion have a lower TSS reduction potential since erosion control measures will not capture the total amount of sediment being eroded. Small areas of erosion have a greater TSS reduction potential since the likelihood of being able to catch most of the sediment being eroded is increased. Areas of high erosion, in red, are the highest priority.

In the immediate future, the City Public Works Department will be focusing on repair of existing stormwater infrastructure and will use these sites as a guide to prioritize efforts. Since this assessment was completed, significant storm events with strong erosive capabilities have been seen in the Chequamegon Bay area at a greater frequency than historically documented. As a result, efforts are needed to assess the impact of streambank erosion within the city. However, streams in rural areas outside of the city contribute sediment to the bay on orders of magnitude greatly exceeding the urban contribution (Fitzpatrick, 1999). Regional partnership beyond the scope of the city will be necessary to appropriately remedy this. Efforts are being initiated to this end, as illustrated in Section 7.4.1.

5.4.3 Construction Sites

Land disturbance during both residential and commercial construction projects exposes bare soil which can erode during storm events. Sediment runoff rates from construction sites can be 10-20 times greater than agricultural lands. To prevent degraded water quality in streams and lakes near construction sites, it is necessary to decrease the amount of sediment that runs off during a storm event. This includes diverting storm water around disturbed or exposed construction site areas as well as trapping sediment and controlling the transport of sediment off site. It is important to have procedures for implementing proper pollution control measures before development starts as well as procedures for site inspection and enforcement of control measures. Erosion control plans contain specific practices to reduce erosion, divert storm water from disturbed or exposed construction site areas, and trap and control the transport of sediment.

The Wisconsin DNR Storm Water Program regulates storm water discharges from construction sites that disturb one acre or more of land through clearing, grading, excavating, or stockpiling of fill material. For these projects, the landowner can request coverage under the Construction Site Storm Water Runoff General Permit No. WI-S067831-5 by submitting an application to the DNR called a Water Resources Application for Project Permits (WRAPP). Landowners submitting a WRAPP agree to comply with all the permit requirements.

5.4.4 Road Salt Usage

Substantial application of road salt in the U.S. began in the 1940s. Chloride, a key component of road salt, is soluble, highly mobile in water, and can be toxic to aquatic vegetation and wildlife at high concentrations. Trends showing increasing chloride concentrations have been observed in water bodies of the U.S. and are attributed, at least in part, to road salt influence. Road deicing by cities, counties, and state agencies accounts for a significant portion of salt applications, but salt is also used by many public and private organizations and individuals for deicing. As urban land cover increases, applications of road salt for deicing are likely to increase.

A 2015 USGS study looked at chloride trends in urban streams in the Northern U.S. (Corsi, et. al, 2015). The study found that flow-normalized concentrations estimated from 1980 to 2010 for 19 streams had increasing chloride concentrations at almost every site. For the more urban sites, concentration increases were greatest in winter periods but summer periods also experienced increases. Increasing trends were also found in the less urban watersheds, with concentrations during the winter being greater or similar to summer. A notable finding of the study is that the rate of chloride concentration increase outpaced that of urbanization, so increasing urban land cover alone cannot account for upward chloride trends. This may be attributed to several potential factors. First, it is possible that more salt was applied per unit urban area during the latter portion of the study period than during the early portion. This conclusion is supported by road salt sales in the northern U.S., which outpaced the rate of increase in urban land cover by 40% during the study period. Second, the continued road salt input to the shallow groundwater system and inability of the system to recover to background concentrations before the next deicing season begins results in an increase in the chloride concentrations of shallow groundwater. Chloride is slowly discharged to the stream, as indicated by increasing summer concentrations.

The nature of salt presence in the environment coupled with the necessity of roadway safety makes chloride a difficult issue to address. Common stormwater practices rely on settling or filtration of particulate matter. Since salt dissolves readily in water, these management practices do not remove salt from runoff. This means the only reliable way to reduce the impact of road salt on surface water is to reduce applications.

The City of Ashland is responsible for winter maintenance of 67 miles of streets and 14 miles of alleyways. The city uses several techniques that have been documented for reduction of road salt application which are discussed in Section 7.3.5. Some of these practices include salt management planning, pre-wetting of granular salt to maximize salt retention on paved surfaces, vehicular mounted calibrated applicators that vary by ground-speed, and decision support systems to evaluate ice forming conditions to inform deicing activities (Fay et al., 2013).

5.5 Rural Nonpoint Sources Of Pollution

Non-point source (NPS) pollution originating from the undeveloped and sparsely developed land within the SWP area is considered rural NPS pollution. Rural NPS pollution is difficult to control because the sources are spread out over the landscape and cross multiple jurisdictional areas. Rural areas in the primary source water protection area include land under the jurisdiction of the City of Ashland, Ashland County, and Bayfield County as well as numerous towns.

This section breaks NPS pollutants of primary concern into three categories: sediment, nutrients, and pathogens. While these three categories are looked at separately, they are all related. For example, certain nutrients and pathogens travel with sediment. Additionally, certain pollutant sources such as land spreading of waste and agricultural runoff are given their own section. For each pollutant, it is important to think about how they move with surface water runoff: as a dissolved load, suspended load, or bed load.

There have been several studies conducted in the Chequamegon Bay region that look at NPS pollution loading to the bay. Some of these reports are specific to the primary or secondary source water protection areas; however, even the studies that are not locally specific contain valuable insight into the type and extent of NPS pollution loading to Chequamegon Bay. Several of these reports also contain recommendations to reduce the pollutant.

5.5.1 Sediment Transport & Loading

Excess sediment in surface water is the largest nonpoint source pollution concern in the Chequamegon Bay region of Lake Superior (Andrews et al., 1976, 1980; Robertson, 1997; Fitzpatrick et al., 1999; Stable Solutions LLC and Community GIS Inc, 2007). Excess sediment refers to erosion and sedimentation processes that are directly the result of human modifications to the landscape. Some sediment entering the system is normal, but historic changes in land use have accelerated rates of erosion in many areas of the watershed (see section 5.1.2). Excess sediment has many detrimental effects to surface water, but the most relevant related to drinking water protection are that it decreases the lifespan of filters used to treat drinking water and increases the amount of chlorine necessary to treat the water, thus increasing the likelihood of disinfection byproduct formation, which can be hazardous to human health(see section 4.1). Nonpoint Source Pollution studies conducted in the SWP area focus heavily on characterization of the amount and source of sediment being carried downstream and delivered to surface waters. This is fitting given the flashy hydraulic characteristics of the area and the highly erodible nature of the interwoven sand and clay soils, as discussed earlier in this plan. The primary sources of concern for sediment loading are streambank and bluff erosion, runoff from clear-cut timber stands, runoff from row-crops/cultivated fields, and erosion from road/stream intersections (culverts and bridges-fully functioning or damaged). According to a 1999 study by Faith Fitzpatrick, bluff erosion in this section of the watershed is by far the largest contributor of sediment to Chequamegon Bay (Fitzpatrick et al., 1999).

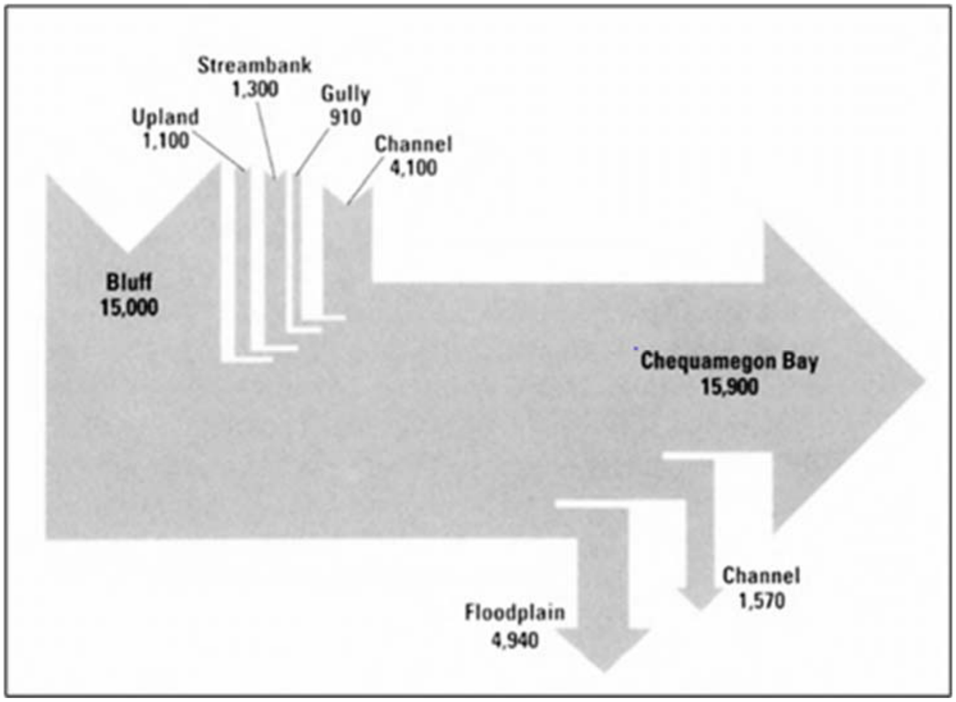


Figure 11: Historical Annual Sediment Budget For North Fish Creek In Metric Tonnes Per Year.

5.5.2 Nutrient Transport And Loading

The clay soils of the lower elevations of the North and South Fish creek watersheds hold water more effectively than the sandy outwash in the higher elevations, making them suitable for agriculture (Bro and Fratt, 2011). Agricultural fertilizers are associated with nutrient overloading that can cause algal blooms. Nutrient related issues of importance are discussed in the following subsections.

5.5.2a Phosphorus

Phosphorus is a limiting nutrient for plant growth. In a rural setting, it can come from the weathering and erosion of streambanks. Additionally, phosphorus is a component of agricultural fertilizers and manure. Phosphorus adsorbs onto sediment particles and is deposited into water bodies in runoff from precipitation or irrigation. Excess phosphorus in surface water can lead to excessive algae and plant growth, which can eventually lead to eutrophication. Erosive processes at high flow conditions are likely the primary source of elevated phosphorus levels in Chequamegon Bay tributaries. Elevated phosphorus levels during low flow conditions are most likely attributable to other processes (Hudson and Lehr, 2019). According to the latest Wisconsin Department of Natural Resources assessment in 2020, three Chequamegon Bay tributaries are on the Wisconsin impaired waters list due to high levels of phosphorus. Phosphorus does not pose a direct threat to the drinking water system, however algal blooms caused by excess phosphorus are a potential concern (see 5.5.2c).

Site	TP Criterion	Median [ug/L]	L90% [ug/L]	U90% [ug/L]	Impairment Threshold
Bay City	75	122.4	112.8	139.9	Clearly Exceeds
Bono Creek	75	67.0	68.3	93.6	May Exceed
Little Sioux	75	31.0	35.9	70.2	Cleary Meets
N. Fish	75	26.5	31.7	49.3	Clearly Meets
N. Fish (Ino)	75	59.9	48.7	67.0	May Meet
N. Fish Trib.	75	63.1	57.7	77.8	May Meet
Pine	75	28.1	30.2	49.1	Cleary Meets
S. Fish Cr.	75	119.7	119.3	164.4	Clearly Exceeds
S. Fish Trib.	75	160.0	147.9	205.0	Clearly Exceeds
Sioux	75	36.7	48.3	70.3	Clearly Meets
Thompson's	75	55.0	65.2	87.7	May Meet
Whittlesey	75	30.0	35.2	48.8	Cleary Meets

Table 4: Total Phosphorus Concentrations From Chequamegon Bay Tributary Sites And Impairment Threshold Calculations Using Wisconsin's Consolidated Assessment And Listing Methodology (WDNR, 2017). L90% and U90% represent the upper and lower confidence intervals around the median. *Note: Only samples collected using biweekly sampling protocols were used to assess impairment conditions.*

5.5.2b Nitrogen

Nitrogen, like phosphorus, is found in agricultural fertilizer and animal manure as well as eroding stream banks. It is also a limiting nutrient for plant growth. Excess nitrogen in a water body can lead to the formation of algal blooms. Drinking water contaminated with nitrates is known to cause infant methemoglobinemia, or "blue baby syndrome." In severe cases, this can cause death. The city is required to monitor Nitrogen levels in finished water as part of WI DNR drinking water regulations. Results show that nitrogen levels in the source water are low relative to maximum contaminant levels, and it is not thought that nitrogen is a major concern at this time as a drinking water contaminant; although, as with phosphorus, excess nitrogen in Chequamegon Bay has the potential to trigger an algal bloom that could impact the drinking water system.

5.5.2c Algal Blooms

Algal blooms occur when colonies of algae grow out of control, and they have the potential to produce toxic cyanobacteria. Blooms typically form when excess nitrogen and phosphorus cause eutrophication in a water body (Heiskanen and Leppanen, 1995; Anderson et al., 2002, Paerl et al., 2011). Historically, Lake Superior was thought to be too cold to provide the necessary conditions for algal blooms, but as the fastest warming great lake, conditions are becoming more favorable for cyanobacteria growth (Austin and Coleman, 2008). Since 2012, several algal blooms have been documented in Western Lake Superior, with one just 10 miles away from Ashland. According to Gina LaLiberte from the Wisconsin Department of Natural Resources during the International Joint Commission's visit to Northland College in 2019, the particular strain of cyanobacteria documented in Lake Superior is *dolichospermum lemmermannii* (Meador, 2019). Common cyanobacterial toxins associated with dolichospermum species are the peripheral nerve toxins anatoxin-a, guanitoxin, and saxitoxin; the liver toxins microcystin and nodularin; and the multi-organ toxin cylindrospermopsin. Despite the risk of toxins, they have not yet been detected at hazardous levels in Lake Superior blooms. *D. lemmermannii* is also known to produce geosmin, which causes taste and odor problems in drinking water. Geosmin has a significant economic impact on drinking water production. It is worth noting that cyanobacteria produce many toxins that do not yet have established health standards.

