Source Water Assessment for North Shore Water Commission

Glendale, Wisconsin

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A report by the
Wisconsin Department of Natural Resources
Bureau of Drinking Water and Groundwater

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Summary

The 1996 amendments to the Safe Drinking Water Act require that States complete source water assessments for all public drinking water systems. The primary purpose of this assessment is to determine the relative susceptibility of the North Shore Water Commission's (NSWC) source water to contamination. For this assessment, 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. Source water is untreated water from streams, rivers, lakes, and groundwater aquifers. A susceptibility determination is based on a stepwise synthesis of information regarding the well or surface water intake vulnerability and the source water's sensitivity to a potential source of a contaminant of concern. Due to the vulnerable nature of surface water, most drinking water systems utilizing surface water are determined to have high levels of susceptibility to source water contamination.

Affordable, safe drinking water is essential to the health, development and stability of all communities. Conventionally, treatment has been the only step in maintaining safe drinking water for surface water systems. The quality of your community's drinking water is a function of the pretreatment water quality. Little concern has been paid to a preventive approach of protecting the source water. One of the best ways to ensure safe drinking water is to develop a local program designed to protect the source of drinking water against potential contamination. Not only does this add a margin of safety, but it also raises the awareness of consumers and/or the community of the risks of drinking water contamination. It is expected that source water assessment results will provide a basis for developing a source water protection program.

The NSWC is located in southeastern Wisconsin. It treats source water drawn from southern Lake Michigan through a surface water intake to reliably provide more than 35,000 consumers serviced by Fox Point Waterworks, Glendale Waterworks, Whitefish Bay Waterworks, WIS GAS-Pelham Heath and WI GAS-Port Road with high quality treated drinking water.

A source water area is the area that contributes source water to the public drinking water system. Lake Michigan drains approximately 45,600 square miles. Due to its size and diverse variety of land covers, it is not feasible to assess the impact of the entire Lake Michigan drainage basin on the NSWC's source water. In attempt to improve source water quality at a practical scale, the WDNR delineated source water areas based on local watersheds that may specifically impact source water entering the NSWC's intake. It is important to note that a source water area is only one potential factor in the quality and susceptibility of source water. Other factors may include unmanageable, lake-wide episodic events that have little to do with human activities.

Located in southeastern Wisconsin, the NSWC's source water area includes portions of Milwaukee, Waukesha, Washington, Ozaukee, Sheboygan and Fond du Lac Counties. The source water area is nearly 900 square miles and is mainly drained by the Milwaukee, Menomonee and Kinnickinnic Rivers. Soils of the source water area vary from well-drained sandy loams to poorly drained clayey silts. The agricultural land cover that predominates in the northern portions of the source water area, gives way to a large urban area in the southern half of the source water area. The soils and land cover of the source water area coupled with historical clearing and draining of forest and wetland areas cause large amounts of precipitation and meltwater to flow overland. This overland flow results in contaminated surface water and drastically fluctuating stream flows.

North Shore Water Commission reliably provides high quality drinking water to its customers. Treatment of the source water from Lake Michigan includes flocculation, sedimentation, filtration and chlorination. The treatment facility supplies an average of 5 million gallons of drinking water per day (mgd) but has a capacity of 18 mgd.

As with most surface water systems, NSWC's source water is highly susceptible to contamination and significantly impacted by local impacts. This is due to land usage and the distribution of potential contaminant sources in the source water area. NSWC's source water is commonly impacted during spring thaw, periods of heavy precipitation and windstorms.

It is hoped that this assessment will lead towards future source water protection efforts involving the formation of a source water protection team that can deal effectively with negative local impacts on source water.

A paper copy of the detailed assessment is available at the Glendale Public Library. An electronic version of the detailed assessment is accessible on the Wisconsin Department of Natural Resources website at http://www.dnr.state.wi.us/org/water/dwg/gw/SWP.HTM

Introduction

In 1996, the U.S. Congress amended the Safe Drinking Water Act to provide resources for states to conduct Source Water Assessments. Information about Wisconsin's Source Water Assessment Program can be found on the Wisconsin Department of Natural Resources (WDNR) website mentioned previously. In cooperation with other Great Lakes states, WDNR has developed a method--Wisconsin's Source Water Assessment Program, Appendix R (Assessment Protocol for Great Lake Sources)--for conducting Source Water Assessments for water supplies that use the Great Lakes as their water source. A source water assessment involves identifying a source water area, analyzing the sensitivity of the source to natural conditions, conducting potential contaminant source inventories and determining the susceptibility of the source to contamination.

The requirements for public water supplies in Wisconsin to meet U.S. Environmental Protection Agency maximum contaminant levels (MCLs) provide a base level of assurance of safe drinking water. However, all systems are vulnerable to some degree to potential contamination. With this in mind, susceptibility determinations were made qualitatively relative to other systems.

Purpose of this Assessment

The purpose of this source water assessment is to determine the susceptibility of NSWC's source of drinking water to contamination and to make recommendations on how to help protect this valuable resource.

Safe, affordable drinking water in ample quantity is essential to the health, development and stability of all communities. Conventionally, treatment has been the only step in maintaining safe drinking water for surface water systems and little concern has been paid to a preventive approach of protecting the source water. The quality and cost of treated drinking water is often a function of pretreatment source water quality.

Source water quality can be improved through the implementation of a source water protection program. A source water protection program is composed of four steps: assessment, planning, implementation and long term management. By assessing localized impacts on source water quality, this assessment completes the first step in a source water protection program. For more information on completing a source water protection program please visit http://www.epa.gov/safewater/protect/protect.html on the World Wide Web.

Source Water Contaminant Categories

Source water can be contaminated by microbial, inorganic, synthetic organic, volatile organic, precursors of disinfection by-products and radioactive contaminants. These contaminants can enter source water through various means. Pathways of contamination can be split into two major categories, point source pollution and nonpoint source pollution. Point source pollution includes specific, identifiable dischargers of contaminants. Examples of these include industrial and municipal wastewater outfalls. Point source dischargers are more easily regulated and held accountable for contaminating source water. Non point source pollution comes from no specific source and diffusely enters source water. Examples of nonpoint source pollution include runoff from land cover, leaching of contaminants into groundwater and atmospheric deposition.

This assessment describes these general contaminant categories associated with potential contaminant sources. For a more detailed description of contaminants associated with potential contaminant sources please visit http://www.epa.gov/OGWDW/swp/sources1.html on the World Wide Web. For information on health effects and methods of protection from particular chemical contaminants please visit http://www.epa.gov/safewater/hfacts.html on the World Wide Web.

- *Microbial contaminants*, such as viruses and bacteria, which may come from sewage treatment plants, septic systems, agricultural livestock operations, and wildlife. Microbial contaminants can lead to

widespread acute illnesses in customers of a contaminated drinking water system. Examples of microbial contaminants include *Giardia*, *Cryptosporidium* and *E. coli*.

