Lake Michigan shoreline in the Port Washington source water area
Photograph courtesy of NHI staff

Source Water Assessment
For the City of
Port Washington, Wisconsin

March 27, 2003

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

WISCONSIN
DEPT. OF NATURAL RESOURCES

Table of Contents

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 Port Washington's 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 intakes 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 treated 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 City of Port Washington is located in eastern Wisconsin along Lake Michigan. The Port Washington Water Utility treats source water drawn from Lake Michigan through two surface water intakes to reliably provide its more than 10,000 consumers 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 land uses, assessing the entire Lake Michigan source water area is not a practical method for determining the individual susceptibility of Port Washington's source water. In an 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 Port Washington's intakes. 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 portions of Sheboygan and Ozaukee counties, Port Washington's delineated source water area is 58 square miles. It includes the WDNR delineated Sauk and Sucker Creek Watershed. Historical logging and draining of wetlands has allowed agriculture to become the dominant land cover in the source water area.

Treatment of source water at the Port Washington water treatment plant includes flocculation, sedimentation, filtration, chlorination and fluoridation.

As with most surface water systems, Port Washington's source water is highly susceptible to contamination. Port Washington's source water is significantly impacted by both manageable local factors in the source water area and larger less controllable features of Lake Michigan. Port Washington's source water is commonly impacted during and immediately following spring thaw, heavy precipitation and sustained winds.

Source water protection for Port Washington should begin with the formation of a source water protection team composed of delegates from local, regional, state and federal organizations. This group could plan and implement best management practices to reduce the impact from manageable factors. Initial source water protection projects should focus on managing runoff from agricultural and urban areas in the source water area.

A paper copy of the detailed assessment is available at the Port Washington 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 in the Executive Summary. 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 Port Washington'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 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 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 can occur naturally or come 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.

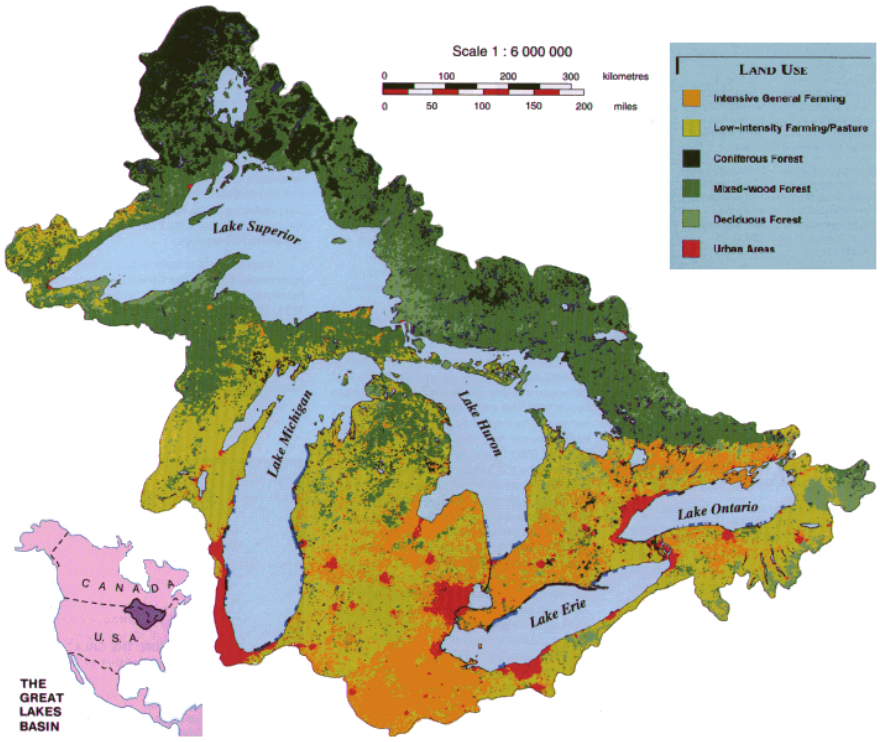
- *Synthetic organic contaminants*, such as industrial products, pesticides and herbicides may come from a variety of sources such as agriculture, storm water runoff, industrial activities, landfills, wastewater treatment facilities and residential areas. As well as being carcinogenic, synthetic organic 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 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 more than 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 Port Washington's source water. In response to this, the WDNR identified smaller local source water areas that contribute source water to Lake Michigan in close proximity to the drinking water intakes. Source water areas are composed of one or more established watersheds that discharge near the surface water intakes. Source water areas for this assessment were delineated based on WDNR surface watersheds, not