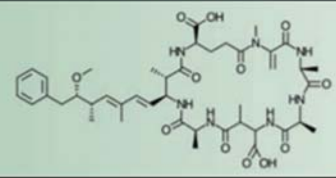
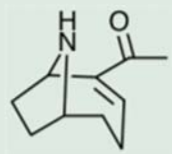
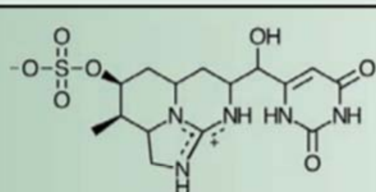
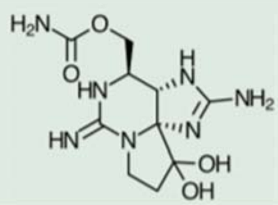
Toxin	Structure	Organ	Genera
Microcystin		Liver (possible carcinogen)	*Microcystis* *Anabaena* *Planktothrix* *Anabaenopsis*
Anatoxin - a		Neurotoxin (nerve synapse)	*Anabaena* *Planktothrix* *Aphanizomenon* *Cylindrospermopsis*
Cylindrospermopsin		Liver (possible kidney, genotoxic and carcinogen)	*Cylindrospermopsis* *Aphanizomenon*
Saxitoxin		Neurotoxin (sodium channel blocker)	*Anabaena* *Aphanizomenon* *Cylindrospermopsis* *Lyngbya* *Planktothrix*

Figure 12: Common Cyanotoxin Structures, Toxicological Effects, And Known Producers (American Water Works Association and Water Research Foundation, 2015).

One study suggests that nutrient loading is not the primary factor contributing to the appearance of algal blooms in Lake Superior. There have been no drastic increases in agricultural land use in the region, so nutrient runoff from farms is likely not a large driver of the Lake Superior blooms. Extremely large rain-events have been coincident with blooms seen on the south shore of Lake Superior. It is possible that propagules and nutrients derived from tributaries are the culprit, but further research is needed (Sterner et al., 2020). Studies show that climate change could result in modified patterns, intensities, and duration of precipitation and drought (Paerl and Huisman, 2009). Increased frequency of large storm events as well as warmer overall climate may increase the frequency of algal blooms in the Lake Superior Region. *Dolichospermum* blooms are often accompanied by surface scums, reduced water transparency, anoxic conditions, and reduced diversity of natural phytoplankton (O'Neil et al., 2012). For a discussion on how algae blooms could affect Ashland's drinking water system, see section 4.2 above.

5.5.3 E. Coli

Total coliform levels at the drinking water intake are highly dependent on wind, precipitation, and runoff. E. coli levels can range from 0-25 colonies per mL during total ice cover up to the maximum detectable amount of 2419.6 colonies per mL after a large rain event or during spring melt. E. coli contamination is a problem for public health at beaches in the City of Ashland, but it is not considered a drinking water concern, as it is effectively removed through the normal drinking water treatment process.

5.5.4 Hydrodynamics

Understanding water movement within Chequamegon Bay and how that water interacts with tributaries and the rest of Lake Superior can play an important role in anticipating water quality conditions and threats to the drinking water system. Wind and water patterns control movement of sediment, nutrients, and pathogens around Chequamegon Bay. Efforts are underway to study these patterns for the development of predictive models (section 7.4.2).

5.5.5 Land Spreading Of Waste

The WDNR Wastewater Program regulates land spreading activities for wastewater and wastewater generated solids from different sources including:

- Municipal – Wastewater Treatment Plant (WWTP) sewage sludge (NR 204)
- Septage – servicing of private sewage systems (NR 113)
- Industrial – land treatment of industrial liquid wastes and by-product solids and sludges (NR 214)

In general, WDNR determines the suitability of a requested land application site based upon land owner agreement to accept, soil type/characteristics and description, permeability, depth to groundwater/bedrock, slope, proximity to waterways, and other landscape features (i.e. ditches, sinkholes, etc.). Approved application rates for time of year may be limited based on the soil type, wastewater characteristics (what kind of waste and strength) to be land spread, and the nutrient needs of the crop.

Wastewater characterization varies by waste type/source. Septage, holding tank, or septic tank characteristic values are established using historic default values for nitrogen at a rate not to exceed the agronomic need for the crop grown.

Industrial and municipal wastewater characterization is source specific, and WPDES permit required sampling is necessary to determine appropriate agronomic rates of application for nitrogen. Additional permit required sampling may be required for compliance with other potential pollutants of concern and is limited by application rate. Such additional and re-occurring sampling may include: chloride, sodium, potassium, phosphorus, metals, bacteria, or other priority pollutants as required by specific code.

Site management plans outline the timing and volume of material that can be spread to meet the conditions of the appropriate code. The type of crop and crop year for any approved fields is a consideration in site management plants. Planning applications must also be coordinated to meet the needs and operational considerations of the landowner/farmer to complement a farm's nutrient management plan or other logistical needs.

Reporting of all WDNR regulated land application activity is required annually. Specific department forms are generated for the facility or hauler to submit per the conditions of the appropriate regulating code. Examples of data recorded on these forms include fields used, number of acres used, and gallons applied by waste type on each field.

Winter spreading is permissible for septage (NR 113) and industrial (NR 214) waste; however, application is conditionally site specific to slopes between 0 – 2%. Other site considerations are evaluated during approval such as the potential for runoff to surface water. Additional conditions may be included such as increased site separation distance or other requirements. Application on sites during a precipitation event is not explicitly prohibited; however, current soil conditions and future weather forecasts need to be evaluated prior to application and need to be taken into consideration by the applicator to ensure site runoff from the application does not occur. Site conditions are typically addressed within the approved management plan, as application during saturated soil conditions is environmentally detrimental and will likely result in loss of use of the field by the farmer.

From 1996 to 2016, a total of 4,931.5 acres have been permitted for land spreading in the Primary and Secondary Source Water Protection Area (Figure 8). In 2016, the number of permitted sites actively utilized for land spreading was much smaller than the amount permitted over the 20-year time period from 1996-2000. The WDNR provided Wisconsin Pollutant Discharge Elimination Systems (WPDES) data from the 2016 calendar year on the distribution and volume of land spreading in the source water protection area (Figures 13 & 14). In 2016, a total of 412.3 acres were approved for land spreading of waste in the Primary and Secondary SWPP area (Table 5). Waste spreading occurred on 366.2 acres, totaling 1,975,678 gallons. Septage was the only type of waste applied in the Primary Source Water Area, and it was the most common type of waste applied throughout both the Primary and Secondary Source Water Protection Areas overall at 77% of the total acreage and over 90% by volume. Industrial waste from the Flambeau River Paper mill was spread on one site near Mellen. The only municipal waste spread was from the Village of Mason. The watersheds with the highest amounts of land spreading are the Headwaters of North Fish Creek, Whittlesey Creek-Frontal Chequamegon Bay, Troutmere Creek-Marengo River, and Fish Creek-Frontal Chequamegon Bay.

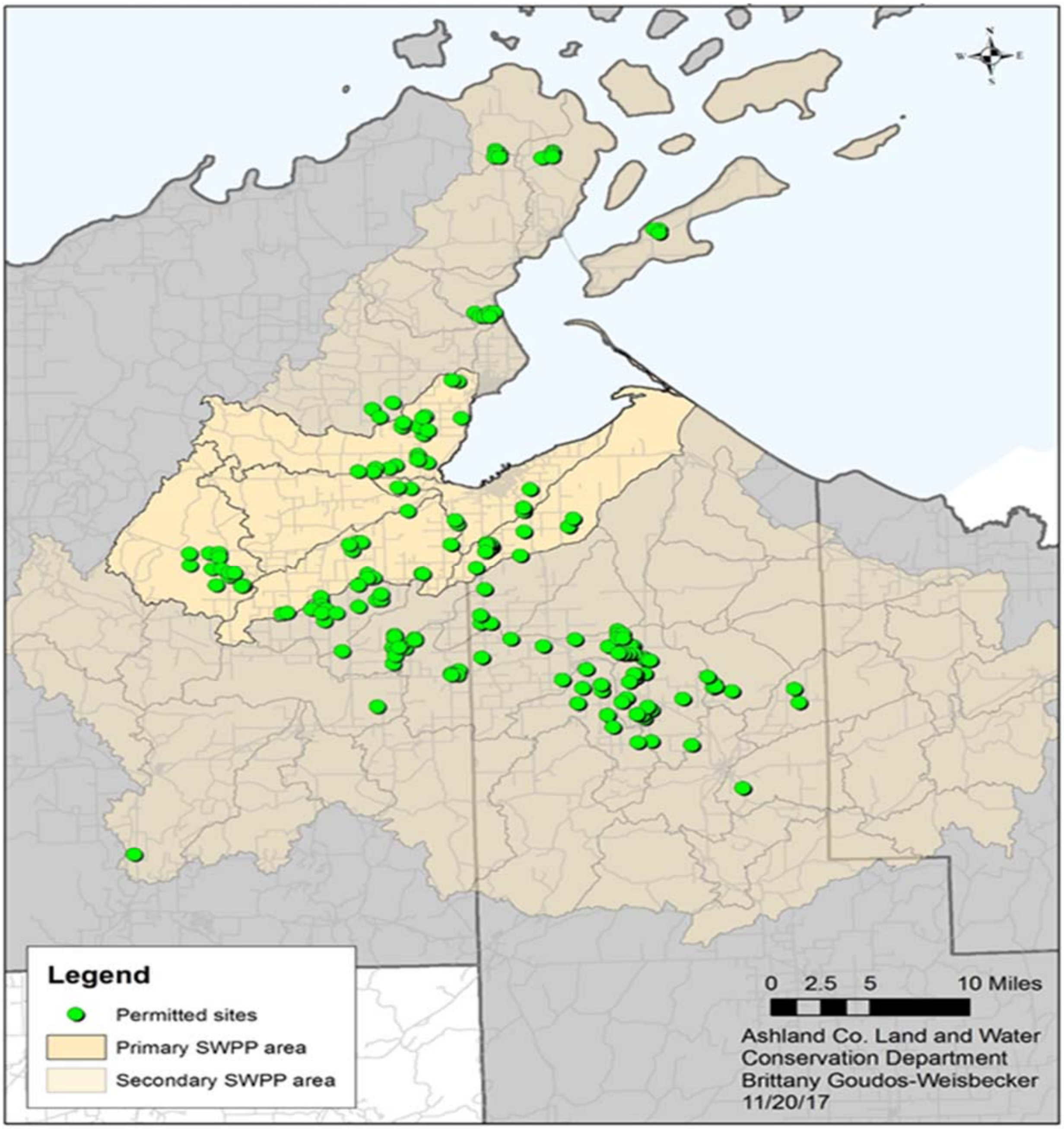


Figure 13: General locations of fields with WPDES permits for land spreading from 1996 to 2016 in the City of Ashland's Primary and Secondary Source Water Protection Areas

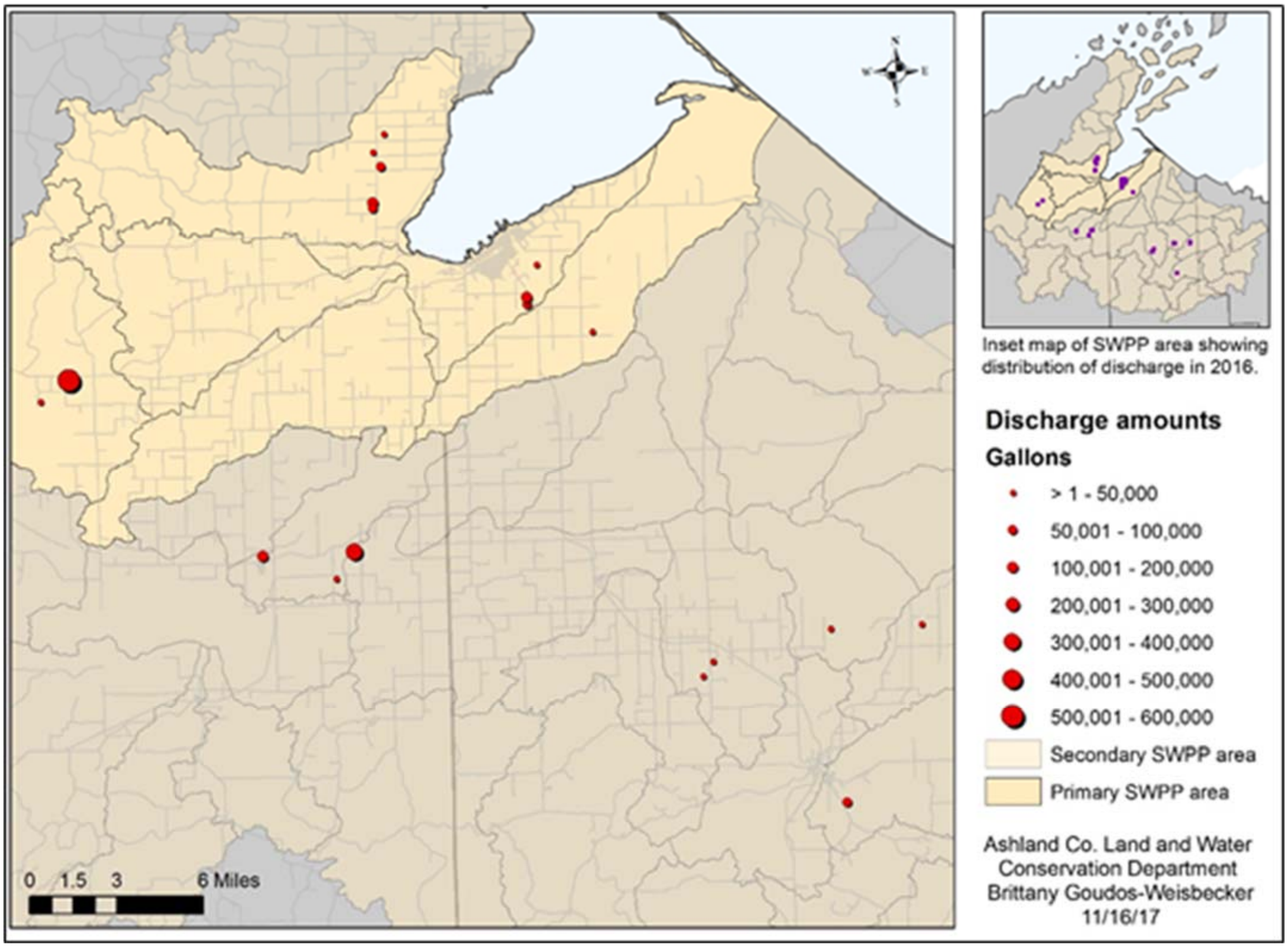


Figure 14: WPDES Permitted Waste Spreading Sites In 2016 In The City Of Ashland's Primary And Secondary Source Water Protection Area