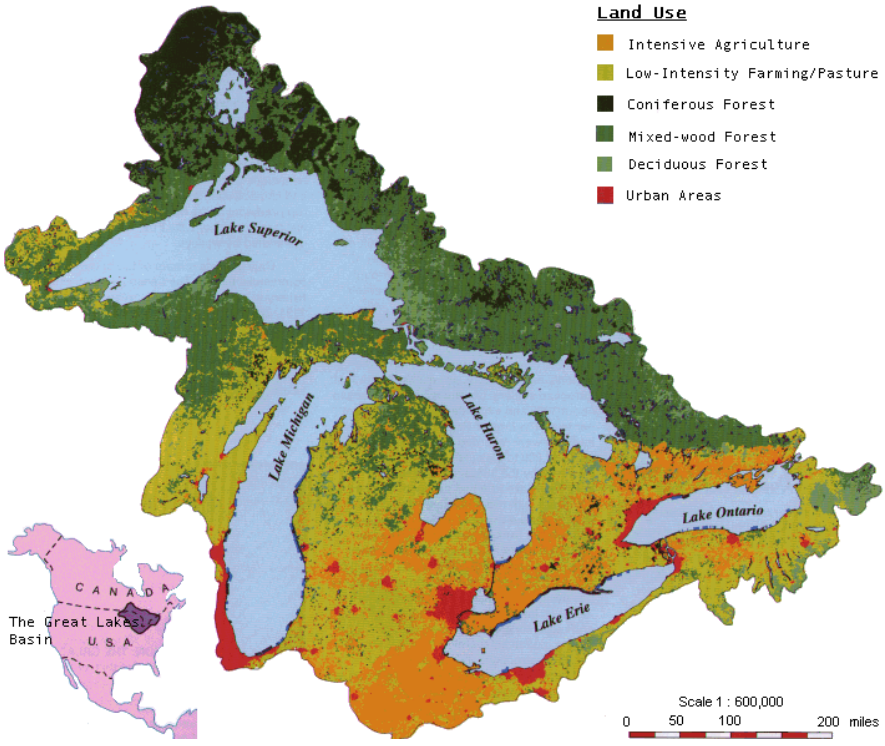
- *Inorganic contaminants*, such as salts and metals, which can occur naturally or result from among other sources, urban storm water runoff, industrial or domestic wastewater discharges, oil and gas production, mining, or farming. Among other detrimental health affects, inorganic contaminants can negatively impact various organs and the circulatory system in the human body. Some examples of inorganic contaminants include nutrients such as nitrogen and phosphorous and heavy metals such as cadmium, lead and mercury.
- *Synthetic organic contaminants*, such as industrial products, pesticides and herbicides, which may come from a variety of sources such as agriculture, storm water runoff, industrial activities, landfills, wastewater treatment facilities and residential areas. As well as being carcinogenic, synthetic organic contaminants can negatively impact the nervous system, liver and kidneys and affect development. Some examples of synthetic organic contaminants include the pesticides atrazine and lindane, as well as industrial products such as polychlorinated bi-phenyls (PCBs).
- *Volatile organic contaminants*, such as petroleum products, solvents, cleaners and degreasers, which may come from industrial activities, petroleum production, gas stations, urban storm water runoff, wastewater treatment facilities and septic systems. As well as being carcinogenic, volatile organic contaminants can negatively impact the nervous system, liver and kidneys and affect development. Some examples of volatile organic contaminants include benzene, vinyl chloride and styrene.
- *Precursors of disinfection by-products* lead to the formation of carcinogenic by-products during source water treatment. Likely sources of dissolved organic carbon are from agricultural and urban storm water runoff. Some examples of precursors of disinfection by-products include dissolved organic carbon and bromide.
- *Radioactive contaminants*, can be naturally occurring or be the result of oil and gas production and mining activities. Radioactive contaminants are carcinogenic. Some examples of radioactive contaminants include radium and uranium.

Hydrologic Setting

Description of the Source Water Area

As shown in Figure 1, the Great Lakes drains over 200,000 square miles of varying land uses. The size and variety of land uses found in this drainage basin make a basin-wide assessment impractical and ineffective at identifying impacts on South Milwaukee's source water. In response to this, the WDNR identified smaller local source water areas that contribute source water to Lake Michigan in close

Figure 1: Great Lakes Drainage Basin



proximity to the drinking water intake. Source water areas are composed of one or more established watersheds that discharge near the surface water intake. Source water areas for this assessment were delineated based on WDNR surface watersheds, not groundwater basins. Generally, groundwater basin boundaries are similar to their surface water counterparts but may vary due to geology.

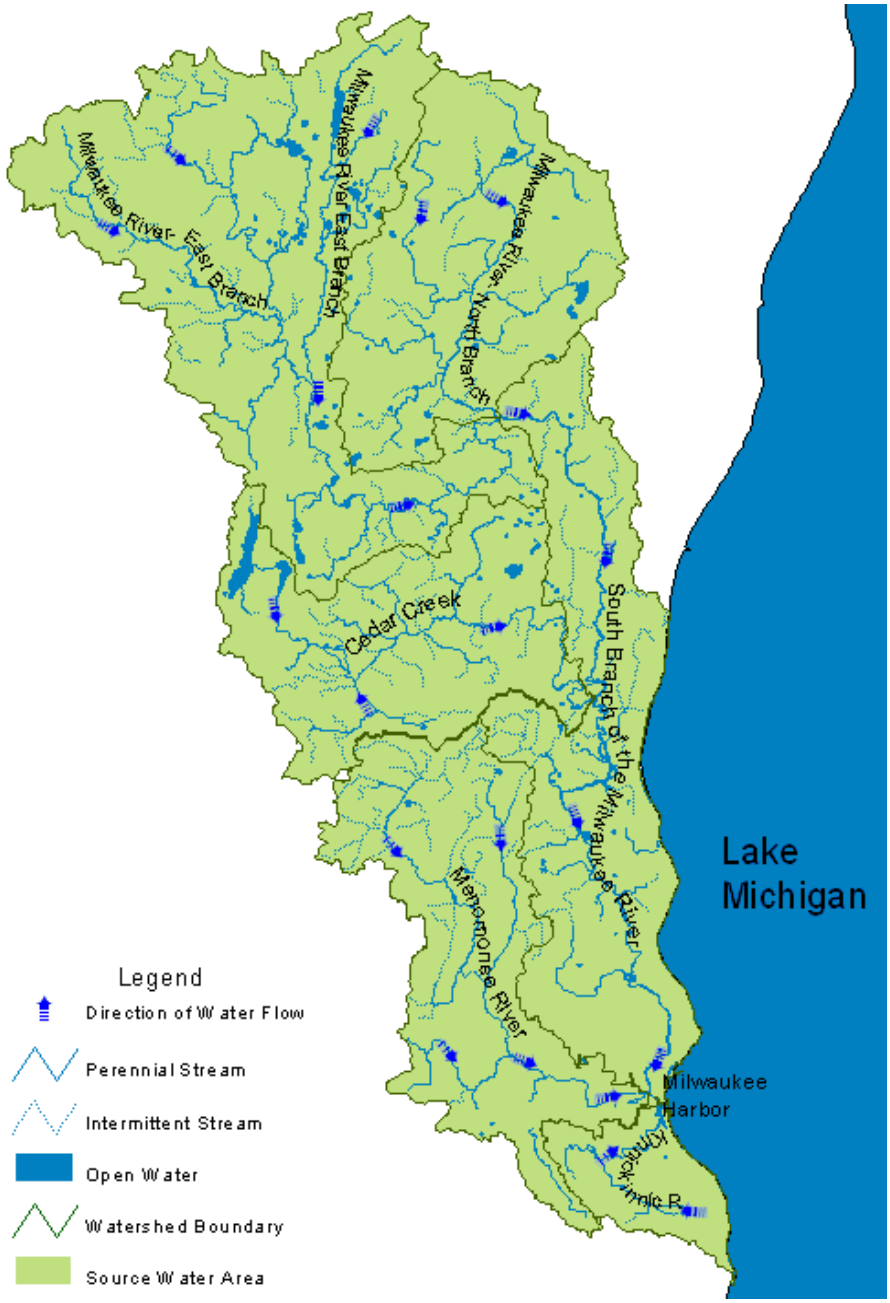
As shown in Figure 2, NSWC's source water area is located in portions of Milwaukee, Waukesha, Washington, Ozaukee, Sheboygan and Fond du Lac Counties in Southeastern Wisconsin. Some cities located in the source water area include Cudahy, St. Francis, West Allis, Brookfield, Menomonee Falls, Milwaukee, Cedarburg, West Bend, Auburn and Lyndon. The source water area is approximately 882 square miles.

Figure 2: NSWC Source Water Area

Hydrology

As shown in Figure 3, the majority of the source water area is drained by the Milwaukee, Kinnickinnic and Menomonee Rivers, which join together in the Milwaukee Harbor prior to entering Lake Michigan. The Milwaukee River, which drains most of the source water area, originates in Fond du Lac and Sheboygan counties as three different streams. These streams are the East, West and North Branches of the Milwaukee River. These streams flow south from their headwaters and join together to form the South Branch of the Milwaukee River, which continues south gaining flow from the Cedar Creek, before entering into the Milwaukee Harbor. The Menomonee River and the Kinnickinnic River drain the southwestern and southern portions of the source water area respectively. As shown in Figure 3, the Milwaukee Harbor discharges into Lake Michigan approximately eight miles south of the intake. With a ten-year average flow at the city of Milwaukee of 497 cubic feet per second, the Milwaukee River contributes far more source water than the other two major streams in this source water area.

Figure 3: Drainage pattern of source water area



As shown in Figure 3, the land adjacent to Lake Michigan directly west of the intake does not drain into the Milwaukee Harbor. Instead this strip of land that varies from less than a mile to multiple miles in width drains directly into Lake Michigan through runoff, groundwater flow and an unnamed stream that discharges into Lake Michigan five miles north of the intake. The proximity of this area to the intake causes it to have a greater potential affect on source water at the intake.