Figure 1: Great Lakes Drainage Basin and Land Use



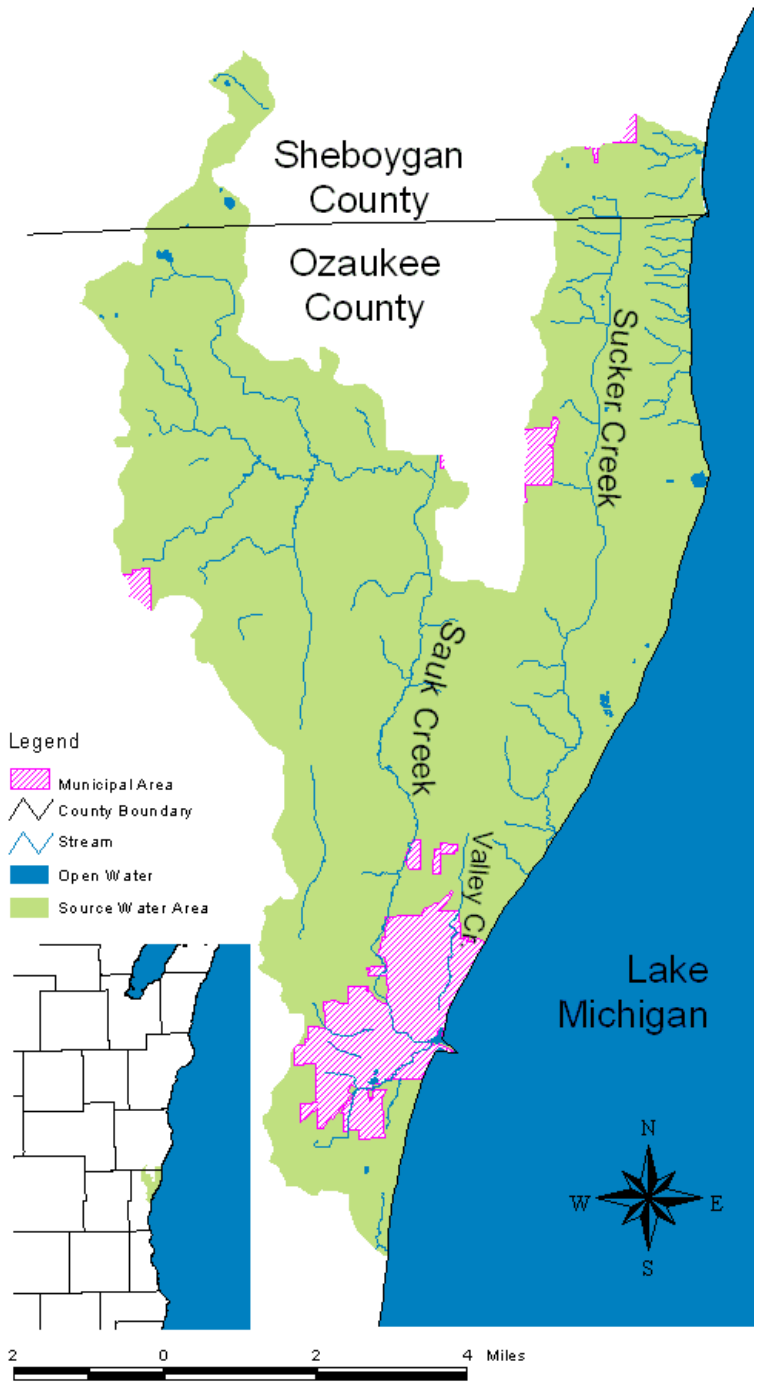
groundwater basins. Generally, groundwater basin boundaries are similar to their surface water counterparts but may vary due to geology.

As shown in Figure 2, Port Washington's source water area is located in east central Wisconsin. It includes portions of southern Sheboygan and northeastern Ozaukee counties. Urban areas in the source water area include the city of Port Washington and portions of the towns of Belgium and Fredonia. The total source water area is 58 square miles.

Hydrology

As shown in Figure 2, the Sauk, Sucker and Valley Creeks as well as multiple independent small streams drain the clay soils of the source water area. Sauk Creek originates in the northwestern portions of the source water area flowing east and then south through primarily agricultural land. It then passes through the city of Port Washington and enters Lake Michigan through the Port Washington Harbor, which is approximately 2/3 miles west southwest of the surface water intakes. Valley Creek drains northern Port Washington and enters into Lake Michigan approximately 2/3 miles west of the surface water intakes. Sucker Creek drains agricultural land in the northern portions of the source water area and discharges into Lake Michigan over 3 miles north of the surface water intakes.

Figure 2: Source Water Area



Flow has not been monitored at any of these streams, but flow has been observed to fluctuate drastically during periods of thawing and precipitation. This is due to clay soils, impervious surfaces and removal of wetlands within the source water area, which prevents precipitation from filtering slowly through the ground before entering streams and causes it to flow quickly overland.