Watershed (HUC 12)	SWPP Area	Waste Type	# of Acres approved for spreading	# of Acres Applied	Discharge Amount (gal)
Beartrap Creek – Frontal Chequamegon Bay	Primary	Septage	5	5	6,100
Fish Creek - Frontal Chequamegon Bay	Primary	Septage	39[1]	40	298,971
Whittlesey Creek - Frontal Chequamegon Bay	Primary	Septage	69.1	69.1	356,757
Headwaters North Fish Creek	Primary	Septage	53	53	553,993
Primary Source Water Area Total			166.1	172.1	1,215,821

Lower Tyler Forks	Secondary	Septage	30	5	3,000
Copper Falls State Park - Bad River	Secondary	Industrial	67.7	67.7	29,059
Devils Creek - Bad River	Secondary	Septage	8	8	54,150
Marengo River	Secondary	Septage	32	27	59,200
White River Flowage - White River	Secondary	Septage	57.1	52.1	99,400
White River Flowage - White River	Secondary	Municipal	14.5	14.5	144,300
Troutmere Creek - Marengo River	Secondary	Septage	36.9	20	338,618
Secondary Source Water Area Total			246.2	194.3	727,727
Overall Total [1]Data on acres approved not available for one site. 39 acres is the known amount of approved acres.			412.3	366.4	1,943,548

Table 5: Discharge Amounts Of Land Spreading In Each Huc 12 Watershed Located In The SWPP In 2016**.**

5.5.6 WPDES Permitted Agricultural Operations (CAFOs)

Agricultural operations with more than 1,000 animal units are known as Concentrated Animal Feeding Operations (CAFO). An animal unit is defined as an animal equivalent of 1,000 pounds live weight and equates to 1,000 head of beef cattle, 700 dairy cows, 2, 500 swine, 125,000 broiler chickens or 82,000 laying hens. With so many animals in one place, CAFOs generate large quantities of manure. This manure must be disposed of, with the most common practice spreading it on farm fields near the CAFO in spring and fall. There is often not enough nearby farmland to safely spread all the manure, leading to overspreading. Nutrients such as phosphorus and nitrate as well as bacteria have the potential to wash into streams and lakes causing algae blooms. CAFOs are required under the Clean Water Act to have a DNR approved Wisconsin Pollution Discharge Elimination System (WPDES) permit in place when they operate.

6. GROUNDWATER ASSESSMENT

6.1 Introduction

The primary focus of the City of Ashland source water protection program is protecting the city's surface water intake. However, the planning committee believes it is important to acknowledge the use of groundwater as the source of drinking water for residents in the SWP area who are not connected to municipal water. The protection measures that benefit source water quality in the bay also benefit groundwater quality in the SWP area. SWP requires partnerships that cross political and municipal water service area boundaries; therefore protecting groundwater as the source of drinking water for those within the SWP Area not serviced by a municipal water supply is important.

6.2 Groundwater Overview And Use

Groundwater is used as the source of drinking water in several ways. Private wells are utilized by residents of the city that are not served by the municipal water supply as well as residents outside of the City of Ashland who are not served by a municipal water supply. Non-municipal public wells are utilized within the SWP area to serve places such as businesses, schools, churches or a transient population such as patrons of restaurants or public parks. One such notable well is the artesian well at Maslowski Beach which is a popular place for people to fill jugs for use as drinking water.

According to the USGS, 17.6% of the water used in 2005 in Ashland County was supplied by groundwater and 40% of the water used in 2005 in Bayfield County was supplied by groundwater (Protecting Wisconsin's Groundwater Through Comprehensive Planning, 2007). The locations of private wells are not well tracked and ensuring safe water quality is the well owner's responsibility. Public wells are regulated by the DNR and water quality testing is required on varying intervals depending on what type of public well it is. Locations of public supply wells are given in Figure 15.

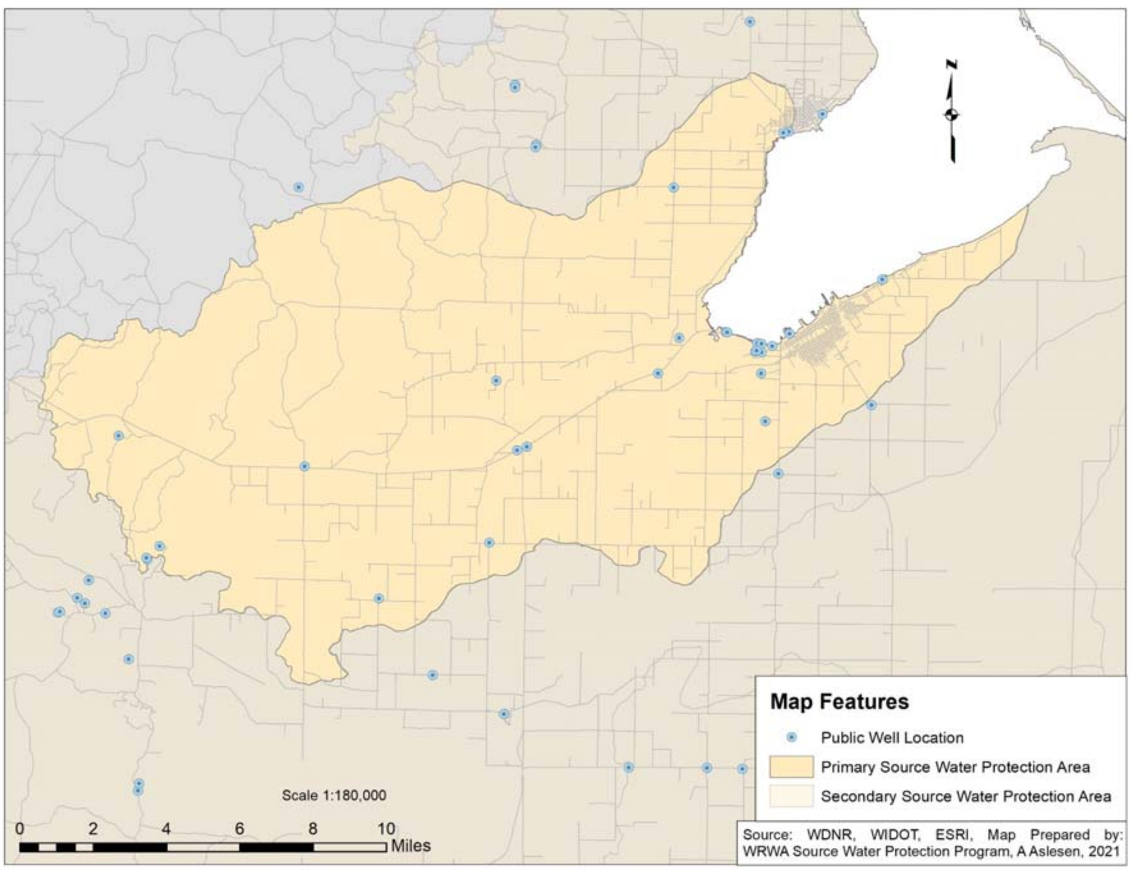


Figure 15: Locations Of Public Supply Wells In The Primary SWP Area

General groundwater quality for any given area in the state can be found by using the interactive well water quality viewer developed by UW-Steven's Point Center for Watershed Science and Education. The viewer aggregates water quality samples from a variety of sources to give a snapshot of the groundwater quality at a county, township or section scale. The viewer is good at identifying areas where water quality issues exist, but is not designed to look at trends in water quality over time. The viewer can be found here: https://www.uwsp.edu/cnr-ap/watershed/Pages/WellWaterViewer.aspx

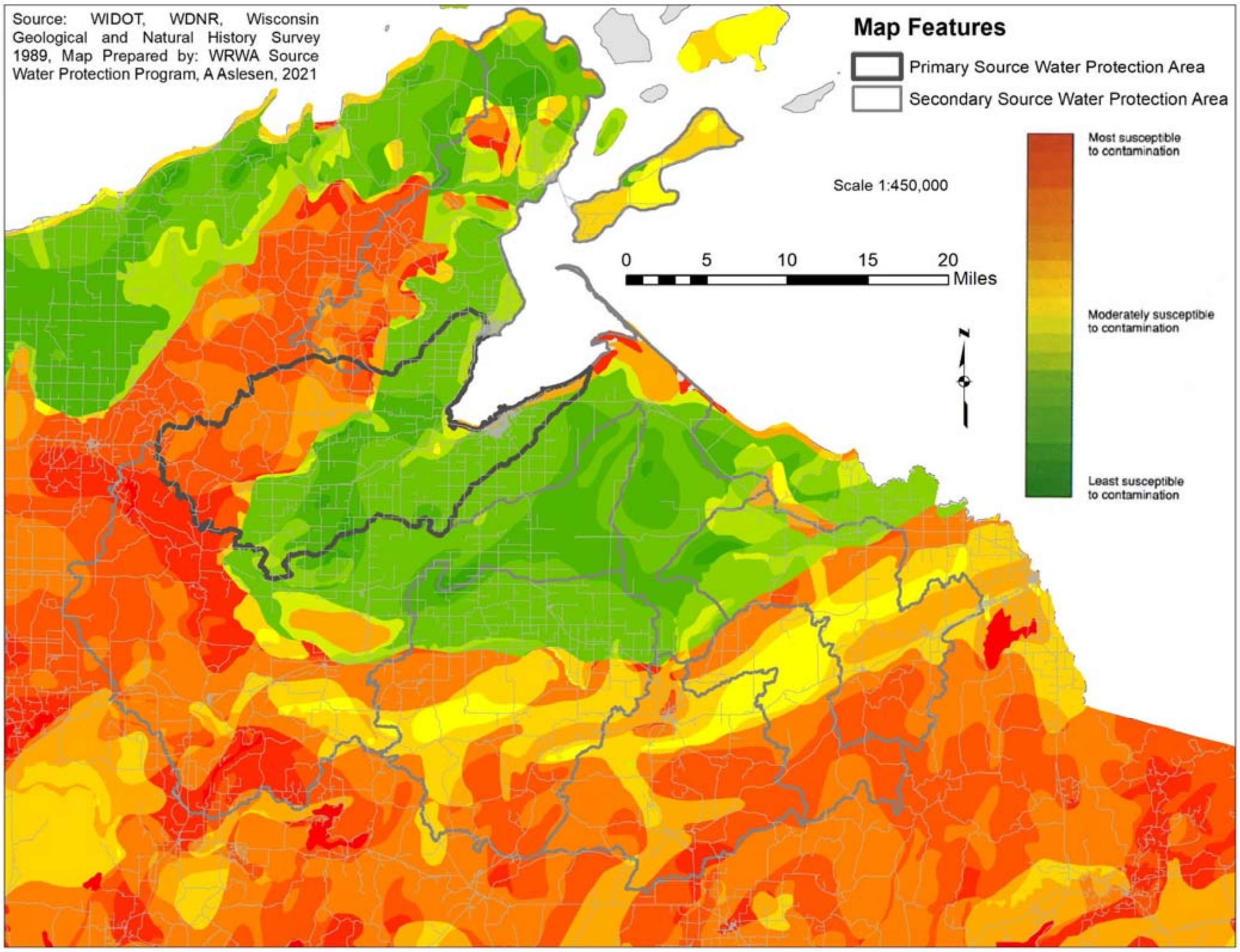


Figure 16: Map of groundwater contamination susceptibility in the primary and secondary watersheds.

6.3 Area Groundwater Studies

There are several groundwater studies that cover all or part of the Ashland SWP area. A brief summary of relevant study reports are given below along with links to the full report.

6.3.1 Groundwater And Wells In Agricultural Regions Of Bayfield County, Wisconsin-wgnhs Technical Report 2.2016

http://wgnhs.uwex.edu/pubs/tr002/

In 2016, the Wisconsin Geological and Natural History Survey was commissioned by the Large-Scale Livestock Study Committee and the Bayfield County Board of Supervisors to study the groundwater resources in two agricultural regions of Bayfield County. The study results are outlined in a report available on the WGNHS Website. Much of the Fish and Whittlesey Creek watersheds are included in the study's "eastern agricultural region".

The report identifies two distinct regions, the sand and gravel upland and the silt and clay lowland as well as the implications the regions have on groundwater and surface water quality. The silt and clay lowland is underlain by low permeability, fine-grained glacial deposits of the Miller Creek Formation which have increased runoff to streams. Livestock operations and manure management within these areas have a greater potential to impact surface-water quality. The sand and gravel upland is underlain by the sandier Copper Falls Formation, more precipitation and snowmelt tends to infiltrate. Livestock operations and manure management have a greater potential to impact groundwater quality in this area. Site-specific groundwater quality monitoring systems can be designed using the water table maps and hydrogeologic cross-sections developed by the report.

Well construction is an important factor in a well's vulnerability to contamination from the surface. A majority of the wells in the eastern agricultural region are completed in the sand and gravel deposits. Wells completed at greater depths, beneath thicker deposits of fine-grained material, have more protection from surface contamination than shallower wells. Well water quality is site specific, and it is suggested that well owners test water quality annually, particularly for bacteria and nitrate.