The northern portions of the source water area are characterized by permeable sandy loams, which allow for more infiltration of precipitation into the ground. Clayey soils coupled with less natural vegetation in the southern half of the source water area inhibit precipitation from entering the ground. This results in precipitation flowing over land and entering surface water unfiltered. Precipitation flowing overland is referred as runoff. Runoff may result in widely fluctuating stream flows and contaminated surface water.

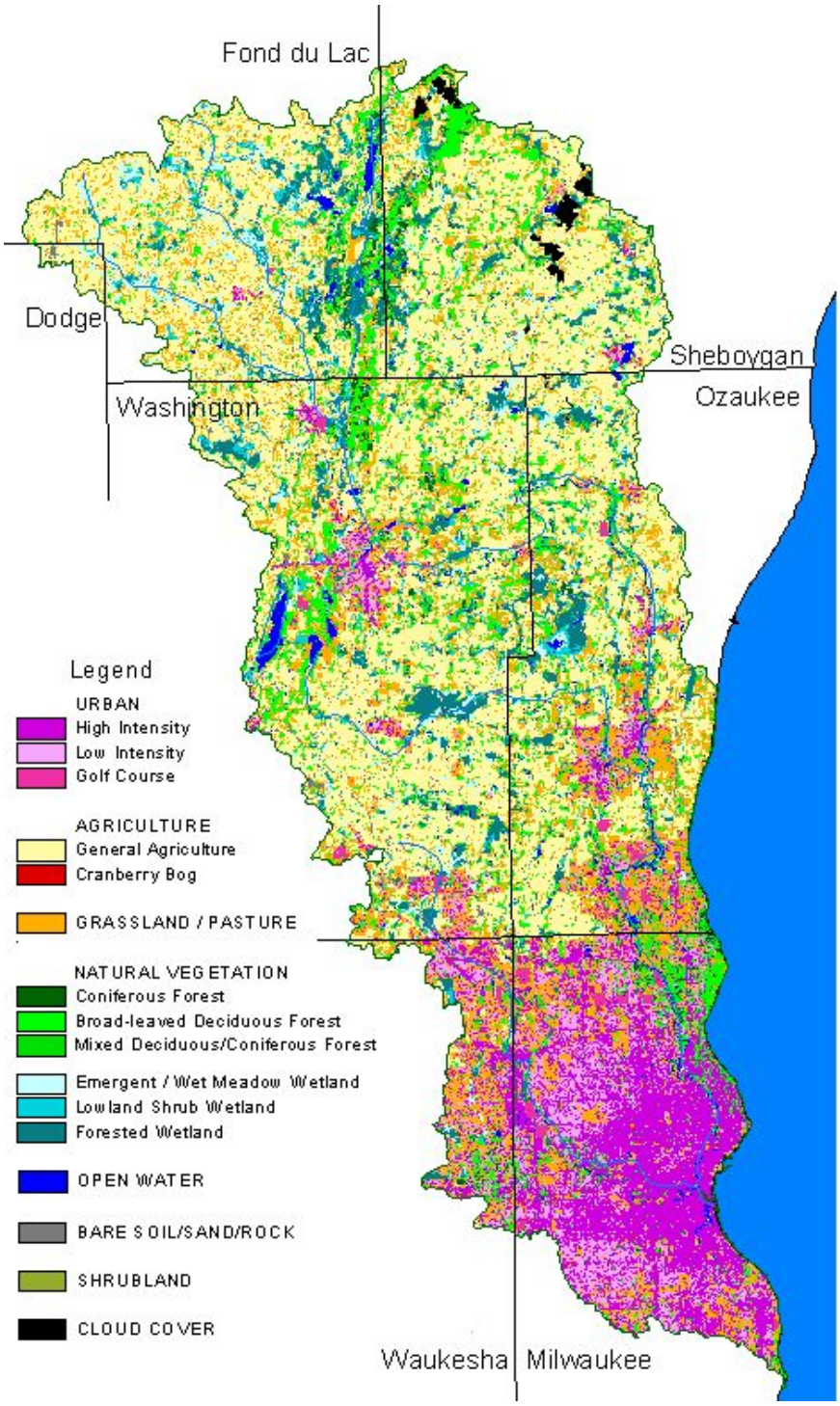
Land cover

Land cover can play a major role in source water quality. Spatial data in Figure 4 was generated from interpretations of aerial photographs taken from 1971 to 1982.

As shown in Figure 4, agricultural areas and pockets of natural vegetation in the northern portions of the source water area give way to residential and heavily urbanized areas to the south. Urban areas are believed to be negatively impacting source water in various streams throughout the source water area. Particular areas of concern are urban areas that drain into the East, West and South Branches of the Milwaukee River along with the Kinnickinnic and Menomonee Rivers. Runoff from agricultural land is believed to be negatively impacting the East and West Branches of the Milwaukee River.

Urban areas depicted in Figure 3 include residential, industrial and commercial activities. Contaminants associated with residential land cover include synthetic organic, volatile

Figure 4: Land cover

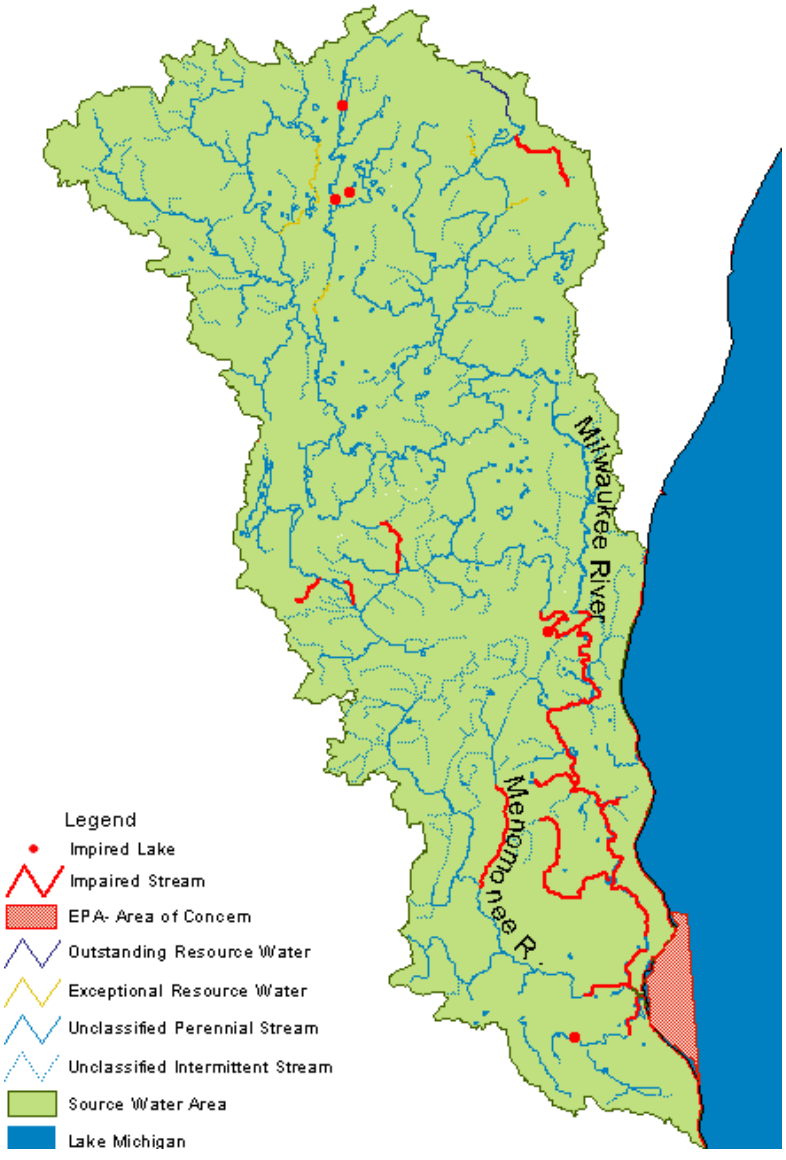


organic, inorganic, precursors of disinfection by-products and microbial contaminants. Due to high concentrations of impermeable surfaces, such as streets, driveways, parking lots, sidewalks and roofs, urban areas have increased potential to create large quantities of runoff during and following precipitation events. Runoff from residential areas transports contaminants associated with this land cover into source water. These contaminants can also enter source water from residential areas through point source discharges and atmospheric deposition.

For this assessment agricultural land cover includes cropland, pasture, orchards and nurseries. Agricultural practices generally cause the land to be more susceptible to erosion and runoff than naturally vegetated land. Due to common practices and activities, agricultural land cover can be a major source of inorganic, treatment by-product precursors, microbial and synthetic organic contaminants for the source water.