Water quality in the source water has been determined by the WDNR to be generally fair to poor. The main causes of poor water quality in the source water area have been identified as stream channelization and nonpoint source pollution from agricultural and urban areas.

Land Cover

Land cover can play a major role in source water quality. Spatial data in Figure 3 was generated from interpretations of aerial photographs taken from 1971 to 1982.

- *Agricultural*

  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.

  As shown in Figure 3, agriculture is the dominant land use in the source water area. The WDNR classified nonpoint source pollution from streambank pasturing, cropland runoff and barnyard runoff as negative impacts to streams in the source water area.

- *Urban*

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

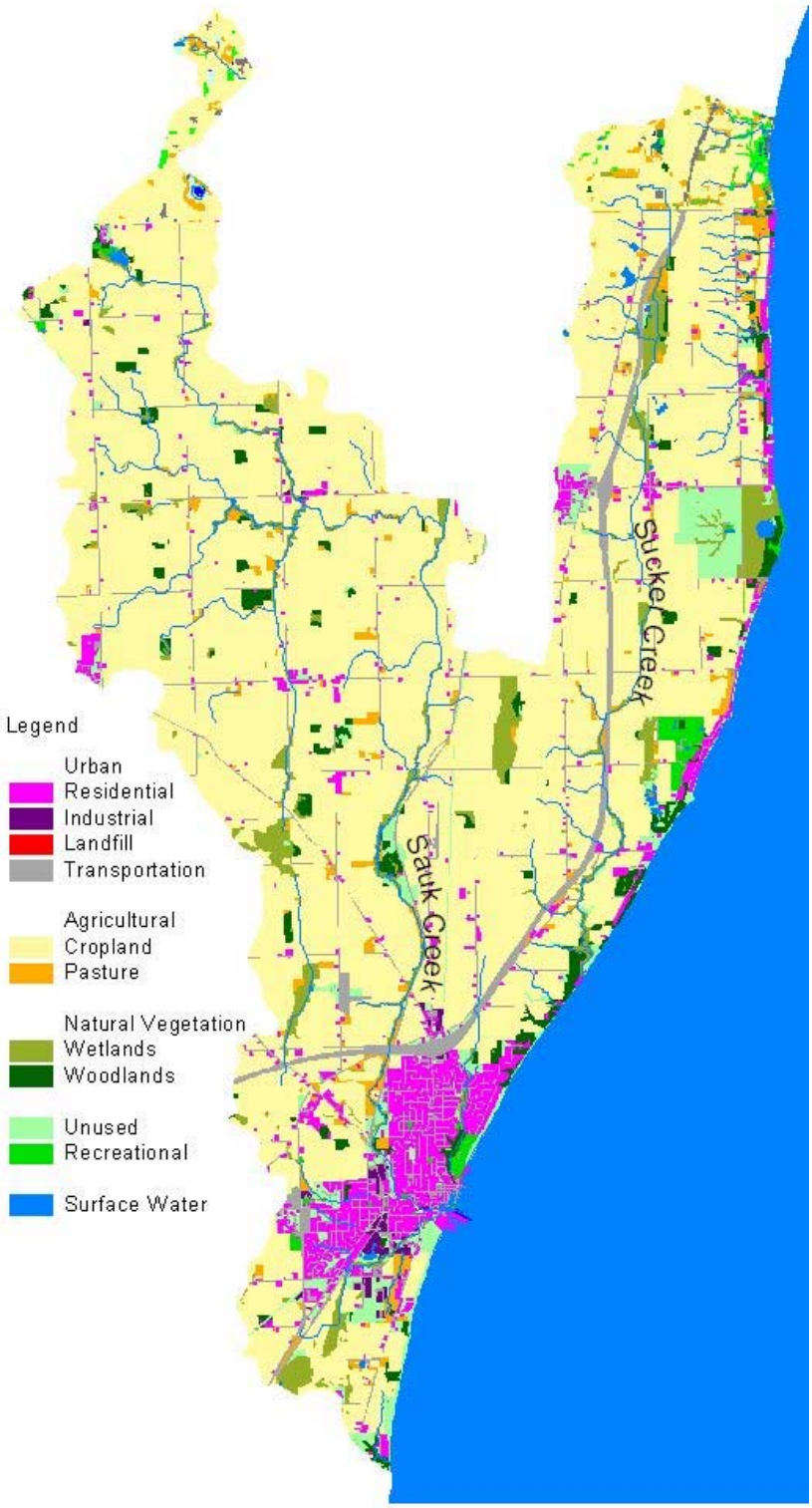
  The WDNR has determined that runoff from urban areas is negatively impacting source water. This is the case in the lower portions of Sauk Creek and most of Valley Creek.