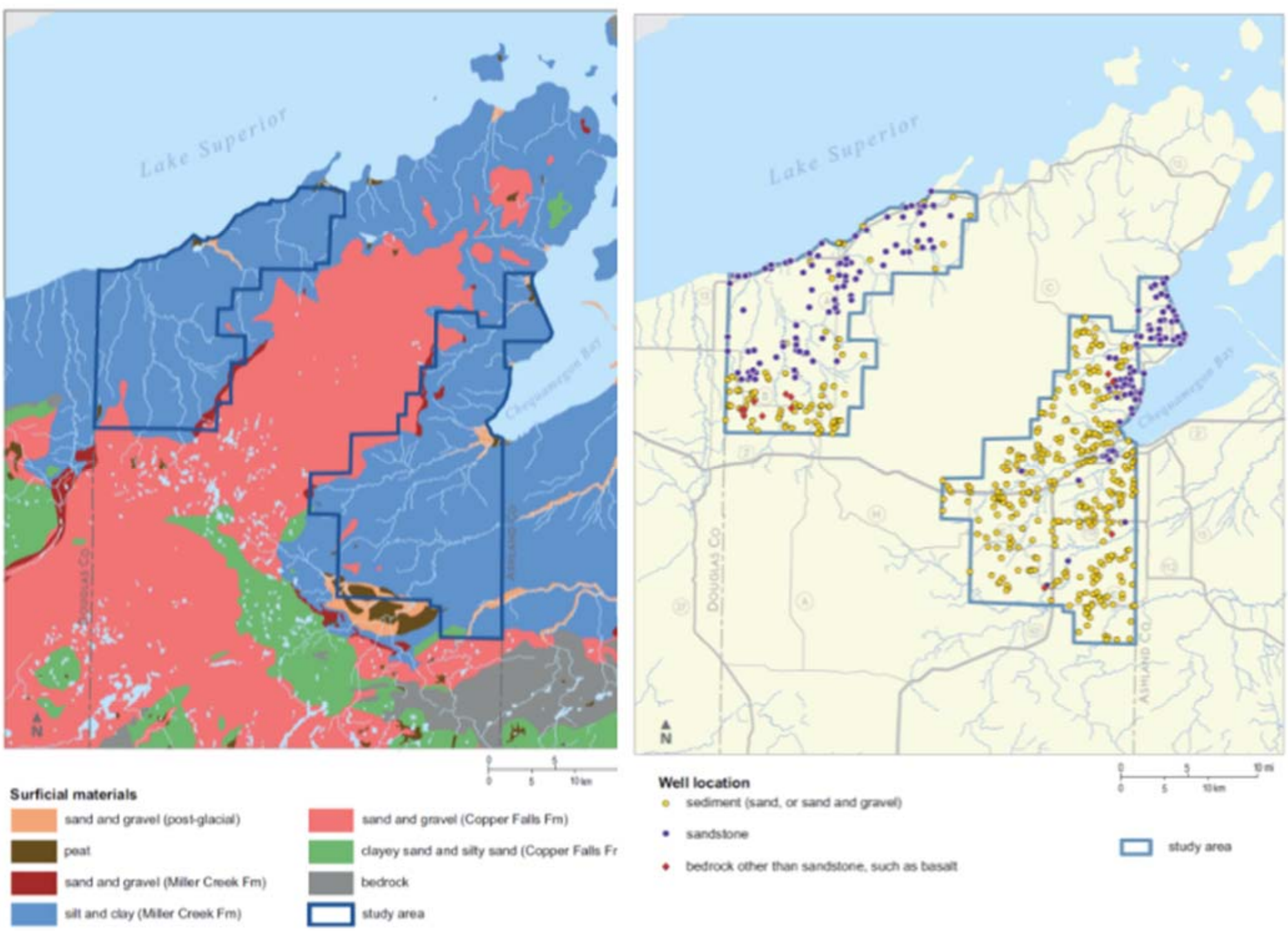


Figure 17: The Study Area Along With Surficial Geologic Deposits And Well Construction.

6.3.2 Hydrogeologic Atlas Of Bayfield County, Wisconsin-WGNHS Technical Report 005.2019

https://wgnhs.wisc.edu/catalog/publication/000967

In 2019 the Wisconsin Geological and Natural History Survey published a Hydrogeological Atlas of Bayfield County (Graham, 2019). The atlas provides a regional-scale interpretation and analysis of groundwater resources in the county. It includes an overview of typical well construction and interpretive maps of water-table elevation & groundwater flow direction, depth to the water table, depth to bedrock, distribution of groundwater recharge and relative susceptibility to groundwater contamination.

The regional geology of northern Wisconsin controls the hydrogeologic setting. Glacial deposits cover most of the county and primarily consist of clayey lowlands that stretch inland for 5 to 10 miles from Lake Superior, sandy uplands that cover the center of the county and rocky uplands that contain abundant lakes and streams to the south. Most groundwater recharge occurs in the upland areas. Low-permeability clay in the lowlands limits the recharge and provides natural protection by slowing the downward migration of contaminants. Areas with coarse sands or shallow fractured bedrock are most vulnerable to rapid migration of contaminants.

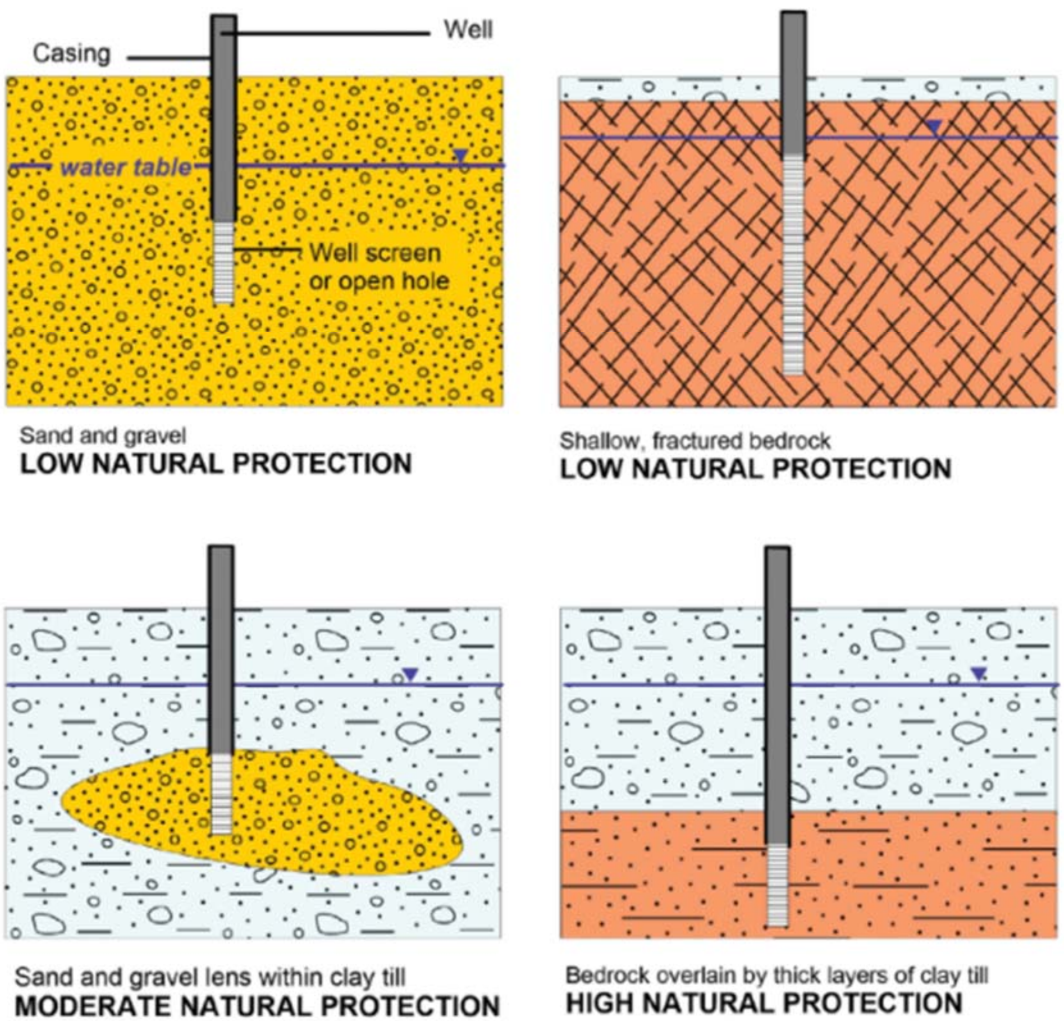


Figure 18: Relates General Susceptibility Of Wells In Bayfield County Based On Their Construction.

7. SOURCE WATER PROTECTION PLAN IMPLEMENTATION

7.1 Implementation Strategies To Reduce Water System Susceptibility

Potential threats to the City of Ashland water system have been outlined in section 4. This section outlines strategies that the city and others can use to protect drinking water while it travels through the system from the intake to the tap.

7.1.1 Sanitary Surveys

A sanitary survey is an inspection of a water system's facilities, operations, and records to ensure the delivery of safe and reliable drinking water. As required by the WI DNR under section NR809.35, the DNR must complete a sanitary survey every 3 years. Several deficiencies were identified during the most recent sanitary survey conducted in 2018 that have yet to be corrected. The city must prioritize fixing these deficiencies as well as any additional deficiencies identified during the next sanitary survey conducted during summer of 2021.

7.1.2 Elevated Turbidity

Issues caused by elevated turbidity from excess sediment are discussed above in Section 4.1. Actions taken to reduce both urban and rural nonpoint source pollution will help reduce the water system's susceptibility to turbidity. Those implementation measures are discussed below in the appropriate sections. While the city works collaboratively to implement nonpoint source pollution reduction strategies, the water utility can continue to optimize filtration plant efficiency and prolong the life of the filters, with the goal of reaching the expected 10 year lifecycle.

The city intends to develop a second water intake structure (as described in section 7.1.5 below). Part of the process of locating the intake will include a study to determine the location that will receive the least amount of turbidity in the source water at the intake.

7.1.3 Harmful Algal Blooms

At the state level, Wisconsin does not have health advisory levels (HALs) for cyanotoxins. The EPA and WHO have developed health advisories for two toxins produced by HABs: microcystins and cylindrospermopsin, but there are currently no enforceable standards under the Safe Drinking Water Act, which means these levels act as informal guidance for decision makers. Preventative actions taken to reduce both urban and rural nonpoint source pollution will help reduce the water system's susceptibility to HABs. The city should stay up to date on the most recent regulations and research on drinking water treatment of toxins produced by HABs. Below are several resources that can be utilized to keep informed on the situation. In the event that a HAB occurse, response plans vary based on each utility's unique characteristics and priorities, so there is no standard procedure to follow. If it is determined that Chequamegon Bay is at high risk for cyanobacteria blooms, the City of Ashland water utility will develop a monitoring and response plan after assessing their capabilities and priorities. When creating a plan, the water utility must decide when to test for cyanobacteria, which testing method to use, which step in the drinking water treatment process to collect samples from, and which method of decontamination to use. Resources are available for cyanobacteria response plan guidance through the Environmental Protection Agency and the American Water Works Association's cyanotoxins page.

USEPA's 10-Day Health Advisory Levels for Microcystins and Cylindrospermopsin

Cyanotoxin	Bottle-Fed Infants and Preschool Children (<6 Years Old) *μg/L*	School-Age Children and Adults (≥6 Years Old) *μg/L*
Microcystins	0.3	1.6
Cylindrospermopsin	0.7	3

USEPA—US Environmental Protection Agency

Figure 19: EPA's Health Advisory Guidelines For 2 Cyanotoxins. These Are Not Legally Enforceable, But Many States Use These As A Guide.

Great Lakes HABs Collaborative - Great Lakes Commission (glc.org)

North Central Region Water Network Algal Bloom Action Team

7.1.4 Chemical Compounds

Maximum Contaminant Levels MCLs for regulated chemical compounds are set forth in the National Primary Drinking Water Regulations 40 CFR § 141.11. The water utility tests for all regulated compounds on an annual basis. Reducing the water system's susceptibility to chemical compounds can be accomplished by working directly with businesses that use or store chemical compounds and educating the general public about the hazard chemicals pose to the city's water supply. In the event that a discharge occurs, proper preparation and response can mitigate negative impacts from the discharge. The first to respond to a contaminant spill would be the Ashland Fire Department, which combines with the City of Superior Fire Department to form a Type II regional hazardous materials response team. Additionally, the fire department also performs semi-annual fire inspections at every commercial structure in the city. Chemical compounds that are a fire hazard also pose a threat to drinking water. The public works department should coordinate with the fire department to help prevent spills of chemical compounds through the fire inspection program.

7.1.5 Redundant Water Intake

The City of Ashland has received grant funds from the U.S. Army Corp of Engineers for the construction of a new drinking water intake to serve the city water system. The total estimated cost of the project is around $3 million with the grant providing $1.9 million. The city is pursuing funds from the WI DNR Safe Drinking Water Loan program (SDWL), which offers low interest rates and principal forgiveness to low income communities for water system improvements. The benefits of the SDWLP will allow the city to limit user rate increases to cover the cost of the new intake. Preliminary design concepts include the incorporation of the new intake piping into the existing pumping facility in a manner that will allow the continued use of the existing intake piping as backup source of water supply. Although the existing intake piping has exceeded its useful life and will eventually begin to fail, rehabilitation of some portion of the piping will likely allow the city to continue use of the existing intake as a redundant source of water supply, as recommended by the WI DNR.