For this assessment, natural vegetation includes wetlands, woodlands and some unused lands. Generally, natural vegetation has positive impacts on source water. These impacts include increased infiltration of precipitation into the ground, decreased quantity of storm water runoff, removal of contaminants from source water, reduced potential for erosion and less drastic fluctuations of streamflow.

Figure 5: Impaired, excellent and outstanding source water



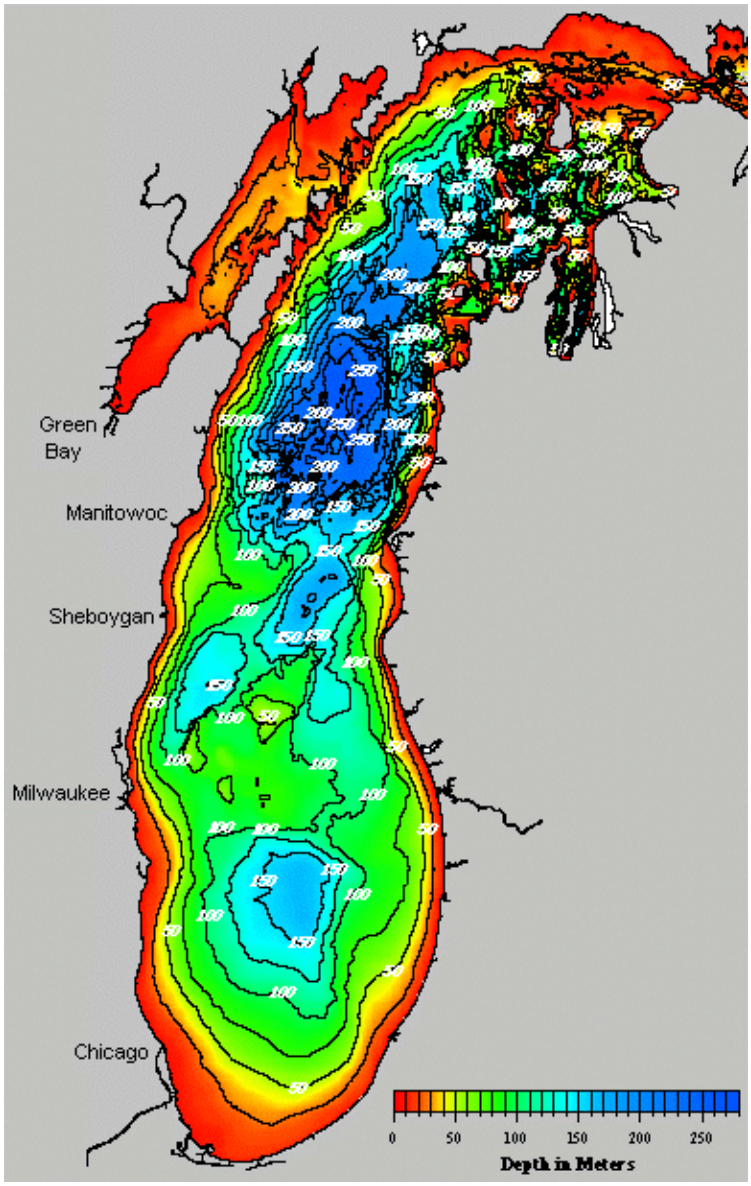
Water quality

Water quality varies from region to region in the source water area. The northern portions of the source water area generally have much higher water quality. As shown in Figure 5, sections of the headwaters of the Milwaukee River are classified as Outstanding or Excellent Resource Waters of Wisconsin. Outstanding resource waters are defined as a lake or stream having excellent water quality, high recreational and aesthetic value, high quality fishing and is free from point and non-point source pollution. Exceptional resource waters are defined as a stream exhibiting the same high quality resource values as outstanding waters but may be impacted by point source or have the potential for future discharge from a small sewer community. However, as the Milwaukee River flows downstream gaining flow from more heavily stressed areas its water

quality degrades. The lower twenty-six miles of the Milwaukee River are listed as an impaired water body. Impaired waters are defined by the WDNR as waters, which are not meeting water quality standards for specific substances or their designated uses.

Other impaired waterbodies in the source water area include five lakes, the lower sections of the Menomonee and Kinnickinnic Rivers and the Milwaukee Estuary. Typical water quality problems in these impaired waterbodies include sedimentation as well as synthetic organic, microbial and inorganic contamination. Causes of these impairments identified on the WDNR's 303(d) list include non-point source pollution, urban runoff, sanitary sewer overflows, atmospheric deposition, barnyard runoff and landfills. The Milwaukee Estuary is classified as an Area of Concern. Areas of Concern are defined by the U.S.-Canada Great Lakes Water Quality Agreement (Annex 2 of the 1987 Protocol) as "geographic areas that fail to meet the general or specific objectives of the agreement where such failure has caused or is likely to cause impairment of beneficial use of the area's ability to support aquatic life." The Milwaukee Estuary Area of Concern includes nearshore waters of Lake Michigan, Milwaukee Harbor and the lower portions of the Menomonee, Milwaukee and Kinnickinnic Rivers. It extends north to the Milwaukee Waterworks Linwood Plant surface water intake, which is approximately four miles south of the intake. Some of the major environmental problems identified in this area of concern include combined sewer overflows, contaminated sediments, storm water runoff, sewage treatment plant effluent and industrial process discharges.

Figure 6: Bathymetry of Lake Michigan



Description of Lake Michigan near the Source Water Area

Bathymetry

As shown in Figure 6, the NSWC receives source water near the edge of a drop off from White Fish Bay. This shallow area near the intake may have a negative impact on source water quality by preventing dilution of contaminants and allowing for more easily resuspended lake bottom sediments. However, the protection afforded by Whitefish Bay may allow for higher water quality near the intake.

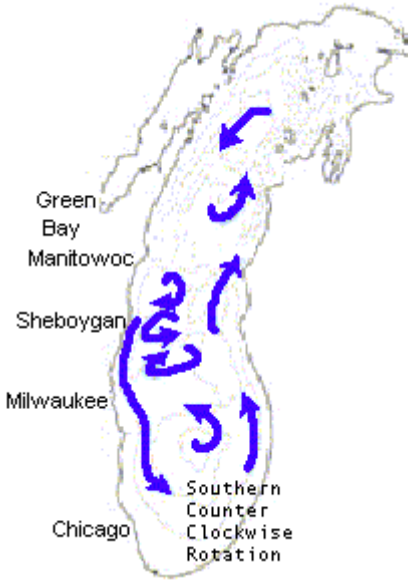
Wind

Wind plays a major role in circulation patterns and water quality in near-shore areas on Lake Michigan's western shore. The prevailing wind is out of the southwest going across the lake from the NSWC source water area. Variable winds frequently alter circulation direction and speed along with causing fluctuations in water quality. Easterly winds, which are

frequently associated with poor source water quality occur most frequently during the spring and summer months.

Currents

Figure 7: Lake Michigan Circulation



Direction and speed of currents in Lake Michigan are highly variable and largely dependent upon wind direction. As shown in Figure 7, unaffected currents near the NSWC intake travel south as part of a larger southern Lake Michigan counterclockwise rotation. The affect of Whitefish Bay on local currents is unknown. Easterly and southeasterly winds can quickly reverse the circulation pattern or cause lake water to stagnate along the shoreline near the intake.

Water quality

Water quality in Lake Michigan improves with distance from shore. Nearshore water quality is generally lower and more prone to fluctuations. Nearshore water quality fluctuations frequently occur in spring when precipitation and snow melt transport contaminants from land into Lake Michigan. Fluctuations also occur during windstorms, which can churn up lake bottom sediments. Atmospheric deposition of contaminants occurs near concentrated urban areas.

With distance from shore most contaminants evaporate, settle into the lake bottom sediments or dilute to undetectable levels allowing water quality to reach near drinking water purity. Farther from shore, Lake Michigan contains very low concentrations of drinking water contaminants. Organic chemicals and heavy metals are below levels of detection. The majority of these contaminants enter the lake via non-point source pollution and atmospheric deposition. Coliform and microbial contaminants are higher nearshore, but have been detected farther from shore. Similar to nearshore areas, easterly windstorms can resuspend sediments far from shore, which can cause water quality fluctuations.

It is important to note that water quality of source water at the intake is based almost entirely on monitoring that occurs at the drinking water intake. Few contaminants have been comprehensively monitored in source water at the intake. According to water monitoring carried out from 1994 to 1997, water clarity at the intake does not fluctuate widely but is lowest from late fall through the spring months as lake bottom sediments are suspended in the water column by windstorms and meltwater enters streams and Lake Michigan. Taste and odor problems occur during late summer and are associated with alga blooms and warmer lake temperatures. Daily samples of coliform, an indicator of microbial contamination are frequently positive. The microbial pathogen *Cryptosporidium* has been detected in source water at the drinking water intake.