- *Natural vegetation*

  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.

  Historical clearing of wetlands has been identified by the WDNR as having a negative impact of streams in the source water area.

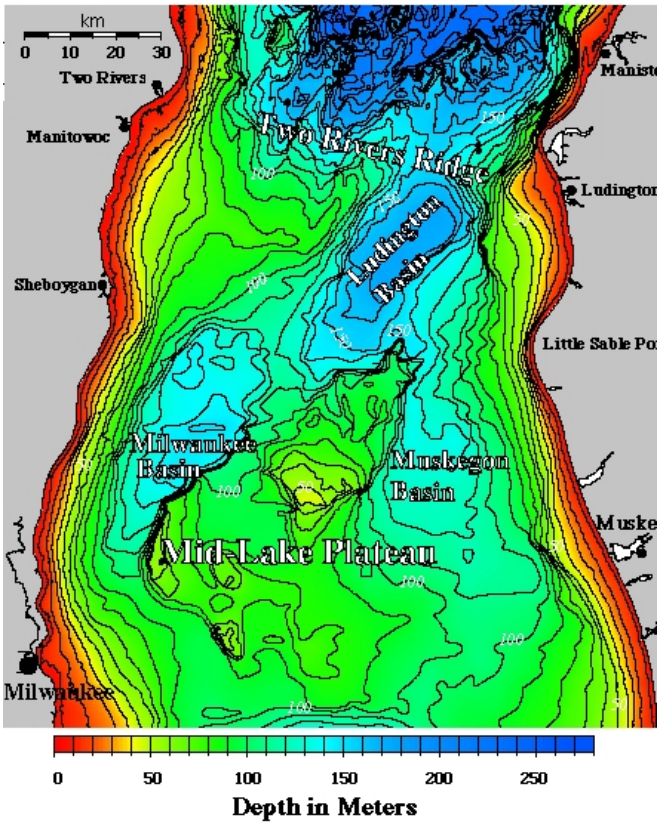
Figure 3: Land Cover



Description of Lake Michigan near the Source Water Area

Bathymetric and shoreline features

Figure 4: Mid-Lake Michigan Bathymetry



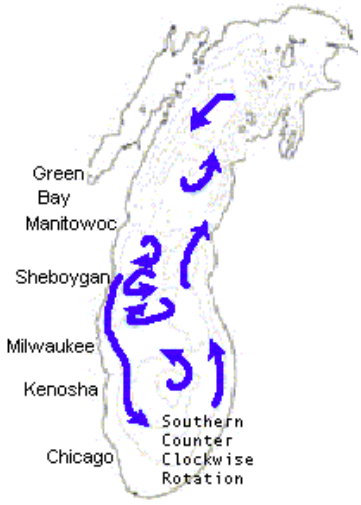
As shown in Figure 4, the City of Port Washington is located south of a relatively shallow glacial feature named the Two Rivers Ridge and west of the relatively deep Milwaukee Basin. The Two Rivers Ridge creates a permeable divide between northern and southern Lake Michigan. The quick drop off of the Milwaukee Basin may inhibit wind borne suspension of lake-bottom sediments that can cause a drop in source water quality along much of the Lake Michigan shoreline.

The shoreline near the intake is free of breaks and with the exception of the man-made break walls of the Port Washington Harbor. The northern wall of the harbor may provide some protection for the surface water intake from the Sauk Creek.

Winds

Wind can play a major role in Lake Michigan circulation patterns and water quality in near-shore areas. Calm westerly breezes generally coincide with good water quality, and strong easterly winds can coincide with the worst source water quality at the intakes. In a matter of hours strong easterly winds can churn up lake-bottom sediments causing poor source water at the intakes. As mentioned previously, the impact of easterly winds may be reduced by the relatively deep Milwaukee Basin. Southeasterly winds have been observed to push discharge from the Sauk Creek north towards the intakes.

Figure 5: Lake Michigan Circulation Patterns



Currents

Currents in Lake Michigan, particularly along the western shore near Port Washington are highly variable. As shown in Figure 5, the Port Washington intakes are located east of an area of mixing between the northern Lake Michigan counter-clockwise rotation and the southern Lake Michigan counter-clockwise rotation. Typically, nearshore northerly currents are experienced at Port Washington. This nearshore current causes discharge from nearby streams and runoff to flow south upon entering Lake Michigan. However southern flow of this current can quickly be altered or reversed during periods of sustained southerly winds.