7.2 Point Source Pollution Load Reductions

7.2.1 Municipal Wastewater Treatment Plant Effluent Load Reductions

The table below shows monthly maximum influent flow at the Ashland wastewater treatment plant. Influent flow data show that Ashland sees excessive seasonal fluctuations in influent flow, highlighting the need for collection system improvements to address the impact of I&I in the system, as described

	Influent Flow (mgd)				
	2012	2013	2014	2015	2016
January	0.65	0.76	0.84	0.86	0.83
February	0.66	0.70	0.78	0.77	1.08
March	1.37	0.96	1.33	1.08	2.47
April	1.06	2.84	3.45	1.18	1.86
May	1.69	3.14	2.64	1.06	1.55
June	1.76	1.90	1.61	0.94	1.98
July	0.84	1.05	1.02	0.87	1.49
August	0.70	1.37	1.24	0.81	0.84
September	0.66	0.90	1.78	0.76	0.87
October	0.79	1.62	1.29	0.77	0.90
November	0.73	1.07	1.19	1.11	
December	0.84	0.80	1.47	1.37	
Average	0.98	1.43	1.55	0.97	1.39
Maximum Month	1.76	3.14	3.45	1.37	2.47
Minimum Month	0.65	0.70	0.78	0.76	0.83

in Sections 7.2.2 and 7.2.3.

Table 6: Monthly Average WWTP Influent Flows (2012 To October 2016)

The Wastewater Utility anticipates that regulatory changes in the next 10-20 years will further work to reduce loading to Chequamegon Bay through the regulation of phosphorus and nitrogen. Modeling of Lake Superior is likely to result in lower effluent discharge limits for phosphorus than that described in Section 5.2.1 The WPDES permit currently does not require continuous monitoring of nitrogen levels. While the WI DNR may present alternatives such as adaptive watershed management and/or water quality trading, it is very possible that the regulatory changes will result in the need for additional wastewater treatment to reduce phosphorus and nitrogen levels in effluent, which would be referred to tertiary treatment in Ashland’s system.

In addition to the likelihood of necessitating a higher level of wastewater treatment in Ashland’s system, these changes may require modification to the city’s procedures for sludge disposal. More stringent regulation of phosphorus and nitrogen may require the city to spread sludge over a larger land area and/or haul it further away from Chequamegon Bay prior to application.

While these changes have not yet been established by the WI DNR, the city should monitor the regulatory process and prepare for the impact of these requirements from a technical and managerial perspective.

7.2.2 City of Ashland Sanitary System Load Reductions

During testing of the sanitary sewer collection system in 2019, city staff noticed an usually high amount of clear water flowing into a manhole near the water treatment plant. Field investigation revealed that backwash water, used to clean filtration units used in the drinking water treatment process, was being disposed of in the sanitary sewer system. Upon consultation with the WI DNR, it was determined that this water could instead be directly discharged to the storm sewer system and Chequamegon Bay, as it was free of any of the chemicals used at the water treatment plant. Piping modifications have since resulted in the elimination of approximately 60,000 gallons of water per day, or roughly the equivalent of 3,500 showers at a residential home, of clearwater discharge to the sanitary sewer system.

City staff are currently pursuing an aggressive program to evaluate the collection system and anticipates the identification and elimination of similar discharges to the sanitary sewer as these efforts are further implemented.

7.2.3 Sanitary Sewer Overflow/Inflow and Infiltration Reduction

The first step to managing the I&I issue is to measure the extent of the problem; a 2009 report completed by Short Elliot Hendrickson on behalf of the city started this process. The city's sewer collection system was divided into 13 different metering districts, with wet and dry weather flows measured in each district in order to quantify the extent of I&I.

Flow Meter Summary

Sewer District	Daily Dry Weather Flow (DWF) mgd	Daily Wet Weather Flow mgd	Peak I/I Flow Rate mgd	Ratio of Peak I/I Flow Rate vs. DWF
1	0.191	0.770	2.721	14.2
2	0.059	0.230	1.519	25.7
3	0.042	0.158	1.247	29.7
4	0.026	0.125	0.691	26.6
5	0.057	0.164	0.792	13.9
6	0.047	0.067	0.236	5.0
7	0.122	0.482	3.653	29.9
8	0.028	0.226	6.204	221.6
9	0.049	0.097	0.468	9.6
10	0.040	0.050	0.120	3.0
11	0.155	0.425	1.573	10.1
12	0.067	0.351	2.281	34.0
13	0.001	0.004	0.034	34.0
Totals	**0.884**	**3.149**	**21.539**	

Note:
Dry weather flows were based on the data obtained during the week of June 29, 2006. Daily and peak wet weather flow rates were based on a storm event on July 29, 2006 when 0.92 inches in one hour and 1.34 inches of rainfall in a 24 hour period was recorded during flow monitoring.

Table 7: Flow Meter Summary Of Each Of The 13 Sewer Districts In The City Of Ashland.

Districts 7 and 8 were identified as the locations of the largest sources of I&I, with Districts 1, 2, 3, 4 and 11 as the next tier. Districts 7 and 8 were inspected via Closed Circuit Television (CCTV) and submersible camera in 2011, and tested through smoke and dye testing in 2013. Smoke or dye testing works by introducing either smoke or dye into the sanitary sewer system and determining where it comes out. CCTV inspection is used to look for cracks or other damages in a sewer pipe. Generally speaking, CCTV inspection identifies sources of infiltration, and smoke testing identifies sources of inflow.

Following this testing work, repairs consisting of pipe replacement through open cut excavation and pipe rehabilitation through cure in place pipe (CIPP) technologies, were completed in 2013 in parts of District 7. Collection system manholes were also replaced and/or rehabilitated.

In 2019, the city implemented an aggressive program for maintenance of the sewer collection system, utilizing contracted services to clean and televise 11 miles of sewer main in Districts 1, 3, and 4, followed by another 15 miles in Districts 2, 11, and 12. This level of maintenance has resulted in the city being compliant with goals established by the WI DNR for the first time in nearly 10 years.

Smoke testing to identify leaking sewer lines was also completed in 2019 but results were inconclusive, an indication that I&I is seen from multiple diffuse sources. A pilot study completed with a specialized firm from Finland resulted in the identification of a few large sources of inflow, including one from a private property. The city is working to partner with the property owner on necessary repairs, but future changes to applicable city ordinances and regulations will be necessary for the efficient organization and enforcement of similar repairs throughout the city.

More extensive work with the firm from Finland was planned for 2020, but work was disrupted due to the COVID-19 pandemic. Future inflow investigations are anticipated through partnership with this firm and their methods. Results from the CCTV inspections, along with data on the location of customer sewage backups, have been used to prioritize capital improvements to the sewer collection system. In 2020, almost 2/3 of a mile of sewer main was replaced in Districts 4, 11, and 12, while another 1.75 miles were rehabilitated via CIPP in Districts 7 and 8.

A 2021 CIPP project is planned for Districts 1, 3, and 4, as well as several high capacity, high criticality mains in Districts 7 and 8. This project will result in the rehabilitation of nearly 3 miles of sewer main and 22 manholes. It will be funded by a low interest loan with possible principal forgiveness from the WI DNR Clean Water Fund, which has the mission of administering "…affordable financial assistance to communities within Wisconsin for water infrastructure projects that protect and improve public health and water quality for current and future generations."

https://dnr.wisconsin.gov/aid/EIF.html

Future capital projects for the sewer collection system will be scheduled annually and supported by a funding allocation directed by the city council. Beginning in 2015, the council has directed a budget provision that $300,000 be annually allocated for collection system and asset related repairs.

The burden of these costs to city ratepayers may be offset by effective use of the DNR Clean Water Fund and the principal forgiveness and low interest loans that are prioritized for low income communities. In addition, city staff have identified federal grant funding available from the U.S. Army Corp of Engineers Section 154 program which authorizes the Corp to "provide assistance to northern Wisconsin public entities in the form of design, construction, and reconstruction assistance for water-related environmental infrastructure, resource protection and development projects. These include navigation and inland harbor improvement and expansion, wastewater treatment and related facilities, water supply and related facilities, environmental restoration, and surface water resource protection and development." https://www.mvp.usace.army.mil/Home/Projects/Article/621682/environmental-infrastructure-assistance-section-154-northern-wisconsin/

To help determine where I&I into a sanitary sewer system is occurring, the city has completed significant work to locate and record information relating to a variety of issues including but not limited to pipe/manhole condition, observed overflows, measured or observed surcharges, reported bypasses, customer backup complaints, and chronic maintenance activities. In addition to flow monitoring, there are other tests that will be used to identify sources of I&I. These tests include dye and smoke testing and visual inspection. Smoke or dye testing works by introducing either smoke or dye into the sanitary sewer system and determining where it comes out. Visual inspection can be done with remote television monitoring devices and used to look for cracks or other damage in a sewer pipe.

Efforts related to visual inspection of sewer pipes and manholes were completed in 2019 and 2020, and are planned to continue annually. Generally speaking, pipes in poor condition can be correlated to infiltration and are being replaced and/or rehabilitated after identification and within the utility's current financial ability.

The wastewater utility is in a good position to address the impact of I&I on the sewer collection system as a result of council direction to prioritize this work and the annual allocation of funds to support it. However, it is critical that the city continue to prioritize and support these efforts on a long term and ongoing basis in order to ensure control of I&I and ensure source water protection through the regular collection, treatment, and disposal of wastewater in accordance with WI DNR requirements.

Private Property Inspections

In 2013, the City of Ashland implemented a private property I&I program to reduce I&I and improve operations of the sanitary sewer system. This program was initiated because of basement backups and sanitary sewer overflow events. Private property inspections are completed by city staff during a half-hour appointment with a property owner where city staff look for illegal or inappropriate connections to the sanitary sewer system such as sump pumps, area drains, foundation drains, and downspouts. In recent years, this program has not been implemented due to a lack of staff time and a need to focus on measures to address public sources of I&I. As mentioned in Section 5.2.2, a planned project for complete replacement of the city's existing water meter system presents an opportunity to implement a program to systematically address these sources of I&I to the system.

7.2.4 Rural Sanitary Waste Load Reductions

A properly functioning septic system should not convey contaminants to the city's sourcewater. Onsite wastewater treatment and recycling systems are regulated at the state level by the Department of Safety and Professional Services under Chapter SPS 383, and county planning and zoning offices oversee implementation at the local level. In Bayfield County, sanitary permits are issued by the planning and zoning office. In-ground and mound systems are required to be pumped and reported to the county every three years. Maintenance and reporting requirements for holding tanks and ATU's are based on usage. In Ashland County, the planning and zoning office issues sanitary permits for private on-site wastewater treatment systems in the county. In-ground and mound systems are required by code to be pumped at specified intervals and maintenance agreements with licensed installers are required for more technically complex septic systems.

In addition to regulations, educating septic system owners on the proper care and maintenance of their systems is an important implementation measure. Educational information is available from the Wisconsin DSPS and the EPA, among others.

https://dsps.wi.gov/Documents/Programs/POWTS/GrassGreener.pdf

https://www.epa.gov/septic/septic-systems-outreach-toolkit

7.2.5 Incidental Spills of Hazardous Materials Reductions

Reducing the incidence of hazardous material spills in the source water protection area employs two strategies. The first is proper handling and storage of hazardous materials. The second is hazardous materials spill preparation and response.

Businesses in Ashland are inspected annually by the Fire Department to ensure that handling, storage, and disposal of chemicals and chemical waste is in compliance with all state and federal requirements. The use of Material Safety Data Sheets (MSDS) is required on the premises and all proper personal protection equipment (PPE) must be worn. Disposal of these chemicals must be documented. The City of Ashland Wastewater utility does not allow chemical dumping into the Sanitary Sewer. The city must be notified of any questionable dumping to the sanitary sewer; even just large amounts of water must be authorized.

The WI DNR requires the city wastewater utility to conduct a combination of surveys and facility inspections at locations known to be responsible for handling of mercury to ensure safe and effective handling and disposal. Testing of mercury and other hazardous contaminants in effluent disposed at the WWTP indicates low levels of these contaminants and supports the effectiveness of existing city programs.

In the event of a hazardous material spill, Wisconsin has a hazardous materials response system in place (WHMRS) overseen by the Wisconsin Department of Military Affairs. The Ashland Fire Department is a "Type 3" hazmat team which can assess and mitigate known chemical spills. Additionally, the Ashland Fire Department can join with the Superior Fire Department to become a joint "Type 2" hazmat team which can assess and mitigate known and unknown chemical spills.

7.3 Urban Nonpoint Source Pollution Load Reductions

7.3.1 Urban Runoff Load Reductions

Stormwater Utility

Managing stormwater quality is a requirement, particularly for communities located adjacent to pristine water resources. As such, municipal stormwater management programs are becoming an important part of a community's infrastructure and overall operational costs. As comprehensive stormwater management programs grow in complexity they begin to resemble electric, water, and wastewater utility systems. It is becoming increasingly common to consider stormwater management as a public utility.

Currently, there are about 30 stormwater utilities in Wisconsin. They have been developed by municipalities as an equitable way of paying for stormwater management requirements imposed by federal law. A stormwater utility provides a community with a stable funding source that more fairly and equitably collects revenue from those who are creating the need for services. Under the current property tax system, homeowners pay about 70 percent of the cost of municipal services. However, a larger percentage of stormwater facilities and programs are focused on the problems caused by runoff from large commercial and industrial impervious areas. A stormwater utility makes everyone pay their fair share of the cost of stormwater management.

A stormwater utility (like water and wastewater) provides a service to the public supported by charging fees to its users. The services include:

- drainage
- flood damage protection
- water quality management
- erosion and sediment control

The fee is based on the amount of stormwater runoff that properties generate. A successful program provides a far more equitable way of generating revenue to cover municipal expenditures associated with the aforementioned services for two main reasons: first, fees are based on use and second, all properties pay – including those that are tax exempt. This shifts financial tax burden away from homeowners and some businesses.

As stated above, over 30 communities in Wisconsin have utilities, and surveys indicate that many more are considering it out of necessity. Both the City of Washburn and the City of Superior have implemented utilities to cover stormwater related expenditures. Creation of a stormwater utility ultimately should be the future long-term end goal of the City of Ashland.