Susceptibility Assessment

For the purposes of Wisconsin's source water assessments, susceptibility is defined as the likelihood that a contaminant of concern will enter a public water supply at a level that may result in an adverse human health impact. This definition applies to groundwater and surface water-based public water supplies. A susceptibility determination is based on a stepwise synthesis of information regarding the well or surface water intake vulnerability and the source water's sensitivity to a potential source of a contaminant of concern.

Methodology

For a detailed explanation of the protocol for Great Lake source water assessments see Appendix R of Wisconsin's Source Water Assessment Program Plan Appendices.

An initial survey was performed on the North Shore Water Commission's source water area to assess local impacts to the source water. The initial survey included interviewing water treatment system operators, conducting a sensitivity analysis, delineation of a critical assessment zone and reviewing existing data. The initial survey revealed that source water is impacted by local factors.

A more in-depth study of the source water area was carried out to determine what activities and areas within the source water area affect the source water's susceptibility to particular types of contaminants. This more in-depth study reviewed the distribution of potential contaminant sources in the source water area, historical data, localized water quality of tributaries and background water quality levels and characteristics of Lake Michigan.

Sensitivity Analysis

Sensitivity is defined as the likelihood that source water will be impacted by contaminants due to the intrinsic physical attributes of the source water area. Sensitivity is determined from the natural setting of the source water and indicates the natural protection afforded the source water. Factors in sensitivity include hydrologic characteristics of the source water area, proximity, direction and quantity of discharge relative to the intake and degree of dilution afforded by distance from shore and depth of intake. Based on the Great Lakes Protocol for conducting a sensitivity analysis, calculated sensitivity is the product of the intake's distance from shore and the depth of water at the intake. It is important to keep in mind that this does not take into account numerous site-specific variables. Relative levels of calculated sensitivity include moderate, high and very high. The calculated sensitivity of the NSWC intake is moderate.

Critical Assessment Zone

In keeping with the Great Lakes protocol, a critical assessment zone was delineated based upon the intake calculated sensitivity. Any land, particularly shoreline, which is within the delineated critical assessment zone, must be part of an in-depth assessment. The zone is a circle centered on the intake. The size of the circle depends on the calculated sensitivity rating. The critical assessment zone for the NSWC drinking water intake extends 1,000 feet from the intake and does not encompass any land.

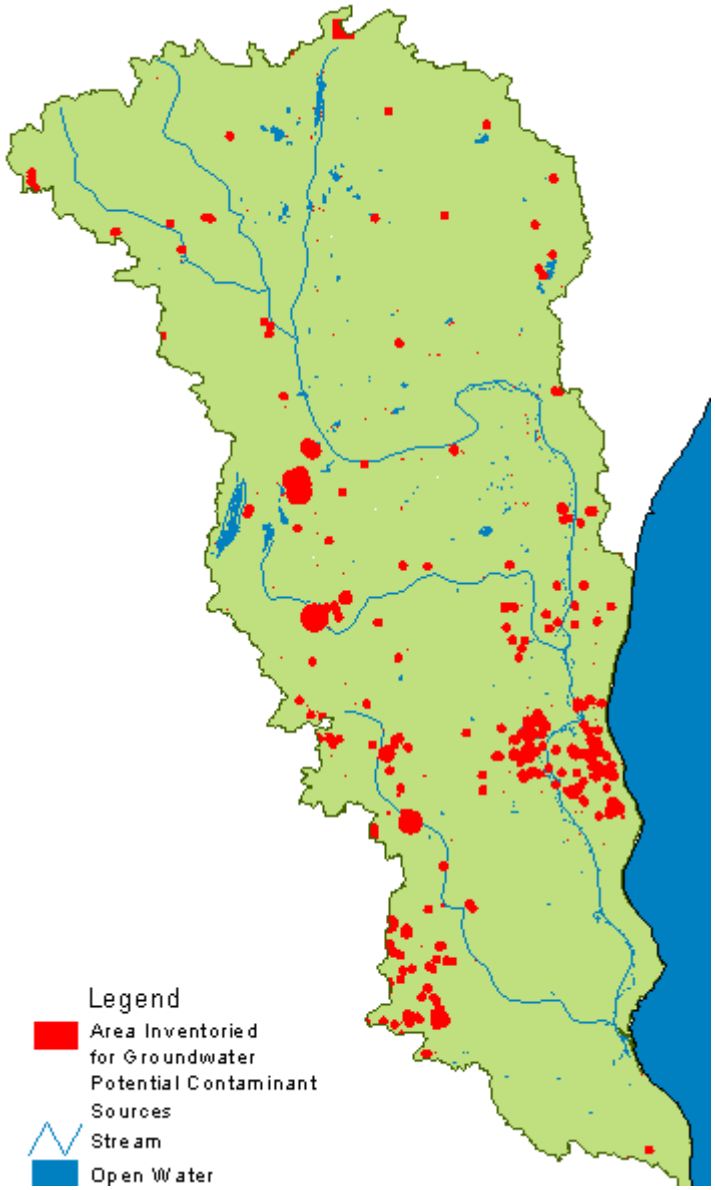
Potential Contaminant Source Inventory

A major component of the susceptibility determination is based on the distribution of potential contaminant sources in the source water area. A high density of potential contaminant sources in the source water area would indicate a higher probability of contaminating source water. Source water from a source water area with a low density of potential contaminant sources would be less likely to become contaminated.

It is important to understand that a potential contaminant source is not necessarily a source of contaminants. It has the potential to become a source of contaminants but if managed properly won't impact the source water.

Data used in the significant potential contaminant source inventory includes source water area-wide, county-wide and localized information sources. Source water area-wide data for potential contaminant sources are displayed on Figures 9 and 10. Countywide and source water area-wide potential contaminant sources in Milwaukee County are shown in Figure 10. Locational information for localized potential contaminant sources were inventoried only within areas encompassed by the source water areas for groundwater drinking water systems. Figure 8 depicts the limited amount and distribution of land in the source water area inventoried for localized significant potential contaminant sources. Information concerning the distribution of localized potential contaminant sources is not available for land outside of the red areas in Figure 8. Localized potential contaminant sources are displayed on Figures 11, 12, 13 and 14.

Figure 8: Area inventoried for localized potential contaminant sources



Landfills

In the past landfills were unregulated and were common sources of contaminants. Some of these are now classified as Bureau of Remediation and Repair Tracking System sites, which are discussed below. Licensed landfills are now strictly regulated and monitored. Closed and active landfills are frequently sources for inorganic, synthetic organic and volatile organic contaminants in source water.

As shown in Figure 9, there are 22 known landfills in the source water area. Some of these are located adjacent to major streams, which drain into Lake Michigan near the intake. As mentioned previously, waste disposal sites are identified by the WDNR as a cause for the impairment of waterbodies located in the source water area. These waterbodies include three tributaries to Cedar Creek and two tributaries to the South Branch of the Milwaukee River.

Wastewater Treatment Facilities

Wastewater treatment facilities (WWTFs) include municipal and industrial operations. Municipal facilities can be sources of inorganic, microbial, synthetic organic and volatile organic contaminants as well as hormones, pharmaceuticals and other organic contaminants that have been linked to developmental and reproductive defects in animals. Following treatment, effluent is frequently discharged through an outfall directly into surface water. Typical treated and disinfected sewage contains low concentrations of contaminants. During or following a storm event, the municipal WWTF may be inundated with more raw sewage than it can process. In the event of this a bypass or sanitary sewer overflow occurs. This allows untreated sewage to enter directly into surface water. A typical bypass will contain a high concentration of contaminants associated with urban runoff and WWTFs. For more information on sanitary sewer overflows and bypasses please visit http://cfpub1.epa.gov/npdes/home.cfm?program_id=4 on the World Wide Web. Contaminants associated with industrial WWTFs are dependent upon the specific industry but may include microbial, volatile organic, inorganic and synthetic organic contaminants.

Locations of WWTF outfalls for the source water area are displayed in Figure 9. Sanitary sewer overflows have been identified as a cause of severe environmental degradation in the Milwaukee Estuary Area of Concern discussed previously. Municipal wastewater treatment facilities have been identified by the WDNR as a negative impact on source water in the lower portions of the Milwaukee River and the Menomonee River. Point source discharges from industry were identified to be negatively impacting source water in the Cedar Creek, Menomonee River, Kinnickinnic River and lower sections of the Milwaukee River.