Water quality

Water quality in Lake Michigan improves with distance from shore. Near shore water quality is generally lower and more prone to fluctuations, which frequently occur during and following periods of thawing and precipitation when contaminants from land are transported into Lake Michigan. Fluctuations also occur during easterly windstorms, which can churn up lake-bottom sediments. Atmospheric deposition of contaminants often occurs near more concentrated urban

areas. The majority of contaminants enter the lake via non-point source pollution and atmospheric deposition. With distance from shore most contaminants evaporate, settle into the lake bottom sediments or dilute to levels below EPA Maximum Contaminant Levels, a standard for potable drinking water.

It is important to note that water quality of source water at the intakes is based almost entirely on monitoring that occurs at the drinking water intakes. Few contaminants, outside of conventional water quality indicators have been comprehensively monitored in source water at the intakes. Conventional water quality parameters such as clarity, temperature, taste and odor indicate that source water quality drops during storms and late summer. Chlorine is applied at the intakes to control zebra mussel growth. This is an important step in providing sufficient drinking water to Port Washington's customers, but application of chlorine prevents proper microbial contaminant monitoring in source water. However, microbial contaminants, such as *Cryptosporidium* and *Giardia* have been detected in source water entering the surface water intakes. Volatile organic contaminants have been detected in the source water at the intake repeatedly. Concentrations of treatment by-products, total trihalomethanes are indicative of moderate levels of dissolved organic carbon in the source water. This is particularly the case in late summer and early fall when lake water temperatures are at their highest.

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 adversely impacting human health. A susceptibility determination is based on a stepwise synthesis of information regarding the surface water intake's 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 please see Appendix R of Wisconsin's Source Water Assessment Program Plan Appendices.

An initial survey was performed on the Port Washington source water area to assess local impacts to the source water. The initial survey included interviewing Port Washington Water Utility employees, conducting a sensitivity analysis, delineation of a critical assessment zone and reviewing existing data. The initial survey revealed that source water quality was frequently susceptible to contamination.

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 range from moderate to very high.

Port Washington Water Utility has two surface water intakes. Both of these intakes have moderately high calculated sensitivities. These calculated sensitivities do not account for the proximity of the discharges of the Sauk and Valley Creeks. When this is taken into account the sensitivity ratings for the Port Washington drinking water intakes may be high.

Critical Assessment Zone

In keeping with the Great Lakes protocol, a critical assessment zone was delineated based upon the intakes 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 zones for the active Port Washington drinking water intakes do not encompass any land or shoreline.

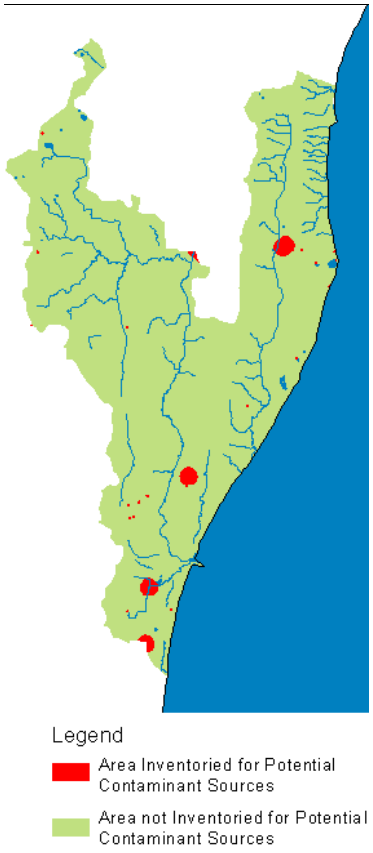
Potential Contaminant Source Inventory

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 area-wide and localized information sources. Area-wide locational data are displayed in Figures 7. Information for the remainder of the potential contaminant sources was inventoried only within source water areas for ground water systems. These areas of localized potential contaminant source inventories are shown on Figure 6. Information concerning the distribution of localized significant potential contaminant sources is not available for land outside of the red areas in Figure 6. Potential contaminant sources inventoried within these areas are shown on Figures 8.

Figure 6: Area Inventoried for Potential Contaminant Sources



Animal feeding operations

Animal feeding operations are agricultural operations where animals are kept and raised in confined situations. Animal feeding operations generally congregate animals, feed, manure, dead animals, and production operations on a relatively small area of land. Feed is brought to the animals rather than the animals grazing or otherwise seeking feed in pastures. Animal waste and wastewater can enter water bodies from spills or breaks of waste storage structures (due to accidents or excessive rain), and manure spreading practices. Animal feeding operations have the potential to contribute pollutants such as inorganic, synthetic organic, microbial contaminants as well as hormones and antibiotics to the source water.