In 2006, the city interviewed firms interested in assisting the city with studying the possible creation of a stormwater utility. Three firms presented their qualifications at the meeting: OMNNI Associates, MSA Professional Services, and SEH. Based on qualifications and project approach, MSA was selected to assist with completion of a feasibility study. Their goal was to perform a land use analysis and then estimate what the utility rates would be for various properties throughout the community. From this, they were to assist in revealing the financial impacts to the city's operational budget and how the utility might provide funding to construct and improve the city's stormwater management infrastructure. The feasibility study was completed in June 2007, and it identified a number of benefits to creating a Stormwater Utility, including the following:

- It will help protect our environment, Lake Superior, and the health and welfare of our citizens by providing the financial means for better management of stormwater and other surface water discharges.
- It will contribute to the costs of maintaining the city's infrastructure by spreading those costs on an equitable basis.
- Existing taxpayers will not be the sole contributors to the utility; the costs will be shared by all users with approximately 31% borne by property tax-exempt entities.

At the time of the study, it was estimated that the annual revenue requirement for a stormwater utility in Ashland was $555,000. This would result in an Equivalent Residential Unit (ERU) charge of approximately $5.00 per month for an ERU of 3,160 square feet of impermeable surface. The enabling ordinance, operating policies, and final revenue requirement were anticipated to be developed for future Council approval prior to June of 2009 in anticipation of billing for the second one-half of 2009. On November 18, 2008, the city council voted in opposition of creating a stormwater utility.

Since that time, the Wisconsin Legislature has made it very difficult for municipalities to implement any new fees. On or after July 2, 2013, if a municipality adopts a new fee or increases fees to cover services (which were partly or wholly funded in 2013 by property tax levy), that municipality must reduce its levy limit in the current year by the amount of the new fee or fee increase, less any previous reductions. This also applies to payments in lieu of taxes. The end result is that if a stormwater utility is created there will be no new revenues to allocate to stormwater improvements as the city would have to reduce the total levy elsewhere. A legislative amendment would be necessary to make it beneficial for the city to pursue the creation of a stormwater utility. Although the creation of a stormwater utility is not feasible at this time, a long-term priority with a funding strategy will need to be developed in order to provide a means for implementation that does not further diminish available resources for other city priority programs.

Ongoing City Efforts

The City continues to seek opportunities to best reduce nonpoint source pollution and source pollution within the storm sewer system. Road reconstruction and paving projects frequently result in reduced roadway widths and associated runoff. A 2019 project at Maslowski Beach saw the installation of a bioswale for the collection, treatment, and disposal of runoff. Another example is the construction of the new police station, which incorporated onsite facilities for stormwater treatment. Reducing nonpoint source pollution should be a top priority in any development or redevelopment projects.

Green Infrastructure

Green infrastructure efforts must be balanced with general stormwater infrastructure maintenance. As described above, the city requires additional resources to perform general stormwater maintenance such as cleaning debris out of the system. The city has equipment and staff knowledge to perform this work but lacks manpower to perform periodic maintenance and capital resources to address depreciation of existing stormwater infrastructure. City resources should not be funneled into green infrastructure efforts until the existing vital parts of the stormwater system are being properly maintained. Well maintained stormwater infrastructure is a key component to stormwater runoff management and should be the city’s first priority with installation of green infrastructure being a secondary goal.

<u>7.3.2 Streambank Erosion Within The City Load Reductions</u>

The city is currently conducting several projects to reduce streambank erosion within the city and focusing on reducing streambank erosion will be a priority in future infrastructure projects. In 2021, a city project will result in replacement of a storm outfall structure near Main St E and 29th Ave E damaged during a major storm event. This location was identified by MSA Professional Services as one of the locations contributing significant amounts of sediment. The replacement structure will allow for effective dissipation of energy from the water flowing from the outfall in order to reduce streambank erosion.

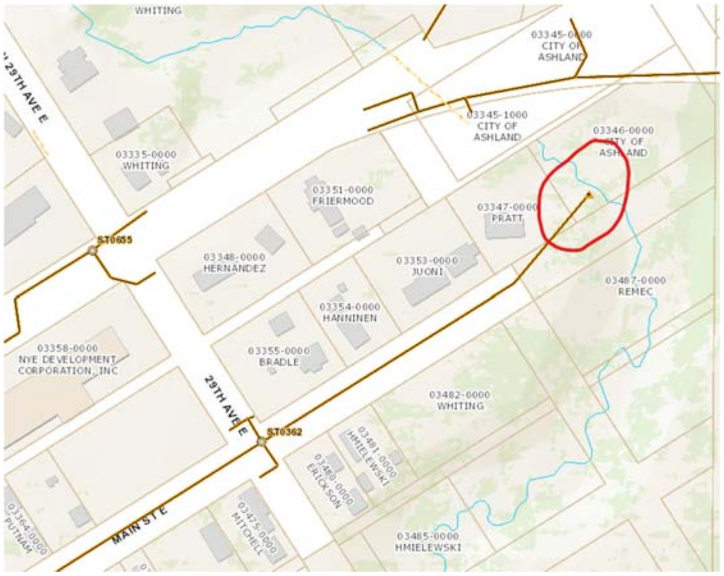


Figure 20: Location Of The City's 2021 Stormwater Outfall Replacement Project

The reconstruction of Stunz Ave from US2 to the Ore Dock will include green infrastructure to reduce quantity and potentially improve the quality of stormwater collected for disposal to the adjacent Bay City Creek at two different outfalls. The use of similar techniques on future projects will be evaluated to most effectively utilize limited resources for stormwater control and management.

The city should implement similar, additional projects as funds are available. However, under the city's current funding structure, stormwater infrastructure will continue to compete for funding with parallel needs such as roadway improvements, public safety, parks, and general operation of city facilities and services. This makes any increase in funding for improved stormwater infrastructure difficult without implementation of a funding source such as a stormwater utility, as identified in Section 7.3.1.

7.3.3 Construction Site Load Reductions

Prior to construction activities that disturb a land area of one acre or more, a DNR storm water construction site general permit must be acquired. The permit requires landowners to install best management practices to control stormwater and limit the amount of sediment runoff. Best management practices are divided into 2 categories: erosion control and sediment control. Erosion control BMPs directly protect the disturbed soil surface. Sediment control BMPs aid in the removal of sediment from water after the erosion process has already begun. Appropriate BMPs must be selected and properly installed based on the most recent Wisconsin Technical Standards (see below). Additionally, engineers and builders should consult the Wisconsin Department of Transportation Product Acceptability List (PAL) for guidance in installation and proper use of erosion and sediment control products (Montgomery Associates Resource Solutions LLC, 2016). The permit also includes post-construction stormwater management requirements. The city continues to incorporate this requirement into all municipal projects and requires all contractors and agents working for the city to adhere to applicable WI DNR requirements.

Current Wisconsin Technical Standards:
https://dnr.wisconsin.gov/topic/Stormwater/standards/const_standards.html
Product Acceptability List:

http://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrces/tools/pal/default.aspx

The City of Ashland requires a separate development permit for grading, filling, and/or excavation of land in excess of 50 cubic yards of material, not associated with any other development. Depending on the extent of the work, an erosion and sediment control plan, pursuant to Section 8.2 Construction Site Erosion Control and Section 8.3 Post Construction Stormwater Management of Ashland's Unified Development Ordinance (UDO), may be required.

7.3.4 Road Salt Usage Load Reduction

The city recognizes the safety concerns associated with icy roads and winter driving conditions and tries to maintain, to the extent practicable, reasonably clear roads during the winter months. Additionally, the city recognizes the potential water quality concerns that come from road salt-laden runoff from roadways. It is important to find a balance between maintaining safe roads and reducing the amount of road salt used. Essentially, the goal is to use the least amount of salt possible to get the job done.

Road salt is applied by city, town, and county employees responsible for clearing roads, parking lots, sidewalks, and trails, as well as private contractors and residents. The strategy for reducing road salt-laden runoff to Chequamegon Bay includes education, outreach, and implementing best practices.

City vehicles used for winter maintenance on emergency routes are equipped with pre-wetting equipment, as designated by city ordinance Chapter 542, which allows for the application of a liquid deicing chemical that allows for a more effective adherence of salt to roadway surfaces. This allows for a 20-30 percent reduction in overall salt use. These vehicles also allow for salt application at lower speeds to further increase the efficiency of the salt adherence. (https://epd.wisc.edu/tic/wp-content/uploads/sites/3/2019/12/Bltn_022_Prewetting_Anticing.pdf)

The city only applies 100 percent road salt on approximately 30 miles of designated emergency routes. To assist in determining when to apply roadway salt and at what concentration, the city uses the WI Department of Transportation's Maintenance Decision Support System (MDSS), which combines small scale weather forecasts with information about the roadway to provide recommendations on winter maintenance treatments, such as the application of roadway salt. (https://wisconsindot.gov/Documents/doing-bus/local-gov/hwy-mnt/mntc-manual/chapter06/06-25-10.pdf)

The remaining 36 miles of city streets and alleyways are maintained with a salt-sand mixture that includes very low levels of salt intended to prevent the material from freezing prior to application. These streets are low speed areas with low traffic volumes. Avoiding the use of road salt significantly reduces the amount of salt applied in the city. This salt-sand mix is also applied to designated emergency routes during periods when air temperatures are below 10 degrees fahrenheit, as road salt has little melting effect in severely cold weather. The combination of these practices has allowed the city to reduce the amount of roadway salt applied in recent years, as shown by the table below.

Year	Salt (TN)	Snowfall (in)
05/06	882	68
06/07	637	57
07/08	929	85
08/09	788	43
09/10	666	37
10/11	753	55
11/12	620	45
12/13	774	64
13/14	1137	122
14/15	638	40
15/16	687	46
16/17	471	37
17/18	643	80
18/19	631	No data
19/20	586	80

Table 8: Snowfall Totals Collected From NOAA's "Global Summary Of The Month" Dataset At The JFK Airport In Ashland, WI.

City staff in the Streets Department have received training from a variety of organizations on the effective planning and management of roadway salt application, including the Wisconsin Salt Wise Partnership, which is a coalition of organizations from across Wisconsin working together to reduce salt pollution in our lakes, streams, and drinking water. The primary goal is educating residents, leaders, and winter maintenance professionals on salt pollution and solutions, providing training, and promoting best practices to reduce salt pollution and recognize contractors committed to using the right amount of salt for conditions.

The city continues to provide this training to new employees. The city also continues to evaluate new technology and alternatives with the potential to reduce road salt application, such as new plow blades for existing equipment that can more effectively remove ice from roadways.

7.4 Rural Nonpoint Source Pollution Load Reductions

The primary organizations working to reduce rural Non Point Source (NPS) pollution are the county Land & Water Conservation Departments (LWCDs) of Ashland and Bayfield County. The history of LWCDs in Wisconsin began in 1937 with the state statutes Chapter 92, which created Soil Conservation Districts and enabled the state to receive technical assistance from the federal Soil Conservation Service (now the Natural Resources Conservation Service). Through the 1940s and 1950s, most of Wisconsin's counties formed conservation districts which remained in place until Chapter 92 was revised. In 1982, the conservation districts were abolished, and their authority was transferred to the newly created Land Conservation Committee (LCC), which is part of the county board and possesses legislative authority. The primary role of the LCC is to create and implement county conservation programs as well as state and federal conservation programs. The LWCD implements the county programs including planning and technical assistance for natural resource conservation. The knowledge and expertise of both Bayfield and Ashland County LWCDs were instrumental in developing this section of the plan.

7.4.1 Sediment Load Reductions

The Mary Griggs Burke Center for Freshwater Innovation, along with other partners, have completed one bluff restoration project on North Fish Creek, and another is scheduled to begin construction in the summer of 2021. Prioritizing restoration in this area of the watershed is vital to reducing sediment loads in Chequamegon Bay since eroding bluffs in North Fish Creek are the primary contributors of sediment into the watershed.

Figure 21: An Eroding Bluff On North Fish Creek Was Stabilized In 2018 Using A Log Cribwall. Similar Projects Are Recommended To Decrease The Sediment Load Of Chequamegon Bay.

7.4.2 Hydrodynamics

The Mary Griggs Burke Center for Freshwater Innovation, in conjunction with the United States Geological Survey, the U.S. Fish and Wildlife Service, and the National Parks Service, conducted a hydrodynamic modeling project to determine predominant patterns of surface water movement in Chequamegon Bay. This project used circular regression modeling, wind and water data from the Ashland Breakwater Lighthouse, and water profile trends throughout the bay to characterize water patterns. During 2018-2019, Acoustic Doppler Current Profiler data were collected at 14 field visits. The goal was to use data from one fixed station to predict water patterns at other locations in Chequamegon Bay. The data collected from the lighthouse showed that a change in water direction took up to 4.5 (±1) hours on average after a significant change in wind direction. Water level loggers attached to buoys collected temperature data at the mouth of Chequamegon Bay (between Houghton Point and the tip of Long Island) oriented in a Southwest to Northeast direction. Based on this study, northeasterly and southwesterly winds drive water circulation. More work needs to be done to study the impacts of seiche and bathymetry on water patterns. The Lake Superior Nearshore Monitoring group is spearheading future research efforts. Bathymetry mapping efforts are planned for 2021. The city does not need to be directly involved with this project at this time, but it is important to keep up to date with research findings, which will help anticipate potential threats to the drinking water system based on patterns of pollutant movement.

7.4.3 Nutrient Load Reductions

Nutrient load reductions are achieved by reducing the amount of nutrient laden surface water runoff that reaches lakes and rivers and when the amount of nutrients contained in the surface water runoff is reduced. Agricultural runoff management is regulated by the state through NR151, which sets performance standards and prohibitions for agriculture operations. A summary of these standards which will help achieve nutrient load reductions is included below.