Construction Sites

Due to uncovered material, handling of toxic chemicals and exposed ground construction sites can heavily impact the source water. For more information on impacts and regulations of construction sites please visit http://cfpub1.epa.gov/npdes/stormwater/const.cfm?program_id=6 on the World Wide Web.

Construction projects occurring in Milwaukee County in 1995 are shown in Figure 10. Population size of the basin has grown by 2.2 percent since 1970. Most growth has occurred in Washington and Ozaukee Counties, which have grown by 89 and 64 percent respectively. This increase in population has resulted in large development projects particularly in the northern and western portions of the source water area. The WDNR identified sections throughout the Milwaukee and Menomonee Rivers as being degraded by construction site runoff.

Boating Related Activities

Boating related activities are potential sources of volatile organic, synthetic organic, inorganic and microbial contaminants to the source water. Contaminants can enter directly into the source water through spills or indirectly through runoff from marinas and shipyards where many cleaning agents, paints, petroleum products and other chemicals are commonly stored and used. For more information on the effects of and preventive measures for boating related activities please visit http://www.epa.gov/owow/nps/mmsp/index.html

Recreational boating is very popular along the southwestern shore of Lake Michigan. There are 3 public boat launches and 6 marinas along with multiple shipyards, piers, boat storage facilities and private docks located in the source water area.

WDNR's Bureau of Remediation and Redevelopment Tracking System

The WDNR Remediation and Redevelopment Program keeps track of sites where chemical contamination of soil, surface water and/or groundwater has occurred. The Bureau of Remediation and Redevelopment Tracking System (BRRTS) is the Department's database for tracking the status of investigation and cleanup activities at these sites. There are several types of sites that are tracked by BRRTS, including leaking underground storage tank sites, Environmental Repair Program sites, spill sites and Superfund sites. For information on specific contamination sites in Wisconsin please visit BRRTS at, http://www.dnr.state.wi.us/org/aw/rr/brrts/index.htm on the World Wide Web.

- Leaking Underground Storage Tank sites

  A Leaking Underground Storage Tank (LUST) site is defined as a leaking underground storage tank that has contaminated soil and/or groundwater with petroleum, a volatile organic contaminant.

  There are 248 LUST sites in the source water area identified by the WDNR. As shown in Figure 9, high concentrations of LUSTs in the source water area are generally found in urban areas.

- Environmental Repair Program sites

  Environmental Repair Program (ERP) sites are sites other than LUSTs that have contaminated soil and/or groundwater. Often, these are old historic contaminant releases to the environment. They frequently include abandoned landfills, coal gasification and metal stripping sites, among other contaminant sources. Contaminants associated with ERP sites are site specific, but they frequently include volatile organic, synthetic organic and inorganic contaminants.

  There are 142 ERP sites in the source water area identified by the WDNR. As shown in Figure 9, high concentrations of ERP sites in the source water area are generally found in urban areas. Many of these sites are located along streams, which drain into Lake Michigan near the intake.

- Spill sites

  Spills are defined as a discharge of hazardous substances that may adversely impact, or threaten to adversely impact public health, welfare or the environment. Volatile organic contaminants are frequently associated with spills. There were 2051 spills within the city of Milwaukee reported to the WDNR from January of 1978 to September of 2002

- Superfund sites

  Superfund sites are highly contaminated areas that have been set aside for cleanup by the USEPA. For more information on the Superfund program and individual sites please see http://www.epa.gov/superfund/ on the World Wide Web.

  As shown in Figure 9, there are 2 Superfund sites in the source water area. They are the Boundary Road Landfill site located in the town of Menomonee Falls and the Moss-American (Kerr-Mcgee Oil Co.) site located west of the Little Menomonee River.

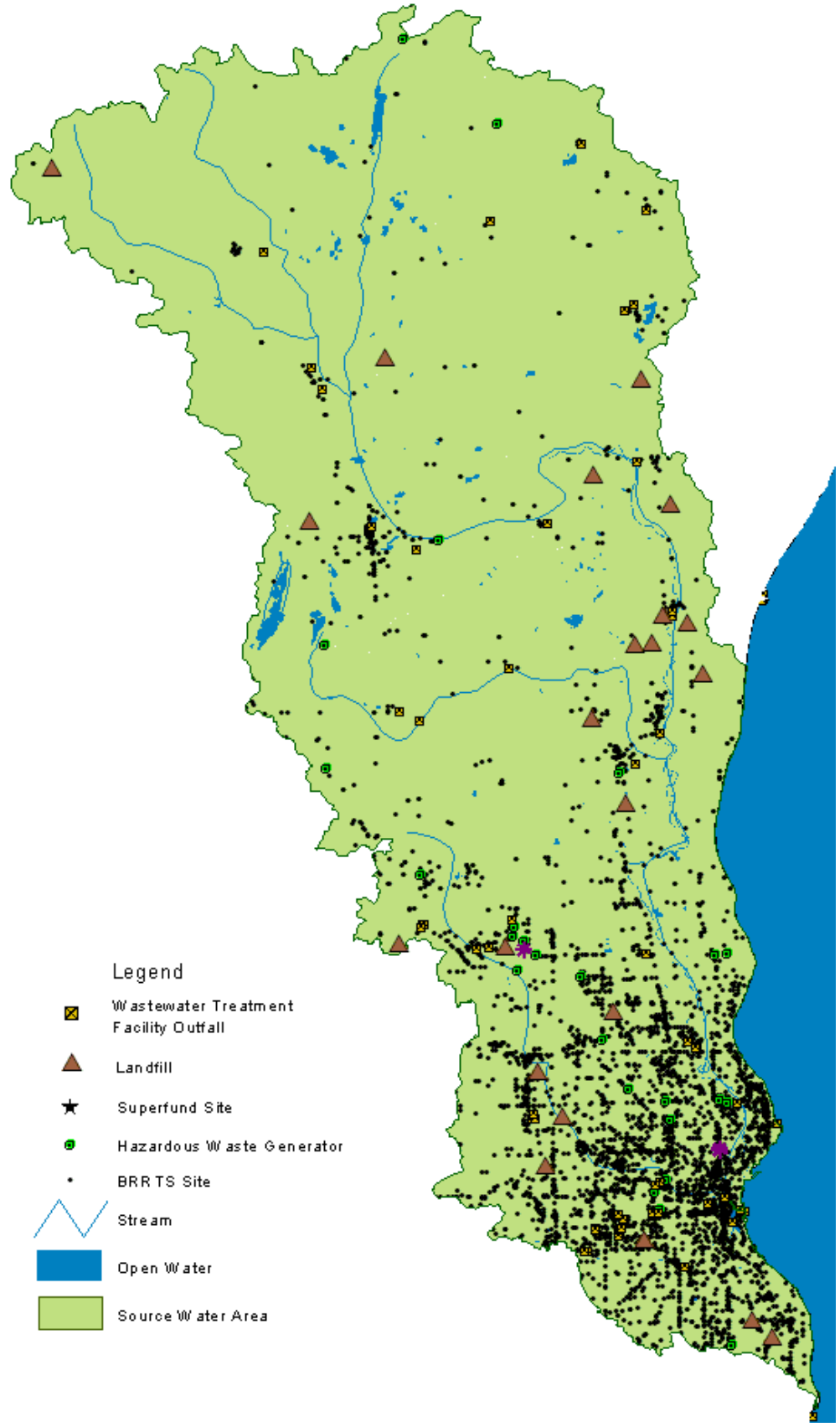
  The Boundary Road Landfill site has contaminated soil and water with volatile organic and inorganic contaminants. This site drains directly into the Menomonee River. The Moss-American site was a site for preserving railroad ties, poles and fence posts. It has contaminated sediments, soil, groundwater and surface water with volatile organic contaminants and a group of contaminants referred to as semi-volatile organic contaminants. This site has significantly impacted the Little Menomonee River.

Hazardous Waste Generators

Hazardous waste generators are defined as facilities, which handle materials classified as hazardous waste. Hazardous waste is defined as any substance that is toxic to humans. Contaminants associated with hazardous waste generators are site specific. Hazardous waste generators include a wide array of facilities ranging from hospitals and schools to manufacturing and industrial operations.

As shown in Figure 9, there are 26 large quantity hazardous waste generators located in the source water area. They are concentrated in the southern half of the source water area. This does not depict the more numerous small quantity hazardous waste generators, which are found throughout the source water area.