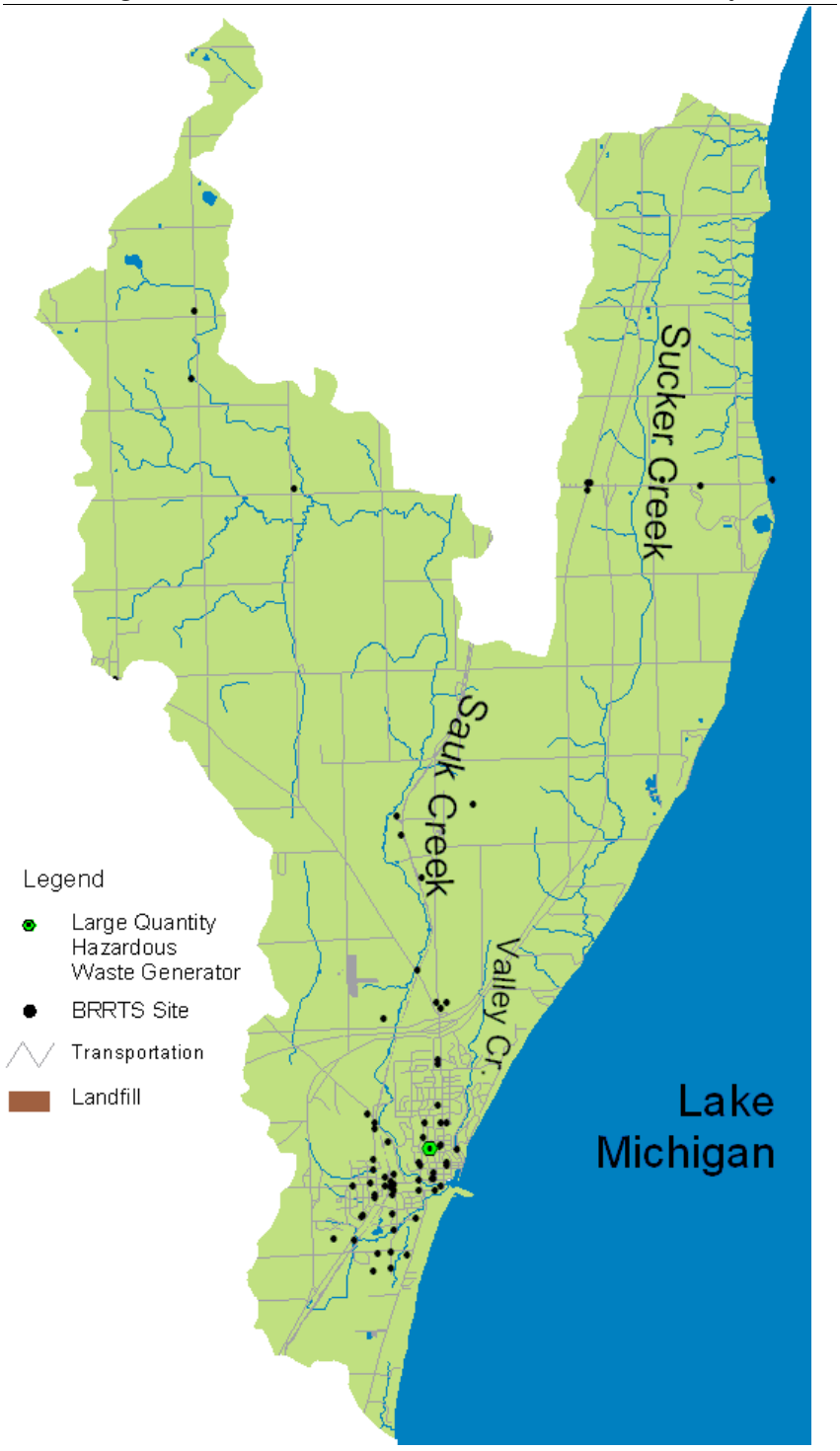
Animal feeding operations shown on Figure 7 include only the larger animal feeding operations (over 1,000 animal units), which are regulated for wastewater discharge. This does not provide an accurate distribution of the more common smaller animal feeding operations. A limited distribution of smaller animal feeding operations in the source water area is depicted in Figure 8. Stream bank pasturing, barnyard runoff and manure spreading practices were identified as negative impacts on several streams in the source water area.

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.

Landfills shown in Figures 7 include currently licensed landfills and landfills identified in the 1995 Southeast Wisconsin Regional Planning Commission land cover assessment. This does not take into account the more numerous abandoned small dumps that historically operated with no regulation. Landfills have been determined by the WDNR as a negative impact on a tributary to Sauk Creek

Figure 7: Area-wide Potential Contaminant Source Inventory



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. A 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 may contain high concentrations of contaminants associated with urban runoff and WWTFs. Contaminants associated with industrial WWTFs are dependent upon the specific industry but may include microbial, volatile organic, inorganic and synthetic organic contaminants.