NR151 Agricultural Performance Standards

- Sheet, rill, and wind erosion: All cropped fields shall meet the tolerable (T) soil erosion rate established for that soil.
- Tillage setback: No tillage operations may be conducted within 5 feet of the top of the channel of surface waters of the state.
- Phosphorus index: Croplands, pastures, and winter grazing areas shall average a phosphorus index of 6 or less over the accounting period and may not exceed a phosphorus index of 12 in any individual year within the accounting period.
- Manure storage facilities: All new, substantially altered, or abandoned manure storage facilities shall be constructed, maintained, or abandoned in accordance with accepted standards. Failing and leaking existing facilities that pose an imminent threat to public health or fish and aquatic life or violate groundwater standards shall be upgraded or replaced.
- Process wastewater handling: There may be no significant discharge of process wastewater to waters of the state.
- Clean water diversions: Runoff from agricultural buildings and fields shall be diverted away from contacting feedlots, manure storage areas, and barnyards located within water quality management areas (300 feet from a stream or 1,000 feet from a lake or areas susceptible to groundwater contamination).
- Nutrient management: Agricultural operations applying nutrients to agricultural fields shall do so according to a nutrient management plan.

Manure Management Prohibitions

- No overflow of manure storage facilities.
- No unconfined manure piles in a water quality management area.
- No direct runoff from feedlots or stored manure into state waters.
- No unlimited livestock access to waters of the state in locations where high concentrations of animals prevent the maintenance of adequate or self-sustaining vegetative cover.

NR 151 defines when landowners and producers are required to meet compliance standards. In general, if cropland is new, or if cost-sharing has been offered, then compliance is required.

Local Regulations on Livestock Operations

Local governments have three basic options to regulate livestock operations: control land use through zoning districts, adopt ordinances that require permits for new and expanding livestock facilities, or rely on existing state laws to regulate operations. Additional information on these three options can be

found on the DATCP website:
https://datcp.wi.gov/Pages/Programs_Services/LSLocalImplementation.aspx

Ashland County: Ashland County has adopted NR151 rules and is able to enforce NR 151 regulations at the county level.

Bayfield County: Bayfield County has adopted NR151 rules and is able to enforce NR 151 regulations at the county level. In addition, they have adopted a number of county ordinances to manage large scale livestock operations.

- Animal Manure and Center Pivot Irrigation Ordinance https://www.bayfieldcounty.wi.gov/DocumentCenter/View/3591/TITLE-5-CHAPTER-3-Sec-5-3-1-Application-of-Liquid-Livestock-Manure-Using-Spray-Irrigation-Systems?bidId=
- Large-Scale Concentrated Animal Feeding Operations Ordinance https://www.bayfieldcounty.wi.gov/DocumentCenter/View/3599/TITLE-5-CHAPTER-6-Sec-5-6-1-Large-Scale-Concentrated-Animal-Feeding-Operations-Ordinance?bidId=
- Human Health Hazards Ordinance https://wi-bayfieldcounty.civicplus.com/DocumentCenter/View/4799/Title-5-Chapter-8---Human-Health-Hazard?bidId=

Counties offer cost share for farmers who want to develop nutrient management plans. Farms work with the county and UW Extension Agricultural Agent to develop and implement the nutrient management plans.

7.4.4 Land Spreading Load Reductions

As discussed earlier in section 5.5.5, waste from municipal wastewater treatment, septic sludge, and industrial waste is disposed of through land application. All of these applications are required to have a WPDES permit. The WPDES permit process is intended to reduce the pollutant load from land spreading of waste. The WI DNR Division of Environmental Management, Water Quality Program, Wastewater section is responsible for issuing WPDES permits and compliance enforcement. Additional information can be found on the DNR website:https://dnr.wisconsin.gov/topic/Wastewater.

The City of Ashland has the most direct control over land spreading of municipal sludge from Ashland's wastewater treatment plant. The city has a WPDES permit (#0030767) that regulates the city's land spreading. The wastewater utility is responsible for complying with the terms of the WPDES permit and completing all required testing. The wastewater treatment plan is under the supervision of the City of Ashland Public Works Department. The wastewater department should consider SWP during long range planning and look for opportunities to upgrade facilities and improve processes to reduce pollutant runoff and improve source water quality.

The wastewater department is currently investigating the potential of contracting for sludge processing and hauling services. Contracted services may offer the potential to spread municipal sludge in an area that has less potential risk to the city's source water.

7.4.5 WPDES Permitted Concentrated Animal Feeding Operation (CAFO) Load Reductions

There are currently no CAFOs within the source water protection area. If a CAFO were developed, NR243 requires CAFOs to obtain a Wisconsin Pollution Discharge Elimination System (WPDES) permit. The permit requires these farms to develop and follow nutrient management plans.

In 2015, a proposal by Iowa-based Reicks View Farms to build a 26,000 hog CAFO capable of producing 10 million gallons of manure each year brought a new awareness to the issues surrounding CAFOs. The proposal spurred an interest in protecting water quality in Chequamegon Bay and is part of the reason the City of Ashland decided to develop a source water protection plan. Development of the proposed CAFO has not proceeded, likely due to the inability of Reicks View Farms to secure permission to spread manure on enough nearby fields. Since the proposal, Bayfield County has put in place several ordinances that provide a higher level of protections on water quality by regulating CAFOs and Animal Manure Storage.

As with any regulating system, it is only as good as the enforcement behind it and Wisconsin has had a number of issues enforcing CAFO regulations. Problems include CAFOs operating on expired permits, lack of inspections, and farms not submitting required reports. This lack of enforcement is likely a result of cuts in DNR staffing and regulating power. Local action, such as with the Bayfield County ordinances and the City of Ashland source water protection plan are necessary to ensure that pollutant loads from agricultural operations are balanced with the use of the watershed for a variety of beneficial purposes, including but not limited to drinking water source, fisheries, recreation and tourism.

7.5 Management Measures To Achieve Groundwater Source Protection

The primary focus of this plan is protecting the source of water for the City of Ashland's public drinking water supply which serves a majority of the residents of the City of Ashland. However, it is important to acknowledge that groundwater is utilized as the source of drinking water by many people within the SWP area. This includes residents of the city that are not served by the municipal water supply and utilize private wells. Additionally, a majority of the SWP area lies outside of the City of Ashland and not served by a municipal water supply. Finally, there are non-municipal public wells within the SWP area that serve people at places such as work, school, church, or in a transient capacity at restaurants or public parks.

7.5.1 City Of Ashland Private Well Ordinance

Cities have the authority to regulate private wells within the municipal boundary. Private wells in the City of Ashland are regulated under Chapter 705 *Water Utility Rates and Regulations*, Section 705.19(b).

Generally speaking, the city can better ensure the quality and reliability of drinking water through the public water system, rather than private wells, due to the technical staff and regulation associated with the system. The city should more strongly enforce the provisions of the above ordinance and also consider modifications to require connection to the public water system for all residences, commercial, industrial, and institutional entities within the municipal boundary in a designated time period. Currently, the ordinance allows private wells to be maintained in perpetuity, albeit with some conditions.

7.5.2 County Well Testing And Education Programs

Private well water quality is not regulated and the protection and maintenance of private wells is largely the owner's responsibility. However, a better understanding of their well water can be facilitated through education and testing programs. One of the best ways to implement a private well testing and education program is at the county level. A robust program would include scheduling a well testing day or event where well owners are encouraged to collect and submit a water sample to the county. Promoting and spreading the word about the testing event, and providing follow up education about what the testing results mean and how they can continue to protect their wells. This has the added benefit of providing the county with a snapshot of the groundwater quality in the county. These programs are typically administered through either the county Land & Water Conservation department or the county health department or a joint effort by both. General information on private well testing can be found on the DNR website. https://dnr.wi.gov/regulations/labcert/documents/testsforwell.pdf

Bayfield County provides in-house total coliform bacteria testing for residents as well as third party homeowner test kits through the UW-Oshkosh Environmental Research and Innovation Center. Information on Bayfield County's water quality testing program is available here: https://www.bayfieldcounty.org/230/Water-Quality-Testing

Ashland County Public Health department has an in-house water quality testing program for both bacteria and nitrate for a cost of $25 for each sample . Information on Ashland County's water quality testing program is available here:https://co.ashland.wi.us/wellwatertesting

7.5.3 Capture Zone Delineation

Having a better understanding of where groundwater pumped from a well comes from allows for better decision making on how to protect the well. While it is not practical to delineate the capture zones for the many private wells in the SWP area, delineating capture zones for the 28 non-municipal public supply wells within the SWP area could be completed with a reasonable amount of effort. The City of Ashland should support efforts to work with Ashland and Bayfield counties to better understand and delineate groundwater capture zones for non-municipal public wells within the SWP area.

7.5.4 County WHP Ordinance

A common regulatory approach to protecting public wells is adopting a wellhead protection ordinance. A wellhead protection ordinance works to protect groundwater quality near a well by regulating land use within a specified distance of the well and maintaining minimum setbacks from potential groundwater contaminant sources. Municipalities often use this approach, but it can easily be expanded to non-municipal public wells at a county wide scale. Several counties in Wisconsin, including Portage, Eau Claire, and Chippewa have county wellhead protection ordinances in place. The City of Ashland should support efforts to work with Bayfield and Ashland counties to develop and adopt county wellhead protection ordinances.

7.6 Education And Outreach

The following section outlines the City of Ashland's strategy for educating its customers and residents within the SWP area as well as strategies for coordinating efforts with other local entities.

7.6.1 Community Education And Outreach

The City of Ashland plays a major role in providing resources, services, and information to residents, commercial entities, and industries within the city in order to promote and encourage source water protection measures. The drinking water system provides an annual report to customers of the system, as required by the EPA and WI DNR. This report is referred to as a "Consumer Confidence Report" and provides customers with information on water quality testing results for the municipal water supply as well as educational information regarding potential sources of contamination.

The water utility recently switched to full size water bills, moving away from postcard-type documents that have been used in the past. Full size water bills have allowed for more effective communication with customers regarding issues with the drinking water system, including potential source water issues, as water bills are mailed to customers at regularly scheduled intervals.

The wastewater utility has recently developed educational materials regarding the proper disposal of waste products in order to allow for reliable operation of the sewage collection system and wastewater treatment plant. These educational materials have been distributed to the public via the water bills. The wastewater utility's WPDES permit also requires outreach to encourage reduction of mercury in the wastewater effluent discharge. Residences are directed to annual "Clean Sweep" events to allow for the safe disposal of potentially hazardous materials while businesses (e.g. dentists), commercial entities, and other institutions (e.g. schools) known are periodically contacted and potentially inspected to ensure adequate measures are being taken for management and disposal of mercury.

City beaches are monitored seasonally for the presence of E. coli. The city partners with Northland College to perform the testing, which is funded by the WI DNR. Any exceedances and swimming advisories or beach closures are reported to the WI DNR and health department. Notices are provided to the public through posted signs, the city website, and social media.

In 2019, the city hired two interns sponsored by Americorps. These staff members were focused on educational and outreach efforts related to water quality and emphasized the importance of stormwater management. Programs such as "Adopt A Storm Drain" were a main focus to foster participation from community members. Other projects included promotional videos and flyers distributed through the water bills to encourage the community to take measures such as disconnecting sump pumps and reducing water usage during storm events in order to reduce the frequency and probability of sewage overflows. The city should seek opportunities to staff this type of effort in the future, either in a short term or permanent capacity, as well as look to broaden the approach to incorporate sanitary sewer and drinking water management.

7.6.2 Coordination With Local Organizations

The City of Ashland coordinates with local groups and organizations on a variety of efforts to protect water quality in the Chequamegon Bay. The city should seek additional opportunities to work with organizations to promote source water protection or activities that protect and improve water quality. The following are groups or organizations that the city has worked with in the past or could coordinate with on future efforts.

- League of Women Voters

    - The League of Women Voters has collaborated with the City of Ashland on sewer overflow issues.
- Superior Rivers Watershed Association
    - The Superior Rivers Watershed Association's mission is to promote and protect clean water resources in Wisconsin's Lake Superior basin. They accomplish this through water quality monitoring, watershed restoration, and educational programing. Superior Rivers Watershed Association has a staff member on the Ashland Source Water Protection committee. https://www.superiorrivers.org/
- Lake Superior Collaborative
    - The City of Ashland is a partner-at-large of the Lake Superior Collaborative (LSC). LSC is a network of organizations working in partnership to coordinate protection, restoration, and climate resilience efforts in the Wisconsin portion of the Lake Superior watershed. https://fyi.extension.wisc.edu/lakesuperiorcollaborative/
- UW Extension
    - The City of Ashland has worked with the Ashland County UW-Extension's Community Development Educator to promote various water quality protection efforts.
- Local Schools
    - The City of Ashland should look for opportunities to work with local elementary, middle and high schools to educate students on the importance of protecting water resources.
- City of Ashland's Public Works Advisory Committee

7.7 Administration And Oversight

This section describes how the maintenance and ongoing implementation of the source water protection plan will be achieved. The plan was developed by the Public Works Department with oversight and input from the Source Water Protection Committee.

7.1.1 Administration

The final source water protection plan will be Administered by the Public Works department under the direction of the Public Works Director.

7.1.2 Coordination With Other Departments

The plan has been provided to other city departments for awareness and discussion regarding the implementation. Source water protection impacts all departments in a variety of ways but key stakeholders within the city include the Public Works, Finance, Planning, Parks and Recreation, and Fire/EMS Departments.

As described above, the Public Works Department is responsible for administering the plan as well as the development of various projects and initiatives related to the drinking water and sanitary sewer systems. The Finance Department needs to be aware of these projects and initiatives in order to ensure financial support is available and coordinate the need for financial resources related to source water protection with existing needs within the city. The Planning Department has the ability to impact source water protection through the oversight provided to development within the city, such as land use and zoning regulations. In addition, the Planning Department is responsible for ensuring that developers within the city incorporate measures related to green infrastructure and best management practices for stormwater, as directed by the City Council. The Parks and Recreation department administers water quality monitoring on city beaches and any closures. In addition, many of Ashland's parks are situated on the waterfront and the mission of the Parks and Recreation department is to promote and encourage use of the recreation facilities within the city. Fire/EMS conducts annual fire inspections on facilities that handle or store hazardous chemicals and provide emergency response in the event of a hazardous chemical spill. Additionally, some products used by the fire department during certain emergency responses have the potential to impact surface water quality.