Figure 9: Area-wide potential contaminant sources



Cemeteries

Cemeteries are potential sources of microbial, inorganic and synthetic organic contaminants. Contaminants from cemeteries can enter source water via leachate into groundwater or runoff into surface water. There are multiple cemeteries located throughout the source water area. As shown in Figure 10, there are 27 cemeteries of varying size located in Milwaukee County within the source water area.

Golf Courses

Golf courses are potential sources of inorganic and synthetic organic contaminants. There are many golf courses located in the source water area. As shown in Figure 10, there are 12 golf courses located in Milwaukee County within the source water area. The close proximity of the majority of these golf courses to streams, which discharge into Lake Michigan near the intake creates easily contaminated source water

Airports

Airports are potential sources of inorganic and volatile organic contaminants. There are two airports located in Milwaukee County within the source water area. The northern portion of General Mitchell Field, a large international airport drains directly into the Kinnickinnic River. Timmerman Airport, a smaller regional airport drains into the Menomonee River.

Railroads and Switchyards

Railroads and switchyards can be sources of contaminants via spills, which are transported as cargo on trains or by contaminants used in the day to day operation of trains. Contaminants associated with spills of cargo vary depending on individual trains and regions, but in 2000 there was an estimated 4.4 million tons of hazardous material transported by rail statewide. Contaminants associated with the day to day operation and maintenance of railroads and switchyards include synthetic organic, volatile organic and inorganic contaminants. The City of Milwaukee is a hub for railroads in Wisconsin. As shown in Figure 10, there are multiple switching yards located near the Milwaukee Harbor. Rail corridors crisscross the source water area.

Pipelines

Pipelines have the potential to be major sources of contaminants to source water. Contaminants associated with pipelines are specific to individual pipelines, but generally contain volatile organic contaminants. Contaminants from pipelines may enter source water through small leaks or accidental spills.

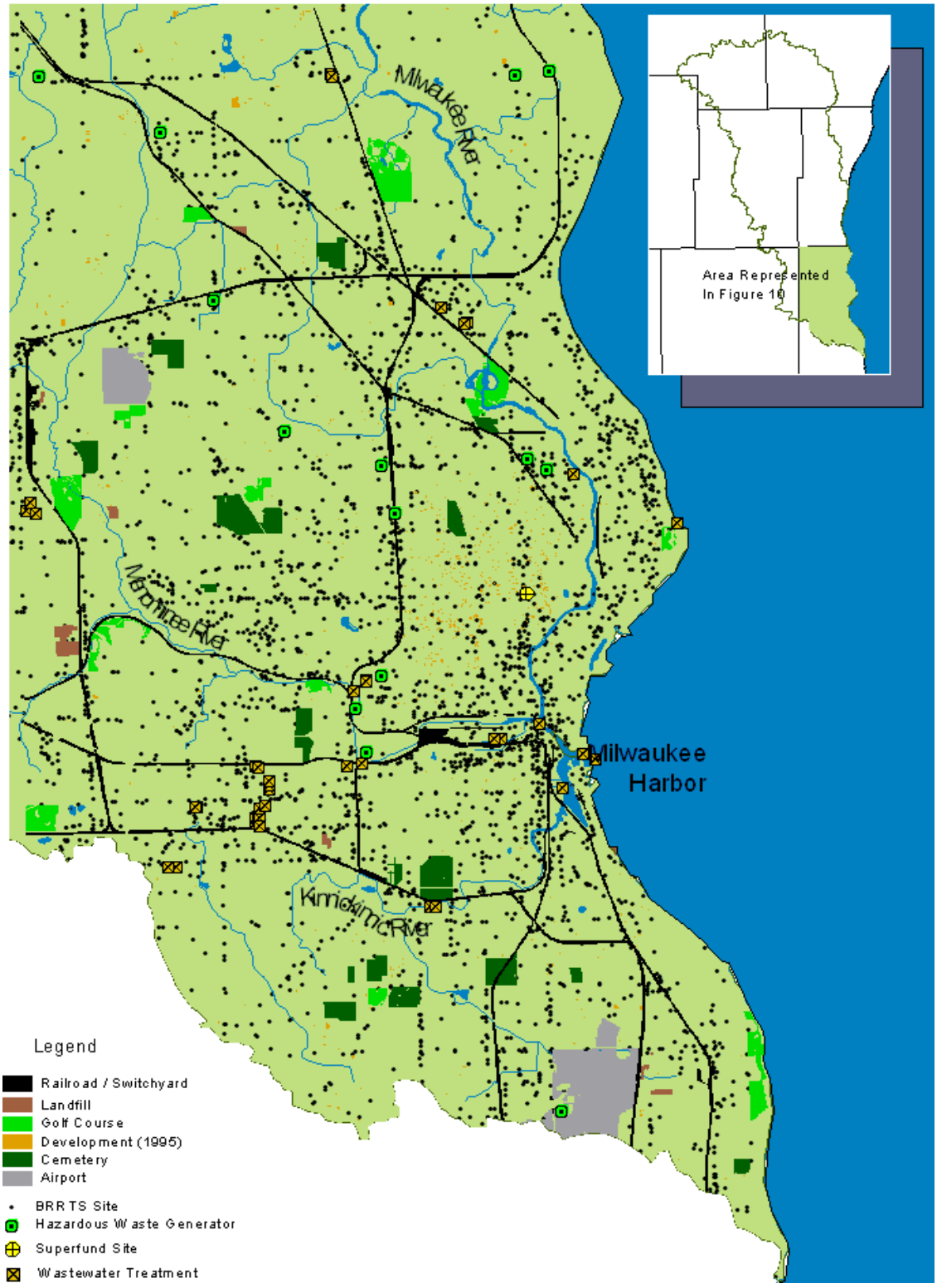
An underground gasoline and distillate pipeline runs through the source water area from north to south. This pipeline crosses multiple streams in the source water area.

Septic Systems

Septic systems are commonly found in rural communities without sanitary sewers. If maintained and operated correctly, they serve as a functional method of waste disposal. Unfortunately, many septic systems due not function properly and can lead to contamination of source water. Microbial and inorganic contaminants are associated with faulty septic systems.

The WDNR identified failing septic systems to be a threat to source water in lakes in the northern portions of the source water area.

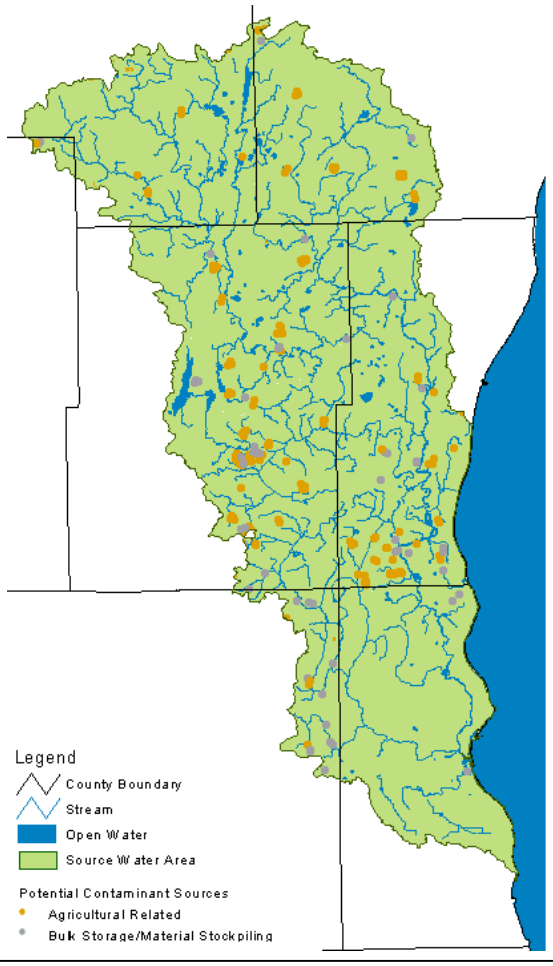
Figure 10: Potential contaminant sources in source water area in Milwaukee County



Localized Agricultural and Bulk Storage Potential Contaminant Sources

Localized agricultural and bulk storage potential contaminant sources are shown in Figure 11. Agricultural potential contaminant sources include active farming operations, animal feedlots, agricultural irrigation and lined and unlined manure storage facilities. These activities are potential sources of synthetic organic, inorganic and microbial contaminants. Bulk storage potential contaminant sources include feed mills, agricultural co-ops, 500 gallon and larger petroleum and chemical storage sites and road salt storage sites. Contaminants associated with storage facilities are largely site-specific, but generally they are potential sources of inorganic, synthetic organic and volatile organic contaminants.