See Figure 7 for locations of WWTFs in the source water area. Wastewater treatment facilities have not been identified as negative impact to source water. The Port Washington Municipal WWTF has overflowed 11 times from 1996 through 2000.

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. There are 49 LUST sites in the City of Port Washington.

- 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. There are 19 ERP sites located in the City of Port Washington.

- 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. It is important to note that the number of unreported spills is unknown, but is probably well beyond those spills that are reported. From May of 1978 to October of 2000, there have been 75 spills reported in the City of Port Washington. Of these, at least 6 entered into storm sewers and 21 entered directly into surface water. For information on particular spills please visit the previously mentioned BRRTS Internet site.

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 7, there are not many large quantity hazardous waste generators in the source water area. These are most concentrated along the major transportation corridors. This does not account for the more numerous smaller quantity hazardous waste generators. For a more complete image visit USEPA's Enviromapper on the World Wide Web at http://maps.epa.gov/enviro/html/mod/enviromapper/index.html.

Boating Related Activities

Boating related activities are potential sources of synthetic organic, volatile 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. There is one marina located in the city of Port Washington.

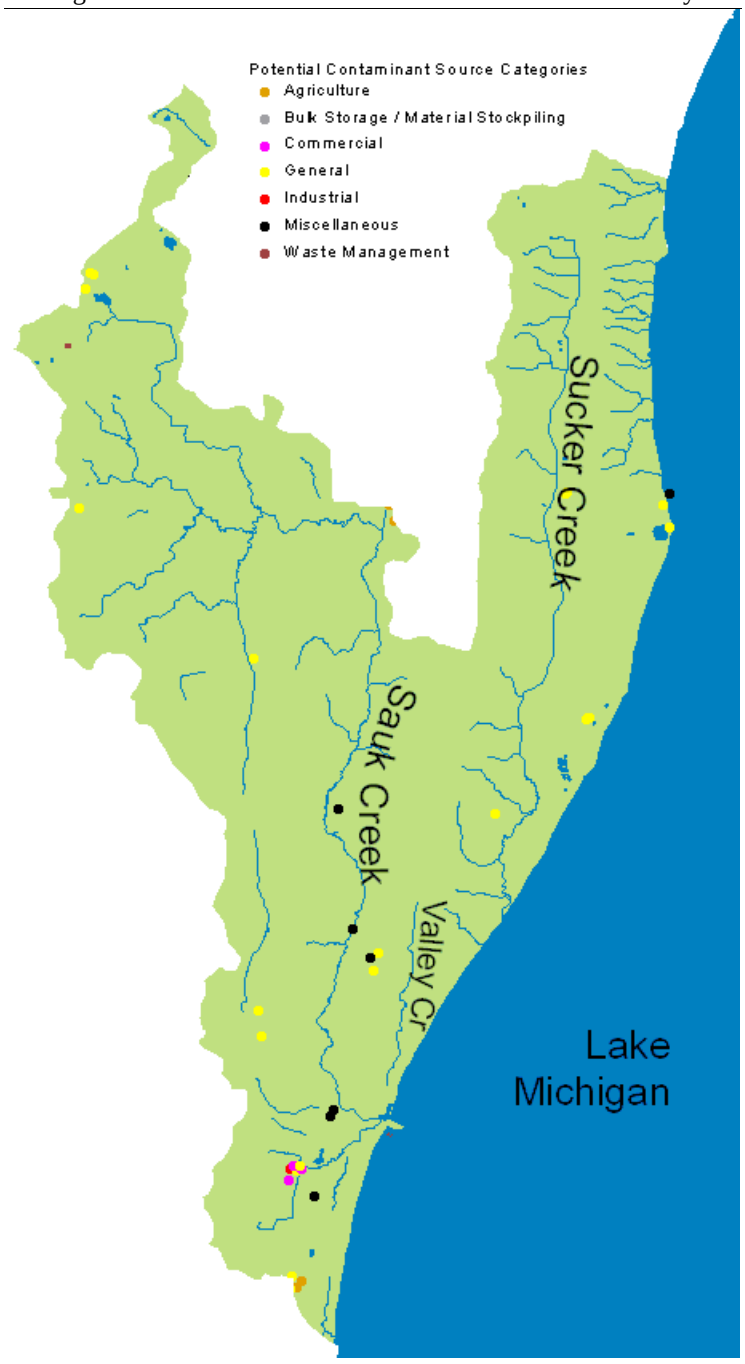
Construction Sites

Due to uncovered material, handling of toxic chemicals and exposed ground construction sites can heavily impact the source water. They are potential sources of inorganic, volatile organic and synthetic organic contaminants. The population in the source water area, particularly in to the south has grown rapidly in

recent years. Construction was identified as a negative impact to Sauk Creek and its lower tributaries as well as Valley Creek.