The source water protection plan should be used as a guidance and reference to these departments as they conduct planning activities and implementation related to their department's mission and associated goals. Departments should periodically review the plan to ensure members are familiar with its recommendations and goals.

7.1.3 Ashland City Council

The city council plays a vital role in administering the source water protection plan by supporting the work done by city departments to improve source water quality. This includes helping to support agenda items that specifically relate to improvements in water quality and developing policies that promote improved water quality. Finally, the city council directs funding and should consider ways to increase or create funding mechanisms to implement source water protection.

8. CONTINGENCY / COMMUNICATION PLAN

8.1 Introduction

8.1.1 Purpose

This plan provides guidance for the City of Ashland to communicate with agencies and the public in case of a spill, contamination event, or other situation that poses a potential threat to public health and safety. The procedures and responsibilities described in this plan apply to all City of Ashland public water systems. Specific contact details for individual systems are provided in the corresponding Facility Emergency Response Plan.

8.1.2 Regulatory Requirements

Wisconsin Administrative Code Section NR 810.23(2) requires public water systems to develop a "communications plan that documents the manner in which the public water utility, working in concert with state and local emergency response agencies, shall notify the local health agencies and the public of the initial spill or contamination event and provide updated information related to any contamination or impairment of the source water supply or the system's drinking water supply, with an initial notification to occur in any event no later than thirty minutes after the public water system becomes aware of the spill, release or potential contamination of the public water system."

The city's primary tool for communications plan related to the drinking water system is as a stakeholder in the Ashland County Emergency Operations plan (EOP). Discussions with the WI DNR have brought up that this plan needs to be updated. The city should participate in and support efforts to update the Ashland County EOP.

8.2 Roles And Responsibilities

The city communication team listed in the EOP includes the City Administrator, Public Works Director, and Utility Manager as city staff responsible for working cooperatively with the Ashland County Emergency Response Team to notify the public in a situation that poses a potential threat to public health and safety. The team will also provide updated information related to the situation as appropriate.

8.2.1 Designated Spokesperson

The City Administrator is designated to serve as the Public Information Officer (PIO) for the City of Ashland and is authorized to speak on behalf of the city to partner agencies, the public, and the news media. The City of Ashland Designated Spokesperson may authorize and/or direct others to issue information that has been approved by the management team.

8.2.2 Interagency Coordination

The Designated Spokesperson, President and other members of the communication team will coordinate with PIOs from other agencies on statements, updates, joint press conferences, etc. as needed. Message coordination between emergency response agencies, health agencies and water utilities is important when responding to an incident/event.

Wis. stat 323.14 establishes Ashland County as the lead agency coordinating emergency response in the County. As such, the EOP establishes procedures and policies for emergency management that the water utility, with the help of the city, can follow to notify the public and effectively mitigate risk in a situation that poses a potential threat to public health and safety.

In addition, the city has adopted the Ashland County Hazard Mitigation Plan, which identifies how the city should coordinate with other local and regional agencies on public communication in the event of a water source disruption.

8.3 Communication Procedures

8.3.1 Core Messages And Actions

Clear, consistent, and timely messages are important for effectively communicating information about an incident/event with the public. These messages should include only relevant information and clear actions presented in positive terms (e.g., “stay calm” instead of “don’t panic”). Repeating a message often helps the audience retain the information.

Message Development

- What happened? (who, what, where, why, when, how)
- What is being done to address it?
- What are the health impacts, if any?
- What are customers instructed to do, if anything?
- When and where will information updates be available?
- When will the problem be resolved?

The Center for Disease Control (CDC) has developed templates that can be used in any type of emergency and includes guidelines for risk communication principles and message components. Key points when communicating during an incident/event include the following:

- The health and safety of our customers and our employees is our number one priority. We are working on the matters we have identified so far with the information available to us at this time.
- Clearly define whether the city's drinking water is safe to continue using for drinking water purposes or if an alternative drinking water source (such as bottled water) will be provided.
- Our city employees are working very hard to investigate the situation and will help provide possible resolutions to matters we find during the investigation.
- We are working with our partners at the local, state, and federal level to resolve the situation as quickly and as safely as we can.

8.3.2 Communication Methods

Communications with the public regarding source water quality issues may be provided by several different methods depending on the situation. The City of Ashland will notify customers potentially affected by an incident/event using one or more of the following options:

- Direct contact (phone, text and email)
- Local media (press release, press conference, updates)
- County emergency alert system
- Website and social media (Facebook, Twitter)
- Door-to-door/door hangers
- Posted notices (city hall, public library)

A template for direct contact, local media and/or door hangers is provided below for use in an emergency response situation. For longer term trends related to source water quality, the City of Ashland Water Utility will provide notice to customers via the consumer confidence report.

CITY OF ASHLAND ISSUED NOTICE – LEVEL A PUBLIC WATER SYSTEM ANNOUNCEMENT

A WATER SYSTEM INVESTIGATION IS UNDERWAY

On __________ at____:____AM/PM, the City of Ashland Public Water System began investigating an incident that may affect local water quality.

The incident involves the following situation at this location:

____
____
____

There are no restrictions on water use at this time. As always, if water system customers notice anything unusual about their water – such as abnormal odors, colors, sheen, etc. – they should contact the water system at_____________________.

At this time there is no need for concern if you have consumed or used the water.

Regular updates will be provided about this Announcement as water system staff continue their investigation. Again, there are no restrictions on water use at this time.

State Water System ID#_______________Date Distributed: ________________

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App

CONT CODE	CONTAMINANT SOURCE	DESCRIPTION	SPECIFIC CONTAMINANTS
AAH	Animal housing		Livestock sewage wastes, nitrates, phosphates, chloride, chemical sprays and dips for controlling insect, bacterial, viral , and fungal pests, coliform bacteria, viruses
AFA	Animal Feedlot		Livestock sewage wastes, nitrates, phosphates, chloride, chemical sprays and dips for controlling insect, bacterial, viral , and fungal pests, coliform bacteria, viruses
AFP	Agricultural farming	Active farming operations	Pesticides, fertilizers
AIA	Irrigation system	Agricultural irrigation	Pesticides, fertilizers
AMH	Agriculture milkhouse		Livestock sewage wastes, nitrates, phosphates, chloride, chemical sprays and dips for controlling insect, bacterial, viral , and fungal pests, coliform bacteria, viruses, acids
AMS	Manure storage	Lined and unlined manure storage facilities	Livestock sewage wastes, nitrates, phosphates, chloride, chemical sprays and dips for controlling insect, bacterial, viral , and fungal pests, coliform bacteria, viruses
BCT	Chemical storage	500 gallon or more	Specific to chemical product stored at site
BFS	Fertilizer storage/mixing	Feed mill, agricultural co-op	Nitrates
BFT	Petroleum storage	500 gallon or more	Specific to petroleum product stored at site
BGS	Grain storage site		Fungicides
BPS	Pesticide storage / mixing / load	Feed mill, agricultural co-op	Herbicides, insecticides, rodenticides, fungicides, avicides
BSS	Road salt storage	Bulk storage sites	Sodium chloride, calcium chloride, waste oil
CAI	Airport		Jet fuels, deicers, batteries, diesel fuel, chlorinated solvents, automobile wastes, heating oil, building wastes
CBS	Auto body shop		Paints, solvents
CBY	Boat yard		Diesel fuels, batteries, oils, septage from boat waste disposal areas, wood preservatives, paints, waxes, varnishes, automotive wastes
CCE	Cemetery		Leachate (formaldehyde), lawn and maintenance chemicals
CCW	Car wash	Car washes in unsewered areas	Soaps, detergents, waxes, miscellaneous chemicals
CDC	Dry cleaning		Solvents (tetrachloroethylene, petroleum solvents, freon), spotting chemicals (trichloroethane, ammonia, rust removers)
CLD	Laundromat	Laundromats in unsewered areas	Detergents, bleaches, fabric dyes
CMP	Plating facility	Jewelry and metal plating	Cyanide, heavy metals
CMW	Machine / metal working shop		Solvents, metals, organics, sludges, cutting oils, degreasers
CPH	Photo processing	Only include processing facilities, don't include photo drop off sites	Cyanides, biosludges, silver sludges
CPR	Printing		Solvents, inks, dyes, oils, organics, chemicals
CPS	Paint shop		Paint, paint thinner, solvents
CRT	Railroad track		Spills
CRY	Rail yard		Spills
CSP	Seed production plant		Fumigants
CSS	Gas service station		Gasoline, oils, solvents, miscellaneous wastes
CSY	Scrap/junkyard		Oil, gasoline, antifreeze, PCB contaminated soils, lead acids batteries
CVR	Motor vehicle repair shop		Waste oils, solvents, acids, paints, automotive wastes,
GFA	Fuel storage tank - above ground	Non-service station tanks	Gasoline, diesel fuel, other petroleum products
GFB	Fuel storage tank - underground	Non-service station tanks	Gasoline, diesel fuel, other petroleum products
GSA	Sewage absorption area	Drainfields, mounds, dry wells	“
GSL	Sewer line (municipal)	Municipal sewer lines	Septage, coliform bacteria, viruses, nitrates
GSN	Sewer line (non-municipal)	Non-municipal sewer lines	“
GST	Sewage tank	Holding tanks, septic tanks, sumps	Septage, coliform bacteria, viruses, nitrates, heavy metals, synthetic detergents, cooking and motor oil, bleach, pesticides, paints, paint thinner, photographic chemicals, septic tank cleaner chemicals, chlorides, sulfate, calcium, magnesium, potassium, phosphate
GWA	Water well (active production)		Potential conduit
GWI	Water well (unused or improperly abandoned)		Potential conduit
IAS	Asphalt plant		Petroleum derivatives
ICM	Chemical production	Industrial chemical production facilities	Chemicals
IEE	Electrical and electronic products		Cyanides, metal sludges, caustics, solvents, oils, acids, alkalis,

	manufacturing		paints, methylene chloride, tetrachloroethylene, trichloroethane, acetone, toluene, PCBs
IES	Electroplating / metal finishing facility		Acids, alkaline solutions, cyanide, metallic salts, solvents, cyanide, heavy metal contaminated wastewater
IFM	Furniture or wood manufacturing / refinishing / stripping		Paints, solvents (toluene, methylene chloride), degreasing sludges
IFW	Foundry / smelting plant		Cyanides, sulfides
IGS	Gravel and Sand pits		Spills, miscellaneous chemicals, bacteria
IMQ	Mining / Mine waste		Cyanide, sulfides, metals, acids drainage
IPC	Plastics manufacturer / molder		Solvents, oils, organics and inorganics, paint wastes, cyanides, acids, alkalis, sludges, esters, surfactants, glycols, phenols, formaldehyde, peroxides
IPM	Paper mill		Metals, acids, minerals, sulfides, chemicals, sludges, chlorine, hypochlorite, chlorine dioxide, hydrogen peroxide
IPP	Pipeline (petro./chem.)		Petroleum, chemicals
ISQ	Stone quarries		Spills, miscellaneous chemicals, potential conduit, bacteria
ITP	Textile / polyester manufacturer		Chemicals
IWT	Wood preserving facility		Treated wood residue, preservatives (pentachlorophenol, chromate, copper arsenate,), tanner gas, paint sludges, solvents, creosote, coating wastes
MFT	Fire training facility		Chemicals
MGC	Golf course		Fertilizers, herbicides, pesticides for controlling mosquitoes, ticks, ants, gypsy moths, and other pests., automotive wastes
MGP	Manufactured gas plant / gasification plant		Petroleum VOCs, Benzo(a)pyrene, PAHs, cyanide
MLA	Laboratory (college, medical, school, private, etc.)		Biological wastes, disinfectants, acids, formaldehyde, miscellaneous chemicals
MMI	Military installation		
MMP	Medical Installation (e.g. Hospital)		X-ray developers and fixers, infectious wastes, radiological wastes, biological wastes, disinfectants, asbestos, beryllium, acids, formaldehyde, miscellaneous chemicals
MOT	Other (specify) _______________		
WDR	Class V injection well	Any well, drilled or dug hole, used to inject fluids into the subsoil	Chlorides, pathogens, petroleum products, pesticides
WHS	Hazardous waste generator (SARA Title III) / RCRA authority clean-ups	Any facility listed on the SARA Title III list thought to pose a threat to the well / RCRA clean-ups	Hazardous waste
WIN	Incinerator (municipal)		Metals, combustion by-products
WLA	Landfill	Solid and hazardous waste sites listed in the DNR "Registry of Waste Disposal Sites in Wisconsin"	Leachate
WLS	Leaking underground storage tank (LUST)	LUST Sites included in the DNR "Leaking Underground Storage Tank List"	Gasoline, diesel fuel, other petroleum products
WRF	Recycling facility		Petroleum products, chemicals
WRP	ERRP Site	Sites on the DNR "Emergency and Remedial Response" list	Spills
WSI	Wastewater Spray Irrigation		Coliform bacteria, nitrate, chloride, pathogens, viruses
WSS	Sludge spreading	Municipal wastewater sludge, paper mill sludge	Viruses, coliform bacteria, heavy metals, dioxins
WSW	Storm water retention pond		Metals, petroleum products
WTS	Solid waste transfer station		Miscellaneous chemicals
WUC	Superfund site	Sites listed in the DNR "Superfund Sites in Wisconsin"	Miscellaneous contaminants
WWL	Wastewater lagoon	Treatment and/or storage lagoons	Coliform bacteria, viruses
WWO	Wastewater discharge to surface water	Surface water outfall	Coliform bacteria, viruses
WWP	Wastewater treatment plant		
WWS	Wastewater discharge to groundwater	Absorption and seepage cells, spray irrigation, subsurface systems, etc.	Coliform bacteria, viruses