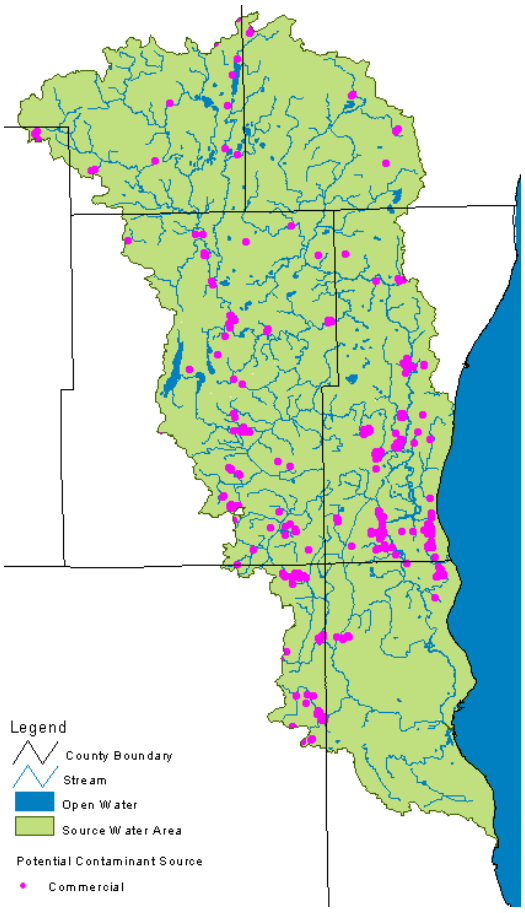
Figure 11: Agricultural and bulk potential contaminant sources



Localized Commercial Potential Contaminant Sources

Localized commercial potential contaminant sources are shown in Figure 12. Commercial potential contaminant sources include airports, auto body shops, boat yards, car washes and Laundromats in unsewered areas, cemeteries, dry cleaners, gas service stations, machine/metal working shops, motor vehicle repair shops, paint shops, photo processing facilities, jewelry and metal plating facilities, printing facilities, rail yards, rail road tracks, scrap/junk yards and seed production plants. These activities are frequently associated with inorganic and volatile organic contaminants.

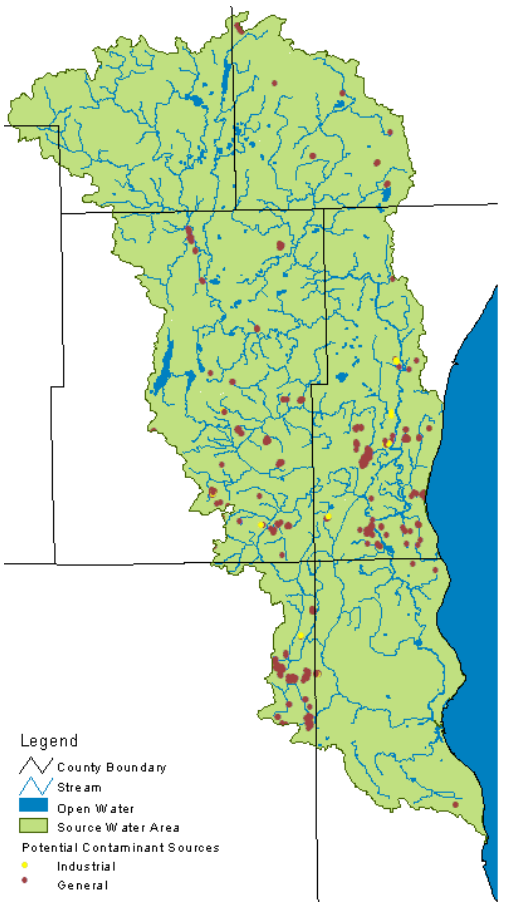
Figure 12: Commercial potential contaminant sources



Localized General and Industrial Potential Contaminant Sources

Localized general and industrial potential contaminant sources are shown in Figure 13. General activities include above-ground and below-ground storage tanks, municipal and non-municipal sewer lines, sewage holding tanks, septic tanks, sumps, drainfields, mounds and dry wells. These activities are potential sources for synthetic organic, volatile organic, inorganic and microbial contaminants. Industrial potential contaminant sources include asphalt plants, industrial chemical production facilities, electronic product manufacturers, electroplating / metal finishing facilities, furniture or wood manufacturing / refinishing / stripping facilities, foundries / smelting plants, mining operations / mine waste sites, paper mills, petroleum and chemical pipelines, plastics manufacturer / molding facilities, wood preserving facilities. These activities are potential sources of volatile organic, synthetic organic and inorganic contaminants.

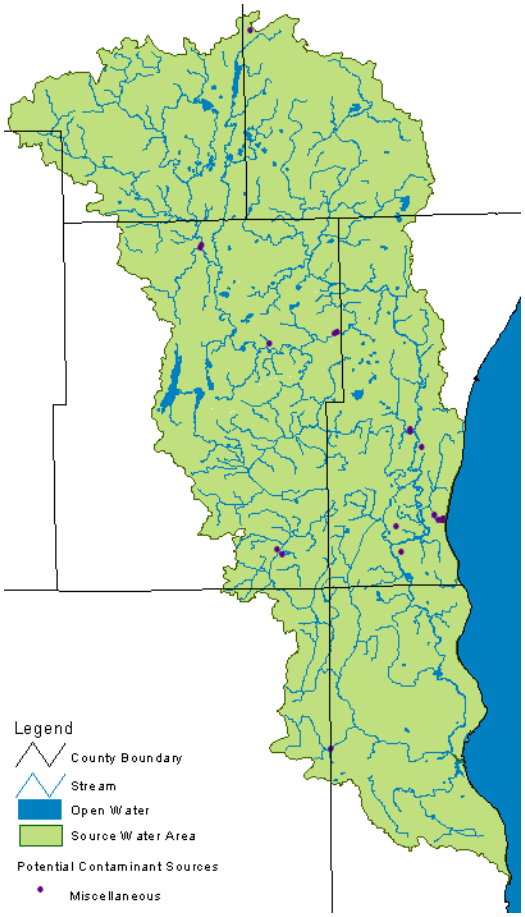
Figure 13: General and potential contaminant sources



Localized Waste Management and Miscellaneous Potential Contaminant Sources

Localized waste management and miscellaneous potential contaminant sources are shown in Figure 14. Waste management potential contaminant sources include municipal incinerators, injection wells, sludge spreading sites, solid waste transfer stations and wastewater lagoons. These activities are potential sources of inorganic, synthetic organic, microbial and volatile organic contaminants. Miscellaneous potential sources include fire training facilities, golf courses, gasification plants, laboratories and military installations. These sources are associated with microbial, synthetic organic and volatile organic contaminants.

Figure 14: Waste management and miscellaneous potential contaminant sources



Description of North Shore Water Commission Water Treatment System

NSWC reliably provides excellent quality treated drinking water to its customers. The NSWC treatment facility can safely treat a maximum of 18 million gallons of drinking water per day. The year round average water demand is 5 million gallons per day. Source water is drawn through a surface water intake to the NSWC water treatment facility. The treatment process includes chemical flocculation and physical sedimentation to remove larger particulate material from the source water. Following this, source water undergoes filtration to remove smaller contaminants. Finally, chlorine is added to source water as a disinfectant prior to distribution.

Susceptibility Determination

Like most surface water systems, NSWC's source water is highly susceptible to contamination and significantly impacted by local factors. This is based on the distribution of land uses and potential contaminant sources in the source water area and frequent indications of microbial contamination in the source water.

Recommendations

The first step in source water protection should involve the formation of a team composed of local, regional and state participants to carry out a comprehensive source water protection program. Potential members of the source water protection team are among others delegates from the water utility, the regional planning commission, the city council, county land and water agencies, non-profit organizations and the WDNR. The initial purpose of this team will be to more comprehensively assess impacts to source water than was possible within the scope of this assessment. Following this, a long-term source water protection strategy can be developed to address how source water protection can be financed, carried out and monitored to prevent localized negative impacts to source water.

For NSWC, source water protection may begin with working to manage urban runoff in the southern portions of the source water area, further reduce wastewater discharges, manage agricultural runoff from the northern portions of the source water area and remediation of historical contamination releases in the Milwaukee Estuary Area of Concern.

As mentioned previously a comprehensive source water protection plan is beyond the scope of this assessment. The source water protection team may consider using resources provided by the USEPA at http://www.epa.gov/safewater/protect/sources.html on the World Wide Web. This website offers general source water information, financial assistance contacts, source water protection case studies, contaminant source inventories and contingency planning among other subjects.

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