Localized Agricultural and Bulk Storage Potential Contaminant Sources

Figure 8: Localized Potential Contaminant Source Inventory



Localized agricultural and bulk storage activity locations for this assessment are shown in Figure 8. Agricultural activities 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 activities 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. As mentioned previously agricultural practices have been identified as major negative impacts to source water.

Localized Commercial Potential Contaminant Sources

Localized commercial activities locations for this assessment are shown in Figure 8. Commercial activities 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.

Localized General and Industrial Potential Contaminant Sources

Localized general and industrial activities for this assessment are shown in Figure 8. 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 activities

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.

Localized Waste Management and Miscellaneous Potential Contaminant Sources

Localized waste management and miscellaneous activities and contaminant conduits are shown in Figure 8. Waste management activities 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 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.

Description of Port Washington Public Drinking Water Treatment System

Port Washington Water Utilities reliably provide high quality drinking water for its more than 10,000 consumers. The capacity of the water treatment plant is 4 million gallons of drinking water per day (mgd), but the average demand is only 1.4 mgd.

Currently, source water enters the treatment plant through 2 intakes located Lake Michigan east of Port Washington. Chlorine is applied to incoming source water at the intakes to control zebra mussel growth. Upon entering the water treatment plant source water undergoes chemical flocculation and physical sedimentation to remove larger contaminants from source water. Following this, chlorine is again added to deactivate microbial contaminants in source water. The final step in treatment prior to distribution is filtration to physically remove remaining contaminants. Powder activated carbon is used during warmer periods to control taste and odor.

Susceptibility Determination

As with most surface water systems, Port Washington's source water quality is significantly impacted by the source water area and highly susceptible to contamination. This is due to the ease with which surface water is contaminated, land usage in the source water area and the proximity of the intakes to the discharge of the Valley and Sauk Creeks. As discussed in the section concerning Lake Michigan water quality, little is known concerning concentrations of particular contaminants occurring in the source water at the intakes, but based on general water quality indicators contaminants from the source water area frequently reach the drinking water intakes.

Recommendations

Source water protection should begin with the formation of a team composed of local, regional and state members to more completely assess impacts to source water and implement best management practices to prevent source water contamination. Initial source water protection efforts of this team should focus on the following,

- Runoff from agricultural and livestock activities drained by the Sauk Creek
- Runoff from urban areas draining into Sauk and Valley Creek

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 for overall source water protection planning. This website offers general source water information, financial assistance contacts, source water protection case studies, contaminant source inventories and contingency planning among other subjects. For specific information concerning best management practices and dealing with potential contaminant sources please visit http://www.epa.gov/ogwdw/protect/swpbull.html on the World Wide Web.

Selected References

- Beletsky, D.; Saylor, J. H.; Schwab, D. J., 1999, Mean Circulation in the Great Lakes, Journal of Great Lakes Research.
- The Government of Canada; US Environmental Protection Agency, 1995, The Great Lakes: An Environmental Atlas and Resource Book.
- Hole, F.D., 1980, Soil Guide for Wisconsin Land Lookers, University of Wisconsin-Extension.
- Knuth, D.; Jankowski, S., 1980, Municipal Water Supply Lake Michigan Water Quality Inventory.
- Mason, R.P.; Sullivan, K.A. 1997. Mercury in Lake Michigan. Environmental Science and Technology.
- National Oceanic and Atmospheric Agency, Bathymetry of Lake Michigan, available on the World Wide Web at http://www.ngdc.noaa.gov/mgg/greatlakes/lakemich_cdrom/start.htm visited on 8/7/02.
- Skinner, E.L.; Borman, R.G., University of Wisconsin-Extension. Geological and Natural History Survey. 1973. Water Resources of Wisconsin-Lake Michigan Basin. US Geological Survey.
- Port Washington Water Utility employees, 2002, Personal interviews.
- Wisconsin Department of Natural Resources (WDNR), The Sheboygan River Basin State of the Environment of the Report, available on the World Wide Web at http://www.dnr.state.wi.us/org/gmu/sheboygan/sote.htm visited on 8/7/02.
- WDNR, 2001,The State of the Sheboygan River Basin.
- WDNR, 2001, Water Resources of the Sheboygan River Basin.
- WDNR, 1999, Wisconsin's Source Water Assessment Program Plan.
- WDNR, 1999, Wisconsin's Source Water Assessment Program Plan Appendices.